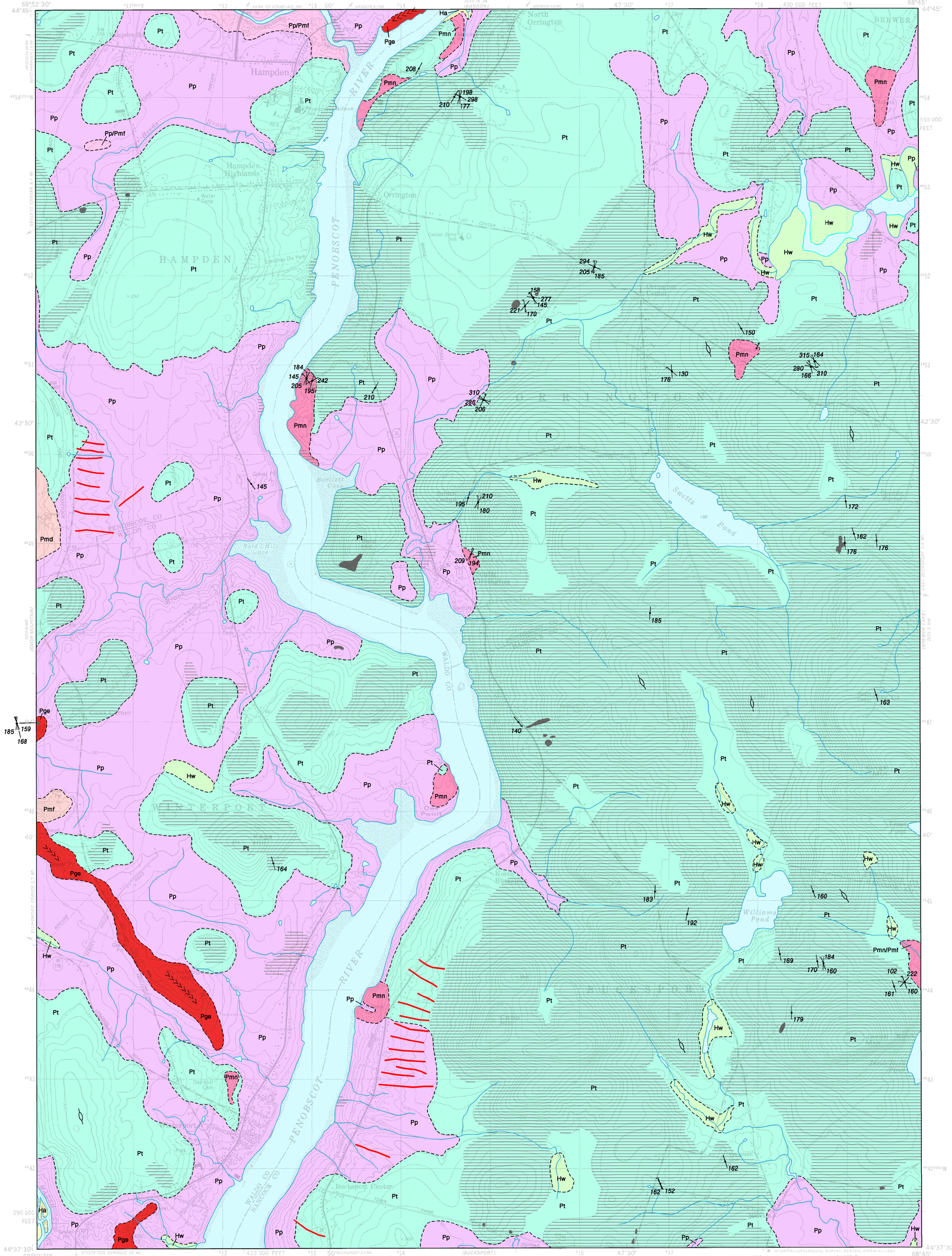
Surficial Geology



SOURCES OF INFORMATION

Modified in 2011 and in 2013 based on field work by Alice R. Kelley and Lynn Caron. Surficial geologic mapping of the Hampden quadrangle was conducted by Kent M. Syverson and Jeffrey D. Olson in 2009 for the STATEMAP program.

Quadrangle Location

Topographic base from U.S. Geological Survey Hampden quadrangle, scale 1:24,000 using standard U.S. Geological Survey topographic map symbols.

The use of industry, firm, or local government names on this map is for location purposes only and does not impute responsibility for any present or potential effects on the natural resources.

Ha **Stream alluvium -** Sand, gravel, and silt deposited on flood plains of streams. May include some wetland deposits.

Hw **Wetland sediment -** Peat, muck, silt, and clay in poorly drained areas.

Pmn **Glaciomarine nearshore deposits -** Massive to stratified and cross-stratified sand, silt, and minor gravel. Consists partly of undifferentiated beach and nearshore deposits formed in relatively shallow water by the reworking of older glacial deposits by wave action. Locally may contain boulders and gravel. Found as a blanket deposit over bedrock and older glacial sediments.

Pmn/Pmf **Glaciomarine nearshore deposits overlying glaciomarine fan sediment -** Massive to stratified and cross-stratified sand, silt, and minor gravel (Pmn) overlying submarine fan sediment (Pmf) containing well stratified sand and gravel.

Pp **Presumpscot Formation -** Glaciomarine silt, clay, and sand deposited on the late-glacial sea floor.

Pmd **Glaciomarine deltas -** Sand and gravel deposited into the sea and built up to the ocean surface. Commonly displays large foreset beds and features such as faults and soft-sediment folding. Formed at the glacier margin during recession of the late Wisconsinan ice sheet.

Pp/Pmf **Presumpscot Formation overlying glaciomarine fan sediment -** Glaciomarine silt, clay, and sand (Pp) overlying submarine fan sediment (Pmf) containing well stratified sand and gravel.

Pmf **Glaciomarine fans -** Sand and gravel deposited as submarine fans at the glacier margin during recession of the late Wisconsinan ice sheet.

Pge **Esker -** Sand and gravel deposited by glacial meltwater streams in tunnels beneath the ice. Esker deposits in this region generally are draped by fine-grained glacial marine sediments. Chevron symbols show inferred direction of former stream flow.

Pt **Till -** Loose to very compact, poorly sorted, massive to weakly stratified mixture of sand, silt, and gravel-size rock debris deposited by glacial ice. Locally includes lenses of water-laid sand and gravel. Boulders commonly present on ground surface.

Bedrock outcrops/thin-drift areas - Ruled pattern indicates areas where bedrock outcrops are common and/or surficial sediments are generally less than 10 ft thick. Mapped from air photos and ground observations. Actual thin-drift areas probably are more extensive than shown. Dots mark locations of small individual outcrops.

Contact - Approximate boundary between map units.

Moraine ridge - Line shows inferred crest of moraine ridge deposited along the retreating margin of the most recent (late Wisconsinan) glacial ice sheet.

225 135 180 135 180 **Glacial striation locality -** Arrow shows ice-flow direction inferred from striations on bedrock. Dot marks point of observation. Number is azimuth (in degrees) of flow direction. At sites where two or more sets of striations are present and relative ages could be determined, the flagged arrows indicate the older flow directions.

Glacially streamlined hills

Dip of cross bedding - Arrow shows average dip direction of cross-bedding in fluvial or deltaic deposits, which indicates direction of stream flow or delta progradation. Dot marks point of observation.

>>>>> **Crest of esker -** Alignment of symbols shows trend of esker ridge. Chevrons point in direction of meltwater flow.

USES OF SURFICIAL GEOLOGY MAPS

A surficial geology map shows all the loose materials such as till (commonly called hardpan), sand and gravel, or clay, which overlie solid ledge (bedrock). Bedrock outcrops and areas of abundant bedrock outcrops are shown on the map, but varieties of the bedrock are not distinguished (refer to bedrock geology map). Most of the surficial materials are deposits formed by glacial and deglacial processes during the last stage of continental glaciation, which began about 25,000 years ago. The remainder of the surficial deposits are the products of postglacial geologic processes, such as river floodplains, or are attributed to human activity, such as fill or other land-modifying features.

The map shows the areal distribution of the different types of glacial features, deposits, and landforms as described in the map explanation. Features such as striations and moraines can be used to reconstruct the movement and position of the glacier and its margin, especially as the ice sheet melted. Other ancient features include shorelines and deposits of glacial lakes or the glacial sea, now long gone from the state. This glacial geologic history of the quadrangle is useful to the larger understanding of past earth climate, and how our region of the world underwent recent geologically significant climatic and environmental changes. We may then be able to use this knowledge in anticipation of future similar changes for long-term planning efforts, such as coastal development or waste disposal.

Surficial geology maps are often best used in conjunction with related maps such as surficial materials maps or significant sand and gravel aquifer maps for anyone wanting to know what lies beneath the land surface. For example, these maps may aid in the search for water supplies, or economically important deposits such as sand and gravel for aggregate or clay for bricks or pottery. Environmental issues such as the location of a suitable landfill site or the possible spread of contaminants are directly related to surficial geology. Construction projects such as locating new roads, excavating foundations, or siting new homes may be better planned with a good knowledge of the surficial geology of the site. Refer to the list of related publications below.

OTHER SOURCES OF INFORMATION

1. Syverson, K. M., and Olson, J. D., 2011, Surficial geology of the Hampden 7.5-minute quadrangle, Hancock, Penobscot, and Waldo Counties, Maine: Maine Geological Survey, Open-File Report 11-7.
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6. Weddle, T. K., and others, 2010, A glacial geology transect through the Ellsworth and Bangor region of Maine, *in* Gerbi, C., Yates, M., Kelley, A., and Lux, D., Guidebook for Field Trips in Coastal and Interior Maine: New England Intercollegiate Geological Conference, 102nd Annual Meeting, University of Maine, Orono, p.133-151.

Hampden Quadrangle, Maine

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This map supersedes Open-File Map 11-31.
For additional information, see Open-File Report 11-7.

SURFICIAL GEOLOGY OF MAINE

Continental glaciers like the ice sheet now covering Antarctica probably extended across Maine several times during the Pleistocene Epoch, between about 1.5 million and 10,000 years ago. The slow-moving ice superficially changed the landscape as it scraped over mountains and valleys, eroding and transporting boulders and other rock debris for miles. The sediments that cover much of Maine are largely the product of glaciation. Glacial ice deposited some of these materials, while others washed into the sea or accumulated in meltwater streams and lakes as the ice receded. Earlier stream patterns were disrupted, creating hundreds of ponds and lakes across the state. The map at left shows the pattern of glacial sediments in the Hampden quadrangle.

The most recent "Ice Age" in Maine began about 30,000 years ago, when an ice sheet spread southward over New England (Stone and Borns, 1986). During its peak, the ice was several thousand feet thick and covered the highest mountains in the state. The weight of this huge glacier actually caused the land surface to sink hundreds of feet. Rock debris frozen into the base of the glacier abraded the bedrock surface over which the ice flowed. The grooves and fine scratches (striations) resulting from this scraping process are often seen on freshly exposed bedrock, and they are important indicators of the direction of ice movement. Erosion and sediment deposition by the ice sheet combined to give a streamlined shape to many hills, with their long dimension parallel to the direction of ice flow. Some of these hills (drumlins) are composed of dense glacial sediment (till) plastered under great pressure beneath the ice.

A warming climate forced the ice sheet to start receding as early as 21,000 calendar years ago, soon after it reached its southernmost position on Long Island (Ridge, 2004). The edge of the glacier withdrew from the continental shelf east of Long Island and reached the present position of the Maine coast by about 16,000 years ago (Borns and others, 2004). Even though the weight of the ice was removed from the land surface, the Earth's crust did not immediately spring back to its normal level. As a result, the sea flooded much of southern Maine as the glacier retreated to the northwest. Ocean waters extended far up the Kennebec and Penobscot valleys, reaching present elevations of up to 420 feet in the central part of the state.

Great quantities of sediment washed out of the melting ice and into the sea, which was in contact with the receding glacier margin. Sand and gravel accumulated as deltas and submarine fans where streams discharged along the ice front, while the finer silt and clay dispersed across the ocean floor. The shells of clams, mussels, and other invertebrates are found in the glacial-marine clay that blankets lowland areas of southern Maine. Ages of these fossils tell us that ocean waters covered parts of Maine until about 13,000 years ago. The land rebounded as the weight of the ice sheet was removed, forcing the sea to retreat.

Meltwater streams deposited sand and gravel in tunnels within the ice. These deposits remained as ridges (eskers) when the surrounding ice disappeared. Maine's esker systems can be traced for up to 100 miles, and are among the longest in the country.

Other sand and gravel deposits formed as mounds (kames) and terraces adjacent to melting ice, or as outwash in valleys in front of the glacier. Many of these water-laid deposits are well layered, in contrast to the chaotic mixture of boulders and sediment of all sizes (till) that was released from dirty ice without subsequent reworking. Ridges consisting of till or washed sediments (moraines) were constructed along the ice margin in places where the glacier was still actively flowing and conveying rock debris to its terminus. Moraine ridges are abundant in the zone of former marine submergence, where they are useful indicators of the pattern of ice retreat.

The last remnants of glacial ice probably were gone from Maine by 12,000 years ago. Large sand dunes accumulated in late-glacial time as winds picked up outwash sand and blew it onto the east sides of river valleys, such as the Androscoggin and Saco valleys. The modern stream network became established soon after deglaciation, and organic deposits began to form in peat bogs, marshes, and swamps. Tundra vegetation bordering the ice sheet was replaced by changing forest communities as the climate warmed (Davis and Jacobson, 1985). Geologic processes are by no means dormant today, however, since rivers and wave action modify the land, and worldwide sea level is gradually rising against Maine's coast.

References Cited

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Stone, B. D., and Borns, H. W., Jr., 1986, Pleistocene glacial and interglacial stratigraphy of New England, Long Island, and adjacent Georges Bank and Gulf of Maine, *in* Sibrava, V., Bowen, D. Q., and Richmond, G. M. (editors), Quaternary glaciations in the northern hemisphere: Quaternary Science Reviews, v. 5, p. 39-52.

Syverson, K. M., and Thompson, A. H., 2011, Surficial geology of the Bangor quadrangle, Maine: Maine Geological Survey, Open-File Map11-6.

Figure 1. Thin till overlying glacially eroded bedrock on Route 17 in Township D, Maine. Most till in the Hampden quadrangle is quite thin over the bedrock surface.

Figure 2. Ablation till over basal melt-out till near Phillips, Maine. The lower, more uniform basal till unit was deposited directly by glacier ice and is typical of the glacial till in the Hampden quadrangle. The upper cobble- and boulder-rich sediment melted out on top of the glacier and was sorted by water and gravity processes.

Figure 3. Horizontally stratified gravelly sand and cobble gravel deposited as a submarine fan near the ice margin. This gravel pit is in part of the Hampden esker-fan complex located southwest of Coles Corner.

Figure 4. Boulder to pebble gravel (right side) deposited in the ice tunnel. This esker sediment is overlain by silty glaciomarine sediment (upper left side) interbedded with coarse material that slumped off the esker during recession of the ice margin. The gravel pit is located south of China Lake, Maine.

Figure 5. Clast-supported pebble to boulder gravel deposited in an ice tunnel. This gravel pit is in part of the Hampden esker-fan complex located near the crest of Punchbowl Hill.

Figure 6. Silt and clay of the glaciomarine Presumpscot Formation overlying stratified sand, gravelly sand, and sandy gravel. The stratified sediment might have been deposited in a submarine fan at the ice margin or could have been eroded from the crest of the Hampden esker. Located just east of the crest of Punchbowl Hill.

Figure 7. Fossil mussel shells washing out of silt and clay of the glaciomarine Presumpscot Formation, East Hampden, Maine (located 1.4 miles north of the Hampden 7.5' quadrangle in the Bangor 7.5' quadrangle).

Figure 8. Large crag-and-tail features cut by younger erosional marks at the intersection of Interstate Highway 395 and Parkway South in Brewer, Maine (Syverson and Thompson, 2011). Older grooves and crag-and-tail features represent southerly flow during the ice-flow maximum (180° azimuth). Younger striae and crag-and-tail features (inset photo) indicate an ice-flow direction to the west-northwest (290° azimuth). The younger, secondary flow directly toward the Penobscot River valley is evidence for a calving embayment. Such features are similar to those mapped in the Hampden 7.5' quadrangle to delineate the calving embayment.