ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

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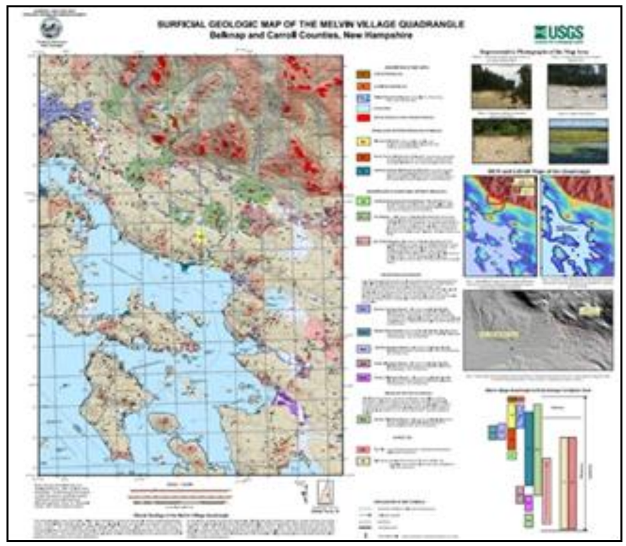
Surficial Geologic Mapping



Recording and studying the geology of an area serves as the base of knowledge of the region's natural resources and leads to a better understanding of the environment as a whole. The New Hampshire Geological Survey (NHGS) was started in 1839 to describe the state's geology and to create a central location for the information collected about the natural resources of the state. The survey has evolved over the years but one of its core missions is still to provide information about New Hampshire's land resources. To do that, NHGS coordinates highly skilled contract and staff geologic mappers to produce bedrock and surficial materials maps every year.

Mapping is a combined effort between NHGS and the United States Geological Survey (USGS) through the National Cooperative Geologic Mapping Program (NCGMP), and the products are utilized by stakeholders for a multitude of purposes.

Surficial Geology in New Hampshire

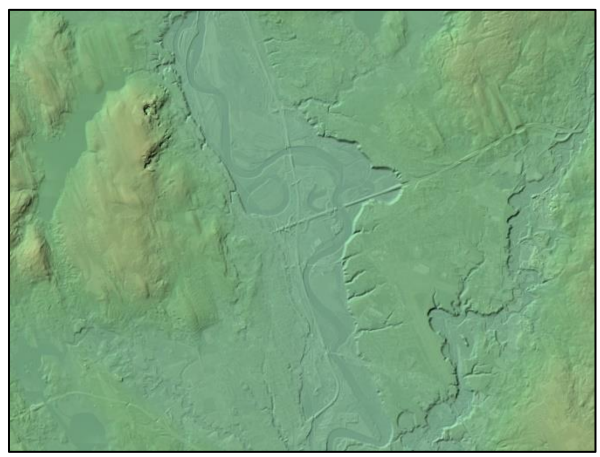
Geologic processes, including weathering and erosion, have broken down bedrock into smaller particles of sediment over time. "Surficial" geology refers to these materials that are on or near the Earth's surface; it is the term for the sand, gravel and other material that lies above the bedrock. Here in New Hampshire, the form of surficial materials and their distribution on the landscape today are primarily the reworked products of glaciers, water, and more recently, human activities.

Glaciers and ice sheets have shaped New Hampshire several times. The most recent event was the Wisconsinan glaciation, which ended in this area 13,000 to 15,000 years ago. The ice that covered this region scraped over mountains, carved deep valleys, and left sediment deposits. These deposits have taken many forms.

Till, which is sediment with an assortment of grain sizes ranging from clay to boulders that was directly deposited and molded by glacial ice, is a very common glacial deposit in New Hampshire. Glaciers also led to deposition of a variety of other features, such as drumlins (smooth elongated hill of till) and eskers (ridges deposited by meltwater channels at the bottom of a glacier).

Retreating glaciers gave way to new landscapes, with lakes as an important landscape feature. Such lakes were created as blocks of ice or deposits of sediment dammed glacial meltwater within their valleys. Glacial meltwater runoff flowed into these large glacial lakes, depositing even more material. After the glacial lake dams burst, rivers then cut down through and reworked these glacial deposits, and other meltwater channels on the landscape, ultimately leaving the valleys and surficial materials we see on the land today. The surficial materials in the state’s river valleys and former glacial lake beds are sources of sand and gravel for construction, infrastructure, and roads, and also act as groundwater aquifers.

People have further reshaped the surficial geology of the state by excavating and moving material, such as during the construction of roadbeds. (For example, the beds of Interstates 93 and 393 in Concord are clearly seen in the LiDAR image at right, going over the floodplain and glacial lake sediments and glacially-molded hills.) In short, glaciers and their meltwater laid the geologic framework for surficial materials to serve as one element of New Hampshire’s economic base and which provides a portion of the state’s groundwater. Thus, understanding surficial geology is vital to resource management.



How Surficial Geology is Mapped

Surficial geology is primarily mapped at the 1:24,000 scale. A key purpose of geologic mapping is to produce maps that represent surficial materials of different textures and origins, which are grouped together into units. The process of mapping a quadrangle begins with an inspection of existing topographic maps, aerial photographs, surficial geologic maps in adjacent areas, and LiDAR (Light Detection and Ranging). Georeferenced water well data, maintained by NHGS and the Drinking Water and Groundwater Bureau at NHDES, mostly representing private domestic water wells drilled in bedrock, are compiled for each map area.

Depth to bedrock information from these wells serve as valuable supplements to field observations. A reconnaissance or “windshield” survey of the landscape is then conducted by driving as much of the road network in the map area as possible. Subsequent mapping is conducted on foot, preferably taking advantage of improved visibility during “leaf off” conditions in the early spring and late fall when possible. Exposures of undisturbed material, such as active or abandoned gravel pits, road cuts and building excavations provide critical access for examining surficial geologic deposits and material textures.

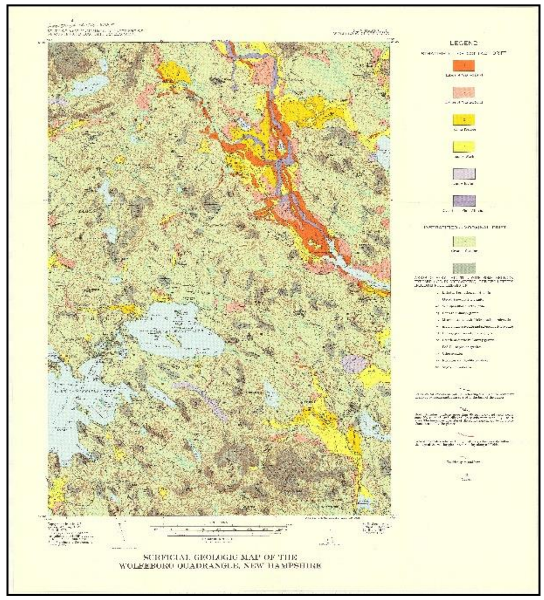
Mappers supplement observations at these sites by digging shallow holes with a shovel or extracting samples with a soil auger. Locations of bedrock outcrops are also noted to identify the extent of thin surficial materials, and to observe and record erosional features such as striations that indicate the direction of glacial ice movement. This texture information is critical for producing the mapped units of materials upon completion of the project. Field data is located by Global Positioning System (GPS) and plotted directly on field sheets, consisting of either 1:24,000-scale topographic base maps and/or georeferenced LiDAR prints, or mapped in real time on mobile GPS-aided mapping software on handheld tablets.

Once field work is complete, all data localities are plotted as accurately as possible on a 1:24,000-scale topographic base map or a desktop computer using Geographic Information System (GIS) software. Interpretation of mapped features is aided by additional sources of information, including hydrography datasets and aerial photographs. Then the geologic mapper uses their field observations, knowledge, and experience to decide which geologic map units are most appropriate, such as till, river alluvium, and former lakebed deposits, among many others. These units convey information about the surficial materials and material sizes that can be expected in an area, so it is important that they are as accurate as possible. NHGS houses the map products both in paper and digital forms. Ultimately, a surficial geologic map shows the distribution of the loose materials that overlie bedrock, which directly supports New Hampshire’s economy and policy makers’ understanding of groundwater resources. These mapping projects also contribute to science through the interpretation and reconstruction of surficial process and glacial history in an area that further tells the story about New Hampshire’s geologic history.

Mapping Progress

NHGS is working to map the entirety of the state at the 1:24,000 scale, and you can see the progress on the surficial and bedrock geologic mapping status maps. NHGS’ 1:24,000 surficial geology quadrangles have been mapped by a variety of mappers through the years.

As a result, geologic units may have been classified differently between maps and the units at the map edges may not have always aligned correctly. NHGS pursues compilation projects to address these issues within 30-foot x 60-foot quadrangle blocks, once all of the 1:24,000 quadrangles within a larger block are completed and resources allow. NHGS' completed maps can be accessed from our publications library.



Applications for Surficial Maps

Surficial geologic maps are important data sources that support a variety of the applied geoscience needs of New Hampshire. They provide information that support, and have supported, the following applications and users:

- Groundwater resources identification utilizes high-quality geospatial data products that accurately delineate the surficial geologic conditions.
- Coastal zone management uses maps in the assessment of riverine flooding, shoreline change, and erosion management.
- Town conservation commissions and planning boards reference maps to conduct research into their local land areas.
- Consultants to the construction aggregate industry use NHGS mapping products during resource evaluations.
- New Hampshire Homeland Security and Emergency Management coordinates responses to flooding, which is New Hampshire's most recurrent natural disaster. Surficial geologic information is essential to identify areas prone to erosion and to provide hazard mitigation planning and response.

- Environmental researchers use geologic maps to understand the potential for erosion in watersheds and to investigate the connections between surficial geology and the classification of soils.
- Archeologists have referenced surficial and bedrock maps to understand where ancient Native Americans obtained stone to manufacture tools.

- Geotechnical engineering companies and environmental managers use surficial maps to know what to expect on a site, and while drilling. They also utilize geologic GIS data sets to provide town-wide site screening and to perform assessments of the migration of contaminant plumes.
- State park associations have used geologic maps to create educational publications and events for the public.

Suggestions for Additional Reading

Eusden, J.D. and others, 2013. The Geology of New Hampshire's White Mountains. Available at www.DurandPress.com, gives an excellent overview of the geology of NH.

Koteff, C. and Pessl, F., Jr., 1981, Systematic Ice Retreat in New England: U.S. Geological Survey, Professional Paper 1179, 20p.

The New Hampshire Geological Survey has PDF versions of maps available for free on the NHDES website.