Hydrogeologic Effects of Flooding in the Partially Collapsed Retsof Salt Mine, Livingston County, New York

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The Retsof Salt Mine is in Livingston County, New York, about 25 mi (40 km) southwest of Rochester (fig. 1). This mine, which has been in operation for 110 years and is about 1,100 ft (335 m) below land surface, supplies road salt to 14 States in the Northeast. Retsof Salt Mine is the largest salt mine in the Western Hemisphere and includes an underground area that is roughly the size of Manhattan (6,500 acres or about 2,630 hectares). An underground room near the southern end of the mine near Cuylerville collapsed on March 12, 1994, and an adjacent room collapsed in early April. Two large, circular collapse features that are several hundred feet apart have developed at land surface above the two collapsed mine rooms. The northernmost feature, which is about 700 ft (213 m) in diameter, includes a central area about 200 ft (60 m) wide that has subsided about 20 to 30 ft (6 to 9 m). The southernmost feature, which is about 900 ft (274 m) in diameter, includes a central area that is about 700 ft (213 m) wide that has subsided about 70 ft (21 m). The subsidence in the collapse area has forced the closure of a section of State Route 20A as a result of the partial collapse of a New York State Department of Transportation bridge.

During the formation of these collapse features, hydraulic connections formed between aquifers and the mine that had been previously isolated from each other by confining units. These new connections have provided routes for rapid migration of ground water downward to the mine level. Since March 12, ground water draining from overlying aquifer systems has been progressively flooding the mine at inflow rates averaging about 18,000 gal/min (1,135 L/s). This aquifer drainage has caused inadequate water supplies in a number of local wells, and some wells actually have gone dry. The U.S. Geological Survey (USGS) has been working with the Livingston County Department of Health since March 1994 to provide technical expertise in dealing with this situation. A regional ground-water-level monitoring network has been established to observe the rate, magnitude, and extent of aquifer drainage related to the mine collapse. Data collected since the initial collapse show that water levels in some wells drilled in the flood-plain sediments and upland bedrock units are showing only expected seasonal changes. Significant water-level declines resulting from aquifer drainage into the mine have been observed in some wells completed in glacial deltaic deposits along the valley walls in an extensive basal sand-and-gravel aquifer in the Genesee Valley and in the uppermost bedrock near the collapse features (fig. 1). The basal sand-and-gravel aquifer and the thin water-bearing zone at the top of bedrock are hydraulically connected.

A conceptual model of the ground-water flow system has been developed on the basis of knowledge of the hydrogeology of similar valleys in central and western New York, borehole geophysical surveys of 18 wells drilled in and adjacent to the collapse features, and marine seismic-reflection profiling on the Genesee River. The complex ground-water flow system involves multiple aquifers in the glacial sediments and the bedrock. In June 1994, a team of specialists from the USGS examined the environmental effects of the partial collapse of the mine. The team compiled a list of options for further short-term and long-term studies to address the major issues of public safety, aquifer drainage, and subsidence. The USGS, the mining company, and the Livingston County Department of Health continue to monitor ground-water levels in the area, and the USGS is constructing a preliminary numerical model to assess the long-term effects of the partial mine collapse on the regional ground-water flow system.

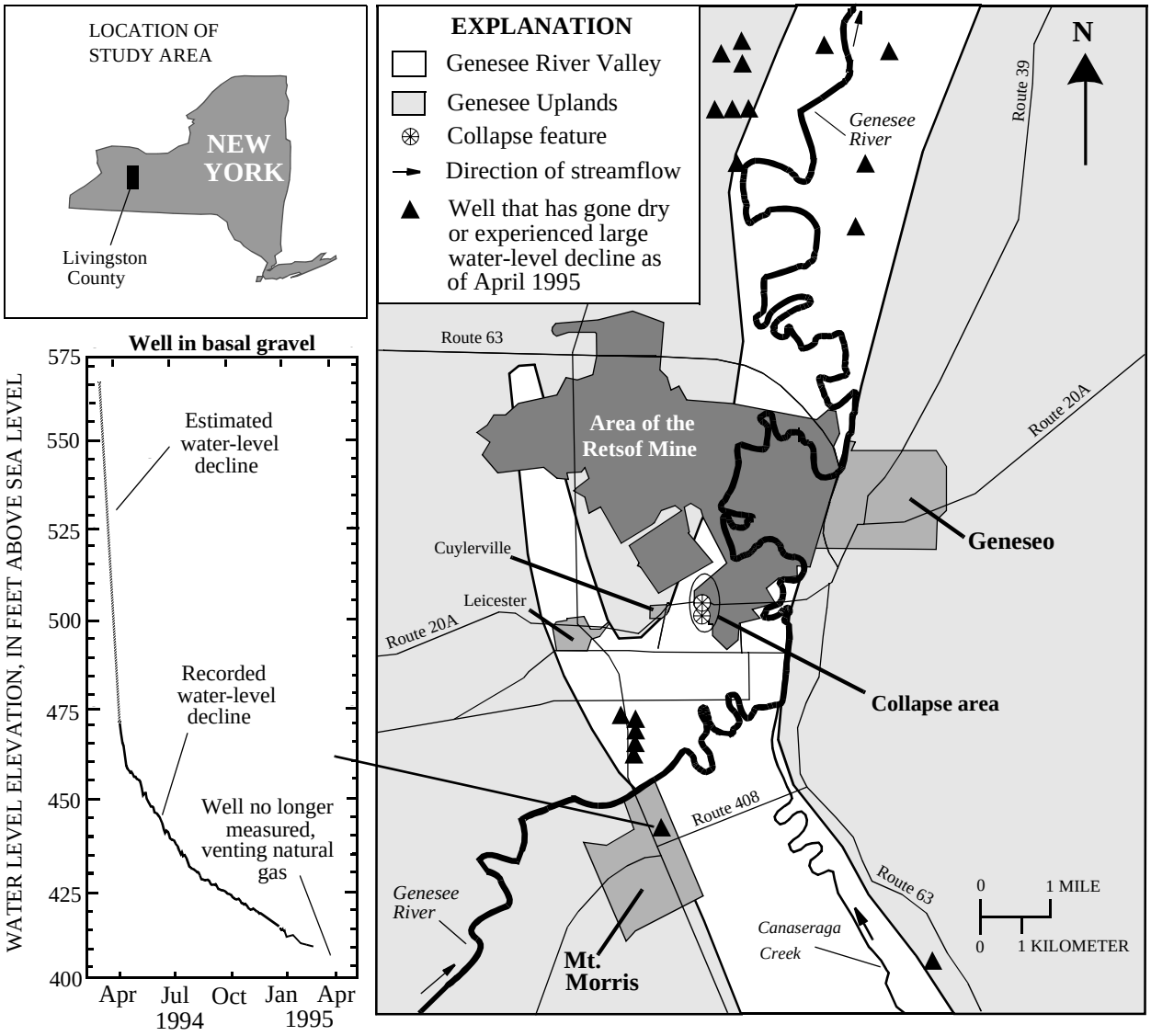

Figure 1. Location of Retsof Salt Mine, area of collapse, and hydrograph of water-level decline in a well 3.5 miles from the mine.