26

SOIL SURVEY OF MANITOULIN ISLAND

REPORT No. 26 OF THE ONTARIO SOIL SURVEY

Prepared jointly by the Research Branch, Canada Department of Agriculture and the Ontario Agricultural College

CANADA DEPARTMENT OF AGRICULTURE, OTTAWA
ONTARIO DEPARTMENT OF AGRICULTURE, TORONTO

SOIL SURVEY
of
MANITOULIN ISLAND
Ontario

by

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SOIL SURVEY MAPS AND REPORTS
PUBLISHED BY COUNTIES

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The soil map was prepared for lithographing by the Cartographic section of the Soils Research Institute, Central Experimental Farm, Ottawa.

TABLE OF CONTENTS

ILLUSTRATIONS

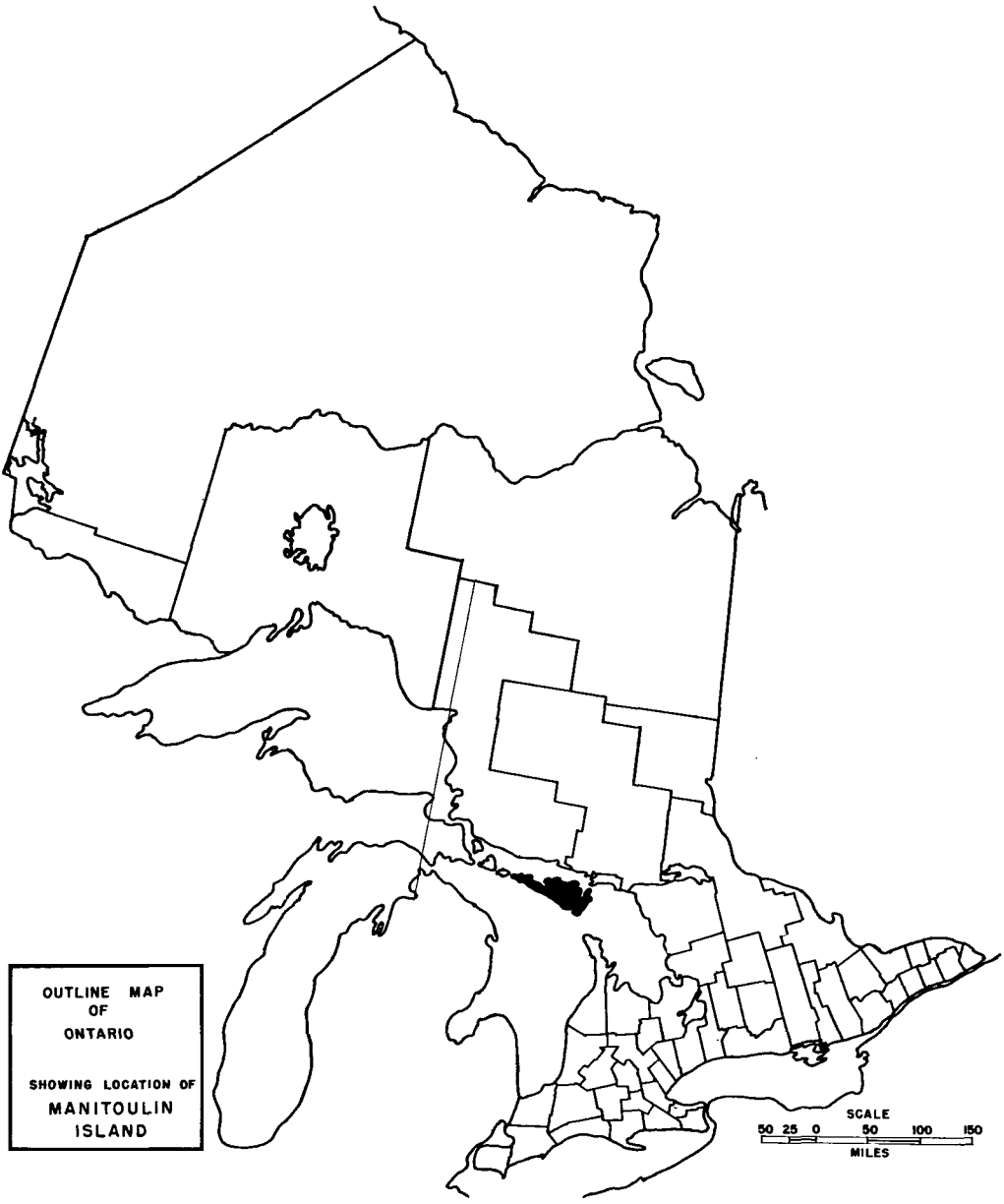

FIGURE 1: Outline Map of Ontario Showing Location of Manitoulin Island.

Soil Survey Report of Manitoulin Island, Ontario

by

D. W. HOFFMAN,[1] R. E. WICKLUND,[2] *and* N. R. RICHARDS[3]

INTRODUCTION

A survey of the soils of Manitoulin Island was begun in the summer of 1953 with the object of obtaining information about the soils occurring in this area. The soil map that was prepared showing the extent and distribution of the various types of soils found, accompanies this report.

The variations in soils occurring in this area, are not as great as those found in many other counties in Ontario. The relief is low, and flat lying limestone bedrock is at or very near the surface over a large part of the island. The soils that can be used for cultivation are those occurring on lake-laid clays, sandy outwash and till plains and many of the shallow soils are used as grazing land for livestock. The agricultural potential of this area in terms of soil use is limited. However increases in the production of cereal grains, hay, and pasture can be expected with improved methods of soil management.

This report deals with the characteristics of the soils as to their formation, nature, capabilities and suitability for agricultural use. Each soil type is described in detail and its location can be identified on the soil map.

A section on soil management and a rating of the soils according to their suitability for various crops is included in the report. Much of this information is general, and is an attempt to present the principles of good soil management as they apply to all soils. Sources of additional information with regard to crops and fertilizer practices are listed for the interested reader.

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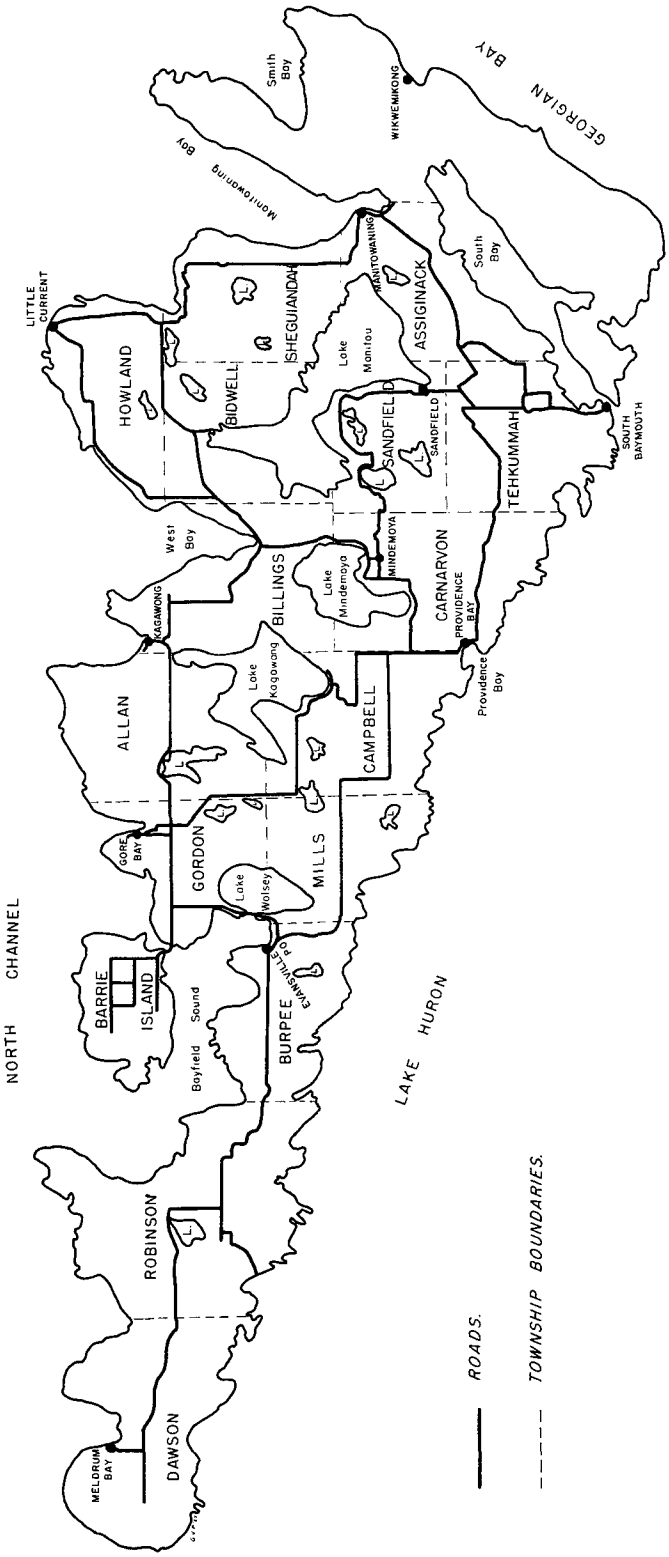


FIGURE 2: Outline Map Showing Townships, Principal Centres, etc.

GENERAL DESCRIPTION OF THE AREA

Location

Manitoulin Island is located in the northern part of Lake Huron approximately at 45° latitude and 82° longitude. It is said to be the largest "freshwater" island in the world.

The total land area is about 712,000 acres (1,100 square miles) of which 290,000 acres or about 40 per cent is occupied farm land.

Principal Towns

There are two incorporated towns on the Island each having less than 2,000 inhabitants. Gore Bay (770) is the shopping and administrative centre for the western end of the Island. The office of the Agricultural Representative is located here and nearby is a large Canadian Government airport. Little Current (1,614) is the gateway to the mainland, the only railway contact and chief port.

The small unincorporated centres of South Baymouth, Sheguiandah, Mindemoya, Kagawong, Spring Bay, Silverwater and Meldrum Bay, provide shopping facilities and tourist accommodation.

Population and Racial Origin

According to the 1951 Census the total population of the Island was 11,214. Approximately 90 per cent (9,817) of the people were rural dwellers but only 46 per cent lived on farms.

The trend in population from 1871 to 1951 is shown in Table 1.

TABLE 1
TREND IN TOTAL POPULATION

Year	Population	Year	Population
1871	2,231	1921	10,468
1881	8,460	1931	10,734
1891	10,794	1941	10,841
1901	11,828	1951	11,214
1911	11,324		

TABLE 2
POPULATION BY PRINCIPAL ORIGINS, 1951 CENSUS

Canadians of British Origin	7,690	68.6%
Native Indians	2,450	21.9%
Canadians of French Origin	515	4.6%
Canadians of Other Origins	559	4.9%
Total Population	11,214	100.0%

Transportation

Manitoulin Island is fairly well supplied with roads but transportation facilities from the Island to the mainland are poor. Roads traverse the Island connecting the population centres. Many of the main roads are oil surfaced but the township roads are few in number and often rough. A rough, twisting road from Little Current to Espanola is the only connecting road from the Island to the mainland. Running more or less parallel to this road is a spur line of the Canadian Pacific Railway which ends at Little Current.

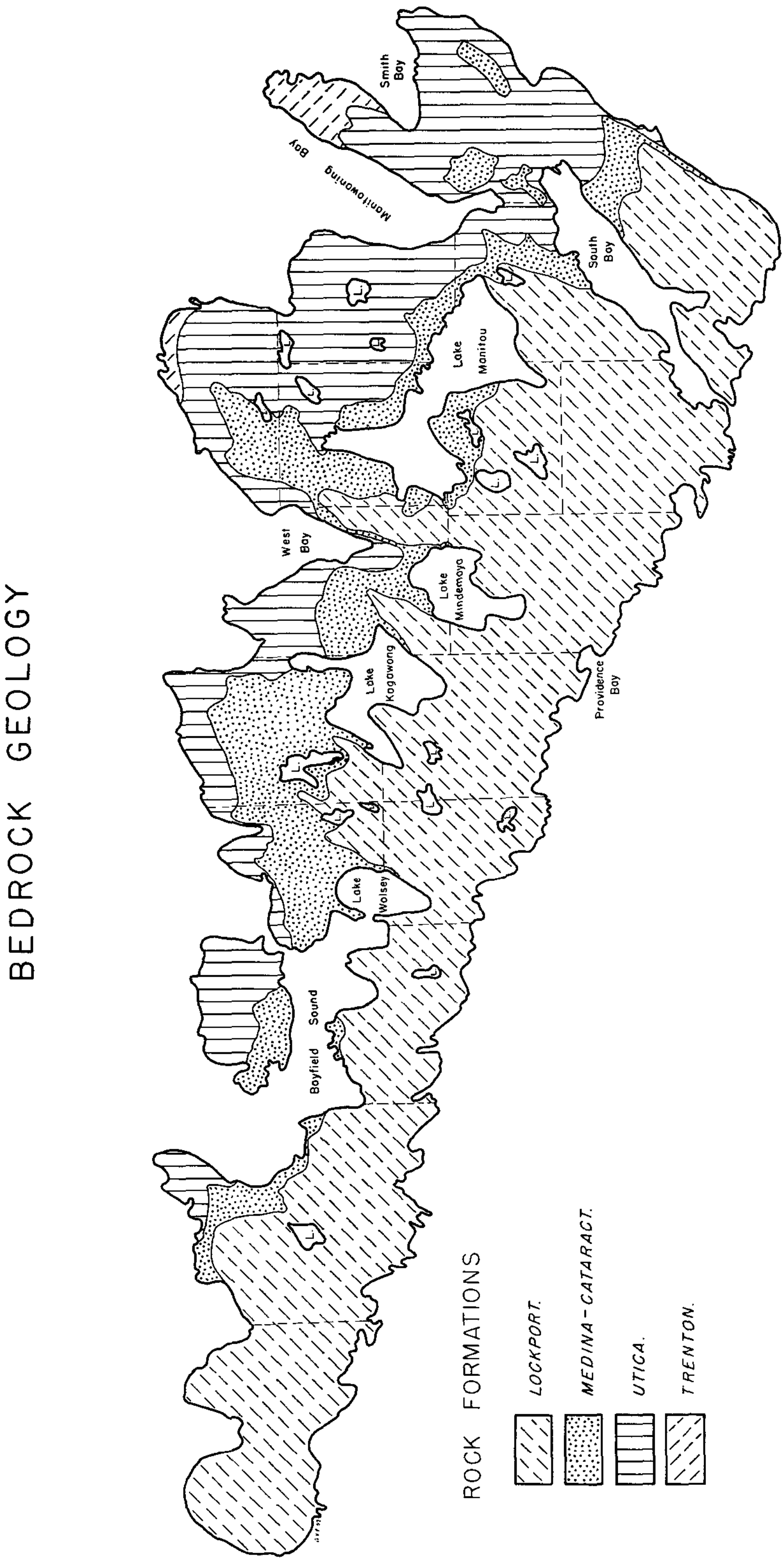


FIGURE 3: Outline Map Showing Bedrock Geology.

Geology of the Underlying Rocks

Manitoulin Island is underlain by rocks of Ordovician and Silurian ages which outcrop in many places. Limestones of the Trenton, Medina-Cataract and Lockport formations and shales of the Utica and Meaford formations are present.

The Trenton formation is seen only on the northeast part of the Island near Little Current and again on the long peninsula farther east that terminates in Bold Point. This limestone is of the magnesian variety and contains on the average 6 per cent of silica, iron and alumina.

The dolomite of the Medina-Cataract formation is also siliceous and argillaceous containing on the average about 7 per cent of impurities. This dolomite is dark brown to dark bluish grey in colour with seams of blue shale occurring in some localities. It is hard and contains silicified fossils and small nodules of white chert.

The Lockport dolomite which composes the major part of the Island, is over 300 feet thick. West of Campbell Bay this dolomite is brown and has a high silica content with numerous silicified fossils. A very pure cream to buff coloured porous dolomite is more common east of Campbell Bay. Some of the purest limestone on the Island occurs at South Baymouth.

The shales of the Utica and Meaford formations are grey to dark bluish grey in colour and contain layers of calcareous sandstone and sandy shale.

TABLE 3

ANALYSES OF THE UNDERLYING LIMESTONE FORMATIONS MANITOULIN ISLAND

	1 Trenton Formation	2 Medina Formation	3 Lockport Formation
Silica ($Si O_2$)	4.16	6.50	1.22
Ferric Oxide ($Fe_2 O_3$)	0.80	0.54	0.14
Alumina ($Al_2 O_3$)	1.46	1.84	0.32
Calcium Phosphate ($Ca_3(PO_4)_2$)	0.09	0.11	0.02
Calcium Carbonate ($Ca CO_3$)	82.41	50.16	53.54
Magnesium Carbonate ($Mg CO_3$)	10.54	40.95	43.96
Total	99.46	100.10	99.20

Samples for analyses from:
(1) Little Current (2) Gore Bay (3) Evansville

A ridge of white quartzite of Precambrian age protrudes through the Palaeozoic strata appearing in the neighbourhood of Sheguiandah.

The distribution of the different bedrock formations is shown in Figure 3.

Suface Deposits

The surface deposits in the Manitoulin area are chiefly of glacial origin and they form the parent material from which the soils have developed. The variations that occur in texture, relief and drainage of soils are a result of differences in the nature of these deposits.

The principal types of surface deposits are described in Table 4 and their distribution is shown in Figure 4.

A large part of the Island consists of scoured rock plains, that are flat, and covered with only a few inches of soil. In some places the drift deposits by the

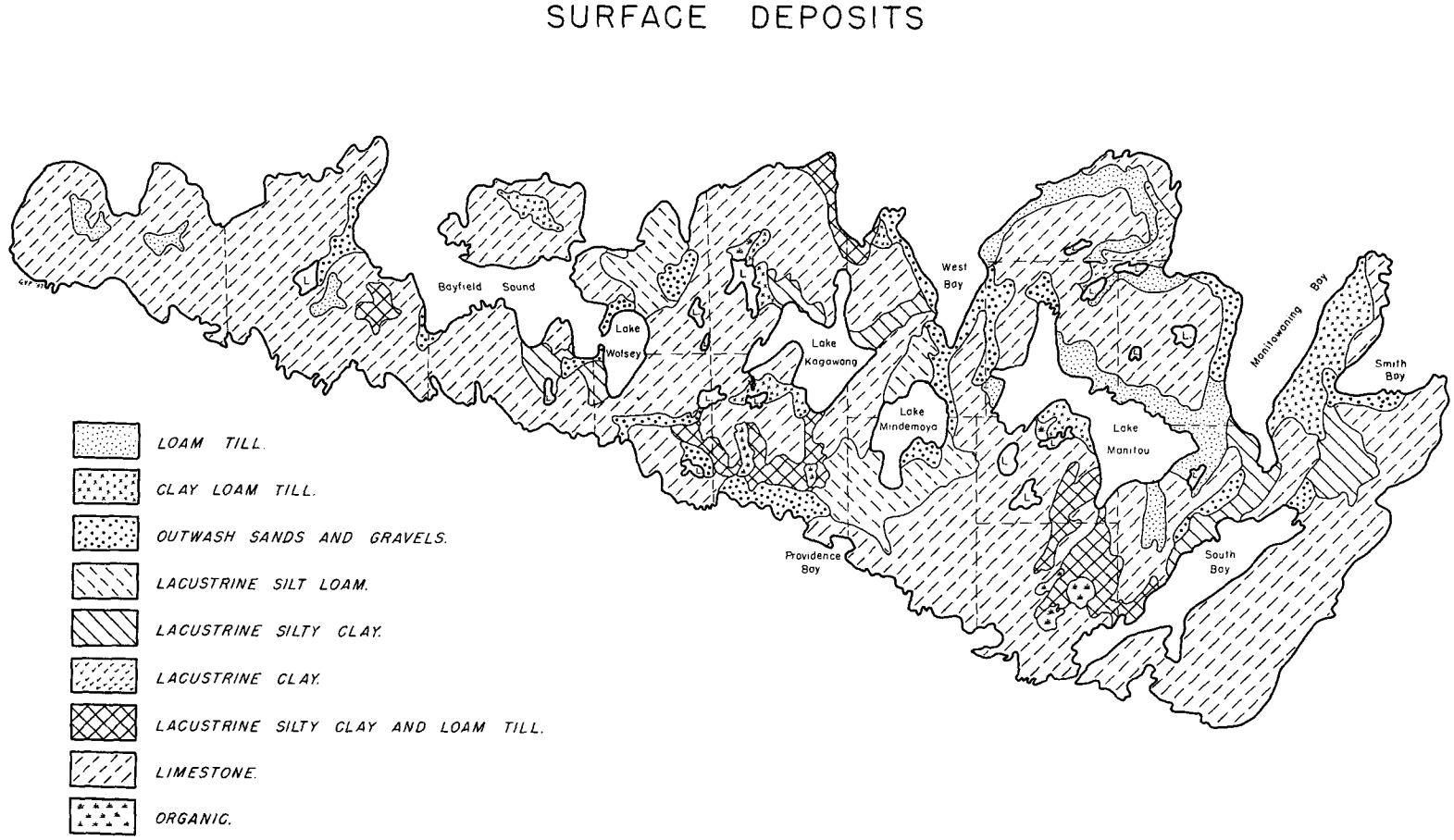


FIGURE 4: Outline Map Showing Distribution of Surface Deposits.

melting ice of the Wisconsin glaciation, is deeper and till plains, drumlins, moraines, outwash plains and lake-laid silts and clays occur.

The glacial till materials occur near Lake Manitou, Manitowaning Bay and the eastern part of the north shore and also as underlying deposits below the lacustrine and outwash materials of the various basins and depressional areas. This till is generally coarse textured and consists of a mixture of boulders, cobbles, gravel, sand, silt and clay. These materials have formed loam to clay loam soils with various degrees of stoniness and a topography which varies from regular moderately sloping to irregular, hilly.

Ground moraine, which is by far the most extensive form in which these till deposits occur in this area, is characterized by knolls and numerous sloughs. The terminal moraine on the other hand is usually rough consisting of hills that were formed at the terminus of the glacier when it melted. An area of terminal moraine occurs a few miles south of Little Current.

Another form of till deposit is the elongated hill or drumlin. Manitoulin Island has about 175 drumlins. They were all submerged in Lake Algonquin and as a result of wave action large numbers of boulders remain on their crowns and sides.

Outwash deposits are represented by coarse material sorted from glacial till by rapidly-flowing glacial streams.

During the process of sorting the fast-flowing water removed most of the silt and clay and left a residue of sand, gravel, cobbles and boulders. These coarse textured materials were laid down in running water in patterns which are recognized as outwash plains, beaches and kames. The outwash plains occur as gravelly or sandy areas having gently sloping topography. Gravel bars are common on the Island having been produced by various receding levels of Lake Algonquin.

TABLE 4

SURFACE DEPOSITS OCCURRING IN THE MANITOULIN MAP AREA

Deposit	Description
1. GLACIAL TILL:	
Ground Moraine	Generally unsorted material. Topography is characterized by a succession of low knolls and depressions. Textures are loam to clay loam — contains stones and boulders.
Terminal Moraine	Often modified or resorted. Topography is rough to hilly. Textures range from sandy loam to clay loam — stonier than ground moraine.
Drumlin	Elongated hill lined in the direction of ice advance, usually unsorted. Textures loam to clay loam. Contains stones and boulders.
2. GLACIO-FLUVIAL:	
Outwash Plain	Sandy and gravelly area occurring on a nearly level plain but may be marked by enclosed depressions and by incised ravines. Often cobbly but is usually boulder-free.
Kame	Short hill of sand and gravel — may contain resorted till. Contains some stones and boulders.
3. LACUSTRINE	Clays, silts and sands laid down in glacial lakes. Topography is usually very gently sloping, although moderately steep slopes are encountered in some areas. Stones are few to absent except in areas where thin lacustral deposits are underlain with till.
4. RECENT ALLUVIAL	Post-Glacial deposits of sands, silts and clays along streams, meadows, sloughs and marshes. Also includes mucks and peats. Soils are immature; topography is nearly level to depressional. Stones are rare.

The kame deposits, consisting of gravel, occur in the form of short hills. In general these hills of gravel are associated with till deposits occurring also in a rough topography.

The lacustrine deposits occupy the lower flatter areas which represented the bed of glacial Lake Algonquin. Most of the glacial lake deposits have regular, gently sloping topography although some dissection by streams has caused unevenness of the terrain. The texture of the lacustrine deposits varies from silt loam to clay. Most of these deposits are free of stone, particularly where they are thick. Where more than an occasional boulder is encountered the lacustrine deposit is usually thin and the underlying till is close to the surface. Some stones and boulders may have been rafted into these lakes by ice.

Deposits of organic materials occur throughout the Island. They are the partly decayed remains of trees, shrubs and mosses and have been classified as muck.

Vegetation

The type of natural vegetation found in an area is determined by climatic and soil factors. When vegetation becomes established it in turn exerts considerable influence on the development of a soil and therefore is an important factor in soil formation. The extent to which vegetation influences soil development varies with the type of vegetation.

Since vegetation is one of several inter-related soil forming factors, it is very difficult to measure the exact effect that it has had on the profile features which are used to make soil type separations. A survey of the vegetation shows, in a general way, what tree associations most commonly occur on some of the more

A typical woodlot on Manitoulin Island.

TABLE 5

TEMPERATURE AT GORE BAY, PROVIDENCE BAY AND OTHER SELECTED POINTS

Month	Temperature in Degrees F.				
	Gore Bay (22)*	Providence Bay (26)	Kapuskasing (19)	Huntsville (30)	Brantford (51)
December	21	22	6	19	26
January	14	16	−2	14	22
February	13	15	2	12	20
Winter	16	18	2	15	23
March	24	25	14	24	31
April	35	37	31	39	43
May	50	48	36	52	55
Spring	36	37	30	38	43
June	60	57	57	61	65
July	66	64	62	66	70
August	64	63	60	64	67
Summer	63	61	60	64	67
September	57	57	51	57	61
October	46	46	39	45	48
November	33	33	22	32	37
Fall	45	45	37	45	49
Annual	40	40	32	41	45
May 1 to Oct. 1	59	58	55	60	64

*Years Observed.

important soils. This information is given in the discussion of each soil series in the next chapter of this report.

The most commonly occurring trees are sugar maple, red maple, elm, basswood, yellow birch, red and white oak, ironwood, beech, white and black ash,

aspen, and white birch. Conifers are scattered generally but in no great quantity and consist of white and red pine, white spruce, balsam, fir, and hemlock.

Climate

There are two meteorological stations on Manitoulin Island located at Gore Bay and Providence Bay. Climatic data is presented in Tables 5 and 6 from these stations and other selected points. Data from Kapuskasing are included to represent the northern coniferous region and that from Huntsville represents the transitional zone between hardwoods and conifers. Records from Brantford are included to represent the hardwood region in Southern Ontario.

According to Table 5 the winters in the surveyed area are cold with a mean temperature of 16° to 18°F and the summers are warm with a mean temperature of 61° to 64°F. Temperature differences between the regions listed are greater in winter than in summer. For instance the difference between Gore Bay and Brantford is 7 degrees in February and 4 degrees in July. In May the mean temperature at Gore Bay has risen above 42 degrees which is sometimes used as a value to mark the beginning of crop growth.

The extreme high records are 97 degrees and 100 degrees. The lowest temperature on record is minus 41 degrees, giving an extreme range of 141 degrees which is rather wide for a region surrounded by water.

The frost free period averages 125 to 129 days from about May 26 to the end of September, however, frosts have been recorded in all months. The growing season opens April 24 to 26 and closes October 21 to 25; the average length being 178 to 186 days.

Precipitation includes both rain and snow with the latter recalculated to its rainfall equivalent in inches of a ratio of ten to one. The average annual precipitation at Providence Bay is 31.57 inches, one third of which falls during the growing season.

There is a winter maximum and summer minimum in precipitation. The light rainfall in March and April is favourable as it allows the land to dry up so that it may be cultivated. However the precipitation for the summer months is also low resulting in a high drought frequency. As a result pastures become dry, grasses wither, and the carrying capacity of the natural pasture is considerably reduced.

Snowfall ranges from 83 to 118 inches. The climate of Manitoulin Island is in brief one of moderately cold, snowy winters with late springs, dry and sunny summers and open falls.

Relief

In general, Manitoulin Island varies in altitude from 600 to 800 feet above sea level with some hills above 1000 feet. Along the south shore of the Island the rocky floor dips gradually under the water but perpendicular cliffs are common near the north shore. For the most part the relief of the Island is level to undulating.

Drainage

Manitoulin Island contains more than one hundred lakes, the three largest, Kagawong, Mindemoya, and Manitou, together cover more than 65 square miles. Rivers draining the area are generally shallow and small. The largest are Blue Jay Creek, Manitou Creek and Mindemoya River. These flow in a southerly direction and empty into Lake Huron.

TABLE 6

PRECIPITATION AT GORE BAY, PROVIDENCE BAY AND OTHER SELECTED POINTS

Month	Precipitation in Inches				
	Gore Bay (22)*	Providence Bay (26)	Kapuskasing (19)	Huntsville (30)	Brantford (51)
December	2.97	3.22	1.90	3.28	2.24
January	2.45	4.27	2.00	3.09	2.61
February	1.98	3.01	1.06	2.45	2.12
Winter	7.40	10.50	4.96	8.82	6.97
March	2.32	2.59	1.56	2.78	2.16
April	2.19	1.97	1.82	2.09	2.54
May	2.12	1.86	2.12	2.85	2.90
Spring	6.63	6.42	5.50	7.74	7.60
June	2.25	2.43	2.33	3.69	2.65
July	1.90	1.95	3.43	2.96	3.05
August	2.03	1.91	2.94	2.70	2.93
Summer	5.78	6.29	8.70	9.35	8.63
September	2.81	2.59	3.54	3.84	2.63
October	2.98	3.00	2.50	3.44	2.47
November	3.09	2.72	2.39	3.24	2.40
Fall	8.88	8.31	8.43	10.52	7.50
Annual	29.09	31.52	27.59	36.41	30.70
May 1 to Oct. 1	11.11	10.74	14.36	16.04	14.16

*Years observed.

THE CLASSIFICATION AND DESCRIPTION OF THE SOILS

The surface geological deposits previously described are the parent materials from which the soils have developed. This development has taken several forms as a result of differences in the parent materials as well as the effects produced by differences in drainage and in vegetation.

Under the cool humid conditions present in this region, and with forest vegetation, the processes of soil development tend toward acid conditions. This acid condition is the result of the removal of bases, particularly calcium, from the surface layers of the soil by percolating water. This is referred to as a process of leaching and the effect produced on the soil is in the development of layers or horizons that differ from one another in thickness, colour, texture and structure.

A cut made through the horizons exposes what is known as the soil profile. In agricultural practice it is often customary to refer to the different combinations of horizons as surface soil, subsurface soil, subsoil and parent material. However because many soils have more than four horizons it is convenient to use the specific pedological terms A horizon, B horizon and C horizon which are further designated as A_0, A_1, A_2, B_1, B_2, C, etc. for more detailed and accurate descriptions where the main soil horizons are subdivided.

The A horizon is the horizon where maximum weathering takes place and from which the downward movement of water removes the bases. In many soils the A horizon can be subdivided into A_1 and A_2. The A_1 horizon contains the largest amounts of organic matter and the A_2 is the horizon of greatest leaching or eluviation. Some of the materials leached from the A_2 accumulate in the B horizon. The B horizon is often finer in texture and more compact as a result of the accumulation of clay and other fine materials carried down from the A horizon. Underlying the B horizon is the C horizon which may be unaltered or only slightly altered by the soil forming processes. The geological deposits on which the soil is developed are known as parent material.

Poorly drained soils in which ground water stands in the soil profile have a condition designated as "Gley". The gley or G horizon is a layer in which intermittent water logging causes partial oxidation and reduction of iron and is recognized by bluish grey, brownish grey as well as mottled colours and the presence of iron concretions.

Soils are classified on the basis of the development of the horizons which make up the soil profile.

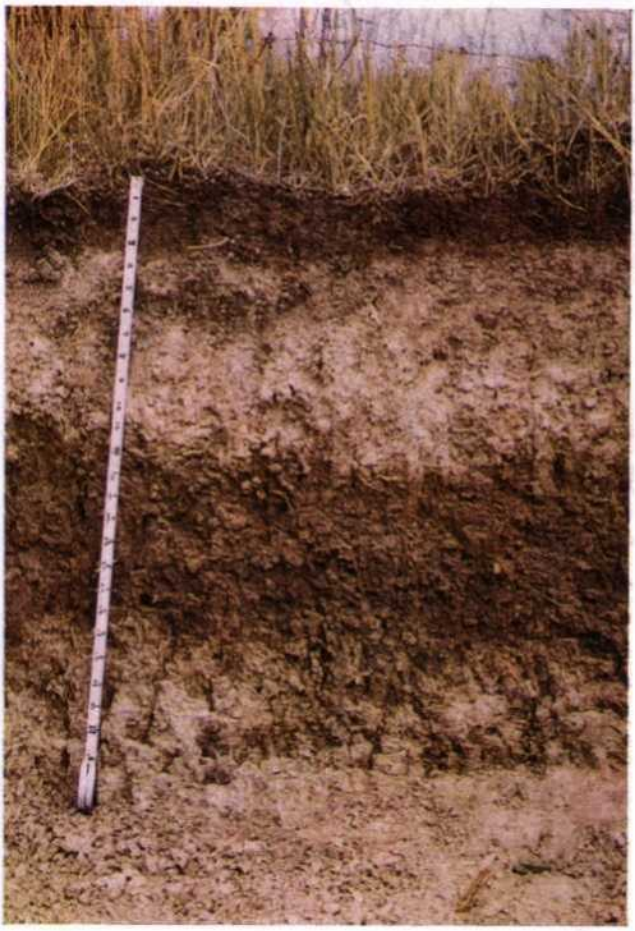
Eighty-one different soils were recognized and mapped on the Island. These soils differ from one another in one or more of the following features of the soil profile – number, colour, thickness, texture, structure and chemical composition of the horizons, or in drainage, depth to bedrock and stoniness.

Because many soil series have certain features in common they are grouped into Great Soil Groups. Those occurring on Manitoulin Island are Alluvial, Brown Forest, Grey-Brown Podzolic, Grey Wooded, Brown Podzolic, Podzol, Dark Grey Gleisolic, Shallow Organic and Organic. A generalized description of some of these groups follows.

Soils of the Brown Forest Great Soil Group exhibit shallow profiles and a brownish colour in the subsoil.

The Brown Forest soils occur chiefly on highly calcareous till materials. These soils have a dark brown surface horizon high in organic matter with a neutral or mildly alkaline reaction. The A_1 horizon is about 4 inches in thickness and is underlain by a brown coloured B horizon which may contain slight accumulation of sesquioxides and some clay. In general the B horizon shows no colour subdivisions and the brown colour carries down to the parent material at a depth of about 18 inches. The base saturation of all horizons is taken to be 100 per cent.

The Grey Wooded soils occur on lacustrine sediments or fine textured till deposits, both of which are calcareous. These soils have a bleached grey surface horizon and a darker coloured subsurface horizon containing accumulations of clay, sesquioxides, and organic materials. In a virgin state the soil profile consists of a thin A_0 horizon underlain by a light brownish grey or white A_2



This profile exhibits the characteristics of the Grey Wooded Great Soil Group. The A_1 horizon is very thin.

horizon, that is very low in organic matter and is slightly to moderately acid in reaction. The B horizon is dark brown in colour, contains more clay and sesquioxides than the horizons above and some form of blocky structure. The greying from the A_2 horizon carries down over the upper part of the B to form a pronounced AB horizon. As a consequence the profile exhibits an overall greyish colour. Depths of profiles are usually 20 to 26 inches.

The Grey-Brown Podzolic soils in this area occur only on coarse textured deposits. Under normal conditions they differ from the Grey Wooded on the basis of colour and also on the development of the surface horizons. The profile possesses a dark greyish brown A_1 horizon, 3 inches thick and relatively high in organic matter, which is underlain by a yellowish brown A_2 horizon that becomes lighter in colour with depth. The B horizon is brown in colour and is

A Grey-Brown Podzolic Soil Profile.

finer in texture than other horizons in the profile. It contains accumulations of clay. The calcareous parent material occurs at depths of 20 to 30 inches.

The Podzol soils have an A_0 horizon 1 to 2 inches thick which is underlain by a grey or white A_2 horizon varying from 1 to 2 inches in thickness. The B horizon is reddish brown and contains accumulations of sesquioxides and organic matter or both and is usually divisible into two subhorizons B_{21} and B_{22}.

A large part of the deep soils on Manitoulin Island have developed under poorly drained conditions. The poorly drained soils of the Island are representative of the Dark Grey Gleisolic and Organic Great Soil Groups.

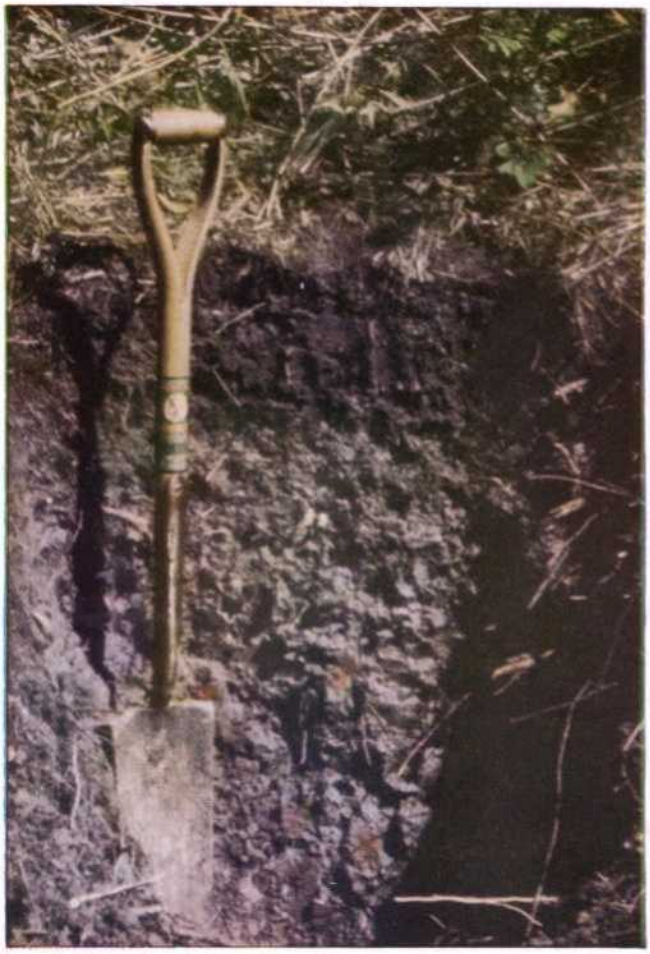
The Dark Grey Gleisolic soils have a mineral surface soil high in organic matter and a dull coloured subsoil with yellow and orange mottling. In the profile a very dark grey A_1 horizon generally 7 to 8 inches thick occurs. This is underlain by a mottled dark grey to greyish brown "gley" horizon which rests on the parent material.

Soils of the Podzol Great Soil Group exhibit an ashy grey A_2 horizon.

The Organic Soils consist of an organic accumulation on the surface more than 12 inches thick. This is underlain by a strongly gleyed mineral soil or rock. The surface layer may differ depending on the type of vegetation from which the organic accumulation has been formed and on the degree of decomposition of the organic materials. The Shallow Organic soils are similar to the Organic soils except that the organic accumulation is less than 12 inches thick.

Series, Types and Phases

Soils are classified and placed in categories such as series, types and phases. The principal mapping unit is the series which in turn may consist of two or more types or phases. The features that characterize the series are determined from the profile and all the soils included in a series are relatively uniform both in their development and in their land use. The soil type, a subdivision of the



Note profile characteristics of a Dark Grey Gleisolic soil — Surface soil is a dark grey colour; subsoil a drab grey with reddish brown mottling.

soil series, is based on the texture of the surface soil. The full name of the soil type is a combination of the series name and the surface texture, for example, Little Current clay. The soil phase is not a part of the natural classification of soils and can be a subdivision of the soil type, series or any other classification unit. Phases are usually subdivisions of soil types and are based on external characteristics of the soil. These separations are introduced to show differences in slope, degree of erosion or content of surface stone.

The soils of Manitoulin Island have been classified and grouped on the basis of differences in parent material and drainage as presented in the key below.

SOIL KEY

	Acreage	% of Total
A. Soils Developed on Glacial Till		
I. Stony, calcareous, sandy loam parent material		
(a) Good Drainage		
1. Dumfries loam (G.B.P.)	1,200	0.2

	Acreage	% of Total
(b) Imperfect Drainage		
1. Killean loam (G.B.P.)	100	—
(c) Poor Drainage		
1. Lily loam (D.G.G.)	100	—
II. Calcareous, loam parent material		
(a) Good Drainage		
1. Vasey loam (B.P.)	12,800	1.8
2. Vasey loam — shallow phase (B.P.)	1,000	0.2
(b) Imperfect Drainage		
1. Howland loam (B.P.)	5,900	0.8
2. Howland loam — shallow phase (B.P.)	2,100	0.3
3. Howland sandy loam (B.P.)	100	—
(c) Poor Drainage		
1. Lyons loam (D.G.G.)	3,500	0.5
2. Lyons loam — shallow phase (D.G.G.)	2,300	0.3
III. Calcareous, clay loam parent material		
(a) Good Drainage		
1. Buzwah clay loam (G.W.)	22,400	3.1
2. Buzwah silty clay loam (G.W.)	2,100	0.3
3. Buzwah clay loam — shallow phase (G.W.)	2,200	0.3
4. Buzwah silty clay loam — stony phase (G.W.)	8,500	1.3
(b) Imperfect Drainage		
1. Leech clay loam (G.W.)	7,800	0.7
2. Leech silty clay loam (G.W.)	1,000	0.2
3. Leech clay loam — shallow phase (G.W.)	2,600	0.4
4. Leech silty clay loam — shallow phase (G.W.)	2,400	0.3
5. Leech silty clay loam — stony phase (G.W.)	700	0.1
(c) Poor Drainage		
1. Phipps clay loam (D.G.G.)	2,700	0.4
2. Phipps silty clay loam (D.G.G.)	700	0.1
3. Phipps clay loam — shallow phase (D.G.G.)	500	0.1
4. Phipps silty clay loam — stony phase (D.G.G.)	300	—
B. Soils Developed on Outwash		
I. Stone and gravel parent material		
(a) Good Drainage		
1. Donnybrook sandy loam (G.B.P.)	3,100	0.5
II. Medium and fine sand parent material		
(a) Good Drainage		
1. Bridgman sand (R)	1,700	0.2
2. Wendigo sandy loam (P)	21,400	3.0
3. Wendigo sand (P)	800	0.1
4. Wendigo fine sandy loam (P)	1,400	0.2
(b) Imperfect Drainage		
1. Mallard sandy loam (P)	3,200	0.5
2. Mallard sandy loam — stony phase (P)	100	—
3. Mallard sandy loam — shallow phase (P)	200	—
(c) Poor Drainage		
1. Kenabeek sandy loam (D.G.G.)	7,500	1.2
(d) Very Poor Drainage		
1. Burpee muck (S.O.)	1,000	0.3
III. Loam and sandy loam deposits underlain by gravel		
(a) Good Drainage		
1. Burford loam (G.B.P.)	13,200	1.9
2. Burford loam — shallow phase (G.B.P.)	300	—
3. Burford sandy loam (G.B.P.)	500	0.1
(b) Imperfect Drainage		
1. Brisbane loam (G.B.P.)	600	0.1
(c) Poor Drainage		
1. Gilford loam (D.G.G.)	1,600	0.2
2. Gilford sandy loam (D.G.G.)	300	—

	Acreage	% of Total
C. Soils Developed on Sands Underlain by Silty Clay		
(a) Good Drainage		
1. Bucke fine sandy loam (P)	1,200	0.2
2. Bucke sandy loam (P)	900	0.1
(b) Imperfect Drainage		
1. Otterskin sandy loam (P)	2,200	0.3
2. Otterskin fine sandy loam (P)	1,000	0.2
(c) Poor Drainage		
1. Englehart fine sandy loam (D.G.G.)	2,000	0.3
2. Englehart sandy loam (D.G.G.)	800	0.1
D. Soils Developed on Lacustrine Deposits		
I. Non-Calcareous Silt Loam Underlain by Silty Clay		
(a) Good Drainage		
1. Thwaites silt loam (P)	3,100	0.4
(b) Imperfect Drainage		
1. Casey silt loam (P)	1,000	0.2
II. Calcareous silt loam parent material		
(a) Good Drainage		
1. Evanturel silt loam (G.W.)	6,500	0.9
2. Evanturel silt loam — stony phase (G.W.)	100	—
3. Evanturel silt loam — shallow phase (G.W.)	100	—
(b) Imperfect Drainage		
1. Earlton silt loam (G.W.)	10,600	1.5
2. Earlton silt loam — stony phase (G.W.)	500	0.1
3. Earlton silt loam — shallow phase (G.W.)	500	0.1
(c) Poor Drainage		
1. Cane silt loam (D.G.G.)	4,500	0.6
2. Cane silt loam — stony phase (D.G.G.)	100	—
3. Cane silt loam — shallow phase (D.G.G.)	100	—
III. Calcareous silty clay parent material		
(a) Good Drainage		
1. Campbell silty clay loam (G.W.)	4,300	0.6
2. Campbell silty clay loam — stony phase (G.W.)	500	0.1
3. Campbell silty clay loam — shallow phase (G.W.)	200	—
4. Campbell silty clay loam — shallow, stony phase (G.W.)	500	0.1
(b) Imperfect Drainage		
1. Gordon silty clay loam (G.W.)	21,400	3.0
2. Gordon silty clay loam — stony phase (G.W.)	1,500	0.2
3. Gordon silty clay loam — shallow phase (G.W.)	2,600	0.4
4. Gordon silty clay loam — shallow, stony phase (G.W.)	1,900	0.3
(c) Poor Drainage		
1. Wolsey silty clay loam (D.G.G.)	9,500	1.3
2. Wolsey silty clay loam — stony phase (D.G.G.)	600	0.1
3. Wolsey silty clay loam — shallow phase (D.G.G.)	400	—
4. Wolsey silty clay loam — shallow, stony phase (D.G.G.)	1,000	0.2
IV. Calcareous clay parent material		
(a) Good Drainage		
1. Pike clay (G.W.)	1,000	0.2
2. Pike clay — stony phase (G.W.)	800	0.1
(b) Imperfect Drainage		
1. Bass clay (G.W.)	500	0.1
2. Bass clay — stony phase (G.W.)	600	0.1
(c) Poor Drainage		
1. Perch clay (D.G.G.)	500	0.1
2. Perch clay — stony phase (D.G.G.)	1,000	0.2

	Acreage	% of Total
E. Shallow Soils		
I. Calcareous loam and silt loam material underlain by limestone		
(a) Good Drainage		
1. Farmington loam (B.F.)	429,200	60.3
2. Kagawong silt loam (B.F.)	5,600	0.8
II. Calcareous clay underlain by calcareous shale		
(a) Good Drainage		
1. Little Current clay (B.F.)	1,700	0.3
F. Organic Soils		
(a) Very Poor Drainage		
1. Muck (O)	22,700	3.0
G. Miscellaneous Soils		
1. Marsh (A)	1,300	0.2
2. Rock-Wendigo complex	9,200	1.3
3. Rock	400	—

GREAT SOIL GROUPS

A — Alluvial
B.F. — Brown Forest
O. — Organic
B.P. — Brown Podzolic
D.G.G. — Dark Grey Gleisolic
G.B.P. — Grey-Brown Podzolic
G.W. — Grey Wooded
P. — Podzol
S.O. — Shallow Organic
R — Regosol

A. Soils Developed on Glacial Till

DUMFRIES SERIES

These soils occupy a continuous block of land 1,200 acres in size on the eastern end of Manitoulin Island a few miles south of the town of Little Current. They are developed on stony soil material which has been derived mainly from limestone rocks. The material is therefore calcareous, and free carbonates can be found at depths of 18 to 24 inches.

The topography is more rugged than is characteristic of other soils on the Island. Slopes are steep, irregular and generally short. All of the Dumfries soils are well drained but associated imperfectly and poorly drained areas are to be found in the depressions. These depressions often occur as "potholes" and contain water during a large part of the year. They cannot be easily drained and therefore are not arable. The soils are stony and possess both granite and limestone boulders at the surface and throughout the soil mass.

Stones in the Dumfries profile usually interfere with cultivation.

Because of the steep slopes Dumfries soils are very susceptible to erosion and should be kept under a cover of trees or grass for as long as possible. The natural vegetation in woodlots consists of sugar maple, silver birch, beech, poplar and basswood.

A typical profile of a Dumfries soil possesses a dark grey A_1 layer, 3 to 4 inches thick. This A_1 layer is stony, neutral in reaction and has a granular structure. The A_2 is yellowish brown and becomes lighter in colour with depth. The B horizon is dark brown and contains more clay than the soil above or below it. The parent material that occurs at depths of 18 to 24 inches is a light grey calcareous, stony sandy loam. This is a Grey-Brown Podzolic soil.

The Dumfries soils have been cleared and cultivation has been attempted in some areas. In the main these soils are too stony and too steep for cultivation but can be used as pasture land. The existing pasture lands are often weedy and growth of grasses is sparse in many areas. These pastures could be improved economically by spraying to get rid of the weeds. The native grasses would then be able to increase in number and vigour. Care should be taken to prevent the overgrazing of pasture lands. As soon as the pasture shows signs of being overgrazed the livestock should be removed and no further grazing be permitted until the grass has had a chance to recover. The grass should be permitted to make a reasonable amount of growth before winter sets in.

KILLEAN SERIES

The Killean soils occur in association with the Dumfries and occupy about 100 acres. The topography is irregular, gently sloping and the drainage is imperfect. The slopes are gentle and there is little danger of erosion. The land is covered with tree vegetation which consists mainly of sugar maple and soft maple.

The profile of Killean loam, the only soil type mapped, is similar to that of the Dumfries loam except that the horizons are not as well defined and the A_2 and B horizons are usually mottled. Mottling is the result of slow drainage.

Killean loam is neutral to slightly acid and contains more stones and boulders than are usually found in the Killean soils mapped in Southern Ontario.

The small areas of this soil that occur on the island must be considered as non-agricultural.

LILY SERIES

The Lily soils are unimportant soils on Manitoulin Island both from the standpoint of acreage occupied and their uses for agricultural purposes. They occupy a total mappable area of about 100 acres and are to be found associated with the Dumfries soil. Although the Lily soils are developed on materials similar to those of the Dumfries they are poorly drained and the topography is depressional. They are very stony and possess both granite and limestone boulders at the surface and throughout the soil profile.

A typical soil profile possesses a very dark greyish brown A_1 horizon about 6 inches thick. This horizon is very stony and is alkaline in reaction. The G horizon is greyish brown, stony and very mottled and is more alkaline than the A_1 horizon. The parent material that occurs at depths of 20 to 24 inches is a calcareous, very stony sandy loam.

The large number of stones and boulders on the soil surface and poor drainage exclude the use of these soils for cultivated crops. However they could be used for growing certain tree species. Present wooded areas are made up mainly of elm and white cedar.

VASEY SERIES

The Vasey soils are stony and have developed from a till that has been derived from Precambrian granites and limestones of a more recent age. These soils occupy a total area of 13,800 acres or 2.0 per cent of the surveyed area. The largest areas of Vasey soils are to be found in the eastern and western ends of the Island. These soils occur in other parts of the Province particularly in northern Simcoe County.

The topography of the Vasey soils is somewhat more rugged than is characteristic of some of the other soils on the Island. In general slopes are moderate over most of the land but steeper slopes are found where it is drumlinized. All of these soils are well drained but associated imperfectly and poorly drained soils are to be found in the depressions.

Soil development shows some of the characteristics of both the Brown Podzolic Great Soil Group and of the Grey-Brown Podzolic soils. The upper part of the soil profile is characteristic of the former but a fairly well developed textural B horizon is always present at a depth of about 30 inches. The soil profile possesses a dark greyish brown A_1 horizon which rests on a dark brown B horizon. The B horizon becomes lighter in colour with depth and is underlain by a very pale brown horizon which is considered to be the remaining portion of the A_2 of the original Grey-Brown Podzolic soil. It rests on a yellowish brown B horizon. This B horizon contains more clay than the layers above or below it.

Most of the Vasey soils on Manitoulin Island are non-arable because of the large number of stones and boulders on the soil surface. However they are used to a considerable extent for grazing purposes and in some instances, where the stones have been removed, are used to grow spring grains and hay.

These would appear to be ideal soils for forest lands. The sugar maple is the dominant species and is associated with a great variety of other trees such as silver birch, basswood, poplar, beech and spruce. The use of the stony Vasey soils as permanent forest sites should be encouraged.

HOWLAND SERIES

The Howland soils are found in association with the Vasey soils and have developed on the same kind of materials. The topography is very gently sloping and the drainage is imperfect. Most of the land is covered by trees and maple, elm, silver birch, poplar, spruce and hemlock are the chief species.

Howland loam (5,900 acres), Howland loam – shallow phase (2,100 acres) and Howland sandy loam (100 acres) are included in the series and make up 1.1 per cent of the surveyed area. The profile is similar to that of the Vasey soils except that the horizons are not as well developed and reddish mottles occur in the parent materials, the B horizons and the A_2. Stones are numerous both on the surface and throughout the soil mass.

The soils of the Howland series that occur on the Island are non-arable. However they are used for grazing purposes although they are stony and, for the most part, covered with trees. Because of the stony nature of these soils it is doubtful that any program of pasture improvement would be economical. These would appear to be suited to the growing of trees and the use of Howland soils for forest sites should be encouraged.

LYONS SERIES

The Lyons soils occupy 5,800 acres or almost one per cent of the whole area and are usually found in association with the Vasey and Howland soils. The topography is level. Although the surface soil is strewn with stones and boulders of dominantly igneous origin, some of the stones are derived from adjacent formations of limestone and calcareous shale.

The soil drainage is poor as a result of slow run-off. Most of the land is covered with trees and black spruce, alder, poplar, cedar, hemlock and elm are the most common species.

Lyons loam (3,500 acres) has the characteristics of the Dark Grey Gleisolic Great Soil Group and consists of a very dark grey to black A_1 horizon about six inches thick followed by a mottled drab grey G horizon. The G horizon has a massive structure and is alkaline in reaction and rests on stony calcareous sandy loam till.

A profile of Buzwah clay loam.

Where the soil is between one foot and three feet deep over limestone bedrock it has been mapped as Lyons loam – shallow phase. Twenty-three hundred acres of this soil have been mapped on the Island.

Because of excessive stoniness and poor drainage the Lyons soils on Manitoulin Island should be considered as non-agricultural.

BUZWAH SERIES

The Buzwah soils are important because they are deep and can be used in some areas for the growing of crops. These soils range from very to moderately stony. The Buzwah soils are developed from a till that has been derived from dolomitic limestone and reddish calcareous shale.

Soils included in the Buzwah series are the clay loam (22,400 acres), silty clay loam (2,100 acres), clay loam – shallow phase (2,200 acres) and silty clay loam – stony phase (8,500 acres). They occupy a total area of 35,200 acres or 5 per cent of the Island. The largest area of the Buzwah soils is to be found west of Wikwemikong but other areas of considerable size occur near Lake Manitou, Lake Kagawong, Ice Lake and on Barrie Island.

The topography of the Buzwah soils is smooth, moderately sloping except where they occur near the shores of Manitowaning Bay. Here there is a relatively

Landscape showing the undulating surface of the Buzwah soils.

sharp drop to the water's edge and slopes are steep. All of these soils are well drained but small areas of imperfectly and poorly drained soils are to be found in the depressions.

The soil profile has a dark greyish brown A_1 horizon about 2 inches thick. This layer has a granular structure and is slightly acid in reaction. The A_2 horizon is yellowish brown and becomes lighter in colour with depth. This horizon is also acid to a depth of approximately 16 inches. At this depth a well developed dark brown B horizon is present that contains more clay than the soil above or below it. This horizon has a nuciform structure and is neutral in reaction.

The parent material that occurs at depths of 20 to 24 inches is a pinkish grey, calcareous, stony, clay loam till and a pale brown, stony loam till which may be layered or mixed. This kind of soil development may be considered to be a weak form of Grey Wooded.

Most of the Buzwah soils are non-arable because of stoniness. These soils are used for grazing purposes and although they are stony they serve some useful purposes as grazing land. These would appear to be ideal soils for the growth of forest tree species. Sugar maple and silver birch are the dominant species and are associated with a great variety of other trees such as beech, poplar, basswood, elm, spruce and hemlock.

Less stony areas of these soils occur on Barrie Island and near Ice Lake and are used for the growing of hay, alfalfa, clovers, oats and barley. Yields of timothy and clover hay average 1½ to 2 tons per acre and barley and oats average 30 to 40 bushels to the acre. Usually the crops grown are fed to beef cattle thus providing manure which is used to good advantage on the land.

LEECH SERIES

The soils of the Leech series are moderately fine textured Grey Wooded soils that have developed on the same calcareous till as the Buzwah soils. They occupy 11,500 acres or 1.7 per cent of the total land area and occur in association with the Buzwah soils. The topography is smooth gently sloping and there is little or no danger of erosion because water run-off is slow. The tree cover on the virgin soils consists mainly of poplar, elm, cedar, silver birch and hemlock. These soils are imperfectly drained but small areas of Phipps soils are found in the depressions.

Soil types included in the Leech series are clay loam and silty clay loam. In some areas, particularly on the eastern side of Lake Kagawong, the soil materials are only 1 to 3 feet deep over the limestone bedrock and a shallow phase of these soils has been mapped. Surface stones are sometimes numerous in the silty clay loam and in such very stony locations a stony phase was mapped.

The soil profile is like that of the Buzwah soils but is not as well developed. Red and yellowish mottles occur in the B horizon and parent material of the soils giving evidence of imperfect drainage.

The less stony fields and fields where the stones have been removed are suited to most of the crops grown in the area. Clovers, timothy, oats, and barley produce good yields. Legume, grass crops should be used in rotation with coarse grains to provide feed for livestock and a source of manure. Fertilizers should be used

to improve soil fertility. Much of this land is non-arable due to stoniness and is used for woodlots or pastures.

PHIPPS SERIES

The Phipps soils often occur in small areas scattered throughout the Island but some larger areas are located at the bases of the many limestone bluffs occurring in the area. They occupy a total area of 4,200 acres and are some of the less important soils on the Island.

The topography is depressional although where the soils occur near the limestone ridges the land is gently sloping. The drainage is poor due to the very slow run-off or the seepage from adjacent higher land. Most of the soils are forested, cedar and poplar being the dominant species present.

The Phipps series consists of the clay loam and silty clay loam types. Clay loam — shallow phase and silty clay loam — stony phase are also mapped.

A typical soil profile possesses a black A_1 horizon about six inches thick. This horizon has a nuciform structure and is neutral in reaction. The G horizon is grey and contains many yellow and reddish mottles. The parent material that occurs at about 20 inches is the same as that of the Buzwah.

The Phipps soils are non-arable due to stoniness and poor drainage and are used for trees or rough pasture.

B. Soils Developed on Outwash Materials

DONNYBROOK SERIES

The Donnybrook soils are developed on calcareous, gravelly outwash containing a large number of stones and boulders. They occupy a total area of 4,300 acres and may occur on long narrow ridges known as eskers, on beaches or on kames. These soils occur under similar situations in other parts of the Province particularly in Huron and Bruce Counties.

The topography of the Donnybrook soils is rugged and consists of irregular steep slopes. Moisture percolates easily through the coarse materials and runs rapidly off the steep slopes. All of these soils are therefore well drained. The dominant trees found on areas of these soils that are still forested are sugar maple and beech. Red pine occur on the sandier locations.

The soil profile is characteristic of the Grey-Brown Podzolic soils and possesses a dark greyish brown A_1 horizon about 4 inches thick. The A_2 horizon is yellowish brown and becomes lighter in colour with depth. This horizon is 6 to 12 inches thick, slightly acid in reaction and has a weak platy structure. A dark brown B horizon that contains more clay than the soil above or below it occurs below the subsurface layer. The parent material occurs at about 18 inches and is a very pale brown gravelly, calcareous outwash. These materials are not uniform, and small pockets of sand or calcareous loam till may be present.

The Donnybrook soils that occur on Manitoulin Island are non-arable soils. However they are used for grazing purposes and although the topography is rough and they have a low moisture holding capacity they provide roughage for livestock for a part of the growing season. Because of the stony nature of these soils and the rugged topography any program of pasture improvement would be difficult.

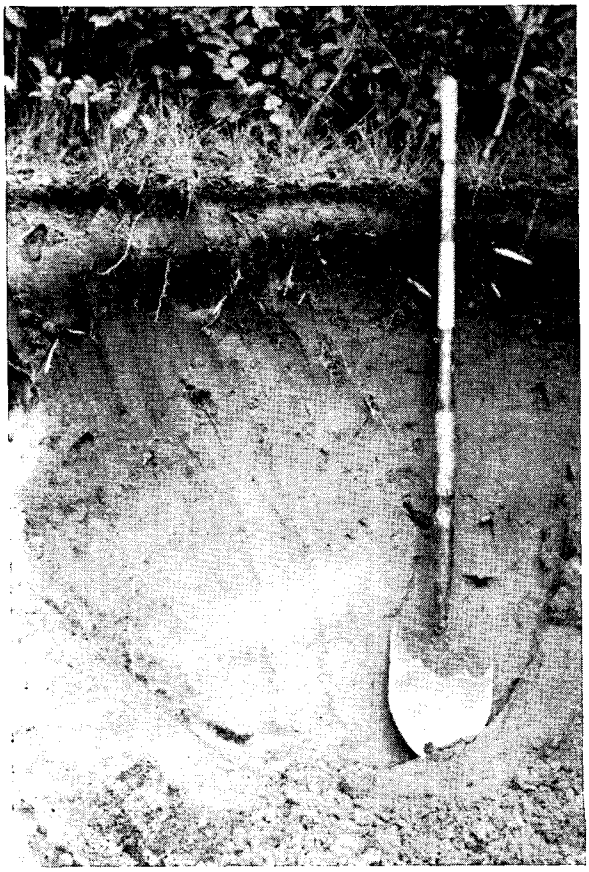
These soils would appear to be ideal sites for the growth of some forest tree species and their use for this purpose should be encouraged.

BRIDGMAN SERIES

The Bridgman soil occurs on a ridge in the vicinity of Providence Bay where it occupies a total area of 1,700 acres. This soil occurs in areas of drifting sand where the dark surface soil has been entirely removed by wind and water erosion. Areas mapped as Bridgman sand include eroded areas and areas where materials have accumulated.

The soil profile shows little or no development. The surface layer is either eroded away or buried by the moving sand. The remainder of the profile consists of loose, coarse and medium sand with some gravel and boulders, which grades in colour from yellow to very pale brown from the surface to the parent materials.

Bridgman sand should be considered as a non-agricultural soil. In its present condition the sand carried from the eroded areas by the wind accumulates on cropland, pastureland, and woodland. All "blow-outs" should be reforested and fenced from livestock.



A Wendigo sandy loam profile.

WENDIGO SERIES

The soils of the Wendigo series occupy 23,600 acres or slightly over 3 per cent of the total land area and are often found near a body of water. They are formed from very pale brown, water-worked, stratified medium to fine sands.

The soils have a smooth gently sloping topography and are well drained. A large percentage of the precipitation, seeps rapidly through the soil, due to the porous nature of the materials. The original vegetation probably consisted mostly of red pine however, much of the pine has been cut and remaining woodlots are made up of silver birch, basswood, and poplar with some maple, spruce and fir. Most of the land which at one time was cleared and cultivated has subsequently been abandoned and it is now covered with grasses, weeds and some trees.

Three soil types of the Wendigo series are mapped on Manitoulin Island, namely Wendigo sandy loam, Wendigo sand and Wendigo fine sandy loam.

In undisturbed locations the profile has a very dark grey strongly acid A_0 horizon about 1 inch thick made up of decomposed needles, leaves and twigs. The A_2 horizon is white, strongly acid and about 2 inches thick. The B horizon is yellowish brown and becomes lighter in colour with depth. The parent material that occurs at depths of 24 to 30 inches is non-calcareous sand. Soils with this kind of development are classified as Podzols.

The cultivated surface soil of the Wendigo soils is generally brownish grey in colour, very loose and contains very little organic matter and plant nutrients. Areas mapped as Wendigo fine sandy loam are sometimes underlain by calcareous very fine sand or silt loam at depths of five to six feet.

Only a small percentage of the Wendigo soils is under cultivation. Most of the land is in pasture or trees. However, an area near Gore Bay is being cultivated and fair yields of oats and hay are obtained when the soil is carefully managed. In general hay and grain yields are low due to the low fertility, low moisture holding capacity and the acid nature of the soils.

In the management of the Wendigo soils for crop production the state of the organic matter content must be given major consideration. The organic matter content should be increased and maintained by heavy applications of barnyard manure. The organic matter not only adds nitrogen, but also increases the moisture holding capacity of the soil. Lime is required for most crops, particularly clovers. The amount to add is best determined by a soil test. Complete commercial fertilizers are required for the production of most crops. The rate of application and the type of mixture used varies greatly with the crops grown and the amount of manure used.

When there is sufficient moisture and the soils are heavily fertilized certain special crops such as potatoes and raspberries may be grown. However it is unlikely that the Wendigo soils will be intensively cultivated due to the high cost of fertilizer and the danger of crop failures because of lack of moisture.

MALLARD SERIES

The Mallard soils occupy a total area of 3,500 acres on Manitoulin Island, and are not of any great importance as agricultural soils. Their materials consist

of non-calcareous outwash sand that has been derived from Precambrian granites. These soils occur in small blocks in association with the Wendigo soils.

The topography of the Mallard soils is similar to that of other imperfectly drained soils on the Island. Slopes are smooth and gentle. Percolation of water through the soil is slow because of the presence of underlying rock or clay and run-off is slow due to the gentle slopes. Therefore the soil is imperfectly drained. The trees found in existing woodlots are mainly spruce and hemlock with some silver birch and pine.

The sandy materials from which the Mallard soils have developed have been deposited over clay or bedrock to various depths. The thickness of the sand varies from 2 to 10 feet and where the sand is less than 3 feet deep over bedrock the soil has been mapped as Mallard sandy loam—shallow phase. Mallard sandy loam—stony phase is mapped where cobbles and boulders appear on the soil surface.

The profile consists of a black organic A_0 horizon underlain by a well developed, white, strongly acid A_2 horizon. This rests on a reddish brown to brown B horizon which sometimes contains an "ortstein" formation. The "ortstein" formation is likely formed by the cementation of the sand particles by iron and organic compounds. The parent material that occurs at depths of 18 to 24 inches is a non-calcareous sand.

Since the Mallard soils are strongly acid, low in fertility and imperfectly drained they should be considered non-agricultural. Most of the land was once cleared and cultivated but many of the fields have been abandoned and are now covered with small trees and scrub growth. Although a few acres are used for rough pasture the soil should be allowed to return to forest.

KENABEEK SERIES

The soils of the Kenabeek series have formed from sandy materials and occur in association with the Wendigo soils. They occupy depressions in the landscape and therefore the drainage is poor. The tree vegetation consists mainly of spruce, cedar, tamarack and some willow.

The Kenabeek soils occupy 7,500 acres on Manitoulin Island and have the characteristics of the Dark Grey Gleisolic Great Soil Group. A typical soil profile possesses a very dark brown A_1 horizon 5 to 6 inches thick. This horizon has a crumb structure and is strongly acid in reaction. The G horizon is grey, very mottled and becomes less acid with depth. The parent material occurs at a depth of approximately 18 inches and is similar to that of the Wendigo soils.

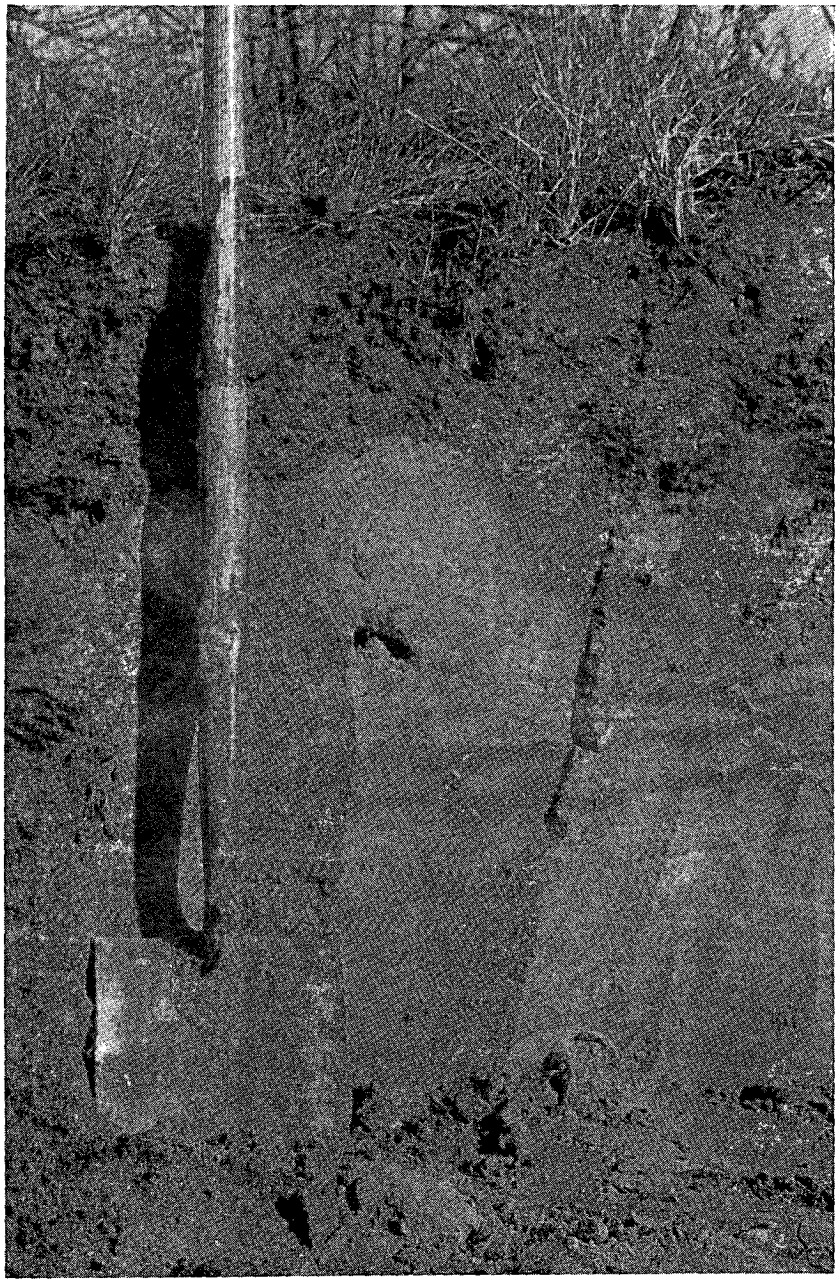
Kenabeek soils are non-arable because of poor drainage, acidity and low fertility and are best used as woodlots.

BURPEE SERIES

The Burpee soils occur near the southern shore of the Island west of Providence Bay and occupy a total area of 1,000 acres. They are formed on sandy materials similar to those from which the Wendigo soils have developed. The land surface is depressional and consequently water accumulates on the surface resulting in a very poorly drained soil. Most of the Burpee soils are

covered by trees with white spruce, white cedar, silver birch and a few white pine most commonly occurring.

The external appearance of the Burpee soil is somewhat similar to the Kenabeek but it has a much higher organic matter content and less mottling. The profile consists of a well decomposed, organic, neutral to slightly acid surface layer less than 12 inches deep but with an average depth of 8 inches. The G



Burpee muck — The organic surface is about 8 inches deep.

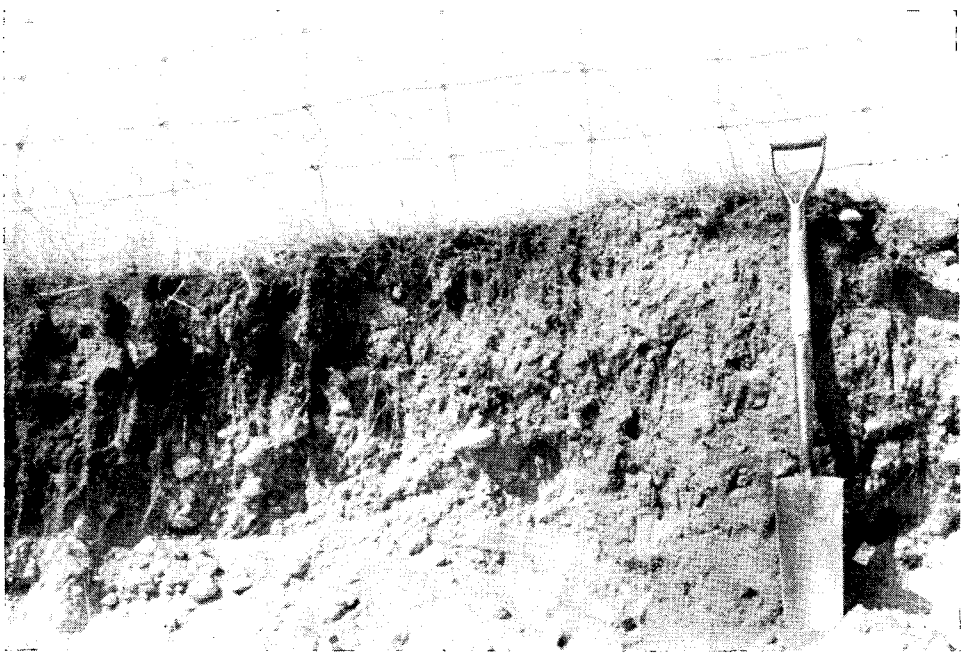
horizon is drab greyish brown slightly mottled and neutral in reaction. The parent material is non-calcareous sand.

The Burpee soil is non-agricultural because of very poor drainage and is used for growing trees.

BURFORD SERIES

The Burford soils occupy a total area of 14,000 acres or 2.0 per cent of the Island. The largest of these areas are to be found along the south shore of Smith Bay, near the east shore of West Bay and along the west shore of Manitowaning Bay. Smaller blocks occur in other parts of the Island.

The topography is smooth, gently sloping except in some places where steeper ridges have been formed by wave action. All of these soils are well drained but small areas of other imperfectly and poorly drained soils are to be found in the depressions. Most of the land is forested and sugar maple, silver birch, poplar and spruce are the chief species found as well as a variety of other trees such as pine, oak, ironwood and basswood.



A Burford loam profile. Note the wavy B horizon.

The Burford series has been classified into two types; loam and sandy loam. Two hundred acres of the Burford loam is underlain by bedrock at depths of less than three feet and these areas are mapped as Burford loam – shallow phase.

Although the soil profile is Grey-Brown Podzolic it is not as well developed as that of the Burford soils found in more southerly parts of the Province. It consists of a thin, medium acid, dark greyish brown A_1 horizon underlain by a yellowish brown A_2 horizon which becomes lighter in colour with depth. This is followed by a dark brown, slightly acid to neutral B horizon which contains

more clay than the soil above or below it. The B horizon is wavy and as a result the depth of the solum varies considerably. This profile rests on calcareous, pale brown stratified gravel and has no unaltered parent material. Stones and gravel occur in varying amounts throughout the profile.

Although the Burford soils are fairly well suited to the growing of general farm crops and certain specialized crops a large part of the land remains under tree cover. In some locations the lack of cultivation of the land is likely due to the presence of large numbers of stones and boulders strewn about the surface of the soil.

Where the land is cultivated, yields of grasses and clovers are good. Alfalfa produces well due to the abundance of lime and the good drainage of the soils. However, these soils are low in fertility and have a low moisture reserve and the best yields are obtained only in seasons of adequate rainfall and when the soils receive sufficient amounts of commercial fertilizers.

BRISBANE SERIES

The Brisbane soils occupy a total area of only 600 acres on the Island and are therefore of minor importance agriculturally. They are situated on the very gentle slopes that occur in the depressions of the Burford soils. The drainage is imperfect because of seepage of water from the surrounding higher land. The loam is the only soil type in the Brisbane series mapped on the Island.

The soil profile possesses a dark coloured A_1 horizon which is often thicker and contains more organic matter than the A_1 horizon of the Burford soils. This horizon has a granular structure and is slightly acid in reaction. The A_2 horizon is mottled, yellowish brown and is more acid than the A_1. A brown, mottled B horizon occurs at a depth of about 12 inches which contains more clay than the soil above or below it but is less well developed than the similar horizon in the Burford soils. This profile rests on stratified gravel similar to that on which the Burford profile rests. However, as with the Burford, this gravel material is not the same material from which the profile developed.

This kind of soil development may be considered to be a weak form of Grey-Brown Podzolic or, on the other hand, a transitional form from Grey-Brown Podzolic to Dark Grey Gleisolic.

Most of the land is forested and tree species such as poplar, balsam and spruce are most commonly found. Cleared areas are used for rough pasture. The Brisbane soils on Manitoulin Island have not been cultivated because of slow drainage and stoniness.

GILFORD SERIES

The soils of the Gilford series occupy a total area of 1,900 acres and usually occur in small blocks that are found in the depressional areas among the Burford soils. They are poorly drained because water accumulates in the depressions and remains for a large part of the year. The soils are stony and both granite and limestone boulders occur at the surface and throughout the soil mass. Most of the Gilford soils are wooded and tree species such as elm, soft maple, poplar, spruce and willow most commonly occur.

Gilford loam (1,600) and Gilford sandy loam (300) are the types in the Gilford series mapped on the Island.

A typical soil profile has a black A_1 horizon 6 to 8 inches thick. This horizon has a granular structure and is slightly alkaline in reaction. The G horizon is greyish brown, very mottled and has a blocky structure. This rests on calcareous, stratified gravel.

The Gilford soils that occur on the Island are non-arable and are used for trees and rough pasture. Because of the poor drainage and the stony nature of these soils it is doubtful that any program of land improvement would be practical. These soils are best used for forestry.

C. Soils Developed on Sands Underlain by Silty Clay

BUCKE SERIES

The Bucke soils occur in small blocks in the vicinity of Gore Bay and Mindemoya and have been mapped in other parts of Northern Ontario, particularly in the southeastern part of the Temiskaming District. They occupy a total area of 2,100 acres or 0.3 per cent of the area of the Island. These soils have developed from non-calcareous sand that has been deposited to a depth of less than 3 feet over calcareous silty clay.

The topography of the Bucke soils is not as rugged as many of the other well drained soils on the Island. In general, slopes are smooth and gentle except for an area south of Gore Bay where they are more rolling. Water percolates rapidly through the sandy materials until it reaches the less permeable silty clay. At this point it runs over these finer materials and into the drainage waters. Much of the land has been cleared but where trees remain silver birch, pine, sugar maple and beech are the main species found.

Except for the presence of silty clay at depths of 3 feet and less and the absence of sand parent material the Bucke profile resembles that of the Wendigo. Sandy loam and fine sandy loam soil types are mapped on the Island. A typical virgin soil profile has a thin very dark grey A_0 horizon which is composed of leaf litter and roots. The A_2 horizon is light grey and is strongly acid in reaction. This horizon is about 2 inches thick and rests on a yellowish brown B horizon that becomes lighter in colour with depth. The B horizon is underlain by varved, calcareous silty clay that is unlike the material from which the profile developed.

In some locations, where the soil surface has been disturbed, a thin, dark grey mineral layer is found below the organic surface layer, and where the soil has been cultivated the surface and subsurface have been more or less intermixed with the upper portion of the subsoil resulting in a greyish brown surface layer about six inches thick.

The Bucke soils are dry, strongly acid and of low fertility. Where they are cultivated the Bucke soils are used for general farming and sometimes for gardening. Although the natural fertility is low it can be improved considerably. The ability of the soil to retain moisture and plant nutrients can be increased by plowing down buckwheat or clover. Growers report yields obtained with the use of some manure but without commercial fertilizer, on the Bucke sandy loam, average 1 to 1½ tons per acre for hay, 20 to 30 bushels per acre for oats and 150-200 bushels per acre for potatoes. Yields on the Bucke fine sandy loam are some-

what higher because of its higher natural fertility. Increased yields can be expected when commercial fertilizer is used. The analysis and rate of fertilizer to be used depends upon the crop to be grown and the soil test. Lime is necessary for the normal growth of clover, especially alfalfa.

OTTERSKIN SERIES

The Otterskin soils are imperfectly drained, occur in association with the Bucke soils and occupy 3,200 acres of the total land area of Manitoulin Island. They are stonefree soils and consist of medium or fine sands deposited over silty clay at depths of 3 feet or less.

The topography is smooth, very gently sloping which is characteristic of many of the imperfectly drained soils on the Island. Because of the very gentle slopes water run-off is low. Water percolation is rapid through the sandy materials in the upper part of the soil but is slowed down considerably when it reaches the underlying clay. The trees found in existing woodlots consist mainly of poplar, spruce and pine. Both sandy loam and fine sandy loam soil types have been mapped.

Englehart fine sandy loam. The deep dark coloured surface soil is typical of poorly drained soils.

These are acid, leached soils having a Podzol type of soil development. A virgin profile possesses a very dark grey A_0 horizon 2 inches thick. This horizon is composed of raw humus and roots and is strongly acid in reaction. The A_2 horizon is light grey and is often more acid than the layer above or below it. The B horizon is yellowish brown and becomes lighter in colour with depth. Unweathered sand parent materials are absent and the profile rests on varved, calcareous silty clay.

Although the average depth of sand over silty clay is 20 inches there is considerable variation in the depth of the sand and therefore some variability in soil profile. Where the sandy overburden is thin a subsoil horizon is sometimes developed from the silty clay materials and where the sandy overburden is close to 3 feet deep non-calcareous sandy parent material may occur over the silty clay.

Most of the Otterskin soils are cleared and cultivated and are used for general farming. Hay, pasture and oats are the chief crops grown but yields are low because of the poor fertility of these soils. Hay yields range from ¾ to 1 ton, oat yields from 20 to 30 bushels and potatoes yield from 100 to 200 bushels per acre. However, these yields can be increased by the use of manure, fertilizer and lime.

Manure should be added to the soil each year and it can be plowed into the soil during cultivation or applied as a topdressing on hay and pasture crops. The kind and amount of fertilizer to use is best determined by a soil test although in general, crops will respond to applications of fertilizers high in nitrogen and phosphorus. Lime is required by the clovers in the hay and pasture mixtures being grown on these soils and is best applied the year before seeding down.

ENGLEHART SERIES

The soils of the Englehart series occur in small scattered areas throughout the central portion of the Island and occupy a total area of 2,000 acres. They are made up of medium or fine sand which is underlain by silty clay at depths of three feet or less. The Englehart soils occur in the depressions of the associated Bucke and Otterskin soils and since they are found in such depressional areas water accumulates and they are therefore poorly drained. The organic matter content of the surface soil is higher than that in the surface of associated soils found on the better drained sites.

The soil types occurring in the Englehart series are the fine sandy loam and the sandy loam. These soils are classified as Dark Grey Gleisolic and the soil profile possesses a black A_1 horizon about 6 inches thick. This horizon has a crumb structure and a strongly acid reaction. The G horizon is mottled, grey and strongly acid and rests on calcareous, silty clay.

The Englehart soils that occur on the Island are non-arable. However, they are used for natural hay and pasture land and although they are wet they serve some useful purpose as grazing land. Pasture land could be improved by spraying to kill the weeds that interfere with the growth of the native grasses. These soils are suited for the growth of certain tree species, especially spruce, cedar and poplar which are the dominant species found in existing woodlots.

D. Soils Developed on Lacustrine Deposits

THWAITES SERIES

The Thwaites soils consist of non-calcareous silt loam one to three feet deep that is underlain by calcareous silty clay. They occupy a total area of 3,100 acres and occur near the northeastern shore of Lake Kagawong. The topography is smooth, moderately sloping except near the banks of streams. Here the rapidly moving water has washed the soil away and steeper slopes have developed. Although percolation of water through the soil is slow, because of the fineness of the materials, the rolling land provides high run-off and a well drained soil has formed.

The upper part of a virgin Thwaites soil profile is a Podzol and possesses a thin organic A_0 horizon that is very dark grey in colour and strongly acid in reaction. The A_2 horizon is a white, strongly acid layer about 2 inches thick and is underlain by a yellowish brown B horizon. The B horizon becomes lighter in colour to a depth of about 18 inches. At this point a yellowish brown B horizon of a Grey Wooded soil is present that contains more clay than the soil above it. This profile rests on light brownish grey, calcareous silty clay which is similar to the parent materials of the Gordon soils described on one of the following pages of this report. This kind of soil development may be considered as a transition from Grey Wooded to Podzol since the profile consists of a Podzol superimposed on the B horizon of what may be a Grey Wooded soil.

Thwaites silt loam is the only type mapped in the series and is used for general farming. Hay, pasture, oats, and some wheat are grown and yields are fair. The following yields per acre may be considered as averages: hay, 1½ to 2 tons; oats, 30 to 40 bushels; fall wheat, 25 to 35 bushels. Potatoes should be suited to this soil and yields of 300 to 350 bushels can be obtained when adequate amounts of fertilizer are used. Pastures are generally fair but the excess acidity of the soil favours the rapid growth of weeds such as horsetail and sorrel.

The Thwaites soils can be improved by the application of manure and complete fertilizers to improve soil fertility and the use of lime to correct soil acidity. In general, crops respond to applications of nitrogen, phosphorus and potassium.

CASEY SERIES

The Casey soils occupy only a small part of the Island and small blocks, covering a total area of 1,000 acres, occur in the central part of the Island. These soils have developed from non-calcareous silt loam that is underlain by silty clay at an average depth of 24 inches. Slopes are smooth and gentle and therefore water runs off the soil surface slowly. The imperfect drainage of these soils is the result of this low run-off as well as slow percolation of moisture through the fine materials. Most of the Casey soils have been cleared but trees in the remaining woodlots are mainly elm, spruce and maple.

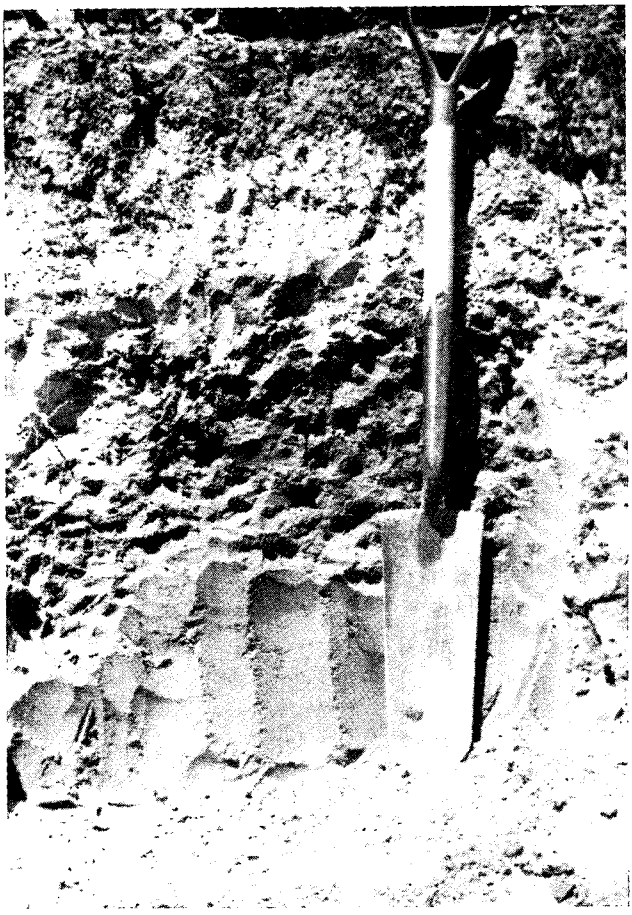
Casey silt loam is the only type mapped and except for the presence of reddish coloured mottles in the subsurface and subsoil and less well developed horizons it is similar in appearance to the Thwaites soil.

This soil is used for general farming and is fairly well suited to growing most of the crops on the Island. The main crops grown are hay, pasture and oats all of which are used to feed the livestock on the farms. Yields are medium to

low but could be improved by additions of manure, commercial fertilizer and lime.

EVANTUREL SERIES

The Evanturel soils consist of a stonefree silt loam that has been derived chiefly from limestones. They occupy a total area of 6,700 acres or approximately 1 per cent of the Island area and are found in the vicinity of Lake Mindemoya



A profile of Evanturel silt loam.

and the town of Gore Bay. In general these soils have a smooth, moderately sloping relief but steep slopes occur in some localities particularly where small streams have dissected the land. All of these soils are well drained but small areas of Earlton and Cane soils are to be found in the depressions.

The silt loam is the only type in the Evanturel series mapped on the Island. However, a shallow phase of the silt loam has been mapped where the depth of soil over bedrock was between one and three feet. Where numerous stones occurred on the soil surface a stony phase of the silt loam was mapped.

A typical soil profile has a grey A_1 horizon 3 inches thick. This horizon has a granular structure and is medium acid in reaction. The A_2 horizon is pale yellowish brown and becomes lighter in colour with depth. A yellowish brown B horizon occurs below the subsurface at depths of 18 to 24 inches. This horizon contains more clay than the soil above or below it and also becomes lighter with depth.

The parent material that occurs at depths of 30 to 36 inches is a pale brown, calcareous silt loam. The kind of development outlined by the above description may be considered to be a weak form of Grey Wooded or on the other hand a transitional form from Grey Wooded to Podzol especially when, in some virgin locations, a Podzol profile has developed in the subsurface of the Grey Wooded soil. Although the surface layer is thicker and better developed than is common for Grey Wooded soils it is assumed that the highly leached subsurface and the presence of calcareous materials is associated with the development of the Grey Wooded characteristics.

Most of the Evanturel soils on the Island have been cleared and are used to considerable extent for pasture, hay and oats. They are fertile and good yields can be obtained when the soils are well managed. Although the Evanturel soils are productive, manure and phosphatic fertilizer are required to maintain production at a reasonable level. Yields vary from year to year due to differences in weather and management. The yield of oats averages 60 bushels per acre and that of hay is about 2 tons per acre.

Evanturel soils are susceptible to erosion and they should be managed in such a way that excessive soil loss is prevented. It might be wise to keep the steep slopes under a permanent cover of grass or trees.

EARLTON SERIES

The Earlton soils are relatively important soils on the Island because of their wide agricultural uses. Like the Evanturel soils they consist of a silt loam lacustrine material that is calcareous. These soils occupy a total area of 11,600 acres or 1.7 per cent of the Island area. The largest area of these soils is to be found in the vicinity of Lake Mindemoya. However, smaller blocks are found in association with the Evanturel soils. These soils occur under similar situations in other parts of the Province and were first found in the New Liskeard-Englehart area of the Temiskaming District.

The topography is smooth, gently sloping and, as a result, water run-off is slow. The percolation of moisture through the soil is also slow and, therefore, the soil is imperfectly drained. Most of the land has been cleared of trees and is being cultivated. However, species such as sugar maple, elm, spruce, silver birch and alder are found in the woodlots that remain.

Earlton silt loam and stony or shallow phases of this type are mapped on the Island. A typical profile has a dark grey A_1 horizon 3 inches thick. This horizon has a granular structure and is medium acid in reaction. The A_2 horizon is light grey in colour, 4 to 8 inches thick, mottled and is the most acid layer in the soil. This horizon is underlain by a light olive brown B horizon that contains more clay than the soil above or below it. The parent material that occurs at depths of 24 to 30 inches is the same as that of the Evanturel soils.

A profile of Earlton silt loam. The surface is thicker than is common in virgin locations.

This kind of soil development may be considered to be Grey Wooded or, on the other hand, a transition form from Grey Wooded to Dark Grey Gleisolic.

The Earlton soils are among the most fertile in the surveyed area. They are used for dairying, livestock raising, and mixed farming and crops such as hay, pasture, spring grains, and wheat are grown. Hay yields average 2 tons per acre. Good stands of red clover have been observed and alfalfa does well when climatic conditions are good. When adequate amounts of fertilizer and manure are added to the soil the average yield for oats is 75 bushels, for barley is 55 bushels, for field peas is 50 bushels, for fall wheat is 35 bushels and for silage corn is 18 tons per acre. Yields of oats over 100 bushels per acre have been reported. Root crops such as mangels and turnips do well on this soil and are an excellent cattle feed, but due to the amount of hand labour required are not extensively grown.

Additions of manure and commercial fertilizer are necessary to maintain crop production. The use of phosphorus will increase the yields of all crops as will additions of potassium. If hay crops are emphasized the chemical fertilizer should be applied at the time of seeding down, having applied the manure to the hoed crop previously in the rotation. Experiments show that pasture yields can be increased over 50 per cent by adding fertilizer.

CANE SERIES

The Cane soils occur in association with soils of the Evanturel and Earlton series and, on Manitoulin Island, they occupy a total area of 4,700 acres. The percolation of water through the soil is low and excess water runs off very slowly due to the flatness of the land. As a result these soils are poorly drained. Tree species such as spruce, silver birch and alder are found in the woodlots.

Cane silt loam and the stony or shallow phases of this type are mapped on the Island. The soil profile has a very dark grey A_1 horizon 6 inches thick. This A_1 horizon is neutral in reaction and has granular structure. The G horizon is a very mottled pale yellow colour, slightly alkaline in reaction and is underlain by a very mottled light yellowish brown subsoil. The parent material that occurs at depths of 24 to 30 inches is the same as that of the Evanturel and Earlton soils. This is typical of a Dark Grey Gleisolic soil.

The land is not reliable for growing most agricultural crops because of poor drainage and as a result much of the land is used for pasture. In order to prevent water-logging of the soil, ditches or drains with good outlets are needed. Surface drainage can be improved by ploughing the land up in ridges and leaving a dead furrow between the ridges. It is then possible for surface water to run from the ridges into the furrow and down to the drainage outlet.

The Cane soils when drained, will produce good yields of oats, barley and hay but present yields are medium to low. As a matter of fact during wet seasons it is often impossible to sow or harvest a crop. When drainage is improved soil fertility must be maintained by additions of manure and chemical fertilizers.

CAMPBELL SERIES

The Campbell soils are stonefree and consist of a calcareous lacustrine deposit with a silty clay texture. These soils occupy a total area of 5,500 acres and occur in small blocks in the central and western portions of the Island. Slopes are smooth and moderate, much like those of the Evanturel soils. Although the percolation of moisture through the soil is low because of the impermeability of the clay materials, water runs rapidly off the rolling slopes and the soil is well drained. This rapid run-off results in the removal of valuable topsoil, particularly where the soil is cultivated and left without vegetative cover. Most of the land is cleared but some woodlots remain in which elm and sugar maple are the dominant tree species.

Campbell silty clay loam is the only type mapped. A shallow phase of this type has been mapped where the depth of soil over bedrock varies from 12 to 36 inches. A stony phase of the silty clay loam was mapped where numerous stones were present both on the soil surface and throughout the soil mass and where the soil was both shallow and stony a shallow-stony phase was delineated. The soil profile is somewhat similar to that of the Evanturel silt loam but contains a greater amount of clay. The cultivated profile has a dark grey A_1 horizon about 6 inches thick which is underlain by a light grey, medium acid A_2 horizon. The B horizon is brown in colour and contains more clay than the soil above or below it. This B horizon is neutral in reaction and has a blocky structure. The parent material that occurs at depths of 18 to 24 inches is a calcareous light brownish grey silty clay. In undisturbed locations a Podzol development consisting of a

thin organic A_0 horizon, a thin white A_2 horizon and a yellowish brown B horizon occurs in the top 6 inches of the profile described above. These soils are considered to have a form of Grey Wooded development or a transitional form from Grey Wooded to Podzol.

Hay, pasture, oats and mixed grains are the chief crops grown on the Campbell soils. Yields of mixed hay average 1½ to 2 tons per acre and oat yields average 50 bushels per acre. Phosphorus is generally the element most deficient in the Campbell soils but crops also respond to additions of potassium and nitrogen.

Campbell silty clay loam. A weak Podzol profile has developed in the upper 7 inches of this profile.

GORDON SERIES

The Gordon soils are important both from the standpoint of acreage occupied and their uses for agricultural purposes. They are derived from calcareous, lacustrine clay sediments. They occupy a total area of 27,400 acres or about 4 per cent of the Island area. Areas of these soils are found chiefly in the vicinity of Lakes Kagawong and Wolsey and occur in association with the Campbell soils.

In some parts of the Island they occupy the gently sloping plains between the long, cigar-shaped till ridges or drumlins.

The Gordon soils are imperfectly drained. Percolation through the soil is slow because of the fineness of the materials. Most of the soils are cleared but small woodlots, in which elm are the dominant species, are found in some districts. Silty clay loam is the only type mapped as well as the stony, shallow and shallow-stony phases of this type.

The cultivated soil profile has a dark grey A_1 horizon about 6 inches thick. This horizon has a nuciform structure and is slightly acid in reaction. The A_2 horizon is mottled, very pale brown and is the most acid layer in the profile. It is underlain by a brown, mottled B horizon that contains more clay than the soil

A profile of Gordon silty clay loam.

above or below it. The parent material that occurs at depths of 15 to 20 inches is the same as that of the Campbell soils. This kind of soil development is considered to be Grey Wooded.

The Gordon soils are among the most fertile in the area and are used for livestock raising and mixed farming. The land is well suited to hay and produces

2 to 2½ tons per acre. Crops such as oats, mixed grains, barley, wheat and fodder corn are grown as well as hay and pasture but the acreages of these crops are relatively small. When adequate amounts of manure are added to the soil the average yield for oats is 55 bushels, for barley is 45 bushels and for winter wheat is 30 bushels.

Although these soils are quite productive they are low in phosphorus and organic matter. Additions of barnyard manure will help to maintain the organic matter content and phosphorus levels can be increased by using chemical fertilizers high in that element.

The stony phase of Gordon silty clay loam is generally too stony to cultivate and is used for rough pasture. The stones could be removed by heavy machinery but this may prove to be uneconomical. The shallow phase tends to be droughty and the growth of roots is restricted for some plants.

WOLSEY SERIES

The Wolsey soils are the poorly drained soils associated with the Campbell and Gordon soils and are derived from the same kind of soil material. They occupy a total area of 11,500 acres or 1.6 per cent of the Island area. The drainage is poor because the percolation of the water through the fine soil materials is slow and excess water runs off very slowly because of the flatness of the land. Water collects and tends to remain at or near the surface for a large part of the year. The tree cover in the woodlots consists mainly of elm, alder and spruce.

Silty clay loam is the only soil type mapped but this type has been subdivided into stony, shallow and shallow-stony phases. The cultivated surface of the soil profile is a very dark grey, moderately friable to hard, slightly acid silty clay loam. This is underlain by a very mottled dark greyish brown G horizon which becomes lighter in colour and more alkaline with depth. The pale greyish brown, calcareous, silty clay parent materials that occur at depths of 15 to 20 inches are the same as those of the Campbell and Gordon soils.

The Wolsey soils are fertile and produce good yields of hay and spring grains, if climatic conditions are favourable. Hay yields of 2½ to 3 tons have been reported. Excess moisture in the spring retards planting and a wet fall prevents harvesting on these flat poorly drained soils. These soils should be worked under optimum moisture conditions for if they are worked when too wet they puddle and bake on drying, which has a poor effect on the growing crop. If the soils are cultivated when too dry they will remain too lumpy for a satisfactory seed bed.

Excess water can be removed by a system of open ditches or by under drainage. The most efficient system is by under drainage. However the cost of installation of a good tile drainage system is high, and monetary returns from the crops grown may not be great enough to make it profitable.

Yields on the Wolsey soils can be increased by additions of phosphatic fertilizers and barnyard manure. The stony phase of Wolsey silty clay loam is too stony for cultivation and is best used for trees or rough pasture.

PIKE SERIES

The Pike soils have developed partly on lacustrine deposits and partly on residual material derived from weathered grey calcareous shale. They occupy a total area of 1,800 acres and are found south of Little Current in the vicinity of Bass and Pike lakes.

The topography is very rugged and slopes are steep. Surface run-off is therefore rapid and much of the surface soil has been eroded.

Pike clay and Pike clay – stony phase are two separations made in this series. The profile horizons are not as well defined in these soils as they are on other well drained soils on the Island. This may be due to the slight percolation of water through the profile and hence a lessening of the movement of minerals, clay, and humus within the profile. However, the soil profile has a light brownish grey A_1 horizon 2 inches thick which is underlain by a light grey A_2 horizon. This subsurface layer has nuciform structure, very plastic consistency and is slightly acid. The B horizon is mottled, yellowish brown and contains more clay than the soil above it. The parent material that occurs at depths of 14 to 18 inches is a calcareous grey clay. This kind of soil development may be considered to be weakly developed Grey Wooded or a transitional form from Regosolic to Grey Wooded.

The gentle slopes of these soil areas are used for pasture and the steep slopes are kept under a cover of trees and grass. Pasture should not be overgrazed or grazed during periods of excess moisture. The use of Pike soils as permanent forest sites should be encouraged.

BASS SERIES

The soils of the Bass series consist of Bass clay and Bass clay – stony phase and they are derived from materials similar to those of the Pike soils. They occupy a total area of 1,100 acres. Since these soils occupy the depressions associated with the Pike soils the drainage is slow and water accumulates readily.

The soil profile is similar to that of the Pike except that it is not as well developed and is mottled. A typical soil profile has a dark grey A_1 horizon 3 inches thick underlain by a pale brown, mottled A_2 horizon. The B horizon is a mottled light yellowish brown colour and contains more clay than the soil above it. The parent materials that occur at depths of 12-15 inches are the same as those of the Pike soils.

Approximately half of the area occupied by Bass clay is under cultivation and is used for general farming. The remainder of the Bass soil is forested and species such as elm and spruce commonly occur. Bass soils are moderately to slightly acid, fertile, but very difficult to handle since they contain more clay than most of the soils in the district. Ploughing and other cultivation practices require much power and can be carried out only when the land has an optimum amount of moisture.

The maintenance of good structure is of prime importance on this soil. Apart from cultivating at proper moisture conditions, the granular structure can be maintained or improved by draining, by liming and by generous addition of organic matter.

Mixed hay, pasture, oats and mixed grains are grown and although no definite data have been obtained on the yields of the different crops the following estimates may be given: mixed hay 1 to 1½ tons per acre; oats 30 to 40 bushels per acre.

PERCH SERIES

The Perch soils are the poorly drained soils associated with the Pike and Bass soils and are derived from the same kind of parent material. This smooth, very gently sloping land occupies a total area of 1,500 acres. Water movement over the surface and through the soil is very slow and, as a result, water accumulates on the surface during periods of high moisture. Elm is dominant in the woodlots and small numbers of spruce and alder also occur.

Perch clay and Perch clay – stony phase are both mapped. The soil profile consists of a very dark grey A_1 horizon 6 inches thick that is sticky when wet and very hard when dry. The G horizon is brownish grey, very mottled, massive layer that becomes greyer with depth. The parent material that occurs at depths of 12-16 inches is calcareous mottled grey clay.

The soil where cultivated, is commonly used for general farming and the principal crops grown are pasture and mixed hay. Yields are dependent on the proper amount of rainfall.

A Perch clay profile.

Drainage problems are serious on the Perch soils since the clay is comparatively impervious and the land is flat. Rounded ploughing or under drainage can be used to get rid of excess water as quickly as possible.

Great care should be taken to keep the cultivated soil in good physical condition. Additions of organic matter will help in maintaining soil structure.

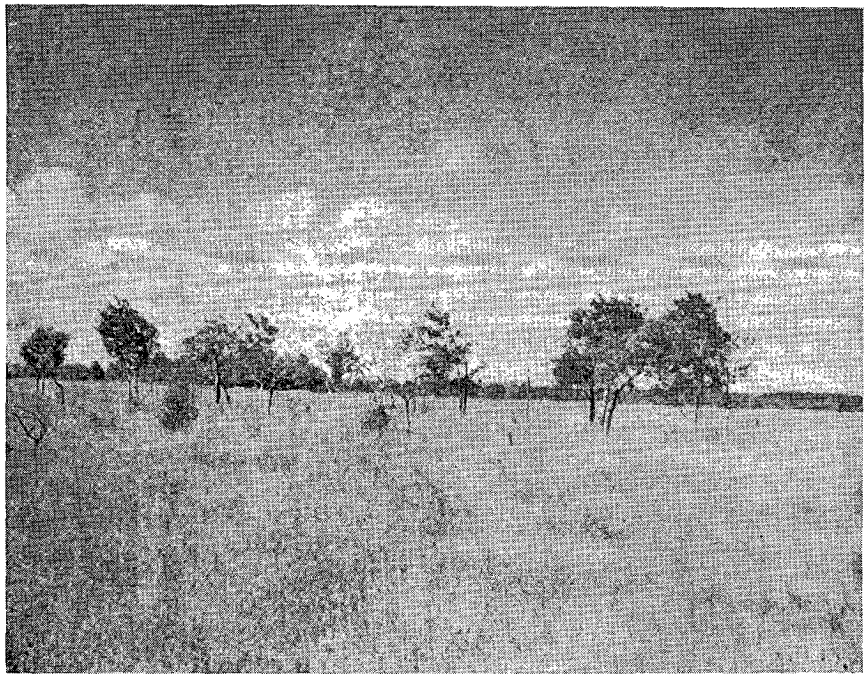
E. Shallow Soils

FARMINGTON SERIES

The Farmington soils are shallow and consist of a till that is derived from limestone and is less than one foot deep. In some areas the underlying limestone bedrock appears at the surface and the till can only be seen in the crevasses of the rock. These soils occupy a total area of 429,200 acres or approximately 60 per cent of the Island.

The topography is level except where it is broken by rocky ledges. These ledges are very steep and form the perpendicular cliffs common in many parts of the Island. The soils are well drained and are droughty during the summer months.

Within the areas mapped as Farmington are small areas of somewhat deeper soils and soils of poorer drainage. The deeper soils rarely exceed a depth of 20 inches and have developed from the same calcareous till as the Farmington soils. They commonly have a weakly developed A_2 horizon between the A_1 and B horizons described for the Farmington soils. These deeper soils and soils of poorer drainage occur to such a small extent that they cannot be separated except on a much more detailed survey. The profile varies. In very shallow soils there is seldom more than a thin organic layer over the bedrock but in the somewhat deeper



Much of the Island consists of flat rock plains covered by a thin layer of soil.

soils the dominant horizon is a brown to dark brown subsoil layer just below the surface soil. The parent material is a calcareous, stony loam. This kind of soil development may be considered to be Brown Forest.

Forestry and grazing are the two chief uses of this soil. Poplar is common where there are a few inches of soil. In the deeper crevasses hard maple grows very well. In the original forest, maple was doubtless the dominant tree species on the shallow limestone plains. Since clearing, and the subsequent loss of organic matter and soil, the areas able to produce maple have been considerably reduced. Reforestation with maple would appear to be highly desirable in many sections.

Large areas are devoted to grazing. This appears to provide the farmer with a living, providing that he has sufficient acreage or can supplement his income from other sources. For crop production this soil must be considered a marginal type. Lack of moisture reduces the efficiency of methods of improving soil fertility which have proven economical on other types. Large investments in fertilizers would not be economical. However, clovers can be grown with fair success in favourable seasons. By growing clovers frequently and using all available farmyard manure and crop residues, a fair state of fertility can be maintained. Liming is not necessary.

The best planned economy for these lands would appear to be the establishment of comparatively large holdings for a single operator which would be largely used for grazing and forestry. The houses of the operators should be fairly well centred in a community so as to provide transportation and social facilities at a minimum of cost. Deeper pockets of soil could be used advantageously to provide for household needs. To a degree this is the present situation in many sections, as many of the farm buildings have been abandoned and the land taken over by neighbours. This has resulted in a very scattered settlement.

KAGAWONG SERIES

The Kagawong silt loam occupies a total of 5,600 acres. This soil is developed on gently undulating to level silt loam materials of less than one foot in depth over limestone bedrock. Most of these materials, although lacustrine in origin, are somewhat stony. The drainage is good to excessive.

Commonly the profile consists of a dark grey surface layer 4 inches thick. This surface layer has a granular structure and is neutral in reaction. The subsoil is yellowish brown, slightly alkaline and has a weak nuciform structure. The pale brown, calcareous parent material only appears where the soil is 8 to 11 inches deep over the bedrock. In a few locations, where the soil approaches 12 inches in depth, a very thin leached subsurface layer occurs. This kind of soil development is Brown Forest or a transitional form from Brown Forest to Grey Wooded. The Kagawong silt loam is used for grazing in much the same way as the Farmington. However, greater content of fine materials gives the Kagawong a higher moisture reserve and level of natural fertility than the Farmington.

LITTLE CURRENT SERIES

Little Current clay occupies a total area of 1,700 acres near the town of Little Current. It consists of less than 12 inches of clay over calcareous, shale bedrock.

The topography is level and the drainage is good. The profile is similar to those of the other shallow soils ranging from a thin organic layer over the rock to a profile having a very dark grey surface soil followed by a very dark greyish brown subsoil layer. This subsoil layer is slightly alkaline and has a massive structure. The soil appears to have weathered directly from the shale bedrock, and is considered to be residual. It has a Brown Forest type of profile development.

The soil is used for grazing. Grazing should not be permitted during periods of excess moisture since plants are punched out and killed by the hoofs of the animals and soil structure is destroyed.

F. Organic Soils

MUCK

Muck soils occupy about 3 per cent or 22,700 acres of the surveyed area. These organic deposits are formed mainly by the decomposition of grasses, sedges and wood debris. The black organic deposit is well decomposed and rests on varved clay, silt loam, sand or bedrock. The muck varies from 18 inches to 10 feet deep but it is generally about 3 feet deep.

Few of the muck soils are cultivated and most of them are covered by tree vegetation composed of spruce, willow and alder. In Manitoulin Island muck soils have not been used to any extent for vegetables because of the long, cold winters. The muck may be used as a source of organic matter for mineral soils.

G. Miscellaneous Soils

MARSH

Areas that are covered by water for a long time and lack a well developed profile are mapped and designated as Marsh. These areas occuping 1,300 acres are covered by water-loving plants such as cattails and sedges and by scrub vegetation, the chief of which is willow. The soil surface may consist of sand, clay or thin muck deposits. These areas are unsuitable for agricultural purposes.

ROCK-WENDIGO COMPLEX (9,200 acres)

Adjacent to the Lake Huron shore of the Island there are areas of limestone bedrock pocketed with small areas of sand. It was found impossible to separate the components of this mixed area on a map of scale 1 inch equals one mile and was mapped as a complex. The dominant components of the complex, are exposures of bedrock and Wendigo sand. Small pockets of Mallard series, Kenabeek series and Muck also occur in the complex. These soils have been described previously in this report.

The Rock-Wendigo complex is unsuitable for agricultural purposes and is best used for recreation or forestry.

ROCK (400 acres)

In the Sheguiandah area there appears a ridge of white quartzite of Precambrian age protruding through the Palaeozoic strata. This ridge has little or no covering of soil and has been mapped as Rock.

Grasses and trees, dominantly maple, get their nutrients from the soil and organic material that has accumulated in the cracks and crevasses in the rock. The area mapped as Rock is not suitable for agricultural purposes and should be reforested where possible.

AGRICULTURAL METHODS AND MANAGEMENT

The kinds of crops grown on Manitoulin Island are limited because of the cool climate and the small acreage of deep soils suitable for cultivation. Timothy, clover, alfalfa, oats and mixed grains are the chief crops grown. Small acreages of spring wheat, fall wheat, barley, fall rye, buckwheat, peas, silage corn and potatoes are also grown. The Statistics Branch of the Ontario Department of Agriculture reports the acreage of field crops on Manitoulin Island in 1955 shown in Table 7.

TABLE 7
ACREAGE OF FIELD CROPS IN MANITOULIN ISLAND
(Agricultural Statistics for Ontario 1956)

Hay	38,297
Oats	7,513
Mixed grains	5,990
Winter wheat	791
Corn for fodder	714
Barley	352
Potatoes	324
Spring wheat	98
Buckwheat	89
Corn for husking	84
Peas	45
Field Roots	31
Fall rye	11

The agriculture on the island tends to follow two main patterns. The deeper soils are used for the growing of mixed grains, oats, hay and silage corn, while the stony and shallow soils are used only for grazing. Many farmers own 100 acres in the areas of better soil and keep small herds of breeding stock. In addition they

Hay is one of the chief crops grown on the Island.

have several hundred acres of rangeland on which they pasture their growing animals during the summer. Hereford cattle predominate because of their adaptability to range conditions. The island cattle are in great demand among the farmers of Southern Ontario who purchase them for feeders. Dairying is of minor importance but there are a few good dairy herds which furnish the local milk supply.

The emphasis on grazing is confirmed by the figures for livestock – which are 23,000 cattle – most of them beef breeds – and 14,000 sheep. A noteworthy enterprise on the Island is the raising of turkeys. In 1955 about 25,000 were marketed. Another specialty is fur farming.

Much of Manitoulin remains in forest but most of the good saw-timber has been removed. Spruce and poplar are cut for pulpwood. At one time the fishing industry was very important and in 1931 the catch was more than 3,000,000 pounds. However, in recent years fishing has greatly decreased.

The crops are generally grown in a four-year rotation. The first year of the rotation includes: oats, barley, barley-oats mixture, or potatoes. The second year oats or barley – oats mixture are seeded down with a mixture of red clover, alsike clover, timothy and sometimes alfalfa. Hay is harvested during the two following years and hay aftermaths may be used to supplement the pasture. On farms where there is little or no permanent pasture the rotation may be lengthened to six years and the hay fields used as pastures for the last two years.

All the farm manure is spread on the land. The quantity of manure used varies greatly depending on the number of cattle kept. On farms where large quantities of manure are used annually the soils are rich in humus, have a high fertility level and good physical condition.

Very little commercial fertilizer is used by the farmers because of the cost of transportation. High cost of transportation has also prevented the use of lime on the farms.

Soil Management

The term soil management refers to the various practices that are used or recommended in the use of soils for the growing of agricultural crops. These practices vary with different soils and with different crops and the farmer learns through experience the kind of practices that give the best results. The reason why many different methods are necessary is that soils may be too hilly, too sandy, too dry, too wet or too infertile for good farming. Whatever the limitations of the soil of a particular farm may be the central problem of soil management is to develop and maintain a proper relationship between the plant and the soil in which it grows.

Success in the growing of crops depends therefore on the farmer knowing two sets of factors: the requirements of the different plants he can grow and the characteristics of the soil on his farm. Almost any kind of soil can be modified by management to grow any climatically adapted plant if one is willing to go to the trouble. Most successful farmers try to find satisfying combinations of plants that require a minimum of soil change for good growth.

As mentioned in previous pages most soils consist of a series of definite layers or horizons one above the other, with different colours and other properties.

Much of the shallow land is used for grazing.

These horizons collectively are called the soil profile. Very young soils or those occurring in poorly drained positions may not have horizons.

In examining soils the main things to look for are depth, texture, structure, drainage and nutrients.

Depth

Since almost 62 per cent of the total land area of Manitoulin Island is made up of shallow soils it is important to know the depth of the whole soil, both surface and subsoil, over the limestone bedrock. The depth of the loose soil material on the shallow soils of the Island may vary from less than one inch to a depth of one or two feet. Such soils can provide only a small space for roots and the storage of water. During much of the growing season, therefore, these soils cannot supply the plant with the moisture it needs for normal growth. The months of July and August are the most critical and during this time the grasses lose their active growth which, combined with overgrazing, permits weeds and bushy plants to become established.

These shallow soils are good grazing lands during the spring and fall seasons when rainfall is high, but good management dictates that in order for grass to compete successfully with weeds it should not be overgrazed during the dry summer periods.

It is possible that the use of some management practices could improve the quality and quantity of the forage plants growing on these soils. Such practices would include the eradication of weeds, irrigation and fertilization where possible. However, land use on the shallow soils will have to be based on a minimum of capital expenditure because of the low market value of the land and it is unlikely that such practices would be advantageous at the present time.

Texture

This term refers to the relative proportion of sand, silt and clay that make up the soil material. The texture in most soils changes from horizon to horizon and extremes are often present when one kind of deposit overlies another. In many of the soil series described the subsoil or B horizon contains more clay than the soil above or below it.

The classes of soil texture start with sand which has only a little silt and clay. Then with increasing amounts of clay the principal classes are loamy sand, sandy loam, loam, silt loam, clay loam and clay. The classes can be distinguished by squeezing a moist sample between the fingers. The sands are harsh and gritty and the particles scarcely hold together. At the other extreme clay can be rolled into a smooth sticky ball.

In general, soils of intermediate texture such as sandy loams, loams and silt loams are easiest to handle. Sands and loamy sands are open and water drains readily through them so they hold rather small quantities of water and are said to be droughty soils. However, their water holding capacity can be increased to some extent by adding liberal amounts of barnyard manure or other forms of organic material. Clays, on the other hand, tend to become hard and stick together in clods unless they are handled carefully.

Structure

The individual soil particles – sand, silt or clay – group themselves to form various kinds of aggregates which are called structure. The ideal structures are those which are small and soft such as granular or crumb. The next best are the small blocky nut-like aggregates, between which water and roots can move.

The formation of desirable soil aggregates is generally enhanced by organic matter, that is the dead portions of plant materials which are added to soils either by the death of plants at the surface or the decay of plant roots. In cultivated soils where crops are continually being removed there is little return made to the soil of this very important material.

In sandy soils each grain of sand is often by itself. Clayey soils on the other hand, if deficient in organic matter, becomes cloddy if ploughed when too wet or too dry. Wherever they occur within the depth of normal rooting of plants such hard, cloddy soils must be reworked to make them granular or blocky. It is not enough to break up massive clods. Organic matter must be added as is done by the addition of barnyard manure or the ploughing down of green manure in order that fragments will not flow back together into masses when they are wet again.

Drainage

Poorly drained soils are rarely, if ever, productive. It is possible for grass crops to survive and frequently flourish under extremely wet conditions but most cultivated plants cannot remain too long in soils that are saturated with water.

In most cases the drainage condition of the soil can be determined by its position in the landscape. Often, however, there is little evidence in the surface soil alone of poor drainage beneath. Therefore it is important that such condi-

tions be identified by an examination of the soil profile. The conditions of soil drainage are indicated fairly reliably by soil colours. Bright solid colours of brown or yellow suggest fairly good drainage, but in low ground, grey and mottled horizons indicate poor drainage.

A summary of the drainage conditions of the soils occurring on Manitoulin Island is given in the following table.

TABLE 8
DRAINAGE OF MANITOULIN ISLAND SOILS

Drainage Class	Acreage	% of Total Area	Arable (Acres)	Non-Arable (Acres)
Good	558,500	79.8	98,600	459,900
Imperfect	67,300	10.7	65,000	2,300
Poor	40,000	6.0	20,700	19,300
Very Poor	25,800	3.5	—	25,800

The remedy that must be applied to conditions of poor drainage must be determined for each individual field. Where open ditches and high crowns may be satisfactory for one field, tile drainage may only be suitable for another. In all cases the cost of installation and maintenance of a drainage system in relation to the price of the crop produced, will need to be considered.

Nutrients

Nutrients are the food that plants derive from the soil. They cannot be seen in the soil but they can be estimated from the vigor of growing plants. A measure of nutrients contained in the soil can be obtained accurately in the laboratory from samples collected by the individual farmer. Soil sample boxes and the procedure for collecting samples can be obtained from the office of the local Agricultural Representative at Gore Bay. The samples are tested free of charge in the laboratory at the Agricultural College, Guelph.

Some general statements can be made with respect to the nutrient elements that will apply to all soils occurring in this area.

One of the most important conditions required for good plant growth is that there be a balance of plant nutrients in the soil. All plants take at least 12 essential elements from the soil. The most common elements found to be deficient are nitrogen, phosphorus and potassium. These are the elements contained in mixed fertilizers. Calcium and magnesium are included in liming materials and small amounts are usually present in mixed fertilizers. The other elements used in lesser amounts are sulphur, iron, boron, manganese, copper, zinc and molybdenum.

Each of the above elements is contained in manure, but since it would take a long time to build up the phosphorus content of a phosphorus deficient soil with manure alone, it is more practical to use chemical fertilizer in addition to organic matter. Deficiencies of nitrogen can be remedied by manure, nitrogenous fertilizers or by the growing of leguminous crops such as red clover and alfalfa particularly if it is ploughed down while a good stand is still remaining. But only a part of the phosphorus and sulphur supplied to crops is derived from this organic matter. The remaining portion is derived from the inorganic fraction of the soil.

The inorganic or mineral fraction makes up the bulk of most soils. It is derived from rocks of various kinds and their degradation products. The nutrient supplying power of the larger particles – that is, the sand and silt – are quite different from those of the fine particles or clay fraction. Since the nutrient elements are held in the soil mainly by the finer particles, clay textured soils are commonly considered to have a higher nutrient supply than coarser textured soils.

In order to estimate the amounts of fertilizer that it is necessary to apply to achieve a balance of plant nutrients in the soil several things need to be determined: the nutrients already in the soil, plus those normally added in manure; the general requirements of the plants to be grown; and the amounts of the nutrients contained in the various fertilizer materials available for use.

This information is being obtained for a great many specific soil types by the research being done on experimental stations and experimental farms and by soil testing laboratories. Differences in climate, soil, and plants mean that the research must be conducted in many locations. For localities in which no research results are available, recommendations are based on results obtained in related conditions.

Experiments conducted at the District Experimental Substation at Mindemoya indicate that the use of phosphorus alone or in combination with potash and nitrogen gave the largest increases in yields of the crops tested. Nitrogen and potassium alone produced less consistent results but complete fertilizers at moderate rates produced increased yields. The complete fertilizers in the case of most soils should contain substantial amounts of phosphorus, medium levels of potassium and variable amounts of nitrogen depending on other manurial treatments. Manure gives increased yields on all soils. It not only supplies nitrogen and to a lesser degree phosphorus and potassium but also improves the physical condition and increases the moisture holding capacity of the soil. In general the nitrogen needed for the grain crops can be supplied by growing legumes. In this way the nitrogen is supplied and the soil is kept in good physical condition. For specific recommendations with regard to fertilizer analyses and rates to be used on crops grown on the Island the reader is referred to the recommendations given by the Advisory Fertilizer Board for Ontario.

Lime is deficient in some of the soils on Manitoulin Island. Lime is required on the Wendigo, Mallard, Thwaites, Casey, Bucke, and Otterskin soils. Soil tests should be used to determine the need for lime on the other soils of the surveyed area. The limestone rock in the area could be used as a source of lime if crushed and finely pulverized. For quick effects, it is desirable to use a product the most of which will pass through a 100-mesh screen.

Sources of Information

Agricultural colleges and the Experimental Farm system can give much information that is useful in solving soil management problems for any particular

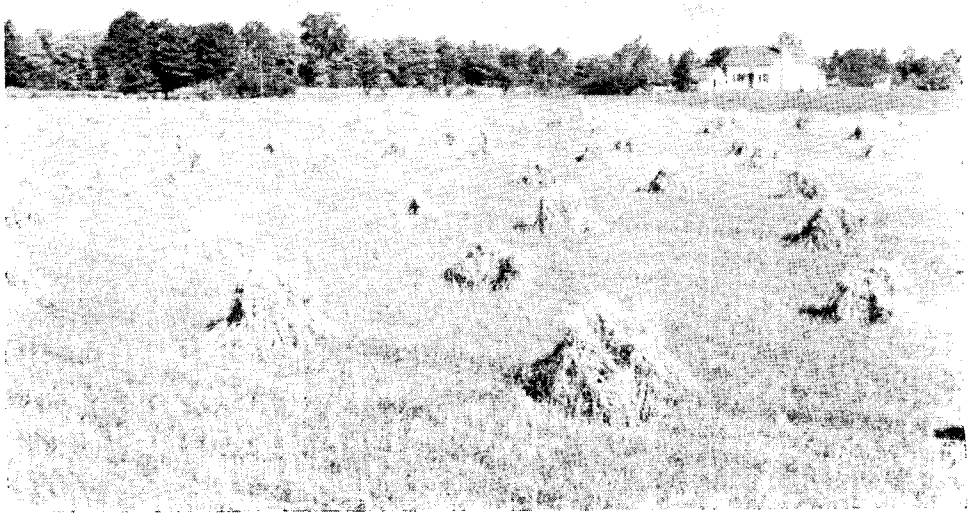
region. Experimental work is being done at the District Experimental Substation at Mindemoya and the Illustration Stations at Manitowaning and Gore Bay and information can be obtained on the uses of fertilizer, the testing of new crops and the various farm practices that apply to Manitoulin Island from these places. If information is needed about the soil itself this can best be obtained by collecting soil samples, as directed by the Agricultural Representative, and mailed to the Soils Department, Ontario Agricultural College, Guelph.

Further information on crops can be obtained from the Research Branch, Central Experimental Farm, Ottawa and the Field Husbandry Department, Ontario Agricultural College.

Ratings of the Soils According to Their Suitability for Different Crops

Although the soils listed in this report have characteristics by which they differ from one another, many of these characteristics have only a slight effect on the ability of the soil to produce crops. There are therefore, many soils which should have approximately equal potentials in crop production and may be grouped together for that purpose.

It is recognized that a poor soil that is well managed may outyield a good soil poorly managed. In the ratings given no assessment has been made of the effect that a particular kind of management may have on the crop potentials of the soils but it is assumed that the normal farm practices are carried out on all the soils listed. The different soil types and phases have been placed in one of six



Oat crop on Evanturel silt loam.

groups namely, good cropland, good to fair cropland, fair cropland, fair to poor cropland, poor cropland and unsuitable for crops.

This rating represents an estimate of the crop producing ability of the soil based on the characteristics of the soil itself and the crops observed on the soil, together with information supplied by farmers and experimental workers. Although the reliability of these groupings have not been verified by crop yield figures they have in other counties proven to be reasonably accurate for purposes of farm management and land use planning.

The meanings of the letters used in the tables are as follows: G-Good, G-F Good to Fair, F-Fair, F-P Fair to Poor, P-Poor.

TABLE 9
CROP ADAPTABILITY RATINGS FOR GOOD CROPLAND

Soil Type	Oats	Mixed Grains	Alfalfa	Red Clover	Alsike	Timothy	Potatoes	Pasture
Earlton silt loam	G	G	F	G	G	G	F	G
Gordon silty clay loam	G-F	G-F	F	G	G	G	F	G
Evanturel silt loam	G-F	G-F	G-F	G	G	G	F-P	G
Campbell silty clay loam	G-F	F	F	G-F	G-F	G	F-P	G

The soil types included in this group give higher yields and are adaptable to a greater variety of crops than any other soils occurring in the district. They possess the ideal texture for this region; they are stone free and have sufficient depth for root development and storage of moisture. The Earlton and Gordon soils can be improved by draining and in this respect are inferior to the Campbell and Evanturel soils. The latter are subject to surface erosion by water, a problem that is serious only where the soil is left bare during heavy rainy seasons.

TABLE 10
CROP ADAPTABILITY RATINGS FOR GOOD TO FAIR CROPLAND

Soil Type	Oats	Mixed Grains	Alfalfa	Red Clover	Alsike	Timothy	Potatoes	Pasture
Buzwah clay loam	F	F	G-F	G-F	G-F	G-F	P	G-F
Buzwah silty clay loam	F	F	G-F	G-F	G-F	G-F	P	G-F
Burford loam	G-F	G-F	F	F	F	F	F	G-F
Thwaites silt loam	G-F	G-F	F-P	F-P	F	G-F	G-F	G-F

The soils in this group possess certain limitations in crop production that make them less suitable and less productive than the previous group. The Burford soils have only a moderate water holding capacity and are frequently stony. The Thwaites soil is susceptible to water erosion. The Buzwah soils are stony and the stones are so numerous that they must be removed before cultivation. In general these soils produce only moderate yields of oats and mixed grains but are probably as good as the first group of soils in the production of hay. Satisfactory yields of grain or hay require frequent use of commercial fertilizers. Some application of lime may also be necessary on the Thwaites soils.

TABLE 11
CROP ADAPTABILITY RATINGS FOR FAIR CROPLAND

Soil Type	Oats	Mixed Grains	Alfalfa	Red Clover	Alsike	Timothy	Potatoes	Pasture
Casey silt loam	F	F	F-P	F-P	F	F	G	F
Earlton silt loam—shallow phase	F	F	F-P	F-P	F	F	F	G-F
Campbell silty clay loam—shallow phase	F	F	F-P	F	F	F	F-P	F
Evanturel silt loam—shallow phase	F	F	F-P	F	F	F	F-P	F
Gordon silty clay loam—shallow phase	F	F	F-P	F-P	F	F	F-P	F
Burford sandy loam	F-P	F-P	F	F	F	F	F-P	F
Cane silt loam	F	F	P	F-P	F	F	F-P	F
Vasey loam	F	F	F-P	F	F	F	P	F-P
Wolsey silty clay loam	F-P	F-P	P	F	F	F	P	F
Dumfries loam	F-P	F-P	P	F	F	F	P	F-P

This group includes those soils which have severe limitations in crop production, as a result of poor texture or shallowness over bedrock. Both of these conditions control the moisture supply in the soil so that cereal and hay crops are affected in spite of good management practices. Stones interfere with cultivation on the Vasey and Dumfries soils and require constant removal as they occur in the soil mass as well as at the surface.

These soils can be used for growing both grain and hay but such crops will require the use of commercial fertilizers. Since the yields of grain can be expected to be lower on these soils than on the soils of the better groups, cost of production may eliminate their use for that purpose.

TABLE 12
CROP ADAPTABILITY RATINGS FOR FAIR TO POOR CROPLAND

Soil Type	Oats	Mixed Grains	Alfalfa	Red Clover	Alsike	Timothy	Potatoes	Pasture
Leech clay loam	F-P	F-P	F-P	F	F	F	P	F-P
Leech silty clay loam	F-P	F-P	F-P	F	F	F	P	F-P
Buzwah clay loam—shallow phase	F-P	F-P	F-P	F-P	F	F	P	F
Donnybrook sandy loam	P	P	F	F	F	F	P	F
Bucke fine sandy loam	F-P	F-P	P	P	F-P	F	G-F	F-P
Wendigo fine sandy loam	F-P	F-P	P	P	P	F	G-F	F-P
Leech silty clay loam—shallow phase	F-P	F-P	F-P	F-P	F	F	P	F
Leech clay loam—shallow phase	F-P	F-P	F-P	F-P	F	F	P	F
Pike clay	F-P	P	F-P	F-P	F-P	F	P	F
Otterskin fine sandy loam	F-P	F-P	P	P	P	F-P	F	F-P
Burford loam—shallow phase	P	P	F-P	F-P	F-P	F-P	P	F
Brisbane loam	F-P	P	P	F-P	F-P	F-P	P	F-P
Howland loam	F-P	F-P	P	P	F-P	F-P	P	F-P

The soil types included in this group possess characteristics that limit their suitability to a few crops or to agricultural uses that do not require cultivation. The problems associated with these soils are drainage, shallowness, low fertility, susceptibility to erosion and stoniness. Any one or a combination of several of these problems may be associated with a particular soil in this group. A soil may be improved without entirely correcting or overcoming the problem. Such im-

provement, although only partial improvement for potential hay and pasture land, may be economical. The soil types that have some potential uses for cereals are the Leech soils.

TABLE 13
CROP ADAPTABILITY RATINGS FOR POOR CROPLAND

Soil Type	Oats	Mixed Grains	Alfalfa	Red Clover	Alsike	Timothy	Potatoes	Pasture
Howland sandy loam	F-P	P	P	P	F-P	F-P	P	F-P
Bucke sandy loam	F-P	F-P	P	P	P	P	F-P	F-P
Bass clay	F-P	F-P	P	P	P	F-P	P	F-P
Vasey loam—shallow phase	P	P	P	F-P	F-P	F-P	P	F-P
Wolsey silty clay loam—shallow phase	F-P	F-P	P	P	P	F-P	P	F-P
Otterskin sandy loam	F-P	F-P	P	P	P	P	F-P	P
Cane silt loam—shallow phase	P	P	P	P	P	F-P	P	F
Howland loam—shallow phase	P	P	P	P	F-P	F-P	P	F-P
Englehart fine sandy loam	P	P	P	P	P	F-P	P	F-P
Wendigo sandy loam	P	P	P	P	P	P	F-P	P
Wendigo sand	P	P	P	P	P	P	F-P	P
Phipps clay loam	P	P	P	P	P	P	P	F-P
Phipps silty clay loam	P	P	P	P	P	P	P	F-P
Englehart sandy loam	P	P	P	P	P	P	P	P
Mallard sandy loam	P	P	P	P	P	P	P	P

This group includes a large number of minor soil types which are used chiefly for grazing or for forestry. However, many of the soil types here could be used for growing a wider range of crops if improved. Soils such as Wendigo sandy loam, Bucke sandy loam, Otterskin sandy loam and Mallard sandy loam are being used successfully for specialized crops elsewhere in the province.

TABLE 14
NON-ARABLE LAND

Wolsey silty clay loam—stony phase
Campbell silty clay loam—shallow, stony phase
Gordon silty clay loam—shallow, stony phase
Kagawong silt loam
Phipps clay loam—shallow phase
Bass clay—stony phase
Perch clay
Leech silty clay loam—stony phase
Cane silt loam—stony phase
Wolsey silty clay loam—shallow, stony phase
Phipps silty clay loam—stony phase
Perch clay—stony phase
Buzwah silty clay loam—stony phase
Farmington loam
Little Current clay
Donnybrook sandy loam
Evanturel silt loam—stony phase
Earlton silt loam—stony phase
Campbell silty clay loam—stony phase
Gordon silty clay loam—stony phase
Pike clay—stony phase
Muck

The soils included in this group comprise about 72 per cent of the land area of Manitoulin Island. With the exception of the Farmington soils most of them occur as small isolated areas and can serve as woodlots or grazing land. The Farmington soils make up 60 per cent of the land area and although they are unsuitable for the growing of cultivated crops they are the grazing land soils of Manitoulin Island.

TABLE 15
UNSUITED FOR AGRICULTURE

Gilford loam	Lyons loam—shallow phase
Gilford sandy loam	Bridgman sand
Killean loam	Burpee muck
Lily loam	Marsh
Lyons loam	Rock—Wendigo
Kenabeek sandy loam	Rock
Mallard sandy loam—shallow phase	
Mallard sandy loam—stony phase	

The soils included in this group are unsuited to agriculture since they cannot be cultivated nor can they be used for grazing. In some places the soils are covered with stones and trees and grass is sparse; in others, there is no cover of any kind and the bare rock or soil materials are exposed. The soils should be reforested.

APPENDIX

TAXONOMIC CLASSIFICATION, PROFILE DESCRIPTIONS AND ANALYTICAL DATA

In the following pages profile descriptions of each soil series are presented together with analytical data for selected soils. The analyses of surface samples are included to indicate comparative levels of plant nutrients in the surface soils of the island.

The methods of analysis were as follows:

Mechanical Analysis	—	Bouyoucos Hydrometer Method, Soil Science, Vol. 42, 1936, p. 225.
Reaction	—	Atkinson H. J. et al., Contribution 169, Canada Department of Agriculture 1955.
Base Exchange Capacity and Exchangeable Bases	—	Schollenberger Method, Soil Science, 51:1, 1945.
Organic Matter	—	Walkley Method, Soil Science 63:251-264, 1947.
Calcium and Magnesium	—	Cheng Methods, Soil Science 72:449-558, 1951 and Soil Science 75:37-40, 1953.
Fusion Analysis	—	Robinson Method, Soil Science 59:7-9, 1945.

DUMFRIES SERIES

LOCALITY: Lot 3, Con. VI, Howland Twp.

PARENT MATERIAL: Stony calcareous, sandy loam till

*CLASSIFICATION: Great Soil Group — Grey-Brown Podzolic
Soil Group — Orthic Grey-Brown Podzolic
Family — Dumfries

DESCRIPTION: A_0 — Thin layer of partially decomposed leaves, twigs, etc.

A_1 — 0-3 inches loam; dark brown (10 YR 4/3); fine granular structure; friable consistency; frequent stones; pH — 6.5.

A_{21}—3-6 inches loam; yellowish brown (10 YR 5/4); weak platy; friable; few stones; pH — 6.3.

A_{22}—6-10 inches loam; pale brown (10 YR 6/3); weak platy; friable; occasional stones; pH — 6.0.

B_1 — 10-13 inches loam; dark yellowish brown (10 YR 4/4); fine nuciform; friable; moderately stony; pH — 6.5.

B_2 — 13-20 inches clay loam; dark brown (10 YR 4/3); medium nuciform; friable; very stony; pH — 7.0.

C — Stony sandy loam till; light grey (10 YR 7/2); single grain; loose; calcareous; pH — 7.8.

*The classification of each series, into Soil Group and Family is made on the basis of the definitions given by the National Soil Survey Committee 1958.

KILLEAN SERIES

LOCALITY: Lot 5, Con. IV, Howland Twp.

PARENT MATERIAL: Stony, calcareous, sandy loam till

CLASSIFICATION: Great Soil Group – Grey-Brown Podzolic
Soil Group – Gleyed Grey-Brown Podzolic
Family – Killean

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-5 inches loam; very dark greyish brown (10 YR 3/2); fine granular structure; friable consistency; pH – 6.8.
A_2 – 5-12 inches loam; yellowish brown (10 YR 5/4); slightly mottled; weak platy; friable; very stony; pH – 6.4.
B_2 – 12-20 inches loam; dark brown (10 YR 4/3); mottled; medium nuciform; friable; very stony; pH – 7.0.
C – Stony sandy loam till; light grey (10 YR 7/2); single grain; loose; many stones and boulders; calcareous; pH – 7.4.

LILY SERIES

LOCALITY: Lot 3, Con. IV, Howland Twp.

PARENT MATERIAL: Stony, calcareous, sandy loam till

CLASSIFICATION: Great Soil Group – Dark Grey Gleisolic
Soil Group – Orthic Dark Grey Gleisolic
Family – Lyons

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-7 inches loam; black (10 YR 2/1); fine granular structure; friable consistency; very stony; pH – 7.2.
G – 7-20 inches loam; greyish brown (10 YR 5/2); very mottled; weak medium nuciform; friable; very stony; pH – 7.3.
C – Coarse sandy loam till; light grey (10 YR 7/2); many stones and boulders; calcareous; pH – 7.6.

VASEY SERIES

LOCALITY: Lot 21, Con. IX, Robinson Twp.

PARENT MATERIAL: Calcareous, loam or sandy loam till

CLASSIFICATION: Great Soil Group – Grey-Brown Podzolic
Soil Group – Bisequa Grey-Brown Podzolic
Family – Vasey

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-2 inches loam; very dark greyish brown (10 YR 3/2); medium granular structure; friable consistency; very stony; pH – 5.6.
B_{21p} – 2-12 inches loam; dark brown (7.5 YR 4/4); weak medium nuciform; friable; moderately stony; pH – 5.8.
B_{22p} – 12-19 inches loam; yellowish brown (10 YR 5/6); weak fine nuciform; friable; moderately stony; pH – 6.0.

TABLE 16
CHEMICAL AND PHYSICAL ANALYSES OF VASEY LOAM

Horizon	Mechanical Analyses			pH	% O.M.	Exchange Capacity m.e./100 gm.	Exchangeable Bases			SiO_2 %	R_2O_3 %	Fe_2O_3 %	Al_2O_3 %	CaO %	MgO %	K_2O %
	% Sand 1-.05 mm	% Silt .05-.002 mm	% Clay <.002 mm				Ca m.e./100 gm.	Mg m.e./100 gm.	K m.e./100 gm.							
A_1	49.7	38.2	12.1	5.6	3.3	14.7	10.7	2.5	0.1	71.6	18.7	4.8	15.2	2.4	1.2	2.8
B_{21}	47.2	40.0	12.8	5.8	0.4	5.6	3.6	0.8	0.08	70.8	18.9	5.4	15.3	2.3	0.9	2.7
B_{22}	48.4	40.4	11.2	6.0	0.1	5.1	3.1	0.7	0.06	70.6	20.2	5.1	15.7	2.4	0.8	2.6
A_2G.B.P.	52.1	36.9	11.0	6.1	0.0	4.0	2.8	0.4	0.04	78.3	14.3	2.3	11.9	1.9	0.6	2.6
B_2G.B.P.	49.2	35.2	15.6	6.7	0.0	7.3	6.0	0.9	0.1	70.2	20.4	5.9	15.4	2.7	1.1	2.7
C	57.9	30.5	11.6	7.8	0.0	3.9	16.5	2.1	0.08	66.6	18.6	5.0	12.6	7.6	2.3	2.5

A_{2gbp}—19-30 inches loam; very pale brown (10 YR 7/4); weak fine platy; friable; moderately stony; pH — 6.1.

B_{2gbp}—30-34 inches loam; yellowish brown (10 YR 5/4); weak medium nuciform; friable; moderately stony; pH — 6.7.

C — Loam till; pale brown (10 YR 6/3); friable; very stony; calcareous; pH — 7.8.

HOWLAND SERIES

LOCALITY: Lot 51, Con. II, Assiginack Twp.

PARENT MATERIAL: Calcareous, loam or sandy loam till

CLASSIFICATION: Great Soil Group — Grey-Brown Podzolic
Soil Group — Gleyed Grey-Brown Podzolic
Family — London

DESCRIPTION: A_0 — Thin layer of partially decomposed leaves, twigs, etc.

A_1 — 0-3 inches loam; very dark greyish brown (10 YR 3/2); medium granular structure; friable consistency; very stony; pH — 6.0.

A_{21}—3-14 inches loam; brown (10 YR 5/3); slightly mottled; weak medium nuciform; friable; moderately stony; pH —6.3.

A_{22}—14-23 inches loam; light yellowish brown (10 YR 6/4); mottled; weak fine nuciform; friable; moderately stony; pH — 6.4.

B_2 — 23-26 inches loam; yellowish brown (10 YR 5/6); mottled; weak fine nuciform; friable; moderately stony; pH — 7.0.

C — Loam till; pale brown (10 YR 6/3); friable; very stony; calcareous; pH — 7.8.

LYONS SERIES

LOCALITY: Lot 29, Con. XI, Dawson Twp.

PARENT MATERIAL: Calcareous, loam or sandy loam till

CLASSIFICATION: Great Soil Group — Dark Grey Gleisolic
Soil Group — Orthic Dark Grey Gleisolic
Family — Lyons

DESCRIPTION: A_0 — Thin layer of partially decomposed leaves, twigs, etc.

A_1 — 0-6 inches loam; black (10 YR 2/1); medium granular structure; friable consistency; very stony; pH — 7.4.

G — 6-20 inches loam; dark grey (10 YR 4/1); very mottled; weak medium nuciform; friable; very stony; pH — 7.0.

C — Loam till; light yellowish brown (10 YR 6/4); very mottled; very stony; calcareous; friable; pH — 7.8.

BUZWAH SERIES

LOCALITY: Lot 15, Con. II, Tehkummah Twp.

PARENT MATERIAL: Layers of reddish clay loam till and greyish loam till; often mixed to form variegated colored till. Tills derived from Medina and Trenton bedrock.

CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Orthic Grey Wooded
Family – Haileybury

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.

A_1 – 0-2 inches clay loam; very dark greyish brown (10 YR 3/2); medium granular structure; friable consistency; very stony; pH – 6.2.

A_{21}–2-5 inches clay loam; yellowish brown (10 YR 5/6); medium granular; friable; very stony; pH – 6.0.

A_{22}–5-15 inches loam; very pale brown (10 YR 7/4); weak fine platy; friable; moderately stony; pH – 5.7.

AB–15-20 inches clay loam; yellowish brown (10 YR 5/4); medium nuciform; firm; aggregates coated with very pale brown material; stony; pH – 6.4.

B_2 – 20-26 inches clay loam; dark brown (7.5 YR 4/4); medium nuciform; firm; very stony; pH – 6.8.

C – Clay loam till; pinkish grey (7.5 YR 6/2); and pale brown (10 YR 6/3); hard; calcareous; moderately to very stony; pH – 7.8.

TABLE 17

CHEMICAL AND PHYSICAL ANALYSES OF THE CULTIVATED SURFACE OF SOME BUZWAH SOILS

Horizon	Location			Mechanical Analyses			Exchange Capacity m.e./100 gm.	Exchangeable Bases			pH	% O.M.
	Township	Conc.	Lot	% Sand 1-.05 mm	% Silt .05-.002 mm	% Clay <.002 mm		Ca m.e./100 gm.	Mg m.e./100 gm.	K m.e./100 gm.		
Cultivated Surface	Sandfield	VI	22	31.0	41.2	27.8	20.18	13.57	1.66	0.15	5.9	6.0
" "	Sandfield	IV	15	33.4	42.4	24.2	23.75	16.95	2.81	0.17	6.2	8.2
" "	Tehkummah	III	20	34.8	34.0	31.2	24.17	18.94	2.04	0.13	6.4	5.5
" "	Sandfield	XI	16	34.5	36.0	29.5	28.66	21.32	4.47	0.24	6.5	8.7
" "	Assiginack	II	27	37.2	23.1	39.7	25.76	24.36	3.73	0.45	6.8	7.5

LEECH SERIES

LOCALITY: Lot 45, Con. II, Assiginack Twp.

PARENT MATERIAL: A variegated layering of calcareous clay loam and loam tills.

CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Gleyed Grey Wooded
Family – Renfrew

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.

A_1 – 0-2 inches clay loam; very dark greyish brown (10 YR 3/2); fine nuciform structure; friable consistency; moderately stony; pH – 6.4.

A_2 – 2-9 inches clay loam; very pale brown (10 YR 7/3); mottled; weak fine platy; friable; moderately stony; pH – 6.0.

AB–9-12 inches clay loam; pale brown (10 YR 6/3); mottled; medium nuciform; firm; aggregates coated with very pale brown material; stony; pH – 6.4.

B_2 – 9-18 inches clay loam; brown (7.5 YR 5/2); mottled; fine blocky; plastic when wet, hard when dry; moderately stony; pH – 6.8.

C – Clay loam till; pinkish grey (7.5 YR 6/2); and grey (10 YR 6/1); hard; calcareous; moderately stony; pH – 7.8.

PHIPPS SERIES

LOCALITY: Lot 10, Con VII, Barrie Island

PARENT MATERIAL: A variegated layering of calcareous clay loam and loam till

CLASSIFICATION: Great Soil Group – Dark Grey Gleisolic
Soil Group – Orthic Dark Grey Gleisolic
Family – Brookston

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.

A_1 – 0-5 inches clay loam; black (10 YR 2/1); fine nuciform structure; friable consistency; moderately stony; pH – 6.6.

G – 5-19 inches clay loam; grey (10 YR 5/1); very mottled; mottles strong brown (7.5 YR 5/6) in colour; coarse blocky; hard when dry, plastic when wet; moderately stony; pH – 7.0.

C – Clay loam till; pinkish grey (7.5 YR 6/2) and grey (10 YR 6/1); very mottled; hard when dry, plastic when wet; calcareous; moderately stony; pH – 8.0.

DONNYBROOK SERIES

LOCALITY: Lot 6, Con. VII, Howland Twp.

PARENT MATERIAL: Stony, gravelly, calcareous outwash

CLASSIFICATION: Great Soil Group – Grey-Brown Podzolic
Soil Group – Orthic Grey-Brown Podzolic
Family – Dumfries

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.

A_1 – 0-4 inches gravelly sandy loam; dark grey-brown (10 YR 4/2); fine crumb structure; very friable consistency; moderately to very stony; pH – 7.2.

A_{21}–4-6 inches gravelly sandy loam; yellowish brown (10 YR 5/6); weak fine platy; very friable; pH – 6.9.

A_{22}–6-10 inches gravelly sandy loam; pale brown (10 YR 6/3); single grain; loose; pH – 6.7.

B_2 – 10-16 inches gravelly sandy loam; dark brown (10 YR 4/3); weak fine nuciform; friable; very stony; pH – 7.2.

C – Sand and gravel; very pale brown (10 YR 7/3); single grain; loose; calcareous; very stony; pH – 8.0.

TABLE 18
CHEMICAL AND PHYSICAL ANALYSES OF WENDIGO SANDY LOAM

Horizon	Mechanical Analyses			pH	% O.M.	Exchange Capacity m.e./100 gm.	Exchangeable Bases			SiO_2 %	R_2O_3 %	Fe_2O_3 %	Al_2O_3 %	CaO %	MgO %	K_2O %
	% Sand 1-.05 mm	% Silt .05-.002 mm	% Clay <.002 mm				Ca m.e./100 gm.	Mg m.e./100 gm.	K m.e./100 gm.							
A_2	70.3	27.0	2.7	4.8	0.62	2.18	0.39	0.17	0.04	82.7	11.6	0.8	10.4	1.4	0.1	2.1
B_2	81.3	16.4	2.3	5.6	0.93	4.53	0.28	0.14	0.07	74.2	16.4	3.0	13.2	2.1	0.6	1.8
B_3	86.8	13.6	1.6	5.9	0.35	2.62	0.45	0.18	0.04	75.6	15.9	2.8	12.9	2.1	0.7	1.8
C	95.6	4.2	0.2	6.2	0.00	0.91	0.11	0.05	0.02	75.6	15.5	2.8	12.6	2.3	1.0	1.9

WENDIGO SERIES

LOCALITY: Lot 8, Con. VI, Billings Twp.
PARENT MATERIAL: Non-calcareous outwash sand
CLASSIFICATION: Great Soil Group — Podzol
Soil Group — Orthic Podzol
Family — Wendigo
DESCRIPTION: A_0 — 1-0 inches raw humus and roots; very dark grey (10 YR 3/1); pH — 5.2.
A_2 — 0-3 inches sand; white (10 YR 8/2); single grain structure; loose consistency; pH — 5.0.
B_{21}—3-12 inches sand; yellowish brown (10 YR 5/8); single grain; loose; pH — 5.5.
B_{22}—12-26 inches sand; light yellowish brown (10 YR 6/4); single grain; loose; pH — 5.8.
C — Sand; very pale brown (10 YR 7/2); single grain; loose; non-calcareous; pH — 6.0.

MALLARD SERIES

LOCALITY: Lot 12, Con. VIII, Billings Twp.
PARENT MATERIAL: Non-calcareous outwash sand
CLASSIFICATION: Great Soil Group — Podzol
Soil Group — Gleyed Podzol
Family — Rubicon
DESCRIPTION: A_0 — 1-0 inches raw humus and roots, very dark grey (10 YR 3/1); pH — 5.0.
A_2 — 0-4 inches sandy loam; white (10 YR 8/2); single grain structure; loose consistency; pH — 4.5.
B_2 — 4-20 inches sandy loam; brown (10 YR 5/3); mottled; single grain; occasionally cemented; pH — 5.6.
C — Sandy loam; pale brown (10 YR 7/3); mottled; single grain; pH — 6.1.

KENABEEK SERIES

LOCALITY: Lot 11, Con. VII, Billings Twp.
PARENT MATERIAL: Non-calcareous outwash sand
CLASSIFICATION: Great Soil Group — Dark Grey Gleisolic
Soil Group — Orthic Dark Grey Gleisolic
Family — Kenabeek
DESCRIPTION: A_1 — 0-5 inches sandy loam; very dark brown (10 YR 2/2); highly organic; fine crumb structure; friable consistency; pH — 5.2.
G — 5-18 inches sandy loam; grey (10 YR 6/1); very mottled; single grain; loose; pH — 6.0.
C — Sandy loam; very pale brown (10 YR 7/3); very mottled; single grain; loose; pH — 6.6.

BURPEE SERIES

LOCALITY: Lot 21, Con. XIII, Campbell Twp.
PARENT MATERIAL: Non-calcareous outwash sand
CLASSIFICATION: Great Soil Group — Gleysol
Soil Group — Peaty Gleysol
Family — Burpee
DESCRIPTION: A_0 — 6-0 inches; well decomposed organic material; black (10 YR 2/1); pH — 6.5.
G_1 — 0-12 inches sand; greyish brown (10 YR 5/2); slightly mottled; single grain structure; loose consistency; pH — 6.7.
G_2 — 12-24 inches sand; brown (10 YR 5/3); slightly mottled; single grain; loose; pH — 6.8.
C — Sand; dark greyish brown (10 YR 4/2); slightly mottled; single grain; loose; pH — 6.9.

BURFORD SERIES

LOCALITY: Lot 3, Con. I, Billings Twp.
PARENT MATERIAL: Loam and sandy loam deposits underlain by gravel
CLASSIFICATION: Great Soil Group — Grey-Brown Podzolic
Soil Group — Orthic Grey-Brown Podzolic
Family — Burford
DESCRIPTION: A_0 — Thin layer of partially decomposed leaves, twigs, etc.
A_1 — 0-3 inches loam; very dark greyish brown (10 YR 3/2); fine granular structure; friable consistency; few stones; pH — 6.0.
A_{21}—4-17 inches loam; yellowish brown (10 YR 5/4); weak fine platy; very friable; few stones; pH — 5.4.
A_{22}—17-20 inches gravelly loam; light yellowish brown (10 YR 6/4); weak fine platy; very friable; pH — 6.2.
B_2 — 20-33 inches gravelly loam; dark brown (10 YR 4/3); medium nuciform structure; hard consistency; gravelly; moderately stony; pH — 6.8.
D — Gravel and sand; pale brown (10 YR 6/3); single grain structure; loose consistency; calcareous; pH — 7.8.

BRISBANE SERIES

LOCALITY: Lot 27, Con. VI, Howland Twp.
PARENT MATERIAL: Loam and sandy loam deposits underlain by gravel
CLASSIFICATION: Great Soil Group — Grey-Brown Podzolic
Soil Group — Gleyed Grey-Brown Podzolic
Family — Brady
DESCRIPTION: A_0 — Thin layer of partially decomposed leaves, twigs, etc.
A_1—0-6 inches loam; very dark greyish brown (10 YR 3/2); fine granular structure; friable consistency; moderately stony; pH — 6.6.
A_2 — 6-10 inches loam; yellowish brown (10 YR 5/4); slightly mottled; weak fine platy; friable; very stony; pH — 6.0.

B_2 – 10-22 inches gravelly loam; dark brown (10 YR 4/3); mottled; medium nuciform; firm; moderately stony; pH – 7.0.

D – Gravel and sand; pale brown (10 YR 6/3); single grain; loose, calcareous; pH – 7.8.

GILFORD SERIES

LOCALITY: Lot 30, Con. V, Howland Twp.

PARENT MATERIAL: Loam and sandy loam deposits underlain by gravel

CLASSIFICATION: Great Soil Group – Dark Grey Gleisolic
Soil Group – Orthic Dark Grey Gleisolic
Family – Granby

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.

A_1 – 0-6 inches loam; very dark brown (10 YR 2/2); fine granular structure; friable consistency; very stony; pH – 7.0.

G – 6-16 inches loam; greyish brown (10 YR 5/2); mottled; medium blocky; friable; moderately stony; pH – 7.2.

D – Gravelly outwash; pale brown (10 YR 6/3); single grain; loose; calcareous; pH – 7.8.

BUCKE SERIES

LOCALITY: Lot 38, Con. VII, Burpee Twp.

PARENT MATERIAL: Non-calcareous outwash sand underlain by calcareous silty clay at depths of less than 3 feet

CLASSIFICATION: Great Soil Group – Podzol
Soil Group – Orthic Podzol
Family – Bucke

DESCRIPTION: A_0 – 1-0 inches raw humus and roots; very dark grey; (10 YR 3/1); pH – 5.2.

A_2 – 0-2 inches fine sandy loam; light grey (10 YR 7/2); single grain structure; loose consistency; stonefree; pH – 6.3.

B_{21}–2-9 inches fine sandy loam; (10 YR 5/8); single grain; loose; stonefree; pH – 6.3.

B_{22}–9-18 inches fine sandy loam; brownish yellow (10 YR 6/6); mottled; weak fine nuciform; loose; stonefree; pH – 6.4.

D – Silty clay; light brownish grey (10 YR 6/2); varved; very plastic when wet, very hard when dry; stonefree; calcareous; pH – 7.8.

OTTERSKIN SERIES

LOCALITY: Lot 7, Con. VII, Carnarvon Twp.

PARENT MATERIAL: Non-calcareous outwash sand underlain by calcareous silty clay at depths of less than 3 feet.

CLASSIFICATION: Great Soil Group – Podzol
Soil Group – Gleyed Podzol
Family – Locksley

DESCRIPTION: A_0 – 2-0 inches raw humus and roots; very dark grey (10 YR 3/1); pH – 5.0.

A_2 – 0-2 inches sandy loam; light grey (10 YR 7/1); single grain structure; loose consistency; stonefree; pH – 4.8.

B_{21}–2-18 inches sandy loam; yellowish brown (10 YR 5/6); mottled; single grain; loose; stonefree; pH – 5.4.

B_{22}–18-25 inches sandy loam; brownish yellow (10 YR 6/6); mottled; single grain; loose; stonefree; pH – 5.8.

D – Silty clay; light brownish grey (10 YR 6/2); varved; very plastic when wet, very hard when dry; stonefree; calcareous; pH – 7.8.

ENGLEHART SERIES

LOCALITY: Lot 18, Con. IV, Gordon Twp.

PARENT MATERIAL: Non-calcareous outwash sand underlain by calcareous silty clay at depths of less than 3 feet

CLASSIFICATION: Great Soil Group – Dark Grey Gleisolic
Soil Group – Orthic Dark Grey Gleisolic
Family – Kenabeek

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.

A_1 – 0-5 inches fine sandy loam; very dark brown (10 YR 2/2); fine crumb structure; very friable consistency; stonefree; pH – 5.2.

G – 5-16 inches fine sandy loam; grey (10 YR 6/1); very mottled; single grain; loose; stonefree; pH – 5.4.

D – Silty clay; light brownish grey (10 YR 6/2); varved; very plastic when wet, very hard when dry; stonefree; pH – 7.8.

THWAITES SERIES

LOCALITY: Lot 28, Con. IX, Billings Twp.

PARENT MATERIAL: Non-calcareous silt loam underlain by silty clay at depths of less than 3 feet

CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Bisequa Grey Wooded
Family – Evanturel

DESCRIPTION: A_0 – 1-0 inches raw humus and roots; very dark grey; (10 YR 3/1); pH – 5.2.

A_{2p} – 0-2 inches silt loam; white (10 YR 8/2); fine platy structure; soft consistency; stonefree; pH – 5.2.

B_{2p} – 2-10 inches silt loam; yellowish brown (10 YR 5/6); weak platy; soft; stonefree; pH – 5.3.

A_{2gw}– 10-18 inches silt loam; very pale brown (10 YR 7/3); weak platy; soft; stonefree; pH – 5.3.

B_{2gw}– 18-26 inches silty clay loam; yellowish brown (10 YR 5/4); medium nuciform; friable; stonefree; pH – 5.6.

D – Silty clay; light brownish grey; (10 YR 6/2); massive structure; very plastic when wet, very hard when dry; stonefree; calcareous; pH – 7.8.

CASEY SERIES

LOCALITY: Lot 26, Con. VII, Billings Twp.

PARENT MATERIAL: Non-calcareous silt loam underlain by calcareous silty clay at depths of less than 3 feet.

CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Gleyed Grey Wooded
Family – Earlton

DESCRIPTION: A_0 – 1-0 inches raw humus and roots; very dark grey; (10 YR 3/1); pH – 5.3.

A_{2p} – 0-2 inches silt loam; white (10 YR 8/2); fine platy structure; soft consistency; stonefree; pH – 5.0.

B_{2p} – 2-8 inches silt loam; yellowish brown (10 YR 5/8); slightly mottled; weak platy; soft; stonefree; pH – 5.2.

A_{2gw} – 8-15 inches silt loam; very pale brown (10 YR 7/3); mottled; weak platy; soft; stonefree; pH – 5.2.

B_{2gw} – 15-24 inches silty clay loam; brown (10 YR 5/3); mottled; medium nuciform; friable; stonefree; pH – 5.7.

D – Silty clay; light brownish grey (10 YR 6/2); massive; very plastic when wet, very hard when dry; stonefree; calcareous; pH – 7.8.

EVANTUREL SERIES

LOCALITY: Lot 22, Con. II, Carnarvon Twp.

PARENT MATERIAL: Calcareous, stonefree, silt loam

CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Bisequa Grey Wooded
Family – Evanturel

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.

A_1 – 0-2 inches silt loam; grey (10 YR 5/1); medium granular structure; friable consistency; stonefree; pH – 6.1.

B_{2p} – 2-15 inches silt loam; light yellowish brown (10 YR 6/4); medium granular; friable; stonefree; pH – 5.6.

A_{2gw} – 15-18 inches silt loam; very pale brown (10 YR 8/3); fine platy; friable; stonefree; pH – 5.5.

AB_{gw} – 18-23 inches silty clay loam; yellowish brown (10 YR 5/4); medium nuciform; firm; aggregates coated with very pale brown materials; stonefree; pH – 5.9.

B_{2gw} – 23-30 inches silty clay loam; yellowish brown (10 YR 5/4); medium blocky; firm; stonefree; pH – 6.2.

C_1 – 30-38 inches silt loam; pale brown (10 YR 6/3); mottled; mottles brownish yellow (10 YR 6/6); laminar; firm; stonefree; pH – 7.4.

C_2 – Silt loam; pale brown (10 YR 6/3); laminar; friable; stonefree; calcareous; pH – 8.0.

EARLTON SERIES

LOCALITY: Lot 17, Con. IV, Billings Twp.

PARENT MATERIAL: Calcareous, stonefree silt loam

CLASSIFICATION: Great Soil Group — Grey Wooded
Soil Group — Gleyed Grey Wooded
Family — Earlton

DESCRIPTION: A_0 — Thin layer of partially decomposed leaves, twigs, etc.

A_1 — 0-3 inches silt loam; dark grey (10 YR 4/1); fine granular structure; friable consistency; stonefree; pH — 6.0.

A_2 — 3-8 inches silt loam; light grey (2.5 Y 7/2); mottled; fine platy; friable; stonefree; pH — 5.6.

AB—8-17 inches silty clay loam; light yellowish brown (2.5 Y 6/4); mottled; fine nuciform; firm; aggregates coated with light grey materials; stonefree; pH — 6.5.

B_2 — 17-26 inches silty clay loam; light olive brown (2.5 Y 5/4); mottled; medium nuciform; firm; stonefree; pH — 7.0.

C — Silt loam; pale brown (10 YR 6/3); laminar; friable; stonefree; calcareous; pH — 8.0.

TABLE 19

CHEMICAL AND PHYSICAL ANALYSES OF CULTIVATED SURFACE FROM SOME EARLTON SOILS

Horizon	Location			Mechanical Analyses			Exchange Capacity m.e./100 gm.	Exchangeable Bases			pH	% O.M.
	Township	Conc.	Lot	% Sand 1-.05 mm	% Silt .05-.002 mm	% Clay < .002 mm		Ca m.e./100 gm.	Mg m.e./100 gm.	K m.e./100 gm.		
Cultivated Surface	Carnarvon	X	3	31.2	56.5	12.3	9.82	3.85	0.62	0.13	5.7	2.7
" "	Carnarvon	IX	2	13.9	65.1	21.0	13.23	11.13	2.35	0.09	6.9	2.9
" "	Gordon	VIII	19	28.7	50.5	20.8	12.94	9.67	2.46	0.14	6.5	3.3

CANE SERIES

LOCALITY: Lot 4, Con. XI, Carnarvon Twp.

PARENT MATERIAL: Calcareous, stonefree silt loam

CLASSIFICATION: Great Soil Group — Dark Grey Gleisolic
Soil Group — Orthic Dark Grey Gleisolic
Family — Colwood

DESCRIPTION: A_0 — Thin layer of partially decomposed leaves, twigs, etc.

A_1 — 0-6 inches silt loam; very dark grey (10 YR 3/1); medium granular structure; friable consistency; stonefree; pH — 6.7.

G_1 — 6-20 inches silt loam; pale yellow (2.5 Y 7/4); very mottled; mottles olive yellow (2.5 Y 6/8); laminar; friable; pH — 7.0.

G_2 — 20-29 inches silt loam; light yellowish brown (2.5 Y 6/4); very mottled; massive; friable; stonefree; pH — 7.4.

C – Silt loam; light grey (10 YR 7/2); laminar; friable; stonefree; calcareous; pH – 8.0.

CAMPBELL SERIES

LOCALITY: Lot 7, Con. X, Campbell Twp.
PARENT MATERIAL: Calcareous, stonefree silty clay
CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Orthic Grey Wooded
Family – Haileybury
DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-1 inches silty clay loam; dark grey (10 YR 4/1); fine nuciform structure; friable consistency; stonefree; pH – 5.8.
A_2 – 1-9 inches silty clay loam; light grey (10 YR 7/2); fine platy; firm; stonefree; pH – 6.2.
AB–9-16 inches clay; pale brown (10 YR 6/3); medium blocky; hard; aggregates coated with light grey materials; stonefree; pH – 6.5.
B_2 – 16-21 inches clay; brown (10 YR 5/3); coarse blocky; very hard when wet, very plastic when dry; stonefree; pH – 6.7.
C – Silty clay; light brownish grey (10 YR 6/2); very hard when dry, very plastic when wet; stonefree; calcareous; pH – 7.8.

GORDON SERIES

LOCALITY: Lot 25, Con. VII, Burpee Twp.
PARENT MATERIAL: Calcareous, stonefree silty clay
CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Gleyed Grey Wooded
Family – Renfrew
DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-2 inches silty clay loam; dark grey (10 YR 4/1); fine nuciform structure; friable consistency; stonefree; pH – 6.4.
A_2 – 2-7 inches silty clay loam; very pale brown (10 YR 7/3); mottled; weak fine platy; friable; stonefree; pH – 6.3.
AB–7-11 inches clay; pale brown (10 YR 6/3); mottled; medium blocky; hard; aggregates coated with very pale brown materials; stonefree; pH – 6.5.
B_2 – 11-17 inches clay; brown (10 YR 5/3); mottled; medium blocky; very hard when dry, very plastic when wet; stonefree; pH – 6.9.
C – Silty clay; light brownish grey (10 YR 6/2); very hard when dry, very plastic when wet; stonefree; calcareous; pH – 7.8.

TABLE 20

CHEMICAL AND PHYSICAL ANALYSES OF CULTIVATED SURFACE FROM SOME GORDON SOILS

Horizon	Location			Mechanical Analyses			Ex-change Capacity m.e./100 gm.	Exchangeable Bases			pH	% O.M.
	Township	Conc.	Lot	% Sand 1-.05 mm	% Silt .05-.002 mm	% Clay <.002 mm		Ca m.e./100 gm.	Mg m.e./100 gm.	K m.e./100 gm.		
Cultivated Surface	Campbell	XI	15	15.0	58.5	26.5	14.87	9.59	2.39	0.16	6.1	3.3
" "	Campbell	X	15	19.4	47.4	33.2	16.61	8.09	2.00	0.20	5.7	3.1
" "	Tehkummah	I	15	13.7	54.9	31.4	14.09	9.42	2.43	0.15	6.4	3.2

WOLSEY SERIES

LOCALITY: Lot 25, Con. IV, Mills Twp.

PARENT MATERIAL: Calcareous, stonefree silty clay.

CLASSIFICATION: Great Soil Group – Dark Grey Gleisolic
Soil Group – Orthic Dark Grey Gleisolic
Family – Brookston

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.

A_1 – 0-5 inches silty clay loam; dark grey (10 YR 4/1); fine nuciform structure; plastic consistency when wet, friable when dry; stonefree; pH – 6.8.

G_1 – 5-9 inches silty clay loam; dark greyish brown (10 YR 4/2); very mottled; plastic when wet, hard when dry; medium blocky; stonefree; pH – 7.1.

G_2 – 9-15 inches silty clay loam; greyish brown (10 YR 5/2); very mottled; coarse blocky; plastic when wet, hard when dry; stonefree; pH – 7.4.

C – Silty clay light brownish grey (10 YR 6/2); mottled; very plastic when wet, very hard when dry; stonefree; calcareous; pH – 7.8.

TABLE 21

CHEMICAL AND PHYSICAL ANALYSES OF CULTIVATED SURFACE FROM SOME WOLSEY SOILS

Horizon	Location			Mechanical Analyses			Ex-change Capacity m.e./100 gm.	Exchangeable Bases			pH	% O.M.
	Township	Conc.	Lot	% Sand 1-.05 mm	% Silt .05-.002 mm	% Clay <.002 mm		Ca m.e./100 gm.	Mg m.e./100 gm.	K m.e./100 gm.		
Cultivated Surface	Carnarvon	IV	16	20.2	40.2	39.6	18.96	17.04	3.54	0.18	7.4	3.4
" "	Robinson	VI	14	13.9	55.1	31.0	27.23	24.13	3.76	0.19	7.0	5.9
" "	Tehkummah	A	23	21.6	48.4	30.0	25.80	23.76	4.89	0.19	7.6	5.3
" "	Dawson	IX	26	17.3	51.2	31.5	23.36	20.05	3.72	0.18	7.1	4.9

PIKE SERIES

LOCALITY: Lot 5, Con. XI, Bidwell Twp.
PARENT MATERIALS Calcareous, stonefree clay
CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Orthic Grey Wooded
Family – Haileybury

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-2 inches clay; light brownish grey (10 YR 6/2); fine nuciform structure; very plastic consistency when wet, friable when dry; stonefree; pH – 6.4.
A_2 – 2-5 inches clay; light grey (10 YR 7/2); medium nuciform; very plastic when wet, very hard when dry; stonefree; pH – 6.4.
AB–5-9 inches clay; pale brown (10 YR 6/3); coarse nuciform structure; very plastic when wet, very hard when dry; stonefree; pH – 6.7.
B_2 – 9-15 inches clay; yellowish brown (10 YR 5/4); mottled; massive; very plastic when wet, very hard when dry; stonefree; pH – 7.2.
C – Clay; grey (10 YR 6/1); mottled; massive; very plastic when wet, very hard when dry; stonefree; pH – 7.6.

BASS SERIES

LOCALITY: Lot 7, Con. I, Howland Twp.
PARENT MATERIAL: Calcareous, stonefree clay.
CLASSIFICATION: Great Soil Group – Grey Wooded
Soil Group – Gleyed Grey Wooded
Family - Renfrew

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-3 inches clay; dark grey (10 YR 4/1); fine nuciform structure; very plastic consistency when wet, friable consistency when dry; stonefree; pH – 6.1.
A_2 – 3-7 inches clay; pale brown (10 YR 6/3); mottled; fine nuciform; very plastic when wet, very hard when dry; stonefree; pH – 6.1.
B_2 – 7-14 inches clay; light yellowish brown (10 YR 6/4); mottled; coarse nuciform; very plastic when wet, very hard when dry; stonefree; pH – 6.8.
C – Clay; grey (10 YR 6/1); mottled; very plastic when wet, very hard when dry; stonefree; calcareous; pH – 7.6.

PERCH SERIES

LOCALITY: Lot 9, Con. I, Howland Twp
PARENT MATERIAL: Calcareous, stonefree clay
CLASSIFICATION: Great Soil Group – Dark Grey Gleisolic
Soil Group – Orthic Dark Grey Gleisolic
Family – Welland

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-6 inches clay; very dark grey (10 YR 3/1); fine nuciform structure; very plastic consistency when wet, friable when dry; stonefree; pH – 6.6.
G – 6-15 inches clay; light brownish grey (10 YR 6/2); very mottled; massive; very plastic when wet, very hard when dry; stonefree; pH – 7.0.
C – Clay; grey (10 YR 6/1); very mottled; massive; very plastic when wet, very hard when dry; stonefree; calcareous; pH – 7.6.

FARMINGTON SERIES

LOCALITY: Lot 14, Con. XI, Allan Twp.
PARENT MATERIAL: Calcareous loam till over limestone bedrock at depths of less than 1 foot.
CLASSIFICATION: Great Soil Group – Brown Forest
Soil Group – Orthic Brown Forest
Family – Farmington
DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-5 inches loam; very dark greyish brown (10 YR 3/2); fine granular structure; friable consistency; moderately stony; pH – 7.2.
B_2 – 5-9 inches loam; dark brown (10 YR 4/3); weak medium nuciform; friable; moderately stony; pH – 7.6.
C – 9-10 inches gravelly loam till; pale brown (10 YR 6/3); loose; stony; calcareous; pH – 8.0.
D – Limestone bedrock.

KAGAWONG SERIES

LOCALITY: Lot 16, Con. XI, Billings Twp.
PARENT MATERIAL: Calcareous, stonefree silt loam over limestone bedrock at depths of less than 1 foot.
CLASSIFICATION: Great Soil Group – Brown Forest
Soil Group – Orthic Brown Forest
Family – Ameliasburg
DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-4 inches silt loam; dark grey (10 YR 4/1); medium granular structure; friable consistency; moderately stony; pH – 6.8.
B_2 – 4-8 inches silt loam; yellowish brown (10 YR 5/6); weak medium nuciform; friable; stonefree; pH – 7.2.
C – 8-10 inches silt loam; pale brown (10 YR 6/3); laminar; firm; calcareous; pH – 7.8.
D – Limestone bedrock.

LITTLE CURRENT SERIES

LOCALITY: Lot 17, Con. XI, Howland Twp.

PARENT MATERIAL: Calcareous clay over shale bedrock at depths of less than 1 foot.

CLASSIFICATION: Great Soil Group – Brown Forest
Soil Group – Orthic Brown Forest
Family – Ameliasburg

DESCRIPTION: A_0 – Thin layer of partially decomposed leaves, twigs, etc.
A_1 – 0-4 inches clay; very dark grey (10 YR 3/1); fine nuciform structure; very plastic when wet, friable when dry; stonefree; pH – 6.5.
B_2 – 4-8 inches clay; very dark greyish brown (10 YR 3/2); very plastic when wet, very hard when dry; stonefree; pH – 7.2.
D – Shale bedrock.