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SCIENTIFIC INVESTIGATIONS MAP 2005-2914
SURFICIAL GEOLOGY -- PLATE 3 OF 8
Hetcher-Aguila, K.K., and Miller, T.S., 2005,
Geohydrology of the Valley-Fill Aquifers Between the Village of Greene,
Chenango County, and Chenango Valley State Park, Broome County, New York

GLACIAL HISTORY OF THE STUDY AREA

Continental glaciers covered most of New York at least twice during the Pleistocene Epoch (1.8 million to 10,000 years ago). Ice advanced southward and retreated northward in response to changes in climate. Intensive scouring by glaciers deepened and widened major valleys. In the uplands, the ice removed previously deposited unconsolidated material from north-facing slopes and deposited thick amounts of drift (mostly till) on south-facing slopes (till-shadow hills). More detailed descriptions of the glacial history and the geomorphology in the Chenango River valley are in Cadwell (1972), Cadwell and Muller (1986), Randall (2001), Fleisher (1977, 1986a, 1986b), and MacNish and Randall (1982).

VALLEY-FILL DEPOSITS

Most of the older unconsolidated deposits in the study area were removed during the last advance of ice and most of the present-day deposits in the Chenango River valley are the result of deposition during the last retreat of the glacier (Wisconsinan) about 13,000 years ago. The glacial sediments include till, ice-contact deposits, lacustrine deposits, and outwash. The buried, coarse-grained glaciofluvial deposits that overlie bedrock in the deep parts of the valley and, in some places, are exposed at land surface along the valley walls (pl. 8) consist of ice-contact deposits that settled in front of, next to, or beneath the ice during transport by glacial meltwater. In the low areas on the valley floor, there has been subsequent alluvial deposition by postglacial streams.

Till

Till is an unsorted mixture of boulders, cobbles, gravel, sand, silt, and clay deposited directly by the glacier. It generally covers the bedrock uplands and locally underlies other valley-fill deposits along the sides of the valley. It is generally absent in the central parts of the Chenango River valley throughout the study area. Till has low permeability because (1) it is poorly sorted, (2) it is highly compacted, and (3) its matrix has a high silt and clay content. Its thickness in the uplands ranges from several feet to tens of feet.

Ice-Contact Deposits

Ice-contact deposits were laid down beneath, alongside, or in front of the glacier as eskers, kames, kame terraces, and kame moraines. These deposits consist mostly of permeable sand and gravel, but can have layers or lenses of fine sand, silt, and clay within them.

When the rate of glacial melting exceeded the rate of southward glacial advance, the ice front receded northward. Meltwater streams that drained the glacier and tributaries that drained exposed uplands typically flowed along the sides of tongues of ice that extended several miles down the valley in front of the main continental ice sheet. These streams transported large amounts of sand and gravel; some of this sediment was deposited between the side of the ice tongue and the valley walls. As the ice that was supporting the sediments eventually melted, these sediments collapsed into the valley and formed kames and kame terraces along the sides of the valleys. These collapsed kame terraces are important recharge areas for the unconfined aquifer and the confined aquifer because they extend from land surface at the valley walls out into the center of the valley, where they are commonly confined by overlying lacustrine deposits (see geohydrologic section B-B', pl. 8).

Sometimes, however, the rate of glacial melting was equal to the rate of southward glacial movement, and the ice front remained stationary for many years; these periods are known as stillstands. During stillstands, the melting of the ice front allowed the continuous release of ice-borne sediment. This process resulted in the deposition of a large moraine that is comprised of stratified coarse-grained sediments (sand and gravel), and is typically a complex mound of outwash, kames, kame terraces, and kame deltas. One such major stillstand occurred in the southern part of the area now occupied by Chenango Valley State Park. A large moraine spanned the entire width of the valley, forming a plug or dam that impounded drainage when the ice front began to recede northward again. A temporary lake, called a proglacial lake, formed between the moraine and the retreating ice front (Cadwell, 1972; Cadwell, 1981; MacNish and Randall, 1982).

Lacustrine Deposits

Sediments transported by meltwater and upland tributaries were deposited into the proglacial lake and formed deltas and lake-bottom deposits (Flint, 1971; Randall, 2001). The coarse-grained material (sand and gravel) was deposited along the shoreline, and the fine-grained sediment (clay, silt, and fine-to-medium sand) settled farther out in the lake. The large amounts of fine-grained sediment that settled within this lake formed thick layers of lake-bottom deposits that buried (confined) the older ice-contact deposits in the center of the valleys. These relatively impermeable lacustrine sediments form a major extensive confining unit in the study area. The older coarse-grained deposits that underlie the lacustrine unit form the confined aquifer in the valley.

Infilling of the lake in Chenango River valley ceased when the lake filled in with sediments and/or the lake level declined (essentially draining the lake dry) as overflow incised the moraine, cutting an outlet channel along the west side of the valley where the present-day Chenango River flows. The overflow eroded a channel through the unconsolidated morainal sediments, but downcutting essentially halted when the channel reached relatively resistant bedrock. The bedrock is now exposed in a 1,500-foot reach of the Chenango River channel from the State Route 79 Bridge to just above the confluence with the Tioughnioga River.

Outwash and Alluvium

Eventually, meltwater from northward-retreating ice deposited outwash (stratified sand and gravel) on top of the lacustrine deposits. Much of these outwash deposits have been removed or reworked by postglacial streams. Outwash and recent alluvial floodplain and channel deposits are generally 10 to 40 feet thick in the Chenango River valley. Saturated outwash and alluvium, along with ice-contact deposits, form the unconfined valley-fill aquifer. Several well logs from the study area, especially within the Village of Greene, indicate very thin (less than 10 feet thick) or nonexistent alluvium and outwash (for example, wells CN 44, CN 907, CN 915, and CN 925, pl. 2).

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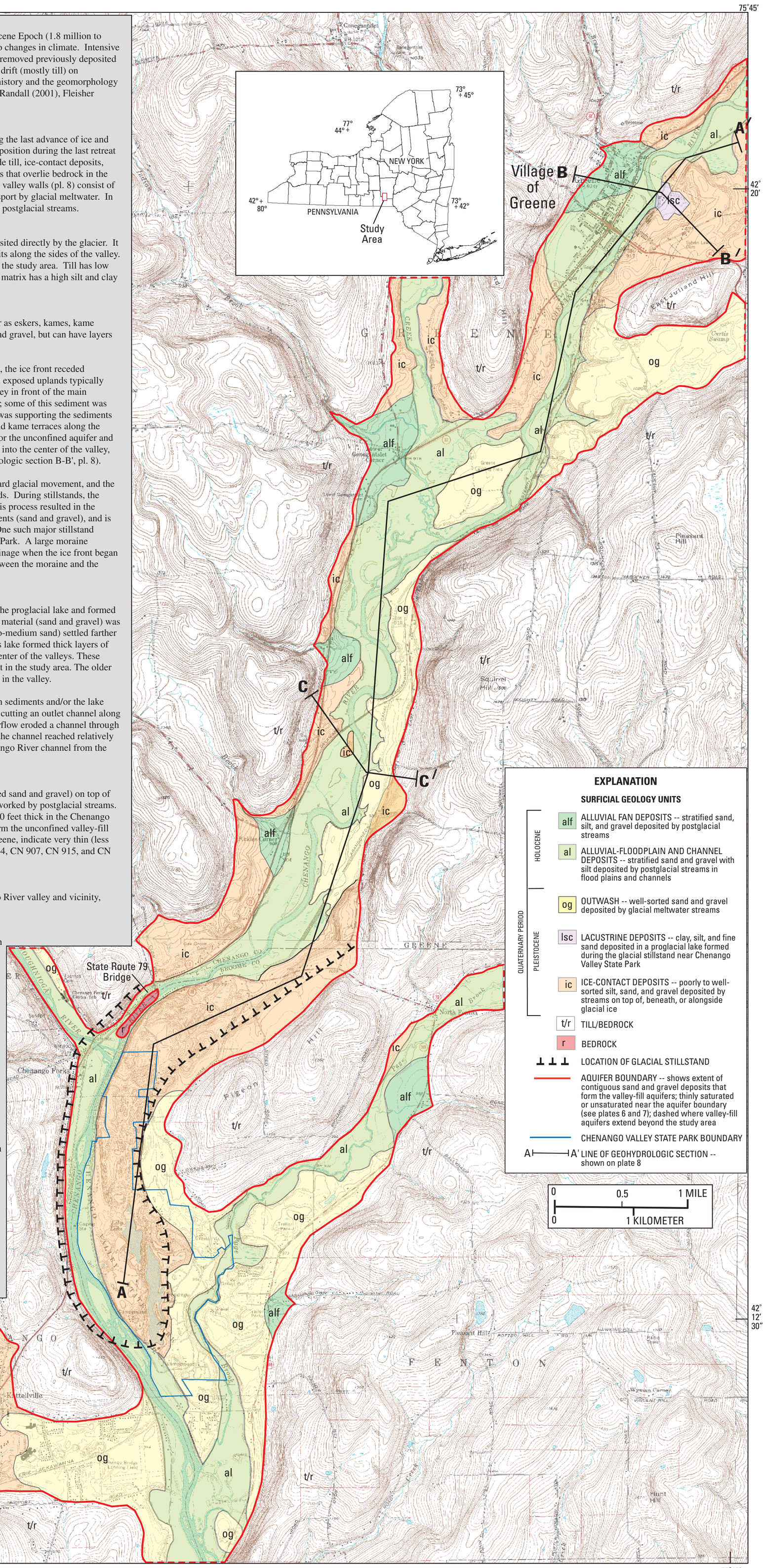

Base from U.S. Geological Survey
1:24,000 series Digital Raster Graphic topographic maps,
from New York State Department of Environmental
Conservation image catalog, 2000.
Universal Transverse Mercator, Zone 18, NAD83.

Aquifer boundary based on surficial geology modified from Cadwell and Muller (1986) and Cadwell (1972).

SURFICIAL GEOLOGY BETWEEN VILLAGE OF GREENE AND CHENANGO VALLEY STATE PARK, NEW YORK

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