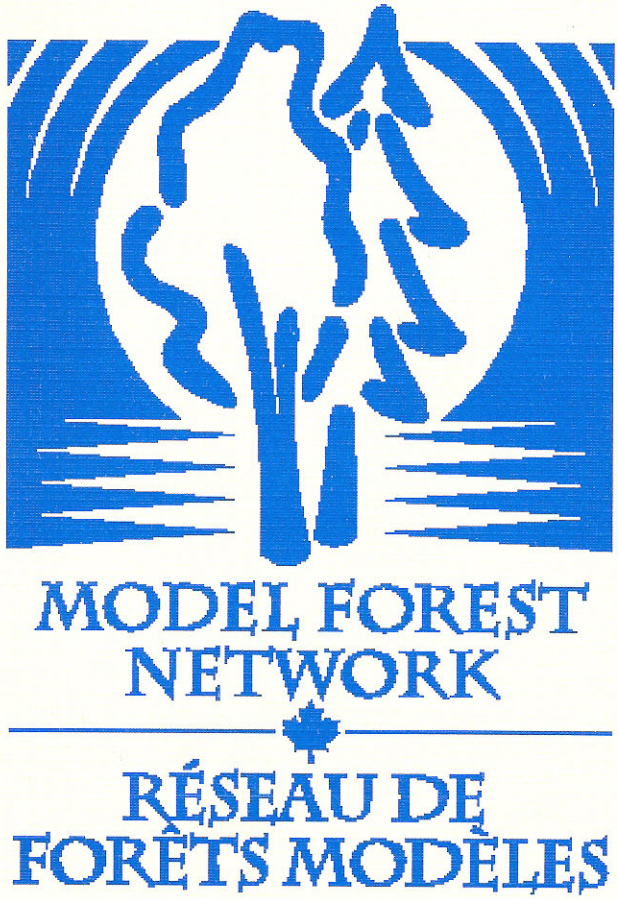
FUNDY MODEL FOREST

SOILS

OF THE

FUNDY MODEL FOREST



SOILS

OF THE

FUNDY MODEL FOREST

SOILS OF THE FUNDY MODEL FOREST

Sherif H. Fahmy

Agriculture and Agri-Food Canada
Research Branch, Centre for Land
and Biological Resources Research
Land Resources Division

and

Mark C. Colpitts

New Brunswick Department of
Natural Resources and Energy
Timber Management Branch

CLBRR Contribution No. 95-56

This project was funded by the Model Forests Program
Canada's Green Plan

1995

- Copies of this report are available from:

Agriculture and Agri-Food Canada, Research Branch,
New Brunswick Land Resources Unit,
Centre for Land and Biological Resources Research
P.O. Box 20280, Fredericton, NB E3B 4Z7

- New Brunswick Department of Natural Resources and Energy, Timber Management Branch, P.O. Box 6000, Fredericton, NB E3B 5H1

- Fundy Model Forest
R.R. #4, Aiton Road, Sussex, NB E0E 1P0

Digital data for the soil maps are available from the Fundy Model Forest office at a scale 1:50,000

TABLE OF CONTENTS:

TABLE OF CONTENTS: (Cont'd.)

LIST OF TABLES

LIST OF FIGURES

ACKNOWLEDGMENTS

The authors wish to thank the members of the soils technical sub-committee of the Fundy Model Forest for encouragement and support for this project. Thanks are also extended to the management and members of the Fundy Model Forest Geographic Information System and to the New Brunswick Department of Natural Resources and Energy (NBDNR&E) Timber Management Branch teams for their effort in the production of the soils map and the publication of this report. We would also like to thank Dr. Taumey Mahendrappa of Natural Resources Canada, Canadian Forest Service-Maritime, Mr. Herb Rees of Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research (CLBRR), and Mr. Vincent Zelazny of the New Brunswick Department of Natural Resources and Energy, Timber Management Branch for their suggestions during the project and for reviewing the manuscript of this report.

SUMMARY

This report concerns the mapping of forest soils of the Fundy Model Forest, the mapped area covers approximately 410 000 hectares. The area is bordered by latitude 45°10` in the south and latitude 46°15` in the north, longitude 64°35`in the east and longitude 66°05` in the west.

Along the Fundy Coast and extending to the central plateau, elevation ranged between 275 and 450 metres. In the Anagance Ridge area of the Caledonian Highlands elevation range is from 120 to 220 metres. In the Grand Lake Basin, elevations are found to be no greater than 180 metres. Drainage is generally good in the highlands and impeded in areas of lower elevation. The inland climate is drier and warmer than the climate along the Fundy Coast. The bedrock geology of the Fundy Model Forest is mainly of precambrian origin overlain by cambrian, lower ordovician, or carboniferous sedimentary and igneous rocks. The surficial deposits are of pre-Wisconsinan and Wisconsinan morainal, colluvial, and glacial outwash origin.

Seventy three percent of the area is under forest cover and 10% is in agriculture. Twenty-three percent of the forest cover is softwood, 25% hardwood, and 21% is mixed wood. The Fundy National Park constitutes 5% of the Fundy Model Forest area.

The basic unit of mapping in this report is the Forest Soil Unit. Forest Soil Units are defined in terms of the regolith's properties of the area and gross morphology of its profiles. Mineral forest soil units are dominated by well to imperfectly drained Podzols with minor occurances of Brunisols and few poorly drained Luvisols and Gleysols.

The overall texture of the solum and parent material is generally medium to coarse; few finer textured soils are also found. The coarse fragment content is generally $<$20-50% but with a few occurrences of $>$50%. Available rooting depth varies from $<$30 cm to 100 cm, with only minor occurrences of soils with $>$100 cm.

Forest Soil Units are described in this report, and their locations and geographic distribution are displayed on the map included in the inside of the back cover. More specific soil distribution information can be obtained from the digital data residing in the Fundy Model Forest Geographic Information system.

INTRODUCTION

The model forest approach deals with the balance of environmental, economic, and social needs of the forest inhabitants and users. The Fundy Model Forest is one of ten large scale working models of sustainable forest resource management development in Canada. It represents the Maritime Region of eastern Canada. Soil is considered to be one of twelve issues that had been identified to have an effect on the sustainable integrated management plan of the forest. In order to maintain the environmental integrity of the area, this forest soils report and map provide options and/or directions to forest managers during the planning and implementation stages. The map is used to quantify the abundance of different forest soils, and the spatial referencing of these soils will provide basic information needed to locate operations and research projects. It can also form the basis for analysis of other resources, for example, wood supply analysis requires site productivity information which can be partially derived from this

map. Similarly, ecological, bio-diversity, landscape, and water resources analysis also depend on the interpretation of soil resource data provided herein.

GENERAL DESCRIPTION OF THE AREA

Location and Extent

The 409 768 hectares of the Fundy Model Forest are located in southern New Brunswick. The general area is bordered to the south by that portion of the Fundy Bay between the town of Alma to the east and the Salmon River to the west. The eastern border stretches from Alma to Salisbury where the northern border follows Highway 112 parallel to the Canaan River west to Washademoak Lake. The western border follows the Saint John River from Belleisle Bay to the northern tip of the Kennebecasis Bay to the Salmon River (Figure 1).

The area encompasses all or part of the following National Topographical System (NTS) maps of 1:50 000 scale:

Map		Map	
Number	Name	Number	Name
G09	Hampstead	H13	Codys
G16	Grand Lake	H14	Petitcodiac
H04	Cape Spencer	H15	Hillsborough
H05	Lock Lomond	I02	Moncton
H06	Salmon River	I03	Salisbury
H10	Alma	I04	Chipman
H11	Waterford		
H12	Sussex		

Climate

Climate of the Fundy Model Forest area is typical of the Harvey-Harcourt and Fundy site regions (Zelazny et al. 1989). The inland Harvey-Harcourt site region has annual growing degree days above 5°C of 1400-1800 and mean total rainfall of 610 mm for the period April to November. Total snowfall averages 190 cm between November and April. Whereas, the thin strip of the Fundy site region along the Fundy Bay has fewer annual growing degree days above 5°C of 1400-1600 and more total rainfall of 761 mm during the period april to November, total snow fall averges 216 cm between November and April (Dzikowski et al. 1984 and Van Groenewoud 1983).

Based on climatic, physiographic and forest composition characteristics of the Fundy Model Forest, Matson and Power 1994 further subdivided the area by identifying the following climatic regions: the Fundy Coast, the Fundy Highland, the Southern Uplands, the New Brunswick Lowlands, and the Grand Lake regions (Figure 2).

Topography and Drainage

According to Bostock (1970) and Rampton et al. (1984), the majority of the survey area lies in the Caledonian Highlands, with only a small portion located in the New Brunswick Lowland's Grand Lake Basin.

Along the Fundy Coast and extending inland to the central plateau, the slopes are steep giving a rolling landform of elevations 275-450 m above sea level and an average relief of 60-90 m.

The ridge and valley topography of the Anagance Ridges reaches elevations of up to 300 m and an average relief range of 120-220 m. The small portion of the Grand Lake

Figure 1. General location of the Fundy Model Forest.

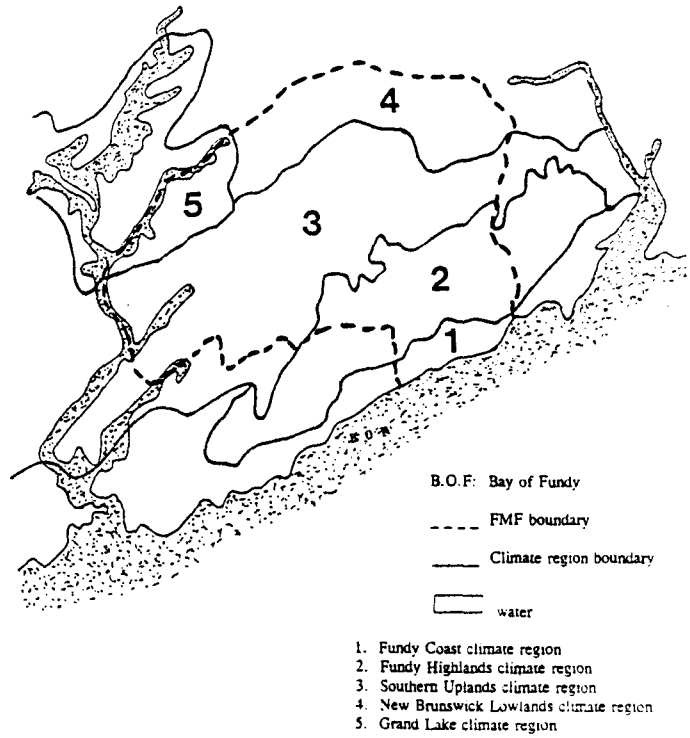


Figure 2. Climate regions of the Fundy Model Forest (modified from Matson and Power 1994).

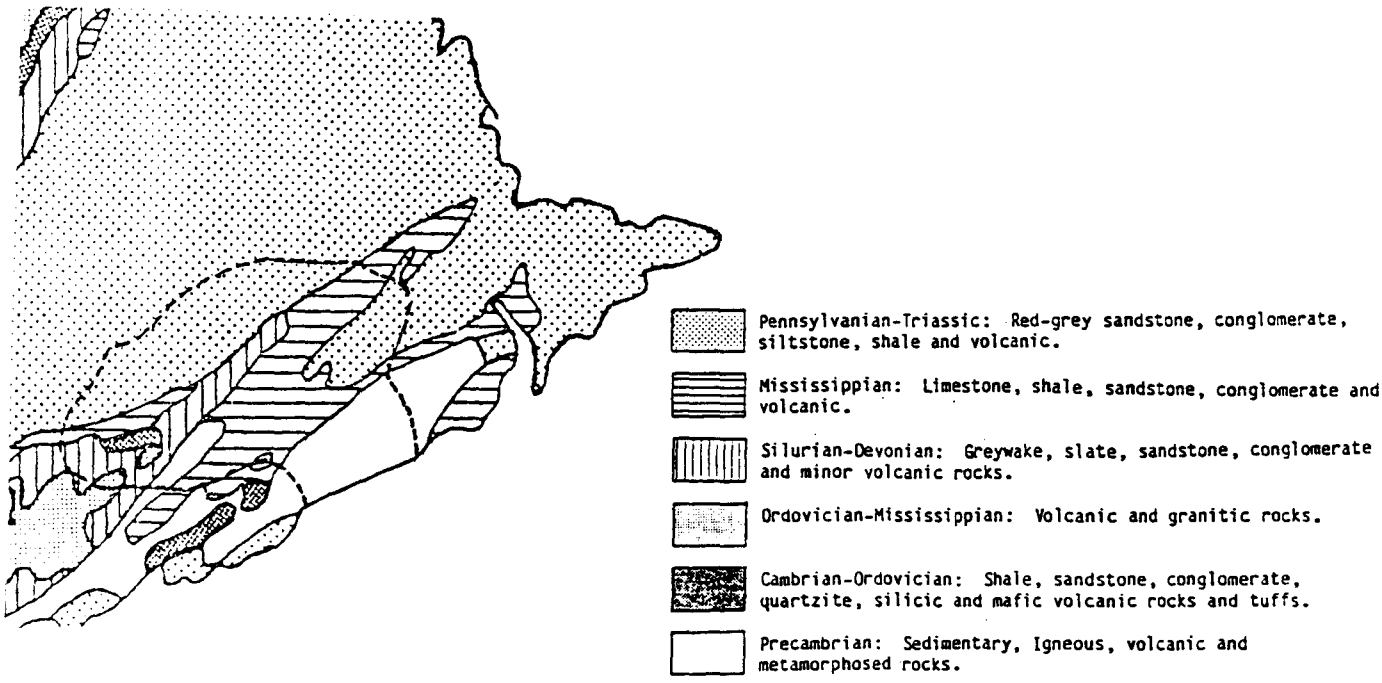


Figure 3. General rock types of the Fundy Model Forest (modified from Rampton et al. 1984).

Basin that occurs in the New Brusnwick Lowland is relatively flat, having elevations of no greater than 180 m and an average relief of 40-75 m resulting in the distinctive undulating landform of the basin.

The central plateau is generally well drained except on flat and depressional areas, where the drainage becomes impeded. The drainage pattern is predominantly radial with deeply incised streams, except at the southwestern end of the plateau where the drainage pattern becomes irregular due to glacial derangement, that resulted in less incised streams in the plateau surface.

The characteristic trellis drainage pattern of the high relief topography is observed in the Anagance ridges where drainage is generally good. In the wide valley bottoms, the drainage becomes impeded due to the deposition of glacial drift or alluvium and intertidal sediments (Rampton et al. 1984). The main drainage channels of this area are the Petitcodiac, Anagance, Kennebecasis, Hammond, and Salmon Rivers. The Grand Lake basin drainage is somewhat impeded due to the undulating and flat topography. The Canaan River and Washademoak Lake are the main drainage channels of this basin.

Geology

Bedrock Geology

The Fundy Model Forest lies within three tectonostratigraphic zones namely: the Caledonia, the Moncton Basin, and Central Platform (Rampton et al. 1984). In the Caledonia zone's western section, the Precambrian carbonate and clastic rocks are overlain by felsic volcanic rocks, but in the eastern section it is overlain by mafic

volcanic with minor felsic rocks. This Precambrian strata is also overlain by Cambrian to lower Ordovician shale, siltstone, sandstone, conglomerate, quartzite, and minor limestone. Parts of the zone is also overlain by Mississippian and Pennsylvanian sedimentary and volcanic rocks. The Moncton Basin is composed of carboniferous clastic sedimentary rock and red clastic, limestone, gypsum, and salt rocks.

The Central Platform is composed mainly of carboniferous Pennsylvanian sandstone with some local presence of siltstones, shales, and conglomerates. Some isolated outcrops of Mississippian and Silurian rocks are also present. Figure 3 depicts the bedrock geology of the Fundy Model Forest.

Surficial Geology

The pre-Wisconsinan and Wisconsinan surficial deposits of the Caledonian highlands dates back to early or middle Wisconsinan age (Rampton and Paradis 1981). Deposits are of undifferentiated stoney morainal and colluvial nature deposited as a blanket of stoney lodgment till with some scattered ablation till. The till varies from sandy to clayey and is rubbly to stoney to bouldery with an average thickness of 0.5 to 1.5 metres. Areas of colluvium and rock outcrop are present along the deeply entrenched valleys that drain the Central Plateau.

The northern edge of the Central Plateau is composed of sandy regolith over shattered sandstone. Ice contact gravels and outwash have also been identified within the Central Plateau of the Caledonian Highlands in the form of esker ridges and kettled gravelly outwash along the melt water channels crossing the plateau. Extensive areas

of outwash are present in the valley trains on the upper reaches of the Kennebecasis River. Subtill outwash is found along Smith Creek south of Cornhill in the Anagance Ridges.

Vegetation

The distribution of cover types within the Fundy Model Forest is reported in Table 1. Seventy three percent of the total area is forest; 10% is agriculture, mainly pasture, forages, and grain productions; 2% is cutover; and 5% is occupied by the Fundy National Park. The remainder is non productive and other lands. Geomorphology and climate play a major role in the distribution of the forest vegetation. Midslopes and valley bottoms of the Fundy Model Forest inland Harvey-Harcourt site region (Zelazny et al. 1989) are dominated by spruce-fir forest type, while upper slope supports the growth of yellow birch, *Betula alleghaniensis*, beech, *Fagus grandifolia*, and sugar maple, *Acer saccharium.* Red oak, *Quercus rubra*, white ash, *Fraxinus americana* and black cherry, *Prumus serotina* can be found on nutrient rich south facing sites. Abandoned farm land is colonized by white spruce, *Picea glauca.* Black spruce, *Picea mariana* and eastern larch, *Larix laricina* dominate the poorly drained lowerlands position.

The upland flats of the Fundy site region are occupied by yellow birch, red spruce, *Picea rubens*, and balsam fir, *Abies balsamea.* Tolerant hardwoods are found mainly on hilltops and at lower elevations white and red spruce and balsam fir are dominant. Old fields in this region have been invaded by white and red spruce and balsam fir.

Matson and Power (1994) reported that tolerant hardwoods on hilltops and mixed woods and conifers in low lying areas are the characteristic forest composition of the Fundy Highlands and southern Uplands climate regions, but in the New Brunswick lowlands climate region; conifers forms the majority of mixed stands. Greater diversity is found in the vegetation of the Grand Lake climate region where 32 tree species of the Great Lakes-St. Lawrence zone variety occur.

Agricultural land is dominated by dairy farms with large areas under pasture, forage, and mixed small grains. A very small area is under row crop production.

Table 1. Distribution of cover type within the Fundy Model Forest*

Cover type	Area in hectares	Percent of total area
Hardwood forest	105 605	25%
Softwood forest	96,233	23%
Mixedwood forest	88 028	21%
Agricultural land	42 316	10%
Other land	41 608	10%
Fundy National Park	20 700	5%
Forest plantation	14 836	4%
Cutover area (clearcut)	9 940	2%
Total	419 266	100%

*Courtesy J.D. Irving, Limited (1992) "The Fundy Model Forest Proposal" Saint John, New Brunswick

FOREST SOIL MAP COMPILATION

Methodology

Prior to the delineation of forest soil map unit polygons all existing relevant data sources were compiled, these data differed with respect to scale, content, and data quality. All existing geological (bedrock and surficial geology) and soil survey maps were reproduced as 1:50,000 scale paper and plastic overlays. The most detailed data was obtained from field check points. Since vegetation types are known to be correlated with specific soil conditions, New Brunswick forest inventory data was also used. The vegetation data assisted in the interpretation of organic deposits, impeded drainage areas, and poor versus rich site conditions.

Using the compiled information and professional knowledge of forest soil relationships as an "expert system," forest soil unit polygons were delineated on the 1: 50 000 scale plastic sheets. The degree of interpretation required during each mapping session, and our confidence in the resulting definition of the forest soil unit, was a function of the resource information available for the area and the intensity of actual field sampling (soil pits dug) at the above mentioned scale as recommended by the Mapping System Working Group (1981).

Although boundaries between soil polygons are shown as single lines, in reality they represent approximate gradients or transition zones where one forest soil unit grades into another. Due to the scale of mapping and the often complex and intricate pattern of soils across landscapes, inclusions of unspecified soils or non-soil bodies may occupy up to 30% of each forest soil unit polygon.

Legend Development

The basic unit of mapping in this report is the **Forest Soil Unit** which is defined as a "*naturally occurring segment of the regolith with distinct lithology characterized by the overlying parent material and solum*". The solum (A and B horizons) and parent material (C horizon) of each unit are described in terms of their primary lithology, mode of deposition, textural class, depth to contrasting layer or thickness, and coarse fragment content (Colpitts et al. 1995).

The central concepts of forest soil units are based on mapping units known as "Soil Associations" (Fahmy et. al. 1986). Soils associations are natural groupings of soils with similarities in climatic and geomorphologic factors and in soil parent material. The basic difference between a soil association and a forest soil unit is that a soil association possess a regional climatic context that is built into its definition and distribution, **whereas forest soil units do not connote a climatic regime, but are defined wholly on the regolith's properties and gross morphology of its profile**. Forest soil units with equivalent soil associations and series are reported in Colpitts et al. (1995).

In the Fundy Model Forest area there are a total of 34 forest soils units; of which 33 are mineral soil and one is an organic soil. Mineral soil map units are differentiated on parameters which includes: the primary lithology of the parent material(s); texture class of the solum (A and B horizons) and the parent material (C horizon); and depth to a contrasting layer (contrasting due to texture, consistency, degree of compaction or cementation and/or the presence of bedrock). They are described fully in Table 2.

Mapping Units

The mapping unit consists of the abbreviated Forest Soil Unit name (2 letters) followed by a numerical drainage class modifier followed by a letter indicating slope class ((ie. CA3b). Both internal drainage (resulting from texture, consistence, porosity, presence of compaction, stoniness and/or rockiness) and external drainage (resulting from slope, slope position, and the catchment area of the polygon) are integrated into the numerical drainage class modifier.

Table 2. Forest Soil Units Legend.

Forest Soil Unit	Map Symbol	Total Hectares	Primary Lithology of Parent Materials	Mode of Deposition	Texture Class Solum PM		Depth to Contrasting Layer	Coarse Fragment Content
Saltsprings	SS	6 292	**Grey Calcareous Mudstones Feldspathic to Lithic Sandstones and Minor Polymictic Conglomerates**	Compact Till	F	F	2-3	L
Erb Settlement	EB	7 528		Non-Compact Till or Residual	M-F	M-F	1-3/R	L-M
Salisbury	SA	53 821	**Red Mudstones, Feldspathic to Lithic Sandstones and Polymictic Conglomerates**	Compact Till	M-C	M-F	2-3	L
Parry	PR	23 675			M-C	M-C	2-3	L
Cornhill	CH	11 014		Residual	M-C	F	1-3/R	L
Parleeville-Tobique	PT	57 145	**Calcium Carbonate Present in the Cementing Material Minor Igneous and Metasedimentary Clasts**	Non-Compact Till	M-C	M-C	4	M-H
Kennebecasis	KN	11 269		Glaciofluvial	M-C	M-C	4	M-H
Tracadie	TD	223		Glaciomarine or Lacustrine	M	F	2-3	L
Stony Brook	SB	38 494	**Red Mudstones (Weathered)**	Compact Till	M	F	1-2	L
Harcourt	HT	29 644	**Minor Grey-Red Lithic-Feldspathic Sandstones, Quartzose Sandstones and Polymictic Conglomerates**		C-M	F	2-3	L-M
Becaguimec	BE	156		Non-Compact Till	M	M-C	4	L-M
Barriceau-Buctouche	BB	710		Glaciomarine/ Compact Till	C	M-F	3	L
Reece	RE	7 257	**Grey Lithic-Feldspathic Sandstones and Quartz Pebble Conglomerates**	Compact Till	C-M	M-F	2	M
Sunbury	SN	30 492		Non-Compact Till	C-M	C	4	M-H
Fair Isle	FA	1 754	**Minor Quartzose Sandstones, Polymictic Conglomerates and Red Mudstones**	Residual	M-C	C	1-3/R	M-H
Riverbank	RI	1 487		Glaciofluvial, Marine or Eolian	C	C	3-4/R	L-H
Tetagouche	TT	205	**Mafic Volcanics, Gabbros and Diorites**	Compact Till	M	F	2	M
Kingston	KI	1 252			M	M-C	2	M
Mafic Volcanic	MV	3 790		Residual or Non-Compact Till	M	F-M	1-3/R	M-H
Tuadook	TU	1 221	**Gneiss, Granites, Alkali Granites, Granodiorites and Quartz Diorites**	Compact Till	M-C	M-C	2	L
Juniper	JU	11 937		Non-Compact Till	M-C	C	4	L-M
Big Bald Mountain	BD	1 413		Residual	M-C	C	1-2/R	M-H
Popple Depot	PD	16 302	**Felsic Volcanic or Mixed Igneous Rocks and Felsic Pebble Conglomerates**	Compact Till	M	M-C	2	L-M
Jacquet River	JR	21 308		Non-Compact Till	M	M-C	4	M
Lomond	LO	26 401		Non-Compact Till or Residual	M	M-C	1-3/R	M-H
Gagetown	GG	3 526		Marine or Glaciofluvial	M-C	M-C	4	M-H
Long Lake	LL	6 728	**Metasedimentary Rocks Mixed With Igneous Rocks**	Compact Till	M	M	2	L
Britt Brook	BR	13 310	**[Igneous Clasts 20 - 50%]**	Non-Compact Till	M	M-C	4	L-M
Serpentine	SP	219		Residual	M	M	1-2/R	M-H
Catamaran	CT	1 153	**Igneous Rocks Mixed With Metasedimentary Rocks**	Compact Till	M	M-C	2	L
Irving	IR	7 335	**[Sedimentary Clasts 20 - 50%]**	Non-Compact Till	M	M-C	4	M-H
Pinder	PI	181		Residual	M-C	M-C	1-3	M-H
Interval	IN	8 655	**Undifferentiated**	Alluvial	M-C	M	4	L
Organic Soil	OS	3 851		Paludification				

Key to Forest Soil Units Legend (Table 2)

Primary Lithology

In the forest soil unit legend (Table 2), forest soil units are initially grouped according to their primary lithology or mineralogical composition of their parent material. Primary lithology is the percentage of the individual rock types of which the parent material is composed. Rock types and geological terms used in the legend are based on nomenclature used in the bedrock geology maps of New Brunswick reported in Colpitts et al. 1995 and Fahmy et al. 1986.

The proportions of rock types associated with each forest soil unit are related to distinct geomorphological districts or GDs. A GD indicates the surface expression and geographical approximation of major bedrock formation(s) or groups, of known composition, that have been modified through glaciation and fluvial erosion. The relative weatherability and fertility of rock types within each GD and parent material greatly affect the physical and chemical properties of the soil, and influence the potential amount and type of nutrients available for tree growth.

In the field, primary lithology is determined by identifying the relative proportion of different rock types in the coarse fragment content of the soil.

Mode of Deposition

Surficial deposits are the result of past and present weathering within a geological environment (Rampton et al. 1984). The modes of deposition refer to the origin of these surficial materials or which are referred to as regolith. The modes of deposition used in the forest soil unit legend are:

1. Alluvial (post-glacial streams sediments)
2. Compact (basal) till (bottom of glacial advance deposits)
3. Eolian (deposits by wind)
4. Glaciofluvial (glacial streams sediments)
5. Glaciomarine (combined glacial & marine sediments)
6. Lacustrine (fresh water lakes sediments)
7. Non-compact (ablation) till (top of glacial retreat deposits)
8. Marine (salt water sediments)
9. Paludification (peat formation deposits)
10. Residual (pre-glacial, in place weathering)

Depth to Contrasting Layer

The depth to contrasting layer refers to a distinct soil profile horizon having a firm or very firm consistency. This layer or horizon inhibits root penetration. A compacted soil parent material and bedrock are common examples of such layers. The depth to contrasting layer classes used in the forest soil unit are:

1. < 30 cm
2. 31-65 cm
3. 66-100 cm
4. > 100 cm

R. indicates that the contrasting layer is Bedrock

Texture Class

The relative proportion of sand, silt and clay particles (< 2 mm diameters) by weight in a soil sample determines what is referred to as soil texture. A textural class is given to the solum and to the parent material. As reported in Zelazny et al. (1989), the textural classes used in the forest soil unit are:

F = Fine = sandy clay loam, clay loam and clay

M = Medium = silt loam and loam

C = Coarse = sandy loam, loamy sand, sand.

Coarse Fragment Content

All rock fragments in the soil > 2 mm in diameter are known as coarse fragments. From smallest to largest they include gravels (2 mm-7.5 mm), cobbles (7.6 mm-25 cm), stones (25 cm-100 cm), and boulders (>100 cm). The classes, in percent by volume, used in the forest soil unit are:

L = Low < 20%

M = Medium 21-50 %

H = High >50%

FOREST SOIL UNIT DESCRIPTION

The spatial distribution, composition, structure, and texture of regolith determine its permeability, surface area available for leaching, and ability to produce plant nutrients. The following key to forest soil units describes the major regolith units, their associated rock types, and the forest soil units that have formed in conjunction with them.

I. Forest Soil Units (Regolith) Derived from Calcareous Sedimentary Rocks

Forest Soil Units derived from *calcareous grey mudstones, feldspathic* to *lithic sandstones,* and *polymictic conglomerates*.

The Erb Settlement (EB) and Saltspring (SS) Units are found in the Anagance Ridges geomorphologic region, the parent material has developed mainly from grey, calcareous, non-metamorphosed mudstones and sandstones. These units occur in close association with the soil units of the Salisbury Unit (discussed below) but have a grey colored parent material and a relatively higher inherent fertility.

The Saltspring Unit have developed on compact, lodgement till derived mainly from grey, calcareous mudstones. They are fine textured soils (clay loam to clay) and contain few coarse fragments. The Erb Settlement Unit occurs as morainal veneer over sandstone or mudstone bedrock. The soil material is non-compact, medium to fine textured with moderate coarse fragment content. In general, the Erb Settlement Unit occupies crest and upper slope positions, while the Saltspring Unit occurs in lower slope positions.

Forest Soil Units derived from *non-* to *slightly-calcareous red mudstones, feldspathic* to *lithic sandstones,* and *polymictic conglomerates*.

The Parleeville-Tobique (PT), Salisbury (SA), Parry (PR), Cornhill (CH), Tracadie (TD), and Kennebecasis (KN) Units are found mainly within the Anagance Ridges portion of the Grand Lake Basin and a small area of the Central Lowlands geomorphologic subregions of the Fundy Model Forest. The strongly rolling to flat topography is the result of differing modes of deposition and variability in bedrock weathering rates. The parent rocks, although similar in appearance to the mudstones of the Stony Brook group, are richer in calcium and feldspars, giving them higher inherent fertility and increased potential for plant nutrition. Large tracts of cultivated land associated with these units occur in the Sussex area.

The Salisbury and Parry Units have developed on well- to imperfectly-drained lodgement tills and are separated on the basis of their parent material textures and parent material origin. The Salisbury Unit is derived mainly from red mudstone and has a fine-textured parent material (loam to sandy-clay loam). The Parry Unit has a coarse-textured parent material (loam to sandy loam) and is primarily derived from red conglomerates and sandstones, with higher amounts of gravels and stones. The Parleeville-Tobique Unit shares many characteristics of the Parry Unit but has developed on a loose (non-compact), gravelly ablation till or has weathered in situ. The Cornhill Unit is similar to the Salisbury Unit, but occurs mainly in association with the tops of ridges, where bedrock is closer to the surface. The coarse-textured

(loamy sand to sand) Kennebecasis Unit has formed from glaciofluvial deposits usually along river or stream valleys. The Tracadie Unit has developed from glaciomarine, marine and/or lacustrine deposits. These soils are fine textured and generally contain no coarse fragments.

II. Forest Soil Units (Regolith) Derived from Non-Calcareous Sedimentary Rocks

Forest Soil Units derived from *red mudstones* (weathered).

The Stony Brook (SB), Harcourt (HT), Barrieau-Buctouche (BB), and Becaguimec (BE) Units are found mainly in the New Brunswick Lowlands Region. These soils are typically of impeded drainage, acidic, and have a red, fine textured parent material. The parent rocks are not metamorphosed and lack calcium, and the inherent fertility is moderate. The coarse fragments found in the soil are of weathered grey sandstone origin. Due to the relatively fast weathering rates, the parent rocks (red mudstones) are generally not found in the profile and the topography is gently rolling to flat.

The Stony Brook and Harcourt Units are compact lodgment tills characterized by their dark reddish brown, firm to very firm, slowly permeable, loam parent material. The Harcourt Unit is differentiated by a cap of yellowish-brown, friable sandy-loam till. The Barrieau Buctouche Unit is restricted mainly to coastal regions and contains a surface mantle (25 - 100 cm) of marine and glaciofluvial loamy sand, overlying a clay-loam to sandy clay-loam parent

material. The Becaguimec Unit is the only member of this group that lacks a compact parent material.

Forest Soil Units derived from *grey lithic* and *feldspathic sandstones*.

The Reece (RE), Sunbury (SN), Fair Isle (FA), and Riverbank (RI) Units are found mainly in the New Brunswick Lowlands and to a lesser extent in the Caledonia Highlands. The parent rocks are non-metamorphosed grey sandstones, which lack calcium and contain high proportions of lithic and quartz fragments. These units occur in close association with the units of the Harcourt group, but have coarse-textured, grey coloured parent material, and may contain higher proportions of stone and gravel.

The Reece Unit is the most common of the group. This unit has formed in a compact till on undulating to gently rolling terrain and consists of a medium-textured solum (sandy loam to loam) over a medium to fine-textured, yellowish-brown parent material. On average these units are moderately well-drained and contain low proportions of coarse fragments. The Sunbury and Fair Isle Units generally contain higher proportions of coarse fragments, and are mapped as coarse-textured, non-compact till deposits. The parent material is usually yellowish brown, friable, rapidly permeable sandy loam to loamy sand. Fair Isle is distinguished from Sunbury by a shallow lithic layer less than 1 metre from the soil surface. The Riverbank Unit consists of coarse-textured marine and glaciofluvial deposits containing very few coarse fragments. The parent material

is usually yellow-brown, acidic, loose, and rapidly-permeable loamy sand or sand. Bedrock may occur within 1 m of the soil surface.

III. Forest Soil Units (Regolith) Derived from Igneous Rocks

Forest Soil Units derived from *mafic volcanics, gabbros,* and *diorites*.

The Mafic Volcanic (MV), Tetagouche (TT), and Kingston (KI) Units are found in the Caledonia Highlands. The parent rocks of these units contain high percentages of plagioclase (sodium and calcium) feldspars, magnesium, and iron. The presence of these dark-coloured minerals and the relative lack of quartz and potassium produce tills of relatively high inherent fertility. The weatherability of the parent rocks is intermediate between that of sedimentary and felsic igneous rocks.

The Mafic Volcanic and Tetagouche Units are medium- to fine-textured tills, developed from mafic rocks of fine crystalline structure. The Mafic Volcanic Unit occurs in upper slope and hill crest positions where bedrock outcrops are common and stoniness increases. The Tetagouche Unit is a compact lodgment till occurring in mid- and lower-slope positions. The Kingston Unit has developed from parent rocks of coarser crystalline structures (gabbros and diorites), it has formed in a compact lodgment till with a medium to coarse parent material texture and moderate coarse fragment content.

Forest Soil Units derived from *gneiss, granites, alkali granites, granodiorites* and *quartz diorites*.

The Tuadook (TU), Juniper (JU), and Big Bald Mountain (BD) Units are found in the Caledonia Highlands. Their parent rocks have formed from slow cooling of molten lava high in quartz and feldspars. Their composition and coarse crystalline structure result in slow weathering, a correspondingly rugged topography, and a slow release of plant nutrients. Granodiorite and quartz diorite rocks contain calcium-rich feldspars, iron, and magnesium-rich minerals, and therefore have higher inherent fertility than other granitic rocks. In contrast, the alkali granites contain sodium- and potassium-rich feldspars but lack calcium, resulting in lower inherent fertility.

The Juniper and the Tuadook Units are located in rolling to hilly topography. The Juniper Unit is loose, coarse-textured, friable, brown to yellowish-brown, and contains between $<50\%$ stones and boulders. The Tuadook Unit has developed on lodgement till, and is usually compact between 30 to 65 cm depth. Parent material texture ranges from loam to silt loam, and contains moderate amounts of coarse fragments. The Big Bald Mountain Unit has formed in a shallow, rocky residual soil developed from the *in situ* weathering of granitic rocks. This unit occurs on hill crests and upper slopes where bedrock outcrops are common. The profile is coarse-textured (sandy loam) and highly gravelly and stony.

Forest Soil Units derived from *felsic volcanic rocks*.

The Popple Depot (PD), Lomond (LO), Jacquet River (JR), and Gagetown (GG) Units are found in the Caledonia Highlands, the parent rocks of these units that are formed from the rapid cooling of molten rock containing high percentages of quartz and alkali (sodium- and potassium-rich) feldspars. These dense rocks with fine crystalline structures, produce rock formations that are resistant to weathering, and give rise to high relief and steep topography. The inherent fertility of the regolith derived from these rocks is low.

The Popple Depot Unit has developed on compact, loamy to sandy loam, yellowish-brown to olive-brown lodgement till, containing 20-40% coarse fragments. The Lomond Unit is composed of shallow, rapidly- to well-drained sandy loam stony tills. In the Central Plateau of the Caledonia Uplands these tills are often found on undulating to gently rolling terrain. The Jacquet River Unit is a non-compact, yellowish-brown, water-reworked till often found on lower slopes and flats. The texture is loam to sandy loam, and the coarse fragment content is moderate to high. The Gagetown Unit has formed on glacial outwash and glaciofluvial material. The soil profile is coarse textured and friable throughout with high proportions of gravels and cobbles often present.

IV. Forest Soil Units (Regolith) Derived from Rocks of Mixed Lithologies

Forest Soil Units derived from *metasedimentary rocks mixed* with some *igneous rocks*.

The Long Lake (LL), Britt Brook (BR), and Serpentine (SP) Units are found in the Caledonia Highlands where smaller percentages of igneous rocks are mixed into a regolith primarily composed of non-calcareous metamorphosed sediments. Increasing abundance of some types of igneous rocks such as granite and gneiss in the till may generally be associated with decreasing inherent fertility.

The Long Lake Unit, the most common unit of this group, usually occurs on well- to moderately well-drained mid- to lower-slope positions. The olive-brown till is loam to sandy loam in texture, compact at depths between 30 to 65 cm, and is moderately stony. The Britt Brook Unit occurs on lower slopes and in valley bottoms as loose, water-reworked till. The yellowish-brown parent material is non-compact, medium-textured and contains moderate quantities of coarse fragments. The Serpentine Unit has developed on non-compact materials usually occurring on upper slopes and crests. The soils of this unit are usually medium (silt loam) textured, rapidly to well drained, and highly stony.

Forest Soil Units derived from *igneous rocks* mixed with some *metasedimentary rocks*.

The Catamaran (CT), Irving (IR), and Pinder (PI) Units are found in the Caledonia Highlands, and they are formed in areas where parent rock of igneous origin are mixed with lesser percentages of metasedimentary rocks. Larger

amounts of metasediments in the soil relative to igneous materials is associated with increasing levels of plant nutrients and improved productivity.

The Catamaran and Pinder Units are coarse textured throughout their profiles. The Irving Unit consists of a well- to imperfectly-drained, non-compact till normally found in lower landscape positions and is of a silt loam texture. The Catamaran is a lodgement till, compact between 30 to 65 cm. This Unit occurs in mid-slope positions and has a low to moderate abundance of coarse fragments. The Pinder Unit has formed in highly stony residual deposits, but with some colluvial or till material occupying upper slopes and hillcrest positions.

V. Forest Soil Units Derived from Undifferentiated Parent Materials

Three Forest Soil Units have originated from alluvial, and organic deposits that have developed following the retreat of the Wisconsinan glaciers. Their lithology is classified as being undifferentiated.

The Interval Unit (IN) is found throughout the Fundy Model Forest, on river terraces and flood plains where unconsolidated materials have been laid down by the seasonal flooding of rivers. These units often have little or no horizon development because of their young age. Their profiles are usually deep, medium-textured, and relatively free of stones and gravels. Most of these soils were mapped as moderately-well and imperfectly drained.

The Organic Soil (OS) is comprised of very poorly-drained deposits that have developed primarily from the remains of sphagnum mosses, sedges, rushes, and forest peat (swamps, fens, and bogs). The depth of organic material over the mineral soil depends on the decomposition rate, which is a function of the

mineral content and pH of waters coming in contact with the decomposing material. Slowest decomposition rates are associated with the nutrient-poor centres of domed peat bogs where precipitation is the sole source of water. Extensive areas of this unit occur where flat topography impedes drainage and acidic geological materials create optimum conditions for accumulation of organic debris.

LITERATURE CITED

Bostock, H.S. 1970. A provisional physiographic map of Canada. Geol. Surv. Can. paper 64-35, 1964 and Geol. Surv. Can. Map 1245A.

Colpitts, M.C., Fahmy, S.H., MacDougal, J.E., Ng, T.T.M., McInnis, B.G. and Zelazny, V.F. 1995. Forest Soils of New Brunswick, CLBRR Contribution No. 95-38, Agriculture and Agri-Food Canada, Research Branch; New Brunswick Dept. of Natural Resources, Timber Management Branch; and Natural Resources Canada, Canadian Forestry Services. 75 pages.

Dzikowski, P.A., Kirby, G., Read, G., and Richards, W.G. 1984. The climate for agriculture in Atlantic Canada. Publication No. ACA 84-2-500, Agdex No. 070, 52 pages.

Fahmy, Sherif H., Rees, Herbert W., and MacMillan, John K. 1986. Soils of New Brunswick: a first approximation. New Brunswick Department of Agriculture, Fredericton, New Brunswick, Canada, 105 pages.

Mapping System Working Group. 1981. A soil mapping system for Canada: revised LRRI Contribution No. 142, Research Branch, Agriculture Canada, 94 pages.

Matson, B.E. and Power, R.G. 1994. Developing an ecological land classification for the Fundy Model Forest, southern New Brunswick, Canada. Paper presented at Global to Local: Ecological Land Classification Workshop, August 15-17, 1994, Valhalla Inn, Thunder Bay, Ontario, 19 pages.

Rampton, V.N., Gauthier, R.C., Thibault, J. and Seaman, A.A. 1984. Geology of New Brunswick. Mem. 416, Geol. Surv. Can. 77 pages.

Rampton, V.N. and Paradis, S. 1981. Quaternary geology of the Amherst map area (21 H), New Brunswick, NB Dept. of Nat. Res., Map Report 81-3, 36 pages.

Van Groenewoud, H. 1983. Summary of climatic data pertaining to the climatic regions of New Brunswick. Information report M-X-146, Maritime Forest Research Centre, Canadian Forestry Services, Environment Canada. 70 pages.

Zelazny, V.F., Ng, T.T.M., Hayter, M.G., Bowling, C.L., and Bewick, D.A. 1989. Field guides to forest site classification in New Brunswick, Harvey-Harcourt-Fundy site region, NB Dept. Nat. Res. & Energy, Timber Management Branch, Fredericton, NB, Canada, 43 pages.