

## Recent Landslides in the Lander, Wyoming Area

by

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On Friday, April 30, 1999, the Wyoming State Geological Survey was asked by Fremont County and the Wyoming Emergency Management Agency to assess the status of the recent landslides in Lander and vicinity. The assessment was conducted during the evening of April 30, 1999, on May 1, 1999, and on May 2, 1999.

### Typical Landslide Scenario for Lander

Many of the landslides in the Lander area occurred because of the local geology. There are many relatively flat surfaces that cap the Cody Shale in the area. The flat surfaces are primarily old alluvial, terrace, and bench deposits that are fairly permeable. Precipitation that falls on the flat surfaces generally percolates through the surficial materials until it reaches the relatively impermeable Cody Shale. The water then has a tendency to flow towards any exposed contact between the surficial materials and the Cody Shale. Landslides often form in the areas where the water discharges. Most of the landslides that form under these conditions are slump/flow complexes or block slide/flow complexes.

### Buena Vista Drive Area

In 1995, a landslide adversely affected Buena Vista Drive and some utility corridors. In that case, the Middle Fork of the Popo Agie River undercut a slope that was also being saturated from above because of the conditions described in the typical landslide scenario. The riverbank was stabilized and a retaining wall was constructed. During this most recent event, the retaining wall with associated drains (located between Buena Vista Drive and the Middle Fork of the Popo Agie River) was not completely draining the previously unstable slope located above the retaining wall. Fill material placed around the drainpipes on the upslope side of the retaining wall should have allowed subsurface water to drain through the retaining wall. The fill material, however, appeared to be a poorly graded sand. When the sand saturated, it flowed into the drainpipes, which then became clogged. The WSGS recommended that the drainpipes be unclogged, and that they should be monitored to ensure that the drains remain open. This was accomplished by the City of Lander. The WSGS also recommended that the designer/builder of the retaining wall be contacted to determine what remedial actions would be necessary to ensure that the problem not occur again in future events. Some deformation of the retaining wall may have occurred.

Northeast of the retaining wall, another landslide activated. This landslide was near a power substation, but the substation was not immediately threatened. In the future, the continued growth of the landslide could pose a threat to the substation.

Landslides will continue near Buena Vista Drive in the areas where the road, homes, or other structures are near a steep face. There is much evidence of earlier landslides in the area. Consideration should be given to designing and constructing additional retaining walls in the area. In addition, it is necessary to establish proper drainage in the steep slopes.

#### Landslides near the Lander Golf and Country Club, Hunt Field, Hill Drive, and Bonnie Brae Street

A series of landslides were observed northeast of the Lander Golf and Country Club. The first landslide observed was a slump/flow complex near a storage facility for removed underground storage tanks in the vicinity of Hill Drive (Steve Lee slide). If this landslide expands, it could affect the storage facility. The second landslides observed were a series of slump/flow, block slide/flow, and flow complexes near a RV park in the vicinity of Bonnie Brae Street. If these landslides expand, they could affect the safety of residents both above and below the landslides. In both of these areas, the typical landslide scenario was observed. In addition, irrigation canals were present near landslides in both areas. The irrigation canals posed a dual hazard. First, they appeared to be unlined. Seepage from the canals could either lead to slope instability or could accelerate the movement of a landslide. Second, a landslide could either block or rupture the canals, leading to additional flooding problems. After my visit to Lander, a landslide initiated just past the northeast end of the Hill Field airport. Based upon descriptions provided, that landslide appears to be a slump/flow and block slide/flow complex.

The landslides need to be stabilized and consideration should be given to lining the irrigation canals. A number of smaller landslides were also observed in these areas, but none posed any significant threat to property.

#### Cedar Ridge Subdivision

The Cedar Ridge Subdivision is located approximately four miles west of Lander on the Squaw Creek road. The sole road into the subdivision, Juniper Lane, was partially destroyed by a block slide/flow complex. The landslide occurred in weathered materials derived from the Chugwater Formation. The Chugwater Formation is generally composed of red colored claystones, siltstones, and sandstones. It appeared that the exposed parts of the Chugwater Formation were nearly saturated, leading to a series of spring discharges in the lower exposed parts of the Formation. In the case of the road, it appeared that water discharging from the bedrock saturated the weathered material and fill the road was built upon. This led to the formation of the landslide. In addition, it was discovered that an old irrigation canal was present on the slope above the failed part of the road. A pipe was placed in the old canal, and the canal was filled. The filled area is relatively flat, which allows snow to accumulate. Rain falling on this flat area would have a tendency to seep into the ground rather than run off. This may be adding to the saturated slope conditions below the old canal. Although traffic was still able to pass on the part

of the road that remained, such activity was dangerous. My concern was that the road would completely fail. Continued precipitation in the area only adds to this concern.

Southeast of the landslide in Juniper Lane, and just before the Squaw Creek road, a small landslide initiated in the slope above a home. The geologic and surficial conditions present at the road were also present above the home. Fortunately, no significant damage occurred at the home.

The part of the road where the landslide occurred needs to be reconstructed and designed to allow for the adequate drainage of the slope and bedrock above the road. The filled irrigation canal should also be investigated to determine if it is contributing to the instability in the area.

### Squaw Creek/Baldwin Creek Road

A road segment located to the west of the Cedar Ridge Subdivision connects the Squaw Creek and Baldwin Creek roads. The roads form a loop to Lander. Three small block slide/flow and slump/flow complexes that formed in weathered material derived from the Chugwater Formation affected the connecting road segment. The landslides did temporarily affect traffic flow on the road, but did not cause any permanent damage.

The landslides should not pose a significant problem to the integrity of the road, but could continue to disrupt traffic. They could pose a hazard to safety if someone drove into them after they activated and covered the road. In this case, the only reasonable and cost effective method to reduce the potential of the landslides activating may be to remove a portion of the weathered materials that the landslides formed in. If that is not done, then consideration should be given to posting signs that caution drivers about potential landslide hazards.

### Summary

Landslides have occurred in and around Lander historically. Many have occurred and will continue to occur in areas that have already been developed. Consideration should be given to constructing retaining walls and/or establishing the proper drainage of slopes in key areas.