To: Laurence Becker, Vermont State Geologist

From: George Springston, Research Associate, Norwich University

Date: 9/6/2007

Subject: Slope instability and flood damage along Honey Brook in East Barre

On August 8, 2007 I visited Honey Brook and surrounding areas in East Barre with Patrick Ross, DEC Stream Alteration Engineer, Steve Malnati, and Harry _____ from Barre Town in order to examine the results of flooding and stream erosion from the heavy rain of July 11. Mr. Malnati is the son of the owner of flood-damaged property at the bottom of the watershed. I conducted an additional site visit on August 9. Honey Brook is a tributary of the Jail Branch and drains the Trow Hill and Cobble Hill areas and areas north as far as The Pinnacle). Figures are shown in the Powerpoint presentation that accompanies this memo. Site locations for these visits are shown in Figure 1 of the presentation, as well as sites visited upstream of the Foster Property on the south side of the Jail Branch.

Heavy rains associated with thunderstorms on July 11, 2007 caused heavy damage in central Vermont. According to a summary published on the Burlington National Weather Service web site this was the culmination of three days of severe weather. Towns that I know of with significant damage include Plainfield, Barre City, Barre Town, Williamstown, Bethel, and Stockbridge. I'm sure this is not a complete list, but have not seen a final compilation beyond the articles in the newspapers.

Observations

The storm caused extensive road washouts and numerous culvert blockages. We examined the culverts where Nuissl Road crosses the east branch of Honey Brook and where East Cobble Hill Road crosses the main branch. Figure 2 shows the East cobble Hill Road culvert after much debris was removed.

Downstream of East Cobble Hill Road I observed extensive areas of stream bed and bank scour, many flood-transported boulders, and numerous large debris jams. One of the debris jams is shown in Figure 3.

On the channel bottom the flood stripped away sections of stream bed gravels to expose the underlying materials; dense, silt-matrix till with abundant clasts and granite bedrock. Although the till is relatively resistant to stream erosion, the power of the flood resulted in the formation of headcuts up to several feet deep into the till in the stream bottom (Figure 4). The abundant clasts in the till are shown in Figure 5.

The stream banks, soil was stripped away to expose fresh, unweathered till and overlying stream terrace deposits of loose, sandy, cobble and boulder gravel and loose, cobbly to bouldery sand (Figure 6).

A granite gorge section is located upstream of the confluence of the main stem with the east branch.

The major landslides begin below the gorge. The first is located on the outside of a meander bend on the west side of the brook at Station EB-13. This slide is about 150 feet high extends about 150 feet along the brook. Figure 7 is taken looking down this slide toward the brook. The materials consist of about 60 feet of ice-contact sands and gravels overlain by dense, silt-matrix till. A closeup of the contact between these materials is shown in Figure 8 and a view of the lower portion of the sand and gravel is shown in Figure 9. Flows of till have washed out over much of the underlying sand and gravel, partially obscuring the stratigraphy. Note that this slide has been reactivated by the recent flooding. Mr. Malnati stated that landsliding had occurred here during the 1973 flood. This is confirmed by abundant early successional vegetation on much of the slopes.

The debris jams continue throughout this section of the stream. An example of a gravel bar that accumulated during the waning of the flood flow is shown in Figure 10. This is a good example of the temporary sediment storage that is occurring behind jams throughout this section of the stream.

A tremendous landslide is located downstream at Site EB-15 on the outside of a bend on the east side of the brook (Figure 11). This is approximately 180 to 190 feet high and about 230 feet long. The lower portion of the deposit consists of 50 feet of coarse sandy pebble gravel (Figure 12) overlain by dense, silt-matrix till. At about 94 feet above the stream there is a zone of at least 6 feet of laminated diamict. From here up the till appears to be massive, although I did not go out on this part of the face. About 25 feet below the top there appears to be about 5 feet of fine lacustrine deposits and then the upper 20 feet consist of bedded pebble gravel and pebbly sand (stream terrace deposits).

Another large landslide is located downstream at Site EB-16 on the west bank of the brook. As with the others, this is on the outside of a meander bend. The slide is about 70 feet high and 180 feet long. This is composed of ice-contact fine sand and pebbly fine sand. A large debris jam is present at this site.

Note that another, smaller landslide is located downstream on the east side of the brook at the next bend. Debris jams continue. In this lower section of the stream the gradient is decreasing and deposition of flood deposits is extensive.

Figures 13 and 14 show the aftermath of the flooding downstream at the Malnati residences. During the storm, the bridge that carries the brook under U.S Route 302 clogged up with debris, the highway was flooded, and extensive scour occurred as the stream found a new course through the Malnati property to the Jail Branch. Following the recession of the floodwaters the channel of the stream was roughly relocated back behind the buildings as shown in the photos.

Analysis:

It is very clear from my site visits that this stream has a long history of landslides. Mr. Malnati stated that the only extensive damage at the bottom of the stream had been from the 1974 flood. Although I have not examined the aerial photos to confirm this, I suspect that the slides have been at least intermittently active during other storms as well. Regardless of whether or not this historical analysis is correct, the current situation looks hazardous for the following reasons:

1. The stream has scoured away the bases of the slides and further slope failures are very likely.

2. The potential scale of the slope failures is severe, given the height of the banks.

3. Unlike many landslides in till, these have sand and gravel below the till. This is more easily erodible by the stream than till and it makes the potential landslides likely to be deeper and more extensive.

4. The narrow valley bottom and abundant debris jams already present along the brook add to the potential for unpredictable damming of flood waters and sediment should further landslides occur.

Considering the size of the landslides, it appears unlikely that stream restoration techniques could stabilize these banks. Given this, the sizing of the bridge carrying the brook under the highway needs to be adequate to carry floodwaters **and considerable debris.** The hazards to the downstream residences should be carefully evaluated given the likelihood of further slope failures.

cc: Jim Ryan, Vt. DEC Water Quality Division, Watershed Coordinator; Patrick Ross, Vt. DEC Water Quality Division, Stream Alteration Engineer; Barry Cahoon, Vt. DEC Water Quality Division, Rivers Management Program Coordinator

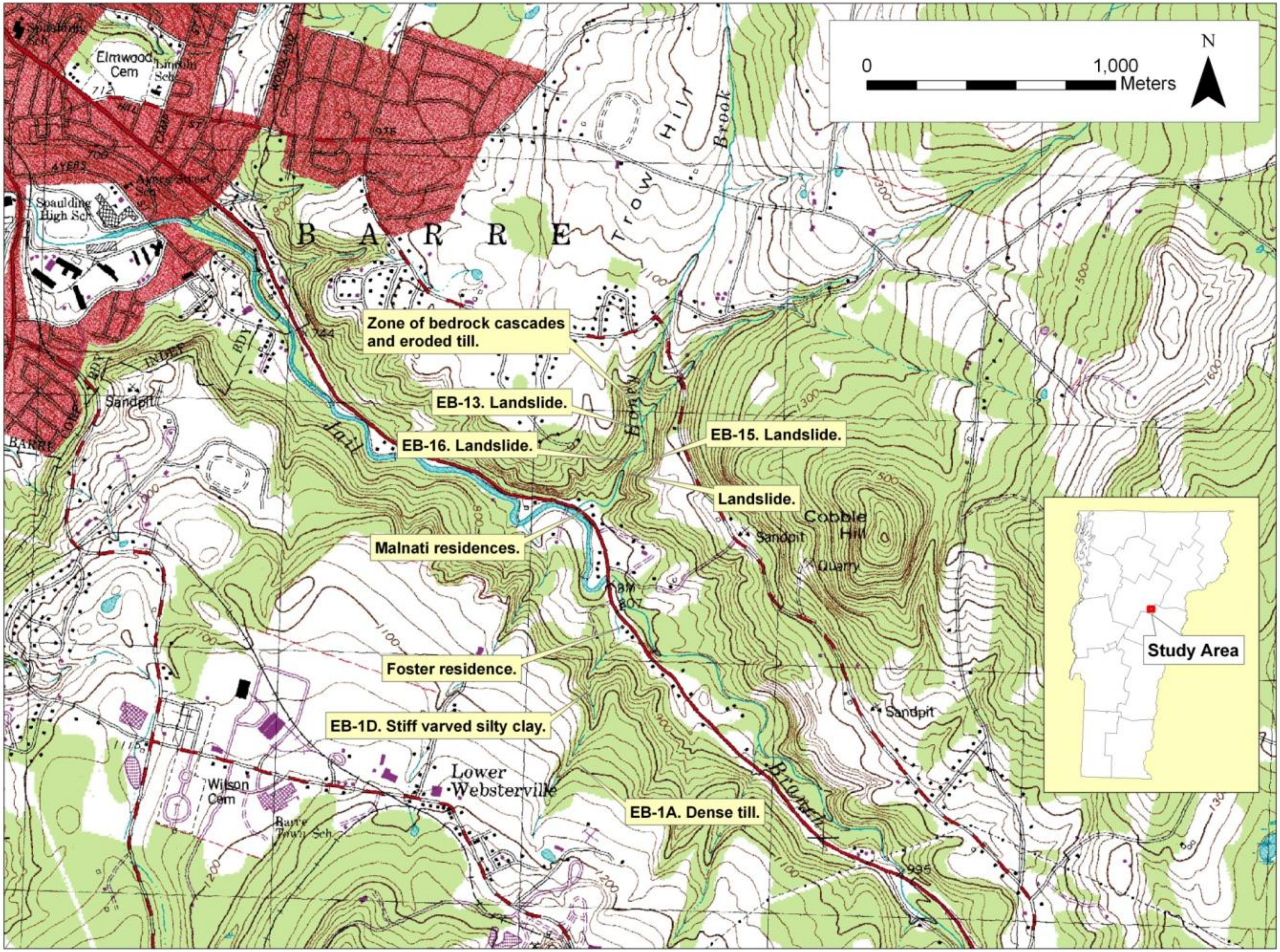

Figure 1. Base map from USGS Barre East quadrangle.

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Figure 2. Culvert that clogged during flood.

Figure 3. Recent debris jam on right with bedrock grade control on left. Looking downstream.

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Figure 4. Freshly eroded dense till exposed at headcut in Honey Brook at EB-12A.

Figure 5. Freshly eroded dense till with granite clasts. Site EB-12A.

Figure 6. Till overlain by bouldery stream terrace deposit. Site EB-12B.


Figure 7. Looking down reactivated landslide at EB-13. Looking ESE.
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Figure 8. Dense, silt-matrix till overlying deformed, bedded, ice-contact sands. SE is to the left.

Figure 9. Ice-contact sand and gravel at base of landslide. EB-13.

Figure 10. Cobble bar deposited behind debris jam at EB-14.

Figure 11. Reactivated landslide at Site EB-15. Looking east.

Figure 12. Ice-contact sands exposed at base of reactivated landslide at Site EB-15.

Figure 13. Flood damage at base of Honey Brook. Looking west.

Figure 14. Flood damage at base of Honey Brook. Looking east.