New York State Museum & Science Service

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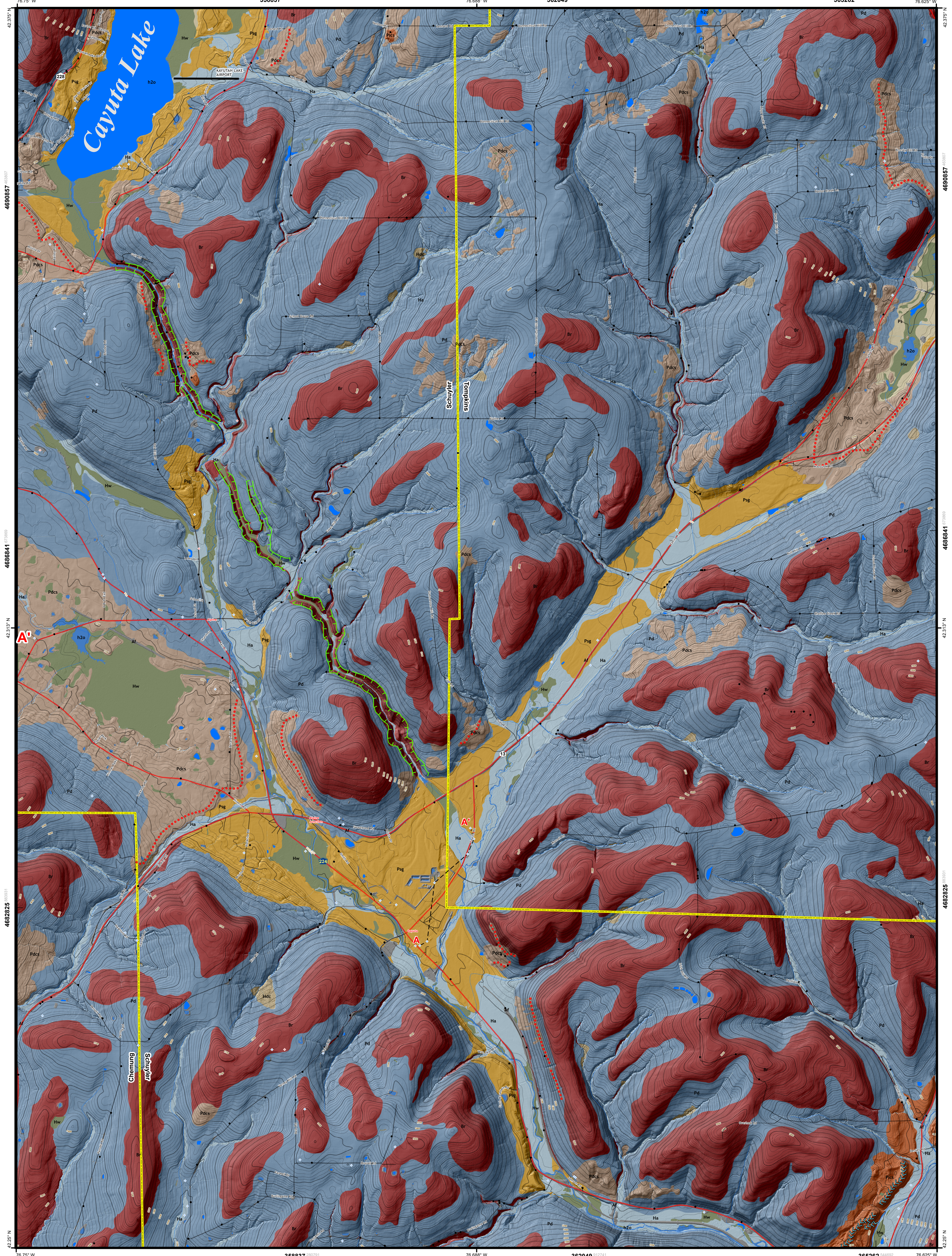
New York State Geological Survey
Dr. Andrew L. Kozlowski, Director



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

Hydrology, and planimetry layers from the New York State DOT Raster Quadrangle separates for Chemung, Schuyler, and Tompkins Counties (https://gis.ny.gov/gisdata/inventories/member.cfm?OrganizationID=108)

Geographic data layers from 2023 TIGER/Line shapes for transportation and hydrograpghy (https://www.census.gov/cgi-bin/geo/shapefiles/index.php)

Shaded relief from the 2020 Central Finger Lakes and 2019 FEMA 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, S. Grasing, H. Forgeng, 2023-24
Digital data and cartography, K. Backhaus, 2023-24

MN
GN
11° 35' 206 MILS
1° 8' 20 MILS

UTM GRID AND 2023 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

SURFICIAL GEOLOGY OF THE ALPINE 7.5-MINUTE QUADRANGLE, CHEMUNG, SCHUYLER, AND TOMPKINS COUNTIES, NEW YORK

Karl J. Backhaus, Sean P. Grasing and Hailey M. Forgeng

2024

SURFICIAL GEOLOGY OF THE ALPINE 7.5-MINUTE QUADRANGLE, CHEMUNG, SCHUYLER, AND TOMPKINS COUNTIES, NEW YORK

prepared by
Karl J. Backhaus

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INTRODUCTION:

The Alpine 7.5-Minute Quadrangle was mapped as part of the 2022 National Cooperative Geologic Mapping Program funded STATEMAP project (award #G22AC00366). This quadrangle is one of the twelve quadrangles that were mapped as part of the Tompkins County Surficial Geologic Mapping Project currently being undertaken by the NYSGS beginning in 2018 and expected to conclude in the mid-2020s. The purpose of this mapping is 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 approximately 55 square-mile area.

The Alpine Quadrangle is located along the northeastern, southeastern, and southwestern portions of Chemung, Schuyler, and Tompkins Counties, respectively. It lies within the Finger Lakes Region of New York State, about 6 miles southwest of the City of Ithaca, New York. The Town of Cayuta, Hamlet of Alpine Junction, and Village of Alpine are the main municipalities within this quadrangle. This quadrangle is largely rural with large tracts of state-owned forest and private rural farmland. The Cliffside State Forest and the Connecticut Hill Wildlife Management Area are found in the southeastern and northwestern portions of the quadrangle, respectively. This quadrangle, situated within the Allegheny Plateau physiographic province, is generally described as dissected, high-elevation uplands with deeply eroded gorges that open into wide, flat lying valleys. There is roughly 983 feet (300 meters) of elevation change between the highest elevation at the intersection of Connecticut Hill and Boylan Roads at 2,043 feet above mean sea level (623 meters-amsl), and the Cayuta Creek valley in the southeast corner of the quadrangle at 1,060 feet-amsl (323 meters-amsl). Cayuta Lake, Cayuta Creek, and Pony Hollow Creek are the major water bodies in the area along with various swamps and wetlands within the Cayuta Creek Valley.

Bedrock in the area is generally consists of 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 interbedded 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, Middlesex, and Beers Hill Shale; Grimes Siltstone, Dunn Hill, Millport, and Moreland Shales, Gardeau Formation, and the Roricks Glen Shale (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, till moraine, till, thin till over rock, and alluvium (Muller and Cadwell, 1986). Limited mapping has been completed at a higher resolution than that of Muller and Cadwell, (1986) with the most recent mapping concentrated on the Cayuta Inlet Valley by Miller and Pitman (2012) interpreting previous mapping efforts at 1:24,000 scale.

METHODOLOGY:

To create the surficial geology map of the Alpine 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). The most commonly used tool is an entrenching shovel with a pick. This primary purpose of employing this tool was to remove topsoil and/or eroded sediments from outcrops/exposures for analysis. At each field stop, the coordinates (latitude and longitude in decimal degrees) were recorded using a Garmin GPS 66st, descriptive notes were obtained on the sediments observed including mention ofwhether a sample and/or shigh-resolution photos were taken, and the time at which the stop was made. These details were logged into a field notebook in accordance with NYSGS Surficial Mapping Protocols.

At most of the field sampling sites, a soil sample was collected for grain-size analysis. This analysis method employes 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 ESRI ArcMap and Adobe Illustrator CS6 software. The cross sections were created in ArcMap using the XActo CrossSection 10 Tool and then exporting the cross section into Adobe Illustrator to connect the stratigraphic units. The surficial geologic map was created by generating the digital draft 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 419 field stops were conducted within the quadrangle, resulting in 112 samples collected for grain-size analysis (see Appendix). At some stops, multiple samples were collected due to the presence of stratigraphic variations, either in exposures or at depth as revealed by the hand auger. The final count of lithologies identified during field sampling included 258 stops with diamicton, 116 with bedrock, 32 with sand and gravel, seven with alluvium, three with sand and cobbles, two with sand, and one with wetlands. The surficial geologic units found within the quadrangle are as follows:

Artificial Fill (Af)
This unit is generally comprised of coarse/fine sediment, 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 topographic 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 developed due to restricted drainage. This lithology consists of peat, marl, clay, or sand..

Pleistocene Sand (Ps)
Ps consists of well-sorted, stratified sand deposited associated with fluvial, lacustrine, or eolian processes, often linked to distal glacial environments. These well-sorted sands, observed down-slope from coarser sand and gravel deposits (Psg), indicate decreased depositional energy. The two deposits of this type were found on the eastern end of Banfield Road and along Carter Creek Road in a large fan deposit.

Pleistocene Sand and Gravel (Psg)
Psg, characterized by well-sorted, stratified sand and gravel, is interpreted as glacial meltwater deposits at or near the margin of former glaciers. This deposit is found in the Cayuta Lake basin, along the highlands of the Cayuta Creek and within the Newfield and Cayuta Creek Valleys.

Pleistocene Cobbles to Sand (Pics)
Pics consists of stratified, ice-contact deposits with variable coarse-grained sediment, from boulders to sand sized grains. Inferred to be deposited at a stagnant ice margin in the form of sand and gravel hummocks, from melted ice blocks or as esker deposits representing subglacial rivers in a sinuous form. This deposit was identified in two locations in the southeast corner of the quadrangle as part of the Jackson Creek Esker System (Gillespie, 1980) and as a kame deposit above the Cayuta Creek meltwater channel (see summary).

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 deposited by glacial action, therefore it is referenced as glacial till. It is generally matrix supported, sand-dominant, and tan and reddish brown in color. Diamicton is observed throughout the quadrangle independent of elevation and underlies most of the other surficial geologic units within the quadrangle.

Pleistocene Diamicton (Clast-Supported) (Pdcs)
This unit is an admixture of unsorted sediment from clay to boulders, typically clast supported, massive, rich in clasts, and is interpreted as till. Within this quadrangle, identified moraines consist of clast supported till, with some being gravel-rich and exhibiting hummocky topography along morainal boundaries. Pdcs is observed throughout the quadrangle independent of elevation(see Summary and Conclusions).

SUMMARY AND CONCLUSIONS:

The Alpine Quadrangle lies within the southwestern portion of Tompkins, northeastern Chemung, and southeastern Schuyler Counties. The dissected plateaus of the highlands throughout the quadrangle are comprised of Devonian shales, sandstones, and limestones. Since their deposition and subsequent lithification, these vast formations have undergone periods of erosion and incision by fluvial and glacial processes. Multiple orogenic events caused shifting, fracturing, and tilting of these formations towards the south. Evidence of these geologic events and processes occurring over many millions of years prior to Holocene is observed across the mapping area including bedrock-only outcrops at exposed high points, valley stream beds, and road-cuts. The largest outcropping of rock is found along the Cayuta Creek meltwater channel in the north and western portion of the quadrangle, in the Towns of Catherine and Alpine. This meltwater channel encapsulates the modern Cayuta Creek and consists of interbedded tan and grey shale and sandstones. At its tallest, the outcrop is about 100 feet (30.5m) in height. Overlying the bedrock, the most common lithologic unit is diamicton (Pd). The diamicton is made up of mostly mottled to brown sand-dominant diamicton, matrix-supported, while the size of the gravel clasts within range from pea-gravel to boulder in size. This lithologic unit can be diagnostic in showing the movement and interaction of the Ontario Lobe, of the Laurentide Ice Sheet, and its sub lobes throughout the valleys in this quadrangle based on its sediment characteristics. The diamicton found in most areas of the quadrangle is indicative of lodgement inantly local bedrock clasts and many faceted clasts. In a few areas, a supraglacial, or melt out, diamicton were observed as semi-cohesive, mainly unconsolidated, sand-dominant diamicton that contained coarse gravel to boulder clasts. Along former ice-marginal position are deposits of a clast-supported and boulder rich till (Pdcs) and are indicative of an ice-marginal position. Deposits of outwash sand and gravel deposits are abundantly found throughout this quadrangle as both glacial outwash or fluvial deposits (Psg). These deposits consist mostly of medium sand with smaller percentages of coarse/fine sand and also medium to coarse gravel with an occasional boulder. The coarsest deposits of sand and gravel in the county were deposited proximal to the ice-margin by subglacial meltwater flows or through moulins in the ice sheet. These deposits contain the coarsest materials of sand and a higher percentage of gravel clasts due to their proximity to the ice margin. Stratified fine to medium sand deposits were found interbedded with sand and gravel deposits in the Carter Creek Valley, proximal to the Valley Heads Moraine in the Town of Newfield and underlying the ice-contact deposits in the southeastern corner of the quadrangle. Since the deposition of these units, they have undergone almost constant erosion and transportation due to fluvial or colluvial processes forming alluvial (Ha) terraces along stream and creek beds. Other areas have impounded water and formed wetlands (Hw) with kettles or former meanders in a creek. Most of these wetlands are found within the Cayuta Lake and Cayuta Creek Valleys while some occupy former kettle lakes and ponds.

Glacial landforms observed within this quadrangle reflect proximal deposition and erosion due to the type and sediment makeup of each landform. Of the landforms identified, none were as long and apparent as the Jackson Creek Esker System, named by Gillespie (1980), in the southeastern corner of the quadrangle. This esker is 55 feet (16.7m) at its tallest and over half a mile long in the quadrangle alone. A kame deposit was interpreted above the Cayuta Creek meltwater channel just to the southeast of Cayuta Lake. This conical landform is comprised of stratified sand and gravel with some finer sand beds. Meltwater channels are observed just to the north and northeast of the Town of Alpine, starting at the outlet of Cayuta Lake and ending at Hendershot Gulf north of the Town of Cayuta along NYS Route 13. Lastly, the largest and most abundant landforms in the quadrangle were the multiple recessional, terminal, and lateral moraines. The end moraines associated with the Valley Heads Moraine System (Fairchild, 1934) are seen at the southwestern end of Cayuta Lake, within the Towns of Cayuta and Alpine and in the northeastern corner of the quadrangle. Lateral moraines are observed at high elevations on the southwest facing slopes in the Cliffside State Forest above the Cayuta Creek.

SUMMARY AND CONCLUSIONS: Continued...

Within the Alpine quadrangle there are three major principal east-west ice marginal landforms: the Cayuta, Newfield and Cayutaville Moraines which are all part of the VHMS These moraines are comprised of clast-supported diamicton (Pdcs), deposited over previously deposited glacial till (Pd) that is found throughout the quadrangle. There are other deposits of clast-supported diamicton throughout the quadrangle that represent recessional or discontinuous moraine systems that are not as predominant. With the lobes terminating at the VHMS during the last major advance, the development of Glacial Lake Cayutaville occurred as meltwater flows were channeled in the Cayuta Lake Basina and upper Cayuta Creek. This former glacial lake basin partially overlaps with the current Cayuta Lake basin and is surrounded by extensive swamp deposits. The meltwater within this glacial lake escaped, leading to the formation of the Cayuta Creek meltwater channel. Meltwater flowing through this channel led to the downcutting and incision of the valley through the weaker shale layers that are dipping parallel to the trend of the channel. At the outlet of this channel, called Hendershot Gulf, lies a vast deposit of outwash sand and gravel and alluvium. Meltwater also eroded a sizable channel through the Newfield Moraine in the northeastern portion of the quadrangle. Subsequent retreat from the VHMS led to deposits of outwash sand and gravels and the formation of modern steam channels and alluvial deposits seen across the quadrangle.

Upon completion of field mapping within this portion of the Alpine Quadrangle, features and the distribution of sediment deposits suggest that the expansive glacial till and defined ice margins are likely due to the advance and the retreat of the Ontario Lobe from east to west, and south to north. The existence of lateral moraines further east and at an average elevation of 350 feet higher than the valley floor suggests there was an earlier, and more expansive, advance in this region than the last glacial advance. The Jackson Creek Esker System, which is not associated with any ice marginal position of the VHMS in this area, was formed by subglacial meltwater flows in and northeast-southwest trend. To deposit this feature, an ice lobe would have to advance into this area from the northeast, much further south and at a higher elevation than the terminal moraine in the Town of Spencer (Backhaus and others, 2021). An Optically Stimulated Luminescence (OSL) sample was taken in a basal sand deposit beneath the esker with the results pending at the time of this report. Lastly, a large fan deposit was observed on Carter Creek Road, a mile south and 100 feet higher than the Newfield Moraine in the northeastern corner of the quadrangle. Multiple channel fill/scour lenses and cemented sand and gravel sequences are observed. Further work will need to be completed to determine the age and extent of these deposits and their relation to the VHMS and surrounding region.

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DESCRIPTION OF MAP UNITS

Holocene

Af — **Artifical Fill (Af)**
This unit is generally comprised 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.

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.

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.

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.

Pics — **Cobbles to Sand (Pics)**
Stratified, ice contact 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 diamicton (flow till).

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

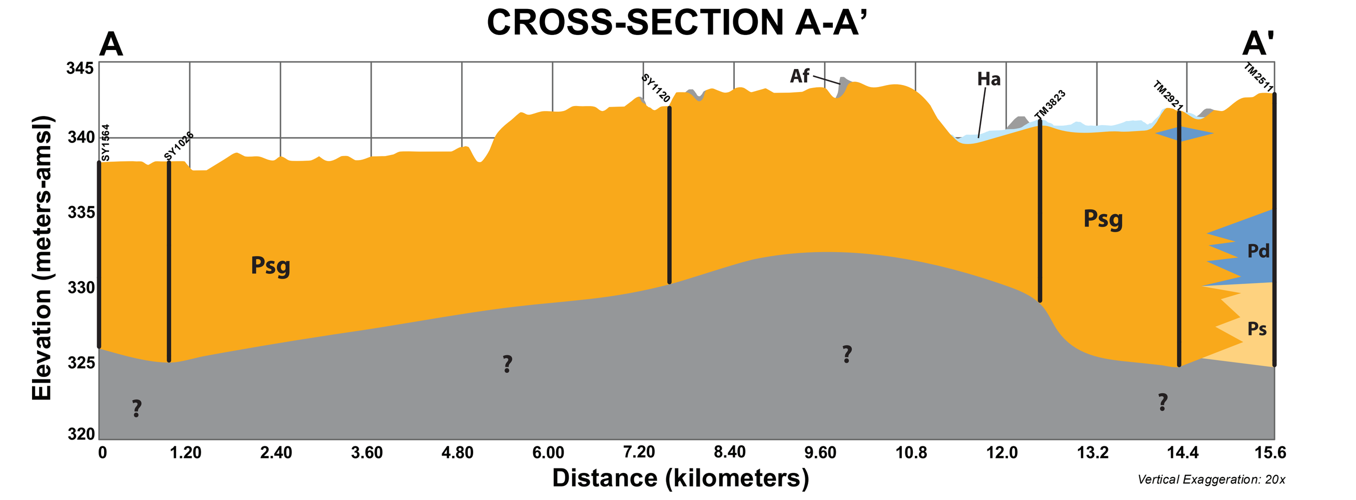
Pdcs — **Diamicton (Pdcs)**
An admixture of unsorted sediment ranging from clay to boulders. Generally clast-supported, massive and clast-rich.

Pre-Pleistocene

CROSS-SECTION A'A'

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.

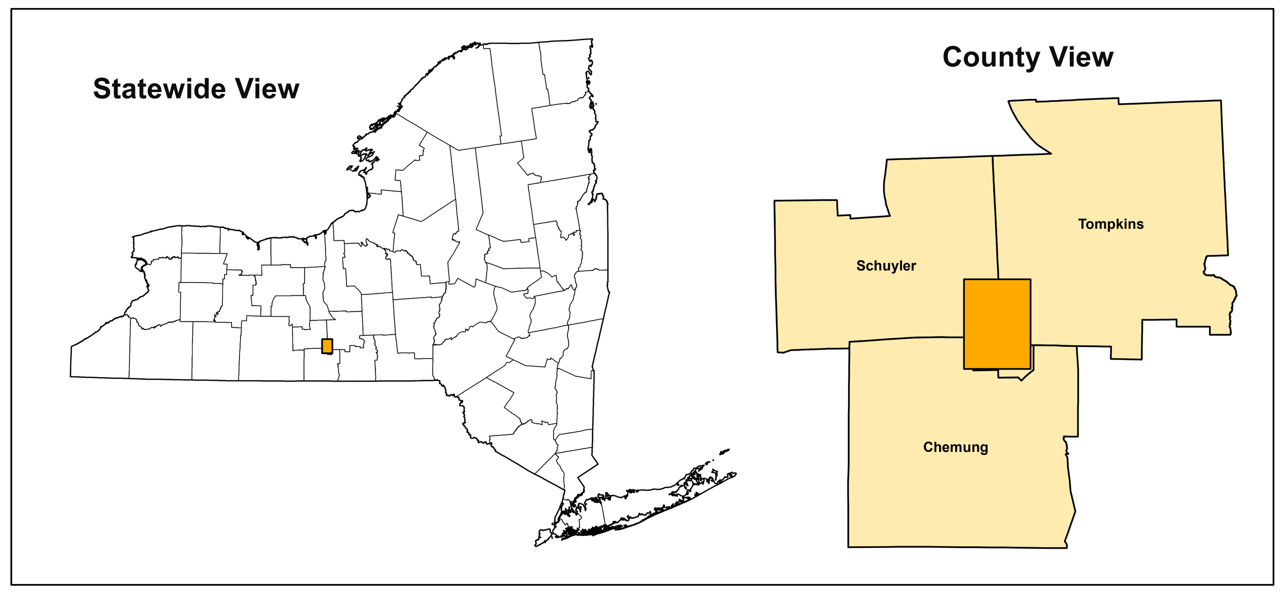
CROSS-SECTION A-A'



SYMBOLS

- Street
- Highway
- Airport Runway
- County Line
- Water Body
- Stream
- Contour
- Cross-Section Line
- NYSGS Sample Location
- NYSDEC Water Well Location
- NYSDOT Boring Location
- NYSDEC Oil & Gas Well
- Esker
- Meltwater Channel
- Moraine
- Striation Location

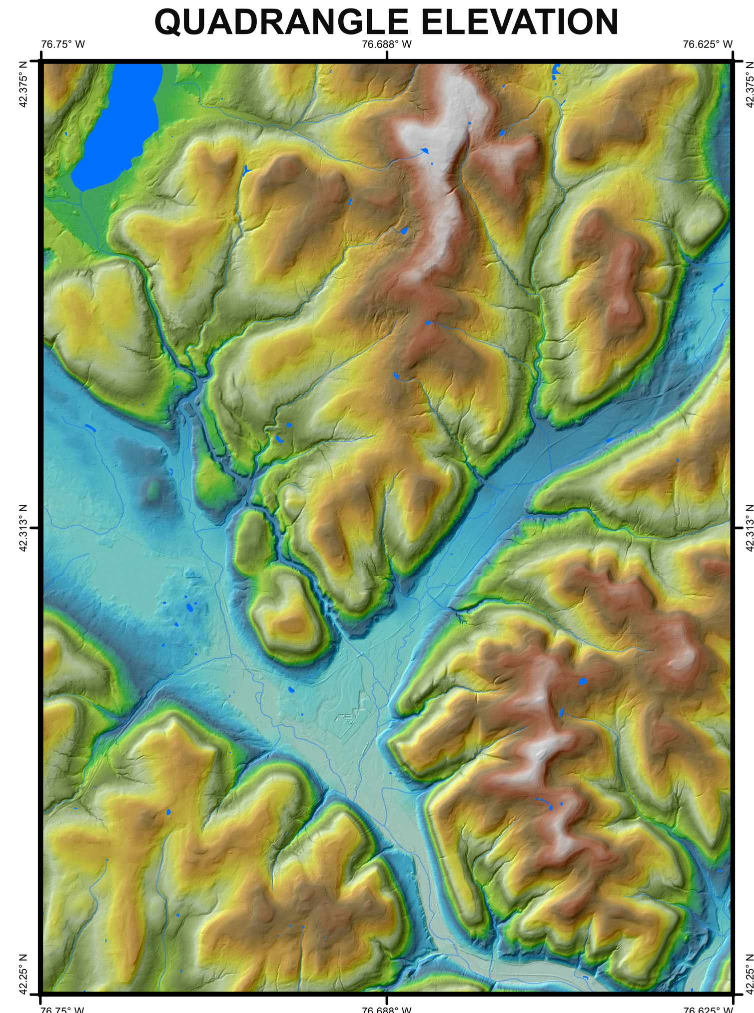
QUADRANGLE LOCATION



ADJOINING QUADRANGLES

Burdett	Mecklenburg	Ithaca West
Montour Falls	Alpine	West Danby
Horseheads	Erin	Van Etten

QUADRANGLE ELEVATION



1:75,000 scale; 2x vertical exaggeration

Feet-amsl
1060 2045

Shaded relief generated from 2020 Central Finger Lakes 1m and the 2019 FEMA 1m lidar data sets.

New York State Museum Map & Chart No. 143

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