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SURFICIAL GEOLOGY OF THE TOMPKINS COUNTY PORTION OF THE MECKLENBURG 7.5-MINUTE QUADRANGLE, NEW YORK

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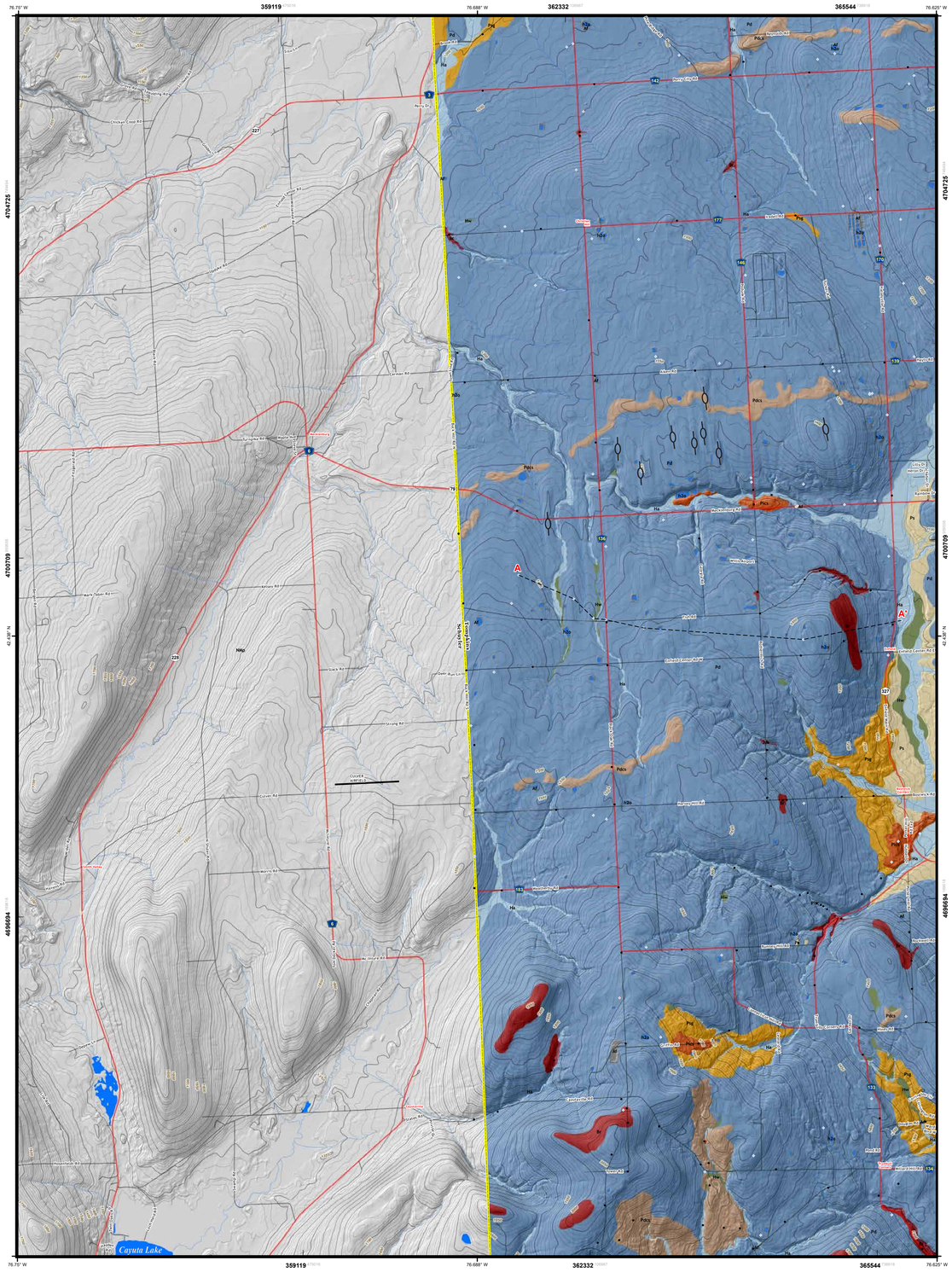
Supported in part by the U.S Geological Survey Cooperative Agreement Number G20AC00418
National Cooperative Geologic Mapping Program (STATEMAP)



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 Schuyler and Tompkins Counties (https://gis.ny.gov/gisdata/inventories/member.cfm?OrganizationID=108). Geographic data layers from 2019 TIGER/Line shapes for transportation and hydrogrpaghy (https://www.census.gov/cgi-bin/geo/shapefiles/index.php)

Shaded relief from Seneca Watershed, Tompkins County and NYS 10m DEM Lidar (http://www.cayugacounty.us/portals/0/planning/nteractivegis.htm),10 m DEM (http://gis.ny.gov/elevation/index.cfm)

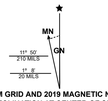
Magnetic declination from the NOAA online Declination Calculator: http://www.ngdc.noaa.gov/geomag-web/#declination

SCALE 1:24,000

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

CONTOUR INTERVAL: 10 FEET

Geologic mapping by K. Backhaus, A. Kozlowski and A. Alrubay, 2021
Digital data and cartography, K. Backhaus, 2021



UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SURFICIAL GEOLOGY OF THE TOMPKINS COUNTY PORTION OF THE MECKLENBURG 7.5-MINUTE QUADRANGLE, NEW YORK

Karl J. Backhaus and Andrew L. Kozlowski
2021

INTRODUCTION:
The Mecklenburg 7.5-Minute Quadrangle was mapped as part of the 2018 National Cooperative Geologic Mapping Program funded STATEMAP project (award #G20AC00418). This quadrangle was one of twelve quadrangles to 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 and geologic materials with the intent that this information can guide municipalities in land use, environmental and natural resource decisions across its roughly 55 square mile area.

The Mecklenburg quadrangle along the central-western Tompkins County and eastern-central boundary of Schuyler County in the Finger Lakes Region of New York State about 6 miles west of the City of Ithaca, New York. The Town of Enfield, Town of Mecklenburg, and Village of Cayutaville are the main municipalities within this quadrangle. This portion of Tompkins County is largely rural with large tracts of state-owned forest and private rural farmland. The Connecticut Hill Wildlife Management Area is found in the south-central portion of the quadrangle. This quadrangle is situated within the Alleghany Plateau physiographic province is generally ramping higher elevation ridges to the south and west of the Town of Enfield with deep, broad valleys between them. There is roughly 1,115 feet (340 meters) of elevation change between the highest peak at Connecticut Hill at 2,094 feet above mean sea level (638 meters-amsl) to the Taughannock Valley floor at 980 feet-amsl (299 meters-amsl). Cayuta Lake, Taughannock Creek, Cayuta Inlet and the Fivemile Creek are the major water bodies in the area.

Bedrock in the area is generally grey shales and sandstones that are Devonian in age (Rickard and Fisher, 1970). The predominant bedrock found in the quadrangle were grey to blue shales with intermittent sandstone beds. Limestones were found outcropping in two spots, but relatively thin in size. According to the Finger Lakes sheet of the Geologic Map of New York State, the bedrock in the quadrangle is comprised of the Cashaqua and Middlesex Shales, Beers Hill Shale; Grimes Siltstone, Dun Hill, Millport and Moreland Shales, Geneseo Shales and the Ithaca Formation - shale, siltstone and the Sherburne Siltstone (Rickard and Fisher, 1970).

The surficial geologic units in this quadrangle were previously mapped at 1:250,000 scale and were reported to be swamp deposits, outwash gravels, kame moraine, kame, till, thin till over rock, and lacustrine silt and clays and (Muller and Cadwell, 1986). Limited mapping has been completed at a higher resolution than that of Muller and Cadwell, (1986). :

METHODOLOGY:
To create the surficial geology map of the Mecklenburg quadrangle, preliminary field maps were created using the ESRI ArcMap 10.8 software and consisted of all available topographic data (roads, lidar surface terrain and hydrography) to plot all field data on including field stops, bedrock outcrops and important site information. Surficial soil sampling employed the use of a five-and-a-half-foot hand auger to allow sampling below the variably thick organic soil horizon (below the topsoil). Another tool used is an entrenching shovel and pick. This tool was used to remove topsoil and/or eroded sediments from outcrops or exposures to expose fresh sediments for analysis. At each field stop, the coordinates (latitude and longitude in decimal degrees) were taken using a Garmin GPS 86st, descriptive notes on the sediment found, whether a sample and/or a high-resolution, scaled photo were taken, and the time at which the stop was taken were logged into a field notebook (Backhaus_21).

At most of the field sampling sites, a soil sample was taken for grain-size analysis. This employed the use of either one or two processes: dry-sieve or wet-sieve analysis. These processes followed the procedure outlined by Bowles (1978), while only using a seven-tiered sieve stack (#5, #10, #18, #35, #60, #120, #230, and Pan) for both dry-(mechanical) and wet- (hydrometer) sieve analysis. The predominantly cohesive (fine-grain dominant) samples were sorted using the wet-sieve analysis, while the cohesionless (coarse-grain dominant) samples were sorted using the dry-sieve analysis.

The final surficial geologic map, cross-section and elevation maps were produced using the ESRI ArcMap and Adobe Illustrator CS6 programs. The cross-sections were created in ArcMap using the XActo Cross-section 10 tool developed by Jennifer Carell, formerly of the Illinois Geologic Survey, and then exporting the cross-section into Adobe Illustrator to connect the stratigraphic units. The surficial geologic map was created by scanning the mylar sheet (MBG_Backhaus_Mylar_21) drafted from the geologic field map. Polygons were then produced by digitizing this map in ArcMap and colored according to surficial geologic units found within the quadrangle. The final map was drafted in Adobe Illustrator and exported as a PDF file.

RESULTS:
A total of 139 field stops were taken, with 64 samples for grain-size analysis (see Appendix), within the quadrangle. Some stops contained more than one sample as they exhibited stratigraphy either in an exposure or at depth with the hand-auger. The final count for lithologies found during field sampling was: 96 stops were diamicton, 21 were bedrock, 15 were sand and gravel, three were glaciolacustrine sediment, three were sand and one was alluvium. The surficial geologic units found within the quadrangle are as follows:

Artificial Fill (Af)
This unit is generally composed of coarse/fine, large cement mounds and/or crushed rock anthropogenically transported and used for construction purposes. This material is used in artificial dams, built to retain water, and large, raised roadbeds for bridges within the quadrangle.

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 process 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.

Pleistocene 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 varves. Plsc is found within lower elevations of Virgil and Sixmile creek valleys and within a large exposure in the Ringwood Preserve along the western edge of the quadrangle.

Pleistocene Sand (Ps)
Well sorted and stratified sand, deposited by fluvial, lacustrine or eolian processes. Inferred as deposits associated with distal glacial environments. Well-sorted sand deposits were observed down-slope from deposits of coarser sand and gravel deposits (Psg), likely due to a decrease in energy during deposition.

Pleistocene Sand and Gravel (Psg)
Characterized as well-sorted and stratified sand and gravel this unit is interpreted to be deposited by glacial meltwater at or very near the glacier and can be found several meters in elevation higher than the present-day river valley floors. Psg is found in the on the near the banks of the Dryden Lake/Virgil Creek, Sixmile and East Branch Owego Creek Valleys. Psg is also found as small flat-topped terraces in smaller creek valleys, and in front of the large moraine complexes along the western edge of the quadrangle.

Pleistocene Cobbles to Sand (Pics)
Stratified ice contacted deposits, variable coarse-grained sediment consisting of boulders to sand size particles. Inferred to be deposited with stagnant ice in the form of sand and gravel hummocks with the northeast and northern section of the quadrangle as kame moraine deposits.

Pleistocene Diamicton (Pd)
This unit is a mixture of sediment grains that range from clay to boulders in size. In this quadrangle, all diamicton is interpreted to be glacial till, sediment deposited directly beneath the glacier. It is generally matrix supported, sand-dominant, and tan and reddish brown in color. Diamicton is found throughout the quadrangle independent of elevation and underlies much of the other surficial geologic units within the quadrangle.

Pleistocene Diamicton (Clast Supported) (Pdcs)
The unit is an admixture of unsorted sediment ranging from clay to boulders. Generally, clast supported, massive and clast rich. Interpreted as till. In this quadrangle identified moraines are comprised of clast supported till ranging from gravel rich in some cases showing hummocky topography along the morainal boundary.

SUMMARY AND CONCLUSIONS:
The Mecklenburg quadrangle lies along the western boundary of Tompkins County and has the highest point in the county at Connecticut Hill in the south-central portion of the quadrangle. Bedrock (Br) underlies the sediment found atop the highlands and within stream-cut chasms are comprised of Devonian age sedimentary rocks consisting of interbedded shales, sandstones, and limestones. The predominant bedrock was black to grey shale with some sandstone interbeds. Bedrock outcropped either in deep bedrock chasms, sporadically in stream beds mainly within the tributary to the Enfield Creek along Trumbull Corners Road (County Route 113) or in freshly cleared ditch exposures. The bedrock in quadrangle was covered in blue/tan, sand dominant diamicton (Pd). This diamicton is interpreted as lodgement glacial till, deposited at the base of the Ontario Lobe of the Laurentide Ice Sheet during the previous advances through the area. The deposit is a lodgement type of till based on the bimodal distribution of grains and its high density. The clasts within the till were an intermix of pea-sized to boulder sized and faceted to rounded exotic, tillstones and local bedrock clasts incorporated in its sandy clay matrix. One distinction in the glacial tills are the grain-size distribution and characteristics of the matrix in the quadrangle. Former ice-marginal positions have a distinct clast-supported matrix that generally have an armored surface comprised of mostly pea sized to basketball size boulder and cobble clasts (Pdcs). MBG-21-07 was sampled into the road cut in the Perry City Moraine and was difficult to retrieve as the Pdcs.

The glacial till is overlain by mostly coarse-grained deposits within the lowlands of the quadrangle comprised of the sand and gravel deposits predominantly comprised of medium sand to coarse gravel (Psg). These deposits are massive, exhibit no bedding and contain clasts of mostly subrounded to rounded clasts of exotic and local bedrock clasts. Most of the low-lying tributary valleys are lined with Psg and do contain sporadic ice-contact sand to cobble deposits (Pics) just downslope or clast-supported glacial till deposits (Pdcs). Due to their distribution behind and/or adjacent to glacial till it can be inferred that these deposits were deposited as outwash sediments in meltwater emanating from the retreating Ontario Lobe flowing southward through the Taughannock Creek, Enfield Creek and the West Branch of the Cayuta Inlet. In the lowest elevations along these creeks deposits of silty fine to medium sand (Ps) were found adjacent or just above the modern flood plain. Stop MBG-21-123 was taken along the tributary to the Enfield Creek at the southern edge of mapping area and was diamicton over lying a massive bed of fine-medium sand. An OSL sample was taken and will help constrain the timing of the till deposition. These deposits also exhibited massive-bedding and were likely the final deposits emanating from the retreating Ontario Lobe as the energy of the flows

SUMMARY AND CONCLUSIONS: Continued...
them. More evidence of this was found as MBG-21-125 with vertically bedded and folded silty fine to medium sand with rusty interbeds atop these glacial till deposits just upstream from MBG-21-118 and -119.

While the topography is gradually rising in elevation to the south-central portion of quadrangle the surface is predominantly flat-lying and dissected by modern stream channels. There are four main east-west running ice marginal landforms called the Perry City, Aiken, Black Oak and Cayutaville Moraines from north to south, respectively. These moraines are comprised of clast-supported diamicton (Pdcs), deposited atop previously deposited glacial till (Pd) while the Enfield moraine is classified as a kame moraine comprised of ice-contact sand and cobbles. Streamlined landforms are only found in one section between the Aiken and Black Oak moraines, suggesting that a possible surge event occurred during one of the southward advances of the Ontario Lobe. Towards the southern end of the mapping area, the topography is mountainous and is draped with hummocky topography comprised of ice-contact cobbles and sand, clast-supported diamicton and medium sand and gravel. Within the deposits just north of Cayutaville Road lies a lone, kame deposits. This deposit is comprised of bedded medium sand with sporadic distribution of subrounded gravel clasts.

Upon completion of field mapping within this portion of the Mecklenburg quadrangle, the geomorphic features and distribution of deposits found suggests that the larger swathes of glacial till and clearly defined ice margins are a result of the retreating Ontario Lobe out of the mapping area to the north. The small patch of the drumlins in the center of the mapping area are a possible result of a small readvance from the Aiken Moraine to the Black Oak Moraine, but more evidence would have to be collected to determine the overall timing of the advance and recession of the entire ice sheet in the mapping area. Further work will be conducted along the tributary of the Enfield Creek to further the dating of the deposits in this area as the results of the OSL sample and AMS radiocarbon results were still pending at the time of this report.

REFERENCES:
Backhaus, K.J. and Kozlowski, A. L, 2021, Surficial Geology of the Tompkins County Portion of the Trumansburg 7.5-Minute Quadrangle, New York State Museum, Map and Chart Series, No. 141.

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.

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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.

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.

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).

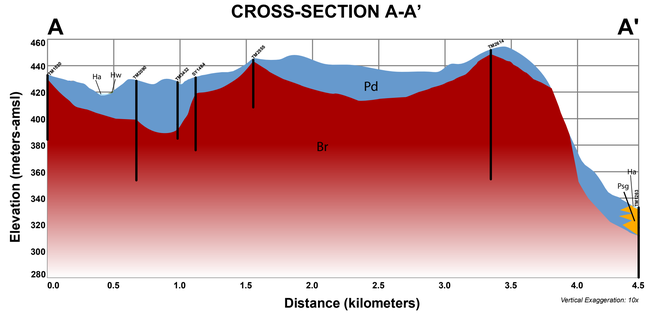
Pd — **Diamicton (Pd)**
An admixture of unsorted sediment ranging from clay to boulders. Generally matrix supported, massive and clast-rich.

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

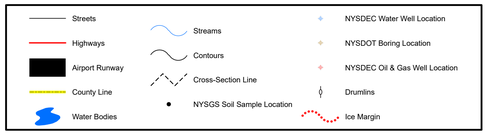
Pre-Pleistocene

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.

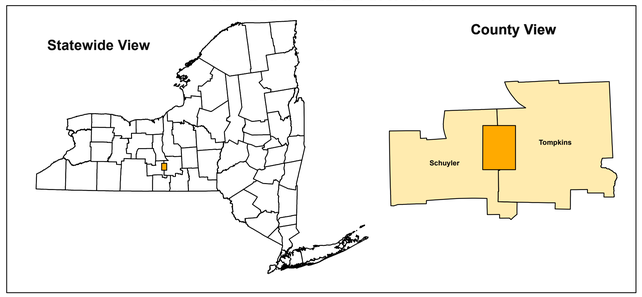
CROSS-SECTION A-A'



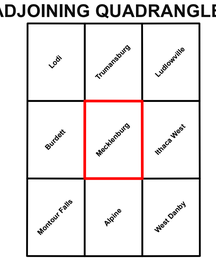
SYMBOLS



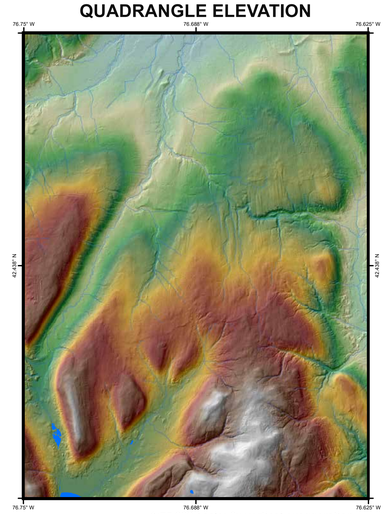
QUADRANGLE LOCATION



ADJOINING QUADRANGLES



QUADRANGLE ELEVATION



1:75,000 scale; 2x vertical exaggeration

Shaded relief generated from 2008 Tompkins County Soil and Water Conservation District 2-meter, the 2012 Seneca Watershed 2-meter, and the 2000 NYS 10-meter lidar set by the United States Geological Survey.

New York State Museum Map & Chart No. 142
ISSN:0097-3793 ; ISBN:978-1-55557-385-0