Soils, capability and land use in the

OTTAWA URBAN FRINGE

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OTTAWA URBAN FRINGE

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Preface

A field study comprising soil survey and land use of the Ottawa urban fringe was initiated in 1973 and completed in 1975. Excluding the National Capital Commission (NCC) Greenbelt, most of the area is subject to the pressures of urban expansion. Results of the study are presented in this report and in a series of maps located in the back pocket. These constitute an information package describing the physical land resources of the Ottawa area.

Three major subject areas are discussed in the report. The first and most detailed one is a description of the soils, their geomorphological setting and properties. This is followed by a section on soil capability and its application to land planning. In a separate bulletin, and located in the package, is a description of land use current to 1975.

Three maps at scales of 1:25 000 included with the report supplement each of the major subject areas. The soil map shows the location, shape, extent, surface texture and main topographic features of individual soil areas. An expanded legend, showing all basic soil data, accompanies the map. The soil map has been interpreted to produce the capability map, to show the kinds and severity of limitations to use in each soil area. The land use map depicts the character and extent of land use activities in the area.

The beginning sections of the report outline the geomorphological and environmental character of the area. The section on techniques of soil mapping includes a discussion on how to interpret the soil map.

In the report, soils are described on the basis of soil associations and soil landscape units. Each association is described in terms of the material on which it occurs, the landform and topography on which it is found, and the drainage characteristics and texture of its soils. Each landscape unit is defined in relation to topography, drainage and soils.

The capability section describes the capability classification developed for this survey and how it differs from the traditional approach used for the Canada Land Inventory. It also discusses in detail the application of the system for biologically and non-biologically oriented uses.

In a separate bulletin, but included as an integral part of the report, the land use section describes the various land uses observed at the time of mapping. A section on land ownership comments on several land use problems observed. Unlike soils and capability which are basic data sources remaining unchanged over long periods, land use and ownership must be continually updated to remain relevant.

Technical soil data and definition of terms used in the report can be found in the appendixes.

CONTENTS

CONTENTS (cont'd)

TABLES

FIGURES

How to Use the Report

This report is a basic information document prepared for many users. It is not intended that it be read from cover to cover, but used as a reference text in relation to problems encountered or decisions to be made on the land areas of the region.

In general terms the maps and reports can be used to answer many queries, but most of these fall into two general categories: (a) What are the nature and properties of the soils at a given location?, and (b) What is the suitability of a given location for a particular use? Procedures for each situation are outlined below.

(a) What are the soils at this location?

(1) Find the location on the soil map.
(2) Write the map notation(s) on a separate sheet of paper.
(3) Refer to the map legend to determine the meaning of each symbol in the notation(s).
(4) Using each symbol, refer to the expanded map legend for a summary of the soil and land characteristics present in the area.
(5) Consult the table of contents in the report and find the section(s) describing the notation soil association(s) noted in 2 above. Read these sections for more detailed information.
(6) If information on capability and/or land use is required at that location, repeat the pertinent parts of 1 to 5 above.

(b) What is the suitability of this location for this use?

(1) Study the use in question to determine the physical land properties essential for its proper or optimal installation and operation. For example septic disposal fields require, among other things, more than 2 m of medium-textured, well-drained soils with a water table or impermeable layer greater than 2 m below the surface.
(2) Determine the soils present at the site by proceeding through points 1 to 6 in the first example.
(3) Estimate how well the soil conditions meet the requirements of the use. In some cases the location is ideal, but in most instances one or more of the soil requirements are absent. In such cases it may be possible to estimate the costs of improving the site for that use.
(4) Verify your conclusion(s) by inspecting the site in the field.

In addition to the above, the capability section and map provide considerable guidance on the land factor limitations present in the area as well as the general types of uses possible. The capability scheme is agricultural in focus, but useful information can be extrapolated for other uses. Thorough familiarity with the capability section will give many users a cursory insight of the information that might be obtained from the report.

In its present form, this report is incomplete. It lacks an engineering section and the results of the computerized mapping exercise. These will be made available as they are completed. The remaining area (about 202 000 ha) of the Ottawa-Carleton Regional Municipality is being mapped at present, and a comprehensive description of the soil will be available when this is completed.

Acknowledgments

The soil survey of the Ottawa urban fringe was carried out by the Land Resource Research Institute, Agriculture Canada, with funding support from the National Capital Commission. Between 1974 and 1976 the primary author was employed by the Surveys and Mapping Branch, Energy, Mines and Resources, and later by the Lands Directorate, Fisheries and Environment Canada. The support and cooperation received from these ministries were invaluable in completing the project.

Laboratory analyses were conducted by the Service Laboratory, Land Resource Research Institute, and the Soil Survey Laboratory, University of Guelph. Engineering analyses were done by the Ontario Ministry of Transportation and Communications. Data on groundwater levels and soil water relationships were obtained from the research of Dr. G.C. Topp. The Geological Survey of Canada provided data on the surficial geology of the area, and many of the required base maps.

The soils, capability and land use maps were drafted and digitized by the Cartography Section, Land Resource Research Institute. The maps were printed at Energy, Mines and Resources.

Technical assistance for the project was provided by J.M. Cossette, R.A. MacMillan, and D.G. Berry. Dr. B. Kloosterman assisted in the computer compilation of the data and with the field mapping. The manuscript and maps were reviewed by J.H. Day and J.L. Nowland. Mrs. J. Lendvay-Zwickl assisted in the final preparation of the manuscript.

The authors acknowledge the cooperation and counsel received from Dr. C.J. Acton and Mr. B. van den Broek, University of Guelph.

Introduction

This report describes a study undertaken to catalog the physical soil and land resources of the Ottawa urban fringe. The study area which includes the entire National Capital Commission (NCC) Greenbelt, as well as the Municipal Townships of Gloucester and Nepean, has a total area of about 40 500 hectares (ha).

The formation of the Ottawa-Carleton Regional Government and the advent of regional development planning created new and more sophisticated demands for physical land data. In 1970 in the Ottawa area, the urban land uses serviced by central sewer and water occupied approximately 11 700 ha, and the population was about 403 000 persons (Regional Government, 1974). In the proposed official plan the Regional Government projected that the population would grow to approximately one million in the next 30 yr. This would require an expansion of the urban area to about 24 300 ha, with 6100 ha being "new" townsites outside the NCC Greenbelt.

When the proposed official plan was formulated, the only soils information available was that published in 1944 (Hills, Richards, and Morwick). This survey was based on 200 000 ha of field mapping in one field season without the aid of aerial photographs, and the map was published at 1:126 720. It was felt that this information was no longer adequate for present planning needs, and thus the resurvey at 1: 25 000 was begun.

Knowledge of the physical characteristics of land is fundamental to rational land planning. Spurr (1976) describes the four filters effective in determining supply of development land as: physical, timing, legal/financial, and ownership. The physical filter, including topography, soil conditions, drainage and tract size, is the initial factor determining supply of expansion land.

The above considerations were the basis for the inventory of the physical land resources of the Ottawa area. Information was collected on soils and their properties, drainage, topography and general landscape conditions. The data were complemented by a special study on land use and ownership (separate bulletin in map pocket). The results of the entire study constitute the major portion of this report.

This study serves a second major objective which was to evaluate the benefits, costs and procedures of soil data computerization, and to prepare a computerized soil data package for planning purposes. These results are not complete and will be published separately at a later date.

Physical Environment

A. Climate

The climate of Ottawa is dominantly humid, cool continental characterized by warm summers and severe winters, with considerable variability throughout the year. Bright sunshine averages 1995 hours for the year with July normally experiencing the longest duration with 277 h, and November the least with 76 h.

Mean monthly temperatures in the Ottawa Valley are as low as -16°C during January and as high as 27°C in July. The extreme temperature range over the past 35 years has been from 38°C in August to -27°C in February. The mean annual temperature for the area is 5.8°C. Since the mid-1950s there has been an overall drop in mean annual temperature of about 0.9°C. The mean monthly and annual temperatures are given in Table 1.

Table 1. Monthly temperature and precipitation data: 1941-1970
Location: Ottawa, airport

Element	Unit	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year
Mean daily temp.	°F	12.3	14.9	26.5	42.1	54.4	64.7	69.2	66.7	58.3	47.6	34.5	18.2	42.5
	(°C)	(-10.9)	(-9.5)	(-3)	(5.6)	(28.6)	(18.2)	(20.7)	(19.3)	(14.6)	(8.7)	(1.4)	(-7.7)	(5.8)
Mean daily max. temp.	°F	20.5	23.5	34.4	51.7	65.0	75.2	79.6	77.2	68.2	56.8	41.1	25.3	51.5
	(°C)	(-6.4)	(-4.7)	(1.3)	(10.9)	(18.3)	(24)	(26.4)	(25.1)	(20.1)	(13.8)	(5.1)	(-3.7)	(10.8)
Mean daily min. temp.	°F	4.0	6.1	18.5	32.5	43.7	54.2	58.6	56.3	48.3	38.4	27.7	11.1	33.3
	(°C)	(-15.6)	(-14.4)	(-7.5)	(0.3)	(6.5)	(12.3)	(14.8)	(13.5)	(9.1)	(3.6)	(-2.7)	(-11.6)	(0.7)
Max. temp.	°F	52	53	80	85	91	97	98	100	95	82	75	59	100
	(°C)	(11.1)	(11.7)	(26.7)	(29.4)	(32.8)	(36)	(36.7)	(37.8)	(35)	(27.8)	(23.9)	(15)	(37.8)
Min. temp.	°F	-32	-33	-23	2	22	33	41	37	27	18	-7	-30	-33
	(°C)	(-35.6)	(-36.1)	(-30.6)	(-16.7)	(-5.6)	(0.5)	(5)	(2.8)	(-2.8)	(-7.8)	(-21.7)	(-34.4)	(-36.1)
Mean rainfall	in.	0.55	0.44	1.02	2.30	2.71	2.86	3.20	3.21	3.10	2.51	2.23	1.13	25.26
	(cm)	(1.4)	(1.1)	(2.6)	(5.8)	(6.9)	(7.3)	(8.1)	(8.2)	(7.9)	(6.4)	(5.7)	(2.9)	(64.2)
Mean snowfall	in.	19.1	18.8	13.8	3.1	0.3	0.0	0.0	0.0	TR	0.7	8.8	20.3	84.9
	(cm)	(48.5)	(47.8)	(35.0)	(7.9)	(0.8)	(0.0)	(0.0)	(0.0)	(TR)	(1.8)	(22.4)	(51.6)	(215.6)
Mean total precipitation	in.	2.36	2.24	2.40	2.66	2.76	2.86	3.20	3.21	3.10	2.59	3.09	3.03	33.50
	(cm)	(6.0)	(5.7)	(6.1)	(6.8)	(7.0)	(7.3)	(8.1)	(8.2)	(7.9)	(6.6)	(7.8)	(7.7)	(85.1)
Max. monthly precipitation	in.	4.30	6.62	5.44	4.77	5.59	6.88	7.34	7.31	6.81	7.19	6.52	5.29	7.31
	(cm)	(10.9)	(16.8)	(13.8)	(12.1)	(14.2)	(17.5)	(18.6)	(18.6)	(17.3)	(18.3)	(16.6)	(13.4)	(18.6)
Min. monthly	in.	0.55	0.97	0.53	0.82	0.95	0.72	1.21	0.33	0.52	0.28	1.07	1.16	0.28
	(cm)	(1.4)	(2.5)	(1.3)	(2.1)	(2.4)	(1.8)	(3.1)	(0.8)	(1.3)	(0.7)	(2.7)	(2.9)	(0.7)

The length of the growing season is governed by the occurrence of the last spring frost and the earliest fall frost. The average date of the last frost in the spring is May 11, and the first frost in the fall is October 1, giving an average frost free period of 142 days. Dates for probability of frost occurrence are shown in Table 2.

Precipitation is spread evenly throughout the year, averaging about 71 mm/mo and 850 mm/yr. Average annual snowfall is about 2160 mm. July and August have the highest mean precipitation with 82 mm/mo.

Precipitation decreased during the 1940s to the 1950s, but increased during the 1960s and early 1970s. Snowfall has ranged from a low of less than 1016 mm in the winter of 1952-53 to a high of 4427 mm in 1970-71. Ten-year mean snowfalls in excess of 2160 mm in the early 1940s decreased to less than 2030 mm by the mid-1960s. The most recent 10-yr mean (1965-1975) now exceeds 2540 mm. The mean monthly and mean annual precipitations for Ottawa are shown in Table 1.

The soil climate of the Ottawa area is humid, mild mesic. The mean annual soil temperature is 8 to 15°C and the mean summer soil temperature is 15 to 22°C. The actual soil temperature at Ottawa follows a wave pattern in response to seasonal air temperature change (Figure 1). The response is greater near the surface with a slight time lag at depth. Soils gain heat from mid-April to early August, then lose heat from September to March. At the 20 cm depth, the soil can be expected to freeze in mid-January with decreases in temperature to mid-February. The soil does not freeze at depths below 50 cm if protected by snow.

The growing season occurring at temperatures above 5°C is 200 to 240 days. There are 1720 to 2220 degree-days above 5°C (3100 to 4200 above 41°F) during the growing season, and the thermal period* when soil temperature is above 15°C is 120 days.

In the humid regime (Figure 2), no part of the soil becomes dry for a period of 90 consecutive days, although there may be very slight water deficits equivalent to 2.5 to 6.4 cm in the growing season.

**Thermal period is a period during which the temperature of the soil at 20 in. (50 cm) depth reaches or exceeds 59°F (15°C).*

B. Vegetation

The Ottawa area lies within the upper St. Lawrence section of the Great Lakes-St. Lawrence forest region. The original forest was dominantly deciduous with sugar and red maple (*Acer saccharum* and *Acer rubrum*), beech (*Fagus grandifolia*), yellow birch (*Betula alleghaniensis*), basswood (*Tilia americana*), white ash (*Fraxinus americana*), large tooth aspen (*Populus grandidentata*), and local occurrences of oak (*Quercus*) and elm (*Ulmus*).

Settlement and agricultural development have left little if any of the original climax forest intact. The area was originally logged and then almost entirely cleared for farming. Since the war, the effects of rapid continued urban expansion, the establishment of the Greenbelt, gradual withdrawal of marginal farmland, and the process of public and private land banking for development purposes have contributed to the evolution of a disjointed vegetation pattern in various stages of development.

A sequence of forest succession has developed on the land which has reverted to forest during the past half century. Low shrubs and brush consisting of alders and willows commonly appear within the first 20 yr of land abandonment, followed by dominantly aspen forest. This stage is succeeded by balsam fir and spruce, followed in the final stages by a true climax forest of maple, beech and birch. Two fine examples of the original climax forest remain in the study area—one near Highway 16 and Woodroffe Avenue in Nepean, and the second, east of Highway 31, on Regional Road No. 8 in Gloucester. Originally, there were no pine forests in the Ottawa area, but forest fires resulted in considerable regeneration of pine forests.

The present distribution of various tree species reflects the nature of the parent materials and drainage conditions. White and red pine are found on deep sandy soils, due either to regeneration after forest fires, or to the more recent reforestation projects of the Ministry of Natural Resources. The latter situation is found primarily within the Greenbelt boundary, and in areas outside the Greenbelt as wind erosion control measures. On the deeper, better-drained glacial tills, a mixture of aspen and developing maple, birch and beech species is prevalent. The widespread, shallow bedrock plains are dominated by cedar and maple species with some aspen in isolated pockets. Poorly drained sites, located in ponded depressions on almost all surface materials, are dominated by cedar with some tamarack and spruce. Tree species found on the Mer Bleue are dominantly tamarack (*Larix*), black spruce (*Picea mariana*), and white cedar (*Thuja occidentalis*).

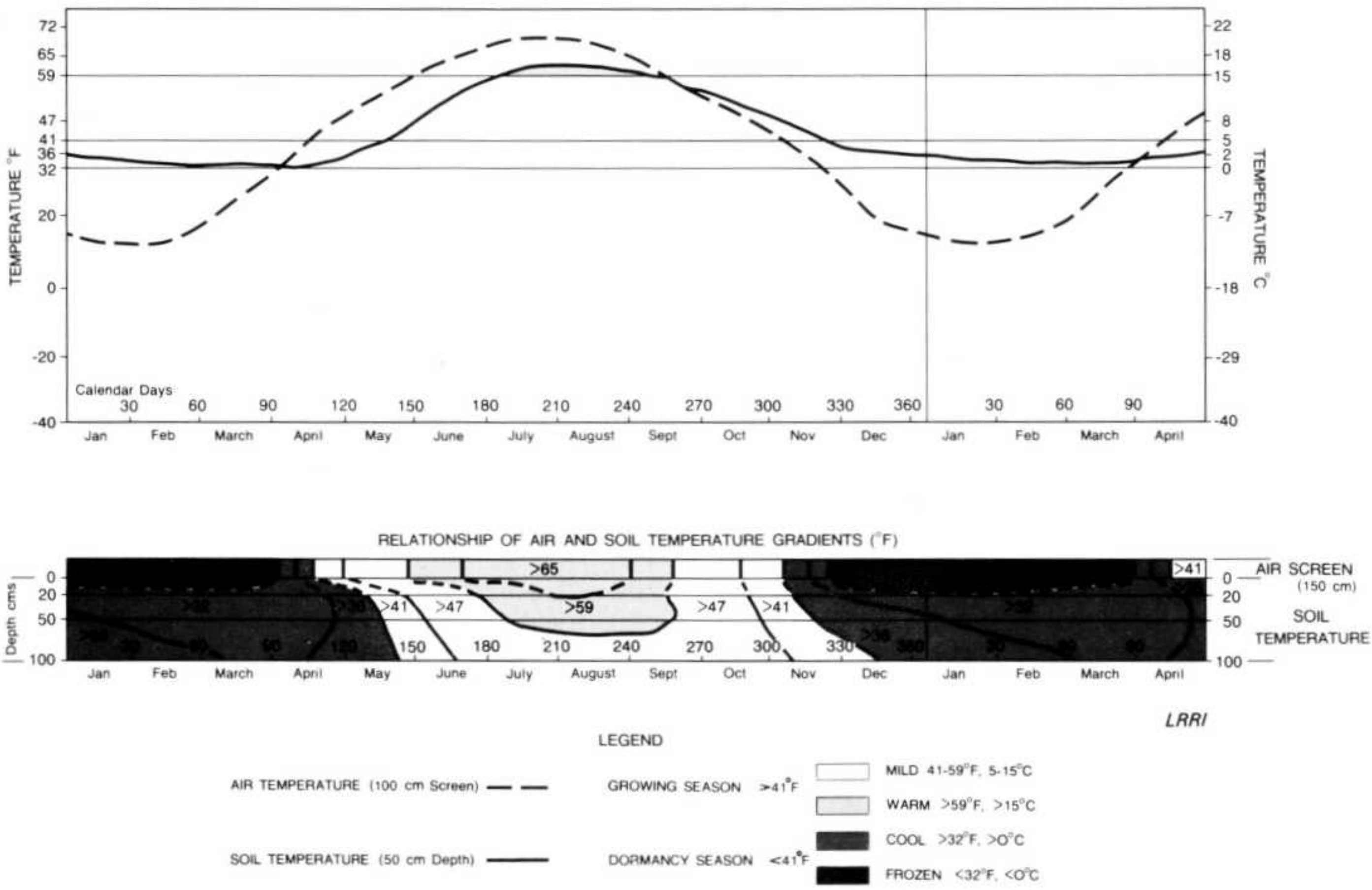
Much of the recent forest vegetation was confined to small woodlots found on stony till ridges or in low, poorly drained depressions. However, today, considerable areas are slowly reverting to either alder-willow or aspen forest as a result of farmland abandonment and land banking for development.

C. Relief and Drainage

The Ottawa Valley lies in a sedimentary basin surrounded by ancient Precambrian shield rocks (Figure 3). The lowlands between the Ottawa River and the Gatineau Hills vary between 61 and 122 m (amsl), but the elevation rises sharply to between 152 and 335 m in the Gatineau Hills, largely due to faulting (Eardley Fault). The sedimentary strata are tilted towards the west and are bounded on the west and south by faults. The western boundary (Gloucester Fault) is a bluff facing the northeast. A few Precambrian outliers are exposed in Nepean Township along the main Hazeldean Fault west of Ottawa, which passes through Hazeldean and forms the northern flank of

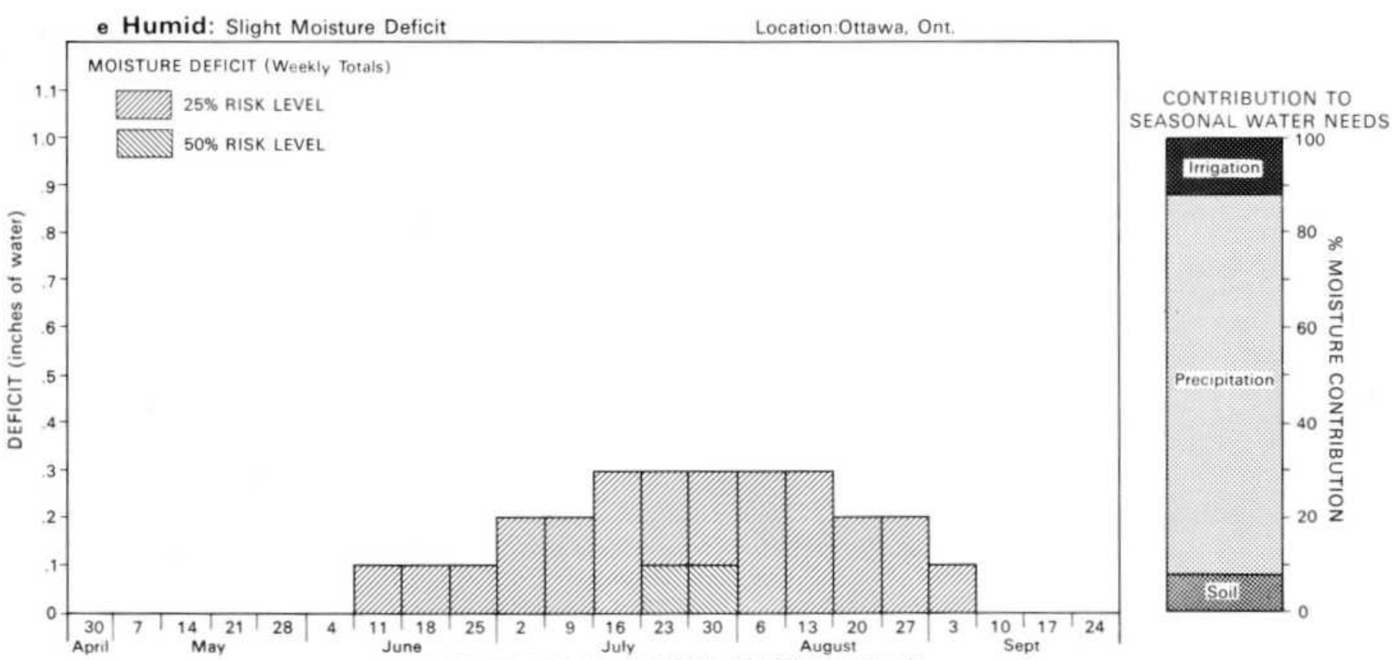
Table 2. Probability of frost occurrence: 1941-1970
Location: Ottawa

	Probability of last spring frost occurring on or after dates indicated				Probability of first frost occurring on or before dates indicated			
Temp.	3 yr in 4	1 in 2	1 in 4	1 in 10	1 in 10	1 in 4	1 in 2	3 in 4
-6.7°C	Mar 25	Apr 2	Apr 10	Apr 18	Aug 17	Aug 25	Sept 3	Sept 12
-1.1°C	Apr 28	May 6	May 15	May 23	Sept 21	Sept 26	Oct 2	Oct 8



Reference Lajoie, P.G. Agricultural lands in Southern Quebec: distribution, extent and quality.

Figure 1. Air and soil temperatures at Ottawa



	ANNUAL	SEASONAL	POTENTIAL WATER USE		19.6
PRECIPITATION	34.0	15.6	IRRIGATION REQUIREMENT	25% RISK LEVEL	3.4
POTENTIAL EVAPOTRANSPIRATION	22.9	19.9		50% RISK LEVEL	2.0

Reference Lajoie, P.G. Agricultural lands in Southern Quebec: distribution, extent and quality.

LRRI

Figure 2. Soil moisture regime at Ottawa

the Carp Valley (Figure 4). Most faults are parallel or at right angles to the shield.

The land surface of Gloucester and Nepean Townships south of the Ottawa River is a level to gently undulating plain of marine and moraine deposits interrupted by local bedrock uplands. The principal relief and drainage features of the two townships are shown in Figure 5.

The lowest elevations, ranging between 43 and 58 m (amsl), are found in the narrow plain along the Ottawa River between Ottawa and Orleans. Here the river level is approximately 40 m. West of Ottawa, the narrow river plain rises to between 58 and 76 m. Beyond the abandoned river channels, the altitude of the land ranges between 61 and 122 m.

The marine plain, which is level to very gently sloping, lies between 76 and 99 m and generally slopes from west to east. Windblown marine and fluvial sands impart a slight wavelike pattern to parts of this plain, but most of the undulating to rolling relief is found in association with the glacial tills and fluvioglacial sands and gravels. The steepest slopes and highest elevations are confined to the bedrock-controlled upland plains, usually bounded by one of the fault line ridges, and to the two major fluvioglacial ridges. The elevation of these deposits usually lies between 94 and 122 m. Local relief of the glacial and fluvioglacial ridges can be as high as 23 m above the surrounding level marine plain, but in most cases the ridges merge gradually with the neighboring level plains. The bedrock-controlled ridges and eroded clay escarpments rise less than 15 m, directly above the level plains. The steep north-facing bedrock scarps, overlooking the Ottawa River, rise in some places higher than 30 m above the river plain and gently slope to the south.

Both townships are drained exclusively by the Ottawa River and its tributaries. Only two other rivers traverse the area, namely, the Rideau and its tributary, the Jock. The Rideau River bisects the study area from the south to north forming the major drainage outlet to the Ottawa River, and defines the political boundary between Nepean and Gloucester Townships. The Jock River joins the Rideau River approximately 3.2 km north of Manotick and provides the major drainage outlet for the southern half of Nepean Township.

A slight incised dendritic dissection of the area has occurred on the marine clay plains, primarily near the Rideau and Ottawa Rivers. Watts, Ramsay and Green Creeks have been deeply incised into the clay, in some places to depths greater than 23 m. Most of the smaller drainage channels are 3 to 9 m deep, adding a slightly undulating relief to the interfluves. Incision is less pronounced away from the major rivers and rarely affects the overall flat character of the plains. In Nepean Township, the Jock River has very few tributary streams and these have been only slightly incised.

Bearbrook Creek and its tributaries flow southeastward to the South Nation River along the edge of the Mer Bleue. This is the only drainage network in the region which does not flow directly into the Rideau or Ottawa Rivers.

In many areas there is sufficient slope to provide a reasonable degree of regional drainage, but there are serious drainage problems in flat or depressional areas especially those occupied by organic deposits. Over much of the level marine plains, a subsidiary network of drainage ditches has been connected to the natural drainage system to aid in the removal of excess spring runoff and to lower the regional water table. In most years, the Jock River, major creeks and small drainage channels are reduced to a very low volume or are dry by mid to late summer.

D. Geology and Surficial Materials

The surficial deposits found in the mapped area during this survey have been separated into a number of physiographic subdivisions on the basis of landform and geological materials (Figure 6). These subdivisions are explained in relation to the nature of the material and its mode of deposition. All such materials are related to the Champlain Sea epoch which began about 11 500 yr ago and lasted approximately 2000 to 3000 yr (Karrow, 1961).

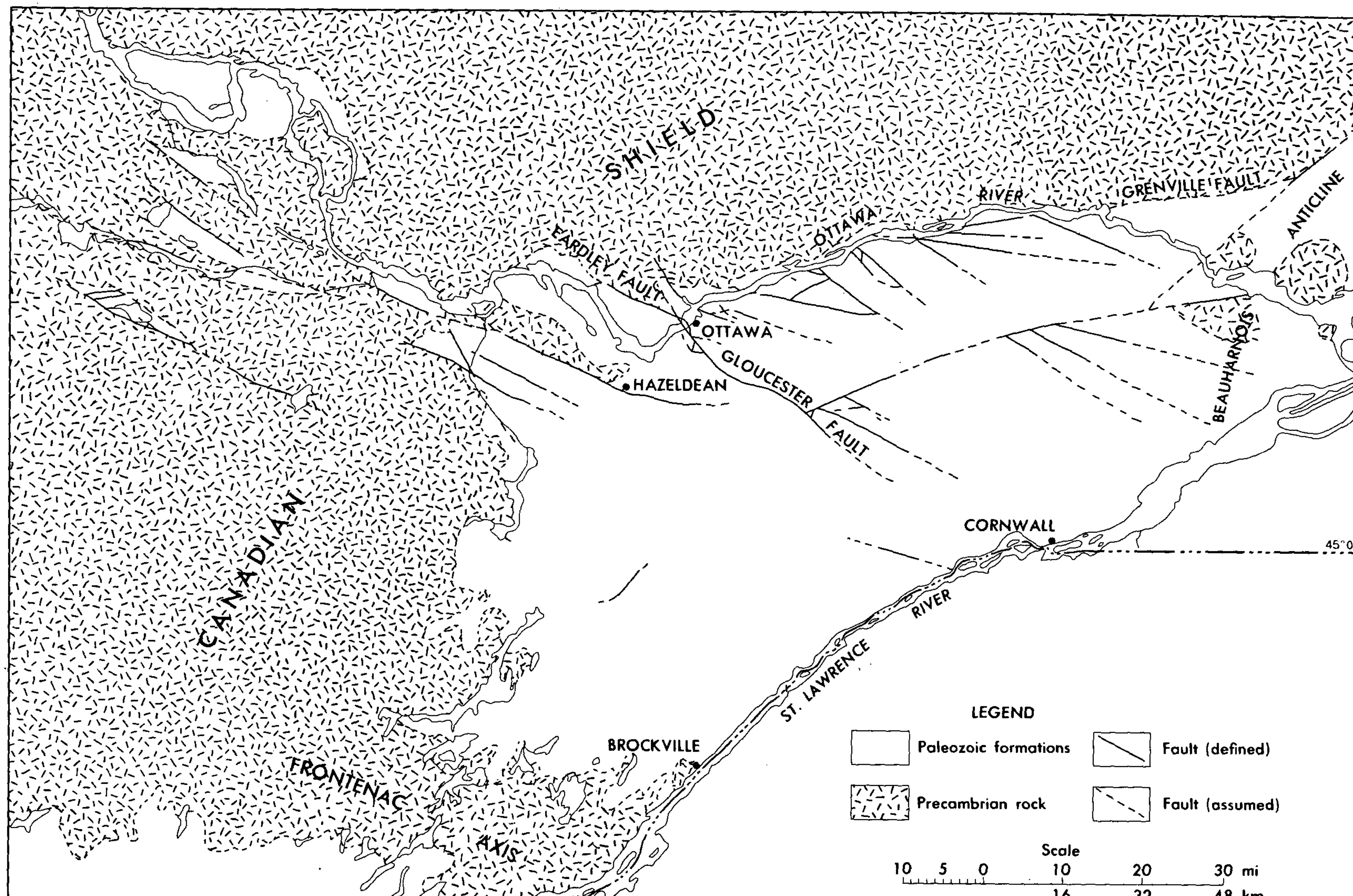
Pre-Champlain Sea materials are those of the bedrock plains, glacial till plains and fluvioglacial ridges. These were overlain by marine clays of the Champlain Sea, by fine-textured deltaic deposits and finally by organic materials. The development of abandoned river channels, organic peat deposits and present-day, eroded river and stream channels followed the recession of the sea.

Bedrock formations are predominantly of the Ordovician period (Figure 4). The Precambrian basement, composed of gneiss and crystalline limestone, outcrops only on the northwest corner of Nepean Township. The sedimentary strata of the Ordovician period have been very gently folded, resulting in broad, bedrock-controlled plains at or near the surface, usually bounded by faults. The sandstones and quartzites at the base of the Nepean formation are overlain by limestone and dolomite of the March and Oxford formations, which in turn are overlain by a number of shale formations namely Billings, Carlsbad and Rockcliffe. Sandstones and quartzites are concentrated in the bedrock plains north of the Hazeldean fault stretching from Barrhaven to the Connaught Rifle Range in Nepean Township. Limestone and dolomite-controlled bedrock plains are centered on the Hazeldean fault west and south of Bells Corners in Nepean Township and on the west side of the Gloucester fault south of Leitrim. Other less extensive exposures of limestone, exposed through fluvial erosion, can be found in the abandoned channels of the Ottawa River, and on the raised fault block northeast of Blackburn Hamlet near Orleans. Very shallow, unconsolidated drift materials overlying crystalline, limestone-dolomite and sandstone-quartzite formations have been mapped respectively as the Anstruther, Farmington, and Nepean soil associations.

Shales of the Billings and Carlsbad formations exist about 1 m below the surface in a small area centered on the east side of the Gloucester fault near Leitrim. In this area, the shallow tills mapped as the Leitrim and Ellwood soil associations are strongly affected by the underlying shales as indicated by their relatively high clay content.

Glacial tills are usually found in the form of isolated drumlinoid ridges or as larger blocks of undulating to hummocky till plains. Elongated drumlinoid or ridged forms occur on the highest elevations and are surrounded by finer-textured marine deposits. The other major till landscapes are bedrock-controlled, gently undulating beveled till plains, closely associated with the Gloucester and Hazeldean faults. West of the Gloucester fault, the tills are underlain by limestone-dolomite or sandstone-quartzite complexes and are generally composed of compact, stony calcareous sandy tills. The tills usually contain an equal proportion of Precambrian granitic rocks and Paleozoic boulders.

The calcareous tills underlain by limestone and dolomite were mapped as the Grenville soil association. Sandier, less calcareous tills underlain by sandstone or



After Wilson, A.E. 1956. Canadian Field Naturalist Vol. 70, No. 1, pp. 1-68, 1956. (Guide to Geology of the Ottawa District).

Figure 3. Structural geology map of Ottawa - St. Lawrence lowland showing faults affecting the Paleozoic formations

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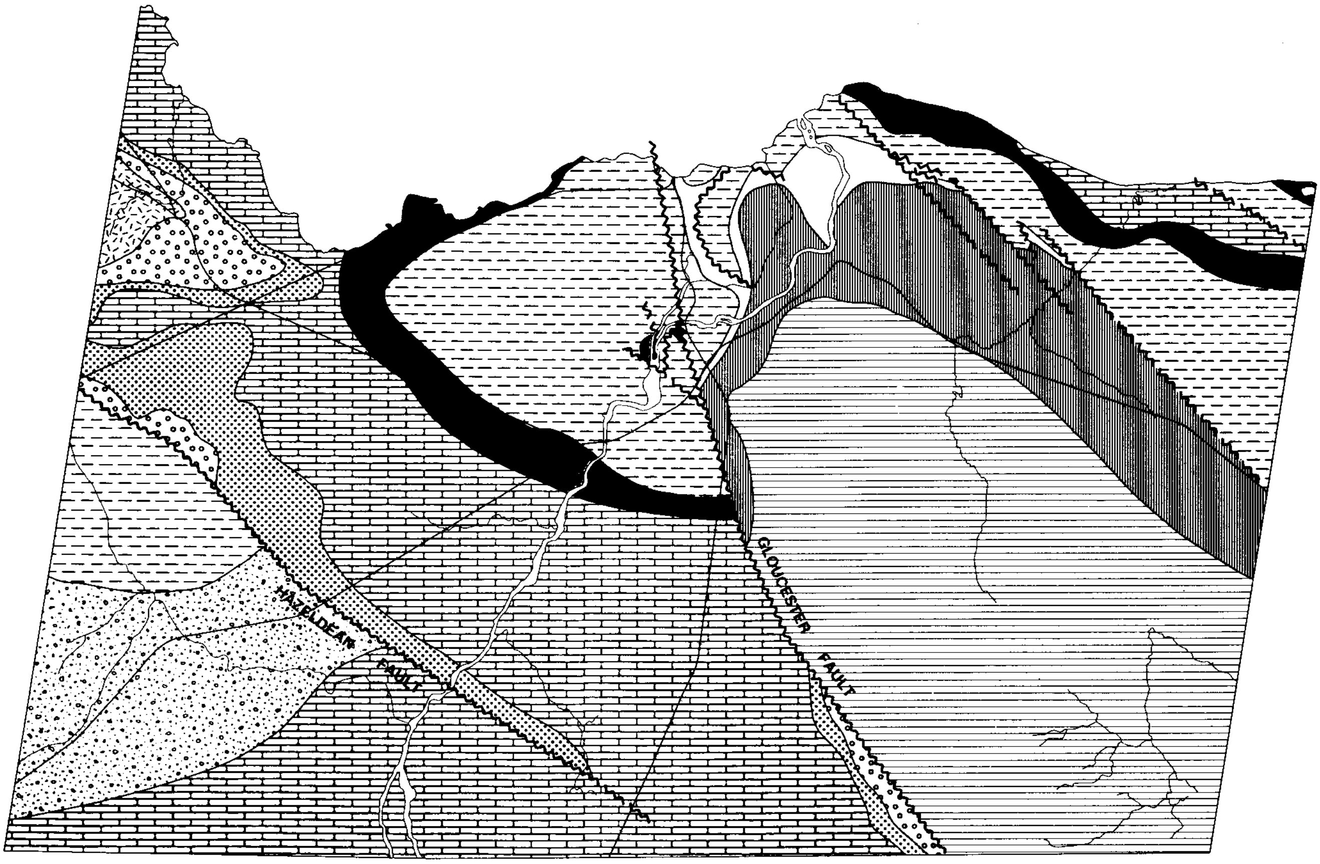


LEGEND

QUATERNARY

11 - PLEISTOCENE AND RECENT
Recent alluvium and glacial deposits

ORDOVICIAN

10 - LORRAINE
CARLSBAD FORMATION: grey shale, sandy shale, some dolomitic layers

9 - GLOUCESTER
BILLINGS FORMATION: black shale, with a little brown shale

8 - COLLINGWOOD
EASTVIEW FORMATION: limestone

7 - BLACK RIVER AND TRENTON
OTTAWA FORMATION: limestone, some dolomite layers in lower part, considerable interbedded shale with some sandstone in basal part

6 - CHAZY
ST. MARTIN FORMATION: shale, sandstone, impure limestone, dolomite

ORDOVICIAN

5 ROCKCLIFFE FORMATION: shale with lenses of sandstone

4 - BEEKMANTOWN
OXFORD FORMATION: dolomite and limestone

3 MARCH FORMATION: interbedded sandstone and sandy dolomite

ORDOVICIAN or CAMBRIAN

2 NEPEAN FORMATION: sandstone

PRECAMBRIAN

1 GRENVILLE FORMATION: Crystalline limestone, quartzites and metamorphic rocks; associated granite and granite-gneiss

After Wilson, A.E. 1964 "Geology of the Ottawa - St. Lawrence Lowland" Geological Survey of Canada, Memoir 241

Figure 4. Bedrock geology of Nepean and Gloucester Townships

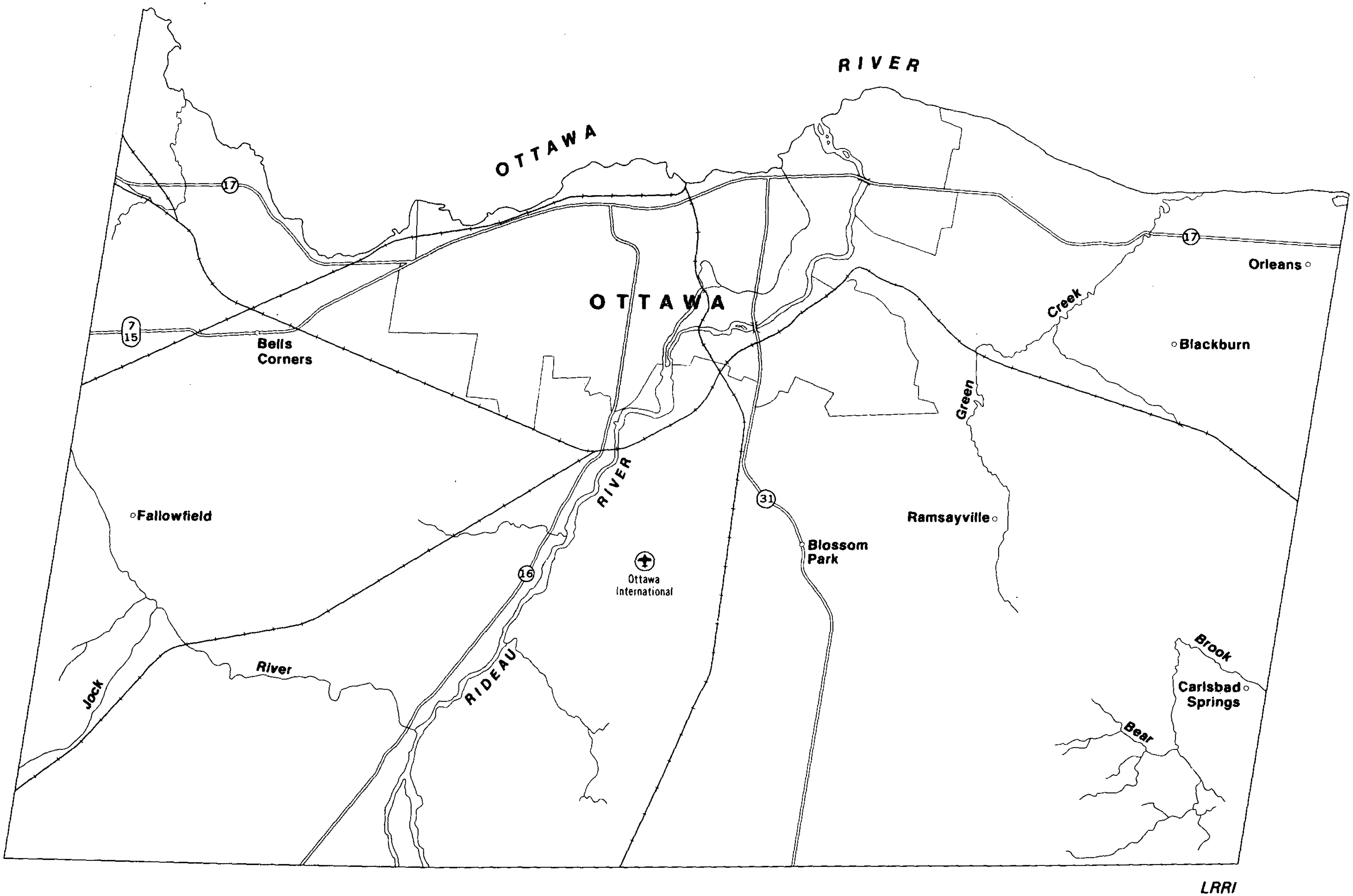
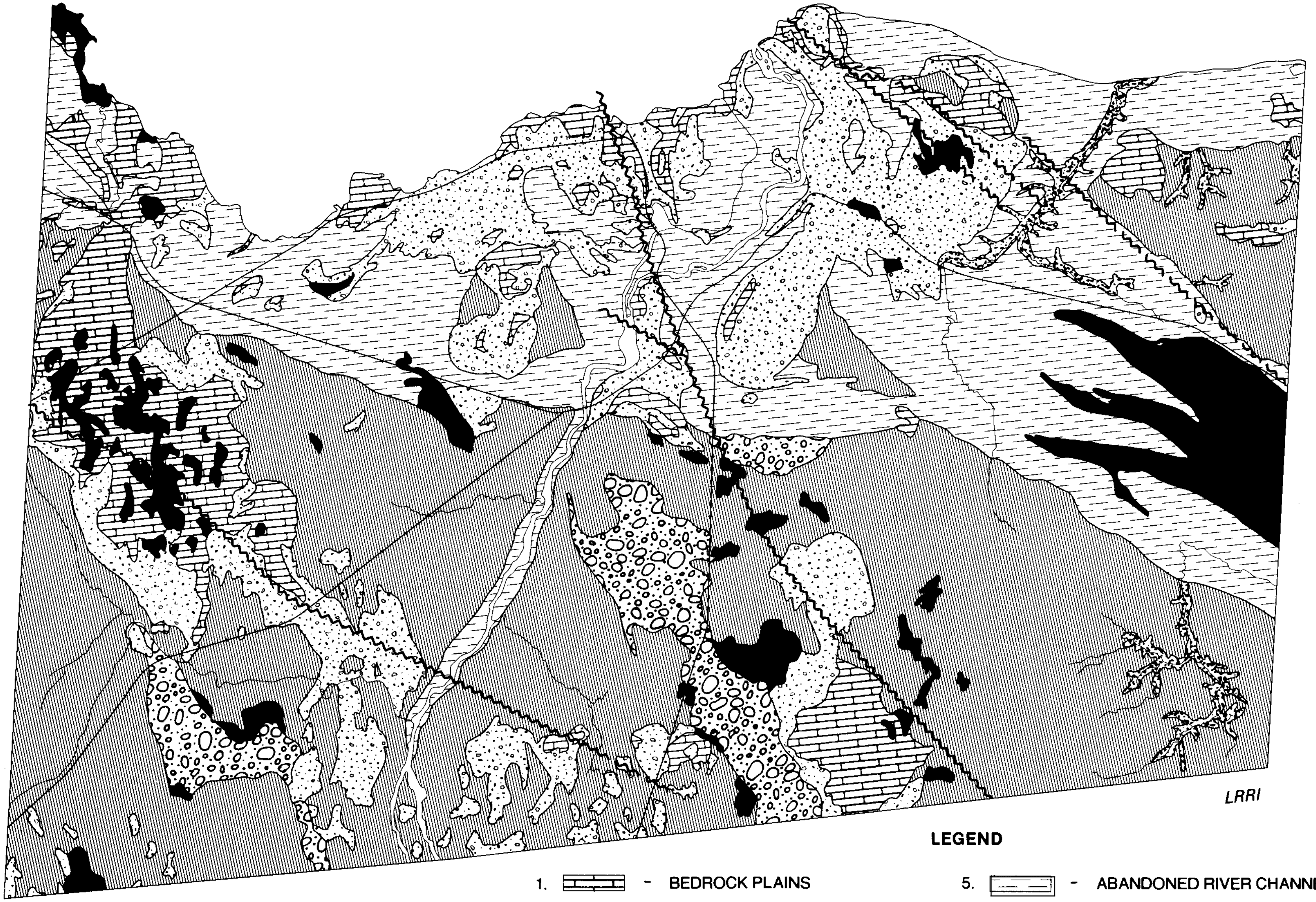


Figure 5. Drainage map of Nepean and Gloucester Townships



LEGEND

1. BEDROCK PLAINS
2. GLACIAL TILL PLAINS
3. FLUVIOGLACIAL RIDGES
4. MARINE PLAINS
5. ABANDONED RIVER CHANNELS: PRE-OTTAWA
6. ORGANIC PEAT PLAINS
7. ERODED STREAM VALLEYS

\- FAULTS

Figure 6. Physiographic subdivisions of Nepean and Gloucester Townships

quartzite were mapped in the Queensway soil association.

Ice margin deposits, consisting of fluvioglacial ridges in the form of eskers and kames as well as other ice contact features, were left during various halts in the retreat of the last ice sheet. Two fluvioglacial ridges mapped in this survey are composed of well-sorted and bedded non-fossiliferous gravels, sand and cobbles dip steeply interspersed with lenses of glacial till. The largest ridge, in Gloucester Township, stretches from the Ottawa International Airport southward to South Gloucester. A smaller ridge stretches from Kars in Rideau Township to the Jock River near Fallowfield, in Nepean Township. These materials have been mapped as the Kars and Mille Isle soil associations.

The complex pattern of block faulting in the vicinity of Ottawa formed a basin for deposition of marine sediments during the Champlain Sea epoch. The highest traces of the sea are fossiliferous beach deposits with an elevation of 205 to 213 m found near Kingsmere north of the sandy area (Johnson, 1917). Strongly developed shoreline features are rare, indicating that the duration of the highest water level was short.

Most fossiliferous beach deposits occur between 99 and 205 m in the Ottawa region. The gravelly beach deposits have been formed by reworking Paleozoic rock fragments and glacial and fluvioglacial deposits into a series of long, linear, raised beaches. The most extensive deposits are found on the steeper slopes of till and fluvioglacial ridges. Shoreline erosion acted first on glacial and fluvioglacial deposits, then later on marine sediments at successively lower elevations as the land rose isostatically. These coarse-textured beach deposits have been mapped as the Oka soil association.

In lower reaches of the sedimentary basin, fine-textured marine sediments (silt and clay) were widely deposited over the deep water sections of the sea, in layers up to 61 m thick (Antev's, 1925). In this survey these deposits have been separated into two layers on the basis of modifications to the original clay deposits in the upper 5 m. The two clays have been described in detail, first by Gadd (1961) and later by Crawford and Eden (1965). The original or lower layer, which forms the bulk of the deposit, is very soft, fossiliferous, slightly calcareous and extremely sensitive. This has been mapped as the Rideau soil association.

The upper layer, which appears to have been affected by redistribution and modification of the original marine clays by estuarine or fluvial action, is noncalcareous, non-fossiliferous, oxidized and highly fissured. This imparts contrasting chemical and physical characteristics to the upper layer relative to that below. The clays found in this upper layer have been mapped as either the North Gower or Dalhousie soil associations, depending on the texture.

Variations in the color and deposition of the marine clays have added further complexity to the deposits. Alternating bands of reddish brown (or pink) and greenish gray to olive gray clay were identified east of the Gloucester fault in Gloucester Township and mapped as the Bearbrook soil association. This clay has characteristics similar to those of the Rideau soil association.

The Champlain Sea progressed gradually to an estuarine and, finally, to a freshwater environment through isostatic uplift and the deposition of sediment. During this period large quantities of sand, forming extensive deltas, were deposited by rivers fed from the melting ice sheet. As the Champlain Sea receded and the marine environment changed to an estuarine coastal environment, the sand was deposited as a mantle on the clays.

The thickest sand deposits, usually exceeding 20 m in the map area, are found in the deltaic remnants at the Ottawa International Airport. The remaining deltaic and marine sands are generally much shallower, ranging from 1 to 5 m and sometimes as thick as 10 m. They usually become thinner and finer-grained to the south and southeast.

The deeper sands were mapped as either the Uplands or Jockvale soil associations, and the finer-textured silts were mapped as the Piperville soil association. Sands and silts less than 1 m thick were mapped as either the Manotick or Castor soil associations.

Although the most significant aspect of the Champlain Sea was the deposition of thick beds of clay and silt, its modifying effect on existing deposits was considerable. Elevated sedimentary bedrock plains and glacial tills were modified by wave action and, in places, partially covered by coarse beach deposits and finer-textured marine sediments. The tops of till ridges have either been reworked to alter the texture and structure, or a considerable amount of fine soil material has been removed from their flanks, leaving extremely stony surfaces. In many places, however, the lower slopes of till ridges are covered by a thin layer of marine silts or clays. Soil developed on these materials was mapped as either the Ironside or Chateauguay soil associations.

The original, steeply sloping fluvioglacial ridges were also modified during the withdrawal of the Champlain Sea. Marine wave action and longshore drift formed long, gently sloping upland plains. This process accounts for the deeper, widespread sand deposits (Uplands and Jockvale soil associations) found bordering the fluvioglacial ridges. The upper slopes of the fluvioglacial ridges are masked by a series of long linear beaches (Oka soil association), generally varying in thickness from 1 to 4 m. Several discontinuous, offshore bars are present to the east of Blossom Park and Leitrim. These run in a northwest-southeast direction and are fossiliferous in places. Due to their limited distribution and similar physical characteristics, these features were included in the Mille Isle soil association.

The most significant alterations to the landscape following the withdrawal of the Champlain Sea are related to the shifting channels of the Ottawa River. A series of terraces and abandoned channels in the vicinity of Ottawa indicates that the ancestral Ottawa River was much larger than at present. The Pre-Ottawa River flowed across what is now the Connaught Rifle Range north of Bells Corners, and across the Experimental Farm and Dows Lake. The channel divided into two east of Ottawa passing north and south of the faulted limestone block north of Blackburn Hamlet. Isostatic adjustment and the erosion of a lower channel upstream from Ottawa gradually caused the river to abandon the southern channel and shift to the north, to occupy the preglacial valley and what is now the Ottawa River channel. Terraces at various levels in the clay between 46 and 76 m contours mark successive periods of downcutting by the Pre-Ottawa River.

The south channel east of Ottawa has several cross channels separated by elongated islands underlain by marine clay and covered by fluvial sands of the Jockvale, Uplands or Manotick soil associations. Some of the channels are still occupied by small streams, but most of the south channel southeast of Blackburn Hamlet is occupied by the Mer Bleue Bog. A carbon date obtained from the peat (GSC-681, 7650 $\pm$ 120 yr B.P.) indicates this bog to be at least 7700 yr old. This material was mapped as the Mer Bleue soil association.

Many former channel bottoms and terraces consist of exposed marine clay, but significant areas are still covered

Table 3. Surficial materials of Nepean and Gloucester Townships

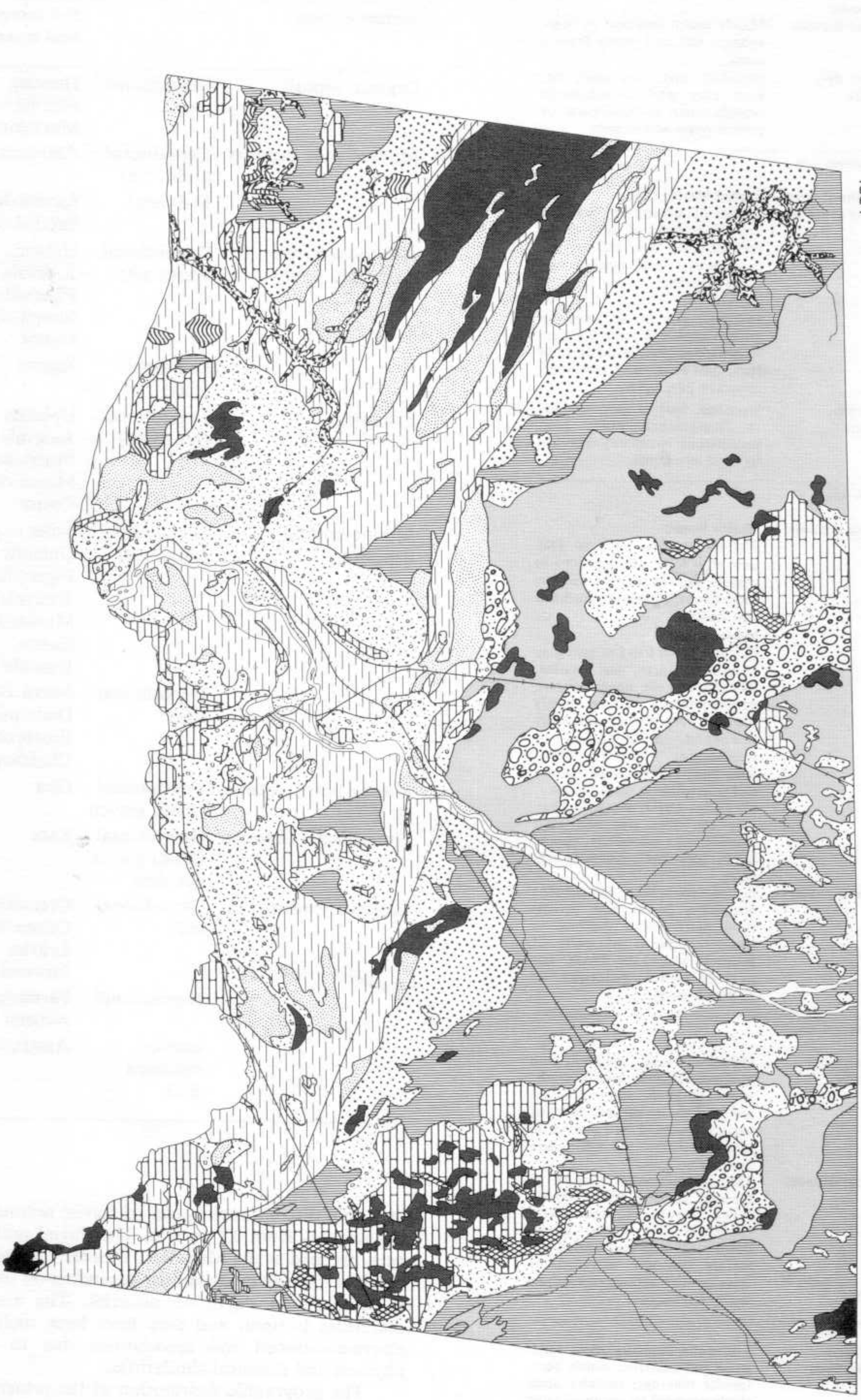
Recent deposits	
Organic deposits	Mainly mulch and peat in bogs, swamps, and very poorly drained areas.
Modern river deposits	Stratified sand, silty sand, silt, silty clay and disseminated organic matter on flood plains of present rivers and streams.
Post-Champlain Sea deposits	
Abandoned river channel deposits	**Eroded Marine Clays:** consist of Champlain Sea clay deposits stripped of most of the variable upper layer and overlain in places by a fluvial veneer of fine sands and silts. **Fluvial:** stratified, grey to buff medium-grained sand with some silt, non-fossiliferous often in the form of bars, spits or terraces; commonly reworked into dunes.
Estuarine deposits	Stratified, buff to grey, medium to fine-grained sand; non-fossiliferous; commonly reworked by wind into dunes.
Champlain Sea deposits	
Bottom deposits	**Marine Sands:** Well-sorted, fine, buff to gray sand with some silt, deposited in shallow water as near shore facies; fossiliferous, commonly reworked into dunes. **Marine Clay:** (i) **Upper Layer** 0 to 5 m, stiff gray to brownish gray, rust mottled, silty clay and silt; noncalcareous, nonfossiliferous oxidized, highly fissured, very plastic, commonly reworked in estuarine or freshwater environment. Associated with erosional features and susceptible to slope failure. (ii) **Lower Layer** very soft, blue-gray silt, silty clay and clay; fossiliferous, calcareous nonoxidized 'leda clay', extremely sensitive.
Beach deposits	Gravel, coarse sand, and cobbles; containing fossils and derived from older glacial deposits; in places composed of slabs of bedrock where the beach was derived from outcrops of Paleozoic rock.
Pre-Champlain Sea deposits	
Fluvioglacial deposits	Gravel and sand, stratified, with numerous cobbles and boulders, some till; in the form of eskers and various ice-contact deposits; surface reworked into beaches in locations below the Champlain Sea marine limit.
Glacial deposits	Till; heterogeneous mixture of material ranging from clay to large boulders, generally calcareous and sandy, grades downwards into unmodified till; surface generally modified by wave or river action; topography flat to hummocky.
Bedrock	
Paleozoic sedimentary	Limestone, dolomite, shale, sandstone and quartzite; mainly bare, tabular outcrops; includes areas thinly veneered by unconsolidated sediments up to 1 m thick.
Precambrian intrusive and metamorphic	Mainly bare, isolated hilly rock knob uplands; includes areas thinly veneered by unconsolidated sediments 1 m thick.

Table 4. Correlation between surficial materials, soil associations and land types

Surface material		Soil associations and land types
Organic deposits	Depositional (peat)	Huntley, Mer Bleue, Marshland
Modern river deposits	Depositional (sand, silt)	Alluvium
	Erosional	Landslides, Eroded channels
Abandoned river channel deposits	Depositional (sand, silt)	Uplands, Jockvale, Piperville, Manotick, Castor
	Erosional (clay)	Rideau
Estuarine	Depositional (sand, silt)	Uplands, Jockvale, Piperville, Manotick, Castor
Marine bottom deposits	Depositional (sand, silt)	Mille Isle, Uplands, Piperville, Jockvale, Manotick, Castor, Ironside
	Depositional (clay)	North Gower, Dalhousie, Bearbrook, Chateauguay
Marine beach deposits	Depositional (sand, gravel)	Oka
Fluvioglacial deposits	Depositional (sand, gravel, cobbles)	Kars
Glacial Deposits	Depositional (till)	Grenville, Queensway, Leitrim, Ellwood
	Depositional	Farmington, Nepean
	unconsolidated drift	Anstruther

by a thin discontinuous layer of fluvial sediments varying in thickness from 0.5 to 3 m. The fluvial sediments have been mapped as the Manotick, Castor, Uplands, Jockvale or Piperville soil associations, depending on the difference in texture and depth of material. The area of these sediments is small and they have been included in the above-mentioned soil associations due to their close physical and chemical similarities.

The geographic distribution of the principal surficial materials is shown in Figures 7 and 8 and the characteristics of each are described in Table 3. Correlation between surficial materials, soil association and land type is given in Table 4.



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LEGEND

1. - ORGANIC DEPOSITS: PEAT

2. - MODERN RIVER DEPOSITS: UNDIFFERENTIATED

3. - ABANDONED RIVER CHANNEL DEPOSITS
   - 3A -- ERODED MARINE CLAYS
   - 3B -- FLUVIAL SANDS

4. - ESTUARINE DEPOSITS: SAND

5. - SEA BOTTOM DEPOSITS
   - 5A -- MARINE SANDS
   - 5B -- MARINE CLAY

6. - MARINE BEACH DEPOSITS: SAND AND GRAVEL

7. - FLUVIOGLACIAL DEPOSITS: SAND, GRAVEL, COBBLES.
   - 7A -- UNMODIFIED
   - 7B -- MODIFIED: MARINE REWORKED

8. - GLACIAL DEPOSITS: TILL

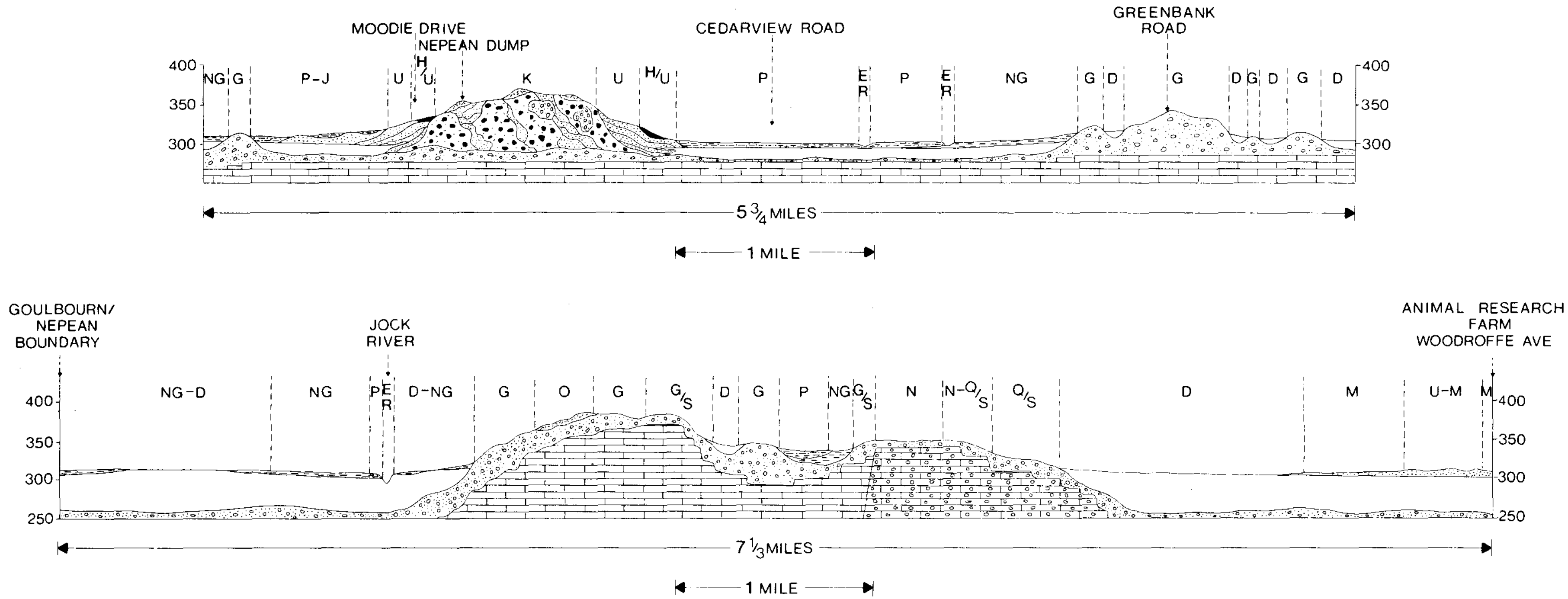
9. - BEDROCK
   - 9A -- PALEOZOIC SEDIMENTARY
   - 9B -- PRECAMBRIAN INTRUSIVE AND METAMORPHIC

ER - ERODED CHANNELS

LD - LANDSLIDES

Generalized from a compilation map in J.E. Harrison and J.R. Belanger; 1976 "Regional Geoscience Information: Ottawa-Hull"; Geological Survey of Canada, paper in press

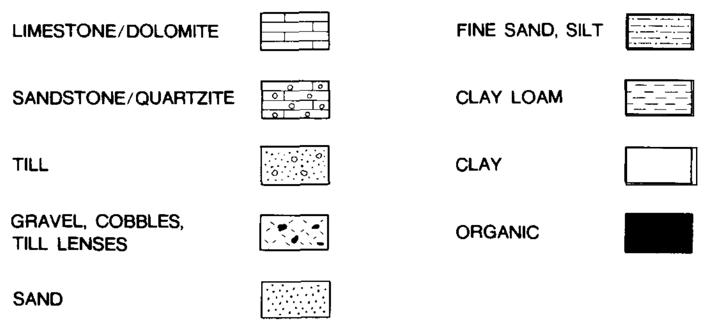
Figure 7. Surficial materials of Nepean and Gloucester Townships



SOIL ASSOCIATIONS

NG	NORTH GOWER	NG-D	NORTH GOWER-DALHOUSIE
G	GRENVILLE	O	OKA
P-J	PIPERVILLE-JOCKVALE	G/S	GRENVILLE/SHALLOW
U	UPLANDS	N	NEPEAN
H/U	HUNTLEY/UPLANDS	N-Q/S	NEPEAN-QUEENSWAY/SHALLOW
K	KARS	Q/S	QUEENSWAY/SHALLOW
P	PIPERVILLE	M	MANOTICK
ER	ERODED CHANNELS	U-M	UPLANDS-MANOTICK
D	DALHOUSIE		

SURFACE MATERIALS



NOTE Below the 10 foot level these diagrams are schematic representations of the surficial deposits, giving only their approximate relationships.

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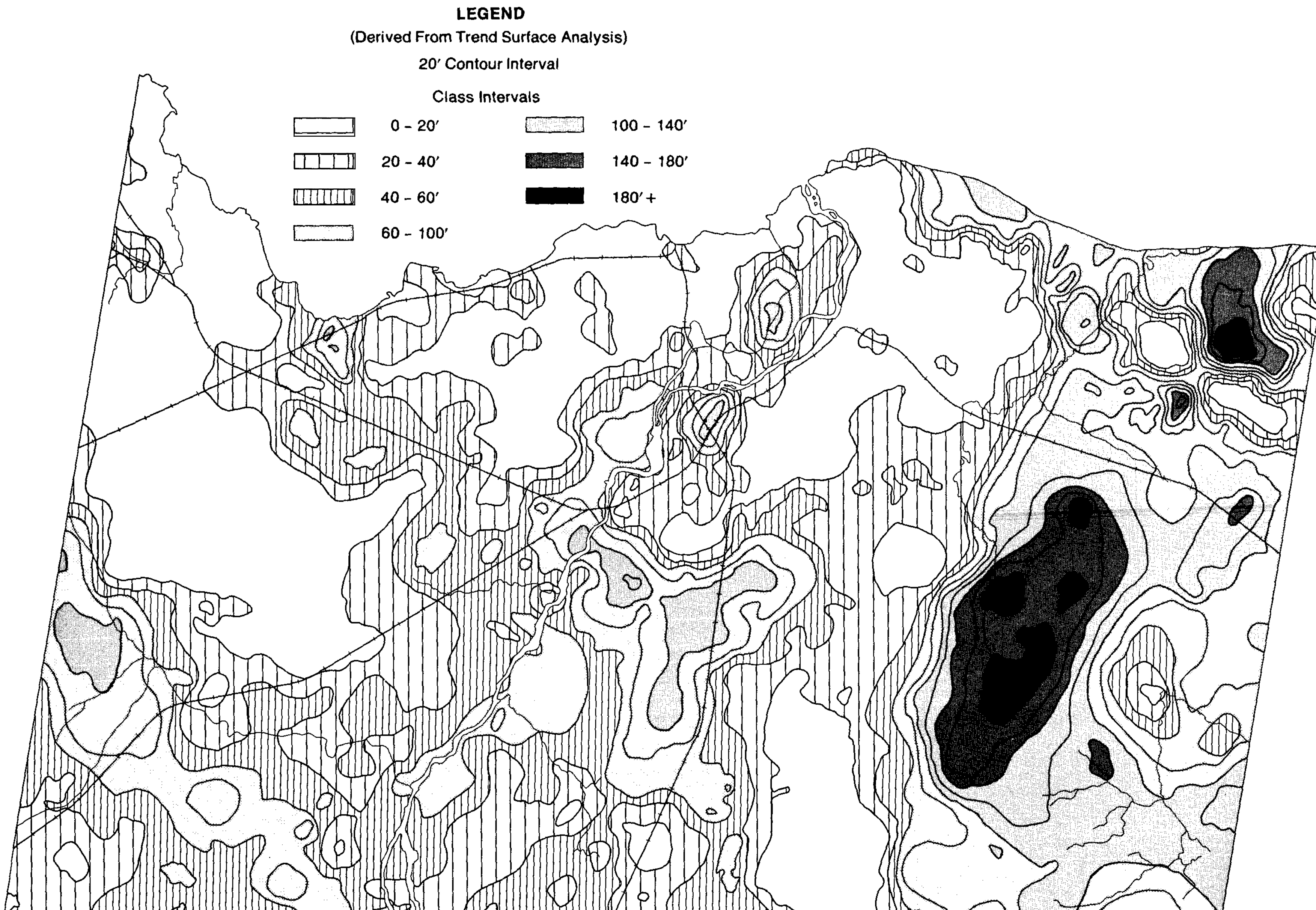
Figure 8. Stratigraphic cross sections of surficial materials



Generalized from a compilation map in J.E. Harrison and J.R. Belanger; 1976 "Regional Geoscience Information: Ottawa-Hull"; Geological Survey of Canada, paper in press

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Figure 9. Thickness of surface materials

Trend surface analysis of depth to bedrock, using data collected from borehole, seismic and well log records, has been carried out by the Terrain Sciences Division, Geological Survey of Canada. Results have been plotted in the form of a contour map. Figure 9 illustrates the thickness of surface materials in the portion of the map covering Nepean and Gloucester Townships. Several distinct patterns are evident.

Exposures of bare rock and very shallow surface deposits (< 10 cm) are widely distributed throughout Nepean and Gloucester Townships. The rock outcrops are concentrated on the flat, sedimentary bedrock plains adjacent to the Gloucester and Hazeldean faults. Others are found in the abandoned channels of the Pre-Ottawa River and on the raised fault block northeast of Blackburn Hamlet. Some of the thickest materials (10 to 75 m) are marine deposits in a deep trough running from Rockcliffe to Orleans along the Ottawa River, and southward through Green Creek in a line east of the Gloucester fault. Most of the surface material in this trough is 18 to 45 m thick. A shallower trough, in which the thickness of surface materials varies from 12 to 30 m, closely corresponds with the present-day Rideau River Valley. In Nepean Township marine deposits of up to 43 m thick are found in the southern end of the Carp Valley trough occupying the level clay plains north of Richmond.

Thick deposits are also found in the two glacial and fluvioglacial ridges laid down on the relatively flat interfluves of sedimentary bedrock. The thickness of the deposits in these ridges varies between 20 and 45 m.

Survey Methods

Soil survey is the systematic delineation of land areas in which the soils and their properties and the topography possess a certain homogeneity or distinctive pattern within defined limits. It is a specialized endeavor which follows procedures set at biennial meetings of the Canada Soil Survey Committee. These procedures ensure that the concept of soil is applied uniformly across Canada but, in addition to this, each pedologist must define limits for features and concepts peculiar to his working area. This is true particularly of those features and concepts that bear directly on the prescribed or best use of the soils in that area.

This section describes the basic procedures and concepts employed in this soil survey, most of which are standard to all soil surveys in Canada, but some were developed especially for this area.

Field Procedures and Access

Field work in the Ottawa urban fringe map area was begun in the summer of 1973 and completed by late fall of 1975. Initially the soils and their properties were recognized and described according to criteria outlined by the Canada Soil Survey Committee (1973), but these were later revised to be in accord with those of 1978 (CSSC, 1978). All stereoscopic phototyping was carried out using 1972 aerial photographs (1:15 840 or 4 in./mi), with hand transfer onto 1:20 000 orthophoto field sheets projected on a 3 degree modified Universal Transverse Mercator base using a 4 km x 4 km grid. Towards the end of the survey the multiple collection of field sheets was reduced and recompiled at 1:25 000, and then subjected to exhaustive field checking. The final result was the compilation of the soil map published at 1:25 000.

Certain published and unpublished information was fundamental to the successful completion of this survey. The most noteworthy of these were the earlier investigations on soils (Hills, Richards, and Morwick, 1944; Lajoie, 1960, 1962), and surficial materials of the area (Gadd, 1961 and 1962). Beyond this, considerable additional information was gleaned from the revised surficial geology map of the area provided from the open file system of the Geological Survey of Canada (Richard, 1976), and from studies of "Leda" clay by the National Research Council.

The area has an extensive road network providing easy access to all parts of the area, except the Mer Bleue bog. All roads and trails were traversed by truck, and areas between were covered on foot. Controlled systematic traversing was used whereby traverses were planned to cover the greater variability in terrain conditions.

Considerable effort was expended to keep traverses approximately 100 to 400 m apart, with additional subtraverses where necessary. In general, areas with high variability received the greatest amount of coverage. Soil and terrain observations along a traverse varied within a horizontal distance of 25 to 200 m, depending on the complexity of the soil pattern. Soil observations made at each site included: an appraisal of the soil parent material, soil profile and morphology, reaction (pH), texture of the surface and parent material, internal drainage, stone content, depth and character of nonconforming layers, depth to lime, character of the landform on which the site was located, and nature of land use and vegetation. Generally, observations were recorded to depths of 1 m with extrapolation to 2 m.

At the end of each field season the soils mapped were sampled in detail for laboratory analysis and verification. Sites selected were carefully chosen to be representative of the soils mapped. The major soils of the area were replicated at least four times, and all soils were sampled and described at least once. Chemical and physical analyses were conducted by the Analytical Services Section, Soil Research Institute, Ottawa, and by the Department of Land Resource Sciences, University of Guelph. Engineering analyses were done by the Engineering Services Branch, Ontario Ministry of Transportation and Communications, Downsview.

All data collected in the course of the field work were entered into CanSIS (Dumanski, Kloosterman, and Brandon, 1975), a computerized data management system for soil surveys. Traverse observations were encoded using a specially designed input form based on the standard 80-column card. Sites described in detail and sampled for laboratory analysis were encoded using the standard CanSIS detail form (CanSIS Working Group, 1975). All data were geographically referenced to the 3-degree modified UTM projection. In addition to this, the final soil map was digitized prior to publication, in preparation for producing a variety of derived or interpretive maps and for easy area calculation on a variety of classifications.

In addition to mapping the soils of the region, two subprojects were undertaken to characterize the water regime of the area. The first one, begun in the fall of 1972, involved the installation of shallow piezometers at eight representative sites in the region and the systematic monitoring of water table levels throughout the year. The piezometers were 2 cm in diameter and were installed at depths ranging from 1.5 to 5 m. Results indicating the response of the water table to major precipitation events are shown on the expanded legend.

The second subproject involved the characterization of saturated hydraulic conductivity of the major map units using the modified air-entry permeameter (Topp and Binns, 1976). Duplicate readings were taken at three depths: 10 to 20 cm, 35 to 45 cm, 90 to 100 cm or to the water table, with seven to eight replications per map unit. Duplicate soil cores (7.6 x 7.6 cm) were removed at each depth at each site and used for the calculation of water desorption curves and bulk densities. Some results are shown on the expanded legend, but most will be reported in a future publication.

Problems Associated with Mapping

Specific problems exist in the survey area concerning accurate representation of the soils information on a map. The most serious problem concerns the exceedingly complex geomorphological and sedimentary history of the area. A series of major depositional events succeeded one another in the region, but not always uniformly nor in all areas. These events began with glaciation followed by marine invasion, recession and delta formation. During and subsequent to these events there was redeposition of materials by streams and winds, and erosion by meandering rivers, particularly that of the Pre-Ottawa River. The result is a very complex pattern of materials (glacial, marine, estuarine, aeolian, eroded) that could be mapped with confidence only by extensive digging.

The second major problem relates to the complexity of soil formation in the area, as reflected by the nature and distribution of soil profiles over the landscape. Although most of the area is poorly drained, it was often difficult to distinguish a Gleysolic soil from a gleyed phase of a well-drained soil. The translocation of iron and/or clay within a well-drained soil was often minimal with the result that the field differentiation between Podzols and Brunisols, or Brunisols and Luvisols was often tenuous and required laboratory confirmation.

The arbitrary differentiation of acid and nonacid soils on the basis of pH 5.5 in the solum was difficult to apply because of the long history of cultivation and past liming practices in this area. Above this, other human activities that altered the properties of the soils were tile and surface drainage, topsoil removal, and the extraction or deposition of fill associated with residential or industrial expansion. In some cases the effects on the soil were so great as to warrant their separation as miscellaneous land types rather than natural soil areas.

A further problem was to relate the soil information mapped during this survey to that mapped previously in the area (Hills, Richards, and Morwick, 1944), and in adjacent regions of Quebec (Lajoie, 1960 and 1962). Both former surveys were mapped on the basis of soil series, but with increased technology and changing concepts the series has changed from a field-oriented entity to strictly a category of the taxonomic classification of soils. Also many of the old "series" were broad in their properties relative to the detailed needs of this survey. However, because so many of the names had become well known through continual use, it was decided to retain as many of them as possible, but to regroup and redefine them within the context of a comprehensive mapping system. Most names from the old "series" referred in fact to kinds of soil parent materials, and this greatly facilitated the correlation of names and the development of the mapping system. This is described further in the following section.

Mapping System Used in the Survey

A categorical mapping system (Figure 10) was used. In this approach the surveyor uses aerial photography and his observations, knowledge and experience to define naturally occurring, scientifically sound soil patterns that relate directly to the landscape, the scale of survey, and the probable interpretations that will be made from the survey. Such patterns are distinguished on the basis of topography, drainage properties, and defined proportions of taxonomic soil components. They are controlled by those features readily observable on the ground and on aerial photographs, and thus can be readily mapped. In this report, these patterns are called soil landscape units (Dumanski et al, 1972).

Soil landscape units are central to the mapping system shown in Figure 10. They are subdivisions of landforms and soil parent materials which in turn are subdivisions of broad pedoclimatic areas. At the same time they are made up of one or several taxonomic soil series, each of which occupies set positions in, and defined proportions of, the landscape unit. Traditional soil taxonomy, soil description procedures, and results of laboratory analyses are applied at the level of the soil series, but because this is part of a larger land unit the results and interrelationships of each series are treated in a land perspective. Variations, called phases, are used to show the presence of any mappable soil or land situation not handled as system criteria.

Soil landscape units are topographic subdivisions of a broader grouping called soil associations. Each association represents a variety of soils of similar materials with similar climatic, physiographic and general landform properties. The emphasis is on the lithologic nature of the material rather than its genetic origin, but attempts are made to correlate each association to the stratigraphic column. Thus, in this system, it is of no consequence to designate, for example, the Jockvale association as either fluvial or estuarine. It could be either, depending on where it is being mapped in the area. Of far greater consequence is the lithologic nature of the material and the properties of the soils that develop on it.

Individual areas outlined on the map are called map delineations, and these are defined by a collection of symbols representing discrete soil/land elements. Because each delineation is "homogenous" with respect to its characteristics, each is a discrete, scientifically sound, pedoecological area that can be reinterpreted as needed for a multitude of uses. The information carried by each map delineation can be deciphered from the expanded legend.

Further information on the soil association, landscape unit and map delineation can be found in the section dealing with explanatory notes on the soil map and legend.

Conventions Used in Mapping

Most of the standard Canada Soil Survey feature classifications, such as slope and reaction classes and textural groupings, were used in this survey. All of these are self-explanatory classes that are fully outlined in the map legend. In addition to these, however, a series of procedural rules particular to this survey were used:

ROCK OUTCROP exposures of limestone, dolomite, sandstone, quartzite or crystalline igneous or metamorphic bedrock, devoid of, or overlain by, less than 10 cm of unconsolidated surface soil. This was applied where the estimated summation of all bedrock exposures in an area was greater than 60%.

ORGANIC MATERIAL partially or completely decomposed organic soil material greater than 40 cm thick. Poorly drained soils with organic accumulations thinner than the specified limits were mapped as Gleysols.

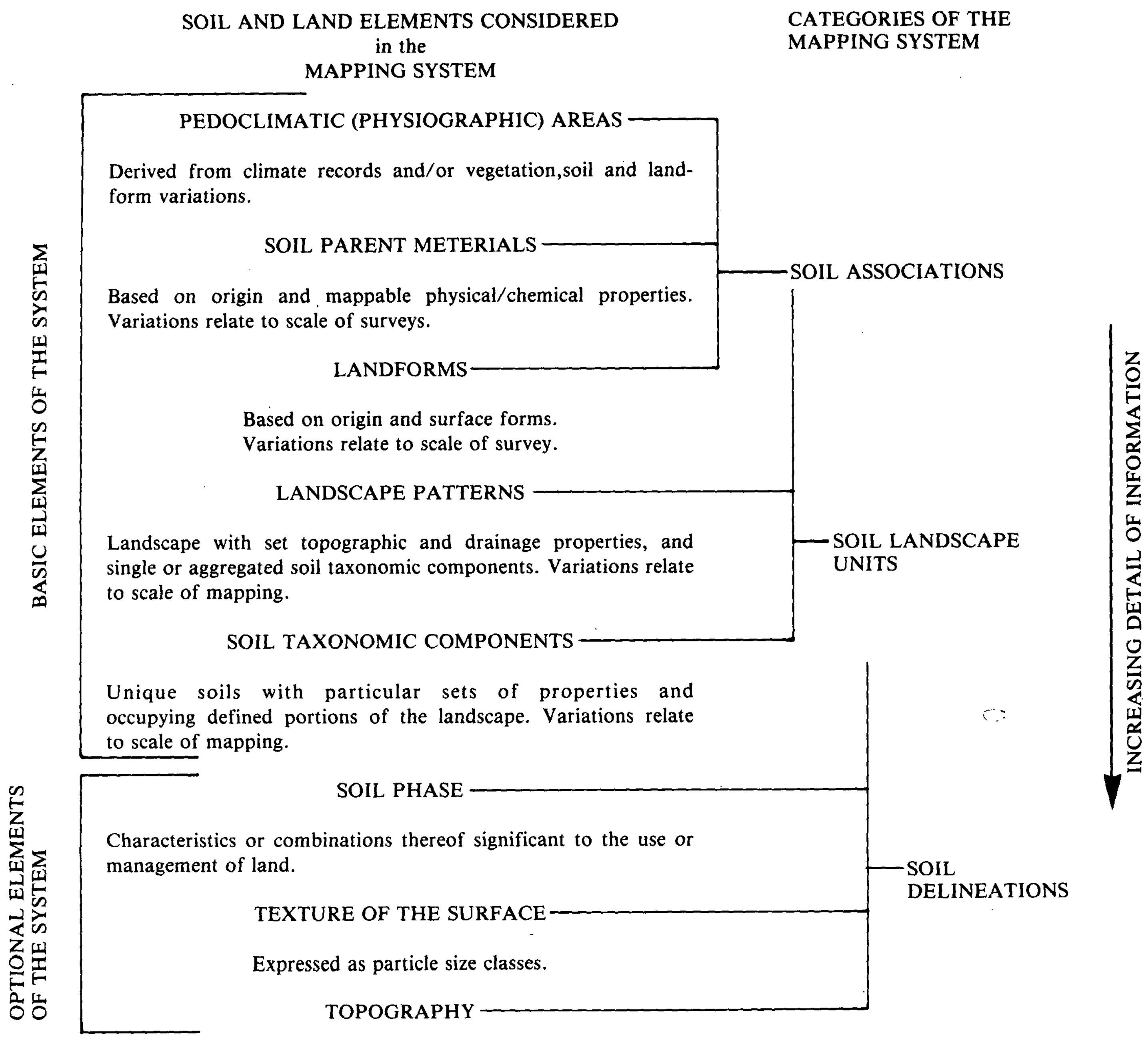

Figure 10. Categories and elements of the soil mapping system employed in the survey Note that the optional elements listed are supplementary to the basic elements, and are those that were considered to be particularly important in the area mapped. Other elements could have been used.

OVERLAY MATERIALS soil parent materials in which one material of strongly contrasting character overlies another within 1 m of the surface. The most common situation is that of the Manotick and Castor associations which are examples of sands and silts overlying marine clays. Other examples are the Ironside association which is sand overlying till, and the Chateauguay association which is clay overlying till. This classification was reserved for deep, mineral soils. It was never used for soils shallow to bedrock or for organic soils.

SOIL VARIANT a soil variant properly is a taxonomic soil unit closely related to a soil series but differing in at least one major characteristic. In this survey they were used to indicate small textural variations from the normal range of physical characteristics, but of too limited extent to warrant separation into new associations.

The variant was used with the North Gower association to denote an abnormally high incidence of silt banding throughout the material. It was used with the Jockvale association to indicate the presence of slightly finer, Piperville type material at about 1 m depth.

SOIL PHASE any subdivision of a taxonomic class based on characteristics or combinations thereof which are significant to man's use or management of the land. Four soil phases, shallow, peaty, stony and marl were used in this survey:

Shallow phase used in certain areas, and only with mineral soil materials that were defined as being thicker than 1 m, but had bedrock between 50 and 100 cm of the surface in that area. This should not be confused with soil associations such as Farmington, Nepean and Anstruther, which were defined as being less than 50 cm to bedrock.

Peaty phase used where mineral soils had 15 to 40 cm of surface peat accumulation. Such soils were invariably wet throughout the year.

Stony phase used with mineral soil materials that were very stony or exceedingly stony on the surface (stone content 3 to 15%). Stone contents of that magnitude are recognized impediments to mechanical cultivation.

Marl phase used with organic soil materials that were underlain by marl deposits. Such areas could be expected to be less acid than would be normal for peats of the area.

Explanatory Notes on the Soil Map and Legend

Two legends accompany the soil map for the area. The first is shown directly on the map and explains the color scheme in relation to soil associations and lithologic materials. It can be used to quickly derive information on the nature and distribution of soil parent materials in the area. This legend is a condensation of the detailed, expanded legend which is shown on a separate sheet.

The expanded legend is an integral part of the soil map in that it fully explains the categories and terms employed in the survey and shows ever increasing detail from left to right. It gives only factual data; interpretive or use related information can be found in appropriate sections of this report. The various categories in the expanded legend are listed below. Most definitions are taken from the Glossary of Terms in Soil Science (Agriculture Canada, 1976).

SOIL ASSOCIATION a natural grouping of soils based on similarities in climatic or physiographic factors and soil parent materials.

As used in this survey, the soil associations reflect lithological differences in parent material properties. They are subdivided into soil landscape units (soil catenas) upon observation that various profiles of a given association occur in close, predictable, geographic association, usually, but not necessarily, within strict limits of topography.

Soil associations are identified by using geographic place-names such as Grenville, Castor and Rideau. These names have been related as far as possible to the "series" used in the earlier soil surveys of the area, but in this case they refer strictly to a particular kind of material. (Refined soil series have been identified with geographic names as well, and the dominant taxonomic (series) members of each association carry the same name as the association itself.) Each soil association has been color coded on the soil map.

The soil association is strictly a mapping convenience used to group collections of soils to reflect pertinent aspects of the landscape. It is not a category of the Canadian System of Soil Classification.

PARENT MATERIAL the unconsolidated and chemically weathered mineral or organic material from which the soil developed by pedogenic processes.

The parent material of each soil association is described according to its genetic origin, texture (particle size distribution), thickness, reaction (acidity) and surface texture. Because a lithologic rather than genetic basis of definition was used, certain associations have more than one possible origin, for example, marine and fluvial. In such cases the textural class of the materials is identical and within narrowly defined limits. For most use considerations, the texture of the material is more critical than the nature of its origin.

The surface textures listed for each association represent the normal or most common situation. However, the very complex sedimentation patterns give rise to many soils with nonconforming surface layers. Thus, surface texture was mapped as an independent variable.

LANDFORM the various shapes of the earth's surface resulting from actions such as deposition, erosion and earth crustal movements.

The landform classification system used was devised by the Landform Classification Subcommittee (CSSC, 1978) of the Canada Soil Survey Committee. This system, developed particularly for application in regional reconnaissance soil surveys, is based on the origin, nature and form of materials. Its basic structure was retained in this survey but its style of application was modified to suit the greater detail of work.

Landform is not shown on the map but can be implied from the definition of each soil association.

SOIL LANDSCAPE UNIT subdivisions of soil associations based on differences in types of frequencies of slopes (surface expression of topography), and resultant differences in soil drainage and proportions of dominant and significant soils. Individual soil landscape units (soil catenas) have uniform characteristics of soil, topography and drainage, and each unit is shown on the map with a symbol and an enclosed line. They are the smallest uniform land areas that can be shown cartographically at the selected scale of map production. In this map area the smallest units were slightly smaller than 4 ha, except for depressional areas which could be smaller.

The factors of slope morphology, the associated variation of soil drainage, and proportions of soil taxonomic components define each soil landscape unit as a natural land area with a stated range of physical characteristics.

SOIL DRAINAGE the rapidity and extent of removal of water from the soil in relation to additions from precipitation, runon or groundwater flow. Soil drainage reflects a number of factors including texture, structure, gradient, length of slope and water holding capacity, acting separately or in combination.

Soil drainage was estimated using the standard CSSC soil drainage classification system. This is a seven-category, irregular-interval ordinal system based on the capacity of the soil to store water, and the ease with which water passes through the profile. The poorest condition is very poorly drained in which the water table remains at or near the surface most of the year. This is in contrast to very rapidly drained at the other end of the scale, whereby excess water flows downward very rapidly, and the soil dries soon after receiving precipitation.

SOIL TAXONOMIC COMPONENT individual soils which differ from each other in one or more of the major profile characteristics (except the texture of the A horizon), and are identified using one of the standard categories of taxonomic soil classification. This is the one common link between soil mapping and soil classification, and its employment ensures that the criteria required for classification are used in mapping to the maximum extent possible.

Soil taxonomic components are identified in the expanded legend at the subgroup level of classification with soil series, the basic level of classification, in parentheses. Soil series known to be present, but which occupy only minor portions of the map area, are only identified by their subgroup names.

DOMINANT AND SIGNIFICANT a mapping convention referring to the relative proportions of a given soil series and the drainage state as they occur in a soil landscape unit. **Dominant** means that more than 40% of a landscape unit are occupied by that series or drainage state; greater than 20% but less than 40% are **significant.** In most cases only one series or drainage state is significant. Generally only one series or drainage stage is indicated as occupying dominant or significant portions of the landscape unit. Where two are listed it means that together these make up over 40% or over 20% of the landscape unit, whatever the case may be.

SOIL MAPPING DELINEATION each soil area on the map is enclosed by a boundary line. The area within each boundary line is identified by a collection of symbols which together comprise the soil mapping unit. The information shown in a delineation is explained in the following example:

soil landscape unit

soil association → G1.S ← soil phase

3.2

surface texture group → 3 ; 2 ← topographic class

The soil map delineation identifies all the important physical features that can be found in that area. Referring to the expanded legend, the above example yields the following kinds of information:

G Grenville association; mildly alkaline, generally thick, stony glacial till occurring on drumlinoid ridges and undulating to hummocky till plains; textures range from sandy loam to loam; engineering properties as listed in the legend.

1 gently to moderately sloping and undulating landscapes, with good internal drainage; the area is uniform with respect to soil type, consisting of only the Grenville soil series (Eluviated Melanic Brunisol). Referring to the Canadian System of Soil Classification (CSSC, 1978), Eluviated Melanic Brunisols are soils with a dark colored surface horizon, underlain by grayish black and yellowish brown subsurface horizons. They are slightly acid to neutral in reaction, have a relatively high degree of base saturation, and are fertile.

S shallow phase; soils in this area are only 50 to 100 cm thick which is shallower than normal for Grenville soils.

3 surface texture group; medium-textured, loam, silt loam or silt.

2 topographic class; very gently sloping, 0.5 to 2% slopes.

The above example explains one of a large number of map delineations. There are many permutations possible. A list of those identified and mapped, complete with area compilation, is given in Appendix E.

Land areas which consist of collections of soil associations are shown as combined delineations, e.g. (P4.J4)/2.2, with the first symbol of the combination always representing more than one-half of the delineated area. The potential of such areas for various use considerations is dependent on the kinds and proportions of each soil association and its respective properties.

MISCELLANEOUS LAND TYPES land areas which have little or no natural soil, or in which the soil profiles have been highly complexed or destroyed by erosion, deposition or mass movement. In such cases information portrayed on the map is restricted to the nature of the material and its surface form.

MISCELLANEOUS LAND USE TYPES areas of land in which the soils have been destroyed beyond recognition because of urban related land use activities. Only the current use of such areas is shown.

Description of Soil Associations

Anstruther (A)

The Anstruther association consists of a moderately coarse-textured, thin veneer of stony undifferentiated drift material overlying Precambrian igneous and metamorphic rock. It is found only in the northwest corner of Nepean Township and is associated with Precambrian outcrops. The soils are predominantly Sombric Brunisols. Only 13.7 ha of the Anstruther association were mapped.

Anstruther material is a friable, dark reddish brown to brown, sandy, wave washed drift material derived from the original gray, highly calcareous sandy Grenville type till. The till deposits have been completely reworked leaving a very thin weathered drift material with only a very small proportion of the original limestone and dolomite stone content. Thickness varies between 10 and 25 cm and the drift material is generally less compact than the thicker Nepean and Farmington associations. These soils are very strong to strongly acid.

Landscapes associated with the Anstruther association are controlled by the topography of the underlying Precambrian bedrock, and are in the form of isolated, undulating to gently rolling rock knobs, rising 7 to 15 m above the level clay plains.

Soil drainage ranges from excessive to moderately well on all slopes, with only minor areas near the base of slopes affected by lateral seepage. Due to the steep slopes high runoff is expected, but much of the water would be transmitted through rock fractures.

SOIL LANDSCAPE UNITS Only one unit was identified in the Anstruther association. It is described as follows:

A1: Dominantly well-drained Orthic Sombric Brunisol occurring on gently to strongly sloping topography, with minor inclusions of exposed bedrock.

Soil Series Only one soil series was identified in the Anstruther association. The very thin Anstruther soils are well drained with thin dark brown to dark reddish brown subsoils, 10 to 25 cm thick. The soil is granular at the surface and granular to fine subangular blocky in the subsoil. Textures of the surface are dominantly sandy loam, with significant occurrences of loams, while subsoil textures vary from very stony loamy sands to sandy loams. The soils are rapidly permeable.

Bearbrook (B)

The Bearbrook association comprises a collection of soils developed in very fine-textured marine materials. Soil profiles include Gleyed Orthic Melanic Brunisols, Orthic Humic Gleysols and Rego Gleysols. This association is found in Gloucester Township on the east side of the Gloucester fault. The thickest and most extensive deposits are found between the 76 and 88.4 contours north and south of the Mer Bleue. Bearbrook soils are differentiated from soils of the Rideau association solely on the basis of the occurrence of reddish brown layers of varying thickness within 2 m of the surface, and on the morphology of their deposition. About 1516.5 ha of the Bearbrook association were mapped.

Parent materials of the Bearbrook soils consist of alternating bands of reddish brown and greenish gray to olive gray, neutral heavy clay, with clay content varying between 70 and 80%. The material is very plastic when wet. The alternating layers of reddish brown and gray clay generally vary between 3 and 20 cm in thickness. The total depth of the banded clay varies from 3 to 10 m north of the Mer Bleue to 0.5 to 4 m south of the Mer Bleue channels between Carlsbad Springs and the Gloucester fault. Here the Bearbrook soils have coarse beds of clay separated by thin layers of fine sand and silt less than 5 mm thick. The clay beds break into a medium to coarse subangular structure.

The Bearbrook clays found south of the Mer Bleue are generally covered by marine or estuarine sands and silts varying in depth between 0.5 and 5 m. In this area, the coarser soils are mapped as Manotick or Castor associations if less than 1 m thick over clay, or as Uplands, Jockvale and Piperville associations if greater than 1 m thick. Bearbrook materials usually have thin sandy loam surfaces less than 25 cm thick and are frequently mapped in combination with the Manotick association.

Along the eroded channel bluffs bordering the Mer Bleue, the gray beds of the Bearbrook clays are generally much thicker and frequently only one or two reddish brown bands occur in the upper 3 to 7 m of clay. It is in this area that the transition from the Bearbrook to Rideau associations is made. The distinctive coloration of the reddish brown bands continues to persist even after weathering, and soil processes seem to have very little effect on altering the color.

Two different structural developments occur in the parent material of Bearbrook soils. The most widespread is a coarse to very coarse, angular, pseudoblocky to massive structure, with concoidal fractures; the other more massive structure, with less pronounced fracturing, is confined to the area south of the Mer Bleue underlying the coarser marine and estuarine sediments.

The major landforms associated with Bearbrook soils are level to very gently sloping plains. Undulating topography is limited to the eroded divides between stream channels. Gently to moderately sloping bluffs are found along the channels cut by the Pre-Ottawa River to the south of Mer Bleue.

Poor to very poor drainage conditions prevail on all the level to very gently sloping plains, and this condition accounts for greater than 90% of the area mapped in the Bearbrook association. Imperfectly drained soils are restricted to the upper to mid slopes of undulating to inclined channel bluffs and terraces.

SOIL LANDSCAPE UNITS Three units are recognized in the Bearbrook association. They are described as follows:

- B1: Dominantly imperfectly drained Wendover series (Gleyed Melanic Brunisol) found on gently to moderately sloping eroded stream divides and channel bluffs with slopes between 2 and 9%.
- B2: Dominantly poorly drained Bearbrook series (Orthic Humic Gleysol) on level to very gently sloping topography with slopes between 0 and 2%.
- B3: Dominantly very poorly drained peaty Rego Gleysols with minor inclusions of Bearbrook series on level to depressional sites, slopes 0 to 0.5% in the abandoned river channel floors of the Pre-Ottawa River.

The **Wendover** series is a moderately well to imperfectly drained soil, meaning that it is water saturated for only a short time during the growing season. This soil has dark grayish brown, granular surface horizons (Ap) 10 to 12 cm thick. The underlying subsoil grades from grayish brown in the Bm horizon, 15 to 40 cm thick, to olive gray and reddish brown in the BC and C horizons. In these horizons the structure is medium to coarse subangular blocky and the soils friable to firm in consistency. The underlying parent material is coarse angular blocky grading to massive at depth with concoidal fractures. The slightly imperfect drainage conditions are indicated by faint yellowish brown mottles in the lower B and BC horizons.

The **Bearbrook** series is similar to the Wendover, but it is slowly pervious and subject to water saturation for a much longer part of the growing season. The granular surface Ap horizon is thicker (15 to 20 cm), and has a higher organic content, varying in color from dark brown to very dark grayish brown. Structure of the subsoil is medium and coarse subangular blocky to massive in the lower C horizon. The Bg and transitional BCg horizons of the subsoil are mottled a prominent yellowish brown and the matrix of the clay becomes grayer with depth.

The very poorly drained peaty **Rego Gleysols** are found in level to depressional sites with year-round water tables at or near the surface. These soils have a well-decomposed humic peat layer varying in thickness from 10 to 30 cm overlying a highly reduced amorphous, bluish gray to greenish gray clay subsoil. They are subject to very slow internal drainage.

Surface textures of the Bearbrook association are dominantly clay loams and clay with significant areas of sandy loam and loam textures where residual marine and fluvial sands have been intermixed with the clay.

SOIL COMBINATIONS Bearbrook association soils were mapped as the dominant soil in combination with the Manotick association on 195.2 ha. The Bearbrook-Manotick combination is most common on the marine plains and abandoned river channels east of the Gloucester fault, on gently undulating topography. The marine and estuarine sands of the Manotick deposits form long smooth knolls less than 1 m thick overlying Bearbrook clays. The level Bearbrook soils between the sand knolls usually have sandy loam surface textures.

Castor (C)

The Castor association consists of soils developed on medium to slightly acid, moderately coarse to medium-textured marine, estuarine and fluvial materials, 25 to 100 cm thick, overlying neutral, moderately fine to fine-textured marine deposits. Soil profiles include Orthic Melanic Brunisols, Gleyed Orthic Melanic Brunisols, Orthic Humic Gleysols and Rego Gleysols.

The most widespread deposits of the Castor association are found on the level plains east of the Gloucester fault and on level to depressional sites between, and adjacent to, till ridges on both sides of the Rideau River near Manotick. Less extensive fluvial sediments of the same texture and physical characteristics are found along the floodplain of the Rideau River, and in the abandoned river channel floors and terraces of the Pre-Ottawa River. About 1365.5 ha of the Castor association were mapped.

Castor parent materials grade upwards from the underlying heavy marine clay into alternating bands of silt and fine sand, showing evidence of deposition in shallowing water. Thus the character of these materials is uneven and a considerable variation in depth will be found within any one mapped area. More than 80% of the fine sand and silt overlays are 50 to 100 cm thick, the remainder are less than 50 cm. The average depth is 60 cm.

The clay underlying the veneer of silt and fine sand has not been differentiated in the soil legend. A veneer of silt and fine sand was mapped as Castor, regardless of whether the underlying clay was of the Rideau, Bearbrook, Dalhousie or North Gower type. Castor materials overlie Rideau clays along the Rideau River and in the river channel floors and terraces of the Pre-Ottawa River. They are found on Bearbrook clays between Orleans and the Gloucester fault and on Dalhousie-North Gower clays west of the Gloucester fault. The texture, color and structure of the underlying clays in the Castor association will generally have the same characteristics as the Rideau, Bearbrook and Dalhousie associations depending on the location of the map units.

The Castor association is differentiated from the Manotick on the basis of texture, mode of deposition and soil reaction. Castor soils have a greater percentage of silt and clay, there is a considerable textural variation due to the alternating layers of silt and fine sand, and the alternating layers range widely in thickness, frequently becoming homogeneous deposits dominated by either sand or silt fractions.

The sand fraction dominates most of the Castor soils mapped, resulting in sandy loam to very fine sandy loam textures. Only one-quarter of the soils mapped were dominated by silt and silt loam textures throughout the overlays. More than half the Castor soils mapped had loam surface textures, the remainder of the soils having very fine sandy loam and silt loam surface textures. Soil reaction in the parent materials is medium to slightly acid, with most soils falling into the latter class.

Landscapes of the Castor association are level to very gently sloping; this topography being common to the flat marine clay plains of the area. Slight undulations are present in certain local areas due to very smooth windblown sands. Fluvial sediments in the form of sandbars, or long narrow ridges on terraces with very gently to gently sloping topography, are found on the eroded channel floors and terraces of the Pre-Ottawa River and adjacent to the Jock and Rideau Rivers.

Poorly drained soil conditions affect 90% of the Castor soils mapped. Moderately well to imperfectly drained soils account for the remainder of the area. These soils are found on the crests and upper slopes of very gently to gently sloping and undulating sand dunes and sandbars. The textures of the overlays on the fluvial sediments and sand dunes are generally sandy loams with less silt and clay than is normal for Castor materials.

Castor soils generally have poor percolation rates and are susceptible to surface puddling and sheet erosion. Improved drainage conditions are found on the slopes of eroded channels and terraces where lateral seepage over the underlying clays helps to lower the water tables.

SOIL LANDSCAPE UNITS Six units were identified on the Castor association. These are described as follows:

- C1: Dominantly moderately well-drained Orthic Melanic Brunisols with significant areas of imperfectly drained Castor soils (Gleyed Melanic Brunisol) found on gently sloping to undulating topography with slopes between 3 and 6%.
- C2: Dominantly imperfectly drained Castor series (Gleyed Melanic Brunisol) found on gently sloping topography with slopes between 2 and 5%.
- C3: Dominantly imperfectly drained Castor series (Gleyed Melanic Brunisol) with significant areas of poorly drained Bainsville series (Orthic Humic Gleysol). Topography varies between 1 and 3% with rising knolls alternating with local depressions.
- C4: Dominantly poorly drained Bainsville series (Orthic Humic Gleysol) with significant areas of imperfectly drained Castor series (Gleyed Melanic Brunisol). Topography varies between 0.5 and 2% with the generally flat depressional terrain broken by sligh local rises.
- C5: Dominantly poorly drained Castor series (Orthic Humic Gleysol) found on level to very gently sloping topography with slopes between 0 and 2%.
- C6: Dominantly very poorly drained peaty Rego Gleysols found on level to depressional topography with slopes between 0 and 1%.

Soil Series The Castor association contains the Castor (Gleyed Melanic Brunisol) and Bainsville (Orthic Humic Gleysol) series. Two additional series, the Orthic Melanic Brunisol and peaty Rego Gleysol, have been mapped but not named due to their limited extent.

The well-drained **Orthic Melanic Brunisols** have very dark grayish brown to dark brown granular surface horizons 12 to 15 cm thick. The underlying subsoil is yellowish brown to brownish gray, with weak subangular blocky to single grain structures. Frequently the fine sands and silts appear to have a laminated structure. A discontinuous, weakly developed light gray Aej horizon (4 to 8 cm) is sometimes present below the surface layer. These soils are moderately pervious.

The imperfectly drained **Castor** series is subject to water saturation for short periods during the growing season. The surface horizon is thicker (15 to 20 cm) and has a higher organic content than the well-drained Orthic Melanic Brunisol. The remaining profile characteristics are similar, with the exception of the reddish brown and olive gray mottles in the subsoil. The soils are moderately pervious.

The poorly drained **Bainsville** series are found on level to very gently sloping sites subject to water saturation for significant periods of the growing season. The granular surface horizon is thick (15 to 25 cm) and high in organic matter. The underlying subsoils are light brownish gray and olive gray to gray in color, with yellowish brown and olive brown mottling. The structure of the subsoil is massive, with occasional laminated structures present. Although moderately pervious, surface runoff is very poor on Bainsville soils.

The very poorly drained peaty **Rego Gleysols** are found in level to depressional sites with year-round water tables at or near the surface. These soils have well-developed, humic peat surface layers, 10 to 40 cm thick. The underlying sand and silts are massive olive gray to light olive gray in color, and are usually between 20 and 50 cm thick above the clay stratum. These soils are very similar to the peaty Rego Gleysols found on the sandy materials of the Manotick association, texture being the only major difference between the two soils. The occurrence of the peaty phase soils is minor and confined to small depressions in the level plains east of the Gloucester fault. No other phase notations were used on the Castor association.

SOIL COMBINATIONS Castor association soils were mapped as the dominant soil in combination with other soil associations on 261.9 ha. The combination of Castor soils with the soils of the Dalhousie, Bearbrook, Rideau and North Gower associations accounts for over half of the total, the majority of which are found adjacent to the Rideau River and the channel floors of the Pre-Ottawa River. The Castor-Piperville combination, for those areas where the variability in depth of the fine sand and silts is 0.5 to 2 m, accounts for one-third of the above total. The remaining Castor soils are found in combination with the Manotick association where the deposits of fine sand and silts were so variable that the two associations could not be mapped separately.

Chateauguay (Ch)

The Chateauguay association consists of well, imperfectly and poorly drained soils developed in medium to moderately fine-textured modified marine materials, 25 to 100 cm thick overlying moderately coarse textured, stony glacial till. Soil profiles are Eluviated Melanic Brunisols, Gleyed Eluviated Melanic Brunisols and Humic Gleysols. This soil association is found west of the Gloucester fault in both Nepean and Gloucester Townships on the lower slopes between undulating till ridges or mantling more subdued till knolls that just break the surface of the marine clay plains. It covers about 151.4 ha.

Both the marine overlay and the underlying glacial till of Chateauguay soils have been altered considerably by marine and estuarine wave action. The marine veneer has a variable texture due to the washing of fine sand, limestone grit and small proportions of stones from the till knolls, and intermixing with the marine clay. About one-quarter of the area mapped has loam to silt loam textures in the upper solum, the remainder are in the clay loam to sandy clay loam range. In most cases, the underlying tills have been reworked in the upper metre, incorporating a higher percentage of silt and clay. Soil reaction in the marine veneer is slightly acid to neutral and in the underlying till, mildly alkaline.

The modified marine veneer of the Chateauguay association is brown to dark brown in color, with a coarse to medium granular structure. In places where the underlying till has been reworked, the structure is slightly stratified, pseudoplaty to granular, otherwise, the structure and coloration are the same as that found in the parent materials of the Grenville association. The stone content is generally less than 15% by weight compared to 20 to 40% in the Grenville till.

Landscapes associated with the Chateauguay association are controlled by the topography of the underlying glacial till. The relatively thin marine overlay only slightly modifies the landscape. Landforms occur as isolated, gently undulating till knolls with low local relief (2 to 5 m), or as mid to lower slopes and depressions between or adjacent to undulating gently rolling till ridges.

Soil drainage varies from moderately well on convex upper slopes to gleyed and poorly drained on mid to lower slopes and depressions. Internal soil drainage is good, with the exception of lower slope and depressional sites subject to the effects of lateral seepage. All Chateauguay soils have good moisture holding capacity.

Surface textures are dominantly loams and clay loams with minor areas of sandy loams adjacent to tills or marine sands and silts.

SOIL LANDSCAPE UNITS Two units and three soil series are recognized in the Chateauguay association. They are described as follows:

CH1: Dominantly moderately well-drained Chateauguay series (Eluviated Melanic Brunisol) with significant areas of imperfectly drained Gleyed Eluviated Melanic Brunisols. This unit is found on rounded knolls of undulating topography with slopes between 2 and 5%.

CH2: Dominantly imperfectly drained Gleyed Eluviated Melanic Brunisols with significant areas of poorly drained MacDonald series (Orthic Humic Gleysol). This unit is found on very gently sloping to gently undulating topography, slopes between 0.5 and 2%, with a significant number of depressional areas.

Soil Series The Chateauguay association contains the Chateauguay series (Eluviated Melanic Brunisol), MacDonald series (Orthic Humic Gleysol) and one other series that has been mapped but not named due to its limited extent, Gleyed Eluviated Melanic Brunisol.

The **Chateauguay** series is a well to moderately well-drained soil found on the upper to mid slopes of smooth, gently sloping till knolls. These moderately fine-textured soils have very dark gray to very dark grayish brown surface horizons, 15 to 25 cm thick, and brown to dark brown subsoils. The soil is granular at the surface and subangular blocky breaking to granular in the subsoil. The subsoil has pale colored eluviated horizons underlain by weakly developed Btj horizons indicating only slight increases in clay accumulation. The structure of the underlying light gray to light olive gray calcareous till grades downward from pseudoplaty to massive. The soils are moderately pervious.

The imperfectly drained **Gleyed Eluviated Melanic Brunisols** are situated on the lower slopes of very gently sloping till knolls. These soils have the same profile characteristics as the Chateauguay series, except for the distinct yellowish brown mottles in the lower half of the subsoil and the duller olive brown colors and faint mottling in the parent material. Although these soils remain moderately pervious, some seepage and periodic high water tables are evident in the early part of the growing season.

The poorly drained **MacDonald** series is subject to saturated conditions for a much longer period during the growing season due to its level to slightly depressed topographic position and moderately slow internal drainage. The very dark gray to dark brown granular surface horizon is underlain by dark grayish brown to olive gray subangular blocky subsoils. The subsoil and parent material have prominent yellowish brown mottles.

SOIL COMBINATIONS Chateauguay units were mapped as the dominant soil in combination with the Grenville association on 9.0 ha. These areas represent till ridges on which the amount of Grenville till material exposed at the surface was too small to separate and map on its own.

Dalhousie (D)

The Dalhousie association consists of soils developed in fine-textured, modified marine materials. Soil profiles are Gleyed Orthic Melanic Brunisols, Orthic Humic Gleysols and Rego Gleysols. This soil association is found widely distributed west of the Gloucester fault, between 85.3 and 103.6 m contours. A few areas are found between 103.6 and 112.8 m where isolated pockets of marine clay are found in depressions between till ridges. The most extensive areas are located on both sides of the Rideau River extending southeast from Bells Corners to the level plains southwest of the Airport. In Nepean Township, the clay plains stretching from Fallowfield to Richmond are highly modified on both sides of the Jock River and result in large areas of complexed Dalhousie-North Gower soils. The Dalhousie association was mapped on approximately 5157.9 ha.

Parent material of the Dalhousie association is coarser and more variable in composition than the clays of the Bearbrook and Rideau associations. The marine clays that form the basis of the Dalhousie parent materials have been modified under estuarine and fluvial conditions, altering the composition of the upper 2 m, leaving thin interbedded layers of silty sediments. Clay content is normally between 50 and 60% with the sand fraction generally less than 10%. The high variability in silt in the upper 2 m results from the interbedded, 10 to 25 cm thick layers of silty clay loam in the clay matrix. Under these conditions clay content varies between 33 to 45%. Surface modification of the marine plains is largely responsible for the complex intermixing of Dalhousie and North Gower soil associations.

The Dalhousie material is olive gray to gray in color, firm, and very plastic when wet. Soil structures in the upper 2 m range from medium to fine, subangular and angular blocky to coarse granular. The structure of the underlying clays becomes more massive and bedded with depth. Minor occurrences of varve-like laminations with coarse platy to granular structures occur in association with North Gower materials. Surface textures are clay loam and loam, with minor areas of clay.

Landscapes associated with Dalhousie soils are level to very gently sloping plains, accounting for more than 90% of the total area mapped. The remainder consists of very gently to gently sloping topography limited to inclined slopes of eroded channel bluffs along the Rideau River, and divides between actively eroding stream channels.

Poorly drained soil conditions on level to very gently sloping plains account for approximately 95% of the Dalhousie soils mapped. Imperfectly to moderately well-drained soils, constituting the remainder, are found on gently sloping, inclined to slightly convex eroded channel bluffs and stream divides.

SOIL LANDSCAPE UNITS Four units and three soil series are recognized in the Dalhousie association. They are described as follows:

D1: Dominantly imperfectly drained Dalhousie series (Gleyed Melanic Brunisol) found on very gently to gently sloping eroded stream divides and channel bluffs, with slightly inclined to convex slopes between 1 and 5%.

D2: Dominantly imperfectly drained Dalhousie series (Gleyed Melanic Brunisol) in combination with significant areas of poorly drained Brandon series (Orthic Humic Gleysol). This landscape unit is found on very gently to gently sloping eroded stream divides and channel bluffs, slopes between 1 and 3%, the bottom portions of which are concave in form.

D3: Dominantly poorly drained Brandon series (Orthic Humic Gleysol) found on level to very gently sloping topography with slopes between 0 and 2%.

D4: Dominantly very poorly drained peaty Rego Gleysols found in depressions between till ridges with slopes between 0 and 2%.

Soil Series The Dalhousie association contains the Dalhousie (Gleyed Melanic Brunisol) and Brandon (Orthic Humic Gleysol) soil series. A third soil series (peaty Rego Gleysol) has been identified and mapped during the course of the study but not named due to its limited extent.

The **Dalhousie** series is an imperfectly drained soil that is subject to saturation for only a short time during the growing season. The soils have very dark grayish brown, granular surface horizons (Ap), 10 to 16 cm thick. The underlying subsoil is dark grayish brown grading to olive gray and dark gray colors in the BC and C horizons. In these horizons the structure is medium to coarse subangular to angular blocky, and frequently shows evidence of varve-like laminations. The slightly imperfect drainage conditions are indicated by yellowish brown mottles in the lower B and BC horizons. The moderate to slow internal perviousness reflects the massive character of the clays at depth.

The poorly drained **Brandon** series is found on level to very gently sloping positions, subject to water saturation for a much longer part of the growing season. The granular surface Ap horizon is thicker (16 to 28 cm), has a higher organic content, and varies in color from very dark brown to dark grayish brown. The underlying subsoil is gray to very dark grayish brown with structures similar to that of the Dalhousie series. The Bg and transitional BCg horizons are mottled a prominent yellowish brown. Internal perviousness and surface runoff are both slow on these soils.

The very poorly drained peaty **Rego Gleysols** are found on level to depressional sites with year-round water tables at or near the surface. These soils have well-decomposed black humic peat surface horizons varying in thickness from 10 to 30 cm. The surface horizons are friable and granular in texture. The underlying subsoils are highly reduced, amorphous olive gray to greenish gray clays. Prominent yellowish brown mottles may be present in the upper half of the subsoil when drainage conditions have been improved by ditches or tiles.

Shallow and peaty soil phase notations have been used to a limited extent with the Dalhousie association.

SOIL COMBINATIONS Dalhousie association was mapped as the dominant soil in combination with other soil associations on 1071.0 ha. The Dalhousie-North Gower combination is the most extensive, accounting for approximately 15% of all Dalhousie soils mapped. Dalhousie soils occurred to a much lesser degree in combination with Manotick and Castor associations. These combinations were due to the variability in the thickness and distribution of the marine and estuarine fine sands and silts overlying the clays.

Ellwood (E)

The Ellwood association is a group of soils developed on a gravelly, moderately fine-textured, glacial till veneer, 50 to 100 cm thick, overlying fragmented shales. Soil profiles are Eluviated Sombric Brunisols, Gleyed Eluviated Sombric Brunisols and Orthic Humic Gleysols. This soil association is found in a small area of shale bedrock centered on Leitrim, to the east of the Gloucester fault. Approximately 122.0 ha of Ellwood soils were mapped.

Ellwood soils are dark brown to brown, friable, gravelly clay loams. The glacial till veneer of the parent material has been extensively wave modified under marine and estuarine conditions removing much of the original till material. Shale fragments normally account for 40 to 60% of the parent material and are almost all less than 2 cm in size. The unfragmented Lorraine shales of the Carlsbad formation are usually 1 to 2 m below the surface, and commonly, there is at least a metre of unweathered shale fragments overlying the unfragmented shale bedrock. Shale fragments increase in size toward the unfragmented bedrock contact.

Ellwood soils are strongly acid, due to the very high shale content of the till. Exceptions occur in minor areas of Ellwood soils bordering Grenville till ridges, where eroded limey soil materials have been incorporated into the upper solum. The heavier-textured clay loam tills of the Ellwood soils become plastic when wet.

Landscapes associated with the Ellwood soils are closely related to those of the Leitrim association. Both are controlled by the underlying topography of the shale bedrock, which rises above the adjacent level marine plain in a series of eroded step-like ridges and plateaus. Ellwood soils are normally found on the very gently sloping plateaus or depressions between the steeper sloping ridges of the Leitrim or Grenville associations. Significant areas of long, smooth, gently sloping ridges occur where the shale tills merge with the level marine plain.

Soil drainage on Ellwood soils varies from moderately well to poorly drained. Moderately well to imperfectly drained soils are found on very gently to gently sloping topography adjacent to the steeper ridges of the Leitrim association. Poorly drained soils are found on very gently sloping topography and on level to depressional sites between till ridges. These latter soils are affected by lateral seepage of water from the adjacent ridges.

Surface textures are dominantly clay loams; significant areas of loamy textures are found adjacent to Grenville and Piperville associations.

SOIL LANDSCAPE UNITS Three units and three soil series are recognized in the Ellwood association. They are described as follows:

E1: Dominantly moderately well-drained Eluviated Sombric Brunisols in combination with significant areas of imperfectly drained Ellwood series (Gleyed Eluviated Sombric Brunisol). This unit was found on mid to lower slopes of very gently to gently sloping ridges, with slopes between 2 and 3%.

E2: Dominantly poorly drained Orthic Humic Gleysols in combination with significant areas of imperfectly drained Ellwood series (Gleyed Eluviated Sombric Brunisol) found on very gently sloping topography with slopes between 1 and 2%.

E3: Dominantly poorly drained Orthic Humic Gleysols found on level to depressional sites adjacent to or between till ridges with slopes between 0 and 1%.

Soil Series The Ellwood association contains the Ellwood series (Gleyed Eluviated Sombric Brunisol) and two other series which have been mapped but not named due to their limited extent, Orthic Eluviated Sombric Brunisol and Orthic Humic Gleysol.

The moderately well-drained **Orthic Eluviated Sombric Brunisols** have a dark brown, granular surface horizon (Ahp) 12 to 15 cm thick, underlain by weakly developed brown to dark brown, fine subangular blocky to granular eluviated layers (Ahej or Aej) 6 to 10 cm thick. The underlying subsoil structure varies from weak subangular blocky to single grain, and dark brown to brown in color. The subsoil grades from gravelly clay loam to shattered shale bedrock between 50 and 80 cm of the surface. The heavier nature of the parent material and the close proximity of the bedrock restricts drainage more in the Ellwood association than the closely related, lighter-textured Leitrim soils.

The imperfectly drained **Ellwood** series is found on lower slopes subject to increased lateral seepage of water from adjacent ridges. Although internal drainage is moderate to slow, it is aided by the high gravel content of the parent material. The profile characteristics are similar to the above moderately well-drained series with the exception of distinct yellowish brown to reddish brown mottles in the subsoil and parent material.

The poorly drained **Orthic Humic Gleysols** occupy level to depressional sites that are saturated for much of the growing season. These soils have very dark brown to brown granular surface horizons, 12 to 18 cm thick. The structure of the underlying subsoil and parent material is granular to single grain, the color of which is dark grayish brown with distinct yellowish brown and reddish brown mottles.

SOIL COMBINATIONS Ellwood association units were mapped as the dominant soil in combination with the Piperville association on 26.8 ha. This soil combination represents areas of gently undulating, bedrock-controlled landscapes in which residual deposits of marine sand and silt have remained in isolated depressions between the Ellwood till knolls.

Farmington (F)

The Farmington association is made up of soils developed in a moderately coarse-textured, thin (10 to 25 cm) veneer of stony undifferentiated drift material, overlying stratified limestone and dolomite bedrock. Soil profiles are Orthic Melanic Brunisols, Gleyed Orthic Melanic Brunisols and Orthic Humic Gleysols. This soil association is found in Nepean and Gloucester Townships on Paleozoic, bedrock-controlled upland plains. These plains have steep scarps facing northward towards the Ottawa River and slope gently to the south. A total of 1102.9 ha of the Farmington association was mapped.

The distribution of Farmington parent materials is closely related to the two major faults in the map sheet. In Nepean Township, they are centered on the Hazeldean fault west and south of Bells Corners, and on the west side of the Gloucester fault south of Leitrim, in Gloucester Township. Less extensive occurrences are located along the Ottawa River, exposed by fluvial erosion. Although the faults play an important role in the distribution of the landforms on which Farmington materials are found, the steep bedrock escarpments which delineate the upland plains and separate Farmington map units are largely the result of differential weathering and fluvial erosion. The bedrock-controlled upland plains rise 5 to 25 m above the level marine plains. The most prominent increases in elevation are 15 to 25 m along the north facing bedrock escarpments.

Much of the wave washed drift material of the Farmington association was derived from gray, highly calcareous, sandy Grenville tills. The original till deposits have been reworked leaving a very thin veneer, generally 20 to 40 cm thick. Occasionally, small till deposits greater than 50 cm thick are located in bedrock depressions. Approximately one-third of the Farmington areas are affected by intermittent bedrock exposures that account for approximately 10 to 20% of the area of each map unit. The unconsolidated drift material is very stony and mainly composed of partly weathered limestone and dolomite with a small percentage of Precambrian, crystalline rocks.

Sandy loam textured soils predominate, with structures varying from weak, subangular blocky to single grain. Loamy sand and sandy clay loam textured materials occur in small pockets. Loamy sands combined with small amounts of gravel or rounded limestone flags are normally found bordering Ironside and Oka associations. Surface textures are dominantly loam and sandy loam with minor included areas of loamy sand. Soil reaction is neutral to slightly alkaline.

Landscapes of the Farmington association reflect the topography of the bedrock. The predominance of level to gently sloping landscapes is due largely to the stratified nature of the underlying limestone and dolomite. Gently to strongly sloping escarpments and ridges which break the continuity of the level bedrock plains are the result of differential erosion and local block faulting.

Soil drainage ranges from excessive to well on the gently to strongly sloping sites, and moderately well to imperfect on very gently sloping sites. Poorly drained soils are found in depressional sites bordering marshlands or organic deposits of the Huntley association. Internal drainage is good in all soils with the exception of depressional sites where lateral seepage accumulates over the underlying bedrock. Moisture holding capacity is limited, due to the shallowness of the soil.

The stony phase was commonly used in the Farmington association. Very stony surface conditions seriously affected more than 50% of the Farmington soils. The remainder of the soils had slightly to moderately stony surface conditions.

SOIL LANDSCAPE UNITS Five units and three soil series are recognized in the Farmington association. Unlike the Nepean association, almost one-fifth of the area mapped had complex topography, but this topographic condition was not significant enough to indicate in the map units. The map units are described as follows:

F1: Dominantly well-drained Farmington series (Orthic Melanic Brunisol) found on gently sloping topography with slopes between 2 and 5%. Included in this map unit are minor areas of moderately sloping escarpments and ridges with slopes between 6 and 9%.

F2: Dominantly imperfectly drained Franktown series (Gleyed Melanic Brunisol) with minor inclusions of moderately well-drained Farmington series (Orthic Melanic Brunisol) found on very gently to gently sloping topography with slopes between 0.5 and 3%.

F3: Dominantly poorly drained Brooke series (Orthic Humic Gleysol) found on level to depressional topography with slopes less than 1%.

F4: Dominantly well to moderately well-drained Farmington series (Orthic Melanic Brunisol) in combination with significant areas of imperfectly drained Franktown series (Gleyed Melanic Brunisol) found on very gently to gently sloping topography with slopes between 1 and 4%. Almost two-thirds of area mapped as F4 had less than 3% slope.

F5: Dominantly Franktown series (Gleyed Melanic Brunisol) in combination with poorly drained Brooke series (Orthic Humic Gleysol) found on very gently sloping topography, slopes between 0.5 and 2%, with concave toeslopes. Included in this map unit are minor areas of nearly level topography and gently sloping ridges between 2 and 4%.

Soil Series The Farmington association contains the Farmington (Orthic Melanic Brunisol), Franktown (Gleyed Melanic Brunisol) and the Brooke series (Orthic Humic Gleysol).

The **Farmington** series consists of thin, well-drained soils with very dark grayish brown surface horizons, 8 to 12 cm thick, and dark yellowish brown to brown subsoils, 10 to 20 cm thick. The soil is granular at the surface, granular to weak subangular blocky at depth, and rapidly permeable.

The imperfectly drained **Franktown** series is similar to the Farmington in profile characteristics, but is subject to water saturation for short periods during the growing season. These soils are found on lower slopes and flat topography subject to lateral seepage. The subsoil is distinguished by distinct yellowish brown mottles.

The **Brooke** series consists of poorly drained soils saturated for long periods during the growing season. Located in depressional sites subject to periodic ponding, the dark brown surface horizons are slightly thicker and higher in organic content. The subsoil is 10 to 25 cm thick with a grayish brown to light brownish gray matrix and prominent dark yellowish brown mottles. The structure varies from granular to weak subangular blocky.

SOIL COMBINATIONS Farmington soils were mapped as the dominant soil in combination with other associations on 172.5 ha. The areas mapped in combination with limestone and dolomite bedrock exposures were the most widespread, largely due to the overall thinness of the drift material. The Farmington-Grenville shallow phase combination represented areas of Grenville till 50 to 100 cm thick, not large enough to be separated on their own, but significant enough to indicate areas of surface deposits thicker than normal.

Grenville (G)

The Grenville association consists of soils developed in moderately coarse to medium-textured, stony till. Soil profiles are Eluviated Melanic Brunisols, Gleyed Eluviated Melanic Brunisols and Orthic Humic Gleysols. This soil association is widely distributed, and occurs in the form of isolated drumlinoid ridges or as larger blocks of undulating to hummocky till plains. It can be found generally on the highest elevations surrounded by finer-textured marine and estuarine deposits. In Gloucester Township, the Grenville soils are confined to the area between the Rideau River and the Gloucester fault. In Nepean, these soils are concentrated in a northwest-southeast belt, stretching from Kanata to Manotick. A smaller group of isolated drumlinoid ridges is concentrated in the southwest corner of Nepean Township near Richmond. Approximately 3061.1 ha of the Grenville association were mapped.

Grenville till, which constitutes the parent material of the Grenville association, is a friable, light grayish brown to olive gray unsorted till, with many angular and slightly rounded stones and boulders. Although strongly influenced by the underlying Paleozoic limestone and dolomite, the soil materials contain a considerable mixture of granitic material originating in the Precambrian area of the Canadian Shield.

The compact, calcareous, sandy tills have been subject to the effects of marine and fluvial erosion. The upper 50 to 100 cm have either been reworked to alter the texture and structure, or a considerable proportion of the finer soil materials has been removed leaving very stony surfaces. The texture of the parent material ranges from sandy loam to loam, with the stone content varying between 20 and 40% by volume. The structure of the reworked upper solum is generally granular to single grained. The underlying subsoil, depending on the degree of modification, is more compact with massive to weak subangular blocky structure. The Grenville parent materials are mildly alkaline due to the relatively high percentage of limestone and dolomite fragments.

Landscapes associated with Grenville soils are dominated by drumlinoid or ridged forms, generally less than 1 km in length. Some are oval in shape, but most are elongated. Many of the drumlins merge or are superimposed to a certain extent, giving an undulating or hummocky terrain effect. Most of these landforms rise 7 to 15 m above the surrounding flat marine plains. The slopes on these landforms are generally 3 to 9%, except for a small number of very gently sloping, isolated till knolls.

Bedrock-controlled, gently undulating to undulating beveled till plains are the other major landscape on which Grenville soils can be found. These landforms are concentrated along the Hazeldean and Gloucester faults where the differential erosion of the Paleozoic bedrock can be easily observed. The glacial tills are thinner in these areas, more highly modified, and frequently found in combination with the Farmington association on slopes between 1 and 3%.

The Grenville soils have good natural drainage, moderate moisture holding capacity and a permeable upper solum which absorbs moisture rapidly. All upper to mid slope positions are well-drained. The soil becomes imperfectly drained on the lower slopes of ridges, or on isolated drumlins with very low local relief. Poorly drained soils are found on level to depressional areas between till ridges, or on shallow till landscapes controlled by bedrock. Under these circumstances the natural drainage is poor. Less than 10% of the Grenville soils mapped are affected by poor drainage conditions.

Surface textures on Grenville soils are loams or sandy loams. Subsoil textures are generally sandy loams, occasionally loamy sands.

SOIL LANDSCAPE UNITS Five units and three soil series are recognized in the Grenville association. They are described as follows:

G1: Dominantly well-drained Grenville series (Eluviated Melanic Brunisol) on gently to moderately sloping ridges with slopes between 3 and 9%. Included in this map unit are significant areas of very gently to gently undulating and hummocky terrain with slopes between 1 and 5%.

G2: Dominantly imperfectly drained Matilda series (Gleyed Eluviated Melanic Brunisol) on the lower slopes of very gently to gently sloping inclines and ridges with slopes 1 to 3%.

G3: Dominantly poorly drained Lyons series (Orthic Humic Gleysol) on level to very gently sloping depressions with slopes between 0 and 1%.

G4: Dominantly well-drained Grenville series (Eluviated Melanic Brunisol) in combination with significant areas of imperfectly drained Matilda series (Gleyed Eluviated Melanic Brunisol) found on gently sloping ridges, slopes between 2 and 5%, with concave toeslopes. Included in this map unit are significant areas of gently undulating and hummocky terrain with slopes between 2 and 4%.

G5: Dominantly imperfectly drained Matilda series (Gleyed Eluviated Melanic Brunisol) in combination with significant areas of poorly drained Lyons series (Orthic Humic Gleysol) found on very gently sloping lower slopes and depressions with slopes between 0.5 and 2%.

Soil Series The Grenville association consists of the Grenville series (Eluviated Melanic Brunisol), Matilda series (Gleyed Eluviated Melanic Brunisol) and the Lyons series (Orthic Humic Gleysols).

The **Grenville** series has good to rapid natural drainage and moderately pervious subsoils. These soils have a very dark grayish brown granular surface horizon (Ap), 12 to 18 cm thick, usually high in organic matter. The underlying subsoil structure varies from subangular blocky to granular and grayish brown to light brownish gray in color. Light brownish gray eluviated layers (Ae), underlain by weakly developed illuviated (Btj) horizons, occur at depths between 25 to 50 cm. The parent material is a compact, massive, slightly impervious till, olive gray to light grayish brown in color.

The **Matilda** series is an imperfectly drained soil, subject to water saturation for short periods during the growing season. The compact, slightly impervious parent material and downslope position cause the slightly poorer drainage condition. The profile characteristics of the Matilda series are similar to those of the Grenville, with the exception of distinct yellowish brown mottles found in the lower half of the subsoil and parent material.

The **Lyons** series is a poorly drained soil saturated for much of the growing season. These soils are found in depressional sites subject to excessive seepage and runoff in the spring and early summer. The soils have very dark brown to very dark grayish brown granular surface horizons (Ap), 15 to 20 cm thick, and high in organic matter. The structure of the underlying subsoil and parent material is medium to coarse subangular blocky. The color varies from light olive gray to gray. The subsoil is distinguished by prominent dark yellowish brown mottles.

Shallow and stony phases were used within the Grenville association. The stony phase is the result of marine wave action eroding the tills and leaving very stony surfaces. Stones usually are granites, gneisses, and crystalline limestone cobbles and boulders. The most extreme cases are found on the crests and upper slopes of ridges, generally facing east. Almost one-quarter of the Grenville soils mapped are affected by very stony to exceedingly stony surfaces.

The shallow phase of the Grenville association was applied when the till was 50 to 100 cm thick over limestone or dolomite bedrock. It was used primarily in the bedrock-controlled upland plains bordering the Hazeldean and Gloucester faults, in combination with, or adjacent to, Farmington soils. Approximately 469.5 ha of Grenville soils are mapped as shallow phases or are a mixture of Grenville and shallow Grenville soils.

SOIL COMBINATIONS Grenville soils were mapped as the dominant soil in combination with other soil associations on 156 ha. Oka and Farmington associations account for half of this total. The Grenville shallow phase is found in combination with the very thin Farmington soils on the bedrock-controlled upland plains. Marine beach materials of the Oka association are found masking significant portions of the upper slopes of till ridges, but these are sometimes too discontinuous to separate from the Grenville tills.

Marine sediments of the Jockvale, Piperville, Chateauguay and North Gower associations have been mapped in combination with Grenville soils. These occupy depressional sites between till ridges in undulating to hummocky terrain.

Huntley (H)

The Huntley association consists of organic soils developed on moderately to well-decomposed forest and fen peat derived from sedges, reeds, leaf and needle fragments, and grasses. These soils are found throughout Nepean and Gloucester Townships in relatively small, level to shallow depressions and channel fillings. The most extensive Huntley deposits are found in shallow depressions on the northeast side of the fluvioglacial ridges, along the edges of the Mer Bleue, and at the base of the escarpments bordering its tributary channels. The remainder is found along the edge of the Ottawa River and in concave or level topographic positions of the bedrock plains in Nepean Township. The organic deposits of the Huntley association are generally found bordering deposits of the Piperville, Jockvale and Uplands associations. Those found in the Mer Bleue are closely associated with peaty phases of the Rideau, Bearbrook and Manotick associations. A total of 764.5 ha of the Huntley association was mapped.

The organic soils of the Huntley association are medium to slightly acid and generally contain small amounts of woody debris, stems, branches and roots. The native vegetation includes poplar, birch, cedar and an undergrowth of sedges, reeds and grasses. In Gloucester Township, willows and alders prevail around the edges of the Mer Bleue and some of the smaller forest swamps are dominated by cedar trees. The soils are commonly saturated to within a few centimetres of the surface throughout the year and are generally subjected to flooding during the spring season.

These soils are uniformly shallow, with less than 20% of the area mapped exceeding 160 cm in depth. The shallow phase (50 to 100 cm) accounted for more than 70% of the area mapped. Two-thirds of the underlying mineral substratums of the shallow organics, identified in the H3 and H4 soil landscape units, were sandy loams and loams.

The remainder were equally divided between sandy and clayey textures. The colors of the underlying mineral substratums are light gray to olive gray for sandy to loamy textures and olive gray to bluish gray for clay textured soils. In Gloucester Township at depths between 150 and 225 cm, layers of whitish colored marl (composed of precipitated and biologically deposited calcium carbonate) are found in varying thicknesses between 5 and 50 cm (the average thickness was 10 to 15 cm).

Subgroup organic soil profiles classified in the Huntley association are Typic Mesisols, Humic Mesisols, Terric Humic Mesisols, Mesic Humisols, Terric Humisols and Terric Mesic Humisols. The wide range of organic soils found in the Huntley association is further expanded by the textural variability of the underlying mineral substratums. Three soil profiles, namely the Terric Mesic Humisols, Terric Humisols and Terric Humic Mesisols with their varying mineral substratums, accounted for greater than 80% of the organic soils mapped in the Huntley association.

Terric Mesic Humisols have developed on predominantly well-decomposed, slightly acid humic forest and fen peat with a subdominant but significant layer of mesic peat. The medium acid mesic layer is 25 cm or more in thickness, and is usually found at depths between 50 to 90 cm. In some instances the mesic layer extends into the lower half of the surface tier, between 25 and 40 cm of the surface. The thickness of the total organic section ranges from 60 to 150 cm, however, most deposits are less than 110 cm thick.

The organic section of the Terric Humisols ranges between 42 and 120 cm, the majority of which is less than 75 cm thick. In some instances, a very thin (< 15 cm) discontinuous medium acid, partially decomposed mesic layer overlies the humic peat at the surface of the profile. Similar, very thin mesic layers occur within the lower half of the organic deposits.

The Terric Humic Mesisols have developed on partially decomposed medium acid mesic forest and fen peat 50 to 140 cm thick. The uniform mesic peat has alternating subdominate layers of slightly acid, highly decomposed humic peat, 25 cm or more in thickness between depths of 80 to 140 cm. In many cases a thin discontinuous layer, generally less than 15 cm thick, of strongly acid fibric peat is found overlying the mesic peat at the surface.

The above three profiles are underlain by sandy, loamy and clayey mineral substratums. Terric Mesic Humisols have thin layers of marl overlying the sand and loamy mineral substratums. The reaction of the underlying mineral soils is strong to medium acid for the sandy deposits, medium acid to neutral on the loamy deposits and neutral for the clays.

SOIL LANDSCAPE UNITS Four units and fifteen soil series were identified in the Huntley association during the course of the survey. However, series names and final designation of soil classification will not be decided until soil mapping of the entire Ottawa-Carleton Regional Municipality is completed. The map units are described as follows:

H1: Dominantly Typic Mesisols found on very gently sloping bedrock-controlled depressions with slopes between 0.5 and 2%. The total depth of the organic section overlying the bedrock substratum ranges from 20 to 120 cm.

H2: Dominantly Humic Mesisols in combination with significant amounts of Mesic Humisols found in level to depressional topography. The organic deposits range in depth from 175 to 275 cm overlying sandy to loamy mineral substratums.

H3: Dominantly Terric Humisols in combination with significant amounts of Terric Mesic Humisols found in shallow depressions. The organic deposits range in depth from 40 to 150 cm overlying sandy, loamy and clayey mineral substratums. The average depth is between 60 and 75 cm. Two-thirds of the area mapped are underlain by loamy textured mineral deposits.

H4: Dominantly Terric Mesic Humisols in combination with significant amounts of Terric Humic Mesisols found in level to predominantly depressional topography. The organic deposits range in depth from 45 to 170 cm overlying sandy, loamy and clayey mineral substratums. The average depth is between 45 and 95 cm. One-half of the area is underlain by loamy deposits and a third by sandy textured deposits.

Ironside (I)

The Ironside association consists of a group of soils developed in moderately coarse-textured modified marine and estuarine materials, 25 to 100 cm thick, overlying moderately coarse-textured stony glacial till. Soil profiles are Orthic Melanic Brunisols and Gleyed Orthic Melanic Brunisols. This soil association is found in Nepean Township under similar depositional conditions as the Chateauguay association. Approximately 63.4 ha were mapped, 47.0 of which were mapped as the dominant association in combination with other soils.

Modified marine or estuarine materials overlying till occur under three conditions in the Ironside association. The most extensive condition is located near Fallowfield, between the marine beach deposits of the Oka association on bedrock-controlled plains and the tills of the Grenville association. These are found at lower elevations bordering the clay plains. The second situation occurs on the lower slopes of isolated till knolls rising 2 to 5 m above the level clay plains. Shallow fluvial materials overlying Queensway tills (the third situation) occur in the eroded channel of the ancestral Ottawa River north of Bells Corners. These materials were included in the Ironside association due to their similar physical and chemical characteristics and limited occurrence.

The moderately coarse-textured waterlaid sediments of the overlay are light olive brown to yellowish brown in color. The structure is commonly single grained. Loamy sand textures are found adjacent to the Oka association beach materials and, frequently, thin lenses of interbedded fine gravels occur in the upper 50 cm of the deposit.

Surface stones can be present but are not prevalent features of Ironside soils. Only those soils mapped in combination with Oka or Grenville associations had slightly to moderately stony surface conditions.

In places where the underlying olive gray till has been reworked by water, the structure is loose, moderately compact and frequently slightly stratified. It is similar in many respects to the Grenville association, but the stone content is less than 15% by weight compared to 20 to 40% in the Grenville till. Soil reaction in the overlay is medium to slightly acid and mildly alkaline in the underlying till. Ironside soils have low natural fertility.

Landscapes associated with the Ironside association are controlled by the topography of the underlying glacial till. The relatively thin overlay only slightly modifies the landscape. Landforms are very gently sloping on the mid to lower slopes of isolated till knolls. In the Fallowfield area, bordering the bedrock-controlled beach and till ridges, landforms are gently sloping to undulating.

Ironside soils are generally well to moderately well drained, but tend to be imperfectly drained on mid to lower slopes due to downslope lateral seepage. The moderately coarse-textured overlay is very permeable and water percolates rapidly.

Surface textures are dominantly loamy sands and sandy loams, with minor areas of loam adjacent to the level marine plains.

SOIL LANDSCAPE UNITS Two mapping units and two soil series are recognized in the Ironside association. They are described as follows:

I1: Dominantly well-drained Ironside series (Orthic Melanic Brunisol) found on gently sloping topography with slopes between 2 and 4%.

I2: Dominantly imperfectly drained Gleyed Melanic Brunisols found on very gently sloping topography with slopes between 1 and 2%.

Soil Series The Ironside association contains the Ironside series (Orthic Melanic Brunisol) and a Gleyed Melanic Brunisol series. The latter has been mapped but not named due to its limited extent.

The **Ironside** series consists of well-drained soils found on the upper to mid slopes of till ridges and isolated knolls. The sandy overlay of these soils has granular, dark grayish brown to dark brown surface horizons, 10 to 15 cm thick. The dark yellowish brown to brown subsoil horizons, 15 to 45 cm thick, are underlain by light olive brown to light yellowish brown parent materials. Both the subsoil and parent materials are structureless. The underlying calcareous till is grayish brown to olive gray in color.

The imperfectly drained **Gleyed Melanic Brunisols** are found on lower slopes of till knolls. The slightly poorer drainage conditions are a result of downslope seepage over the underlying compact tills. The profile characteristics of these soils are similar to those of the Ironside series except for the slightly deeper overlay and duller colors in the subsoil. The subsoil has olive patches and distinct yellowish red mottles, and the underlying calcareous till is distinguished by faint yellowish brown mottles. These soils have a slightly better moisture holding capacity.

The shallow phase was used with the Ironside association. It is limited in extent and mapped only as a subdominant component in combination with the Queensway association. The moderately coarse-textured overlay is generally less than 50 cm thick.

SOIL COMBINATIONS Ironside units were mapped as the dominant soil in combination with other associations on 47.0 ha. The areas mapped in combination with Grenville soils represent till ridges on which Grenville materials are intermittently exposed at the surface, but too small to separate and map individually. The Ironside-Oka combination represents a complex of coarse beach deposits intermixed with the sandy overlays downslope from the main beach ridges.

Jockvale (J)

The Jockvale association is a collection of soils developed in medium acid, fine sand to loamy fine sand marine, estuarine and fluvial materials. Soil profiles are Orthic Melanic Brunisols, Gleyed Orthic Melanic Brunisols, Orthic Humic Gleysols and Rego Gleysols. Jockvale materials are found on the level, formerly offshore plains bordering the glaciofluvial ridges, downslope from the coarser materials of the Mille Isle and Uplands associations. In Gloucester Township, extensive deposits of Jockvale materials are found on level situations or local depressions adjacent to glacial till and bedrock-controlled ridges. Due to their limited extent, fluvial sediments of the same texture and physical characteristics as those found along the flood plains of the Rideau River and in the abandoned river channel floors and terraces of the Pre-Ottawa River have been included in the Jockvale association. A total of 2401.8 ha of the Jockvale association was mapped.

Jockvale parent materials grade from the underlying marine clay upwards through silt into fine sand, showing evidence of deposition in progressively shallowing water. The sediments are well sorted, with silt content increasing with depth. Fluvial deposits generally occur as isolated sandbars in channels of the Pre-Ottawa River. The parent materials are usually 1.5 to 3 m thick over the underlying marine clay.

Jockvale materials less than 1 m thick were mapped as the Manotick association. Deposition of the fine sand over the clay is uneven for both soil associations and a considerable variation in depth will be found within any one mapped area.

Parent materials of the Jockvale association are light olive brown to pale brown, with fine sand and loamy fine sand textures. Surface textures are dominantly fine sandy loams and loamy fine sands. Approximately one-quarter of the area has loam and peaty surface textures. Soil structure on Jockvale materials is single grained.

The Jockvale association is generally on level to very gently sloping plains. Gently undulating topography, resulting from very smooth, widely spaced windblown sand knolls less than 2 m above the level sand plain, is present on J3 and J4 map units. These units account for 40% of the area mapped in the Jockvale association. Gently sloping and undulating fluvial deposits occur as isolated sandbars and terraces in the Pre-Ottawa River channels.

Poorly drained soil conditions prevail on Jockvale soils, affecting almost 90% of the area. Poor drainage conditions occur on all flat topographic positions and lower slopes of the very gently sloping sand knolls. Well to imperfectly drained soils are found exclusively on the steeper fluvial sandbars and long, gentle, lower slopes bordering the glaciofluvial ridges. Imperfectly drained soil conditions are largely the result of the slightly higher elevations of the windblown sand knolls. Poor drainage and high water tables occur on flat topography. This latter condition is due to the impermeable clay layers invariably found within 1 to 2 m of the surface.

The Jockvale association could be confused with the Uplands association, but these are differentiated on the basis of texture, soil reaction and mode of deposition. Jockvale soils have a larger percentage of fine sand and silt, and clay content is generally two to three times that of the Uplands soils. Clay content varies between 2 and 9% and the silt content between 3 and 21% in Jockvale soils, and thus give the Jockvale soils slightly better moisture holding capacity than is common with Uplands soils. Stratification of the sediments increases with depth and occasional silt layers less than 2 cm thick occur in the upper metre of the profile. Soil reaction is higher, usually in the medium to slightly acid range, whereas Uplands soils are predominantly very strongly acid. Jockvale soils have low natural fertility but not as poor as that of Uplands soils. Unlike the Uplands soils, the Jockvale materials have only been slightly altered by wind action, and are usually flat and poorly drained.

SOIL LANDSCAPE UNITS Six units and four soil series were identified in the Jockvale association. They are described as follows:

J1: Dominantly well-drained Jockvale series (Orthic Melanic Brunisol) in combination with significant areas of Achigan series (Gleyed Melanic Brunisol) found on gently sloping and undulating topography, slopes between 2 and 5%. Alternating swells and swales of low local relief impart an overall undulating effect.

J2: Dominantly imperfectly drained Achigan series (Gleyed Melanic Brunisol) on very gently sloping topography with slopes between 1 and 2%.

J3: Dominantly imperfectly drained Achigan series (Gleyed Melanic Brunisol) in combination with significant areas of poorly drained Vaudreuil series (Orthic Humic Gleysol) found on very gently sloping to undulating topography with slopes between 1 and 3%.

J4: Dominantly poorly drained Vaudreuil series (Orthic Humic Gleysol) in combination with significant areas of imperfectly drained Achigan series (Gleyed Melanic Brunisol) found on very gently sloping to gently undulating topography. Slopes vary between 1 and 2%, but are predominantly very low.

J5: Dominantly poorly drained Vaudreuil series (Orthic Humic Gleysol) found on level to very gently sloping topography with slopes between 0 and 2%.

J6: Dominantly very poorly drained peaty Rego Gleysols on level to depressional topography with slopes between 0 and 1%.

Soil Series The Jockvale association consists of the Jockvale (Orthic Melanic Brunisol), Achigan (Gleyed Melanic Brunisol) and Vaudreuil (Orthic Humic Gleysol) soil series. A fourth soil series (peaty Rego Gleysol) has been identified and mapped, but not named due to its limited extent.

The well-drained soils of the **Jockvale** series have very dark grayish brown, weakly developed granular surface horizons, 10 to 20 cm thick, underlain by yellowish brown to yellowish red subsoils with loose, single grained structures. The Jockvale series is rapidly permeable but has a slightly better moisture holding capacity than the Carlsbad or Uplands series. Under virgin forest or reforested conditions, these soils have a surface mat of relatively undecomposed leaves, needles and twigs.

The imperfectly drained **Achigan** series is found on mid to lower slopes, subject to water saturation for short periods during the growing season. The profile characteristics are similar to those of the Jockvale series except for slightly darker surface horizons and a transitional light yellowish brown BC horizon. The slightly poorer drainage conditions are indicated by yellowish brown and olive mottles in the BC and C horizons. These soils are rapidly pervious.

The poorly drained **Vaudreuil** series is subject to water saturation for much of the growing season due to its level or depressional topographic position. It has a very dark grayish brown to dark gray surface layer, 15 to 20 cm thick, with a weakly developed granular structure. The subsoil is amorphous to single grained, and light olive brown to olive gray in color. Both the subsoil and parent material have prominent yellowish brown to strong brown mottles.

The very poorly drained peaty **Rego Gleysols** are found on level to depressional sites with year-round water tables at or near the surface. The soils have well to partially decomposed black peat surface horizons varying in thickness from 10 to 30 cm. The underlying soils are amorphous with gray to olive gray colors.

Shallow and peaty soil phases have been used with the Jockvale association. The least extensive is the shallow phase, less than 100 cm thick over limestone bedrock, which occurs in a few isolated map units on the level bedrock-controlled plains near Shirley's Bay.

The peaty phase is more widespread, accounting for approximately 5% of the Jockvale soils mapped. The peaty surface consists of well-decomposed organic material less than 40 cm thick. Such conditions are found on level to depressional sites adjacent to deeper organic deposits of the Huntley association.

JOCKVALE VARIANT The Jockvale variant indicates small variations of these materials from the normal range of physical characteristics found in the Jockvale association. The minor differences and limited extent of the Jockvale variant made it impractical to establish another soil association. Only 10% of the Jockvale soils mapped were of this type.

The Jockvale variant consists of a thin veneer of fine sands and fine loamy sands, 25 to 100 cm thick, overlying medium-textured marine and estuarine materials (Piperville materials). Unlike the normal Jockvale soils, the entire gradation from the underlying clay upwards through silt to fine sand generally is within 50 to 100 cm of the surface.

The Jockvale variant was mapped as the subdominant component with the Jockvale association on level to very gently sloping topography bordering the major topographic ridges. Soil drainage on the variant is poor, with only minor areas of imperfectly drained soils on very gently sloping terrain.

Only two map units were identified during the course of the survey, J2.V and J4.V. Both have the same drainage, soil profile and topographic characteristics as described above for the J2 and J4 map units.

SOIL COMBINATIONS Jockvale units were mapped as the dominant soil in combination with other soil associations on 691.6 ha. The Jockvale-Piperville combination is the most extensive, accounting for about half of this total. Other combinations are with the Uplands, Mille Isle, Manotick, Castor and North Gower associations.

Kars (K)

The Kars association is a group of soils developed in coarse-textured gravelly and cobbly, glaciofluvial materials. Soil profiles are Rego Gleysols and Eluviated Melanic Brunisols. Kars soils form the central core of two major northwest-southeast trending glaciofluvial ridges. The largest, in Gloucester Township, extends from the Airport to South Gloucester. The smaller ridge is located in Nepean Township, extending northwestward from Kars in Rideau Township to the Jock River near Fallowfield. The glaciofluvial Kars materials do not outcrop extensively at the surface and are usually buried beneath a covering of marine beach deposits. The Kars materials which are exposed can be found near the center of the present marine modified glaciofluvial ridges at the highest elevations, between the 106.7 and 118.9 m contours. Approximately 523.3 ha of Kars soils were mapped.

The original glaciofluvial ridges, deposited in the form of eskers, kames and other ice contact features, have been spread out laterally by marine action to form long gentle slopes. It is common to see gently dipping to horizontal beds of secondary gravels or sands overlying the central core of glaciofluvial deposits.

The parent material of the Kars association is nonfossiliferous, well-sorted and bedded gravels, sands and cobbles, steeply dipping and frequently interspersed with lenses of glacial till. The parent materials vary according to the thickness and size of the alternating beds of sand and gravel, but in most cases they are either dominantly gravels and cobbles or they are dominantly sand. In the former case gravels and cobbles account for 40 to 70% of the volume, about 30% of which are cobbles greater than 10 cm in diameter, and 60% are gravels less than 3 cm in diameter. In the sandier materials, gravels account for 10 to 40% of the volume, and are generally less than 3 cm in diameter.

Kars soils are dark yellowish brown to brown in the upper solum and pale yellow to light gray in the parent material. Textures of the parent material vary from very gravelly coarse sands to very gravelly loamy sand. Structure is generally single grained, and reaction is slightly acid to neutral.

When present, the overlying marine beach deposits are fossiliferous, well-sorted gravels and sands. Limestone and dolomite content is considerably less than in Oka beach materials. These beach deposits form a series of strandlines along the length of the ridges, varying in depth from 0.5 to 2 m, and exceeding 5 m in isolated pockets. The strandlines are discontinuous and do not entirely mantle the Kars materials. They have the same physical characteristics as the Oka association, but were not mapped separately due to their textural similarity and complex intermixing with the underlying Kars deposits.

The original steeply sloping landscapes of the glaciofluvial ridges have been modified considerably by wave action to form long, very gently to gently sloping upland plains, with slopes between 1 and 5%. Areas mantled by beach ridges have more complex undulating topography. Moderately to strongly sloping Kars materials, slopes 6 to 12%, occasionally accentuated by beach deposits, form elongated bluffs facing east and west. Texture of the surface horizons is dominantly loamy sands and sandy loams.

Soil drainage on Kars soil areas varies from excessive to well drained on all slope positions with minor exceptions, and the moisture holding capacity is very low. Water percolates very rapidly, giving rise to droughty conditions. Small areas of very poorly drained peaty Gleysols are found in Nepean Township adjacent to organic swamp deposits of the Huntley association. Such poor drainage conditions are largely the result of regional seepage from the highly permeable deposits of the adjacent glaciofluvial ridge.

SOIL LANDSCAPE UNITS Two mapping units and two soil series are recognized in the Kars association. They are described as follows:

- K1: Dominantly excessively drained Kars series (Eluviated Melanic Brunisol) found on gently sloping topography with slopes between 2 and 5%. Included in this unit are significant areas of moderately to strongly sloping ridges and bluffs with slopes between 6 and 12%.
- K2: Dominantly very poorly drained peaty Rego Gleysols found in very gently sloping to depressional sites, slopes between 0 and 1%. These are usually at the base of steeply sloping ridges and bluffs.

Soil Series The Kars association contains the excessive to well-drained Kars series (Eluviated Melanic Brunisol) and a second series, the peaty Rego Gleysol, which has not been named due to its very limited geographic extent.

The rapidly pervious **Kars** series has a thin fine-textured surface, and subsoil horizons in which the gravel and sand content increases with depth. There is a very dark to dark grayish brown surface, 10 to 16 cm thick, underlain by a slightly eluviated layer which is dark yellowish brown at the top but pales in color with depth. The thin, dark yellowish brown to brown subsoil, 6 to 12 cm thick, grades downward to the light gray parent material. The structure is granular to weak subangular blocky in the surface, but subsoil horizons and the parent material are single grained.

The very poorly drained peaty **Rego Gleysols** have black humic to mesic peat surface layers, 10 to 40 cm thick, overlying amorphous light gray to light olive gray sands and gravels. These soils are found at the base of ridges in ponded depressions adjacent to organic swamp deposits.

Leitrim (L)

The Leitrim association is made up of soils developed in a gravelly, medium-textured, till veneer, 50 to 100 cm thick, overlying fragmented shale bedrock. Soil profiles are Eluviated Sombric Brunisols, Gleyed Eluviated Sombric Brunisols and Orthic Humic Gleysols. This soil association is found in a small area of shale bedrock centered on Leitrim, to the east of the Gloucester fault. About 218.5 ha of Leitrim soils were mapped.

The parent material of the Leitrim association is similar in almost all characteristics to the Ellwood association, except for lighter textures and steeper landforms. Leitrim materials are dark grayish brown to dark brown in color, friable and granular in structure and gravelly loam to silt loam in texture. The till veneer has been extensively wave modified under marine and estuarine conditions, removing much of the original, finer deposits. The unfragmented Lorraine shales of the Carlsbad formation are usually 1 to 2 m below the surface. In the Leitrim association, there are few surface stones or boulders. Shale fragments, less than 2 cm in size and increasing with depth, form a large proportion of the parent material, and account for 40 to 60% of the soil. They increase in size within 25 cm of the unfragmented bedrock. The soil reaction is strongly to medium acid due to the very high shale content.

Landscapes associated with the Leitrim soils are controlled by the topography of the underlying, shale bedrock. The bedrock rises above the level marine plains in a series of eroded steplike ridges and plateaus, and the relatively thin overlay of till only slightly modifies this form. Topography is very gently to gently sloping, with slopes between 2 and 6%. Occasionally, depressions in the bedrock give rise to undulating landforms.

Leitrim soils are well to moderately well drained on gently sloping and undulating upper slopes and crests of the till ridges. Imperfectly drained soils are found on gently undulating knolls and lower slopes of ridges, while level to depressional landscapes situated between till knolls or adjacent to steep ridges are poorly drained. Leitrim parent materials have good to excessive natural drainage with the exception of depressional sites affected by lateral seepage, and areas with bedrock within one-half metre of the surface.

Surface textures are dominantly loam and clay loam with minor areas of sandy loam in areas adjacent to deposits of the Jockvale and Piperville associations.

SOIL LANDSCAPE UNITS Four units and three soil series are recognized in the Leitrim association. They are described as follows:

- L1: Dominantly well-drained Leitrim series (Eluviated Sombric Brunisol) found on gently to moderately sloping ridges with slopes between 2 and 6%. Included in this unit are significant areas of very gently sloping knolls, with slopes between 1 and 2%.
- L2: Dominantly imperfectly drained, Gleyed Eluviated Sombric Brunisols found on very gently sloping topography, with slopes between 1 and 2%.
- L3: Dominantly well-drained Leitrim series (Eluviated Sombric Brunisol) in combination with significant areas of imperfectly drained, Gleyed Eluviated Sombric Brunisols found on gently sloping ridges with slopes between 2 and 4%. Included in this unit are significant areas of gently undulating knolls and depressions with slopes between 1 and 2%.

L4: Dominantly imperfectly drained, Gleyed Eluviated Sombric Brunisols in combination with significant areas of poorly drained Orthic Humic Gleysols found on nearly level to gently undulating topography with slopes between 0 and 3%.

Soil Series The Leitrim association contains the Leitrim series (Eluviated Sombric Brunisol) and two other series which have been mapped but not named due to their limited extent, namely, Gleyed Eluviated Sombric Brunisol and Orthic Humic Gleysol.

The **Leitrim** series has good to excessive natural drainage. These soils have a very dark grayish brown granular surface horizon (Ap), 8 to 20 cm thick, underlain by weakly developed dark grayish brown to brown eluviated layers (Ahej or Aej) 8 to 15 cm thick. The underlying subsoil structure varies from medium granular to single grain, and dark yellowish brown to dark brown in color. The subsoil usually grades from gravelly loam to shattered shale bedrock between 70 and 100 cm of the surface.

The imperfectly drained **Gleyed Eluviated Sombric Brunisols** are found in very gently sloping knolls and the mid to lower slopes of ridges. The profile characteristics are similar to those of the Leitrim series with the exception of distinct strong brown to reddish brown mottles and duller grayish colors in the subsoil and parent material. Although these soils remain quite pervious, periodically, high water tables are evident in the early part of the growing season.

The poorly drained **Orthic Humic Gleysols** occupy level to depressional sites that are saturated much of the growing season. These soils have dark brown to very dark grayish brown granular surface horizons 15 to 20 cm thick. The structure of the underlying subsoil and parent material is granular to single grain, the color of which is grayish brown, with prominent yellowish brown to reddish brown mottles. Occasionally weakly developed Aegj horizons are evident, but not uniformly distributed.

MAP COMBINATIONS Leitrim units were mapped as the dominant soil in combination with the Piperville association on 26.3 ha. These areas represent gently undulating bedrock-controlled landscapes in which residual deposits of marine sands and silts have remained in isolated depressions between the Leitrim till knolls.

Manotick (M)

The Manotick association is a group of soils developed in strongly acid, coarse-textured marine, estuarine and fluvial veneer, 25 to 100 cm thick, overlying neutral, moderately fine to fine-textured marine materials. Soil profiles are Orthic Sombric Brunisols, Gleyed Sombric Brunisols, Gleyed Humo-Ferric Podzols, Orthic Humic Gleysols and Rego Gleysols. The most extensive deposits of the Manotick association are found in close association with the Uplands association in Gloucester. In Nepean, the Manotick materials are found to the south of the old Pre-Ottawa River channel, on the Animal Research Farm. Included in the Manotick association, are fluvial sediments of the same texture and physical characteristics as those found on the former floodplain of the Rideau River and in the abandoned river channel and terraces of the Pre-Ottawa River. The veneer of coarse-textured Manotick sands can be viewed as a transition between the thicker Uplands-Jockvale sediments and the underlying clays of the Rideau, Bearbrook and Dalhousie associations. A total of 4646.7 ha of the Manotick association was mapped.

Manotick parent materials grade from the underlying marine clay upwards through silt into sand, showing evidence of deposition in progressively shallowing waters. Deposition of the Manotick materials is uneven and, therefore, a considerable variation in depth will be found within any one mapped area. Eighty percent of the coarse-textured overlays are between 50 and 100 cm thick, the remaining overlays are less than 50 cm deep. The average depth is between 50 and 70 cm. The texture of the veneer is predominantly fine sand and loamy fine sand, with the exception of the narrow transition zone at the clay contact where textures can vary from fine sandy loam to silt loam. The structure of the coarse-textured overlay is single grained and occasionally bedded. Occasional silt layers less than 2 cm thick are found in the Manotick materials.

The clay underlying the thin veneer of coarse-textured Manotick material has not been differentiated in the soil legend. However, its character can be inferred from the distribution of the Rideau, Bearbrook, Dalhousie and North Gower map units. Manotick materials overlie Rideau clays along the Rideau River and on the river channel floors and terraces of the Pre-Ottawa River. They are found on Bearbrook clays between Orleans and the Gloucester fault and on Dalhousie-North Gower clays west of the Gloucester fault.

In certain areas the Manotick materials have been altered by wind action. The isolated windblown knolls are usually 30 to 40 cm thicker than the normal flat-lying Manotick materials.

Landscapes associated with the Manotick association are dominantly level to gently sloping. Very smooth windblown sand and isolated sandbars, less than 1.5 m above the normally flat terrain, give rise to the very gently to gently undulating topography found occasionally in the Manotick association. Approximately one-quarter of all Manotick soils are mapped in combination with Uplands soils either as the dominant or subdominant component. This situation accounts for a large portion of the moderately well to imperfectly drained Manotick soils.

Poor natural drainage conditions affect more than 90% of the Manotick soils. Water percolates quickly through the thin veneer of sand but is held up by the clay subsoil resulting in perched and high water tables. Moderately well to imperfectly drained soils are found exclusively on the crests and upper slopes of the undulating sand dunes and fluvial sandbars. Higher elevations on the sand knolls give better drained soil conditions. Improved drainage conditions are also found on the slopes of eroded channels and terraces where lateral seepage helps to lower the water tables.

Surface textures are dominantly sandy loam and loamy sand. The texture of approximately one-fifth of the area is loam or peaty surface.

SOIL LANDSCAPE UNITS Eight units and five soil series are identified in the Manotick association. They are described as follows:

M1: Dominantly well-drained Manotick series (Orthic Sombric Brunisol) in combination with significant areas of imperfectly drained Mountain series (Gleyed Sombric Brunisol) and poorly drained Allendale series (Orthic Humic Gleysol) found on gently sloping and undulating, swell and swale topography with low local relief. Slopes vary between 2 and 4%.

M2: Dominantly well-drained Manotick series (Orthic Sombric Brunisol) in combination with significant areas of imperfectly drained Mountain series (Gleyed Sombric Brunisol) found on gently sloping and undulating topography with slopes between 2 and 5%.

M3: Dominantly imperfectly drained Mountain series (Gleyed Sombric Brunisol) in combination with significant areas of poorly drained Allendale series (Orthic Humic Gleysol) found on very gently sloping and gently undulating, swell and swale topography with very low local relief. Slopes vary between 1 and 3%.

M4: Dominantly imperfectly drained Mountain series (Gleyed Sombric Brunisol) and poorly drained Allendale series (Orthic Humic Gleysol) found on gently undulating high frequency swell and swale topography with slopes between 1 and 3%.

M5: Dominantly poorly drained Allendale series (Orthic Humic Gleysol) in combination with significant areas of imperfectly drained Mountain series (Gleyed Sombric Brunisol), found on very gently sloping and gently undulating but predominantly level topography with slopes between 0.5 and 2%. Included in this unit are significant areas of gently sloping and undulating topography mapped in combination with undulating Uplands units.

M6: Dominantly poorly drained Allendale series (Orthic Humic Gleysol) found on level to very gently sloping topography with slopes between 0 and 2%.

M7: Dominantly very poorly drained, peaty Rego Gleysols found on level to depressional topography with slopes between 0 and 1%.

M8: Dominantly poorly drained Allendale series (Orthic Humic Gleysol) in combination with significant areas of imperfectly drained St. Damase series (Gleyed Humo-Ferric Podzol) and Mountain series (Gleyed Sombric Brunisol), found on very gently sloping and gently undulating topography with slopes between 0.5 and 2%. Included in this unit are significant areas of gently sloping to undulating topography mapped in combination with undulating Upland units.

Soil Series The Manotick association contains the Manotick (Orthic Sombric Brunisol), Mountain (Gleyed Sombric Brunisol), St. Damase (Gleyed Humo-Ferric Podzol) and Allendale (Orthic Humic Gleysol) soil series. A fifth soil series, peaty Rego Gleysol, has been identified and mapped but not named due to its limited extent.

The **Manotick** series is a well to moderately well-drained soil found on the crests and upper slopes of undulating knolls. These soils have very dark grayish brown to dark brown, granular, surface horizons, 10 to 20 cm thick, and strong brown to yellowish brown subsoils. A thin, light olive brown BC horizon frequently overlies the marine clay substratum. The subsoil is single grained and rapidly pervious. The sand overlay of the Manotick series is often slightly duned.

The imperfectly drained **Mountain** series is found on mid to lower slopes and is subject to water saturation for short periods during the growing season. The coarse-textured overlay is generally thinner than that of the Manotick series, but the profile characteristics are similar except for duller, grayish brown subsoils and the presence of yellowish brown and olive brown mottles.

The imperfectly drained **St. Damase** series is frequently found in association with the Uplands and Rubicon series on undulating to ridged topography, or on shallow very gently sloping sand knolls. These soils have very dark grayish brown surface horizons, 10 to 15 cm thick, overlying thin, light gray Ae horizons (7 to 12 cm), which in turn rest on yellowish red to reddish brown subsoils. The subsoil contains strongly cemented yellowish red iron concretions and duller olive gray to olive brown mottles. Generally, on level to gently sloping plains, the surface horizons and part of the subsoil have been destroyed through plowing.

The poorly drained **Allendale** series is found on level to very gently sloping sites and is subject to water saturation for much of the growing season. The granular surface horizons are dark gray to black in color and occasionally underlain by light olive gray Aejg layers. The surface horizon is generally thicker (15 to 20 cm) and higher in organic matter. Subsoil colors grade downward from grayish brown to olive gray and gray above the clay substratum. Prominent reddish brown to dark yellowish brown mottles are found throughout the subsoil.

The very poorly drained peaty **Rego Gleysols** have water tables at or near the surface throughout the year. These soils have well-decomposed black peat surface layers, 15 to 30 cm thick. The underlying sandy subsoils are amorphous olive gray to light gray in color, and usually less than 50 cm thick.

The peaty phase was used in mapping the Manotick soil association in Gloucester Township in the eroded channel floors of the Pre-Ottawa River. The Manotick peaty phase is found in level to depressional sites adjacent to the shallow organic deposits of the Huntley and Mer Bleue associations, and as isolated peat covered sandbars located in the main body of the Mer Bleue.

SOIL COMBINATIONS Manotick soils were mapped as the dominant soil in combination with other soil associations on 1487.6 ha. The combination of Manotick soils with the clays of the Rideau, Bearbrook and Dalhousie associations accounts for over one-half of this total. The Manotick soils found in these soil combinations are on very gently undulating sand knolls separated by clays with sandy surface textures on the level to slightly depressional areas.

The Manotick-Uplands and Manotick-Jockvale soil combinations account for over one-third of the above total. The Manotick soils occupy the lower slopes and level to depressional sites between the steep sand dunes and ridges of the Uplands and Jockvale materials. The remainder of the Manotick soils is found in combination with the Castor association where the deposition of fine sands and silts is so variable that the two associations cannot be mapped separately.

Mer Bleue (MB)

The Mer Bleue association consists of organic soils developed on thin or absent layers of poorly decomposed sphagnum moss peat overlying partially decomposed fen peat derived from sedges, reeds and grasses. These soils are found exclusively in Gloucester Township in what is called the Mer Bleue Bog. The Mer Bleue occupies most of the south channel cut by the Pre-Ottawa River southeast of Blackburn Hamlet. The organic deposits of the Mer Bleue are generally found bordering those of the shallower Huntley association and the peaty phase of the Rideau and Manotick associations. A total of 1448.4 ha of the Mer Bleue association was mapped.

The organic soils of the Mer Bleue association are strongly to medium acid and generally contain small woody fragments in the surface tier. The sphagnum, woody peat and wood fragments in the surface tier are a more recent factor. The current surface vegetation is dominantly blueberries and sphagnum mosses. The sphagnum mosses range in depth from 10 cm near the edge to 70 cm in the center of the old abandoned channel. Although a relatively open fen, the Mer Bleue has become heavily wooded around the edges within recent times. This accounts for the increased wood content in the surface tier and the development of shallow forest peat deposits similar to those of the Huntley association. Dense stands of willows, alders and poplar prevail near the edges bordering the swamp depressions of the Huntley association. Invading the central portion of the Mer Bleue are scattered tamarack and black spruce, usually within those units mapped as MB3, MB4 and MB5. The soils are commonly saturated throughout the year due to restricted, very slow internal drainage. Intermittent hydric layers are encountered at depths between 100 and 130 cm in those areas mapped as MB1.

The organic soils are much deeper than those of the Huntley association, reaching in isolated pockets to depths of 7 m. Most deposits are between 2 and 3 m thick, with the exception of a few long troughs, 3 to 5 m thick, corresponding closely to the MB2 map units. Less than 20% were mapped as shallow organics between 50 and 150 cm thick (MB4, MB5). The mineral substratums of the shallow organics identified in the MB4 and MB5 landscape units were sands and fine sandy loams to silts. The colors of the underlying mineral substratums are light gray to olive gray.

Subgroup organic soil profiles classified in the Mer Bleue association are Typic Mesisols, Humic Mesisols, Mesic Humisols, Terric Mesic Humisols and Terric Humic Mesisols. The range in organic soils is further expanded by the textural variability of the underlying substratums in the MB4 and MB5 units. Three soil profiles, namely the Typic Mesisols, Humic Mesisols and Mesic Humisols, accounted for greater than 80% of the organic soils mapped in the Mer Bleue association.

Typic Mesisols have developed on predominantly partially decomposed, strongly acid mesic fen peat. The total depth of the organic section of this soil ranges from 2 to 6 m, most of which is less than 5 m thick. Occasional hydric layers are encountered at depths between 100 and 130 cm, varying in thickness from 0.5 to 1 m. The soil has developed a subdominant but significant surface layer of fibric sphagnum moss. This continuous surface fibric layer usually ranges from 30 to 60 cm in thickness, and is very strongly acid.

The uniform mesic fen peat of the Humic Mesisols has alternating subdominant layers of strongly to medium acid, highly decomposed humic fen peat, which when combined, accounts for more than 25 cm of the total middle tier. The profile has a similar continuous surface layer of fibric sphagnum mosses.

The Mesic Humisols have developed on well-decomposed, strongly to medium acid humic fen peat. Subdominate layers of mesic fen peat greater than 25 cm thick are found at depths between 40 and 120 cm. A mesic layer of partially decomposed sphagnum moss forms a continuous surface cover to a depth of 30 to 60 cm. Occasionally, alternating layers of thin fibric sphagnum moss are present on the surface, generally less than 30 cm thick. The above three profiles have small fragments of dead trees, stems and roots in the upper metre of the profile.

SOIL LANDSCAPE UNITS Five units and seven soil series were identified in the Mer Bleue association during the course of the survey. As in the case of the Huntley association, series names and final designation of soil classification will not be done until the soil mapping of the entire Ottawa-Carleton Regional Municipality is completed. The map units are described as follows:

MB1: Dominantly Typic Mesisols with minor inclusions of Hydric Mesisols found on slightly convex very gently sloping topography. The total depth of the organic section overlying the mineral substratum ranges from 2 to 6 m, most of which are less than 5 m.

MB2: Dominantly Humic Mesisols in combination with significant amounts of Mesic Humisols found on level to slightly convex topography. The total depth of the organic section overlying the mineral substratum ranges from 175 cm to 4 m.

MB3: Dominantly Mesic Humisols in combination with significant amounts of Humic Mesisols found on level to slightly convex topography. The total depth of the organic section overlying the mineral substratum ranges from 175 cm to 3 m.

MB4: Dominantly Terric Mesic Humisols in combination with significant amounts of Terric Humic Mesisols found on level to depressional topography. The organic deposits range in depth from 60 to 150 cm overlying sandy and loamy mineral substratums.

MB5: Dominantly Terric Humic Mesisols in combination with significant amounts of Terric Mesic Humisols found on level to depressional topography. The organic deposits range in depth from 80 to 150 cm overlying sandy and loamy mineral substratums.

Mille Isle (MI)

The Mille Isle soils are developed in coarse-textured marine and estuarine materials. Soil profiles are Orthic Sombric Brunisols, Gleyed Sombric Brunisols and Orthic Humic Gleysols. They are found in both Nepean and Gloucester Townships adjacent to, or overlying, the lower slopes of the glaciofluvial ridges and as former offshore bars. They cover 214.6 ha, 76.0 of which were mapped as the dominant association in combination with other soils.

Parent materials of the Mille Isle association are grayish brown to brown colored, strongly acid, coarse sands. The Mille Isle materials are fossiliferous in places and contain small amounts of gravel, generally less than 2 cm in diameter. The normal grain size distribution of the parent material is 50 to 65% coarse sand and 25 to 35% medium sand, but textures are variable in the upper 50 cm. The combined clay and silt content rarely exceeds 10%.

Mille Isle deposits are found in two geomorphic settings. The most extensive setting is former nearshore marine and estuarine sands washed from the glaciofluvial deposits. The Mille Isle deposits, along with marine sands of the Uplands association, have combined to modify the original steep-sided glaciofluvial ridges by forming long gentle slopes that wedge out laterally to the flat marine plains. A similar but less extensive setting is what appears to be a series of offshore bars that run in a northwest-southeast direction approximately 1 km east of Blossom Park and 2 km east of Leitrim. The sandbars are broken into segments ranging from 0.5 to 2 km in length and 25 to 100 m in width. They overlie clay and are 1 to 4 m thick.

Mille Isle landscapes found on the flanks of the glaciofluvial ridges form smooth, gently to moderately sloping inclines. Minor landscape areas of very gently sloping topography occur at the base of steeply sloping bluffs of the Kars association. Offshore bars east of the Gloucester fault form a series of parallel ridges, 4 to 6 km in length, with a distinct undulating topographic pattern. The hummocky pattern of the ridges is accentuated by windblown sand and the discontinuous nature of the ridges.

Soil drainage on Mille Isle soils is excessive to good on the crests and mid slopes of inclined and undulating topography. Imperfectly drained soils are found in lower slope and depressional sites between or at the base of ridges. The imperfect to poorly drained conditions are more widespread on the offshore bars possibly because of perched water tables. The water holding capacity of Mille Isle soils is very low, and the soils are generally droughty, except for the imperfect and poorly drained areas.

Surface textures are dominantly loamy sands and loamy coarse sands, with minor areas of sandy loams.

SOIL LANDSCAPE UNITS Three units and three soil series were identified in the Mille Isle association. They are described as follows:

MI1: Dominantly excessive to well-drained Mille Isle series (Orthic Sombric Brunisol) found on smooth, gently sloping inclines with slopes between 3 and 5%. Included in this unit are significant areas of moderately sloping ridges and bluffs with slopes between 5 and 9%.

MI2: Dominantly well-drained Mille Isle series (Orthic Sombric Brunisol) in combination with significant areas of imperfectly drained Gleyed Sombric Brunisols found on the gently undulating to undulating, generally smooth, swell and swale, linear offshore bars with slopes between 1 and 5%.

MI3: Dominantly poorly drained Orthic Humic Gleysols found on very gently sloping depressions at the base of the glaciofluvial and till ridges.

Soil Series The Mille Isle association contains the Mille Isle series (Orthic Sombric Brunisol) and two other series called Gleyed Sombric Brunisol and Orthic Humic Gleysol, which have been mapped but not named due to their limited extent.

The excessive to well-drained **Mille Isle** series is characterized by a very dark grayish brown surface horizon 20 to 30 cm thick, underlain by a dark yellowish brown to brownish yellow subsoil 25 to 40 cm thick. The soil grades from weak subangular blocky in the surface horizons to single grain throughout the subsoil and parent material.

The imperfectly and poorly drained soils are found where the Mille Isle deposits are generally less than 2 m thick over clay, and where perched water table conditions exist. The imperfectly drained **Gleyed Sombric Brunisols** are found on the lower slopes of ridges and bars. The profile is the same as that of the Mille Isle series except for the prominent olive gray mottles and somewhat duller colors in the B and C horizons.

The poorly drained **Orthic Humic Gleysols** have high water tables throughout a major part of the growing season. The subsoil is characterized by prominent olive gray and reddish brown mottles. The parent material is olive gray to light olive gray in color. Structure throughout is single grain.

SOIL COMBINATIONS Mille Isle units were mapped as the dominant association in combination with the Uplands association on approximately 76.0 ha. The combination of coarse and medium sands of these two associations occurs on the steeply inclined flanks of the glaciofluvial ridges in Gloucester Township.

Nepean (N)

The Nepean association is made up of soils developed in a thin veneer, 10 to 50 cm thick, of stony, coarse to moderately coarse-textured, undifferentiated drift material overlying stratified sandstones and quartzite. Soil thickness ranges from 10 to 50 cm, and profiles are Orthic Melanic Brunisols, Gleyed Melanic Brunisols and Orthic Humic Gleysols. The Nepean soils are found centered on the Hazeldean fault west and south of Bells Corners. These soils occupy the major portion of the bedrock-controlled upland plains, stretching from the Connaught Rifle Range in the northwest to Barrhaven in the south. The distribution and landform characteristics of the Nepean association are similar to those of the Farmington association except that Farmington overlies limestones and dolomite. A total of 1116.7 ha of the Nepean soils was mapped.

In the Nepean association, the bedrock-controlled upland plains rise 10 to 25 m above the level marine plains. The highest increases in local relief, 15 to 25 m, occur on scarps formed in the sandstone and quartzite bedrock.

In addition to the difference in the underlying bedrock there are several physical and chemical characteristics which distinguish parent materials of the Nepean association from those of the Farmington association. Nepean parent materials are brown to yellowish brown, with a larger proportion of sand and a tendency to be more acid. The veneer of drift material is thinner, exposing a larger percentage of bedrock. The strong influence of the underlying sandstone and quartzite results in coarser parent materials which range in texture from loamy sands to sandy loams. Single grain structures prevail on the materials.

Stone content, composed mainly of fractured, angular fragments of sandstone and quartzite, is very high. In places, varying amounts of limestone and dolomite from adjacent Farmington or Grenville associations are incorporated into the drift, and there is a small percentage of stones of Precambrian origin. Although strongly influenced by the underlying bedrock, some of the original till composition is evident in deeper depressions or isolated till knolls. In places where such deeper deposits were greater than 50 cm, and large enough to be mapped separately, they were grouped with the Queensway association.

Although these materials vary in depth between 10 and 50 cm, most are less than 25 cm thick. This accentuates the stoniness and rockiness on the Nepean soils. More than half of the units are affected by intermittent bedrock exposures, and these account for approximately 10 to 20% of the area of each unit. Soil reaction is medium acid due to intermittent pockets of limestone and dolomite, or Grenville till.

Landscapes of the Nepean association are strongly controlled by the underlying topography of the bedrock. The horizontal beds of sandstone and quartzite result in level to very gently sloping landscapes. Gently to strongly sloping escarpments and ridges account for almost one-third of the area mapped and are largely the result of differential erosion.

Soil drainage is the same as that on Farmington soils with few exceptions. Poorly drained soils are found in depressional sites bordering marshlands or organic deposits, while moderately well to imperfectly drained soils are found on very gently sloping landscapes. Soil drainage ranges from excessive to good on the gently to strongly sloping areas. On the steeper slopes water percolation is rapid, especially on sandier soils, causing periodic droughty conditions. Moisture holding capacity is limited due to the shallowness of the soil and the general sandy texture.

Surface textures are dominantly sandy loam and loam, with significant areas of loamy sand.

SOIL LANDSCAPE UNITS Five units and three soil series are recognized in the Nepean association, all of which occur on simple slopes. They are described as follows:

N1: Dominantly well-drained Nepean series (Orthic Melanic Brunisol) found on very gently to gently sloping topography with slopes between 1 and 5%. Included in this unit are minor areas of moderately sloping escarpments and ridges with slopes between 6 and 9%.

N2: Dominantly imperfectly drained Fallowfield series (Gleyed Melanic Brunisol) with minor inclusions of moderately well-drained Nepean series (Orthic Melanic Brunisol) found on very gently to gently sloping topography with slopes between 0.5 and 3%.

N3: Dominantly poorly drained Barrhaven series (Orthic Humic Gleysol) found on level to very gently sloping topography with slopes generally less than 1%.

N4: Dominantly well-drained Nepean series (Orthic Melanic Brunisol) in combination with significant areas of Fallowfield series (Gleyed Melanic Brunisol) found on very gently to gently sloping topography with slopes between 1 and 4%.

N5: Dominantly imperfectly drained Fallowfield series (Gleyed Melanic Brunisol) in combination with significant areas of poorly drained Barrhaven series (Orthic Humic Gleysol) found on very gently sloping topography with slopes between 0.5 and 2%.

Soil Series Nepean association consists of the Nepean series (Orthic Melanic Brunisol), Fallowfield series (Gleyed Melanic Brunisol) and Barrhaven series (Orthic Humic Gleysol).

The **Nepean** series is a very thin, well-drained soil with dark grayish brown surface horizons (Ah), 6 to 10 cm thick, and yellowish brown to brown subsoils, 5 to 15 cm thick. The soil is granular at the surface and generally single grain to weak granular in the subsoil. It is friable, very loose and rapidly permeable.

The **Fallowfield** series is imperfectly drained and subject to water saturation for short periods in the growing season. This soil is distinguished from the Nepean series by the presence of dark yellowish brown mottles in the subsoil. Occupying the lower slopes and flat topographic positions, these soils are subject to some lateral seepage.

The **Barrhaven** series is found in depressional sites subject to periodic ponding and water saturation for long periods during the growing season. The subsoil has a yellowish brown to light brownish gray matrix with prominent dark yellowish brown to yellowish red mottles.

The stony phase was used in the Nepean association. Very stony to excessively stony conditions seriously affected 30% of the Nepean soils. The remainder of the soils had slightly to moderately stony surface conditions.

SOIL COMBINATIONS Nepean soils were mapped as the dominant soil in combination with other associations on 281 ha. Minor pockets of finer-textured Piperville and North Gower soils were found in depressional sites on gently undulating topography. Almost one-quarter of the Nepean soils were mapped in combination with sandstone or quartzite bedrock exposures.

North Gower (NG)

The North Gower association is made up of soils developed in moderately fine-textured, modified marine parent materials. Soil profiles are Humic Gleysols, Rego Gleysols and Gleyed Gray Brown Luvisols. This soil association is found widely distributed west of the Gloucester fault between the 85.3 and 103.6 m contours. The most extensive areas are found on both sides of the Rideau River and on the level clay plains in Nepean Township. Approximately 3348.4 ha of the North Gower association were mapped, of which 905.4 ha were mapped as the dominant association in combination with other soils.

The North Gower association is similar to Dalhousie because both are estuarine and fluvial modified marine clays. The major differences are the lower clay content of the upper 2 m, the wider range in pH and the coarser structures of the North Gower materials. The clay content of the upper 1 to 2 m varies between 28 and 36%, with occasional interbedded layers of silty clay 10 to 25 cm thick. The underlying Dalhousie type materials range from 40 to 60% clay.

The wider range in pH on North Gower soils, from neutral to mildly alkaline, is largely due to localized accumulations of limestone grit embedded in the waterlaid layers.

Soil structures are medium to coarse, subangular and angular blocky. In those areas with distinct varve-like laminations, the structure is moderate to strong, coarse pseudoplaty breaking to weak subangular blocky and granular. The structure of the underlying clays becomes more massive and bedded with depth. The soil is permeable, free of stones, and has a high moisture holding capacity.

The major landforms are level to very gently sloping plains. Undulating topography is limited to the erosion slopes along the Rideau River, the long, gently inclined slopes westward from the bedrock-controlled ridges near Fallowfield, and the lower slopes between till ridges.

Poorly drained soils prevail on the level to gently sloping plains, accounting for greater than 80% of the area mapped as North Gower. The better drained soils are found on the upper to mid slopes of the undulating landforms and are, at best, imperfect to moderately well drained.

Surface textures are loams, silt loams and clay loams; more than 70% are loams.

SOIL LANDSCAPE UNITS Four units and three soil series were recognized in the North Gower association. They are described as follows:

NG1: Dominantly imperfectly drained Carp series (Gleyed Gray Brown Luvisol) found on gently sloping topography, with slopes between 2 and 5%.

NG2: Dominantly poorly drained North Gower series (Orthic Humic Gleysol) found on level to very gently sloping topography, with slopes between 0 to 2%.

NG3: Dominantly imperfectly drained Carp series (Gleyed Gray Brown Luvisol) in combination with significant areas of poorly drained North Gower series (Orthic Humic Gleysol). This unit is found on very gently sloping to undulating topography, slopes between 1 and 5%, with local areas of level to depressional topography.

NG4: Dominantly very poorly drained Belmeade series (peaty Rego Gleysol) with minor inclusions of poorly drained Humic Gleysols. This unit is found on level to depressional topography with slopes less than 1%.

Soil Series The North Gower association contains the Carp (Gleyed Gray Brown Luvisol), North Gower (Orthic Humic Gleysol) and Belmeade (Rego Gleysol) soil series.

Soils of the **Carp** series occur on the mid to upper slopes of gently sloping landforms and are imperfectly drained. The soil profile is thicker than most of the soils in the region. It has a very dark gray, granular surface layer, high in organic matter, 12 to 20 cm thick underlain by an eluviated light gray to light pale brown (Ae) horizon. A transitional AB horizon with characteristics of both eluviated and illuviated horizons is a common feature. The subsoil is generally composed of an illuviated grayish brown to brown Btgj horizon and a similarly colored transitional BC layer, both containing yellowish brown mottles. The structure of the subsoil is subangular to angular blocky with frequent varve-like laminations. The Carp soils are moderately to slowly pervious.

The poorly drained **North Gower** series is found on level to very gently sloping positions. These soils are slowly pervious, being subject to water saturation for a much longer part of the growing season. The granular to cloddy surface horizon is thicker (20 to 25 cm) and varies in color from very dark gray to very dark grayish brown. The underlying subsoil is olive gray to dark gray, with structure similar to that of the Carp series. Prominent yellowish brown to dark yellowish brown mottles are present in both the subsoil and parent material.

The very poorly drained **Belmeade** series is found in level to depressional sites with year-round water tables at or near the surface. This soil has well-decomposed humic peat surface layers, varying in thickness from 10 to 40 cm, which overly a highly reduced, massive, olive gray to greenish gray subsoil. In many areas much of the peat has been burned off or incorporated into the mineral subsoil.

Shallow and peaty soil phases were used with the North Gower association. The least extensive is the peaty phase which occupies only two limited areas in Nepean Township on level to depressional sites bordering shallow organic swamps of the Huntley association. The peaty surface is well-decomposed organic material, less than 40 cm thick. The underlying silty clay loam soils are very poorly drained Rego Gleysols, subject to ponding in the spring season.

The shallow phase of the North Gower association is found in Gloucester Township. These soils are between 50 and 100 cm thick overlying limestone or shale. The limited extent and variability of the moderately fine-textured materials overlying bedrock did not necessitate setting up a new soil association. Shallow clay loam soils overlying shale bedrock at 60 to 120 cm are located east of Blossom Park on gently undulating topography. Surface textures are of sandy loam, loam and clay loam. Frequently the upper 50 cm ranges from loamy sand to sandy loam, when found adjacent to Uplands, Manotick or Jockvale soil associations. Near the bedrock contact, shale fragments are incorporated into the overlying clay loam and sandy clay loam materials.

Shallow clay loam soils overlying limestone are found south of Orleans in the center of the flat clay plains of the Bearbrook association. The overlying soils are uniformly clay loam in texture from the surface to the bedrock contact. The depth to bedrock varies from 60 to 90 cm on gently undulating topography.

North Gower: Variant The variant was established to indicate small variations of these materials from the normal range of physical characteristics found in the North Gower association. The minor differences and limited extent of the North Gower variant made it impractical to establish another soil association.

The determining physical feature identifying the variant is the presence of interbedded lenses of moderately coarse to medium-textured marine sands and silts, 20 to 60 cm thick, within 1 m of the surface. The lenses are either high in sand or high in silt giving fine sandy loam, silt or silt loam textures. The structure of the interbedded lenses is weak, fine to medium granular or single grain. The underlying clay is massive to weak, coarse angular blocky. There is also a noticeable absence of the varve-like laminations that are frequent in the North Gower materials. Surface textures are loams and clay loams.

These soils are poorly drained and situated on level to gently undulating plains. The most significant concentration of the North Gower variant is located south of the Airport, between the Rideau River and the Uplands-South Gloucester glaciofluvial ridge. They are found at the contact between the clay plains and the fine sands and silts bordering the glaciofluvial and till ridges. Others are found south of the Connaught Rifle Range near Shirley's Bay where the sand lenses are primarily the result of fluvial deposition.

Only two map units were identified during the course of the survey, NG2 V and NG4 V. Both have the same drainage profile and topographic characteristics as those described in the NG2 and NG4 map units.

SOIL COMBINATIONS North Gower units were mapped as the dominant soil in combination with other soil associations on 905.4 ha. The North Gower-Dalhousie combination is the most extensive, accounting for more than 60% of the total. The extent of this combination is due primarily to the variability of the surface of the marine clay plains.

North Gower soils are also found in combination with Piperville, Jockvale, Castor and Manotick associations but to a much lesser extent. The occurrence of these combinations is due largely to the variability in the thickness and distribution of the marine fine sands and silts overlying the clays.

Minor areas of North Gower-Grenville and North Gower-Queensway combinations are found on undulating topography. In these cases the North Gower clays are located in depressions between the till knolls.

Oka (O)

The Oka association consists of soils developed in gravelly, coarse to moderately coarse-textured, fossiliferous, marine beach materials. Soil profiles are Orthic Melanic Brunisols and Gleyed Orthic Melanic Brunisols. This soil association is found widely distributed along the Gloucester fault, and throughout Nepean Township on the crests and upper slopes of ridges. Approximately 463.0 ha of the Oka association were mapped.

The marine beach deposits were derived by reworking glaciofluvial deposits and Paleozoic rock fragments into a series of long, narrow, raised beaches. The most extensive Oka deposits were found overlying glacial till and glaciofluvial ridges. In situations where the beach deposits overlie the glaciofluvial deposits, they were included in the Kars association.

Where Oka materials occur on the crests and upper slopes of till ridges, the beach materials vary in depth from 1 to 4 m (mean depth 2 to 3 m). The underlying gray glacial till is relatively unaffected; it is stony, compact and sandy. Frequently, the till is exposed in depressions between successive beach ridges, giving rise to Oka-Grenville soil combinations.

Marine beach deposits found overlying Paleozoic bedrock are composed primarily of angular and slightly rounded limestone and dolomitic slabs and shingles. Oka soils found overlying bedrock are generally thinner, varying from 1.5 to 2 m in thickness, and are slightly higher in gravel and stone content. The exception to the above occurs near Leitrim, where the beach ridges are composed largely of shale fragments derived from the nearby Leitrim and Ellwood associations.

Parent material of the Oka association is brownish gray to olive gray in color, and gravelly loamy coarse sand to coarse sandy loam in texture. The structure is predominantly single grained, with moderate to weakly developed granular structures in the upper solum of loam textured soils. The gravel content varies with the degree of sorting, usually between 40 and 70% by weight. The gravel is predominantly angular limestone fragments, only slightly rounded, varying in size from 2 to 10 cm. Significant amounts of large limestone flags, 10 to 20 cm, and lenses of well-rounded gravel of Precambrian origin are also present. On the lower slopes, Oka materials grade into poorly sorted till-like materials containing occasional gravelly layers. Soil reaction in Oka association varies from neutral to mildly alkaline.

Landscapes associated with the Oka association are gently to moderately sloping, narrow, linear ridges. The beach ridges modify the underlying till and glaciofluvial ridges only slightly, adding only 1 or 2% slope to the undulating landforms. Oka areas have more local relief when overlying flat Paleozoic bedrock.

Soil drainage is excessive to good on all slopes except for imperfectly drained sites located in lower slopes and depressions. Frequently, when bedrock is within 1 to 2 m of the surface in depressions, it acts as a local water catchment. Oka soils have a very low moisture holding capacity. Water percolates very rapidly through the very permeable coarse materials, giving rise to periodic droughty conditions.

Surface textures are loamy sands and sandy loams, with minor pockets of loam found in Oka-Grenville combinations.

SOIL LANDSCAPE UNITS Two units and two soil series were recognized in the Oka association. They are described as follows:

O1: Dominantly excessive to well-drained Oka series (Orthic Melanic Brunisol) found on gently to moderately sloping ridges, with slopes between 3 and 8%. Included in this map unit are significant areas of very gently sloping topography between ridges with slopes less than 2%.

O2: Dominantly imperfectly drained Gleyed Melanic Brunisols found on bedrock-controlled level to very gently sloping depressions with slopes between 0 and 2%.

Soil Series The Oka association contains the well-drained Oka series (Orthic Melanic Brunisol) and a second imperfectly drained series (Gleyed Melanic Brunisol) which was mapped but not named due to its limited extent.

The **Oka** series is an excessive to well-drained soil characterized by very dark grayish brown to dark brown surface horizons (Ah, Ap), 12 to 18 cm thick, and brown to dark brown subsoils, 18 to 50 cm thick. The structure ranges from granular and weak subangular blocky in the surface and subsoil horizons to single grain in the parent material. These soils are rapidly permeable with a low moisture holding capacity.

In the imperfectly drained Gleyed Melanic Brunisol, the profile resembles that of the Oka series except for yellowish brown mottling and somewhat duller colors in the B and C horizons. The higher water table reflects their location at toeslopes and in depressions.

Both shallow and stony phases were used with the Oka association. The shallow phase of the Oka association was found exclusively on the upland bedrock plains of Nepean Township. The stony phase was widespread on all Oka map units due to the very high flaggy content of the soil, and the proximity of the Oka association to Grenville tills. Frequently, the Grenville tills mapped in combination with or adjacent to Oka soils have been seriously affected by wave action, leaving boulder pavements.

SOIL COMBINATIONS Oka soils were mapped in combination with Grenville and Uplands soils on a total of 111.8 ha. The Oka-Uplands combination is minor and occurs adjacent to Kars and Uplands associations on glaciofluvial ridges. The Oka-Grenville combination is the result of a series of beach lines masking the upper slopes of till ridges. The Grenville tills are exposed in small but significant amounts between the beach lines.

Piperville (P)

The Piperville association is a group of soils developed in slightly acid to neutral, moderately coarse to medium-textured, marine, estuarine and fluvial materials. Soil profiles are Gleyed Melanic Brunisols, Orthic Humic Gleysols and Rego Gleysols. The most extensive Piperville deposits are found on level to very gentle slopes between the coarser Jockvale fine sands and the level marine clays of the North Gower and Dalhousie associations. Due to their limited extent, fluvial sediments of the same texture and physical characteristics, found along the floodplains of the Rideau River and in the abandoned river channel floors and terraces of the Pre-Ottawa River, have been included in the Piperville association. Approximately 2773.7 ha of the Piperville association were mapped.

Piperville parent materials grade from the underlying clay upwards through silt into fine sand showing deposition in progressively shallowing water. The sediments are well sorted and stratified. The parent materials are usually only 1 to 2 m thick over the marine clay (material less than 1 m was mapped as the Castor association). In both associations deposition of materials over clay is uneven and, therefore, a considerable variation in depth will be found within any one mapped area. In the Shirley's Bay area fluvial deposits generally occur as thin veneers overlying bedrock or clay.

The Piperville association is differentiated from the Jockvale primarily on the basis of texture. Piperville soils have a higher percentage of silt and clay, and greater textural variation due to the alternating layers of silt and fine sand. These layers range widely in thickness, and frequently become homogeneous deposits dominated by either the sand or silt fraction. In Gloucester and Nepean Townships the sand fraction dominates the upper metre of sediment resulting in fine sandy loam and very fine sandy loam textures. Silt and silt loam layers become increasingly evident below about 75 cm. Only one-fifth of the Piperville soils mapped were dominated by silt and silt loam textures throughout the parent materials.

The landforms of the Piperville association are dominantly level to very gently sloping. Piperville soils are also located on level to depressional sites between till knolls or adjacent to bedrock-controlled ridges. These soils can also be found on undulating to gently sloping landforms overlying limestone bedrock in the eroded channels of the Pre-Ottawa River, and overlying marine clays adjacent to the Jock and Rideau Rivers.

Poorly drained soil conditions affect 95% of the Piperville soils mapped. Moderately well to imperfectly drained soils account for the remainder, and these are found on very gently to gently sloping and undulating topography. Piperville soils have a very slow percolation rate, and are highly susceptible to surface puddling and sheet erosion after heavy rain storms.

Surface textures are loam, fine sandy loam and very fine sandy loam. Soil reaction in the parent materials is predominantly neutral to slightly acid.

SOIL LANDSCAPE UNITS Five units and three soil series were identified in the Piperville association. They are described as follows:

P1: Dominantly imperfectly drained Piperville series (Gleyed Melanic Brunisol) found on gently sloping topography with slopes between 2 and 3%.

P2: Dominantly imperfectly drained Piperville series (Gleyed Melanic Brunisol) in combination with significant areas of poorly drained Carsonby series (Orthic Humic Gleysol) found on very gently to gently sloping and undulating topography, slopes between 1 and 3%.

P3: Dominantly poorly drained Carsonby series (Orthic Humic Gleysol) with significant areas of imperfectly drained Piperville series (Gleyed Melanic Brunisol) found on very gently sloping topography with slopes between 1 and 2%. Included in this unit are significant areas of very gently undulating topography.

P4: Dominantly poorly drained Carsonby series (Orthic Humic Gleysol) found on level to very gently sloping topography with slopes between 0 and 2%.

P5: Dominantly very poorly drained peaty Rego Gleysols with minor inclusions of Carsonby series (Orthic Humic Gleysol) found on level to depressional topography with slopes between 0 and 1%.

Soil Series The Piperville association contains the Piperville (Gleyed Melanic Brunisol) and Carsonby (Orthic Humic Gleysol) soil series. A third soil series (peaty Rego Gleysol) has been identified and mapped, but not named due to its limited extent.

The **Piperville** series is an imperfectly drained soil subject to water saturation for short periods during the growing season. The soil has a very dark grayish brown granular surface horizon, 10 to 15 cm thick. The underlying subsoil is light yellowish brown to brownish yellow, while the parent material is olive gray to gray. Structures in the subsoil and parent material are massive to single grain with occasional laminations. The imperfect drainage conditions are indicated by olive to strong brown mottles in the subsoil and yellowish brown mottles in the parent material. The soils are moderately pervious, with slow surface runoff.

The poorly drained **Carsonby** series is found on level to very gently sloping positions, subject to water saturation for much of the growing season. The very dark grayish brown surface horizon is 5 to 10 cm thicker than that of the Piperville series. A light olive gray, eluviated (Ae) horizon, 10 to 15 cm thick is sometimes present. The color of the underlying subsoil and parent material grades from light gray to olive gray and gray. Structures of the surface horizon are coarse granular to single grain and those of the underlying subsoil are massive to single grain. Poor drainage conditions are indicated by coarse, prominent yellowish brown mottles throughout the subsoil and parent material. These soils are only moderately pervious and subject to very slow surface runoff.

The very poorly drained peaty Rego Gleysols are found on level to depressional sites with year-round water tables at or near the surface. These soils have well-decomposed black humic peat surface horizons varying in thickness from 15 to 40 cm. The underlying fine sands and silts of the substratum are massive with olive gray to gray colors.

Shallow and peaty soil phases were used with the Piperville association. The peaty phase occurs in a few isolated depressions bordering organic deposits of the Huntley association. Isolated shallow Piperville soils with peaty phases are found in depressions between till ridges along the Gloucester fault.

The shallow phase is more widely distributed, found throughout Nepean and Gloucester Townships on limestone and shale bedrock. Shallow Piperville materials overlying shale are found in combination with soils of the Leitrim and Ellwood associations near Leitrim and in combination with Jockvale sediments east of Blossom Park. Shallow materials overlying limestone are widely distributed along the Ottawa River and Shirley's Bay area, overlying the limestone fault block north and east of Blackburn Hamlet, and in isolated pockets on the upland bedrock plains between Barrhaven and Bells Corners.

SOIL COMBINATIONS Piperville soils were mapped as the dominant soil in combination with other soil associations on 635.1 ha. The Piperville-Jockvale combination is the most widespread accounting for more than one-half of the total. Others include the North Gower and Castor associations on the marine clay plains, and the Ironside, Grenville and Nepean associations on the till and bedrock-controlled terrain.

Queensway (Q)

The Queensway association is made up of soils developed in medium to slightly acid, moderately coarse-textured, stony glacial till. Soil profiles are Eluviated Melanic Brunisols, Gleyed Eluviated Melanic Brunisols and Orthic Humic Gleysols. These soils occur on the bedrock-controlled upland plains centered on the Hazeldean fault, stretching from the Connaught Rifle Range in the north to Barrhaven in the south. The distribution of Queensway soils is closely associated with those of the Nepean association. Approximately 282.7 ha of the Queensway association were mapped.

Parent material of the Queensway association closely resembles that of the Grenville association both being glacial tills that have been slightly modified under marine and estuarine conditions. They are distinguished by the shallowness of the Queensway deposits, sandier textures, more acid soil reaction and lack of excessively stony surface conditions. The parent material of the Queensway association is a friable, light olive brown to olive gray unsorted till, with many angular and slightly rounded stones and boulders throughout the profile. Although the parent material is strongly influenced by the underlying sandstone and quartzite, it contains a considerable amount of Precambrian granitic material originating from the Canadian Shield.

Queensway tills rarely exceed 2 m in thickness and more than two-thirds of the soils mapped are less than 1 m thick. Soil reaction is more acidic than Grenville due to the general absence of limestone and dolomite fragments. However, Queensway soils that are thicker than normal take on characteristics similar to those of the Grenville tills.

The upper 50 cm of the till are less compact than below and the structure is generally granular to single grained. On the thicker Queensway tills, the underlying subsoil, depending on the degree of modification, is more compact with massive to weak subangular structures. Texture of the parent material varies from loamy sand to sandy loam, but the coarser textured loamy sands are generally found on the shallow phase. Queensway tills have only slight to moderately stony surface conditions.

Landscapes are strongly influenced by the underlying topography of the bedrock, hence, the predominance of gently sloping landscapes. Gently to moderately sloping bedrock-controlled ridges and inclined slopes are found on the outer edges of the bedrock plains. These soils rarely occur as isolated drumlins or hummocky terrain.

Most Queensway soils are moderately well drained on all crests and upper slopes. The lower slopes and level to depressional sites receive seepage water, giving rise to poorer drainage conditions. Poorly drained sites are found in bedrock-controlled depressions and bordering marshlands or organic deposits of the Huntley association.

Surface textures of the Queensway soils are generally sandy loam, loamy sand or loam.

SOIL LANDSCAPE UNITS Five units and three soil series were recognized in the Queensway association. They are described as follows:

Q1: Dominantly well-drained Queensway series (Eluviated Melanic Brunisol) found on gently sloping topography with slopes between 2 and 5%. Included in this unit are minor areas of moderately sloping, bedrock-controlled ridges with slopes between 5 and 8%.

Q2: Dominantly imperfectly drained Gleyed Eluviated Melanic Brunisols found on the lower slopes of very gently to gently sloping inclines, with slopes between 1 and 3%.

Q3: Dominantly poorly drained Orthic Humic Gleysols with minor inclusions of peaty Rego Gleysols found on level to very gently sloping depressions with slopes between 0 and 1%.

Q4: Dominantly well-drained Queensway series (Eluviated Melanic Brunisol) in combination with significant areas of imperfectly drained Gleyed Eluviated Melanic Brunisols found on very gently to gently sloping topography, with slopes between 1 and 4%. Included in this unit are significant areas of bedrock-controlled undulating terrain with slopes between 2 and 4%.

Q5: Dominantly imperfectly drained Gleyed Eluviated Melanic Brunisols in combination with significant areas of poorly drained Orthic Humic Gleysols found on very gently sloping lower slopes and depressions with slopes between 1 and 2%.

Soil Series The Queensway association contains the **Queensway** series (Eluviated Melanic Brunisol) and two other series that have been mapped, but not named due to their limited extent. These are Gleyed Eluviated Melanic Brunisol and Orthic Humic Gleysol. Most of these series were mapped in the shallow phase.

The well to moderately well-drained soils of the **Queensway** series have very dark grayish brown, granular surface horizons, 10 to 15 cm thick, underlain by brownish gray to light olive gray eluviated (Ae) horizons and by weakly developed grayish brown illuvial (Btj) horizons. The subsoil and parent materials are subangular blocky to granular in structure, sometimes coarse platy. Faint yellowish brown mottles due to restricted percolation are common at depth.

The imperfectly drained Gleyed Eluviated Melanic Brunisols are found on the mid to lower slopes, subject to water saturation for short periods during the growing season. The profile characteristics are similar to those of the Queensway series with the exception of distinct yellowish brown mottles and duller colors in the lower half of the subsoil and parent material.

The poorly drained Orthic Humic Gleysols occupy level to depressional sites that are water saturated for much of the growing season. The surface horizons are very dark brown to very dark grayish brown, with granular structures. The olive gray to gray subsoils are mottled a prominent dark yellowish brown. The subsoil has subangular blocky structure. These soils are moderately permeable, but downward percolation is seriously restricted by their shallow depth to bedrock.

Two phases, shallow and peaty, have been identified on the Queensway association. The shallow phase of the Queensway association occurs when the till is 50 to 100 cm thick over sandstone and quartzite bedrock. It has been widely used throughout the bedrock-controlled upland plains, bordering the Hazeldean fault and in combination with soils of the Nepean association.

The use of the peaty phase on Queensway soils has been limited to a few isolated, very poorly drained depressional sites bordering the marshland and Huntley map units. The map units designated as having peaty surfaces do not have a continuous humic peat layer, but are a mixture of peaty Gleysols and nonpeaty Orthic Humic Gleysols.

SOIL COMBINATIONS Queensway soils were mapped as the dominant soil in combination with Nepean and Ironside associations on approximately 76.6 ha. The Queensway-Nepean combination located north of Barrhaven was the most extensive. Minor areas of shallow Ironside soils mapped in combination with Queensway tills are found on isolated bedrock ridges in the eroded river channel north of Bells Corners.

Rideau (R)

The Rideau association is a group of soils developed in neutral, very fine-textured marine materials. It is located in abandoned river channels and terraces of the Pre-Ottawa River. Soil profiles are Gleyed Melanic Brunisols, Orthic Humic Gleysols and Rego Gleysols. Approximately 2227.0 ha of the Rideau association were mapped.

These soils developed from the deep water faces of the marine or "Leda" clays of the Champlain Sea. Below the 76.2 to 82.3 m contours, this material was exposed by ancient fluvial erosion that has cut terraces at various levels in the horizontal clay beds. Moderately sloping bluffs and steep escarpments rise abruptly above the sides of the channels. The channels vary in width from 3 to 10 km, and in some places are 20 m deep.

Rideau parent materials consist of olive gray to gray, very firm and very plastic clays (65 to 80% clay). The structure of the clay changes with depth from coarse angular and subangular blocky in the upper solum to massive with concoidal fracture at depth. Surface textures are dominantly clay loam and clay, but significant areas of sandy loam and loam surface textures are found on the eroded channel floors and terraces south and west of Blackburn Hamlet. Rideau, Bearbrook and Dalhousie materials are similar in many ways, but Rideau lacks the reddish brown bands typical of Bearbrook, and is more uniform in texture and structure than Dalhousie.

Greater than 85% of the Rideau soils are mapped on level to very gently sloping plains. The remainder are found on gently to moderately sloping convex slopes between erosion gullies and streams, or on the inclined slopes of eroded channel bluffs and terraces.

Poor drainage conditions prevail on the level to gently undulating slopes, where very little surface runoff can take place. Soils are imperfectly drained on the sides of gently to moderately sloping gullies, terraces and channel bluffs. Surface runoff is high on the steeper sloped clays, but internal percolation is more variable.

SOIL LANDSCAPE UNITS Four units and three soil series were recognized in the Rideau association. They are described as follows:

R1: Dominantly imperfectly drained Rideau soils (Gleyed Melanic Brunisol), found on gently to moderately sloping eroded stream divides, terraces and channel bluffs with slopes between 3 and 9%. Included in this unit are areas of very gently undulating topography, adjacent to streams and gullies, with slopes between 1 and 2%.

R2: Dominantly imperfectly drained Rideau series (Gleyed Melanic Brunisol) in combination with significant areas of poorly drained St. Rosalie series (Orthic Humic Gleysol), found on gently sloping and undulating topography, with alternating swell and swale topography of low local relief, and slopes between 2 and 5%. This unit is typically located adjacent to streams and gullies.

R3: Dominantly poorly drained St. Rosalie series (Orthic Humic Gleysol) developed on level to very gently sloping topography with slopes between 0 and 2%.

R4: Dominantly very poorly drained Laplaine series (peaty Rego Gleysol) with minor inclusions of poorly drained St. Rosalie series (Orthic Humic Gleysol), found on level to depressional channel bottoms, with slopes between 0 and 1%.

Soil Series The Rideau association contains the Rideau (Gleyed Melanic Brunisol), St. Rosalie (Orthic Humic Gleysol), and Laplaine (Rego Gleysol) soil series.

Rideau series is an imperfectly drained soil subject to water saturation for short periods during the growing season. The soil has a thin, dark grayish brown, granular to subangular blocky surface horizon (Ap), 8 to 16 cm thick, with low organic matter content. The underlying subsoil grades from dark grayish brown to olive in the transitional AB horizon to an olive gray and gray in the BC and C horizons. The subsoil has well-defined coarse angular to subangular blocky structure. The imperfect drainage conditions are reflected in the fine yellowish brown mottles found in the subsoil. The massive character of the parent materials restricts internal percolation in these soils.

The poorly drained condition of the **St. Rosalie** series is largely due to its flat topographic position and the massive character of the underlying clays. Excess water disappears slowly without artificial drainage. The granular surface Ap horizon is very dark grayish brown to very dark gray in color, and 20 to 28 cm thick. Unlike the Rideau series, the surface horizon is thicker, more friable and higher in organic content. Although the structure of the underlying subsoil is similar to that of Rideau, the color is slightly darker with distinct olive brown to brown mottles.

The very poorly drained **Laplaine** series is found on depressional sites with year-round water tables at or near the surface. The surface layer is black, friable, granulated, humic peat 10 to 40 cm thick. The underlying mineral substratum is olive gray to bluish gray amorphous clay, which breaks conchoidally to coarse angular blocky. Reducing conditions are present in the upper one-half metre of the profile as evidenced by yellowish brown mottles.

The shallow and peaty soil phases were used with the Rideau association. The shallow phase was mapped in the Crystal Beach area of Nepean Township, where the Rideau clays vary from 0.5 to 3 m in depth. The peaty phase was found on level to depressional channel bottoms of the Pre-Ottawa River, adjacent to the deep organic deposits of the Mer Bleue.

SOIL COMBINATIONS Rideau soils were mapped as the dominant soil in combination with map units of the Manotick and Castor associations on 180.4 ha. Such areas represent a thin veneer of fluvial sands and silts, 50 to 100 cm thick, overlying the Rideau clays. Rideau soils exposed in level to depressional areas between Castor and Manotick soils usually have sandy loam or loam surface textures.

Uplands (U)

The Uplands association is a collection of soils developed in medium to fine-grained marine, estuarine and fluvial sands. Soil profiles are Orthic Sombric Brunisols, Gleyed Orthic Sombric Brunisols, Orthic Humo-Ferric Podzols, Gleyed Orthic Humo-Ferric Podzols, Orthic Gleysols and Rego Gleysols. Soils of the Uplands association are more widely distributed and have the widest range of origin and soil profile development of all soils mapped in the area. Approximately 5815.9 ha of the Uplands association were mapped.

Most Uplands soils are of marine-deltaic origin. Deltaic sand plains were formed where the Pre-Ottawa River and other streams emptied into the Champlain Sea. As the sea lowered, the river gradually lengthened, cutting down one delta to build up another at a lower level. The remnants of a large delta formed this way are centered at the Airport.

As the Champlain Sea receded, the marine environment changed to shallow estuarine, with continual cutting of channels by the Pre-Ottawa River. During this recession the original steeply sloping fluvioglacial ridges were modified considerably by marine wave action and longshore drift, to form long gently sloping elevated plains.

The thickest deposits (15 to 20 m) of the Uplands association are found on the remnants of the large delta at the Airport. The remnants of the delta form an elevated plateau, continuous with the fluvioglacial ridge extending southeast to South Gloucester. The plateau is often capped by sand deposits, the thickness of which is quite variable, but usually greater than 2 m.

Widespread deposits of marine-estuarine sands are found on the undulating offshore plains, extending from Blossom Park southeast toward Edwards and along the southern edge of the Pre-Ottawa River channels. In these areas the deposits vary in depth from 1 to 7 m, commonly 2 to 5 m. Fluvial sediments of the same texture and physical and chemical characteristics are found in the abandoned river channels and terraces of the Pre-Ottawa River, the most extensive of which are on the three elongated islands bordering the Mer Bleue.

Uplands materials are somewhat similar to Jockvale, differentiation being on the basis of texture and mode of deposition. The sand content of Uplands soils ranges from 91 to 97% and the combined silt and clay content rarely exceeds 5%. The medium sand fraction is variable but generally higher, and ranges between 15 and 45%. Uplands soils are generally extremely loose but show some compaction with slight stratification in the depressional to level sites between sandy knolls.

The Uplands association is distinguished from the Jockvale also by the fact that Uplands materials have been reworked into dunes. These dunes generally lie in a northwest-southeast direction, giving the Uplands landforms a characteristic undulating to hummocky, duned topography. The main exception to this is the extensive sand deposits found overlying or adjacent to the fluvioglacial ridges where blowouts are insignificant and long gentle slopes prevail.

Soil reaction of the Uplands soils is very low, usually very strong to strongly acid, and the soils have very low natural fertility. Surface textures are dominantly loamy sands and sands, but approximately one-fifth of the area has sandy loam and peaty surface textures. Soil structure is single grained and loose, but more compact slightly massive structures are common in the poorly drained sites.

Landscapes associated with the Uplands association are highly diversified, more so than on any other soil association in the area. The offshore sediments of the marine-estuarine plains and the elongated terraces of the abandoned Pre-Ottawa River channels are dominated by undulating to hummocky landforms. Windblown sand knolls and ridges vary in height from 1 to 5 m above the level plains, but there are also extensive areas of level to depressional topography.

Approximately 70% of the Uplands soils overlying or bordering the fluvioglacial ridges have very gently to gently sloping topography, with long smooth slopes, but occasionally these are rippled by blowouts. Soil landscape units associated with these landforms are primarily U1, U2 and U5.

Unlike many other soils of the area, poor drainage conditions affect only about 40% of the Uplands soil areas. Poorly drained soils occur on all flat to depressional topographic positions and lower footslopes of gently undulating sand knolls and ridges. These conditions are caused by high water tables which occasionally result from impermeable clay layers within 1 to 2 m of the surface. Imperfectly drained soils are located on the lower slopes of sand knolls and on the smooth slightly concave depressions of long, gently inclined ridges. They are found also on level to very gently undulating terrain where the local relief of the sand knolls is less than 2 m. These soil conditions are represented in the U6, U7, U8 and U12 landscape units.

Excessive to well-drained soil conditions are found in two situations. The first is the gently sloping landscapes associated with the fluvioglacial ridges and the deltaic deposits near the Airport. The sand deposits are generally quite deep, usually greater than 5 m thick. The U1 and U2 landscape units prevail on these landforms. The second situation occurs on the gently undulating to hummocky marine and estuarine plains, where the stabilized sand dunes have short steep slopes with local relief of 3 to 5 m. The steep sand ridges are closely spaced, frequently within 5 m of each other resulting in a mixture of well-drained and poorly drained soils. The pattern of the dunes and ridges, coupled with the development of podzols and brunisols on upper to mid slope positions, necessitated a wider range of map units, namely U3, U5, U6, U9, U10 and U12. The undulating Uplands materials north of the Animal Research Farm have been less affected by podzolization and, therefore, only the U1 and U2 landscape units prevail.

The fluvial sands deposited on the terraces and islands of the abandoned river channels are generally thinner than normal and the dunes are not as evident. The landscape units are a mixture of U2 and U7.

Uplands parent materials have a very high porosity, thus precipitation percolates rapidly. This rapid movement of water and low moisture holding capacity cause periodic droughty conditions, especially on the crests of dunes and on the glaciofluvial ridges. Uplands soils become less permeable when underlain by clay and silt within 1 to 2 m of the surface; water is then forced to move laterally.

The Uplands materials are susceptible to wind erosion without vegetative cover, but with the exception of a small area near Merivale Gardens (Nepean Township), all Uplands soils are now stabilized.

SOIL LANDSCAPE UNITS Fourteen units and six soil series were identified in the Uplands association. These units are described as follows:

- U1: Dominantly excessive to well-drained Carlsbad series (Orthic Sombric Brunisol) found on gently to moderately sloping and gently rolling topography with slopes between 2 and 7%. These are predominantly long gentle slopes with significant areas of undulating topography.
- U2: Dominantly excessive to well-drained Carlsbad series (Orthic Sombric Brunisol) in combination with significant areas of imperfectly drained Ramsayville series (Gleyed Sombric Brunisol), found on gently sloping and undulating, swell and swale topography with long gently sloping depressions. Slopes range between 2 and 5%.
- U3: Dominantly well-drained Carlsbad series (Orthic Sombric Brunisol) and Uplands series (Orthic Humo-Ferric Podzol) in combination with significant areas of imperfectly drained Ramsayville series (Gleyed Sombric Brunisol) and Rubicon series (Gleyed Humo-Ferric Podzol), found on gently sloping and undulating complex terrain, slopes between 2 and 5%. This landscape has short, gently sloping depressions.
- U4: Dominantly well-drained Carlsbad series (Orthic Sombric Brunisol) in combination with significant areas of poorly drained St. Samuel series (Orthic Humic Gleysol), found on gently sloping and undulating topography with slopes between 2 and 5%. This unit has undulating terrain with gentle, convex slopes and narrow depressions.
- U5: Dominantly well-drained Carlsbad series (Orthic Sombric Brunisol) and Uplands series (Orthic Humo-Ferric Podzol) in combination with significant areas of St. Samuel series (Orthic Humic Gleysol), found on gently sloping and undulating topography, slopes 2 to 5%, with short convex slopes and narrow depressions.
- U6: Dominantly imperfectly drained Ramsayville series (Gleyed Sombric Brunisol) in combination with significant areas of well-drained Carlsbad series (Orthic Sombric Brunisol) and imperfectly drained Rubicon series (Gleyed Humo-Ferric Podzol), found on gently sloping to undulating topography with slopes between 2 and 5%. This unit has undulating terrain with short, convex slopes and long, gently sloping depressions.
- U7: Dominantly imperfectly drained Ramsayville series (Gleyed Sombric Brunisol) in combination with significant areas of poorly drained St. Samuel series (Orthic Humic Gleysol), found on very gently sloping and gently undulating topography with slopes between 1 and 2%.
- U8: Dominantly imperfectly drained Ramsayville series (Gleyed Sombric Brunisol) and Rubicon series (Gleyed Humo-Ferric Podzol) in combination with significant areas of poorly drained St. Samuel series (Orthic Humic Gleysol), found on very gently undulating topography, slopes 1 to 2%, with significant amounts of level and depressional topography.
- U9: Dominantly poorly drained St. Samuel series (Orthic Humic Gleysol) in combination with significant areas of well-drained Carlsbad series (Orthic Sombric Brunisol), found on very gently sloping and undulating swell and swale topography with slopes between 1 and 3%. This is undulating terrain with gentle, convex slopes and long, very gently sloping to level depressions.
- U10: Dominantly poorly drained St. Samuel series (Orthic Humic Gleysol) in combination with significant areas of Carlsbad series (Orthic Sombric Brunisol) and Uplands series (Orthic Humo-Ferric Podzol), found on gently sloping and undulating topography with slopes between 2 and 3%. This unit has undulating terrain with short convex slopes and long, very gently sloping to level depressions.
- U11: Dominantly poorly drained St. Samuel series (Orthic Humic Gleysol) in combination with significant areas of imperfectly drained Ramsayville series (Gleyed

Sombric Brunisol), found on very gently sloping topography with slopes between 0.5 and 2%. This unit is primarily level but includes widely spaced slightly undulating sand knolls.

U12: Dominantly poorly drained St. Samuel series (Orthic Humic Gleysol) in combination with significant areas of imperfectly drained Ramsayville series (Gleyed Sombric Brunisol) and Rubicon series (Gleyed Humo-Ferric Podzol), found on very gently undulating topography with slopes between 1 and 2%. This unit is primarily level but includes widely spaced undulating sand knolls and some podzolized soils.

U13: Dominantly poorly drained St. Samuel series (Orthic Humic Gleysol) found on level to very gently sloping topography with slopes between 0 and 1%.

U14: Dominantly very poorly drained Borthwick series (peaty Rego Gleysol), found on level to depressional topography with slopes between 0 and 2%.

Soil Series The Uplands association contains the Uplands (Orthic Humo-Ferric Podzol), Rubicon (Gleyed Humo-Ferric Podzol), Carlsbad (Orthic Sombric Brunisol), Ramsayville (Gleyed Sombric Brunisol), St. Samuel (Orthic Humic Gleysol) and Borthwick (peaty Rego Gleysol) soil series. Complexes of well to imperfectly drained Sombric Brunisols and Humo-Ferric Podzols are found on undulating to hummocky topography of the U3, U5, U6, U8, U10 and U12 landscape units. Minor inclusions of Fera Gleysols were found in poorly drained components of the U7, U8, U9, U10, U12 and U13 landscape units.

The **Uplands** series is an excessive to well-drained soil found near the crest of irregular undulating to hummocky dunes. It has a surface mat of undecomposed to semidecomposed leaves, needles and twigs overlying a weak granular, dark gray to very dark brown Ah horizon, 8 to 12 cm thick. This is underlain by a thin, light gray eluviated horizon (Ae), 5 to 10 cm thick, which in turn rests on a strong brown to reddish brown subsoil (Bf), 20 to 30 cm thick. The eluviated Ae horizon is usually missing in cultivated fields. The structure of the subsoil and parent material is single grained, except for strongly cemented, yellowish red ortstein concretions found in the upper half of the subsoil. These are discontinuous and vary in size from coarse granular to very coarse subangular blocky. The Uplands soils are very rapidly pervious.

The imperfectly drained **Rubicon** series is found on lower slopes subject to water saturation for short periods during the growing season. Profile characteristics are similar to those of the Uplands series with the exception of duller olive gray colors and brown to olive brown mottling in the lower half of the subsoil. The Rubicon soils are rapidly pervious.

The **Carlsbad** series is an excessive to well-drained soil found on the crests and upper slopes of knolls and inclined ridges. This series is found in close association with the Uplands series on highly undulating topography. A thin surface mat of partially decomposed leaves, needles and twigs is present in forested areas, otherwise the surface layer is composed of a thin, dark brown Ah horizon, 5 to 15 cm thick. The underlying subsoil has a yellowish brown to strong brown color grading downward to yellow and light olive brown in the parent material. The structure of the subsoil and parent material is single grained. The soil is very rapidly pervious.

The imperfectly drained **Ramsayville** series is found on lower slopes subject to periodic water saturation. The colors of the surface horizon tend to be slightly duller than Carlsbad, otherwise the profile characteristics are similar. The slightly poorer drainage is indicated by the duller pale yellow and olive gray colors in the parent material and olive gray to reddish brown mottles in the subsoil. The Ramsayville soils are rapidly pervious.

The poorly drained **St. Samuel** series is found on level to depressional sites subject to water saturation for much of the growing season. The black to dark gray granular surface horizons are generally thicker (7 to 15 cm) and higher in organic content than the better drained soils found in the Uplands association. The underlying subsoil is light olive brown to brown in color grading to an olive gray and gray parent material. Occasionally, the surface layer is underlain by a thin discontinuous light olive gray eluviated horizon (Aejg). The poor drainage conditions are indicated by the yellowish brown and yellowish red mottles throughout the profile.

The very poorly drained **Borthwick** series is found in depressional sites subject to year-round water tables at or near the surface. These soils have partially to well-decomposed, black peat surface layers varying in thickness from 15 to 40 cm. The underlying mineral substratum is amorphous with olive gray to gray colors.

The peaty phase was used with Uplands soils. It is most extensive on level to depressional sites near Leitrim, where seepage water collects in the relatively shallow sands at the base of the glaciofluvial ridges. Other minor areas are found east of Leitrim on the undulating sand plains. A similar situation occurs in Nepean Township, adjacent to the major glaciofluvial ridge south of the Jock River. In both cases the peaty phase borders the deeper organic deposits of the Huntley association.

SOIL COMBINATIONS Uplands soils were mapped as the dominant soil in combination with other soil associations on 1595.4 ha. The combination of Uplands-Manotick, whereby Manotick soils occupy the lower slopes and level to depressional sites between the steep dunes and ridges of the Uplands materials, accounts for almost 80% of this total.

The combination of coarse and medium-textured sands of the Uplands and Mille Isle associations occurs on the steeply inclined slopes of the fluvioglacial ridges and the wind modified offshore bars near Blossom Park. Minor areas of Uplands-Jockvale soil combinations are found on the eroded island terraces of the Pre-Ottawa River channels.

Miscellaneous Land Units

Eroded Channels

The eroded channel landscapes were formed by recent or historical erosion and consist of steeply sloping, narrow, continuous landforms paralleling river and stream courses. Along the rivers and major creeks, the eroded channel slopes are generally steep and short, ranging between 5 and 40%.

The smaller tributaries and their network of erosion gullies and rill-like channels are less prominent. The slopes vary between 5 and 15%, and are generally incised into the level plains only 2 to 5 m in depth.

The downslope movement and slumping of soil materials is a common occurrence where the channels have cut into thick deposits of marine clay or sand over clay. Localized landslides are more prevalent along the steep channels cut to depths greater than 20 m.

Included in the eroded channels landscape unit are localized floodplains of recent alluvium which are too small to delineate separately at the published scale.

Soil profiles identified are dominantly Orthic Regosols and Melanic Brunisols, with some Rego Gleysols.

Escarpment (X)

These are bedrock and clay escarpments that exist as short steep slopes and form a natural barrier to the continuous utilization of the adjacent lands. Two kinds of escarpments were recognized.

Bedrock scarps are largely the result of faulting, being closely related to the Gloucester fault, Hazeldean fault, and the large fault block northeast of Blackburn Hamlet. Bedrock escarpments are found on limestone and dolomite in Gloucester Township, and on sandstone and quartzite in Nepean Township. The bedrock scarps vary in height from 5 to 25 m, and are usually between 5 and 50 m wide. The highest scarps are found facing north overlooking the Ottawa River, their vertical expression further enhanced by the erosion of marine clay deposits by the Pre-Ottawa River. Surface materials found on the escarpments are generally very thin till-like materials or undifferentiated drift, covering less than 40% of the surface. In most cases the escarpments border Farmington or Nepean units.

Clay escarpments, found along the Rideau River and the abandoned Pre-Ottawa River channels and terraces, form very long continuous landforms varying in length from less than 2000 m to 5 km. The escarpments rise 5 to 12 m in elevation and vary between 15 and 50 m in width. The clay escarpments found in the eroded channels bordering the Mer Bleue have 1 to 3 m of sand overlying the clay. These escarpments have been prone to landslide in the past and continue to exhibit slump features.

Three landscape units were established to differentiate the bedrock and clay escarpments. They are as follows:

X1: Clay escarpments with moderately fine to fine surface textures found on strongly sloping topography with slopes between 9 and 15%.

X2: Clay escarpments with a coarse to moderately coarse-textured surface veneer 1 to 3 m thick found on strongly to steeply sloping topography with slopes between 9 and 30%.

X3: Sedimentary bedrock scarps found on moderately to steeply sloping topography with slopes between 6 and 45%. Limestone and dolomite scarps are generally more prominent with slopes between 9 and 45%. Sandstone and quartzite scarps range between 5 and 30%, with most falling between 5 and 9%.

Landslide (Ld)

The landslide unit consists of undifferentiated, tilted or slumped blocks of clay interbedded with vertical and horizontal lenses of sand. Landslide areas include the head scarp and the zones of material removal and deposition.

The landslides, also called flowslides (Lajoie, 1974), are located along active stream sides or the banks and terrace bluffs of the former Ottawa River channels. These banks consist of unstable, highly sensitive, marine 'Leda' clay, similar in most respects to Rideau or Bearbrook materials. They may be covered by more recent sandy deposits.

Although the landslides can vary widely in texture, topography and drainage, they usually result in one of three morphological conditions, depending on the lithology of the original surface of the land. With marine clay, the stabilized slide material will be only reconstituted and have a more varied relief. Frequently, there is a sandy overlay on the surface, and this becomes mixed with the underlying mass of marine clay. After sliding, this surface is partly or completely buried generally in tilted beds. Where the original sand surface was 2 to 5 m thick, the resulting landslide material varies between coarse and fine materials at the surface, with the sand partially buried in vertical lenses in the clay. Often one or more of these conditions will have occurred within the same slide area, adding to the complexity of the slide material.

Topography varies greatly, consisting of large tilted blocks of clay and downslope fans and aprons. The eroded scars and head scarps have slopes varying between 5 and 15%. The aprons and fans are undulating to irregular with slopes of 2 to 9%.

The reconstituted material of the slide ranges from moderately well drained on the steep crests to poor on level to depressional lower slopes.

Only one map unit was identified and it was characterized by topography alone. Landslides were mapped exclusively in the northeast of Gloucester Township between the north arm of the Mer Bleue and the Ottawa River. There is a large number of minor landslides or slumps along Green Creek, Ramsay Creek, Bear Brook and the Ottawa and Rideau Rivers.

Marshland (Ml)

The marshland landscape unit consists of periodically flooded or continuously wet areas of partially decomposed organic matter with marshland vegetation. The landscape unit is found solely in the northwest of Nepean Township in the bedrock-controlled area.

The organic matter consists of partially decomposed mesic peat derived from sedges, reeds, leaf and needle fragments, and grasses that contain wood fragments and stumps. The organic matter has a mean depth of 60 cm but ranges from 15 cm to 200 cm. The underlying mineral layer is primarily composed of Nepean or Farmington soil materials, generally less than 40 cm thick, overlying sedimentary bedrock. The organic soil profiles are dominantly Typic Mesisols with significant areas of Terric and Fibric Mesisols.

The landscapes associated with the marshlands are controlled by the topography of the underlying bedrock, which consists of horizontal beds of either sandstone-quartzite or limestone-dolomite, forming level to depressional basins. The depth to bedrock varies from 20 to 90 cm.

Ponded, very poor drainage conditions are primarily due to the downslope movement of water into the bedrock depressions and the activities of man and beavers in blocking natural drainage outlets.

Vegetation on this landscape unit consists of a variety of rushes, reeds, grasses and sedges. The marshes are usually bordered by willows and birch with some alders and maples. A mixture of cedar, aspen and spruce are found on less severely ponded sites. Some marshland sites are deeply ponded throughout the year and vegetation over the years has slowly died, leaving dead elm, birch and aspen trees.

Recent Alluvium (AR)

These landscape units consist of a heterogeneous collection of soils developed on recent alluvial deposits. These deposits vary greatly in material and profile characteristics and could not be separated into distinct map units. The parent materials are variable in the upper solum, and consist of successive layers of silt, fine sand and clay, occasionally intermixed with layers of organic matter. In most cases the alluvial deposits are underlain by marine clays. About 139.5 ha were mapped.

Drainage on these materials is poor, with occasional imperfect to moderately well-drained soils occurring closer to the foot slopes of steep valley walls. Soil profiles identified are dominantly Orthic and Rego Gleysols and peaty Gleysols, with minor inclusions of Gleyed Melanic Brunisols.

The alluvial soils were divided into the following three units according to surface texture:

AR1: Alluvial deposits with moderately fine to fine surface textures on nearly level topography.

AR2: Alluvial deposits with moderately coarse to medium surface textures on level to gently undulating topography.

AR3: Alluvial deposits with organic surface textures on level to depressional topography.

Rock Outcrop (△)

These are units of land where more than 60% of a given area is exposed bedrock. Although widely distributed throughout Nepean and Gloucester Townships, rock outcrops are concentrated on the sedimentary bedrock plains adjacent to the Hazeldean and Gloucester faults. Other less extensive exposures can be found in the abandoned channels of the Pre-Ottawa River, and on the raised fault block northeast of Blackburn Hamlet. Minor outcrops of Precambrian crystalline bedrock are located in the northwest corner of Nepean Township, near Kanata.

Small pockets of very thin, coarse to moderately coarse-textured undifferentiated drift materials are usually interspersed throughout the units. Landscapes are generally level to gently sloping, but gently to moderately sloping escarpments and ridges may be present. Rock outcrops were normally mapped in combination with the very thin undifferentiated drift materials of the Anstruther, Farmington and Nepean associations.

Four units were established to distinguish the bedrock exposed. They are as follows:

△1: Exposures of limestone and dolomite found on very gently to gently sloping topography, with slopes between 1 and 5%. Minor, moderately high ridges are also present with slopes between 5 and 7%.

△2: Exposures of Precambrian crystalline rocks found on isolated gently to steeply sloping outcrops with slopes between 3 and 15%.

△3: Exposures of sandstone found on very gently to gently sloping topography, with slopes between 1 and 4%.

△4: Exposures of quartzite found on very gently to gently sloping topography, with slopes between 1 and 4%.

Soil Capability for Agricultural Use

Capability Classification Scheme

The Soil Capability Rating for Agriculture used in Nepean and Gloucester Townships is based on the system used in the Canada Land Inventory and developed by the Canada Soil Survey Committee. The system, called the Soil Capability for Agriculture, was described in the following terms in Report No. 2 (1965) of the Canada Land Inventory, and on the legend of the published maps:

> The soil capability classification for agricultural purposes is one of a number of interpretive groups that may be made from soil survey data. As with all interpretive groupings, the capability classification is developed from the soil-mapping units. In this classification the mineral soils are grouped into seven classes according to their potentialities and limitations for agricultural use. The first three classes are considered capable of sustained production of common cultivated crops, the fourth is marginal for sustained arable culture, the fifth is capable of use only for permanent pasture and hay, the sixth is capable of use only for wild pasture, while the seventh class is for soils and land types (including rock outcrop and small unmappable bodies of water) considered incapable of use for arable culture or permanent pasture. While the soil areas in classes one to four are capable of use for cultivated crops they are also capable of use for perennial forage crops. Soil areas in all classes may be suited for forestry, wildlife and recreation. For the purposes of this classification, trees, tree fruits, cranberries, blueberries and ornamental plants that require little or no cultivation are not considered as cultivated or common field crops.

Some of the important factors on which the classification is based are:

- The soils will be well managed and cropped under a primarily mechanized system.
- Land requiring improvements including clearing, that can be made economically by the farmer himself, is classed according to its limitations to use after the improvements have been made.
- Land requiring improvements beyond the means of the farmer himself is classed according to its present condition.
- The following are not considered: distance to markets, kinds of roads, location, size of farms, type of ownership, cultural patterns, skill or resources of individual operators, and risk of crop damage by storms.

The capability classification applied in Canada comprises two main categories: (1) the capability class, and (2) the capability subclass. The class and subclass together provide the map user with information about the degree and kind of limitation for broad land use planning, and for the assessment of conservation needs.

CAPABILITY CLASSES

The class, the broadest category in this classification, is a grouping of subclasses that have the same relative degree of limitation or hazard. The limitation or hazard becomes progressively greater from Class 1 to Class 7. The class indicates the general suitability of the soils for agricultural use.

Class 1: SOILS IN THIS CLASS HAVE NO SIGNIFICANT LIMITATIONS IN USE FOR CROPS. The soils are deep, well to imperfectly drained, hold moisture well, and in the virgin state were well supplied with plant nutrients. They can be managed and cropped without difficulty. Under good management they are moderately high to high in productivity for a wide range of field crops.

Class 2: SOILS IN THIS CLASS HAVE MODERATE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE MODERATE CONSERVATION PRACTICES. The soils are deep and hold moisture well. The limitations are moderate and the soils can be managed and cropped with little difficulty. Under good management they are moderately high to high in productivity for a fairly wide range of crops.

Class 3: SOILS IN THIS CLASS HAVE MODERATELY SEVERE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE SPECIAL CONSERVATION PRACTICES. The limitations are more severe than for soils in class 2. They affect one or more of the following practices: timing and ease of tillage, planting and harvesting, choice of crops and methods of conservation. Under good management they are fair to moderately high in productivity for a range of crops.

Class 4: SOILS IN THIS CLASS HAVE SEVERE LIMITATIONS THAT RESTRICT THE RANGE OF CROPS OR REQUIRE SPECIAL CONSERVATION PRACTICES, OR BOTH. The limitations seriously affect one or more of the following practices: timing and ease of tillage, planting and harvesting, choice of crops and methods of conservation. The soils are low to fair in productivity for a fair range of crops but may have high productivity for a specially adapted crop.

Class 5: SOILS IN THIS CLASS HAVE VERY SEVERE LIMITATIONS THAT RESTRICT THEIR CAPABILITY TO PRODUCING PERENNIAL FORAGE CROPS, AND IMPROVEMENT PRACTICES ARE FEASIBLE. The limitations are so severe that the soils are not capable of use for sustained production of annual field crops. The soils are capable of producing native or tame species of perennial forage plants, and may be improved by use of farm machinery. The improvement practices may include clearing of bush, cultivation, seeding, fertilizing, or water control.

Class 6: SOILS IN THIS CLASS ARE CAPABLE OF PRODUCING ONLY PERENNIAL FORAGE CROPS, AND IMPROVEMENT PRACTICES ARE NOT FEASIBLE.* The soils provide some sustained grazing for farm animals, but the limitations are so severe that improvement by use of farm machinery is impractical. The terrain may be unsuitable for use of farm machinery, or the soils may not respond to improvement, or the grazing season may be very short.

Class 7: SOILS IN THIS CLASS HAVE NO CAPABILITY FOR ARABLE CULTURE OR PERMANENT PASTURE. This class also includes rockland, other nonsoil areas, and bodies of water too small to show on the maps.

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* *Class 6 soils do not occur in Gloucester and Nepean Townships because there are no agricultural soils on which "improvement practices are not feasible", other than those of class 7.*

Organic Soils

Because of their special properties, these soils are not rated in the capability scheme.

CAPABILITY SUBCLASSES

The subclass, which is a grouping of soils with similar kinds of limitations and hazards, defines the kind of conservation problem or limitation. Excepting class 1, the classes are divided into subclasses on the basis of kinds of limitation. The subclasses are as follows:

Subclass C: adverse climate — The main limitation is low temperature or low or poor distribution of rainfall during the cropping season, or a combination of these.

Subclass D: undesirable soil structure and/or low permeability — The soils are difficult to till, absorb water slowly, or the depth of the rooting zone is restricted.

Subclass E: erosion damage — Past damage from erosion limits agricultural use of the land.

Subclass F: fertility — Low natural fertility due to lack of available nutrients, high acidity or alkalinity, low exchange capacity, high levels of calcium carbonate or presence of toxic compounds.

Subclass I: inundation — Flooding by streams or lakes limits agricultural use.

Subclass M: moisture — A low moisture holding capacity, caused by adverse inherent soil characteristics, limits crop growth. (Not to be confused with climate drought.)

Subclass N: salinity — The soils are adversely affected by soluble salts.

Subclass P: stoniness — Stones interfering with tillage, planting and harvesting.

Subclass R: shallowness to solid bedrock — Solid bedrock is less than 1 m from the surface.

Subclass S: soil limitations — A combination of two or more subclasses D, F, M and N.

Subclass T: adverse topography — Either steepness or the pattern of slopes limits agricultural use.

Subclass W: excess water — Excess water, other than from flooding, limits use for agriculture. The excess water may be due to poor drainage, a high water table, seepage or runoff from surrounding areas.

Subclass X: minor cumulative limitations — Soils having a moderate limitation due to the cumulative effect of two or more adverse characteristics which individually would not affect the class rating. (This subclass is always used alone and only one class below the best possible in a climatic subregion.)

It is important to note that the rating system into classes and subclasses applies to field crops taken *collectively*. The rating would be somewhat different if *each crop* within the group of field crops was considered individually. For example, in such individual ratings, alfalfa would rate highest in deep well-drained soils, whereas timothy grass would do better in soils with high moisture close to the surface.

Although the ratings would be different if applied to garden and nursery crops or to orchards, the discrepancies would not always be large and differences would occur mainly in soils of classes 2 to 4.

To be applied nationally, the original system had to have a very broad basis to accommodate wide variations in climate, cultural practices and types of farming. In applying the national system to a restricted area such as the National Capital Region where variations in climate are minimal, it is possible to make more specific ratings by refining the system.

Rating Soils for Agricultural Use in Nepean and Gloucester Townships

Major refinements were confined to the manner of dealing with subclass limitations, hereafter called land factor limitations (Table 5). Each land factor limitation was rated by three degrees of intensity or severity of limitation, i.e. each was indicated as being either a major, moderate or minor limitation. This procedure resulted in more specific ratings than was previously possible. Also, it assists users in gaining better knowledge of soil quality. The revised system was developed according to the principles stated below. It is felt that these are applicable to the entire central St. Lawrence Lowland region.

(a) Unless otherwise stated, the classification is applied for the purpose and in the manner described in the Canada Land Inventory Report No. 2, 1965. It relates only to field crops grown on mineral soils. Definitions and connotations of the soil classes have remained unchanged.

(b) The three degrees of land factor limitation or subclass severity are major, moderate or minor, represented respectively by an uppercase letter with apostrophe, an uppercase letter, and lowercase letter, e.g. D', D, d.

Table 5. Land factor limitations (subclasses) defined by three degrees of severity

Major	Moderate	Minor
D': Massiveness, poor structure and/or firm to very firm consistency in cultivated layer and in subsoil causing insufficient aeration, slow moisture absorption and distribution. Surface soil is difficult to till, seedbed preparation requires special management and trafficability for common farm implements is poor (wet conditions).	D: Massiveness, poor structure and/or firm consistency causing poor aeration and root penetration, mainly in the subsoil.	d: Undesirable structure causing minor air and water permeability problems.
F': Very low nutrient status and base exchange capacity due to low organic matter and/or low clay content; possible severe nutrient imbalance due to high acidity (pH < 4.5) or alkalinity (pH > 7.6) in the cultivated layer.	F: Low organic matter and/or low clay content resulting in low nutrient status and/or moderate nutrient imbalance, acidity (pH 4.5 to 5.5) or alkalinity (pH 7.4 to 7.6) in the cultivated layer restricts growth of many plants.	f: Minor nutrient imbalance, lack of organic matter and unsuitable reaction (pH) affecting only a few crops. Moderate lime needs.
I': Frequent land flooding of extended duration (> 5 days) during the growing season.*	I: Occasional overflow of short duration (< 5 days) causing high water tables of extended duration (> 5 days).	i: Occasional very brief (1 day) inundation, added to very high water table and affecting only deep rooted plants such as alfalfa. Often used with W' to indicate possibility of local innundation.
M': Soil droughtiness in well to excessively drained sands and gravels requiring irrigation for normal crop production under average weather conditions. Such soils are exposed to wind erosion when non-irrigated and unprotected by vegetation, wind breaks or strip cropping.	M: Soil droughtiness in well to excessively drained loamy sands and coarse sandy loams, as well as on fine sandy loams and loams overlying sands or gravels. Without irrigation, crop yields may be economically acceptable during average to wet years, but not in dry years.	m: Soil droughtiness in well-drained fine sandy loams or loams, especially those having a fine-textured substratum. Good soil moisture conservation practices on these soils generally results in acceptable yields under average climatic conditions.
P': Soils sufficiently stony (3 to 15% on surface) to significantly increase the difficulty of tillage, planting and harvesting.	P: Soils of stoniness 2 (0.1 to 3% stones on surface) causing minor nuisance for tillage, planting and harvesting operations.	p: Soils of stoniness 1 (0.1% of stones on surface). This applies mainly to stony soils from which stones have been removed for cultivation but from which some stones have yet to be removed occasionally.
R': Solid, hard rock at less than 0.5 m with outcrops covering more than 10% of surface.	R: Solid, hard rock between 0.5 and 1 m, with outcrops covering less than 10% of the surface, or shattered soft rock (shale, schist) between 30 cm and 1 m, with outcrops covering less than 20% of the surface.	r: Solid, hard rock at more than 1 m or shattered soft rock, (shale, schist) between 0.5 and 1 m, affecting moisture distribution, stoniness, etc.
T': Slopes (< 100 m) steeper than 9% affecting machine workability and needing protection measures against water erosion.	T: Slopes (< 100 m) less steep than 9% interfering slightly with the use of farm machinery and needing some special practices to prevent water erosion.	t: Slopes of 3 to 6% not interfering with use of farm machinery but causing some slight water erosion and/or lack of uniformity in moisture distribution, seed germination and plant growth. When used within parentheses (t), slopes are not considered in the rating.
V': Repetitive variations in drainage of two or more drainage classes within an undulation-depression cycle shorter than 50 m and having a height of 1 m or more. Drainage varying generally from rapid on the undulation to poor in the depressions. In sandy soils, wind erosion is sometimes a problem on the upper part of the undulation. (Never used with W', W or M' and M).	V: Repetitive variations in drainage of one drainage class within an undulation-depression cycle longer than 50 m and of less than 1 m in height from top of undulation to bottom of depression. Drainage varying generally from good to imperfect. (Never used with W' and W or M' and M).	v: Any (repetitive or nonrepetitive) minor variation in drainage within very short distances (< 100 m) resulting in a visible lack of uniformity in crops. Used with W', W and w or M', M, and m as a modifier to indicate drainage variations within map units.
W': Excessive wetness or very poor drainage generally due to ponding, seepage or impermeable subsoil. Excessive moisture may come up to the surface and stay long enough to suffocate plants. Winter killing of plants is also frequent due to surface ice formation during the cold season.	W: Wetness or poor to very imperfect drainage on flat to very gently sloping land. Occurs normally on clay land or on porous soils resting on flat impervious substratum.	w: Periodic wetness or imperfect drainage on sloping land. Occurs mainly on mid and lower slopes of till soils surrounding till ridges.

**This refers to inundations during the growing period. Flooding due to spring runoff on flood plains is not included.*

(c) A major limitation downgrades a soil by at least two classes and a moderate, by one class. Two minor limitations are needed for downgrading by one class. A soil may remain in class 1 with one minor limitation. 1 MAJOR - 2 MODERATE - 4 MINOR.

(d) The placing of soils in various classes is normally done by the additive process, based on severity and number of limitations, e.g. 2W, 2pt, 3W', 3RP, 4P'W, 4W'R, 5P'T'. However, the degree of severity of individual land factors I', P', R', T', and W' may be sufficient to downgrade a soil by more than two classes, and be responsible for having a soil placed in class 4, 5, 6 or 7, e.g. 5P', 7R'. When used alone, subclass D' downgrades a maximum of 2 classes. When used singly or together, subclasses F' and M' attain their maximum intensity at Class 4, e.g. 4F'M'. However, subclasses D', F', and M' may be used in conjunction with the other subclasses to downgrade soils to classes 5, 6, and 7.

(e) There is no limit to the number of major, moderate or minor land factors that can be used for characterizing an area on a map. All factors or subclasses are listed in order of importance.

(f) The subclass V has been introduced to cover more adequately the variations in drainage observed in the sandy materials overlying flat impermeable substratum such as clay or bedrock. Due to their micro-relief, these materials exhibit extremely variable drainage conditions within very short distances.

(g) Subclasses C, E, N, S, and X are not used. Climatic subclass C is not used because climate is not considered a limiting factor in the Central St. Lawrence Lowlands. The erosion subclass E is not used although it is recognized that water erosion occurs in various degrees of severity in different kinds of materials on different slopes. In the Lowlands, slopes are short and this tends to restrict the severity of water erosion. In the absence of sufficient data on the amount of erosion under various conditions, the degree of severity of potential erosion is partly expressed by the use of subclasses T', T, and t. On the other hand, the susceptibility to wind erosion related to the aridity of the soils is expressed by the use of the major subclass M'. Salinity subclass N is not a land factor limitation in the Lowlands. Subclasses S and X are not used because this refined system allows for more detailed characterization than has been possible with these two subclasses in the past.

Relationships Between the National and the Regional (Central St. Lawrence Lowlands) Soil Rating Systems

The same definitions apply to the capability classes in both the national and regional systems, and it should be expected that in both cases the ratings would be the same at the class level. Generally, the regional rating does not differ from the national class rating which has been published at a scale of 1:250 000. However, there are some changes due mainly to the much more detailed survey at the scale of 1:25 000, and to the greater refinement of the subclass distinctions. The introduction in the regional system of a minor subclass affecting the rating by only one-half of a class distinguished between the upper and the lower limits of every class. This is equivalent to doubling the number of classes.

In the national system the use of subclasses is limited to two main land factors sometimes selected from several to express soil limitations. In the regional system described here, every land factor present in the area being rated is considered, and these are expressed individually at their level of intensity. In the national system, the subclasses indicate only the kinds of land factors concerned, whereas in the regional system the subclasses indicate both the kind and the degrees of severity applied to the individual land factors. The final rating is obtained by "adding" the degrading values of each of the land factors, where a major subclass downgrades by at least two classes, a moderate by one class and a minor by one-half of a class.

The guidelines established for applying the national system (Report No. 2 of CLI) also apply to the regional system. However, the following guidelines apply specifically to the central St. Lawrence Lowland system used in Nepean and Gloucester Townships.

Guidelines Used in the Rating of Agricultural Capability in Nepean and Gloucester Townships

DOWNGRADING LAND FACTORS

Wetness W and Drainage Variability V Where the natural soil drainage is uniform throughout the mapping unit, the land factors used are:

- w with imperfect to moderately good drainage in the lower portion of the solum (mainly till soil)
- W with imperfect drainage up to the upper solum or poor drainage (in Gleysols)
- W' with very poor drainage (Gleysols)
- W'i with very poor and ponded drainage

Where variations in drainage occur within a mapping unit, the minor factor v is used together with w, W, and W' (and sometimes with m) to describe the many situations encountered. In these ratings, the minor factor v is used in a positive way, affecting the rating, or, in a neutral or negative way, not affecting the rating. In the latter case, the factor v is placed within parenthesis (v). The land factor (v) is negative and does not affect the rating when the secondary component(s) of the mapping unit is (are) better-drained than the main component, e.g. well or imperfectly drained soils included in predominantly poorly drained units. The land factor v is positive and affects the rating when the secondary component(s) of the mapping unit is (are) not as well drained as the major component, e.g. poorly or imperfectly drained components in a generally well-drained unit.

When used as a modifier to indicate variations in drainage, the minor land factor v or (v) is placed immediately after M', M, m or W', W, w. The following are examples of the usage of v or (v) in such cases:

Soil	Dominant drainage	Included drainage	Condition of v	Rating
M2	rapid	imperfect	+	3FMv
F4	good	imperfect	+	5R'Pv
M3	imperfect	poor	+	3Fwv
J3	imperfect	poor	+	4F'Wv
P3	poor	imperfect	-	3W(v)F
M5	very poor	imperfect	-	4W'(v)F

Inundation I Used to indicate soils subject to flooding during the growing season. Also, the minor factor "i" is used where the soil map indicates the presence of organic material overlying mineral soil, R3.0. It is assumed that such soils are affected with continual high water tables. The rating for R3.0 is 3W'i, as compared with a rating of 3W' for R3.

Shallow to Hard Rock R The factors R', R, and r are used as defined. In Grenville materials, the factor P or p is used together with R in all cases of shallowness, because stones are generally present in significant number in these shallow soils.

Topography T The basic rating is done on soils with slope classes 1, 2 and 2/3 (slope range 0 to 2%). Such soils do not show a limitation for topography. Soils with steeper slopes get downgraded in the following manner: t with slope classes 3 and 3/4, T with slope classes 4 and 4/3, and T' with slope classes of 5 and steeper (slope >9%). The land factor limitations T and t apply mainly to morainic (normal or shallow) and glaciofluvial materials. Slopes along gullies and escarpments are very steep and are generally rated T'. The minor factor t is sometimes used within parenthesis (t), in a manner not affecting the rating, to indicate the possibility of water erosion and some minor difficulties in using the heavy farm machinery.

T and t are important land factors where irrigation is used, as they reflect the uniformity of water distribution to the soil. In the Uplands and other sandy materials, T or t is used with slope classes 3 or 4 where soils are uniformly drained throughout the map unit, e.g. 4M'F't, 5M'F'T. Where there is drainage variability indicated by V', V, and v, the use of t or T is redundant because the variations in drainage are due to topographic conditions.

Areas of concave or depressional relief (0 on the soil map) are downgraded by the use of i. These areas are not only subjected to high water tables but may be flooded for brief periods.

Stoniness P Stones are found on morainic and glaciofluvial materials. Although many stones have been removed from farmed areas, in certain materials such as the Grenville soils there are always some stones remaining that require removal after normal stone clearing. This residual stone content is expressed by the use of the minor land factor p, e.g. soil G1 is rated 1p. Where a stony phase "P" is indicated on the soil map, a downgrading of 2 classes is applied, e.g. G1-P is rated 3P'. As mentioned, the moderate or minor land factor, P or p, is used with shallow Grenville materials, e.g. G1-S is rated 3RP.

UPGRADING LAND FACTORS

Surface Texture The basic rating in the sandy Castor, Jockvale, Manotick, Piperville and Uplands soils refers to surface textures indicated as texture classes 1 and 2 on the soil map. Such soils are generally low in natural fertility and have a limited response capacity to management. Where these soils have a surface texture of classes 3 or 4, a general upgrading is applied by substituting the moderate factor F with the minor factor f, improving the rating by one-half of a class, e.g. from 2Fv to 2fv and from 3Fvw to 2Fvw, or by substituting the major land factor F', with the moderate factor F, upgrading the rating by a full class, e.g. from 3F'v to 2Fv. In all cases this is due to the enhanced natural fertility and management response capacity due to the finer texture of the surface horizon.

Variants No change from the basic rating is indicated in the case of soil variants shown V on the soil map.

Agricultural capability ratings A list of ratings was developed for each map unit recorded in the Nepean-Gloucester area by applying the guidelines cited above. These are given in Table 6. This list illustrates how the ratings evolved using the deep, nonstony material on level to gently sloping land (slope classes 1 and 2) as a reference, how downgrading was applied for slope, rockiness or stoniness, or temporary inundation in depressional areas, and how upgrading was effected on sandy materials where the surface texture is finer than normal.

The Capability Map and Its Use in Agricultural Planning

The class and subclass symbols on the agricultural capability map express the relative biological quality of land, indicated by the class number, and the kind and degree of severity of land factor limitations to be considered in the management of these lands (Table 6). The capability ratings refer specifically to field crops, these being the dominant crops grown in the townships surveyed and in climatically similar areas elsewhere.

The capability map is similar to the soil map since the latter is the base of the former. However, the capability map is considerably simplified, carries less basic information and, in some cases, is physically less complex.

Although the ratings are based on the characteristics of land for growing field crops, they have some application to other agricultural uses. The weight given to some factors in a field crop system is of a different magnitude, but may be similar in kind when applied to other crops. A soil rated Class 1 for field crops is generally excellent for garden crops, orchards, small fruits and nurseries. The factors of stoniness and degree of slopes are less important for orchards compared with factors such as good natural drainage and aeration or depth of rooting. For use as orchards, soils rated 2D, 2W and 3DW in the present system should be avoided, but soils rated 3P' or 4TP' could probably be considered suitable.

Applying the ratings to garden crops, small fruits, and nurseries, the factors stoniness and slope would have about the same weight as in the field crop system. However, the fertility factor (F), and, to a certain degree, the droughtiness or wetness factor (M) or (W) would be less important. This is because the value of the crops per unit area is much higher in these more intensive uses, allowing for greater inputs in fertilizers and moisture control (irrigation and drainage), especially on medium to light-textured soils. The most suitable soils for these uses would be the 3F', 3FM and 3FW or the 4F'M' and 4F'W. Input costs associated with using class 4 soils would be greater than those for class 3.

These extensions of the field crop capability system do not replace specific crop ratings, but they allow for extrapolations toward other systems and uses. The following are some examples of the information the capability map ratings are meant to convey to land users practicing commercial agriculture:

1w Excellent, deep, fertile soil, affected by imperfect drainage mainly in the lower solum. No improvement is needed to grow shallow rooted plants, but tile drainage would likely be beneficial for deep rooted plants such as alfalfa, although it is not mandatory. Extrapolation: soil suitable to the full range of agricultural uses possible under the local climate.

1p Excellent, well-drained, fertile soil. Occasional stones to be removed. Extrapolation: soil suitable to the full range of agricultural uses possible under the prevailing climate.

2W Good quality, deep, fertile, but poorly drained soil. Unsuitable in the natural state to deep rooted plants, but once drained, suitable to a wide range of crops. Yields expected to improve considerably with drainage. Extrapolation: unsuited to orchards; suitability for market crops and nurseries generally low, except for medium to light-textured soils with efficient tile drainage.

Table 6. Agricultural capability ratings for the soils of Nepean and Gloucester Townships

Soil Map Symbols*	Land Factors					
	Downgrading					Upgrading
	Slope Classes					Fine-textured surface layers
	1,2,2/3	3,3/4	4,4/5	5, >5	0(depressional)	(Classes 3-4)
Anstruther-A						
A1	5R'P'	5R'P't	5R'P'T			
Alluvium-AR						
AR1	5I'W				5I'W'F	
AR2-AR3	5T'WF					
Bearbrook-B						
B1	3DW	3DWt	4TDW			
B2	3Wd				3W'i	
B3-0					3W'i	
Castor-C						
C1	2Fv	2Fv(t)				2fv/2fv(t)
C2	2Fw	2Fw(t)	2Fwt			2fw/2fw(t)
C3	2Fw(v)	2Fw(v)t				2fw(v)
C4	2W(v)F					2W(v)f
C5	3WF				4W'Fi	2Wf
C5-S	4RWF					3RWf
C6	4W'Fi				5W'Fi	4W'fi
Chateauguay-CH						
CH1	1w	2wt				
CH2	2W					
Dalhousie-D						
D1	1w	1w(t)				
D1-S	2Rw	2wt				
D2	2wv	2wvt				
D3	2W	2Wt			2Wi	
D3-0	2Wi				2Wi	
D3-S	3RW					
D4	3W'i					
Ellwood-E						
E1	1f					
E1-S	2fr					
E2-S	3Wfr					
E3-S	3W'r					
Eroded-ER						
ER				7T'		
Farmington-F						
F1	5R'P	5R'Pt	7R'PT			
F1-P	5R'P'	5R'P't	7R'P'T'			
F2	5R'Pw					
F2-P	5R'P'w					
F3	7R'W'P					
F3-P	7R'W'P					
F3-0					7R'W'Pi	
F4	5R'Pv	5R'Pvt	5R'PTv			
F4-P	5R'P'v	5R'P'vt				
F5	7R'PWv					
F5-P	7R'P'Wv					

Table 6 (continued)

Soil Map Symbols*	Land Factors					
	Downgrading					Upgrading
	Slope Classes					Fine-textured surface layers
	1,2,2/3	3,3/4	4,4/5	5, >5	0(depressional)	(Classes 3-4)
Grenville-G						
G1	1p	2pt	2Tp	3T'P		
G1-P	3P'	3P't	4P'T	5P'T'		
G1-S	3RP	3RPt	4RPT			
G1-SP	4P'R	4P'Rt	5P'RT			
G2	2pw	2pwt	3Tpw			
G2-P	3P'w	4P'wt	4P'Tw			
G2-S	3RPw					
G2-SP	4P'Rw					
G3	3W'p	4W'pt			4W'pi	
G3-S	5W'RP	5W'RPt				
G3-P	5W'P'					
G3-SP	7W'P'R					
G4	2pv	2pvt				
G4-P	3P'v	4Pvt				
G4-S	3RPv	4RPvt			4RPvi	
G4-SP	4P'Rv	4P'Rvt				
G5	3Wvp	3Wvpt				
G5-S	4RWvP					
G5-SP	5P'RWv					
Huntley-H						
H1, H2, H3, H3-S	0					
H4, H4-S, H5	0					
Ironside-I						
I1	3F'	3F't				
I1-S	4F'R					
I2	3F'v					
I3	4W'F					
Jockvale-J						
J1	3F'v	4F'vt				2Fv
J2-J2V	3F'w	4F'wt				2Fw/3Fwt
J3	4F'Wv	5FWvt				3WvF
J3-S	4RFWv					
J4	4W'(v)F					3W'(v)f
J4-S	4RFW					3RWf
J5-J5V	4W'F				4W'Fi	3W'f
J5-S	5W'RF					
J6	5W'Fi				5WF'i	
Kars-K						
K1	4MFP	4MFPt	5MFPT	5TMFP		
K2	4W'Pi					
K2-0					4W'Pi	
Leitrim-L						
L1-S	2rf	2rft	3rft			
L2-S	2rfw					
L3-S	2rfv	3rfvt				
L4-S	3Wrf					
Landslide-Ld						
Ld	3DW		4TDW			

Table 6 (continued)

Soil Map Symbols*	Land Factors					
	Downgrading					Upgrading
	Slope Classes					Fine-textured surface layers
	1,2,2/3	3,3/4	4,4/5	5, >5	0(depressional)	(Classes 3-4)
Manotick-M						
M1	3FVm	4FVmt				2Vf
M2	3FMv	4FMvt				2fmv
M3-M4	3Fwvt					2fwv/2fwv(t)
M5	4W'(v)F	4W'(v)Ft				3W'(v)f
M6	4W'F					3W'f
M7	5W'F				5W'Fi	
M8	4W'(v)F					
Mer Bleue-MB						
MB1, MB2, MB3	0					
MB4, MB4-S	0					
MB5, MB5-S	0					
Mille-Isles-MI						
MI1	4F'M'	4F'M't				
MI2	4F'M'v	5F'M'vt	5F'M'vT			
MI3	5W'F'					
Marshland-ML						
ML	7W'I'					
Nepean-N						
N1	5R'P	5R'Pt	7R'PT			
N1-P	5R'P'	5R'P't	7R'P'T			
N2	5R'Pw					
N2-P	5R'P'w					
N3	7W'R'P					
N3-P	7W'R'P'					
N4	5R'Pv	5R'Pvt				
N4-P	5R'P'v	5R'P'vt				
N5	7R'Pwv					
N5-P	7R'P'wv	7R'P'wv(t)				
North Gower-NG						
NG1	1w	2wt				
NG2-NG2V	2w	2W			2Wi	
NG2-S	3RW					
NG3	2wv	2wvt				
NG4-0					3W'i	
Oka-0						
01	4MFP	4MFPt	5MFPT			
01-S	5RMFP	5RMFPt	5RMFPT			
01-P	5P'MF	5P'MFt	5P'MFT			
01-SP	5P'MFR	5P'MFRt	5P'MFRT			
02	4MFPv					
02-S	5RMFPv					
Piperville-P						
P1	2Fw					2fw
P1-S	3RFw	3RFw(t)				3Rfw(t)
P2	3Fwv					2fwv/2fw(v)t
P2-S	3RFw(v)	3RFw(v)				3Rfw(v)
P3	3W(v)F					2W(v)f
P3-S	4RW(v)F					3RW(v)f
P3-P	4PW(v)F					
P4	3WF				3WFi	2wf/3W'f
P4-S	4RWF		5RWFT		4RWFi	3RWf
P5-0					4W'Fi	
P5-SO					4RWFi	

Table 6 (continued)

Soil Map Symbols*	Land Factors					
	Downgrading					Upgrading
	Slope Classes					Fine-textured surface layers
	1,2,2/3	3,3/4	4,4/5	5,>5	0(depressional)	(Classes 3-4)
Queensway-Q						
Q1	2fp	2fpt				
Q1-S	3Rfp	3Rfpt				
Q1-P	3P'f	4P'ft	4P'Tf			
Q1-SP	4P'Rf	5P'Rft				
Q2	2fpw	3fpwt				
Q2-S	3Rfpw					
Q3	3Wpf				3Wpfi	
Q3-S	4WRpf				4WRpfi	
Q4	2fpv					
Q4-P	4P'fv					
Q4-S	3Rfpv	4Rfpvt				
Q4-SP	5P'rfv	5P'Rfvt				
Q5	3fpwv					
Q5-S	4Rfpwv					
Rideau-R						
R1	3DW	3DWt	4TDW			
R2	3DWv	3DWt	4T'Dw			
R3	2Wd				3W'i	
R3-S	3RWd					
R4-0	3W'i				3W'i	
Uplands-U						
U1	4F'M'	4F'M't	5F'M'T			
U2-U3	4F'V	4F'Vt				3FV
U2-S	5F'RV					
U4-U5	5F'V'	5F'V't				
U6	4F'V	4F'Vt				
U7-U8	4F'Wv	5F'Wvt				
U7-S	5F'RWv					
U9-U10	5W'(v)F'	5W'(v)F't				
U11-U12	5W'(v)F'	5W'(v)F't				
U11-S	5RW'(v)F					
U13	5W'F'	5W'F't			5W'F'i	
U13-S	5W'F'R				5W'F'Ri	
U13-P	5W'F'P					
U14	5W'F'i					
U14-0	5W'F'I				5W'F'I	
Escarpments-X						
X1			5T	7T'		
X2				7T'F		
X3			7R'T	7R'T'		
Bedrock						
1-2	7R'	7R't	7R'T	7R'T'	7R'i	
3-4	7R'	7R't	7R'T		7R'i	

**These are symbols shown on the soil map. A terminal V, e.g. J2V, signifies a variant; likewise S indicates shallow phase, P stony phase and 0 peaty phase. V and P as capability land factors are defined differently.*

3RFw Good quality soil, but shallow over rock, low in natural fertility and affected by imperfect drainage in the lower solum. The soil can be used for shallow rooted plants, provided fertilization is more generous or frequent than average. Because the soil is resting on bedrock, it is probably not practical to install tile drains, but surface drainage will improve yields. Extrapolation: suited for orchards; suitability for market crops, nurseries and others is generally good.

3DW Good quality soil, fertile, but difficult to cultivate and maintain in good tilth due to massive soil structures combined with persistent wetness during rainy periods. Tile drainage less effective than in 2W soils, but definitely needed, improving performance considerably. Poorly suited to row crops. More suited to forage crops than to grain crops. Extrapolation: unsuitable for orchards; poorly suited for market crops, nurseries and others.

3W'i Good quality soil, fertile but very poorly drained and susceptible to inundation. Artificial drainage is mandatory but may be difficult to achieve due to the depressional relief. Without efficient artificial drainage, deep rooted plants (alfalfa, clover) may be killed by winter frosts or during periods of inundation. Water tolerant forages, timothy or canary grass may be grown. Range of crops and yields dependent upon efficiency of drainage. Extrapolation: unsuited for orchards and most garden crops.

4F'M' Soil of marginal quality for cultivated crops due to droughtiness and very low natural fertility. Soil needs liming (generally), frequent fertilizations and irrigation. Soils suited to some special row crops and to high value special crops that economically justify the high input costs required; poorly suited for forage crops. Cultivated soils require protection from wind erosion. Extrapolation: generally unsuited for orchards; suited for market crops with proper fertilization and irrigation.

4W'(v)F Soil of marginal quality for field crops due to very poor drainage (with some variability) and low natural fertility. It is usually unprofitable to establish an artificial drainage system on such soils and they are generally left unimproved. Only special high value crops would justify the costs of drainage improvement and fertility maintenance. Extrapolation: unsuitable for orchards; suitability for garden crops dependent upon efficient artificial drainage.

5R'P Generally nonarable soils due to shallowness over hard rock, high stone content and high frequency of rock outcrops. Such land is often left wooded, but if cleared its use is restricted to pasture and forage harvest. Soils often become droughty in summer. Improvements are generally restricted to stone clearing, fertilization and maintenance of permanent grass cover. Extrapolation: unsuited for annual crops.

7R'W'P Generally nonagricultural soils due to wetness and shallowness over hard rock. It is not feasible to drain the land artificially, and it is not worthwhile to pick the stones. Such lands are generally left unimproved.

The Capability Map and Its Use for Nonagricultural Purposes

The soil capability maps collectively reflect the compendium of land factors present in an area. Although the map is drawn for agricultural purposes, it can be useful for general planning provided the land factors are interpreted correctly for other purposes. Many of the land factors which affect agricultural uses, inundation (I), rockiness (R), stoniness (P), steep slopes (T), drainage variability (V) and natural drainage (W) are also fundamental to many nonbiological uses. Some of these are dwellings, playgrounds, effluent disposal, sewage tanks, highways, airports, underground cables, drains, and pipelines.

Such uses are affected only slightly or not at all by soil specific factors such as poor structure (D), low fertility (F) and droughtiness (M). At the same time, these factors along with others can play major roles in biologically oriented but nonagricultural uses such as reforestation, landscaping, playground maintenance, and recreation planning. Thus the usefulness of the capability map can be extrapolated beyond its immediate agricultural use, but only by focusing exclusively on the land factors listed for each area; the capability class, a value rating of land quality, relates strictly to field crop agriculture. Expressed in another way, this means that lands rated as 4M'F', 4MFP, 4F'V, 4F'Wv, or 5W'F', 5W'F'R, 5W'F'i, 5F'MT, and other similar lands rated either as marginal (class 4) or as submarginal (class 5) for agriculture can often be considered moderately to well suited to certain other uses. This also means that certain users should be encouraged to look at these lands as a possible solution to their needs, even if such lands have not been cleared or drained as have the better agricultural lands of classes 1 to 3.

The areas affected by inundation (I) and rated 5I'W or 5IW'F are extremely limited in their capability even for nonagricultural uses. Floods are most frequent between mid-March and mid-May, but they are unpredictable. Generally, such areas have been and should remain wild lands.

Rockiness or shallowness of the soil is often as much a limiting land factor in other uses as in agriculture. Rockiness interferes strongly with small-scale projects, but for certain large projects, such as high-rise construction, it may be an asset. The extra cost of developing such lands may be partly offset by the lower cost of acquisition. The capability map may be used to estimate whether or not rockiness in an area will be a desirable or detrimental factor, by referring to the location and definition of the factors (R'), (R) or (r).

Problems created by stoniness vary in intensity with different uses. Stones interfere least in forested lands and lands reserved in their natural state. Where land is to be developed, an abundance of large stones could impose special design problems and somewhat higher costs. Generally, however, these have not proven to be insurmountable. The capability map refers only to surface stoniness, but amounts below the surface are generally consistent with that at the surface. There are exceptions however. Where stoniness is indicated (p), surface stones have been removed and the amount of stones below the surface may be as great as in areas rated with (P) or (P').

The presence of steep (T) and very steep (T') slopes affects many nonagricultural uses, especially when the slopes are composed of unstable material. The recreational advantage of long steep slopes is recognized, but in the St. Lawrence Lowlands such slopes are extremely rare. In most cases slopes are short, but even these have a certain aesthetic value, as they break the monotony of the landscape and sometimes offer excellent scenic lookouts.

Although the steep slopes bordering clay ravines have some aesthetic value, they are also the most treacherous. These slopes are rated 7T'. Permanent structures and roads should not be built in, or adjacent to, such areas, as these ravines are susceptible to sliding. Slopes rated 7T'F have a thin mantle of sand over the clay, but the identical sensitive situation exists, and the same cautions apply. Steep slopes resting on bedrock are rated 7T'R and these are generally stable. Some steep sandy slopes are droughty and require protection against wind erosion, especially where they are facing the predominant westerly winds.

Poor (W) and very poor (W') drainage (with or without temporary local flooding) affects many uses, and costs of improvements are often very high on an individual basis. Large-scale community developments, whereby costs for individual plots are absorbed in the project as a whole, have proven more successful. Moreover, such projects have generally provided more efficient control of soil moisture and water tables. Where outlets are available, tile drainage has proved more effective than surface drainage.

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