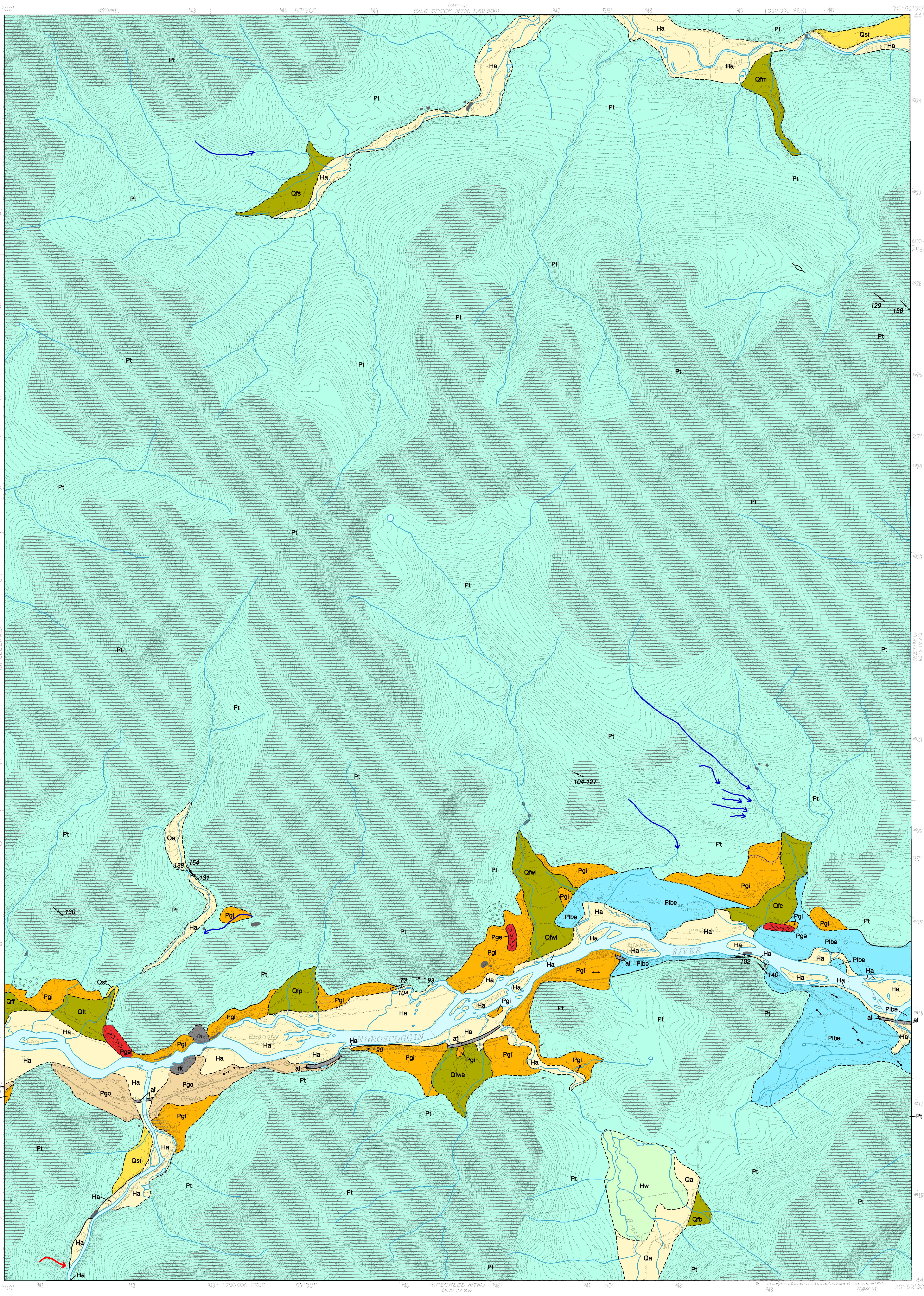
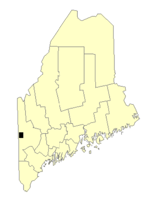
Surficial Geology



SOURCES OF INFORMATION

Surficial geologic mapping of the Gilead quadrangle was conducted by Woodrow B. Thompson in 1982-83 for the Maine Geological Survey's sand and gravel aquifer mapping program and in 2002-3 for the STATEMAP program. Additional data were collected during the 1980's and 1990's by W. B. Thompson, including information from pipeline construction in 1998.



Quadrangle Location

SCALE 1 : 24,000

1 0 1 MILE
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
1 0 1 KILOMETER

CONTOUR INTERVAL 20 FEET

TRUE NORTH

Topographic base from U.S. Geological Survey Gilead 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** - Gravel and sand deposited on flood plains of modern streams. Unit may include some wetland areas.
- **Hw** — **Wetland deposits** - Peat, muck, silt, and clay in poorly drained area of Bog Brook valley.
- **Qst** — **Stream terrace** - Sand and gravel terraces in Wild River and Sunday River valleys.
- **Qa** — **Stream alluvium** - Gravel and sand deposited on a steeply sloping alluvial surface by Twitchell Brook and in the Bog Brook valley. Age may range from early postglacial to recent.
- **Qfs** — **Sunday River fan** - Coarse stream gravel deposited in early postglacial to recent time along the steep headward part of Sunday River valley.
- **Qfm** — **Merrill Brook fan** - Gravel deposited in fan along lower part of Merrill Brook in Sunday River valley.
- **Qff** — **French Brook fan** - Gravel deposited in fan along lower part of French Brook in the Androscoggin Valley.
- **Qft** — **Twitchell Brook fan** - Gravel deposited in fan along lower part of Twitchell Brook in the Androscoggin Valley.
- **Qfp** — **Peabody Brook fan** - Gravel deposited in fan along lower part of Peabody Brook in the Androscoggin Valley.
- **Qfwi** — **Whites Brook fan** - Gravel deposited in fan along lower part of Whites Brook in the Androscoggin Valley.
- **Qfc** — **Chapman Brook fan** - Gravel deposited in fan along lower part of Chapman Brook in the Androscoggin Valley.
- **Qfwe** — **Wheeler Brook fan** - Gravel deposited in fan along lower part of Wheeler Brook in the Androscoggin Valley.
- **Qfb** — **Bog Brook fan** - Sand and gravel deposited in fan on east side of Bog Brook valley.
- **Pgo** — **Outwash deposits** - Sand and gravel deposited by glacial meltwater streams in the Androscoggin Valley. May include deltaic sediments.
- **Pge** — **Esker deposits** - Sand and gravel deposited by meltwater streams in glacial ice tunnels in the Androscoggin Valley.
- **Plbe** — **Glacial Lake Bethel deposits** - Deltaic sand and gravel deposited in a glacial lake that occupied part of the Androscoggin River valley. The lake level was controlled by one or more spillways at ~690-700 ft elevation in the Bethel area to the east.
- **Pgi** — **Ice-contact deposits** - Sand and gravel deposited in contact with remnants of glacial ice in the Androscoggin River and Twitchell Brook valleys.
- **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 waterlaid sand and gravel.
- **Bedrock outcrops / thin-drift areas** - Ruled pattern indicates areas where outcrops are common and/or surficial sediments are generally less than 10 ft thick (mapped partly from air photos). Gray dots show individual outcrops.
- **rk** — **Bedrock** - Area of nearly continuous bedrock outcrop.
- **af** — **Artificial fill** - Earth, rock, and/or man-made fill along roads and railroads.

- **Contact** - Boundary between map units. Dashed where inferred.
- **Scarp** - Scarp separating adjacent levels of unit Pgi in the Androscoggin Valley.
- 135 — **Glacial striation locality** - Arrow shows ice-flow direction(s) inferred from striations on bedrock. Dot marks point of observation. Number is azimuth (in degrees) of flow direction. Where relative ages could be determined, flagged direction is older.
- **Dip of cross-bedding** - Arrow shows average dip direction of cross-bedding in fluvial deposits, which indicates direction of current flow. Dot marks point of observation.
- **Meltwater channel** - Channel eroded by glacial meltwater stream. Arrow shows inferred direction of former stream flow.
- >>>>> **Crest of esker** - Shows trend of esker ridge. Chevrons point in direction of meltwater flow.
- **Area of many large boulders**, where observed. May be more extensive than shown.
- **Path of 1998 landslide.**

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. Thompson, W. B., 2003, Surficial geology of the Gilead 7.5' quadrangle, Oxford County, Maine: Maine Geological Survey, Open-File Report 03-58.
2. Thompson, W. B., and Locke, D. B., 2003, Surficial materials of the Gilead quadrangle, Maine: Maine Geological Survey, Open-File Map 03-56.
3. Neil, C. D., 2003, Significant sand and gravel aquifers of the Gilead quadrangle, Maine: Maine Geological Survey, Open-File Map 03-99.
4. Thompson, W. B., 1979, Surficial geology handbook for coastal Maine: Maine Geological Survey, 68 p. (out of print).
5. Thompson, W. B., and Borns, H. W., Jr., 1985, Surficial geologic map of Maine: Maine Geological Survey, scale 1:500,000.

Gilead Quadrangle, Maine

Surficial geologic mapping by
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Funding for the preparation of this map was provided in part by the U.S. Geological Survey STATEMAP Program, Cooperative Agreement No. 02HQAG0032.

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Open-File No. 03-57
2003

For additional information, see Open-File Report 03-58.

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 Gilead quadrangle.

The most recent "Ice Age" in Maine began about 25,000 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 years ago, soon after it reached its southernmost position on Long Island (Sirkin, 1986). The edge of the glacier withdrew from the continental shelf east of Long Island and reached the present position of the Maine coast by 13,800 years ago (Dorion, 1993). 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. Age dates on these fossils tell us that ocean waters covered parts of Maine until about 11,000 years ago, when the land surface rebounded as the weight of the ice sheet was removed.

Meltwater streams deposited sand and gravel in tunnels within the ice. These deposits remained as ridges (eskers) when the surrounding ice disappeare. 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 10,000 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

Davis, R. B., and Jacobson, G. L., Jr., 1985, Late-glacial and early Holocene landscapes in northern New England and adjacent areas of Canada: Quaternary Research, v. 23, p. 341-368.

Dorion, C. C., 1993, A chronology of deglaciation and accompanying marine transgression in Maine: Geological Society of America, Abstracts with Programs, v. 25, no. 2, p. 12.

Sirkin, L., 1986, Pleistocene stratigraphy of Long Island, New York, *in* Caldwell, D. W. (editor), The Wisconsinan stage of the first geological district, eastern New York: New York State Museum, Bull. 455, p. 6-21.

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.

Figure 1: Till exposure (unit Pt) on west side of Wild River valley, in southwest corner of quadrangle.

Figure 2: Glacially transported boulder on southeast flank of Peaked Hill, Gilead.

Figure 3: Gravel and sand (unit Pgi) deposited by glacial meltwater on south side of Androscoggin Valley, Gilead.

Figure 4: Sand beds deformed by melting of adjacent glacial ice, in same pit as Figure 3.

Figure 5: Pipeline trench across glacial Lake Bethel delta (unit Plbe), south side of Androscoggin Valley, Gilead.

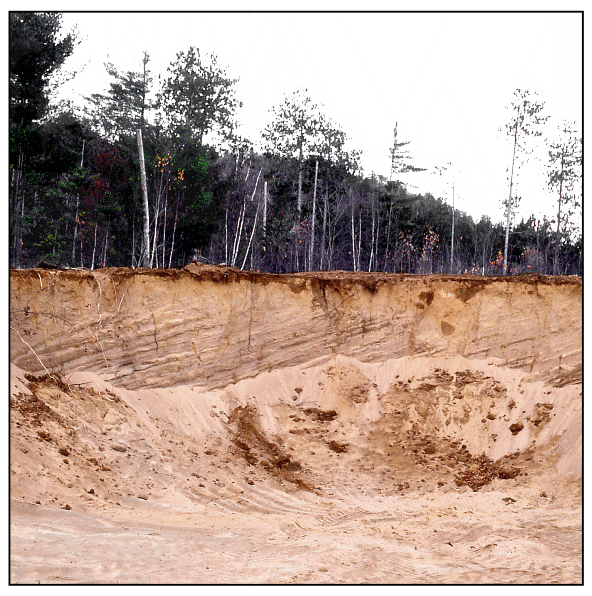

Figure 6: Foreset beds in glacial Lake Bethel delta (unit Plbe), just west of junction of Route 2 and Bog Road, Gilead.

Figure 7: Scar from landslide of July, 1998, in till along small ravine on west side of Wild River, southwest corner of quadrangle. Photo taken 11/3/98.

Figure 8: Trees swept into Wild River by the 1998 landslide shown in Figure 7. Note remnant of slide deposit on top of large boulder in foreground. Photo taken 10/30/98.