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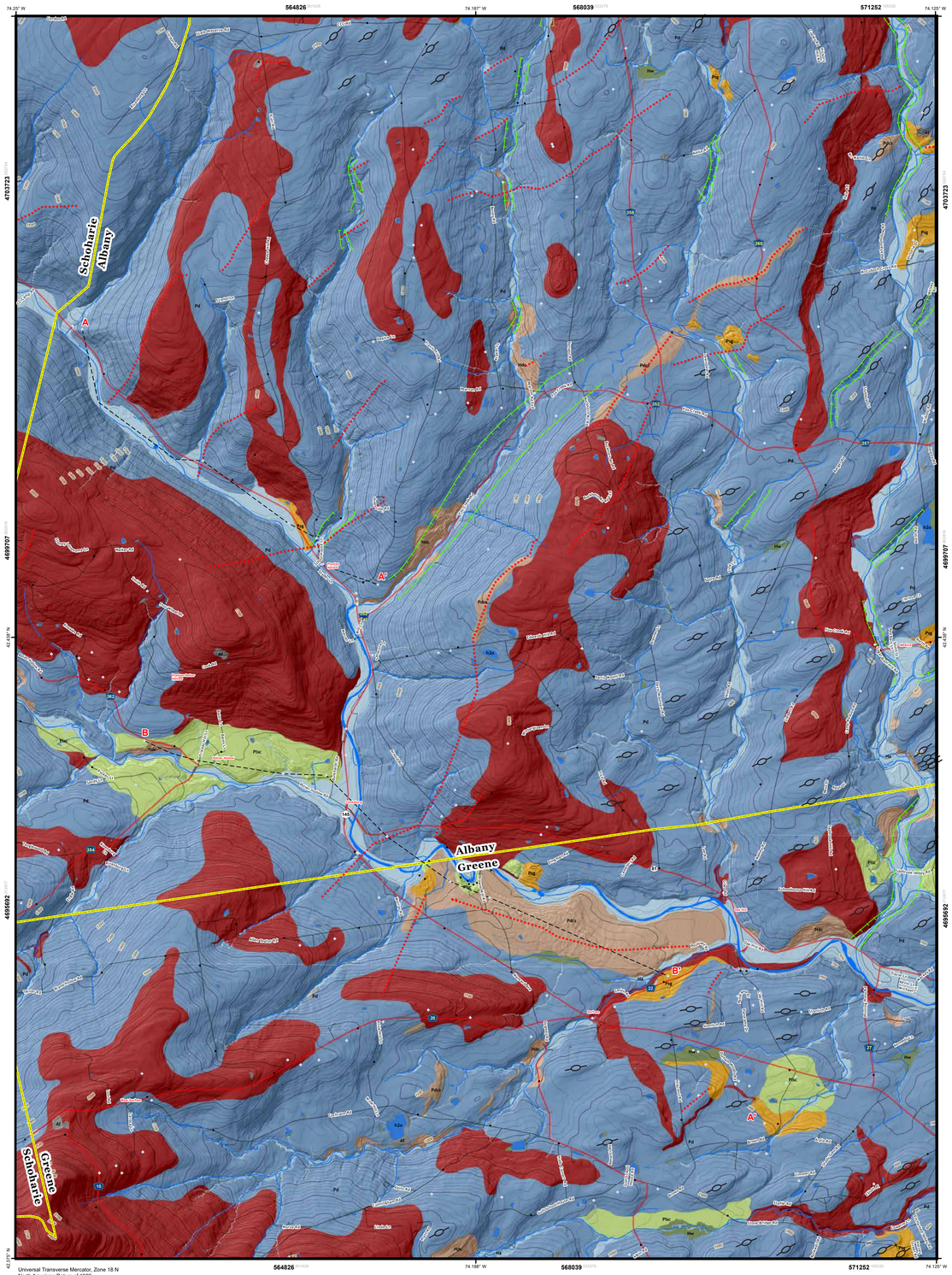
New York State Geological Survey

SURFICIAL GEOLOGY OF THE DURHAM 7.5-MINUTE QUADRANGLE, ALBANY, GREENE AND SCHOHARIE COUNTIES, NEW YORK

prepared by
James R. Leone and Karl J. Backhaus

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

Hydrology, and planimetry layers from the New York State DOT Raster Quadrangle separates for Albany Greene and Schoharie Counties (https://gis.ny.gov/gisdata/inventories/member.cfm?OrganizationID=108). Geographic data layers from 2020 TIGER/Line shapes for transportation and hydrogrpaghy (https://www.census.gov/cgi-bin/geo/shapefiles/index.php)

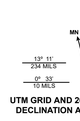
Shaded relief from Capital District 2m, West of Hudson/Greene County 2m, Schoharie 1m and NYS 10m DEM lidar data sets (http://gis.ny.gov/elevation/index.cfm).

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

SCALE 1:24,000

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, A. Alrubay, A. Kozlowski and K. Backhaus, 2021
Digital data and cartography, J. Leone and K. Backhaus, 2021



UTM GRID AND 2019 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET

IINTRODUCTION:

The Durham 7.5-Minute Quadrangle was mapped as part of the 2020 National Cooperative Geologic Mapping Program funded STATEMAP project (award #G20AC00418). This quadrangle is one of 18 full and partial quadrangles to be mapped as part of the Albany County Surficial Geologic mapping project currently being undertaken by the NYSGS started in 2016 and concluding sometime in the early to mid-2020s. 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 Durham quadrangle is situated in southwestern Albany, northern Greene and in two sections of eastern Schoharie county. The quadrangle is approximately 25 miles southwest of the City of Albany. The towns of Rensselaerville with the hamlets of Medusa, Preston Hollow and Potter Hollow are located within Albany County. The Town of Durham and its hamlets of Durham and Oak Hill are located within Greene County. The Town of Conesville is located within the small section of Schoharie County within the quadrangle The quadrangle is largely made of up forests with rural vacant farmland and recreational property. Large tracts of the quadrangle are made up of New York State Land, and private nature preserves.

The quadrangle is situated in the northern portion of the Catskill Physiographic Province. The topographic is very mountainous with deep, narrow, and wide valleys with almost 2,500 feet of elevation change. The summit of Mount Pisgah is the highest point at an elevation of 2,912 feet (887 meters) above mean sea-level (amsl). The lowest elevation at 561 feet-amsl (171 m-amsl) where the Catskill Creek flows east out of the quadrangle. The Catskill Creek drainage basin makes up the entire quadrangle draining out all 55 square miles through many tributaries and water bodies.

The bedrock within the Durham quadrangle consists of sandstones and shales of the Middle Devonian Hamilton Group and the Upper Devonian Genesee Group (Rickard, 1970). These sedimentary rock formations make up what is known as the Catskill Delta, a massive wedge of clastic rocks that occupy New York's Catskill region and a large portion of northeastern Pennsylvania. The rocks were deposited in a riverine and proximal shoreline setting (Rickard, 1975). The bedrock units in the quadrangle are roughly flat-lying and subtly dip towards the south.

The surficial geology of this quadrangle was previously mapped at 1:250,000 scale by Cadwell and others (1986) and were reported to be kame, lacustrine sand, recent deposits (alluvium), till, kame moraines, outwash sands and gravels, and lacustrine silt and clay. Dineen (1986) suggests that the quadrangle was ice-covered during the Rosendale readvance which he was unable to estimate the age of due to the lack of datable materials. After the Rosendale readvance, the Middleburgh readvance (16,000 – 14,000 years before present (yrs. BP)) may have established what is known as the Oak Hill Moraine. The large, streamlined topographic features, made up of drumlins and flutes make up some of the landscape along the eastern edge of the quadrangle. Field mapping in adjacent quadrangles connects these features with what is known as the Helderberg Sub-lobe of the Hudson Lobe. The timing of the Helderberg Sub-lobe is currently being investigated by the NYSGS at the time of this report.

METHODOLOGY:

Field mapping in the quadrangle took place during the Spring and Summer of 2021. Field mapping was undertaken by traverses either in state vehicle and/or by foot. 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. An entrenching tool, which consists of a shovel and pick that is used to expose fresh sediments for collection. At each field stop, the coordinates (latitude and longitude in decimal degrees) were taken (using a handheld Garmin GPS 66st unit), descriptive notes on the sediment found, indicate whether a high-resolution photo and/or sample was/were taken, and the time at which the GPS coordinates were logged into a field notebook (Leone_21, TPK_FN6). A dry erase note card was used in each photo to denote the field stop number.

At most of the field sampling sites, a soil sample was taken for grain-size analysis. This employs 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.

To create the surficial geology map of the Durham 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. The information plotted on the field map was transferred onto mylar and materials-based polygons were drafted by hand. When the hand-drawn map was finalized, it was scanned on a large format scanner into an image file to be digitized.

The final surficial geologic map, cross-sections, and elevation maps were produced using the ESRI ArcMap and Adobe Illustrator CS6 programs. The subsurface and surface units were compiled using 168 water wells and one oil and gas well from the New York State Department of Environmental Conservation and 24 engineering boreholes by the New York State Department of Transportation. The cross-sections were created in ArcMap using the XArcto 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 producing polygons to digitize the 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 179 field stops were made, with 88 samples collected for grain-size analysis, within the quadrangle. Some stops contained more than one sample as they exhibited stratigraphy either in exposure or at depth with the hand-auger. The final count for lithologies found during field sampling was: 120 stops were diamicton, 43 were bedrock, 10 stops were glaciolacustrine silt, fine sand, and clay, eight were sand and gravel, and three were fine to coarse sand. 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 for large, raised roadbeds and bridges.

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 a 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.

Holocene Diamicton 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. These sediments are prevalent along throughout the quadrangle given the steep nature of valley walls and stream banks.

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 in a few areas along the Catskill Creek and its tributaries.

Pleistocene 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 ice margins. Mostly adjacent to the Pics deposits, sand and gravel deposits were found along the top of the Oak Hill Moraine in the Catskill Creek area and along with some isolated deltaic deposits in the northern portion of the quadrangle.

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 is deposited directly beneath the glacier. It is generally matrix-supported, sand-dominant, and blue and purple, brown. Diamicton is found throughout the quadrangle independent of elevation, underlies much of the other surficial geologic units, and makes up the drumlins 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. Slightly different till fabric than the adjacent diamicton on either side. Pdcs is present along the Catskill Creek on the northern edge of the Oak Hill Moraine.

SUMMARY AND CONCLUSIONS:

The Durham quadrangle is largely covered with till, and bedrock is well exposed throughout the quadrangle. Streamlined drumlins and flutes are well formed in the eastern portion of the quadrangle and end almost abruptly along the Oak Hill Moraine (OHM). The western is rugged with bedrock well exposed at the surface and think sections of till filling deep existing valley systems. The Catskill Creek Valley has recorded multiple glacial cycles with the OHM likely representing the last glacial advance into the area.

Drumlins and flutes in the Durham quadrangle are somewhat broader and irregular in shape compared to the highly streamlined drumlins and flutes in the Westerlo quadrangle (Leone et. al., 2020). Based on the direction of orientation of these landforms in the quadrangle represent a slight direction change as the Helderberg Sub-lobe entered the lower elevations of the pre-exiting Catskill Creek system. The shape of the drumlins may also have been formed prior to the advance of the Helderberg Sub-lobe and they could be older palimpsest drumlins that already existed. South of the Catskill Creek the drumlins have a very subdued and were possibly underwater at some point. These drumlins end somewhat abruptly along the OHM.

The Oak Hill Moraine is a circuitous ice margin that bulges west into the quadrangle. Portions of the OHM can be observed north and south of the Catskill Creek Valley. The till left on the mountainous landscape west of the OHM is smoother, and minimally streamlining. The OHM is not the only observable moraine in the quadrangle, possible recessional moraine positions are recorded in the valleys between the north to south ridges north of the Catskill Creek Valley. Speculatively this till older than the till on the surface east of the OHM and was deposited on the landscape during older glacial advances through the region. These moraines are oriented like the recessional moraines identified in the Rensselaerville quadrangle (Leone, 2021), NYDEC water well records in the Catskill Creek valley, have records of more than one glacial till unit. In some cases, glaciolacustrine sediments and/or sand and gravel has been reported between layers of till.

Pro-glacial lakes likely formed several times during previous glacial cycles. Glaciolacustrine sediments are located on both sides of the Oak Hill Moraine.Several field stops, and samples collected around the Catskill Creek Valley were silt, some areas had beds of sand in the section as well. The Catskill Creek Valley is considerably lower in in elevation to the surrounding area and likely acted as a localized sink for glacial ice, in particular the end of the Helderberg Sub-lobe may have diverted and accelerated into the creek valley before terminating in the Oak Hill vicinity. Ahead of the fluctuating lobe of glacial-ice, proglacial lakes formed in the in the western Catskill Creek Valley. The main north branch of the Catskill Creek flows through a very steep valley roughly parallel to State Route 145. This valley has NYDEC water well records that record deep sections stratigraphy.

Different flow rates of glacial ice through the quadrangle can be inferred. Well-formed streamlined drumlins and flutes appearing to end almost abruptly along the OHM represent what might be the advance of the Helderberg Sub-lobe into the area. Other moraines found in the quadrangle could suggest there is a more complex advance and recessional history in the quadrangle. Prior advances of the Helderberg Sub-lobe or even a prior glacial cycle through the area might have deposited the older tills in deep preexisting valleys. The till in the ravines in northern half of the quadrangle could be remnant older till that has been incised by modern drainage. These modern drainages could be following old, buried valleys filled in with glacial sediments.

The moraines in the valleys and melting glaciers may have formed temporal glacial lakes. These lakes may have only been around for short periods of time. The larger lakes system west of the OHM identified by Dineen (1986) was named Lake Oak Hill. As meltwater filled in behind the moraines it likely set in place the drainage pathways that the small streams follow today. Specifically, the TMC Valley that likely drained glacial lakes, Lake Gifford Hollow (Leone, 2021) and for a time Lake Fox Creek (Dineen, 1986) out of the Rensselaerville Quadrangle. The TMC drainage likely began shortly after glacial ice began to retreat out of the Catskill Creek Valley towards the Hudson Lobe.

The Fox Creek Valley (unrelated to glacial Lake Fox Creek) and an unnamed tributary are two other observable meltwater pathways that were exploited by meltwater from the Helderberg Sub-lobe. The Fox Creek Valley was likely draining out its present-day valley to the north but was also draining outwash from in front of the OHM a nick-point marks the likely spillway on Kenyon Road. When the ice began to melt back from the OHM where it crosses Lewisdale Road in Medusa a temporal lake formed and lasted long enough form a delta (Lewisdale Delta) on the east side of the unnamed stream. The lake eventually drained when water found access to Catskill Creek Valley.

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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

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 (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.

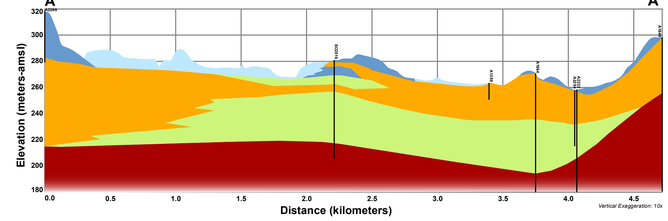
Pd — **Diamicton (Pd)**
An admixture of unsorted sediment ranging from clay to boulders. Generally matrix supported, massive and clast-rich.

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

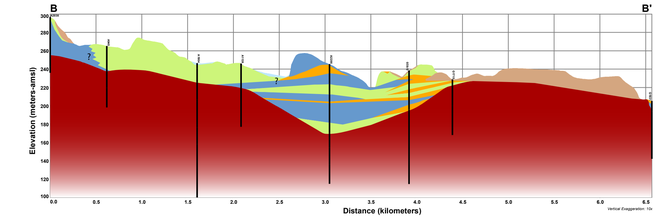
Pre-Pleistocene

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'



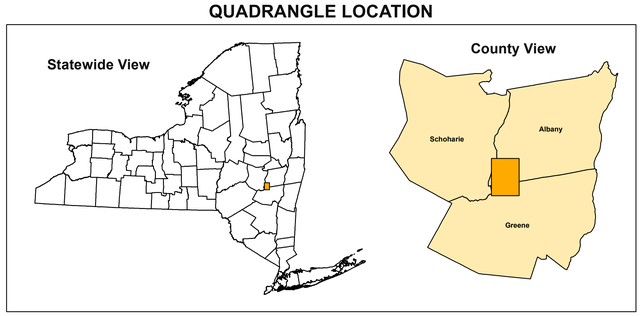
CROSS-SECTION B-B'



SYMBOLS

- Streets
- Highways
- County Lines
- Water Bodies
- Streams
- Contours
- Cross-Section Line
- NYSGS Soil Sample Locations
- NYSDEC Water Well Location
- NYSDOT Boring Location
- NYSDEC Oil & Gas Well Location
- Drumlins
- Ice Margins
- Meltwater Channel

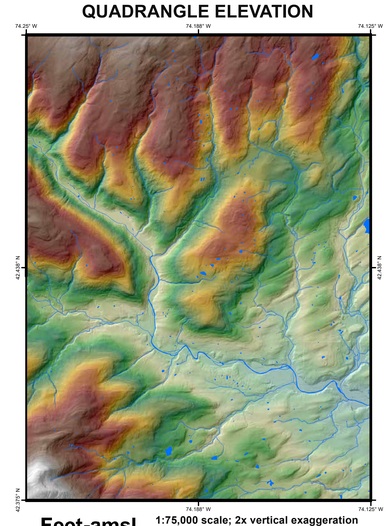
QUADRANGLE LOCATION



ADJOINING QUADRANGLES

Middleburgh	Rensselaerville	Westerlo
Lexington	Durham	Greenville
Ashland	Hensonville	Freehold

QUADRANGLE ELEVATION



Feet-amsl
555 2915

1:75,000 scale; 2x vertical exaggeration

Shaded relief generated from 2008 Capital District 2-meter, 2014 Schoharie 1-meter, 2009/10 West of Hudson/Greene County 2-meter and the 2000 NYS 10-meter lidar data sets.

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