DEPARTMENT OF CONSERVATION
Maine Geological Survey
Robert G. Marvinney, State Geologist

OPEN-FILE NO. 99-108

Title: *Surficial Geology of the Bar Mills 7.5-minute Quadrangle, York County, Maine*

Author: *Lewis E. Hunter*

Date: *1999*

Financial Support: Funding for the preparation of this report was provided in part by the U.S. Geological Survey Cooperative Geological Mapping (COGEO-MAP) Program, Cooperative Agreement No. 14-08-0001-A0432.

Associated Maps: Surficial geology of the Bar Mills quadrangle, Open-File 99-77
Surficial materials of the Bar Mills quadrangle, Open-File 98-179

Contents: 9 p. report

Maine Geological Survey
Open-File 99-108

Surficial Geology of the Bar Mills 7.5-minute Quadrangle, York County, Maine

Lewis E. Hunter
Department of Geology
Northern Illinois University
DeKalb, Illinois 60115

INTRODUCTION

The Bar Mills 7.5-minute quadrangle is located approximately 20 kilometers (12 miles) west of Portland and 28 kilometers (17 miles) east of the New Hampshire border. The quadrangle lies in the Seaboard Lowland zone, a subdivision of the New England Province of the Appalachian Highlands physiographic province (Fenneman, 1938; Thornbury, 1965). The Seaboard Lowland zone is characterized by low-lying topography, generally below 90 meters, but locally exceeding 400 meters (Smith, 1985). Major drainage of the Bar Mills region is southeast, down the Saco River, through the town of Saco and eventually to the Gulf of Maine.

The bedrock geology of the Bar Mills quadrangle consists of plutonic and complexly deformed metamorphic rocks (Hussey, 1985). The metamorphic rocks are steeply dipping and strike roughly northeast-southwest. This metamorphic grain produces an elongation of some of the hills in the area. The structural grain is also strongly evident in stream patterning. This probably accounts for jogs in the course of the Saco River where it preferentially follows faults and pluton boundaries. Topographic highs in the region are underlain by igneous plutons suggesting there was preferential glacial erosion of the surrounding, less resistant metamorphic rocks.

Much of the present topography is the product of Late Wisconsinan glaciation which last affected the area approximately 12,000 years ago. Glacially streamlined landforms are common in the area, superimposing a northwest-southeast overprinting on the northeast-southwest structural grain. Most noticeable in the Bar Mills region are the effects of late-glacial sedimentation which subdue the bedrock topography by depositing a blanket of clay, sand, and gravel over most of the region. The largest feature in the area is a large glaciomarine delta which extends from south of Goodwins Mills to Hollis, and which can be traced to the west into Waterboro.

Previous work on surficial materials in the Bar Mills region includes aquifer studies by Prescott and Drake (1962; Appendix A) and Tolman and others (1983) and reconnaissance mapping of the surficial geology by Smith and Thompson (1977) at a scale of 1:62,500. Other selected well data has been accumulated by the Maine Geological Survey (Appendix B). During the summer of 1987, more detailed surficial mapping was conducted by Hunter (1989; Appendix C) at a scale of 1:24,000.

GLACIAL AND POSTGLACIAL DEPOSITS

The surficial geology of the Bar Mills quadrangle developed as a result of late-glacial and postglacial sediment deposition and erosional processes (Figures 1, 2, and 3). As the Late Wisconsinan Laurentide Ice Sheet retreated across coastal Maine, deglaciation was accompanied by marine submergence on the order of 80 meters above present sea level in the Bar Mills area. During deglaciation, marine and glaciomarine deposition, accompanied by sediment remobilization, shaped the seabed and produced the hummocky and gently rolling topography we see today between the marine limit and present sea level. Above the marine limit, glacial and glaciofluvial processes dominated, and with only minor postglacial modifications, these landforms have survived to the present.

Glacial till (Table 1; map unit Pt) is common in the Bar Mills area, but outcrops are poorly exposed and occur only above the marine limit along the western edge of the quadrangle. These tills are typically poorly sorted and massive, with highly variable thicknesses, and contain boulders and cobbles generally suspended in a silt-sand-clay matrix. Both thickness and composition of this deposit are highly variable due to the nature of till genesis. The tills within the area are interpreted as glacial lodgement deposits, but may contain components of melt-out till or flowtill (where stratified). Glacial lodgement till occurs as a smearing of basal and englacial debris beneath an ice sheet, forming a blanket deposit over the substrate. Topographic highs above the marine limit are commonly underlain by till, while

TABLE 1: EXPLANATION FOR THE SURFICIAL GEOLOGIC MAP

SYMBOL	UNIT	DESCRIPTION
Ha	Alluvium	Well-sorted and stratified sand, silt, and gravel. Comprises flood plains along present streams and rivers.
Hws	Swamps	Muck, peat, silt, and sand (undifferentiated) in poorly drained areas. Commonly associated with standing water.
Hwfm	Freshwater marsh	Poorly drained freshwater grassland.
Hst, Qst	Stream terrace deposits	Sand and gravel deposited on former flood plains in late-glacial (Qst) to postglacial (Hst) time.
Pmn	Nearshore deposits	Generally poorly-sorted mixture of silt, sand, and gravel formed by wave reworking of glacial sediments during marine regression. Variable thickness generally less than 3 m. Associated with paleobathymetric highs.
Pmrs	Marine regressive sand deposits	Massive to stratified, well-sorted, gray to yellow-brown sand. Overlies Pp with gradational or interlaminated transition zone. Deposited through reworking of older glacial sediments during regressive phase of marine submergence.
Pp	Presumpscot Formation	Laminated to massive, gray to green-gray silt and clay. Occurs as a blanket deposit of variable thickness from 0 to 50 meters over older glacial deposits. May locally contain boulders, sand, and gravel. Deposited during period of late-glacial marine submergence.
Pgo	Glaciofluvial outwash	Stratified sand, gravel, and some silt deposited by glacial meltwater streams.
Pmd	Glaciomarine delta (undifferentiated)	Generally stratified fine to coarse sand and gravel. Surface topography is flat to gently sloping away from the paleo ice margin. Formed by glacial stream discharge into late glacial sea. Commonly exhibit kettles at the head-of-outwash marking former ice position.
Pmd_1	Lyman Delta sequence	Glaciomarine delta sequence that constitutes first morphologic sequence in Bar Mills quadrangle. Deposited while ice margin was located at the southern portion of the Massabesic Experimental Forest. The delta was fed by a chain of beaded eskers.
Pmd_2	Hollis Delta sequence	Second morphologic sequence, deposited while the ice margin was located in the vicinity just south of Bear Hill. The delta was fed by an esker chain to the west near the town of Waterboro.
Pmdf	Glaciomarine delta foresets	Steeply dipping (10-35^{o}) stratified sand and gravel that grades into Pp down slope. Located along the seaward margin of Pmd, where the delta front slopes eastward, and also exposed where channels have been eroded in the deltas. The topset-foreset contact occurs at approximately 80 m above present sea level, marking the maximum limit of marine submergence.
Pmf	Glaciomarine fan	Sand and gravel deposited in the sea as subaqueous fans at the margin of the last glacial ice sheet.
Pemc	End-moraine complex	Coarse till, gravel, sand, and silt associated with ridges and mounds that formed at or near the front of a retreating marine-based glacier. Mapped in areas of closely spaced (DeGeer) end moraines. Sediments are commonly deformed.
Pge	Esker	Sinuous ridges comprised of stratified, coarse sand and gravel. Commonly found at the heads of large glaciomarine deltas (Pmd). Deposited in subglacial and englacial meltwater tunnels.
Pgi	Ice-contact deposits	Sand and gravel deposited adjacent to glacial ice.
Pt	Till	Poorly sorted mixture of gray to gray-brown silt, sand, and gravel. Forms a blanket deposit over bedrock and is inferred to underlie younger sediments where not exposed at the surface. Commonly less than 3 m thick over bedrock highs.

topographic lows generally contain younger deposits overlying till.

Other terrestrial glacial deposits are confined to the western border of the Bar Mills quadrangle and consist of eskers and glaciofluvial outwash. *Eskers* (Table 1; map unit Pge) develop in subglacial or englacial stream channels where stratified fluvial sand and gravel is deposited in conduits in or under a glacier. As the ice melts, the removal of support allows the sides of the stream gravels to collapse, developing the pseudoanticlinal structure of eskers. Topographically, eskers form sinuous, discontinuous ridges. *Glaciofluvial outwash* and *ice-contact deposits* (Table 1; map units Pgo and Pgi) are composed of coarse, poorly to well sorted, stratified to internally massive sand and gravel that grades eastward into two broad and flat *glaciomarine-delta sequences* (Table 1; map units Pmd_1 and Pmd_2). The geometry, morphology, and close association with kettles and eskers at the heads of these glaciomarine-delta sequences allow the deltas to be associated with ice-frontal positions in accordance with the morphologic sequence concept of Koteff (1974; see discussion of glacial history for more detailed explanation). Stratigraphically below the glaciomarine-delta topset beds lie thick (locally greater than 56 meters) *glaciomarine-delta foresets* (Table 1; map unit Pmdf). These are generally well sorted, stratified sand and gravel deposited on the front margin of a glaciomarine-delta prograding into a shallow marine basin (generally less than 30 meters water depth).

Sediment winnowing and wave reworking of paleobathymetric highs during marine regression are believed to have produced *nearshore deposits* (Table 1; map unit Pmn). Nearshore deposits are common in the central and southeastern portion of the Bar Mills quadrangle. These sediments are characterized by a mixture of silt, sand, and gravel of variable thickness that was derived from till, glaciomarine outwash, and the Presumpscot Formation silt and clay. Bedrock outcrops are commonly associated with nearshore deposits where wave erosion during marine regression was locally intensive enough to expose bedrock highs.

End-moraine complexes (Table 1; map unit Pemc) are common below the marine limit. They are composed of closely spaced end moraines and ice-frontal submarine fans that developed as ice retreated from the coastal zone. End-moraine complex deposits also include reworked and winnowed sands, gravel, and coarser material interfingering with marine silts and clays along their margins. Winnowing and remobilization occurred during marine regression due to wave and tidal processes. The coarse nature and relatively good drainage associated with end-moraine complexes affect surface vegetation (dry on moraine crests and wet along the lower flanks), allowing end-moraine complexes to be easily identified from aerial photographs.

End-moraine complexes are exposed in sand and gravel pits where a complex stratigraphy can be observed and studied (Smith, 1982, 1985, 1999a,b,c,d; Thompson, 1982; Hunter, 1989). Sediments within end moraines vary from till and stratified submarine outwash to distal marine muds. Commonly, these sediments are intensely deformed and sheared (glacially thrusted). Where surface deposits have not been reworked, glaciomarine silts and muds usually overlie thick deposits of submarine outwash. Only the uppermost deposits are shown on the map.

Glaciomarine silt and clay (and fine sand) in coastal Maine were named by Bloom (1960) as the *Presumpscot Formation* (Table 1; map unit Pp). Originally mapped by Goldthwait (1949), the Presumpscot Formation occurs as a discontinuous marine cover up to 50 meters thick, consisting of distal glaciomarine muds (rock flour) that flocculated and settled prior to marine regression. The classic blue-gray to gray-green Presumpscot Formation silt and clay (Pp) dominates the surficial marine record, and is thickest in topographic lows. An overlying sandy unit (Pmrs) with a gradational contact to the silts and clays (Pp), is considered to represent a regressive marine deposit.

During the late-glacial and early Holocene periods, swamps and alluvium were deposited. *Swamps* (Table 1; map unit Hws), which are classified by thickness and ash content of peat, developed in subtle depressions where surface water accumulates and drainage is poor. *Stream alluvium* (Table 1; map unit Ha) in the Bar Mills area occurs adjacent to the Saco River as deposits on postglacial flood plains. Older alluvial deposits are mapped as *stream terraces* (Qst, Hst).

GLACIAL AND POSTGLACIAL HISTORY

During the Pleistocene Epoch, coastal Maine experienced glaciation more than once. Each subsequent glacial event virtually erased the glacial record of previous events, except in a few isolated cases where older tills can be found, such as in the York Harbor area (Clinch and O'Toole, 1999a,b). This is not the case in the Bar Mills quadrangle, where mapped deposits are exclusively Wisconsinan or younger. Glacially scoured and streamlined bedrock surfaces and ridges indicate that ice flow was generally south-southeast, with a few deviations around topographic highs. The pattern of submarine end moraines (ribbed or DeGeer moraines: Smith, 1982) and morphologic sequences along the western margin of the Bar Mills quadrangle define a northwest retreating ice margin (Figures 1b and 2a; Hunter and Smith, 1988; Hunter, 1989).

Around 18,000 years ago, the Laurentide ice sheet had reached its terminal position at the edge of the continental shelf (Hughes and others, 1985). Between 17,000 and 15,000 years ago, the ice retreated across the Gulf of Maine and reached a position roughly parallel, but seaward of the present coastline by 14,000 years ago (Smith, 1985). As the ice margin retreated toward the present coastline, shallowing water depths may have helped reduce the retreat rate by slowing calving rates. Radiocarbon dates on shells collected from Great Hill and the Kennebunk landfill site indicate that ice may have been present along the coast until 13,200 years ago (Smith, 1985).

The abundance of end moraines, as well as the general lack of ice-rafted debris, suggests a slow rate of ice retreat as the ice margin neared the Bar Mills region. Water depths were on the order of 30 meters or less, lessening the effects of buoyancy on the ice margin and increasing the stability of the ice. Kettles found in sand and gravel pits in the Old Orchard Beach quadrangle and in the vicinity of Salmon Falls indicate that there was stagnant ice, or at least isolated ice blocks which were buried rapidly by large volumes of sediment being discharged by the ice.

As the ice margin neared the marine-terrestrial transition, water depths continued to decrease, and the ice margin attained a more gently sloping and stable profile. Toward the east and central portions of the Bar Mills quadrangle, where water depths were greatest, the ice margin had a general east-west orientation (Figures 1 and 2a). As the ice margin retreated onshore, the con-

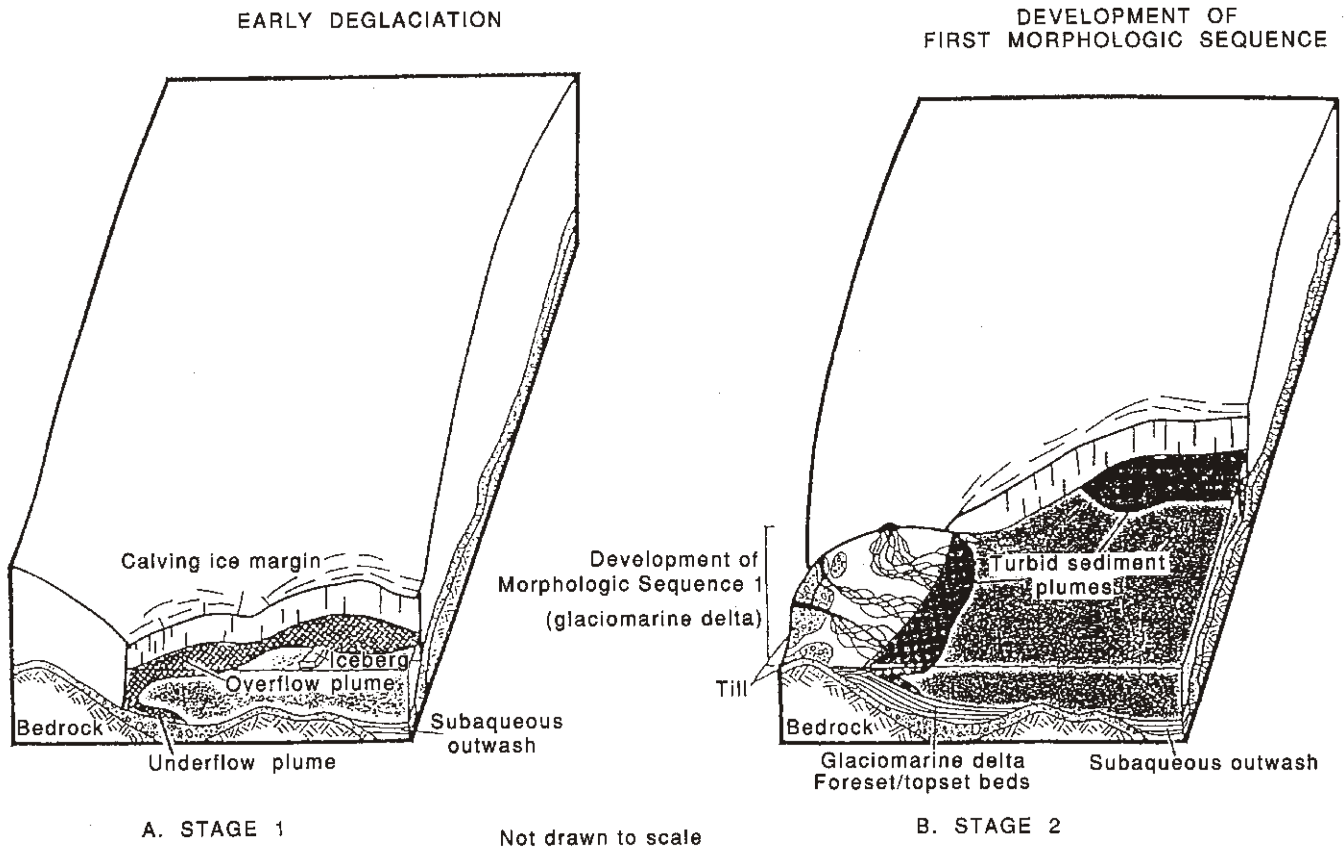

Figure 1. Early deglaciation of the Bar Mills quadrangle. (a) an actively calving ice margin oriented approximately east-west began retreating across the southeastern corner. (b) as water depth decreased, the ice margin rotated to a general northeast-southwest trend and a large glaciomarine delta developed forming morphologic sequence 1.

figuration of the ice margin shifted, assuming a general southwest-northeast orientation.

The sedimentary record in the Bar Mills quadrangle developed in response to a sequential transition from ice-proximal to ice-distal deposition. In the ice-proximal marine environment, coarse submarine fan complexes and stratified submarine outwash graded into increasingly finer mid-fan and distal-fan deposits. This transitional fining was recorded both distally and upsection as the ice retreated. As ice continued to retreat, fine silt and mud settled from suspension forming a muddy blanket deposit (Presumpscot Formation). As long as ice retreat was constant, the sedimentary sequence was left undisturbed, but periods of minor readvance (possibly annual) were common. During these readvances, previously deposited sediments were shoved and redeposited as submarine end moraines or DeGeer moraines.

Along the western margin of the Bar Mills quadrangle, two large glaciomarine deltas with ice-contact heads developed. These deltas are morphologic sequences (Koteff, 1974), indicating the position of the ice margin at the time of their development (Figures 1b and 2a). The delta represented by map unit Pmd_1 (Lyman Delta sequence) prograded to the south and southeast as the ice margin was located along the southern border of the Massabesic Experimental Forest. Two chains of beaded eskers terminate in the vicinity of Parker Pond, marking the main sources of glaciofluvial sediments which comprise the first morphologic sequence (Figure 1b). The second morphologic sequence (Pmd_2; Hollis Delta sequence) crops out from the Massabesic Experimental Forest to the Clarks Mills area, and appears to have been fed by glacial meltwater discharged near the town of Waterboro. Sand and gravel infilled a shallow basin bound by the Lyman Delta sequence to the south, a till high to the east, and the retreating Laurentide ice margin to the north (Figure 2a). Deeply incised channels along the delta margins suggests that the channels remained active as relative sea level dropped. These two large deltas mark the end of large-scale deposition within the quadrangle. Probably between 13,000 and 12,500 years ago, the ice margin retreated from the Bar Mills quadrangle and continued to retreat to the northwest.

Following ice retreat from the Bar Mills quadrangle, isostatic adjustment began to uplift the landscape. As the land rose, relative sea level dropped, and sediments being affected by waves and marine currents were winnowed and remobilized. This produced the sandy regressive sediments (Pmrs) and near-

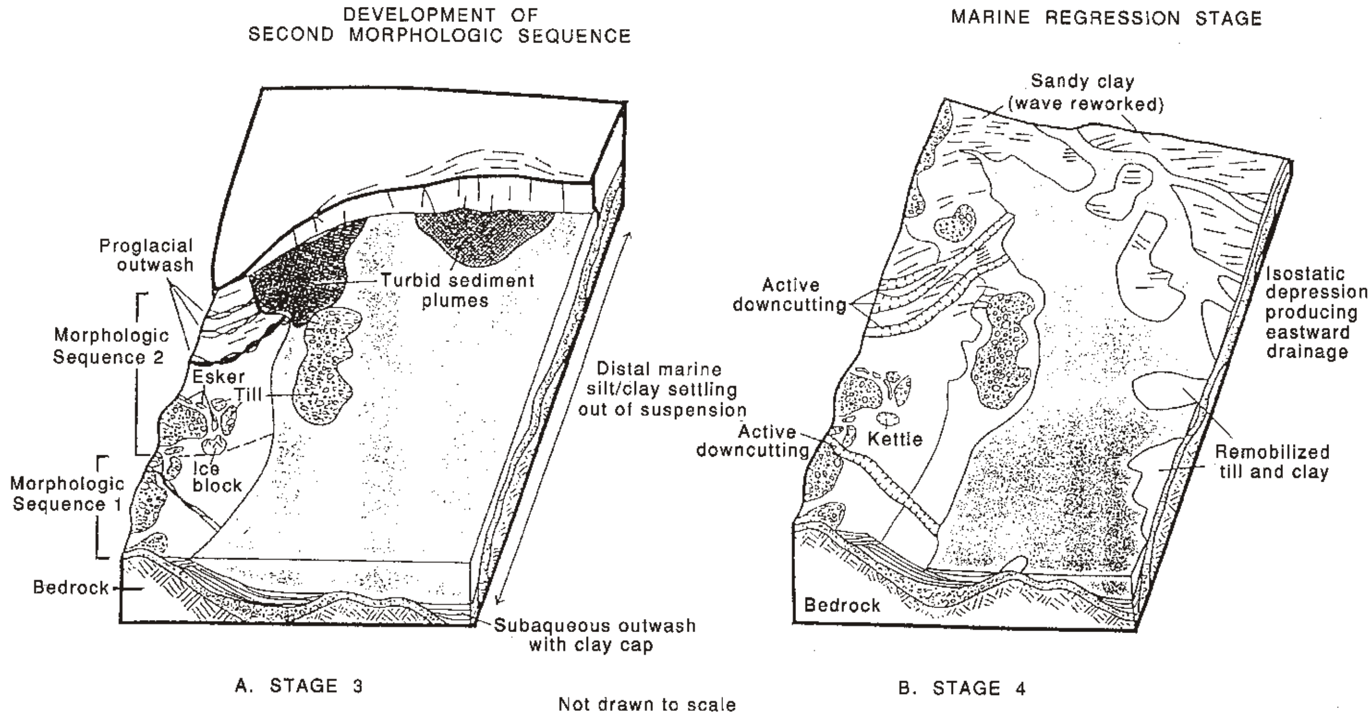

Figure 2. Late stages of deglaciation. (a) Ice has retreated to the northern edge of the Bar Mills quadrangle and has been accompanied by the development of morphologic sequence 2. (b) Following deglaciation and during initial isostatic adjustment, the sea level dropped and marine clays were reworked and winnowed by wave action forming the sandy facies of the Presumpscot Formation. Active downcutting in the deltas also accompanied sea level lowering.

shore deposits (Pmn) on paleobathymetric highs (Figure 2b). In time, an estuary developed which drained seaward to the east through a series of channels (Figure 2b) and to the south into the open sea. To the west, as sea level dropped, glaciofluvial channels became incised by nonglacial streams cutting into the deltas and eventually developed into tributaries of the Saco River following marine regression.

As isolated uplift decreased, the encroaching eustatic sea level produced a mid to late Holocene sea level rise (Figure 3). This produced the base level to which modern streams are graded, allowing some streams to develop flood plains. In freshwater wetlands, fine-grained sediments and organic material continue to accumulate.

REFERENCES CITED

Bloom, A. L., 1960, Late Pleistocene changes in sea level in southwestern Maine: Maine Geological Survey, 143 p.

Clinch, J. M., and O'Toole, P. B., 1999a, Surficial geology of the York Harbor quadrangle, Maine: Maine Geological Survey, Open-File Map 99-107.

Clinch, J. M., and O'Toole, P. B., 1999b, Surficial geology of the York Harbor 7.5-minute quadrangle, York County, Maine: Maine Geological Survey, Open-File Report 99-138, 6 p.

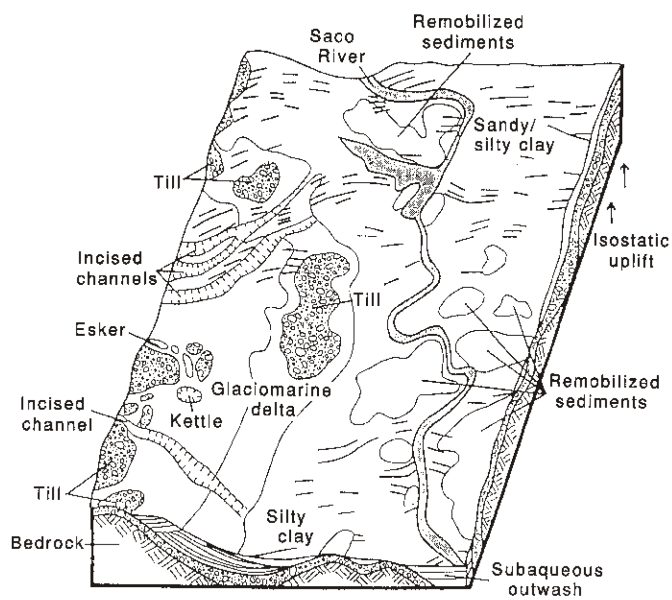

Figure 3. Following late stages of isostatic uplift, the present topography and drainage of the Bar Mills quadrangle was established.

Fenneman, N. M, 1938, Physiography of the eastern United States: McGraw-Hill Book Co., Inc., New York, New York, 714 p.

Goldthwait, L., 1949, Clay Survey 1948: Maine Development Commission, Report of the State Geologist, 1947-1948, Augusta, Maine, p. 63-69.

Hughes, T., Borns, H. W., Jr., Fastook, J. L., Hyland, M. R., Kite, J. S., and Lowell, T. V., 1985, Models of glacial reconstruction and deglaciation applied to Maritime Canada and adjacent New England, *in* Borns, H. W., Jr., LaSalle, P., and Thompson, W. B. (eds.), Late Pleistocene history of northern New England and adjacent Quebec: Geological Society of America, Special Paper 197, p. 139-150.

Hunter, L. E., 1989, Late Wisconsinan deglaciation of the Bar Mills quadrangle, York County, Maine: M. S. thesis, Ohio University, Athens, Ohio, 161 p.

Hunter, L. E.,and Smith, G. W., 1988, Late Wisconsinan deglaciation of the Bar Mills quadrangle, York County, Maine: Geological Society of America, Abstracts with Programs., v. 20, p. 29.

Hussey, A. M., II, 1985, Bedrock geology of the Bath and Portland 2-degree map sheets, Maine: Maine Geological Survey, Open-File Report 85-87, 82 p.

Koteff, C., 1974, The morphologic sequence concept and deglaciation of southern New England, *in* Coates, D. R. (ed.), Glacial geomorphology: State University of New York at Binghamton, p. 121-144.

Prescott, G. C., and Drake, J. A., 1962, Records of selected wells, test holes, and springs in southwestern Maine: U. S. Geological Survey, Maine Basic Data Report No. 1, Ground Water Series: Southwestern Area, 35 p.

Smith, G. W., 1982, End moraines and the pattern of last ice retreat from central and south coastal Maine, *in* Larson, G. J., and Stone, B. D. (eds.), Late Wisconsinan glaciation of New England: Kendall/Hunt Pub. Co., Dubuque, Iowa, p. 195-209.

Smith, G. W., 1985, Chronology of Late Wisconsinan deglaciation of coastal Maine, *in* Borns, H. W., Jr., LaSalle, P., and Thompson, W .B. (eds.), Late Pleistocene history of northern New England and adjacent Quebec: Geological Society of America, Special Paper 197, p. 29-44.

Smith, G. W., 1999a, Surficial geology of the Dover East quadrangle, Maine: Maine Geological Survey, Open-File Map 99-82.

Smith, G. W., 1999b, Surficial geology of the Dover East 7.5-minute quadrangle, York County, Maine: Maine Geological Survey, Open-File Report 99-113, 6 p.

Smith, G. W., 1999c, Surficial geology of the Portsmouth quadrangle, Maine: Maine Geological Survey, Open-File Map 99-96.

Smith, G. W., 1999d, Surficial geology of the Portsmouth 7.5-minute quadrangle, York County, Maine: Maine Geological Survey, Open-File Report 99-127, 5 p.

Smith, G. W.,and Thompson, W. B., 1977, Reconnaissance surficial geology of the Buxton quadrangle, Maine: Maine Geological Survey, Open-File No. 77-19.

Thompson, W. B., 1982, Recession of the Late Wisconsinan ice sheet in coastal Maine, *in* Larson, G. J., and Stone, B. D. (eds.), Late Wisconsinan glaciation of New England: Kendall/Hunt Pub. Co., Dubuque, Iowa, p. 211-228.

Thornbury, W. D., 1965, Regional geomorphology of the United States: John Wiley and Sons, Inc., New York, New York, 609 p.

Tolman, A. L., Tepper, D. H., Prescott, G. C., and Gammon, S. O., 1983, Hydrology of significant sand and gravel aquifers: northern York and southern Cumberland Counties, Maine: Maine Geological Survey, Open-File Report 83-1.

APPENDIX A. SELECTED WELLS-BAR MILLS QUADRANGLE, MAINE
(Tabulated from Prescott and Drake (1962))

Well No.	Town	Elevation (Feet a.s.l.)	Well Log*	Material
24	Lyman	210	38/--/--	Gravel
25	Dayton	180	145/--/near	Bedrock surface
26	Lyman	210	28.2/27.9/--	Gravel (ice-contact)
27	Lyman	200	153/--/--	Bedrock
29	Lyman	267	16/14/--	Sand and gravel (ice-contact)
30	Lyman	210	12.1/9.7/--	Sand and gravel (ice-contact)
42	Dayton	185	79/--/--	Gravel (pre-marine stratified)
43	Dayton	180	90/--/--	Gravel (pre-marine stratified)
44	Dayton	180	142/--/--	Bedrock
45	Dayton	265	54/--/--	Sand and gravel (ice-contact)
46	Dayton	180	100/60/--	Pre-marine stratified drift
47	Dayton	180	56/--/18	Bedrock
52	Buxton	220	208/ 4/15	Bedrock
57	Buxton	245	100/21.5/--	Bedrock
58	Hollis	130	35/18.5/--	Sand (marine)
59	Hollis	200	66/--/--	Bedrock
64	Buxton	205	55/--/--	Clay
65	Buxton	220	100/--/--	Bedrock
66	Dayton	150	100/30/--	Bedrock
68	Dayton	180	100/45/93	Outwash (?)
69	Dayton	160	273/40-50/--	Bedrock
70	Dayton	160	355/--/ 3	Bedrock
71	Dayton	160	111/--/--	Bedrock
72	Dayton	160	172/--/--	Bedrock
73	Dayton	160	296/--/--	Bedrock
73a	Dayton	160	512/--/--	Bedrock
74	Biddeford	100	121/ 4/77.16	Bedrock
76	Lyman	310	--/9.44/--	Till
101	Buxton	250	110/--/54	Bedrock
102	Buxton	200	175/26/--	Bedrock
103	Buxton	200	175/--/--	Bedrock
111	Hollis	225	192/--/--	Bedrock
112	Hollis	108	108/--/--	Bedrock
113	Hollis	160	100/--/--	Bedrock
114	Hollis	160	225/15/--	Bedrock
115	Buxton	160	127/--/--	Bedrock
116	Buxton	160	127/ 3/--	Bedrock
117	Hollis	160	18/8.9/22	Clay
248	Buxton	180	38/--/--	Bedrock
274	Hollis	160	99/35/ 9	Bedrock
276	Hollis	170	147/11/16	Bedrock
495	Lyman	220	220/--/--	Bedrock
496	Dayton	240	15/--/--	Sand (outwash)
497	Hollis	235	30/--/--	Outwash
498	Hollis	280	14/--/--	Till
499	Dayton	250	30/--/--	Ice-contact sediments
500	Hollis	130	12/--/--	Till
502	Dayton	240	14/--/--	Sand (outwash)
503	Hollis	200	27/--/--	Sand (outwash)
504	Hollis	180	14/--/--	Till
510	Hollis	200	93/ 9/13	Bedrock
544	Buxton	180	--/--/ 3	Bedrock
546	Saco	170	350/--/ 2	Bedrock
549	Dayton	130	300/ 8/ 4	Bedrock
550	Saco	140	265/--/--	Bedrock
551	Saco	140	80/--/near surface	Bedrock
552	Dayton	200	9/1.1/--	Clay
590	Lyman	210	14/--/--	Sand (ice-contact)
596	Dayton	250	100/--/--	Bedrock
601	Hollis	160	196/--/--	Bedrock
602	Buxton	250	40/--/--	Sand and gravel (outwash)

*Well log notation: (Depth of well / water depth / depth to bedrock)

APPENDIX B. SELECTED WELLS - BAR MILLS QUADRANGLE, MAINE
(Maine Geological Survey Data)

Well No.	Depth to Bedrock	Material
769	35	---
773	40	---
791	17	Gravelly clay
798	170	---
804	47	---
807	10	---
808	10	---
817	20	---
829	150	---
831	80	---
835	5	---
864	15	---
892	40	Cobbles and clay
919	12	---
922	93	Soft spot, chunky and rusty water
924	75	Loam, gravel, sand and clay
931	10	Loam and clay
946	10	Loam, sand and clay
947	75	Sand
956	18	Clay and gravel

APPENDIX C. DATA ON SURFICIAL MATERIALS OF THE BAR MILLS QUADRANGLE, MAINE
(Hunter, 1989)

Site No.	Elevation (Feet a.s.l.)	Materials Description
01	230	Auger hole; 24 inches of interbedded coarse to fine sand.
02	250	Auger hole; 18 inches of brown to tan sand with fine gravel.
03	220	Auger hole; 30 inches yellowish-brown, coarse sand and gravel on 10 inches fine silty-sand.
04	200	Auger hole; 40 inches of gray clayey silt coarsening downward into coarse sand.
05	170	Auger hole; 15 inches of silty sand on 10 inches of gray-green Presumpscot Formation clay.
06(a)	165	Auger hole; 20 inches gray-green Presumpscot Formation clay.
06(b)	190	Auger hole; 24 inches silty clay.
07	290	Auger hole; boulders or cobbles near surface, coarse sand and gravel.
08	300	Building excavation; 5 to 6 feet till with sand and gravel matrix.
09	290	Road cut; 10 to 18 inches coarse sand and gravel with cobbles.
10	280	Road cut; 10 inches coarse sand and gravel with cobbles.
11	250	Building excavation; 30 inches of yellow sand and gravel with cobbles.
12	220	Building excavation; 30 inches of coarse sand fining downward into sandy clay.
13	210	Auger hole; 3 holes less than 1 foot into coarse, clayey sand. Auger stopped by boulders or cobbles. Surface scattered with boulders.
14	160	Auger hole; 15 inches into gray-green Presumpscot Formation clay.
15	150	Auger hole; 10 inches gray-green Presumpscot Formation clay.
16	130	Bedrock; horizontal surface gives striation orientation of S39° E.
17	110	Building excavation; 6+ feet of gray-green Presumpscot Formation clay. Just prior to investigation, large ice-rafted (?) boulder, approximately 2 feet in diameter, was removed from base of section.
18	80	Auger hole; 18 inches of gray-green Presumpscot Formation clay. Near large subaqueous end moraines.
19	205	Auger hole; 18 inches of coarse sand and gravel.
20	160	Auger hole; 24 inches of dry silty clay and clayey silt.
21	170	Auger hole; 30 inches of clayey silt and silty clay with clay stringers.
22	185	Auger hole; 25 inches of reddish, silty sand and fine gravel on 12 inches clayey silt.
23	185	Auger hole; 14 inches of gray-green Presumpscot Formation clay.
24	180	Auger hole; 24 inches of gray-green silty Presumpscot Formation clay fining downward into clay.
25	200	Auger hole; 48 inches of fine to coarse, reddish yellow sand with interbeds of gray clayey-silt at 38 inches.

APPENDIX C. CONTINUED.

Site No.	Elevation (Feet a.s.l.)	Materials Description
26	210	Auger hole; 30 inches of fine to coarse sand with interbeds of gray, silty sand at 13 inches.
27	210	Auger hole; 20 inches of oxidized sand with lenses of gray silt. Near moraine ridge oriented S75°E.
28	200	Auger hole; 14 inches of gray, silty sand.
29	230	Auger hole; 12 inches brown, silty sand on 16 inches yellowish-brown, sandy-clay. Unable to penetrate past 28 inches.
30	230	Auger hole; (on moraine ridge oriented S40°W), 30 inches coarse sand and gravel, fining to silt near base. Unable to penetrate past 30 inches.
31	200	Auger hole; 24 inches sand and gravel grading downward into brown, sandy-clay.
32	215	Auger hole; 26 inches brown, sandy clay. Unable to penetrate past 26 inches.
33	-----	Buxton Landfill
34	-----	Buxton Landfill
35	225	Auger hole; 18 inches of brown sand and gravel.
36	210	Auger hole; 22 inches of dry, silty and sandy clay. Unable to penetrate past 22 inches.
37	210	Auger hole; off driveway to pit 88TH; 20 inches of silty to sandy gravel with some clay near the surface.
38	225	Excavation; 0-3 feet coarse, yellow sand with occasional boulders.
39	150	Auger hole; 14 inches of wet, gray-green Presumpscot Formation clay.
40	150	Auger hole; 20 inches of brown, clayey silt grading downward into 10 inches of dry silt over 10 inches of silty clay.
41	145	Auger hole; 18 inches of greenish-gray silty clay with boulders or cobbles at 18 inches.
42	140	Auger hole; 12 inches of clayey silt. (increasing amount of sand and cobbles between 42 and 43).
43	170	Auger hole; 18 inches of clayey-silt, becoming hard and dry around 18 inches.
44	185	Auger hole; 16 inches of reddish-brown silt over 26 inches of upward-fining silt and gravel. Boulders or cobbles at 42 inches (Cobbles exposed between 44 and 43).
45	175	Auger hole; 20 inches of silty clay, increasing in sand content with depth.
46	200	Auger hole; 14 inches of silty clay.
47	210	Auger hole; 6 inches of sandy clay over 5 inches clayey silt grading into 10 inches of interbeded sandy clay and clay.
48	185	Auger hole; 12 inches of interbedded sandy clay and silty clay on 10 inches of gray green, silty clay.
49	230	Auger hole; 25 inches of reddish-brown sand and gravel over 5 inches of gravelly sand. Cobbles at 30 inches.
50	130	Auger hole; 4 inches of clayey silt grading to 18 inches of gray-green silty clay.
51	180	Auger hole; 10 inches of silty, black sand over 14 inches of red sand and gravel. Cobbles at 24 inches.
52	110	Auger hole; 11 inches of clayey silt over 10 inches of coarse sand and gravel.
53	210	Auger hole; 24 inches of poorly sorted, coarse sand over 4 inches of coarse gravel and sand.
54	190	Auger hole; 9 inches of reddish-brown, clayey silt over 16 inches of tan, clayey sand to sand.
55	170	Auger hole; 12 inches of black, sandy gravel fining to clayey silt at 34 inches.
56	160	Auger hole; 16 inches of clayey sand and gravel over 14 inches of silty clay.
57	170	Auger hole; 5 inches of sand and gravel over 4 inches of clayey sand grading into silt at 20 inches.
65	110	Auger hole; 21 inches of reddish-brown clay with coarse gravel over 5 inches of yellow silty-clay and gravel.
66	100	Auger hole; 20 inches of gray-green, silty clay.
67	225	Auger hole; 30 inches of yellow-brown, fine to coarse sand over 18 inches of gravelly sand.
68	160	Auger hole; 14 inches of gray, silty clay.
69	280	Bedrock; crescentic gouge oriented S9°W.