LANDSLIDES AND FLASH FLOODS IN THE GREAT BROOK WATERSHED, PLAINFIELD, VERMONT

A presentation by George Springston, Norwich University, 2016

Studies funded through:
Vermont Geological Survey
Department of Environmental Conservation
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Landslides and Flash Floods in the Great Brook Watershed, Plainfield, Vermont

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Department Presentation, February 19, 2016
Outline

Introduction
Landslides, gullies, and mapping of the Landslide Hazard Zone
Tour of watershed from headwaters to Plainfield Village
Rainfall and stream runoff studies in the watershed
Summary

Right: Landslide at Site GB-3, Great Brook, Plainfield. 4/26/2012. George Springston.
“The downslope movement of soil, rock and organic materials under the influence of gravity and also the landform that results from such a movement” (The Landslide Handbook, USGS Circular 1325, p. 4).

Landslides are sometimes called “Mass Failures”
Some Causes of Landslides in Vermont

- Stream erosion resulting in over-steepening of the base of a slope.

- Heavy rainfall or snowmelt causing saturation of soil and increase in pore pressure.

- Adding excess load onto slopes, such as by dumping of fill onto a slope.

- Excavation of base of slope, resulting in over-steepening.

- Reduction in strength of materials due to physical and chemical weathering of soil.
Great Brook watershed in Plainfield, Groton, and Orange, central Vermont.

Drainage Area = 14.5 sq. miles. Channel length 8 miles. Elevations range from 3352 feet on Signal Mountain down to 712 feet at the Winooski River.
The longitudinal profile can be divided into three segments: Upper, Middle, and Lower.
A typical view of Great Brook and the Brook Road. Note bridge crossing at lower right and landslide on far bank in center. Aerial view of site GB-1021 on 9/21/2011
General map of landslides, gullies, and Landslide Hazard Zone.

Study identified 47 active landslides, 3 inactive ones, 7 streambank erosion sites, and 15 sites with gullying.
Landslide Hazard Zone outlined in red: Left, northern; right, southern reaches.
Alluvial fans and gullies. Lee Road
Size of Landslides. Note that most of the largest ones are in downstream reaches below Lee Road.
Bedrock outcrops in channel. Note that most are in the upstream reaches above Lee Road.
Rapid Geomorphic Assessment Results for Great Brook.

Data from Bear Creek Environmental (2013)
Overall Geomorphic Condition of Great Brook.

Data from Bear Creek Environmental (2013)
Headwaters of Great Brook

Rapid Geomorphic Assessment Score

George Springston, 6/18/2013
Site GB-1053
Site GB-1053, looking downstream. Note bedrock exposed on right bank at pack. Landslide on left bank. George Springston, 8/6/2013.
Sites GB-1050 and GB-1043
Sites GB-1050 and GB-1043
Evidence of channel incision (downcutting).

Site GB-1050, looking downstream. Freshly scoured dense till exposed on bank and in bed. George Springston, 8/1/2013.
Typical small landslide in till at Site GB-1043.

Left: Landslide in dense, massive, gray, silt-matrix till, nearly two years after Irene.

Right: Weathering of the till is leading to detachment of irregular blocks. George Springston, 8/1/2013.
Site GB-1050, looking upstream from on top of bank. Freshly scoured dense till exposed on bank and in bed. George Springston, 8/1/2013.

Evidence of channel incision (downcutting).
Sites GB-1036
Typical large landslide in till at Site GB-1036, 7/30/2013, Post-Irene. George Springston.
Site GB-1032
Site GB-1032
Glacial till freshly exposed at Site GB-1032 in a landslide on Great Brook, two days after May flood. Note overhangs at base and fallen blocks of till. George Springston, 5/29/2011.
Changes at Site GB-1032, Photo 3 of 4

Site GB-1032, 4/26/2012, Post-Irene. George Springston.
Changes at Site GB-1032, Photo 4 of 4

Site GB-1032, 10/18/2012, one year after Irene. Photo courtesy of Bear Creek Environmental.
Site of the Grout House, destroyed in the 1989 Flood.
Grout House, 1989 Flood

Ed LeTourneau
Location of the Gauthier House, destroyed in the 1984 Flood
Site of the Gauthier House, destroyed in the 1984 Flood. All that was left was the well casing (center of photo).
Rapid Geomorphic Assessment Results for Great Brook.

Data from Bear Creek Environmental (2013)
Large gullies in highly erodible sand and silt at the MacLaren Farm and Fowler sand pit.
Site GB-1010, looking down MacLaren-Fowler gully. Material is ice-contact fine to very fine sands and silt with gravel lenses. George Springston, 7/16/2013.
Site GB-1010, looking up MacLaren-Fowler gully. Note active scour at base of slope on left. George Springston, 7/16/2013.
Site GB-1023
Example of a house site that is threatened by an imminent slope failure. Site GB-1025.
Active landslide west of Cameron Road on Great Brook. Photo taken after Tropical Storm Irene, September, 2011.
Site GB-1025, looking across at right bank. Note peak of garage roof at top. Slope is 56 feet high and slope angle is 49°. George Springston, 7/29/2013.
Site GB-1025, July 21, 2015. Top of landslide is very close to back of garage.

Imagery courtesy of Jarlath O’Neil-Dunne of the University of Vermont Spatial Analysis Lab.
Site GB-1025, June 25, 2015.

Imagery courtesy of Jarlath O’Neil-Dunne of the University of Vermont Spatial Analysis Lab.
Site GB-1025, Spring, 2014. No trees left between house and top of landslide.
Site GB-1025, Spring, 1996. No house present.
Changes at Site GB-3, Photo 6 of 10

Changes at Site GB-3, Photo 8 of 10

Site GB-3, 5/16/2015. Photo by George Springston.
Site GB-3, 9/25/2015. Photo by George Springston.
Changes at Site GB-3, June 2015

http://www.uvm.edu/~ebuford/ol3/greatbrook_swipe.html
Changes at Site GB-3, June 2015, pre-flood
Changes at Site GB-3, July 2015, post-flood
Peak runoff values are estimates except for those from 1999 and 2000, which are derived from stream gaging. See Springston (2015) and Milone and MacBroom (2016) for further details.
Rainfall Associated with Flooding Since 1973

- June 1973: 4.1” rain
- June 1984: ?
- Aug. 1989: 6.7”
- Aug. 1990: 3.9”
- Sep. 1999: 5.3”
- Dec. 2000: 3.3”
- May 2011: 5.2”
- Aug. 2011: 5.1”
- July 2015: 3-4”

Hurricane Floyd reached Vermont on 9/15--17, 1999. Soils were dry and streams were low due to a prolonged drought.

Hurricane Floyd September 14-17, 1999

Maximum: 24.06" Southport 5N, NC

From: http://www.hpc.ncep.noaa.gov/tropical/rain/
Accessed 1/30/2012
Rainfall and runoff (stream flow) from Hurricane Floyd in Great Brook, Plainfield, Vermont, 9/15--17, 1999

Time from peak rainfall to peak runoff is about 150 minutes (2.5 hours). This is consistent with watershed size, slope of stream, etc.
Summary

• Study identified 47 active landslides, 3 inactive ones, 7 streambank erosion sites, and 15 sites with gullying.

• Landslides occur repeatedly in similar locations on steep slopes near the streams.

• Most landslides are in the lower reaches, which lack bedrock grade control in the channel.

• Additional rejuvenated landslides can be expected to occur after any future large floods.

• Two houses have been destroyed due to fluvial erosion since 1984. Several others are currently at risk.

• Many of the problems are related to constrictions at bridges, channelization of the stream, removal of boulders from channel, armoring of banks with rip-rap, berming, and floodplain encroachment.
Acknowledgements

• Funding supplied by the Central Vermont Regional Planning Commission through an Ecosystem Restoration Program Grant from the Vermont Department of Environmental Conservation, Agency of Natural Resources.

• Additional funding for landslide investigations supplied by the Vermont Geological Survey.

• Thanks to Mary Nealon and Pam DeAndrea of Bear Creek Environmental in Middlesex for geomorphic data and photographs.

• Thanks to Staci Pomeroy of the Vermont Rivers Program for post-Irene aerial photos.

• The spectacular 2015 imagery is courtesy of Jarlath O’Neil-Dunne of the University of Vermont Spatial Analysis Lab.

• Thanks to Lori Barg for sharing photographs and for her leadership in undertaking the original fluvial geomorphic assessment work along the brook.

• Many area residents assisted with aspects of the post-flood studies, including Allen Clark, Charlie Cogbill, Dan Gadd, Brett Engstrom, Rose Paul, Sacha Pealer, Matt Peters, and Bram Towbin.
Further Information

**Landslides in General:**


**Great Brook:**
Bear Creek Environmental, 2014, Great Brook watershed river corridor plan: Report prepared for Central Vermont Regional Planning Commission, Montpelier, 89 p. plus 4 appendices.


1989 Flood

Ed LeTourneau