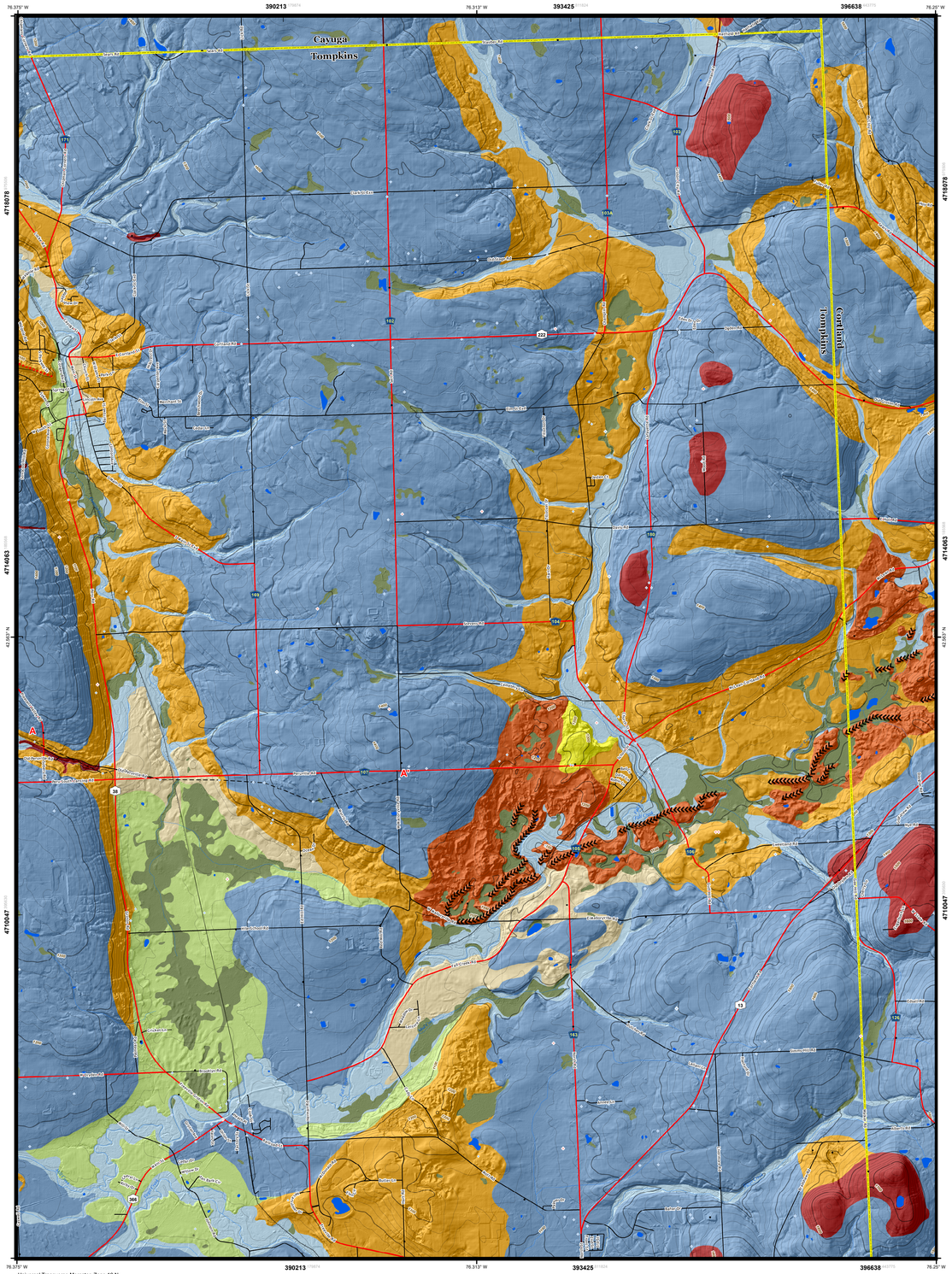
New York State Museum
Mark Schaming, Director

New York State Geological Survey

SURFICIAL GEOLOGY OF THE GROTON 7.5-MINUTE QUADRANGLE, CAYUGA AND TOMPKINS COUNTIES, NEW YORK

prepared by
James R. Leone and Karl J. Backhaus

Supported in part by the U.S Geological Survey Cooperative Agreement Number G18AC00232
National Cooperative Geologic Mapping Program (STATEMAP)



Universal Transverse Mercator, Zone 18 N
North American Datum of 1983

Hygrology, and planimetry layers from the New York State DOT Raster Quadrangle separates for Cayuga, Cortland and Tompkins Counties (https://gis.ny.gov/gisdata/inventories/member.cfm?OrganizationID=108). Geographic data layers from 2019 TIGER/Line shapes for transportation and hydrography (https://www.census.gov/cgi-bin/geo/shapefiles/index.php)

Shaded relief from Cayuga County and Tompkins County SWCD 2-meter Lidar (http://www.cayugacounty.us/portals/0/planning/interactivegis.htm), and 10 m DEM (http://gis.ny.gov/elevation/index.cfm)

Magnetic declination from the NOAA online Declination Calculator: http://www.ngdc.noaa.gov/geomag-web/#declination

SCALE 1:24,000

1 0.5 0 KILOMETERS 1 2
1000 500 0 METERS 1000 2000
1 0.5 0 1
MILES
1000 500 0 1000 2000 3000 4000 5000 6000 7000 8000 9000 10000
FEET

CONTOUR INTERVAL: 10 FEET

Geologic mapping by J. Leone and K. Backhaus, 2019
Digital data and cartography by K. Backhaus, 2019.

MN 12° 4' 215 MILS
GN 0° 53' 16 MILS

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Introduction:
The Groton 7.5-Minute Quadrangle was mapped as part of the 2018 National Cooperative Geologic Mapping Program funded STATEMAP project (award #G18AC00232). This quadrangle is one of twelve quadrangles to be mapped as part of the Tompkins County Surficial Geologic mapping project currently being undertaken by the NYSGS starting in 2018 and concluding sometime in the early to mid-2020's. The purpose of this map was to identify and delineate various surficial geologic formations in the Groton Quadrangle and to provide information to guide municipalities in land use, environmental, and natural resource decisions across its roughly 88-square mile area.

The Groton quadrangle is in northeastern Tompkins County in the Finger Lakes Region of New York State about 15 miles west of Interstate 81. The quadrangle also lies within southern Cayuga and eastern Cortland Counties. The town of Groton and Dryden, villages of Mclean, Groton City, Lafayette Corners, Freeville and Nubia are the major municipalities in the quadrangle. This portion of Tompkins County consists are large tracts of private farmland, gravel pits and nature preserves. This quadrangle is situated within the Allegheny Plateau near the southern edge of the Finger Lakes. The topography is pretty gradual with rolling hills and deep valleys but not as mountainous as the areas to the east and south. There is about 900 feet of elevation change between the highest elevation at 1,759 feet above mean sea level (amsl), 536 meters-amsl, and the lowest elevation at 882 feet-amsl, or 236 meters-amsl, in the Town of Groton along the Owasco Inlet. The drainage divide between Cayuga Lake and Owasco Lake is present along Freeville-Groton Road in the Village of Freeville. The three major waterways in the quadrangle is the Owasco Inlet, Fall Creek and Beaver Creeks. The Owasco Inlet flows north towards Owasco Lake along the western boundary of the quadrangle from the Village of Freeville through the Town of Groton. Fall and Beaver Creeks flow from east to west towards Cayuga Lake from the northeast to southwest corners and along the southern edge of the quadrangle, respectively.

Bedrock in the area is generally grey shale and sandstones that are Devonian in age (Fisher, et. al., 1970). The predominant bedrock in the quadrangle were mainly Upper Devonian Genesee Group as fossil-rich grey sand- and siltstones. Towards the southeast corner the bedrock changes to an Upper Devonian Sonyea Group identified by an outcrop along Walker Road of dark-grey shale with some interbedded fine-grained sandstone beds.

The surficial geology of the Groton quadrangle was previously mapped at 1:250,000 scale and reported kame moraines, kame deposits, lacustrine silt and clay, thin till over rock, till, till moraines, lacustrine sand and outwash sand and gravels with occasional bedrock outcrops (Cadwell, et. al., 1986). No published mapping has been completed at a higher resolution than that of Cadwell, et. al., (1986). Previous small-scale studies were conducted to the south in the Virgil Creek/Dryden Lake drainage basins by Miller (1993) and Miller and Bugliosi (2013) to investigate the hydrology and geology of these valleys for their aquifer potential and subsurface materials.

Methodology:
Field mapping for this quadrangle was completed during the summer of 2019 over the course of seven-and-a-half field days. Mapping efforts included traversing the quadrangle primarily along roadways, sandpits, and ravines where access was permitted. Sample collection used a variety of tools and methods to retrieve soil samples from throughout the area. Sediment was scrapped to exposed fresh sediment using an entrenching tool and shovel from outcrops in drainage ditches, road/streams cuts or within quarry/sand and gravel pits. To get below the organic soil horizon, sediment samples were collected using a two-meter long hand- auger where possible.

Water wells (43 in total) and Oil and Gas Wells (17 in total) from the Department of Environmental Conservation and engineering borings (1 in total) from the Department of Transportation were used to interpret the subsurface geology of the quadrangle. The subsurface data from these wells were interpreted, and then translated from the well driller's description into a standardized lithologic (materials based) description used by the NYSGS. The location, thickness and depths of all lithologies were also recorded and used the XActo Cross-Section tool developed by Jennifer Carell, formerly of the Illinois Geological Survey, and then exporting the cross-section into Adobe Illustrator to connect the stratigraphic units from the borings logs and subsurface geology of the quadrangle.

Field data were compiled onto semi-transparent mylar sheets and polygons were drawn by hand to then be digitized in ESRI's ArcMap 10.6 program. Polygons were created based upon the lithology of the surface material and the sample and boring locations were plotted. The geologic, geographic, and topographic and cross-section data were compiled into the final map product using the Adobe Illustrator CS6 program from the data created in the ArcMap program.

Results:
A total of 82 observation points were completed during the mapping process, with 73 of the samples collected for grain size analysis. The soil samples collected and field observations made during the mapping efforts were representative of the following lithologic units from across the quadrangle.

Artificial Fill (Af)
Surficial sediment composed of coarse/fine and or crushed rock anthropogenically transported and used for construction purposes.

Holocene Alluvium (Ha) and Holocene Wetland Deposits (Hw)
Post glacial sediments occupy the low areas or land depression throughout the quadrangle. Ha is associated with fluvial processes in creek valleys throughout the quadrangle. This lithology generally consists of stratified silt, sand, and gravel. Hw is associated with low areas and depressions in the highlands of the quadrangle where wetlands form due to poor drainage. This lithology consists of peat, marl, clay or sand in these areas of poor drainage.

Stratified Sand (Ps)
Bedded and well-sorted fine to medium sand is encountered in lower elevations throughout the quadrangle. Sample locations of this unit are found in northern portions of the Owasco Inlet Valley, the northern end of North road, and along Stevens Road. These sediments are interpreted as to be deposited by fluvial, lacustrine or eolian processes and inferred as deposits associated with distal glacial environments.

Silt and Clay (Plsc)
Stratified, fine-grained sediment consisting of fine sand, silt and clay size particles. Inferred to be deposited in mid shore to deep water settings of glacial lakes. May include marl, rhythmites, and varved sediments. Silt and clays were found in both subsurface samples and in outcrops within the Fall Creek and Owasco Inlet valleys. On the valley floors silts and clays were sampled on Hile and Brooklyn Roads while a grey well-sorted silt was exposed in an outcrop in a small tributary stream bed into Fall Creek in the Genung Nature Preserve. These sample locations are about 1,030 feet-amsl, or 315 meters-amsl, in elevation while three other lacustrine sediment samples were collected at a slightly higher elevation of approximately 1,070 feet-amsl, or 325 meters-amsl, along the valley.

Ice-Contact Silt and Clay (Pics-iw)
Stratified, fine-grained sediment consisting of fine sand, silt and clay size particles. Constrained to isolated pockets, inferred to be deposited in circular depressions within or on former ice sheets. Amid the kames, kettles and eskers a sample was collected on the east end of Peruville Road in bedded silt and fine sand at an elevation around 1,200 feet-amsl, or 365meters-amsl. This raised deposit of fine-grained stratified sediment could be the remnants of an ice-walled lake plain. The ice-walled lake plain is found amongst a larger deposit of stratified ice-contact deposits such as coarse-grained sediment consisting of boulders to sand size particles and may include interbedded coarse lenses of gravel and clast-supported diamicton (flow tills).

Cobbles to Sand (Pics)
Stratified ice contact deposits, variable coarse-grained sediment consisting of boulders to sand size particles. Much of the Lower Fall Creek Valley is inferred to be ice-contact sediment deposits. The hummocky topography in the Lower Fall Creek Valley is likely from sediment deposition over stagnant ice that remained in the valley while the lobes melted back from the prior readvance.

Stratified Sand and Gravel (Psg)
Well-sorted and stratified sand and gravel. This unit is found within the Owasco Inlet Valley, the Upper and the Lower Fall Creek valleys and along the entire length of the Beaver Creek. Cemented sands and gravels are found in two locations on eastern portion of the quadrangle (Figure 1). Deposits may include cobbles and boulders and are inferred to be delta, fan or lag deposits in glacial channels or near ice margins.

Diamicton (Pd)
An admixture of unsorted sediment ranging from clay to boulders. Generally, matrix supported, massive and clast-rich. This unit is generally interpreted as glacial till. The surface till exhibits colors ranging from shades of brown, grey and bluish-grey tills throughout the quadrangle. Larger clasts within this unit were found to be rounded, faceted "till stones" or tabular flat, angular pieces of sandstone that are likely from the adjacent bedrock.

Summary and Conclusions:
The Groton quadrangle is located 18 kilometers south of Owasco Lake and 12 kilometers east of Cayuga lake. The surficial units within the quadrangle were deposited through a variety of glacial mechanisms. Diamicton was found in abundance throughout the quadrangle primarily at higher elevations and deposited either subglacially during the advance of the ice sheet through the area as a lodgement till or near the ice margin during stagnation or recession as flow tills likely during the last glacial cycle. The diamicton varies in color from light to dark brown, tan and grey. Many of the valleys within the quadrangle contain deposits of stratified sand and gravel along with interbeds of silts and clays. According to water well records in these valleys the sediments mentioned above are deposited over till in many locations, thus indicating that the clastic materials above the tills are a result of the recession of the ice sheet In the Lower Fall Creek Valley. Stagnant ice blocks remained and melted in place in some locations creating the kettles within the hummocky topography to the north of the Town of Dryden along Beaver and Fall Creeks. During recession of the ice sheet, meltwater traveling through subglacial tunnels formed the multiple esker trains within the Beaver Creek Valley. Holes within the ice sheet created by surface melt allowed surface sediments on the ice sheet to flow to the buried surface of the landscape and accumulate as stratified conic mounds of sediment called kame. These are found throughout the same valley as the eskers and hummock topography. Lastly, a raised mound of bedded lacustrine sediment (clay, fine-sand and silts) is found near the confluences of Fall and Beaver Creeks is likely another remnant of the stagnant ice sheet known as an ice-walled lake plain.

Summary and Conclusions Continued...
There are also remnants of a pro-glacial lake suggested by small deposits of bedded grey and brown silt and clays with interbeds of fine sand were found on both sides of the modern drainage divide that separates Fall Creek from the Owasco Inlet, which is also the main drainage divide between Cayuga and Owasco Lakes. This lake has been suggested by (Karig, et. al., 2019) as Lake Enigma caused by impounded ice within the Fall Creek and Owasco Inlet Valleys causing meltwater to flow into this proglacial lake. It is not clear whether the lake would have coalesced with a larger pro-glacial lake or if it was isolated within this valley.

References:
Bowles, J.E., 1978, Engineering Properties of Soils and Their Measurement", McGraw Hill Book Company, New York, Second Ed., 213pp.

Cadwell, D.H., and Muller, E.H., 1986, Surficial Geologic Map of New York, Finger Lakes Sheet, New York State Museum, Map and Chart Series, No. 40. 1:250,000 Scale.

Fisher, D.W., Y.W. Isachsen, and L.V. Rickard. Geologic Map of New York State, 1970. Consists of five sheets: Niagara, Finger Lakes, Hudson-Mohawk, Adirondack, and Lower Hudson, Map and Chart Series No. 15. 5 Geologic Bedrock Maps: 1:250,000 Scale

Karig, D.E., and Miller, T.S., 2019, Northward Subglacial Drainage During the Mackinaw Interstade in the Cayuga Basin, Central New York. Canadian Journal of Earth Sciences, In-press, October 2019, 61pp.

Miller, T.S., 1993, Glacial geology and the origin and distribution of aquifers at the Valley Heads moraine in the Virgil Creek and Dryden Lake-Harford valleys,

DESCRIPTION OF MAP UNITS

Holocene

Af — **Artifical Fill (Af)**
Surficial sediment composed of coarse/fine and or crushed rock anthropogenically transported and used for construction purposes.

Ha — **Stratified silt, sand and gravel (Ha)**
Sorted and stratified silt, sand, and gravel, deposited by rivers and streams. May include cobbles and boulders. Inferred as post-glacial alluvium and includes modern channel, over-bank and fan deposits

Hw — **Wetland Deposit (Hw)**
Peat, muck, marl, silt, clay or sand deposited in association with wetland environments. Various sediments can be present at transitional boundaries from one facies to another

Pleistocene

Ps — **Stratified Sand (Ps)**
Well sorted and stratified sand, deposited by fluvial, lacustrine or eolian processes. Inferred as deposits associated with distal glacial environments.

Plsc — **Silt and Clay (Psc)**
Stratified, fine-grained sediment consisting of fine sand, silt and clay size particles. Inferred to be deposited in mid shore to deepwater settings of glacial lakes. May include marl, rythmites, and varves.

Pics-iw — **Ice-Contact Silt and Clay (Pics-iw)**
Stratified, fine-grained sediment consisting of fine sand, silt and clay size particles. Constrained to isolated pockets, inferred to be deposited in circular depressions within or on former ice sheets.

Pics — **Cobbles to Sand (Pics)**
Stratified ice contacted deposits, variable coarse-grained sediment consisting of boulders to sand size particles. Inferred to be deposited along an ice-margin. May include, interbedded coarse lenses of gravel and clast supported diamictons (flow tills).

Psg — **Stratified sand and gravel (Psg)**
Well-sorted and stratified sand and gravel. May include cobbles and boulders. Inferred to be delta, fan or lag deposits in glacial channels or near former ice margins.

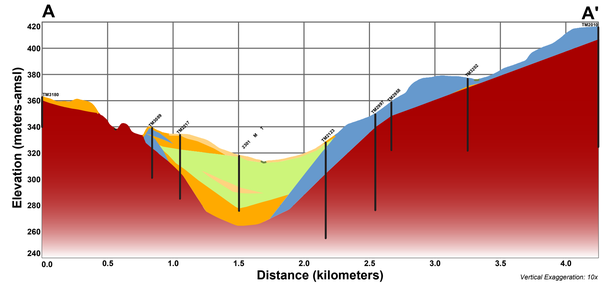
Pdcs — **Diamicton (Pdcs)**
An admixture of unsorted sediment ranging from clay to boulders. Generally clast supported, massive and clast-rich.

Pd — **Diamicton (Pd)**
An admixture of unsorted sediment ranging from clay to boulders. Generally matrix supported, massive and clast-rich.

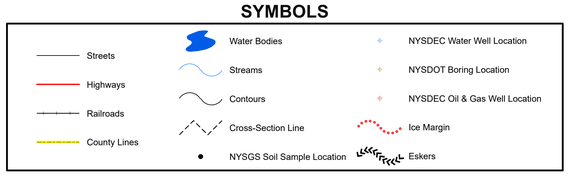
Pre-Pleistocene

Br — **Bedrock (Br)**
Non-glacially derived, hard rock, pre-pleistocene in age. May be covered up to a meter in diamicton, sand and gravel, or sand and clay in areas marked as Br.

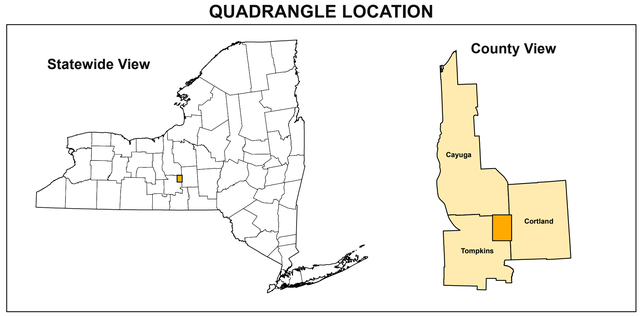
CROSS-SECTION A-A'



SYMBOLS



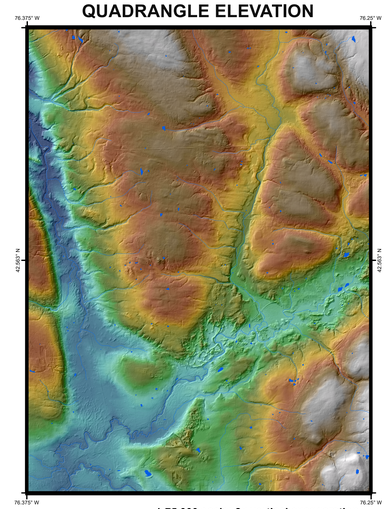
QUADRANGLE LOCATION



ADJOINING QUADRANGLES

Moravia	Sempronius	Homer
West Groton	Groton	Cortland
Ithaca East	Dryden	Harford

QUADRANGLE ELEVATION



Feet-amsl
950 1770

1:75,000 scale; 2x vertical exaggeration

Shaded relief generated from 2008 Tompkins County Soil and Water Conservation District 2-meter lidar set, the Cayuga and Oswego County 1-meter by the Federal Emergency Management Agency,and the 2000 NYS 10-meter by the

NOTICE

This geologic map was funded in part by the USGS National Cooperative Geologic Mapping Program STATEMAP award number ***G18AC00232*** *in the year 2019.*

The views and conclusions contained in this document are those of the authors and should not be interpreted as necessarily presenting the official policies, either expressed or implied, of the U.S. Government.

While every effort has been made to ensure the integrity of this digital map and the factual data upon which it is based, the New York State Education Department ("NYSED") makes no representation or warranty, expressed or implied, with respect to its accuracy, completeness, or usefulness for any particular purpose or scale. NYSED assumes no liability for damages resulting from the use of any information, apparatus, method, or process disclosed in this map and text, and urges independent site-specific verification of the information contained herein. Any use of trade, product, or firm names is for descriptive purposes only and does not imply endorsement by NYSED.

New York State Museum Map & Chart No. 120
ISSN:0097-3793 ; ISBN:978-1-55557-363-8

SURFICIAL GEOLOGY OF THE GROTON 7.5-MINUTE QUADRANGLE, CAYUGA, CORTLAND AND TOMPKINS COUNTIES, NEW YORK

James R. Leone and Karl J. Backhaus
2018