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Surficial Geology of the Prouts Neck 7.5-minute Quadrangle, Cumberland and York Counties, Maine

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INTRODUCTION

Surficial mapping in the Prouts Neck 7.5' quadrangle was conducted during the summer of 1987, as part of a COGEOMAP program of the Maine Geological Survey and the United States Geological Survey. The purpose of this cooperative program is to provide detailed surficial geologic information for the Coastal Lowlands geomorphic province, an area undergoing rapid urban growth due to its proximity to Portland, Maine, and its popularity as a residential area for commuters working in the Boston metropolitan area. For each quadrangle mapped as part of this program, two 1:24,000 maps are prepared, a surficial materials map (Clinch and Thompson, 1999b) which shows the thickness, composition, and interpreted origin of surficial materials at points where surface and subsurface observations were made, and a surficial geologic map (Clinch and Thompson, 1999a) showing the distribution of geologic units and (where possible) features that record the geologic history of the quadrangle.

In this report, the surficial deposits mapped in the Prouts Neck quadrangle are described in detail, and the glacial and postglacial history of the quadrangle is presented. An appendix is also included, which describes the surficial materials detected in a large number of subsurface test borings made as part of site investigations for sewers and highways in the Borough of Scarborough, the largest city within the quadrangle. Due to the quantity of subsurface data, the distribution of most of the mapped units is well constrained, and the geologic history interpreted from these deposits is also well understood. However, all of these interpretations must still be regarded as tentative, since detailed subsurface data is not available everywhere.

PREVIOUS WORK

Surficial deposits in the Prouts Neck quadrangle were mapped by Thompson (1976a) based on reconnaisance mapping and examination of active gravel pits, and by Smith (1980), who relied chiefly on air photo interpretation. These data were used to prepare the Surficial Geologic Map of Maine (Thompson and Borns, 1985a).

Information concerning the composition and origin of glacial and postglacial deposits in the region is given in Bloom (1960, 1963); Smith (1982, 1984, and 1985); Stuiver and Borns (1975); Thompson (1982); Thompson and Borns (1985b); and Belknap and others (1987). Five quadrangles south and west of the Prouts Neck quadrangle have been mapped as part of the COGEOMAP program, including Dover East (Smith, 1999a,b), Portsmouth (Smith, 1999g,h), York Harbor (Clinch and O'Toole, 1999a,b), York Beach (O'Toole and Clinch, 1999c,d), and Kittery (O'Toole and Clinch, 1999a,b). In addition, Smith (1977, 1999c-f,i,j) and Neil (1999) have mapped the four 7.5 minute quadrangles of the Kennebunk 15 minute quadrangle, and detailed mapping for the COGEOMAP program is being conducted in the other nearby quadrangles shown in Figure 1. Information obtained from these detailed maps was useful in interpreting the deposits and stratigraphic relationships observed during this mapping.

The elevation of glacial-marine deltas and other marine limit indicators were measured and reported by Thompson and others (1989), and the upper limit of the postglacial marine transgression was interpreted from these data. While no data were available from the Prouts Neck quadrangle, a marine limit eleva-

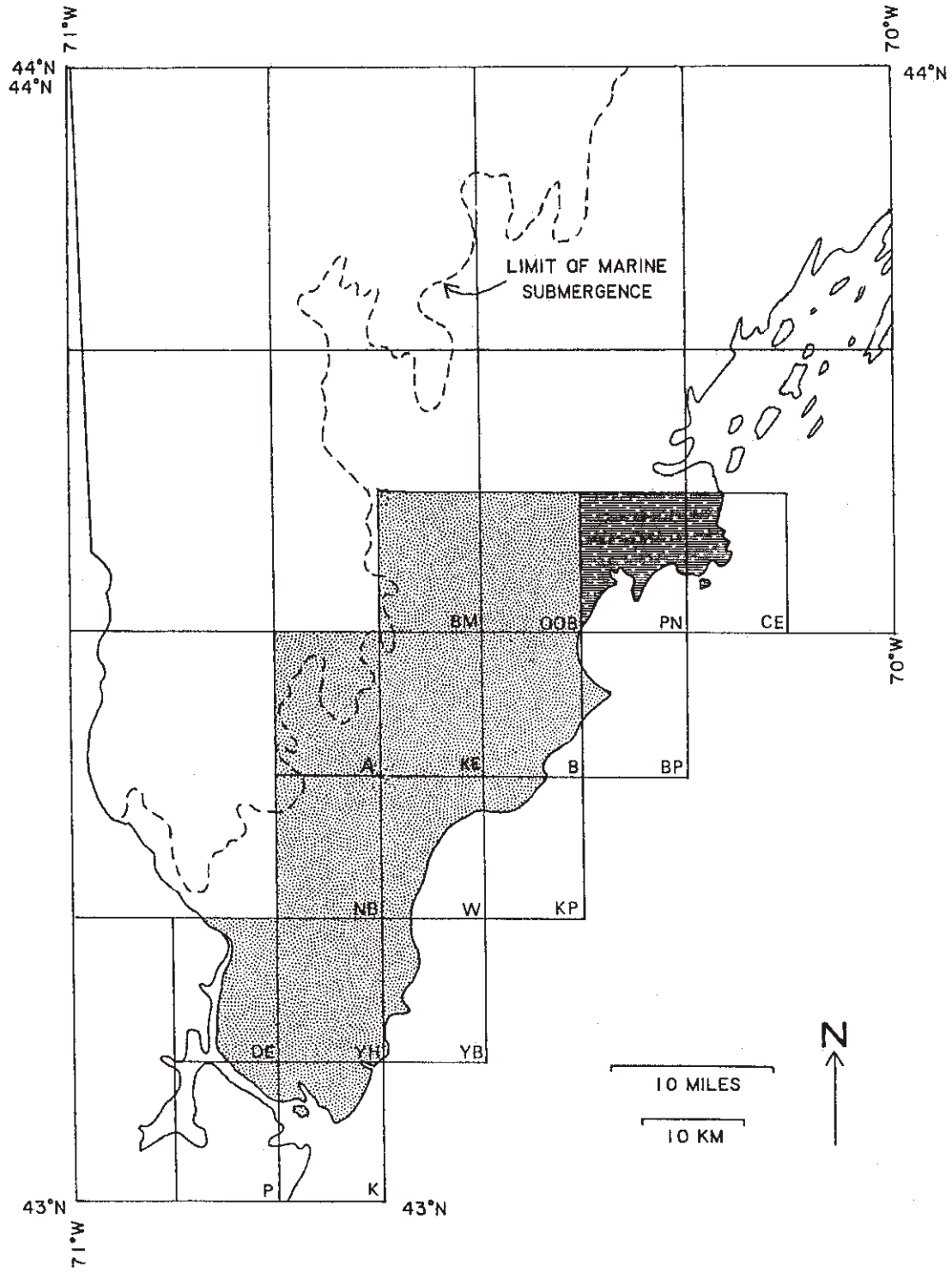

Figure 1. Location map, showing the Prouts Neck and Cape Elizabeth quadrangles (lined pattern). Other quadrangles mapped in detail through 1987 are shown in the dot pattern. Quadrangle names are as follows: A - Alfred, BM - Bar Mills, B - Biddeford, BP - Biddeford Pool, CE - Cape Elizabeth, DE - Dover East, KE - Kennebunk, KP - Kennebunkport, K - Kittery, NB - North Berwick, OOB - Old Orchard Beach, P - Portsmouth, PN - Prouts Neck, W - Wells, YB - York Beach, YH - York Harbor.

tion of 240 to 260 feet is estimated from data in nearby areas. This reconstruction indicates that the entire Prouts Neck quadrangle was flooded during glacial retreat, and that all of the ice-marginal deposits within the quadrangle were formed in a submarine environment at or beneath a calving glacier margin.

LOCATION AND TOPOGRAPHY

The Prouts Neck quadrangle extends from 43 30'N to 43 37'30"N and from 70 15'W to 70 22'30"W, and covers an area of 54 square miles, of which approximately 30% is covered by the ocean. The quadrangle is located on the coast of Maine at the border of York and Cumberland Counties and includes portions of Old Orchard Beach, Scarborough, Cape Elizabeth, and South Portland. This area is immediately south of Portland, the largest city in Maine, and is the site of rapid development.

Elevations within the study area range from sea level to a maximum elevation of 176 feet a.s.l. on Barren Hill, in the northeast corner of the quadrangle. The maximum local relief is approximately 130 feet, between the Dunstan River and the summit of Scottow Hill, along the western border of the quadrangle. However, large portions of the quadrangle have only low local relief, while other areas are virtually flat.

Areas of higher elevation and higher topographic relief are concentrated along the coast between Scarborough Beach and Higgins Beach, and in the northeast corner of the quadrangle, where several northeast-southwest trending bedrock ridges are present, with only a thin covering of till and reworked material. Scattered bedrock knobs such as Oak Hill, Scottow Hill, and Hunnewell Hill are located inland from the coastal belt of ridges, and the intervening lowlands are covered by Quaternary deposits, occasionally up to 100 feet thick.

Most of the quadrangle is drained by tributaries of the Scarborough River, including the Dunstan, Nonesuch, and Libby Rivers. The lower reaches of these rivers have been drowned during Holocene marine transgression, and they are now estuaries occupied by salt marshes. Small areas in the northeastern corner of the quadrangle are drained by the Spurwink River, another estuarine system, and by Trout Brook, which drains northward into Portland Harbor. Large areas of the quadrangle are poorly drained due to the low local relief and the presence of Presumpscot Formation marine silty clays in the lowlands, and are now occupied by wetlands.

BEDROCK GEOLOGY

The distribution of bedrock units in the Prouts Neck and neighboring Cape Elizabeth quadrangles was mapped by Hussey (1985). Bedrock exposed within the region includes a variety of metamorphic lithologies of the Casco Bay Group. The formations of the Casco Bay Group and gross lithologies of each unit are (Hussey and others, 1986):

Macworth Formation - (uppermost unit) fine grained, slightly calcareous and feldspathic, thinly laminated gray granofels with sporadic thin beds of metafelsite tuff and coarse granule beds.

Jewell Formation - rusty and non-rusty weathering, gray phyllites with minor greenish gray chlorite phyllite.

Spurwink Metalimestone - thin, ribbon bedded, gray impure marble and quartz-biotite-plagioclase granofels.

Scarboro Formation - rusty and non-rusty weathering, gray phyllites with minor greenish-gray chlorite phyllite, lithologically identical to the Jewell Formation.

Diamond Island Formation - rusty weathering graphite-quartz-muscovite phyllite with tissue-thin quartz laminae parallel to foliation.

Spring Point Formation - a varied sequence of mafic metavolcanic, metasedimentary and felsic metavolcanic rocks, metamorphosed from chlorite grade (chlorite-spessartitic garnet phyllite) to garnet grade (biotite-actinolite-plagioclase gneiss).

Cape Elizabeth Formation - thin-bedded quartz-plagioclase-biotite phyllite, schist, or gneiss, metamorphosed from chlorite to K feldspar-sillimanite grade, with interbeds of metapelite, rusty phyllite and schist.

Cushing Formation - (lowest unit) felsic to intermediate metavolcanics and medasedimentary rocks with lesser mafic metavolcanics, calc-silicate granofels, marble, and sulfidic schist.

The Casco Bay Group is dated as Precambrian to Ordovician(?) in age. These units have undergone one major deformation which produced north-northeast trending upright folds with gentle plunges. Evidence for an earlier stage of deformation is locally observed in the Cape Elizabeth Formation, but has not been observed in the other units. Bedding, differential weathering along more easily erodible lithologies, and structural features all impart a strong northeast to southwest trending grain to the topography, clearly visible in the bedrock ridges in the eastern half of the quadrangle.

INVESTIGATION PROCEDURE

Exposure of surficial deposits within the Prouts Neck quadrangle is poor and has deteriorated since earlier mapping by Thompson (unpub. notes). Few natural exposures exist, due to the lack of substantial erosion by the low gradient rivers. The best exposures were located in active and inactive gravel pits scattered throughout the quadrangle, but the majority of these pits have been either exhausted and abandoned, or else have been graded and covered by housing developments. The only remaining large active pit, the Prouts Pit along Black Point Road, has now been excavated well below sea level, and in the near future the pit walls will be graded and the pit will be operated solely by dredging.

In addition, wave activity during the Pleistocene marine recession has reworked sediments exposed on hill crests and slopes and produced a blanket of sand and gravel several feet thick over virtually all areas not covered by Presumpscot Formation clays or Holocene deposits. This sand and gravel blanket completely masks the presence of underlying units in shallow shovel excavations, auger holes, and even some shallow foundation excavations. This wave activity has also smoothed the topography of many of the Pleistocene deposits to such an extent that deposit morphology cannot be used reliably to infer the distribution of glacial deposits or interpret the recessional history of the glaciers that occupied this area.

Finally, the majority of elevated locations have been developed, including virtually all sites underlain by submarine fans or end moraines. The sites which have not been modified by culture are usually those flats underlain by Presumpscot Formation silty clays or by wetlands, which are less suitable sites for residential development.

These three factors severely limit the amount of field exposure of glacial and glaciofluvial deposits. Therefore, field work was largely limited to observation of the few active gravel pits and mapping of the location of exposed bedrock outcrops and the distribution of Presumpscot Formation marine sediments, Pleistocene alluvium, and Holocene wetlands and beach deposits. The remaining areas were assumed to be either Wisconsinan till and/or submarine fan deposits, but the true composition and distribution of these deposits could not be accurately determined.

Fortunately, a considerable body of subsurface data was available for this quadrangle, due to the construction of an extensive sewer network within Scarborough. The first sewer line was constructed in 1976, and served only the Oak Hill area. A limited number of test borings were made along the main outfall line, and numerous probes to refusal were made along the residential streets south of Route 1. During construction of other segments of the sewer network, from 1977 to the present, a large number of test borings were made, often to considerable depth. A summary of the original drill logs are found in Appendix A, together with a geologic interpretation of the units detected. Data were also included from test borings along the I-295 connector, obtained from the Maine Department of Transportation Scarborough office.

The availability of this subsurface data means that the glacial and glaciofluvial deposits can be easily detected, mapped, and differentiated, and that the glacial history of the region can be determined in more detail. This data also introduces some complications in mapping, as at least some of the submarine fan deposits detected in the subsurface data are buried by significant, mappable thicknesses of other, postglacial deposits, including Presumpscot Formation marine clays, Pleistocene and Holocene beaches, and Holocene wetlands. Thus, a true surficial geologic map could only be compiled by eliminating units important in elucidating the geologic history, while a map which shows all of the ice marginal deposits needed to explain the geologic history would not reflect the composition of the material actually found at many sites.

For this map, a compromise philosophy was adopted. In all cases where the surface topography and morphology suggests that submarine fans and/or moraines are present (for example, the proximal portions of fans present along Black Point Road southeast of Scarborough) the glacial deposit was mapped, even when several feet of marine clay or offlap sands are present. Where no surface topography is present, a sandwich symbol was used (e.g. Pms/Pempn, Pleistocene marine shoreline deposit overlying the Prouts Neck end moraine). The generalized composition and thickness of materials overlying the mapped unit is given in the unit descriptions, and the specific data obtained at each observation site is given on the surficial materials map and in the appendix.

The surficial geologic map was prepared by plotting all contacts mapped in the field and adding the point data from the sewer and road borings. This data was supplemented by contacts inferred from analysis of stereo photographs, which were chiefly useful in refining the limits of units first detected from the subsurface data and resolving the locations of terrace scarps in wooded areas. A number of presumed ice marginal deposits were also inferred from the air photos, including probable De-Geer moraines in wooded areas on the flanks of Hunnewell Hill, and possible moraines or submarine fans in the swampy flats adjacent to Rigby Yards, in South Portland. These inferred ice marginal deposits have little, if any, topographic expression, and show up as light colored (presumed well-drained) areas surrounded by darker colored, saturated areas underlain by Presumpscot Formation clays. All units mapped as end moraine/submarine fan deposits solely from air photo interpretation are parallel to other, better established ice-marginal positions and are consistent with mappable margins northeast and southwest of these positions.

Due to the large number of mappable ice-marginal deposits present within the quadrangle, and the correlations between these ice margins that can be supported, the deposits were mapped as morphosequences (Koteff, 1974; Koteff and Pessl, 1981). Successive submarine fans and end moraines along the inferred ice flow direction within a limited geographical area were given a single geographic name and differentiated by number (e.g. the submarine fans along Black Point Road southeast from Scarborough Center, $Pmfsc_1$-$Pmfsc_5$). Since correlations were often made from deposit to deposit by reasonable reconstruction of the ice margin parallel to better constrained ice margins, and not because the deposits are continuous, the same name was not used along any single ice margin, so that the correlation can be changed should new information require such a change. The correlations made between mapped deposits are indicated by the dashed ice margin lines on the map, and by the correlation chart shown in Figure 3. End moraines and submarine fans mapped in the Cape Elizabeth quadrangle, immediately east

of the Prouts Neck quadrangle, were also assigned unique names based on their geographic location and origin, and are included on the correlation chart. Finally, two marine fan deposits located in the quadrangles north of the mapped area were also included.

Wetlands boundaries for this quadrangle were mapped in part by Cornelia Cameron, U. S. Geological Survey. Additional information concerning the distribution of wetlands deposits was provided by inspection of the National Wetlands Inventory Map of the Prouts Neck quadrangle, prepared by the Office of Biological Services, U. S. Fish and Wildlife Service, Department of the Interior. Unit contacts were modified from this mapping by field observations and by air photo analysis.

SURFICIAL DEPOSITS

The composition and distribution of the mapped units is listed below. The descriptions are based primarily on field observations, supplemented where necessary with test boring data.

Bedrock

Bedrock (mapped as rk) has been mapped solely along the modern shoreline, where it is exposed either in cliffs up to 20 feet high, or as wave-cut marine terraces at the base of these cliffs, which are emergent at low tide. Striated bedrock surfaces are exposed in the floors of several abandoned gravel pits, near the crest of Blue Point Hill, and on the flanks of Scottow Hill, Pleasant Hill, and Sandy Hill. Minor outcrops are present near the crests of many of the bedrock ridges covered by thin drift, and these are shown by a pattern on the surficial geologic map.

Thin Drift Areas

Most hillslopes at elevations greater than 20 feet along the coastline to 60 feet near the northwest corner of the quadrangle are underlain by less than ten feet of surficial material over bedrock, shown by the horizontally ruled pattern over areas mapped as Pt (Pleistocene till). These areas were mapped in the field on the basis of the abundance of bedrock outcrops, supplemented by test boring data, but the chief criterion used to determine the limits of this unit was whether or not the underlying bedrock structure was visible on the air photos. The dominant surficial lithology within these areas is till, with lesser amounts of Presumpscot Formation clays and marine nearshore sands. Till exposures are most common on ridge crests and consist of diamictons with a silty-sand matrix. These diamictons are cobbly to bouldery, often with a cobble to boulder lag at the land surface, indicative of winnowing by wave activity during marine recession. Thin layers of Presumpscot Formation marine silty clays overlie till in hollows and depressions. On steeper slopes, both the till and the Presumpscot Formation are overlain by thin (2-5 ft) sands and gravels, interpreted as nearshore deposits formed during marine recession when the till matrix was eroded by wave activity. Small bedrock outcrops and larger areas of numerous small outcrops are present near the crest of many ridges and hills. These are indicated by solid black areas on the map.

Wisconsinan Till

Till (mapped as Pt) was detected in numerous subsurface borings and at a limited number of surface exposures. While till commonly covers areas mapped as thin drift, the only sites where thicknesses greater than ten feet were mapped are northwest and southeast of Blue Point Hill. Here, as at exposures in the thin drift areas, there is a surface lag near hill crests, and the lower slopes are covered by a thin layer of reworked beach sand. Till in subsurface test borings is typically described as gravelly silty sand or poorly sorted sand and gravel with trace (0-10%) or little (10-20%) silt. Typically, till is present immediately overlying bedrock, or weathered bedrock. No diagnostic exposures of till were observed, so that no unequivocal interpretation of the till facies could be made. However, the high blow count needed to penetrate till in test borings suggests that the till is highly consolidated, indicative of lodgment till. There is no evidence to suggest that there are multiple tills formed during different glaciations within the quadrangle, and all of the tills are assumed to be Late Wisconsinan in age.

Tills were also detected in subsurface borings near the proximal limit of many of the marine fans, underlying, interlayered with, and overlying coarse sand and gravel. These were described in a variety of ways in the original logs, none of which are diagnostic of any particular origin. However, the topographic distribution of the tills detected, and their relationship to the submarine outwash sediments suggest that these tills are formed from remobilized sediments on the proximal face of the submarine fans, deformed and emplaced during minor readvances of the glacier. Flowtills have been described in submarine fans in southeastern Maine by other workers, but none were observed in the Prouts Neck quadrangle.

End Moraines

End moraines have been mapped in numerous locations throughout the quadrangle, chiefly on the basis of air photo analysis. Uncorrelated end moraines have been mapped as Pem, while those that can be correlated to other nearby ice marginal deposits are assigned a local geographic name, and a five letter designation consisting of a single-letter age designator (P, for Pleistocene), “em” for end moraine, and a two-letter location designator (eg. sr for Spurwink River). Several moraines in the same area are differentiated by numbers. Typically, these moraines are located on the flanks of bedrock knobs, adjacent to large areas underlain by Presumpscot Formation clays. This dis-

tribution may reflect the preservation of the moraines and not their original distribution. It is likely that if moraines were formed across elevated bedrock knobs, they would have been completely reworked during the marine recession, when wave activity winnowed the till that covered these knobs and formed the blanket of nearshore sands found on the slopes of these knobs. End moraines are probably also present beneath the submarine outwash fans and Presumpscot Formation clays, but these moraines are now covered and hidden.

Most of the end moraines mapped are small, with heights of no more than 10-15 feet, widths of approximately 100 feet, and exposed lengths of approximately 1000 feet. The internal structure of these moraines in the Prouts Neck quadrangle is unknown, since no exposures are present within them. Smith (1982), Smith and others (1979), and Jong (1980) have described the internal structure of similar moraines in coastal areas of Maine and have noted that most exposed moraines consist of interbedded pebble to cobble gravels and fine to coarse sand, intensely deformed by ice-push. These moraines are usually overlain by Presumpscot Formation clays and nearshore sands. In the Prouts Neck quadrangle, all moraines were mapped on the basis of morphology; and the composition of the overlying sediments that partially masked the moraines was ignored.

A group of larger moraines (the Pleasant Hill, Rigby Yard, and Fogg Road end moraines, $Pemph_{3\text{-}8}$, $Pemry_{1,\,2}$ and Pemfr) were mapped in the flats northeast of Pleasant Hill Road from near the intersection of Pleasant Hill and Fogg Roads to immediately northwest of Route 1 in the Sunset Park development. A single moraine (the Spurwink River end moraine, Pemsr) was mapped along Route 77 near Spurwink Church. These moraines are 20 to 40 feet high and 400 to 600 feet wide, and individual moraine segments along a single ice margin can be traced for 1500 to 2000 feet. A similar moraine in the Cape Elizabeth quadrangle which correlates to the Spurwink River end moraine can be traced for approximately a mile, and the ice margin defined by the two moraine segments can be traced for approximately two miles. The only exposure of these moraines is located in $Pemph_7$, immediately south of Route 1. Here, a badly slumped face in an abandoned gravel pit suggests that the bulk of the moraine is composed of bedded sand and cobbles, overlain on the ice proximal face by a thin bouldery diamicton. Similar stratigraphic relationships are suggested by multiple smaller exposures in the Spurwink River end moraine, where thick sand and gravel is present in abandoned gravel pits south of Route 77, while at least four feet of massive, sandy-matrixed till is exposed in grave excavations at Riverside Cemetery on the proximal face of the end moraine.

Most of the end moraines trend northeast to southwest, parallel to the regional trend for moraines, but minor variations in the moraine trend suggest that the retreating glacier was pinned laterally on bedrock knobs. This is well demonstrated by the trend of the Spurwink River end moraine and the correlative Great Pond end moraine in the Cape Elizabeth quadrangle. Over the entire length of the ice margin, the moraine trend is northeast to southwest, but locally the trend is controlled by bedrock knobs, so that the Spurwink River end moraine trends northwest to southeast. This pattern of moraine trends is typical of calving ice margins in a marine environment.

The final end moraine mapped is the Prouts Neck end moraine, detected solely in subsurface test borings along Prouts Neck. Till was detected in most of the test borings on the ice-proximal side of the feature and along Spurwink Road, while submarine outwash was detected beneath private side roads southeast of the main road. These sediments are overlain by Presumpscot Formation clays and by thick sands interpreted as a Pleistocene beach and dune complex.

Submarine Outwash Fans

Submarine outwash fans have been mapped in several locations in the Prouts Neck quadrangle. Like the end moraines, each of these fans or groups of fans were assigned a local geographic name to aid in correlation of ice marginal positions. On the map, a five letter designator was used, consisting of a single capitalized letter (P) indicating the unit age (Pleistocene), two letters (mf) designating the feature a submarine fan, and two letters indicating the geographic location of the unit. Multiple fans developed in sequence in a limited topographic area were assigned the same letter designation and are differentiated by numbers. In addition, when submarine outwash was detected beneath significant thicknesses of younger deposits, a sandwich symbol was used, recording the composition of the overlying unit above the line, and the identity of the underlying fan. When it could not be clearly established which of the fans is covered by the younger deposits, the submarine outwash is simply designated as Pmf. All marine fan deposits mapped are composite units and include not only sand and gravel, but also significant amounts of till at the proximal margin of the fan, thick layers of Presumpscot Formation silty clay interbedded with and overlying the submarine fan sand and gravel, and a surface blanket of nearshore deposits reworked from the underlying materials by wave activity during marine regression.

These submarine fans are thought to consist of fluvial debris transported in subglacial tunnels and deposited at the ice margin at the mouths of these tunnels. No eskers have been mapped in the Prouts Neck quadrangle, but openwork cobble gravels interpreted as eskers were occasionally detected near the apex of some fans in test borings, and esker-fed deltas are commonly found near the marine limit. The majority of these fans are located adjacent to bedrock knobs, which would have been favorable sites for deposition at a calving ice margin, as subglacial tunnels tend to migrate towards these knobs where the ice thickness is less. Other fans, most notably those southeast of Scarborough along Black Point Road, have no obvious relationship to the bedrock topography, although operators of a sand and gravel pit in one of these fans have reported detecting a bedrock knob in a pit wall, which has since been covered when the pit wall was graded. Unpublished mapping by the senior author at modern

marine glacier termini suggests that fans and deltas the size of those found in the Prouts Neck quadrangle can form in as short a time as a decade.

The stratigraphy within the submarine outwash fans is complex. The best exposure within a submarine fan is located in the Prouts Pit, a large sand and gravel pit located approximately 0.6 miles southeast of Scarborough. This pit has been excavated below the local water table. The pit operators have reported openwork cobble gravel from a zone in the center of the pit, interpreted as a possible esker, located at the apex of the fan. The pit wall on the northeast side of the pit exposes several distinctive units, including: (1) till, (2) submarine outwash, (3) Presumpscot Formation, and (4) recessional beach deposits.

(1) The pit floor at this site and the lowest 10 feet of the pit wall are formed by a compact, sandy to silty-matrixed till with abundant striated stones. The till has no apparent fabric or fissility, and occasional sand lenses are preserved in an otherwise massive till. The composition and structure of this unit suggests that the till may be a basal melt-out till formed in a marine environment near the grounding line of the glacier. Local irregularities in the contact between the till and overlying gravel suggest that the till may have been deposited as minor DeGeer moraines now buried by the sand and gravel.

(2) The till is interbedded with, and overlain conformably by, up to 2 feet of coarse pebble to cobble size, clast-supported gravel, containing occasional striated clasts. This unit is overlain conformably by approximately 15 feet of bedded fine to coarse sand, with occasional half-inch clay seams. Individual sand layers are planar-bedded, but channel cut-and-fill features up to 2 feet thick are common. Beds pinch and swell over 100 feet of exposure, recording a shifting locus of fluvial or submarine sedimentation. Minor folds and thrust features are preserved, suggesting the presence of active ice nearby. These beds are gradationally overlain by 4 feet of thick fine-sand layers interbedded with one-inch layers of silty clay, then by 6 feet of thin to thick (6 inch) layers of laminated silty clay, with occasional angular dropstones, interbedded with thin sand layers. This uppermost unit is interpreted as the distal portion of the submarine fan complex, where sand is only occasionally deposited and which is interbedded with the Presumpscot Formation silty clay. When units similar to this were detected in test borings, they were interpreted as distal submarine outwash.

(3) The interbedded sand and silty clay are conformably overlain by a variable thickness of laminated to massive silty clay which drapes over the underlying units, filling depressions and smoothing the topography. In localized zones and layers the lamination is contorted, indicating soft-sediment deformation. A prominent shelly horizon is exposed here and in other nearby pits. This unit is part of the Presumpscot Formation, a marine clay deposited immediately following ice retreat.

(4) The exposure is capped by a thin (3-5 feet) layer of poorly sorted silty sand and gravel, overlying both the Presumpscot Formation silty clays and the underlying sand and gravel above an erosional angular unconformity. This unit is crudely laminated, parallel to the land surface, and contains incorporated blocks of the underlying material in its base. The unit is interpreted as a reworked blanket of the underlying material, formed by wave activity during marine recession. It is called a nearshore deposit.

Test borings in other submarine fans indicate that this stratigraphy is typical of the fans, and that the units detected not only reflect the vertical stratigraphy at any one point, but also the lateral composition of the fan, with finer-sized sands and more abundant silty clay layers at increasing distance from the apex of the fan. Test borings also detected layers of till interbedded with coarse sand and gravel, and capping the proximal face of many of the fans, including the Pleasant Hill marine fans ($Pmfph_{1-3}$) and several of the Scarborough Center marine fans (Pmfsc). These tills could not be observed at the Prouts Pit exposure, as they are probably present only beneath a cemetery at the western limit of the pit, so that they will never be exposed. Thus, no genetic interpretation of these tills is now possible.

Idealized cross sections of a typical large end moraine and submarine fan are shown in Figure 2. The composition and structure of the submarine fans is similar to that of the larger end moraines. Till occurs only in the proximal parts of these features, and the bulk of the sediment is composed of sand and gravel. The distinction between the features is probably arbitrary and was made here primarily on the basis of the form of the outcrop and subcrop pattern; linear features were called end moraines, while more elliptical to equant features were called submarine fans. In many cases, end moraines were mapped adjacent to prominent marine fans, and the boundaries between them are arbitrary.

Presumpscot Formation

Thick silts and clays of the Presumpscot Formation (mapped as Pp) underlie virtually all of the low-relief areas of the quadrangle. Test borings and direct observations in gravel pit exposures indicate that the clays disconformably overlie till and bedrock, and are interbedded with and conformably overlie end moraine and submarine fan deposits, as was previously discussed. The Presumpscot Formation consists of massive to laminated silty clays, with rare ice-rafted clasts. Fossiliferous shell horizons were observed in several gravel pits, approximately 5 feet above the highest sand layer. Unoxidized Presumpscot Formation clays have a blue-gray color and are characterized by their low bearing capacity; in many places, probes through unweathered Presumpscot Formation can penetrate the clay simply due to the weight of the hammer placed atop the probe. Weathered Presumpscot Formation is an oxidized olive gray to green color and has a higher bearing capacity and resistance to penetration. Wells and test borings indicate that the maximum thickness of the clays may be over 100 feet.

The Presumpscot Formation consists of silts and clays delivered to the glacier terminus by subglacial fluvial activity. Coarser sand and gravel was deposited at the mouths of these tunnels as submarine fans, while the finer silt and clay were

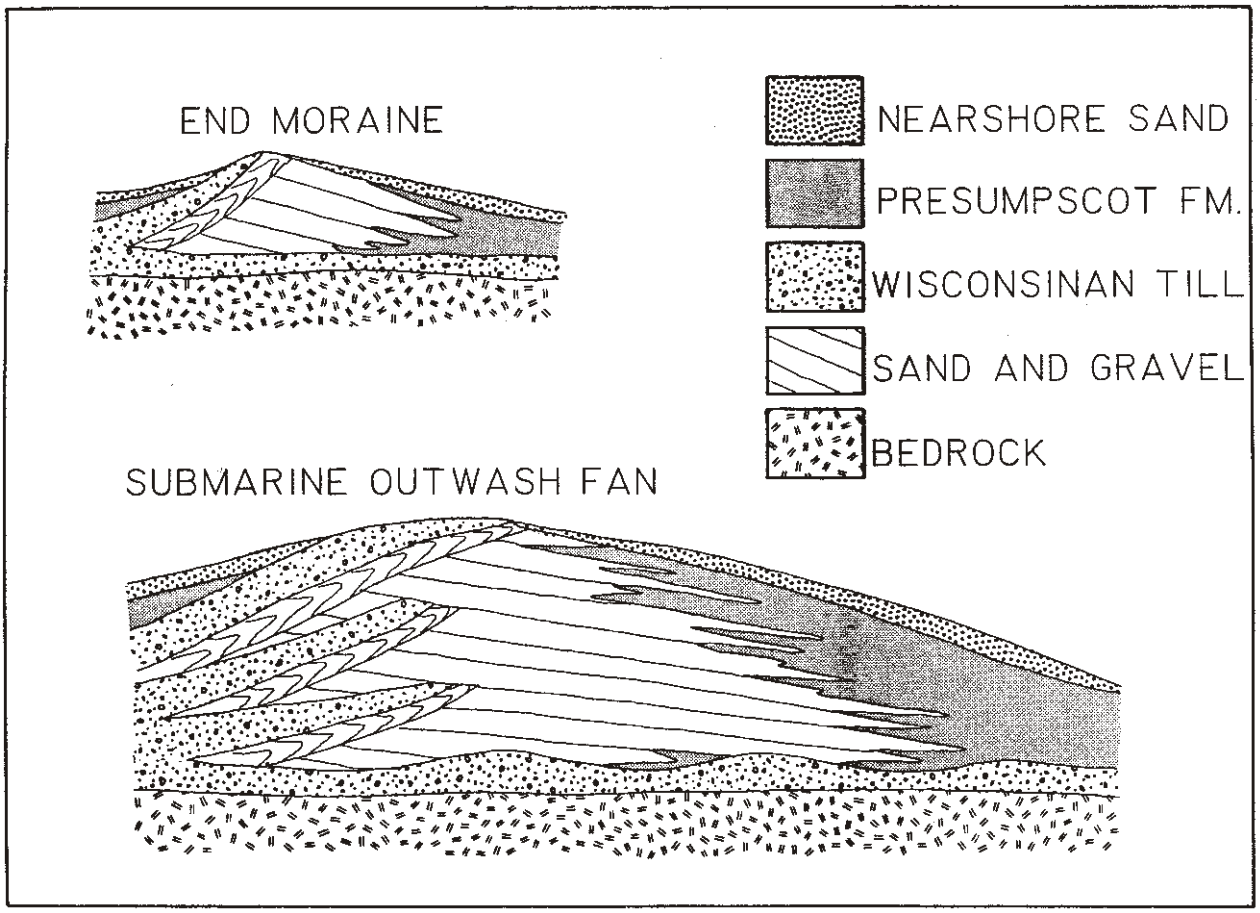

Figure 2. Idealized cross sections of the larger end moraines and submarine outwash fans in the Prouts Neck quadrangle, based on pit exposures and subsurface test boring data. This illustrates how similar the two types of deposits are.

transported farther from the ice margin, where they eventually settled out as blankets of marine clay that preferentially infilled topographic lows and covered all but the steepest slopes.

Nearshore Deposits

Following deposition of the Presumpscot Formation, all surficial materials were winnowed and reworked by wave activity during marine recession. This reworking is recorded by a thin to thick blanket of reworked sand, sand and gravel, or silty sand , mapped and interpreted as nearshore deposits (Pmn), which covers virtually all hillslopes and the flats adjacent to these hillslopes. This layer is detected in virtually all natural exposures and test borings, as noted in the logs appended to the surficial materials map, but it was only included on the surficial geology map where it completely obscures and masks the older, ice-contact deposits.

While these deposits are the result of wave activity along or near ancient shorelines, they are not mapped as beaches, because they are not associated with definite beach morphology. Beach morphology related to a Pleistocene shoreline is possibly preserved at only one site, on Prouts Neck, where thick beach and dune sands are present atop a buried end moraine at elevations above modern shoreline deposits. This area has been mapped as a Pleistocene beach developed on the end moraine (Pms/Pempn).

Pleistocene Alluvium

A thin to thick sand layer, mapped as either Pa or Pa/Pp depending on the preserved thickness of the sand, unconformably overlies the Presumpscot Formation on several terrace levels on either side of the Nonesuch River. Exposures in this sand layer at a terrace scarp near Nonesuch Cove show prominent fluvial cross-beds. This unit is interpreted as Pleistocene alluvium of the Nonesuch River, deposited during the marine recession following deposition of the Presumpscot Formation. These sands have been removed by erosion from lower, cut terraces.

Similar sand sheets have been described along the course of other major rivers in southern Maine, including exposures along the Piscataqua and Salmon River (Smith, 1999a,b,g,h), and in the Kennebunk 15' quadrangle (Smith, 1977). A lithologi-

cally similar deposit, the Embden Formation, has been mapped along the Kennebec River, and a similar origin for this deposit has been proposed.

HOLOCENE ALLUVIUM, ESTUARINE SEDIMENTS, AND WETLANDS DEPOSITS

Holocene wetland deposits have been mapped over a large portion of the quadrangle. The largest wetlands are the salt marshes developed in the drowned estuaries along the Scarborough and Spurwink Rivers and their tributaries. Test borings across these marshes indicate that the Presumpscot Formation silty clays exposed in the scarps fringing the salt marshes were removed by fluvial erosion to a depth of at least 20 feet below sea level, during a relative low stand of sea level. During the subsequent marine transgression, these rivers were drowned, the valleys were filled by estuarine sands and muds, and the salt marshes developed atop these estuarine sediments.

Wetlands also occupy the upper reaches of the tributaries to the Scarborough River, upstream from the influence of salt water. Test borings across these swamps reveal a history similar to that of the salt marshes; an episode of downcutting below the modern river grade followed by a period of aggradation and development of swamps and marshes.

Other wetlands are present atop the wide, undissected flats underlain by the Presumpscot Formation silty clays and are the result of poor drainage caused by the low permeability of these clays. Soil saturation occurs intermittently or seasonally at virtually all of these sites, but the only swamps mapped on the surficial geologic map are those where the soil is continually saturated. The distribution of these wetlands is strongly controlled by local drainage patterns; as the edges of the largest swamps are often defined by terrace scarps and eroded stream channels cut into the Presumpscot Formation flats.

All wetland deposits were distinguished on the basis of whether the water in these areas is brackish or salt (salt marshes, Hwsm), or fresh (all other wetlands), and by the vegetation present in these areas: grasses and sedges (salt marshes, Hwsm, and freshwater marshes, Hwfm); bushes and scrub brush (heaths, Hwh); or trees (swamps, Hws). Suffixes are used to describe the abundance of peat in the wetlands, with p designating over 5 feet of commercial quality peat (ash content less than 25%, dry basis), t designating less than 5 feet of commercial peat or any thickness of non-commercial peat, and no subscript to designate a mineral substrate.

Holocene Beach Deposits

Modern beaches and dunes, mapped as Hms and Hd, are mapped along the modern shoreline. The morphology of these beaches suggest a variety of prevailing sand transport directions; northeast from Old Orchard Beach to the western side of Prouts Neck, southwest along Scarborough Beach, and northeast along Higgins Beach. The small pocket beaches east of the Spurwink River and eastward into the Cape Elizabeth quadrangle, in contrast, are all formed in protected coves between projecting bedrock headlands.

GLACIAL AND POSTGLACIAL HISTORY

While it is almost certain that numerous glaciations have helped to shape the coastal area of Maine, there is no evidence within the Prouts Neck quadrangle that can be used to demonstrate these older glacial events. All deposits mapped within the quadrangle or detected in subsurface test borings were deposited during the most recent glacial advance-retreat cycle either in Late Wisconsinan time, or during postglacial time.

Striation directions measured within the Prouts Neck and adjoining Cape Elizabeth quadrangles are nearly unidirectional, with ice flow directions varying between 160° and 175°. No crossing striations were noted.

Regional studies indicate that ice completely covered the Gulf of Maine during the last glacial maximum. Retreat probably began approximately 17,000 yr B.P., and the ice margin may have been near the coast of Maine at approximately 14,000 yr B.P. No radiocarbon dates have been obtained from deposits in the Prouts Neck or Cape Elizabeth quadrangles, but dates limiting the time of deglaciation are available from nearby areas. Smith (1985) described the stratigraphic implication of two dates obtained from exposures in the Kennebunk area, from Great Hill (13,830 100 yr B.P., QL-192) and from the Kennebunk landfill (13,200 120 yr B.P., Y-2208), which he interpreted as dating the presence of the ice margin at these sites. If these dates are correct, reconstruction of the ice margin at that time demonstrates that the Prouts Neck quadrangle would have been covered by ice. Four dates have been obtained from shelly horizons in the Presumpscot Formation exposed in the Portland West quadrangle, immediately north of the Prouts Neck quadrangle, 12,370 140 yr B.P. (Y-2209), 12,350 140 yr B.P. (Y-2210), 12,040 105 yr B.P. (SI-3926) and 11,640 115 yr B.P. (DIC-1595) (Smith, 1985). All of these are minimum dates for the deglaciation of the region and demonstrate that the Prouts Neck and Cape Elizabeth quadrangles were deglaciated prior to approximately 12,500 B.P.

During glacial retreat through the Prouts Neck quadrangle, the glacier retreated by calving into open ocean waters, which covered the entire quadrangle. While ocean levels worldwide were considerably lower than modern sea level due to the tremendous volume of water stored as ice in the continental glaciers, in Maine the land surface was isostatically depressed, so that local sea level was higher than the modern sea level. Extrapolation of shoreline elevation data from neighboring areas suggests that the Pleistocene relative sea level was approximately 240-260 feet above modern sea level (Thompson and others, 1989).

Glaciers retreat in this environment by calving; shedding icebergs at sites where the glacier had thinned sufficiently that it started to float. Ice margins in such an environment are the re-

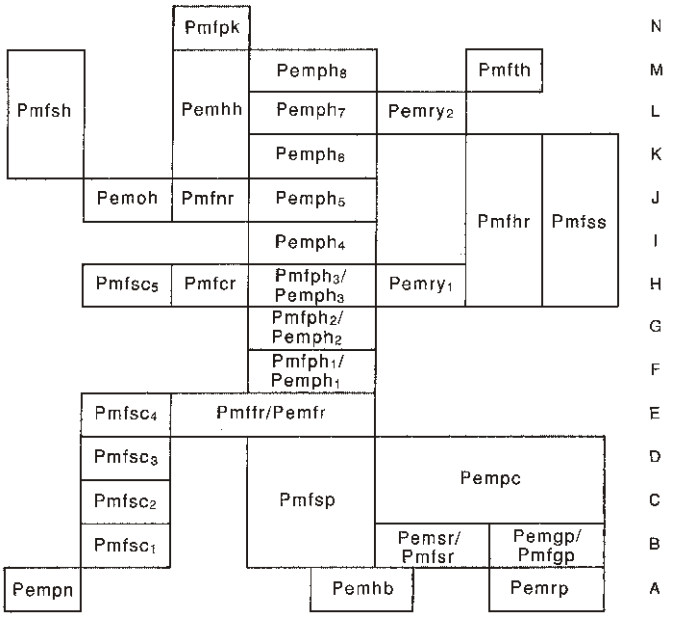

Figure 3. Correlation chart, showing which ice marginal deposits record successive retreat positions in the Prouts Neck and Cape Elizabeth quadrangles, and portions of the neighboring quadrangles. Each successive ice margin is designated by the letters A through N, which are used to label the ice margins in Figure 4.

verse of what would be expected from sites with similar topography above the marine limit. Deeper water within topographic lows promotes more rapid calving retreat, leading to an embayed ice margin at these sites. In contrast, the glacier retreats more slowly over topographic highs, resulting in local promontories of ice at these sites. Ice marginal positions in a topographic low should therefore be concave downglacier, and the trace of successive positions typically pivots about particularly high points on either side of these valleys. This pattern for ice retreat is well displayed in the Prouts Neck and Cape Elizabeth quadrangles.

A total of fourteen successive ice-marginal positions could be identified by reasonable correlations of the ice-marginal deposits, as shown in the correlation chart (Fig. 3) and by the mapped ice margins shown in Figure 4. The mapped ice margins are designated by capital letters, A to N. Uncorrelated minor end moraines are present between some of these major ice margins and southwest of Blue Point Hill.

The earliest ice margin (A) is defined by the Prouts Neck end moraine (Pempn), which underlies the unconsolidated deposits that connect Prouts Neck itself with the mainland. The ice margin is correlated with the Higgins Beach end moraine cluster (Pemhb) and tentatively correlated with the Richards Pond end moraine in the Cape Elizabeth quadrangle, although this last correlation cannot be proven with certainty.

The glacier retreated rapidly up the valley of the Spurwink River and the Scarborough River (and in the low now occupied by Great Pond, in the Cape Elizabeth quadrangle), and less rapidly on the highlands between these lows. A second ice margin (B) is defined by the first of the Scarborough Center marine fans ($Pmfsc_1$), the Sanford Pit marine fan (Pmfsp), the Spurwink River marine fan and end moraine (Pemsr, Pmfsr), and the Great Pond end moraine and marine fan (Pemgp, Pmfgp) in the Cape Elizabeth quadrangle.

The glacier remained pinned on the highlands adjacent to the Sanford Pit marine fan, while retreating in the lowlands adjacent to this highland. In the Scarborough River basin, at least two more small marine fan complexes were deposited ($Pmfsc_2$, $Pmfsc_3$), which define ice margins C and D, while a group of DeGeer moraines was formed north of the Spurwink River, the Pond Cove end moraines (Pempc). Following deposition of these units, the glacier retreated away from the coastal highlands.

The next ice marginal position (E) is defined by the largest of the Scarborough Center marine fans ($Pmfsc_4$), the Fogg Road marine fan (Pmffr), and the Fogg Road end moraine (Pemfr). Preserved deposits define virtually all of the length of this retreat position. The trend of ice margins B, C, D, E, and H suggest that these margins were laterally pinned on Blue Point Hill and probably correlate to minor end moraines to the southwest, but no evidence for these correlations is preserved.

As the glacier retreated from the Fogg Road marine fan/ end moraine position, the glacier margin was pinned on Pleasant Hill, and several marine fans were built at this site. Short lengths of two ice marginal positions (F and G) can be defined at the northwest margin of the first two Pleasant Hill marine fans and associated end moraines ($Pmfph_1$, $Pemph_1$, $Pmfph_2$, $Pemph_2$), but no other deposits within the quadrangle can be correlated to these deposits.

Following continued glacier retreat, a well defined ice margin (H) was developed north and south of Pleasant Hill, defined by the last of the Scarborough Center marine fans ($Pmfsc_5$), the Chamberlain Road marine fan, a buried deposit (Pmfcr), the third Pleasant Hill marine fan and end moraine ($Pmfph_3$, $Pemph_3$), the first Rigby Yard end moraine ($Pemry_1$) and the earliest portion of the Highland Road marine fan (Pmfhr). Reconnaisance mapping suggests that a marine fan located near Sawyer Road in the Portland East quadrangle can also be correlated to this ice margin.

As the glacier retreated farther, the lateral pinning point on Pleasant Hill was abandoned, and the glacier retreated rapidly in the flats to the north. The trends of the successive moraine positions $Pemph_4$ (I), $Pemph_5$ (J), and $Pemph_6$ (K) all indicate that the glacier was pinned northeast of this flat, and that fluvial sediment continued to be delivered to this margin as the Highland Road marine fan grew (mapped as positions H-K). This ice margin was abandoned following deposition of $Pemph_6$, in favor of a new pinning point at Sandy Hill which was occupied during the deposition of the last two Pleasant Hill end moraines ($Pemph_7$, $Pemph_8$), the second Rigby Yard end moraine ($Pemry_2$) and the Thornton Heights marine fan (Pmfth), ice marginal positions L

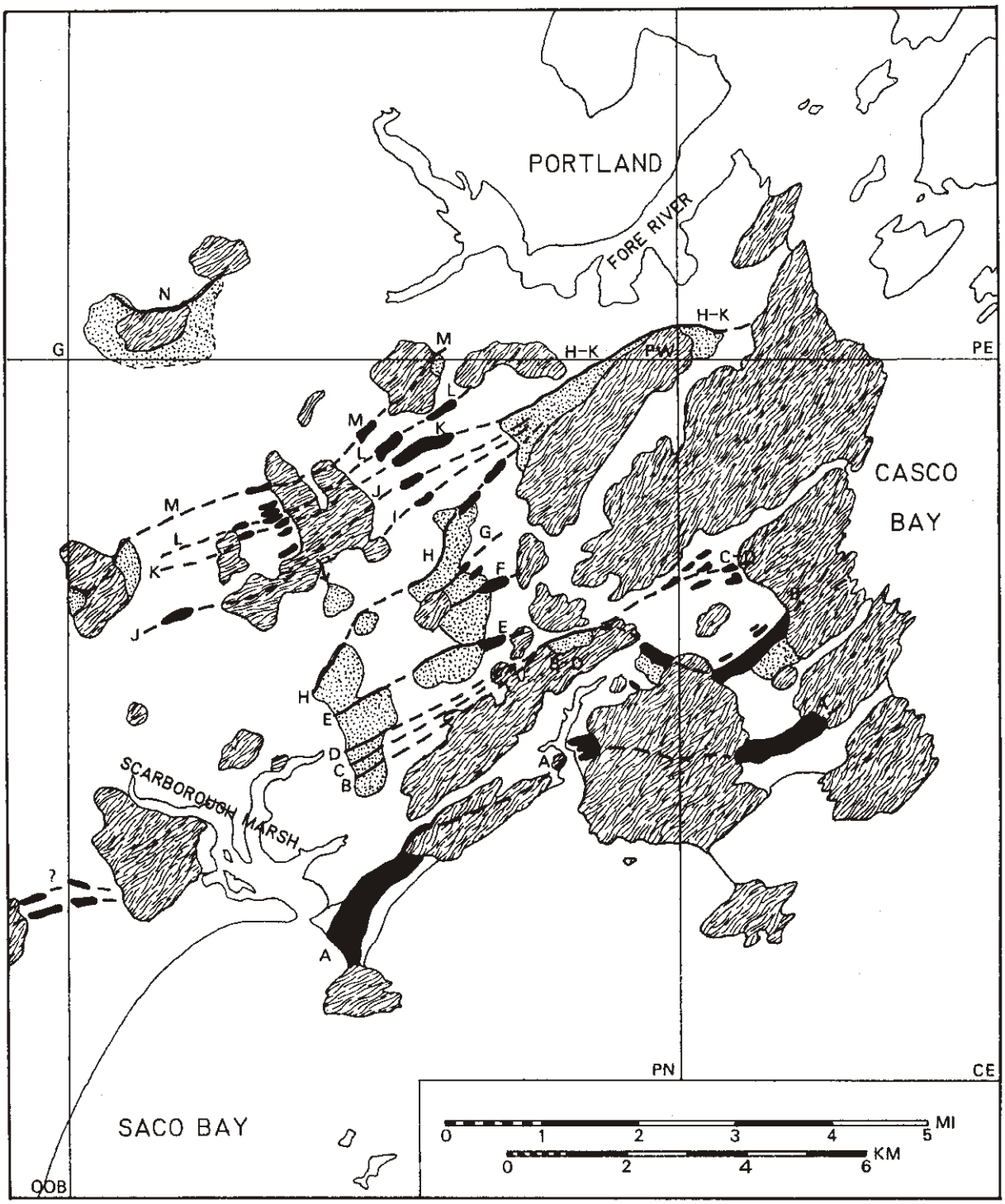

Figure 4. Sketch map of successive ice marginal positions in the Prouts Neck (PN) and Cape Elizabeth (CE) quadrangles, and portions of the Portland East (PE), Portland West (PW), and Old Orchard Beach (OOB) quadrangles. End moraines are shown in black, submarine fans are shown by the sand pattern and bedrock knobs are shown by the schist pattern.

and M. To the southwest of the area occupied by the Pleasant Hill end moraines, the Nonesuch River marine fan (Pmfnr) was deposited southeast of the bedrock ridge now occupied by Route 1, the Oak Hill end moraine (Pemoh) and the Hunnewell Hill end moraine cluster (Pemhh) were emplaced, and marine fans were deposited on the flanks of Scottow Hill (Pmfsh). No exact correlation of these deposits can be made to the Pleasant Hill end moraines, except on the basis of the extrapolation of the ice margins reconstructed from each deposit. The most probable correlations are indicated on the correlation chart.

No ice margins could be identified in the Prouts Neck quadrangle north of a line connecting Scottow Hill, Hunnewell Hill, and Sandy Hill, as all ice marginal deposits that may have been deposited in this area are completely covered by thick Presumpscot Formation silty clays. Distal submarine outwash was detected in several test borings along Spring Street, north of Eight Corners, at the northern border of the quadrangle. These are probably the distal portion of a prominent submarine fan located in the Portland West quadrangle, exposed in gravel pits adjacent to Pig Knoll (ice marginal position N).

As the glacier occupied each of these ice-marginal positions in succession, coarse clastic debris was deposited in the immediate vicinity of the glacier margin, in the form of submarine outwash and/or till, now preserved as submarine fans and end moraines. Finer clastic debris delivered to the glacier margin in subglacial tunnels was more widely dispersed, and was deposited beyond the glacier margin as the Presumpscot Formation. The pattern of glacial retreat in the area suggests that the position of the ice margin was largely or entirely controlled by local topography, with no evidence for climatically controlled readvances.

Local uplift, the result of isostatic rebound, took place during glacial retreat, causing a marine recession shortly after the glaciers left the area. Regional data reported by Belknap and others (1987) suggests that the recessional sea level reached modern sea level at approximately 11,000 yr B.P. During this recession, wave activity winnowed tills and other deposits mantling hillslopes, forming the blanket of nearshore deposits found on hillslopes and the flats adjacent to hills. When the Presumpscot Formation flats were ultimately exposed to subareal deposition, a thick blanket of alluvial sands was deposited adjacent to the course of the Nonesuch River. During continued marine recession, several terraces were formed along the Nonesuch River, and a beach was developed atop the Prouts Neck end moraine. These features demonstrate that there were interruptions in the marine recession.

The source for the sand in the Pleistocene alluvium along the Nonesuch River is unknown. The Nonesuch River now drains only a small basin, underlain almost solely by Presumpscot Formation silty clays, with no apparent source for the sands preserved in the mapped terraces. Topographic relationships suggest that the Nonesuch River may have been the postglacial channel for the Saco River, beheaded by headward erosion along the modern lower course of the Saco River. Further study in the adjacent Old Orchard Beach (Retelle, 1999a,b) and Bar Mills (Hunter, 1999a,b) quadrangles is needed to prove or disprove this hypothesis.

Relative sea level continued to lower, until approximately 9,000 yr B.P., as isostatic rebound continued to outpace eustatic sea level rise caused by the melting glaciers (Belknap and others, 1987). During this time interval, downcutting occurred along all of the major drainages to levels below modern sea level. Since 9,000 yr B.P., sea level has risen to its modern level, causing aggradation within the river channels, drowning of the lower portions of the channels to form estuaries now filled by salt marshes, and the formation of modern beaches.

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Appendix A: Surficial Materials of the Prouts Neck Quadrangle

J. Michael Clinch and Woodrow B. Thompson

INTRODUCTION

The surficial materials map of the Prouts Neck quadrangle shows the location of sites where detailed materials data were obtained and the composition of the material at each site. The sources of this data include field observations of natural exposures, gravel pits, and auger and shovel holes made during 1976 by Thompson (1976b) and by Clinch during 1987. These data were supplemented by a large number of test borings made for the Scarborough Sewer Authority and the Maine Department of Transportation. The composition of the materials observed in the field is shown on the map. However, the logs of materials in the test holes could not be shown on the map. For the sake of clarity, these test hole logs are listed here in tabular form.

The unit descriptions in this table are taken directly from the original drill logs, and are not modified. Colors listed in the descriptions were not retained, since they were inconsistently listed and described, and usually reflect the extent of post-depositional oxidation.

Each unit was interpreted, where possible, from the unit descriptions given in the log, and these interpretations are subject to change as additional data are obtained. The interpretations were based not only on the unit descriptions, but also on the stratigraphy within the test hole and on local topographic constraints. The easiest unit to interpret was the Presumpscot Formation marine silts and clays, typically described as clay, silty clay, clayey silt or silt and clay. If the Presumpscot Formation was encountered, it was usually possible to differentiate deposits above and below this unit. When no marine clays were encountered, it was often difficult to distinguish between nearshore deposits (a reworked blanket of locally derived material formed during marine recession) and underlying till and submarine outwash deposits, which usually acted as sources for the nearshore deposits.

Tills and submarine deposits were differentiated chiefly on the basis of the poor sorting of the tills, which were typically described in the driller's logs as silty sands and gravels, or as poorly sorted sands with varying amounts of gravel and silt. In contrast, the units interpreted here as submarine outwash usually lacked silt and were usually described as sand and gravel. This distinction is not completely reliable, as was observed at gravel pit exposures where outwash sands and gravels are commonly interbedded with Presumpscot Formation silts and clays. Thus, it is possible that some of the units interpreted as tills in this table are actually submarine outwash.

TEST BORINGS, SEWER SYSTEM, TOWN OF SCARBOROUGH

Test borings were made by cable tool methods, typically a 140 lb. hammer dropped 30 inches, with split spoon samples taken as necessary. The description of the materials was made by the driller, by visual inspection. Approximate percentages corresponding to the written descriptions are:

and	=	35-50%
some	=	20-35%
little	=	10-20%
trace	=	0-10%

Thanks are extended to Charlie Anderson, the head of the Scarborough Sewer Authority, for permission to study the original boring records.

APPENDIX A. SURFICIAL MATERIALS OF THE PROUTS NECK QUADRANGLE.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
1	2	pebbly sand with little gravel	artificial fill
	8	fine sand	sand dunes
	3	fine sand, layers of fine gravel	beach sediments
3	4	pebbly sand, trace fine gravel, silt, organics	artificial fill
	9	fine sand	sand dunes
	3	fine sand, layers of fine gravel	beach sediments
5	19	fine sand	sand dunes
	3	medium to coarse sand, trace fine sand	beach sediments
8	22	fine sand	sand dunes and/or beach sediments
11	10	fine sand	sand dunes
14	10	fine sand	sand dunes
	16.5	fine sand, layers medium to coarse sand	beach sediments
16	11	fine sand	sand dunes
	16	fine sand, layers of medium to coarse sand	beach sediments
19	12	fine sand	sand dunes
20	12	fine sand	sand dunes
23	10.5	fine sand	sand dunes
	1.5	fine to medium sand layers of gravel	beach sediments

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
27	12.5	fine sand	sand dunes
	1.5	peat	salt marsh
	8	fine sand	Pleistocene or Holocene alluvium
30	8.5	fine sand	sand dunes
	10.5	fine sand, layers of medium to coarse sand	beach sediments
32	13	fine sand	sand dunes
34	11	medium to fine sand with shells	beach sediments
35	10.5	fine sand	sand dunes
	1.5	fine sand, layers of medium to coarse sand	beach sediments
38	8	medium to fine sand	sand dunes
	4	medium to fine sand trace shells	beach sediments
46	6	medium to fine sand trace gravel	sand dunes reworked from dredge spoils
	5	fine sand, trace medium sand	sand dunes reworked from dredge spoils
	1	poorly sorted sand some gravel	dredge spoils

NOTE - Steve Dickson (Maine Geological Survey) has reported independent evidence that a portion of Pine Point is not a natural feature, but is a natural modification of dredge spoils. Test boring number 46 is the most landward site where this was detected in the test boring data. The feature was mapped as beach sediments and sand dunes on the geologic map, since these deposits now have the appropriate morphology.

48	12	fine sand	sand dunes reworked from dredge spoils
51	8	fine sand	sand dunes reworked from dredge spoils
57	10	medium to fine sand	reworked dredge spoils
59	15	fine sand, trace organics at 11 feet	reworked dredge spoils
62	10	fine sand, trace gravel	reworked dredge spoils
64	11	medium to fine sand	sand dunes reworked from dredge spoils
66	10	medium to fine sand	sand dunes reworked from dredge spoils
68	12	fine sand	sand dunes reworked from dredge spoils
70	6.5	medium to fine sand	sand dunes reworked from dredge spoils
	4.5	medium to fine sand trace gravel	dredge spoils
72	14	medium to fine sand	sand dunes reworked from dredge spoils
74	10	medium to fine sand	sand dunes reworked from dredge spoils
76	14	peaty silt and clay	salt marsh
	10	fine sand	Pleistocene or Holocene alluvium
77	6	artificial fill	
	2	peat	salt marsh
	3	peat, layers of silt and fine sand	salt marsh
78	14	fine sand	Pleistocene or Holocene alluvium
79	6	artificial fill	
	5.5	silt and fine sand layers of peat	salt marsh
	3	silty clay	estuarine muds
	15.5	silty fine to medium sand, trace organics	Pleistocene or Holocene alluvium
81	3	artificial fill	
	8	peat	salt marsh
	0.5	fine sand	Pleistocene or Holocene alluvium
82	6	artificial fill	
	3	peat	salt marsh
	4	silty fine sand	Pleistocene or Holocene alluvium
83	5	silty sand, some gravel	nearshore deposit
	10	silty sand, trace fine gravel, clay	Wisconsinan till
83-A	2.5	artificial fill	
	3	silty fine sand, trace gravel	nearshore deposit
	2.5	silty clayey sand, trace gravel	Wisconsinan till
	6	clayey silty sand and gravel, poorly sorted	Wisconsinan till
85	5.5	poorly sorted sand with some gravel, trace silt	nearshore deposit
	12	silty fine sand occasional gravel, cobbles	Wisconsinan till
86	5.5	silty gravel with cobbles	nearshore deposits
	7.5	clayey silty sand, trace fine gravel	Wisconsinan till
87	5.5	clayey silt and poorly sorted sand, little gravel	Presumpscot Formation interbedded with nearshore deposits
88	3.5	artificial fill	
	5	poorly sorted silty sand	nearshore deposit
	Refusal		
89	2.5	silty sand and peat little gravel	marsh
	2.5	peaty silt	marsh
	3.5	medium to coarse sand some fine gravel	nearshore deposit
	3.5	clayey silt, little fine sand and gravel, occasional cobble	proximal Presumpscot Formation with dropstones, interbedded with submarine outwash
90	7.5	gravelly sand with cobbles	submarine outwash
	4.5	stratified fine sand and sandy gravel	submarine outwash
91	10	medium sand, layers of fine to coarse gravel	nearshore deposit
	2	clayey silt with little fine sand	Presumpscot Formation
93	4	medium sand	nearshore deposit
	4.5	fine to coarse sand some gravel	nearshore deposit
	8.5	layers of clayey silt fine to medium sand and fine gravel to cobbles	Presumpscot Formation interbedded with nearshore deposit or submarine outwash

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
95	3	medium sand	nearshore deposit
		Refusal	
96	Refusal at 4.6 feet		
97	5	poorly sorted sand and gravel	nearshore deposit
	2.5	weathered rock	
		Refusal on rock	
98	Refusal at 6 feet		
99	8	fine to medium sand, little silt, some coarse sand and gravel	Wisconsinan till
	0.5	weathered rock	
		Refusal on rock	
100	Refusal at 6.5 feet		
101	5	silty fine to medium sand, some coarse gravel	Wisconsinan till
	0.5	weathered rock	
	5	rock	
102	Refusal at 3 feet		
103	4.5	poorly sorted sand and gravel	Wisconsinan till
	6.5	silt with weathered rock	
105	5	fine to medium sand, little silt, organics	nearshore deposit with soil development
	6	silty fine sand, trace medium sand	nearshore deposit
	1	silt, some fine sand	proximal Presumpscot Formation
106	10	gravelly silty sand with cobbles	Wisconsinan till
	Refusal		
107	5	fine to medium sand, some gravel, little organics	nearshore deposit with soil development
	4.5	silt, trace fine sand	proximal Presumpscot Formation
108	12	gravelly silty sand some cobbles	Wisconsinan till
109	4	fine to medium sand with organics, trace silt, some gravel	nearshore deposit with soil development
	6	clayey silt	Presumpscot Formation
	4	silty clay, sand layers	Presumpscot Formation interbedded with submarine outwash
	5	silty clay	Presumpscot Formation
111	3	artificial fill	
	2.5	silty clay, trace organics	salt marsh
	4.5	silty clay	Presumpscot Formation
112	4.5	poorly sorted sand trace silt	nearshore deposit
	7	silt and fine sand trace fine gravel	Wisconsinan till
114	3	silty sand, trace fine gravel	nearshore deposit
	8.5	silt and sand, trace fine gravel, occasional cobble	Wisconsinan till
116	5.5	medium to fine sand trace fine gravel, silt	nearshore deposit
	8.5	clayey silt with little fine sand and gravel	proximal Presumpscot Formation
118	Refusal at 5.1 feet		
119	5.5	poorly sorted sand little fine gravel	nearshore deposit
	3	weathered rock	
121	6	silty sand	nearshore deposit
	6	rock	
122	Refusal at 3 feet		

NOTE - Probes were made at five points in the area, designated as points 124, 126, 128, 130 and 134, but no refusal was encountered. These points were not plotted on the materials map.

125	4	fine to medium sand	nearshore deposit
	6	silty fine sand, trace coarse sand, silt	Wisconsinan till
127	5.5	fine to medium sand interbedded with fine to coarse gravel	nearshore deposit
	1.5	silt	Presumpscot Formation
	5	rock	
129	2	poorly sorted sand trace silt, gravel	nearshore deposit
	5	poorly sorted sand trace gravel, silt layers	Wisconsinan till
	0.5	silty gravel	Wisconsinan till
	8.5	weathered rock	
131	5.5	silty fine sand	nearshore deposit
	2.5	fine sand, trace silt	nearshore deposit
	2.5	weathered rock	
135	3.5	poorly sorted sand little gravel	nearshore deposit
	6.5	silty clay, trace fine sand	Presumpscot Formation
136	3	silty fine sand	nearshore deposit
	3	medium to fine sand	nearshore deposit
	2	silty gravelly sand	Wisconsinan till
	4	gravelly silty fine sand	Wisconsinan till
	Refusal		
137	4.25	artificial fill	
	0.25	peat	swamp
	4.5	medium to fine sand	nearshore deposit
	4	sandy clay, trace gravel	proximal Presumpscot Formation
139	4.5	fine sand	nearshore deposit
	2.5	silty fine sand occasional gravel	Wisconsinan till
	3	boulder (cored)	
	3	silty sand, some gravel	Wisconsinan till
141	5.5	medium to fine sand	nearshore deposit
	6.5	clay, little silt fine sand layers	Presumpscot Formation interbedded with submarine outwash
142	0.5	silty medium sand	nearshore deposit
	9.5	silty clay	Presumpscot Formation
143	1	artificial fill	
	10	silty clay, trace fine sand	Presumpscot Formation
	3	fine sandy clay	proximal Presumpscot Formation
144	0.5	artificial fill	
	8.5	clay	Presumpscot Formation
	3	clayey silt	Presumpscot Formation
	4	rock	

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
145	0.5	artificial fill	
	10.5	poorly sorted sand, trace gravel, silt	Wisconsinan till
	5	rock	
146	2	artificial fill	
	6	silty clay	Presumpscot Formation
	6.5	silty fine sand, little gravel, trace clay	Wisconsinan till
	5	rock	
148	3	artificial fill	
	1	gray silt	swamp
	0.5	organic silt	swamp
	9.5	silty clay	Presumpscot Formation
149	3	artificial fill	
	13.5	silty clay	Presumpscot Formation
150	1.5	artificial fill	
	15	silty clay	Presumpscot Formation
151	1.5	artificial fill	
	11	silty clay	Presumpscot Formation
	0.5	clay	Presumpscot Formation
155	2	artificial fill	
	7.5	silty clay	Presumpscot Formation
	1	silty clay, layers of silt, some gravel	Presumpscot Formation interbedded with submarine outwash
156	8.5	silty clay, layers of sandy silt	Presumpscot Formation interbedded with nearshore deposits
	2	silty clay	Presumpscot Formation
	2.5	rock	
158	10	artificial fill	
160	3	artificial fill	
	7.5	silty clay, trace fine sand	proximal Presumpscot Formation
	7.5	gravelly silty sand poorly sorted	Wisconsinan till
	Refusal on boulder or ledge		
162	5	artificial fill	
	5	gravelly sand, trace silt	Wisconsinan till
163	10	silty clay, trace sand and gravel	proximal Presumpscot Formation
164	4.5	artificial fill	
	7.5	silty clay, thin sand layers	Presumpscot Formation interbedded with nearshore deposits
165	3	clayey silt, trace fine sand	Presumpscot Formation interbedded with nearshore deposits
	11	clay, trace silt	Presumpscot Formation
166	3.5	artificial fill	
	4.5	poorly sorted sand	nearshore deposits
	2.5	layered silty clay sandy gravel and silty sand	Presumpscot Formation interbedded with nearshore deposits
167	12	fine sand, trace silt	nearshore deposit
	2	fine to medium sand, trace silt, coarse sand	distal submarine outwash
168	12	fine sand, trace silt	nearshore deposit
170	4	silty fine sand	nearshore deposit
	4.5	silty fine sand and gravel	Wisconsinan till
	9.5	silty fine sand	submarine outwash
	6	silty fine sand	Wisconsinan till
172	26	silty fine sand	submarine outwash possibly overlain by nearshore deposit
174	6	fine to medium sand	nearshore deposit
	4	silt	Presumpscot Formation
	10	fine to medium sand, fine gravel	submarine outwash
	4	fine sand and gravel	submarine outwash
175	10	fine sand, trace gravel and silt	nearshore deposit
	5	compact fine to medium sand and gravel	Wisconsinan till or overridden submarine outwash
	5	medium to fine sand, little gravel and silt	submarine outwash
175	2	compact silty fine sand	Wisconsinan till
176	10	poorly sorted sand, some gravel, trace silt	submarine outwash
	14	poorly sorted sand and gravel	submarine outwash or Wisconsinan till
178	10	fine sand, trace silt	nearshore deposit
	3	fine sand, little silt	distal submarine outwashor proximal Presumpscot Formation
180	8	fine sand, trace silt	nearshore deposit
	5	fine to medium sand, trace silt	submarine outwash
182	10	fine sand, trace silt	nearshore deposit
	6	medium to fine sand, trace silt and coarse sand	submarine outwash
184	5	fine sand, trace silt	nearshore deposit
	9	fine sand, little silt	distal submarine outwashor proximal Presumpscot Formation
186	9	fine to medium sand	nearshore deposit?
	12	medium to fine sand, trace silt	submarine outwash
188	15	poorly sorted sand and gravel, trace silt	Wisconsinan till
	11	medium to coarse sand and gravel	submarine outwash
	2	boulders to cobbles	esker sediments?
189	12.5	fine to medium sand, little silt	nearshore deposit
	7	silty clay, little fine sand	proximal Presumpscot Formation
	3.5	silty fine to medium sand, little fine to medium gravel	distal submarine outwash
190	8	silty fine to medium sand, trace peat and clay	artificial fill
	6	peat	salt marsh
	2	clayey silt, trace peat	estuarine muds
	1	poorly sorted sand	submarine outwash
191	10	silty clay	Presumpscot Formation
	2.5	fine sand and silt	distal submarine outwash or proximal Presumpscot Formation
	5.5	silty fine to medium sand	submarine outwash
192	9.5	clayey silt, fine sand lenses	Presumpscot Formation
	2.5	fine sand	submarine outwash
193	Probe, no refusal		

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
194	1	fine to medium sand, trace silt, gravel and coarse sand	nearshore deposit
	3	clayey silt	Presumpscot Formation
	7	fine sand, trace silt	submarine outwash
195	Refusal at 5.5 feet		
196	4.5	poorly sorted sand, some silt, little fine to medium gravel	Wisconsinan till
	0.5	weathered rock	
	5	rock	
197	Probe, no refusal at 11 feet		
198	4.5	sand and gravel	Wisconsinan till?
	0.5	weathered rock	
	5	rock	
199	Probe, no refusal at 11 feet		
200	4	sand and gravel	Wisconsinan till?
	5	rock	
201	Probe, no refusal at 11 feet		
202	4	poorly sorted sand, some gravel, trace silt	Wisconsinan till
	7	medium sand, little gravel, trace fine sand	submarine outwash
203	Probe, no refusal		
204	5	fine to medium sand, some gravel, little silt	Wisconsinan till
	5	fine to medium sand	submarine outwash
205	Probe, no refusal		
206	2	artificial fill	
	1.5	weathered rock	
	5.5	rock	
207	Probe, no refusal		
208	4	fine sand, trace silt	nearshore deposit
	3.5	poorly sorted sand, little fine to medium gravel	Wisconsinan till
	2.5	fine to medium sand, trace coarse sand	submarine outwash
210	10	fine sand, little silt	nearshore deposit or Pleistocene? beach or spit
212	3	poorly sorted sand, little fine gravel	Wisconsinan till
	5	poorly sorted sand, trace fine gravel and silt	Wisconsinan till
	2	medium to fine sand	submarine outwash
214	7	fine to medium sand	Pleistocene? beach
	3	clayey silt and fine sand	proximal Presumpscot Formation
215	8	poorly sorted sand, trace fine gravel, silt	Wisconsinan till?
	2	clayey silt and fine sandy silt	proximal Presumpscot Formation
216			
217	10	sand	Pleistocene? beach or dune sands
220	0.5	fine sandy silt	nearshore deposit
	11.5	silty clay	Presumpscot Formation
301	2	silty sand and cobbles	artificial fill
	27.5	silty clay	Presumpscot Formation
	0.5	silty clay with sand layers	proximal Presumpscot Formation
301-A	15	material flushed from hole	
	15	silty clay	Presumpscot Formation
	3	interlayered silty clay and fine sand	Presumpscot Formation interlayered with distal submarine outwash
	15	silt and fine sand some gravel	distal submarine outwash
304	3	artificial fill	
	5	silty peat	salt marsh
	1.5	medium to fine sand	Holocene estuarine sands
	0.5	silty fine sand	Holocene estuarine sands
306-A	4	artificial fill	
	6	sand, trace peat and silt	salt marsh
	13.5	fine sand, trace silt shells and medium sand	Holocene estuarine sands
	6.5	clayey silt, trace shells	Presumpscot Formation
	2.5	silty clay	Presumpscot Formation
	17.5	clay	Presumpscot Formation
306-C	4	artificial fill	
	4	peat, sand layers	salt marsh
	3	fine sand, peat layers	salt marsh
	11.5	fine sand, layers of organic silt	Holocene estuarine sands
	2.5	organic silt	Holocene estuarine muds
	0.25	peat	early Holocene? salt marsh
	5.75	silty clay	Presumpscot Formation
	Probed to 85 feet, refusal		
306-D	5.5	artificial fill	
	16.5	silty fine sand	Holocene estuarine sands
	8	silty clay, peat layers	Presumpscot Formation
	17	silty clay	Presumpscot Formation
307-A	4	artificial fill	
	6.5	fine to medium sand, peat layers	salt marsh
	9	fine sand	Holocene estuarine sands
	10.5	clayey silt, little sand, trace shells	Presumpscot Formation
	9	silty clay, trace sand	Presumpscot Formation
	13	clay, little silt	Presumpscot Formation
307-C	6.5	artificial fill	
	40.5	clayey silt, peat	Presumpscot Formation
307-D	4	artificial fill	
	7	silty fine to medium sand, layers of organics	salt marsh
	7	fine to medium sand, occasional organics layers	Holocene estuarine sands
	8	peaty organic silt	Holocene estuarine muds
	4.5	organic clayey silt trace fine sand and shells	Presumpscot Formation
	Probed, refusal at 93 feet		
309	6	artificial fill	
	4.5	silty fine sand and peat	salt marsh
311	6	artificial fill	
	3	peat	salt marsh
	1.5	fine to medium sand, peat	salt marsh

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
313	3	artificial fill	
	5.5	peat, layers fine sand	salt marsh
	2	silty medium sand	Holocene estuarine sands
316	2	artificial fill	
	4	medium to fine sand, trace peat	salt marsh
	4.5	peat, layers fine to medium sand	salt marsh
319	0.5	artificial fill	
	3	fine to medium sand, trace coarse sand	Pleistocene? or Holocene alluvium
	7	silty clay	Presumpscot Formation
321	0.5	artificial fill	
	2.5	fine to medium sand	Pleistocene? or Holocene alluvium
323	1	artificial fill	
	2.5	poorly sorted sand and gravel, trace silt	nearshore deposit
	7	silty clay	Presumpscot Formation
326	1	artificial fill	
	2	fine to medium sand	Pleistocene? or Holocene alluvium
	8	clay	Presumpscot Formation
329	2	clayey silt, some organics, fine to medium gravel	salt marsh developed in colluviating material from nearby slopes
	3.5	fine sand and peaty silt	salt marsh
	5	silty clay	Presumpscot Formation
	0.5	sandy silt	proximal Presumpscot Formation
331	1	artificial fill	
	2.5	fine sand	Pleistocene ? or Holocene alluvium
	0.5	silty gravel	Wisconsinan till
	6.5	silty clay	Presumpscot Formation
	5	silty clay	Wisconsinan till
334	1	artificial fill	
	3.5	fine sand	Pleistocene? or Holocene alluvium
	5.5	silty clay	Presumpscot Formation
336	9	artificial fill	
	0.5	organic sand	salt marsh
	0.5	fine sand, little silt	Holocene estuarine sands
338	0.5	artificial fill	
	5.5	fine to medium sand, little silt, trace coarse sand and fine gravel	colluvium
	2	organic sand	salt marsh
	2	fine to medium sand, layers of silt	Holocene estuarine sands
340	1	artificial fill	
	2.5	medium to fine sand, some gravel, little coarse sand	Pleistocene? or Holocene alluvium
	0.5	silty clay	Presumpscot Formation
	3	silty fine sand	nearshore deposit
	6	silty clay	Presumpscot Formation
342	5	fine to medium sand, trace coarse sand	Pleistocene alluvium
	5	clay	Presumpscot Formation
343	4.5	fine sand	Pleistocene alluvium
	2.5	clayey silt interbedded with fine sand with distal submarine outwash	proximal Presumpscot Formation interbedded
	3	fine sand, trace silt	submarine outwash
344	3	fine sand	Pleistocene alluvium
345	3.5	fine to medium sand	Pleistocene alluvium
	4.5	silty fine sand	distal submarine outwash
346	6	clay	Presumpscot Formation
347	9	silty fine sand	Pleistocene alluvium
	8	clay	Presumpscot Formation
348	9.5	artificial fill	
	2.5	clay	Presumpscot Formation
349	4.5	peat	salt marsh
	4	silty fine sand	Pleistocene? or Holocene alluvium
	3.5	clay	Presumpscot Formation
350	3	artificial fill	
	5	peat and clay	salt marsh
	2	silt, fine sand and peat	salt marsh
351	10	artificial fill	
	3.5	organic silt and peat	salt marsh
	1.5	silty sand, little fine gravel	Pleistocene? or Holocene alluvium
352	10	artificial fill	
	2	clay	Presumpscot Formation
	3	fine to medium sand, trace coarse sand	submarine outwash
353	4	artificial fill	
	5.5	fine sandy silt, trace peat	salt marsh
	2.5	medium to fine sand, little silt, trace	submarine outwash? Pleistocene? or Holocene alluvium?
354	2	artificial fill	
	8	fine to medium sand and coarse to fine gravel	Wisconsinan till
356	4	fine to medium sand, trace silt	nearshore deposit
	5	poorly sorted sand and fine gravel	Wisconsinan till
	3	poorly sorted sand and gravel, little silt	Wisconsinan till
358	5	artificial fill	
	3.5	poorly sorted sand and gravel	Wisconsinan till
	2.5	fine to medium sand	submarine outwash
359 (88 ft)	5	fine to medium sand, trace fine gravel and coarse sand	nearshore deposit
	5	poorly sorted sand, little fine to medium gravel	Wisconsinan till
	2	medium to fine sand, trace fine gravel, silt	Wisconsinan till or submarine outwash
363 (87 ft)	11	fine to medium sand, trace coarse sand	nearshore deposit
	2	fine to medium sand, trace silt, coarse sand	submarine outwash

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
365	1.5	artificial fill	
(91 ft)	5.5	rock	
366	6.5	silty fine sand, little medium to coarse sand, fine gravel	Wisconsinan till
(82 ft)	6.5	fine sand, trace silt medium sand	submarine outwash
367	5	fine to medium sand, little silt, trace fine to coarse gravel	Wisconsinan till
(91 ft)	5	poorly sorted fine sand little fine gravel, trace silt, cobbles	Wisconsinan till
	3	poorly sorted sand and fine gravel, trace silt	Wisconsinan till
369	5	poorly sorted sand, little fine to coarse gravel, trace silt, cobbles	Wisconsinan till
(78 ft)	5	silty fine sand	submarine outwash
	3	fine sand, little silt	submarine outwash
370	4	fine to medium sand and gravel, nodules of silt	nearshore deposit
(75 ft)	9.5	poorly sorted sand, fine to medium gravel, trace silt	Wisconsinan till
		Refusal	
371	2	artificial fill	
(74 ft)	3.5	poorly sorted sand little fine to medium gravel, trace silt	Wisconsinan till
	4.5	fine sand, little silt	distal submarine outwash
	4	sandy silt and gravel trace clay	Wisconsinan till
372	2	artificial fill	
(73 ft)	12	fine sand, trace silt	distal submarine outwash
373	3	artificial fill	
(68 ft)	6	layered silty fine sand and silty clay	distal submarine outwash interbedded with Presumpscot Formation
	3	fine sand, little silt	distal submarine outwash
374	6	fine to medium sand little fine gravel, trace coarse sand	submarine outwash
(55 ft)	6	silty fine sand	distal submarine outwash
375	5	artificial fill	
(47 ft)	5	medium to fine sand little silt	submarine outwash
	1	medium sand	submarine outwash
	1	silty clay	Presumpscot Formation
376	1	artificial fill	
(45 ft)	4	fine sand	distal submarine outwash
	10	fine sand, some silt	distal submarine outwash
377	2	artificial fill	
(42 ft)	8	fine to medium sand little silt	submarine outwash
	2	fine sand, trace silt	distal submarine outwash
	2	silty fine sand	distal submarine outwash
378	2.5	artificial fill	
(38 ft)	9.5	fine to medium sand little silt	submarine outwash
379	2	artificial fill	
(37 ft)	6	fine sand	nearshore deposit
	5	silty clay, trace fine sand	proximal Presumpscot Formation
380	2	artificial fill	
(33.5)	5.5	silty fine to medium sand	nearshore deposit
	2.5	silty clay	Presumpscot Formation
381	5	medium to fine sand trace coarse sand and fine gravel	submarine outwash
(39 ft)	7	fine sand, little silt	distal submarine outwash
382	3.5	poorly sorted sand, trace fine gravel	submarine outwash
(35 ft)	6.5	poorly sorted sand, little fine gravel, trace silt	submarine outwash
	5	fine to medium sand, little silt	submarine outwash
384	4	artificial fill	
(77 ft)	4	medium to fine sand, some silt, fine to medium gravel	Wisconsinan till
	1	weathered rock	
		rock	
389	5	poorly sorted sand, trace fine gravel	Wisconsinan till
(80 ft)	7	fine sand, trace silt and fine gravel	distal submarine outwash
391	3.5	fine to medium sand	nearshore deposit
(78 ft)	14.5	silt and poorly sorted sand, some fine gravel	Wisconsinan till
		Refusal	
392	4.5	artificial fill	
(70 ft)	7.5	fine sand, some silt	nearshore deposit
393	1	topsoil with rock fragments	
(75 ft)	5	rock	
395	5	fine sand, some fine to medium gravel and coarse to medium sand	nearshore deposit
(73 ft)	7	silty fine sand	distal submarine outwash
	2	silt and fine sand	distal submarine outwash or proximal Presumpscot Formation
396	4	fine to medium sand	nearshore deposit
(71 ft)	5	silty fine sand, clay lenses	distal submarine outwash
	2	silty fine sand	distal submarine outwash
397	4	poorly sorted gravel and weathered rock	washed Wisconsinan till
(68 ft)	5	rock	
398	2.5	silt and weathered rock	washed Wisconsinan till
(60 ft)	5	rock	
399	3	artificial fill	
(46 ft)	9	fine sand, little silt	nearshore deposit
401	3.5	poorly sorted sand little fine to medium gravel	nearshore deposit
(61 ft)	4	clayey silt, trace fine gravel	proximal Presumpscot Formation
	4.5	silty fine to medium sand, trace fine gravel	distal submarine outwash

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
402	4.5	silty, poorly sorted.....	Wisconsinan till
(69 ft)		sand with fine gravel	
	5	rock	
405	5	fine to medium sand.....	nearshore deposit
(34 ft)	5	silt and fine sand	proximal Presumpscot Formation
406	2.5	poorly sorted sand.....	Wisconsinan till
(48 ft)	5	rock	
408	4	fine to medium sand.....	Wisconsinan till
(62 ft)		trace fine gravel and coarse sand	
	1	boulder (in till)	
	2	silty fine to medium sand...	Wisconsinan till
	5	rock	
410	5	fine sand, little silt.....	nearshore deposit
(52 ft)		fine gravel, organics	with soil development
	7	fine sand, little silt.....	nearshore deposit or distal submarine outwash
411	4	fine to medium sand.....	nearshore deposit
(46 ft)		trace coarse sand, silt and gravel	
	4	poorly sorted sand.....	Wisconsinan till
		some gravel	
	2	weathered rock	
	Refusal		
413	5	fine sand, trace silt	nearshore deposit
(40 ft)	5	silty fine sand	distal submarine outwash
	2	weathered rock	
414	5	poorly sorted sand.....	nearshore deposit
(38 ft)		little silt, fine gravel	
	5	fine to medium sand.....	submarine outwash
		trace silt	
	2	medium to fine sand.....	submarine outwash
414-A	5	artificial fill	
(36 ft)	7	clayey silt with	Presumpscot Formation
		fine sand lenses	interbedded with distal submarine outwash
415	1	artificial fill	
(34 ft)	4	fine sand, some silt.....	submarine outwash
		little fine to coarse gravel	interbedded? with proximal Presumpscot Formation
	8	silt and weathered rock	Wisconsinan till
417	5	medium to fine sand.....	nearshore deposit or
(53 ft)		trace silt, coarse sand, fine gravel	Wisconsinan till
	4	silty fine to medium	Wisconsinan till
		sand and gravel	
	0.5	silty fine sand	Wisconsinan till
		and gravel	
	Refusal		
418	2	artificial fill	
(37 ft)	7.5	fine sand and silty clay	distal submarine outwash or proximal Presumpscot Formation (interbedded)
	1	boulder (till?)	
	1	weathered rock	
	6	rock	
420	4	fine sand with.....	nearshore deposit
(37 ft)		little silt	
	6	silty fine sand	nearshore deposit
	2	silty clay and fine sand	proximal Presumpscot Formation
421	1.5	artificial fill	
(39 ft)	10.5	clayey silt	Presumpscot Formation
	2	clayey silt and fine sand.....	Presumpscot Formation interbedded with distal submarine outwash
423	5	fine to medium sand with ..	nearshore deposit or
(44 ft)		little fine gravel and weathered rock	colluviated till
	5	fine sand and silt lenses	nearshore deposit
	3	fine silt and sand	Wisconsinan till
		little fine gravel and weathered rock	
	2	silt and fine to medium	Wisconsinan till
		sand and weathered rock	
425	5	silty fine sand	nearshore deposit
(33 ft)	5	fine to medium sand with ..	Wisconsinan till
		little silt, coarse sand and weathered rock	
	2	poorly sorted silty sand.....	Wisconsinan till
		trace fine gravel	
427	4	silty fine sand	nearshore deposit
(29 ft)	11	clay with little silt	Presumpscot Formation
	2	silty clay and silty	Presumpscot Formation
		fine sand	interbedded with distal submarine outwash
429	2	artificial fill	
(35 ft)	8	fine sand, trace	distal submarine outwash
		silt lenses	with lenses of Presumpscot Formation
	10	fine sand, little silt.....	distal submarine outwash
430	4	fine sand	nearshore deposit
(32 ft)	4	silty fine sand	distal submarine outwash
	4	clay with little silt	Presumpscot Formation
432	4	topsoil with roots	
(34 ft)	6.5	silty clay, trace	proximal Presumpscot
		fine sand	Formation
	1.5	silty fine sand, trace	distal submarine outwash
		medium sand	
433	2	artificial fill	
(34 ft)	7	silty fine sand	distal submarine outwash
	6	fine to medium sand.....	submarine outwash
		trace silt	
435	20	fine sand, trace silt	submarine outwash
(36 ft)			
436	3	artificial fill	
(34 ft)	5.5	poorly sorted sand, some ...	proximal submarine
		fine to medium gravel	outwash or Wisconsinan till
	10.5	clay, trace fine sand.....	Presumpscot Formation
		and silt	
437	3	artificial fill	
(37 ft)	5	fine to medium sand.....	submarine outwash
		trace fine to medium gravel, coarse sand	
	7	clay, trace silt	Presumpscot Formation
	5	fine sand	distal submarine outwash
	6	medium to fine sand.....	submarine outwash

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
438	8	poorly sorted sand and fine to medium gravel little silt	submarine outwash
(42 ft)	22	poorly sorted sand and fine gravel, trace silt	submarine outwash
	6	poorly sorted silty sand,some fine to medium gravel	Wisconsinan till
439	2	artificial fill	
(32 ft)	13	poorly sorted sand, some fine to medium gravel	submarine outwash
	6	poorly sorted sand and fine to medium gravel	submarine outwash
440	3	topsoil with clayey silt	
(25 ft)	4	silt, trace fine sand	Presumpscot Formation
	3	clayey silt, some fine sand	proximal Presumpscot Formation
	1	silty clay, trace fine sand	Presumpscot Formation
	9	clayey silt, some fine sand	Proximal Presumpscot Formation
	10	fine sand with little silt	distal submarine outwash
441	1	artificial fill	
(32 ft)	1.5	fine to medium sand	nearshore deposit
	7.5	silty fine sand little fine to coarse gravel	submarine outwash
	5	silt and fine sand with some gravel	submarine outwash
	2	silty, poorly sorted sand and gravel with weathered rock	Wisconsinan till
	2	silt and very fine to medium sand with little fine gravel	submarine outwash
443	3.5	artificial fill	
(12 ft)	4.5	silty clay	Presumpscot Formation
	2	clay with fine sand	Presumpscot Formation interbedded (?) with distal submarine outwash
445	4	silt, little fine sand	nearshore deposit
(18 ft)	14	clay	Presumpscot Formation
446	3	artificial fill	
	5.5	silty clay, little fine sand	proximal Presumpscot Formation
	9.5	clay, little silt trace fine sand	Presumpscot Formation
447	3	artificial fill	
(14 ft)	6	medium to fine sand	nearshore deposit
	4	clay	Presumpscot Formation
448	1.5	artificial fill	
	2.5	fine sandy silt	nearshore deposit
	5	medium to fine sand little silt	nearshore deposit
	13	clay, trace silt	Presumpscot Formation
449	2	artificial fill	
(18 ft)	6	silty very fine sand	nearshore deposit
	9	clay	Presumpscot Formation
451	10	clay with little silt	Presumpscot Formation
(13 ft)			
453	10	clay with little silt	Presumpscot Formation
(16 ft)			
455	2	clay, trace fine sand	Presumpscot Formation
(20 ft)	8	clay	Presumpscot Formation
456	5	silty clay with organics trace fine sand	Presumpscot Formation with soil development
	6	clay, little silt	Presumpscot Formation
	2	silty fine sand and silty clay	distal submarine outwash interbedded (?) with Presumpscot Formation
457	2	topsoil, silt and fine sand	nearshore deposit with soil development
(31 ft)	7.5	clay, trace silt	Presumpscot Formation
	5.5	fine sand	distal submarine outwash
	4	very fine sand with some silt layers	distal submarine outwash interbedded with Presumpscot Formation
458	Probe, refusal at 3.4 feet		
459	4.5	clayey silt with little poorly sorted sand and gravel	Wisconsinan till
460	2.5	artificial fill	
	0.5	weathered rock	
	5	rock	
462	4	sand and gravel	Wisconsinan till
	5	rock	
464	8	silty clay	Presumpscot Formation
	5	rock	
466	5	artificial fill	
	1.5	weathered rock	
	5	rock	
469	2	artificial fill	
	5	rock	
471	0.5	silty sand, little gravel	Wisconsinan till
	0.5	weathered rock	
	5	rock	
472	7.5	silty clay	Pesumpscot Formation
	4.5	silty sand, little gravel	Wisconsinan till
473	8.5	silty clay rock	Presumpscot Formation
474	5	medium sand	nearshore deposit
	1.5	silty sand, little gravel	Wisconsinan till
	5	rock	
475	9	sandy silt	proximal Presumpscot Formation
	2	medium to fine sand trace silt and gravel	submarine outwash
477	4	artificial fill	
	2	weathered rock	
	4	rock	
479	5	poorly sorted sand trace silt and gravel	Wisconsinan till (colluviated?)
	5	silty clay	Presumpscot Formation
	2	fine sand	proximal Presumpscot Formation
487	10	fine sand, trace silt	nearshore deposit
490	1.5	poorly sorted sand trace silt and gravel	Wisconsinan till
	0.5	weathered rock	
	5	rock	
493	5	fine sand	nearshore deposit
	7	fine sand, trace silt	nearshore deposit
494	8	silt and fine sand trace gravel and peat	artificial fill
	2	fine sand	nearshore deposit
495	5	fine sand, trace gravel and peat	salt marsh
	5	rock	

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
496	10	sand	Pleistocene? beach and dunes
	14	sand, little gravel	Wisconsinan till or submarine outwash
498	7	fine sand	Pleistocene? beach and dunes
	15	poorly sorted sand, little gravel, silt	Wisconsinan till
500	10	poorly sorted sand	Pleistocene? beach
	5	medium sand	Pleistocene? beach
	4	poorly sorted sand, little silt and gravel	Wisconsinan till
	4	poorly sorted sand	submarine outwash
503	21	sand, gravel and cobbles coarsening with depth	Wisconsinan till or submarine outwash
505	10	sand	Pleistocene? beach or dune sands
	8	silty sand	Wisconsinan till
507	14	poorly sorted sand	Wisconsinan till
	4	fine to medium sand, minor silt	submarine outwash?
509	16	gravelly sand	Wisconsinan till or submarine outwash
510	5	sand	nearshore deposit
	8	silty clay	Presumpscot Formation
511	10	sand	nearshore deposit
512	7.5	sand	nearshore deposit
	3.5	weathered rock	
513	13	sand, minor silt and gravel	Wisconsinan till
515	8	medium sand	Pleistocene or Holocene dunes
	4	poorly sorted sand, fine gravel	Wisconsinan till
516	8	silty sand	Pleistocene beach
517	12	silty fine sand	Pleistocene beach
518-A	6	fine to medium sand	Holocene dune sand
	1	peat	salt marsh
	4	fine to medium sand	Pleistocene beach
521	4	artificial fill	
	0.5	peat	salt marsh
	7.5	poorly sorted silty sand	Wisconsinan till
523	4	gravelly fine sand	Wisconsinan till or submarine outwash
	9	silty fine sand	Wisconsinan till
525	4	poorly sorted sand, little gravel	Wisconsinan till
	3	silty fine sand	Wisconsinan till
	5	silty fine to medium sand, little gravel	Wisconsinan till
535	5	fine to medium sand, trace coarse sand, fine gravel	nearshore deposit
	6	fine to medium sand, trace fine gravel, coarse sand	Wisconsinan till or submarine outwash
	2	fine sand, little silt	distal submarine outwash
538	5	fine sand, trace fine to medium gravel, silt	nearshore deposit
	2.5	fine to medium sand, little fine to medium gravel, trace silt	Wisconsinan till
	5.5	silty fine sand, little fine gravel, coarse sand	Wisconsinan till
539	5	fine sand, trace coarse sand, fine gravel	nearshore deposit
	5	silty fine sand	submarine outwash
541	2	poorly sorted sand, little fine gravel, silt	Wisconsinan till
	4	fine sand, little fine to medium gravel, silt	Wisconsinan till
	1	silty fine sand	distal submarine outwash
	5	fine sand, some silt	submarine outwash
543	3.5	poorly sorted sand, little fine to medium gravel and silt	Wisconsinan till
	4.5	silty fine sand	distal submarine outwash
	5	fine to medium sand, trace silt, fine gravel	Wisconsinan till
544	10	artificial fill	
	4	poorly sorted silty sand gravel and boulders	Wisconsinan till
	3	silty fine sand, trace medium to coarse sand	distal submarine outwash
546	4	silt, trace medium to fine sand	proximal Presumpscot Formation
	5	poorly sorted sand, little fine gravel	Wisconsinan till
	3	poorly sorted sand and clayey silt, trace fine gravel	submarine outwash interbedded (?) with Presumpscot Formation
	2	fine sandy silt, trace clay, fine to medium gravel	distal submarine outwash
547-A	2	artificial fill	
	6.5	silt, fine sand and fine to coarse gravel	nearshore deposit or colluviated till
	6.5	silty clay, trace fine sand	Presumpscot Formation
	2	silty fine sand	distal submarine outwash
	5	silty, poorly sorted sand little fine gravel	Wisconsinan till
549	5	medium to fine sand, trace silt and gravel	nearshore deposit
	5	fine to medium sand, little coarse sand and gravel, trace silt	submarine outwash
	5	poorly sorted sand, trace silt, fine gravel	submarine outwash
	5	compact silty fine to medium sand, little coarse sand, fine gravel	Wisconsinan till
	2	compact silty very fine sand	overridden distal submarine outwash
	2	compact silty fine sand, trace fine gravel	overridden submarine outwash
550	3	poorly sorted sand, little silt, fine to medium gravel	Wisconsinan till
	5	fine sand, trace silt coarse sand	submarine outwash
	4	medium to coarse sand and poorly sorted gravel, little silt	Wisconsinan till
	2	silt and fine sand, trace coarse sand	distal submarine outwash

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
553	5	artificial fill	
	4	silt, little clay, fine sand	proximal Presumpscot Formation
	3	fine sand, little silt	distal submarine outwash
569	5	silty fine sand, angular gravel and clay	colluvium or nearshore deposits
	1	silty fine sand, trace gravel and clay	Wisconsinan till
	4	rock	
571	3	fine sand, some silt, trace gravel	nearshore deposit
	3	gravel and poorly sorted sand, trace silt	Wisconsinan till
	5	silty fine sand, some gravel, trace clay	Wisconsinan till
573	4.5	silty fine sand, little fine to medium gravel, trace organics	colluvium or nearshore deposit
	1.5	silt, little fine sand and fine gravel	Wisconsinan till
	5	rock	
575	3.5	fine to medium sand, boulders and gravel, trace clay	Wisconsinan till
	4	sandy silt, boulders and gravel, trace clay	Wisconsinan till
	4.5	rock	
577	4	fine sand with gravel and cobbles, little silt	Wisconsinan till
	5	fine sand, some gravel little silt, trace clay	Wisconsinan till
577 (cont)	0.5	silty fine sand, little coarse sand, some gravel weathered rock	Wisconsinan till
579	5.5	silty sands fine gravel	Wisconsinan till
	1	weathered rock	
	4.5	rock	
580	6	fine to medium sand, some gravel, coarse sand, trace silt	Wisconsinan till
	3	silty sand, trace gravel	Wisconsinan till
	5	rock	
581	3	poorly sorted sandy gravel	Wisconsinan till
	0.5	weathered rock	
	6	rock	
583	2	silty fine to coarse gravel and weathered rock	colluvium
	2	fine to coarse sand	subaqueous outwash
	5	weathered rock	
585	2	artificial fill	
	5	silty fine sand little gravel	Wisconsinan till
	5	silty sand, trace clay some gravel	Wisconsinan till
586	7.5	artificial fill	
	5.5	silty peat, little poorly graded sand	swamp deposit atop nearshore deposit
	8	clayey silt, some fine sand, weathered rock	Presumpscot Formation
587	4.5	medium to fine silty sand trace clay, some gravel	nearshore deposit
	6.5	silty clay	Presumpscot Formation
	1.5	sand, silt and clay layers	Presumpscot Formation interbedded with submarine outwash
	9.5	sand and gravel trace clay	submarine outwash
600	2	artificial fill	
	8	silty clay, some interbedded with nearshore deposits	Presumpscot Formation
	5	clay	Presumpscot Formation
	3	silty fine sand trace clay	distal submarine outwash
	7	silty fine sand	distal submarine outwash
	4	fine to medium sand little silt	submarine outwash
	2	fine to medium sand	submarine outwash
601	3	fine sand, trace gravel	nearshore deposits
	5	silty clay	Presumpscot Formation
	23	very fine sand trace silt	submarine outwash
602	3	artificial fill	
	7	clay	Presumpscot Formation
	5	layered silty clay interbedded with fine sand	Presumpscot Formation interbedded with distal submarine outwash
	5	silty fine sand	distal submarine outwash
	4	fine to medium sand little silt	submarine outwash
	2	silty fine sand, trace medium sand and fine gravel	Wisconsinan till
603	3	artificial fill	
	7	silty clay, trace fine sand	proximal Presumpscot Formation
604	8	fine sand, trace silt	nearshore deposit
	22	fine to medium sand little fine gravel, trace silt	submarine outwash
	5	poorly sorted sand some fine to medium gravel, trace silt	Wisconsinan till?
	7	fine to medium sand little fine gravel, trace silt	submarine outwash
	8	poorly sorted sand and gravel, trace silt	Wisconsinan till
606	4	fine to medium sand trace silt	nearshore deposit
	2	fine to medium sand and medium to coarse gravel	submarine outwash
	3	fine to medium sand, some silt, little fine to medium gravel, trace coarse sand	Wisconsinan till

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
606 (cont.)	3	fine to medium sand, some fine to medium gravel, trace silt	submarine outwash
	2	poorly sorted sand and gravel	Wisconsinan till
	6	fine to medium sand, little fine gravel, trace silt	submarine outwash
	4	fine to coarse sand some fine to medium gravel, some silt	submarine outwash
	2	fine to medium sand, trace fine gravel	submarine outwash
	8	poorly sorted sand and gravel, trace silt	Wisconsinan till
	16	poorly sorted sand, little fine gravel trace silt	Wisconsinan till or submarine outwash
608	4	fine to medium sand	nearshore deposit
	11	medium to fine sand, trace fine gravel coarse sand	submarine outwash
609	0.5	peat	swamp
	0.25	fine sand	nearshore deposit
	4.25	silty clay, trace medium to coarse sand	Presumpscot Formation
	2.5	silty clay, seams of fine sand	proximal Presumpscot Formation
	6	fine to medium sand, fine gravel and clayey silt	Wisconsinan till
	1.5	weathered rock	
611	4.5	fine to medium sand, trace silt and coarse sand	nearshore deposit
	7.5	silty clay	Presumpscot Formation
613	7	silty clay	Presumpscot Formation
	3	clay, little silt	Presumpscot Formation
615	2	artificial fill	
	8	silty clay	Presumpscot Formation
617	2	artificial fill	
	8	silty clay	Presumpscot Formation
622	3.5	artificial fill	
	0.5	peat	salt marsh
	1.5	fine sand, trace peat	salt marsh
	0.5	peat	salt marsh
	2	fine sand, trace peat	salt marsh
	0.5	silty sand, trace gravel	Wisconsinan till
	0.5	weathered rock	
	5	rock	

Test holes 701-711 were drilled by a different driller, with different percentage limits defined for the qualitative visual estimates. These limits are:

and = 40-50%
some = 10-40%
trace = 0-10%

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
701	2	fine to medium sand	Pleistocene alluvium
	6	fine sand, some silt	Pleistocene alluvium
	7	fine sand, some silt, trace gravel, clay	Pleistocene alluvium or submarine outwash
	3	fine sand, trace silt	Pleistocene alluvium or submarine outwash
702	1	artificial fill	
	6.5	fine sand, some silt	Pleistocene alluvium
	4.5	clay	Presumpscot Formation
	2	fine sand, trace silt	distal submarine outwash
703	1	artificial fill	
	2	fine sand, trace silt	Pleistocene alluvium
	2	fine to coarse sand	Pleistocene alluvium
	5	fine sand, trace silt	Pleistocene alluvium
	2	fine sand, trace silt	Pleistocene alluvium
704	5	fine sand	Pleistocene alluvium
	5	fine sand, trace silt	Pleistocene alluvium
705	4	fine sand	Pleistocene alluvium
	5	silty clay	Presumpscot Formation
	3	clay	Presumpscot Formation
	6	silty fine sand trace clay	distal submarine outwash
706	3	artificial fill	
	2	fine to medium sand	Pleistocene alluvium
	5	fine sand	Pleistocene alluvium
	2	fine sand and silt	Pleistocene alluvium
	3	silt	Presumpscot Formation
707	1.5	fine sand	Pleistocene alluvium
	3.5	fine to coarse sand	Pleistocene alluvium
	4	fine sand and silt	Pleistocene alluvium
	6	silt	Presumpscot Formation
708	9	fine sand, trace silt	Pleistocene alluvium
	6	silt	Presumpscot Formation
	3	very fine sand and silt	distal submarine outwash
709	5.5	fine sand, some silt	Pleistocene alluvium
	3.5	fine sand and silt some clay	Pleistocene alluvium
	32.5	clay	Presumpscot Formation
	3.5	fine sand, trace silt and clay	distal submarine outwash
710	8	fill and peat	filled swamp
	7	fine sand, trace silt	Pleistocene alluvium
711	5	silty clay	Presumpscot Formation
	5	fine sand, some silt	distal submarine outwash
1-1	2	peat	salt marsh
1-1	8	sandy peat	salt marsh developed in estuarine sands
1-2	11	silty sand	Pleistocene alluvium
1-3	15	silty sand	Pleistocene alluvium
1-4	13	silty sand	Pleistocene alluvium
1-5	11	silty sand	Pleistocene alluvium
1-6	11	silty sand	Pleistocene alluvium
1-7	2	organic sandy silt	salt marsh developed in Pleistocene alluvium
	8	silty sand	Pleistocene alluvium
	15	silty clay, sand layers	Presumpscot Formation
1-8	3	organic silt	salt marsh developed in Pleistocene alluvium
	3	clayey gravel and sand	Pleistocene alluvium
	25	sandy silty clay	proximal Presumpscot Formation
1-11	2	topsoil	
	8	silty sand	Pleistocene alluvium
	1	silty sandy clay	proximal Presumpscot Formation

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
1-13	6	silty sandy clay	proximal Presumpscot Formation
	2	silty clayey sand	distal submarine outwash
	14	silty sandy clay	proximal Presumpscot Formation
1-19	11	clay	Presumpscot Formation
	2	silty sand and clay	distal submarine outwash interbedded (?) with Presumpscot Formation

TEST HOLES FROM OLD MILLBROOK DEVELOPMENT

These holes were drilled for the development contractor to aid in the construction of the sewer system in that area. On completion, the sewers were turned over to the Scarborough Sewer Authority, together with the construction records. These borings were made by cable tool methods, with split spoon samples taken as needed and materials descriptions made by the driller, by visual inspection. The approximate percentages corresponding to the descriptions are:

and = 40-50%
some = 10-40%
trace = 0-10%

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
14-1	16	fine to coarse sand and gravel	Pleistocene alluvium
14-2	2.5	fine to coarse sand and gravel	Pleistocene alluvium
	2.5	sand, trace gravel and silt	Pleistocene alluvium
	7	fine to coarse sand	Pleistocene alluvium
	3	silt and clay, trace fine sand	Presumpscot Formation
14-3	7	artificial fill	
	3	fine sand and gravel	Pleistocene alluvium
14-4	7	silt, some fine sand, trace gravel	proximal Presumpscot Formation
	2	very fine sand, trace gravel	distal submarine outwash
	3	silt and very fine sand	proximal Presumpscot Formation
14-5	12.5	fine to coarse sand trace gravel and silt	Pleistocene alluvium
	3.5	clay and some silt, trace sand	Presumpscot Formation
14-6	6	silt, trace sand	Presumpscot Formation
	6	silt, some fine sand, trace clay	distal submarine outwash
14-7	6	artificial fill	
	2	peat and fine sand	salt marsh
	5	silt, some clay	Presumpscot Formation
14-8	5	artificial fill	
	2	peat, wood and sand	salt marsh
	3	clay, some silt	Presumpscot Formation
	5	clay, trace silt	Presumpscot Formation
14-9	4.5	artificial fill	
	4	peat and sand	salt marsh
	2.5	silt, some clay trace sand	Presumpscot Formation
14-11	6	artificial fill	
	4	muck, some sand and peat	salt marsh
	5	clay, some silt	Presumpscot Formation

TEST HOLES FROM SEWER CONTRACT 18 AREA, HUNNEWELL HILL AND EIGHT CORNERS REGION, BOROUGH OF SCARBOROUGH

Copies of the original drill logs for sewers in this area, under construction during 1987, were kindly provided by Bob Arsenault and John Kennedy, of the Scarborough office of Whitman and Howard, the engineering firm supervising construction. These data are summarized in tabular form here, and the copies of the logs are on file at the Maine Geological Survey. No quantitative estimates of the material composition were provided in these logs; only qualitative descriptors.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
18-1	3	gravelly fine sand	artificial fill
	6	fine sand	nearshore deposit
	6	silty clay	Presumpscot Formation

NOTE - observations made adjacent to the road suggest that 2 to 3 feet of coarse to fine sand are present above the silty clay of the Presumpscot Formation. This material has been removed and replaced by artificial fill along the paved road between sites 18-2 and 18-6.

18-2	3	gravelly fine sand	artificial fill
	9	silty clay	Presumpscot Formation
18-3	3	gravelly fine sand	artificial fill
	5	silty clay	Presumpscot Formation
18-4	3	gravelly fine sand	artificial fill
	5	silty clay	Presumpscot Formation
18-5	3	gravelly fine sand	artificial fill
	6	silty clay	Presumpscot Formation
18-6	3	gravelly fine sand	artificial fill
	6	silty clay	Presumpscot Formation
18-7	4	gravelly medium to fine sand	artificial fill
	3.5	silty clay	Presumpscot Formation
	0.5	fine gravelly, fine sandy silt with decayed rock	Wisconsinan till
	Refusal		
18-8	4	gravelly medium to fine sand	artificial fill
	2.5	silty clay	Presumpscot Formation
	0.5	fine gravelly fine sandy silt	Wisconsinan till
	0.5	rock	

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
18-9	3	gravelly fine sand	artificial fill
	4	silty clay	Presumpscot Formation
	3.4	fine sandy silt trace fine gravel	Wisconsinan till
	Refusal		
18-10	3	gravelly fine sand	artificial fill
	4	fine sand	nearshore deposit
	7	silty clay	
18-11	3	gravelly fine sand	artificial fill
	4	fine sand	nearshore deposit
	7	silty clay	Presumpscot Formation
18-12	7	fine sand	nearshore deposit
	10.7	fine sandy silt with fine gravel	Wisconsinan till
18-13	4	gravelly fine sand	artificial fill
	0.7	rock	
18-14	3	gravelly fine sand	artificial fill
	11	silty clay	Presumpscot Formation
	1	medium to fine sand with weathered rock	Wisconsinan till
18-15	3	gravelly fine sand	artificial fill
	11	fine sandy silt	nearshore deposit
	9	fine sandy silt with fine gravel	Wisconsinan till or distal submarine outwash
18-16	3	gravelly fine sand	artificial fill
	10	medium to fine sandy silt	nearshore deposit
	8.3	fine sand	submarine outwash
	3.7	weathered rock	
	Refusal		
18-17	3	gravelly fine sand	artificial fill
	6	silty clay	Presumpscot Formation
	12.1	medium to fine sand	submarine outwash
	Refusal		
18-18	3	gravelly fine sand	artificial fill
	4	medium to fine sand	nearshore deposit
	8.5	silty clay	Presumpscot Formation
	5.5	medium to fine sand	submarine outwash
18-19	3	gravelly fine sand	artificial fill
	5	medium to fine sand	nearshore deposit
	8	silty clay	Presumpscot Formation
	1	fine sandy silt with fine gravel	Wisconsinan till
18-20	3	gravelly fine sand	artificial fill
	10.5	silty clay	Presumpscot Formation
	0.5	fine sandy silt	distal submarine outwash
18-21	3	gravelly fine sand	artificial fill
	11	silty clay	Presumpscot Formation
	1	fine sandy silt	distal submarine outwash
18-22	3	gravelly fine sand	artificial fill
	5	fine sand	nearshore deposit
18-22	6	silty clay	Presumpscot Formation
18-23	3	gravelly fine sand	artificial fill
	6	fine sand	nearshore deposit
18-24	9	fine gravelly fine sand	nearshore deposit
	0.5	fine sandy silt	distal submarine outwash
18-25	10	fine gravelly fine sand	nearshore deposit
	0.1	weathered rock	
	Refusal		
18-26	12	fine gravelly fine sand	nearshore deposit
18-27	8.5	fine gravelly fine sand	nearshore deposit
	0.5	fine sandy silt with fine gravel	Wisconsinan till
18-28	4.5	fine gravelly sand	nearshore deposit
	0.5	rock	
	Refusal		
18-29	8.5	fine gravelly fine sand	nearshore deposit
	Refusal		
18-30	9.6	fine gravelly fine sandy silt	Wisconsinan till
	Refusal		
18-31	4.7	gravelly fine sandy silt	Wisconsinan till
	0.4	rock	
	Refusal		
18-32	8.5	fine gravelly fine sandy silt	Wisconsinan till
	0.5	rock	
	Refusal		
18-33	11.4	fine gravelly fine sandy silt	Wisconsinan till
	Refusal		
18-34	10	fine gravelly fine sandy silt	Wisconsinan till
18-35	9	fine gravelly fine sandy silt	Wisconsinan till
18-36	8.3	fine gravelly fine sandy silt	Wisconsinan till
	Refusal		
18-37	3	gravelly fine sand	artificial fill
	5	fine sandy silt	proximal Presumpscot Formation
	3.3	gravelly fine sand with weathered rock	Wisconsinan till
18-38	3	fine gravelly fine sand	artificial fill
	7	fine sandy silt	proximal Presumpscot Formation
18-39	3	fine sand	nearshore deposit
	2	silty clay	Presumpscot Formation
	3	fine sandy silt	proximal Presumpscot Formation
	0.7	rock	
	Refusal		
18-40	5	fine gravelly fine sand	nearshore deposit
	0.5	fine sand with weathered rock	Wisconsinan till
18-41	9	fine sand	nearshore deposit
18-42	8	fine gravelly fine sand	nearshore deposit
	1	fine gravelly fine sandy silt	Wisconsinan till
18-43	3	fine gravelly fine sand	nearshore deposit
	4.5	fine sand	nearshore deposit
	1.5	fine sandy silt trace clay	proximal Presumpscot Formation
18-44	7	fine gravelly medium to fine sand	nearshore deposit
	2	silty clay	Presumpscot Formation
18-45	3	fine gravelly medium to fine sand	nearshore deposit
	5	fine sandy silt	proximal Presumpscot Formation
	0.5	fine sandy silt with weathered rock	Wisconsinan till
	Refusal		
18-46	10	fine gravelly medium to fine sand	nearshore deposit
18-47	9	fine gravelly fine sand	nearshore deposit
	1	fine gravelly sandy silt	Wisconsinan till

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
18-48	4	fine sand	nearshore deposit
	1	rock	
	Refusal		
18-49	3	fine sand	nearshore deposit
	5.5	silty clay	Presumpscot Formation
	0.5	medium to fine sand	submarine outwash
18-50	3	gravelly fine sand	nearshore deposit
	7	gravelly fine sandy silt	Wisconsinan till
18-51	4	fine gravelly fine sand	nearshore deposit
	0.5	rock	
	Refusal		
18-51A	7	fine gravelly fine sand	nearshore deposit
	14	fine gravelly fine sandy silt	Wisconsinan till
18-52	9	gravelly medium to fine sand	Pleistocene alluvium
18-53	3	gravelly fine sand	artificial fill
	5	fine sand	Pleistocene alluvium
	4	silty clay	Presumpscot Formation
18-54	3	gravelly fine sand	artificial fill
	11	fine sand	Pleistocene alluvium
	1.5	silty clay	Presumpscot Formation
18-55	7	gravelly medium to fine sand	artificial fill and/or Pleistocene alluvium
	7	silty clay	Presumpscot Formation
18-56	5.5	gravelly fine sand	artificial fill
	6.5	silty clay	Presumpscot Formation
18-57	4	gravelly fine to medium sand	artificial fill
	9	silty clay	Presumpscot Formation
18-58	4	gravelly fine sand	Pleistocene alluvium
	5.3	silty clay	Presumpscot Formation
	3.7	gravelly fine to medium sand	submarine outwash
	6.5	gravelly fine sandy silt	Wisconsinan till
18-58A	3.5	silty fine to coarse sandy gravel	artificial fill
	7.5	silty fine sand, fine sandy silt, trace organics	Holocene alluvium of Red Brook
	2	fine to medium sandy silt with coarse sand and gravel	Wisconsinan till
	8.5	fine to coarse sand sand with gravel, trace silt	submarine outwash
18-60	3	gravelly fine sand	artificial fill
	14.2	silty clay	Presumpscot Formation
	8.3	fine to medium sand trace fine gravel	submarine outwash
18-61	3	gravelly fine sand	artificial fill
	10.6	silty clay	Presumpscot Formation
	16.4	silty fine to medium sand with fine gravel	distal submarine outwash
18-62	3	gravelly fine sand	artificial fill
	11	silty clay	Presumpscot Formation
	17.5	fine to medium sand with fine gravel	submarine outwash
18-63	3	gravelly fine sand	artificial fill
	14.2	silty clay	Presumpscot Formation
	10.8	fine to medium sand with trace fine gravel	submarine outwash
18-64	3	gravelly fine sand	artificial fill
	21.5	silty clay	Presumpscot Formation
18-65	5	gravelly fine sand	artificial fill
	7.8	silty clay	Presumpscot Formation
	8.7	silty fine sand	distal submarine outwash
18-66	4	gravelly fine sand	artificial fill
	10	silty clay	Presumpscot Formation
	7.5	silty fine sand	distal submarine outwash
18-67	3.7	gravelly fine sand	artificial fill
	21.8	silty clay	Presumpscot Formation
18-68	21.5	silty clay	Presumpscot Formation
18-69	4	gravelly fine sand	artificial fill
	16	silty clay	Presumpscot Formation
18-70	3	gravelly medium to fine sand	artificial fill
	7	silty clay	Presumpscot Formation
18-71	3	gravelly medium to fine sand	artificial fill
	5	silty clay	Presumpscot Formation
18-72	3	gravelly fine sand	artificial fill
	9	silty clay	Presumpscot Formation
18-73	4	gravelly fine sand	artificial fill
	8	silty clay	Presumpscot Formation
18-74	3.7	gravelly fine sand	artificial fill
	8.3	silty clay	Presumpscot Formation
18-75	3	gravelly fine sand	artificial fill
	9	silty clay	Presumpscot Formation
18-76	4	gravelly fine sand	artificial fill
	6	silty fine sand	Holocene alluvium
18-77	3	gravelly fine sand	artificial fill
	3.5	silty clay	Presumpscot Formation
	1.5	silty clay with sand layers	proximal Presumpscot Formation
18-78	6	gravelly fine sand	artificial fill and Pleistocene alluvium
	0.5	fine sand	Pleistocene alluvium
	1.5	silty clay	Presumpscot Formation
18-79	8	gravelly fine sand	artificial fill and Pleistocene alluvium
18-80	3	gravelly fine sand	artificial fill
	7	silty clay	Presumpscot Formation
18-81	11	gravelly fine sand	Pleistocene alluvium
18-82	4	gravelly fine sand	artificial fill
	5	fine sand	Pleistocene alluvium
18-83	4	gravelly fine sand	artificial fill
	3	fine sand	Pleistocene alluvium
	6	silty clay	Presumpscot Formation
18-84	4	gravelly fine sand	artificial fill
	9	silty clay	Presumpscot Formation
18-85	3.5	gravelly fine sand	artificial fill
	12.5	silty clay	Presumpscot Formation
18-86	4	gravelly fine sand	artificial fill
	4	silty fine sand	Holocene alluvium of the Nonesuch River
18-87	3.5	gravelly fine sand	artificial fill
	4.5	sandy silt	Holocene alluvium of the Nonesuch River
18-87	2	silty clay	Presumpscot Formation
18-88	4	gravelly fine sand	artificial fill
	6	silty clay	Presumpscot Formation
18-89	5	gravelly fine sand	artificial fill
	5	silty clay	marsh sediments
	7	sandy silt with organics	Holocene alluvium and marsh sediments of the Nonesuch River
	11	silty clay	Presumpscot Formation

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
18-90	3	clayey silt, trace organics	marsh sediments
	4	fine to medium sand with wood	Holocene alluvium of the Nonesuch River
	13.5	silty clay	Presumpscot Formation
18-90A	1.5	fine sandy silt with organics	Holocene alluvium
	0.5	silty fine to medium sand	Holocene alluvium
	29.5	silty clay	Presumpscot Formation
18-90B	2	fine sandy silt with organics	Holocene alluvium
	2	fine to medium sand with coarse sand, trace silt	Holocene alluvium
	32.5	silty clay	Presumpscot Formation
	4	silty fine to coarse sand with gravel, trace cobbles	Wisconsinan till
	11	fine to coarse sandy silt with trace gravel	Wisconsinan till
18-91	7	gravelly fine sand with cobbles	Holocene alluvium
18-92	3	gravelly fine sand	artificial fill
	3	silty fine sand	Holocene alluvium
	2	silty clay	Presumpscot Formation
18-93	3	gravelly fine sand	artificial fill
	5	fine sandy silt with organics	swamp deposits
18-94	8	fine sandy silt with trace gravel	Holocene alluvium

NOTE - observations made adjacent to the road suggest that 2 to 3 feet of coarse to fine sand are present above the silty clay of the Presumpscot Formation. This material has been removed and replaced by artificial fill along the paved road between sites 18-95 and 18-99.

18-95	3	gravelly fine sand	artificial fill
	9	silty clay	Presumpscot Formation
18-96	4	gravelly fine sand	artificial fill
	12	silty clay	Presumpscot Formation
18-97	4	gravelly fine sand	artificial fill
	6	silty clay	Presumpscot Formation
18-98	3.5	gravelly fine sand	artificial fill
	6.5	silty clay	Presumpscot Formation
18-99	4	gravelly fine sand	artificial fill
	6	silty clay	Presumpscot Formation
18-100	5	gravelly medium to fine sand	artificial fill
	2	silty clay	Presumpscot Formation
	1	silty clay with sand layers	Presumpscot Formation interbedded with distal submarine outwash
18-101	4	fine sand	nearshore deposit
	4	silty clay	Presumpscot Formation
18-102	2	fine sand	nearshore deposit
	5	silty clay	Presumpscot Formation
	1	silty clay with sand layers	Presumpscot Formation interbedded with distal submarine outwash
18-103	3	fine sand	nearshore deposit
	3.5	silty clay	Presumpscot Formation
	1.5	fine sand with decayed rock	Wisconsinan till
	Refusal		
18-104	3	fine sand	nearshore deposit
	8	silty clay	Presumpscot Formation
	1	fine sand with weathered rock	Wisconsinan till
18-105	3	fine sand	nearshore deposit
	1	fine sand with fine gravel	submarine outwash
	1	weathered rock	
	Refusal		
18-106	4	gravelly fine sand	nearshore deposit
	4	silty clay	Presumpscot Formation
	2	fine sandy silt with fine gravel	Wisconsinan till
	Refusal		
18-106A	3	gravelly fine sandy silt	Pleistocene alluvium
	4	silty clay	Presumpscot Formation
	Refusal		
18-107	2	gravelly fine sand	artificial fill
	7	silty clay	Presumpscot Formation
18-108	2	gravelly medium to fine sand	artificial fill
	6	silty clay	Presumpscot Formation
18-109	10.5	silty clay	Presumpscot Formation
	1.5	gravelly fine sandy silt	Wisconsinan till
18-110	4	gravelly fine sand	artificial fill
	26	silty clay	Presumpscot Formation
18-111	6	gravelly medium to fine sand	artificial fill
	4.5	silty clay	Presumpscot Formation
	16.5	fine gravelly fine sandy silt	Wisconsinan till
18-112	3	gravelly medium to fine sand	artificial fill
	20	silty clay	Presumpscot Formation
	2	silty fine sand	distal submarine outwash
18-113	3	gravelly medium to fine sand	artificial fill
	19	silty clay	Presumpscot Formation
18-114	3	gravelly medium to fine sand	artificial fill
	18	silty clay	Presumpscot Formation
18-115	4	gravelly medium to fine sand	artificial fill
	17.5	silty clay	Presumpscot Formation
18-116	3	gravelly medium to fine sand	artificial fill
	11	silty clay	Presumpscot Formation
	5.5	gravelly medium to fine sand	submarine outwash
18-117	5.5	gravelly medium to fine sand	artificial fill
	11.5	silty clay	Presumpscot Formation
18-118	1	gravelly medium to fine sand	artificial fill
	14.5	fine sand	Pleistocene alluvium
18-119	8	gravelly medium to fine sand	artificial fill and/or Pleistocene alluvium
	4	fine sand	Pleistocene alluvium

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
18-120	7	gravelly medium to fine sand	artificial fill and/or Pleistocene alluvium
	4.5	fine sand	Pleistocene alluvium
18-121	10	gravelly medium to coarse sand	Pleistocene alluvium

TEST BORINGS ALONG THE I-295-ROUTE 1 CONNECTOR RIGHT OF WAY

These test borings were made along the right of way of the Interstate Highway 295-Route 1 connector, shown on the surficial materials map. The format for the boring site information is:

First line: Numeric designation of the test hole, given in the Department of Transportation files. These usually consist of two letters followed by numbers. This designation is omitted when none was assigned.

Second line: Station location of the test hole, given as the number of 100 foot stations from the start of the project plus the number of feet beyond the station.

Third line: Number of feet left (east) or right (west) of the centerline (cl) of the right-of-way, or cl for test holes on the right-of-way line. For reference in the field, the two lanes of the highway are usually 32 feet left and right of the right-of-way line.

Fourth line: The elevation of the test hole site in feet, where this information is available.

The authors wish to acknowledge the cooperation of the Scarborough office of the Maine Department of Transportation, who permitted access to their files.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
AC-64	10	coarse sand	Pleistocene alluvium
160-00	5	silty clay, sand layers	Presumpscot Formation
3 rt	15	silty clay	Presumpscot Formation
(48 ft	15	silty clay, shells	Presumpscot Formation
	24	silty clay, sand layers	Presumpscot Formation
	Refusal		
161+00	20	sand	Pleistocene alluvium
	5	interbedded sand and clay interbedded with estuarine sands during recession	Presumpscot Formation
	23	clay	Presumpscot Formation
	7	stony clay	Wisconsinan till
AC-65	3	topsoil	
163+00	6	medium sand	Pleistocene alluvium
5 rt	9	fine sand	Pleistocene alluvium
(49 ft)	5	interbedded sand silt and clay	Presumpscot Formation interbedded with estuarine sands
AC-65 (cont.)	14	sensitive silty clay	Presumpscot Formation
	8	sensitive silty clay with shells	Presumpscot Formation
	5	silty sand	distal submarine outwash
165+00	19	sand	Pleistocene alluvium
	2	clayey silt	Presumpscot Formation
	Probed to 43 feet, no refusal		
CB-1	2	sand and wood	topsoil
166+50	18	sand	Pleistocene alluvium
	14	silty clay, sand layers	Presumpscot Formation interbedded with estuarine sands
	21	silty clay, shells	Presumpscot Formation
	3.5	sand and gravel	submarine outwash
	5	rock	
167+50	7	sand	Pleistocene alluvium
	Probed to 39 feet, no refusal		
168+50	14	sand	Pleistocene alluvium
	2	clay	Presumpscot Formation
	Probed to 55 feet through clay to a high blow count layer (till ?)		
169+50	8	sand	Pleistocene alluvium
	5	clay	Presumpscot Formation
	Probed to 38 feet through clay to a silty sand layer		
171+50	5	sand	Pleistocene alluvium
	8	clay	Presumpscot Formation
	Probed to 31 feet through clay to a high blow count layer (till ?)		
AB-34	4	peat	swamp
172+00	1	sand	Pleistocene alluvium
CL	5	sandy silty clay	Presumpscot Formation mixed with estuarine sands during recession
	19	silty clay	Presumpscot Formation scattered shells
	6	silty sand, many stones	Wisconsinan till
172+50	Probed to 30 ft, low blow count (clay ?) Probed to 38 ft, high blow count (till ?) Refusal		
173+50	6	sand	Pleistocene alluvium
	21	clay	Presumpscot Formation
176+50	5	sand	Pleistocene alluvium
	14	clay	Presumpscot Formation
179+50	9	sand	Pleistocene alluvium
	7	clay	Presumpscot Formation
	Probed to 55.5 ft through clay		
181+00	11	sand	Pleistocene alluvium
183+00	6.5	sand	Pleistocene alluvium
184+00	6	sand	Pleistocene alluvium
185+00	8	sand	Pleistocene alluvium
186+00	5	sand	Pleistocene alluvium

NOTE: Stations 189+00 to 194+00 - Most borings indicate up to 10 feet of sand, interpreted as Pleistocene alluvium deposited during the marine regression, overlying Presumpscot Formation silty clays, which are locally up to 80 feet deep.

189+50 cl (49 ft)	7	sand	Pleistocene alluvium
190+00 32 lt (48 ft)	4.5	sand	Pleistocene alluvium
	1	silty clay	Presumpscot Formation

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
190+00	10	sand	Pleistocene alluvium
32 rt			
(48 ft)			
191+00	5	sand	Pleistocene alluvium
32 lt	1	clayey silt	Presumpscot Formation
(44 ft)	4	sand	submarine outwash
191+00	10	sand	Pleistocene alluvium
cl			
(48 ft)			
191+00	10	sand	Pleistocene alluvium
32 rt	1	clayey silt	Presumpscot Formation
(48 ft)			
192+00	9	sand	Pleistocene alluvium
32 lt			
(47 ft)			
192+00	7.5	sand	Pleistocene alluvium
32 rt	1.5	clayey silt	Presumpscot Formation
(47 ft)			
192+50	8	sand	Pleistocene alluvium
cl			
(47 ft)			
193+00	8	sand	Pleistocene alluvium
32 lt			
(45 ft)			
193+00	7	sand	Pleistocene alluvium
32 rt			
(45 ft)			
193+50	10	sand	Pleistocene alluvium
cl			
(43 ft)			
NOTE: Stations 194+00 to 208+00 - On a lower terrace surface, only a thin remnant of the Pleistocene alluvium is preserved over the Presumpscot Formation silty clays. Some thin surface peats are present in minor swamps.			
194+00	1	peat	swamp
32 lt	3.5	sand	Pleistocene alluvium
(37 ft)			
194+00	1.5	peat	swamp
32 rt	2.5	sand	Pleistocene alluvium
(37 ft)	0.5	clayey silt	Presumpscot Formation
194+50	1	peat	swamp
cl	1	sandy silt	swamp
(36 ft)	2	sand	Pleistocene alluvium
195+00	1	peat	swamp
32 lt	4	coarse sand	Pleistocene alluvium
(36 ft)			
195+00	1	peat	swamp
32 rt	3.5	sand	Pleistocene alluvium
(36 ft)			
196+00	5	sand	Pleistocene alluvium
32 lt			
(36 ft)			
196+00	4	sand	Pleistocene alluvium
32 rt		clay seam	
(36 ft)	1	sand	Pleistocene alluvium
197+00	1.5	humus	soil
32 lt	3.5	coarse sand	Pleistocene alluvium
(36 ft)			
197+00	7.5	sand	Pleistocene alluvium
32 rt			
(36 ft)			
197+50	1	humus	soil
cl	4	sand	Pleistocene alluvium
(37 ft)			
198+00	1	humus	soil
32 lt	6	sand	Pleistocene alluvium
(35 ft)			
198+00	3	sand	Pleistocene alluvium
32 rt			
(36 ft)			
198+50	5	sand	Pleistocene alluvium
cl			
(35 ft)			
199+00	4	sand	Pleistocene alluvium
cl	1	pebbly sand	Pleistocene alluvium
(34 ft)			
199+00	5	sand	Pleistocene alluvium
32 rt			
(34 ft)			
200+00	5.5	sand	Pleistocene alluvium
cl			
(33 ft)			
200+50	5	sand	Pleistocene alluvium
32 lt			
(34 ft)			
200+50	5	sand	Pleistocene alluvium
32 rt			
(33 ft)			
201+50	3	silty pebbly sand	Pleistocene alluvium
32 lt	1.5	pebbly sand	Pleistocene alluvium
(35 ft)	3.5	sand	Pleistocene alluvium
201+50	8	sand	Pleistocene alluvium
32 rt			
(35 ft)			
202+50	7	sand	Pleistocene alluvium
32 lt			
(33 ft)			
202+50	5	sand	Pleistocene alluvium
32 rt			
(32 ft)			
203+50	2.5	sand	Pleistocene alluvium
32 lt	2	clay interbedded with sand and silt	Presumpscot Formation interbedded with distal submarine outwash
(31 ft)			
203+50	6	sand	Pleistocene alluvium
32 rt			
(31 ft)			
204+00	4	sand	Pleistocene alluvium
cl	3	clay, sand layers	Proximal Presumpscot Formation
(31 ft)	Probed to 32 feet, clay		
204+50	3	sand	Pleistocene alluvium
32 lt	1.5	sand and silt	Pleistocene alluvium
(31 ft)	0.5	clayey silt	Presumpscot Formation
	2.5	sand	submarine outwash
	0.5	clay, sand and silt	distal submarine outwash
204+50	5	sand	Pleistocene alluvium
32 rt	3.5	interbedded sand clay and silt	distal submarine outwash
(31 ft)			
205+50	8	sand	Pleistocene alluvium
32 lt			
(29 ft)			

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
205+50	3	sand	Pleistocene alluvium
32 rt	2	clay to silt	Presumpscot Formation
(28 ft)	Probed to 15 ft, clay		
206+00	4	sand	Pleistocene alluvium
cl	5	clay, sand layers	proximal Presumpscot Formation
(28 ft)			
206+50	7	sand	Pleistocene alluvium
32 lt			
(28 ft)			
206+50	4	sand	Pleistocene alluvium
32 rt	3	clay with sand layers	proximal Presumpscot Formation
(26 ft)			
207+00	3.5	sand	Pleistocene alluvium
cl	1	clay, silt	Presumpscot Formation
(27 ft)	2	sand	(?)
	4	clay	Presumpscot Formation
	Probed to 79 ft, clay		
207+50	5	sand	Pleistocene alluvium
32 lt			
(26 ft)			
207+50	2	sand	Pleistocene alluvium
32 rt	0.5	clay, silt	Presumpscot Formation
(26 ft)	1	sand	submarine outwash
	1	clay, silt	Presumpscot Formation
	2	sand	submarine outwash

NOTE: Stations 208+00 to 212+00 - Interbedded Holocene alluvial sands and organic silts and clays, up to 17 feet thick, cut into the Presumpscot Formation. These sensitive clays thin and shallow to bedrock at Station 212+00.

208+00	7	sand	Holocene alluvium
cl			
(26 ft)			
208+50	5.5	sand	Holocene alluvium
32 lt	Probed to 50 ft, low blow count (clay?)		
(23 ft)	Probed to 58 feet, no refusal		
208+50	2	peat	swamp
32 rt	2	sand	Holocene alluvium
(25 ft)	2	clay	Presumpscot Formation
	1	sand	estuarine sand (?)
	Probed to 55 ft, clay		
CB-60	9	clayey silt, organic	Holocene swamp and
209+48		and sand layers	alluvial deposits
32 lt	13	silty clay, sand and silt layers at base	Presumpscot Formation
	3	silty sand and gravel	Wisconsinan till
	Refusal		
CB-61	10	silty clay, sand layers	Holocene swamp
209+55	9	silty clay	Presumpscot Formation
32 rt	10	silty clay, sand layers	proximal Presumpscot Formation
	2	sand and gravel	Wisconsinan till
	Refusal		
CB-59	3	sand	Holocene alluvium
209+60	6	sandy clayey silt	Holocene alluvium
100 lt		and sand layers	
	7	fine to coarse sand and organic silt	Holocene alluvium
	9	silty clay	Presumpscot Formation
	8	silty clay, sand layers	proximal Presumpscot Formation
	Refusal		
CB-62	9	silty clay	Presumpscot Formation
210+00	19	silty clay, scat. shells	Presumpscot Formation
100 rt	3	silty sand and gravel	Wisconsinan till
CB-66	7	organic sandy silt and silty sand	Holocene swamp and alluvium
210+05			
32 lt	4	coarse sand and gravel zones of organics	Holocene alluvium
	2	interlayered silty clay and coarse sand, gravel	Holocene swamp and alluvium
	5	silty clay	Presumpscot Formation
	5	silty sand and gravel	Wisconsinan till
CB-65	8	interlayered silty clay	Holocene swamp
211+00		and coarse sand	and alluvium
65 lt	Rock		
CB-64	6	medium to coarse sand	Holocene alluvium
211+00	8	silty clay	Presumpscot Formation
CL	4.5	silty sand and ang. rock	Wisconsinan till
	Rock		
NR-3	17	silt, sand and rotten wood	Holocene swamp
210+45	6	silt, sand, gravel	Wisconsinan till
CL		and weathered rock	
	6	rock	
CB-63	4	silty clay	Holocene swamp
211+00	2	fine sand, scat. pebbles	Holocene alluvium
65 rt	2	silty clay, sandy layers	Holocene alluvium
	10	clayey, silty sand and gravel	Wisconsinan till
	7	silty clayey gravel	Wisconsinan till
	4.5	rock	
NR-2	2	organic silt	Holocene swamp
211+45	5	silt and sand	Holocene alluvium
65 lt	1.5	silt, sand and gravel	Wisconsinan till
	6.5	rock	
NR-1	2	organic silt	Holocene swamp
211+45	7	silty clay	Presumpscot Formation
65 rt	7.5	sand and gravel alternate layers of silty clay	submarine outwash interbedded with Presumpscot Formation

NOTE: Station 212+00 to 216+00 - Thin till over bedrock.

NOTE: Station 216+00 to 225+00 - Thin nearshore sands overlying interbedded silty clay and sand and gravel, interpreted as proximal Presumpscot Formation, or Presumpscot Formation interbedded with submarine outwash.

CB-67	2	sand and gravel	nearshore deposit
218+55	13	silty clay, sand	proximal Presumpscot Formation
75 rt	5	silty gravelly sand	Wisconsinan till
CB-71	2	silty sand	nearshore deposit
219+50	7	silty clay	Presumpscot Formation
75 lt	4	silty clay, sand layers	proximal Presumpscot Formation
	2	silty clay, gravel layers	proximal Presumpscot Formation
	6	silty clay	Presumpscot Formation
	3.5	silty clayey sand and gravel	Wisconsinan till
CB-68	1	organic sandy silt	Holocene swamp
219+50	2	silty sand	nearshore deposit
75 rt	10	silty clay	Presumpscot Formation
	6	layered silty clay, silt and sand	proximal Presumpscot Formation
	4	silty sand and gravel	Wisconsinan till

APPENDIX A. CONTINUED.

Boring No.	Thickness (in feet)	Description of Subsurface Materials	Lithologic Interpretation
CB-70	2	silty sand	nearshore deposit
220+50	14.5	silty clay, sand	Presumpscot Formation
75 lt		layers at base	
	Refusal		
CB-69	1	organic sandy silt	Holocene swamp
220+50	1	sand and gravel	nearshore deposit
75 rt	20	silty clay	Presumpscot Formation
	8	silty sand and gravel	Wisconsinan till
	Refusal		

NOTE: Station 225+00 to 231+00 - Five to ten feet of Presumpscot Formation silts and clays with some interbedded sands, overlying thin Wisconsinan till.

NOTE: Station 231+00 to End of Project - Thin Wisconsinan till over bedrock, with occasional ponded pockets of Presumpscot Formation silts and clays.

CB-79	9	silty clay	Presumpscot Formation
238+40	6.5	silty pebbly sand	Wisconsinan till
169 lt	5	rock	
CB-78	12	sand and silt, pebbles	Wisconsinan till
239+11		and weathered rock	
212 lt	5	rock	
CB-84	9	sandy, clayey silt	proximal Presumpscot Formation
239+32	9.5	gravelly sandy	Wisconsinan till
125 lt		clayey silt	
	6.5	rock	
CB-74	11	sandy silty clay	proximal Presumpscot Formation
239+40	3.5	silty sand with	Wisconsinan till
169 lt		sandy silt	
	5	rock	
CB-73	14	clayey sandy silt	proximal Presumpscot Formation
239+73	1	sand and gravel	submarine outwash
122 lt	5	rock	
CB-80	10	silty clay	Presumpscot Formation
240+06	4	silty sand	distal submarine outwash
201 lt	1	sand and gravel	submarine outwash
	7	rock	
CB-77	5	silty clay	Presumpscot Formation
240+16	1	sand and gravel	submarine outwash
201 lt	1	weathered rock	
	10	rock	
CB-76	11	sandy silty clay	proximal Presumpscot Formation
240+46	3	silty sand with rocks	Wisconsinan till
160 lt		and silty clay	
	6	rock	
CB-75	4	silty clay	Presumpscot Formation
240+94	1	weathered rock	
107 lt	7	rock	
240+96	3.5	silty sand and gravel	Wisconsinan till
154 lt	8	rock	
241+25	6	silt, sand, broken rock	nearshore deposit
107 lt	4	rock	
241+30	11	rocky sandy clayey silt	Wisconsinan till
72 lt	5	rock	
241+59	9	sandy silt, weath. rock	Wisconsinan till
40 lt	4	rock	
241+97	10	sandy silt	nearshore deposit
19 rt	2	sandy silt and	Wisconsinan till
		coarse gravel	
	6	rock	
242+35	2	organic silt	swamp deposit
67 rt	11	sandy silt	nearshore deposit
	6	rock	
242+80	5.5	sandy silt, broken rock	nearshore deposit
19 rt	6	rock	