Field Investigation and Provisional Map of the Buffalo Creek Debris Slide Rutherford County, North Carolina

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Introduction

This report accompanies the map of the Buffalo Creek debris slide requested by the Town of Lake Lure. Figure 1 is a location map for the slide area and vicinity. Figure 2 is the map that shows the approximate limits of the active slide zone and the provisional limits of a precautionary zone around the slide as observed by the North Carolina Geological Survey (NCGS) geologists. The intent of the map (Figure 2) is to convey some of the relevant geologic conditions in and around the debris slide area as they pertain to public safety. It is not intended to be a detailed report of the slide history and geologic conditions related to the slide.

The included map (Figure 2) is a reference guide for planning purposes and not a substitute for a site map prepared by a licensed land surveyor. Map unit boundaries shown are subject to change in the future as: 1) slide conditions evolve; 2) new information becomes available; and, 3) ground disturbing activities or environmental conditions that influence slide movement occur.

Methods and Data Sources

NCGS geologists conducted field investigations of the slide area on March 3, March 13, and April 2, 2019 and collected data using field computers equipped with mapping grade global

positioning satellite (GPS) location systems. Topographic contours, and shaded relief and slope maps derived from a 20-foot pixel resolution Light Detecting And Ranging (LiDAR) digital elevation model were used for geomorphic analyses. Orthophotography dated 1993, 1998, 2010 and 2015 augmented the mapping. The North Carolina Department of Transportation (NCDOT) Geotechnical Engineering Unit provided selected historical reports, recent maps, monitoring data, and georegistered unmanned aerial systems (UAS) imagery. The Town of Lake Lure also provided UAS imagery. Specific data sources are given in the references section.

Background

Bedrock exposures outside of the slide area are comprised of weathered granitic orthogneiss designated as the Henderson Gneiss (Davis and Yanagihara, 1993). Rock fragments within the debris deposits that make up surface exposures in the slide area are gravel- to boulder-sized clasts of weathered (stained state to completely decomposed state) Henderson Gneiss.

The Buffalo Creek debris slide has a documented history of movement over a 45-year period. A 1988 NCDOT memorandum (NCDOT, 1988) documented that NCDOT investigated the slide in 1974 and 1980. In that memorandum the author concluded that, "The slide has the potential to continue movement indefinitely, varying in speed with the seasons. Movement will be faster in the rainy season, but is unlikely to stop completely." Reconnaissance by NCGS geologists in 2006 noted distress to Buffalo Creek Road (SR 1314) in this area indicative of slide movement at some time. Recent movement became apparent in May of 2018 at which time the NCDOT took measures to the repair SR 1314. The NCDOT was notified of further movement on January 2, 2019 and subsequently closed the road to traffic.

Slide movement has also damaged houses and utilities. The 1980 NCDOT memorandum states that one house appeared to be affected by the slide with erratic foundation settlement; another house was moved to avoid ground movement; and water supply lines were disrupted. In March 2019 the Rutherford County Building Inspections Department condemned one home in active slide area at 140 Sleeping Bear Lane because of severe damage to the foundation.

Two homes outside of the active slide zone but located in the precautionary zone were recently condemned because of severe foundation damage, one at 1641 Buffalo Creek Road, and one at 159 Young's Mountain Drive. Foundation distress at these two locations does not appear to be directly connected to the recent movement in the active slide zone but related to slope and/or foundation conditions specific to the house sites. These two houses are interpreted to be on the slopes of the south flank of the prehistoric-historic slope movement that predates the present-day Buffalo Creek debris slide.

Active Slide Zone

The active slide zone shown in Figure 2 encompasses the area with evidence of ground movement associated with the Buffalo Creek debris slide. The total area of the active zone is approximately 3.6 acres, which includes as much as 1 acre below lake level. Inclinometer data provided by the NCDOT indicate that slide movement is on the order of 42-55 feet below ground surface in portions of the slide. Depths and rates of movement within the slide mass vary. Rates of movement vary over time, and are probably on the order of inches/year to as much as feet/month.

Evidence of ground movement within the active slide zone includes the following:

- Ground rupture (i.e., scarps and tension cracks)
- Leaning and/or downed trees
- Bulging and/or subsidence of the ground surface
- Cracked and broken pavement on Buffalo Creek Road (SR 1314)
- Displacement of NCDOT survey monitoring points
- Deflection of NCDOT slope inclinometer casings.

Precautionary Zone

The precautionary zone shown in Figure 2 delineates the area around the active slide zone that is potentially unstable, or could become unstable with enlargement of the active zone of the Buffalo Creek debris slide.

Slopes within the precautionary zone meet one or more of the following criteria:

- Deposits from past landslide activity are exposed at the ground surface and excavated slopes.
- Located within the area interpreted to be part of prehistoric and historic slope movements involving the present day Buffalo Creek debris slide.
- Ground cracks on the margins of the active slide area are present.
- Include small debris slides on steep slopes of adjacent drainage ways (flanks of related prehistoric-historic slope movements involving the present day Buffalo Creek slide).
- Ground slope is generally in excess of approximately 18-21 degrees (32%-38%) as estimated from a 20-foot pixel resolution LiDAR digital elevation model.

Findings and Recommendation

General

Given the long history of slide movement at this location it is reasonable to assume that the slide will continue to move intermittently for the foreseeable future. Periods of increased or decreased rates and magnitudes of movement will likely be related to wet and dry weather patterns.

Bald Mountain Lake likely contributes somewhat to the instability of the slide because it maintains saturated conditions at the toe of the slide. Rapid drawdown of Bald Mountain Lake may trigger or accelerate movement of the slide. Rapid drawdown of the lake in which the lake level drops faster than the internal water within the slide drains may result in slide movement. Any drawdown of the lake should consider possible effects to the slide and should be done under the guidance of qualified engineers and/or geologists. Installation of piezometers in the toe of the slide upslope of the lake level may aid in assessing lake lowering rates and ground water levels in the slide.

Issuance of building permits or property sales in the active slide or precautionary zones should be accompanied by disclosure of the information regarding the debris slide and potential hazards, including the potential for enlargement of the active and precautionary slide zones. Repairs to structures to maintain their structural integrity in response to ground movements within the active and precautionary slide zones should be done under guidance of qualified structural and/or geotechnical engineers.

It is important to note that typical home owner's insurance policies in North Carolina do not cover damage related to landslide movement.

Long term monitoring of the active and precautionary slide zones is recommended, but is beyond the resources and authority of the North Carolina Geological Survey.

Active Slide Zone

Any new construction in the active slide zone is not recommended and should be done with extreme caution, and under the guidance of qualified geologists and/or engineers.

Slide movement can severely damage structures, access roads, driveways, and utilities including water and electrical supply lines, and septic systems.

Plumbing and electrical systems within homes can be compromised and result in damage such as flooding and fires.

Trees affected by slide movement can fall unexpectedly.

Structures and homes can be built to withstand certain levels of slide movement; however, such measures are likely to be expensive and should be done under the guidance of qualified structural and geotechnical engineers.

Precautionary Slide Zone

Siting new construction in the precautionary zone should be done by qualified geologists and/or geotechnical engineers.

It is recommended that foundation design in this zone should be done by a qualified geotechnical engineer.

Information Sources

Davis, T.L., Yanagihara, G., 1993, Geologic map of the Columbus Promontory, western Inner Piedmont, North Carolina, *In*: Hatcher, R.D., Davis, T.L., eds., Studies of Inner Piedmont Geology, with a focus on the Columbus Promontory, Carolina Geological Society Field Trip Guidebook, 144p., map scale, 1:48,000.

NCDOT, 1988, Slide on SR 1314 Fairfield Mtns. Development, Lake Lure; P. Winchester memorandum to A. Melnik, April 27, 1988.

NCDOT, 1980, Slide investigation on SR 1314, near Lake Lure, F.D. McKinley memorandum to W.D. Bingham.

NCDOT, georegistered UAS imagery dated January 21, 28, and March 22, 2019.

NCDOT, monitoring point surveys dated January 21, 28, and February 7, 2019.

NCDOT, Inclinometer readings dated Jan. 15, 18, 22, 26, 29, 2019.

North Carolina Geological Survey landslide geodatabase.

Town of Lake Lure UAS imagery dated March 13, 2019.



Figure 1. Location map for the Buffalo Creek debris slide area and vicinity with point locations for landslides in the NCGS landslide geodatabase as of 2019/04/02. Map base is 2015 orthophotography.



Figure 2. Provisional map of the Buffalo Creek debris slide area showing the active slide zone and precautionary zone and other slope movement features as of 2019/04/02. Topographic contours (20 foot contour interval) derived from a 20-foot pixel resolution LiDAR (Light Detecting And Ranging) digital elevation model. LiDAR data acquisition pre-dates recent slide movement. Approximate land parcel boundaries (white) courtesy of the Rutherford County GIS Department. Map base is 2019 unmanned aerial systems (UAS) ortho-mosaic provided by NCDOT. Data Sources: NCGS and NCDOT. **Notes:** 1. All locations and boundaries are approximate. 2. Areas of ground cracks within the active slide and precautionary zones are not shown. 3. Map unit boundaries are subject to change as slide conditions and extents may change. 4. This map is not a substitute for a map prepared by a licensed land surveyor.