Landslides, Subsidence & Fractures

Onondaga Creek Fact Sheet

TULLY VALLEY LANDSLIDES

Numerous Landslides have occurred in the Tully Valley over a 15 year interval, April 1993 to present.

Land slumping on a valley wall occurred at the foot of Bare Mountain on April 27, 1993, when 1.3 million cubic yards of land slid across Tully Farms Road towards Onondaga Creek. (Fig.1) Research by the US Geological Survey (USGS) of other sites along the foot of Bare Mountain found evidence of previous landslide occurrences that ranged from 7,000 to 10,000 years ago.

A shale ledge failure released glacial sediments into Rainbow Creek. Some time in the early 1970's a shale ledge (waterfall) failed (Fig. 2a) along Rainbow Creek between I-81 and State Route 11A. This lead to the presently-ongoing landslide which has carried large volumes of sediment down to the valley floor, filling culverts under State Route 11A with substrates ranging in size from boulders to cobbles, down to silt and clay which add turbidity to Onondaga Creek. (Fig. 2b) The landslides along Rainbow Creek are due to rapid erosion of the creek bed behind the former shale ledge and subsequent toe-cutting[1] of steep slopes on either side of the creek.

Stream toe-cutting into glacial sediments along Rattlesnake Gulf. Ongoing landsliding in Rattlesnake Gulf has also cut away at the base of a massive bluff consisting of clay soil on the south side of this steep stream channel. The face of the bluff continues to slide into the stream, further exposing the bluff to rapid erosion and partly blocking the channel under the bridge at Tully Farms Road and also adding turbidity to Onondaga Creek. This landslide area was apparently active before the late 1930s (when the first aerial photography of the region was collected) and continues to erode into the steep hillside today (2008). Previous

Figure 1: Oblique aerial view of the Tully valley landslide taken April 30, 1993, three days after the slide. Debris moved toward the viewer, in the process covering Tully Farms Road (dashed line) with up to fifteen feet of reddish remolded clay. Three people were rescued by helicpoter behind the white house (lower left) from the rapidly advancing landslide. Springs are located between the red arrows.

source: http://pubs.usgs.gov/fs/fs13-98

Figure 2a

source: USGS William M. Kappel presentation to US EPA, April 7, 2008, slide 42

1 The toe is synonymous with the base of the slope forming a stream bank.

Figure 2b
Source: USGS William M. Kappel, presentation to US EPA April 7, 2008, Slide 44

Figure 3
Source: USGS photo of Rattlesnake Gulf, Tully Valley, New York

landslides along Rattlesnake Gulf are attributed either to bedrock failure or sediment-slope failure, both related to stream toe-cutting. (Fig. 3)

TULLY VALLEY SUBSIDENCE

Cracking and subsidence of bedrock along the east and west valley walls has occurred in the former brine field areas at the southern end of the Tully Valley due to the removal of halite (rock salt), at a depth of 1,200 feet below land surface. For a century (1880s to 1980s) the halite was solution-mined for the production of soda ash in Syracuse (Solvay Process Company – Allied Chemical Corporation).

Deformation of rock is visible in the broken and tilted rock layers at Emerson Gulf (Fig. 4).

Collapse of rock into voids left by brine mining occurred where wells drilled to depths of 1,100 to 1,300 feet had removed layers of halite that were over 150 feet thick. The overlying bedrock collapsed, which is expressed as land-surface displacement along the edges of the valley in this area.

Subsidence of the land surface in the former brine fields is visible on the east and west sides of the valley floor, above the subsurface rock-collapse zones (Figure 5a, sinkhole). The subsidence extends across the valley floor between the east and west brine fields (Fig.5b, map).

Subsidence also occurs at the mudboils several miles north of the brine fields, and is due to the discharge of unconsolidated very-fine sand, silt, and clay, which is carried by water under artesian pressure. (See Mudboil Fact Sheet)

TULLY VALLEY FRACTURES

Vertical to horizontal cracks (joints) extend hundreds of feet through the bedrock due to tectonic forces that formed the Earth's continents over many millions of years. These joints have been identified regionally through mapping of bedrock joints and fractures in stream channels and other bedrock exposures.

Multiple new bedrock fractures have opened along these joint surfaces in the east and west valley walls (Fig. 6), upslope of the brine field subsidence. These fissures have opened at a rate which can be identified by tree roots that straddle a fissure (Fig. 7). Hydraulic connections may have developed within these 'enhanced' fracture zones and the unconsolidated mudboil aquifer.

Figure 4
Source: USGS William M. Kappel presentation to US EPA, April 7, 2008, slide 31

Figure 5a
Source: USGS William Kappel presentation to US EPA April 7, 2008, slide 33

Figure 5b
Source Figure 13 in Kappel, W.M., D. A. Sherwood, and W.H. Johnston. 1996. Hydrogeology of the Tully valley and characterization of mudboil activity, Onondaga County, New York. WRIR96-4043. U.S.Dept. of the Interior U.S. Geological Survey; Branch of Information Services distributor, Ithaca, N.Y., Denver, C.O.

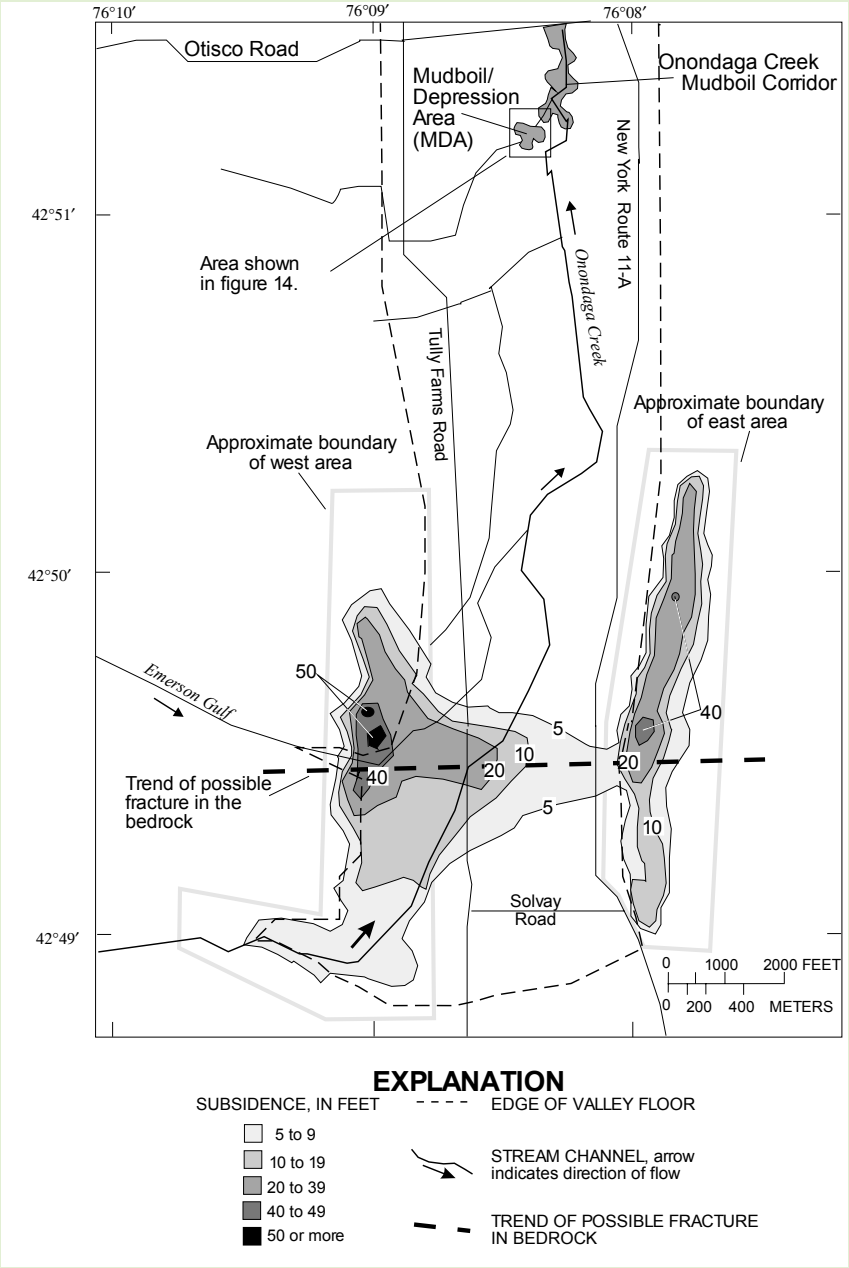

Figure 6
Source: USGS William M. Kappel presentation to US EPA, April 7, 2008, slide 32

Figure 7
Source: USGS William M. Kappel (2008)

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The Onondaga Lake Partnership (OLP) sponsors the Onondaga Creek Revitalization Plan project with funds from the U.S. Environmental Protection Agency. Visit www.onlakepartners.org for more information about the OLP.

This fact sheet and additional information about the Onondaga Creek Revitalization Plan project can be found on the World Wide Web at www.esf.edu/onondagacreek/.