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Dr. Andrew Kozlowski, Director

SURFICIAL GEOLOGY OF THE TRUMANSBURG 7.5-MINUTE QUADRANGLE, CAYUGA, SCHUYLER, SENECA AND TOMPKINS COUNTIES, NEW YORK

prepared by
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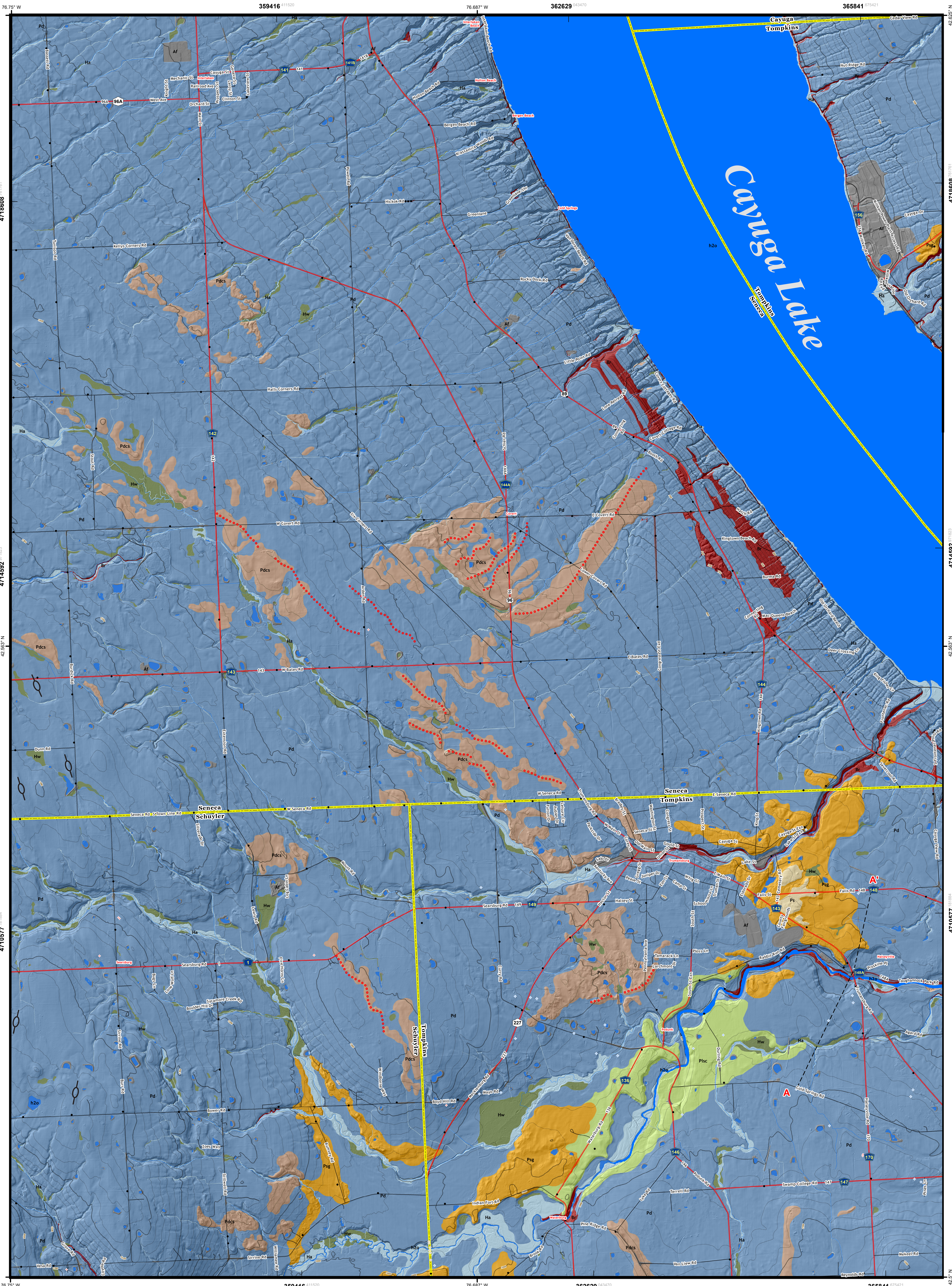
Supported in part by the U.S Geological Survey Cooperative Agreement Numbers G20AC00418 and G22AC00366
National Cooperative Geologic Mapping Program (STATEMAP)



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

Hydrography and planimetry layers from the New York State DOT Raster Quadrangle separates for Cayuga, Schuyler, Seneca 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 the 2018 Cayuga/Oswego and 2020 Central Finger Lakes 1m lidar data sets (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

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

CONTOUR INTERVAL: 10 FEET

Geologic mapping by K. Backhaus, A. Kozlowski
S. Grasing and A. Alrubay, 2021-2023
Digital data and cartography, K. Backhaus, 2021, 2023

MN GN
11° 50' 210 MILS
1° 8' 20 MILS

UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

Introduction:

The Trumansburg 7.5-Minute Quadrangle was mapped as part of the National Cooperative Geologic Mapping Program's STATEMAP projects in 2020 and 2022, funded by awards #G20AC00418 and #G22AC00366. This quadrangle is one of twelve that have been mapped under the Tompkins County Surficial Geologic Mapping Project, which the NYSGS initiated in 2018 and aims to conclude in the mid-2020s. The purpose of this map is to identify and delineate various surficial and geologic materials with the intent to inform and guide municipalities in land-use, environmental, and natural resource decisions across its approximately 55-square-mile area.

The Trumansburg Quadrangle is located within the Finger Lakes Region of New York State, at the intersection of several county boundaries. It encompasses the southwestern corner of Cayuga County, the southeastern corner of Seneca County, the northeastern corner of Schuyler County, and the northwestern corner of Tompkins County. The primary municipalities within the Trumansburg Quadrangle are the Town of Ulysses, the Town of Ludlowville, and the Village of Trumansburg. The Finger Lakes National Forest, along with a few privately-owned nature preserves, are within its boundaries, which are largely surrounded by private agricultural farms. The largest protected area within the quadrangle is Taughannock Falls State Park, located in its southeastern area.
The quadrangle is part of the Alleghany Plateau physiographic province and features generally flat-lying hilltops, separated by a deep, broad valley containing Cayuga Lake. The elevation varies by approximately 1,110 feet (338 meters), from the highest point in the southwestern corner of the quadrangle at 1,490 feet above mean sea level (454 meters amsl), to the surface of Cayuga Lake at 380 feet amsl (116 meters amsl). Major water bodies in the area include Cayuga Lake and Taughannock Creek.

Bedrock in the Trumansburg Quadrangle predominantly consists of grey to blue shales and sandstones, which are Devonian in age (Rickard and Fisher, 1970). Limestone outcroppings are found in two spots but are relatively thin. According to the Finger Lakes sheet of the Geologic Map of New York State, the quadrangle's bedrock comprises the Cashaqua and Middlesex Shales, Beers Hill Shale, Grimes Siltstone, Dun Hill, Millport and Moreland Shales, Geneseo Shale, and the Ithaca Formation, which includes shale, siltstone, and Sherburne Siltstone (Rickard and Fisher, 1970).
The surficial geologic units in this quadrangle were previously mapped at a 1:250,000 scale and were reported to include swamp deposits, outwash gravels, kame moraine, kame, till, thin till over rock, lacustrine silt and clays, and alluvial deposits (Muller and Cadwell, 1986). Limited mapping has been completed at a higher resolution than that used by Muller and Cadwell in 1986.

Methodology:

To create the surficial geology map of the Trumansburg Quadrangle, preliminary field maps were generated using ESRI ArcMap 10.8 software. These maps incorporated all available topographic data, including roads, lidar surface terrain, and hydrography, to serve as a base for plotting field data. These data comprised field stops, bedrock outcrops, and other important site information. For surficial soil sampling, a five-and-a-half-foot hand auger was used to enable sampling below the variably thick organic soil horizon, which is situated beneath the topsoil. An entrenching shovel and pick were also used to remove topsoil and/or eroded sediments from outcrops or exposures, thereby exposing fresh sediments for analysis. At each field stop, various details were logged into a field notebook. These details included the coordinates, captured using a Garmin GPS 66st, descriptive notes on the sediment encountered, any samples taken, the time of stop, and any high-resolution photographs that were taken.

At most of the field sampling sites, soil samples were collected for grain-size analysis. This involved the use of either one of two methods: dry-sieve or wet-sieve analysis. Both methods followed the procedure outlined by Bowles (1978), but utilized a seven-tiered sieve stack (#5, #10, #18, #35, #60, #120, #230, and Pan) for both dry (mechanical) and wet (hydrometer) sieve analysis. Predominantly cohesive samples, which are fine-grain dominant, were analyzed using wet-sieve methods, while cohesionless samples, which are coarse-grain dominant, were analyzed using dry-sieve methods.

The final surficial geologic map, along with cross sections and elevation maps, were generated using ESRI ArcMap and Adobe Illustrator CS6 software. Cross sections were initially created in ArcMap utilizing the XActo Cross Section 10 Tool. These cross sections were then exported to Adobe Illustrator for the correlation of stratigraphic units. The surficial geologic map was developed by scanning mylar sheets that had been drafted based on the geologic field maps. Polygons were then created by digitizing these scanned maps in ArcMap and color-coding them to represent different surficial geologic units within the quadrangle.

Results:

A total of 293 field stops were conducted within the quadrangle, yielding 110 samples for grain-size analysis (Appendix A). Some stops produced more than one sample, as they exhibited stratigraphy either in surface exposures or at depths accessible via the hand auger. The final tally of lithologies discovered during field sampling is as follows: 217 stops were diamicton, 41 exposed bedrock, 22 were sand and gravel, eight were glaciolacustrine sediment, and five were sand. The surficial geologic units identified within the quadrangle are as follows:

Artificial Fill (Af)
This unit generally consists of coarse-to-fine materials such as large cement mounds and crushed rock, which have been transported anthropogenically for construction purposes. These materials are commonly used in artificial dams designed to retain water, as well as in elevated roadbeds for bridges within the quadrangle that are raised above the surface.

Holocene Alluvium (Ha) and Holocene Wetland Deposits (Hw)
Post-glacial sediments are found in low-lying areas or land depressions throughout the quadrangle. Holocene alluvium is associated with fluvial processes in creek valleys across the area and primarily consists of stratified silt, sand, and gravel. Holocene wetland occurs in low areas and depressions in the highlands of the quadrangle, where wetlands form due to limited drainage capacity. The lithology in these areas generally comprises peat, marl, clay, or sand.

Holocene Diamict Colluvium (Hdc)
This deposit consists of unsorted and unstratified materials, including gravel, sand, silt, and clay, with the potential presence of boulders and cobbles. Often described as mass-wasting deposits, they are typically found at the bases of steep hillslopes and cliffs, usually as part of slumps or hillslope failures. Such sediments are particularly prevalent along the west shore of Cayuga Lake, owing to the steep nature of the valley walls and stream banks.

Pleistocene Silt and Clay (Plsc)
This stratified, fine-grained sediment is composed of fine sand, silt, and clay-sized particles. It is inferred to have been deposited in mid-shore to deep-water settings of glacial lakes and may include marl, rhythmites, and varves. The Plsc unit is primarily located at lower elevations on both sides of Taughannock Creek, in the south-central portion of the quadrangle.

Pleistocene Sand (Ps)
Well-sorted and stratified sand is deposited through fluvial, lacustrine, or aeolian processes. These are inferred to be deposits associated with distal glacial environments. Observations indicate that these well-sorted sand deposits often overlie coarser sand and gravel deposits (Psg), likely as a result of a decrease in depositional energy or potential aeolian activity. Ps deposits are predominantly located east of New York State Route 96, situated atop layers of stratified sand and gravel.

Pleistocene Sand and Gravel (Psg)
Characterized by well-sorted and stratified sand and gravel, this unit is believed to have been deposited by glacial meltwater at or very near the glacier's edge. It is often found at elevations several meters higher than the floors of present-day river valleys. The Psg unit is primarily located to the west of Taughannock Creek, along its banks and tributaries within the Town of Trumansburg, and along the east shore of Cayuga Lake as part of a hanging delta.

Pleistocene Diamicton (Pd)
This unit consists of a heterogeneous mixture of sediment grains, ranging in size from clay to boulders. In this quadrangle, all diamicton is interpreted as glacial till, which is sediment deposited directly beneath a glacier. It is generally matrix-supported and dominated by sand, featuring a color spectrum that includes both tan and reddish-brown hues. Diamicton is ubiquitous throughout the quadrangle, irrespective of elevation, and underlies many of the other surficial geologic units within the quadrangle.

Pleistocene Diamicton (Clast Supported) (Pdcs)
This unit is an admixture of unsorted sediment, ranging in size from clay to boulders. It is generally clast-supported, massive, and clast-rich, and is interpreted as till. Within this quadrangle, identified moraines consist of clast-supported till that can be gravel-rich, with some areas exhibiting hummocky topography along the morainal boundary. Pdcs is prevalent throughout the quadrangle and is primarily found at elevations higher than those of Taughannock Creek. The most substantial deposit of this unit is located in the central part of the quadrangle, along the western portion of the Kings Ferry Moraine.

Summary and Conclusions:

The Trumansburg Quadrangle is situated in the northwestern corner of Tompkins County, at the point where Seneca, Schuyler, and Tompkins counties intersect. The topography here is largely flat but punctuated by steep valley walls that descend into the Cayuga Lake Basin. This topographic arrangement results from the westward extension of Devonian Age shales, sandstones, and limestones. Generally, the bedrock outcroppings found within the quadrangle are composed of black and grey shales with interspersed layers of sandstone and limestone. The most prominent exposures of this bedrock are visible along the courses of Taughannock and Trumansburg Creeks and within the deep, 180-foot gorge of Frontenac Falls. Most of the bedrock exposures in this quadrangle can be observed in drainage ditches alongside roads. The most extensive of these ditches is located along Route 89, opposite the Scenic Parking Area just to the east of Brown Road. Within the Finger Lakes National Forest, the Spring Brook forms a narrow, steep-walled bedrock valley mainly consisting of sandstone interbedded with black and grey shales.

Overlaying the bedrock is a prevalent lithologic unit known as diamicton (Pd), which primarily consists of mottled to tan, sand-dominant material. The gravel clasts within this diamicton range from pea gravel to boulder size. This unit is particularly useful for understanding the movement and interactions of the Ontario Lobe of the Laurentide Ice Sheet, based on its sediment characteristics. Most of the diamicton appears to be lodgement till, indicated by its density, bimodal grain distribution, local bedrock clasts, and the presence of faceted clasts. An exceptional exposure along South Frontenac Road features two separate layers of matrix-supported, sandy diamicton divided by a layer of silty fine sand and silt. Some exposures of diamicton also show signs of being ablation or supraglacial till, as indicated by their clast-supported, coarse, and less consolidated nature. This kind of diamicton (Pdcs) usually represents areas where the retreating glacier stalled, depositing moraines. The most substantial of these moraine deposits lies across Lower Covert Road, just west of NYS Route 89 and follows the line of Six Corners Road in the Town of Covert.

Summary and Conclusions Continued...
Sand and gravel deposits form the second most common lithologic unit in the quadrangle and are mainly located at lower elevations within valleys. In the valleys of Taughannock and Bolter Creeks, these deposits are categorized as outwash sediments close to the ice sheet or as delta deposits into a pro-glacial lake. These deposits were found to be stratified, medium to coarse sand and rounded gravel deposits (Psg). The town of Trumansburg is constructed on a flat-lying area that was once a delta formed by meltwater carrying sediment downstream into Glacial Lake Ithaca. Other sand and gravel deposits, particularly along the southern border of the quadrangle, are believed to be delta terrace deposits into a short-lived, higher-elevation proglacial lake. Deposits of well-sorted fine to medium sand (Ps) have been observed in the Town of Trumansburg, which currently hosts a cemetery and a nature preserve. The well-sorted character of these sediments suggests a possible reduction in energy during deposition or even the influence of aeolian processes. Additionally, as glaciers advanced and retreated, proglacial lakes formed, either dammed by the ice sheet itself, detached ice blocks, or due to isostatic rebound of the region. In the southern part of the quadrangle, glaciolacustrine sediments (Plsc) have been identified. Notably, a large exposure at the intersection of Curry and Waterburg Roads revealed laminated layers of tan and gray silt and clay. These glaciolacustrine deposits extend from the southern tip of Waterburg Road to an area just east along Rabbit Run Road. Numerous man-made ponds (H2O) and older wetland areas (Hw) are scattered throughout the quadrangle, situated atop either bedrock, diamicton, or alluvium (Ha).

The glacial landforms within this quadrangle exhibit characteristics of both proximal and distal glacial and fluvial environments, depending on the type and makeup of the sediment in each form. Among these landforms, the Kings Ferry Moraine in the Town of Covert stands out in the central portion of the quadrangle. This moraine reaches more than 40 feet in relief at its highest point and extends for 1,600 feet before flattening. The surface of the moraine is heavily fortified with clast-supported diamicton and is surrounded by the more commonly found matrix-supported diamicton throughout the quadrangle. Other, smaller moraine fragments also composed of clast-supported diamicton are distributed across the area. Many of these smaller deposits are linked to the retreat of the Ontario Lobe from the Kings Ferry Moraine or to older, less prominent ice-marginal positions. The larger delta and glaciolacustrine deposits are historically associated with Glacial Lake Ithaca and Newberry, as described by Fairchild in 1894.

Upon the completion of field mapping within the Trumansburg Quadrangle, it has become apparent that the area has witnessed multiple glacial episodes. This conclusion is supported by exposures featuring multiple layers of diamicton interbedded with either outwash or glaciolacustrine deposits. These indicate at least two advances and one retreat of the ice sheet. Future work in the Taughannock Creek Valley and the Town of Trumansburg may involve Optically Stimulated Luminescence (OSL) dating of sand deposits to further refine these findings.

References:
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Fairchild, H.L., 1894, Glacial lakes of western New York: Geological Society of America, Bulletin, Vol. 6., No.1., pp. 353-374.

Rickard, L.V., and Fisher, D.W., 1970, Geologic map of New York, Finger Lakes Sheet: New York State Museum, Map and Chart Series No. 15, scale 1:250,000.

DESCRIPTION OF MAP UNITS

Holocene

Af — Artifical Fill (Af)
This unit is generally composedconsists of coarse/-to-fine, materials such as large cement mounds and/or crushed rock , which have been transported 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.

Hdc — Diamict Colluvium (Hdc)
Unsorted and unstratified deposit of gravel, sand, silt, clay, with boulders/cobbles possible. Described as a mass-wasting deposit at the base of steep hillslopes and cliffs as part of a slump or hillslope failure.

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

Plsc — 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 deepwater settings of glacial lakes. May include marl, rythmites, and varves.

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

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.

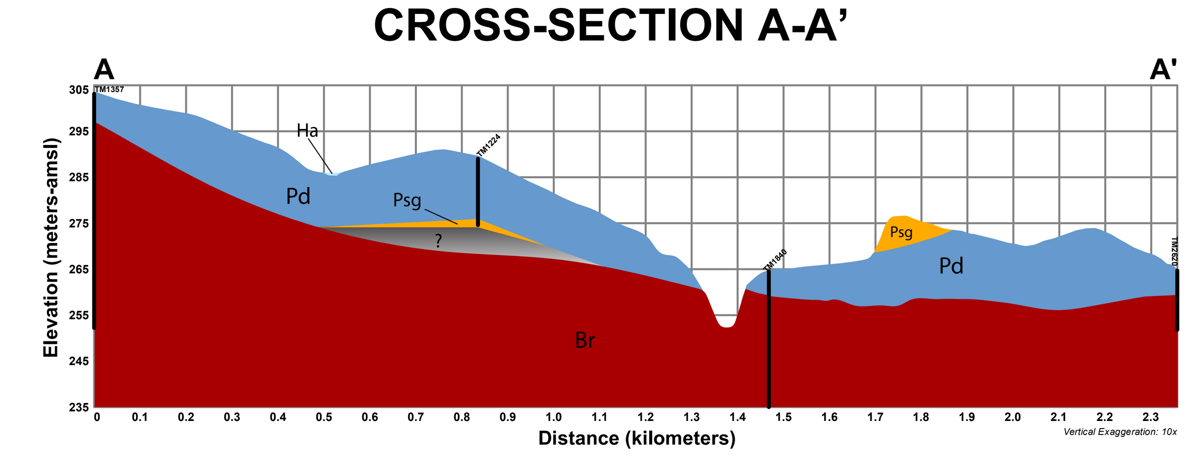
Pd — Diamicton (Pd)
An admixture of unsorted sediment ranging from clay to boulders. Generally matrix-supported, massive and clast-rich.

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

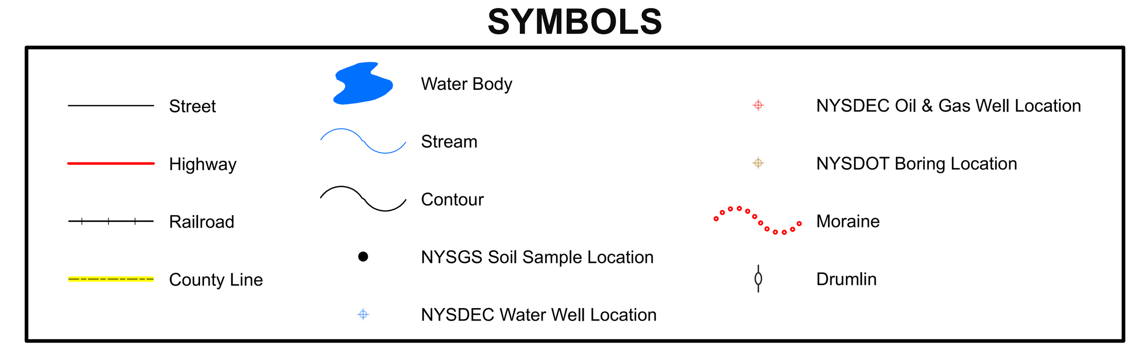
Pre-Pleistocene

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.

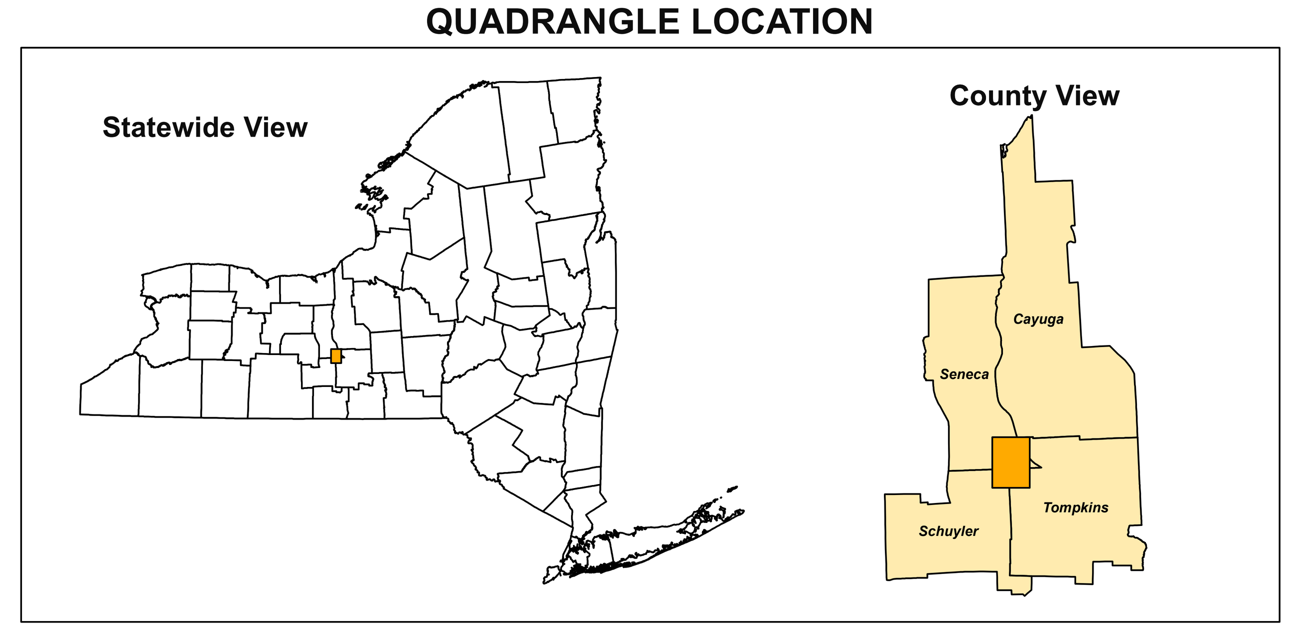
CROSS-SECTION A-A'



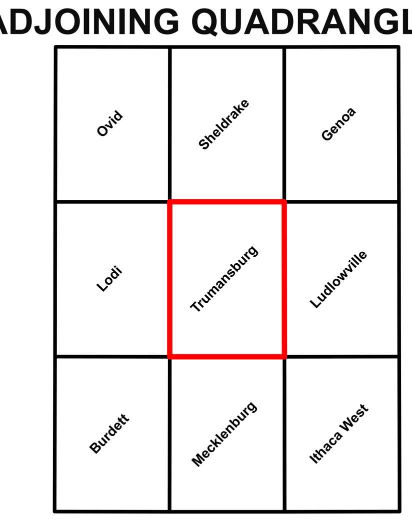
SYMBOLS



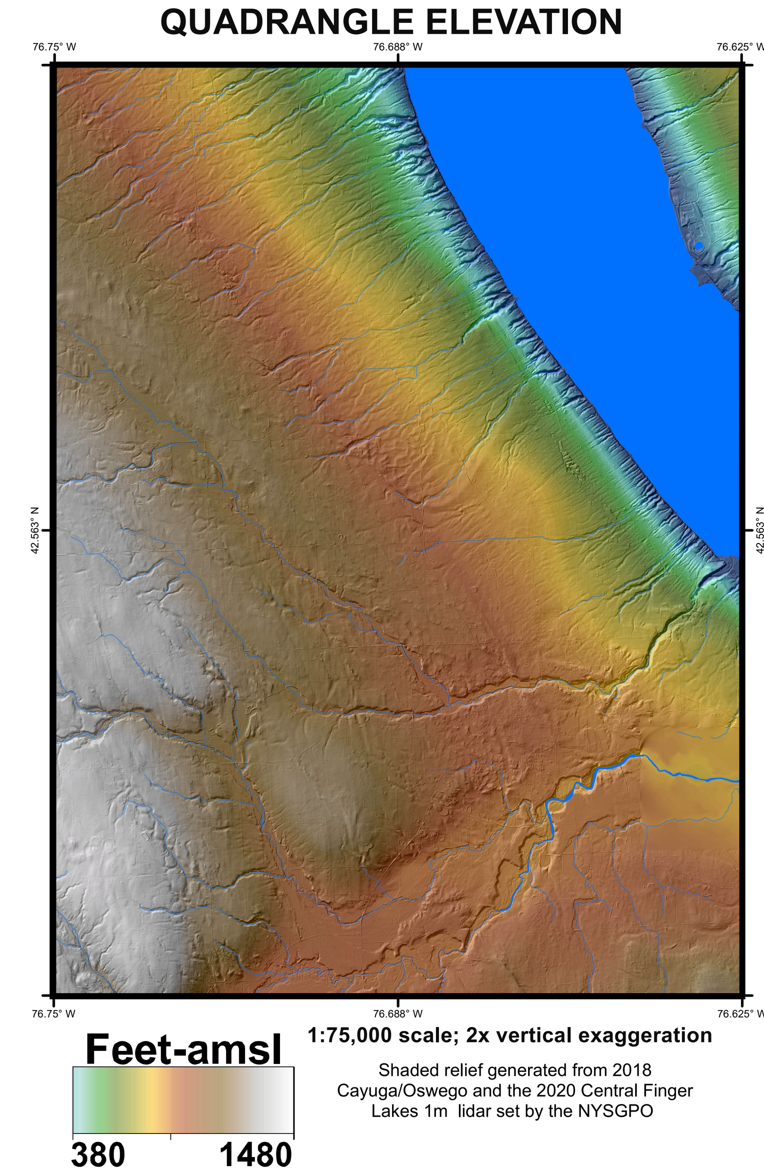
QUADRANGLE LOCATION



ADJOINING QUADRANGLES



QUADRANGLE ELEVATION



1:75,000 scale; 2x vertical exaggeration

Shaded relief generated from 2018 Cayuga/Oswego and the 2020 Central Finger Lakes 1m lidar set by the NYSGPO

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