The Soils of The Regional Municipality of Ottawa-Carleton

(excluding the Ottawa Urban Fringe)

Volume 1

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THE SOILS OF THE REGIONAL MUNICIPALITY OF OTTAWA-CARLETON

(excluding the Ottawa Urban Fringe)

Volume 1

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The Ontario Institute of Pedology has the responsibility for coordinating activities in soil resource inventories and related research in soil genesis, morphology, classification, characterization, and interpretation of Ontario soils.

The Institute consists of three cooperating agencies, namely Agriculture Canada, the Ontario Ministry of Agriculture and Food, and the University of Guelph. These agencies provide on-going support through the Land Resource Research Centre, Research Branch of Agriculture Canada, the Soil and Water Management Branch of the Ontario Ministry of Agriculture and Food, and the Department of Land Resource Science of the University of Guelph. Staff from each of these agencies contribute to the programs of the Institute.

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INTRODUCTION

The soil survey area, which is the subject of this report, does not comprise all of the Regional Municipality of Ottawa-Carleton. A soil survey of the non-urban areas of the cities of Nepean and Gloucester in the Regional Municipality has been previously published in Soil Survey Report No. 47, *Soils, capability and land use in the Ottawa Urban Fringe* (1). The remainder of the Regional Municipality is included in this report. A soil map index pertaining to these surveys is provided in Figure 1.

The soil survey of the Regional Municipality of Ottawa-Carleton, as reported herein, involved a resurvey of areas which previously encompassed part of Russell County as well as the former County of Carleton. The resurvey of these areas is part of an ongoing program in Ontario to provide improved information about the soil resources of the province, which will aid in making decisions relating to the wise use of these resources. The recent survey of the Ottawa Urban Fringe area (1), published at a scale of 1:25,000, provided such information for much of the area adjacent to the City of Ottawa where land use conflicts are more intense. Information available at that time for the remainder of the Regional Municipality, however, continued to be that provided in older surveys which was not sufficient for present-day regional land use decision-making (2,3). Thus, a resurvey of the remaining area of the Regional Municipality, at a scale of 1:50,000, was begun in 1976. Preliminary soil maps, incorporating the new, more detailed soil information, were published as the survey progressed (4,5,6).

The report is divided into two volumes. Volume 1 is intended for general distribution and includes descriptions of the climatological and geologic settings of the soils, general descriptions of the soils, and soil interpretations. Volume 2 (available on request) contains detailed morphological, physical, and chemical descriptions of typical soils, as well as tables of engineering test data. In addition to the report, there are three soil maps provided with Volume 1 which have been published at a scale of 1:50,000.

The information contained in this report is intended to complement previously published soil information for the Ottawa Urban Fringe area. Many of the technical aspects and concepts of the survey for that area were incorporated in this survey in order to maintain as much consistency as possible in published soil information for the entire Regional Municipality.

HOW TO USE THE SOIL MAPS AND REPORT

The soil maps and report have been prepared with the intention of providing basic soils information for many users. For this reason, they contain a wide range of information which can be used to answer many questions. In general terms, however, most of the information provided can be placed into one of two general categories: (a) the nature and properties of the soils which occur within the land areas of the region, and (b) interpretive information which can be used when making land management or land use decisions.

To use the soil maps and report efficiently the following procedure should be followed:

(1) Locate the area of interest in Figure 1, the "Soil Map Index" included with each volume. Determine the appropriate soil map for the area.

(2) Open the appropriate soil map, and locate your specific area of interest. Natural and cultural features on the map, such as streams, roads, lot and concession numbers, should assist in location.

(3) Note the map unit symbol or symbols shown within the map delineations which encompass your area of interest.

(4) Find the section "Explanation of Map Unit Symbols" on the map. This section explains the types of map symbols and their respective components. A map symbol may consist of one or more components, depending on the type of land area it represents and the landscape features which may exist. More detailed explanations of map symbols and components are given in the section "Definitions of Terms Associated with the Soil Maps and Legend" of the report.

(5) Brief descriptions of all symbol components are provided in the border areas of each map. Locate in the Legend the specific Soil Landscape Unit, Land Type Unit, or Miscellaneous Land Unit shown in the symbol. Locate the specific slope class, stoniness or rockiness class, or soil phase shown in the symbol in the appropriate border section which describes those landscape features. Detailed definitions of these are given in Appendix 1 of the report.

(6) For more detailed information on specific Soil Landscape, Land Type, or Miscellaneous Land Units, locate them in Volume 1 of the report. Such information can be found in the section titled "General Descriptions of Soil Associations, Land Types and Miscellaneous Land Units".

(7) For specific types of soil interpretations refer also to Volume 1. The section titled "Soil Interpretations" includes soil capability interpretations for common agricultural field crops, soil erosion interpretations, and land suitability interpretations for common forest tree species.

(8) For detailed morphological, chemical and physical descriptions of typical soils, as well as tables of engineering test data, users are referred to Volume 2.

When using the soil maps and report it is important to have an understanding of the following:

1. All soils, including those in this survey, exhibit a range of properties and characteristics within defined areas. Therefore, the soils occurring within a map delineation and represented by a specific map unit may vary. Likewise, similarly identified soils encompassed within separate map delineations may also vary.
2. The boundaries between map units represent the best estimate of where the soils change. Since these changes at times may be gradual, some boundaries may only be approximately located.
3. Within any delineation on the maps, inclusions of unidentified soil components may be present which are not accounted for in the map unit. These unidentified soil components, which could be as large as 10 hectares (ha) in area, are unavoidable due to the map scale and nature of the soil mapping.
4. Most soils information is based on the examination of soil characteristics to a depth of about 100 cm below the surface.

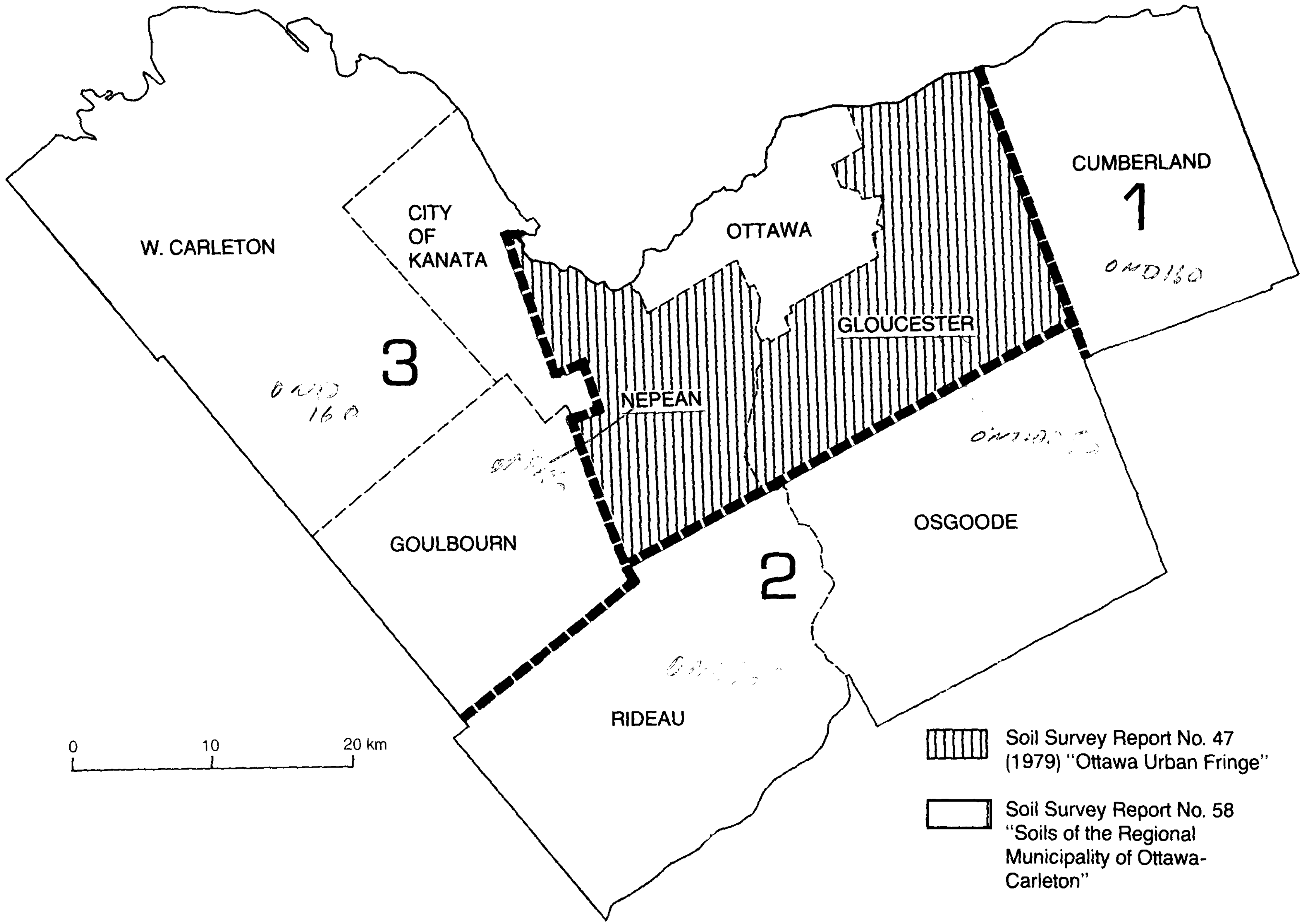


Figure 1.
Soil map index for the Regional Municipality of Ottawa-Carleton.

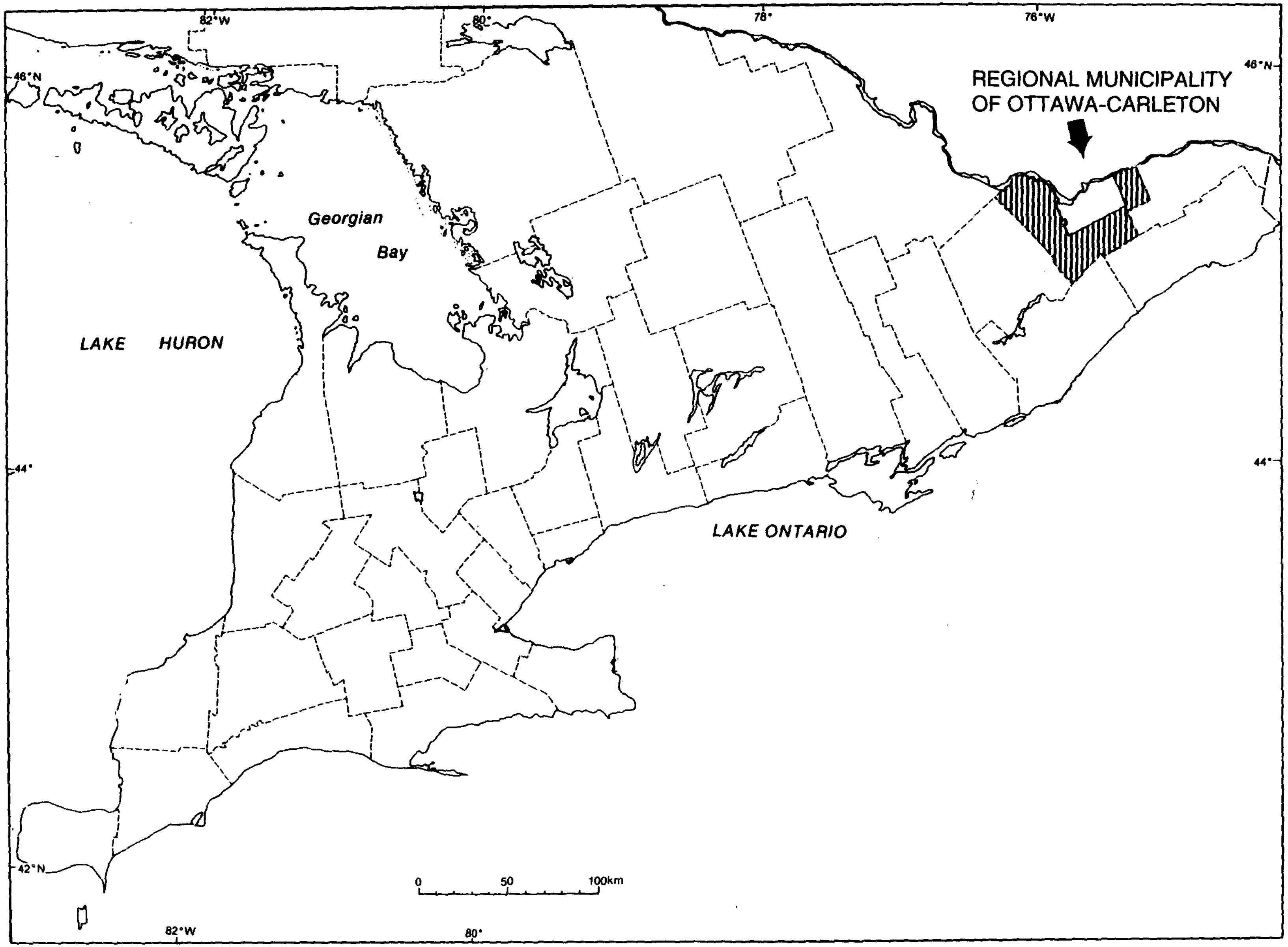


Figure 2.
General location of the Regional Municipality of Ottawa-Carleton and the survey area.

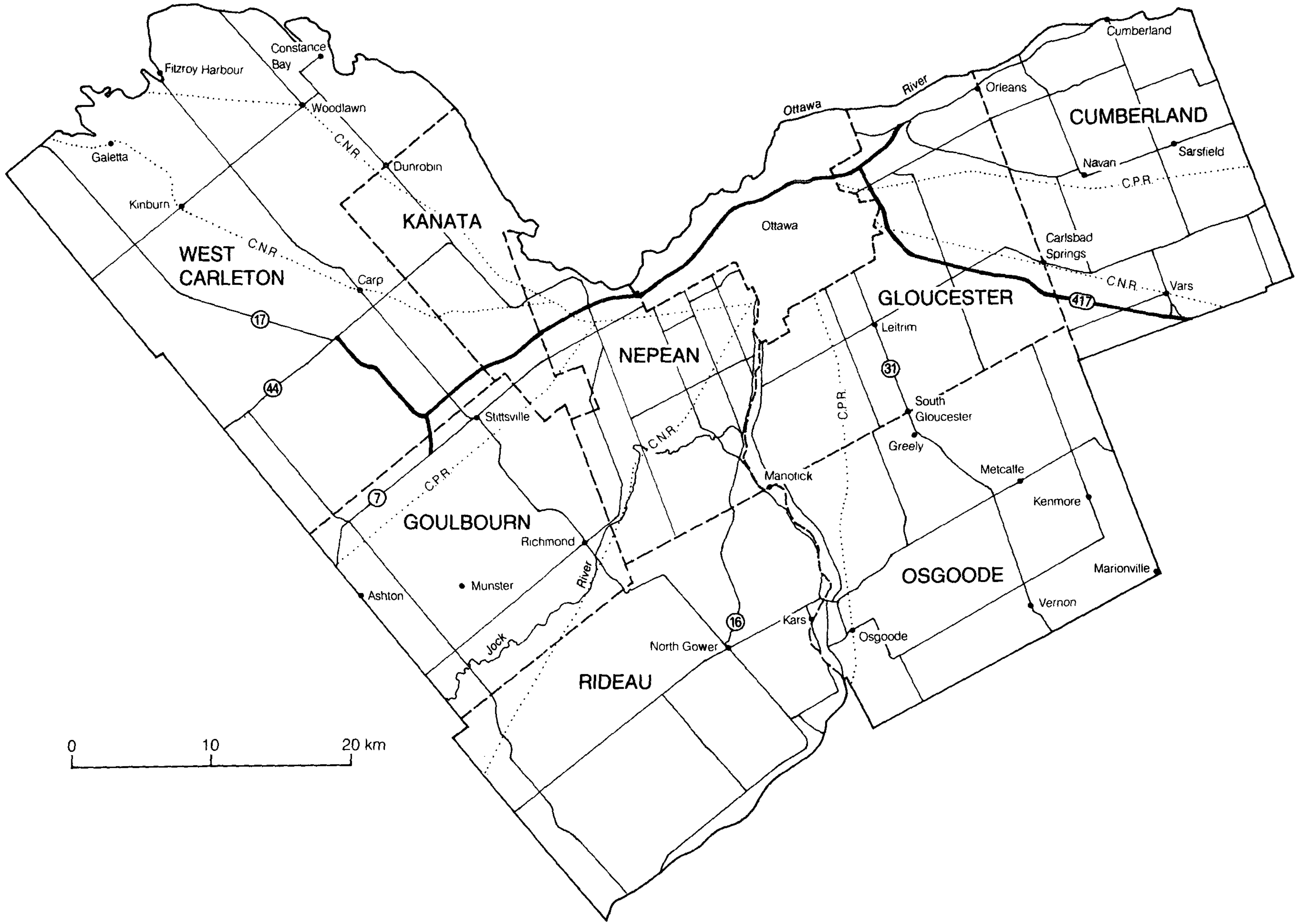


Figure 3.
Main towns, transportation routes, and municipal boundaries of the Regional Municipality of Ottawa-Carleton.

GENERAL DESCRIPTION OF THE AREA

Climate

The Regional Municipality of Ottawa-Carleton is situated in parts of two climatic regions (7). The majority of the regional municipality is situated in the Eastern Counties climatic region. The remainder consisting of the northwestern part of the municipality is situated in the Renfrew climatic region. A summary of pertinent climatic averages for these two regions is provided in Table 1.

Differences between these regions are evident when comparing such statistics as mean average temperatures (6.1 vs 5.0°C), frost-free period (135 vs 130 days), growing season (195 vs 190 days), and mean annual precipitation (762 to 940 mm vs 711 mm).

Climatic trends across the regional municipality generally parallel the broader trends indicated in Table 1. Figure 4 shows the location of climatic stations in the Ottawa-Carleton region and vicinity. Tables 2, 3, and 4 show temperature, precipitation, and growing season data respectively by climatic station. Mean annual temperature data indicate a very slight southerly warming trend with Kemptville registering the highest temperature at 5.9°C. Precipitation data from Table 3 indicate a subtle drying trend northwesterly up the Ottawa valley. For example, mean May to September rainfall values exceed 390 mm at Ottawa and are reduced to 352.7 mm at Arnprior. Growing season values listed in Table 4 exhibit an increasing trend towards the south. A comparison of Arnprior and Kemptville stations shows an increase of approximately 4 days in the growing season, 6 days in the frost-free period, 200 growing degree days, and 100 corn heat units at the latter station.

Table 1. Summary Statistics of the Eastern Counties and Renfrew Climatic Regions[1]

	Eastern Counties	Renfrew
Mean Annual Temperature (°C)	6.1	5.0
Mean Daily Maximum Temperature (°C)		
January	-4.4	-5.5
April	11.1	10.5
July	27.2	26.6
October	13.8	13.3
Mean Daily Minimum Temperature (°C)		
January	-15	-16.1
April	0.5	-1.1
July	13.8	13.3
October	2.7	2.2
Extreme Low Temperature (°C)	-40.0	-40.0
Extreme High Temperature (°C)	40.0	39.4
Mean Date of Last Spring Frost	May 15	May 18
Mean Date of First Fall Frost	Sept. 28	Sept. 25
Mean Annual Frost Free Period	135	130
Start of Growing Season*	Apr. 15	Apr. 18
End of Growing Season	Oct. 28	Oct. 27
Mean Annual Length of Growing Season	195	190
Mean Annual Growing Degree Days*	3400	3100
Mean Annual Precipitation (cm)	76.2 - 94.0	71.1
Mean Annual Snowfall (cm)	203	191

** Based on temperatures above 5 °C*
[1]Data from Brown et al., 1968

Table 2. Temperature data (°C) from the Ottawa-Carleton Region and vicinity[1]

	Mean Annual	Mean Daily Maximum				Mean Daily Minimum				Mean Daily				Highest Recorded	Lowest Recorded
		Jan	Apr	July	Oct	Jan	Apr	July	Oct	Jan	Apr	July	Oct		
Chats Falls	5.8	-6.0	10.8	26.7	13.3	-16.7	0.0	14.7	3.7	-11.3	5.4	20.7	8.5	37.8	-41.1
Arnprior	5.5	-7.2	10.6	26.4	13.1	-15.9	0.0	14.4	3.1	-11.6	5.4	20.4	8.3	37.2	-37.2
Ottawa, Agr. Canada	5.9	-6.4	10.6	26.2	13.1	-15.2	0.7	14.9	3.8	-10.8	5.7	20.6	8.5	37.8	-38.9
Ottawa Int'l. Airport	5.7	-6.4	10.7	26.3	13.0	-15.4	0.3	14.9	3.2	-10.9	5.6	20.6	8.1	37.8	-36.1
Carp	5.4	-7.2	10.4	25.9	13.0	-15.6	0.4	14.5	2.9	-11.5	5.4	20.3	8.0	35.6	-37.8
Russell	5.7	-6.1	10.7	26.3	13.6	-15.8	0.2	14.2	3.1	-11.0	5.5	20.3	8.3	36.1	-40.0
Almonte	5.4	-5.8	10.9	26.4	13.5	-16.2	-0.6	13.4	2.6	-11.0	5.2	19.9	8.1	37.8	-38.9
Ashton Station	5.3	-6.2	10.6	26.2	13.2	-16.0	-0.3	13.6	2.5	-11.1	5.2	19.9	7.9	35.6	-37.2
Kemptville	5.9	-5.4	11.1	26.6	13.6	-15.1	0.2	14.1	3.1	-10.3	5.7	20.4	8.4	38.3	-39.4

[1]Compiled from Environment Canada, Atmospheric Environment Service Climatic Normals, 1951-1980

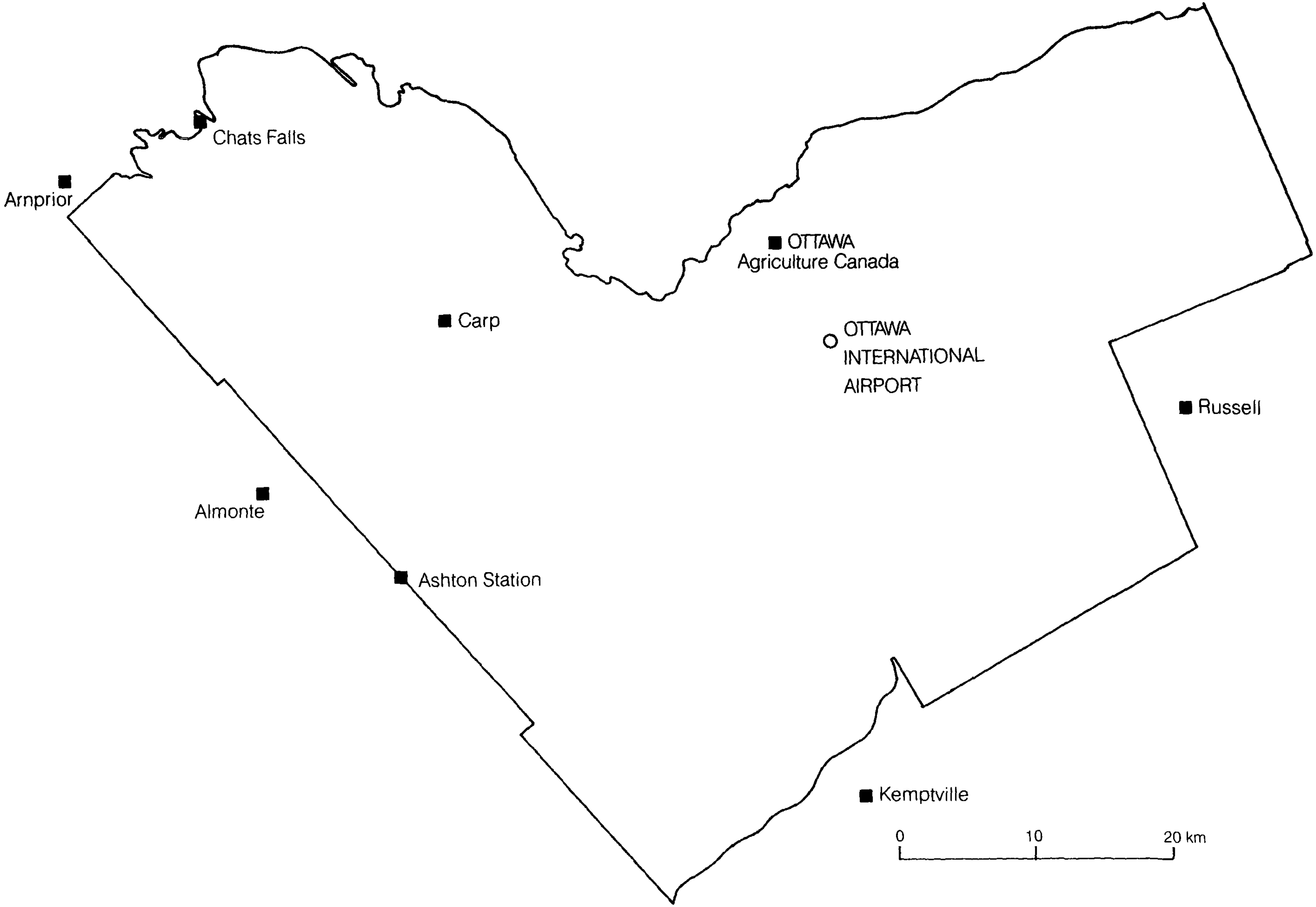


Figure 4.
Location of weather stations in the Regional Municipality of Ottawa-Carleton and vicinity.

A frost-free period ranging from 130 to 140 days makes commercial production of many vegetable crops possible. Table 5 lists the first field seeding or planting dates for common vegetables in Climatic Zone E, which includes the Ottawa-Carleton region.

Soil climate in the Ottawa-Carleton region is generally classified as mild mesic with respect to soil temperature, and humid to subaquic with respect to soil moisture (8). Mean annual soil temperature at 50 cm depth ranges from 8 to 15°C and mean summer soil temperature ranges from 15 to 22°C. Thermal period of the soil, which is the period during which soil temperature exceeds 15°C at 50 cm depth, approaches 120 days. The humid soil moisture regime implies that the period when the soil is dry is less than 90 days in most years, with water deficits ranging from 2.5 to 6.4 cm. Climatic Moisture Index (CMI) for the humid regime is 74 to 84%. This index expresses growing season precipitation as a percentage of potential available water use by annual field crops.

Table 3. Precipitation data from the Ottawa-Carleton Region and vicinity[1]

	Mean Annual Precipitation (mm)	Mean Rainfall May to September (mm)	Mean Annual Snowfall (cm)
Chats Falls	819.6	364.8	205.8
Arnprior	745.6	352.7	158.8
Ottawa, Agr. Canada	846.2	397.3	205.5
Ottawa Int'l. Airport	879.3	393.2	227.3
Carp	854.0	378.4	198.7
Russell	846.4	382.9	178.2
Almonte	735.6	331.6	179.5
Ashton Station	915.1	377.3	225.9
Kemptville	867.0	386.7	185.0

[1]*Compiled from Environment Canada, Atmospheric Environment Service Climatic Normals, 1951-1980*

Table 4. Growing season and frost data from the Ottawa-Carleton Region and vicinity[1]

	Growing Season		Mean Length Growing Season (days)	Mean Annual Growing Degree Days	Mean Annual Corn Heat Units	Mean Date		Mean Annual Frost Free Period
	Starts	Ends				Last Frost	First Frost	
Chats Falls	April 17	Oct 28	194	3200	2500	May 17	Sept 26	132
Arnprior	April 17	Oct 28	194	3200	2500	May 17	Sept 26	132
Ottawa, Agriculture Canada	April 16	Oct 29	196	3300	2600	May 15	Sept 27	135
Ottawa International Airport	April 16	Oct 29	196	3300	2600	May 15	Sept 27	135
Carp	April 16	Oct 28	195	3300	2600	May 16	Sept 27	136
Russell	April 15	Oct 29	197	3400	2600	May 14	Sept 28	139
Almonte	April 16	Oct 29	196	3300	2500	May 17	Sept 27	135
Ashton Station	April 16	Oct 29	196	3300	2600	May 16	Sept 27	136
Kemptville	April 15	Oct 30	198	3400	2600	May 15	Sept 28	138

[1]*Data estimated from Brown et al., 1968*

Table 5. First field seeding or planting dates for commercial production of vegetables in the Ottawa-Carleton Region[1]

Crops	Dates
Frost Hardy	
asparagus, broccoli, Brussels sprouts, cabbage, lettuce, onion, radish, rhubarb, pea, spinach, parsnip, early potato	April 25-May 10
Semi-Frost Hardy	
beet, carrot, cauliflower, celery, late potato, early sweet corn	May 5-15
Semi-Frost Tender	
snap bean, sweet corn, tomato	May 25-June 5
Frost Tender	
lima bean, cucumber, eggplant, muskmelon, pepper, pumpkin, squash, watermelon	June 5-15

[1]*From OMAF Publication 363, Vegetable Production Recommendations*

Bedrock Geology

The bedrock geology of the regional municipality is mainly of Paleozoic era and Ordovician period (10). The exception is a fairly large area of Precambrian bedrock in the western part of the region, extending from the villages of Fitzroy Harbour and Galetta to the City of Kanata (Figure 5). Part of the Grenville supergroup, this Precambrian bedrock consists of quartzites, crystalline limestone, and other metamorphic rocks along with granite and granite-gneiss (11,12). Included in the area is the Carp Ridge, an area consisting of marshlands, bare rock outcrops and thin till deposits generally less than half a metre thick.

The Ordovician or Cambrian sandstone of the Nepean formation is the oldest Paleozoic bedrock in the region (10). Occurring and outcropping in parts of the City of Kanata, this generally cream colored coarse grained sandstone is a source of building stone and underlies much of the shallow Nepean soil association.

The Oxford formation is the dominant bedrock in the region, underlying most of Rideau and Osgoode townships and smaller parts of West Carleton Township and the City of Kanata. It exists in thick beds and consists mainly of weathering dolomite, sometimes varying to grey limestone and magnesian limestone (10). The upper part of the formation may also contain shaly layers. Outcrops are most common in southwestern Rideau Township and northeastern Osgoode Township, where the formation also underlies fairly extensive areas of the shallow Farmington soil association.

Transitional to the Nepean and Oxford formations is the Ordovician March formation which alternates from grey sandstone to sandy, blue-grey dolomite (10). This formation underlies a portion of the City of Kanata.

Of Chazy age are the St. Martin and Rockcliffe formations (10). The Rockcliffe formation consists of grey-green shale with some sandstone lenses. Main areas of occurrence are in the northern and southern parts of West Carleton Township, and northern Cumberland Township. The mainly limestone St. Martin formation outcrops along a narrow fringe in northern Cumberland Township adjacent to the Ottawa River.

The Ottawa formation, which is mostly limestone, constitutes almost as much of the region as the Oxford formation. Approximately half of both West Carleton and Cumberland Townships are underlain by this formation. The upper part of this formation consists of fairly pure limestone with a few shaly layers (10). Materials from this formation continue to be mined and also underlie much of the shallow Farmington soil association.

Intermittently overlying the Ottawa formation is the Eastview formation, which consists of dark grey limestone interbedded with shale (10). Its only location within the region is a narrow band which approximately bisects Cumberland Township from east to west.

The brown to black shales of the Billings formation overlie the aforementioned Eastview formation and constitute the bedrock of central Cumberland Township. This formation is succeeded by the grey and sandy weathering shales of the Carlsbad formation in southern Cumberland and northeastern Osgoode townships. In the same general area, the Carlsbad formation is in turn succeeded by the Queenston formation which consists of red shale (10). The three aforementioned bedrock formations account for the relatively frequent occurrence of the shaly Leitrim soil association in central and southern Cumberland Township. The Queenston formation is also the original source of the reddish bands of silt and clay which characterize the Bearbrook soil association.

Physiography

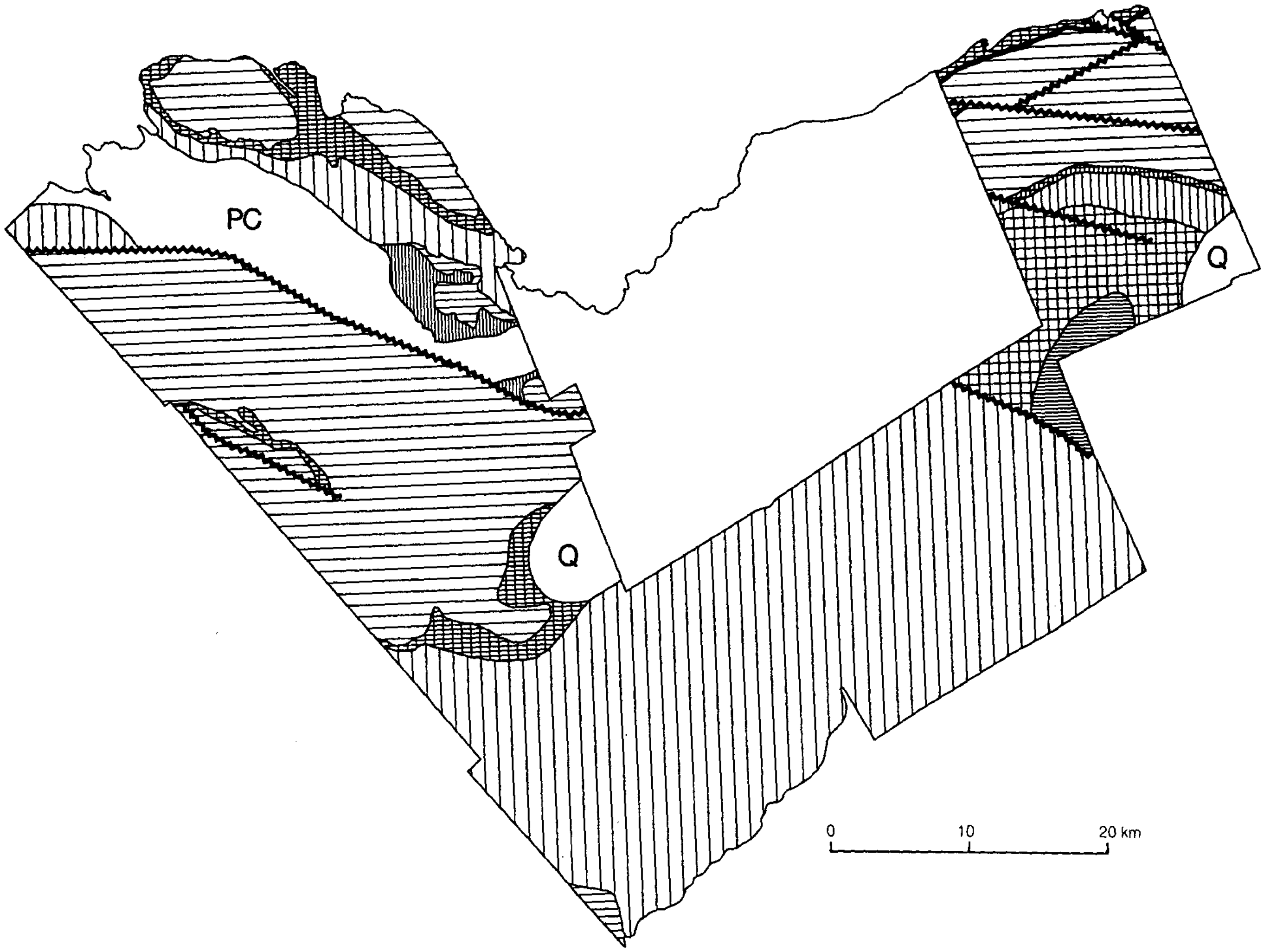
The Ottawa-Carleton map area consists of parts of four physiographic regions. These are the Smiths Falls limestone plain, the North Gower drumlin field, the Ottawa Valley clay plains, and the Russell Prescott sand plains (13). Figure 6 shows the predominance of aspects of these four general regions in comprising the physiography of Ottawa-Carleton. Figure 7 shows the rivers and main streams of the region. Table 6 summarizes the relationships between the physiographic regions, surficial materials, and soils of the region.

The Smiths Falls limestone plain includes the western half of Rideau Township, the majority of Goulbourn Township, and a large part of southernwest Carleton Township. The topography of this area is generally nearly level, being controlled by the shallow and mainly limestone and dolomite Ottawa and Oxford bedrock formations. The thin veneer of till over the bedrock has been sorted and redeposited as beach lines in localized spots. Many of these have been mined for aggregate. Also present are considerable areas of wetlands in the form of stream and basin swamps and a few fen deposits. This physiographic area also includes scattered deposits of deeper clays and sands. Main drainage channels are the Rideau and the Jock Rivers.

The North Gower drumlin field includes the eastern half of Rideau Township and the majority of Osgoode Township. This physiographic region features drumlins and till plains of gently undulating to moderately sloping topography. Low areas adjacent to these deposits commonly consist of finer clays and silts of Champlain Sea origin. These lower deposits are generally poorly drained. Also present is an esker deposit flanking the Rideau River on the west side and occurring in a northsouth direction. This deposit was locally reworked into beach-type landforms on the surface by the Champlain Sea. Resulting topography is somewhat subdued with the original esker flanked by gently sloping sand plains in spots. Intermittent limestone plains and stream swamp deposits also occur in the drumlin field area. The Rideau River is the main drainage channel through the area, serving such minor channels as the Mud and Steven Creeks. In the eastern part of the region, the smaller South Castor and Castor Rivers are also important drainage channels. In general, the high proportion of poorly-drained areas in this physiographic region has necessitated the digging of a considerable municipal drainage network.

The Ottawa Valley clay plains include areas of West Carleton and Goulbourn townships, the City of Kanata, and the majority of Cumberland Township. West of the City of Ottawa, the physiography is a combination of clay plains and bedrock uplands which is due to faulting. A good example of this phenomenon is the Carp Valley and the adjacent Carp Ridge, demarcated from each other by the Hazeldean fault. East of the City of Ottawa, in Cumberland Township, the clay plain borders the present Ottawa River. Further to the south across the middle of the township, the more or less uniform clay plain borders an ancient abandoned channel of the Ottawa River. The channel varies from 3 to 5 km wide and was abandoned due to isostatic uplift of the land surface following glacial retreat. This caused the channel to rise above sea level, therefore confining the river to its modern northern route. Part of the channel is now drained by the Bear Brook, but it is also the site of the poorly drained Mer Bleue bog in the western portion. Most of the channel consists of clay plains alternating with sandy deposits and modified till plains. A few ancient landslide sites are also present (12). Main drainage channels besides the Ottawa River in the clay plains region are the Mississippi River, Carp River, Cardinal Creek, Becketts Creek, as well as the Bear Brook.

To the south of the ancient river channel, in the remainder of Cumberland Township and northern Osgoode Township, the area is part of the Russell Prescott sand plains physiographic region. These sand deposits were originally part of a delta of the early Ottawa River. The delta was subsequently incised during the events of isostatic uplift of the regional land mass and the resulting recession and rerouting of the river's waters. The remaining deposits are generally 5 to 10 m thick, and level to very gently undulating except where they have been reworked into dunes. Main drainage channels in this area are the North Castor River, Shaws Creek, and the South Indian Creek.



QUATERNARY

Q PLEISTOCENE AND RECENT
Recent alluvium and glacial deposits — bedrock unknown

ORDOVICIAN

- Queenston Formation: red shale
- Carlsbad Formation: grey shale, sandy shale, some dolomite layers
- Billings Formation: black shale; minor brown shale
- Eastview Formation: dark grey limestone with shale bands
- Ottawa Formation: mainly limestone, some dolomite, shale and sandstone in basal part
- St. Martin Formation: limestone, minor shale and dolomite
- Rockcliffe Formation: grey-green shale with lenses of grey sandstone
- Oxford Formation: dolomite and limestone
- March Formation: interbedded sandstone and dolomite

ORDOVICIAN OR CAMBRIAN

- Nepean Formation: sandstone

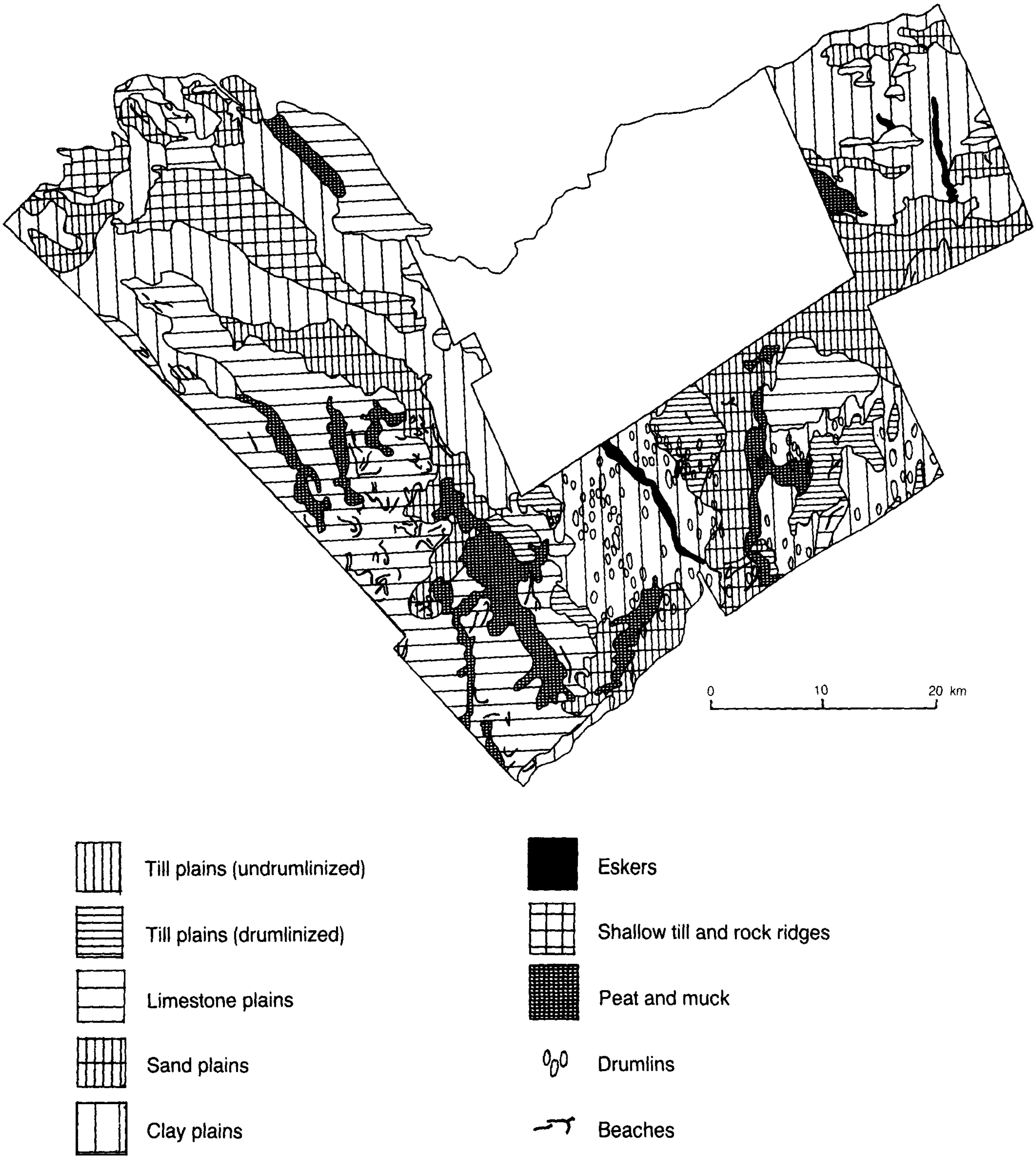
PRECAMBRIAN

PC Grenville Formation: crystalline limestone, quartzites, and metamorphic rocks; associated granites and granite-gneiss

Fault line

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

Figure 5.
Bedrock geology of the Ottawa-Carleton Region.



After Chapman, L.J., and D.F. Putnam 1972, Map 2227, Physiography of the Eastern Portion of Southern Ontario.

Figure 6.
Physiography of the Ottawa-Carleton Region.

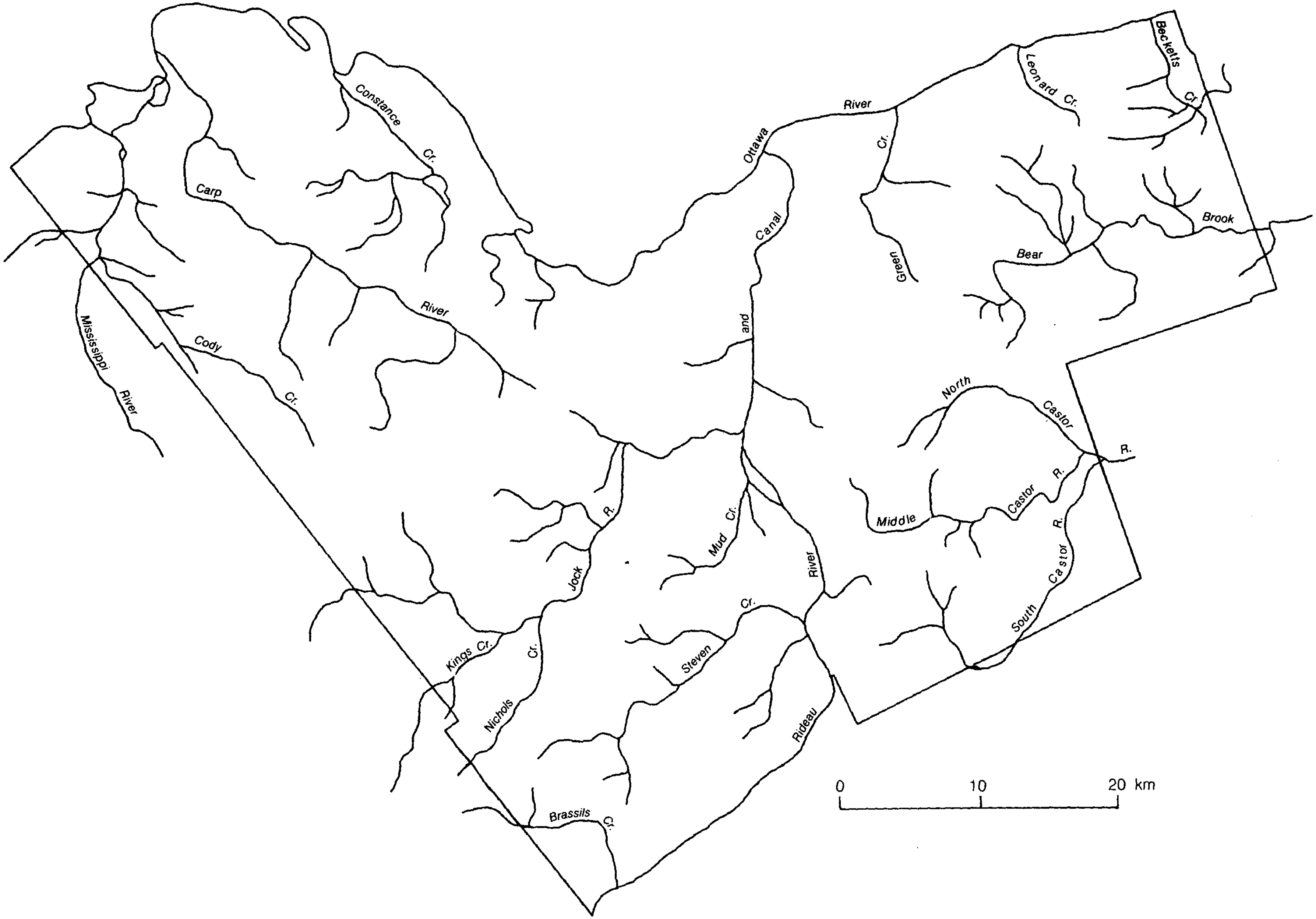


Figure 7.
Drainage map of the Regional Municipality of Ottawa-Carleton.

Surficial Geology and Relationship to Soils of the Region

Surficial geology maps and related information provided useful general guidance in much of the mapping and reporting of the soils of the region. Figure 8 is a generalized map of the surficial deposits. A summary table is also provided in which the physiographic regions referred to in the previous section as well as the surficial materials are related to the various soil associations (Table 6). In addition, three landscape cross-sections in Figures 9, 10 and 11 are provided to further aid understanding of soil-geological relationships in the region.

Fairly extensive areas of the region consist of thin deposits (less than 1 m thick) of unconsolidated sediments over bedrock interspersed with bare bedrock outcrops. This bedrock is generally distinguished as Precambrian or Paleozoic. The thin veneer of unconsolidated material is mostly undifferentiated glacial drift and has been mapped as the Anstruther soil association in the Precambrian areas, the Farmington soil association in the Paleozoic limestone and dolomite areas, and the Nepean soil association in the areas of sandstone. Most of the Anstruther association mapped is on or in the vicinity of the Carp Ridge. The Nepean soil association was mapped mainly in the City of Kanata area. The Farmington association is more widespread, having been mapped extensively in Rideau, Goulbourn and West Carleton townships, as well as in considerable areas of Osgoode and Cumberland townships. Rockland land types have also been mapped in parts of these areas dominated by bare bedrock and veneers of drift less than 10 cm thick.

The thin glacial till veneers in the bedrock dominated areas correspond to a great degree in age and source to two main deeper types of Pre-Champlain Sea deposits (12,14). These are the deep glacial till deposits and fluvioglacial deposits which are products of the Wisconsin age glacial retreat. The tills are characterized by two general landforms, these being elongated drumlin ridges oriented along a northsouth axis, and undulating till plains. The composition of the till is highly influenced by the type of bedrock local to the deposit. Hence the majority of till deposits in the region are calcareous and moderately coarse to medium textured with a fairly high proportion of stones and boulders. High contents of limestone and dolomite reflect the areal predominance of the Ottawa and Oxford bedrock formations in the region (10). These surficial materials were mapped as the Grenville soil association. Extensive deposits occur in Goulbourn, Rideau, Osgoode, and Cumberland townships.

A few till deposits are dominated by sandstone, most notably in areas of northern West Carleton Township in the vicinity of Fitzroy Harbour. These materials are non-calcareous and somewhat sandier than the aforementioned calcareous materials, and were mapped as the Queensway soil association. Till deposits derived chiefly from shale bedrock have been mapped as the Leitrim soil association. Materials derived from a number of shale-bearing formations are included in the Leitrim association. They include the Queenston (red shale), Carlsbad (grey shale), Billings (black shale), Eastview (grey shale) and Rockcliffe (grey-green shale). The most extensive shaly till deposits are located in southern Cumberland township and are associated with the Queenston, Carlsbad, and Billings formations.

All till deposits in the region were subject to modification due to subsequent marine inundation following glacial retreat. In a few areas of high modification, shallow fast moving marine waters removed clay and silt from the till and deposited a veneer of sand most often less than 1 m thick on the till surface. Such deposits were mapped as the Ironside soil association. In a few other localized areas till deposits were submerged in deeper, slower moving marine waters resulting in less than 1 m thick veneers of silt and clay being deposited on the till. These deposits were mapped as the Chateauguay soil association.

Wisconsin glacial retreat also produced well sorted ice-frontal deposits in several areas of the region. Consisting originally of non-fossiliferous sand, gravel, cobbles, and occasional lenses of till, these often esker-like ridges also underwent varying degress of modification during the Champlain Sea inundation. Many deposits were extensively reworked into marine beach deposits and were mapped as the Oka soil association. However, those having undergone lesser modification or which were essentially intact with only thin beach features were mapped as the Kars soil association. Main deposits of this soil material are located in the Stittsville-Huntley area of Goulbourn and West Carleton townships, the Kars area of Rideau Township, Osgoode Township along a line running from Osgoode to Greely, and in the Leonard to Sarsfield area of Cumberland Township.

Table 6. Correlation between physiographic regions[1], surficial materials[2], and soil associations and land types

Physiographic Regions	Surficial Materials	Soil Associations, Land Types, or Miscellaneous Land Units
	Recent Deposits	
Smiths Falls limestone plain, North Gower drumlin field	Organic Deposits: muck and peat in form of bogs, fens and swamps	Borromee Goulbourn Greely Huntley Lemieux Malakoff Mer Bleue Marshland
	Modern River Deposits	Recent Alluvium Eroded Channels
	Post-Champlain Sea Deposits	
Ottawa Valley clay plains	Clayey Abandoned River Channel Deposits: silt and silty clay with sand lenses underlain by unmodified marine clay	Bearbrook Rideau Dalhousie Manotick Castor
Russell-Prescott sandplains, Ottawa Valley clayplains	Sandy Abandoned River Channel Deposits: stratified medium sand deposits, locally reworked into dunes; unfossiliferous	St. Thomas Uplands Ottawa Mille Isle Manotick
Russell-Prescott sandplains	Estuarine and Channel Deposits: stratified medium to fine grained sand; locally reworked into dunes	St. Thomas Uplands Ottawa Manotick Castor
	Champlain Sea Deposits	
North Gower drumlin field, Smiths Falls limestone plain	Littoral Facies: gravel, coarse sands, and cobbles; slabs of bedrock where derived from Paleozoic bedrock; fossiliferous; sometimes overlies fluvioglacial deposits	Oka

(Continued on Page 18)

Table 6. Correlation between physiographic regions[1], surficial materials[2], and soil associations and land types (cont'd)

Physiographic Regions	Surficial Materials	Soil Associations, Land Types, or Miscellaneous Land Units
North Gower drumlin field, Smiths Falls limestone plain	Sub-littoral Facies: uniform, fine buff sand deposited in shallow water as nearshore facies; commonly reworked into dunes; commonly fossiliferous	Jockvale Uplands Manotick Castor Reevecraig Osgoode Mille Isle Ironside
Ottawa Valley clay plain	Deep-water Facies: blue-grey clay, silt, and silty clay; calcareous and fossiliferous at depth; commonly reworked, non-calcareous and non-fossiliferous at surface (2 m depth or less)	Rideau Bearbrook Dalhousie North Gower Chateauguay Castor Landslide
	<u>Pre-Champlain Sea Deposits</u>	
North Gower drumlin field	Fluvioglacial Deposits: gravel and sand, stratified, some till; in the form of eskers and various ice contact deposits; surface reworked into beaches in locations below the Champlain Sea limit.	Kars
North Gower drumlin field	Glacial Deposits: till; heterogeneous mixture ranging from clay to large boulders, generally sandy, grades downward into unmodified till; surface generally modified by wave or river action; topography flat to hummocky	Grenville Leitrim Ironside Chateauguay Queensway
	<u>Bedrock</u>	
Smiths Falls limestone plain	<u>R</u>: limestone, dolomite, locally shale, sandstone (Paleozoic); mainly bare, tabular outcrops; includes areas thinly veneered by unconsolidated sediments up to 2 m thick	Farmington Nepean
Ottawa Valley clay plain	R: intrusive and metamorphic rocks (Precambrian); mainly bare, hummocky, rolling or hilly rock knob upland; includes areas thinly veneered by unconsolidated sediments up to 2 m thick	Anstruther

[1]*From Physiography of Southern Ontario, Third Edition, by L.J. Chapman and D.F. Putnam, Ontario Geological Survey.*

[2]*From Map 1425A, Surficial Materials and Terrain Features, by S.H. Richard, N.R. Gadd, and J.S. Vincent, Geological Survey of Canada.*

- Intrusive and metamorphic precambrian bedrock; occurs either at or near the surface
- Paleozoic bedrock either at or near the surface; limestone, dolomite, locally shale or sandstone; usually significant areas of marine beach and organic deposits are included
- Glacial till deposits; minor areas of Paleozoic bedrock at or near the surface may also occur
- Fluvioglacial deposits; cobbly sand and gravel
- Marine clay deposits; includes eroded marine clays associated with old river channels
- Marine clay deposits, with significant areas of glacial till deposits in the form of drumlins and till plains.
- Marine clay deposits, with significant areas of Precambrian bedrock outcrops
- Marine sand deposits; minor areas of glacial till deposits may also occur
- Marine beach deposits; cobbly or flaggy sand and gravel
- Fluvial or estuarine sand deposits
- Combination of Paleozoic bedrock outcrops, glacial till, and marine clay deposits
- Combination of eroded marine clay deposits and fluvial or estuarine sand deposits
- Organic deposits

Generalized from Richard, S.H., N.R. Gadd, and J.-S. Vincent, 1974, Surficial Materials and Terrain Features, Ottawa-Hull, Map 1425A, Geological Survey of Canada.

Figure 8.
Generalized surficial materials of the Ottawa-Carleton Region.

The Champlain Sea marine inundation resulted in deep water deposits, shallow water or near shore deposits, and shore line or beach deposits influenced by tidal fluctuation (14). The deep water deposits generally consist of blue-grey clay and silty clay. These deposits are also referred to as Leda clay and are usually non-calcareous and non-fossiliferous in the upper metre, and slightly calcareous and fossiliferous at lower depths. Bands of silt and very fine sand commonly occur amongst the clay deposits, especially in areas where the marine clays are adjacent to till knolls which served as an erosional source of the coarser materials during the different stages of sea inundation. Soil associations corresponding to the coarser non-calcareous upper clay layer are the North Gower, Dalhousie, Osgoode, and Castor. The upper clay layer was deposited in a more fresh water environment associated with the late stages of the Champlain Sea and the early stages of the ancestral Ottawa River. The deeper, finer, slightly calcareous and fossiliferous clays were deposited during the earlier stages of the Champlain Sea in a salt to brackish water environment. Soil associations mapped on these deposits are the Rideau and Bearbrook soil associations which are composed of heavy clays. The main areas where North Gower, Dalhousie, Castor and Osgoode soil associations have been mapped are along the Carp Valley in West Carleton Township, the Richmond plain in Goulbourn Township, and in the drumlin field through Rideau and Osgoode townships. Bearbrook and Rideau associations were mapped primarily in Cumberland Township.

Near shore and beach deposits of the Champlain Sea correspond with the latter stages of inundation as the marine waters receded due to isostatic uplift of the region. The near shore deposits are described as medium to fine fossiliferous sands (14). These nearly level to very gently sloping sand plains usually occur adjacent to marine beach deposits. Good examples of these occurrences are located in the Huntley, Stittsville and Stanley Corners area of Goulbourn Township, in the Kars and Watterson Corners area of Rideau Township, and in Osgoode Township between the village of Osgoode and Manotick Station. Soil associations mapped on these surficial materials include the St. Thomas, Jockvale, Mille Isle, Osgoode, and Uplands. Where sand and silt deposits of this type are shallow over marine clay, the Castor and Manotick associations have been mapped.

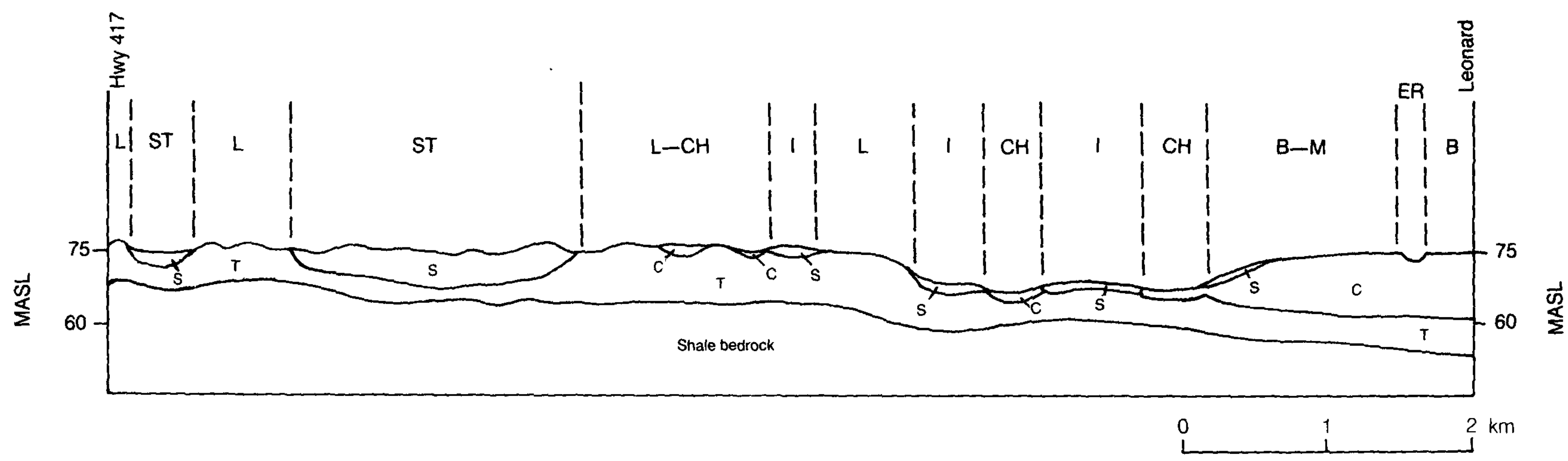
Beach deposits have been mapped as the Oka soil association. These deposits resulted from the reworking by wave action of Wisconsin age fluvioglacial deposits such as eskers, till ridges such as drumlins, and shallow till deposits on Paleozoic bedrock. Oka soils that developed on beach deposits formed on fluvioglacial or ice-contact deposits were mapped in the Stittsville and Manotick Station areas. Oka soils developed on beaches formed on the westerly sides of drumlins are common in Rideau and Osgoode townships. Shallow to bedrock Oka soils developed from the sorting and redeposition of shallow till veneers are common in West Carleton, Goulbourn, and Rideau townships.

Recession of the Champlain Sea was succeeded by stages of the ancestral Ottawa River. Surficial deposits resultant of these stages exist in West Carleton Township following a band from the Galetta area through Fitzroy, Constance Bay, Woodlawn and further southeast into the City of Kanata. In Cumberland Township, ancient channel deposits are found in the northern portion adjacent to the present Ottawa River channel, and across the middle of the township mainly in or near a channel running from west to east. Along the floors and sides of that channel, erosive action exposed what were originally marine clays. These exposed clay deposits were mostly mapped as Rideau and Bearbrook soil associations, and some Dalhousie soil association. Where veneers of silt or sand were left on top of the clay, Castor and Manotick associations were mapped. In the same channel some till deposits were also exposed from underneath the eroded clay. Chateauguay, Ironside, and Grenville soil associations were mapped in this area. Considerable deep deposits of unfossiliferous sand were also deposited on the channel floors, banks and terraces. These deposits were included mostly in the St. Thomas, Ottawa and Mille Isle soil associations. Along the banks of the ancestral Ottawa River are a number of landslide deposits (12). The landslides occurred when the sensitive marine clays became saturated and weakened, allowing large sections of the banks to liquify and flow. Some of these deposits are mapped as the Landslide land unit. Others have been mapped as soil associations, namely the St. Thomas, Ottawa, Rideau and Bearbrook.

The most recent deposits in the map area are the organic deposits and the modern river deposits. The organic deposits have been mapped and classified in seven organic soil associations. The modern river deposits have been mapped as Recent Alluvium land types, or are included in the Eroded Channel land type.

The organic deposits are most extensive in Goulbourn and Rideau townships where they are associated with the Paleozoic bedrock plains of this area. The bedrock is mostly of the Ottawa and Oxford formations (10). Swamp landforms were mapped as the Huntley, Goulbourn, and Greely soil associations. Fen landforms were mapped as the Malakoff soil association. Other areas with extensive organic deposits are in Osgoode Township between Greely and West Osgoode (mainly Huntley and Greely associations) and in central Cumberland Township (mainly Mer Bleue and Malakoff associations).

Modern river channel deposits have been mapped as Recent Alluvium (AR) in areas along the Ottawa River in northern Cumberland Township. Areas around modern streams which were mapped as the Eroded Channel land type also include localized modern river deposits.



GEOLOGICAL MATERIALS

T	Till
S	Sand
C	Clay

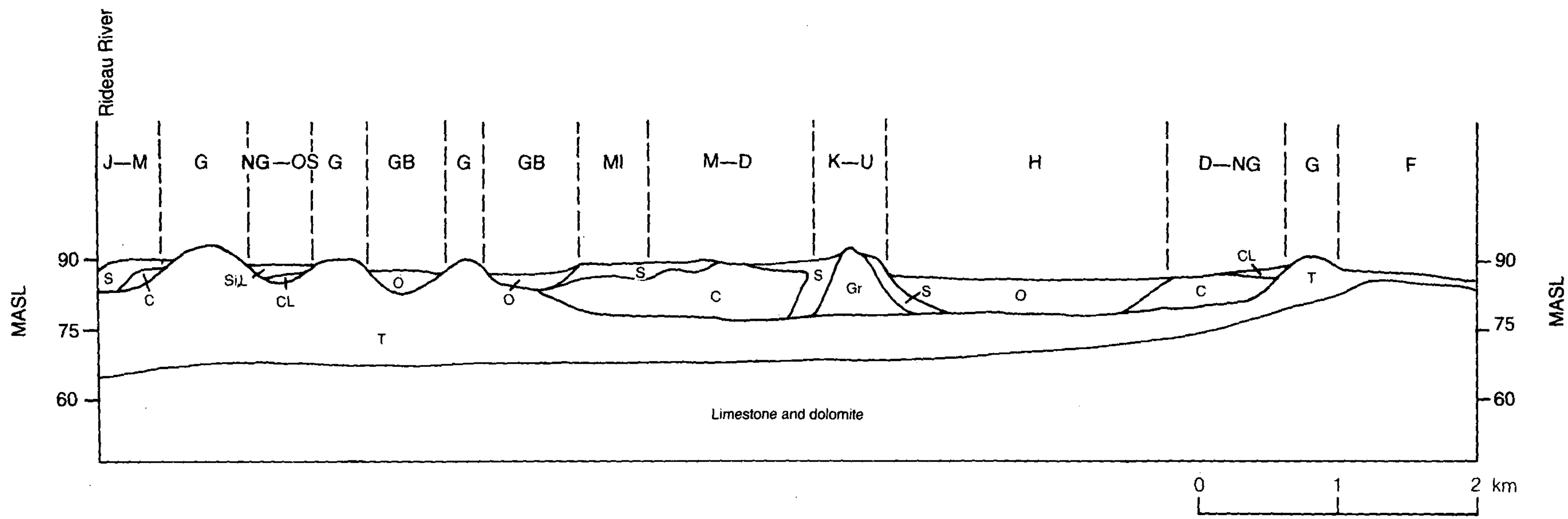
SOIL ASSOCIATIONS OR LAND TYPES

L	Leitrim
ST	St. Thomas
CH	Chateauguay
L—CH	Leitrim-Chateauguay
I	Ironside
B—M	Bearbrook-Manotick
B	Bearbrook
ER	Eroded Channel

Vertical Exaggeration = 33:1

Note: At depths of less than 5 m this diagram is a schematic representation of the surficial deposits showing only their approximate relationships.

Figure 9.
Landscape cross-section showing soils and geology from Vars to Leonard in Cumberland Township.



GEOLOGICAL MATERIALS

T	Till
Gr	Gravel, cobbles
S	Sand
Si,L	Silt, loam
CL	Clay loam
C	Clay
O	Organic

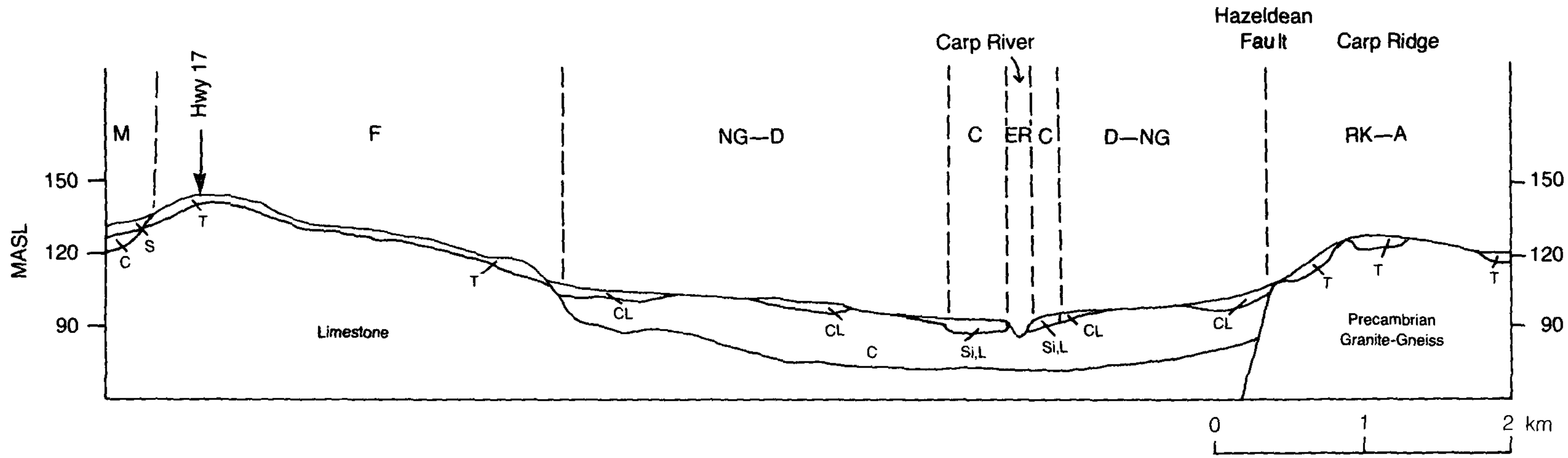
SOIL ASSOCIATIONS

J—M	Jockvale-Manotick
G	Grenville
NG—OS	North Gower-Osgoode
GB	Goulbourn
MI	Mille Isle
M—D	Manotick-Dalhousie
K—U	Kars-Uplands
H	Huntley
D—NG	Dalhousie-North Gower
F	Farmington

Vertical Exaggeration = 33:1

Note: At depths of less than 5 m this diagram is a schematic representation of the surficial deposits showing only their approximate relationships.

Figure 10.
Landscape cross-section showing soils and geology from the Rideau River to east of Herbert Corners in Osgoode Township.



GEOLOGICAL MATERIALS

S	Sand
Si,L	Silt, loam
CL	Clay loam
C	Clay
T	Till

SOIL ASSOCIATIONS OR LAND TYPES

M	Manotick
F	Farmington
NG—D	North Gower-Dalhousie
D	Dalhousie
C	Castor
ER	Eroded Channel
D—NG	Dalhousie-North Gower
RK—A	Rockland-Anstruther

Vertical Exaggeration = 17:1

Note: At depths of less than 5 m this diagram is a schematic representation of the surficial deposits showing only their approximate relationships.

Figure 11.
Landscape cross-section showing soils and geology across the Carp Valley and adjacent bedrock uplands near Marathon in West Carleton Township.

SURVEY METHODS

Introduction

A soil survey involves the systematic examination, description, classification, and mapping of soils in an area (15), as well as interpretation of the information for various purposes relating to use. The resulting soil map identifies the soils which occur, and delineates land areas in which the soils have similar properties and surface expression within defined limits. The survey report provides general as well as specific information about the soils and their respective characteristics, and various types of interpreted information such as soil erosion potential or agricultural capability. The text of this volume of the report includes general information about the soils and three types of interpreted information.

This section of the report describes the basic procedure and concepts employed in the survey. It also provides explanations which will be helpful in understanding and using the soil maps as well as the information provided elsewhere in the report.

Soil Mapping Procedures

The survey conducted for the area was greatly influenced by the survey for the Ottawa Urban Fringe area (1). A legend was developed for that survey which classified the soils into soil associations primarily on their characteristics and surface expression. In order to correlate as closely as possible with the Ottawa Urban Fringe survey, it was decided that the established legend for that survey should be adhered to as much as possible. During the course of mapping, some aspects of the established legend were revised to represent the soils which occurred in the survey area. These revisions included the development of new soil associations, broadening the definitions of several established soil associations, and the development of additional soil landscape units where necessary in some of the established associations. Information from existing resource publications such as geological reports, the old soil map, and soil surveys of surrounding counties, aided in developing the revised legend (14, 16, 17, 18, 19, 20).

Tentative map units and boundaries were drawn on the most recent aerial photographs with the aid of a stereoscope. Color photographs at a scale of 1:25,000 were mainly used for this pretyping of the survey area. The tentative map units and boundaries were then checked in the field, and classified according to the existing legend.

Field checking was mainly carried out along all public roads which generally provided easy access to most parts of the survey area. Periodic examinations were made, especially where stereoscopic investigations had suggested major soil or landscape differences. Most examination sites were confined to fields, woodlots, and undisturbed road allowances. Excavation sites such as drainage ditches and gravel pits, however, were also examined because they provided valuable information on the geologic deposition of the soil materials. The majority of sites were close to roads, but occasionally traverses were made some distance into concessions to verify soil boundaries.

The soil profiles at examination sites were usually checked to a depth of 1 m. The identified soil and its location was then marked on the aerial photograph. Periodically, site information at field checks was recorded and later computerized for future reference. Profile characteristics were recorded as well as many additional site factors such as topography, depth to water table, and surface stoniness where applicable. Soil samples were also taken periodically for laboratory analyses to verify or supplement the field observations.

The next procedure was to compile the field and laboratory information in the office on to a 1:50,000 scale base map so that a preliminary map at that scale could then be published. This involved transferring the information on the generally larger scale photographs on to a 1:50,000 scale mylar base map. The mylar base map was underlain by an NTS topographic map to transfer the information accurately. During the course of the survey, a number of preliminary soil maps were published for areas as the field mapping was completed.

Upon completion of the field mapping, a detailed soil description and sampling program was undertaken to further characterize the soils in the survey area. The most commonly occurring soils were generally described and sampled at least twice, while soils which were less common but still of important areal extent were described and sampled at least once. Soils of very limited areal extent generally were not characterized to this extent. In the program, the properties and characteristics of typical soils were described and recorded in detail, and samples were taken for a broad range of chemical and physical analyses. Descriptions and analyses for these typical soils are provided in Volume 2. Each site assessment was taken from a 1 m square by 1 m deep pit, and all site information was entered into the Canada Soil Information System (CanSIS), a computerized data management system for soil surveys.

The two last procedures in mapping consisted of the preparation of preliminary soil maps, and then the final soil maps. Final legend revisions necessitated some revisions of the preliminary map information, and these were then incorporated in the compilation of the final maps. These were then prepared for final map publication by the Cartography Section of the Land Resource Research Centre, Agriculture Canada, Ottawa. Prior to publication, that unit also digitized the final soils information and stored the information in a computer data file. This data file makes possible computer generated derived and interpretive maps.

Survey Intensity and Map Reliability

In surveys now carried out across Canada, the map scale and the amount of precision or the intensity level with which the soils should be described and mapped are both determined before the survey begins. Each is dependent upon the purpose and objectives of the survey. A "Survey Intensity Level" is therefore assigned to the survey which is an indication of the precision with which the survey was made. Five intensity levels have been established. Survey Intensity Level 1 is the highest intensity, requiring the most detailed procedures and resulting in the greatest level of precision. Detailed, large scale surveys such as those at 1:10,000, would have this intensity level. Survey intensity level 5 has the lowest intensity, the least detailed procedures, and the lowest level of precision. An example would be small scale surveys such as those at 1:250,000, which present generalized soil information (21).

The Survey Intensity Level of the Ottawa-Carleton soil survey is at an intermediate level, or level 3. The soil maps are published at a scale of 1:50,000, which is an appropriate scale at this intensity level. At this scale, the minimum size of delineation which can be shown on the maps is .5 cm^2, which is approximately 12.5 ha on the ground (21). Since the average area covered by delineations on the maps is about 90 ha, additional soils may be present in some map delineations which cannot be shown due to this scale limitation.

In this survey, boundaries were periodically checked in the field, but mainly they were interpreted from aerial photographs. At least one site inspection consisting of soil material and surface feature assessments was made in most map delineations. Soil materials were examined in vertical sections by using a probe, auger, or shovel. Average depth of examination was to about 1 m. At each site, on-site slope as well as surrounding slopes, surface stoniness, and surface rockiness were determined.

The soil maps included in this survey thus provide information at a level of detail which is most suited for making general land assessments and decisions related to use on an overall map delineation basis. They are not suitable for making land assessments or land use decisions for site specific or small land areas within map delineations, such as potential building sites or fields within individual farms. In such cases, an on-site examination of soil characteristics is recommended.

The Mapping System

The mapping system employed in the survey is similar to the system employed in the survey of the Ottawa Urban Fringe area (1). In each survey, a categorical system is used to define land areas at different levels of detail. Such a system allows naturally occurring landscape patterns to be identified and mapped at the scale of the survey. Categories employed in this survey to define land areas are shown in Figure 12.

The broadest category in the system differentiates a mapped land area into one of three basic types. If the land area consists of recognizable soils, those soils are defined in a particular **soil association**. The soil association is a mapping convenience which groups soils on the basis of similarities in physiographic factors and soil parent materials (1). Thirty soil associations have been defined for different types of soils occurring in the survey area. If the land area consists mainly of unique land features such as materials that cannot be classified as soils, those areas are defined in a particular **land type**. Four land types were defined, with an example being Rockland (RK) in which extensive rock outcropping occurs. Finally, if undisturbed soils or recognizable land features do not occur, those land areas were defined as **miscellaneous land**. An example would be land areas which have been altered by man, such as urban land (U).

Soil associations and land types have been subdivided into a number of landscape descriptors, each of which defines an individual land area. These descriptors are called **soil landscape units** and **land type units**, and compose the next category in the mapping system. Each defines a basic landscape pattern in terms of the range of topographic conditions and the types of soils or land features which are present. Soil landscape units, and to a lesser extent land type units, are the most important land descriptors in the mapping system.

An area on the soil maps enclosed by a boundary line and defined by one or more symbols is called a **map delineation**. A map delineation encloses a particular type of land area, or it may enclose a combination of two separate and distinct types of land areas. Combinations of land areas often had to be included in one delineation due to the map scale. Most often, these combinations involve two soil landscape units.

Each type of land area represented within a map delineation is defined by a **map unit**. A map unit represents discrete soil/land elements and is represented by the following: (1) a soil landscape, land type, or miscellaneous land unit symbol which defines the type of land area; and (2) additional descriptor symbols which define such elements as surface slope, surface stoniness, or rockiness. A map unit including a soil landscape unit as its primary component always has additional descriptors, whereas map units composed of land type or miscellaneous land units usually do not have additional descriptors.

Since a map delineation may represent one or two types of land areas, then one or a combination of two map units are shown to define the land area or areas. The entire amalgamation of symbols shown within the map delineation, which may portray either a single map unit or a combination of two map units, is called the **map unit symbol**. If one map unit composes the symbol, that symbol is a **simple** map unit symbol. If two map units compose the symbol, then that symbol is a **compound** map unit symbol. Some examples of map unit symbols are given in Figure 13. Further explanations of these are given in the section "Definitions of Terms Associated with the Soil Maps and Legend", and definitions of specific symbols are given in Appendix 1. Definitions and explanations are also given on the maps as well.

Soil series were recognized and correlated in accordance with the Canadian System of Soil Classification (22). In the survey, however, large areas of land had to be delineated in which related but significantly different series often occur. Under this circumstance, series information served as an aid in mapping, but was not used as a basis to delineate land areas. Soil association descriptions, therefore, reflect a range in soil characteristics which may comprise a number of different soil series. In all site assessments made during mapping, emphasis was first placed on the nature of the soil materials and then their geologic origin. Thus, the Jockvale association for example, comprises soils developed on both marine and fluvial origin parent materials.

Conventions Used in Mapping

Standard soil classification guidelines outlined in "The Canadian System of Soil Classification" (22) and "The Canadian Soil Information System" (24), were applied in this survey. These publications defined the limits employed for slope, surface stoniness and rockiness classes as well as texture and drainage classes. Component classes used to differentiate soil map units are fully defined in Appendix 1.

In addition to the standard classification guidelines employed, a number of conventions were followed in this survey. These are primarily related to the portrayal of landscape information at the map scale, and the survey objective of correlating as closely as possible with the survey of the Ottawa Urban Fringe area. Aspects of the survey and a brief explanation of the conventions pertaining to them are as follows:

Soil variants A soil variant in this survey is a soil which has characteristics similar to soils included in a particular soil association, but is different in at least one major characteristic. Four types of soil variants were recognized and identified on the soil maps by separate soil landscape units defined for some soil associations. These are:

(1) Soils having significant layers of finer or coarser-textured materials within the profile. An example is the NG5 soil landscape unit of the North Gower association, in which layers of coarser-textured silt, silt loam, or fine sandy loam occur within the profile.

(2) Soils in which underlying materials which occur within 1 m of the surface are significantly different from those materials which normally compose the association. An example would be the I4 landscape unit of the Ironside association, in which Leitrim till rather than Grenville till materials underlie fine sand and loamy fine sand materials.

(3) Soils in which the materials composing the profile have the same origin as those of other soils in the association, but the material composition is significantly different. An example here would be the K3 unit in the Kars association, in which the glaciofluvial material is predominantly coarse sand with fewer coarse fragments than usual.

(4) Soils in which the composite materials are of a somewhat different but nevertheless related geologic type compared to those defined for the association. An example is the L5 unit in the Leitrim association in which the shaly soil materials have originated from soft red shale bedrock rather than soft black shale bedrock.

In all instances where soil variants were mapped, their occurrence was too limited in extent to warrant separation into new associations.

Compound Map Unit Symbols Due to the map scale, combinations of landscapes or land areas often had to be included in one map delineation. These combinations are portrayed on the soil maps by a Compound Map Unit Symbol, and may include two soil landscape units, or a soil landscape unit and a land type unit as the primary components. An example for each of these is given in Figure 13. In each combination, the first landscape or land type unit shown in the symbol is the "dominant" component and occupies the largest proportion of land area, while the second is the "significant" component and occupies a smaller proportion.

When two soil landscape units are shown in a compound map unit symbol, the second or significant landscape unit was restricted to having one drainage member only. Since the proportion of land area occupied by these landscape units is quite small, only the most commonly occurring drainage member occupies enough area of the delineation to justify representation in the map unit.

Stoniness or Rockiness class In some landscapes surface stoniness, or rock outcrops, or a combination of both occur. The degree of occurrence of these features may vary considerably, and significantly influence the agricultural capability of the soils they are associated with. For these reasons, either a stoniness class symbol or rockiness class symbol when applicable is shown in conjunction with the soil landscape unit in the map unit symbol. If both occur in the same landscape, only the most limiting from an agricultural perspective is shown. Definitions of stoniness and rockiness classes applied are given in Appendix 1.

Rockland Land areas were mapped as rockland if 25% or more of the area consisted of either bedrock exposures or areas having 10 cm or less of mineral soil material over bedrock. Bedrock features of this type and proportion essentially rule out their use for agriculture.

Soil Taxonomic components Soils described and sampled for the survey were classified to the subgroup level of the taxonomic classification system (22). This level of classification was deemed appropriate for the scale of mapping, and was therefore emphasized in this report. Soil series (the most detailed level of classification), were determined for only the most commonly occurring soils within each soil association. Named soil series were provided mainly for correlation purposes.

Soil Phases Soil phases have been used when additional soil features are present in the landscape which are not accounted for in the soil association description. They are shown in the map unit symbol as separate components attached to the soil landscape unit. The four soil phases applied were shallow, peaty, coarse, and fine, which are fully defined in Appendix 1.

Definitions of Terms Associated with the Soil Maps and Legend

A number of terms are used in the survey to distinguish and describe land areas and their respective landscape components. Definitions of those terms associated with or occurring on the soil maps and their respective legends are listed below. Some of these definitions are taken from the *Glossary of Terms in Soil Science*, published by Agriculture Canada (15).

Soil Map Legend Each map has an identical legend which provides basic descriptions for soil associations, land types, or miscellaneous land. It also provides a description of soil landscape and land type units and the criteria used to differentiate them. The legend, therefore, is an integral part of each map.

Soil Association A natural grouping of soils based on similarities in climatic or physiographic factors and soil parent materials.

In this survey, soil associations are primarily groups of soils which have developed on and are therefore composed of similar materials. The origin of those materials and their surface expression have played a secondary role in the development of soil associations for the survey.

Most soil association names originate from a dominant soil series (taxonomic component) included in them. Thus, the Grenville series is the dominantly occurring soil in the Grenville association. All soil associations basically represent certain kinds of soil materials, and in most cases consist of more than one soil series.

Soil associations are subdivided into soil landscape units which are more specific landscape descriptors based on certain drainage components with known landscape positions.

Land Type A land area having unique soil, bedrock, or topographic features. They may have large proportions of bedrock outcrops, or they may consist of soil materials which are highly variable and have been recently deposited. They may also consist of land areas with extreme use limitations due to steep slopes. Recent alluvium (AR), Eroded channels (ER), Rockland (RK), and Escarpments (X) are land types identified in the map legend.

Miscellaneous Land A land area in which the naturally occurring soil or land features are not recognizable and could not be mapped. The soils have usually been disturbed or completely altered by urban related land use activities. The present land condition or land use is shown on the soil maps as a miscellaneous land unit.

Soil Material Description When soils that compose associations have developed on materials which are generally uniform, the mineral or organic material comprising the parent material is described. Parent material in this instance consists of the unweathered or partially weathered materials from which the soil has developed. These materials generally occur at some depth from the surface. In layered soils in which one material overlies a dissimilar material, both the overlying material and the underlying material are described. In most soils of this type, the overlying material has been completely weathered.

Materials are described according to their depositional origin, texture, type of coarse fragments, reaction and thickness.

Land Type Description Includes the soil or land criteria used to delineate land areas as Land Types.

Main Surface Textures The surface textures of soils composing associations vary within defined limits which do not affect

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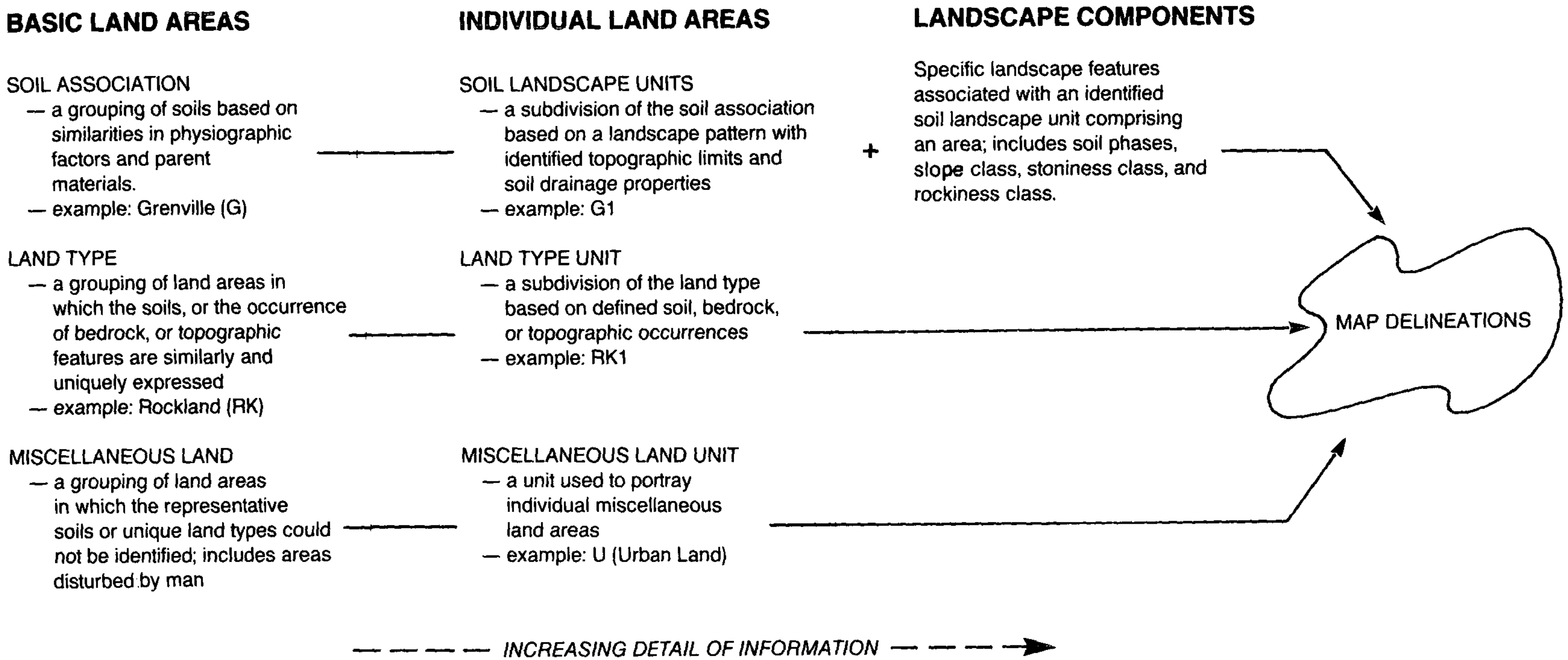
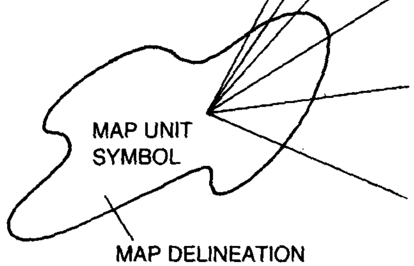


Figure 12.
Categories employed in the survey to define land areas.



EXAMPLES OF MAP UNIT SYMBOLS	KEY COMPONENTS	COMPONENT DESCRIPTION	TYPE OF MAP UNIT SYMBOL
AR1	AR1	A Land Type Unit (Recent Alluvium)	*SIMPLE*
DL	DL	A Miscellaneous Land Unit (Disturbed Land)	
NG2 / 2	NG2	A Soil Landscape Unit (North Gower Soil Association)	
G4·S / S3.2	G4·S	A Soil Landscape Unit (G4; Grenville Soil Association) with a soil phase (S; shallow)	
Q3—J3 / S2.2—4	Q3 and J3	Two Soil Landscape Units (Q3; Queensway Soil Association) (J3; Jockvale Soil Association)	*COMPOUND*
A1—RK3 / R2.3—5	A1 and RK3	A Soil Landscape Unit (A1; Anstruther Soil Association), and a Land Type Unit (RK3; Rockland Land Type)	

Figure 13.
Examples of map unit sumbols and their key components.

their agricultural use. The dominantly occurring textures of those encountered are shown in the legend.

Soil Landscape Unit A subdivision of the soil association representing a landscape area having specific proportions of identified drainage components and surface slopes which occur within a defined range and in a set pattern. On the map, this unit composes part of the map unit symbol shown for a delineated area.

Land Type Unit A subdivision of the land type representing a land area having specific soil or land conditions which serve to distinguish the area from others which may be included in the land type. For example, the Rockland land type has primarily been subdivided into land type units on the basis of different types of bedrock which occur.

Soil Drainage The rapidity with which water is removed from the soil in relation to supply. Supply or additions of water occur in the form of precipitation, groundwater flow, or surface runoff water from surrounding soils. Removal of water relates to a number of factors including texture, structure, landscape position, and length and gradient of slope.

Soil drainage was determined using the drainage classification guidelines outlined in the Canadian System of Soil Classification (22). In this survey, drainage classes defined in that system were grouped resulting in five soil drainage descriptions. These descriptions are as follows: (1) Excessive — very rapidly or rapidly drained; (2) Good — well-drained or moderately well-drained; (3) Imperfect — imperfectly drained; (4) Poor — poorly drained; and (5) Very Poor — very poorly drained. Definitions of the seven soil drainage classes which make up these groupings are given in Appendix 1.

Dominant and Significant These are terms which refer to either the relative proportions of land areas which compose a map delineation represented by a compound map unit symbol, or the relative proportions of soil drainage components composing a soil landscape unit used to define a particular land area. **Dominant** means that more than 40% of the map delineation consists of that type of land area, or, more than 40% of the soil landscape unit and therefore land area is composed of that drainage state. **Significant** means that more than 20% but less than 40% consists of the land area or drainage state indicated. Land areas or drainage conditions occupying 20% or less of the map delineation or area defined by a soil landscape unit are regarded as inclusions and are not identified.

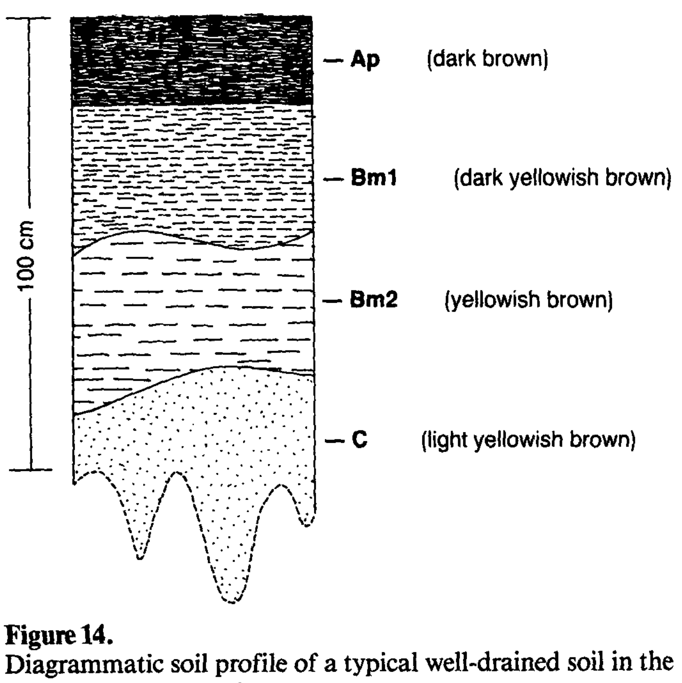


Figure 14.
Diagrammatic soil profile of a typical well-drained soil in the Ottawa-Carleton Region.

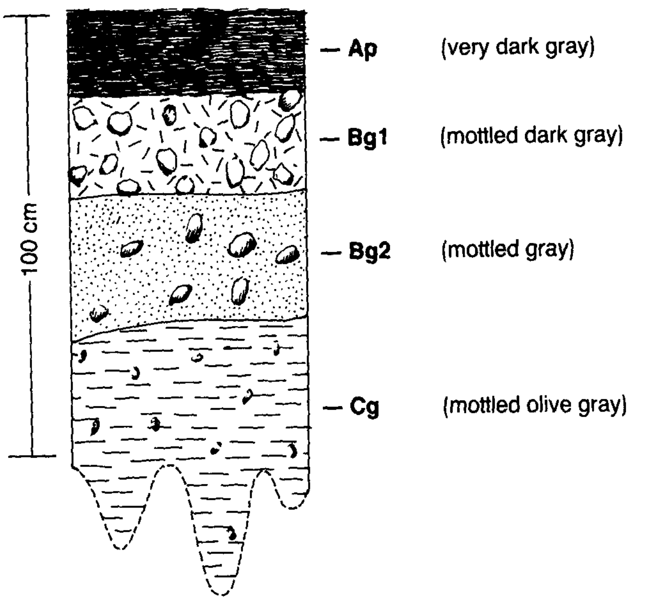


Figure 15.
Diagrammatic soil profile of a typical poorly drained soil in the Ottawa-Carleton Region.

In the soil map legend, many soil landscape units have only one drainage state which is shown as being dominant. In such cases, 80% or more of the unit is composed of that drainage state. Other drainage conditions may be present, but they do not occur in significant proportions.

Map Delineation An area delineated on the map or enclosed by a boundary line, and identified by a map unit symbol composed of one or two map units.

Map Unit A mapped land area defined by one or more symbols representing various landscape components, and composing all or part of the map unit symbol shown within a map delineation. In the survey, many different map units are portrayed in either simple or compound map unit symbols on the soil maps.

Simple Map Unit Symbols Map symbols which contain a single soil landscape, land type, or miscellaneous land unit as defined in the map legend. Examples of some simple map unit symbols and an explanation of their components are as follows:

1. G1.S / S1.3 — simple map unit symbol representing a single soil landscape
   - G1 — soil landscape unit of the Grenville association; the soils have good drainage and meet the material and landform criteria defined for the Grenville association
   - S — soil phase; a shallow phase indicating the soils are only 50 to 100 cm thick over bedrock, which is shallower than normal for Grenville soils. When soil phases are not shown, those soil conditions are not present.
   - S1 — stoniness class; stones which have a diameter greater than 15 cm occupy 0.01 to 0.1% of the surface (class 1). In some symbols, a rockiness class may be shown rather than a stoniness class (for example R2 instead of S1). Rockiness classes identify the amount of surface which is either exposed bedrock or

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has bedrock with 10 cm. When stoniness or rockiness classes are not shown, those surface conditions are not present.

3 — slope class; simple (regular), very gently sloping, 2 to 5% slopes (class 3). Multiple (irregular) slopes having the same limits would have an asterisk (*) after the class number, for example 3*.

2. RK1 — simple map unit symbol representing a single land type area; a land type unit of the Rockland land type in which 25% or more of the area is composed of limestone or dolomite exposures.

3. U — simple map unit symbol representing a single miscellaneous land area; the area has been significantly altered and consists of built-up urban land.

Compound Map Unit Symbols A mapping convention representing a combination of different land areas within one map delineation. Included may be either two soil landscapes, or a soil landscape and a land type area. Dominant and significant land areas composing the map delineation are identified by position of the soil landscape or land type units in the symbol, the first shown representing the dominant area and the second shown the significant area. Examples of compound map unit symbols and an explanation of their components are as follows:

1.	F5-NG4.0 / R2.2*-2	compound map unit symbol representing two soil landscapes
	F5 / R2.2*	dominant soil landscape and components
	NG4.0 / 2	significant soil landscape and components; surface stoniness or rockiness is not present
2.	J8-RK2 / 3*-5*	compound map unit symbol representing a soil landscape and a land type area
	J8 / 3*	dominant components (soil landscape); soil phases, surface stoniness, or surface rockiness are not present
	RK2 / 5*	significant components (land type area)
3.	D3-NG2 / 2	compound map unit symbol representing two soil landscapes
	D3 / 2	dominant soil landscape
	NG2 / 2	significant soil landscape

Note Single components shown in the denominator apply to both soil landscape units shown in the numerator.

GENERAL DESCRIPTION OF SOIL ASSOCIATIONS, LAND TYPES, AND MISCELLANEOUS LAND UNITS

Introduction

The soil legend and the soil association definitions follow those developed for the soil survey of the Ottawa Urban Fringe (1). However, a number of new soil associations were identified. These include the Boromee, Goulbourn, Greely, Lemieux, Malakoff, Ottawa, Reevecraig, and St. Thomas. Also, the Leitrim association definition was broadened to include the Ellwood association and the Piperville association was renamed Osgoode. A number of other associations were modified to better represent soil variability encountered in this survey. Correlation of the soils of the two surveys is discussed in each association description.

Saturated hydraulic conductivity data compiled by McKeague and Topp (35) served as a useful guide in the assessment of the soil moisture characteristics of some of the soil associations.

Soil taxonomy and pedological class definitions and limits used to describe the soil associations are in accordance with the Canadian System of Soil Classification (22) and the Canada Soil Information System (24).

A summary key to the soil associations is provided in Figure 16.

Soil Association Descriptions

ANSTRUTHER (A)

Location and Extent Soils of the Anstruther association occur mainly in West Carleton Township and the City of Kanata, with the majority occurring on, or in close proximity to the ridge of Precambrian bedrock which outcrops north of the village of Carp. Approximately 4,200 ha of Anstruther soils were mapped, of which 4,000 ha or 95% were mapped in combination with either soils of other associations or miscellaneous land units.

Landform and Topography Anstruther soils consist of a 10 to 50 cm thick veneer of undifferentiated drift material which overlies Precambrian igneous and metamorphic bedrock. Often the thin soil veneer is absent in places and the bedrock is exposed at the surface. Topography is controlled by the hummocky nature of the underlying bedrock. Slopes generally range from 3 to 9%, but within map units some areas may have steeper slopes which may range as high as 15%.

Soil Material Anstruther soil materials are moderately coarse to coarse textured and contain a considerable amount of granitic material of Precambrian bedrock origin. Material originating from Paleozoic limestone and dolomite bedrock is also present at times but to a much lesser extent. Depth of material is usually less than 50 cm.

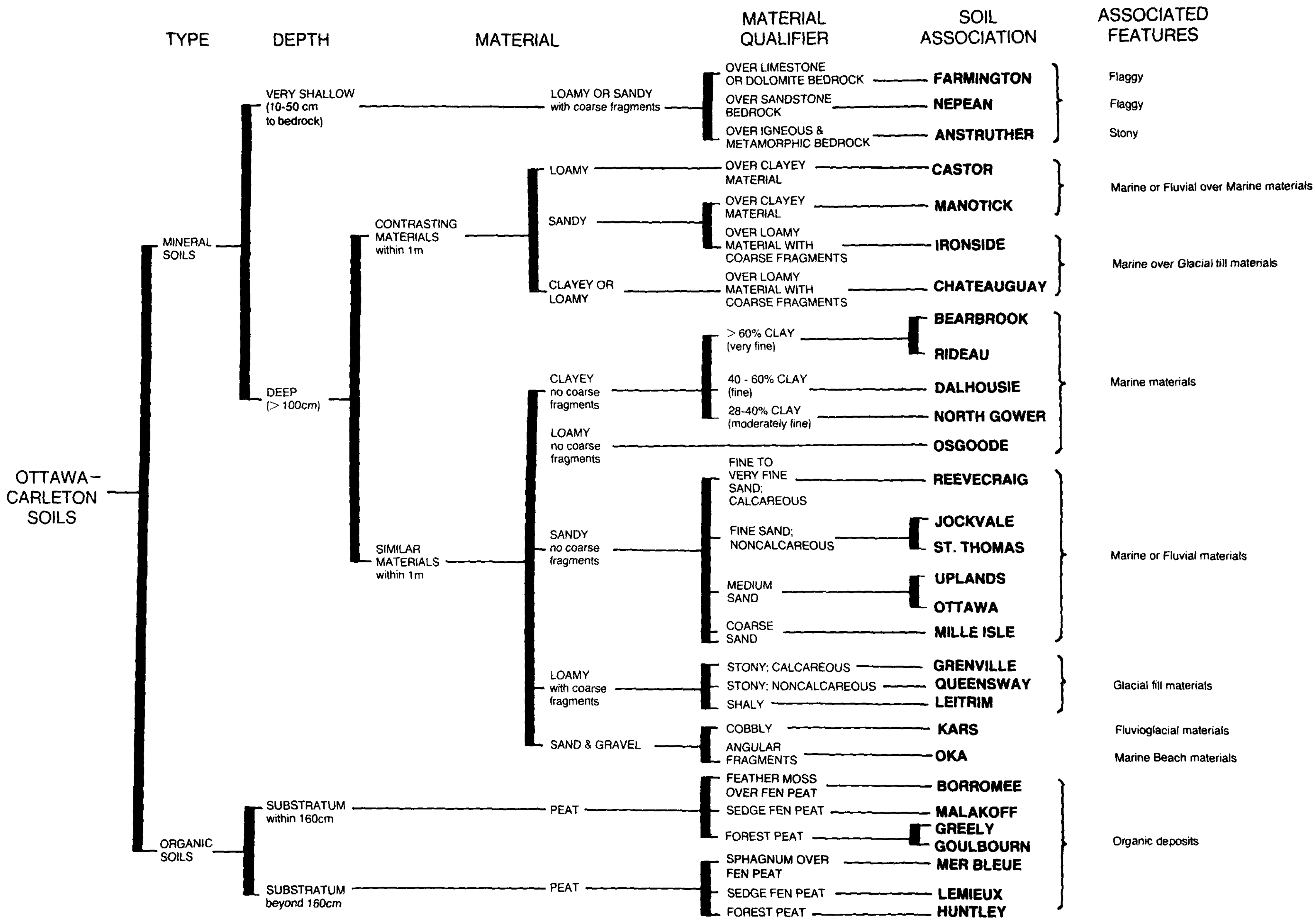

Figure 16.
Soil Association Key.

Soils that compose the association are most often stony, with rounded fragments of granite and gneiss present throughout the soil material. Some cobble size fragments of similar material also are present. Occasionally, rounded fragments of sedimentary bedrock origin may be present in some soil profiles. Total coarse fragment content is variable in Anstruther soils with some soils having few coarse fragments, while others may have amounts ranging as high as 50% by volume. The matrix of the parent material is noncalcareous and dark reddish brown to brown in color. Soil reaction is moderately to very strongly acid, and texture ranges from sand to sandy loam. A slightly higher silt and clay content is present in the surface material, with texture most often being sandy loam or loamy sand.

Surface stoniness is present but generally not as pronounced as other shallow to bedrock soils such as those of the Farmington association. Surface stoniness ranges from slightly to very stony.

Soil Moisture Characteristics Anstruther soils are dominantly rapidly drained to well-drained. In addition, they are rapidly permeable and have a low moisture holding capacity due to four soil factors: (1) coarse-texture; (2) loose single grain or granular structure of the material; (3) shallowness to bedrock; and (4) sloping nature of the underlying bedrock. Surface water runoff rates are generally moderate.

Soil Landscape Units One unit was identified in the Anstruther association. It is described as follows:

		Recognized Subgroups	Recognized Series
A1:	Dominantly rapidly to well-drained soils found on very gently to moderately sloping topography. Slopes range from 4-15%.	Orthic Dystric Brunisols Orthic Sombric Brunisols	Anstruther Kanata

Taxonomic Components The well-drained **Anstruther** series (Orthic Dystric Brunisol subgroup) has a surface A horizon which is less than 10 cm thick, very dark brown in color, and has textures which range from sandy loam to loamy sand. The underlying Bm horizon is dark yellowish brown to dark brown in color and has textures ranging from loamy sand to sand. Most often it has weak subangular blocky structure or is structureless. No unweathered parent material remains in the profile, and Precambrian bedrock occurs at a depth of 20 to 50 cm.

The well-drained **Kanata** series (Orthic Sombric Brunisol subgroup) has most profile characteristics described for the Anstruther series. It differs, however, by having an Ah horizon greater than 10 cm thick.

Mapped Soil Combinations Anstruther soils were most often the significant rather than the dominant member when mapped in combination with either soils of other associations or miscellaneous land units. Approximately 3,500 ha of all Anstruther soils were mapped in this way, with more than 80% of that total occurring in combinations in which a Rockland land unit (RK2 and RK3 landscape units) was the dominant member. Approximately 500 ha of Anstruther soils were mapped in combinations in which they were the dominant member. Of these combinations, the Anstruther-Dalhousie combination is the most extensive.

General Land Use Anstruther soils have little or no agricultural capability and most remain forested.

Correlation to Ottawa Urban Fringe In the soil survey of the Ottawa Urban Fringe, the Anstruther association was defined as having a 10 to 25 cm thick veneer of undifferentiated glacial drift over Precambrian igneous and metamorphic bedrock. In this survey the definition was broadened to include similar materials to a depth of 50 cm.

BEARBROOK (B)

Location and Extent Soils of the Bearbrook association occur mainly in Cumberland Township, with a minor occurrence in West Carleton Township near Constance Bay. Approximately 7,500 ha of Bearbrook soils were mapped, of which approximately 3,500 ha were mapped in combination with soils of other associations.

Landform and Topography Bearbrook soils occur mainly on level to very gently sloping areas of clayey marine material which is greater than 2 m deep. Slopes are usually less than 2%, although steeper slopes may occur in eroded areas between or adjacent to stream channels.

Soil Material Bearbrook soils are predominantly composed of reddish brown to brown heavy clay parent material. Clay content in sampled profiles ranged from 65 to 89%. Frequently, interbedded layers of light gray to olive gray heavy clay may be present which vary in thickness from 3 to 25 cm. Occasionally, interbedded layers consisting of fine to medium sand may occur in place of the heavier textured gray layers. These layers generally range in thickness from 10-20 cm. Soil reaction in the upper weathered layers varies from strongly acid to neutral, while reaction in the parent material is generally neutral. The surface Ap horizons range in thickness from 15 to 25 cm, and are mainly silty clay or clay.

Bearbrook soils are quite variable with respect to the number and thickness of interbedded layers which may be present. In all Bearbrook soils, however, reddish brown to brown heavy clay material is dominant in the profile. Soils in which gray heavy clay is dominant in the profile with minor layers of reddish brown to brown heavy clay also present were included in the Rideau association.

Soil Moisture Characteristics Bearbrook soils are most often poorly drained. A few areas of imperfectly drained and very poorly drained soils also occur. Soils of this association are usually slowly permeable, but permeability can vary widely depending on the amount of macropores present. Groundwater occupies the surface and upper subsoil horizons for long periods most years. Bearbrook soils have medium to high water holding capacities, but can be droughty during dry periods due to high moisture retention characteristics which results in insufficient moisture release for plant use. Surface runoff can be slow to rapid, depending on the topography and incidence of surface cracks.

Soil Landscape Units Four units were identified in the Bearbrook association. They are described as follows:

		Recognized Subgroups	Recognized Series
B1:	Dominantly imperfectly drained soils found on nearly level to gently sloping eroded stream divides and channel bluffs. Slopes generally range from 1 to 9%.	Gleyed Melanic Brunisols	Wendover
B2:	Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	Bearbrook

B3:	Dominantly very poorly drained soils found on level to depressional topography. Slopes are less than 2%.	Rego Gleysols
B4:	Dominantly poorly drained soils having 10 to 20 cm thick layers of interbedded fine to medium sand within 1 m of the surface. Topography is level to nearly level, and slopes range from 0 to 2%.	Orthic Humic Gleysols

Taxonomic Components The **Wendover** series (Gleyed Melanic Brunisol subgroup) is a moderately well to imperfectly drained soil. This soil has dark grayish brown to dark brown, granular surface horizons 10 to 20 cm thick. The underlying subsoil grades from grayish brown or dark yellowish brown in the upper B horizon to reddish brown or brown in the C horizon which occurs at an average depth of 72 cm. The C horizon frequently also has light gray to olive gray interbedded layers of silty clay or heavy clay. Structure in the weathered portion of the subsoil is medium to coarse subangular blocky. In the C horizon or unweathered parent material occurring at depth, soil structure is not usually evident and the material is massive. The restricted drainage conditions are indicated by faint yellowish brown or brownish red mottles in the lower B horizons. In the A and upper B horizons textures consist of silty clay and clay. In the lower B and C horizons texture is mainly heavy clay.

The **Bearbrook** series (Orthic Humic Gleysol subgroup) is a poorly drained soil which is slowly pervious and subject to water saturation for a much longer part of the growing season than the Wendover series. Texture and structure is similar to the Wendover series. The surface Ap horizon, however, tends to be thicker and it has a higher organic matter content. Color of the Ap varies from very dark grayish brown to black. The Bg and transitional BC horizons of the subsoil have prominent mottles which are most commonly yellowish brown, reddish brown, or strong brown.

The very poorly drained **Rego Gleysols** are found in low lying or depressional sites in which the water table is continuously at or near the surface. These soils usually have a well decomposed humic peat layer at the surface which is less than 40 cm thick. Due to its highly saturated condition and very slow internal drainage, reduction has occurred in the subsoil resulting in matrix colors which are more grayish. Reduction processes are even more evident in the interbedded layers in which colors range from greenish gray to bluish gray.

Mapped Soil Combinations Bearbrook soils were most often mapped in combination with soils of the Rideau association. Approximately 2,000 ha were mapped in Bearbrook-Rideau combinations, and 800 ha were mapped in Rideau-Bearbrook combinations. These combinations mostly occur in Cumberland Township on the marine clay plains north of the ancestral river channel of the Ottawa River.

General Land Use Bearbrook soils have moderately severe limitations which affect their use for agriculture. Due to generally slow internal drainage and high moisture holding capacity, these soils do not dry quickly in the spring and cultivation and planting are usually delayed.

Present agricultural land use consists mainly of hay, cereal grain and corn grown in rotation. Legumes often are used for hay production and serve to improve structure and thereby facilitate better drainage.

Correlation to Ottawa Urban Fringe Bearbrook soils in the survey area are similar to those mapped in the Ottawa Urban Fringe.

BORROMEE (BE)

Location and Extent Borromee association soils occur only in Cumberland Township and occupy a very small portion of the Mer Bleue Bog. Approximately 50 ha of Borromee soils were mapped.

Landform and Topography The Borromee association is composed of organic soils which are found in shallow areas within flat bogs, or in horizontal fens adjacent to flat bogs. The topography is level or nearly level, with slopes being 1% or less.

Soil Material Soils included in the association consist of 40 to 160 cm of organic material which is underlain by clayey mineral material. The organic material primarily consists of fen peat, with a thin surface layer of feather or sphagnum moss and fen peat less than 30 cm thick usually present.

When present, the thin surface layer of mixed peat materials is undecomposed or fibric and is dark reddish brown to dark brown in color. Occasionally, the entire organic section of the profile may consist of well decomposed sedge fen peat which is dark reddish brown to black in color. Soil reaction ranges from extremely acid in the upper organic material to strongly acid in the organic material at depth.

Well decomposed or humic sedge fen peat material which is black in color is the dominant material comprising the majority of soils included in the association. Moderately decomposed or mesic sedge fen peat occurs as subdominant layers which are dark reddish brown in color. Both types of organic material are mainly derived from sedge type plants.

The underlying mineral material or substratum is most often clayey, but may also be either sandy or loamy. In all cases, however, it is gray to olive gray in color.

Soil Moisture Characteristics Borromee soils are poorly to very poorly drained, with the water table at or near the surface for most of the year. Groundwater is generally acid and low in nutrients and is therefore not influenced by nutrient rich groundwater discharge from surrounding mineral soils.

Soil Landscape Units One unit was identified in the Borromee association. It is described as follows:

	Recognized Subgroups	**Recognized Series**
BE1: Dominantly poorly to very poorly drained soils found on level or nearly level topography. Slopes are 1% or less.	Terric Mesic Humisols Terric Humic Mesisols	Borromee

Taxonomic Components The **Borromee** series (Terric Mesic Humisol subgroup) represents the majority of soils included in the association. Well decomposed or humic sedge fen peat is the dominant organic material within the control section. The **Terric Humic Mesisol** subgroup occurs less often, with moderately decomposed or mesic sedge fen peat the dominant organic material within the control section.

Mapped Soil Combinations Borromee soils were not mapped in combination with soils of other associations.

General Land Use Borromee soils consist of wetland in which the surface vegetation is usually a mixture of feather or sphagnum moss and sedge. Occasionally black spruce or tamarack trees also occurs.

Correlation to Ottawa Urban Fringe Borromee soils were not mapped as such in the Urban Fringe area. Rather, they were included in the Mer Bleue association as terric components which were represented by the MB4 and MB5 soil landscape units.

CASTOR (C)

Location and Extent Castor association soils occur in each of the three map sheet areas. The most extensive areas are located on the marine plains in the central and eastern portion of Osgoode Township, and on the marine plains adjacent to the Carp River in West Carleton Township. Approximately 8900 ha of Castor association soils were mapped, of which 2,800 ha were mapped in combination with soils of other associations.

Landform and Topography Castor association soils have developed on a 40 to 100 cm thick veneer of medium-textured material which is underlain by moderately fine to fine textured materials. The origin of the veneer material may be fluvial, estuarine, lacustrine, or marine, while the origin of the underlying material may be either lacustrine or marine. Landscapes are most often level or nearly level with slopes less than 2%. Occasionally the topography is very gently sloping with slopes ranging from 2 to 5%.

Soil Materials Soils comprising the association consist of 40 to 100 cm of medium-textured material which is underlain by fine-textured material. Coarse fragments are not present in either material.

The average depth of the upper veneer is approximately 65 cm. Parent materials comprising the veneer are most often yellowish brown to olive gray or gray in color, and have very fine sandy loam, silt loam, or loam textures. Soil reaction ranges from neutral to slightly acid. Surface textures and textures of the weathered subsoil are similar to those of the parent material. Occasionally, layers of loamy very fine sand, fine sandy loam, and silt which have varying thicknesses may be present in the veneer material.

The underlying lacustrine or marine deposits are similar to parent materials comprising the North Gower, Dalhousie, Rideau, and Bearbrook soil associations. In areas where Castor soils were mapped along with soils of one of those associations, the type of underlying material can usually be inferred. Because the underlying material was not differentiated, it may have either clay loam, silty clay loam, silty clay, clay, or heavy clay textures. Colors range from olive gray or gray to reddish brown, with olive gray or gray colors being the most prevalent. Soil reaction ranges from neutral to mildly alkaline, the neutral condition being dominant.

Soil Moisture Characteristics Almost 90% of all Castor soils mapped were poorly drained. They occur on level or nearly level landscapes where surface runoff is slow to very slow, and where water tables may occur in the upper part of the profile for significant periods during the growing season. The small minority of Castor association soils that are imperfectly drained occur on the mid to upper slope positions of very gently sloping landscapes which permit moderate surface runoff. This factor contributes to water tables which are less persistent in the upper part of the profile in comparison to those occurring in the poorly drained soils of the association.

Permeability of the medium-textured veneer is most often moderate, but occasionally may be low. The underlying finer-textured material tends to have much lower permeability if soil structure is massive or platy.

Soil Landscape Units Four units were identified in the Castor association. They are described as follows:

		Recognized Subgroups	Recognized Series
C2:	Dominantly imperfectly drained soils found on very gently sloping topography. Slopes range from 2-5%.	Gleyed Melanic Brunisols	Castor
C3:	Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on very gently sloping topography. Slopes range from 2-5%.	Gleyed Melanic Brunisols (imperfect)	Castor
		Orthic Humic Gleysols (poor)	Bainsville
C4:	Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on nearly level topography. Slopes are less than 2%.	Orthic Humic Gleysols (poor)	Bainsville
		Gleyed Melanic Brunisols (imperfect)	Castor
C5:	Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0-2%.	Orthic Humic Gleysols	Bainsville

Taxonomic Components The imperfectly drained **Castor** series (Gleyed Melanic Brunisol subgroup) has surface Ap or Ah horizons which are 15 to 25 cm thick. They have granular structure and are very dark grayish brown in color. The underlying Bm or Bmgj horizons are yellowish brown to light olive brown in color, and have weak granular to weak subangular blocky structure. Distinct to prominent mottles, which are usually yellowish to reddish brown in color, occur within 50 cm of the surface. The finer-textured parent material at depth is light brownish gray to olive gray in color, and has prominent mottles which are yellowish brown to dark brown in color. Structure ranges from subangular blocky to massive. Contact of the underlying material usually occurs at depths greater than 50 cm.

The poorly drained **Bainsville** series (Orthic Humic Gleysol subgroup) has very dark brown Ap or Ah horizons which have granular to subangular blocky structure. They range from 15 to 25 cm in thickness. The underlying Bg horizons have dark grayish brown to olive gray or gray matrix colors. Prominent mottles which vary in color are present in the Bg horizons as well as the remaining lower portion of the profile. Structure ranges from granular to subangular blocky. The finer-textured parent material at depth is commonly gray to brownish gray in color. Structure may be platy, subangular blocky, or massive.

Mapped Soil Combinations Approximately 30% of all soils included in the association were mapped in combination with soils of other associations. Approximately 2,200 ha were mapped in combinations in which they were the dominant component. In combinations in which they were the significant component, approximately 600 ha were mapped. The combinations of Castor-North Gower and Castor-Manotick were the most extensive, accounting for 1,200 ha and 700 ha respectively. The combination of Dalhousie-Castor was the next most extensive, accounting for 400 ha of all Castor soils.

General Land Use Castor soils have fair to good productivity potential for a wide range of common field crops. They are commonly used for corn, cereal grain, and hay production as well as for permanent pasture. A few limited areas of Castor soils remain as woodland.

Correlation to Ottawa Urban Fringe Castor soils mapped in the survey area are for the most part similar to those characterized for the Ottawa Urban Fringe. Textures and types of materials composing the veneer and underlying materials are similar. There are differences, however, in soil reaction and the depth of the veneer material. In this survey area, soil reaction is commonly neutral rather than medium to slightly acid in both the veneer and underlying material. In addition, the underlying clayey material is occasionally mildly alkaline rather than neutral in reaction. The minimum depth of the veneer material in this survey is 40 cm rather than 25 cm as in the Ottawa Urban Fringe survey. This change was made in order to conform to recent classification guidelines. Since the average depth of the veneer in both areas is substantially more than 40 cm, the difference in minimum depth is not significant.

Two soil landscape units, the C1 and C6, were identified and mapped in the Ottawa Urban Fringe survey but were not mapped in this survey due to very limited occurences.

CHATEAUGUAY (CH)

Location and Extent Soils of the Chateauguay association occur throughout the area, but are most commonly found in Rideau and Osgoode Townships due to the occurrence of interspersed glacial till knolls and marine clay plains. Approximately 2,300 ha of Chateauguay soils were mapped, of which 70% were mapped in combination with soils of other associations.

Landform and Topography Chateauguay association soils consist of a 40 to 100 cm thick veneer of medium to fine textured marine material which is underlain by stony or shaly glacial till. Both the upper marine veneer and underlying glacial till have usually been modified by marine wave action. The veneer may be present on the lower slopes of till ridges or knolls, or it may completely overlay till plains which have more subdued slopes. Slopes range from 0 to 5%, but most often are 2% or less.

Soil Material Chateauguay soil materials are quite variable. Most often the 40 to 100 cm thick marine veneer is nonstony, consisting of silty clay loam or clay loam material which is dark grayish brown to olive gray in color. Soil reaction is neutral. Frequently, however, the veneer may have finer or coarser textures which range from silt loam or loam to heavy clay. The coarser textured material was deposited in shallow marine water, most likely during the recession of the Champlain Sea. Finer textured materials are indicative of less extensive modification and deposition in deep marine water. The average depth of the veneer is 63 cm, and surface textures may be silt loam, loam, or clay loam.

Three types of glacial till materials may underlay the marine veneer in Chateauguay soils. They correspond to the parent materials of the Grenville, Queensway, and Leitrim soil associations. Representative Chateauguay soils are underlain by Grenville till material and are the most common soils included in the association. Soils in which the underlying material consists of either Queensway or Leitrim till occur less often, and were included in the association due to their limited extent.

The underlying Grenville till material is stony and grayish brown to olive gray in color. Coarse fragments primarily consisting of rounded or angular limestone or dolomite are common, and in total usually exceed 20% by volume. Texture of the matrix material is most often sandy loam or loam. However, the upper portion or all of the till occurring within 1 m of the surface has often been modified resulting in a higher proportion of silt and clay than normally found in Grenville till material. A lower proportion of coarse fragments by volume also occurs. Regardless of the extent of modification, the underlying till material is strongly calcareous and alkaline in reaction.

Most Chateauguay soils are nonstony at the surface.

Soil Moisture Characteristics The majority of Chateauguay soils are poorly drained and occur on nearly level to level topography or in depressional areas. Imperfectly drained soils occur on more inclined slopes usually found along the flanks of till ridges and knolls. Surface water runoff is moderate on inclined slopes, and slow on level or nearly level slopes. Chateauguay soils are slowly to moderately permeable, depending on the quantity and condition of macropores in the upper marine veneer. Due to the abundance of fine material in the upper veneer, they have a high moisture holding capacity.

Soil Landscape Units Five units were identified in the Chateauguay association. They are described as follows:

	Recognized Subgroups	Recognized Series
CH3: Dominantly poorly drained soils found on level to nearly level or depressional topography. Slopes range from 0 to 2%. The clayey veneer is underlain by Grenville till.	Orthic Humic Gleysols	MacDonald
CH4: Dominantly imperfectly drained soils found on nearly level to very gently sloping topography. Slopes range from 1 to 5%. The clayey veneer is underlain by Grenville till.	Gleyed Melanic Brunisols Gleyed Eluviated Melanic Brunisols	
CH5: Dominantly imperfectly drained soils found on nearly level to very gently sloping topography. Slopes range from 1 to 5%. The clayey veneer is underlain by Leitrim till.	Gleyed Melanic Brunisols	
CH6: Dominantly poorly drained soils found on level to nearly level or depressional topography. Slopes range from 0 to 2%. The clayey veneer is underlain by Leitrim till.	Orthic Humic Gleysols	

(Continued on Page 36)

CH7: Dominantly poorly drained soils found on level to nearly level or depressional topography. Slopes range from 0 to 2%. The clayey veneer is underlain by Queensway till.	Orthic Humic Gleysols

Taxonomic Components The **MacDonald** series (Orthic Humic Gleysol subgroup) is poorly drained and represents the majority of soils which were mapped. Surface horizons are commonly very dark grayish brown or black in color and have granular structure. Subsurface B horizons of the marine veneer are dark brown to dark grayish brown or olive in color, and C horizons or parent material are dark grayish brown to olive gray. In both horizons, structure is usually subangular blocky. Prominent yellowish brown to dark yellowish brown mottles occur in the veneer within 50 cm of the surface. The stony calcareous till material underlying the veneer is commonly grayish brown to olive gray in color with prominent yellowish brown mottles. Structure is most often subangular blocky, but occasionally may be massive or platy.

The imperfectly drained **Gleyed Melanic Brunisols** and **Gleyed Eluviated Melanic Brunisols** comprising the CH4 soil landscape unit were not named due to their limited extent. Soils which constitute these subgroups have a till underlayer which corresponds to the parent material of the Grenville association. Except for the presence of a slightly illuviated B horizon (Btj) in the latter subgroup, most profile characteristics of each subgroup are similar to the poorly drained MacDonald series. They differ by having slightly browner matrix colors and distinct rather than prominent yellowish brown mottles, characteristics which are indicative of less persistent saturation in the upper profile.

The imperfectly drained **Gleyed Melanic Brunisols** and poorly drained **Orthic Humic Gleysols** comprising the CH5 and CH6 soil landscape units have a till underlayer which corresponds to the parent material of the Leitrim soil association. Profile characteristics of the upper marine veneer are similar to those previously described for the imperfect and poorly drained components underlain by Grenville till. Characteristics of the underlying shaly till are similar to those described for the parent material of the Leitrim association.

The poorly drained **Orthic Humic Gleysols** which constitute the CH7 soil landscape unit have a till underlayer which corresponds to the parent material of the Queensway soil association. Profile characteristics are similar to those given for the MacDonald series except for the absence of carbonates, lower pH, and slightly browner matrix color of the underlying Queensway till material.

Mapped Soil Combinations Approximately 1,600 ha of Chateauguay soils were mapped in combination with soils of other associations. Of this total, 700 ha were mapped in combinations in which they were the dominant component, and 900 ha were mapped in combinations in which they were the significant component. When mapped as the dominant component, the most extensive combinations occur with soils of the Dalhousie and Grenville soil associations. When mapped as the significant component, Grenville-Chateauguay combinations are the most extensive. North Gower-Chateauguay and Dalhousie-Chateauguay combinations also occur but less extensively.

General land use Chateauguay soils are well suited for most annually cultivated crops. They are, therefore, utilized in both rotational cropping systems and in monocultural systems such as continuous corn. In some systems corn may be emphasized in the rotation, while in others more emphasis may be placed on cereal grains.

Correlation to the Ottawa Urban Fringe Chateauguay soils in the area are slightly different from those mapped in the Ottawa Urban Fringe. Although the association concept of marine material overlying glacial till was retained, there are a number of differences with respect to the depth and type of materials. With respect to depth, the marine veneer in this survey was allowed to be 40 to 100 cm rather than 25 to 100 cm as in the Urban Fringe survey in order to conform to recent classification guidelines. Since the minimum veneer thickness in each survey area is usually greater than 40 cm, this difference in depth is not significant. There is, however, a significant difference in the type of materials which comprise the soil association in each survey area. In general, the marine veneer of a Chateauguay soil in each survey area is similar, with clay content usually exceeding 27%. The glacial till underlayer, however, varies considerably. Although the majority of Chateauguay soils in the survey area are underlain by stony Grenville till, they are also occasionally underlain by either stony Queensway till, or shaly Leitrim till. Due to the limited extent of the two latter soils, it was decided that new associations to characterize them were not warranted.

The moderately well drained **Chateauguay** series was identified in the Ottawa Urban Fringe, but not in this survey for a number of reasons. Outside the Fringe area, the occurrence of these is quite limited and they were not mapped mainly due to scale limitations. They occur in small transition areas between better drained soils of the Grenville association having higher elevations, and lower lying poorly drained soils of the Chateauguay association. Also, the marine veneer of these soils tends to be lighter textured, with clay content often less than 27%. With respect to texture they are not significantly different from soils of the Grenville association, and they were therefore mapped as part of that association.

DALHOUSIE (D)

Location and Extent Soils of the Dalhousie association occur quite extensively in most of the townships of the survey area. In West Carleton Township, the most extensive area occurs on the marine clay plains in the vicinity of the villages of Antrim, Kinburn, and Carp. A less extensive area occurs in Goulbourn Township between the villages of Stittsville and Richmond. In Rideau Township, the most extensive area occurs between and in close proximity to the villages of North Gower and Manotick. Less extensive areas occur adjacent to the Rideau River between the hamlets of Reevecraig and Burritts Rapids. An extensive area occurs in the southern portion of Osgoode Township and is centred around the village of Vernon. In Cumberland Township, extensive areas occur adjacent to and north of the village of Navan. Approximately 21,200 ha of Dalhousie soils were mapped.

Landform and Topography Soils of the Dalhousie association have developed on level to very gently sloping marine clay plains. The clayey marine material was deposited in deep water during inundation by the Champlain sea. Slopes are most often less than 2%, but occasionally may range from 2 to 5%.

Soil Materials Dalhousie association soils are predominantly fine textured, noncalcareous, and lack coarse fragments of any type. The parent material of most soils is gray in color and has either silty clay or clay textures. Soil reaction is neutral. Some soils were included in the association, however, which had parent materials which were mildly alkaline in reaction and also weakly calcareous. Surface textures generally have a slightly lower clay content, and are dominantly silty clay loam or clay loam.

In some soils, significant layers of coarser textured materials occur which have clay loam, silty clay loam, silt loam, or loam textures. Thickness of the layers is highly variable. Occasionally, some soil materials also grade into heavy clay near the bottom of the control section.

Four soil phases were recognized, with each being very limited in extent. An organic phase was recognized in which 15 to 40 cm of organic material occurred on the surface of some very poorly drained soils. A coarse phase was applied to Dalhousie soils which had 15 to 40 cm of sandy material at the surface. Occasionally, a shallow phase was necessary where bedrock occurred at depths between 50 and 100 cm, and a rockiness phase was applied to some Dalhousie landscapes with intermittent rock outcrops.

Soil Moisture Characteristics More than 90% of the Dalhousie soils mapped in the survey area are poorly drained. They occur on level or nearly level landscapes having slopes less than 2%. Occasionally, very poorly drained soils occur in depressional areas. In both soils, drainage is restricted due to high water tables resulting from groundwater discharge and surface water runoff from adjacent areas. Imperfectly drained soils also are found in the survey area but are quite limited in extent. They occur on the mid to upper slopes of very gently sloping landscapes. Slopes range from 2 to 5%.

Dalhousie soils have generally medium permeability and high moisture holding capacity. In some soils, permeability has been significantly reduced due to compaction by heavy machinery associated with monocultural tillage practices such as continuous corn cropping. Surface runoff on Dalhousie soils is slow to moderate.

Soil Landscape Units Five units were identified for the Dalhousie association. They are described as follows:

	Recognized Subgroups	Recognized Series
D1: Dominantly imperfectly drained soils found on nearly level to very gently sloping topography. Slopes generally range from 1 to 5%.	Gleyed Melanic Brunisols	Dalhousie
D2: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on nearly level to very gently sloping topography. Slopes generally range from 1 to 3%.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	Dalhousie Brandon
D3: Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	Brandon
D4: Dominantly very poorly drained soils found on level to nearly level or depressional topography. Slopes are less than 2%.	Rego Gleysols	
D5: Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on nearly level to very gently sloping topography. Slopes range from 1 to 3%.	Orthic Humic Gleysols (poor) Gleyed Melanic Brunisols (imperfect)	Brandon Dalhousie

Taxonomic Components The imperfectly drained **Dalhousie** series (Gleyed Melanic Brunisol subgroup) commonly is found on inclined marine clay landscapes which occur infrequently in the survey area. The surface Ap horizons are most often dark brown to very dark grayish brown in color and have subangular blocky to granular structure. The underlying Bmgj horizons are olive to dark grayish brown in color and also have subangular blocky structure. Faint to distinct olive colored mottles may be present in these horizons. The parent material or C horizons are gray in color and have prominent yellowish brown to olive brown mottles. Structure ranges from subangular blocky to angular blocky.

The poorly drained **Brandon** series (Orthic Humic Gleysol subgroup) is found on the level to nearly level marine clay plains which are common in the survey area. Surface Ap horizons are generally very dark grayish brown to very dark gray in color and have subangular blocky to granular structure. The underlying Bg horizons have a dark gray colored matrix and prominent yellowish brown mottles. Structure is subangular blocky. The parent material or C horizons have gray matrix colors and prominent mottles with colors similar to those in the overlying Bg horizons. Structure is commonly subangular to angular blocky.

The very poorly drained **Rego Gleysols** most often occur in wet depressional areas. The majority of these soils have a surface layer of organic material which ranges in depth from 15 to 40 cm. They remain saturated for much of the year which contributes to massive structures and olive gray to greenish gray matrix colors.

Mapped Soil Combinations Approximately 11,900 ha or 56% of all Dalhousie soils were mapped in combination with either soils of other associations or miscellaneous land units. Of this total, approximately 8,500 ha were mapped in combinations in which they were the dominant component, and 3,400 ha were mapped in combinations in which they were the significant component. The combinations of Dalhousie-North Gower, Dalhousie-Rideau, and North Gower-Dalhousie are the most extensive. They account for approximately 5,000, 1,500, and 1,200 ha respectively of all Dalhousie soils mapped. The lack of recognizable topographic differences across the landscapes as well as scale limitations necessitated the mapping of these soils in combinations.

General Land Use Dalhousie soils have good agricultural capability for common field crops. They are widely utilized for the production of corn, cereal grains, and hay. Some soils in small localized areas remain in permanent pasture or are forested.

Correlation to Ottawa Urban Fringe Dalhousie association soils of this survey correlate closely with those of the Ottawa Urban Fringe. The D5 soil landscape unit was developed for this survey in order to characterize landscapes with dominantly poor drainage and significant imperfect drainage. The smaller map scale of this survey made this decision practical.

FARMINGTON (F)

Location and Extent Soils of the Farmington association occur most extensively in Goulbourn, Rideau and West Carleton Townships. Smaller, more localized areas also occur in Cumberland and Osgoode Townships. Approximately 37,400 ha of Farmington soils were mapped, of which approximately 6,800 ha were mapped in combination with either soils of other associations or miscellaneous land units.

Landform and Topography Farmington soils consist of a 10 to 50 cm thick veneer of stony undifferentiated drift material which overlies either limestone or dolomite bedrock. The topography is most commonly level to very gently sloping or undulating with slopes ranging from 0 to 5%. Steeper slopes ranging to 15% occur less frequently and are the result of differential and fluvial erosion as well as local block faulting. Often, the bedrock plains are flanked by steep scarps facing northward towards the Ottawa River, with the remainder of the bedrock plain having a gradual slope to the south.

Soil Material Farmington soil materials are moderately coarse to coarse textured and contain a considerable amount of calcareous material originating from Paleozoic limestone and dolomite bedrock. Original glacial deposits similar to those of the Grenville association have been subsequently reworked leaving a coarser textured veneer of material, generally less than 50 cm thick, over limestone or dolomite bedrock. Occasionally, deposits greater than 50 cm thick occur which are usually confined to depressional areas. Average depth to bedrock from recorded sites was 34 cm. Bedrock exposures are common in many Farmington landscapes, and may account for as much as 25% of the area of some map units.

A significant proportion of Farmington materials consist of flat angular pieces of limestone and dolomite which are present throughout the profile. A small percentage of rounded Precambrian cobbles and stones also are present. Total coarse fragment content is variable and may range as high as 50% by volume. The matrix of the parent material is dark brown to olive in color and strongly to extremely calcareous. Texture is predominantly sandy loam, with lighter textures of loamy fine sand and loamy sand also occurring. Some soils may be completely weathered in which case calcareous parent material is not present in the profile. Soil reaction in the weathered portion is most often neutral, while reaction in the calcareous parent material when present is alkaline. Surface textures are predominantly sandy loam and loam, with fine sandy loam and silt textures also occurring but less extensively.

Surface stones greater than 15 cm in diameter are present to some extent on most Farmington soils. A wide range of surface stoniness conditions occur, the most common classes being either moderately stony or very stony with up to 15% of the surface being occupied by stones.

Two soil phases were applied to some Farmington soils. A fine textural phase was applied to some soils in which the soil material had finer textures which were most often clay loam. An organic phase was applied to some poorly drained soils which had a 15 to 40 cm thick layer of organic material at the surface.

Soil Moisture Characteristics Farmington soils have a wide range of drainage conditions. On very gently to moderately sloping sites, soil drainage varies from excessive to well. On nearly level sites, imperfect drainage conditions prevail. Poor drainage conditions are usually found in depressional sites or in low lying areas which border marshlands, streams, or organic deposits. Lateral seepage is a major contributor to poor drainage conditions in most depressional sites.

Farmington soils are moderately permeable and lateral water movement is common due to the impermeable nature of the underlying bedrock. Moisture holding capacity is low due to the moderately coarse texture of the soil material and the shallowness to bedrock. Surface runoff is slow to moderate depending on the topography.

Soil Landscape Units Six units were identified in the Farmington association. They are described as follows:

		Recognized Subgroups	Recognized Series
F1:	Dominantly well-drained soils found on very gently to moderately sloping topography. Slopes are dominantly 2 to 5%, but may range up to 15%.	Orthic Melanic Brunisols	Farmington
F2:	Dominantly imperfectly drained soils found on nearly level topography. Slopes are 2% or less.	Gleyed Melanic Brunisols	Franktown
F3:	Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	Brooke
F4:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils found on very gently to moderately sloping topography. Slopes are dominantly 2 to 5%, but may range up to 15%.	Orthic Melanic Brunisols (well) Gleyed Melanic Brunisols (imperfect)	Farmington Franktown
F5:	Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils generally found on nearly level to very gently sloping topography. Slopes range from 1 to 5%.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	Franktown Brooke
F6:	Dominantly well-drained soils in combination with significant areas of poorly drained soils generally occurring on nearly level to very gently sloping topography. Depressional areas commonly occur and slopes range from 1 to 5%.	Orthic Melanic Brunisols (well) Orthic Humic Gleysols (poor)	Farmingtor Brooke

Taxonomic Components The well-drained **Farmington** series (Orthic Melanic Brunisol subgroup) has dark brown to black colored surface A horizons and dark yellowish brown to olive colored B and C horizons. Soil structure is generally granular at the surface, and either granular or subangular blocky at depth. Texture and the amount of coarse fragments are quite variable. Surface texture is dominantly sandy loam or loam, with lesser occurrences of silt loam or fine sandy loam. Texture of the B and C horizons is dominantly sandy loam, but coarser textures are common in areas that have been highly reworked or wave washed.

The **Franktown** series (Gleyed Melanic Brunisol subgroup) consists of imperfectly drained soils which are subject to water saturation for short periods during the growing season. Distinct dark yellowish brown to yellowish brown mottles are present in the subsoil which reflect the restricted drainage. Other than the presence of mottles, these soils are similar to the Farmington series in other profile characteristics.

The **Brooke** series (Orthic Humic Gleysol subgroup) consists of poorly drained soils which remain saturated for long periods during the growing season. They are generally located in depressional sites, and are subject to periodic ponding. Surface A horizons are slightly thicker and higher in organic matter content than the better drained soils of the association. Underlying B and C horizons are more grayish in color than the better drained series, and have prominent dark yellowish brown mottles. Other profile characteristics are similar to the better drained series of the association.

Mapped Soil Combinations Less than 20% of the Farmington soils occurring in the survey area were mapped in combination with either soils of other associations or miscellaneous land units. Approximately 5,100 ha were mapped in combinations in which they were the dominant component, and 1,700 ha were mapped in combinations in which they were the significant component. When mapped as the dominant component, the most extensive combinations were with soils of the Grenville, Oka, and Greely associations. The Farmington-Grenville combination was the most extensive of the three, accounting for approximately 1,800 ha of all Farmington soils mapped. In that combination the Grenville soils were most commonly mapped as a shallow phase. When mapped as the significant member, the Oka-Farmington combination was the most extensive. Approximately 700 ha of Farmington soils were mapped with Oka soils as the dominant member.

Mapped soil combinations in which soils of the Oka association are either dominant or significant members occur mainly on the bedrock plains in Goulbourn and West Carleton Townships. The relatively small areas of individual beach deposits in these areas necessitated the use of compound map units in order to accurately represent soil variability which occurs. In Farmington-Grenville (shallow) soil combinations, the majority occur in Rideau and Goulbourn Townships and represent shallow to bedrock areas in which the depth of some soils is 50 to 100 cm. These areas could not be mapped separately.

General Land Use Farmington soils are not suitable for annual cultivation due to shallowness to bedrock, surface stoniness, and bedrock outcropping in most areas. When surface stoniness and bedrock outcrops are not extensive, perennial forage crops which can withstand droughty conditions may potentially be grown on some Farmington soils.

The majority of Farmington soils remain under forest cover. Less extensive areas of abandoned farmland and scrubland are also commonly found on these soils. Agricultural land use is mainly confined to the grazing of sheep and beef cattle.

Correlation to Ottawa Urban Fringe Most Farmington soils in the area are similar to those mapped in the Ottawa Urban Fringe. Some soils, however, have been highly reworked by water action and are coarser textured than those characterized in the Ottawa Urban Fringe report.

GOULBOURN (GB)

Location and Extent Soils of the Goulbourn association occur mainly in Osgoode and Rideau Townships. Less extensive areas also occur in West Carleton and Cumberland Townships. In all areas they occur in low lying depressional landscape positions, and frequently are found adjacent to or are intersected by rivers or streams. Approximately 3,500 ha of Goulbourn soils were mapped, with an estimated 1,100 ha of that total having been mapped in combination with soils of other associations.

Landform and Topography The Goulbourn association is composed of organic soils which are found in horizontal basin or peat margin swamps. The topography is level or depressional, and slopes are usually 1% or less.

Soil Material Soils of the association consist of 40 to 160 cm of moderately to well decomposed organic material which is underlain by mineral material. Most often the organic material is uniformly woody forest peat which is black in color. Soil reaction ranges from neutral at the surface to medium acid at depth. Occasionally, a layer of dark reddish brown to black sedge fen peat which is variable in thickness may underlay the woody forest peat. Soil reaction in this instance is more acidic, ranging from medium acid at the surface to strongly acid at depth.

The woody forest peat comprising all or part of the organic material is primarily moderately decomposed or mesic in terms of its degree of decomposition. Rubbed fibre content generally ranges from 12 to 16%. In some profiles, a significant layer of well-decomposed humic peat is also present which is 25 cm or more thick and has a rubbed fibre content of less than 10%. Either type of material is derived mainly from forest vegetation, particularly coniferous and deciduous tree species. Primary components include leaf and needle material as well as varying amounts of woody debris in the form of stems, branches, and roots.

When present, the layer of sedge fen peat at depth is most often moderately decomposed or mesic. It is dominantly composed of sedge material, with some cotton grass remnants also present. A significant amount of the material is very fine roots of the two previously mentioned plant types.

The underlying mineral material or substratum is quite variable. Sandy loam textures are most common, but sandy and clayey textures occur as well. Color of the substratum ranges from gray to dark greenish gray. The upper portion of the substratum is usually neutral in reaction and noncalcareous, although the presence of carbonates and a higher pH can be expected for some types of substratums at greater depths.

Soil Moisture Characteristics Goulbourn soils are poorly to very poorly drained, with the water table at or near the surface for most of the year. Standing water at the surface is a common occurrence. Due to the nutrient-rich nature of the mineral substratum and the surrounding mineral soils, the groundwater which saturates these soils is also nutrient-rich.

Soil Landscape Units One unit was identified in the Goulbourn association. It is described as follows:

	Recognized Subgroups	Recognized Series
GB1: Dominantly poorly to very poorly drained soils found on level to depressional topography. Slopes are 1% or less.	Terric Mesisols Terric Humic Mesisols Terric Humisols Terric Mesic Humisols	Goulbourn Manion Corners Munroe

Taxonomic Components Four poorly to very poorly drained components compose the Goulbourn association. Most often, the greater part of the organic material of the control section is mesic in terms of its degree of decomposition. Therefore, the dominantly occurring subgroup is the Terric Humic Mesisol, with Terric Mesisols also common but less extensive. Occasionally, all or the greater part of the organic material may be humic rather than mesic. In this instance, the subgroups which occur are Terric Humisols and Terric Mesic Humisols.

The **Goulbourn** series (Terric Mesisol subgroup) is one of the most commonly occurring soils in the association. The organic material consists of mesic woody forest peat which is neutral to medium acid in reaction and black in color. The underlying mineral material is sandy loam in texture, and gray to dark greenish gray in color.

The **Manion Corners** series (Terric Humic Mesisol Subgroup) occurs most often and is similar to the Goulbourn series with the exception of a humic layer of woody forest peat in the profile. The layer is usually thicker than 25 cm and most often occurs at or near the surface.

The **Munroe** series (Terric Humisol subgroup) occurs less frequently than either of the two previously described soils. It is composed of humic rather than mesic woody forest peat. Other profile characteristics are similar to the Goulbourn series.

The **Terric Mesic Humisols** occur occasionally and are mainly composed of humic woody forest peat. A layer of mesic woody forest peat usually occurs in the mid to lower portion of the organic material. Other profile characteristics are similar to the Goulbourn series.

Mapped Soil Combinations Approximately 900 ha of Goulbourn soils were mapped as the dominant component in combination with soils of other associations. Only 200 ha were mapped in combinations in which they were the significant component. The combination representing the largest area consists of Goulbourn soils mapped as the dominant component in combination with soils of the Jockvale association which have a thin organic surface layer (J6.0 map unit). Approximately 650 ha of Goulbourn soils were mapped in this combination.

General Land Use Most Goulbourn soils consist of wetland which has a hardwood cover which predominantly consists of maple, birch, and aspen. Some cedar softwoods are present occasionally. The understory consists of ferns, mosses, grasses, and tall shrubs.

Correlation to Ottawa Urban Fringe Organic soils composing the Goulbourn association were not mapped as such in the Ottawa Urban Fringe. In that survey, they were mapped as terric components of the Huntley association and were represented by either the H3 or H4 soil landscape units. Although adequately characterized and mapped as part of the Huntley association in the Ottawa Urban Fringe, it was decided that a new association for the remaining area of the Regional Municipality was warranted for two reasons. First, by confining the Huntley association to deep (> 160 cm) organic soils and including the shallower (< 160 cm deep) soils in the Goulbourn association, more taxonomically exclusive association concepts were achieved for both associations. Secondly, a large proportion of soils occurring outside the Urban Fringe area have similar depths and the same origin of materials as those represented by the H3 and H4 soil landscape units, but the materials are not as well decomposed. A new association was therefore needed to describe the wider range of soil materials and taxonomic components which occur.

GREELY (GY)

Location and Extent The organic soils of the Greely association occur mainly in Rideau, Goulbourn, and West Carleton Townships in close proximity to areas of shallow Paleozoic bedrock. Therefore, Greely association soils were often mapped adjacent to soils of the Farmington association. Approximately 4,500 ha of Greely soils were mapped.

Landform and Topography The Greely association is composed of organic soils which are found in horizontal basin or stream swamps. The topography is level or depressional, and slopes are usually 1% or less.

Soil Material Soils of the association consist of 40 to 160 cm of moderately to well decomposed woody forest peat underlain by 10 to 50 cm of mineral material overlying paleozoic bedrock. The woody forest peat is black in color and varies in degree of decomposition, with rubbed fibre content on a horizon basis being either slightly higher or slightly lower than 10%. The peat material may be uniformly mesic or humic, or layers of both mesic and humic material generally less than 25 cm thick may occur. All of the organic material is derived from forest vegetation, particularly coniferous and deciduous tree species. Primary components include leaf and needle material as well as varying amounts of woody debris consisting of stems, branches, and roots. Soil reaction of the peat material is neutral to medium acid.

The mineral substratum is variable in texture and thickness. Texture ranges from loam to sand, with sandy loam textures most prevalent. Thickness ranges from 10 to 50 cm. Color of the substratum is most often gray to dark greenish gray. Soil reaction ranges from neutral to mildly alkaline, and carbonates are present occasionally.

These soils are differentiated from those of the Goulbourn association on the basis of a lithic contact which occurs at depth. Paleozoic bedrock usually consisting of either limestone or dolomite underlies the thin mineral substratum.

Soil Moisture Characteristics Greely soils are poorly to very poorly drained, with the water table at or near the surface for most of the year. Standing water at the surface and ponded water in some areas are common occurrences. Moisture retention is high in part to the impermeable nature of the underlying bedrock. The groundwater is nutrient rich due to the underlying mineral material and discharge from adjacent mineral soils.

Soil Landscape Units One unit was identified in the Greely association. It is described as follows:

	Recognized Subgroups	Recognized Series
GY1: Dominantly poorly to very poorly drained soils on level to depressional topography. Slopes are 1% or less.	Typic Humisols Typic Mesisols Terric Mesic Humisols Terric Humic Mesisols	Greely Burritts Rapids

Taxonomic Components Four components were recognized in the association to accommodate variations in degrees of organic material decomposition and mineral substrata thicknesses.

The poorly to very poorly drained **Greely** series (Typic Humisol subgroup) and **Typic Mesisols** have similar depths and origin of organic material, but they are underlain by a thin layer of mineral material less than 30 cm thick which overlies Paleozoic bedrock. The Typic Humisols are dominantly humic in their degree of decomposition, and the Typic Mesisols are dominantly mesic.

The poorly to very poorly drained **Burritts Rapids** series (Terric Mesic Humisol Subgroup) and **Terric Humic Mesisols** also have similar depths and origin of organic materials, but they are underlain by mineral substratum which is 30 to 50 cm thick. The Terric Mesic Humisols are dominantly humic in their degree of decomposition, and the Terric Humic Mesisols are dominantly mesic.

Mapped Soil Combinations Greely soils were most often mapped as the significant component in combinations with soils of other associations. Approximately 900 ha of Greely soils were mapped in combinations, with more than 80% of that total mapped in combinations in which they were the significant component. The Farmington-Greely combination is the most widely occurring in the survey area.

General Land Use Greely soils consist of wetland which has a vegetative cover consisting of a mixture of maple, birch, aspen, and cedar tree species.

Correlation to Ottawa Urban Fringe Organic soils which compose the Greely association were not mapped as such in the Ottawa Urban Fringe. In the survey for that area, they were included in the Huntley association and were represented by the H1 soil landscape unit. A new association to characterize these soils in this survey was developed for two reasons. First, the area of organic soils occurring in bedrock controlled depressions outside the Urban Fringe area was great enough to warrant a new association. Secondly, by limiting the Huntley association in the survey to include only organic soils deeper than 160 cm, a more taxonomically exclusive association concept was achieved for that soil association.

GRENVILLE (G)

Location and Extent Soils of the Grenville association are widely distributed across the survey area. They occur extensively throughout Goulbourn and Osgoode Townships as well as the central and eastern portions of Rideau Township. A less extensive but significant area also occurs in the central portion of Cumberland Township in the ancestral river channel of the Ottawa River. Approximately 21,900 ha of Grenville soils were mapped.

Landform and Topography Soils of this association have developed in stony glacial till which occurs in the form of isolated drumlinoid ridges or larger areas of nearly level to hummocky till plains. Across landscapes the deposits are often surrounded by lower lying nearly level marine and fluvial deposits. Slopes most often range from 2 to 9%, but occasionally steeper slopes of up to 15% also occur.

Soil Materials Grenville soil materials are medium to moderately coarse textured and have a considerable coarse fragment content which generally increases with depth. Angular and slightly rounded stones and boulders dominate the coarse fragment fraction. They occur throughout most materials and have primarily been derived from Paleozoic limestone and dolomite bedrock. Lesser amounts of Precambrian igneous and metamorphic rock fragments as well as Paleozoic shale and sandstone rock fragments also occur in most materials.

The parent material of Grenville soils is commonly referred to as Grenville till. It is a stony, grayish brown to olive gray colored unsorted till in which coarse fragment content usually exceeds 20% by volume. Texture is commonly sandy loam or loam, with sandy loam textures being the most frequent. Soil reaction is mildly alkaline, and the material is also strongly calcareous. The upper weathered material is neutral in reaction and weakly to moderately calcareous. Coarse fragments are also present in this material, but their proportion is usually less than that occurring in the underlying parent material. Surface textures are sandy loam, loam, or silt loam.

Due mainly to the inundation of the Champlain Sea over the area following glaciation, the upper 50 to 100 cm of most Grenville materials have been modified somewhat by marine and fluvial action. Reworking has altered the texture considerably, resulting at times in either finer or coarser textured material than in the unaltered till material at depth. It has also contributed in some areas to very stony surface conditions due to the removal of fine material. The amount of stones occurring at the surface is quite variable, with conditions ranging from slightly to exceedingly stony (<0.1% to 50%). Moderately stony (<3% surface cover) and very stony (3 to 15% surface cover) were the most common surface stone conditions mapped in the Grenville association.

Three soil phases were applied to Grenville soils to indicate differences in materials from those normally found. A shallow phase was used to describe Grenville soils where limestone or dolomite bedrock was present at a depth of 50 to 100 cm. A coarse phase was also applied to Grenville soils which had 15 to 40 cm of sandy material at the surface. Thirdly, an organic phase was occasionally necessary when 15 to 40 cm of organic material was present at the surface.

Soil Moisture Characteristics Soils of the association have a wide range of drainage conditions. The majority, however, are well-drained and occur on mid to upper slope positions. Imperfectly drained soils occur on lower slope positions or on landscapes with low local relief. Poorly and very poorly drained soils occur on nearly level to depressional areas between till ridges or in areas of low local relief.

Grenville soils are moderately permeable and have moderate moisture holding capacities. Surface water runoff is moderate on the well and imperfectly drained soils which most often have very gently to gently sloping topography. Runoff is slow, however, on the nearly level poorly drained soils of the association. Slow surface runoff combined with groundwater discharge from surrounding areas result in high water tables in the poorly and very poorly drained soils for much of the growing season.

Soil Landscape Units Six units were identified in the Grenville association. They are described as follows:

	Recognized Subgroups	Recognized Series
G1: Dominantly well-drained soils found on very gently to gently sloping topography. Slopes commonly range from 2 to 9%.	Eluviated Melanic Brunisols (most common) Orthic Melanic Brunisols Orthic Humic Regosols	Grenville

	Recognized Subgroups	Recognized Series
G2: Dominantly imperfectly drained soils found on nearly level to very gently sloping topography. Slopes commonly range from 1 to 3%.	Gleyed Eluviated Melanic Brunisols	Matilda
G3: Dominantly poorly drained soils found on nearly level topography. Slopes are 2% or less.	Orthic Humic Gleysols	Lyons
G4: Dominantly well-drained soils in combination with significant areas of imperfectly drained soils found on very gently to gently sloping topography. Slopes commonly range from 2 to 9%.	Eluviated Melanic Brunisols (well) Orthic Melanic Brunisols (well) Gleyed Eluviated Melanic Brunisols (imperfect) Gleyed Melanic Brunisols (imperfect)	Grenville Matilda
G5: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on nearly level to very gently sloping topography. Slopes commonly range from 1 to 3%.	Gleyed Eluviated Melanic Brunisols (imperfect) Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	Matilda Lyons
G6: Dominantly very poorly drained soils found on depressional topography. Slopes are 1% or less.	Rego Gleysols	

Taxonomic Components The well-drained **Grenville** series (Eluviated Melanic Brunisol subgroup) is the most commonly occurring soil found when drainage conditions are good. These soils have dark brown Ap horizons with granular structures. Profiles usually have a slightly eluviated Aej horizon which extends deep enough not to have been incorporated into the plough layer where cultivation has taken place. These horizons have granular structure and are commonly dark yellowish brown in color. Under the Aej horizon either Bm or Btj horizons occur which usually have a small amount of illuviated clay and may be brown to dark brown with granular structure. Parent material or C horizons are moderately to strongly calcareous, with calcium carbonate content most often in the 6 to 40% range. They are grayish brown to olive gray in color and have subangular blocky structure.

Under good drainage conditions, two other less extensive components occur. The Orthic Melanic Brunisols are similar to the Grenville series but lack evidence of illuvial clay (Btj) in the weathered subsurface. The Orthic Humic Regosols do not possess a significantly weathered subsurface. In these soils the surface A horizon directly overlies calcareous parent material. The Ap horizons are very dark grayish brown in color and have granular structure. On occasion, A horizons are also calcareous (Apk). The underlying C horizon or parent material consists of relatively compact till which has a higher calcium carbonate content than that normally encountered in other Grenville soils within 1 m of the surface. Calcium carbonate usually exceeds 40% and structure is subangular blocky.

The imperfectly drained **Matilda** series (Gleyed Eluviated Melanic Brunisol subgroup) is similar to the Grenville series in most profile characteristics. It differs by having distinct dark yellowish brown mottles in the weathered subsurface, and distinct to prominent yellowish brown to olive brown mottles in the parent material. The imperfectly drained Gleyed Melanic Brunisols occur less extensively than the Matilda series. In comparison to that series, they have similar mottles but lack eluvial and illuvial horizons.

The poorly drained **Lyons** series (Orthic Humic Gleysol subgroup) is subject to water saturation for much of the growing season. Their lower slope and depressional landscape position is mainly responsible for this saturated condition by making them subject to surface runoff and groundwater discharge from surrounding areas. These soils have prominent light olive brown to yellowish brown mottles and grayish brown to gray matrix colors within 50 cm of the surface.

Occasionally very poorly drained Rego Gleysols occur but their extent is very limited. Saturated conditions evidenced by water tables at or near the surface for much of the year cause reducing conditions, gray colors, and massive structures throughout most of the profile.

Mapped Soil Combinations Approximately 4,700 ha or 21% of all Grenville soils were mapped in combination with soils of other associations. Of this total, 2,700 ha were mapped in combinations in which they were the dominant soils, and 2,000 ha were mapped in combinations in which they were the significant soils. When mapped as the dominant component, almost half were mapped with soils of the Chateauguay association primarily in Rideau and Osgoode Townships. Grenville-Ironside and Grenville-Farmington combinations were the next most extensive. When mapped as the significant component, approximately 1,200 ha were mapped with soils of the Farmington association. The majority of Grenville soils included in this combination were mapped with a shallow phase.

Occasionally combinations of deep and shallow Grenville soils were mapped. In these cases the deep soils could not be delineated from the shallow materials on a consistent basis, therefore necessitating the use of map combinations.

General Land Use Soils of the Grenville association have a wide range of agricultural capabilities which result in varying land uses on a site to site basis. Grenville soils which are very gently to gently sloping, well or imperfectly drained, and relatively free of surface stones have good agricultural capability. Corn, cereal grains, and hay production are frequent uses on these soils. High surface stoniness and/or moderate to strong slopes, however, make intensive agricultural use impractical. Often these limitations are severe enough to restrict agricultural use to that of hay production and permanent pasture.

A large proportion of Grenville soils remain forested. The soils in these instances usually have severe surface stoniness, steep slopes, poor to very poor drainage, or a combination of these limitations.

Correlation to Ottawa Urban Fringe Landscapes and soil materials comprising the association in each survey area are similar. Minor differences, however, are present with respect to the number of recognized taxonomic components as well as soil landscape units. In some Grenville soils of this survey area, eluvial and/or illuvial horizons were not found. Others do not have B horizons of any type. Additional taxonomic components for these soils were therefore necessary in this survey. Also, a small proportion of Grenville soils identified in this survey are very poorly drained. The G6 soil landscape unit was therefore incorporated in this survey in order to map these soils.

HUNTLEY (H)

Location and Extent Soils included in the Huntley association are broadly distributed across the Regional Municipality. Significant areas of these soils occur in each township except Cumberland. Approximately 8,600 ha of Huntley soils were mapped.

Landform and Topography The Huntley association is composed of deep organic soils which are found in either horizontal basin or stream swamps. The topography is level or nearly level, with slopes usually being 1% or less.

Soil Material Huntley soil materials consist of greater than 160 cm of either woody forest peat or a combination of woody forest peat and sedge fen peat. Each may be underlain by loamy or sandy mineral material. When both peat materials are present, the profile may consist of either woody forest peat with a subdominant sedge fen peat layer, or it may consist of woody forest peat underlain by sedge fen peat. Although of different origin, the peat materials do not differ greatly in chemical and physical analysis or color. They are moderately to well decomposed and medium to strongly acid in reaction. Color ranges from black to dark reddish brown. The woody forest peat mainly consists of stem, branch, root, and leaf materials derived from coniferous and deciduous tree species. The sedge fen peat primarily consists of sedge leaves and cotton grass remains. Layers of relatively undecomposed wood in the form of large tree branches and trunks may occur in some materials.

Soil Moisture Characteristics Huntley soils are poorly to very poorly drained with water tables at or near the surface year round. Groundwater is nutrient rich due to the mineral substrata and/or from being discharged either directly or indirectly from adjacent mineral soils having high base saturation.

Soil Landscape Units One unit was identified in the Huntley association. It is described as follows:

	Recognized Subgroups	Recognized Series
H1: Dominantly very poorly drained soils found on level or nearly level topography; slopes are 1% or less.	Typic Mesisols Mesic Humisols Humic Mesisols	Glendale Mersea Corkery

Taxonomic Components The very poorly drained **Glendale** series (Typic Mesisol subgroup) consists mainly of moderately decomposed woody forest peat, with a subdominant portion of moderately decomposed sedge fen peat. The sedge fen peat may occur as a layer within the profile, or it may constitute the entire lower portion.

Other very poorly drained soils identified include the **Mersea** and **Corkery** series (Mesic Humisol and Humic Mesisol Subgroups). The Mersea series is found most often in soil materials consisting entirely or almost entirely of woody forest peat. The Corkery series is found most often in soil materials in which combinations of forest and fen peat are present.

Mapped Soil Combinations Only a small proportion of Huntley soils were mapped in combination with soils of other associations. Approximately 100 ha were mapped as the dominant component in combination with poorly drained soils of the Mille Isle association with a peaty phase 15 to 40 cm thick. Huntley soils were also mapped as the dominant component in combination with other organic soils. Those soils included shallower organic soils of the Greely and Goulbourn associations, with approximately 200 ha and 100 ha respectively of Huntley soils being mapped with soils of these associations.

General Land Use Huntley soils comprise forested wetland in which the common tree species include cedar, tamarack, alder, ash, and willow. An understory of ferns, grasses, mosses, and tall shrubs is also common in these wetlands.

Correlation to Ottawa Urban Fringe The Huntley association defined in this survey differs from the Huntley association of the Ottawa Urban Fringe in the depth of materials. In the Urban Fringe survey, the Huntley association includes both shallow and deep organic soils in which the organic material may overlay mineral material or a bedrock contact. In this survey, the depth of organic material for the association was restricted to greater than 160 cm. Shallower organic materials of similar origin overlying mineral material were characterized as separate soils in the Goulbourn association. Where such organic materials were underlain by Paleozoic bedrock within 160 cm of the surface, the Greely association was incorporated in the survey to characterize those soils.

IRONSIDE (I)

Location and Extent Soils of the Ironside association do not occur extensively in the area. Those which do occur are fairly evenly distributed within each of the three map sheets of the survey area. Approximately 2,200 ha of Ironside soils were mapped, of which approximately 1,300 ha were mapped in combination with soils of other associations.

Landform and Topography Ironside soils consist of a 40 to 100 cm thick veneer of coarse textured marine or fluvial material which is underlain by stony or shaly glacial till. The veneer may be present on the flanks of very gently to gently sloping till ridges or isolated knolls, or it may overlay them completely. It may also occur on level to gently sloping or undulating till plains. Slopes generally range from 0 to 5%, but steeper slopes ranging to 15% also occur occasionally.

Soil Material Ironside soils generally consist of well sorted, fine sand, loamy fine sand, or sand underlain by glacial till at a depth of 40 to 100 cm. Reaction of the sandy overburden ranges from neutral to medium acid. Most commonly, the underlying till corresponds with the parent material of the Grenville association, which is stony with textures consisting of sandy loam or loam and coarse fragment content often exceeding 20% by volume. Reaction is usually mildly alkaline. Less frequently, the underlying till may be strongly to very strongly acid in reaction and have a high shale content. This till material corresponds with parent material of the Leitrim association. A few Ironside soils also are underlain by slightly to medium acid, stony sandy loam till which corresponds to the parent material of the Queensway association. Both overburden soils underlain by Leitrim and Queensway parent materials have been included in the Ironside association due to their limited extent.

The sandy veneer of typical Ironside soils averages 65 cm in depth. It is usually entirely weathered if soil drainage is well to imperfect, with noncalcareous unweathered parent material present most often when drainage is poor. Colors range from dark yellowish brown to yellowish brown in the B and BC horizons, to light olive brown to light brownish gray in the C and Cg horizons. Surface A horizons are usually dark brown to black, with textures dominantly sandy loam, fine sandy loam, or loamy fine sand.

The underlying Grenville till parent material is dark grayish brown to olive gray or gray in color. The upper portion or all of the till occurring within 1 m of the surface has often been reworked by marine or fluvial water, making it less stony and not as compact as the more representative Grenville till which occurs at further depth. Even if reworked, the underlying till is usually strongly calcareous.

Surface stones originating from the underlying till or till materials nearby may be present on Ironside soils. Generally, nonstony or slightly stony conditions prevail when the topography is level or nearly level. Slightly stony to very stony surface conditions are most common on steeper topography, although nonstony conditions may also occur.

Soil Moisture Characteristics Ironside soils may be well, imperfect, or poorly drained. Upper slopes tend to be well-drained, while mid to lower slopes tend to be imperfectly drained mainly due to downslope lateral seepage. Poor drainage conditions are usually found in low lying or depressional areas adjacent to or between till ridges and knolls. Lateral seepage and surface runoff from adjacent soils contributes to poor drainage conditions.

The sandy overburden is rapidly permeable, with the underlying till moderately to rapidly permeable depending on its degree of compaction. Moisture holding capacity is low and droughtiness during periods of low rainfall is a potential problem. Surface runoff is slow.

Soil Landscape Units Six units were identified in the Ironside association. They are described as follows:

		Recognized Subgroups	Recognized Series
I1:	Dominantly well-drained soils found on very gently to moderately sloping topography. Slopes are dominantly 2 to 9%. The sandy veneer is underlain by Grenville till.	Orthic Melanic Brunisols	Ironside
I2:	Dominantly imperfectly drained soils found on nearly level to very gently sloping topography. Slopes range from 1 to 5%. The sandy veneer is underlain by Grenville till.	Gleyed Melanic Brunisols	
I3:	Dominantly poorly drained soils found on level to nearly level or depressional topography. Slopes range from 0 to 2%. The sandy veneer is underlain by Grenville till.	Orthic Humic Gleysols	Dwyer Hill
I4:	Dominantly well-drained soils found on very gently to moderately sloping topography. Slopes range from 2 to 9%. The sandy veneer is underlain by Leitrim till.	Orthic Melanic Brunisols	
I5:	Dominantly poorly drained soils found on level to nearly level or depressional topography. Slopes range form 0 to 2%. The sandy veneer is underlain by Leitrim till.	Orthic Humic Gleysols	
I6:	Dominantly imperfectly drained soils found on undulating topography. Slopes range from 2 to 5%. The sandy veneer is underlain by Queensway till.	Gleyed Melanic Brunisols	

Taxonomic Components The **Ironside** series (Orthic Melanic Brunisol subgroup) is well-drained and is the most commonly mapped soil in the association. Surface horizons are usually very dark grayish brown to dark brown with structure ranging from single grain to granular. Weathered subsoil horizons of the sandy overburden are dark yellowish brown to yellowish brown and have single grain structure. Parent material is lighter in color than the overlying horizons and is light olive brown to light brownish gray in color. Single grain structure again is most common. The underlying material for this series is confined to the stony, calcareous glacial till parent material of the Grenville association. Colors range from dark grayish brown to olive gray, and structure is usually subangular blocky. The upper portion is usually less compact than that which occurs at greater depths.

The imperfectly drained **Gleyed Melanic Brunisols** which have Grenville till material underlying the veneer have not been named due to their limited occurrence. Profile characteristics of these soils are similar to those of the Ironside series except for duller colors in the subsoil and the presence of mottles indicating periodic saturation. Distinct to prominent yellowish red mottles are common in the sandy subsoil, and the underlying calcareous till has distinct to prominent yellowish brown mottles.

The **Dwyer Hill** series (Orthic Humic Gleysol subgroup) is poorly drained and is the next most commonly mapped soil after the Ironside series. The underlying material again is confined to calcareous till of the Grenville association. Surface horizons are darker and have a higher organic matter content than the better drained soils of the association. Color ranges from very dark grayish brown to black. Weathered subsoil horizons range from dark yellowish brown to dark grayish brown, with underlying unweathered sandy parent material grayish brown to light brownish gray. Prominent yellowish red mottles occur in both the weathered and unweathered sandy subsoil. The underlying calcareous till is olive gray to gray in color with prominent brownish yellow mottles. Structure in these poorly drained soils is similar to the better drained members of the association.

The well-drained **Orthic Melanic Brunisols** and poorly drained **Orthic Humic Gleysols** which consist of sandy overburdens over shaly, noncalcareous Leitrim till have been included in the Ironside association and left unnamed because of their very limited extent. Only 250 ha of the well-drained member, and 100 ha of the poorly drained member have been mapped, mostly in Cumberland Township. Profile characteristics of the upper sandy material are similar to those of the Ironside and Dwyer Hill series. If well-drained, the underlying till is dark reddish brown to black in color and has a very high proportion of gravel size soft shale fragments which have similar colors. If poorly drained, shale content is similar but the matrix color is slightly grayer and faint mottles are also present.

The imperfectly drained **Gleyed Melanic Brunisols** which consist of sandy overburdens over stony, noncalcareous Queensway till have also been included in the association and left unnamed due to their very limited extent. Only 40 ha were mapped in West Carleton Township. Most profile characteristics are similar to the Gleyed Melanic Brunisols underlain by Grenville till. The underlying Queensway till, however, is noncalcareous and has a lower pH as well as a more brownish matrix color than Grenville till material.

Mapped Soil Combinations Ironside soils underlain by Grenville till were most commonly mapped in combination with soils of the Grenville and Jockvale soil associations. Approximately 500 ha of Ironside soils occur in combination with Grenville soils, with over half of these soils occurring in Osgoode and Rideau Townships. Approximately 400 ha of Ironside soils occur in combination with Jockvale soils, with the majority again occurring in Osgoode and Rideau Townships.

Ironside soils underlain by Leitrim till are most commonly mapped as significantly occurring soils along with dominantly occurring soils of the Leitrim soil association. Approximately 100 ha of Ironside soils were mapped in this way, with their location confined mainly to Cumberland Township.

General Land Use Hay and improved pasture are common agricultural uses of Ironside soils. Some sites remain forested and others are abandoned farmland.

Correlation to Ottawa Urban Fringe Ironside soils in the area which are underlain by stony Grenville and Queensway tills are similar to those characterized in the Ottawa Urban Fringe. Those underlain by shaly Leitrim till, however, are additional soils included in the association which were not found in the Urban Fringe area. Due to their very limited extent, it was felt that a new association was not warranted even though there is a considerable difference in the underlying till.

In the Urban Fringe survey, Ironside soils are characterized as having a sandy veneer which is 25 to 100 cm thick. In this survey, the thickness of the veneer was changed to 40 to 100 cm to conform to recent classification guidelines. The difference in thickness is minor since the majority of Ironside soils in each area have a veneer which is thicker than 50 cm. In this survey the difference in minimum thickness means that soils with sandy veneers of less than 40 cm overlying glacial till were not mapped as Ironside soils. Rather, they were mapped as coarse phases of the Grenville, Leitrim, or Queensway associations.

JOCKVALE (J)

Location and Extent Soils of the Jockvale association occur only in the southern and western townships of the survey area. They were not mapped in Cumberland Township. In the southern townships of Osgoode and Rideau, the most extensive areas of Jockvale soils occur adjacent to or in close proximity to the Rideau River. In the western townships, the most extensive areas occur in West Carleton Township and are located south and southwest of the village of Carp in close proximity to Highway 17. Approximately 8,100 ha of Jockvale soils were mapped, of which approximately 4,100 ha were mapped in combination with other soils.

Landform and Topography Jockvale soils have developed on a blanket of coarse textured marine or fluvial material which is usually deeper than 2 m. Jockvale soils most commonly have level or nearly level topography. Very gently to gently sloping or undulating topography also occurs but less extensively. Slopes range from 0 to 9%, with the most frequently occurring slopes being 2% or less.

Soil Material Jockvale soils are generally deeper than 2 m in depth and may be underlain by various types of mineral materials which were not differentiated. Parent materials are light yellowish brown to grayish brown with fine sand or loamy fine sand textures. Soil reaction most often ranges from neutral to medium acid, with the majority of soils being slightly to medium acid. The weathered B horizons of Jockvale soils have similar soil textures, but soil reaction tends to be slightly more acidic than that of the underlying parent material. If well or imperfectly drained, B horizons are generally yellowish brown, strong brown, or yellowish red. If poorly drained, very pale brown to grayish brown colors prevail. Surface A horizons are most commonly very dark grayish brown to black, with fine sand, loamy fine sand, and occasionally fine sandy loam textures. Peaty surfaces less than 40 cm thick are present on approximately 9% of all Jockvale soils mapped.

Jockvale materials are well sorted and noncalcareous. Mean sand content of the parent material is 94%, with the mean fine sand proportion being 53%.

Soil Moisture Characteristics Poorly and very poorly drained soil conditions prevail in the majority of Jockvale soils. Approximately 45% of the Jockvale soils mapped were poorly drained, and 15% were very poorly drained. These drainage conditions are due mainly to higher water tables occurring primarily on flat or depressional topography. Imperfectly and well-drained soil conditions also occur, usually on fluvial sandbars or windblown sand knolls, both of which have slightly greater slopes facilitating more rapid surface runoff and lower water tables.

Jockvale soils are moderately permeable and have a low moisture holding capacity. High water tables are responsible for poorly and very poorly drained soil conditions, and result from impermeable substratum and lateral seepage from surrounding soils with higher elevations. Surface runoff is slow in these situations.

Soil Landscape Units Eights units were identified in the Jockvale association. They are described as follows:

		Recognized Subgroups	Recognized Series
J1:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils found on nearly level to very gently sloping or undulating topography. Slopes range from 1 to 5%.	Orthic Melanic Brunisols (well)	Jockvale
		Gleyed Melanic Brunisols (imperfect)	Stapledon

(Continued on Page 46)

	Recognized Subgroups	Recognized Series
J2: Dominantly imperfectly drained soils generally found on nearly level topography. Slopes are 2% or less.	Gleyed Melanic Brunisols	Stapledon
J3: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on nearly level to very gently sloping or undulating topography. Slopes are 2% or less.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	Stapledon Vaudreuil
J4: Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on nearly level topography. Slopes are 2% or less.	Orthic Humic Gleysols (poor) Gleyed Melanic Brunisols (imperfect)	Vaudreuil Stapledon
J5: Dominantly poorly drained soils found on level or nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	Vaudreuil
J6: Dominantly very poorly drained soils, often having peaty surfaces, and found on level or depressional topography. Slopes are less than 2%.	Rego Gleysols	
J7: Dominantly well-drained soils found on very gently to gently sloping topography usually in the form of sand knolls. Slopes range from 2 to 9%.	Orthic Melanic Brunisols	Jockvale
J8: Dominantly well-drained soils in combination with significant areas of poorly drained soils found on very gently undulating topography. Slopes range from 1 to 5%.	Orthic Melanic Brunisols (well) Orthic Humic Gleysols (poor)	Jockvale Vaudreuil

Taxonomic Components The well-drained **Jockvale** series (Orthic Melanic Brunisol subgroup) has dark brown to very dark grayish brown surface horizons which have granular structure. Weathered subsoils are dark yellowish brown to yellowish red, and have single grain structure. Parent material is yellowish brown to light yellowish brown in color, and also has single grain structure. Fine sand and loamy fine sand textures dominate most profiles including the surface.

The imperfectly drained **Stapledon** series (Gleyed Melanic Brunisol subgroup) is subject to water saturation for short periods. Profile characteristics are similar to those of the Jockvale series except for slightly darker surface horizons and the presence of distinct to prominent, yellowish brown to strong brown mottles in the B and C horizons.

The poorly drained **Vaudreuil** series (Orthic Humic Gleysol subgroup) is subject to water saturation for much of the growing season due to its level topography or depressional position. It has a very dark grayish brown to dark gray surface horizon with granular structure. Underlying B and C horizons are grayish brown to gray in color, and structure is single grain. Prominent yellowish brown to strong brown mottles are common below the surface horizon. Textures are similar to those comprising the better drained series.

The very poorly drained **Rego Gleysols** have a year round water table which is at or near the surface. They have been left unnamed due to their limited extent. These soils may have well to moderately well decomposed black peaty surface horizons which are less than 40 cm thick. If peat material has not accumulated at the surface, mineral surface horizons are very dark grayish brown to black. Structure throughout the profile is single grain, and textures again are similar to previously described components.

Mapped Soil Combinations Jockvale soils were most often mapped in combination with soils of the Manotick, Ironside, and Osgoode associations. Approximately 1,400 ha were mapped with these associations in almost equal proportions. Some other soil associations which were mapped in combination with the Jockvale association include the Grenville, Oka, and Kars associations.

General Land Use Jockvale soils have low inherent fertility. Also, well-drained soils tend to be droughty during periods of low rainfall, while poorly drained soils are limited by excessive wetness. For these reasons, Jockvale soils require careful management for growing annually cultivated field crops.

Present land use comprises a mix of agricultural and non-agricultural uses. Jockvale soils not overly restricted by excessive wetness are commonly utilized in hay and cereal grain production. Other sites, especially those that are poor and very poorly drained, remain forested or exist as scrub or abandoned farmland.

Correlation to Ottawa Urban Fringe In the survey area, Jockvale soils have the same modes of deposition as in the Ottawa Urban Fringe but they may overlie a number of different materials such as marine clay, consolidated bedrock, glacial till, or glaciofluvial gravel. The underlying material was not differentiated. In the Urban Fringe area, Jockvale parent materials have mainly been deposited on marine clay by water which was becoming progressively shallower.

A wider range in soil reaction consisting of neutral to medium acid occurs in Jockvale soils in the survey area. This difference is not significant for soil taxonomy or interpretation purposes.

KARS (K)

Location and Extent Soils included in the Kars association are not broadly distributed across the survey area. The most extensive area is found in Osgoode Township along the ridge of glaciofluvial material which begins at South Gloucester in the north and extends southward through the hamlet of West Osgoode. The next most extensive area occurs in West Carleton and Goulbourn Townships along a ridge of similar material which extends in a northwest-southeast direction through the village of Stittsville. Less extensive areas also occur in Cumberland Township near the village of Sarsfield, and in West Carleton Township near the village of Galetta. Approximately 2,900 ha of Kars soils were mapped.

Landform and Topography Most of the soils of the association have developed on ridges of marine modified glaciofluvial material which are fairly low in relief. The original ridges of glaciofluvial material deposited during glaciation were subsequently reworked to varying degrees by marine wave action during the Champlain Sea inundation. The result in most cases was a smoothing of the landscape. Shore formations such as strandlines, gently sloping beaches, and occasional stone and boulder pavements indicate that marine modification has been extensive in some areas. Materials of these formations have been derived mostly from the original ice contact glaciofluvial deposits. Slopes range from 2 to 9% in most landscapes.

Soil Materials Kars soil materials are quite thick and they are commonly mined for aggregate to depths exceeding 5 m. At the surface they are moderately coarse to coarse textured, and in the underlying weathered subsoil and parent material they are coarse textured. A considerable coarse fragment content occurs throughout, with the volume often exceeding 50% in the parent material at depth. Although primarily of Paleozoic sedimentary bedrock origin, a significant portion of the coarse fragments have also originated from Precambrian igneous and metamorphic bedrock.

The parent materials of the association consist of coarse sand and loamy coarse sand matrix material with rounded cobble and gravel sized coarse fragments. Coarse fragment content usually exceeds 20% by volume. Some soils included in the association, however, have parent materials which have a low coarse fragment content and are predominantly coarse sand or loamy coarse sand. Coarse fragment content in these soils is less than 20% by volume. The K3, K4, and K5 soil landscape units represent soils with this material variation. In all soils comprising the association, the parent material has a coarse sand or loamy coarse sand matrix which is moderately calcareous, dark brown to dark yellowish brown in color, and neutral to mildly alkaline in reaction. Materials at the surface commonly have a coarse sandy loam or loamy coarse sand matrix and similar sized coarse fragments.

Surface stoniness is usually present to some extent on the majority of Kars association soils. Surfaces are most often slightly to moderately stony, with less than 3% surface coverage by stones having a diameter of 15 cm or more. Less frequently, very stony surface conditions occur in which stones of similar size cover 3 to 15% of the surface.

Soil Moisture Characteristics Approximately 80% of all Kars soils are rapidly to well-drained. These soils are rapidly permeable and as a result there is virtually no surface water runoff. Water holding capacity is low contributing to droughtiness. Imperfectly or poorly drained soils constitute the remaining portion of the soils in the association. Although highly permeable, these soils remain saturated for significant periods during the growing season due to high water tables influenced by surface runoff and groundwater discharge from surrounding soils.

Soil Landscape Units Five units were identified in the Kars association. They are described as follows:

		Recognized Subgroups	Recognized Series
K1:	Dominantly rapidly to well-drained soils found on very gently to gently sloping topography. Slopes range from 2 to 9%.	Eluviated Melanic Brunisols	Kars
K2:	Dominantly imperfectly to poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Gleyed Eluviated Melanic Brunisols (Imperfect) Orthic Humic Gleysols (Poor)	
K3:	Dominantly rapidly to well-drained soils found on very gently to gently sloping topography. Slopes range from 2 to 9%. Parent materials are predominantly mildly alkaline coarse sands.	Eluviated Melanic Brunisols	
K4:	Dominantly imperfectly to poorly drained soils found on nearly level to very gently sloping topography. Slopes range from 1 to 3%. Parent materials are predominantly mildly alkaline coarse sands.	Gleyed Eluviated Melanic Brunisols (Imperfect) Orthic Humic Gleysols (Poor)	
K5:	Dominantly rapidly to well-drained soils found on very gently to gently sloping topography. Slopes range from 2 to 9%. Parent materials are mildly alkaline coarse sand interbedded with layers of gravel having variable thickness.	Eluviated Melanic Brunisols	

Taxonomic Components The rapidly to well-drained **Kars** series (Eluviated Melanic Brunisol subgroup) has a high gravel content and constitutes the K1 soil landscape unit. These soils have a very dark grayish brown Ap horizon, 15 to 25 cm thick, with weak granular structure. The underlying Bm and Btj horizons are strong brown to dark brown in color and have weak granular structure. The illuvial Btj horizons have a slightly higher clay content but are not easily recognizable. Well defined lighter colored Ae horizons are seldom present in these soils. Texture of the upper A and B horizons is commonly gravelly coarse sandy loam. Reaction in these horizons is neutral to mildly alkaline and they are also weakly calcareous. The underlying parent material or Ck horizons range from yellowish brown to gray in color and they are also neutral to mildly alkaline in reaction. Coarser textures and higher gravel contents are evident, with the most common texture being very gravelly coarse sand. Structure is single grain. Due to the high percentage of limestone and dolomite coarse fragments, the parent material is also moderately to very strongly calcareous.

The imperfectly drained **Gleyed Eluviated Melanic Brunisols** constituting part of the K2 soil landscape unit occur very infrequently. They are similar to the Kars series in most profile characteristics except for the presence of distinct to prominent mottles within 50 cm of the surface. Their lower slope position at the base of ridges contributes to periodic water saturation during the growing season.

The poorly drained **Orthic Humic Gleysols** composing the remainder of the K2 soil landscape unit also occur infrequently and are differentiated from the better drained soils on the basis of light gray to light olive gray colors occurring within 50 cm of the surface. These soils remain saturated for significant periods during the growing season.

The rapidly to poorly drained soils of the K3, K4, and K5 soil landscape units have similar colors, horizonation, and taxonomy to those previously described, but differ significantly in material composition. They are predominantly coarse sand and have a much lower coarse fragment content than those comprising the K1 and K2 soil landscape units. Except for the K5 unit which may have interbedded layers of gravelly material, coarse fragment content in the parent material of these soils usually ranges from 10 to 20%.

Approximately 75% of the soils of the association have a high coarse fragment content which mainly consists of rounded cobble and gravel size fragments. These soils are considered to be representative of the association. The less gravelly soils of the remaining 25% of the association are variants which were included in the association due to their limited extent.

Mapped Soil Combinations Approximately 800 ha or 27% of the soils of the association were mapped in combination with soils of other associations. Of this total, 500 ha were mapped as the dominant component and 300 ha were mapped as the significant component. A single map unit consisting of Kars-Uplands in Osgoode Township accounted for most of the soils mapped as the dominant component. The U15 soil landscape unit in that combination had a high proportion of coarse sand and 10 to 20% gravel in the upper part of the profile. When mapped as the significant component, half of the soils occur in Grenville-Kars combinations. This combination reflects the generally close proximity of the glaciofluvial materials to unsorted till deposits.

General Land Use Kars parent materials have good aggregate potential and considerable mining of these deposits has occurred and is likely to continue for some time. Open gravel pits are common in areas in which Kars soils have been mapped.

Intensive agricultural use of Kars soils is generally not practical due to: (1) surface stoniness and low fertility in most soils; and (2) droughtiness when the soils are rapidly to imperfectly drained. Some cereal grains and corn are grown, but agricultural use is mainly confined to that of hay production and permanent pasture.

Correlation to Ottawa Urban Fringe Kars soils mapped in the survey area are more variable than those which occur in the Ottawa Urban Fringe. Some soils lack the high gravel content which is normally found in highly representative Kars soils. In order to incorporate this variation in materials, the K3, K4, and K5 soil landscape units were added to the association in this survey. In addition, imperfectly and poorly drained soils were identified along the lower flanks of the glaciofluvial ridges in this survey. In the Urban Fringe survey, only very poorly drained peaty Rego Gleysols were mapped in this landscape position as part of the K2 landscape unit. The K2 unit was therefore redefined in this survey to better represent the broader range of drainages which are present in the soils which occur in lower landscape positions.

LEITRIM (L)

Location and Extent Leitrim soils occur in each of the three map areas of the survey, but their extent is quite limited. Approximately 1,900 ha of Leitrim soils were mapped, with nearly 75% of this total occurring in Cumberland Township.

Landform and Topography Leitrim soils have developed on shaly morainal material overlying shale bedrock. The topography is most often ridged or undulating, with slopes ranging from 1 to 9%. Due to the inundation of the Champlain Sea after glaciation, many Leitrim soils have been modified by wave action resulting in the removal to varying degrees of finer material. Wave action also formed some beach ridges and terraces. Leitrim soils are relatively shallow and their surface expression generally conforms to that of the underlying bedrock.

Soil Material Leitrim soil materials are medium to moderately coarse textured and have a considerable coarse fragment content consisting of gravel sized shale. Paleozoic shale bedrock of a similar type underlies the material, usually at a depth of 1 to 2 metres. Occasionally some gravel and stone sized coarse fragments of granite, gneiss, limestone, sandstone, or dolomite are also present in the material.

The parent material of Leitrim soils is variable in color and slightly to strongly acid in reaction. Texture is most often gravelly to very gravelly loam, sandy loam, or coarse sandy loam, with the very gravelly modifier the most predominant. Leitrim soils included in the association have been derived from and generally overlie a number of shale bedrock formations. Soil color and coarse fragment type are therefore directly related to the shale composing these formations. In Cumberland Township, Leitrim soils were mapped on the black and brown shale of the Billings Formation, the gray shale of the Carlsbad Formation, and the red shale of the Queenston Formation. In the City of Kanata and West Carleton Township, they were primarily mapped on the Rockcliffe Formation consisting of gray-green shale with lenses of sandstone. In these latter townships they were also mapped to a lesser extent on the Ottawa Formation which consists of limestone with gray shale partings.

Leitrim materials at the surface usually have textures similar to the underlying parent material. Coarse fragment content, however, tends to be lower and at times is not sufficient to warrant a gravelly or very gravelly modifier.

Surface stones greater than 15 cm in diameter are present on some Leitrim soils but seldom occupy more than 3% of the surface area. When present, surface stones are usually rounded or angular fragments of limestone, sandstone, or dolomite. Due to the soft and easily weathered nature of the shale constituting Leitrim soils, surface stones of that rock type are usually not present.

Soil Moisture Characteristics The majority of Leitrim soils are well-drained, with approximately 1,270 hectares or 68% of all Leitrim soils classified as such. About 530 hectares or 28% were classified as imperfectly drained, while only 77 hectares or 4% of all Leitrim soils mapped were poorly drained.

On well and imperfectly drained sites, surface water runoff is slow to moderate. On level to depressional poorly drained sites, runoff is slow. Leitrim soils are highly permeable and have moderate to low moisture holding capacities due mainly to their high gravel content.

Soil Landscape Units Eights units were identified in the Leitrim association. They are described as follows:

		Recognized Subgroups	Recognized Series
L1:	Dominantly well-drained soils derived from black shale and found on very gently to gently sloping topography. Slopes range from 2 to 9%.	Orthic Melanic Brunisols	French Hill
L2:	Dominantly imperfectly drained soils derived from black shale and found on nearly level topography. Slopes range from 1 to 2%.	Gleyed Melanic Brunisols	
L3:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils, both being derived from black shale. Topography is very gently to gently sloping with slopes ranging from 2 to 9%.	Orthic Melanic Brunisols (well) Gleyed Melanic Brunisols (imperfect)	French Hill (well)
L4:	Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils, both being derived from black shale. Found on very gently sloping topography, with slopes ranging from 2 to 5%.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	
L5:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils, both being derived from red shale. Topography is very gently to gently sloping, with slopes ranging from 2 to 9%.	Orthic Melanic Brunisols (well) Gleyed Melanic Brunisols (imperfect)	Vars
L7:	Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils, both being derived from gray shale. Topography is nearly level, with slopes ranging from 1 to 2%.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	
L8:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils, both being derived from gray shale. Topography is very gently sloping, with slopes ranging from 2 to 5%.	Orthic Melanic Brunisols (well) Gleyed Melanic Brunisols (imperfect)	
L9:	Dominantly well-drained soils derived from gray-green shale and found on very gently to gently sloping topography. Slopes range from 2 to 9%.	Orthic Melanic Brunisols	

Taxonomic Components All Leitrim soils were classified at the subgroup level as either Orthic Melanic Brunisols, Gleyed Melanic Brunisols, or Orthic Humic Gleysols. Soils of the association having these classifications, however, can be further differentiated on the basis of the type of shale from which they are derived. Since each shale type has a recognizable color and specific mineralogy, a number of taxonomic soil series are therefore possible. However, due to the limited extent of many of the soils of the association, series names were given for only the most commonly occurring soils.

The well-drained **French Hill** series (Orthic Melanic Brunisol subgroup) is derived from black shale of the Billings Formation. These soils have a black surface horizon, dark brown weathered subsoils, and dark reddish brown parent materials. Subsoil and parent material structures are granular to structureless, reflecting the high amount of gravel sized shale fragments which usually exceeds 50% by volume.

The imperfectly drained **Gleyed Melanic Brunisols** derived from black shale were not given a series name due to their limited extent. These soils are subject to short periods of saturation during the growing season, and possess similar gravel contents and duller grayish colors in the subsoil and parent material than the French Hill series. Distinct to prominent mottles are present within 50 cm of the surface.

The poorly drained **Orthic Humic Gleysols** derived from black shale occupy low landscape positions and remain saturated for extended periods during the growing season. Gravel content is similar to the well and imperfectly drained soils previously described. Gley colors are not well expressed in these soils, with color of the subsoil and parent material being similar to those found in the imperfectly drained soils. Prominent mottles, however, are present within 50 cm of the surface.

The well-drained **Vars** series (Orthic Melanic Brunisol subgroup) is derived from red shale of the Queenston Formation. These soils possess loam and sandy loam textures and gravel sized shale fragments which often exceed 50% by volume. Soil structure is weak granular throughout the profile. Colors are dark reddish brown in the surface horizon, and reddish brown to dark reddish brown in the subsoil and parent material.

The imperfectly drained **Gleyed Melanic Brunisols** derived from red shale are very limited in extent and are subject to short periods of saturation during the growing season. These soils have profile characteristics similar to the Vars series except for slightly duller colors and distinct to prominent mottles within 50 cm of the surface.

Leitrim association soils derived from gray shales were also not given series names due to their limited extent. The well, imperfect, and poorly drained soils derived from the gray shale of the Carlsbad and Ottawa Formations have subgroup classifications similar to the soils previously described. They differ from those soils, however, by having more brownish matrix colors and a coarse fragment content which is best described as channery. The gray shale fragments of these soils are flat and angular, and they are harder and not as easily weathered as the black and red shale comprising the previously described soils. Due to their harder nature the fragments tend to be quite large, with sizes ranging up to 15 cm in diameter.

The well-drained **Orthic Melanic Brunisols** derived from gray-green shale of the Rockcliffe Formation were also not given a series name due to their limited extent. These soils are similar in most profile characteristics to the French Hill series except for greenish gray profile colors. Coarse fragments in these soils consist of soft, gravel sized shale fragments which are greenish gray in color.

Mapped Soil Combinations Leitrim soils were mapped in combination with soils of other associations on approximately 660 ha. Of this total they were most commonly mapped as the dominantly occurring soil, with 600 ha mapped in combinations of this type. When mapped as the dominant landscape component, approximately 270 ha were mapped with soils of the Ironside and Chateauguay associations. Specific landscape units of those associations included the I4, I5, and CH6 units in which the material underlying the sandy or clayey veneer was Leitrim till rather than Grenville till. Landscapes represented by these combinations, therefore, consist of shaly Leitrim materials which are intermittently overlain by sandy or clayey veneers 40 to 100 cm thick.

Some Leitrim soils derived from gray-green shale were mapped as a shallow phase because hard sandstone bedrock was present at a depth of 50 to 100 cm. Approximately 200 ha of these soils were mapped as the dominant soil in combinations with soils of the Nepean association.

General Land Use Leitrim soils are used for a variety of agricultural uses which include corn, cereal grain, and hay production as well as grazing and pasture. The most common of these uses are hay production and pasture. A small proportion of Leitrim soils remain forested.

Correlation to Ottawa Urban Fringe In the Ottawa Urban Fringe soils of the Leitrim association were derived from the brown Lorraine shale of the Carlsbad Formation. In this survey area, soils of the association have been derived from black, red, gray, and gray-green shale. Also, since shaly soils derived from brown shale were not encountered in the survey area, only the general parent material concept of the Leitrim association was retained. The Leitrim series and other association components identified in the Ottawa Urban Fringe are therefore only applicable to that area.

The Ellwood association identified in the Ottawa Urban Fringe was not mapped in this survey. Since the loam to clay loam shaly till constituting that association is very limited in the survey area, the few soils which occur that have developed on those materials were included in the Leitrim association.

LEMIEUX (LE)

Location and Extent Soils comprising the Lemieux association occur only in Cumberland Township and occupy a small area of what has been called the Mer Bleue Bog. Due to differences in landform and soil material, these soils were differentiated from the Mer Bleue association soils which occupy the greatest portion of the bog. Approximately 60 ha of Lemieux soils were mapped.

Landform and Topography The Lemieux association is comprised of organic soils which are found in horizontal fens. The topography is level or nearly level, with slopes being 1% or less.

Soil Material Soils included in the association consist of organic material greater than 160 cm in depth which is underlain by clayey mineral material. The organic material consists entirely of sedge fen peat.

At the surface a moderately decomposed or mesic sedge fen peat layer is present which is dark reddish brown in color and variable in thickness. Well decomposed or humic sedge fen peat which is black in color occurs beneath the less decomposed surface material. Soil reaction is extremely acid in the upper peat layer, and strongly to very strongly acid in the underlying peat material. The sedge fen peat of both portions of the profile has mainly been derived from sedge type plants.

The underlying mineral material has clay textures and is gray in color.

Soil Moisture Characteristics Lemieux soils are poorly to very poorly drained, with the water table at or near the surface for most of the year.

Soil Landscape Units One unit was identified in the Lemieux association. It is described as follows:

	Recognized Subgroups	Recognized Series
LE1: Dominantly poorly to very poorly drained soils found on level or nearly level topography. Slopes are 1% or less.	Humic Mesisols Mesic Humisols	Lemieux

Taxonomic Components Due to the variable depth of mesic material overlying humic material, soils of the association may belong to either of the **Humic Mesisol** or **Mesic Humisol** subgroups. The **Lemieux** series (Humic Mesisol subgroup) was previously recognized and established as a series within the province.

Mapped Soil Combinations All Lemieux soils which occur were mapped in combination with soils of the Mer Bleue association. They were mapped as the significant component in combination with Mer Bleue soils in a map area which covers 151 ha.

all Leitrim soils classified as such. About 530 hectares or 28% were classified as imperfectly drained, while only 77 hectares or 4% of all Leitrim soils mapped were poorly drained.

On well and imperfectly drained sites, surface water runoff is slow to moderate. On level to depressional poorly drained sites, runoff is slow. Leitrim soils are highly permeable and have moderate to low moisture holding capacities due mainly to their high gravel content.

Soil Landscape Units Eights units were identified in the Leitrim association. They are described as follows:

		Recognized Subgroups	Recognized Series
L1:	Dominantly well-drained soils derived from black shale and found on very gently to gently sloping topography. Slopes range from 2 to 9%.	Orthic Melanic Brunisols	French Hill
L2:	Dominantly imperfectly drained soils derived from black shale and found on nearly level topography. Slopes range from 1 to 2%.	Gleyed Melanic Brunisols	
L3:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils, both being derived from black shale. Topography is very gently to gently sloping with slopes ranging from 2 to 9%.	Orthic Melanic Brunisols (well) Gleyed Melanic Brunisols (imperfect)	French Hill (well)
L4:	Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils, both being derived from black shale. Found on very gently sloping topography, with slopes ranging from 2 to 5%.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	
L5:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils, both being derived from red shale. Topography is very gently to gently sloping, with slopes ranging from 2 to 9%.	Orthic Melanic Brunisols (well) Gleyed Melanic Brunisols (imperfect)	Vars
L7:	Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils, both being derived from gray shale. Topography is nearly level, with slopes ranging from 1 to 2%.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	
L8:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils, both being derived from gray shale. Topography is very gently sloping, with slopes ranging from 2 to 5%.	Orthic Melanic Brunisols (well) Gleyed Melanic Brunisols (imperfect)	
L9:	Dominantly well-drained soils derived from gray-green shale and found on very gently to gently sloping topography. Slopes range from 2 to 9%.	Orthic Melanic Brunisols	

Taxonomic Components All Leitrim soils were classified at the subgroup level as either Orthic Melanic Brunisols, Gleyed Melanic Brunisols, or Orthic Humic Gleysols. Soils of the association having these classifications, however, can be further differentiated on the basis of the type of shale from which they are derived. Since each shale type has a recognizable color and specific mineralogy, a number of taxonomic soil series are therefore possible. However, due to the limited extent of many of the soils of the association, series names were given for only the most commonly occurring soils.

The well-drained **French Hill** series (Orthic Melanic Brunisol subgroup) is derived from black shale of the Billings Formation. These soils have a black surface horizon, dark brown weathered subsoils, and dark reddish brown parent materials. Subsoil and parent material structures are granular to structureless, reflecting the high amount of gravel sized shale fragments which usually exceeds 50% by volume.

The imperfectly drained **Gleyed Melanic Brunisols** derived from black shale were not given a series name due to their limited extent. These soils are subject to short periods of saturation during the growing season, and possess similar gravel contents and duller grayish colors in the subsoil and parent material than the French Hill series. Distinct to prominent mottles are present within 50 cm of the surface.

The poorly drained **Orthic Humic Gleysols** derived from black shale occupy low landscape positions and remain saturated for extended periods during the growing season. Gravel

Mapped Soil Combinations Approximately 200 ha of Malakoff soils were mapped in combination with soils of other associations. Two combinations were mapped, with Malakoff soils being mapped as the dominant component with soils of the Goulbourn and Rideau soil associations.

A transition zone is frequently present between the sandy veneer and the underlying marine material. Most often it is a thin layer which is a mixture of the upper sandy material and the underlying heavier textured material. Textures are commonly fine sandy loam or sandy loam. Transition layers having content is similar to the well and imperfectly drained soils previously described. Gley colors are not well expressed in these soils, with color of the subsoil and parent material being similar to those found in the imperfectly drained soils. Prominent mottles, however, are present within 50 cm of the surface.

The well-drained **Vars** series (Orthic Melanic Brunisol sub-

red, gray, and gray-green shale. Also, since shaly soils derived from brown shale were not encountered in the survey area, only the general parent material concept of the Leitrim association was retained. The Leitrim series and other association components identified in the Ottawa Urban Fringe are therefore only applicable to that area.

silt loam and loam textures may also occur which are the result of deposition which has taken place in progressively shallower waters.

The underlying heavier textured parent material corresponds to parent materials of either the North Gower, Dalhousie, Rideau, or Bearbrook soil associations. It ranges in color from reddish brown (Bearbrook) to light olive gray (North Gower, Dalhousie, Rideau) and is predominantly noncalcareous.

Soil Moisture Characteristics Manotick soils are dominantly poorly drained. Moderately well, imperfect, and very poorly drained members also occur but less extensively. Approximately 70% of all Manotick soils mapped were poorly drained. Moderately well to imperfectly drained soils are found on the crests and upper slopes of sand dunes and fluvial sandbars. The higher elevations of these sand knolls are responsible for the better drained soil conditions. Poorly and very poorly drained soils are found on level to very gently sloping or undulating terrain with persistent high water tables.

The upper sandy veneer of Manotick soils is moderately to rapidly permeable. Downward water movement can be impeded somewhat by the clayey subsoil which is slowly to moderately permeable. Moisture holding capacity is moderate to low due to the variable depth of the clayey subsoil. During times of low rainfall, droughtiness may be a problem due to the low moisture holding capacity of the sandy veneer. Surface runoff is slow.

Soil Landscape Units Six units were identified in the Manotick association. They are described as follows:

	Recognized Subgroups	Recognized Series
M1: Dominantly well to moderately well drained soils in combination with significant areas of imperfectly drained soils found on very gently to gently sloping undulating topography. Slopes range from 2 to 6%.	Orthic Sombric Brunisols (well, mod. well) Gleyed Sombric Brunisols (imperfect)	Manotick Mountain
M3: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on nearly level to very gently undulating topography. Slopes range from 1 to 5%.	Gleyed Melanic Brunisols (imperfect) Gleyed Sombric Brunisols (imperfect) Gleyed Humo-Ferric Podzols (imperfect) Orthic Humic Gleysols (poor)	Becketts Creek Mountain St. Damase Allendale
M4: Dominantly imperfectly drained soils found on nearly level to very gently sloping or undulating topography. Slopes range from 1 to 5%.	Gleyed Melanic Brunisols Gleyed Sombric Brunisols Gleyed Humo-Ferric Podzols	Becketts Creek Mountain St. Damase
M5: Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on predominantly level or nearly level topography but having some very slightly inclined areas. Slopes are 2% or less.	Orthic Humic Gleysols (poor) Imperfectly drained subgroups and series same as M4.	Allendale
M6: Dominantly poorly drained soils found on level or nearly level topography. Slopes are 2% or less.	Orthic Humic Gleysols	Allendale
M7: Dominantly very poorly drained soils found on level, nearly level, or depressional topography. Slopes are less than 2%.	Rego Gleysols	

Taxonomic Components The well to moderately well-drained **Manotick** series (Orthic Sombric Brunisol subgroup) is very limited in extent. These soils have very dark grayish brown to dark brown surface horizons with granular structure. Weathered B horizons are strong brown to yellowish brown and structure is single grain. A thin light olive brown BC horizon also with single grain structure frequently overlies the clayey substratum. Fine sand, loamy fine sand, and sand textures prevail in the B and BC horizons. Surface horizons tend to have a slightly higher silt and clay content, with textures commonly fine sandy loam, sandy loam, or loamy fine sand. Color, texture, and structure of the underlying marine material are consistent with those which describe the parent materials of the North Gower, Dalhousie, Rideau, or Bearbrook soil associations.

Three different taxonomic components are possible and were recognized for Manotick soils which are imperfectly drained. Of the three components, however, some occur more frequently than others. The imperfectly drained **Becketts Creek** series (Gleyed Melanic Brunisol subgroup) occurs most frequently. It is found on mid to lower slopes and is subject to water saturation for short periods during the growing season. These soils have very dark grayish brown to dark brown surface horizons which may have either granular or weak subangular blocky structure. Weathered B horizons of the sandy veneer are dark yellowish brown, and the parent material is usually slightly lighter in color. Structure in the subsoil of the veneer is single grain. The underlying marine material is similar to the parent material of the North Gower, Dalhousie, Rideau, or Bearbrook soil associations. Distinct to prominent dark brown to strong brown mottles are present in the subsoil of the sandy veneer. Prominent dark yellowish brown to brownish yellow mottles are common in the heavier textured marine subsoil.

The imperfectly drained **Mountain** series (Gleyed Sombric Brunisol subgroup) is quite common but does not occur as frequently as the Becketts Creek series. Mountain series profile characteristics, with the exception of lower pH in the upper profile, are similar to the Becketts Creek series.

The imperfectly drained **St. Damase** series (Gleyed Humo-ferric Podzol subgroup) occurs only occasionally and its extent is quite limited. These soils differ from the Becketts Creek series by having weathered Bf horizons in the sandy veneer which are yellowish red to reddish brown in color and have been enriched with iron and aluminum in combination with organic matter. Usually, strongly cemented yellowish red iron concretions are present in the enriched Bf horizons. Thin, light gray Ae horizons may overlay the Bf horizons if they have not been destroyed through plowing.

The poorly drained **Allendale** series (Orthic Humic Gleysol subgroup) is subject to water saturation for much of the growing season. Surface horizons are very dark brown to black and have granular structure. They are usually thicker and have a higher organic matter content than the better drained soils of the association. Subsoil colors of the sandy veneer grade from pale brown or grayish brown near the surface to olive gray and gray at depth. Prominent reddish brown to dark yellowish brown mottles are common and structure is single grain. The underlying heavier textured marine material may have subangular blocky to massive structure, and colors similar to poorly drained parent materials of the previously mentioned soil associations.

The **Rego Gleysols** usually have peaty surfaces and have water tables at or near the surface throughout the year. When present, the peaty surface is 15 to 40 cm thick and is well decomposed. The underlying sandy subsoil is commonly olive gray to light gray in color, and has single grain structure. Structure of the underlying heavier textured subsoil is massive.

Mapped Soil Combinations Manotick soils were most commonly mapped in combination with soils of the North Gower, Dalhousie, Rideau, and Bearbrook soil associations. Approximately 2,000 ha of Manotick soils were mapped in combination with those soils. The Manotick soils found in these soil combinations consist of: (1) sand knolls separated by the clayey soils in level to depressional areas, or (2) uniform areas occurring adjacent to clay plains and requiring map combinations due to scale limitations.

Less common but significant areas of Manotick soils were mapped in combination with soils of the Jockvale, St. Thomas, and Uplands soil associations. Approximately 800 ha were mapped in combination with those soils. The Manotick soils found in these soil combinations usually occupy transitional areas between deep sand deposits in the form of dunes or ridges, and level marine clay plains which occur in close proximity.

General Land Use Manotick soils are most often used for improved pasture and hay production. Hay crops usually consist of a mixture of legumes and grass and are part of a cropping system in which cereal grains are also grown. When used for improved pasture a mixture of grasses (timothy, brome, orchard) is usually grown.

Some grazing is also carried out on Manotick soils. In this instance, uncultivated native grasses often occur. Only occasionally are more intensive cropping systems found on Manotick soils.

Correlation to Ottawa Urban Fringe Manotick soils in the area correlate quite well to those found in the Ottawa Urban Fringe map area. There is, however, a difference in the thickness of the sandy veneer. In the Urban Fringe area the veneer ranges from 25 to 100 cm thick, while in this survey the veneer ranges from 40 to 100 cm thick. A narrower range in veneer thickness was applied in order to conform to recent classification guidelines. As a result, some Manotick soils in the Urban Fringe area would not be mapped as Manotick soils in this survey. Rather, they would be mapped as heavier textured marine soils with coarse textured surface phases (15 to 40 cm of significantly coarser material at the surface).

MER BLEUE (MB)

Location and Extent Soils included in the Mer Bleue association occur only in Cumberland Township and occupy the most easterly portion of the Mer Bleue Bog. Approximately 200 ha of Mer Bleue soils were mapped.

Landform and Topography The Mer Bleue association is comprised of organic soils which are found in either flat, basin, or domed bogs. The topography is level or very slightly inclined, with slopes generally 1% or less.

Soil Material Mer Bleue soil materials consist of greater than 160 cm of sphagnum moss and fen peat overlying clayey mineral material. The upper 30 to 100 cm of organic material is sphagnum moss, while the remainder is fen peat.

The upper layer of sphagnum moss is undecomposed or fibric, and is dark reddish brown to dark brown in color. Rubbed fibre content ranges from 42 to 80%. Soil reaction is extremely acid. Althoughly mainly comprised of sphagnum moss, a small proportion also consists of woody material derived from ericaceous shrubs and tree species such as black spruce and tamarack.

The secondary or underlying layer of fen peat may be either woody fen peat or sedge fen peat. Occasionally, a combination of the two may comprise this peat material. Regardless of origin, it is most often moderately decomposed or mesic with rubbed fibre content ranging from 10 to 34%. However, at times well decomposed or humic peat with a rubbed fibre content less than 10% may comprise a significant portion of the fen material. Soil reaction of the fen peat is strongly to extremely acid. The woody fen peat when present is mainly comprised of stem, branch, and root fragments derived from woody tree species such as tamarack. A significant portion also consists of sedge material comprising the remains of sedge leaves and roots along with some cotton grass remains.

The mineral substratum has clayey textures and is greenish gray to gray in color. Soil reaction is neutral to slightly acid.

Soil Moisture Characteristics Mer Bleue soils are poorly to very poorly drained, with the water tables at or near the surface for most of the year. Groundwater accretion is mainly due to precipitation. The groundwater is generally acidic and nutrient poor.

Soil Landscape Units One unit was identified in the Mer Bleue association. It is described as follows:

	Recognized Subgroups	Recognized Series
MB1: Dominantly poorly to very poorly drained soils found on level or nearly level topography. Slopes are 1% or less.	Typic Mesisols (sphagnic phase)	Mer Bleue
	Fibric Mesisols (sphagnic phase)	Blackburne

Taxonomic Components The poorly to very poorly drained **Mer Bleue** series (Typic Mesisol subgroup) is the most commonly occurring soil within the association. The upper layer of fibric peat material is usually less than 65 cm in thickness, and is dominantly comprised of sphagnum moss.

The poorly to very poorly drained **Blackburne** series (Fibric Mesisol subgroup) occurs less often than the Mer Bleue series. It differs from the Mer Bleue series by having a deeper layer of fibric peat material at the surface of 65 to 100 cm thickness.

Mapped Soil Combinations Mer Bleue soils were only mapped in combination with soils of the Lemieux association. In that combination, they were mapped as the dominant component in a total map area covering approximately 90 ha.

General Land Use Mer Bleue soils consist of wetland in which the surface vegetation is predominantly sphagnum moss and Ericaceous shrubs, with patches of black spruce and tamarack also present.

Correlation to Ottawa Urban Fringe Soils included in the Mer Bleue association for the survey area are similar to soils mapped in the Ottawa Urban Fringe survey with two exceptions. First, soils having less than 160 cm of organic material over the mineral substratum were not included or described, although minor occurrences of such soils may occur. And secondly, an additional taxonomic component (Fibric Mesisol) occurs which was not described in the Ottawa Urban Fringe.

MILLE ISLE (MI)

Location and Extent Soils of the Mille Isle association occur mainly in West Carleton Township. A significant but less extensive amount also occurs in Osgoode Township. In West Carleton Township, the two areas with the greatest concentration of Mille Isle soils are: (1) south of the village of Carp along Highway 17; and (2) north and northeast of the hamlet of Dunrobin bordering Constance Creek. In Osgoode Township, areas of Mille Isle soils occur west of the ridge of sand and gravel which extends from the villages of Greely in the north to West Osgoode in the south. Approximately 2,300 ha of Mille Isle soils were mapped, of which approximately 500 ha were mapped in combination with other soils.

Landform and Topography Mille Isle soils have developed on a blanket of coarse textured marine or fluvial material which is usually deeper than 2 m. Materials which underlay the coarse textured material were not differentiated. Most commonly, Mille Isle soils occur on nearshore marine deposits consisting of coarse sands which have been washed from adjacent glaciofluvial deposits. For this reason, they are usually found adjacent to or on the flanks of glaciofluvial ridges. Less frequently, Mille Isle soils also occur on the floors, terraces, and flood plains of abandoned river channels.

The topography of Mille Isle soils ranges from level to gently sloping or undulating. Immediately adjacent to the glaciofluvial ridges they may be slightly inclined. Windblown sand or sandbars usually account for soils with higher elevations, especially in areas with undulating topography. Slopes range from 0 to 9%, with the majority being 2% or less.

Soil Material Soils of the association have parent materials which consist of brownish yellow to grayish brown, noncalcareous coarse sands. Reaction is most commonly slightly to very strongly acidic, although occasionally some were found to be neutral. Weathered B horizons overlying the parent material are strong brown to dark grayish brown in color and strongly to very strongly acid in reaction. Texturally they are also coarse sands. Surface A horizons are dark yellowish brown to black in color, with dominantly loamy coarse sand and coarse sand textures.

Mille Isle materials most often are well sorted but occasionally may contain small amounts of gravel generally less than 2 cm in diameter. Grain size distribution of the sand fraction is quite variable. Coarse sand content of the parent material ranges from 18 to 50%. Significant amounts of very coarse sand ranging from 3 to 26% are also generally present. Combined, coarse and very coarse sand content ranges from 26 to 68%. Medium sand content of the parent material ranges from 21 to 55%.

Soil Moisture Characteristics Excessively to well-drained soils are found on the crests and mid slopes of inclined and undulating topography. Imperfectly drained soils are found in lower slope positions, or depressional sites in areas with undulating topography. Poorly drained soils are found in either depressional sites or low lying landscape positions. Both poorly drained conditions are due to high water tables, which most often are the result of impermeable substrata.

Mille Isle soils are rapidly permeable and have a very low moisture holding capacity. Well to excessively drained soils are generally droughty, while imperfect and poorly drained soils are not mainly due to the presence of high water tables. Surface runoff is slow.

Soil Landscape Units Six units were identified in the Mille Isle association. They are described as follows:

	Recognized Subgroups	Recognized Series
MI1: Dominantly excessive to well-drained soils found on nearly level to very gently sloping or undulating topography. Slopes range from 1 to 5%.	Orthic Dystric Brunisols Orthic Sombric Brunisols	Constance Bay Mille Isle
MI2: Dominantly well-drained soils in combination with significant areas of imperfectly drained soils found on undulating topography. Slopes range from 1 to 5%.	Orthic Sombric Brunisols (well) Orthic Dystric Brunisols (well) Gleyed Sombric Brunisols (imperfect) Gleyed Dystric Brunisols (imperfect)	Mille Isle Constance Bay Herbert Corners
MI3: Dominantly poorly drained soils found on level, nearly level, or depressional topography. Slopes are less than 2%.	Orthic Humic Gleysols	Dunrobin
MI4: Dominantly imperfectly drained soils found on nearly level topography. Slopes are 2% or less.	Gleyed Sombric Brunisols Gleyed Dystric Brunisols	Herbert Corners
MI5: Dominantly excessive to well-drained soils in combination with significant areas of poorly drained soils found on undulating to hummocky topography in which sand knolls dominate. Slopes range from 2 to 9%.	Orthic Sombric Brunisols (well) Orthic Dystric Brunisols (well) Orthic Humic Gleysols (poor)	Mille Isle Constance Bay Dunrobin

	Recognized Subgroups	Recognized Series
MI6: Dominantly poorly drained soils in combination with significant areas of well-drained soils found on undulating topography dominated by broad depressional areas. Slopes are 2% or less.	Orthic Humic Gleysols (poor)	Dunrobin
	Orthic Sombric Brunisols (well)	Mille Isle
	Orthic Dystric Brunisols (well)	Constance Bay

Taxonomic Components Excessive to well-drained soils of the association have surface A horizons which are variable in thickness. The **Mille Isle** series (Orthic Sombric Brunisol subgroup) has a surface A horizon at least 10 cm thick, with very dark grayish brown to black colors. The underlying subsoil grades from strong brown to dark yellowish brown in the upper B horizons, to brownish yellow in the parent material. Structure at the surface is weak subangular blocky, and weak subangular blocky or single grain in the subsoil. The **Constance Bay** series (Orthic Dystric Brunisol subgroup) has a surface A horizon which is less than 10 cm thick. Occasionally it has a thin eluviated Aej horizon which is light reddish brown in color. Across the landscape the Aej horizon is discontinuous. Colors and structure of the surface and subsoil horizons are similar to the Mille Isle series.

The imperfectly drained **Herbert Corners** series (Gleyed Sombric Brunisol subgroup) has a surface A horizon at least 10 cm thick, and is the most common component associated with imperfect drainage conditions. Occasionally the surface is less than 10 cm thick, in which case the soils are classified at the subgroup level as **Gleyed Dystric Brunisols**. Surface A horizons of the Herbert Corners series are dark yellowish brown, and subsoil B horizons are slightly lighter. Parent material color is pale brown. Structure of the profile grades from single grain or weak subangular blocky at the surface to single grain in the parent material. Distinct to prominent strong brown mottles are present in the subsoil.

The poorly drained **Dunrobin** series (Orthic Humic Gleysol subgroup) has a high water table for a major part of the growing season. Surface A horizons are dark reddish brown to black in color, while underlying B horizons are dark brown to dark grayish brown. Parent material is most commonly grayish brown in color, but may occasionally be grayer. Structure throughout the profile is single grain.

Mapped Soil Combinations Mille Isle soils were usually mapped individually. Therefore, repetitive or commonly occurring map combinations with other soils do not occur. The few combinations which do occur were necessary because of scale limitations, or because the separation of individual soils was not feasible.

General Land Use Woodland is the most common land use associated with Mille Isle soils. Significant but less extensive areas consist of abandoned farmland and scrubland. Agriculture in general is not a significant land use, and if present it usually consists of grazing land. In Osgoode Township, however, some specialty agriculture in the form of sod farms and orchards is found on Mille Isle soils.

Correlation to Ottawa Urban Fringe Mille Isle soils mapped in the survey area are similar in most aspects to those in the Ottawa Urban Fringe area. Some additional taxonomic components, however, were identified in the survey area. Also, a wider range in soil reaction occurs which is not significant for interpretation purposes.

NEPEAN (N)

Location and Extent Soils of the Nepean association occur only in the City of Kanata and some adjacent areas of West Carleton Township. Approximately 1,500 ha of Nepean soils were mapped.

Landform and Topography Nepean soils consist of a 10 to 50 cm thick veneer of stony undifferentiated drift material overlying sandstone and quartzite bedrock. The topography is controlled by the underlying bedrock, and is generally nearly level to very gently sloping with slopes ranging from 1 to 5%. Occasionally gently sloping topography is present, with slopes ranging from 6 to 9%. The underlying bedrock may belong to either the Nepean, March, or Rockcliffe formations since each is either entirely or partially composed of sandstone.

Landform characteristics of the Nepean association are similar to those of the Farmington association except that Farmington soils overly limestone and dolomite bedrock.

Soil Material Nepean soil materials are moderately coarse to coarse textured and contain a considerable amount of angular sandstone fragments. In places, some angular or rounded limestone or dolomite fragments have been incorporated from adjacent Farmington or Grenville soils, and there is also a small percentage of rounded stones of Precambrian origin. Although the thickness of Nepean materials ranges from 10 to 50 cm, the majority of materials are quite shallow and often are less than 30 cm thick. For this reason bedrock exposures are common in most Nepean landscapes and may occupy as much as 25% of the area of some map units.

The parent material of Nepean soils is noncalcareous and acidic in reaction. These factors combined with the overall shallowness of the material makes the differentiation of parent material from weathered subsoil difficult. In many soils all of the material overlying bedrock has been weathered and original parent material is not present. Subsoil materials, therefore, are commonly strong brown to yellowish brown in color and slightly to very strongly acid in reaction. Loamy sand textures are most prevalent, with sandy loam and sand textures also occurring but less extensively. Surface textures are slightly finer with sandy loam being the most common. Occasionally silt loam and loam textures also are present at the surface. Coarse fragments primarily consisting of flat angular pieces of sandstone are present throughout the material, but usually constitute less than 20% of the total volume. Some soils, however, have a significantly higher proportion of coarse fragments.

Stones greater than 15 cm in diameter are present on the surface of most Nepean soils. The amount of stones at the surface, however, are quite variable. The majority of soils are slightly to moderately stony, with less than 3% surface coverage of stones. More severe surface stoniness, however, is common on some soils with as much as 50% of the surface covered by stones.

Materials of the Nepean association can be differentiated from those of the Farmington association on the basis of a number of physical and chemical characteristics. Nepean materials generally have a larger proportion of sand and coarser textures. They contain very few limestone or dolomite coarse fragments, with the predominant type of coarse fragment being sandstone. Subsoil materials tend to be lighter in color, and they are acidic rather than neutral to mildly alkaline in reaction. Nepean soils in general also have a thinner veneer of drift material than that normally found in Farmington soils. Bedrock exposures are therefore more common in Nepean landscapes.

Soil Moisture Characteristics More than 90% of the soils of the association are well-drained. Due to the sandy nature and shallowness of the soil material, Nepean soils have a relatively high permeability and low moisture holding capacity. These factors combined with moderate surface runoff rates on steeper slopes make most well-drained soils in those landscape positions subject to periodic droughty conditions.

Soil Landscape Units Four units were identified in the Nepean association. They are described as follows:

	Recognized Subgroups	Recognized Series
N1: Dominantly well-drained soils found on very gently sloping topography. Slopes range from 2 to 5%.	Orthic Sombric Brunisols Orthic Melanic Brunisols	Marchhurst Nepean
N3: Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	Barrhaven
N4: Dominantly well-drained soils in combination with significant areas of imperfectly drained soils found on very gently sloping topography. Slopes range from 2 to 5%.	Orthic Sombric Brunisols (well) Orthic Melanic Brunisols (well) Gleyed Melanic Brunisols (imperfect) Gleyed Sombric Brunisols (imperfect)	Marchhurst Nepean Fallowfield
N5: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Gleyed Melanic Brunisols (imperfect) Gleyed Sombric Brunisols (imperfect) Orthic Humic Gleysols (poor)	Fallowfield Barrhaven

Taxonomic Components The well drained **Marchhurst** series (Orthic Sombric Brunisol subgroup) has a dark brown Ah or Ap surface horizon with granular structure. Weathered subsoils are strong brown to yellowish brown with weak subangular blocky structure. The weathered subsoil depth tends to extend to the bedrock contact. Soil reaction is very strongly to strongly acid. The **Nepean** series (Orthic Melanic Brunisol subgroup) is also well drained. It differs from the Marchhurst series in soil reaction which is slightly to medium acid. This series has a very dark grayish brown surface horizon with granular structure, and completely weathered subsoils which are brown to yellowish brown in color with granular structure. The **Fallowfield** series (Gleyed Melanic Brunisol subgroup) is imperfectly drained and is subject to water saturation for short periods during the growing season. This series is distinguished from the well drained Nepean series by the presence of distinct to prominent mottles in the subsoil.

The imperfectly drained **Gleyed Sombric Brunisols** are also subject to water saturation for short periods of the growing season. Distinct to prominent mottles and somewhat duller matrix colors distinguish these soils from the well drained Marchhurst series. These soils were not assigned a series name due to their very limited extent.

The poorly drained **Barrhaven** series (Orthic Humic Gleysol subgroup) occupies low lying or depressional sites and is saturated for long periods during the growing season. The subsoils have grayish brown matrix colors and prominent mottles.

Mapped Soil Combinations Approximately 1,300 ha or 85% of all Nepean soils were mapped in combination with soils of other associations. Of this total, 1,000 ha were mapped in combinations in which they were the dominant soil, and 300 ha were mapped in combinations in which they occurred only in significant proportions. The Nepean-Farmington combination is the most extensive, with approximately 650 ha of Nepean soils being included. This combination reflects bedrock variations from sandstone (Nepean) to limestone and dolomite (Farmington) which could not be consistently separated given the density of field checking employed. Combinations of Nepean-Queensway were also mapped, with approximately 270 ha of Nepean soils mapped in this way. Soil materials of these associations are quite similar, and this combination reflects variability in depth to bedrock with both deep and shallow soils present in the landscape. Each could not be delineated separately at a map scale of 1:50,000.

Combinations of Farmington-Nepean and Leitrim (shallow phase)-Nepean are the most extensive in which Nepean soils occur in significant proportions in the landscape.

General Land Use The majority of Nepean soils remain forested. Agricultural use consists mainly of permanent pasture although some soils are used for hay production. Shallowness to bedrock and low inherent fertility make annual cultivation of these soils for common field crops impractical.

Correlation to Ottawa Urban Fringe Nepean soils in the survey area are similar to those in the Urban Fringe area except for a difference in soil reaction. Some Nepean soils mapped were more acidic than those characterized for the Ottawa Urban Fringe area. The association description, therefore, had to be broadened to include soils which are very strongly to strongly acidic. Additional taxonomic designations for those soils also were necessary for the association.

NORTH GOWER (NG)

Location and Extent North Gower soils occur extensively in the southern and western portions of the survey area. The most extensive occurrences are mainly found in four areas: (1) along the Carp River valley in West Carleton township; (2) on the Richmond Plain in Goulbourn township; (3) west of the Rideau River in Rideau township; and (4) the central and south portion of Osgoode township. Approximately 15,600 ha of North Gower soils were mapped, with two-thirds of that total having been mapped in combination with soils of other associations.

Landform and Topography North Gower soils have developed on level to very gently sloping marine clay plains which were deposited in deep water during the Champlain Sea inundation. The upper 1 to 2 m have frequently been modified reflecting the reworking and redeposition of sediments in increasingly shallower water conditions as the Champlain Sea receded. Consequently there is frequent interbedding of materials in the upper strata, with textures varying from clays and heavy clays to clay loams and silt loams. As a result, the dominantly clay loam and silty clay loam textured soils of the North Gower association were often mapped in combination with the clayey textured soils of the Dalhousie association, and the silt loam and loam textured soils of the Osgoode association.

Soil Materials North Gower soils consist of moderately fine textured marine materials which overly fine textured marine material at a depth greater than 1 m. Coarse fragments of any size are not present in these materials.

The parent material is olive gray to grayish brown in color, and is texturally either silty clay loam or clay loam. Soil reaction is most often neutral, but at times may be mildly alklaline. Soils having the latter reaction also are weakly to moderately calcareous. Surface textures are commonly silt loam, loam, silty clay loam, or clay loam.

Occasionally interbedded layers of coarser or finer textured marine material are present in some North Gower soils. These layers are variable in thickness and most often range between 20 and 60 cm. Finer textured layers are usually silty clay, while coarser textured layers may be silt, silt loam, loam, or fine sandy loam. Soils having coarse textured layers were mapped as the NG5 soil landscape unit.

North Gower soils are similar in many respects to the soils of the Dalhousie association. The major difference is clay content, with North Gower soils having a clay content which varies between 28 and 39%. The clay content of Dalhousie soils varies between 41 and 59%.

Soil Moisture Characteristics Approximately 85% of the soils of the association are poorly drained and are situated on level to very gently sloping topography. Most of the remainder of the soils are imperfectly drained and are found on very gently sloping to undulating topography. A few small areas of very poorly drained North Gower soils were also mapped. Soils of the association are slowly to moderately permeable, with the latter case most often associated with well developed subangular blocky structures. Moisture holding capacity is generally quite high, while surface runoff is slow.

Soil Landscape Units Five units were recognized for the North Gower association. They are described as follows:

	Recognized Subgroups	Recognized Series
NG1: Dominantly imperfectly drained soils found on very gently sloping topography. Slopes generally range from 2 to 5%.	Gleyed Melanic Brunisols	Carp
NG2: Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	North Gower
NG3: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on very gently sloping topography. Slopes generally range from 2 to 5%.	Gleyed Melanic Brunisols (Imperfect) Orthic Humic Gleysols (Poor)	Carp North Gower
NG4: Dominantly very poorly drained soils found on level to depressional topography. Slopes range from 0 to 1%.	Rego Gleysols	Belmeade
NG5: Dominantly poorly drained soils found on level to nearly level topography and containing 20 to 60 cm thick layers of coarser textured materials, primarily silt, silt loam, loam, or fine sandy loam. Slopes range from 0 to 2%.	Orthic Humic Gleysols	North Gower (variant)

Taxonomic Components The **Carp** series (Gleyed Melanic Brunisol subgroup) is imperfectly drained and occurs on mid to upper slope positions in the landscape. Surface horizons are generally dark grayish brown with granular to subangular blocky structure. The underlying B horizons are grayish brown to olive gray with distinct olive colored mottles. Structures are subangular blocky to platy. The C horizons are similar in color to the weathered B horizons but structure tends to be somewhat coarser. Platy structure also occurs occasionally.

The poorly drained **North Gower** series (Orthic Humic Gleysol subgroup) has surface horizons which are generally very dark gray to very dark brown in color with subangular blocky to granular structure. The underlying B horizons are generally dark gray to olive gray with dark yellowish brown prominent mottles. Structure varies from subangular blocky to platy with subangular blocky structure occurring most often. The C horizons are gray to olive gray in color and generally have subangular blocky to platy structure. Generally the C horizons have fewer mottles than the upper B horizons.

The very poorly drained **Belmeade** series (Rego Gleysol subgroup) has water tables which remain at or near the surface year round. Structure is massive throughout the profile and colors of gray to greenish gray reflect the highly reduced condition of these soils.

Soils mapped as a variant of the North Gower series were identified in the NG5 soil landscape unit. The occurrence of these soils was not extensive enough for them to be named as a new soil series. The distinguishing characteristic which separates the variant from the North Gower series is the presence of layers of silt, silt loam, or fine sandy loam within 1 m of the surface. The layers range from 20 to 60 cm in thickness, and have structures which range from weak granular to single grain. With the exception of these layers, the variant closely resembles the North Gower series in other profile characteristics.

Mapped Soil Combinations Approximately 5,800 ha of North Gower soils were mapped as dominant soils and 4,800 ha as significant soils in combinations with soils of other associations. When mapped as the dominantly occurring soil, North Gower-Osgoode and North Gower-Dalhousie combinations are the most frequent and extensive, accounting for 2,600 ha and 1,900 ha respectively of all North Gower soils. Combinations of North Gower-Chateauguay, North Gower-Castor, and North Gower-Grenville encompass the majority of the remaining North Gower soils mapped as the dominant component. When mapped as the significantly occurring soil, Dalhousie-North Gower and Osgoode-North Gower combinations are the most extensive, accounting for 2,900 ha and 700 ha respectively of all North Gower soils. North Gower soils mapped in combinations with soils of the Dalhousie and Osgoode associations are indicative of the close interrelationship of the depositional environments in which the materials of these associations were laid down.

General Land Use Except for the very poorly drained soils of the association, North Gower soils have a high agricultural capability for common field crops. They are used for corn, cereal grain, and hay production on a broad scale.

Correlation to Ottawa Urban Fringe In the survey of the Ottawa Urban Fringe, the North Gower variant was mapped as a phase and denoted with a "V" attached to the respective soil landscape unit to which it applied. In this survey, the variant was identified and mapped as a separate soil landscape unit, namely the NG5 unit.

North Gower soils in the survey area are similar to those of the Urban Fringe area in chemical and physical characteristics with one exception. In the imperfectly drained soils mapped, eluvial and illuvial horizons seldom occurred. The absence of these horizons, therefore, necessitated an additional taxonomic classification for those soils.

OKA (O)

Location and Extent Soils of the Oka association occur in each of the three map areas of the survey area. They occur most extensively, however, in Rideau, Goulbourn, and West Carleton townships primarily on the Paleozoic bedrock plains of those areas. Approximately 5,600 ha of Oka soils were mapped, of which 3,000 ha were mapped in combination with soils of other associations.

Landform and Topography Oka association soils have developed on very gently to moderately sloping marine beach materials. Slopes most commonly range between 2 and 9%. Most often the beach materials occur on bedrock controlled landscapes, primarily those in which Farmington association soils underlain by dolomite or limestone bedrock are found. In this case, wave action during the time of the Champlain Sea formed raised beaches which range from less than 1 m to several metres in thickness over bedrock. These landscapes are usually ridged and have very gently to gently sloping topography. Oka soils also have developed on marine beach materials which overly glacial till, mainly in the form of drumlinoid ridges. Wave action in this case has formed beaches on the side of many ridges on the mid to upper slope positions and crests. Oka soils of this type were identified in the North Gower, Richmond, and Manotick areas of Rideau Township. The resultant landscapes are steeper than in bedrock controlled landscapes, often being moderately sloping with slopes ranging from 9 to 15%. A third landscape situation in which Oka soils occur is marine beaches formed on glaciofluvial deposits. In this instance, meltwater from glacial retreat produced esker and other ice contact deposits which were subsequently reworked to varying degrees into beaches during the Champlain Sea inundation which followed glaciation. Soils occurring on the reworked ice contact deposits were mapped as the Kars association where marine reworking was minimal and not easily recognized. Where beach formation was substantial and easily recognizable on these landscapes, the soils were mapped as the Oka association.

Soil Material Oka association soil materials consist of gravelly to very gravelly, coarse to moderately coarse textured marine beach materials which overly either Paleozoic bedrock, glacial till, or glaciofluvial ice contact deposits. The parent material is commonly grayish to dark grayish brown in color, and has coarse sandy loam, loamy coarse sand, or coarse sand textures. Highly representative Oka soils are mildly alkaline in reaction and moderately to strongly calcareous. Occasionally some may be extremely calcareous. The alkalinity and calcareousness of the materials results from the high proportion of limestone and dolomitic rock fragments which are present. Some Oka soils were also mapped on small beach formations which have resulted from wave action on glacial till deposits derived from gray-green and red shale bedrock. These materials occur infrequently and were included in the association due to their limited extent. They possess similar textures and have a high gravel content which primarily consists of channery sized shale fragments. Soil reaction of the parent material of these shaly beach materials ranges from neutral to slightly acidic. The more representative calcareous Oka soil materials in which limestone and dolomite rock fragments are the dominant coarse fragments were designated by either the O1 or O2 soil landscape units. The noncalcareous shaley materials were designated by either the O3 or O5 soil landscape units.

Coarse fragment (gravel) content of Oka materials usually exceeds 40% by weight and may range as high as 80% in some materials. The amount of coarse fragments increases with depth and is greatest in the parent material or Ck horizons. Coarse fragment type, size, and shape are quite variable and are dependent on the type of beach formation. Those resulting from wave deflated glacial till are primarily composed of limestone or dolomite fragments consisting of very angular gravel, angular and subrounded stones, and occasional boulders. Oka materials resulting from subsequent wave action on shallow glacial drift material overlying Paleozoic bedrock are predominantly composed of flat, angular fragments of limestone and dolomite. The materials may be either channery, flaggy, or both. The third type of Oka material resulting from wave action on glaciofluvial deposits is mainly composed of rounded and subrounded cobbles and stones. Although primarily of limestone and dolomite origin, some fragments of granite and gneiss of Precambrian origin are also present.

Oka soil materials tend to be somewhat finer textured at the surface. Surface textures of loamy sand, sandy loam, or loam occur most often. In addition, some materials may have free carbonates in the surface and B horizons.

Soil Moisture Characteristics Oka association soils are dominantly rapidly to well-drained, with imperfectly drained soils also occurring but to a considerably lesser extent. Due to their coarse textures and high coarse fragment content, Oka materials are rapidly permeable and have a low water holding capacity.

Clay illuviation, designated by Btj and Bt horizons, when present in these soils reduces permeability somewhat and increases the water holding capacity slightly. Surface runoff is slow.

(Continued on Page 63)

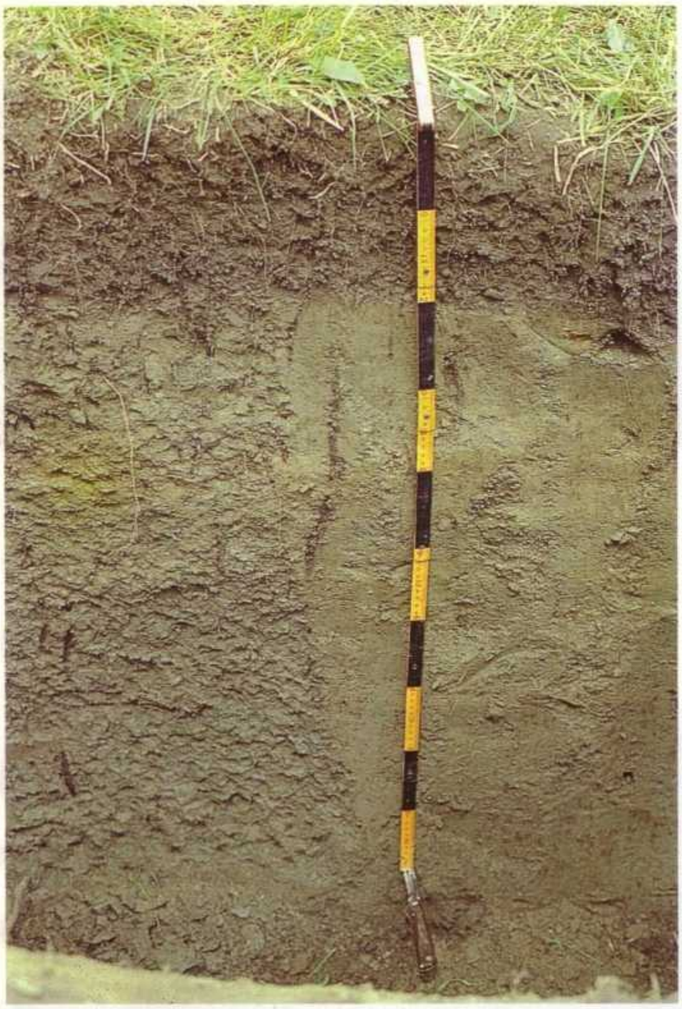

Figure 17.
A poorly drained Orthic Humic Gleysol profile (North Gower series) of the North Gower soil association. Soil materials are of deep marine depositional origin and consist of nonstony clay loam and silty clay loam. These soils were mostly mapped as the NG2 soil landscape unit.

Figure 18.
North Gower association landscapes are nearly level to very gently sloping and have relatively high agricultural capability.

Figure 19.
Dalhousie landscapes are generally level. Agricultural capability for common field crops is relatively high (2W).

Figure 20.
A poorly drained Orthic Humic Gleysol (Brandon series) of the Dalhousie soil association. These soils consist of nonstony clay and silty clay of marine origin and were mostly mapped as the D3 soil landscape unit.

Figure 21.
A poorly drained Orthic Humic Gleysol profile (Bearbrook series) of the Bearbrook soil association. Such soils feature reddish, nonstony heavy clay of deep marine origin. Most Bearbrook association soils are poorly drained and were mapped as the B2 soil landscape unit.

Figure 22.
Bearbrook landscapes are mostly level, characteristic of deep water marine deposits.

Figure 23.
A gently undulating Grenville landscape featuring dominantly well-drained soils with a significant proportion of imperfectly drained soils. This type of Grenville landscape was mapped as the G4 soil landscape unit.

Figure 24.
A well-drained Eluviated Melanic Brunisol profile (Grenville series) of the Grenville soil association. These soils have developed on strongly calcareous loam and sandy loam till and feature B horizons with some accumulation of illuviated clay.

Figure 25.
Manotick association soils feature 40 to 100 cm of sandy material overlying clays. Soils ranging from well to very poorly drained were included in this soil association. This example is a poorly drained Orthic Humic Gleysol (Allendale series) featuring an A horizon rich in organic matter and subsurface horizons which are heavily mottled.

Figure 26.
Manotick landscapes dominated by poor natural drainage are nearly level with persistent high water tables.

Figure 27.
Jockvale landscapes are generally level to very gently undulating.

Figure 28.
An imperfectly drained Gleyed Melanic Brunisol (Stapledon series) of the Jockvale soil association. The neutral to medium acid fine sands and loamy fine sands of this association are mostly imperfectly to poorly drained.

Figure 29.
An imperfectly drained Gleyed Dystric Brunisol (Vinette series) of the St. Thomas soil association. Soil materials are dominated by fine sand textures. This example features some accumulation of iron and aluminum in the B horizon but not sufficient to meet the criteria for a podzolic Bf.

Figure 30.
Imperfectly drained St. Thomas landscapes have nearly level topography.

Figure 31.
A well-drained Orthic Melanic Brunisol (Oka series) of the Oka soil association. Of note is the large volume of limestone and dolomitic gravel and stones, especially in the lower unweathered portion of the profile.

Figure 32.
Oka parent materials, in this case grey-green shale material of the O3 soil landscape unit, are frequently mined for aggregate. Materials at this site have been extracted down to bedrock at about 2 m depth.

Figure 33.
Farmington landscapes reflect the level to very gently sloping limestone and dolomite bedrock less than 50 cm below the surface.

Soil Landscape Units Four units were identified for the Oka association. They are described as follows:

	Recognized Subgroups	Recognized Series
O1: Dominantly rapidly to well-drained soils found on very gently to gently sloping topography. Slopes range from 2 to 9%. Parent materials have been derived primarily from limestone and dolomite bedrock.	Eluviated Melanic Brunisols Orthic Melanic Brunisols	Munster Oka
O2: Dominantly imperfectly drained soils found on level to nearly level topography. Slopes range from 0 to 2%. Parent materials have been derived primarily from limestone and dolomite bedrock.	Gleyed Eluviated Melanic Brunisols Gleyed Melanic Brunisols	
O3: Dominantly well-drained soils found on very gently to gently sloping topography. Slopes range from 2 to 9%. Parent materials have been derived primarily from gray-green shale bedrock.	Orthic Melanic Brunisols	
O5: Dominantly well drained soils found on very gently to gently sloping topography. Slopes range from 2 to 9%. Parent materials have been derived primarily from red shale bedrock.	Orthic Melanic Brunisols	

Taxonomic Components The **Munster** series (Eluviated Melanic Brunisol subgroup) is well-drained and is composed of materials mainly derived from limestone and dolomite bedrock. The Ap horizon is dark brown with granular structure. A yellowish brown Ae or Aej horizon with granular structure is present if it has not been incorporated into the surface Ap horizon. A Btj or Bm horizon, or both, underly the eluviated A horizon. Some illuviated clay is present on the granular structured peds. The unweathered Ck horizon generally occurs within 50 cm depth and clay content is significantly lower than in any of the weathered horizons occurring above it. Texture of the fine earth fraction in the parent material or Ck horizon is commonly loamy coarse sand or coarse sand, with loamy sand and sand textures also occurring but less often. Texture of the fine earth fraction in the upper horizons is slightly finer, having larger proportions of medium sand. Surface textures are most often sandy loam. The Ck horizon has single grain structure, and color ranges from dark yellowish brown to dark grayish brown.

Some Munster profiles exhibit free carbonates in the upper weathered horizons as well as the parent material. When encountered, those horizons were designated with a k suffix eg. Apk, Btjk etc.

The **Oka** series (Orthic Melanic Brunisol subgroup) is similar to the Munster series in material origin. Profile characteristics are also similar except for the absence of eluvial and illuvial horizons. In their place a relatively thick brown to dark brown Bm horizon is most often found.

The **Gleyed Eluviated Melanic Brunisols** and **Gleyed Melanic Brunisols** composing the O2 soil landscape unit are imperfectly drained and are the gleyed equivalents of the better drained series previously described. They are composed of materials which have also been derived primarily from limestone and dolomite bedrock. Profile characteristics of each are similar to their better drained counterparts except for the presence of distinct yellowish brown mottles within the upper 50 cm, and distinct to prominent mottles in the lower 50 cm of the control section. Mottling within either profile is indicative of periodic water saturation, including saturation periods during the growing season.

The well-drained **Orthic Melanic Brunisols** composing the O3 soil landscape unit consist of materials which have primarily been derived from gray-green shale bedrock. Flat angular pieces of noncalcareous gray shale make up a significant proportion of the material, and in some deposits account for nearly all of the coarse fragments within the profile. Varying amounts of calcareous material also occur within the profile. Due to the shale dominance, these soils are less calcareous than the Oka series and at times are noncalcareous. Soil reaction, although highly variable, also tends to be lower than the Oka series.

The well-drained **Orthic Melanic Brunisols** of the O5 soil landscape unit comprise materials which have been derived primarily from red shale bedrock. The dominance of noncalcareous soft red shale fragments in the profile distinguishes these soils from others in the association.

Mapped Soil Combinations More than 50% of all Oka soils were mapped in combination with soils of other associations. Approximately 1,400 ha were mapped in combinations in which they were the dominant component, and 1,600 ha were mapped in combinations in which they were the significant component. Oka-Farmington and Farmington-Oka combinations were by far the most frequent and extensive. Approximately 1,800 ha of Oka soils occur in those combinations in almost equal proportions. Much less extensive but significant amounts of Oka soils were also mapped with soils of the Jockvale and Kars associations.

General Land Use Oka soils at best are of marginal agricultural capability for common field crops. Hay production occurs where surface stoniness is not too severe, but the main agricultural use found on Oka soils is that of permanent pasture. Some Oka beach deposits are being economically mined for aggregate in areas where the materials are thick enough and well sorted. Significant areas of Oka soils also occur as abandoned farmland or remain under forest vegetation.

Correlation to Ottawa Urban Fringe Calcareous Oka soils in the survey area constituted primarily of limestone or dolomite coarse fragments are similar to those found in the Ottawa Urban Fringe. In both surveys these soils represent the vast majority of soils included in the association. Due to the frequent occurrence of shaley beach materials in the survey area, however, additional landscape units for those soils were developed which do not occur in the Urban Fringe survey. It was decided that the limited occurrence and similar mode of deposition of those soils justified a broadening of the association concept.

OSGOODE (OS)

Location and Extent Soils of the Osgoode association occur mainly in Rideau, Goulbourn, and West Carleton townships. In Rideau township, the most extensive occurrences are found adjacent to and south and east of the village of North Gower. In this area, they occur on the level marine plains which are situated between and adjacent to glacial till knolls which occur regularly across the landscape. In Goulbourn township, they are found east of the village of Stittsville and extend as a narrow band southward to the Jock River. This band occurs on the outer flank of the large marine clay plain which is centred northeast of the town of Richmond. In West Carleton township, Osgoode soils occur to the west and south of the village of Carp, and constitute a significant part of the marine plains of the Carp Valley.

Approximately 7,100 ha of Osgoode soils were mapped, of which 5,000 ha or 70% were mapped in combination with soils of other associations.

Landform and Topography Osgoode soils have developed in a blanket of moderately coarse to medium textured marine or fluvial material. It is usually 1 to 2 m thick and overlies heavier textured marine material. A considerable variation in depth of the underlying clayey material occurs due to uneven deposition of the upper material. Most Osgoode soils occur on deep water marine deposits which occasionally have been reworked. Less frequently, they also occur on fluvial sediments found along the ancient flood plains of the Rideau, Carp, and Mississippi rivers.

The topography of Osgoode soils is dominantly level or nearly level, especially when they have developed on materials of marine origin. Very gently sloping or undulating topography also occurs but less frequently. Slopes are most often 2% or less, but steeper slopes may occur which are usually associated with floodplain areas.

Soil Material Osgoode soils are quite variable, especially in soil reaction and calcium carbonate content. Most often the parent material is gray to olive gray in color, and has either very fine sandy loam, loam, or silt loam textures. Soil reaction ranges from slightly acid to mildly alkaline. Occasionally, however, the parent material may be more acidic or more alkaline. Calcium carbonate is not always present within the control section, therefore, the parent material may be either calcareous or noncalcareous. When calcium carbonate is present, the parent material is most often weakly to moderately calcareous. Osgoode soils occurring on large level marine plains were usually found to be noncalcareous, whereas smaller areas occurring near or around other soils with significant carbonate content, such as soils of the Grenville association, were often found to be calcareous.

Weathered subsoil or B horizons overlying the parent material range from dark yellowish brown to gray in color, and also have very fine sandy loam, loam, or silt loam textures. Soil reaction is most often slightly acid to mildly alkaline, but occasionally is more acidic.

Surface A horizons are very dark grayish brown to very dark gray in color, with textures consisting of very fine sandy loam, loam, or silt loam. Soil reaction is usually slightly acid to neutral.

Osgoode soils are usually underlain by heavier textured, clayey marine material which most often occurs at a depth of 1 to 2 m. This material is similar to the parent material of the North Gower, Dalhousie, or Rideau soil associations. When the underlying material occurred at a depth of 1 m or less, those soils were mapped as part of the Castor association. Since deposition of materials over the clayey substratum is uneven, a considerable variation in depth will be found within any particular mapped area.

Due mainly to changes in the depositional environment soil texture may vary considerably within the profiles of soils of the association. In some soils, texture may be uniform throughout the profile. These soils have developed on materials which have been deposited in a marine or fluvial environment which remained fairly constant. In other soils, texture may grade from underlying fine textured clayey material at depths of greater than 1 m upwards through medium textured materials high in silt and very fine sand. This sequence has resulted from deposition in progressively shallower water. Finally, Osgoode materials are often stratified indicative of alternating deep and shallow water deposition. In this instance, layers of finer or coarser textured material which are variable in thickness occur within the soil profile. Coarser textured layers are dominantly loamy very fine sand or loamy fine sand, and occasionally fine sand. Finer textured layers are dominantly clay loam or silty clay loam, and occasionally silty clay or clay.

Soil Moisture Characteristics Poorly drained soil conditions affect approximately 90% of all Osgoode soils mapped. The remainder are imperfectly drained. Poorly drained soils are found on either level or nearly level topography, or in depressional areas. Imperfectly drained soils are found on nearly level or very gently sloping topography.

Osgoode soils are slowly to moderately permeable, with water movement downward somewhat impeded by the underlying finer textured material. Moisture holding capacity is moderate to high, and surface runoff is slow on level topography and moderate on very gently sloping topography.

Soil Landscape Units Four units were identified in the Osgoode association. They are described as follows:

		Recognized Subgroups	Recognized Series
OS1:	Dominantly imperfectly drained soils found on nearly level to gently sloping topography. Slopes range from 1 to 9%.	Gleyed Melanic Brunisols	Piperville
OS2:	Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on nearly level or very gently undulating topography. Slopes are usually 2% or less.	Orthic Humic Gleysols (poor) Gleyed Melanic Brunisols (imperfect)	Osgoode* Carsonby* Piperville
OS3:	Dominantly poorly drained soils found on level, nearly level, or very gently undulating topography. Slopes are 2% or less.	Orthic Humic Gleysols	Osgoode* Carsonby*

	Recognized Subgroups	Recognized Series
OS4: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on nearly level to very gently sloping or undulating topography. Slopes range from 1 to 5%.	Gleyed Melanic Brunisols	Piperville
	Orthic Humic Gleysols (poor)	Osgoode* Carsonby*

** Osgoode series has calcareous parent material; the Carsonby series does not.*

Taxonomic Components The imperfectly drained **Piperville** series (Gleyed Melanic Brunisol subgroup) is subject to water saturation for short periods during the growing season. It has a very dark grayish brown surface horizon with granular structure. The underlying weathered subsoil grades from dark yellowish brown near the surface to light brownish gray at depth. Color of the parent material is olive gray to gray. Structure in both the weathered subsoil and parent material varies, most often being subangular blocky. Platy and massive structures may occur occasionally. Sandy layers, when present in the profile, have structures ranging from single grain to subangular blocky. Clayey layers, when present, have structures ranging from massive to subangular blocky. Distinct strong brown to yellowish brown mottles are present in the upper part of the weathered subsoil (Bmgj horizons). Prominent dark yellowish brown to brownish yellow mottles are present in the lower part of the weathered subsoil and in the parent material.

Poorly drained soils of the association were found to have both calcareous and noncalcareous parent materials. In the case of the latter condition, calcium carbonate is not present within the classification depth or control section, but is usually present at greater depths. The poorly drained **Osgoode** series (Orthic Humic Gleysol subgroup) has calcareous parent material and is subject to water saturation for much of the growing season. It has a very dark grayish brown to very dark gray surface horizon which has granular or subangular blocky structure. The underlying weathered subsoil is grayish brown to gray in color, and the parent material is olive gray to gray. Structure of the weathered subsoil and parent material is similar to the Piperville series. Prominent dark yellowish brown to brownish yellow mottles occur throughout the subsoil and parent material.

The poorly drained **Carsonby** series (Orthic Humic Gleysol subgroup) has been identified as a separate series due to the noncalcareous nature of the parent material. All other profile characteristics, however, are similar to those of the Osgoode series.

Mapped Soil Combinations Osgoode soils were most commonly mapped in combination with soils of the North Gower association. Approximately 2,900 ha of Osgoode soils were mapped in Osgoode-North Gower and North Gower-Osgoode combinations. These combinations usually occur on the more extensive areas of level marine clay plains, and the soils within each are often stratified. Approximately 900 ha of Osgoode soils were also mapped as the dominant component in combination with soils of the Reevecraig association. These mapped combinations occur in Rideau Township south of the village of North Gower. Reevecraig soils are slightly coarser textured, and often have layers of materials which are also found in the Osgoode association. Osgoode soils were also mapped occasionally with soils of the Jockvale, Grenville, and Castor soil associations.

General Land Use Agriculture is the predominant land use found on most Osgoode soils. Many Osgoode soils are used for intensive cropping purposes, with corn making up a significant proportion of the land area. Osgoode soils are also used for cereal grain and hay production as well as permanent pasture. The latter use may be associated with part-time or hobby farm type operations, or the soils may have a severe wetness problem which restricts more intensive use. Woodland is also found occasionally on Osgoode soils.

Correlation to Ottawa Urban Fringe The Osgoode soil association was not characterized for the Ottawa Urban Fringe area. Instead, the Piperville association was described which consisted of noncalcareous soils having similar textures and profile characteristics. In this survey, noncalcareous soils as well as a considerable amount of calcareous soils having similar textures, profile characteristics, and mode of deposition were encountered. The noncalcareous soils encountered were usually calcareous below the control section. Therefore, the Osgoode association was developed to accommodate both calcareous and noncalcareous conditions in the parent material. As a result, soils mapped as Piperville in the Urban Fringe area also occur in the survey area, but are now mapped as part of the Osgoode association.

OTTAWA (OT)

Location and Extent Soils of the Ottawa association occur only in the north portion of West Carleton township on the small peninsula of land protruding into the Ottawa River and flanked by Buckham Bay and Constance Bay. Their extent is very limited, with approximately 500 ha being mapped.

Landform and Topography Ottawa soils have developed in a blanket of coarse textured fluvial or eolian material which is at least 2 m deep. Materials which underlay the coarse sediments were not identified. The topography ranges from very gently undulating to hummocky, with slopes ranging from 2 to 15%.

Soil Material Ottawa soils have parent materials which consist of noncalcareous, light yellowish brown medium sand. Weathered B horizons which overlay the parent material are dark brown to brown in color, and also medium sand in texture. At the surface, a very dark brown layer of accumulated organic material (LFH horizon), less than 10 cm thick, occurs under forest conditions. This layer is mainly composed of leaves, twigs, and evergreen needles which are in various stages of decomposition. Directly underlying the organic surface layer there is a very dark grayish brown mineral A horizon, which is less than 10 cm thick and also medium sand in texture. Organic matter has accumulated in this layer. Under non-forested conditions, only the mineral A horizon is present at the surface.

Soil reaction of the parent material is strongly to extremely acid. Ottawa soils are very well sorted, with medium sand content of the parent material ranging from 63 to 84%.

Soil Moisture Characteristics Ottawa soils are excessive to well-drained on the crests and upper to mid slopes of the sand knolls occurring in the very gently undulating to hummocky topography. Imperfectly drained soils are found in lower slope and depressional areas between the sand knolls. These soils are rapidly permeable, and have a very low moisture holding capacity. Droughty conditions prevail in the excessive to well-drained soils. Surface runoff is slow.

Soil Landscape Units Two units were identified in the Ottawa association. They are described as follows:

	Recognized Subgroups	Recognized Series
OT1: Dominantly excessive to well-drained soils found on undulating to hummocky topography with gentle to moderate slopes. Slopes range from 6 to 15%.	Orthic Dystric Brunisols	Buckham Bay
OT2: Dominantly excessive to well-drained soils found in combination with significant areas of imperfectly drained soils found on very gently undulating topography. Slopes range from 2 to 5%.	Orthic Dystric Brunisols (Ex. to well) Gleyed Dystric Brunisols (Imperfect)	Buckham Bay

Taxonomic Components The excessive to well-drained Buckham Bay series (Orthic Dystric Brunisol subgroup) under forest conditions has a very dark brown LFH surface horizon of accumulated organic material comprising leaves, twigs, and evergreen needles which are in various stages of decomposition. Generally, it is not that well decomposed. Under nonforested conditions, only a very dark grayish brown mineral Ah horizon occurs at the surface. It is usually less than 10 cm thick. Weathered B horizons underlying the Ah horizon are dark brown to brown in color and usually do not extend beyond 60 cm in depth. Parent materials are most often light yellowish brown in color. Soil structure throughout the profile is single grain.

The imperfectly drained Gleyed Dystric Brunisols have slightly duller matrix colors and strong brown to yellowish brown mottles in the subsoil. Other profile characteristics are similar to the Buckham Bay series.

General Land Use A large proportion of Ottawa soils are currently under pine reforestation, possibly for stabilization purposes since these soils are highly susceptible to wind erosion. Woodland and scrubland exist on the remaining portion of these soils.

Correlation to Ottawa Urban Fringe The Ottawa soil association was not mapped in the Ottawa Urban Fringe. It was identified as a separate soil association in this survey due to its unique landform and close similarity to soils mapped as the Ottawa series along the Ottawa River in Pontiac County, Quebec. Soils of the Ottawa association are similar to the Ottawa series in Quebec in that both are derived from medium sand alluvial material deposited very recently by the Ottawa River.

Ottawa soils were not included in the Uplands soil association for two reasons. The first reason is the difference in mode of deposition. Uplands soils have developed on marine or fluvial (deltaic) sands deposited during the time of the Champlain Sea. Ottawa soils have developed on recent fluvial sands deposited by the Ottawa River. The second reason for differentiating Ottawa soils is a marked difference in topography. Ottawa soils have undulating to hummocky topography, whereas the topography of Uplands soils is generally much more subdued.

QUEENSWAY (Q)

Location and Extent Queensway soils occur only in the City of Kanata and the northern part of West Carleton Township. Their extent is quite limited with approximately 1,500 ha having been mapped. Of that total, more than 50% were mapped in combination with either soils of other associations or miscellaneous land units. In general, the distribution of Queensway soils is closely associated with those of the Nepean and Anstruther soil associations.

Landform and Topography Queensway soils have developed on stony glacial till (morainal) material which occurs in the form of subdued till ridges, or as nearly level to gently sloping or undulating till plains. Although easily recognizable in the landscape, the landforms associated with Queensway soils are not as pronounced as those on which soils of the Grenville association are found. Slopes range from 1 to 9%, with the majority of soils having slopes of 2 to 5%.

Soil Materials Queensway soil materials are moderately coarse to coarse textured and have a considerable coarse fragment content. Angular and slightly rounded stones and boulders occur throughout the profile which have primarily been derived from sandstone and quartzite bedrock. A small proportion of Precambrian igneous and metamorphic rock fragments also occur in most materials.

The parent material of Queensway soils is an olive gray to dark brown colored unsorted till which closely resembles that of the Grenville association. Queensway materials, however, are distinguished by having a higher sand content, a more acid soil reaction, no free carbonates, and the absence of substantial amounts of limestone or dolomite coarse fragments. The texture of the parent material is usually sandy loam or loamy sand, with sandy loam being the most common. Soil reaction is medium to slightly acid. The chemical and physical composition of the upper weathered material does not vary significantly from that of the parent material. Surface textures are also predominantly sandy loam.

Surface stoniness varies on Queensway soils, with conditions ranging from nonstony to very stony. In the case of the latter condition, approximately 3 to 15% of the total surface area is covered with stones at least 15 cm in diameter.

Some Queensway soils were mapped with a shallow phase. These soils consist of 50 to 100 cm of Queensway materials which overly sandstone and quartzite bedrock.

Soil Moisture Characteristics More than 85% of all Queensway soils are well-drained. Of the remaining soils, the majority are imperfectly drained with the remainder being poorly drained. The well-drained soils are situated on the middle to upper slope positions of till ridges or plains. Imperfectly drained soils are situated on the middle to lower slope positions, while the poorly drained soils are found on the lowest positions in the landscape which are level to nearly level.

Queensway soils are quite permeable and have a relatively low moisture holding capacity. Surface slopes associated with the well and imperfectly drained soils are primarily responsible for moderate surface runoff on those soils. Due to their lower landscape position the imperfectly drained soils are subject to periodic saturation during the growing season primarily due to high water tables.

The infrequently occurring poorly drained soils have slow surface runoff due mainly to their level or nearly level topography. Slow surface runoff, subsurface seepage from adjacent sloping areas, groundwater flow, and precipitation all contribute to high water tables which persist for extended periods during the growing season.

Soil Landscape Units Three units were identified for the Queensway association. They are described as follows:

		Recognized Subgroups	Recognized Series
Q1:	Dominantly well drained soils found on very gently to gently sloping topography. Slopes generally range from 2 to 5%, but occasionally may approach 9%.	Orthic Melanic Brunisols	Galesburg
		Eluviated Melanic Brunisols	Queensway
Q3:	Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	
Q4:	Dominantly well drained soils in combination with significant areas of imperfectly drained soils found on very gently sloping topography. Slopes generally range from 2 to 5%.	Orthic Melanic Brunisols (well)	Galesburg
		Eluviated Melanic Brunisols (well)	Queensway
		Gleyed Melanic Brunisols (imperfect)	
		Gleyed Eluviated Melanic Brunisols (imperfect)	

Taxonomic Components The well drained **Galesburg** series (Orthic Melanic Brunisol subgroup) is the most commonly occurring series, and most often has a very dark grayish brown to dark brown surface Ap horizon with granular structure. Common colors encountered in the weathered subsurface Bm horizons are dark yellowish brown, dark brown, and strong brown. Structure may range from granular to subangular blocky. The parent materials or C horizons can vary in color from olive gray to dark brown, and they may have granular to subangular blocky structures.

The less frequently occurring **Queensway** series (Eluviated Melanic Brunisol subgroup) differs from the Galesburg series by having a gray to light olive gray eluviated Ae or Aej horizon beneath the Ap horizon, and a slightly illuviated Btj horizon below the Ae or Aej horizon.

The imperfectly drained **Gleyed Melanic Brunisols** of the association were not given a soil series name due to their very limited extent. These soils possess distinct mottles within 50 cm of the soil surface resulting from saturated conditions which persist for short periods during the growing season. Otherwise, these soils resemble the well drained Galesburg series. Similar mottling characteristics exist for the imperfectly drained **Gleyed Eluviated Melanic Brunisols**, also unnamed, which distinguish them from the well drained Queensway series.

The poorly drained **Orthic Humic Gleysols** are very limited in extent. They possess dull grayish matrix colors and prominent mottles both in the weathered Bg horizons and in the Cg horizons or parent materials.

Mapped Soils Combinations Approximately 300 ha of Queensway soils were mapped as the dominant component and 450 ha were mapped as the significant component in combinations with either miscellaneous land units or soils of other associations. Queensway soils were not mapped extensively with any one particular land unit or soil association.

General Land Use Queensway soils support corn and cereal grain production on sites which are not hindered by surface stoniness and/or shallowness to bedrock. However, hay production and pasture are the more predominant uses found on Queensway soils. Some sites remain forested, while others are limited for agricultural use due to their interrelationship in the landscape with shallow soils of the Nepean or Farmington associations.

Correlation to Ottawa Urban Fringe In the Urban Fringe survey the Queensway series (Eluviated Melanic Brunisol subgroup) was recognized as the dominantly occurring taxonomic component for the well-drained soils of the association. In this survey, the Galesburg series (Orthic Melanic Brunisol subgroup) was found to be the dominantly occurring taxonomic component for most well-drained soils. Except for this minor difference in taxonomic components, the Queensway association in both survey areas is similar in regards to soil materials and landscape characteristics.

REEVECRAIG (RE)

Location and Extent Soils of the Reevecraig association are not widely distributed in the survey area. The most extensive areas of Reevecraig soils are located near the Rideau River in southeastern Rideau township, and southwestern Osgoode township. Other small areas occur near the villages of Richmond and Stanley Corners in Goulbourn township. Approximately 2,500 ha of Reevecraig soils were mapped, of which 80% were mapped in combination with soils of other associations.

Landform and Topography Reevecraig soils have developed on a blanket of calcareous, moderately coarse to coarse textured marine or fluvial material. They are usually underlain by finer textured materials which occur at a depth of 1 to 2 m. The underlying materials were not differentiated. During the retreat of the Champlain Sea, the depth of the sea water became progressively shallower resulting in localized near shore calcareous sand deposits. Total retreat of the Champlain Sea was then succeeded by the early stages of the Rideau River, which resulted in fluvial bed and terrace deposits of calcareous sands. Regardless of origin, the topography of Reevecraig soils is level to very gently sloping with slopes usually 3% or less.

Soil Material Reevecraig soil materials consist of fine sand, loamy fine sand, very fine sand, or loamy very fine sand overlying finer textured loamy or clayey material at depths of 1 to 2 m. No coarse fragments are present. Reevecraig association parent materials are grayish brown to olive in color and mildly alkaline in reaction. They are also weakly to moderately calcareous. Reevecraig soils are often bedded and contain finer and/or coarser textured layers. These layers are generally less than 10 cm thick and may have a high silt content, or consist of fine or medium sand. Surface textures are most often finer than the parent material and consist of very fine sandy loam, fine sandy loam, or occasionally loam.

Soil Moisture Characteristics More than 90% of all Reevecraig association soils are poorly drained, with the remainder being imperfectly drained. When poorly drained, the soils are subject to higher water tables and saturation for extended periods during the growing season. Artificial drainage is required for these soils to produce field crops to their full potential. Surface water runoff is slow to very slow.

Imperfectly drained Reevecraig soils are nearly level to very gently sloping and have slow to moderate surface water runoff. They are also subject to high water tables, but their occurrence is mainly confined to a depth of 50 to 100 cm. Reevecraig soils have slow to moderate permeability, and a moderate moisture holding capacity.

Soil Landscape Units Three units were identified for the Reevecraig association. They are described as follows:

	Recognized Subgroups	Recognized Series
RE1: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on nearly level to very gently sloping topography. Slopes range from 1 to 3%.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	Reevecraig
RE2: Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on nearly level topography. Slopes range from 1 to 2%.	Orthic Humic Gleysols (poor) Gleyed Melanic Brunisols (imperfect)	Reevecraig
RE3: Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols Rego Humic Gleysols	Reevecraig

Taxonomic Components The poorly drained **Reevecraig** series (Orthic Humic Gleysol subgroup) has a very dark gray to very dark brown surface A horizon with weak granular structure. Texture is fine sandy loam or very fine sandy loam. The underlying B horizons tend to be olive to grayish brown in color and have prominent brown mottles. These colors are indicative of prolonged periods of saturation associated with poor drainage. The weathered B horizons range from fine sand to loamy very fine sand in texture and possess weak subangular blocky structure. The parent material or C horizons are calcareous and possess the same dull grayish brown and olive colors as the B horizons. Structure ranges from weak subangular blocky to single grain, and texture is commonly loamy fine sand to loamy very fine sand.

The poorly drained **Rego Humic Gleysols** were not given a series name due to their very limited extent. These soils were recognized as a separate taxonomic component because of the presence of free carbonates to the surface and no B horizon development, therefore, necessitating a different subgroup classification from that of the Reevecraig series.

The imperfectly drained **Gleyed Melanic Brunisols** were also not assigned a series name because of very limited extent. These soils possess distinct mottles and higher chroma matrix colors in the weathered B horizons in comparison to the B horizons in the Reevecraig series. Matrix colors range from olive brown to light olive brown. The mottles and matrix colors are indicative of greater oxygen availability than that found under poor drainage conditions.

Mapped Soil Combinations Approximately 2,000 ha of Reevecraig soils were mapped in combination with soils of other associations. Half of this amount was mapped as the dominant component in combinations, and half was mapped as the significant component. The Reevecraig-North Gower combination, specifically comprising the soil landscape units RE3 and NG5, accounts for approximately 500 ha of all Reevecraig soils. The NG5 landscape unit comprises soils in which the materials vary from the usual North Gower materials. The soils contain interbedded layers of coarser textured Reevecraig type material along with the normal clay loam and silty clay loam materials of the North Gower association.

Combinations of Osgoode-Reevecraig and Reevecraig-Osgoode account for 600 ha and 300 ha respectively of all Reevecraig soils mapped. The depositional environment responsible for these combinations parallels that of the Reevecraig-North Gower combinations.

Less extensive but significant proportions of Reevecraig soils occur in combination with soils of the Jockvale association. In these combinations, the parent materials are very similar texturally, but they differ in soil reaction and calcium carbonate content. The Jockvale soils are noncalcareous and slightly to medium acid, while the Reevecraig soils are weakly to moderately calcareous and mildly alkaline in reaction.

General Land Use Reevecraig soils are used for corn, cereal grain, and hay production as well as permanent pasture. These soils require substantial fertilizer inputs and artificial drainage in most cases in order to realize full crop production potential. A significant proportion of Reevecraig soils remain forested.

Correlation to Ottawa Urban Fringe The Reevecraig association was not mapped in the Ottawa Urban Fringe area. Although they bear a strong resemblance to soils of the Jockvale association, they were recognized separately from that association in this survey due to their tendency to be finer textured, and because of the presence of free carbonates within the control section.

RIDEAU (R)

Location and Extent Soils of the Rideau association occur fairly extensively in certain areas but are not broadly distributed across the survey area. The most extensive areas of Rideau soils are located in central and northern Cumberland township. Significant areas also occur in the City of Kanata near the hamlet of Dunrobin, and in northern West Carleton Township near the hamlet of Woodlawn and the village of Fitzroy. Other areas of importance are located adjacent to the Rideau River in the southern portion of Rideau Township. Approximately 7,100 ha of Rideau soils were mapped. Of this total, approximately 4,900 ha or 69% were mapped in combination with soils of other associations.

Landform and Topography Rideau association soils are found on two different but related types of landscapes. They occur on the level marine clay plains deposited by the ancient Champlain Sea, and they occur on the sloping banks and floors of abandoned channels which were cut into marine clay deposits by the ancestral Ottawa River. Most level marine landscapes have slopes which are less than 2%, while slopes may approach 9% on the abandoned channel landscapes.

Soil Material Rideau association soils are predominantly composed of gray to olive gray, heavy clay textured material which generally exceeds 2 m depth. Surface materials usually have a lower clay content, with textures most often ranging from clay to silty clay loam. In some Rideau soils, subsurface beds of clay and silty clay are present, especially when these soils were mapped in combination with soils of the Dalhousie association. Subsurface layers of reddish brown to brown heavy clay material may also be present in some Rideau soils, especially those mapped in combination with soils of the Bearbrook association. Clay content of the heavy clay parent material of Rideau soils ranges from 61 to 80%, with average clay content being 69%.

The parent material of most Rideau soils is noncalcareous and neutral in soil reaction. Occasionally, however, some were found to be mildly alkaline and contain small amounts of calcium carbonates.

Soil reaction in the upper A and B horizons tends to be slightly lower than in the parent material, and generally ranges from slightly acid to neutral.

Soil Moisture Characteristics More than 90% of all Rideau soils are poorly drained and remain saturated or nearly saturated for extended periods during the growing season. These soils occur on level to nearly level topography which results in slow to very slow surface water runoff rates.

Approximately half of the remaining soils were classified as imperfectly drained. These soils may be saturated for short periods during the growing season. Imperfectly drained Rideau soils are primarily found on very gently sloping topography with slopes ranging from 2 to 5%. Slopes of this magnitude permit moderate rates of surface water runoff.

The remaining portion of Rideau soils were classified as very poorly drained. These soils remain saturated throughout most of the year and are found on level to depressional topography. Most often these soils serve as catchment areas for both surface and groundwater, and have water tables which remain at or near the surface for most of the year.

Due mainly to their heavy texture, Rideau soils possess high moisture holding capacity. Soil permeability is generally moderate.

Soil Landscape Units Five units were identified for the Rideau association. They are described as follows:

		Recognized Subgroups	Recognized Series
R1:	Dominantly imperfectly drained soils found on very gently to gently sloping topography. Slopes generally range from 2 to 9%.	Gleyed Melanic Brunisols	Rideau
R2:	Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on nearly level to very gently sloping or undulating topography. Slopes generally range from 1 to 5%.	Gleyed Melanic Brunisols (imperfect) Orthic Humic Gleysols (poor)	Rideau Ste. Rosalie
R3:	Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	Ste. Rosalie
R4:	Dominantly very poorly drained soils found on level to depressional topography. Slopes range from 0 to 1%.	Rego Gleysols	Laplaine
R5:	Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on very gently undulating topography. Slopes range from 2 to 5%.	Orthic Humic Gleysols (poor) Gleyed Melanic Brunisols (imperfect)	Ste. Rosalie Rideau

Taxonomic Components The imperfectly drained **Rideau** series (Gleyed Melanic Brunisol subgroup) is subject to saturation for short periods during the growing season. It possesses a clay loam, silty clay loam, silty clay, clay or occasionally a heavy clay surface horizon which usually is an Ap. The Ap is often dark grayish brown in color, has granular structure, and contains 3 to 4% organic matter.

The underlying B horizon is commonly a Bmgj and has olive gray matrix colors with faint to distinct yellowish brown mottles. Texture is dominantly heavy clay and occasionally layers of silty clay or clay may also occur. Structure is usually angular to subangular blocky but occasionally may be prismatic. The parent material or Cg horizon is commonly olive gray in color and sometimes exhibits yellowish brown mottles. Texture is dominantly heavy clay and structure is usually angular blocky.

The poorly drained **Ste. Rosalie** series (Orthic Humic Gleysol subgroup) is found on level or nearly level landscapes which result in little or no surface water runoff. This factor in combination with high moisture holding capacity of the soil materials results in Ste. Rosalie soils being saturated for extended periods during the growing season. The surface horizons are dark olive gray to black in color and have subangular blocky to granular structure. Organic matter content is 4 to 5%. Surface textures tend to have a lower clay content than in the subsoil and most often are clay or silty clay. Occasionally clay loam, silty clay loam, or heavy clay textures also occur. The underlying Bg horizons are dominated by heavy clay, with occasional layers of silty clay or clay also present at times. Matrix colors are commonly dark grayish brown and prominent dark yellowish brown mottles also are present. Structure of the B horizons ranges from subangular and angular blocky to columnar. The parent material or Cg horizons have heavy clay textures and usually angular blocky soil structures. Matrix colors are commonly olive gray, and yellowish brown prominent mottles may also be present.

The very poorly drained **Laplaine** series (Rego Gleysol subgroup) is subject to saturation or near saturation conditions for most of the year. These soils frequently have a surface horizon of humic peat which is 15 to 40 cm thick. They also have parent materials which consist of massive olive gray to bluish gray colored heavy clay. The subsoil above the parent material at times may have yellowish brown mottles.

Mapped Soil Combinations Sixty percent of all Rideau association soils were mapped in combination with either soils of other associations or with miscellaneous land units. Approximately, 1,800 ha were mapped as the dominant component in complex map units, and 2,500 ha were mapped as the significant component. When mapped as the dominant component, the Rideau-Bearbrook combination is by far the most extensive accounting for approximately 1,200 ha of all Rideau soils. When mapped as the significant component, Bearbrook-Rideau and Dalhousie-Rideau combinations are the most extensive and account for 1,300 ha and 1,000 ha respectively of all Rideau soils mapped.

Large areas of Rideau-Bearbrook and Bearbrook-Rideau combinations were mapped in the northern part of Cumberland Township, and these areas account for the majority of Rideau soils mapped with soils of the Bearbrook association. Several smaller but significant areas of these combinations were also mapped in March and West Carleton townships. Combinations of Dalhousie-Rideau occur on level to nearly level landscapes in which individual separation was extremely difficult at the scale of mapping. The similarity of each association in physical characteristics, especially clay content, also warranted this combination at the scale of mapping.

General Land Use Rideau association soils support a wide range of agricultural land uses including corn, cereal grain, and hay production. These crops are often grown on a rotation basis, the frequency of which depends upon the type of farming operation. Rideau soils are also utilized for permanent pasture, and a significant proportion remain forested.

Correlation to Ottawa Urban Fringe Rideau soils in the survey area for the most part are similar to those mapped in the Ottawa Urban Fringe. Both have developed on grayish colored heavy clay parent material of similar origin. Rideau soils of this area, however, are somewhat more variable with some deposits possessing considerable layers of clay and silty clay.

ST. THOMAS (ST)

Location and Extent Soils of the St. Thomas association occur mainly in Cumberland and West Carleton townships, with a small area also occurring in Rideau Township. In Cumberland Township, they are found on the relatively recent flood plains of the Ottawa River, and in the channel floors and on the ancient flood plains of the ancestral Ottawa River. In West Carleton Township, they are mainly found on what was once the channel floor of the present Ottawa River, or on recent floodplains associated with it. In Rideau Township, they are found on the recent flood plain of the Rideau River in the southern part of the township. Approximately 8,000 ha of St. Thomas soils were mapped, of which 900 ha were mapped in combination with either soils of other associations or the Rockland miscellaneous land unit. Approximately 76% of all St. Thomas soils mapped occur in Cumberland Township. A further 18% occur in West Carleton Township.

Landform and Topography St. Thomas soils have developed in a blanket of coarse textured fluvial or eolian material which is generally 2 m deep or more. Although most often underlain by clayey marine material, the underlying material was not differentiated and may be quite variable. The topography of St. Thomas soils ranges from level to gently sloping or undulating. Slopes range from 0 to 9%.

Soil Material St. Thomas soils have parent materials consisting of noncalcareous fine sand which ranges from light yellowish brown to olive gray in color. Soil reaction of the parent material is medium to strongly acid. Weathered subsoil overlying the parent material also has fine sand textures, and grades from dark brown to strong brown in color nearest the surface, to dark yellowish brown to light olive brown in color at depth. Soil reaction tends to be more acidic than the parent material, ranging from strongly to very strongly acidic. Horizons enriched with iron and aluminum combined with organic matter (Bf and Bfj horizons) commonly occur in the upper portion of the weathered subsoil. A thin eluvial horizon (Ae or Aej horizon), less than 5 cm thick, quite often overlies the weathered B horizons. These horizons have fine sand or loamy fine sand textures, and are brown to light gray in color. Iron, aluminum, and organic matter have been removed from these horizons and transported downward in the profile. Eluvial horizons are not always present, and when they occur are usually not continuous across the landscape.

Under non-forested conditions, a dark yellowish brown to black surface A horizon occurs which is usually less than 10 cm thick. Texturally it may be either fine sand, loamy fine sand, or fine sandy loam. Soil reaction is quite variable, ranging from slightly to extremely acid. Under forested conditions, a layer of accumulated organic matter (LFH horizon) overlies the A horizon at the surface. It is usually less than 5 cm thick, and is very dark brown to black in color. Slightly decomposed leaves and twigs mainly constitute this surface layer.

Soil materials of the association are well sorted, with the sand content of the parent material ranging from 84 to 99%. Mean sand content is 94%. Of the total sand content, the fine sand fraction ranges from 37 to 93%, with the mean fine sand content being 70%. Gravel size particles greater than 2 mm in size are almost non-existent in St. Thomas soils.

Soil Moisture Characteristics St. Thomas soils are excessive to well-drained on the crests and upper slopes of sand ridges or knolls which are common in many landscapes. Imperfectly drained soils are found on the lower slopes of sand ridges or knolls, in depressional areas between well-drained soils, or on the slightly elevated areas in very gently undulating topography. Poorly drained soils occur on level to nearly level topography, or depressional areas between better drained soils.

Due to the coarse nature of the materials, St. Thomas soils are rapidly permeable and have a low moisture holding capacity. Periodic droughty conditions are common in the excessive to well-drained soils. Surface runoff is slow.

Soil Landscape Units Eight units were identified in the St. Thomas association. They are described as follows:

	Recognized Subgroups	**Recognized Series**
ST1: Dominantly excessive to well-drained soils found on very gently to gently sloping or undulating topography. Slopes range from 2 to 9%.	Orthic Humo-ferric Podzols	St. Thomas
	Orthic Dystric Brunisols	Limoges

	Recognized Subgroups	Recognized Series
ST2: Dominantly well-drained soils in combination with significant areas of imperfectly drained soils found on nearly level to very gently sloping or undulating topography. Slopes range from 1 to 5%.	Orthic Humo-ferric Podzols (well)	St. Thomas
	Orthic Dystric Brunisols (well)	Limoges
	Gleyed Humo-ferric Podzols (imperfect)	Achigan
	Gleyed Dystric Brunisols (imperfect)	Vinette
ST3: Dominantly well-drained soils in combination with significant areas of poorly drained soils found on undulating topography. Slopes range from 1 to 9%.	Orthic Humo-ferric Podzols (well)	St. Thomas
	Orthic Dystric Brunisols (well)	Limoges
	Orthic Humic Gleysols (poor)	Cheney
ST4: Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on very gently to gently undulating topography. Slopes range from 1 to 5%.	Gleyed Humo-ferric Podzols (imperfect)	Achigan
	Gleyed Dystric Brunisols (imperfect)	Vinette
	Orthic Humic Gleysols (poor)	Cheney
ST5: Dominantly poorly drained soils in combination with significant areas of well-drained soils found on very gently to gently undulating topography. Slopes range from 1 to 5%.	Orthic Humic Gleysols (poor)	Cheney
	Orthic Humo-ferric Podzols (well)	St. Thomas
	Orthic Dystric Brunisols (well)	Limoges
ST6: Dominantly poorly drained soils found on level or nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	Cheney
ST7: Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on very gently undulating topography. Slopes range from 1 to 2%.	Orthic Humic Gleysols (poor)	Cheney
	Gleyed Humo-ferric Podzols (imperfect)	Achigan
	Gleyed Dystric Brunisols (imperfect)	Vinette
ST8: Dominantly well-drained soils in combination with significant areas of imperfectly drained soils found on very gently to gently undulating topography. Layers of clay or heavy clay occur within 1 m of the surface. Slopes range from 1 to 5%.	Highly variable	

Taxonomic Components Excessive to well-drained soils as well as imperfectly drained soils of the association often have diagnostic Bf horizons which place them in the Podzolic soil order. These horizons, however, do not occur continuously across all landscapes. In some soils, they are not thick enough to be diagnostic for podzolic soils. In others, the accumulation of iron, aluminum and organic matter is not enough to meet the requirements for a podzolic B horizon. In both of these instances, the B horizons (Bm, Bfj horizons) which occur place those soils in the Brunisolic soil order.

The excessive to well-drained **St. Thomas** series (Orthic Humo-ferric Podzol subgroup) under forested conditions has a very dark brown to black LFH surface horizon of accumulated organic matter. It is composed mainly of slightly decomposed leaves and twigs. Under non-forested conditions, a dark yellowish brown to black Ap horizon occurs at the surface which is usually less than 10 cm thick. A brown to light gray Ae horizon, less than 5 cm thick, occurs directly below the A horizon. Immediately below the Ae horizon a dark brown to strong brown Bf horizon occurs which averages 18 cm in thickness. The accumulation of iron, aluminum, and organic matter in this horizon exceeds the limits required for a podzolic B horizon. Lower B and BC horizons are dark yellowish brown to light olive brown in color. Color of the parent material is light yellowish brown to olive. Structure is usually single grain throughout the profile.

The excessive to well-drained **Limoges** series (Orthic Dystric Brunisol subgroup) is similar to the St. Thomas series in most soil profile characteristics. The major difference is the absence of a podzolic B horizon, which then places these soils in the Brunisolic soil order. A yellowish brown to strong brown Bfj or Bm horizon usually occurs in place of a Bf horizon as found in the St. Thomas series. The accumulation of iron and aluminum combined with organic matter in these horizons is not great enough to meet the requirements of a podzolic B horizon. The absence of a well developed Ae horizon also differentiates the Limoges series from the St. Thomas series in cases where the surface has not been disturbed.

The imperfectly drained **Achigan** series (Gleyed Humo-ferric Podzol subgroup) is subject to water saturation for short periods during the growing season. Profile characteristics are similar to the St. Thomas series except for duller yellowish brown to olive gray matrix colors and faint to prominent yellowish red to dark yellowish brown mottles in the lower B horizons and parent material. Like the St. Thomas series, a podzolic Bf horizon is present in these soils.

The imperfectly drained **Vinette** series (Gleyed Dystric Brunisol subgroup) is also subject to water saturation for short periods during the growing season. Profile characteristics are similar to the Achigan series with the exception of the upper B horizons, which are Bm or Bfj horizons rather than Bf horizons.

The poorly drained **Cheney** series (Orthic Humic Gleysol subgroup) is found on level to depressional sites which are subject to water saturation for much of the growing season. The very dark brown to black LFH and Ah horizons at the surface are usually thicker and have a higher organic matter content than those occurring in the better drained members of the association. The underlying subsoil is light olive brown to dark grayish brown in color which grades to olive gray or grayish brown in the parent material. In the B horizons and parent material, low chromas of the matrix colors and prominent strong brown mottles are both indicative of the poor drainage conditions. Structure throughout the profile is single grain.

Mapped Soil Combinations St. Thomas soils were most often mapped as the dominant soil in combination with either soils of other associations or miscellaneous land units. Approximately 700 ha were mapped in this way. The combination of St. Thomas-Rockland land unit is the most extensive but is limited in occurrence. Only two combinations of this type were mapped, with the largest occurring north of the village of Galetta in West Carleton Township. Smaller combinations of St. Thomas-Manotick and Manotick-St. Thomas were mapped in areas where level marine clay plains occur adjacent to deeper marine or fluvial sand deposits. The St. Thomas-Rockland, St. Thomas-Manotick, and Manotick-St. Thomas combinations account for approximately 55% of all St. Thomas soils mapped in combinations.

General Land Use Woodland is the dominant land use found on St. Thomas soils. Occasionally, small areas may be used for growing cereal grains and hay in rotation. More often, however, agricultural use is limited to small areas used for improved pasture or grazing purposes.

Correlation to Ottawa Urban Fringe The St. Thomas soil association was not mapped in the Ottawa Urban Fringe. Soils of the association were included in the Uplands soil association in the Ottawa Urban Fringe for two main reasons. First, extensive areas of St. Thomas soils do not occur in the Ottawa Urban Fringe. Secondly, St. Thomas soils are similar to Uplands soils in many soil characteristics. The high proportion of fine sand in St. Thomas soils is the main differentiating soil characteristic.

Due to extensive occurrences of St. Thomas soil materials in the survey area as well as a difference in mode of deposition from Uplands soils mapped in the Ottawa Urban Fringe survey, it was decided that a new association was warranted to characterize these soils. Interpretations made for either St. Thomas or Uplands soils, however, generally are not significantly different.

UPLANDS (U)

Location and Extent Soils of the Uplands association are not widely distributed across the survey area, and most occur in Osgoode Township. A few small areas also occur in West Carleton Township. In Osgoode township, most Uplands soils are found on or in close proximity to the fluvioglacial ridge that begins at South Gloucester in the north, and extends southward through the township. Approximately 2,000 ha of Uplands soils were mapped, with approximately 50% of that total mapped in combination with soils of other associations.

Landform and Topography Uplands soils have developed in a blanket of coarse textured marine or eolian material which is usually deeper than 2 m. The majority of Uplands soils in the regional municipality including the Urban Fringe area are of deltaic origin, and are found in Gloucester township centred around the Ottawa Airport. In Osgoode township, however, Uplands soils have developed in nearshore, shallow water marine deposits found on or adjacent to the fluvioglacial ridge which extends from South Gloucester southward through the township. During the recession of the Champlain Sea, the original more steeply sloping glaciofluvial ridge was extensively modified by marine wave action and longshore drift. The result was long, elevated sand plains along or near the ridge which have nearly level to very gently sloping or undulating topography. Modification of the original marine deposits by wind resulting in dune formation is quite common in some areas. Slopes range from 0 to 5%.

Soil Material Uplands soils have parent materials consisting of noncalcareous medium sand, which in well or imperfectly drained conditions ranges in color from light olive brown to pale yellow. Under poorly drained conditions, the color of the parent material tends to be grayer. Soil reaction of the parent material is usually medium to very strongly acid. Weathered subsoil overlying the parent material also has medium sand textures and tends to be slightly more acidic in reaction than the parent material. Horizons enriched with iron and aluminum combined with organic matter (Bf and Bfj horizons) commonly occur in the upper portion of the weathered subsoil. These enriched horizons are usually easily recognized by their reddish brown to strong brown colors.

A thin eluvial horizon (Ae or Aej horizon) quite often overlies the weathered B horizons. It is variable in thickness, but is usually less than 15 cm thick. Texture of these horizons is loamy sand or sand. The lighter color exhibited by these horizons is the result of the removal of iron, aluminum, and organic matter which have been transported downward in the profile. Although often present, many Uplands soils do not have eluvial horizons.

Under non-forested conditions, a dark yellowish brown to black surface A horizon occurs which is usually 10 to 20 cm thick. Most commonly the texture is loamy sand, with sand and sandy loam textures less frequent. Soil reaction tends to be slightly more acidic than the parent material. Under forested conditions, a layer of accumulated organic matter (LFH horizon) is usually present at the surface. It is generally less than 5 cm thick, and is very dark brown to black in color. This surface organic layer is composed of leaves and twigs, most of which has undergone little decomposition.

The sand content of the parent material in Uplands soils ranges from 91 to 98%, and the combined silt and clay content seldom exceeds 5%. Uplands soil materials are differentiated from soil materials of the Jockvale and St. Thomas soil associations on the basis of texture and mode of deposition. The medium sand fraction, although variable, generally is higher in Uplands soils resulting in sand rather than fine sand textures. Of the total sand content, the medium sand fraction ranges from 21 to 83%, with the mean medium sand content being 51%. Significant amounts of coarse and very coarse sand as well as some gravel size particles are present in some Uplands soil materials. Coarse and very coarse sand content in the parent material is generally less than 25%, and gravel content when present is usually less than 5%.

Soil Moisture Characteristics Uplands soils are excessive to well-drained on the very gently sloping or undulating landscapes occurring in close proximity to the fluvioglacial ridge in Osgoode township. These drainage conditions also prevail on the crest and upper slopes of sand ridges or knolls which occur in other landscapes. Imperfectly drained soils are found on the lower slopes of sand ridges or knolls, or on nearly level to very gently undulating terrain. Poorly drained soils usually occur in most flat to depressional topographic positions, with poor drainage conditions mainly the result of high water tables.

Uplands soils have a very high porosity and are, therefore, rapidly permeable. They also have a low moisture holding capacity. The combination of these conditions results in periodic droughty conditions in the better drained soils.

Soil Landscape Units Seven units were identified in the Uplands association. They are described as follows:

		Recognized Subgroups	Recognized Series
U1:	Dominantly excessive to well-drained soils found on very gently sloping topography. Slopes range from 2 to 5%.	Orthic Humo-ferric Podzols	Uplands
		Orthic Sombric Brunisols	Carlsbad
U3:	Dominantly well-drained soils in combination with significant areas of imperfectly drained soils found on very gently sloping or undulating topography. Slopes ranged from 2 to 5%.	Orthic Humo-ferric Podzols (well)	Uplands
		Orthic Sombric Brunisols (well)	Carlsbad
		Gleyed Humo-ferric Podzols (imperfect)	Rubicon
		Gleyed Sombric Brunisols (imperfect)	Ramsayville
U5:	Dominantly well-drained soils in combination with significant areas of poorly drained soils, found on very gently to gently sloping or undulating topography. Slopes range from 2 to 9%.	Orthic Humo-ferric Podzols (well)	Uplands
		Orthic Sombric Brunisols (well)	Carlsbad
		Orthic Humic Gleysols (poor)	St. Samuel
U8:	Dominantly imperfectly drained soils in combination with significant areas of poorly drained soils found on nearly level to very gently undulating topography. Slopes range from 0 to 5%.	Gleyed Humo-ferric Podzols (imperfect)	Rubicon
		Gleyed Sombric Brunisols (imperfect)	Ramsayville
		Orthic Humic Gleysols (poor)	St. Samuel
U11:	Dominantly poorly drained soils in combination with significant areas of imperfectly drained soils found on nearly level to gently undulating topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols (poor)	St. Samuel
		Gleyed Humo-ferric Podzols (imperfect)	Rubicon
		Gleyed Sombric Brunisols (imperfect)	Ramsayville
U13:	Dominantly poorly drained soils found on level to nearly level topography. Slopes range from 0 to 2%.	Orthic Humic Gleysols	St. Samuel
U15:	Dominantly excessive to well-drained soils associated with glaciofluvial deposits. The materials are variable, but generally consist of 40 to 100 cm of coarse sand (having less than 10% gravel) over sand. They are found on very gently sloping or undulating topography, and have slopes ranging from 2 to 5%.	Orthic Humo-ferric Podzols Orthic Melanic Brunisols	

Taxonomic Components Excessive to well drained soils as well as imperfectly drained soils of the association often have diagnostic Bf horizons which place them in the Podzolic soil order. These horizons, however, do not occur in all Uplands soils having these drainage conditions. In areas where they are present, they also do not occur continuously across the landscape. In some Uplands soils, Bf horizons are present but they are not thick enough to be diagnostic for podzolic soils. In others, the accumulation of iron, aluminum and organic matter is not enough to meet the requirements for a Bf horizon. In both cases, Bm and Bfj horizons as well as thin Bf horizons occur which place these soils in the Brunisolic soil order.

The excessive to well drained **Uplands** series (Orthic Humo-ferric Podzol subgroup) where under forest conditions has a very dark brown to black LFH surface horizon of accumulated organic matter. It is composed mainly of leaves and twigs which are generally not well decomposed. Under non-forested conditions, the LFH surface layer is absent and a very dark gray or brown Ap horizon occurs at the surface which ranges from to 10 to 20 cm in thickness. A light yellowish or yellowish brown Ae horizon less than 15 cm thick occurs directly below the A horizon. Immediately below the Ae horizon a reddish brown to strong brown Bf horizon occurs which has an average thickness of 13 cm. The accumulation of iron, aluminum, and organic matter in this horizon exceeds the limits required for a podzolic Bf horizon. Lower B and BC horizons are dark yellowish brown to yellowish brown in color. Color of the parent material is light olive brown to pale yellow. Structure is most often single grain throughout the profile, but granular structure may occur in the A horizons of some soils.

The excessive to well drained **Carlsbad** series (Orthic Sombric Brunisol subgroup) is similar to the Uplands series in most profile characteristics. There are, however, two major differences. First, the Carlsbad series does not have a podzolic Bf horizon. Rather, a reddish brown or strong brown Bfj or Bm horizon is present which places these soils in the Brunisolic soil order. The accumulation of iron, aluminum, and organic matter in these horizons is not great enough to meet the requirements of a Bf horizon. In some soils, however, the accumulation may be great enough but the horizons do not meet the minimum thickness of 10 cm. The second major difference from the Uplands series is the absence of a well developed Ae horizon.

The imperfectly drained **Rubicon** series (Gleyed Humo-ferric Podzol subgroup) is found on lower slopes and is subject to water saturation for short periods during the growing season. Profile characteristics are similar to the Uplands series except for duller matrix colors and the presence of mottles in the B horizons and parent material. Colors of the B horizons tend to be less reddish, and colors of the parent materials more grayish then those found in the excessive to well-drained soils. Distinct to prominent, strong brown to yellowish brown mottles also are present in these horizons. A podzolic Bf horizon is present in these soils.

The imperfectly drained **Ramsayville** series (Gleyed Sombric Brunisol subgroup) is also found on lower slopes and is subject to water saturation for short periods during the growing season. Profile characteristics are similar to the Rubicon series with two exceptions. First, these soils have Bm or Bfj horizons rather than podzolic Bf horizons, which place them in the Brunisolic soil order. And secondly, these soils usually do not have an eluvial Ae horizon.

The poorly drained **St. Samuel** series (Orthic Humic Gleysol subgroup) is found on level to nearly level topography or in depressions, and is subject to water saturation for much of the growing season. The surface LFH and/or Ah horizons are usually slightly thicker, and have a higher organic matter content than those occurring in the better drained members of the association. The underlying subsoil is olive brown to brown in color grading to a dark grayish brown to olive gray parent material. Occasionally, a discontinuous olive colored eluvial horizon (Aejg, Aegj) is present which varies in thickness but is usually quite thin. Prominent yellowish red to strong brown mottles are common throughout the profile. Structure is single grain.

Mapped Soil Combinations Approximately 1,000 ha of Uplands soils were mapped in combination with soils of other associations. Equal proportions were mapped as both dominant and significant components, with Uplands-Jockvale and Kars-Uplands combinations the most extensive. In the latter combination, the U15 landscape unit comprised the significant component.

General Land Use Uplands soils are mainly used for hay production, improved pasture, or grazing. At times, cereal grains may be grown in rotation with hay or pasture, but the latter remain the more dominant land uses. Perennial forage crops are grown for hay or improved pasture, but often uncultivated native grasses are relied on for grazing purposes. More intensive agricultural uses, such as continuous corn production, do occur but their extent is quite limited.

Correlation to Ottawa Urban Fringe Uplands soils mapped in this survey correlate closely to those found in the Ottawa Urban Fringe. The majority of Uplands soils mapped occur on the same landscape, on or adjacent to the glaciofluvial ridge which extends southward from Gloucester township in Urban Fringe area into Osgoode township.

Land Type Descriptions

Recent Alluvium (AR)

Land areas of this type are composed of soils which have developed on recent alluvial deposits. They occur primarily as flood plains or river bars and are subject to periodic inundation.

The alluvial deposits occurring in the area vary considerably in material and profile characteristics which made separation into well defined map units difficult. Layers of sand, silt, and clay as well as organic matter constitute many deposits. Due to this variability, alluvial deposits and representative land units were identified on the basis of their dominant materials only. Drainage of most land units ranges from poor to very poor.

Areas of alluvium were mapped as one of two units based on the dominantly occurring material. They are described as follows:

AR1: Dominantly moderately fine to fine textured material most often found on floodplains and subject to periodic inundation. Topography is nearly level with slopes generally less than 2%.

AR2: Dominantly moderately coarse to medium textured material found on floodplains or river bars and subject to periodic inundation. Topography is nearly level to very gently sloping or undulating. Slopes are generally 2% or less.

Eroded Channels (ER)

Eroded channel landscapes were shown on the soil maps as the symbol "ER". These landscapes are the result of erosion which may have occurred either recently or during past geologic times. They primarily consist of steeply to very steeply sloping, narrow, continuous landforms which occur as gullies, valley walls, or creekbeds with embankments.

The most prominent eroded channels occur as valley walls which parallel rivers and stream courses. Slopes associated with these landforms are usually steep and short, most often ranging from 20 to 45%. Less prominent eroded channels occur as gullies or creekbed embankments which are usually associated with smaller tributaries. In most cases these smaller channels occur in areas of level marine plains, and have been cut into the surface often to a depth of 2 to 5 m. Embankments comprising these channels are short and have slopes which are generally not as steep as those found along valley walls. Slopes commonly range from 15 to 45%.

The downslope movement and slumping of soil materials is a common occurrence in and along many eroded channels, especially those cut into thick deposits of marine clay or sand over clay. When these areas were large enough to map individually, they were denoted as a Landslide (LD) unit.

Some areas mapped as eroded channels may have small areas of localized flood plains or recent alluvium within them. These areas were too small to delineate separately at the map scale.

Rockland (RK)

Rockland areas consist of landscapes in which more than 25% of the surface consists of either exposed bedrock or areas having less than 10 cm of mineral material over bedrock. Rockland land units which were developed to portray these areas on the soil maps may occur on Paleozoic sedimentary bedrock plains, or they may occur in areas where Precambrian igneous and metamorphic bedrock outcrops at or near the surface. When found on sedimentary bedrock plains, the most extensive areas of Rockland land units are associated with limestone and dolomite bedrock. Less extensive areas are associated with sandstone bedrock. Both of these occurrences, however, account for only a small percentage of the total area of all Rockland units mapped. The largest areas of Rockland land units are associated with Precambrian igneous and metamorphic bedrock outcrops. The most extensive areas of land units occur on or adjacent to the ridge of granite and gneiss bedrock which outcrops in a northwest to southeast direction in West Carleton Township.

Within Rockland units, significant areas of mineral soils may also occur. Most often these soils consist of moderately coarse to coarse textured undifferentiated drift materials which are less than 50 cm thick over bedrock. Topography in sedimentary bedrock landscapes is most often nearly level to very gently sloping or undulating. In Precambrian bedrock landscapes, the topography is more pronounced, ranging from very gently sloping or undulating to strongly sloping or hummocky. When less than 25% of the surface consisted of exposed bedrock or 10 cm or less of soil materials over bedrock, soil landscape units of the Anstruther, Farmington, or Nepean associations were mapped along with an applicable rockiness phase.

Four units were established to distinguish Rockland areas. They are described as follows:

RK1: Limestone or dolomite bedrock is exposed or occurs very near the surface, constituting 25% or more of the area. Soils of the remainder of the land unit are usually those of the Farmington association, and most often are imperfectly to well-drained. Topography is commonly nearly level to very gently sloping or undulating, with slopes ranging from 1 to 5%.

RK2: Igneous and metamorphic bedrock, primarily granite and gneiss, is exposed or occurs very near the surface and constitutes 25% or more of the area. Soils of the remainder of the land unit are usually those of the Anstruther association and are well-drained. Topography ranges from very gently sloping or undulating to strongly sloping or hummocky. Slopes range from 2 to 15%.

RK3: Igneous and metamorphic bedrock, primarily granite and gneiss, is exposed or occurs very near the surface and constitutes 25% or more of the area. Significant areas of marshland occur in depressional areas of these land units. Soils of the remainder of the unit are those of the Anstruther association and are generally well-drained. Topography ranges from very gently sloping or undulating to strongly sloping or hummocky. Slopes range from 2 to 15%.

RK4: Sandstone bedrock is exposed at or occurs very near the surface and comprises 25% or more of the area. Soils comprising the remainder of the land unit are usually those of the Nepean association, and are imperfectly to well-drained. Topography is commonly nearly level to very gently sloping or undulating, and slopes range from 1 to 5%.

Escarpment (X)

The escarpment land unit consists of either bedrock, clay, or sand over clay scarps having short steep slopes which impede or negate land use practices. Some escarpment land units are used for agricultural purposes, but management of these areas is more difficult than that applied to similar soils found in landscapes with less steep slopes.

Bedrock scarps are found in areas where bedrock occurs close to the surface. They result from local block faulting which left steep, vertical bedrock faces exposed at the surface. Common occurrences are those associated with limestone and dolomite bedrock plains in Cumberland and West Carleton townships as well as the City of Kanata, and those associated with sandstone bedrock plains also in the City of Kanata. The most pronounced bedrock scarps tend to face north and generally parallel the Ottawa River. Surface materials when present in these areas generally consist of thin, flaggy till-like materials or undifferentiated drift which cover less than 50% of the bedrock face. In most cases these scarps border Farmington or Nepean soil landscapes.

Clay or sand over clay scarps generally are found along or near the Rideau and Ottawa Rivers as well as abandoned Pre-Ottawa River channels and terraces. They generally consist of long, narrow, continuous landforms which are usually less than 12 m in elevation. Clay scarps are composed entirely of clayey material, while sand over clay scarps are comprised of similar materials which are overlain by 1 to 3 m of sandy estuarine or fluvial material.

Three land type units were established to identify the types of escarpments which occur. They are described as follows:

X1: Clay escarpments consisting of moderately fine to very fine textured marine material having similar surface textures. Topography consists of moderate to very strong slopes, with slopes ranging from 15 to 45%.

X2: Clay escarpments consisting of moderately fine to very fine textured marine material overlain by a 1 to 3 m thick veneer of moderately coarse to coarse textured estuarine or fluvial material. Topography consists of moderate to very strong slopes, with slopes commonly ranging from 15 to 45%.

X3: Sedimentary bedrock scarps found on moderate to very strongly sloping topography, with slopes most often ranging from 15 to 45%. Limestone and dolomite scarps occur more often than sandstone scarps.

Miscellaneous Land Unit Descriptions

Landslide (LD)

Landslide areas consist of soil materials which have moved downslope from higher positions in the landscape. Areas of this type may include a resulting head scarp as well as zones of material removal and deposition.

Landslide units which were mapped were generally found either along active stream banks or along the banks and terrace bluffs of abandoned river or stream channels. Usually these land features were composed of fine textured marine material which at times was overlain by moderately coarse to coarse textured marine or fluvial material. The cause of downslope movement of material from banks or terraces in most instances can be attributed to unstable, highly sensitive Leda marine clay which constitutes them. Clay of this type is commonly associated with soil materials comprising the Rideau and Bearbrook soil associations.

Soil materials, topography, and drainage in landslide areas may vary considerably. Most often the materials consist of tilted or slumped blocks of clay which may or may not have interbedded vertical and horizontal layers of sand. Either or both types of material may be present at the surface. The landform primarily consists of head scarps and downslope aprons and fans. Topography associated with the head scarps is usually gently to moderately sloping, with slopes ranging from 5 to 15%. Topography of the downslope aprons and fans may be nearly level to undulating or irregular, with slopes ranging from 2 to 9%. Drainage ranges from moderately well-drained on the steeper crests and scarps, to poorly drained on the level to depressional lower slopes. The majority of the soils of most landslide areas are poorly drained.

Most landslide areas mapped occur in close proximity to the Ottawa River.

Marshland (ML)

The marshland land unit consists of wetland which is periodically or continuously flooded. Much of the area consists of standing water, with the remainder consisting of organic soils with wetland vegetation. The organic soils of these units were not characterized and may vary widely in material composition, depth, and degree of decomposition. Sedges, reeds, leaf and needle fragments, grasses, woody fragments and stumps may all constitute marshland organic materials.

Marshland units primarily occur in low lying depressional areas and may overlay various types of mineral materials which were not differentiated. Occasionally thin layers of mineral material underlain by bedrock may occur.

Standing water at the surface and very poor drainage conditions are due to both precipitation and groundwater discharge from adjacent areas, and the lack of adequate natural drainage outlets to remove such additions.

Vegetation found in marshland areas varies, but most often consists of rushes, reeds, grasses or sedges which occur in combination with lesser amounts of birch, alders, or maples. The latter woody species usually can be found in perimeter areas which border better drained mineral soils. Some recent marshland areas, which once had fluctuating water tables, may have a significant number of dead or dying tree species occurring within them.

Land Altered by Man — Disturbed Land (DL), Landfill Site (LF), Sewage Lagoon (SL), Topsoil Removed (TR), Urban Land (U).

Land areas which were altered by man and, therefore, did not occur naturally in the landscape were delineated and shown separately on the soil maps. The types of land occurring in these areas can be inferred from the designation given in each delineation. Undisturbed soils may occur within each type of unit which could not be shown separately at the map scale.

SOIL INTERPRETATIONS

A. AGRICULTURAL CAPABILITY CLASSIFICATION

(a) Explanation of Capability Classifications

(1) Capability Classification for Mineral Soils

The classification system used to determine soil capability for agriculture is a modified version of the Central St. Lawrence Lowlands Soil Capability Classification for Agriculture (1). That system was first applied to the soils of the Ottawa Urban Fringe area and differed from the national Canada Land Inventory (CLI) system (23) due to more refinement in the definition and application of the subclasses. In the system outlined herein, further refinements of the subclasses and their application have been made. All subclasses or limitations which occur are shown in a soil capability rating along with an indication of individual severity of the subclasses. In this way, a more systematic and precise means of determining capability is possible.

The system arrives at capability classes which are similar to those determined in the national CLI system. Both systems group mineral soils into seven capability classes according to their potential for the sustained production of common field crops. Common field crops include corn, oats, wheat, barley, soybeans*, and perennial forage crops such as alfalfa, grasses, and bird's-foot trefoil. The best soils, with no significant limitations for growth of these crops, are designated class 1. Soils designated classes 2 to 6 have decreasing capability for agriculture and class 7 soils have no agricultural potential. Organic soils and specialty crops such as tobacco, fruits, and vegetables are not considered in this classification system.

Before using the soil capability tables or maps provided, it is important that the user have an understanding of the following assumptions upon which the classification is based:

- Good soil management practices that are feasible and practical under a largely mechanized system of agriculture are assumed.
- Land improvements such as drainage works, stone removal, and clearing are assumed to have been made and that soil, landscape, and regional conditions have allowed or would allow these improvements. Therefore, capability ratings applicable to some mapped areas are higher than would be warranted by the present conditions of those areas. Hence, capability ratings always reflect capabilities under improved conditions except those of classes 6 and 7, in which improvements of any kind are not considered feasible.
- Distance to markets, accessibility to transport, location, size of farm, types of ownership, cultural patterns, skill or resources of individual operators, or risk of crop damage by storms are not considered in the classification system.

The capability classification comprises two components: (1) the capability class, and (2) the capability subclass(es). A combination of these two components provide the user with an indication of the degree and kind of limitation or limitations which are present.

**Soybeans may be included in this group of crops with the exception of ratings for stony soils. Fewer surface stones are tolerable for the harvesting of soybeans than for the rest of the crops in this group.*

(a) Soil Capability Classes

The capability class indicates the general suitability of the soil for agricultural use and is indicated by the numeral at the front of each capability rating. An explanation of each follows:

Class 1: Soils in this class have no significant limitations to use for common field crops.

Class 2: Soils in this class have a moderate limitation or combination of minor limitations which restrict the range of crops or require moderate conservation practices.

Class 3: Soils in this class have a major limitation or combination of lesser limitations which restrict the range of crops or require special conservation practices.

Class 4: Soils in this class have a severe limitation or combination of lesser limitations which restrict the range of crops or require special conservation practices, or both.

Class 5: Soils in this class have a very severe limitation or combination of lesser limitations which restrict their capability to producing perennial forage crops. Improvement practices are feasible.

Class 6: Soils in this class are capable of producing only perennial forage crops. Improvement practices are not feasible.

Class 7: Soils in this class have no capability for arable culture or permanent pasture.

(b) Soil Capability Subclasses

The subclass defines the kind of limitation or conservation problem which is present. A soil may, therefore, have one or more subclasses reflecting one or more limitations or problems. Each subclass or limitation may vary in severity. In contrast to the national CLI system, the modified system which has been applied in this survey allows all subclasses or limitations present to be shown in a rating along with an indication of their individual severities. An assessment of overall severity then allows the determination of the appropriate class. The kinds of subclasses are as follows:

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

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

Subclass I: Flooding (inundation) by rivers, streams or lakes.

Subclass M: Low moisture holding capacity caused by adverse inherent soil characteristics.

Subclass P: Stoniness interfering with tillage, planting and harvesting.

Subclass R: Shallowness to solid bedrock. Solid bedrock is 1 m or less from the surface.

Subclass T: Adverse topography. Steepness and pattern of slopes limits agricultural use.

Subclass V: Variations in drainage within soil landscape units resulting in significant variability in soil moisture across the landscape.

Subclass W: Excess water, other than from flooding, due to poor drainage, high water table, seepage, or run-off from surrounding areas.

(c) Subclass Refinements

Each subclass or kind of limitation has been further defined with respect to the different degrees of severity in which the limitation may exist. By refining the subclass in this way, and then applying an appropriate downgrading value to each type and degree of subclass or limitation, classes can be determined more systematically and a better indication of soil quality is presented.

Six degrees of intensity or severity have been established, which consist of minor, moderate, major, severe, very severe, and extremely severe. Minor, moderate and major degrees of severity were previously applied in the classification system developed for the Ottawa Urban Fringe (1). Severe, very severe, and extremely severe degrees of intensity or severity, however, have their origin in the classification system described herein.

All of the previously identified subclasses or limitations except Subclass I have been divided into minor, moderate and major degrees of severity, and definitions of these are given in Table 7. Respectively, they are represented by a small case letter, an uppercase letter, and an uppercase letter with a raised apostrophe e.g. w, W, W'. A minor limitation downgrades by one-half a class, a moderate limitation by one class, and a major limitation by two classes. Thus, two minor limitations are necessary to downgrade by one class, and a soil with one minor limitation would remain in Class 1. The degree of severity of some types of subclasses or limitations, however, is such that downgrading by three or more classes is necessary. To account for this additional downgrading, these limitations have been further divided into severe, very severe, and extremely severe degrees of intensity or severity. They are represented, respectively, by an uppercase letter with a double apostrophe, an uppercase letter with an asterisk, and an uppercase letter which is underlined e.g. W'', W*, W. A severe limitation downgrades three classes, a very severe limitation four classes, and an extremely severe limitation five classes. Only limitations P, R, T and W have been divided further into these degrees of severity and definitions of each are given in Table 8.

Table 7. Major, moderate, and minor subclass definitions

	MAJOR		MODERATE		MINOR
D':	Massiveness, poor structure and/or firm to very firm consistency in entire soil profile causing insufficient aeration and slow moisture absorption and distribution.	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 very low organic matter and/or clay content throughout the rooting zone. High acidity (pH < 5.5) may also occur.	F:	Low nutrient status and/or moderate nutrient imbalance due to low organic matter and/or clay content in part of or all of the rooting zone.	f:	Minor nutrient deficiency or imbalance which may affect some crops.
I':	Frequent land flooding of extended duration.				
M':	Soil droughtiness in well to excessively drained deep sands and gravels requiring irrigation for normal crop production under average weather conditions. Textures include all sands or gravelly sands, and Bt horizons are absent.	M:	Soil droughtiness in well to excessively drained soils subject to moisture deficiencies during dry years. Soil characteristics such as the presence of Bt horizons, underlying finer material, or coarse soil textures having some clay and silt, i.e., loamy sands, all provide some moisture retention.	m:	Soil droughtiness in well-drained fine sandy loams or sandy loams. Used as an indicator of potential droughtiness (not affecting rating) in some instances.
P':	Soils sufficiently stony (3 to 15% of surface) to significantly increase the difficulty of tillage, planting and harvesting. When more than 15% of the surface is composed of stones, cultivation is further restricted or becomes impractical and additional downgrading is required.	P:	Moderately stony soils (0.1 to 3% of surface) causing some interference with tillage, planting and harvesting. Also applied to stony soils requiring regular stone removal.	p:	Slightly stony soils (less than 0.1% of surface). The stones offer slight to no hindrance to cultivation. Also applied to stony soils requiring occasional stone removal.

(Continued on Page 79)

Table 7. (cont'd)

MAJOR	MODERATE	MINOR
R': Soils with a restricted rooting zone (hard rock at 50-100 cm depth) and having localized rock outcrops covering 2-10% of the surface, OR, deep soils (unrestricted rooting zone) with localized rock outcrops covering 10-25% of the surface. Increases in rock outcrops OR more restricted rooting zones (hard rock at less than 50 cm depth) require additional downgrading.	R: Soils with a restricted rooting zone (hard rock at 50-100 cm depth) or deep soils with localized rock outcrops covering 2-10% of the surface.	r: Solid, hard rock at more than 1 m depth or shattered soft rock (shale) between 50 and 100 cm depth affecting moisture distribution, stoniness, etc.
T': Slopes of 10 to 15% affecting machine workability and requiring protection measures against water erosion. Soils with these slopes cannot be rated higher than Class 4. Steeper slopes require more severe downgrading.	T: Slopes of 6 to 9% interfering slightly with the use of farm machinery and requiring some special conservation practices to prevent water erosion.	t: Slopes of 3 to 5% not interfering with the use of farm machinery, but causing some slight water erosion and/or lack of uniformity in moisture distribution, seed germination, and plant growth.
V': Repetitive variations in drainage across the landscape of two or more drainage classes resulting in major soil moisture deficiencies and excesses in the soils which occur. Generally applied to landscapes in which drainage varies from good or excessive on undulations to poor in depressions. (Never used with W', W, M', or M.)	V: Repetitive variations in drainage across the landscape of one drainage class and representing a moderate soil moisture deficiency in some soils which occur. Generally applies to landscapes in which drainage varies from good to imperfect, and where the soils with good drainage are affected by moderate soil moisture deficiencies. (Never used with W', W, M', or M.)	v: Any minor variation in drainage across the landscape which may affect crop growth or farm operations. Generally applied along with wetness or moisture subclasses to landscapes having variations in soil moisture.
W': Excessive wetness associated with poorly or very poorly drained soils, generally due to ponding, seepage, impermeable subsoil, or some combination of these factors. Excessive moisture may persist long enough to adversely affect choice of crops, plant growth, or timeliness of farming operations.	W: Wetness generally associated with poorly drained soils or imperfectly drained soils with high moisture content in the lower profile. Most often associated with clayey soils or porous soils resting on impervious substrata.	w: Occasional wetness generally associated with imperfectly drained soils.

Table 8. Extremely severe, very severe, and severe subclass definitions

EXTREMELY SEVERE		VERY SEVERE		SEVERE	
P:	Excessively stony soils (more than 50% of the surface). The soils are too stony to permit cultivation, and improvement is not practical.	P*:	Soils with enough stones (15 to 50% of surface) to prevent annual cultivation; considerable clearing must be done.		
R:	Soils with a very restricted rooting zone (hard rock at 20-50 cm depth) and rock outcrops covering 10-25% of the surface. If more than 25% of the surface is covered by outcrops, downgrading of six classes may be applied.	R*:	Soils with a restricted rooting zone (hard rock at 50-100 cm depth) and rock outcrops covering 10-25% of the surface, OR, soils with a very restricted rooting zone (hard rock at 20-50 cm depth) and rock outcrops covering 2-10% of the surface.	R'':	Soils with a very restricted rooting zone (hard rock at 20-50 cm depth).
T:	Slopes greater than 30% which prevent the use of farm machinery. Associated with escarpments and eroded channels.	T*:	Slopes of 16-30% severely restricting machine workability and preventing annual cultivation. Require special protection measures against erosion.		
W:	Excessive wetness associated with poor or very poor drainage. Excessive moisture occurs at or near the surface for extended periods during the growing season, and improvement by artificial drainage is not feasible.				

(d) Soil Capability Ratings

A capability rating has been determined for individual land areas, each of which is portrayed as a map unit on the soil maps. Each rating consists of a capability class and all capability subclasses pertinent to the map unit. Within a map delineation there may be one or two map units identified depending on whether one or two distinct types of land areas are present. The amalgamation of symbols within a delineation on the soil maps is referred to as a map unit symbol. A simple map unit symbol represents one map unit. A compound map unit symbol represents two map units each of which must be evaluated separately for its soil capability.

The capability class assigned to each capability rating has been arrived at by assessing the degree of severity of the subclasses or limitations which are attributed to each map unit. If the limitations are minor, moderate, major, or severe, an additive process is used in which the downgrading values of all limitations are added together to arrive at the number of classes the map unit should be downgraded from Class 1. Additively, these limitations can not downgrade the map unit lower than Class 5, even if a more severe downgrading is indicated. The reason for this class restriction is that the individual severity of these limitations is such that each may contribute to reduced capability down to Class 5, but individually or combined they are not severe enough to warrant placing a soil in Class 6 because improvement practices may be feasible.

If a very severe limitation has been attributed to a map unit, soil capability can be no better than Class 5. The presence of a limitation with this degree of severity automatically downgrades a map unit four classes, thus restricting capability to the production of perennial forage crops. Other limitations of equal or lesser magnitude may also be present, some of which have been allowed to downgrade some map units further to Class 6. In these instances, the cumulative severity of the limitations would limit capability to that of permanent pasture, and improvement practices would not be feasible.

The presence of an extremely severe limitation in a map unit is very restrictive because improvement of that limitation is not practical, and soil capability can be no better than Class 6. Additional limitations of equal or lesser magnitude may also be present, some of which have been allowed to downgrade some map units further to Class 7. In these instances, the cumulative severity of the limitations makes any type of agricultural use impractical.

(e) Guidelines Used in Rating Soils

(1) Wetness (W) and Drainage Variability (V)

Natural drainage may be uniform or variable in map units. The defined degrees of severity for wetness given in Tables 7 and 8 are applied when drainage is uniform. However, when variations in drainage occur within map units, limitations v, V, or V' may be applied, depending on the contrast in soil moisture conditions. The minor limitation v is usually applied along with w or W to indicate minor variations in drainage which are not severe enough to warrant downgrading by more than one class. In most instances, it is used when the less extensive or significant drainage component in a map unit is not as well drained as the most extensive or dominant component. An example would be a poorly drained component in a dominantly imperfectly drained unit.

Limitations V and V', however, represent landscape situations in which the difference in soil moisture conditions is significantly more pronounced, and the map unit must be downgraded accordingly. They are applied to map units in which the dominant component has a moisture deficiency (good to rapidly drained), and the significant component has adequate moisture or a wetness limitation (imperfect to poorly drained). Uniformity of plant growth is affected in these instances. Limitations V and V' are never applied along with W', W, M', or M because those limitations adequately downgrade map units having soil moisture excesses or deficiencies.

(2) Limitations Not Affecting the Rating

Occasionally, limitations may be present and shown in some ratings which have not been allowed to influence the class designation, although they may do so in other ratings. Brackets are placed around these limitations which are minor in terms of severity and occur in Class 1 to 5 ratings. One of the following reasons may apply to limitations given in this way:

- they may represent a potential limitation which may not occur consistently, i.e., moisture deficiency (m) applied when depth to impermeable substratum is highly variable.
- they may represent a benefit rather than a limitation. For example, when the secondary drainage component of a map unit is better drained than the main component, the potential benefit to crop growth of the better drained secondary component is recognized with subclass symbol (v) but it is ignored in the overall assessment of limitations to arrive at the capability class. This is the case for most (v) limitations shown in the ratings.
- they are not severe enough to warrant downgrading some soils further than that indicated by the other limitations which are present, for example, (t) in some ratings.

(3) Associated Stoniness

In some soils, stones are present in significant amounts in the material itself and will pose a continual hindrance to annual cultivation even after normal stone removal. Stoniness limitations in some ratings, therefore, may reflect this inherent or residual stone content and not the surface stoniness. One example of associated stoniness occurs in the Farmington soil association where a moderate stoniness limitation P rather than minor limitation p is applied to soils with Stoniness Class 1 (S1).

(4) Limitations Requiring Less Severe Downgrading

When limitations F' and M' are both present, their combined downgrading value is three classes rather than four, e.g. 4 F'M'. If each were allowed to downgrade two classes, a downgrading to Class 5 would be too severe.

(2) Capability Classification for Organic Soils

The previously described classification system applies only to the mineral soils in the survey areas and cannot be applied to the organic soils. A separate classification system for organic soils is necessary due to their unique physical characteristics and properties. The system applied in this survey is based to a great extent on two previously established systems by Leeson (25) and Hoffman and Acton (26). Guidelines and soil parameters of those systems were incorporated into the system described herein which provides a **general** assessment of a soil's agricultural capability.

In the classification system, organic soils are mainly assessed for their long-term capability to intensively grow vegetable crops. It is assumed that substantial costs are associated with the reclamation of most organic soils and that high return crops such as vegetables will have to be grown. Therefore, organic soils which do not have long-term capability for vegetable crop production will have a low agricultural capability. Soils with this capability include those which are restricted to producing crops other than vegetable crops, or those which have no capability for agriculture of any type. In these instances reclamation or improvement practices are not feasible due to either economic or physical limitations.

In general the classification system places an organic soil in one of seven capability classes based on the severity of limitations which are present. Limitations consist of detrimental soil characteristics which adversely affect or limit vegetable crop production.

(a) Organic Soil Capability Classes

The capability class consists of a group of soils which have the same capability or potential for the production of vegetable crops. Class 1 soils have the greatest capability and no limitations for the production of vegetable crops. Class 4 soils have severe limitations and are only marginal for vegetable crop production, while Class 7 soils have no capability for agriculture. Soils grouped in the same class may have various types of limitations. However, the degree of severity of the limitations present in each soil is similar. The soil capability classes are described as follows:

Class 1 — Organic soils of this class have no water, topographical, or pH limitations. They are deep and level and at an intermediate stage of decomposition.

Class 2 — Organic soils in this class have one limitation which restricts their use in a minor way. The limitation may be woodiness, reaction, or depth.

Class 3 — Organic soils in this class have moderately severe limitations that restrict the range of crops, or that require special management practices.

Class 4 — Soils in this class have limitations that severely restrict the range of crops, or require special development and management practices. Reclamation and management costs will be high.

Class 5 — Soils of this class have such severe limitations that they are restricted to the production of crops other than vegetables. Perennial forage or other specially adapted crops may be grown. Large scale reclamation is not feasible.

Class 6 — Class 6 organic soils are capable of producing only indigenous crops consisting of plants which are native to the area. Improvement practices are not feasible.

Class 7 — Organic soils in this class have no capability for agriculture.

(b) Organic Soil Capability Subclasses

A subclass is a group of soils with similar kinds of limitations or hazards. Four kinds of subclasses or limitations have been identified, and they are described as follows:

K — Stage of Decomposition — Mesic soils or soils of intermediate decomposition are the most desirable in order to avoid water control problems associated with fibric or humic soils. Since the upper 40 cm of material will decompose rapidly after only a few years of agricultural use, the material composing the 40-160 cm depth of the profile is assessed because it is this material which will have a continuing effect on the drainage, permeability, capillary rise of water, and rate of subsidence of the profile (25). Organic soils in the survey areas were, therefore, classified based on their stage of decomposition at the 40-160 cm depth of the profile in the following way:

Dominant Material	Capability Class
Fibric — poorly decomposed	Class 4
Humic — well decomposed	Class 3
Mesic — moderately decomposed	Class 1

Note: Humic or Fibric materials in combination with other limitations may further downgrade the capability rating of some soils.

F — Reaction — The fertility level of organic soils is generally low and considerable fertilization will be required for the production of vegetable crops. Soil reaction, however, is an important consideration when assessing organic soils as a growth medium for such crops. Most plant roots will not grow into a highly acid medium, while others do not tolerate alkaline conditions. Organic soils in the survey area were therefore classified on the following criteria:

Reaction	Capability Class
pH 4.5 — 7.0	Class 1
pH 4.5 — 4.0	Class 2
pH 4.0 — 3.5	Class 3

L — Wood Content — Large pieces of wood such as tree trunks, stumps, or branches will probably interfere with cultivation, ditching, or the installation of tile drains. Wood in general also affects the moisture regime of the soil. When large pieces occur within the upper 60 cm of the profile, they will affect cultivation practices within the first few years of agricultural use. Periodic removal of wood fragments may, therefore, be necessary. Organic soils have been classified on the basis of the volume of wood occurring in relation to the total volume of material in the control section. The following ranges in wood content were used for classifying the soils in the survey area:

Wood Content (Percent of total volume)	Capability Class
None	Class 1
1 - 25%	Class 2
26 - 50%	Class 3
> 50%	Class 4 or lower

H — Depth of organic material over type of substratum — Due to subsidence associated with agricultural use, a minimum depth of organic material must be available in order to economically justify reclamation. Long-term agriculture use, therefore, requires a considerable depth of organic material. When such depths are not present, underlying mineral material or bedrock occurring close to the surface will affect the feasibility of subsurface drainage. In these cases, fine textured mineral substrata generally present fewer management problems than medium or coarse textured material or bedrock substrata. The following criteria for depth and type of substrata were used to classify the soils:

Capability Class	Depth of Organic Material	Type of Substratum
Class 1	> 160 cm	- all types
Class 2	130 - 160 cm	- fine textured
Class 3	100 - 130 cm	- fine textured
	130 - 160 cm	- medium or coarse textured
Class 4	100 - 130 cm	- medium or coarse textured
	40 - 100 cm	- fine textured
	130 - 160 cm	- bedrock
Class 5	40 - 100 cm	- medium or coarse textured
	100 - 130 cm	- bedrock
Class 6	40 - 100 cm	- bedrock

(c) Organic Soil Capability Ratings

Capability ratings for soil landscape units are given in Table 10. Most soil landscape units encompass a range of soil characteristics, the most significant being depth of organic material over mineral or bedrock substrata. In such units, a range of limitations are also present which often vary in type and severity. Consequently, a range of capability ratings is necessary for those units to reflect the soils which compose them. When a range of capability ratings is given, these represent the highest and lowest ratings and not all ratings which may apply.

(3) Capability Classification for Land Type and Miscellaneous Land Units

The classification system which was applied to determine the agricultural capability of mineral soils was also applied to these land units. All land type units and some miscellaneous land units were classified and given a capability rating. Units of the latter type which were not classified include land altered by man. Included in this grouping are areas of Disturbed Land (DL), Landfill Sites (LF), Sewage Lagoons (SL), Topsoil Removal (TR), and Urban Land (U). Agricultural use of these areas is either not possible or not feasible due to high reclamation costs.

Capability classes and subclasses as defined in section (1) were applied to units which were classified. Many of the subclasses or limitations defined in that section have been applied. Capability classes are confined to classes 4 to 7 due to the severity of limitations which are present.

(b) Introduction to the Agricultural Capability Rating Tables

When applied to the soil maps, the rating tables (Tables 9, 10 and 11) provide the means of determining the agricultural capability or capabilities of the land area represented by a map delineation. The landscapes which occur within delineations are represented by either a simple or compound map unit symbol on the map. When the components of the symbol are known the applicable agricultural capabilities can be determined.

In order to apply the tables, one must be aware of the following:

1. The letter "N", when it is shown in the Stoniness or Rockiness Class column of Table 9, represents Nonstony and Nonrocky. When a Stoniness Class such as S1, or Rockiness Class such as R2 is not shown in the symbol on the map, Nonstony and Nonrocky (N) is implied.
2. Capability ratings for mineral soils are given in Table 9. Ratings for organic soils are given in Table 10. Ratings for land types and for those miscellaneous land units to which ratings are applicable are given in Table 11.
3. Occasionally, slope classes may be given in some map symbols for Land Type Units which occur. These slopes are not required when determining agricultural capabilities for those units in Table 11.
4. When a soil phase occurs in a map unit symbol, the Soil Landscape Unit having that phase may be rated separately from a similar Soil Landscape Unit not having that phase. For example a G1.S unit is rated separately from a G1 unit. This is necessary when the phase affects capability.

(c) How to Apply the Capability Rating Tables

The following procedure may be followed to determine the appropriate soil capability for a map unit symbol:

1. Study the "Explanation of the Map Unit Symbols" shown on the border of each map. Determine whether the map unit symbol for the delineation in question consists of one map unit (a simple map unit symbol) or two map units (a compound map unit symbol). A capability rating for each map unit must be determined separately.
2. Using the map legend, determine the components of each map unit. Most map units comprise a soil landscape unit and an associated slope class component. In addition, some map units within this group also include a soil phase component and/or a stoniness class or rockines class component. Other map units consist solely of a land type unit or a miscellaneous land unit. A few map units consist of a land type unit and an associated slope class component. However, the slope class component is not considered in the determination of capability in these cases.
3. If a land type unit or miscellaneous land unit is identified, consult Table 11 for its capability rating. If a soil landscape unit representing an organic soil is identified, Table 10 may be consulted for the respective rating. If a soil landscape unit representing a mineral soil is identified proceed to step 4.
4. Having noted the mineral soil landscape unit and its associated components, determine the respective rating by consulting Table 9 using the following procedure:
   1. Locate the soil landscape unit listed alphabetically across and within the table in a number of horizontal columns. The rating will be shown somewhere in the vertical column below the identified unit.
      NOTE: Soil landscape units having soil phases are shown separately.
   2. Now locate the applicable slope class at the left side of the table, and then locate the applicable stoniness or rockiness class from the group listed for that slope class. You have now found the horizontal line in which the rating is given.
   3. Follow the horizontal line across the page to the predetermined vertical column, where the capability rating will be shown.

(d) Examples of Rating Determinations for Some Map Symbols

The following examples use symbols from Figure 34:

#1. Simple Map Unit Symbol

Map Unit Symbol = C5 / 2*
Soil Landscape Unit = C5
Slope Class = 2*
Stoniness or Rockiness Class = not shown, therefore nonstony and nonrocky (N)

The C5 soil landscape unit represents mineral soils as determined from the map legend. Therefore, from Table 9, the Ag. Cap. Rating = 3WF

#2. Simple Map Unit Symbol

Map Unit Symbol = N4 / R2.3*
Soil Landscape Unit = N4
Slope Class = 3*
Stoniness or Rockiness Class = R2 (Rockiness Class 2)

The N4 soil landscape unit represents mineral soils as determined from the map legend. Therefore, from Table 9, the Ag. Cap. Rating = 6<u>R</u> P'tv

#3. Simple Map Unit Symbol

Map Unit Symbol = BE1 / 1
Soil Landscape Unit = BE1
Slope Class = 1
Stoniness or Rockiness Class = not shown, therefore nonstony and nonrocky (N)

The BE1 soil landscape unit represents organic soils as determined from the map legend. Therefore, from Table 10, the Ag. Cap. Rating = 3K to 5HK (a range of capabilities)

For examples #1, #2, #3, **one** rating is determined. In example #3, however, the capability rating consists of a range of capabilities due to the variable nature of organic soils represented by the BE1 soil landscape unit.

#4. Compound Map Unit Symbol

Map Unit Symbol = NG2-D3 / 2*
Soil Landscape Units = NG2 and D3
Slope Class associated with first soil landscape unit = 2*
Slope Class associated with second soil landscape unit = 2*
Stoniness or Rockiness Class = not shown, therefore both are nonstony and nonrocky (N)

(Continued on Page 84)

The NG2 and D3 units both represent mineral soils as determined from the map legend. Therefore,

From Table 9, the Ag. Cap. Rating of NG2/2* = 2W (dominant unit- more than 40% of the area)

From Table 9, the Ag. Cap. Rating of D3/2* = 2W (significant unit- 20 to 40% of the area)

Therefore, the Ag. Cap. Rating for the entire area represented by the map symbol = 2W

#5. Compound Map Unit Symbol

Map Unit Symbol = 01-F1 / S2.3*-S2.2*

01 and F1 soil landscape units represent mineral soils as determined from the map legend. Therefore,

From Table 9, the Ag. Cap. Rating of 01/S2.3* = 4MFPt (dominant unit)

From Table 9, the Ag. Cap. Rating of F1/S2.2* = 5R"P (significant unit)

Therefore, the Ag. Cap. Rating for entire area represented by the map unit symbol = 4MFPt-5R"P

#6. Compound Map Unit Symbol

Map Symbol = G1.S-RK1 / S1.2-2

G1.S is a soil landscape unit representing mineral soils and is a shallow soil phase. RK1 is a land type unit.

From Table 9, the Ag. Cap. Rating of G1.S/S1.2 = 3RP (dominant unit)

From Table 11, the Ag. Cap. Rating of RK1/2 = 7 R̲ (significant unit)

Therefore, the Ag. Cap. Rating for the entire area represented by the map symbol = 3RP-7 R̲

For examples #4, #5, and #6, **two** ratings must be determined. The first map unit shown in the compound symbol is the dominantly occurring unit, and occupies more than 40% of the area. The second map unit shown is the significantly occurring unit, and occupies 20 to 40% of the area.

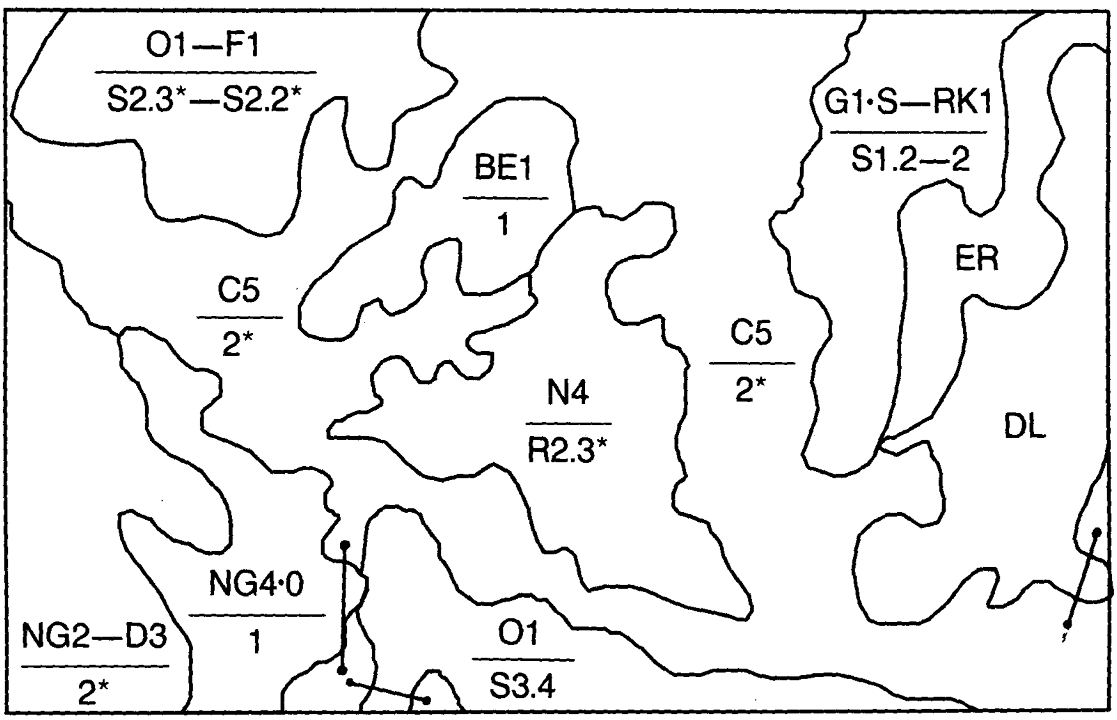

Figure 34.
Example portion of a soil map for the Ottawa-Carleton Region.

(e) The Capability Rating Tables

Table 9. Agricultural capability ratings for soil landscape units representing mineral soils

Slope Class	Stoniness or Rockiness Class	AGRICULTURAL CAPABILITY RATINGS										
		Anstruther	Bearbrook				Castor					Soil Assoc.
		A1	B1	B2	B3	B4	C2	C3	C4	C5	C5.S	Land. Units
1, 1*, 2, 2*	N		3DW	3WD	4W'D	3DW	2Fw	2Fw(v)	3W(v)F	3WF	4WRF	
3, 3*	N		3DWt				2Fw(t)	2Fw(v)(t)		3WFt		
	S1	5R"PFt										
	S2	5R"PFt										
	S3	5R"P'Ft										
	R1	5R*PFt										
	R2	6 R P'Ft						4R'Ftw(v)				
4, 4*	N		4DTW				3TFw	3TFw(v)				
	S1	5R"FTp										
	S3	5R"P'FT										
	R1	5R*PFT										
	R2	6 R P'FT						4R'TFw(v)				

Slope Class	Stoniness or Rockiness Class	Chateauguay						Dalhousie				Soil Assoc.
		CH3	CH4	CH4.S	CH5	CH6	CH7	D1	D2	D2.C	D3	Land. Units
1, 1*, 2, 2*	N	2W	1w	2Rw		2W	2W	1w	2wv	2wv	2W	
	S1	2Wp										
	S2	3WP									3WP	
	R1										3RW	
3, 3*	N		2wt		2wt			1w(t)	2wvt			
	S1		2wtp									
	R1							3Rtw				
4, 4*	N		2Tw		2Tw				3Twv			
	R1							3RTw				

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Table 9. (continued)

Slope Class	Stoniness or Rockiness Class	AGRICULTURAL CAPABILITY RATINGS Dalhousie D3.C	D3.S	D4	D4.O	D5	Farmington F1	F1.F	F2	F2.F	F3	Soil Assoc. Land. Units
1, 1*, 2, 2*	N	2W	3RW	3W'	3W'	2W(v)					7 W R"p	
	S1						5R"P		5R"Pw		7 W R"P	
	S2						5R"P		5R"Pw	5R"Pw	7 W R"P	
	S3						5R"P'				7 W R"P'	
	R1						5R*P					
	R2						6 R P'	6 R P'	6 R P'w		7 WR P	
3, 3*	N		3RWt									
	S1						5R"Pt		5R"Ptw			
	S2						5R"Pt		5R"Ptw			
	S3						5R"P't					
	S4						6P*R"t	6P*R"t				
	R1						5R*Pt					
	R2						6 R P't					
4, 4*	N		4RWT									
	S1								5R"PTw			
	S2						5R"PT					
	S3						5R"P'T					
	S4						6P*R"T					
	R2						6 R P'T					
5, 5*	S2						5R"T'P					
	S3											
	S4						6P*R"T'					
	R2						7 R T'P'					

Slope Class	Stoniness or Rockiness Class	Farmington F3.O	F4	F4.F	F5	F6	Grenville G1,G1.C	G1.S	G2,G2.C	G2.S	G3,G3.C	Soil Assoc. Land. Units
1, 1*, 2, 2*	N	7 W R"P	5R"Pv									
	S1		5R"Pv		6R"PV	6R"V'P	1p	3RP	2pw	3RPw	3W'p	
	S2		5R"Pv		6R"PV	6R"V'P	2P		2Pw	3RPw	4W'P	
	S3		5R"P'v			6R"P'V'	3P'	4P'R	3P'w		5W'P'	
	R1			5R*Pv	6R"PV				3RPw			
	R2		6 R P'v		7 R P'V	7 R P'V'			4R'Pw			

Table 9. (continued)

Slope Class	Stoniness or Rockiness Class	AGRICULTURAL CAPABILITY RATINGS: Farmington F3.O	F4	F4.F	F5	F6	Grenville G1,G1.C	G1.S	G2,G2.C	G2.S	G3,G3.C	Soil Assoc. Land. Units
3, 3*	S1		5R"Ptv		6R"PVt	6R"V'Pt	2pt	3RPt	2wpt			
	S2		5R"Ptv		6R"PVt	6R"V'Pt	2Pt	3RPt	3Pwt			
	S3	5R"P'tv				6R"P'V't	3P't	4P'Rt	4P'wt			
	S4						5P*t	5P*Rt				
	S5						6Pt					
	R1											
	R2		6RP'tv									
4, 4*	S1				6R"PVT		2Tp					
	S2		5R"PTv		6R"PVT	6R"V'PT	3TP	4RPT	3PTw			
	S3		5R"P'Tv			6R"P'V'T	4P'T	5P'RT				
	S4						5P*T	5P*RT				
	R2		6RP'Tv									
5, 5*	S2						4T'P					
	S3		5R"P'T'v				5T'P'					
	S4						6P*T					
	R2		7RT'P'v									

Slope Class	Stoniness or Rockiness Class	Grenville G3.O	G3.S	G4	G4.S	G5	G5.S	G6	G6.O	G6.S	Soil Assoc. Land. Units
1, 1*, 2, 2*	N	3W'p							3W'p		
	S1		5W'RP	2pv		3Wvp		3W'p		7WRP	
	S2		5W'RP	2Pv		3WPv	4RPWv			7WRP	
	S3			3P'v		4P'Wv		5W'P'		7WP'R	
3, 3*	N										
	S1			2pvt	4RPtv	3twvp					
	S2			3Pvt	4RPtv	3Ptwv					
	S3			4P'vt	5P'Rtv						
	S4			5P*tv							
4, 4*	S1			3Tpv	4RTPv	3Twvp					
	S2			3TPv	4RTPv	4TPwv					
	S3			4P'Tv	5P'RTv						
	S4			5P*Tv							
5, 5*	S1			4T'pv							
	S2			4T'Pv							
	S3			5T'P'v							
	S4			6P*T'v							

(Continued on Page 88)

Table 9. (continued)

Slope Class	Stoniness or Rockiness Class	AGRICULTURAL CAPABILITY RATINGS									
		Ironside									Soil Assoc.
		I1	I1.S	I2	I2.S	I3	I3.S	I4	I5	I6	Land. Units
1, 1*, 2, 2*	N	3F'	4F'R	3F'w	4F'Rw	4W'F	5W'RF		4W'F		
	S1			4F'wp		4W'Fp					
3, 3*	N	3F't						3F't			
	S1	4F'tp	5F'Rtp							4F'tpw	
	S2	4F'Pt	5F'RPt	5F'Pwt							
	S3	5F'P't									
4, 4*	N	4F'T						4F'T			
	S1	4F'Tp	5F'RTp							5F'Tpw	
	S2		5F'RTP								
	S3	5F'P'T									
5, 5*	N	5F'T'						5F'T'			
	S1	5F'T'p									

Slope Class	Stoniness or Rockiness Class	Jockvale										Soil Assoc.
		J1	J1.S	J2	J3	J4	J4.F	J4.S	J5	J5.S	J6	Land. Units
1, 1*, 2, 2*	N	3F'v(m)	4F'Rv	3F'w	4F'Wv	4W'(v)F	3W'(v)f	5W'RF	4W'F	5W'RF	4W'F	
3, 3*	N	4F'tv(m)		4F'tw	5F'Wvt	4W'(v)Ft						
	S1			4F'twp								
4, 4*	N	4F'Tv(m)		4F'Tw		5W'(v)FT						
	S1			5F'Twp								

Slope Class	Stoniness or Rockiness Class	Jockvale				Kars					Soil Assoc.
		J6.O	J7	J7.S	J8	K1	K2	K3	K4	K5	Land. Units
1, 1*, 2, 2*	N	4W'F	3F'(m)	4F'R	5F'V'		4FWvp	3MFp	3Fwv		
	S1					3MFp	4FWvp		3Fwvp		
	S2						4FPWv		4FPwv		
3, 3*	N		3F't(m)		5F'V't	4MFtp		4MFtp			
	S1					4MFtp				4MFtp	
	S2					4MFPt	4FPtwv	4MFPt			
	S3					5P'MFt					
	S4					5P*MFt					

Table 9. (continued)

Slope Class	Stoniness or Rockiness Class	Jockvale J6.O	J7	J7.S	J8	Kars K1	K2	K3	K4	K5	Soil Assoc. Land. Units
		AGRICULTURAL CAPABILITY RATINGS									
4, 4*	N		4F'T(m)		5F'V'T	4MFT		4MFTp			
	S1					4MFTp				4MFTp	
	S2					5MFTP	5FPTwv	5MFTP			
	S3					5P'MFT					
5, 5*	S2					5T'MFP					

Slope Class	Stoniness or Rockiness Class	Leitrim L1	L2	L3	L4	L5	L7	L8	L9	L9.S	Soil Assoc. Land. Units
1, 1*, 2, 2*	N		2fw				3Wvfp				
	S1					2fvp					
3, 3*	N	2ft		2ftv		2ftv		3fvtp	2ft	3Rft	
	S1	2ftp		3ftvp				3fvtp	2ftp		
	S2	3Pft			4Pftwv	3Pftv				4RPtf	
4, 4*	N	2Tf		3Tfv		3Tfv					
	S1	3Tfp		3Tfvp				3Tfvp	3Tfp		
	S2	3TPf			4PTfwv	4TPfv				4RTPf	
5, 5*	N			4T'fv							

Slope Class	Stoniness or Rockiness Class	Manotick M1	M1.S	M3	M4	M5	M6	M6.C	M7	M7.O	Soil Assoc. Land. Units
1, 1*, 2, 2*	N	3FMv	4RFMv	3FWv	3FW	4W'(v)F	4W'F	4W'F	4W'F	4W'F	
	S1				3FWp						
	S2			4FPWv							
	S3				5P'FW						
3, 3*	N	4FMvt		3Ftwv	3Fwt						
4, 4*	N	4FMTv		4FTwv	3FTw						

(Continued on Page 90)

Table 9. (continued)

Slope Class	Stoniness or Rockiness Class	AGRICULTURAL CAPABILITY RATINGS: Mille Isle MI1	MI3	MI3.O	MI4	MI5	MI6	Nepean N1	N3	N4	N5	Soil Assoc. Land. Units
1, 1*, 2, 2*	N	4F’M’	4W’F	4W’F	4F’Mw	5F’V’	5W’(v)F’	5R”P				
	S1										6R”PV	
	S2							5R”P				
	R1								7 W R*P			
	R2								7 WR P			
3, 3*	N	4F’M’t				5F’V’t		5R”Pt				
	S1							5R”Pt				
	S2							5R”Pt				
	S3							5R”P’t				
	S4							6P*R”t				
	R1							5R*Pt				
	R2							6 R P’t		6 R P’tv		
4, 4*	N	5F’M’T				5F’V’T						
	S2							5R”PT				
	S3							5R”P’T				
	R2							6 R P’T		6 R P’Tv		
5, 5*	N					5F’V’T’						

Slope Class	Stoniness or Rockiness Class	North Gower NG1	NG1.S	NG2	NG2.C, NG2.O	NG2.S	NG2.CS	NG3	NG4	NG4.O	NG5	Soil Assoc. Land. Units
1, 1* 2, 2*	N	1w	2Rw	2W	2W	3RW	3RW		3W’	3W’	2W	
3, 3*	N	2wt						2wvt				
	R1			3RWt				3Rwvt				
	R2			4R’Wt								
4, 4*	N							3Twv				
	R1			4RWT				4RTwv				
	R2			5R’WT								

Table 9. (continued)

		AGRICULTURAL CAPABILITY RATINGS										
	Stoniness or	Oka						Osgoode				Soil Assoc.
Slope Class	Rockiness Class	O1	O1.S	O2	O2.S	O3	O5	OS1	OS1.C	OS2	OS3	Land. Units
1, 1*, 2, 2*	N							2Fw	2Fw	3W(v)F	3WF	
	S1	4MFP		4MFPw	5MFPRw							
	S2			4MFPw								
	R1										4RWF	
3, 3*	N	4MFpt				4F'Mt	3FMt	3Fwt				
	S1	4MFPt	5MFPRt			5F'Mpt			3Fwtp			
	S2	4MFPt	5MFPRt			5F'MPt						
	S3	5P'MFt										
	S4	5P*MFt										
	S5	6 P MFt										
	R2		6R*P'MFt									
4, 4*	N						4FMT	3FTw				
	S1	5MFPT	5MFPTR			5F'MTp						
	S2	5MFPT				5F'MTP						
	S3	5P'MFT										
	S4	5P*MFT										
	S5	6 P MFT										
5, 5*	S2	5T'MFP										
	S3	5T'P'MF										
	S4	5P*T'MF										
	S5	6 P T'MF										
6, 6*	S4	7T*P*MF										

	Stoniness or	Osgoode (continued)							Ottawa		Soil Assoc.
Slope Class	Rockiness Class	OS3.C	OS3.F	OS3.FO	OS3.O	OS3.S	OS3.SO	OS4	OT1	OT2	Land. Units
1, 1*, 2, 2*	N	3WF	2Wf	3W'f	3W'f	4W'Rf	4W'Rf	3FWv			
3, 3*	N							3Fwvt		4F'Vt	
4, 4*	N							4FTwv	5F'M'T	5F'VT	
5, 5*	N								5F'M'T'		

(Continued on Page 92)

Table 9. (concluded)

Slope Class	Stoniness or Rockiness Class	AGRICULTURAL CAPABILITY RATINGS: Queensway Q1	Q1.S	Q3	Q4	Reevecraig RE1	RE2	RE3	Rideau R1	R2	R3	Soil Assoc. Land. Units
1, 1*, 2, 2*	N					3FWv	4W’(v)F	4W’F	3DW	3DWv	3DW	
	S1	2fp		3Wfp								
3, 3*	N		3Rft						3DWt	3DWv(t)		
	S1	2fpt			3fptv							
	S2	3Pft	4RPft	4WPft	3Pftv							
	S3	4P’ft			4P’ftv							
	R2				5R’P’ftv							
4, 4*	N								4TDW	4DTWv		
	S1	3Tfp			3Tfpv							
	S2	3TPf										
	S3	4P’Tf			5P’Tfv							
	R2				5R’P’Tfv							
5, 5*	N								4T’Dw	4T’Dw		
	S2	4T’Pf										
	S3				5T’P’fv							

Slope Class	Stoniness or Rockiness Class	Rideau (continued) R3.C	R3.S	R4.O	R5	St. Thomas ST1	ST2	ST3	ST4	ST5	ST6	Soil Assoc. Land. Units
1, 1*, 2, 2*	N	3DW	4RDW	4W’D			4F’V	5F’V’	4F’Wv	5W’(v)F’	5W’F’	
3, 3*	N				3DWt(v)	4F’M’t	4F’Vt	5F’V’t	5F’Wvt	5W’(v)F’t		
4, 4*	N				4DTW(v)	5F’M’T	5F’VT	5F’V’T	5F’Twv	5W’(v)F’T		
	R1					5F’M’TR						
5, 5*	N					5F’M’T’		5F’V’T’				
	R1					5F’M’T’R						

Slope Class	Stoniness or Rockiness Class	St. Thomas (continued) ST7	ST8	Uplands U1	U3	U8	U11	U13	U15	Soil Assoc. Land. Units
1, 1*, 2, 2*	N	5W’(v)F’	4F’V			4F’Wv	5W’(v)F’	5W’F’		
3, 3*	N		4F’Vt	4F’M’t	4F’Vt	5F’Wvt			4F’M’t	
	S2								5F’M’Pt	
4, 4*	N		5F’VT		5F’VT	5F’TWv				
	S2								5F’M’TP	

Table 10. Agricultural capability ratings for soil landscape units representing organic soils

Soil Landscape Unit	Soil Association	Dominant Material	Depth (cm)	Capability Ratings*
BE1	Borromee	Humic; non-woody	40-160	3K to 5HK
GB1	Goulbourn	Humic or mesic; 1-25% wood	40-160	3H to 5H
GY1	Greely	Humic or mesic; 1-25% wood	40-160	4H to 6HK
H1	Huntley	Humic or mesic; 1-25% wood	>160	2L to 3K
LE1	Lemieux	Humic or mesic; non-woody	>160	1 to 3K
MB1	Mer Bleue	Mesic; 1-25% wood	>160	2F
MK1	Malakoff	Humic; 1-25% wood	100-160	3HK to 4HK

** A range of capability ratings applies for most soil landscape units due to ranges in depth of organic material to substratum. Slope classes associated with the soil landscape units in the map symbol do not influence the capability ratings.*

Table 11. Agricultural capability ratings for land type and miscellaneous land units

	Eroded Channels	**Escarpments**			**Landslide**	**Marshland**	**Recent Alluvium**		
	ER	**X1**	**X2**	**X3**	**LD**	**ML**	**AR1**	**AR2**	**Land Units**
**Slope Class	7T	6T	7TF'	7RT	4TDW	7WI'	5I'W'	5I'W'F	
	Rockland				**Land altered by man**				
	RK1	**RK2**	**RK3**	**RK4**	**DL, LF, SL, TR, U**				**Land Units**
**Slope Class	7R	7RT'	7RT'	7R	NR				

*** A slope class may or may not be given for Land Type Units. Some are given in compound map units in order that the appropriate slope, stoniness and/or rockiness classes are associated with the correct map unit component. They are not required when determining the agricultural capability rating.*
NR: Not Rated.

B. SOIL INTERPRETATIONS FOR WATER EROSION

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(1) Introduction

Soil erosion by water is a naturally occurring process that can be greatly accelerated by man's activity. Any practice that accelerates soil runoff, or reduces the natural protection afforded by vegetative cover, will generally lead to increasing erosion levels. It is commonly held that soil erosion reduces production potential, depletes nutrients, and degrades soil tilth. However, recent studies in the Canadian Great Lakes basin have illustrated the need to look beyond the on-site effects of soil erosion and consider the role of sediments, derived from cropland, on water quality. Any comprehensive soil conservation program will recognize the dual nature of the problem of soil erosion by water.

The purpose of this section is to provide interpretations of the erosion potential of the Ottawa-Carleton Region soils and soil landscapes. Specifically, the objectives may be summarized as follows:

(a) to determine the relative erodibility of surficial soil materials;

(b) to determine the effect of soil erodibility and slope on soil erosion potential;

(c) to provide information on the effects of different crops and associated cropping practices on soil erosion potential;

(d) to illustrate how the soil maps, in combination with information from the report, can be used to assess site-specific soil erosion problems and alternative solutions;

(e) to provide guidelines for estimating soil erosion potential at the regional scale.

(2) Factors Affecting Soil Erosion by Water

On-site planning for soil and water conservation requires information on the relationship between factors that cause soil erosion, and practices that may reduce soil erosion. The most important factors affecting agricultural erosion are usually considered to be rainfall runoff, soil erodibility, slope gradient and length, and vegetative cover.

Both rainfall and runoff parameters must be considered in the assessment of a water erosion problem. Rainfall-induced erosion is maximum when the energy of the rainfall is greatest. In Ontario, it is the high-intensity, short-duration thunderstorm activity of the summer months that produces the highest-energy rainfall events. On the other hand, runoff from agricultural land is greatest during the spring months when the soils are usually saturated, the snow is melting, and evapotranspiration is minimal. A good soil and water management program must address itself to rainfall and runoff problems, in both the spring and the summer periods.

Soil erodibility is defined as the inherent susceptibility of a soil material to erode. Soil properties that influence erodibility by water are those that affect the infiltration rate, permeability and water-holding capacity of the soil. Soil properties that resist the dispersion, splashing, abrasion and transporting forces of rainfall and runoff, also influence soil erodibility. Silt, silt loam and very fine sand soils often have the greatest soil erodibility potential, whereas coarse sandy and clayey soils usually have the least inherent soil erodibility. Maintenance of soil organic matter and soil structure, through good soil management, can greatly affect soil erodibility potentials.

Soil erosion by water has been found to increase, with both increasing slope gradients and slope lengths. Steep slopes facilitate the runoff of water and reduce the infiltration rate. The potential for erosion on long slopes is enhanced by rapid and voluminous runoff which can generate high erosive energy at downslope positions. Hence the effective slope length should be an important soil conservation consideration in farm field consolidation efforts.

The erosion reduction effects of vegetative cover or mulches are well known. Table 12 illustrates the relative effectiveness of common field crops in reducing water erosion potential in Ontario. If unvegetated or bare soil is assigned a numerical value of 1.0, then the vegetative cover afforded by bean, tomato, or cucumber crops has the potential to reduce soil loss by sheet and rill erosion to approximately 47% of that lost under bare soil conditions (Table 12). Similarly, a hay-pasture or permanent pasture vegetation cover has the potential of reducing water erosion to less than 10% of that from fallow or bare land.

Table 12. The relative effectiveness of common field crops in reducing water erosion in Ontario

Cover type	C-factor value[1]
Fallow land (bare soil)	1.00
Beans	.47
Cucumber	.45
Tomato	.43
Continuous corn	
— fall plowed	.45
— spring plowed	.39
— chisel plowed	.27
— zero tillage	.08
Corn in rotation	.30
Mixed grains	.27
Winter wheat	.25
Rye	.25
Tobacco	.30
Hay-pasture (rotation)	.06
Permanent pasture	.03

[1]*Cropping-management factor, Wischmeier and Smith (27)*

(3) Measurement of Factors Affecting Water Erosion

In order to make meaningful recommendations, with respect to soil conservation practices, one must be able to recognize the significance of a soil erosion problem, and provide appropriate cost-effective erosion control alternatives when a problem is encountered. Although qualitative approaches can be useful in many circumstances, the temporal nature of soil erosion, as well as the difficulty in witnessing sheet erosion losses in the field, make a quantitative approach to erosion assessment and control recommendations more practical.

The quantification of the factors affecting agricultural erosion, i.e., rainfall, soil erodibility, slope vegetation and conservation measures, is based on widespread erosion research compiled from nearly 10,000 plot-years of field data, and from rainfall records obtained from about 2,000 weather stations in North America. The resulting soil erosion formula is in extensive use by the Soil Conservation Service of the United States Department of Agriculture, for applying and planning conservation measures that reduce soil erosion to acceptable amounts (27). It is only recently that the erosion factors have been quantified for use in Ontario (28, 29).

The water erosion formula, A = RKLSCP, used to predict average annual soil loss through sheet and rill erosion, is called the Universal Soil Loss Equation (27), where

A - is the computed soil loss in tons per acre per year.

R - the rainfall factor, is the number of erosion-index units in a normal year's rain.

K - the soil erodibility factor is the erosion rate, per unit of erosion index for a specific soil, in cultivated, continuous fallow. This unit is expressed in tons per acre.

L - the slope length factor is the ratio of soil loss from a field slope length, to soil loss from a 72.6 foot plot.

S - the slope gradient factor is the ratio of soil loss from the field slope gradient, to soil loss from a 9% plot slope.

C - the cropping-management factor is the ratio of soil loss from a field with specific vegetation or cover and management, to soil loss from the standard, bare or fallow condition. This factor measures the combined effect of all the interrelated cover and management variables, plus the growth stage and vegetal cover, during rainfall episodes.

P - the erosion control practice factor is the ratio of soil loss using a particular management practice, to soil loss from a field not using that practice.

When the numerical values for each variable are multiplied together, the product is the average annual soil loss, in t/ac/yr (conversion to metric equivalents, t/ha/yr requires multiplication by 2.24). It should be emphasized that the formula estimates sheet and rill erosion but does not consider soil losses caused by gully erosion or stream channel erosion. Since the erosion formula does not contain a transport or delivery factor it does not predict sediment load of streams. A brief description of each factor in the soil erosion formula follows.

(a) Rainfall Factor (R)

The R-value reflects the erosivity of rains, and is generally related to climatic factors. R-values for Ontario range from 25 to 100. The Ottawa-Carleton Region has an approximate R-value of 50. The distribution of R-values, for southern Ontario, is shown in Figure 35 and discussed elsewhere by Wall et. al. (30).

(b) Soil Erodibility Factor (K)

The K-value reflects the inherent erodibility of a soil due to the erosive activity of water.

Table 13 illustrates the K-values and K-ranges for the soils of the Ottawa-Carleton Region. The K-values were computed by the method outlined by Wischmeier and Smith (27). These K-values range for a low of .05 for the Uplands Association soils, due in part to the high proportion of medium and fine sands characteristics of these soils, to a mean high of .43 for the poorly drained Bainsville soils of the Castor Association, which contain a large proportion of easily erodible very fine sand and silt. In terms of relative erodibility, the Bainsville soils are about 8 times more erodible than the Upland soils (.41/.05), when all other soil loss factors are held constant.

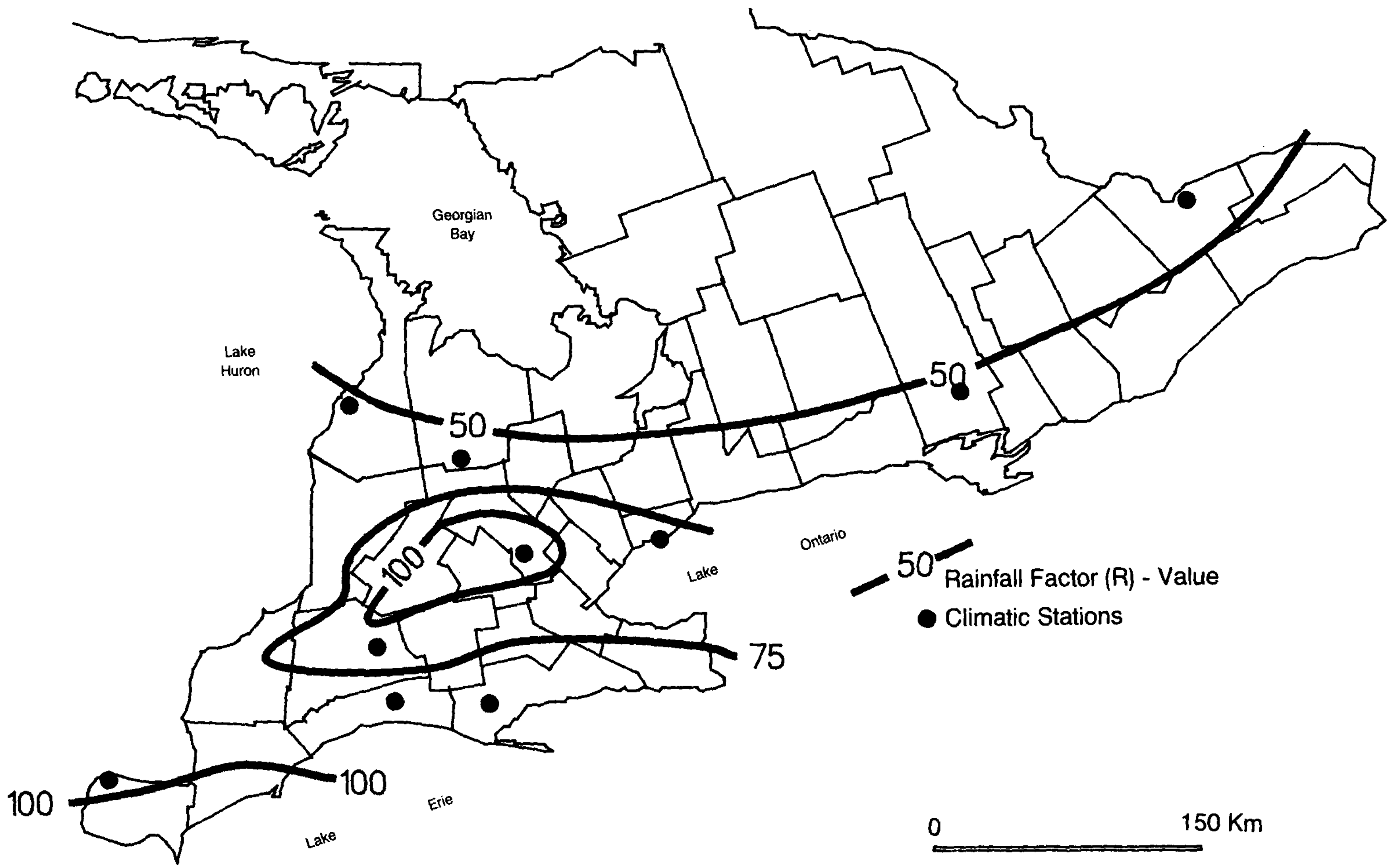


Figure 35.
Distribution of the rainfall factor "R" for southern Ontario.

Table 13. K-values, K-ranges and erodibility classes for the Ottawa-Carleton soils

Soil Association	Soil Series	Drainage Class	Applicable Soil Landscape Unit(s)	Soil Erodibility[1] Value	Soil Erodibility[1] Range	Erodibility Class
Anstruther (A)	Anstruther	W	A1	.20	—	Slight
	Kanata	W	A1	.24	—	Slight
Bearbrook (B)	Wendover	I	B1	.26	—	Slight
	Bearbrook	P	B2 B4	.23	.22-.25	Slight
	Unnamed	VP	B3	—	—	Slight
Castor (C)	Castor	I	C2 C3 C4	.30	.25-.35	Mod. Severe
	Bainsville	P	C3 C4 C5	.43	—	Severe
Chateauguay (CH)	Unnamed	I	CH4 CH5	—	—	Slight
	MacDonald	P	CH3 CH6 CH7	.30	.27-.32	Mod. Severe
Dalhousie (D)	Dalhousie	I	D1 D2 D5	.26	—	Slight
	Brandon	P	D2 D3 D5	.19	.13-.26	Slight
	Unnamed	VP	D4	—	—	Negligible
Farmington (F)	Farmington	W	F1 F4 F6	.23	.11-.35	Slight
	Franktown	I	F2 F4 F5	.20	—	Slight
	Brooke	P	F3 F5 F6	.30	—	Mod. Severe
Grenville (G)	Grenville	W	G1 G4	.31	.23-.38	Mod. Severe
	Matilda	I	G2 G4 G5	.21	.13-.28	Slight
	Lyons	P	G3 G5	.20	—	Slight
	Unnamed	VP	G6	<.20	—	Slight
Ironside (I)	Ironside	W	I1 I4	.13	.12-.14	Negligible
	Unnamed	I	I2 I6	—	—	Slight
	Dwyer Hill	P	I3 I5	.08	—	Negligible
Jockvale (J)	Jockvale	W	J1 J7 J8	.22	—	Slight
	Stapleton	I	J2 J3 J4	.09	—	Negligible
	Vaudreuil	P	J5 J3 J4 J8	.35	—	Mod. Severe
	Unnamed	VP	J6	—	—	Negligible
Kars (K)	Kars	W	K1 K3 K5	.15	.14-.16	Slight
	Unnamed	I	K2 K4	<.15	—	Slight
	Unnamed	P	K2 K4	<.15	—	Slight
Leitrim (L)	Vars	W	L5 L6	.23	—	Slight
	French Hill	W	L1 L3 L9	.16	—	Slight
	Unnamed	I	L2 L3 L4 L5 L7 L8	<.20	—	Slight
	Unnamed	P	L4 L7	<.20	—	Slight
Manotick (M)	Manotick	W	M1	.20	—	Slight
	Becketts Creek	I	M4 M3 M5	.16	.11-.22	Slight
	Allendale	P	M6 M5	.25	.15-.36	Slight
	Unnamed	VP	M7	<.25	—	Slight
Mille Isle (MI)	Constance Bay	W	MI1 MI2 MI5 MI6	.05	—	Negligible
	Herbert Corners	I	MI2 MI4	.06	—	Negligible
	Dunrobin	P	MI3 MI5 MI6	.07	—	Negligible
Nepean (N)	Nepean	W	N1	.24	—	Slight
	Marchhurst	W	N1	.25	—	Slight
	Fallowfield	I	N4 N5	<.25	—	Slight
	Barrhaven	P	N3 N5	<.25	—	Slight
North Gower (NG)	Carp	I	NG1 NG3	.28	—	Slight
	North Gower	P	NG2 NG3 NG5	.26	.22-.34	Slight
	Belmeade	VP	NG4	<.26	—	Slight
Oka (O)	Munster	W	O1	.17	.16-.17	Slight
	Oka	W	O1	<.20	—	Slight
	Unnamed	W	O3	<.20	—	Slight
	Unnamed	W	O4	<.20	—	Slight
	Unnamed	I	O2	<.20	—	Slight
Osgoode (OS)	Piperville	I	OS1 OS2 OS4	.34	—	Mod. Severe
	Osgoode	P	OS2 OS3 OS4	.31	.26-.38	Mod. Severe
	Carsonby	P	OS2 OS3 OS4	<.35	—	Mod. Severe
Ottawa (OT)	Buckham Bay	W	OT1 OT2	<.05	—	Negligible
	Unnamed	I	OT3	<.05	—	Negligible
	Unnamed	P	OT3	<.05	—	Negligible
Queensway (Q)	Queensway	W	Q1 Q4	.13	—	Negligible
	Galesburg	W	Q1 Q4	.14	—	Negligible
	Unnamed	I	Q4	<.15	—	Negligible
	Unnamed	P	Q3	<.15	—	Negligible

(Continued on Page 98)

Table 13. continued

Soil Association	Soil Series	Drainage Class	Applicable Soil Landscape Unit(s)	Soil Erodibility[1] Value	Range	Erodibility Class
Rideau (R)	Rideau	I	R1 R2 R5	.15	—	Negligible
	Ste. Rosalie	P	R2 R3 R5	.15	—	Negligible
	Laplaine	VP	R4	<.15	—	Negligible
Reevecraig (RE)	Unnamed	I	RE1 RE2	<.35	—	Mod. Severe
	Reevecraig	P	RE1 RE2 RE3	.25	—	Slight
St. Thomas (ST)	St. Thomas	W	ST1 ST2 ST3 ST8 ST5	.23	.20-.28	Slight
	Vinette	I	ST2 ST4 ST7 ST8	.22	.14-.30	Slight
	Cheney	P	ST3 ST4 ST5 ST6 ST7	<.05	—	Negligible
Uplands (U)	Uplands	W	U1 U3 U5 U15	.04	—	Negligible
	Rubicon	I	U3 U8 U11	<.05	—	Negligible
	St. Samuel	P	U5 U8 U11 U13	<.05	—	Negligible

[1] *where no soil erodibility value is given the erodibility class has been estimated based on field observations and computed values from other drainage classes of the association and general values for similar surface textures from Table 15.*

Table 14 also categorizes the various soils into five soil erodibility classes (negligible to very severe) based upon their respective K-values. The guidelines used for establishing these soil erodibility classes are given in Table 14. The soils in the Ottawa-Carleton Region range from negligible to severe.

The particle size distribution (% sand, silt and clay) and organic matter content are important factors in determining soil erodibility. Table 15 provides an alternative method of approximating K-values, if only soil texture and organic matter content are known. The K-values reported in Table 15 were computed from data gathered from almost 100 surface horizons, sampled during the soil mapping of the Ottawa-Carleton Region. If the textural class is known, but not the organic matter content, a K-value can be estimated from the range of values of the last column of Table 15.

Table 14. Guidelines for establishing soil erodibility classes

Class	Soil erodibility potential	K-value[1]	Soil characteristics significant for water erosion
1	Negligible	less than .15	Silt and very fine sand <25%; >4% organic matter; very fine granular structure; rapid permeability
2	Slight	.15-.30	Silt and very fine sand, 25-40%; <4% organic matter; medium or coarse granular structure; moderate permeability
3	Moderately severe	.30-.40	Silt and very fine sand, 40-80%; <3% organic matter; medium or coarse granular structure; slow to moderate permeability
4	Severe	.40-.50	Silt and very fine sand, >80%; <2% organic matter; blocky, platy or massive structure; slow permeability
5	Very severe	more than .50	Silt and very fine sand, >90%; <1% organic matter; blocky, platy or massive structure; very slow permeability

[1] *Adapted from Wischmeier, W.H. and D.D. Smith (27)*

Table 15. Soil erodibility (K-factor) values for common surface textures in the Ottawa-Carleton Region

Textural Class	K-factor: Samples with <4% Organic Matter	K-factor: Samples with >4% Organic Matter	Range of Values
Sand	—	—	—
Fine Sand	.16	.12	.08-.24
Very Fine Sand	—	—	—
Loamy Sand	.05	.01	.01-.05
Loamy Fine Sand	.09	.08	—
Coarse Sandy Loam	.15	.13	.10-.16
Sandy Loam	.15	.09	.06-.24
Fine Sandy Loam	.23	.18	.07-.29
Very Fine Sandy Loam	.42	.37	.28-.50
Loam	.32	.24	.21-.43
Silt Loam	.28	.21	.06-.38
Sandy Clay Loam	.19	.14	—
Clay Loam	.22	.17	—
Silty Clay Loam	.24	.15	.11-.26
Silty Clay	.13	.09	.06-.16
Clay	.06	.04	.03-.07

(c) Slope Gradient (S) and Slope Length (L) Factors

The close interaction between slope and field length has resulted in their combination into one variable, LS, known as the topographic factor. Table 16 presents, in chart form, the LS-values covering a wide range of slope and field lengths. For slope or field lengths within the range of the table, but not presented explicitly, linear interpolation will provide a satisfactory value.

(d) Cropping and Management Factor (C)

The C factor reflects the influence of various types of crops and management practices on sheet and rill erosion. The C factor is a quantification of the quantity and quality of protection afforded to the soil by each specific crop and/or management practice at various crop stages throughout the year. The percent of erosive rainfall that can be expected to fall during each of the crop stages is also taken into consideration when calculating C factor values. The correspondence between periods of erosive rainfall and the stages of management operations and crop development differs between geographic regions. Therefore, the C values for specific crops in Ottawa-Carleton, calculated on the basis of climatic, crop and management data from this region, will not necessarily be the same ad C values for the same crops that are developed for other areas in Ontario.

The C factor represents the components of sheet and rill erosion which are most easily controlled or modified through management; whereas the given attributes of a field or area, namely the climate (or more specifically the annual erosive rainfall), soils and landscape are represented by the R, K and LS components of the USLE, respectively.

Information on crop and management practices specific to the Ottawa-Carleton region was obtained from agricultural extension personnel. This included information on the amount and quality of soil protection provided during and between crops; the type and timing of tillage operations; and estimated seedbed preparation, planting, and harvest dates. The climatic information was obtained from previously-published erosion indices (30).

Basically, a C factor is the ratio between the amount of soil eroded from a field under a specific crop and management system to the amount of soil which would be eroded from the same field kept in a bare, continuously fallow state. C factor values range from 0 to 1. A value of 1 represents a bare, continuously-fallow condition. When this value is applied to the rest of the equation, the soil loss calculated form the physical attributes alone (RKLS) essentially remains the same. However, as the value of C approaches 0, this represents an increasingly greater reduction in the potential erosion due to the effects of the crop and management systems. An extreme C value of approximately 0 would indicate that the crop and management system has virtually eliminated the chance of erosion occurring.

C values that are between the two extremes represent the proportion by which the soil loss from a bare field would be reduced under an alternative crop and/or management system. For example, a C value of 0.50 (conventional fall tillage of silage corn following field crops, see Table 17) indicates that this type of crop and management practice reduces the long-term, average annual potential erosion to 50% of that which would have occurred on bare soil. If all other factors are held constant, a winter wheat crop (C = 0.27) planted on the same field after conventional tillage in the fall would reduce the potential erosion to 27%, compared to the loss during bare soil conditions. Potential soil losses would be reduced to 2% if alfalfa (C = 0.02) were present on the field.

Generally, C values are lowest (ie. reflect good erosion-reducing potential) for crop and management systems that cover and protect the soil for the longest period of time, especially during peak annual rainfall periods. Good crop growth, a high percent final canopy cover, residues of plant materials left in the soil and practices which leave residue on the surface also contribute to relatively low C values.

Table 16. LS-values for different combinations of slope length and slope gradient

Slope Gradient Percent	Slope Length (m)														
	10	15	20	25	30	40	50	60	75	100	125	150	200	250	300
0.2	.063	.069	.073	.076	.080	.084	.088	.091	.095	.101	.105	.109	.116	.121	.125
0.5	.076	.083	.088	.092	.095	.101	.105	.109	.114	.121	.126	.131	.139	.145	.151
0.8	.090	.098	.104	.108	.112	.119	.124	.129	.135	.143	.149	.155	.164	.172	.178
2	.144	.162	.177	.189	.200	.218	.233	.246	.263	.287	.307	.324	.353	.377	.399
3	.205	.232	.253	.270	.285	.311	.333	.351	.376	.410	.438	.463	.504	.539	.570
4	.256	.301	.338	.369	.397	.446	.487	.524	.573	.643	.703	.756	.849	.928	.998
5	.306	.375	.433	.485	.531	.613	.685	.751	.839	.969	1.08	1.19	1.37	1.53	1.68
6	.385	.472	.545	.609	.667	.770	.861	.943	1.05	1.22	1.36	1.49	1.72	1.93	2.11
8	.568	.695	.803	.898	.983	1.14	1.27	1.39	1.56	1.80	2.01	2.20	2.54	2.84	3.11
10	.784	.960	1.11	1.24	1.36	1.57	1.75	1.92	2.15	2.48	2.77	3.04	3.51	3.92	4.29
12	1.03	1.27	1.46	1.63	1.79	2.07	2.31	2.53	2.83	3.27	3.65	4.00	4.62	5.17	5.66
14	1.13	1.61	1.86	2.08	2.28	2.63	2.94	3.22	3.60	4.16	4.65	5.09	5.88	6.57	7.20
16	1.63	1.99	2.30	2.57	2.82	3.25	3.63	3.98	4.45	5.14	5.75	6.30	7.27	8.13	8.90
18	1.97	2.41	2.78	3.11	3.41	3.93	4.40	4.82	5.39	6.22	6.95	7.62	8.80	9.83	10.8
20	2.34	2.86	3.30	3.69	4.05	4.67	5.22	5.72	6.40	7.39	8.26	9.05	10.4	11.7	12.8

Table 17. C-Values for Continuous and Rotational Crops in the Ottawa-Carleton Region

Crop	Previous Crop	Management before Crop	C Value
Corn (grain)	corn, grain	Fall moldboard plow	0.37
	corn, grain (first year after meadow)	Fall moldboard plow	0.20
	corn, grain (second year after meadow)	Fall moldboard plow	0.34
	beans	Fall moldboard plow	0.43
	beans (1st yr. after meadow)	Fall moldboard plow	0.23
	beans (2nd yr. after meadow)	Fall moldboard plow	0.41
Corn (silage)	field crops	Fall moldboard plow	0.50
	field crops (1st yr. after meadow)	Fall moldboard plow	0.27
	field crops (2nd yr. after meadow)	Fall moldboard plow	0.47
Soybeans (7″ row)	beans, peas	Fall moldboard plow	0.54
		Fall chisel/disk	0.45
	corn, grain	Fall moldboard plow	0.46
		Fall chisel/disk	0.40
Winter Wheat	field crops	Fall moldboard plow	0.27
	field crops (inter or underseeded with forage crop)	Fall moldboard plow	0.22
	field crops	Fall chisel/disk	0.22
	field crops (inter or underseeded with forage crop)	Fall chisel/disk	0.17
Grain	field crops	Fall moldboard plow	0.41
	field crops (inter or underseeded with forage crop)	Fall moldboard plow	0.30
	field crops	Fall chisel/disk	0.36
	field crops (inter or underseeded with forage crop)	Fall chisel/disk	0.25
Forages	field crops	Fall moldboard plow	
— establishing year (if direct seeded)		(Sept. 10 to Oct. 1)	0.25
		(Oct. 1 to Nov. 15)	0.17
— established meadow			
— Alfalfa			0.02
— Grass and legume mix			0.004
— Red clover			0.015
Canola	canola, beans	Fall moldboard plow	0.43
	corn, grain	Fall moldboard plow	0.39
Peas	canola, beans	Fall moldboard plow	0.55
	corn, grain	Fall moldboard plow	0.49
White Beans	canola, beans	Fall moldboard plow	0.62
	corn, grain	Fall moldboard plow	0.54

Table 17. continued

Crop Rotation	Management before Crop	C Value	No. of Crop Years in Rotation
1 Corn — Soybeans			
a) Grain corn	Fall moldboard plow (before soybeans)	0.45	2
	Fall chisel/disk (before soybeans)	0.42	2
b) Silage corn	Fall moldboard plow (before soybeans)	0.48	2
2 Corn — Winter Wheat			
a) Grain corn	Fall moldboard plow	0.32	2
	Fall chisel/disk	0.30	2
b) Silage corn	Fall moldboard plow	0.39	2
3 Corn — Canola			
a) Grain corn		0.41	2
b) Silage corn		0.47	2
4 Corn — Peas			
a) Grain corn		0.41	2
b) Silage corn		0.50	2
5 Corn — Corn — Corn — Grain — Red Clover — Red Clover			
a) Grain corn			
Direct seeded Red Clover	Fall moldboard plow (before grain)*	0.26	6
	Fall chisel (before grain)	0.25	6
Red Clover Inter or Underseeded in Grain	Fall moldboard plow (before grain)	0.22	6
	Fall chisel (before grain)	0.20	6
b) Silage corn			
Direct seeded Red Clover	Fall moldboard plow (before grain)	0.32	6
	Fall chisel (before grain)	0.30	6
Red Clover Underseeded in Grain	Fall moldboard plow (before grain)	0.27	6
	Fall chisel (before grain)	0.25	6
6 Corn — Corn — Corn — Grain — Alfalfa — Alfalfa — Alfalfa — (Alfalfa)			
a) Grain corn			
Direct seeded Alfalfa (3 year Alfalfa)	Fall moldboard plow (before grain)	0.23	7
	Fall chisel (before grain)	0.21	7
Inter or Underseeded Alfalfa	Fall moldboard plow (before grain)	0.19	7
(3 year Alfalfa)	Fall chisel (before grain)	0.17	7
Direct seeded (4 year Alfalfa)	Fall moldboard plow (before grain)	0.20	8
	Fall chisel (before grain)	0.19	8
Inter or Underseeded Alfalfa	Fall moldboard plow (before grain)	0.17	8
(4 year Alfalfa)	Fall chisel (before grain)	0.15	8
b) Silage corn			
Direct seeded (3 year)	Fall moldboard plow (before grain)	0.28	7
	Fall chisel (before grain)	0.26	7
Inter or Underseeded (3 year)	Fall moldboard plow (before grain)	0.23	7
	Fall chisel (before grain)	0.22	7
Direct seeded (4 year)	Fall moldboard plow (before grain)	0.25	8
	Fall chisel (before grain)	0.23	8
Inter or Underseeded (4 year)	Fall moldboard plow (before grain)	0.21	8
	Fall chisel (before grain)	0.20	8

** The same management before crop is assumed for both corn and grain for this and succeeding examples.*

C values were calculated for common crops and management practices in the Ottawa-Carleton Region, and are presented in Table 17. Field crops grown in the area include canola, corn, forages, grain, peas, soybeans, white beans and winter wheat. The most common tillage practice is fall moldboard plowing (conventional tillage), with some chisel plowing and disking (reduced tillage) done as well. Underseeding or interseeding of the grain and wheat crops with forages are other practices being utilized.

The lowest C values calculated for crops in the Ottawa-Carleton area were for forages (alfalfa, C = 0.02; red clover C = 0.015); crops which tend to provide good cover throughout most of the year, reduce runoff, promote infiltration of rainwater into the soil and the residuals of which can provide erosion resistance for up to two years after the meadow is replaced with other crops. This benefit is reflected in the lower C values for grain corn, one and two years after a meadow crop (C = 0.20 and 0.34, respectively), as compared to a corn crop grown after other field crops and in excess of two years after a meadow crop (C = 0.37).

Grain corn (C = 0.37), which leaves more residue on the surface after harvest than silage corn (C = 0.50), also has a lower C value than the latter. The C value also indicates that soybeans in rotation (C = 0.46) tend to resist erosion better than those grown continuously (C = 0.54) or after similar, low residue-producing field crops. Fall tillage tends to expose the soil surface for a longer period of time than spring tillage. However the heavy texture of many of the Ottawa-Carleton soils does not make spring tillage practices feasible. The necessity of fall tilling can be compensated for, where possible, by reducing tillage operations so that more residue is left on the soil. For example, the soil conserving-benefits of reduced tillage are reflected in the C value for winter wheat after chisel plowing or disking as the only tillage (C = 0.22) as compared to the same crop after moldboard plowing and disking (C = 0.27).

Other practices which can help to control erosion include the inclusion of winter cover crops in a rotation, or underseeding crops to forage crops to provide some soil cover over the winter months (for example, C = 0.41 for grain crops without underseeding, 0.36 for underseeding).

The above C values represent the potential soil loss reduction (compared to bare field condition) during a particular crop year. Crop rotation systems tend to have lower average annual C values than continuous crops, as relatively high C values of some crops are offset by low values of others, when the values for all crops in the rotation are summed and divided by the total number of crop years in the system. For example, continuous silage corn has a C value of 0.50, but if corn was rotated on a one year basis with a crop of a lesser C value (eg. grain after fall chiselling, C = 0.30) the average C value for the two-year rotation would be 0.40 (0.50 + 0.30 / 2).

The introduction of a forage crop into the rotation (eg. alfalfa, C = 0.02) has a beneficial effect during the duration of the meadow, and for up to two years after. A rotation of three years corn, one year fall-plowed grain would have a C value of 0.38. If three years of alfalfa (direct seeded the first year) were added to this rotation, the average annual C value would decrease to 0.25, and if the alfalfa were underseeded in the grain the amount would be reduced even more to a C value of 0.23.

The C factors presented in Table 17 provide an estimate of the erosion-controlling effectiveness of each crop. In practice, this effectiveness will vary depending on the given site conditions and the quality of management. These general values can be used to estimate the effectiveness of existing, or alternative, crop and management systems within the Ottawa-Carleton Region.

(4) Soil Erosion Assessment

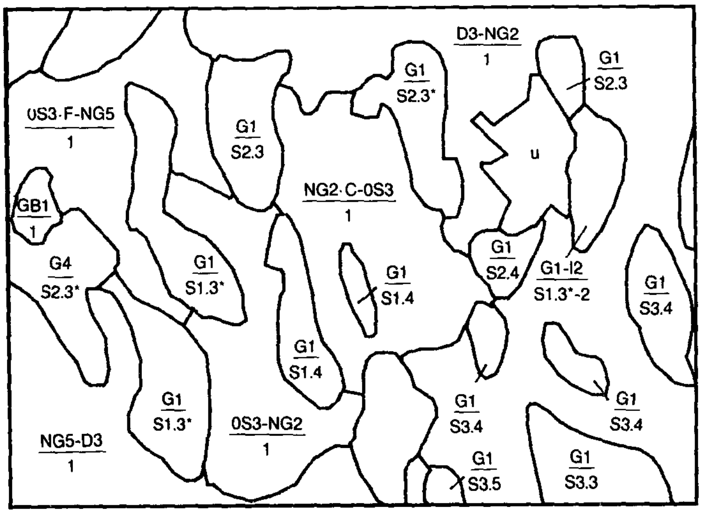
Regional or site-specific assessment of soil erosion potential may be calculated using the quantitative relationships developed in the universal soil loss equation and information contained in this report. A graphical solution of the universal soil loss equation, in the form of a nomograph, is available for ease of computation. The soil loss nomograph provides a rapid method for assessing the effect of many land uses on soil loss potentials, for various soil and slope conditions. The following discussion illustrates how information contained in this section, and elsewhere in the soil report, may be used for predicting soil loss potentials on a regional basis.

Regional Soil Loss Potential

The soil maps of the Ottawa-Carleton Region provide delineations of soil, slope, and drainage conditions, at a scale of 1:50,000. Information contained in this section, with respect to soil erosion, can be used with information contained on the soil maps and legends to assess the relative erosion potential of most map unit delineations. Figure 36 illustrates part of a soil map and legend for the Ottawa-Carleton Region.

Using Figure 36 as an example, the following discussion illustrates how interpretations of regional soil loss potential from erosion can be made.

1. In Figure 36, locate areas on the map for which the erosion potential is desired, and note the map unit symbol. For example, select soil map unit G1/S1.4, which represents 2 areas of well drained soils of the Grenville soil association in Figure 36.
2. Go to the map legend and find the appropriate soil association — Grenville (G), and the appropriate soil landscape unit, ie. G1. Stoniness class (S1) need not be directly considered. Slope Class (4) is noted.
3. Determine the erodibility of the G1 soil landscape unit from Table 13. (G1 = 0.31)
4. Determine the topographic factors (L-S values) for Slope Class 4 (5-9%) from Table 16. For example, use L = 100 m and S = 6%, thus LS = 1.22.
5. Using the soil loss prediction nomograph (Figure 37), locate the K and LS-values for the G1/S1.4 map unit on the appropriate axes (K = .31, LS = 1.22). Draw a line between the K and LS values to intersect the pivot line. Draw another line form the current or proposed land use through the point where the K-LS and the pivot lines intersect, to the soil loss potential axis. For example, if corn was the existing or proposed crop, the soil loss for the corn land use on G1/S1.4 soil map unit would be approximately 14 t/ha, a moderately severe amount. Note that the G1 soil landscape unit has only one drainage component, ie. well or good. Many soil landscape units have two drainage components or classes. G4 soils, for example, are dominantly well drained with significant proportions of imperfectly drained soils. These two components have separate erodibility values, both of which should be considered in an erosion assessment. In addition to this, many soil map unit symbols contain two soil landscape units from different soil associations. In these cases, the K-value of each drainage class of each soil landscape unit should be noted and assessed according to its relative proportion in the soil landscape. (See section on Mapping System.)
6. Repeat interpretations for other map unit symbols in interest to gain a regional perspective of the potential soil erosion loss.



SOIL ASSOCIATION	SOIL MATERIAL DESCRIPTION	MAIN SURFACE TEXTURE	SOIL LANDSCAPE UNIT	DRAINAGE Dominant	DRAINAGE Significant
Grenville (G)	Alkaline, stony, sandy loam, fine sandy loam, loam or silt loam	sandy loam, loam, silt loam	G1	Good	
			G2	Imperfect	
			G3	Poor	
			G4	Good	Imperfect
			G5	Imperfect	Poor
			G6	Very poor	

STONINESS CLASSES		SLOPE CLASSES	
Class	Percent stones on surface	Class	Percent
S1	0.01-0.1	4	5-9

Figure 36.
Portion of a soil map and legend for the Ottawa-Carleton Region.

The potential soil loss, calculated in this way, provides a general estimate of the potential erosion for a region. However, if the regional estimate is applied to specific fields, differences will exist because the regional information lacks the accuracy of a site-specific assessment.

An erosion potential classification system has been developed to quantify potential soil erosion losses into a five-class system, ranging from negligible to very severe (Table 18). Results derived form the soil loss potential can be assessed, using Table 18, to determine whether unacceptable losses occur. If so, the crops or conservation measures that would be most appropriate to reduce erosion can be determined.

Table 18. Guidelines for assessing soil erosion potential classes

Soil erosion class	Soil erosion potential t/ha/yr soil loss	
1	Negligible	(<6)
2	Slight	(6-11)
3	Moderately Severe	(11-22)
4	Severe	(22-33)
5	Very Severe	(>33)

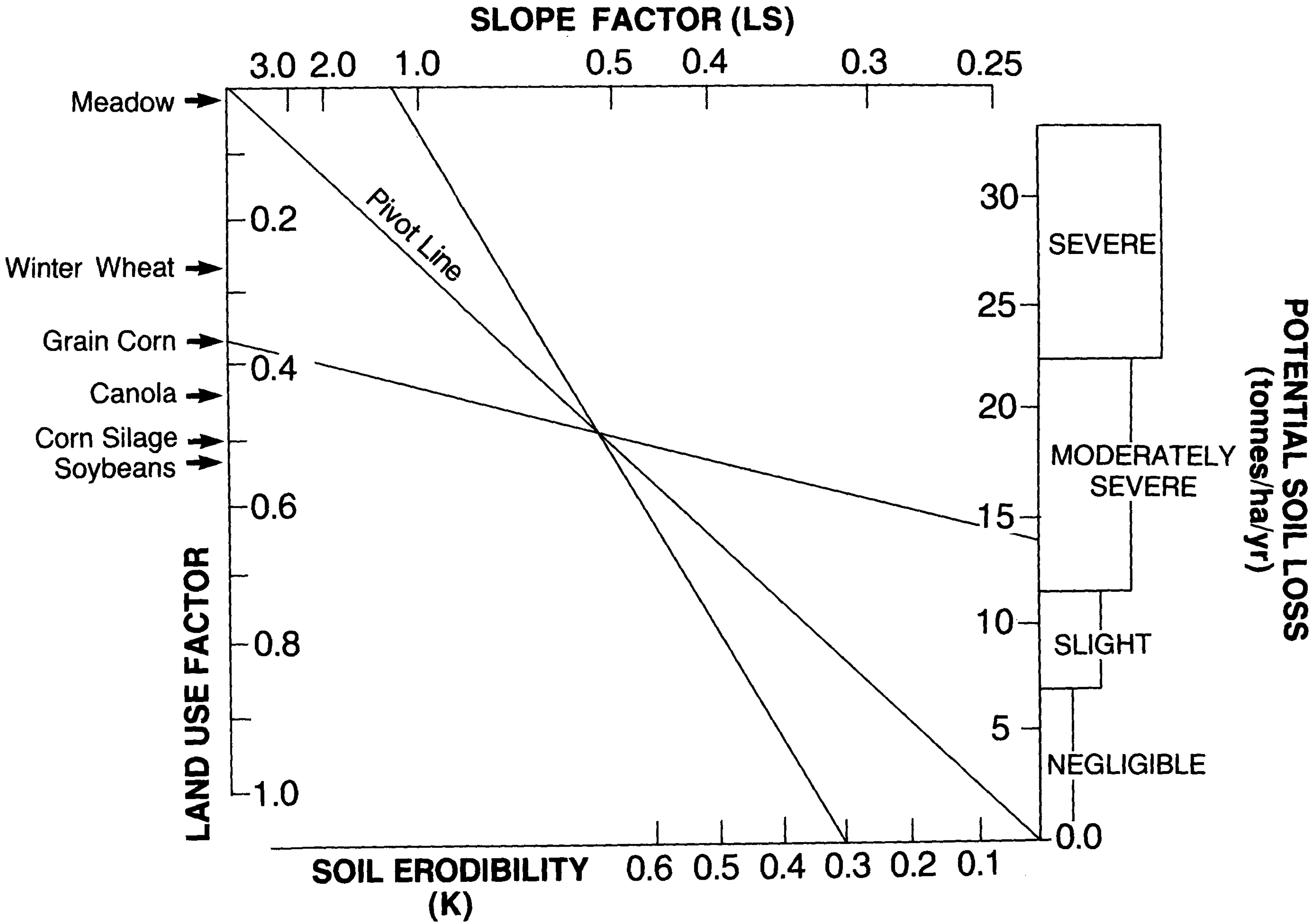


Figure 37.
Nomograph for the prediction of cropland erosion potential in the Ottawa-Carleton Region.

C. LAND SUITABILITY CLASSIFICATION FOR COMMON FOREST TREE SPECIES

by **R.K. Keane**, Senior Program Technician, Fast Growing Forests, Technology Development Group, Ontario Ministry of Natural Resources, Brockville, Ontario

(1) Introduction

The purpose of this section of the soil survey report is to provide a general assessment of the suitability of mapped land areas for commonly planted forest tree species. It is intended to be used only as a guide for broad scale planning purposes, with some potential users being resource managers, urban and regional land use planners and specialists, and private landowners.

For individual site suitability an on-site verification of conditions must be carried out to insure the proper identification of soil types and thus the most suitable species. The forestry staff at your local Ontario Ministry of Natural Resources field office will assist this on-site inspection, and will outline the proper management techniques for successful plantation establishment and future tending.

(2) Methods

Suitability assessments of land areas portrayed on the soil maps were made for eight commonly planted forest tree species. These were based on the consideration of soil characteristics which affect tree growth and survival. Soil characteristics evaluated were: texture, internal drainage, pH, depth to free carbonates, and available rooting volume. Experienced forestry personnel used their knowledge of species soil requirements and responses to particular soil conditions to assess the soil characteristics pertaining to each land area and arrive at potential limiting factors for the growth and survival of each tree species. Based on the combined effect of these limiting factors, an appropriate suitability rating for each tree species was determined. These are given in Table 19.

Assessments were made on a general basis for each type of land area defined in the map legends and in the report. These types of land areas are portrayed on the soil maps as a component or components of the map unit symbol in each map delineation. Types of land areas assessed included: (1) those represented by a soil landscape unit; (2) those represented by a soil landscape unit and applicable soil phase or phases; (3) those represented by a land type unit; and (4) those represented by a miscellaneous land unit.

(3) Explanation of Suitability Ratings

Four suitability classes were established to describe species suitability for each type of land area mapped. These classes are general indicators of suitability since a number of different limiting factors for tree growth and survival may be present in a land area, and these must be evaluated collectively to arrive at an appropriate suitability class. The classes are:

Good(G) — optimum potential for growth and survival
Fair(F) — acceptable potential for growth and survival
Poor(P) — limited potential for growth and survival
Unsuitable(U) — severe limitations for growth and survival

One or a combination of these classes have been used to determine the suitability ratings given in Table 19. A single rating consisting of one suitability class is given when either the land area has only one main drainage condition, or when two drainage conditions are present which affect species performance in a similar manner. Thus the suitability rating for an individual species may be good, fair, poor, or unsuitable. A compound rating consisting of two suitability classes is given when the land area, usually represented by a soil landscape unit, has two drainage conditions for which different suitability classes apply. An example is a rating of FP (Fair to Poor) for White Pine on soil landscape unit C3, which is dominantly imperfectly drained with a significant area also being poorly drained. In this instance, the land area is dominantly Fair (F) for White Pine with a significant portion also being Poor (P).

Suitability classes which compose the ratings are based on identified soil conditions within land areas as defined in the map legend and report. These, in turn, were evaluated for their limiting effects on tree growth and survival. Various soil management techniques could, however, overcome some of the limiting effects of soil conditions identified for some land areas. These were not considered when the appropriate classes and ratings were determined. Thus, an area rated as Poor (P) due to poor drainage could be improved by at least one class if a drainage system were installed, and the appropriate rating would be Fair (F) rather than Poor (P).

In Table 19 suitability ratings applicable to each type of land area mapped are given for the eight most commonly planted forest tree species in eastern Ontario. These are:

Pu — Eastern White Pine; *Pinus strobus*
Pr — Red Pine; *Pinus resinosa*
Sn — Norway Spruce; *Picea abies*
Sw — White Spruce; *Picea glauca*
Ce — Eastern White Cedar; *Thuja occidentalis*
Ta — Tamarack; *Larix laricina*
Le — European Larch; *Larix decidua*
HPo — Hybrid Poplar; *Populus* ssp.

For information on the suitability and management of other forest tree species, contact your local Ontario Ministry of Natural Resources field office.

(4) Limitations to the Rating System

Other landscape features, in addition to the soil features associated with the type of land area, may be present in map delineations which can affect tree growth and survival as well as operations associated with plantation establishment and tending. These features are shown along with the type of land area in the map unit symbol and include: surface stoniness (shown as a stoniness class), surface slope (shown as a slope class), and the presence of rock outcrops (shown as a rockiness class). Surface stoniness and slope, when severe, may pose an operational limitation for plantation establishment and tending. Rock outcrops, which may occur in some areas regardless of soil type, are unsuitable for all forest tree species. The suitability ratings which are given in Table 19 have been determined without taking these local, landscape-specific features into consideration. The presence of such features, however, will influence suitability and they must be considered. In most instances, lower suitability ratings than those given in Table 19 for each type of land area mapped will apply. To illustrate this, consider the following example: If an area of land has been mapped as G1, the rating for White Pine (Pw) is given as G (Good). However, if the area was also found to be excessively stony in that particular map delineation (indicated by a stoniness class of S5 in the map symbol), this would pose an additional limitation for plantation establishment and tending. Thus, a more appropriate rating for the area in that map delineation would in fact be P (Poor).

Within map delineations, other soils or land types may be present which are not indicated in the map unit symbol. This is a limitation of the map scale (1:50,000), which required large areas of land to be delineated. An on-site verification of the types of land areas mapped is, therefore, important in order to identify potential variations and thus operational limitations.

This should be done **before** forest management or establishment activities commence. Contact your local Ontario Ministry of Natural Resources field office for assistance in forest management decisions.

(5) How to Apply the Suitability Ratings Table

Before the suitability ratings table can be applied, one must first be familiar with the map unit symbols which identify the type of land area or areas represented by map delineations. Recognition of the components of each symbol is necessary, since the type of land areas upon which the ratings are based account for at least one component of each symbol.

A map unit symbol may contain one or two components representing types of land areas. If it contains one such component, only one set of suitability ratings for various tree species apply. If it contains two such components, however, two sets of suitability ratings apply, one for each type of land area. When two land area components are shown, the first one is dominant in occurrence while the second occurs in significant proportions. Refer to the section of the report, "Definitions of Terms and Components Associated with the Soil Maps and Legend," for more detailed explanations.

Once the types of land areas which are shown in a map unit symbol have been determined, suitability ratings by species for those areas can be found in Table 19 with one exception. Land areas represented by a soil landscape unit **and** an identified soil phase or phases constitute a separate land entity for which additional ratings by species are given. Four types of soil phases may be shown in a map unit symbol in conjunction with a soil landscape unit. These are:

S — Shallow Phase — bedrock occurs at 50 to 100 cm depth

O — Organic Phase — 15 to 40 cm of organic material at the surface

C — Coarse Phase — 15 to 40 cm of surface material significantly coarser textured than the underlying material

F — Fine Phase — 15 to 40 cm of surface material significantly finer textured than the underlying material

Other symbol components such as slope class or stoniness class are not required to determine suitability ratings in the table. These components were not considered in the interpretive process, but as discussed in the section "Limitations to the Rating System," may be severe enough to warrant modification of the given ratings for each tree species.

The following procedure should be followed when determining the suitability ratings by species for the land area component or components shown in a map symbol:

1. Study the "Explanation of the Map Unit Symbols" shown on the border of each soil map. Also refer to the section of the report "Definitions of Terms and Components Associated with the Soil Maps and Legend." These provide explanations of the various types of map unit symbols and their respective components.
2. Locate the symbol on the soil map for the area you are concerned with.
3. Identify the land area component or components. One or two types of land areas may be portrayed in a map unit symbol, which may be a soil landscape, land type, or miscellaneous land unit as defined in the map legend.
4. Identify any soil phases which are shown and the type of land area or areas they are associated with. Only soil landscape units have associated soil phases.
5. Proceed to Table 19. Suitability ratings by species are given for all types of land areas **without** soil phases, and also for those **with** soil phases.
6. In the Land Area column, find each identified land area with or without associated soil phases. Listed horizontally beside each area are suitability ratings for eight commonly planted forest tree species in eastern Ontario.

(6) Examples of Some Rating Determinations

(a) For a map symbol of $\frac{\text{C3}}{2}$

C3 is the land area component of the symbol for which suitability ratings are given.

From Table 19, locate C3 in the land area column. Listed horizontally beside C3 are the suitability ratings for eight forest tree species, i.e. C3 is rated PU (Poor to Unsuitable) for White Spruce (Sw).

(b) For a map symbol of $\frac{\text{F1-G1}}{\text{R2.3-S1.2}}$

F1 and G1 are the land area components of the symbol for which separate suitability ratings are given.

From Table 19, F1 is rated U (Unsuitable) for White Pine (Pw), and G1 is rated G (Good) for the same species.

From the "Explanations of the Map Unit Symbols" on the soil map, F1 is the dominantly occurring land area, and G1 occurs in significant proportions.

Thus, the delineated area is dominantly Unsuitable for White Pine, with a lesser but significant proportion being Good for the same species.

Table 19. Land suitability ratings for commonly planted forest tree species in Eastern Ontario

Soil association, land type, or miscellaneous land area	Land area	Rating by species							
		Pw	Pr	Sn	Sw	Ce	Ta	Le	HPo
Anstruther (A)	A1	U	U	U	U	F	P	U	U
Recent Alluvium (AR)	AR1	U	U	U	U	U	U	U	U
	AR2	U	U	U	U	U	U	U	U
Bearbrook (B)	B1	F	U	P	U	F	F	P	F
	B2	P	U	U	U	P	P	U	P
	B3	U	U	U	U	U	U	U	U
	B4	P	U	U	U	P	P	U	P
Borromee (BE)	BE1	U	U	U	U	U	P	U	U
Castor (C)	C2	F	U	F	P	F	G	P	F
	C3	FP	U	FP	PU	FP	FP	PU	FP
	C4	PF	U	PF	U	PF	PF	UP	PF
	C5	P	U	P	U	P	P	U	P
	C5.S	P	U	U	U	P	P	U	U
Chateauguay (CH)	CH3	P	U	U	U	F	P	U	P
	CH4	F	U	F	P	F	G	U	G
	CH4.S	P	U	P	U	P	F	U	P
	CH5	F	U	F	P	F	F	U	P
	CH6	P	U	U	U	F	F	U	P
	CH7	P	U	U	U	F	F	U	P
Dalhousie (D)	D1	F	U	F	P	F	G	P	F
	D2	FP	U	FP	PU	FP	GF	PU	FP
	D2.C	FP	U	FP	PU	FP	GF	PU	FP
	D3	P	U	U	U	P	F	U	P
	D3.C	P	U	U	U	P	G	U	P
	D3.S	P	U	U	U	P	F	U	U
	D4	U	U	U	U	U	U	U	U
	D4.O	U	U	U	U	U	U	U	U
	D5	PF	U	UP	UP	PF	FG	UP	PF
Eroded Channels (ER)	ER	P	P	P	P	F	F	U	U
Farmington (F)	F1	U	U	U	U	F	P	U	U
	F1.F	U	U	U	U	F	P	U	U
	F2	P	U	U	U	F	F	U	P
	F2.F	P	U	U	U	F	F	U	P
	F3	U	U	U	U	P	P	U	U
	F3.O	U	U	U	U	P	P	U	U
	F4	UP	U	U	U	F	PF	U	UP
	F4.F	UP	U	U	U	F	PF	U	UP
	F5	U	U	U	U	FP	FP	U	PU
	F6	U	U	U	U	FP	P	U	U
Goulbourn (GB)	GB1	U	U	U	U	U	P	U	U
Greely (GY)	GY1	U	U	U	U	U	P	U	U
Grenville (G)	G1	G	P	F	G	G	F	G	F
	G1.C	G	P	F	G	G	P	G	F
	G1.S	F	U	F	P	F	F	F	P
	G2	G	P	P	F	G	G	F	G
	G2.C	G	P	P	F	G	F	F	G
	G2.S	F	U	P	P	F	G	P	F
	G3	P	U	U	U	F	F	P	F
	G3.C	P	U	U	U	F	P	P	F
	G3.O	P	U	U	U	F	F	P	P
	G3.S	P	U	U	U	F	F	U	P
	G4	G	PU	FP	GF	G	FG	GF	FG
	G4.S	F	U	FP	GP	F	FG	FP	PF
	G5	P	PU	PU	FP	GF	GF	PU	GF
	G5.S	P	U	PU	FU	GF	GF	U	FP
	G6	U	U	U	U	U	U	U	U

(Continued on Page 108)

Table 19. continued

Soil association, land type, or miscellaneous land area	Land area	Rating by species							
		Pw	Pr	Sn	Sw	Ce	Ta	Le	HPo
Huntley (H)	H1	U	U	U	U	U	P	U	U
Ironside (I)	I1	G	F	G	F	F	F	G	P
	I1.S	F	U	F	P	F	F	F	U
	I2	G	P	G	G	F	G	G	F
	I2.S	F	U	F	P	F	G	F	U
	I3	F	U	P	P	F	F	P	F
	I3.S	P	U	U	U	F	F	U	U
	I4	G	G	G	G	P	F	G	P
	I5	F	U	P	P	F	F	P	F
	I6	G	F	G	G	F	G	F	F
Jockvale (J)	J1	FG	GF	FG	PF	PF	PF	GF	UF
	J1.S	PF	FP	PF	UP	PF	PF	F	UP
	J2	G	F	G	F	F	F	F	F
	J3	GF	FU	GF	FU	FP	FP	FP	F
	J4	FG	UF	FG	UF	F	PF	PF	F
	J4.F	FG	UF	FG	UF	F	PF	PF	F
	J4.S	PF	UP	PF	UP	PF	PF	UF	UP
	J5	F	U	F	U	F	P	P	F
	J5.S	P	U	P	U	P	P	U	U
	J6	U	U	U	U	U	U	U	U
	J6.O	U	U	U	U	U	U	U	U
	J7	F	G	F	P	P	P	G	U
	J7.S	P	F	P	U	U	U	F	U
	J8	F	GU	F	PU	PF	P	GP	UF
Kars (K)	K1	U	P	U	F	P	P	F	U
	K2	P	U	P	U	F	F	P	P
	K3	U	P	U	F	P	P	F	U
	K4	P	U	P	U	F	F	P	P
	K5	U	P	U	F	P	P	F	U
Landslide (LD)	LD	U	U	U	U	U	U	U	U
Leitrim (L)	L1	F	G	F	P	P	F	F	U
	L2	F	F	F	P	P	F	P	U
	L3	F	GF	F	P	P	F	FP	U
	L4	FP	FU	FP	PU	PU	FP	PU	U
	L5	F	GF	F	P	P	F	FP	U
	L6	F	G	F	P	P	F	F	U
	L7	FP	FU	FP	PU	PU	FP	PU	U
	L8	F	GF	F	P	P	F	FP	U
	L9	F	G	F	P	P	F	F	U
	L9.S	P	P	P	P	P	P	P	U
Lemieux (LE)	LE1	U	U	U	U	U	U	U	U
Malakoff (MK)	MK1	U	U	U	U	U	U	U	U
Manotick (M)	M1	GF	FP	GF	FP	P	PF	GF	PF
	M1.S	FP	U	FP	U	P	PF	GF	U
	M3	FP	PU	FP	PU	PU	F	FP	FP
	M4	F	P	F	P	P	F	F	F
	M5	PF	UP	PF	UP	UP	F	PF	PF
	M6	P	U	P	U	U	F	P	P
	M6.C	P	U	P	U	U	F	P	P
	M7	U	U	U	U	U	U	U	U
	M7.O	U	U	U	U	U	U	U	U
Mer Bleue (MB)	MB1	U	U	U	U	U	P	U	U
Mille Isle (MI)	MI1	P	G	P	P	U	U	F	U
	MI2	GF	GF	GF	FP	PF	PF	GF	UP
	MI3	P	P	P	U	P	P	P	P
	MI3.O	U	P	P	U	P	P	P	P
	MI4	F	F	F	P	F	F	F	P
	MI5	GP	GP	GP	FU	P	P	GP	UP
	MI6	PG	PG	PG	UF	P	P	PG	PU

(Continued on Page 109)

Table 19. continued

Soil association, land type, or miscellaneous land area	Land area	Rating by species							
		Pw	Pr	Sn	Sw	Ce	Ta	Le	HPo
Marshland (ML)	ML	U	U	U	U	U	U	U	U
Nepean (N)	N1	U	U	U	U	U	U	U	U
	N3	U	U	U	U	U	P	U	U
	N4	UP	U	UP	U	U	UP	U	U
	N5	PU	U	U	U	U	P	U	U
North Gower (NG)	NG1	G	P	G	F	F	G	F	G
	NG1.S	F	U	F	P	F	G	P	P
	NG2	F	U	F	P	F	G	P	F
	NG2.C	F	U	F	P	F	G	P	F
	NG2.O	P	U	P	U	F	G	P	P
	NG2.S	P	U	P	U	F	G	U	P
	NG2.CS	P	U	P	U	F	G	U	P
	NG3	GF	PU	GF	FP	F	G	FP	GF
	NG4	U	U	U	U	U	U	U	U
	NG4.O	U	U	U	U	U	U	U	U
	NG5	F	U	F	P	F	G	P	F
Oka (O)	O1	P	U	P	U	P	P	P	U
	O1.S	P	U	P	U	P	P	P	U
	O2	F	U	F	P	F	F	F	P
	O2.S	P	U	P	U	P	P	P	U
	O3	P	U	P	U	P	P	F	U
	O4	F	U	F	P	F	F	F	P
	O5	P	U	P	U	P	P	F	U
Osgoode (OS)	OS1	G	P	G	F	G	G	F	G
	OS1.C	G	P	G	F	G	G	F	G
	OS2	FG	UP	FG	PF	FG	G	PF	FG
	OS3	F	U	F	P	F	G	P	F
	OS3.C	F	U	F	P	F	G	P	F
	OS3.F	F	U	F	P	F	G	P	F
	OS3.FO	P	U	P	P	F	G	P	P
	OS3.O	P	U	P	P	F	G	P	P
	OS3.S	P	U	P	U	F	F	U	U
	OS3.SO	U	U	U	U	F	F	U	U
	OS4	GF	PU	GF	FP	GF	G	FP	GF
Ottawa (OT)	OT1	P	G	P	F	P	P	F	U
	OT2	PF	G	PF	F	PF	PF	F	UP
	OT3	F	GP	F	FP	F	F	FP	P
Queensway (Q)	Q1	G	F	G	F	F	F	G	P
	Q1.S	F	P	F	P	F	F	G	U
	Q3	P	U	P	U	P	G	P	F
	Q4	G	F	G	FP	F	FG	GF	PF
Reevecraig (RE)	RE1	GP	U	FP	FU	GF	GF	PU	GF
	RE2	PG	U	PF	UF	FG	FG	UP	FG
	RE3	P	U	P	U	F	F	U	F
Rideau (R)	R1	P	U	P	U	F	F	U	P
	R2	PU	U	PU	U	FP	FP	U	PU
	R3	U	U	U	U	P	P	U	U
	R3.C	P	U	P	U	F	F	U	P
	R3.S	U	U	U	U	P	P	U	U
	R4.O	U	U	U	U	U	U	U	U
	R5	UP	U	UP	U	PF	PF	U	UP
Rockland (RK)	RK1	U	U	U	U	F	P	U	U
	RK2	U	U	U	U	F	P	U	U
	RK3	U	U	U	U	P	U	U	U
	RK4	U	U	U	U	U	U	U	U

(Continued on Page 110)

Table 19. continued

Soil association, land type, or miscellaneous land area	Land area	Rating by species							
		Pw	Pr	Sn	Sw	Ce	Ta	Le	HPo
St. Thomas (ST)	ST1	P	F	P	P	P	P	F	U
	ST2	GF	GF	GP	FP	PF	FG	GF	UP
	ST3	GP	GP	GP	FP	PF	FG	GP	UP
	ST4	FP	FP	P	P	F	G	FP	P
	ST5	PG	PG	PG	PF	FP	GF	PG	PU
	ST6	P	P	P	P	F	G	P	P
	ST7	PF	PF	P	P	F	G	PF	P
	ST8	GF	FP	GP	FP	PF	FG	FP	UP
Uplands (U)	U1	P	F	P	P	P	P	F	U
	U3	GF	GF	GP	FP	PF	FG	GF	UP
	U5	GP	GP	GP	FP	PF	FG	GP	UP
	U8	FP	FP	P	P	F	G	FP	P
	U11	PF	PF	P	P	F	G	PF	P
	U13	P	P	P	P	F	G	P	P
	U15	P	F	P	P	P	P	F	U
Escarpment (X)	X1	P	U	P	U	F	F	U	U
	X2	P	P	P	P	F	F	P	U
	X3	U	U	U	U	P	U	U	U
Land Altered by Man	DL, LF SL, TR U	NR: Not Rated							

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Footnote: Some references cited pertain to Volume 2 of the report.

APPENDIX 1.

Definitions of classes and phases used to describe soil and landscape features

(a) Soil Drainage Classes

Five drainage classes were employed in this soil survey which grouped seven drainage classes as defined in the Canada Soil Information System (CanSIS) "Manual for Describing Soils in the Field" (1978; 24). The drainage classes employed and their components are as follows:

Excessive	—	very rapidly and rapidly drained
Good	—	well drained and moderately well drained
Imperfect	—	imperfectly drained
Poor	—	poorly drained
Very Poor	—	very poorly drained

Definitions for very rapidly to very poorly drained classes, as they are given in the manual, are as follows:

Very rapidly drained — Water is removed from the soil very rapidly in relation to supply. Excess water flows downward very rapidly if underlying material is pervious. There may be very rapid subsurface flow during heavy rainfall provided there is a steep gradient. Soils have very low available water storage capacity (usually less than 2.5 cm) within the control section and are usually coarse textured, or shallow, or both. Water source is precipitation.

Rapidly drained — Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Soils have low available water storage capacity (2.5-4 cm) within the control section, and are usually coarse textured, or shallow, or both. Water source is precipitation.

Well-drained — Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Soils have intermediate available water storage capacity (4-5 cm) within the control section, and are generally intermediate in texture and depth. Water source is precipitation. On slopes subsurface flow may occur for short durations but additions are equalled by losses.

Moderately well-drained — Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to low perviousness, shallow water table, lack of gradient, or some combination of these. Soils have intermediate to high water storage capacity (5-6 cm) within the control section and are usually medium to fine textured. Precipitation is the dominant water source in medium to fine textured soils; precipitation and significant additions by subsurface flow are necessary in coarse textured soils.

Imperfectly drained — Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is the major supply. If subsurface water or groundwater, or both, is the main source, the flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is main source if available water storage capacity is high; contribution by subsurface flow or groundwater flow, or both, increases as available water storage capacity decreases. Soils have a wide range in available water supply, texture, and depth, and are gleyed phases of well drained subgroups.

Poorly drained — Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface flow or groundwater flow, or both, in addition to precipitation are the main water sources; there may also be a perched water table, with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, texture, and depth, and are gleyed subgroups, Gleysols, and Organic soils.

Very poorly drained — Water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen. Excess water is present in the soil for the greater part of the time. Groundwater flow and subsurface flow are the major water sources. Precipitation is less important except where there is a perched water table with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, texture, and depth, and are either Gleysolic or Organic.

(b) Slope Classes

Slopes associated with land areas composing map delineations were identified using the following classes:

Class	Slope (%)	Terminology
1	0-0.5	Level
2	0.5-2	Nearly level
3	2-5	Very gently sloping
4	6-9	Gently sloping
5	10-15	Moderately sloping
6	16-30	Steeply sloping

Simple (regular surface) slopes were identified by showing the class number only in the map unit symbol for the land area. These slopes usually consist of long, continuous land surfaces, with one or several composing the overall land area.

Multiple (irregular surface) slopes were identified by showing the class number followed by an asterisk (*) in the map unit symbol for the land area. These slopes usually consist of short, repetitive land surfaces expressed as a series of uplands and depressions.

(c) Stoniness Classes

Surface stoniness classes are based primarily on the percentage of the land surface occupied by rock fragments larger than 15 cm in diameter. Cobbles, flags, and boulders are the most common types of rock fragments. Distance between fragments was used as a general guide to determine surface coverage. The following stoniness classes were used:

Class	Description
S1	Slightly stony — land having 0.01-0.1% of surface occupied by stones. Stones commonly 10-30 m apart. The stones offer only slight to no hindrance to cultivation.
S2	Moderately stony — Land having 0.1-3% of surface occupied by stones. Stones commonly 2-10 m apart. Stones cause some interference with cultivation.
S3	Very stony — Land having 3-15% of surface occupied by stones. Stones commonly 1-2 m apart. There are sufficient stones to constitute a serious handicap to cultivation.
S4	Exceedingly stony — Land having 15-50% of surface occupied by stones. Stones commonly 0.7-1.5 m apart. There are sufficient stones to prevent cultivation until considerable clearing has been done.
S5	Excessively stony — Land having more than 50% of surface occupied by stones. Stones commonly less than 0.7 m apart. The land is too stony to permit cultivation.

(d) Rockiness Classes

Rockiness classes are based on the percentage of surface occupied by exposed bedrock or which has bedrock occurring within 10 cm. The following rockiness classes were used:

Class	Description
R1	Slightly rocky land — Sufficient bedrock exposures to interfere with tillage but not to make intertilled crops impracticable. Depending upon how the pattern affects tillage, rock exposures are roughly 35-100 m apart and cover 2-10% of the surface.
R2	Moderately rocky land — Sufficient bedrock exposures to make tillage of intertilled crops impracticable, but soil can be worked for hay crops or improved pasture if other soil characteristics are favorable. Rock exposures are roughly 10-35 m apart and cover 10-25% of the surface, depending upon the pattern.

Land areas having rockiness conditions which composed 25% or more of the surface were mapped as the Rockland land type.

(e) Soil Phases

Four soil phases were used to describe additional features present in the landscape which are not accounted for by the soil landscape unit shown in the map unit symbol to define the land area. The following soil phases were used:

Shallow phase — A depth modifier applied to mineral soil materials which are defined in the legend and association descriptions as being thicker than 1 m, but in the area delineated have bedrock between 50 and 100 cm of the surface. Thus, underlying bedrock occurs which is not normally present with materials of that type. This bedrock occurrence should not be confused with soil associations such as Farmington or Nepean, which are defined as being 50 cm or less of mineral material over bedrock.

Peaty phase — A surface modifier applied to mineral soils which have 15 to 40 cm of organic (peat) material at the surface. These soils are significantly wetter than similar mineral soils which do not have such accumulations at the surface.

Coarse phase — A surface modifier applied to mineral soils which have 15 to 40 cm of surface material which is significantly coarser textured than materials which normally occur. Sandy loam, loamy sand, and sand are the most common textures associated with coarse phases.

Fine phase — A surface modifier applied to mineral soils which have 15 to 40 cm of surface material which is significantly finer textured than materials which normally occur. Clay loam and silty clay loam are the most common textures associated with fine phases.

(f) Calcareousness Classes

Class	$CaCO_3$ equivalent (%)
Weakly calcareous	<5
Moderately calcareous	5-15
Strongly calcareous	15-25
Very strongly calcareous	25-40
Extremely calcareous	>40

(g) Reaction Classes

Class	pH values
Extremely acid	$\leq$4.5
Very strongly acid	4.6-5.0
Strongly acid	5.1-5.5
Medium acid	5.6-6.0
Slightly acid	6.1-6.5
Neutral	6.6-7.3
Mildly alkaline	7.4-7.8
Moderately alkaline	7.9-8.4
Strongly alkaline	$\geq$8.5

APPENDIX 2.

Correlation of recognized series and subgroups to previously published soil information

Soil Association	Series and (Subgroups)	Status*	Survey in which Soil originated	Soil Name in previous Carleton County Survey	Comments
ANSTRUTHER	Kanata	NEW			
	Anstruther	OLD	Carleton County	Anstruther sand, Chandos sand	
BEARBROOK	Wendover	OLD	Russell and Prescott Counties		
	Bearbrook	OLD	Carleton County	Bearbrook clay	
BORROMEE	(Terric Mesic Humisols)	NEW		Peat	
	(Terric Humic Mesisols)	NEW			
CASTOR	Castor	OLD	Russell and Prescott Counties	Castor silt loam	
	Bainsville	OLD	Russell and Prescott Counties	Castor silt loam	
CHATEAUGUAY	(Gleyed Melanic Brunisols of CH4)	NEW			
	MacDonald	OLD	Ottawa Urban Fringe		
	(Gleyed Melanic Brunisols and Orthic Humic Gleysols of CH5, CH6, and CH7 units)	NEW			These soils are variants which originate in this survey.
DALHOUSIE	Dalhousie	OLD	Gatineau and Pontiac Counties, Quebec		
	Brandon	OLD	Gatineau and Pontiac Counties, Quebec	Rideau clay, North Gower clay loam	
	(Rego Gleysols)	OLD	Ottawa Urban Fringe		
FARMINGTON	Farmington	OLD	Carleton County	Farmington loam, Farmington sandy loam, Farmington -not differentiated	
	Franktown	OLD	Lanark County		
	Brooke	OLD	Lanark County		
GOULBOURN	Goulbourn	NEW		Muck	All Goulbourn soils were previously included in the Huntley association in the survey of the Ottawa Urban Fringe.
	Munroe	OLD	Organic soil maps of Southern Ontario	Muck	
	(Terric Humic Mesisols)	NEW		Muck	
	(Terric Mesic Humisols)	NEW		Muck	
GREELY	Greely	OLD	Organic soil maps of Southern Ontario	Muck	
	(Typic Mesisols)	NEW		Muck	
	(Terric Humisols)	NEW		Muck	
	(Terric Mesisols)	NEW		Muck	

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Soil Association	Series and (Subgroups)	Status*	Survey in which Soil originated	Soil Name in previous Carleton County Survey	Comments
GRENVILLE	Grenville	OLD	Carleton County	Grenville loam, Grenville sandy loam	
	(Orthic Melanic Brunisols)	NEW			Occur less frequently than the Grenville series.
	(Orthic Humic Regosols)	NEW			Occur occassionally on eroded till knolls.
	Matilda	OLD	Grenville County	Lyons loam	Mapped in all surrounding county surveys.
	(Gleyed Melanic Brunisols)	NEW			Occur less frequently than the Matilda series.
	Lyons	OLD	Carleton County	Lyons loam	Mapped in all surrounding county surveys.
	(Rego Gleysols)	NEW			
HUNTLEY	Garry	OLD	Organic soil maps of Ontario	Muck	
	Glendale	OLD	Organic soil maps of Ontario	Muck	
	(Mesic Humisols)	OLD	Ottawa Urban Fringe		
	(Humic Mesisols)	OLD	Ottawa Urban Fringe		
IRONSIDE	Ironside	OLD	Ottawa Urgan Fringe	Grenville sandy loam	
	(Gleyed Melanic Brunisols of I2 unit)	OLD	Ottawa Urban Fringe		
	Dwyer Hill	NEW			
	(Orthic Melanic Brunisols, Gleyed Melanic Brunisols and Orthic Humic Gleysols of I4, I5, and I6 units)	NEW			These soils are variants which originate in this survey.
JOCKVALE	Jockvale	OLD	Ottawa Urban Fringe	Rubicon sand	
	Stapledon	NEW		Rubicon sand	Mapped as Achigan series in Ottawa Urban Fringe survey.
	Vaudreuil	OLD	Gatineau and Pontiac Counties, Quebec	Granby sand	
	(Rego Gleysols)	NEW			
KARS	Kars	OLD	Carleton County	Kars gravelly sandy loam	
	(Gleyed Eluviated Melanic Brunisols of K2 unit)	NEW			
	(Orthic Humic Gleysols of K2 unit)	NEW			
	(Eluviated Melanic Brunisols, Gleyed Eluviated Melanic Brunisols, and Orthic Humic Gleysols of the K3, K4 and K5 units)	NEW			These soils are variants which originate in this survey.

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Soil Association	Series and (Subgroups)	Status*	Survey in which Soil originated	Soil Name in previous Carleton County Survey	Comments
LEITRIM	French Hill	NEW			The Leitrim series in the Ottawa Urban Fringe survey is derived from brown shale.
	(Gleyed Melanic Brunisols derived from black shale)	NEW			
	(Orthic Humic Gleysols derived from black shale)	NEW			
	Vars	OLD	Russell and Prescott Counties		
	(Orthic Melanic Brunisols, Gleyed Melanic Brunisols, and Orthic Humic Gleysols of L5, L7, L8 and L9 units)	NEW			Variants which originate in this survey.
LEMIEUX	Lemieux	OLD	Organic soil maps of Ontario	Muck	
	(Mesic Humisols)	NEW			
MALAKOFF	Summerstown	OLD	Organic soil maps of Ontario	Muck	
	Malakoff	OLD	Organic soil maps of Ontario		
MANOTICK	Manotick	OLD	Carleton County	Manotick sandy loam	
	Mountain	OLD	Dundas County	Manotick sandy loam	
	Becketts Creek	NEW		Manotick sandy loam	
	St. Damase	OLD	Gatineau and Pontiac Counties, Quebec	Manotick sandy loam	
	Allendale	OLD	Carleton County	Manotick sandy loam	
	(Rego Gleysols)	NEW		Manotick sandy loam	
MER BLEUE	Mer Bleue	OLD	Ottawa Urban Fringe	Peat	
	(Fibric Mesisols)	NEW			
MILLE ISLE	Constance Bay	NEW		Uplands sand	
	Mille Isle	OLD	Ottawa Urban Fringe	Uplands sand	
	(Gleyed Dystric Brunisols)	NEW		Rubicon sand	
	Herbert Corners	OLD	Ottawa Urban Fringe	Rubicon sand	Series not named in Ottawa Urban Fringe survey.
	Dunrobin	OLD	Ottawa Urban Fringe	Grandy sand	Series not named in Ottawa Urban Fringe survey.
NEPEAN	Marchhurst	NEW		Nepean sand	
	Nepean	OLD	Carleton County	Nepean sand	
	(Gleyed Sombric Brunisols)	NEW		Nepean sand	
	Fallowfield	OLD	Ottawa Urban Fringe	Nepean sand	
	Barrhaven	OLD	Ottawa Urban Fringe	Nepean sand	

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Soil Association	Series and (Subgroups)	Status*	Survey in which Soil originated	Soil Name in previous Carleton County Survey	Comments
NORTH GOWER	Carp	OLD	Carleton County	Carp clay loam	Classified as Gleyed Gray Brown Luvisol in Ottawa Urban Fringe survey.
	North Gower	OLD	Carleton County	North Gower clay loam	
	Belmeade	OLD	Dundas County		
	North Gower (variant)	OLD	Ottawa Urban Fringe		
OKA	Munster	NEW		Farmington shingly loam	
	Oka	OLD	Gatineau and Pontiac Counties, Quebec	Farmington shingly loam	
	(Gleyed Eluviated Melanic Brunisols of 02 unit)	NEW		Farmington shingly loam	
	(Gleyed Melanic Brunisols of 02 unit)	NEW		Farmington shingly loam	
	(Orthic Melanic Brunisols of 03 and 05 units)	NEW			These soils are variants which originate in this survey.
OSGOODE	Piperville	OLD	Ottawa Urban Fringe	Osgoode loam	
	Osgoode (calcareous)	OLD	Carleton County	Osgoode loam	
	Carsonby (noncalcareous)	OLD	Ottawa Urban Fringe	Osgoode loam	
OTTAWA	Buckham Bay	NEW		Eastport sand	
	(Gleyed Dystric Brunisols of OT2 unit)	NEW		Eastport sand	
QUEENSWAY	Galesburg	OLD	Carleton County	Galesburg sandy loam	
	Queensway	OLD	Ottawa Urban Fringe	Galesburg sandy loam	
	(Gleyed Melanic Brunisols of Q4 unit)	NEW			
	(Gleyed Eluviated Melanic Brunisols of Q4 unit)	OLD	Ottawa Urban Fringe		
	(Orthic Humic Gleysols of Q3 unit)	OLD	Ottawa Urban Fringe		
REEVECRAIG	(Gleyed Melanic Brunisols of RE1 and RE2 units)	NEW		Granby sand	
	Reevecraig	NEW		Granby sand	
	(Rego Humic Gleysols of RE3 unit)	NEW		Granby sand	
RIDEAU	Rideau	OLD	Carleton County	Rideau clay	
	Ste. Rosalie	OLD	Gatineau and Pontiac Counties, Quebec	Rideau clay	
	Laplaine	OLD	Gatineau and Pontiac Counties, Quebec	Rideau clay	

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Soil Association	Series and (Subgroups)	Status*	Survey in which Soil originated	Soil Name in previous Carleton County Survey	Comments
ST. THOMAS	St. Thomas	OLD	Gatineau and Pontiac Counties, Quebec	Uplands sand or Rubicon sand	
	Limoges	NEW		Uplands sand or Rubicon sand	
	Achigan	OLD	Gatineau and Pontiac Counties, Quebec	Uplands sand or Rubicon sand	
	Vinette	NEW		Uplands sand or Rubicon sand	
	Cheney	NEW		Uplands sand or Rubicon sand	
	(Subgroups of ST8 unit)	NEW		Uplands sand or Rubicon sand	These soils are variants which originate in this survey.
UPLANDS	Uplands	OLD	Carleton County	Uplands sand or Rubicon sand	
	Carlsbad	OLD	Ottawa Urban Fringe	Uplands sand or Rubicon sand	
	Rubicon	OLD	Carleton County	Uplands sand or Rubicon sand	
	Ramsayville	OLD	Ottawa Urban Fringe	Uplands sand or Rubicon sand	
	St. Samuel	OLD	Russell and Prescott Counties	Uplands sand or Rubicon sand	
	(Subgroups of U15 unit)	NEW		Uplands sand or Rubicon sand	These soils are variants which originate in this survey.

** Series or subgroups designated as "OLD" originate in previously published soil information, including that for the Ottawa Urban Fringe area. Those designated as "NEW" have been developed for this survey.*