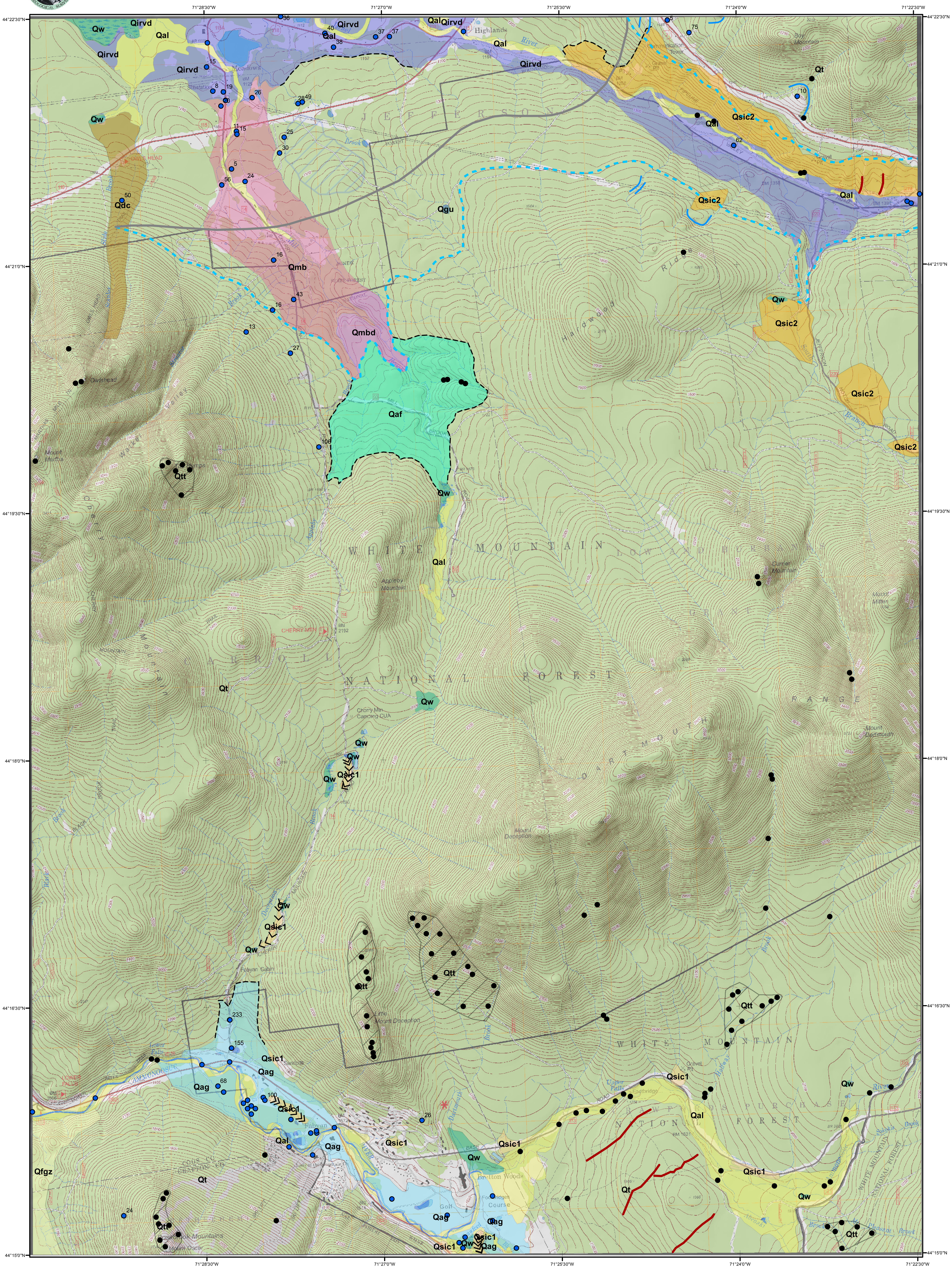
Surficial Geologic Map of the Mount Dartmouth, New Hampshire



Legend

Map Symbols

- Well Location
- bedrock

Type

- Inferred Contact
- Glacial lake level
- Ice Front Position
- Meltwater channel
- Meltwater spillway
- Moraine ridge
- Esker

Surficial Units

- Qfgz - Upper Zealand River Valley Deposit
- Qsic1 - Ice Contact Deposit
- Qsic2 - Ice Contact Deposit
- Qag - Ammonoosuc River Valley Deposit
- Qtt - Thin Till
- Qirvd - Israel River Valley Deposit
- Qmbd - Mill Brook Valley Delta
- Qmb - Mill Brook Valley Deposit
- Qgu - Uncorrelated Glacial Deposit
- Qaf - Alluvial Fan
- Qal - River Alluvium
- Qdc - Colluvial Diamict
- Qt - Till
- Qw - Wetland
- Water
- Area of Massive Boulders

Basemap (provisional) by the US Forestry Service 2010 Mount Dartmouth, New Hampshire. Projection:North American Datum 1983 New Hampshire State Plane Feet. 1000 meter grid in UTM zone 19 North Contour Interval 20 ft

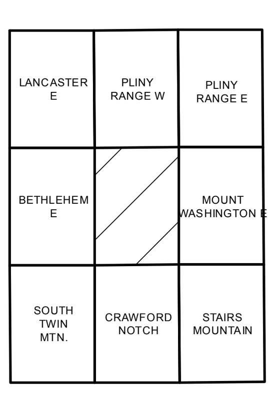
Scale 1:24,000

1 0.5 0 1
Miles

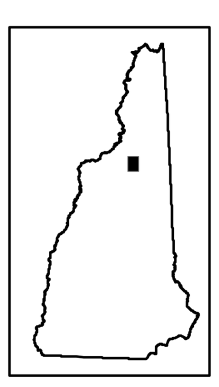
5,000 2,500 0 5,000
Feet

2 1 0 2
Kilometers

MN
2015 Magnetic North Declination at Center of Sheet



Neighboring Quadrangles



Quadrangle Location

Digital Compilation By:Gregory A. Barker, NHGS
Ice front poisitions and paleo lake levels adopted from Thompson, W. B., and Svendsen, K. M., in prep., Deglaciation features of the northern White Mountains, NH: Concord, New Hampshire Geological Survey, Open-File Map (1:100,000 scale).

NHGS Open-File Disclaimer
This map and the accompanying legend(s) are understood to be open-file products. They are draft versions of an unpublished report and represent mapping progress at the time of completion. Newer information may exist. If you have questions, please contact the New Hampshire Geological Survey (NHGS) at: geology@des.nh.gov or (603) 271-1976.

Surficial Geologic Map of the Mount Dartmouth, New Hampshire

By Brian K. Fowler and Gregory A. Barker
New Hampshire State Geologist: Frederick H. Chormann

Surficial Geologic Map Open-File Series GEO-046-024000-SMOF

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Surficial Geology of the Mount Dartmouth 7.5 Minute Quadrangle, New Hampshire
By Brian F. Fowler and Gregory A. Barker

Surficial Unit Descriptions

Qal: STREAM ALLUVIUM (HOLOCENE)
Gravelly to silty sand and wetland soils along the floodplain of the quadrangle streams and rivers.

Qw: SWAMP DEPOSITS (HOLOCENE)
Muck, peat, and silty sand deposited or created by wildlife activity in poorly drained locations, generally 0.3 to 1 m (1 to 6ft) thick, and in steeper locations indistinguishable from, grading into, or interbedded with stream alluvium. Locally pocketed wetlands of limited areal extent are abundant but not individually mapped for clear depiction of underlying units.

Qdc: COLLUVIAL DIAMICT (HOLOCENE)
Post glacial, matrix-supported diamict dominated at the surface and variably downward to ~ 6 m (20 ft) by subangular to rounded, variably weathered boulders and cobbles that grade further downward to cobbly, unstratified often chaotic mixtures of till and clayey to silty diamict and poorly sorted gravel.

Qaf: ALLUVIAL FAN DEPOSITS (PLEISTOCENE - HOLOCENE)
Sand, gravel, and winnowed diamict deposited where fluvial bed gradients shallow.

Qirvd: GLACIOLACUSTRINE AND GLACIOFLUVIAL DEPOSITS OF THE ISRAEL RIVER VALLEY (PLEISTOCENE)
This valley deposit consists of interbedded silt, sand, and gravel deposits that graded to at least three different lake levels (Thompson, refs. 8, 9 & 10). The first stage of paleo Lake Israel (Bowman Stage) graded to a spillway at Bowman, just to the east of the quadrangle, whose elevation is 457 m (1,500 ft; Refs. 8, 10, & 11). The two additional spillways are also off quadrangle, located to the west, and grade to elevations of 429 m (Lake Carroll Stage 3) and 339 m (Bailey Stage). The deposit was subsequently, heavily dissected after by the Israel River. Qirvd is up to 20 m (68 ft) thick and variably overlain by 0.3 to 2.0 m (1 to 6 ft) of sandy-silty Holocene alluvium and wetland soils.

Qmb: MILL BROOK GLACIOFLUVIAL DEPOSIT (PLEISTOCENE)
Cobbley to often boulder, sandy to occasionally silty gravel deposited by glacial meltwater and subsequent Holocene drainage flowing northerly within this valley. Initially these deposits graded to the Bowman Stage of paleo Lake Israel. This is evidenced by the elevation of the delta described in Qmbd. Eventual drainage of Lake Israel led to down cutting of this valley to form the current Holocene level deposits.

Qmbd: MILL BROOK DELTA DEPOSIT (PLEISTOCENE)
This depositional feature consists of sand and sub-rounded gravel and cobbles, overlying basal till. The basal till unit appears to be up to 6 m (20 ft) thick and the overlying delta is as much as 24 m (80 ft) thick.

Qsic: STRATIFIED SUBGLACIAL, SUBAQUEOUS AND SUBAERIAL ICE-CONTACT DEPOSITS (PLIESTOCENE)
Very coarse to medium, often cobbley to occasionally boulder, well-sorted gravel and interbedded coarse to medium sand with frequent lenses of silty sand and pods of un- and poorly sorted glacial till. Morphology of best sorted deposits suggests they were emplaced in various sorts of subglacial drainage

environments, while the less well sorted deposits appear emplaced as lateral embankments and coalescing fans in pro-glacial subaqueous circumstances. Exposures may display intricate cross-bedding and evidence of syn- and post deposition collapse. Units on the map (Qsic1 and Qsic2) are differentiated based on presumed age differences between the Ammonoosuc River valley deposits and the Israel River valley deposits. The Ammonoosuc is presumed to be older than the likely, syn-glacial depositional units within the Israel River valley. In some instances, these units may be covered by alluvial/colluvial or glaciolacustrine or glaciofluvial deposits, particularly in the Israel valley where steep hillside gradients in the valley make these stratigraphic relationships possible.

Qsic1 – These units lie within the Ammonoosuc River valley
Qsic2 – These units lie within the Israel River valley.

Qag: AMMONOOSUC RIVER VALLEY GLACIAL DEPOSITS (PLEISTOCENE)
Cobbley to often boulder, sandy to occasionally silty gravel deposited by glacial meltwater and subsequent Holocene drainage flowing westerly within this valley. Initially these deposits graded to the Crawford Stage of paleo Lake Ammonoosuc, whose spillway was at an elevation of 579 m (1900 ft) within Crawford Notch (Thompson 2009). Subsequent stages of paleo Lake Ammonoosuc drained through two spillways to the west of the quadrangle into the Gale River drainage (Thompson 2009 and in prep.) and based upon these elevations, these deposits would have changed to a glaciofluvial form of deposition and graded to the west to respective elevations of 477 m (1565 ft) and 445 m (1460 ft).

Qfgz: UPPER ZEALAND RIVER VALLEY GLACIOFLUVIAL DEPOSITS (PLIESTOCENE-HOLOCENE)
Cobbley to often boulder, sandy to occasionally silty gravel deposited by glacial meltwater and subsequent Holocene drainage flowing northwesterly from the Zealand Notch drainage divide and adjacent slopes. Initially, it is likely these deposits graded to paleo Lake Ammonoosuc. Up to 3 m (10 ft) thick and variably overlain/intermixed by 0.3 to 1.0 m (1-3 ft) of sandy-silty Holocene alluvium and vegetated hydric soils.

Qt: TILL, LATE WISCONSINAN (PLEISTOCENE)
Ice-contact, ablation and collapse-emplaced, bouldery to cobbley ground moraine with a matrix of tan to dark grayish brown, unsorted to poorly-sorted, loose to moderately compact mixture of clay, silt, sand. Generally less than 6 m (20 ft) thick but up to 30 m (100 ft) thick beneath local hillocks and morainal features. The unit **Qtt** merely denotes areas of till less than 3 m (10 ft) thick.

GEOLOGIC OVERVIEW AND HISTORY
The surficial geologic features of this quadrangle are primarily the result of continental glaciation and deglaciation during the Pleistocene and then various late-to-post glacial, periglacial, and colluvial processes are the driving forces that shape the land proceeding into the Holocene. The topography of the mapping area consists of a centralized chain of mountain peaks with a high notch mountain pass traversing the west central portion of the quadrangle. Two generally east to west striking river valleys, the Israel River Valley and the Ammonoosuc River valley, respectively occupy the north and south edges of the map. An analysis of topographic aspect for the quadrangle indicates a majority of the terrain facing the west to northwest vectors. This presumably relates to the initial advance of the Laurentide ice sheet. Beyond the mapping area, Mount Washington exists to the east with other high mountains to the south and southeast. The Pliny and Pilot Range of mountains occupy the area to the north and the Israel and Johns River valleys occupy the lower elevation area to the northwest. Additional mountainous terrain and the Ammonoosuc River valley occupy the west and southwest.

PREVIOUS WORK

There have been many surficial geologic studies in this region of the White Mountains. W.B. Thompson and J. W. Goldthwait have produced geologic maps that are particularly relevant to this quadrangle. As part of sand and gravel resource identification, Goldthwait in the 1920's and 1930's mapped these resources at a scale of 1:62,500 (Goldthwait, undated). These maps were later updated by Glenn W. Stewart in 1962. Over the past 20 or so years, W. B. Thompson has mapped surficial geologic features in the northern White Mountains. His most recent work (Thompson, et al. in prep.) documents a series of glacial fronts and lakes within both the Israel and Ammonoosuc river valleys.

SURFICIAL GEOLOGIC HISTORY AND FINDINGS

Approximately, 15,000 years BP the Laurentide ice sheet that advanced during the Wisconsinan Glacial Episode began to retreat in New Hampshire. According to age dating by Dorion and Ridge, the edge of the melting glacier would have been within the mapping area 12,500 and 12,000 years BP. Regional scale mapping by Thompson (in prep.) has delineated four locations of ice front positions and areal extents of paleo glacial lakes Ammonoosuc and Israel. The current mapping effort corroborates many of the observations and conclusions by Thompson. Work by Fowler in the Crawford Notch quadrangle (Fowler, 2012) documents glaciolacustrine and glaciofluvial features deposited as a result of glacial Lake Ammonoosuc.

Beginning in the southern portion of the quadrangle, sediments documented from field exposures and soil boring and well data, Lake Ammonoosuc occupied the current day river valley. Lake Ammonoosuc was created between a glacier ice front to the west of the quadrangle, along the current day river valley, and a low point, spillway at Crawford Notch. Lake bottom sediments were encountered toward the middle and bottom of several soil borings excavated at locations through the length of the valley. As the glacier front ablated and receded, a new outlet for the lake was uncovered from ice and allowed drainage into the Gale River valley. Lake levels lowered to this elevation and the beginnings of a fluvial system in the valley developed and now flowed to the west. Subsequently, a third, lower spillway opened again into the Gale River valley allowing the lake to completely drain from the quadrangle and the fluvial system to near completely dominate the valley. During this progression, it is unclear what extent of ice lay to the north of the incipient Ammonoosuc River valley but runoff from down wasting ice would have been directed from these highlands down the current-day main drainage features of Deception Brook, Halfway Brook, the Ammonoosuc headwaters, Abenaki Brook, as well as other smaller tributaries to this drainage systems. These drainage systems would deposit and grade sediments on top of lake bottom deposits previously deposited. Coincident with these glaciolacustrine and glaciofluvial processes, hillside colluvium was being generated from deposited till that may be interbedded with or on top galciolacustrine/glaciofluvial sediments. These occurrences would be at the valley edges.

The central portion of the quadrangle is dominated by till covered mountains, saddles and passes. There are many small drainages coming off these mountains and typically contain alluvium. It seems likely the saddle area containing a wetland just to the east of Cherry Mountain Road, at the center of the quadrangle, was a short lived meltwater spillway. However, this is unconfirmed at this point.

At the other side of this saddle, there is a drainage that leads to Mill Brook drainage. This drainage leads to higher gradient alluvial fans at the start of the Mill Brook deposit. These fans and associated streams provided sediment to the paleo deposit into the Bowman Stage of Lake Israel. Once the lake stage receded a fluvial system ensued and continues in the present-day Mill Brook.

Red Brook, the next drainage east of Mill Brook, presents an interesting contrast. It is a mostly till covered drainage with a small area of uncorrelated sand and gravel that is stratified and fines upward.

The higher level sediments consist of a well sorted, fine sand and fine gravel. This deposit, while 40 feet below the projected Bowman Stage lake level, may represent a beach at the upper limit with a subaqueous deposit near its bottom; but just not at the maximum level of the Bowman stage. In contrast, the bottom of this small valley contains a boulder strewn till, shown in light blue hachure.

Moving into the Israel River proper, a similar history to the Ammonoosuc unfolds. Thompson has delineated three stages of paleo Lake Israel that may be present in deposits that make up this valley. The earliest stage of this lake, Bowman, had its outlet to the east in Bowman. As the glacier ablated and its front moved to the northwest, the two remaining lake stages, Carroll and Bailey, drained through two different, successively lower spillways located to the west and northwest off the quadrangle. Thus the lake and subsequent fluvial system reversed course to flow to the west. Lake bottom sediments were revealed at the surface in the eastern portion along the northern valley side. Lake sediments are encountered at depth in soil borings located at the eastern end of the valley. Overlying these sediments are typically sand and gravel deposits associated with subsequent glaciofluvial systems in the valley. Along the edges of this valley are often ice contact deposits with interspersed colluvial deposits. The ice contact deposits are often times expressed as eskers. Thompson (personal communication) has documented an esker along the northern edge of the valley, starting at the western edge of Qsic2, just south of Route 2. This area couldn't be accessed during this mapping effort so the esker was left undocumented on the map. Ice contact deposits along the southeastern edge of this valley going up Jefferson Notch Road, are likely kame terraces, given their position and likely associated ice positions(Goldthwait and Stewart). On either side of the valley, Thompson documented several meltwater spillways carved within the upland till surface.

There is one historical landslide (Qdc unit) in the northwestern corner of the quadrangle. This slide occurred in 1885 and has become known as the Owls Head Landslide. Based on topography, there also appears to be another slide just to the east of the Qdc unit. There are no extensive exposures of this potential structure and the field evidence gathered suggests that the landform is a till diamict. Greater subsurface dissection of the landform would be needed to make a more complete determination.

Significant References

Dorion, C. C., 2002, Glacial Geology and Archeology of the Northern White Mountains, New Hampshire: Stop 3 Cherry Pond Overlook and Results from Lake Sediment Cores, Jefferson; Guidebook for the 65th Annual Reunion of the Northeastern Friends of the Pleistocene, Littleton, New Hampshire May 17-19, 2002.

Fowler, B.F., 2012, Surficial Geology of the Crawford Notch Quadrangle, NH: Concord, New Hampshire Geological Survey, Open-File Map (1:24,000 scale).

Goldthwait, J. W., undated (updated by G. W. Stewart 1962), Sand and Gravel Resource Maps of New Hampshire: Concord, New Hampshire Department of Resources and Economic Development and Department of Public Works.

Ridge, J.C., 2004, The Quaternary glaciation of western New England with correlations to surrounding areas, Elsevier, Quaternary Glaciations-Extent and Chronology, Part II, J. Ehlers, J. and Gibbard, P.L., editors, p. 169-198.

Thompson, W.B., et al., 2009, Glacial geology, climate history, and late-glacial archeology of the northern White Mountains, New Hampshire, (Part 2): Trip C3 in Westerman, D.S. and Lathrop, A.S., Guidebook for field trips in the Northeast Kingdom of Vermont and adjacent areas: NEIGC, 101st Annual Meeting Guidebook, p. C3-1 to C3-17.

Thompson, W. B., and Svendsen, K. M., in prep., Deglaciation features of the northern White Mountains, NH: Concord, New Hampshire Geological Survey, Open-File Map (1:100,000 scale).

Correlation of Map Units