

The Cotton Brook Landslide in the Mount Mansfield State Forest, Waterbury, Vermont

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Summary

A major landslide occurred on the south side of Cotton Brook in the Mount Mansfield State Forest in Waterbury on May 30-31, 2019. The 12 acre (4.9 hectare) landslide is one of the largest landslides to occur in Vermont in the last 30 years. The volume of material moved during the main landslide event is about 327,000 cubic yards (250,000 cubic meters).

Observations through November of 2019 showed that the site remained hazardous due to trees, boulders, and soil falling in from the margins, active mud flows out on the landslide surface, and collapse of banks due to stream erosion at the toe of the slope.

The landslide blocked the brook, impounding a 1.8 acre (0.7 hectare) pond upstream. The pond water level fluctuated over the course of the next 5 months as mudflows temporarily blocked the outlet and the stream cut back down through the mudflows. The landslide dam finally failed during heavy rain on 10/31/2019, draining most of the pond.

The landslide impacted the brook and reservoir downstream: Sand, gravel, and large quantities of woody debris were deposited along Cotton Brook and a large quantity of sand was deposited in a delta at the shore of the Waterbury Reservoir. Fine-grained sediment from the slide was transported out into the Reservoir and caused an increase in the turbidity of the Little River below the outfall from the Reservoir. This turbidity extended at least as far downstream as the confluence with the Winooski River.

GPS measurements and satellite image analysis in July of this year show that the landslide has continued to expand as blocks of soil and trees collapse in from the margins.

The Fosters Trail has been permanently closed and the Cotton Brook Road at the base was temporarily closed for safety. A future blockage of the brook due to additional slope failures is still possible, but there is no longer concern that material has the capacity to reach Cotton Brook Road.



Figure 3. Cotton Brook landslide, looking south. The landslide deposit is at the bottom, center and the ponded area is at lower right. Height = 358 feet (109 meters), width across base ~570 feet (175 meters). Photo by E. Robinson, VTrans U.A.S. Team, 6/12/2019.



Figure 4. Looking up from toe deposit on north side of brook, 6/4/2019.



Figure 5. On Cotton Brook landslide surface. Note active mudflows and slide scars, 6/12/2019.



Figure 6. Mudflows, saturated sand, and newly deposited boulders and trees indicated the site was still active. Water feeding the mudflows was from seeps partway down the slope, likely at a sand-silt interface or due to elevated water table. Photo on 6/4/2019.

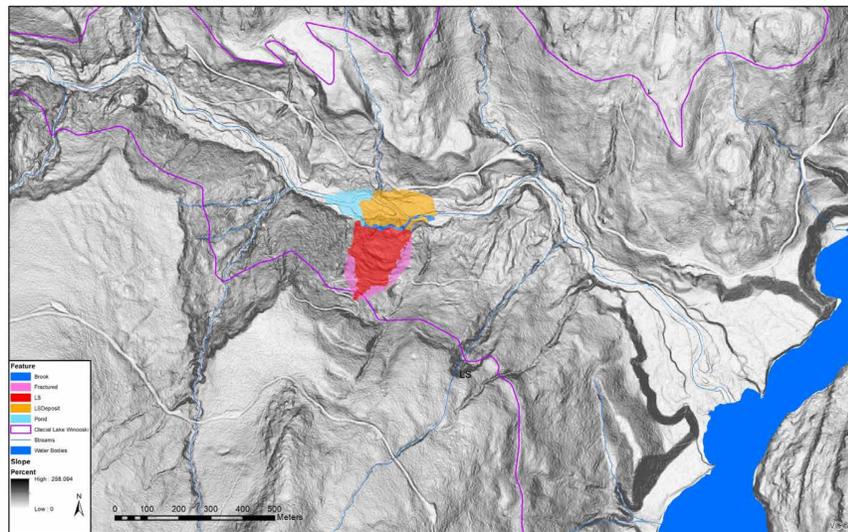


Figure 7. LIDAR slope map of Cotton Brook area showing the extent of the landslide (red), the toe deposit (orange), the ponded area (pale blue), and the fractured area around the margin (lavender). These are as of June, 2019. See the map below for an update.

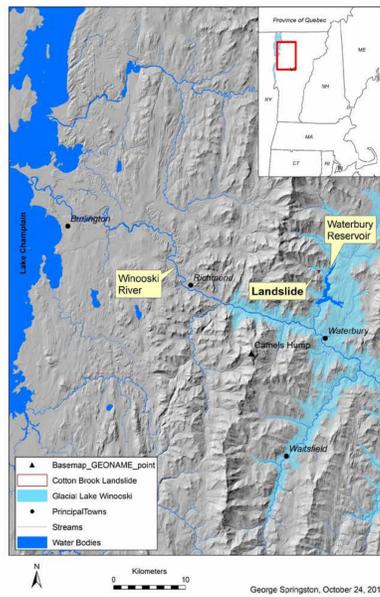


Figure 1. Location map. Glacial Lake Winooski indicated in pale blue.

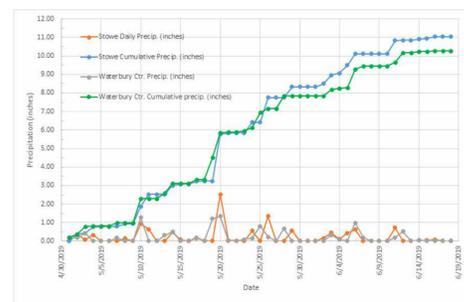


Figure 2. Rainfall recorded at two nearby weather stations. Landslide was reported on May 31, 2019. Rain in excess of 6 inches of rain fell in the preceding three weeks.

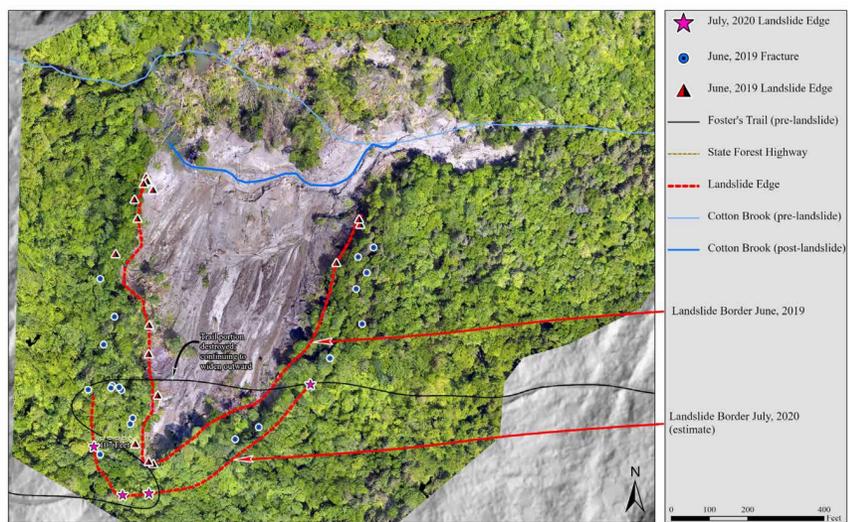


Figure 8. Orthophoto showing the updated extent of the landslide as of July, 2020. Orthophoto courtesy of E. Robinson, VTrans U.A.S. Team.

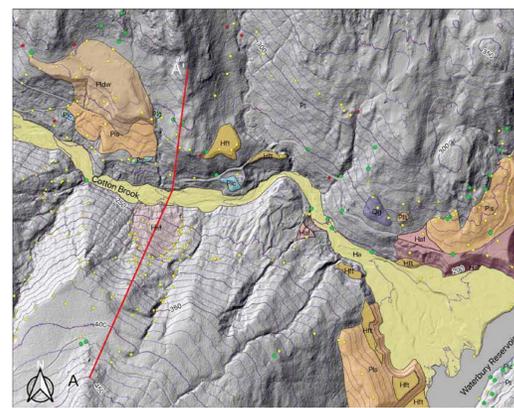


Figure 9. Surficial geologic map, modified from Wright, S.F., 2018, Surficial geology and hydrogeology of the Bolton Mountain quadrangle, Vermont: VGS Open-File Report VG2018-4

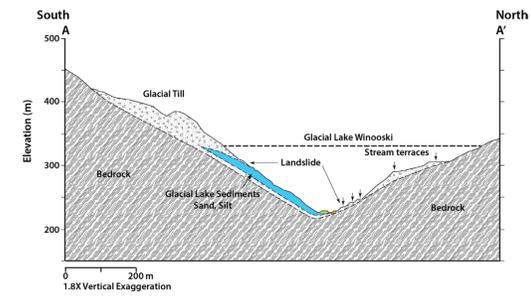


Figure 10. South-North cross-section across the Cotton Brook valley. Bedrock outcrops high along slopes and rarely along Cotton Brook up- and down-stream of the landslide. Glacial till is widely distributed across deeply incised tributaries along the south slope of Cotton Brook. The recent landslide reveals that this till overlies glacial lacustrine sediments at least below the elevation of Glacial Lake Winooski. Numerous high-elevation stream terraces indicate that the valley was largely filled with sediments deposited in Glacial Lake Winooski before the lake drained

Cotton Brook Landslide Stratigraphy

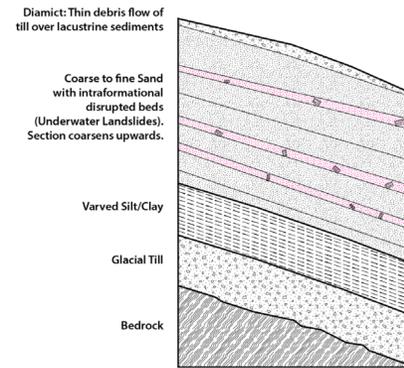


Figure 11. Schematic stratigraphy at Cotton Brook landslide. Not to scale.



Figure 12. Traces of steeply inclined and faulted medium to fine sand and silt beds exposed along the headwall of the Cotton Brook landslide. Bedding disruption occurred in an underwater landslide that occurred shortly after beds were deposited on the steeply-sloping sides of the Cotton Brook valley when the valley was inundated by Glacial Lake Winooski.



Figure 13. Graded beds of coarse to fine sand and silt near top of the exposed section. These are interpreted to be the bottom-set beds of a delta deposited in Glacial Lake Winooski by Cotton Brook.



Figure 14. Beds of coarse sand and pebble gravel at the top of the exposed section incorporate clumps of till that may have been ice-rafted or eroded from farther up-valley and later transported and deposited near the Glacial Lake Winooski delta.



Figure 15. Woody debris field downstream of Cotton Brook landslide, 6/24/2019.



Figure 16. View looking upstream from bridge over Cotton Brook, downstream of the landslide. Note heavy sedimentation on bars and extremely turbid water. Photo taken 6/4/2019.



Figure 17. The enlarged delta in Waterbury Reservoir, 6/12/2019. Photo courtesy of E. Robinson, VTrans U.A.S. Team.



Figure 18. Delta of Cotton Brook building out into Waterbury Reservoir, 6/10/2019.



Figure 19. Sediment plume from the Little River coming in from right and mixing with the waters of the Winooski River, Waterbury, 6/24/2019.



Figure 20. Color infrared Sentinel 2 Satellite from 5/31/2019, immediately after first recognition of landslide. Note the pale blue color of the reservoir waters, interpreted as high sediment load.

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 For more information, go to: <https://dec.vermont.gov/geological-survey/hazards>
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