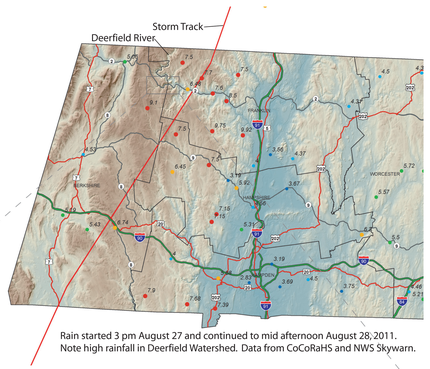
GEOMORPHIC EFFECTS OF TROPICAL STORM IRENE ON WESTERN MASSACHUSETTS: LANDSLIDES AND FLUVIAL EROSION ALONG THE DEERFIELD AND COLD RIVERS, CHARLEMONT AND SAVOY, MA

STEPHEN B. MABEE, MASSACHUSETTS GEOLOGICAL SURVEY

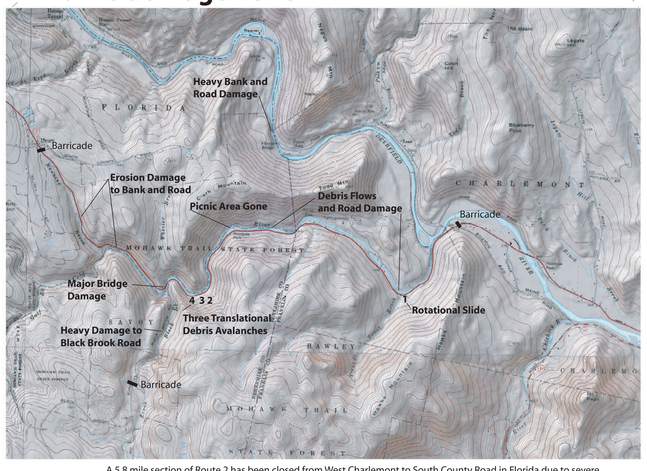
1. The Storm

Storm track beginning on August 28, 2011 (from NOAA)



Rain started 3 pm August 27 and continued to mid afternoon August 28, 2011. Note high rainfall in Deerfield Watershed. Data from CoCoRaHS and NWS Skywarn.

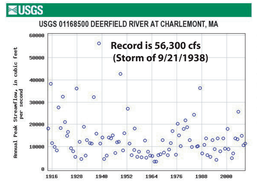
2. The Damage Zone



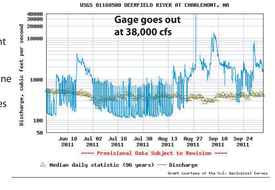
0 500 1,000 2,000 3,000 4,000 Feet

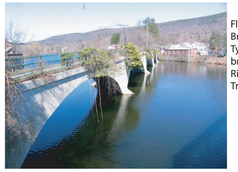
A 5.8 mile section of Route 2 has been closed from West Charlemont to South County Road in Florida due to severe fluvial erosion and undercutting of the roadway, damage to retaining walls, debris flows, landslides and bridge damage. Estimated cost of temporary repairs is $33.5 million.

3. The Flooding



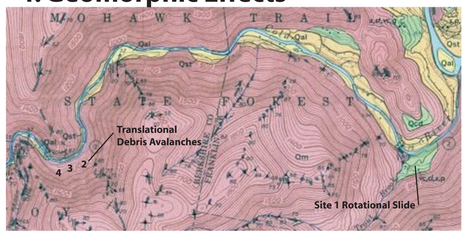
Hydrographs from the Charlemont gaging station. Left: Peak annual streamflow record. Highest flow recorded in the Sept 1938 hurricane at 56,300 cfs. Right: Hydrograph for tropical storm Irene. Gage goes out at 38,000 cfs. Preliminary flow rate from USGS is 53,900 cfs (second highest on record)





Flooding at Shelburne Falls Bridge of Flowers. Left: Typical winter flow. Note brick building in background Right: Flow during peak of Tropical Storm Irene

4. Geomorphic Effects



Bedrock geology is Moretown Fm. (pink) with well developed sheeting joints subparallel with the slope. Translational slides 2, 3 and 4 slid along the sheeting joints as debris avalanches. Geology at site 1, location of rotational slide, consists of lake bottom sediments (green) overlain by debris flow and alluvial fan deposits.

Aerial view of debris avalanches, looking SSW. Slides are numbered. Photo by Chris Condit and John Fellows.

Above: Sheeting joints exposed on slope.

Left: Debris Avalanche 4. 2-3 feet of overburden slid on sheeting joints (284°, 38°). Slide is 620 feet long and estimated volume moved 1860 cubic yards.

Slide number 2. The largest slide: 900 feet long, 1.5 acres and estimated 4950 cubic yards

Right: The near fatality. This guy got caught between slides 2 and 3 at about 11 pm August 27, 2011

Below: Looking across slide number 2.

The statistics on all the slides. Nearly 2500 feet in combined length, 3 acres of coverage and about 9800 cubic yards of material moved.

Parameter	Slide 2	Slide 3	Slide 4
Bottom Width (ft)	120	58	48
Top Width (ft)	45	42	38
Ave. Slope Angle (°)	28	33	33
Horizontal Length (ft)	868	813	520
Slope Length (ft)	902	969	620
Elevation Difference (ft)	460	522	337
Area (sq.ft)	66,881	39,854	25,149
Area (Ac)	1.54	0.91	0.58
Thickness Range (ft)	1.5-2.5	1.5-2.5	1.5-2.5
Min. Volume (CY)	3716	2214	1397
Max. Volume (CY)	6193	3690	2329
Ave. Volume (CY)	4954	2952	1863

Rotational slide at site 1. Road built on lake-bottom sediments overlain by debris flow and alluvial deposits from Trout Brook. Area has had chronic failures due to erosion of toe of slope by the Cold River during periodic flooding, high pore pressures, poor strength soils and added weight due to heavy rains. Area affected is about 800 feet.

Note tension cracks in soil downgradient of the road surface at site of rotational slide.

Erosion damage to unreinforced embankment on Route 2 along the Cold River.

Fluvial erosion damage along Route 2. This repair is estimated at $3 million.

Looking down slide number 2 from the crown. Elevation change of about 460 feet. Cold River at bottom. Average slope angle of 28° to 33°.

Scouring exposed footings of retaining wall and overwash on road surface due to clogged cross culverts caused erosion of roadway and eventual toppling of retaining wall.

Bridge over Cold River in Savoy at intersection with Black Brook. This bridge was not overtopped. Violent eddies at downgradient end of abutment eroded the backfill and undercut road surface causing collapse. This phenomenon was observed at many bridge crossings.