SOILS OF THE RED ROSE-WASHOW BAY AREA

MANITOBA SOIL SURVEY

SOILS REPORT No. 19

1975

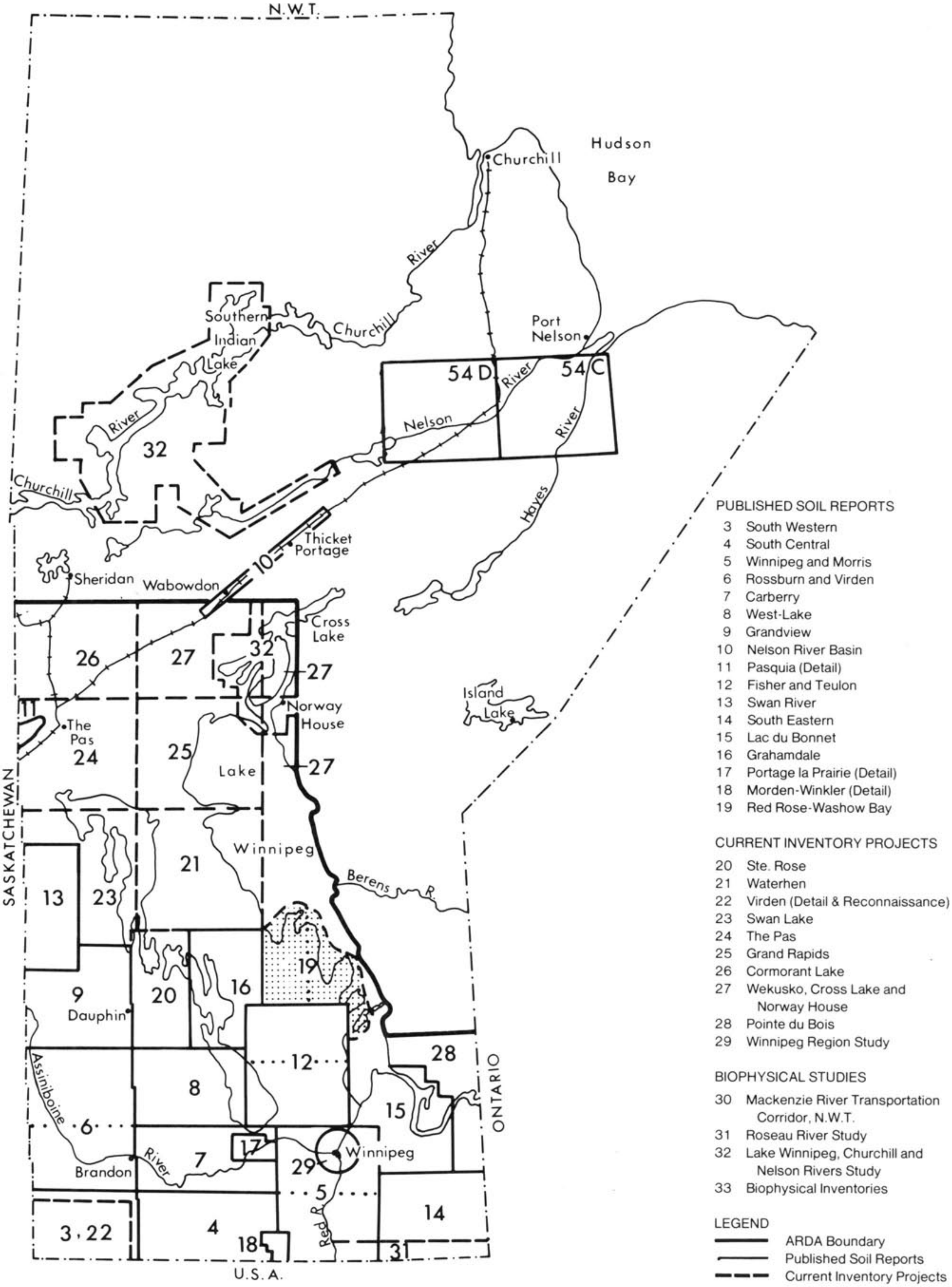

FIGURE 1
Current Status of Soil Survey Mapping Projects in Manitoba.

SOILS

of the

RED ROSE — WASHOW BAY AREA

by

R.E. SMITH, C. TARNOCAI and G.F. MILLS

MANITOBA SOIL SURVEY

CANADA DEPARTMENT OF AGRICULTURE

MANITOBA DEPARTMENT OF AGRICULTURE

MANITOBA DEPARTMENT OF MINES,
RESOURCES AND ENVIRONMENTAL MANAGEMENT

and

DEPARTMENT OF SOIL SCIENCE,
THE UNIVERSITY OF MANITOBA

Report published by the Manitoba Department of Agriculture
Map published by the Canada Department of Agriculture

PREFACE

The Report of The Soils of the Red Rose-Washow Bay Area is the nineteenth in a series of reports devoted to the description of soils in Manitoba. The purpose of the report and map is to supply basic information about the soils of the area, their distribution, their capability for agriculture, forestry and their properties affecting engineering uses, urban development planning and recreational developments.

This publication consists of two parts: a colored map and the report.

The soil map, published at the scale of one inch equals two miles, indicates the distribution and area of soil mapping units. These soil mapping units consist of soil series and phases of soil series. In most of the map area, the soil series and their phases occur in intricate patterns and in such small areas that they cannot be shown separately on the map at the small scale of one inch equals two miles. Such soil areas are shown as complexes of two or more soil series with a symbol for each component followed by a number representing the decile portion of that component in the complex. Mapping Units are colored according to the dominant soil series in the complex. A key to the color and map symbol designations appears in a descriptive legend along the side of the map.

Individual maps showing the relative suitability of limitations of soils for agriculture, forestry and engineering uses can be developed by using the soil map and interpretive information contained in the various sections of the report dealing with these evaluations.

The report is divided into six parts. Part I provides a general physical description of the area. Part II describes the physical features such as bedrock geology, relief, drainage, climate and vegetation that affect the development of soils. Part III deals with the factors affecting the formation of soils, the classification of soils, the method employed in mapping the soils and provides a detailed description of the physical, chemical and morphological features of the important soils in the map area. Part IV presents an evaluation of the soils in the area for agriculture. Part V provides interpretations and evaluations of the soils for forestry uses. Part VI describes the engineering properties of the soils and provides interpretations for numerous engineering and urban development planning applications.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to the following persons and agencies:

H.J. Hortie, Director, Manitoba Soil Survey, 1964 to 1968, who provided valuable assistance in conducting the Red Rose-Washow Bay soil study.

Dr. J. Shields and Mr. J.H. Day, Soils Research Institute, Ottawa, for critical review of the report.

The staff of the Cartographic Section, Soils Research Institute, Ottawa, for publishing the soils maps.

Mr. R. DePape, J. Griffiths, B. Lezak and N. Lindberg for compiling the original map manuscript and assisting in the preparation of the report.

Miss B. Stupak for typing and assisting in the preparation of the report.

Mr. E. St. Jacques for analytical assistance.

The soils were mapped by D.W. Anderson, G.J. Beke, A. LeSann, W. Michalyna, G.F. Mills, C. Tarnocai, F. Wilson and R.E. Smith. Those assisting in the field work were D. Besant, R. Esau, J. Ewanek, R. Hyrich, D. Smith, R. Snider, E. Thompson and W. White.

The Manitoba Department of Agriculture for publishing this report.

SUMMARY

The Red-Rose Washow Bay soil study covers an area of approximately 1,761,039 acres in the east central section of the interlake district of Manitoba. This sparsely populated area occurs on the extreme northeastern fringe of the agricultural region in the province.

The cold, subhumid continental climate of the area is less suitable for hard spring wheat and such special crops as corn and sunflowers because of cooler temperatures and shorter growing season. Mean annual maximum temperatures range from 42°F to 44°F; mean annual minimum temperature ranges from 24°F to 25°F; degree days above 42°F vary from 2400 to 2600; the freeze-free season above 32°F from 113 to 116 days. Annual precipitation ranges from 19 to 21 inches, about 60 to 70 percent occurs between April and October.

The cold subhumid climate and soil conditions have resulted in prevailing vegetation characteristic of the southern part of the Boreal Forest Region as delineated by Rowe. White spruce, black spruce mixed with aspen, some birch and jack pine are characteristic on well drained to moist mineral soils. Black spruce, tamarack with feathermosses, sphagnum mosses, ericaceous shrubs are common on wooded bogs; while sedges, reed grasses, bullrushes, cattails with willow and swamp birch clumps are found in treeless fens.

Soil parent material overlying dolomitic limestones of Silurian and Ordovician periods consists of extensive deposits of peat (46 percent of the total area); 20 percent thick loamy glacial till in the form of fluted moraines and drumlins; 22.5 percent shallow to thin lacustrine clayey sediments overlying the extremely calcareous, stony, regional till; and 4.5 percent deep to shallow sand and gravel outwash and beach deposits.

The dominant soils (46 percent) in the Red Rose-Washow Bay area consist of moderately well decomposed Typic Mesisols, Terric Mesisols, Mesic Fibrisols, Fibric Sphagno-Fibrisols and Terric Fibrisols. Somewhat poorly drained Gleyed Dark Greys (16 percent), poorly drained Rego Humic Gleysols (15 percent), well drained Degraded Eutric Brunisols (12 percent), Orthic Grey Luvisols (6 percent), and Orthic Dark Greys (approximately 5 percent) comprise the remainder.

Approximately 12 percent of the soils are in Agricultural Capability Class 2, the major problems being wetness due to inadequate natural drainage and very slow internal drainage. About 10 percent of the soils are in Class 3. These soils are dominantly clay textured and imperfectly to poorly drained. Approximately 12 percent of all soils in the area are in Class 4 because they are very stony and occur in areas of choppy ridge and swale topography. About 3 percent are in Class 5 and are very stony or poorly drained or are limited because of droughtiness. Class 6 soils (6.5 percent) are suitable for use only in their native state, consist of excessively stony soils, or are very rapidly drained, gravelly and sandy soils that lack natural fertility and are droughty. About 1.5 percent of the area comprise such miscellaneous land types as bedrock outcroppings, recent beaches and flooded marshes. These have no potential for agriculture.

Organic soils in their native state have little or no value for agriculture. Of the 46 percent of the land area consisting of these soils, about 12 percent could be placed in Class 3, about 6 percent in Class 4, 3 percent in Class 5, about 25 percent in Class 6.

Forest capability of the mineral soils in the map area, rated according to their capability to grow commercial timber or pulp, range from Class 3 to Class 5. The productivity on these soils ranging from 90 cubic feet per acre per year to 30 cubic feet per acre per year. The basic limitations to production being regional climate, excessive wetness, vegetative competition or droughtiness of soils. Organic soils range in Capability from Class 5 to Class 7. Productivity ranges from 50 cubic feet of wood production per acre per year to none. The basic limitation to production on these soils being excessive wetness and high water table.

Most of the problems in the use of the soils in the map area for engineering projects and urban development planning purposes are related to: (a) the extensive areas of very poorly drained organic soils (46 percent) that are very highly compressible and lack bearing strength; (b) the high content of clay or non-granular material in the soils, only 1.5 percent of the soil materials in the map area are granular; (c) the high shrink-swell potential, slow to very slow permeability and low to moderate bearing strength of the non-granular material; (d) the high seasonal water table that affects all but the well drained mineral soils in the area.

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PART I
GENERAL DESCRIPTION OF AREA

A. LOCATION AND EXTENT

The Red Rose-Washow Bay map area lies in the eastern central portion of the Interlake district of Manitoba. The location of the area mapped, with respect to other published soil map areas, is shown in Figure 1. The Red Rose-Washow Bay map includes Townships 26 to 36 in Ranges 1 east to 4 west, Townships 26 to 35 in Ranges 5 west and 2 east, Townships 26 to 33 in Ranges 3 east and 4 east, Townships 23 to 32 in Ranges 5 east, Townships 23 to 30 in Range 6 east, and Townships 25 to 27 in Ranges 7 east and 8 east. The map area covers 1,761,039 acres (Lake Winnipeg not included) and includes portions of the Local Government District of Fisher and Unorganized Territory (See Figure 2).

B. POPULATION

The total population for the Red Rose-Washow Bay area is approximately 3,245 based on the 1971 Canada Census. Of this total, approximately 500 live outside of Indian Reserves, whereas Indian Reserve residents number about 2,744 or approximately 85 percent of the total population (See Table 1).

TABLE 1

Population of the
Red Rose-Washow Bay Area

Indian Reserve Residents	**Population (1971)**
Fisher River (1.R. 44, 44A)	906
Jack Head (1.R. 43, 43A)	269
Peguis (1.R. 1B, 1C)	1,540
Little Saskatchewan (1.R. 48A)	29
	2,744
Non-Indian Reserve Residents	501
TOTAL	3,245

This represents a population density of about 1.2 persons per square mile. Approximately 35 percent of these people live in the villages, hamlets and small settlements of Annama Bay, Dallas, Gull Harbour, Harwill, Hecla, Hodgson, Jack Head, Koostatak, Matheson Island, Pine Dock, and Red Rose. The density, however, varies greatly in different portions of the map area (See Figure 2). The Jack Head and Fisher River Indian Reserves have the highest density, being 89 and 50 persons per square mile, respectively. These are followed by the Peguis Indian Reserve and Matheson Island with 12 to 9 persons per square mile and Hecla Island with less than 1 person per square mile. The population density .of the lakshore lot settlements around Pine Dock, and the small agricultural settlements along the Fisher River area, but outside the Indian Reserves, falls between 1 and 3 persons per square mile. The rest of the map area is uninhabited.

C. TRANSPORTATION AND MARKETS

The more densely populated agricultural area, which occurs on the southern fringe of the map sheet, is fairly well provided with roads, but has no rail facilities (Figure 2). Thus, most of the communities have only road service to the Winnipeg market. These roads are only secondary all weather gravel roads. The rest of the map area, covered by forest vegetation and muskeg, has very limited transportation facilities.

Along Lake Winnipeg and on Matheson and Hecla islands, commercial fishing is the main industry. Most of the fish produced is transported to markets outside of the map area. The principal market and processing facilities are located at Winnipeg, approximately 50 miles south of the map area.

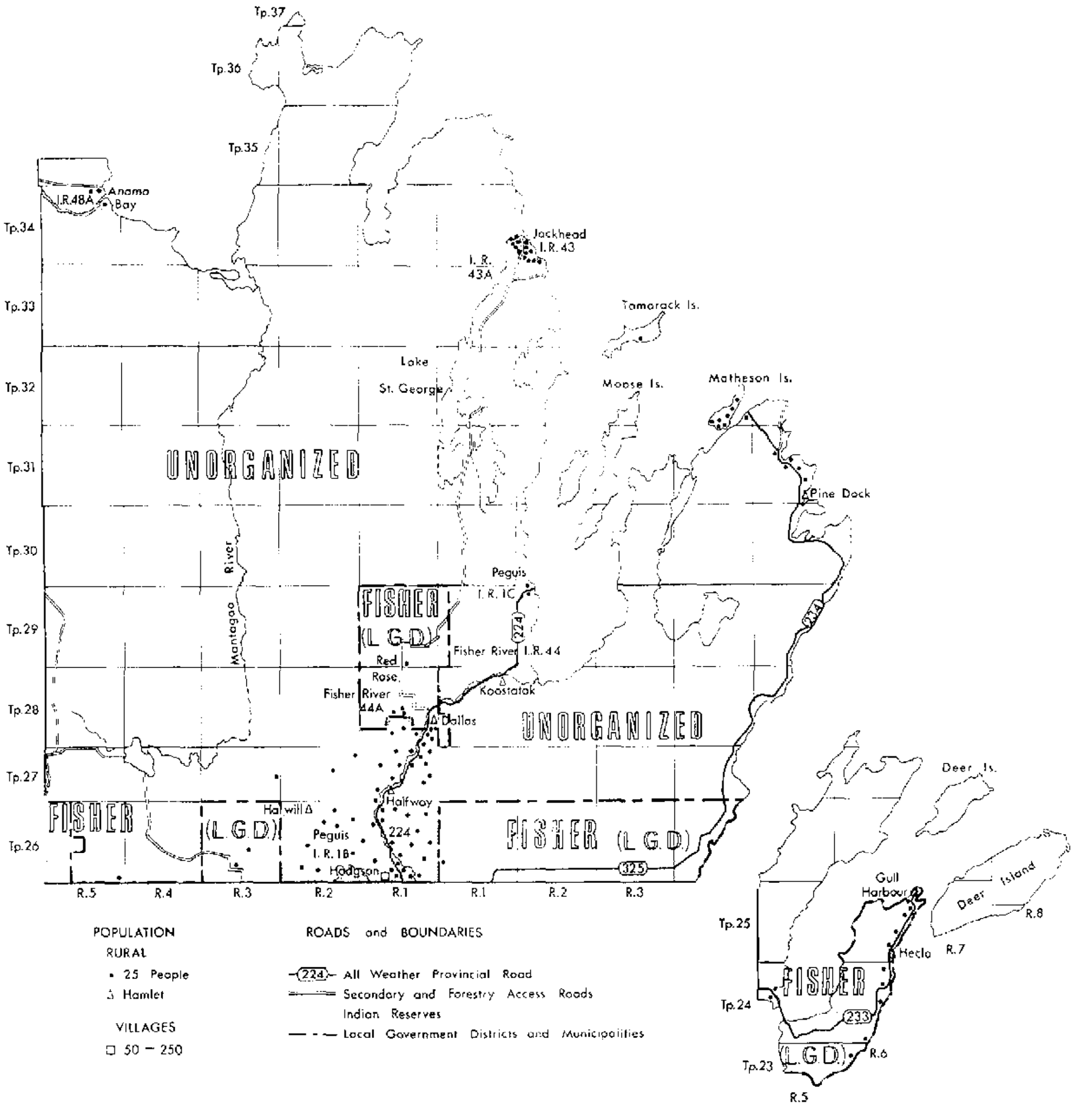


FIGURE 2

Indian Reserves, Local Government District, Distribution of Population and Main Transportation Routes in the Red Rose-Washow Bay Area.

PART II
FACTORS EFFECTING SOIL FORMATION

The principal factors affecting soil formation are: climate, vegetation, parent material, relief, and drainage. The type of soil formed at any one place is dependent upon the interaction of these factors, the length of time they have been operative, and the modifications resulting from the work of man.

A. RELIEF AND DRAINAGE

The principal relief and drainage systems of the Red Rose-Washow Bay Map area are shown in Figure 3 and Figure 4.

There are no prominent relief features in the map areas. The highest land is in the western portion, where the elevation ranges from 900 to 1,000 feet above sea level (a.s.l.). From there it slopes gently north to Lake Winnipeg (712 feet a.s.l.). The western section is characterized by highly intersected till plain, with a series of beaches occurring above the 800 foot contour. The middle part of the map area is drumlinized and has a low ridge and swale topography with a general north to south linear pattern, lying across the general direction of land fall. This has a major damming effect on drainage. The sturgeon and Washow Bay areas are generally level to very gently sloping and poorly drained.

The surface drainage is poorly developed over the map area. The Fisher, Montagao, Jack Head and Dauphin Rivers and Moose Creek, together with their contributory ditches, provide some drainage for the area. These streams flow north to northeast through shallow channels, swamps, and peatlands into Lake Winnipeg. Local flooding often occurs during the spring thaw and after heavy rains. There is no continuous drainage in the till plain area on the western part of the map. The runoff from the ridges collects in the adjoining swales or in the larger peatlands and intermittent lakes. More continuous drainage, however, is found in the drumlinized central section of the area.

B. GEOLOGY AND SOIL PARENT MATERIALS

A surface mantle of unconsolidated rock materials covers the bedrock formations throughout most of the Red Rose-Washow Bay map area. These unconsolidated materials are composed of rock fragments derived from bedrock formations through the action of continental ice sheets which completely covered Manitoba in recent geological times. The ice sheets picked up and transported huge quantities of materials from the bedrock formations over which they passed. When the ice sheets melted these rock materials were deposited as glacial drift in various forms. These drift deposits constitute the parent materials from which the soil have been developed.

(i) Geology of the Underlying Rock:

The bedrock formation of the Red Rose-Washow Bay map area is illustrated in Figure 5. The map area is underlain by Paleozoic limestones and dolostones of the Silurian and Ordovician periods. These limestones and dolostones contribute to the calcareous materials that make up the surface deposits of a large part of the area. Precambrian granitic and volcanic rocks appear in the map area only as isolated, very small outcroppings.

(ii) Surface Deposits and Physiographic Areas:

The distribution of the surface deposits and the physiographic subdivisions of the area into physiographic units is shown in Figure 6 and 7.

The Red Rose-Washow Bay area is divided into two physiographic subdivisions on the basis of landforms and surface deposits; the Interlake Till Plain in the western section of the map area consisting dominantly of water-worked, fluted, ground moraine and the Lake Winnipeg Lowland consisting of drumlinized ground moraine and lacustrine deposits in the eastern section.

The Interlake Till Plain (1) is a strongly intersected, fluted, till plain, characterized by ridge and swale topography and various thicknesses of loamy textured, water-worked, ground moraine. In some portions of the area limestone bedrock outcrops are found at the surface or are covered by only a thin mantle of glacial drift. Beach deposits are common in this area and all of the soils are very stony. The native vegetation consists mainly of a poor growth of hardwoods, but spruce and pine stands are also common.

The Lake Winnipeg Lowland (2) generally occupies the area below the 800 foot (a.s.l.) contour and is divided into three physiographic units: Fisher River Plain, Sturgeon Bay Lowland, and Icelandic River Plain.

Fisher River Plain (2a) is a level, to gently undulating, area consisting of shallow lacustrine deposits over till. The lacustrine deposits found along the Fisher River are strongly calcareous, medium textured sediments, and are usually greater than 30 inches thick. More recent alluvial deposits, found near the river, are also medium textured and strongly calcareous. A large portion of

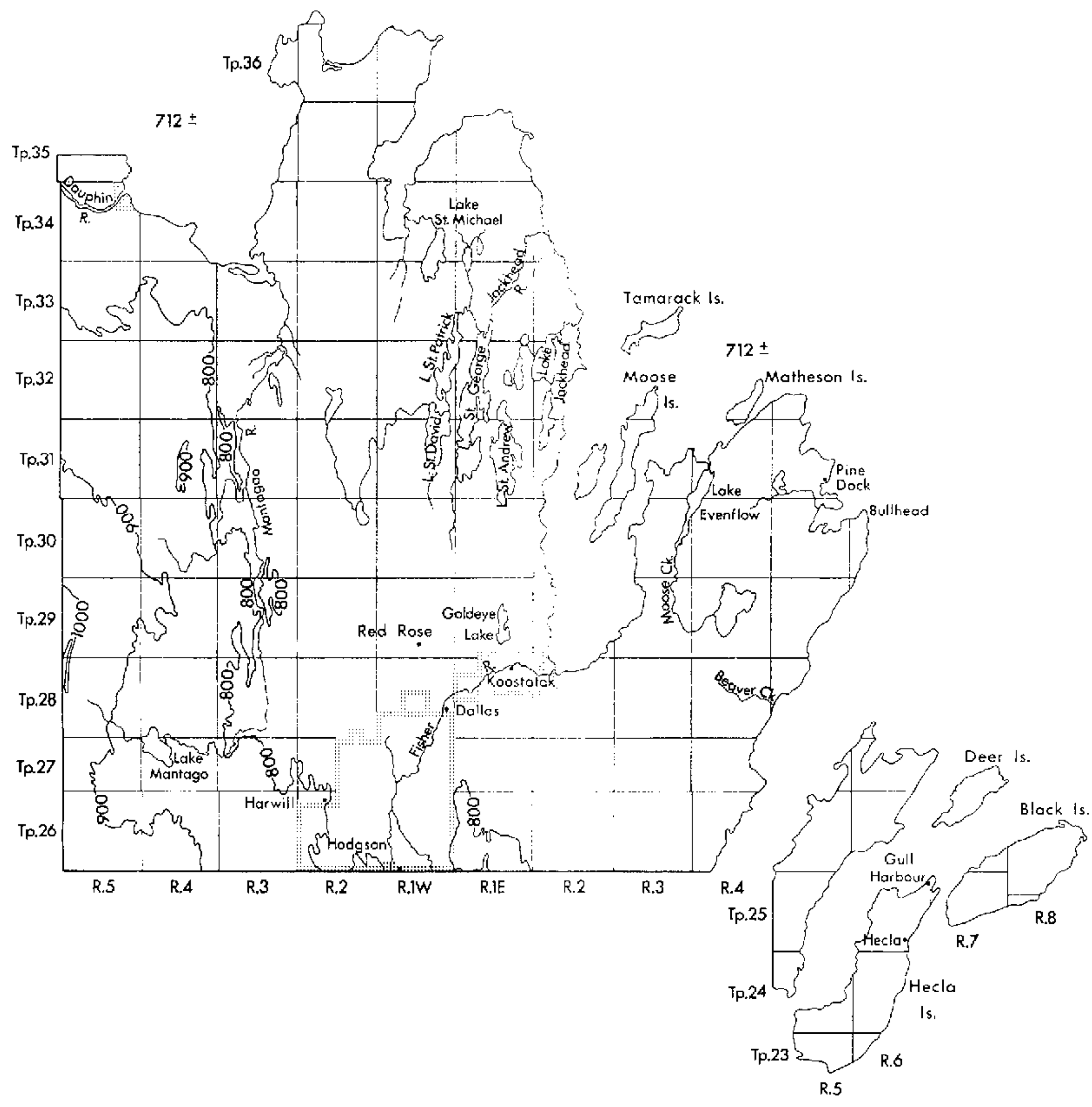


FIGURE 3

Contour Map and Principal Drainage Systems of the Red Rose-Washow Bay Area.

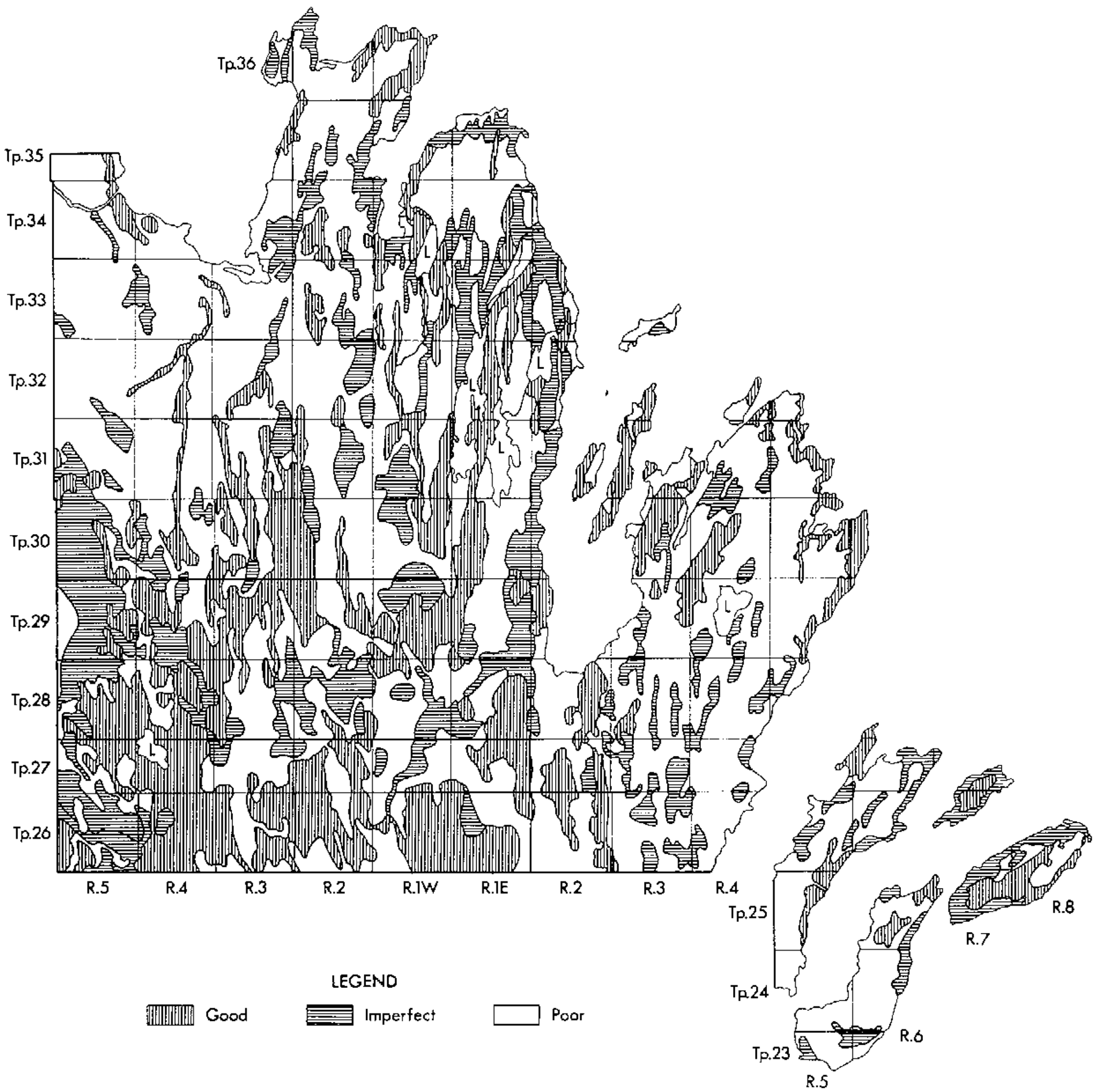


FIGURE 4
Distribution of Surface Drainage Condition
in the Red Rose-Washow Bay Area.

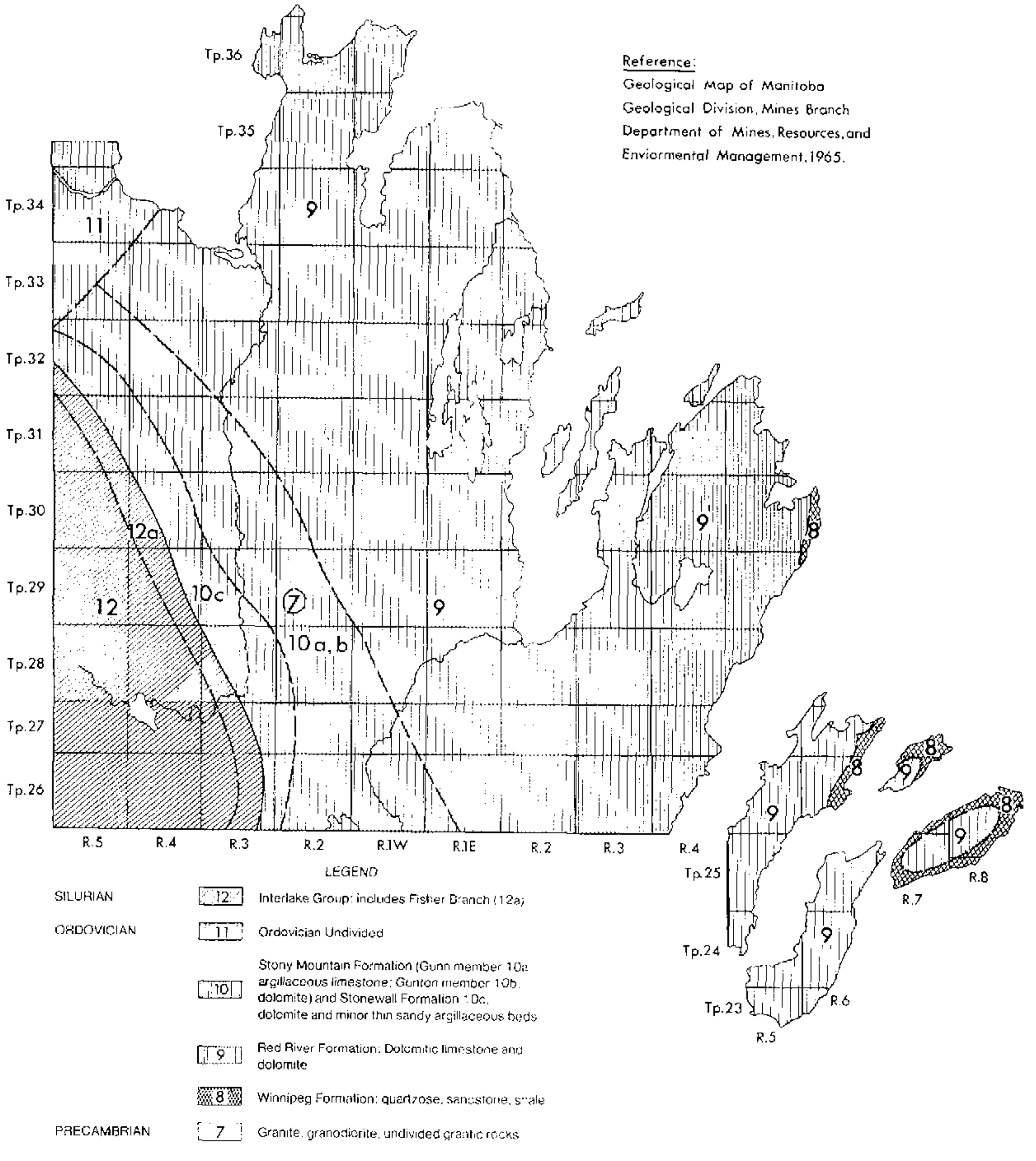


FIGURE 5

Bedrock Formations Underlying the Red Rose-Washow Bay Area.

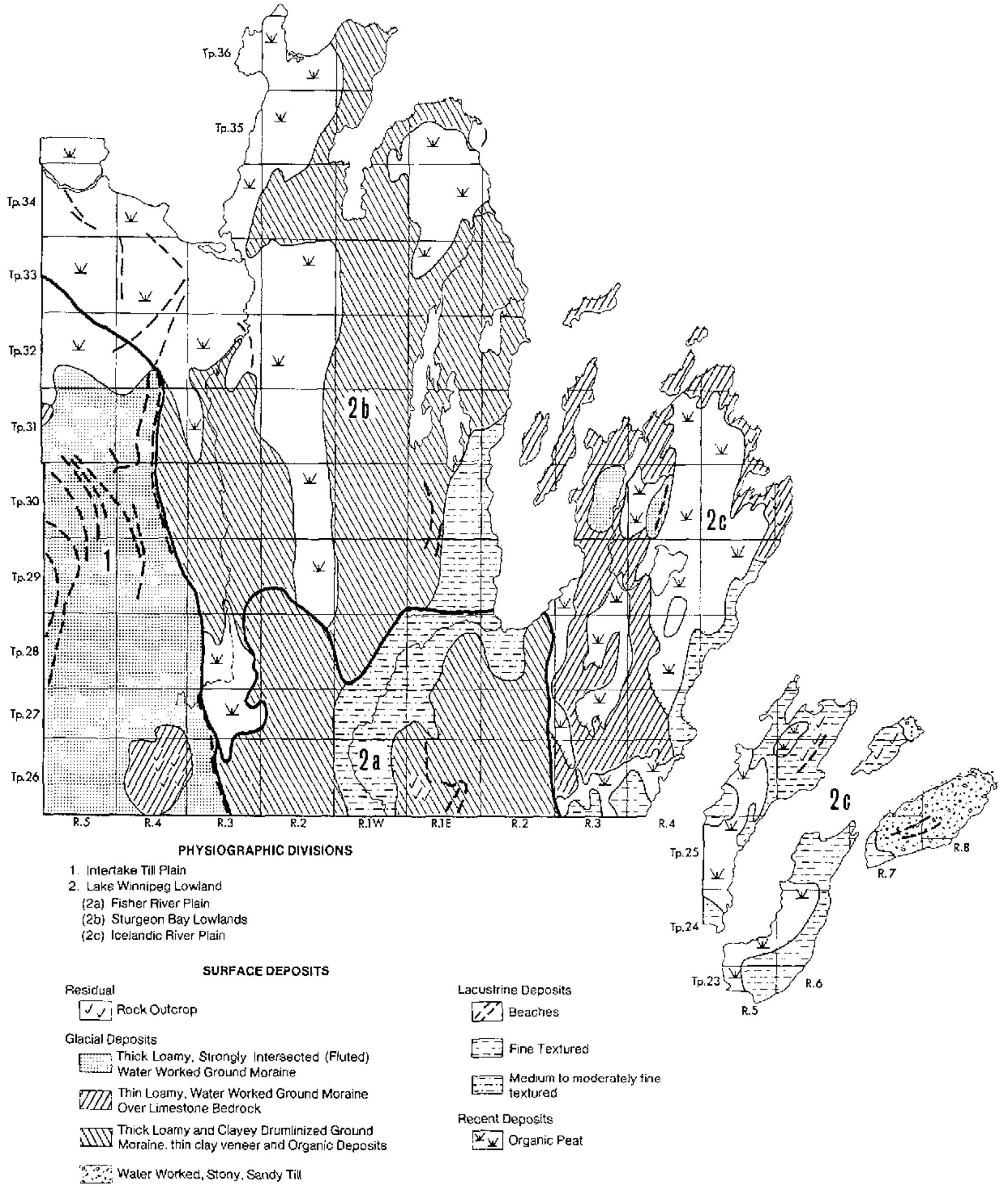


FIGURE 6

Physiographic Subdivisions and Distribution of Surface Deposits in the Red Rose-Washow Bay Area.

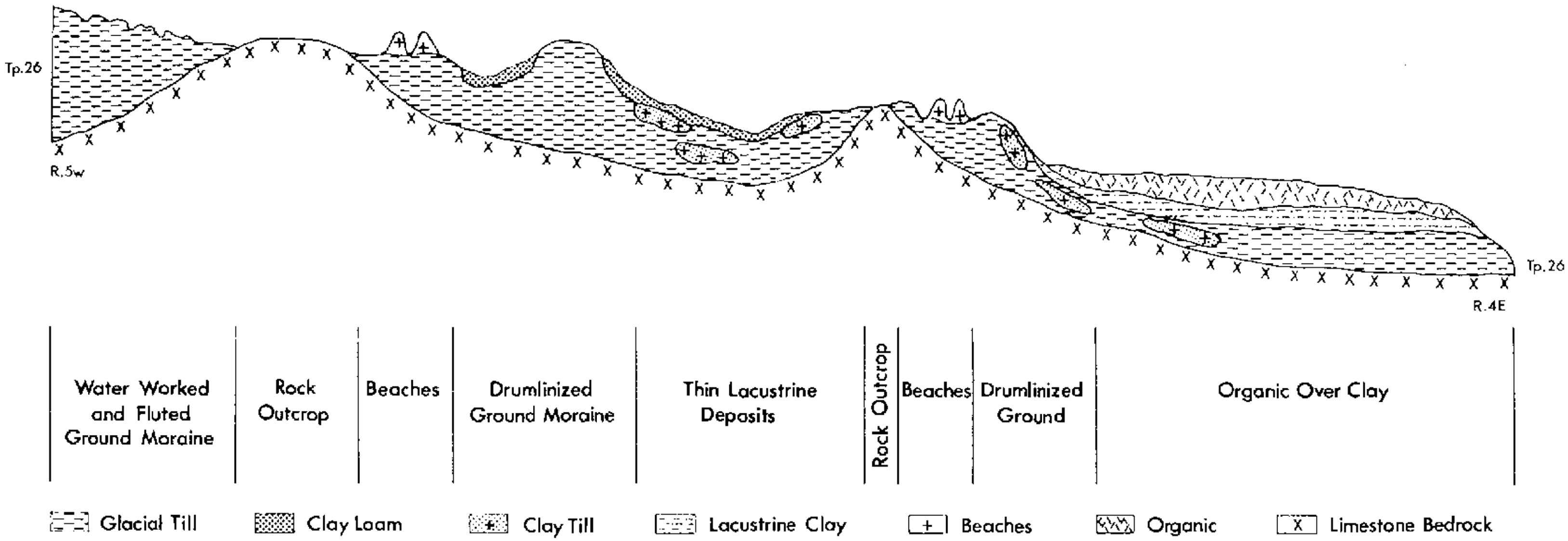


FIGURE 7
Schematic Cross-Section of Surficial Deposits from West to East in the Center of the Red Rose-Washow Bay Area.

this unit is occupied by prominent narrow north to south oriented drumlins. The surface deposits consist dominantly of thick, loam to clay textured, ground moraine on the ridges and thin, fine to moderately fine textured lacustrine deposits overlying strongly calcareous galcial till in the swales. The drainage is rapid on the drumlins and imperfect to poor in intervening swales. In the eastern portion of the plain surface deposits are extremely stony and calcareous, and a few limestone outcrops and beach deposits are also found. The native vegetation consists dominantly of hardwoods with a small amount of spruce.

The Sturgeon Bay Lowland (2b) is a level to gently undulating, moderately drumlinized area. The surface deposits consist dominantly of various thicknesses of lacustrine sediments over till in the low lying areas. On the other hand, the apices of the drumlin ridges consist of extremely calcareous till deposits. Moderately deep to deep organic deposits over lacustrine clay are common in the low lying area near Sturgeon Bay. The drainage is generally poor except for the drumlins and gravel beaches. The native vegetation is dominantly black spruce and black and white spruce mixed with aspen on the low lying areas, and jack pine on the dry uplands.

The Icelandic River Plain (2c) includes Moose, Little Moose, Tamarack, Matheson, Black Bear, Hecla, Deer and Black Islands. The area is depressional to very gently sloping and consists dominantly of deep acidic organic deposits underlain by deep lacustrine clay. The upland areas consist of extremely calcareous, water-worked moraine deposits. Some limestone outcrops are found in the Biscuit Bay area and in the southeastern part of the unit. On the extreme eastern shoreline of Black and Deer Islands the surface deposits consist mainly of siliceous sandy materials originating from quartzose sandstone of the Winnipeg formation. The vegetation in the southern part of the unit is dominantly black spruce and mixed wood.

C.CLIMATE

In relation to worldwide climatic conditions, the Red Rose-Washow Bay area is within the region classified as Dfb[1]. This is an area lying in the centre of the continent, a great distance from oceans and their moderating effect on termperatures. Summer and annual temperatures are higher, winter temperatures are lower, and the annual temperature range is much greater than the world average for the latitude. The area is sub-humid and has a definite summer maximum of precipitation. Approximately 70 percent of the precipitation falls as rain during the period from April to October and about 30 percent as snow during the five winter months from November to March.

(i) Temperature:

The temperature data was obtained by the Agrometeorology Section, Plant Research Institute, using a special computer program to calculate point data for the Canadian Great Plains.[2]

The monthly mean maximum and minimum temperatures and geographical location of the computed points are presented in Table 2. The mean maximum winter temperatures are below freezing, and the mean minimum winter temperatures are below zero. The mean maximum summer temperatures are above 70°F while the mean minimum temperatures are above 50°F in July and August and between 49° and 50°F in June.

The transition from winter to summer is abrupt, generally occurring in April while the change from summer to winter normally occurs in October. While the average monthly temperatures indicate the general conditions of a short, warm summer and long, cold winter, one of the main characteristics of the climate is the great variation in both seasonal and daily temperatures. Temperatures are especially variable during the spring and fall seasons, when the region is affected by a series of low pressure centres passing along the Polar front between the cold and warm air masses. The daily temperature range is normally 15° to 20°F, but more drastic changes often accompany frontal disturbances during the fall, winter and spring seasons.

Degree-Days-Temperature is a good index of the amount of energy available to plants from the sun. Degree-days, sometimes called "heat units", are the accumulation of daily mean air temperatures above a certain base value (See Table 4). For example, if the daily average temperature were 68°F, the number of degree-days in the map area ranges from 2,837 to 2,882 (See Table 3). The map of seasonal accumulations of degree-days can be used to determine whether a particular crop is likely to mature in a given area.

The freeze-free period and the season with temperatures above 42°F are presented in Table 4. The number od days above 42°F, often referred to as the vegetative season, varies from 166 to 172 days. The freeze-free season above 32°F ranges from 113 to 116 days.

The values given are typical of the area, but considerable variation often occurs — for example: frosts are lighter on slopes than on a valley floor; soils that are light in color reflect sunlight thus

[1] W. Koppen and Geiger, Handbuch der Klimatologie, Bond 1, Teil C. Gebuder Borntraeger, Berlin, 1936.

[2] G.D.W. Williams and W.R. Sharp. 1967. A program to estimate normals of temperature and related agroclimatic elements for locations in the Canadian Great Plains. Agr. Met. Tech. Bull 11. Plant Res. Inst., Can. Dept. Agr., Ottawa.

TABLE 2

Mean Maximum and Minimum Temperatures (^{O}F) and Geographic Location of the Computed Points 3

No.	Latitude	Longi tude	Elevation (feet) (a.s.l.)		Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Yearly
225	51 13'	97 2'	730	Mean Max	7	14	27	45	61	70	77	74	62	50	28	14	44
				Mean Min	-11	-7	5	26	40	50	56	54	44	34	16	-2	25
226	51 13'	97 28'	789	Mean Max	7	13	27	45	62	71	77	75	62	50	28	14	44
				Mean Min	-11	-7	5	26	34	50	56	53	43	33	15	-2	25
227	51 13'	97 53'	920	Mean Max	7	13	26	45	62	70	77	75	62	50	28	14	44
				Mean Min	-11	-8	4	26	39	49	55	53	43	33	15	-2	25
316	51 53'	97 16'	715	Mean Max	5	13	26	44	60	70	76	73	61	48	27	12	43
				Mean Min	-12	-9	3	25	39	49	56	53	44	33	15	-3	25
345	51 30'	97 17'	713	Mean Max	6	13	27	45	61	70	77	74	62	49	27	13	44
				Mean Min	-11	-8	4	26	39	50	56	53	44	34	15	-2	25
348	51 48'	97 36'	771	Mean Max	6	13	26	44	61	70	76	74	61	49	27	12	43
				Mean Min	-12	-8	3	25	39	49	55	53	43	33	15	-3	24
361	52 27'	97 57'	719	Mean Max	5	12	26	44	60	60	76	73	60	48	26	11	42
				Mean Min	-13	-9	2	25	39	49	55	53	43	33	14	-4	24

[3] Williams/Hopkins, Agroclimatic Estimates for 1180 points on Canadian Great Plains. Prepared by Agrometerology Section, Plant Research Inst., Res. Branch, Can. Agr., Ottawa, June 18, 1968.

TABLE 3

Degree-Days Above $42^{O}F$ [4]

No.	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Year	Total May 1st to Sept 30th
225	0	0	2	108	238	543	756	683	346	128	33	0	2882	2611
226	0	0	2	103	281	542	757	682	344	126	30	0	2867	2606
227	0	0	0	109	284	534	751	674	336	124	29	0	2841	2579
316	0	0	0	98	262	522	739	664	325	122	19	0	2751	2512
345	0	0	0	101	278	536	751	677	340	129	25	0	2837	2582
348	0	0	0	96	267	523	741	664	326	122	19	0	2758	2521
361	0	0	0	83	256	508	728	650	311	114	24	0	2674	2453

[4] Williams/Hopkins, Agroclimatic Estimates for 1180 points on Canada Great Plains. Prepared by Agrometerology Section, Plant Research Inst., Res. Branch, Can. Agr., Ottawa, June 18, 1968.

tending to remain cool during the day and therefore, they have a relatively low heat content; dry porous soils are unable to transfer heat rapidly to the surface and so are more susceptible to frost.

(ii) Precipitation:

There is no precipitation data available for the map area. The nearest Meteorlogical Stations are found at Berens River, Gimli and Moosehorn.

The mean monthly and annual precipitations recorded at these stations are presented in Table 5. The recorded average annual precipitation at these stations is slightly under 20 inches. There is a progressive decrease in annual precipitation from south to north with that at Gimli being 21.57 inches, at Moosehorn 19.68 inches and at Berens River 19.38 inches. June appears to be the wettest month of the year, but rainfall fluctuates widely from year to year and at Gimli the precipitation was 1.1 inches in June, 1946 and 7.0 inches in June, 1944. The total yearly precipitation has ranged from 15.0 inches in 1948 to 27.1 inches in 1958.

The distribution of precipitation during the summer months from April to October is as follows: Berens River, 14.39 inches; Gimli, 15.90 inches; and Moosehorn, 14.18 inches. During the winter months from November to March the distribution is:

TABLE 4

Season Above 42°F and Freeze-Free Season [5]

No.	Season above 42.0°F	Number of days	Hours of daylight	Freeze-free season (32°F)	Number of days	Hours of daylight	Freeze-free season (28°F)	Number of days	Hours of daylight
225	Apr 26 to Oct 15	172	2574	May 24 to Sept 17	116	1804	May 14 to Sept 29	138	2107
226	Apr 26 to Oct 15	172	2574	May 24 to Sept 17	116	1804	May 14 to Sept 28	137	2095
227	Apr 26 to Oct 14	171	2563	May 25 to Sept 15	113	1763	May 15 to Sept 26	134	2056
316	Apr 28 to Oct 14	169	2552	May 24 to Sept 17	116	1822	May 15 to Sept 28	136	2100
345	Apr 27 to Oct 14	170	2567	May 24 to Sept 17	116	1822	May 15 to Sept 29	138	2127
348	Apr 28 to Oct 14	169	2552	May 25 to Sept 16	114	1793	May 15 to Sept 28	136	2100
361	Apr 30 to Oct 13	166	2512	May 25 to Sept 16	114	1793	May 15 to Sept 28	136	2100

[5] Williams/Hopkins, Agroclimatic Estimates for 1180 points on Canadian Great Plains. Prepared by Agrometeorology Section, Plant Research Inst., Res. Branch, Can. Agr. Ottawa, June 18, 1968.

TABLE 5

Monthly and Annual Precipitation in Inches [3]

	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Yearly Mean
Berens River*	0.77	0.92	1.09	1.20	1.31	2.53	2.16	2.20	3.13	1.86	1.30	0.91	19.38
Gimli***	0.96	0.73	0.94	0.92	2.00	3.38	2.91	2.64	2.30	1.75	1.52	1.52	21.57
Moosehorn*	1.10	0.82	1.18	1.10	1.62	3.39	2.01	2.40	2.01	1.65	1.45	0.95	19.68

* Normals were computed directly from a period of record of 20 to 30 years within the period 1921-1950.

*** These averages are based on a period of record of 16 years with no adjustments.

[3] Temperature and Precipitation Normals for Canadian Weather Station based on the period 1921-1950. By Climatology Division — Meteorlogical Branch — Department of Transport — Canada, June 1959 (mimeographed circular).

Berens River, 4.99 inches; Gimli 5.67 inches; and Moosehorn, 5.50 inches. The precipitation received during the winter months is mainly in the form of snow as a result of frontal storms, usually accompanied by high winds and drifting conditions. The spring and fall precipitation is usually of the frontal type in the form of light rains of long duration. On the other hand, the precipitation in June, July and August is heavy, local thunderstorms of short duration.

D. VEGETATION

The area covered by the Red Rose-Washow Bay map sheet lies within the southern part of the Boreal Forest Region in the Manitoba Lowland Section (B.15), as delineated by Rowe[1]. The distribution of native vegetation throughout the map area is shown in Figure 8.

The characteristic species of the Boreal Forest Region are white and black spruce (*Picea glauca* (Moench) Voss and *P. mariana* (Mill) B.S.P.). White spruce occurs on fresh to moist sites, mainly on mineral soil and very frequently mixed with other tree species, mostly aspen (*Populus tremuloides*-Michx), balsam fir (*Abies balsamea* (L.) Mill), black spruce and white birch (*Betula papyrifera* Marsh). The most common species in the understory are hazel (*Corylus americana* Walt), mountain maple (*Acer spicatum* Lam.), snowberry (*Symphoricarpos albus* (l.(Blanke), *Pryola.* sp., *Equisetum* sp. and *Hylocomium splendens* (Hedw.) B.S.G.

In the southern part of the map area black spruce is found on wet, poorly drained sites, dominantly on organic soils; going northward there is an increasing tendency for black spruce to occupy drier sites. On slightly better drained sites black spruce is associated dominantly with the feather mosses, chiefly *Hylocomium splendens*, *Pleurozium schreberi* (B.S.G.) Mitt., and *Hypnun crista-castrensis* Hedw., while *Dicranum* sp. and-*Polytrichum* species play lesser roles. Labrador-tea (*Ledium groenlandicum* Oeder), bog-rosemary

[1] J.S. Rowe, 1959. Forest Regions of Canada. Canada Dept. of Northern Affairs and Natural Resources, Forestry Branch, Ottawa, 1959. Bulletin 123.

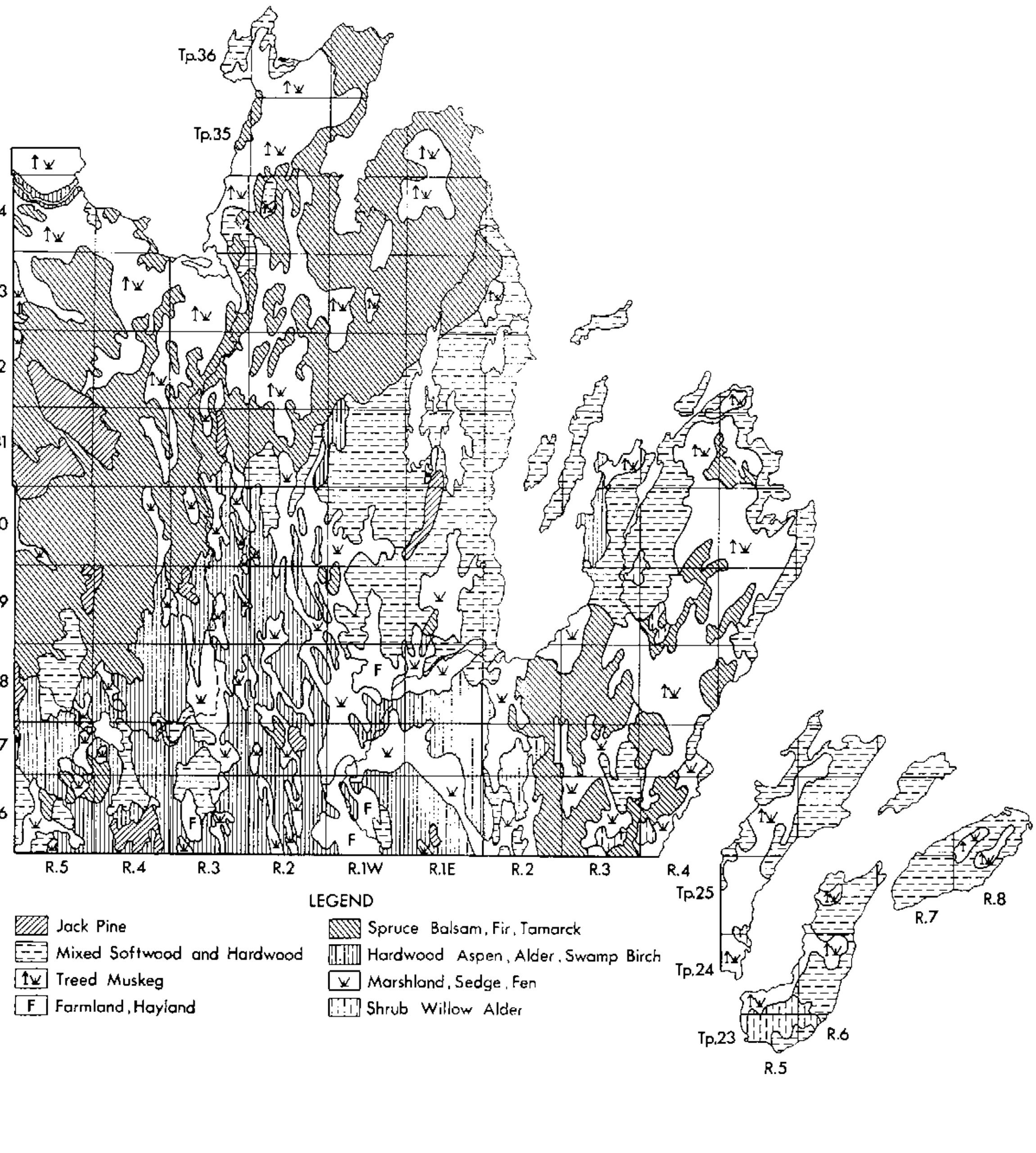


FIGURE 8

The Distribution of the Prevailing Vegetation in the Red Rose-Washow Bay Area.

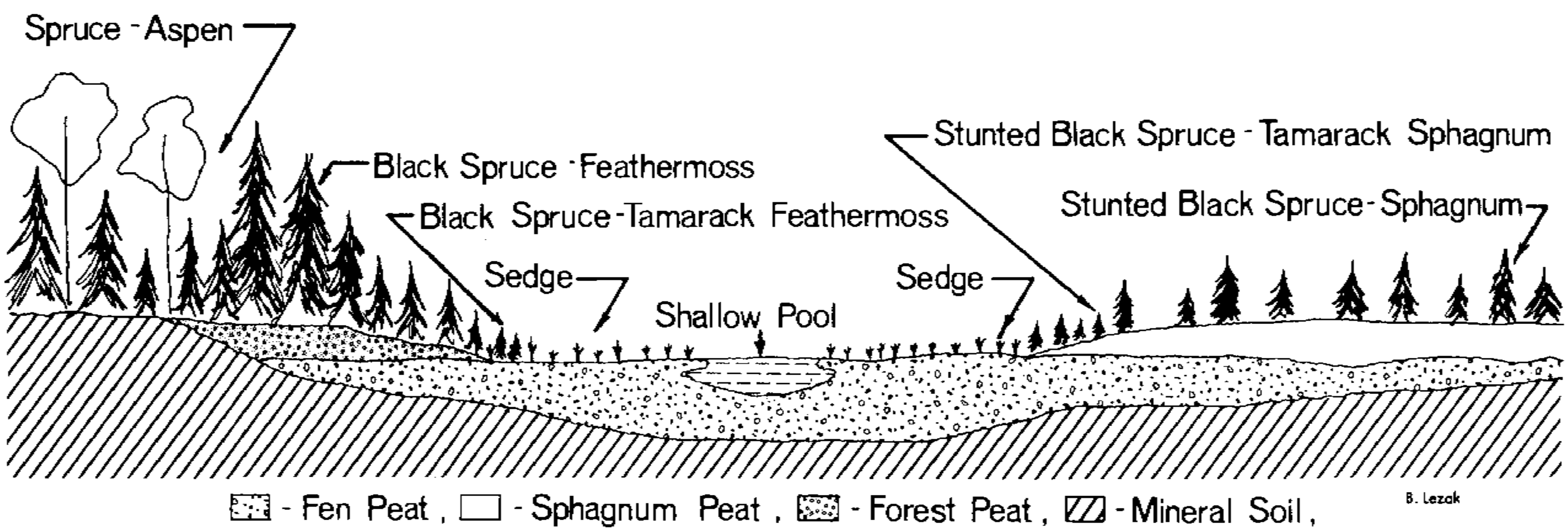


FIGURE 9
A Schematic Cross-Section of a Peatland in the Red Rose-Washow Bay Area.

Andromeda glaucophylla Link), bog Laurel *Kalmia polifolico* Wang.) and dwarf birch (*Betula glandulosa* Michx.) are found in the shrub layer (Figure 9).

Another common site type occurs in marginal areas and in drainage channels, where tamarack (*Larix laricina* (Du Roi) K. Koch) and alder (*Almus rugosa* (Du Roi) Spreng.) are mixed with black spruce.

As a result of repeated fires and logging, the southern part of the Red Rose area consists chiefly of hardwood species, dominantly aspen, on the fresh and moist sites. These aspen communities represent an intermediate stage of the vegetation succession, which occurs after fires or logging. Associated with the aspen are balsam poplar (*Populus balsamifera* L.) white spruce, white birch and balsam fir. In the understory dogwood (*Cornus stolonifera*, Michx.), hazel and *Galium* sp. are the most common species.

The dry areas, generally on low ridges, are forested by pure stands of jack pine (*Pinus baksiana* Lamb.) or jack pine mixed with white birch (*Betula papyrifera* Marsh). Similar dry sties in the southern part of the map area are stocked with bur oak (*Quercus macrocarpa* Michx.). In the understory creeping juniper (*Juniperus horisontalis*-Moench), bearberry (*Arctostaphylos uva-ursi* (L) Spreng.), Rose spp., hazel and snowberry are the dominant species. Pure stands of jack pine may be established on dry to fresh sandy or loamy soils after fires.

On the better drained sites along the rivers and drainage channels elm (*Ulmus americana* L.), green ash (*Fraxinus pennsylvanica* var. *lanceolata* (Borkh.) Sarg.), Manitoba maple (*Acer negundo* L.) and balsam poplar were commonly found.

The vegetation of bog peatlands is highly specialized, acidophilous, and poor in species of flowering plants. The most common species are stunted black spruce with an understory of *Sphagnum* mosses and ericaceous shrubs.

The fen peatlands have richer and more varied vegetation, composed largely of species not present in bogs. This indicates a better nutritional status and less acid conditions than is found in bogs. The characteristic species are sedges (*Carex* sp.), *Drepanocladus intermedius* (Lindb) Warns., reed grasses, bullrishes, cattails, willow and swamp birch. The schematic cross-section of a peatland is shown in Figure 9.

PART III
SOILS

The soils that have developed under the influence of the soil forming factors described in Part II exhibit physical characteristics which reflect their environment. Through observation of these characteristics, it is possible to classify soils in accordance with their genesis or the processes involved in their formation. Such a classification scheme permits the grouping of soils into natural units. The recognition of these units is dependent on the study of the soil profiles.

A. THE SOIL PROFILE

The soil profile is a vertical section of the soil through all its horizons (or layers) extending downward into the unweathered material. The soil horizons differ from one another in one or more of the following features: colour, texture, structure, consistence, reaction, concretions and chemical and biological composition. The master horizons are designated by L, F, H, A, B and C. Lower case letter suffixes are used to indicate the type of horizon and Arabic numeral suffixes are used when further division into sub-horizons are required. If the soil is developed from two or more nonconforming parent materials, Roman numeral prefixes are used to indicate the lithological changes. Examples of the use of these horizon symbols are given in Figure 10.

TABLE 6
Definition of Soil Horizon Symbols

ORGANIC LAYERS

Organic layers may be found at the surface of the mineral soils or at any depth beneath the surface in buried soils or overlying geologic deposits. They contain more than 30% organic matter. Two groups of these layers are recognized:

O — This is an organic layer or layers developed under poorly drained conditions, or under conditions of being saturated most of the year, or on wet soils that have been artificially drained.

- Of —This is the least decomposed layer. It has large amounts of well-preserved fiber that is readily identifiable as to its botanical origin. This layer, called fibric, has a rubbed fiber content of more than 4/10 of the organic volume and an unrubbed fibre content of more than 2/3 of the organic volume.
- Om —This is the intermediately decomposed layer. It has intermediate amounts of physically and biochemically altered fiber. This layer, called mesic, has (i) a rubbed fiber content between 1/10 and 4/10 of the organic volume, and (ii) an unrubbed fiber content of more than 1/3 of the organic volume.
- Oh —This is the most highly decomposed layer. It has the least amount of plant fiber, the highest bulk density, and the lowest water-holding capaicty. This layer, called humic, has (i) a rubbed fiber content of less than 1/10 of the organic volume, and (ii) it usually yields a pyrophosphate extract that is lower in value and higher in chroma than 10YR 7/3.

L-F-H — These organic layers develop primarily from leaves, twigs, woody materials and a minor component of mosses under imperfectly to well drained forest conditions.

- L —This is an organic layer characterized by an accumulation of organic matter in which the original structures are easily discernible.
- F —This is an organic layer characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The layer may be partly comminuted by soil fauna as in moder[1] or it may be a partly decomposed mat permeated by fungal hyphae as in mor[1].
- H —This is an organic layer characterized by an accumulation of decomposed organic matter in which the original structures are indiscernible. This material differs from the F layer by its greater humification chiefly through the action of organisms. This layer, recognized as moder[1], is a zoogenous humus form consisting mainly of spherical or cylindrical droppings of microarthropods and which, at the junction with the mineral soil but frequently throughout the layer, is intermixed with loose mineral grains.

FIGURE 10

An Example of the Use of Horizon Nomenclature.

[1] B. Bernier. 1968. Soils under forest. Proceedings of the Seventh Meeting of the National Soil Survey Committee of Canada.

MASTER MINERAL HORIZONS

Mineral horizons are those that contain less organic matter than that specified for organic horizons.

A —This is a mineral horizon or horizons formed at or near the surface in the zone of removal of materials in solution and suspension or of maximum in situ accumulation of organic matter, or both. Included are:

1) horizons in which organic matter has accumulated as a result of biological activity (Ah);
2) horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of them (Ae);
3) horizons having characteristics of 1) and 2) above but transitional to underlying B or C (AB or A and B);
4) horizons markedly disturbed by cultivation or pasture (Ap).

B —This is a mineral horizon or horizons characterized by one or more of the following:

1) an enrichment in silicate clay, iron, aluminum, or humus, alone or in combination (Bt, Bf, Bfh, Bhf, and Bh);
2) a prismatic or columnar structure that exhibits pronounced coatings or stainings and significant amount of exchangeable Na (Bn);
3) an alteration by hydrolysis, reduction, or oxidation to give a change in color or structure from horizons above or below, or both, and does not meet the requirements of 1) and 2) above (Bm, Bg).

C —This is a mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (i) the process of gleying, and (ii) the accumulation of calcium and magnesium carbonates and more soluble salts (Cca, Csa, Cg, and C). Marl and diatomaceous earth are considered to be C horizons.

R —This is consolidated bedrock that is too hard to break with the hands or to dig with a spade when moist and that does not meet the requirement of a C horizon. The boundary between the R layer and overlying unconsolidated material is called a lithic contact.

LOWER-CASE SUFFIXES

b — Buried soil horizon.

c — A cemented (irreversible) pedogenic horizon. The ortstein of a Podzol, a layer cemented by calcium carbonate and a duripan are examples.

ca — A horizon with secondary carbonate enrichment where the concentration of lime exceeds that present in the unenriched parent material. It is more than 4 inches (10 cm) thick, and if it has a $CaCO_3$ equivalent of less than 15 percent it should have at least 5 percent more $CaCO_3$ equivalent than the parent material (IC). If it has more than 15 percent $CaCO_3$ equivalent it should have 1/3 more $CaCO_3$ equivalent than IC. If no IC is present, this horizon is more than 10 cm thick and contains more than 5 percent by volume of secondary carbonates in concretions or soft, powdery forms.

cc — Cemented (irreversible) pedogenic concretions.

e — A horizon characterized by the removal of clay, iron, aluminum, or organic matter alone or in combination. When dry, it is usually higher in color value by 1 or more units than an underlying B horizon. It is used with A (Ae).

f — A horizon enriched with amorphous material, principally Al+Fe combined with organic matter. It usually has a hue of 7.5YR or redder or it is 10YR near the upper boundary and becomes yellower with depth. When moist, the chroma is higher than 3 or the value is 3 or less. It contains 0.6% or more pyrophosphate — extractable Al+Fe in textures finer than sand and 0.4% or more in sands (coarse sand, sand, fine sand, and very fine sand). The ratio of pyrophosphate — extractable Al+Fe to clay (<.002 mm) is more than 0.05 and organic C exceeds 0.5%. It is used with B alone (Bf), with B and h (Bhf), with B and g (Bfg), and with other suffixes. The criteria for "f" do not apply to Bgf horizons.

The following horizons are differentiated on the basis of organic carbon content:

Bf —0.5% to 5% organic carbon
Bhf —more than 5% organic carbon

g — A horizon characterized by gray colors, or prominent mottling, or both, indicative of permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less. It is used with A and e (Aeg), with B alone (Bg), with B and f (Bfg), with B, h, and f (Bhfg), with B and t (Btg), with C alone (Cg), with C and k (Ckg), and several others. In some reddish parent materials, matrix colors of reddish hues and high chromas may persist despite long periods of reduction. In these soils, horizons are designated as g if there is gray mottling or if there is marked bleaching on ped faces or along cracks.

Aeg —This horizon must meet the definitions of A, e, and g.

Bg —These horizons are analogous to Bm horizons but they have colors indicative of poor drainage and periodic reduction. They include horizons occurring between A and C horizons in which the main features are (i) colors of low chroma, that is, chromas of 1 or less, without mottles on ped surfaces or in the matrix if peds are lacking; or chromas of 2 or less in hues of 10YR or redder, on ped surfaces or in the matrix if peds are lacking, accompanied by more prominent mottles than those in the C horizon; or hues bluer than 10Y, with or without mottles on ped surfaces or in the matrix if peds are lacking, (ii) colors indicated in (i) and a change in structure from that of the C horizons, (iii) colors indicated in (i) and illuviation of clay too slight to meet the requirements of Bt; or accumulation or iron oxide too slight to meet the limits of Bgf, (iv) colors indicated in (i) and removal of carbonates. Bg horizons occur in some Orthic Humic Gleysols and some Orthic Gleysols.

Bfg, Bhtg, Btg, and others — When used in any of these combinations the limits set for f, hf, t, and others must be met.

Bgf —The dithionite-extractable Fe of this horizon exceeds that of the IC by 1% more, and the dithionite-extractable Al does not exceed that of the IC by more than 0.5%. This horizon occurs in Fera Gleysols and Fera Humic Gleysols, and possibly below the Bfg horizons of gleyed Podzols. It is distinguished from the Bfg horizon of Podzols on the basis of the extractability of the Fe and Al. The Fe in the Bgf horizon is thought to have accumulated as a result of the oxidation of ferrus iron. The iron oxide formed is not associated intimately with organic matter or with Al, and it is sometimes crystalline. The Bgf horizons are usually prominently mottled, with more than half of the soil material occurring as mottles of high chroma.

Cg, Ckg, Ccag, Csg, Csag — When g is used with C alone, or with C and one of the lower-case suffixes k, ca, s, or sa, it must meet the definition for C and for the particular suffix.

h — A horizon enriched with organic matter. It is used with A alone (Ah); or with A and e (Ahe); or with B alone (Bh); or with B and f (Bhf).

Ah —A horizon enriched with organic matter that either has a color value at least one unit lower than the underlying horizon or contains 0.5% more organic carbon than the IC, or both. It contains less than 17% organic carbon by weight.

Ahe —An Ah horizon that has been degraded as evidenced, under natural conditions, by streaks and splotches and often by platy structure. It may be overlain by a darker-colored Ah and underlain by a higher-colored Ae.

Bh —This horizon contains more than 1% organic carbon, less than 0.3% pyrophosphate-extractable Fe, and has a ratio of organic carbon to pyrophosphate-extractable Fe of 20 or more. Generally the color value and chroma are less than 3 when moist.

j — Used as a modifier of suffixes e, g, n, and t to denote an expression of, but failure to meet, the specified limits of the suffix it modifies. It must be placed to the right and adjacent to the suffix it modifies.

Aej —It denotes an eluvial horizon that is thin, discontinuous, or slightly discernible.

Btj —It is a horizon with some illuviation of clay, but not enough to meet the limits of Bt.

Btgj, Bmgj — Horizons that are mottled but do not meet the criteria of g.

Btnj —j may be used with n to indicate secondary enrichment of Na insufficient to meet the limits for n.

k — Denotes the presence of carbonate, as indicated by visible effervescence when dilute HCl is added. Most often it is used with B and M (Bmk) or C (Ck), and occasionally with Ah (Ahk).

m — A horizon slightly altered by hydrolysis, oxidation, or solution or all three, to give a change in color or structure, or both. It has:

(1) Soil structure rather than rock structure comprising more than half the volume of all subhorizons.

(2) Some weatherable minerals.

(3) Evidence of alteration in one of the following forms:

(a) Higher chromas and redder hues than the underlying horizons.

(b) Evidence of removal of carbonates.

(4) Illuviation, if evident, is too slight to meet the requirements of a textural B or a podzolic B.

(5) No cementation or induration and lacks a brittle consistence when moist.

This suffic can be used as Bm, Bmgj, Bmk, and Bms.

n — A horizon in which the ratio of exchangeable Ca to exchangeable Na is 10 or less. When used with B it must also have the following distinctive morphological characteristics: prismatic or columnar structure, dark coatings on ped surfaces, and hard to very hard consistence when dry.

p — A horizon or layer disturbed by man's activities, that is, by cultivation, or pasturing, or both. It is used with A or O.

s — A horizon with salts, including gypsum, which may be detected as crystals or veins, as surface cruts of salt crystals, by distressed crop growth, or by the precence of salt-tolerant plants. It is commonly used with C and k (Csk), but can be used with any horizon or combination of horizon and lowercase suffix.

sa — A horizon with secondary enrichment of salts more soluble than calcium and magnesium carbonates, where the concentration of salts exceeds that present in the unenriched parent material. The horizon is 10 cm or more thick. The conductivity of the saturation extract must be at least 4 mmhos/cm and must exceed that of the C horizon by at least one-third.

t — A horizon enriched with silicate clay. It is used with B alone (Bt), with B and g (Btg), and with others.

Bt —A Bt horizon is one that contains illuvial layer-lattice clays. It forms below an eluvial horizon, but may occur at the surface of a soil that has been partially truncated. It usually has a higher ratio of fine clay to total clay than IC. It has the following properties:

(1) If any part of an eluvial horizon remains and there is no lithologic discontinuity between it and the Bt horizon, the Bt horizon contains more total and fine clay than the eluvial horizon, as follows:

(a) If any part of the eluvial horizon has less than 15% total clay in the fine earth fraction, the Bt horizon must contain at least 3% more clay, e.g., Ae 10% clay — Bt minimum 13% clay.

(b) If the eluvial horizon has more than 15% and less than 40% total clay in the fine earth fraction, the ratio of the clay in the Bt horizon to that in the eluvial horizon must be 1.2 or more, e.g., 20% clay increase in the Bt over Ae.

(c) If the eluvial horizon has more than 40% total clay in the fine earth fraction, the Bt horizon must contain at least 8% more clay than the eluvial horizon.

(2) A Bt horizon must be at least 5 cm thick. In some sandy soils where clay accumulation occurs in the lamellae, the total thickness of the lamellae should be more than 10 cm in the upper 150 cm of the profile.

(3) In massive soils the Bt horizon should have oriented clays in some pores and also as bridges between the sand grains.

(4) If peds are present, a Bt horizon shows clay skins on some of the vertical and horizontal ped surfaces and in the fine pores, or shows oriented clays in 1% or more of the cross section.

(5) If a soil shows a lithologic discontinuity between the eluvial horizon and the Bt horizon, or if only a plow layer overlies the Bt horizon, the Bt horizon need show only clay skins in some part, either in some fine pores or on some vertical and horizontal ped surfaces. Thin sections should show that some part of the horizon has about 1% or more of oriented clay bodies.

Btj and Btg are defined under j and g.

x — A horizon of fragipan character. A fragipan is a loamy subsurface horizon of high bulk density. It is very low in organic matter and when dry it has a hard consistence and is seemingly cemented. When moist, it has a moderate to weak brittleness. It has few or many bleached fracture planes and has an overlying friable B horizon. Air dry clods of fragic horizons slake in water.

z — A permanently frozen layer.

y — A horizon affected by cryoturbation as manifested by disrupted and broken horizons and by incorporation of materials from other horizons and mechanical sorting. It is used with A, B, and C alone or in combination with other subscripts, e.g. Ahy, Ahgy, Bmy, Cy, Cgy, Cyg2, etc.

The Bm is similar to the cambic horizon described in the U.S. and World soil classification systems except for the following:

(1) Its lower boundary must be 5 cm or more from the surface compared with 25 cm in the other systems.

NOTES:

(1) Transitional horizons need capitals only:
   (a) If the transition is gradual, use, e.g., AB or BC.
   (b) If the transition is interfingered, use, e.g., A and B, or B and C.
   (c) If desired, dominance can be shown by order, e.g., AB and BA.

(2) The designations for diagnostic horizons must be given in the same sequence as shown for the definition, eg.g, Ahe not Aeh.

B. SOIL GENESIS

Soil genesis is the process or processes responsible for the development of soil. The principal factors of climate, vegetation, relief and drainage act upon the unconsolidated parent material to produce the soil profile or solum. The type of soil formed in any one place is dependent upon the interaction of these factors and upon the length of time they have been active.

The most important factors in soil formation are climate, parent material, vegetation and moisture condition. Climate determines the type of biological life which in turn determines the type of organic matter and the manner in which it is added to the soil. Climate also determines microorganism activity, the decomposition of organic matter, the rate and extent of mineral weathering, and the rate at which products of weathering are accumulated in, or removed from, the soil.

The soils of this map area have developed in the southern fringe of the boreal forest under subhumid continental climatic conditions. Organic matter is added to the soil in the form of forest litter and herbaceous plant materials. Coniferous species dominate the tree canopy but deciduous trees and herbaceous species are still abundant and thus the forest litter is rich in these latter plant materials that are readily decomposed. Consequently, the A horizons of most of the soils are high in organic matter and thus dark in color. Because of climatic conditions and forest vegetation, however, this A horizon is slightly leached. Under these conditions Orthic Dark Grey soils (6 percent) have developed. The drainage condition of the map area is generally poor and thus the dominant mineral soil type is Gleyed Dark Grey which comprises 16 percent of the map area.

Under the same climatic conditions soils show differences due to both texture and mineralogical composition of the parent material. Brunisolic soils (12 percent) have developed on calcareous glacial till; the result of the extremely calcareous nature of the parent material and cool climate. The clay, iron and aluminum in these soils are eratically translocated with the result that Ae horizons are often weakly developed, broken or absent. These soils appear to represent a stage of soil development between Regosolic and Luvisolic soils. Luvisolic soils are found in 5 percent of the area on clayey sediments that have a much lower calcium carbonate content than the glacial tills.

Gleysolic soils (9 percent) have developed in poorly drained areas on a variety of parent materials with textures ranging from clay to sand. Saturated conditions are reflected in soils by dull grey colors and/or iron mottling. In the Red Rose-Washow Bay area, these soils usually have a well developed mesic peat organic surface horizon.

Regosolic soils (1 percent) are confined to the narrow flood plain along the Fisher River.

Organic soils (46 percent) have developed on poorly or very poorly drained areas. The Red Rose-Washow Bay area with a cool subhumid climate, provides conditions suitable for the development of peat deposits. Because these soils are of vegetal origin, they reflect the succession of vegetation deposited, and provide a record of the changing ecology in peatlands. These soils are developed from three kinds of peat materials:

1. Forest peat (6 percent) forms under poorly drained conditions. These sites are under the influence of nutrient rich groundwater. The vegetation occurring on these sites is productive black spruce-feathermoss and black spruce-*Ledum* feathermoss or less productive black spruce-tamarack-*Carex*-feathermoss and tamarach-*Carex* communities. The dominant peat former is feathermoss with some *Sphagnum* sp. and varying amounts of ericaceous shrubs, woody species and sedges. Forest peat is usually moderately decomposed, contains a significant volume of coarse woody fragments and is usually medium to slightly acid in reaction.

2. Fen peat (16 percent) forms under very poorly drained sites which are also influenced by nutrient rich groundwater. The vegetation occurring on these sites is characteristic of *Carex-Drepanocladus, Carex Drepanocladus-Betula* and *Carex-Drepanocladus-Salix* communities. The dominant peat formers are sedges with minor amounts of mosses, reeds, grasses and shrubs. Fen peat is very uniform, non-woody, moderately well decomposed and usually medium acid to mildly alkaline in reaction.

3. Sphagnum peat (24 percent) forms under poorly and very poorly drained sites which are isolated from nutrient rich groundwaters and thus the water is supplied only by rain. The vegetation occurring on these sites is that of the *Sphagnum*-black spruce-*Ledum* or *Sphagnum-Ledum* communities. The dominant peat formers are *Sphagnum* mosses with minor amounts of feather-

mosses and ericaceous shrubs. This material may contain some inclusions of spruce or tamarack wood. Sphagnum peat is relatively undecomposed, quite uniform and usually extremely to slightly acid in reaction.

C.SOIL CLASSIFICATION

The basic unit in the field classification system used in this survey is the soil series. A soil series consists of soils that have developed on similar parent material and under similar environmental conditions. Any significant variation in one or more of these soil forming factors causes dissimilarities of profile features. The soil series may occupy large continuous land areas, but more often occur in association with other soil series in a complex landscape pattern.

When soils have similar profile characteristics but vary in one or more inherent physical features that are of importance to man's use or management, they are classified as types or phases. Soil types are subdivisions of series, based on minor variations in textures of the surface horizons. Soil phases are based on external features such as the occurrence of an unconforming substrate, stoniness, relief, erosion, or topography.

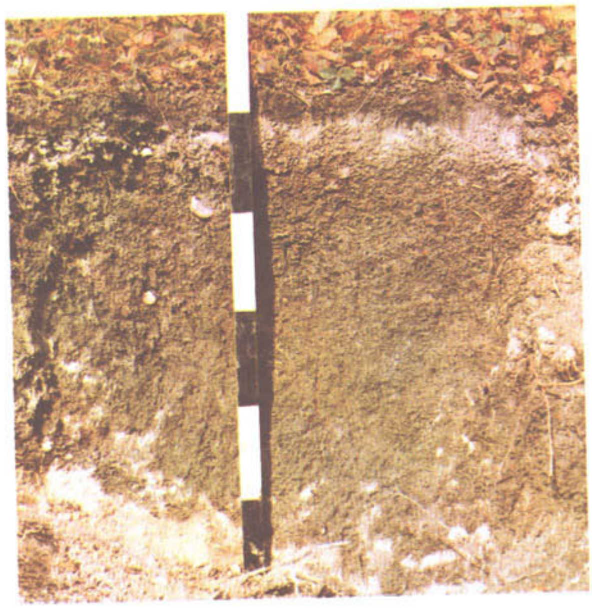
In the Red Rose-Washow Bay area soil series, types and phases are classified according to the taxonomic system of classification outlined by the Canada Soil Survey Committee in 1970 (see Table 7). There are six levels or categories in which soils may be grouped together. These are: order, great group, subgroup, family, series, and type. In the first three categories (order, great group, and subgroup), divisions are based on major differences in morphological features, which relfect the effects of climate, vegetation, local moisture and age of the parent material. That is, while this classification is based on soil profile properties, concepts of soil genesis affect the selection of criteria used for these higher groupings. In the latter three categories (family, series, and type), divisions within any one subgroup are based on soil variations resulting from differences in composition, texture, and mode of deposition of the parent materials, drainage and differences in thickness and degree of development of soil horizons. The soil family is a taxonomic category between the subgroup and series levels that is used to group soils according to certain chemical and physical properties and environmental factors. They are differentiated on the basis of particle size, mineralogy, pedoclimate, reaction, calcareousness and depth. Soils in a family, therefore, have in common a combination of important specific properties, but treated in a broader fashion than for soil series. Families constitute a framework within which series can be established.

FIGURE 11
Characteristic Soil Profiles in the Red Rose-Washow Bay Map Area
(stick interval - 6 inches)

Soil profile of Inwood loam. A thin Gleyed Dark Grey soil developed on extremely calcareous glacial till.

Soil profile of Garson loam. A thin Orthic Grey Luvisol developed on extremely calcareous glacial till.

Soil profile of Homebrook clay. An Orthic Dark Grey soil developed on moderately to strongly calcareous fine textured till.



Soil profile of Kinwow clay. An Orthic Grey Luvisol developed on shallow moderately calcareous fine textured lacustrine deposits overlying glacial till.

FIGURE 11 (Continued)
Characteristic Soil Profiles in the Red Rose-Washow Bay Map Area
(stick interval - 6 inches)

Soil profile of Lundar loam. A thin Gleyed Carbonated Rego Black soil developed on extremely calcareous glacial till.

Soil profile of Fairford loam. A thin Degraded Eutric Brunisol developed on extremely calcareous glacial till.

Soil profile of Meleb loam, peaty phase. A Carbonated Rego Humic Gleysol developed on extremely calcareous glacial till.

Soil profile of Stead Series. A Typic Mesisol developed on deep, moderately well decomposed herbaceous fen peat. Note thin sphagnum cap on the surface.

TABLE 7

Classification of Soils as Mapped in the Red Rose-Washow Bay Area According to the System of Soil Classification for Canada (1970)

ORDER	GREAT GROUP	SUBGROUP	SOIL FAMILY	SERIES
Chernozemic Soils Soils with Chernozemic Ah horizons and B or C horizons of high base saturation with divalent cations, calcium usually being dominant. Well to imperfectly drained soils developed under xero or mesophytic grasses and forbs or under grassland forest transition.	Black Soils Soils with Ah or Ap horizons with dry color Munsell values darker than 3.5. Usually associated with mesophytic vegetation of grasses and forbs.	Gleyed Rego Black Profile type: **Ah** or Ahk, **Cg**, (Ccag), (Ckg)	Loamy, carbonatic, cold, sub-humid	Colby Dencross Lakeland
			Loamy-skeletal, carbonatic, cold, subhumid	Lundar McCreary
	Dark Grey Soils These soils have a leaf mat (L-H) overlying grey to dark grey (Munsell value 3.5 to 5.5 dry, chroma less than 1.5), A horizons. The B horizon is moderately developed, dark brown, coarse granular to blocky and contains concentrations of clay.	Orthic Dark Grey Profile type: (L-H), (Ah), **Ahe**, (Ae), **Bm** or **Bt**, **C**, (Cca), (Ck)	Clayey over loamy-skeletal, montmorillonitic, cold subhumid	Arnes
			Fine loamy, carbonatic, cold, subhumid	Harwill
			Clayey, montmorillonitic, strongly calcareous, cold, subhumid	Homebrook
			Fragmental, mixed, strongly calcareous, cold, subhumid	Leary
			Fragmental over loamy-skeltal, mixed, cold, subhumid	Gunton
			Fragmental, mixed, shallow, strongly calcareous, cold, subhumid	Lynx Bay
		Gleyed Solonetzic Dark Grey Profile type: (L-H), (Ah), **Ahegj**, (Ae), **ABgj**, **Bnjgj**, **Cgj**, (Cca), (Csk)	Clayey, montmorillonitic, strongly calcareous, cold, subhumid	Arborg
			Clayey, montmorillonitic, shallow, strongly calcareous, cold, subhumid	Rosenburg
		Gleyed Dark Grey Profile type: (L-H), (Ah), **Ahegj**, (Ae), **Bmgh**, or **Btgj**, **Cgj**, (Ccag), Ckg)	Clayey, montmorillonitic, strongly calcareous, cold, subhumid	Davis Point
			Loamy-skeletal, carbonatic, cold, subhumid	Fisherton Inwood
			Loamy, carbonatic, cold, subhumid	Framnes Ledwyn
			Loamy-skeletal, carbonatic, shallow, cold, subhumid	Faulkner
			Fragmental, mixed, strongly calcareous, cold, subhumid	Kergwenan
			Fragmental over loamy-skeletal, mixed, cold, subhumid	Louis Island
			Cleyey over loamy-skeletal, montmorillonitic, strongly calcareous, cold, subhumid	Peguis

TABLE 7 Cont'd.

Classification of Soils as Mapped in the Red Rose-Washow Bay Area According to the System of Soil Classification for Canada (1970)

ORDER	GREAT GROUP	SUBGROUP	SOIL FAMILY	SERIES
		Gleyed Rego Dark Grey Profile type: (L-H), (Ah), **Ahegj**, **Cgj**, (Ccag), (Ckg)	Fragmental over loamy-skeletal, mixed, strongly calcareous, cold, subhumid	Goose Island
			Fragmental, mixed, strongly calcareous, cold, subhumid	Spearhill
Luvisolic Soils Well and imperfectly drained soils developed under forest or heath having light-colored eluviated horizons and illuvial horizons with accumulations of sesquioxides, organic matter or clay, or any combination of these.	Grey Luvisol Soils Soils with thin organic layers (L-H), with light-colored eluviated horizons and with illuviated horizons in which clay is the main accumulation product. The solum generally has a medium to high degree of base saturation.	Dark Grey Luvisol Profile type: **L-H**, **Ah** or **Ahe**, **Bt**,-(Cca), **Ck**, (C)	Fragmental, mixed, shallow, strongly calcareous, cold, subhumid	Narrow Island
			Fragmental, over loamy-skeletal, mixed, strongly calcareous, cold, subhumid	Deerhorn
			Fragmental, mixed, strongly calcareous, cold, subhumid	Venlaw
		Gleyed Dark Grey Luvisol Profile type: L-H,-**Ah**, **Ahej**, **Btgj**, (Ccag), **Ckgj**, (Cg)	Fragmental, mixed, strongly calcareous, cold, subhumid	Makinak
			Fragmental over loamy-skeletal, mixed, strongly calcareous, cold, subhumid	Vidir
		Orthic Grey Luvisol Profile type: **L-H**,-(Ah) or (Ahe), **Ae**,-(AB), **Bt**, (Cca), (Ck), **C**	Loamy-skeletal, carbonatic, shallow, cold, subhumid	Devils Lake
			Clayey, montmorillonitic, strongly calcareous, shallow, cold, subhumid	Egg Island
			Loamy-skeletal, carbonatic, cold, subhumid	Garson
			Clayey over loamy-skeletal, montmorillonitic, strongly calcareous, cold, subhumid	Kinwow
			Fragmental over loamy-skeletal, mixed, strongly calcareous, cold, subhumid	Long Point
			Sandy-skeletal, mixed strongly calcareous, cold, subhumid	McArthur
			Sandy over loamy-skeletal, mixed, strongly calcareous, cold, subhumid	St. Labre
			Sandy, mixed, shallow, strongly calcareous, cold subhumid	Harcus
			Fragmental, mixed, strongly calcareous, cold subhumid	Woodridge

TABLE 7 Cont'd.

Classification of Soils as Mapped in the Red Rose-Washow Bay Area According to the System of Soil Classification for Canada (1970)

ORDER	GREAT GROUP	SUBGROUP	SOIL FAMILY	SERIES
		Solodic Grey Luvisol Profile type: **L-H, Ah** or **Ahe, Ae,**-(AB), **Btnj**, (Cca), (Csk), **C**	Clayey, montmorillonitic, strongly calcareous, cold, subhumid	Lettonia
		Gleyed Grey Luvisol Profile type: **L-H,**-(Ah), (Ahe), **Aegj, Btgj, Cgj**, (Ck)	Sandy over loamy-skeletal, mixed, strongly calcareous, cold, subhumid	Caliento
			Clayey over loamy-skeletal, montmorillonitic, strongly calcareous, cold, subhumid	Mantagao
			Sandy-skeletal, mixed, strongly calcareous, cold, subhumid	Pinawa
Brunisolic Soils Well to imperfectly drained soils developed under mixed forest vegetataion, with browish colored sola and without marked eluvial horizons. They may or may not have a distinct Ah horizon.	Eutric Brunisol Soils Soils with organic surface horizons (L-H), with a brownish Bm horizon, a weakly acid to mildly alkaline solum, but without a distinct mineral-organic (Ah) surface horizon.	Orthic Eutric Brunisol Profile type: **L-H,**-(Ah 2"), **Bm,**-(Cca), **Ck**	Fragmental, mixed, strongly calcareous, cold, subhumid	Kawinaw
			Fragmental over loamy-skeletal, mixed, strongly calcareous, cold, subhumid	Pim Lake
			Sandy, mixed, strongly calcareous, shallow, cold, subhumid	Punk
		Degraded Eutric Brunisol Profile type: **L-H, Ae** or **Aej, Bm** or-**Btj, Ck**	Loamy-skeletal, carbonatic, cold, subhumid	Fairford
			Fragmental, mixed, strongly calcareous, cold, subhumid	Freshford
			Fragmental over loamy-skeletal, mixed, strongly calcareous, cold, subhumid	Soul Lake
			Loamy-skeletal, carbonatic, shallow, cold, subhumid	Hilbre
	Dystic Brunisol Soils Soils with organic surface horizons (L-H), with a Bm horizon and a moderately to strongly acid solum, but without a distinct mineral-organic (Ah) horizon.	Degraded Dystic Brunisol Profile type: L-H,-**Ae** or **Aej, Bm** or **Bmcc, C**	Sandy, mixed, acid, cold, subhumid	Sandilands
		Gleyed Degraded Dystic Brunisol Profile type: L-H **Aegj** or **Aejgj, Bmgj**, or **Bmccgj, Cgj**	Sandy, mixed, acid, cold, subhumid	Lonesand
Regosolic Soils Well and imperfectly drained soils with good to moderate oxidizing conditions having horizon development too weak to meet the requirements of soils in any other order.	Regosol Soils Well and imperfectly drained soils with good to moderate oxidizing conditions and weak horizon development.	Orthic Regosol Profile type: (L-H), (Ah), **Ck** or **C**	Loamy, mixed, strongly calcareous, cold, subhumid	Hodgson
		Gleyed Orthic Regosol Profile type: (L-H), (Ahg), **Ckgj** or **Cgj**	Loamy, mixed, strongly calcareous, cold, subhumid	Fisher

TABLE 7 Cont'd.
Classification of Soils as Mapped in the Red Rose-Washow Bay Area
According to the System of Soil Classification for Canada (1970)

ORDER	GREAT GROUP	SUBGROUP	SOIL FAMILY	SERIES
Gleysolic Soils Poorly drained soils which may have an organic horizon, an Ah horizon, or both, or neither of these horizons. The sub-soils show gleying and are dull colored, but may have brighter colored prominant mottles. Soils associated with wetness. They have developed under various climatic and vegetative conditions and in the presence of a high fluctuating water table.	Humic Gleysol Soils Soils with an Ah horizon more than 3 inches thick under virgin conditions. When cultivated to a depth of 6 inches, they have an Ap layer with more than 3 percent organic matter.	Rego Humic Gleysol Profile type: (L-H), **Ah, Cg** or **Ckg** or **Ccag**	Loamy, carbonatic, cold, aquic	Balmoral Foley Tarno
			Fragmental over loamy-skeletal, mixed, strongly calcareous, cold, aquic	Berry Island
			Clayey, montmorillonitic, strongly calcareous, cold, aquic	Fyala
			Clayey, montmorillonitic, strongly calcareous, shallow, cold, aquic	Thickwood
			Sandy, mixed, strongly calcareous, cold, aquic	Malonton
			Loamy-skeletal, carbonatic, cold, aquic	Meleb Pineimuta
			Loamy-skeletal, carbonatic, shallow, cold, aquic	Lee Lake
			Sandy over loamy-skeletal, mixed, strongly calcareous, cold, aquic	Sprague
			Fragmental, mixed, strongly calcareous, cold, aquic	Sundown
	Gleysol Soils Soils with an Ah horizon up to 3 inches thick under virgin conditions and, when cultivated to a depth of 6 inches, they have an Ap layer with less than 3 percent organic matter.	Rego Gleysol Profile type: (L-H), (Ah), **Cg** or **Ckg** or **Ccag**	Sandy, mixed, acid, cold, aquic	Kerry
			Loamy, mixed, strongly calcareous, cold, aquic	Marsh Complex
Organic Soils Soils that have developed dominantly from organic deposits that are saturated for most of the year, and contain 30 percent or more of organic matter to: 1. — a depth of at least 24 inches if the surface layer consists dominantly of fibric moss; or 2.— to a depth of at least 16 inches for other kinds or mixed kinds of organic material; or 3. — to a lithic contact if it occurs at a depth greater than 4 inches but shallower than either 1 or 2.	Fibrisol Organic soils with a dominantly fibric middle tier, or middle and surface tiers if a terric or lithic contact occur in the middle tier.	Terric Fibrisol These soils have a terric layer (mineral soil) beneath the surface tier. Cumulo or limno layers may be present but other kinds are absent.	Sphagnic, euic, cold, aquic, clayey	Hoctor Sadlow
			Sphagnic, euic, cold, aquic, sandy	Flour Point Monkman
			Sphagnic, euic, cold, aquic, loamy-skeletal	Laronde Elmore
		Lithic Fibrisol These soils have a lithic layer (bedrock) beneath the surface tier. Mesic, humic, cumulo or limno layers may be present.	Sphagnic, euic, cold, aquic, shallow	Highrock Atim

TABLE 7 Cont'd.

Classification of Soils as Mapped in the Red Rose-Washow Bay Area According to the System of Soil Classification for Canada (1970)

ORDER	GREAT GROUP	SUBGROUP	SOIL FAMILY	SERIES
		Terric Mesic Firbrisol These soils have a terric layer (mineral soil) beneath the surface tier and a significant subdominant mesic layer thicker than 25 cm in the organic portion of the control section.	Sphagnic, euic, cold, aquic, clayey	Baden Molson
			Sphagnic, euic, cold, aquic, sandy	Catfish Point Sand River
			Sphagnic, euic, cold, aquic, loamy-skeletal	Kanusk Kilkenny
		Sphagno-Fibrisol These soils consist of uniform fibric organic matter dreived from Sphagnum mosses throughout the middle and bottom tiers. They lack mesic & humic subdominant layers. They lack terric, lithic, hydric, cryic or other layers in the control section.	Sphagnic, dysic, cold, aquic	Julius Caldon Mason
		Mesic Fibrisol These soils concist of a diminantly fibric middle iter and a subdominant mesic layer thicker than 25 cm in the moddle or in the bottom tier. Other layers are absent.	Sphagnic, dysic, cold aquic	Whithorn Sproule Denbeigh
	Mesisol These organic soils have a dominantly mesic middle tier, or middle and surface tiers if a terric, lithic, hydric or cryic contact occurs in the middle tier.	Typic Mesisol These soils consist of dominantly mesic material throughout the middle & bottom tiers. The control section lacks any terric, lithic, hydric, cryic, cumulo or limno layers.	Mesic, euic, cold aquic	Baynham Bradbury Macawber Stead
			Sphagnic, euic, cold, aquic	Erskine Katimik Waskwei Chemong Oleson Santon Woody Point
		Limno Mesisol These soils have a limno layer beneath the surface tier. Fibric, humic and cumulo layers may be present but other layers are not present.	Mesic, euic, cold, aquic	Jackhead Wanke

TABLE 7 Cont'd.

Classification of Soils as Mapped in the Red Rose-Washow Bay Area According to the System of Soil Classification for Canada (1970)

ORDER	GREAT GROUP	SUBGROUP	SOIL FAMILY	SERIES
		Terric Mesisol These soils have a terric layer beneath the surface tier. Comulo or limno layers may be presnet but other layers are absent.	Mesic, euic, cold, clayey	Cayer Okno Orok
			Mesic, euic, cold, sandy	Rat River Guy Gill Kircro Sturgeon Gill
			Mesic, euic, cold, aquic, loamy-skeletal	Crane Halcrow Grindstone Shiel
		Terric Fibric Mesisol These soils have a terric layer beneath the surface tier and a subdominant fibric layer thicker than 10 inches in the organic portion of the control section. Cumulo layers may be present but other kinds are not.	Sphagnic, euic, cold, aquic, clayey	Bayton Sisib Kalevala
			Sphagnic, euic, cold, aquic, sandy	Loon Bay Pigeon Point Turnberry
			Sphagnic, euic, cold, aquic, loamy-skeletal	Carscallen Mistatim Ferland
		Terric Humic Mesisol These soils have a terric layer beneath the surface tier and a subdominant humic layer thicker than 10 inches in the organic portion of the control section. Cumulo layers may be present but other kinds are not.	Mesic, euic, cold, aquic, clayey	Volga
			Mesic, euic, cold, aquic, sandy	Grey Point
			Mesic, euic, cold, aquic, loamy-skeletal	Waterhen
		Lithic Mesisol These soils have a lithic layer (bedrock) occurring at depths between 4 and 52 inches or 64 inches from the surface. Fibric, humic, cumulo, or limnic layers may be present.	Mesic, euic, cold, aquic, limestone	Holditch Flathouse Janora Meskanau Primes Whiteway

D. SOIL MAPPING

The mapping of soils in the Red Rose-Washow Bay study was conducted on a reconnaissance basis. That is to say, in the more accessible southern section, in the vicinity of the Fisher River and the Peguis Indian Reserves and the community of Red Rose, soils were systematically examined in test pits at frequent intervals along the sides of each section of land. Field notes on the number, kind and arrangement of soil horizons were recorded. Also recorded were the soil reaction, topography, drainage, stoniness, and other factors influencing soil character or land use. Representative samples of individual soil series were collected for analysis. From this information and the stereoscopic interpretation of aerial photographs, the soil boundaries were determined and plotted on two inches to a mile aerial photo mosaics. From these photo mosaic field sheets, the soil boundaries were transferred to a manuscript of the scale one inch equals one mile. This manuscript was further reduced to a scale of one inch equals two miles for publication. It can be seen that such reduction of scale does not permit the display of small individual areas of local soils which are important to consider in land management. However, many such local soils have been grouped together to form complex mapping units. However, if limitations of scale are taken into account, the soil map in the more settled section of the project area is good.

In the forested peatland areas, which are for the most part inaccessible, traverses were made by foot and helicopter at intervals of seven miles. Examination of soil test pits were considerably fewer here than in the southern section. A boat was employed as an aid in the study of soils along the extensive shoreline of Lake Winnipeg and on adjacent off-shore islands. Foot traverses at regular intervals of several miles were made inland from shore. In these sections of the map area the methods of transportation and the less frequent examination of soil test pits imposed a further limitation on the reliability of the soil map.

E. DESCRIPTION OF SOIL SERIES AND MAPPING UNITS

A key to the soils of the Red Rose-Washow Bay area is presented in Table 8. The soil series are grouped according to parent materials and drainage, with the subgroup to which each series belongs also being indicated in the table. Acreage figures are estimates of each series and include areas mapped as individual series and the portion of areas covered by each series within complex map units.

The soil series descriptions are presented in alphabetical order and generally include: descriptions of the profile type, texture, parent materials, topography, drainage and vegetation; a detailed description of a representative profile; a table of chemical and physical analyses of a representative profile; a brief description of mapping units containing the series. Separate sections of the report deal with the agriculture, forestry, engineering, wildlife, and recreation suitability of the soils.

ARBORG SERIES

The Arborg series consists of imperfectly drained, Gleyed Solonetzic Dark Grey soils developed on moderately to strongly calcareous lacustrine clay deposits. Arborg soils in the adjacent Fisher and Teulon map area were previously classified as Grey Wooded Solodized-Solonetz. In the recent soil classification, however, this soil is classified as Gleyed Solonetzic Dark Grey. This soil is found throughout the map area, generally occupying the level lacustrine areas together with poorly drained Fyala soils. These soils are now partly cultivated, but the uncleared areas support a mixed stand of aspen, black poplar, and spruce. The following profile description is representative of the Arborg clay soil.

L-H — 3 to 0 inches, black (10YR 2/2, moist), leaf mat; strongly acid; abrupt, smooth boundary.

Ahe — 0 to 1½ inches, black (10YR 2/1, moist), clay loam to clay; strong, fine to medium granular; firm when moist, hard when dry; very strongly acid; abrupt, irregular to broken boundary.

Aegj — 1½ to 4 inches, very dark grey to dark grey (10YR 3/1 to 4/1, moist), clay loam to clay; strong medium granular to moderate, coarse platy; firm when moist; hard when dry; very strongly acid; clear, smooth boundary.

FIGURE 12
Soil profile of Arborg Clay, a Gleyed Solonetzic Dark Grey, developed on thick clay lacustrine sediments.

TABLE 8

Key to Soils and their Estimated Acreages in the Red Rose-Washow Bay Area

		Series and Phases		Parent Material	
		Acreage	Percent of Total Map Area	Acreage	Percent of Total Map Area
I.	Soils developed on extremely calcareous glacial till			289,502	16.45
	a. Well and moderately well drained				
	1. Garson series (Orthic Grey Luvisol)	9,014	.51		
	2. Fairford series (Degraded Eutric Brunisol)	139,845	7.94		
	b. Imperfectly drained				
	1. Inwood series (Gleyed Dark Grey)	83,094	4.72		
	2. Lundar series (Gleyed Carbonated Rego Black)	333	.02		
	3. Chitek series (Gleyed Degraded Eutric Brunisol)	27,028	1.54		
	c. Poorly drained				
	1. Meleb series (Carbonated Rego Humic Gleysol)	3,128	.18		
	2. Meleb peaty phase	27,060	1.54		
II.	Soils developed on 20 to 30 inches of extremely calcareous glacial till over limestone bedrock			52,279	2.97
	a. Well and moderately well drained				
	1. Devils Lake series (Orthic Grey Luvisol)	717	.04		
	2. Hilbre series (Degraded Eutric Brunisol)	37,309	2.12		
	b. Imperfectly drained				
	1. Faulkner series (Gleyed Dark Grey)	7,070	.40		
	2. Birch Bay series (Gleyed Degraded Eutric Brunisol)	4,429	.25		
	c. Poorly drained				
	1. Lee Lake series (Carbonated Rego Humic Gleysol)	2,754	.16		
III.	Soils developed on moderately to strongly calcareous lacustrine clay			125,806	7.17
	a. Moderately well drained				
	1. Lettonia series (Solodic Grey Luvisol)	24,789	1.41		
	b. Imperfectly drained				
	1. Arborg series (Gleyed Solonetzic Dark Grey)	51,547	2.95		
	c. Poorly drained				
	1. Fyala series (Rego Humic Gleysol)	4,263	.24		
	2. Fyala peaty phase	45,207	2.57		
IV.	Soils developed on 20 to 30 inches of moderately to strongly calcareous, lacustrine clay over limestone bedrock			2,431	0.14
	a. Moderately well drained				
	1. Rat Lake series (Solodic Grey Luvisol)	144	.01		
	b. Imperfectly drained				
	1. Rosenburg series (Gleyed Solonetzic Dark Grey)	1,158	.07		
	c. Poorly drained				
	1. Thickwood series (Rego Humic Gleysol)	1,129	.06		
V.	Soils developed on 6 to 30 inches of moderately to strongly calcareous, fine textured lacustrine deposits underlain by extremely calcareous loamy till			229,839	13.05
	a. Well and moderately well drained				
	1. Arnes series (Orthic Dark Grey)	60,290	3.42		
	2. Kinwow series (Orthic Grey Luvisol)	25,687	1.46		
	b. Imperfectly drained				
	1. Mantagao series (Gleyed Grey Luvisol)	1,587	.09		
	2. Peguis series (Gleyed Dark Grey)	117,051	6.64		
	c. Poorly drained				
	1. Partridge Creek series (Rego Humic Gleysol)	25,193	1.43		
	2. Partridge Creek peaty phase	31	*		
VI.	Soils developed on moderately to strongly calcareous, fine textured lacustrine deposits underlain by extremely calcareous till; limestone bedrock usually occurs within 20 to 30 inches of the surface			2,340	0.13
	a. Well and moderately well drained				
	1. Egg Island series (Orthic Grey Luvisol)	2,340	.13		

TABLE 8 Cont'd.

Key to Soils and their Estimated Acreages in the Red Rose-Washow Bay Area

		Series and Phases		Parent Material	
		Acreage	Percent of Total Map Area	Acreage	Percent of Total Map Area
VII.	Soils developed on moderately to strongly calcareous clay till			11,938	0.67
	a. Well and moderately well drained				
	1. Homebrook series (Orthic Dark Grey)	6,461	.36		
	b. Imperfectly drained				
	1. Davis Point series (Gleyed Dark Grey)	5,477	.31		
VIII.	Soils developed on 6 to 30 inches of moderately to strongly calcareous lacustrine clay clay underlain by very strongly calcareous silty sediments			5,656	0.32
	a. Imperfectly drained				
	1. Framnes series (Gleyed Dark Grey)	1,204	.07		
	2. Dencross series (Gleyed Rego Black)	2,299	.13		
	b. Poorly drained				
	1. Tarno series (Rego Humic Gleysol)	1,779	.10		
	2. Tarno peaty phase	374	.02		
IX.	Soils developed on very strongly to extremely calcareous, moderately fine textured lacustrine sediments			32,421	1.84
	a. Moderately well drained				
	1. Harwill series (Orthic Dark Grey)	4,769	.27		
	b. Imperfectly drained				
	1. Lakeland series (Gleyed Carbonated Rego Black)	7,187	.41		
	2. Ledwyn series (Gleyed Dark Grey)	2,517	.14		
	c. Poorly drained				
	1. Balmoral series (Carbonated Rego Humic Gleysol)	8,957	.51		
	2. Balmoral peaty phase	8,991	.51		
X.	Soils developed on 6 to 30 inches of very strongly to extremely calcareous, moderately fine textured lacustrine sediments over extremely calcareous glacial till			6,495	0.38
	a. Imperfectly drained				
	1. McCreary series (Gleyed Carbonated Rego Black)	3,243	.19		
	2. Fisherton series (Gleyed Dark Grey)	2,674	.15		
	b. Poorly drained				
	1. Pineimuta series (Carbonated Rego Humic Gleysol)	93	*		
	2. Pineimuta peaty phase	485	.03		
XI.	Soils developed on very strongly to extremely calcareous, medium textured lacustrine sediments			2,164	0.12
	a. Poorly drained				
	1. Foley series (Carbonated Rego Humic Gleysol)	695	.04		
	2. Foley peaty phase	1,469	.08		
XII.	Soils developed on weakly to moderately calcareous, moderately coarse to coarse textured sediments and which are underlain by an extremely calcareous glacial till within 30 inches of the surface			8,826	0.51
	a. Well drained				
	1. St. Labre series (Orthic Grey Luvisol)	4,331	.25		
	b. Imperfectly drained				
	1. Caliento series (Gleyed Grey Luvisol)	3,870	.22		
	2. Colby Gleyed Carbonated Rego Black)				
	c. Poorly drained				
	1. Sprague series (Rego Humic Gleysol)	173	.01		
	2. Sprague peaty phase	452	.02		

TABLE 8 Cont'd.

Key to Soils and their Estimated Acreages in the Red Rose-Washow Bay Area

		Series and Phases		Parent Material	
		Acreage	Percent of Total Map Area	Acreage	Percent of Total Map Area
XIII.	Soils developed on weakly to moderately calcareous, moderately coarse to coarse textured sediments, underlain by extremely calcareous glacial till; limestone bedrock usually occurs within 20 to 30 inches of the surface			63	*
	a. Well drained				
	1. Harcus series (Orthic Grey Luvisol)	63	*		
XIV.	Soils developed on moderately to strongly calcareous sandy deposits			540	0.03
	a. Well drained				
	1. Pine Ridge series (Degraded Eutric Brunisol)	125	.01		
	b. Poorly drained				
	1. Malonton peaty phase (Rego Humic Gleysol)	415	.02		
XV.	Soils developed on 20 to 30 inches of moderately to strongly calcareous sandy deposits over limestone bedrock			69	*
	a. Well drained				
	1. Punk series (Degraded Eutric Brunisol)	69	*		
XVI.	Soils developed on siliceous sandy deposits			7,833	0.45
	a. Rapidly to well drained				
	1. Sandilands series (Degraded Dystic Brunisol)	5,717	.32		
	b. Imperfectly drained				
	1. Lonesand series (Gleyed Degraded Systic Brunisol)	2,035	.12		
	c. Poorly drained				
	1. Kerry series (Rego Gleysol)	81	*		
XVII.	Soils developed on strongly calcareous stratified sand and gravel beach and outwash deposits			25,155	1.42
	a. Well drained				
	1. Leary complex (Orthic Dark Grey, Dark Grey Luvisol)	4,896	.82		
	2. Woodridge complex (Orthic Grey Luvisol, Orthic Eutric Brunisol, Degraded Eutric Brunisol)	15,377	.33		
	b. Imperfectly drained				
	1. Spearhill complex (Gleyed Rego Dark Grey, Gleyed Dark Grey Luvisol, Gleyed Dark Grey)	74	*		
	c. Poorly drained				
	1. Sundown peaty phase (Rego Humic Gleysol)	4,808	.27		
XVIII.	Soils developed on 6 to 30 inches of strongly calcareous stratified sand and gravel beach and outwash deposits over extremely calcareous till			43,960	2.50
	a. Well drained				
	1. Gunton complex (Orthic Dark Grey, Dark Grey Luvisol)	5,075	.41		
	2. Long Point complex (Orthic Grey Luvisol, Orthic Eutric Brunisol, Degraded Eutric Brunisol)	52,600	.02		
	b. Imperfectly drained				
	1. Goose Island complex (Gleyed Rego Dark Grey, Gleyed Dark Grey Luvisol, Gleyed Dark Grey)	5,694	.33		
	c. Poorly drained				
	1. Berry Island series (Rego Humic Gleysol)	18,067	1.03		
	2. Berry Island peaty phase	12,524	.71		
XIX.	Soils developed on 20 to 30 inches of strongly calcareous stratified sand and gravel beach and outwash deposits over limestone bedrock			576	0.03
	a. Well drained				
	1. Lynx Bay complex (Orthic Dark Grey, Dark Grey Luvisol)	576	.03		

TABLE 8 Cont'd.

Key to Soils and their Estimated Acreages in the Red Rose-Washow Bay Area

		Series and Phases		Parent Material	
		Acreage	Percent of Total Map Area	Acreage	Percent of Total Map Area
XX.	Soils developed on moderately coarse to medium textured, moderately calcareous, stony, glacial till			8,708	0.50
	a. Well drained				
	1. McArthur series (Orthic Grey Luvisol)	7,348	.42		
	b. Imperfectly drained				
	1. Pinawa series (Gleyed Grey Luvisol)	1,360	.08		
XXI.	Soils developed on medium to moderately fine textured, very strongly calcareous, stratified recent alluvium deposits			3,372	0.19
	a. Moderately well drained				
	1. Hodgson series (Orthic Regosol)	2,122	.12		
	b. Imperfectly drained				
	1. Fisher series (Gleyed Orthic Regosol)	1,250	.07		
XXII.	Soils developed on thin mucky loam deposits over extremely calcareous till and moderately calcareous clay			14,214	0.81
	a. Very poorly drained				
	1. Marsh complex (Carbonated Rego Gleysol)	14,214	.81		
XXIII.	Limestone and dolostone rock outcrop			9,891	0.56
	a. Rapidly drained				
	1. Rock Outcrop (Regosol)	9,891	.56		
XXIV.	Recent cobbly, sand beach deposits			1,404	0.08
	a. Rapid to imperfectly drained				
	1. Sand Beaches (Regosol)	1,404	.08		
XXV.	Organic soils formed on 16 to 52 inches of mesic forest peat which may have a thin (0 to 24 inches) surface layer of fibric Sphagnum peat; overlying (1) medium to fine textured lacustrine sediments, (2) sand, (3) extremely calcareous till, (4) limestone bedrock			94,939	5.40
	a. Poorly to very poorly drained				
	1. Okno complex	84,172	4.78		
	2. Rat River complex	306	.02		
	3. Grindtsone complex	9,972	.57		
	4. Janora complex	489	.03		
XXVI.	Organic soils formed on 24 to 64 inches of fibric Sphagnum moss peat, underlain by significant amounts of mesic peat, forest and/or sedge peat, overlying (1) medium to fine textured lacustrine sediments, (2) sand, (3) extremely calcareous till			193,787	11.00
	a. Poorly to very poorly drained				
	1. Molson complex	179,877	10.21		
	2. Sand River complex	4,519	.26		
	3. Kilkenny complex	9,391	.53		
XXVII.	Organic soils formed on 16 to 52 inches of moderately decomposed sedge peat with little (less than 6 inches) or no Sphagnum moss peat deposits, overlying (1) medium to fine textured lacustrine sediments, (2) sand, (3) extremely calcareous till, (4) limestone bedrock			161,875	9.18
	a. Very poorly drained				
	1. Cayer complex	115,619	6.56		
	2. Kircro complex	428	.02		
	3. Crane complex	44,335	2.52		
	4. Holditch complex	1,493	.08		

TABLE 8 Cont'd.

Key to Soils and their Estimated Acreages in the Red Rose-Washow Bay Area

		Series and Phases		Parent Material	
		Acreage	Percent of Total Map Area	Acreage	Percent of Total Map Area
XXVIII.	Organic soils formed on mesic forest peat greater than 52 inches thick which may have a thin (0 to 24 inches) surface layer of fibric Sphagnum moss overlying (1) medium to fine textured lacustrine sediments, (2) extremely calcareous till			4,020	0.23
	a. Poorly to very poorly drained				
	1. Baynham complex	3,329	.19		
	2. Bradbury complex	691	.04		
XXIX.	Organic soils formed on greater than 24 inches of fibric Sphagnum moss peat underlain by a significant layer or layers of mesic forest peat or Fibric Sphagnum moss peat greater than 64 inches thick, overlying (i) medium to fine textured lacustrine sediments, (ii) sand, (iii) extremely calcareous till			237,716	13.50
	a. Poorly to very poorly drained				
	1. Julius complex	236,042	13.40		
	2. Sproule complex	1,377	.08		
	3. Denbeigh complex	297	.02		
XXX.	Organic soils formed on greater than 52 inches of mesic herbaceous peat with little (less than 6 inches) or no Sphagnum moss peat deposits, overlying (1) medium to fine textured lacustrine sediments (2) extremely calcareous till			117,965	6.69
	a. Very poorly drained				
	1. Stead complex	104,849	5.95		
	2. Macawber complex	13,116	.74		
	Water	65,255	3.70	65,255	3.70
	TOTAL	1,761,039	100.00	1,695,516	100.00

*less than 0.01 percent

TABLE 9
Analysis of Arborg Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Cal-cite	% Dolo-mite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100 gms				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Ma	H
L-H	3-0	—	—	—	—	5.05	0.61	—	—	—	46.31	1.62	28.6	—	—	—	—	—	—
Ahe	0-1½	C	3	39	58	4.64	0.69	—	—	—	7.36	0.61	12.0	54.64	16.73	15.64	1.44	0.70	13.53
Aegj	1½-4	C	4	25	71	4.80	0.52	0.09	—	—	1.53	0.13	11.8	39.48	12.85	15.69	1.12	0.53	6.84
Btgj	4-14	C	2	18	80	5.20	0.48	0.24	—	—	0.84	—	—	42.43	16.07	21.16	1.08	0.30	3.48
BCgj	14-18	C	0.5	12	87.5	6.95	1.25	0.0	—	—	0.36	—	—	32.70	15.10	27.90	0.67	0.75	0.60
Ckgj	18-30	C	0.5	16	83.5	7.5	0.97	0.70	0.36	0.39	—	—	—	29.94	18.70	14.10	0.75	0.75	0.60

Btgj — 4 to 14 inches, black to very dark grey (10YR 2/1 to 3/1, moist), clay; strong coarse columnar, breaks into strong, coarse subangular blocky structure; firm when moist, very hard when dry; strongly acid; clear, smooth boundary.

BCgj — 14 to 18 inches, dark greyish brown to greyish brown (2.5Y 4/2 to 5/2, moist), clay; moderate, medium to fine granular; firm when moist, very hard when dry; neutral; gradual, smooth boundary.

Ckgj — 18+ inches, dark greyish brown to greyish brown (2.5Y 4/2 to 5/2, moist, clay; moderate, medium to fine granular; firm when moist, very hard when dry; mildly alkaline.

The dominant feature of the Arborg soil profile is the very tough columnar structure of the Bt horizon. The Ae horizon is thin, dark grey in color and platy-structured. This leached horizon extends down the sides of the columns for several inches. The columnar aggregates are dark grey, very firm when moist, and extremely hard when dry. They grade into massive clay in the lower part of the B horizon. Gypsum crystals and salt pseudomycelium are usually present in the upper portion of the C horizon. The soil is slightly to medium acid in the Ae horizon, medium acid to neutral in the B horizon and moderately alkaline below. The exchangeable cations in the B horizon are dominantly magnesium and calcium.

Mapping Units

Arborg series (51,547 acres)

Area of normal Arborg soils with minor areas of Fyala clay being present in many cases.

ARNES SERIES

The Arnes series consists of well drained Orthic Dark Grey soils developed on 6 to 30 inches of moderately to strongly calcareous lacustrine clay over extremely calcareous till. Arnes soils in the adjacent Fisher and Teulon map area were previously classified as Dark Grey Wooded. In the recent soil classification, however, this soil is classified as Orthic Dark Grey. The topography is level to gently sloping. Native vegetation consists of mixed aspen and white spruce. This soil is moderately stony, but stoniness varies with the thickness of clay mantle over the till. A representative profile of Arnes series is described below:

L-H — 2 to 0 inches, very dark brown (10YR 2/2, moist), leaf mat; neutral; abrupt, smooth boundary.

Ahe — 0 to 4 inches, very dark greyish brown (10YR 3.5/2, moist), clay; moderate, fine granular; friable when moist, slightly hard when dry; slightly acid; clear, wavy boundary.

Bt — 4 to 12 inches, very dark grey (10YR 3/1, moist), clay; moderate, coarse granular; very firm when moist, very hard when dry; slightly acid; clear, wavy boundary.

BC — 12 to 16 inches, dark greyish brown (10YR 4/2, moist), clay; moderate, coarse granular; firm when moist, hard when dry; neutral; clear, wavy boundary.

C — 16 to 20 inches, brown (10YR 4.5/2, moist), clay; weak, medium granular; firm when moist, hard when dry; neutral; abrupt, smooth boundary.

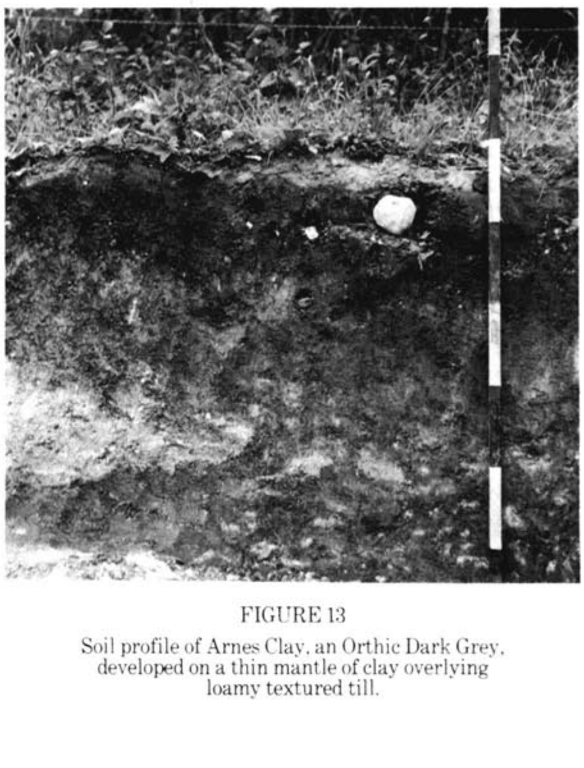


FIGURE 13

Soil profile of Arnes Clay, an Orthic Dark Grey, developed on a thin mantle of clay overlying loamy textured till.

TABLE 10
Analysis of Arnes Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Cal-cite	% Dolo-mite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	6.9	0.48	—	—	—	19.39	1.27	15.3	—	—	—	—	—	—
Ahe	0-4	C	13	21	66	6.3	0.24	—	—	—	1.52	0.10	15.2	36.80	31.40	1.27	0.75	0.20	1.87
Bt	4-12	C	8	17	75	6.4	0.22	—	—	—	0.92	—	—	37.98	21.22	15.82	0.72	0.15	1.90
BC	12-16	C	9	37	54	7.1	0.43	7.58	4.77	2.58	0.91	—	—	—	—	—	—	—	—
C	16-20	C	8	39	53	7.3	0.31	6.93	2.51	4.07	—	—	—	—	—	—	—	—	—
IIC	20+	CL	36	37	27	7.5	1.38	46.97	32.88	12.97	—	—	—	—	—	—	—	—	—

IIC — 20 inches + grey (10YR 5/1, moist), clay loam; weak, medium granular; friable when moist, slightly hard when dry; mildly alkaline.

The Arnes soils have a very dark greyish brown Ahe horizon and a moderately well developed, coarse granular, very dark grey Bt horizon. The BC horizon, of variable thickness, extends down to the contact of the clay mantle and the underlying till. The solum is clay in texture throughout, although there has been considerable movement of clay from the A to the B horizon.

Mapping Unit

Arnes series (60,290 acres)

These areas consist dominantly of normal Arnes soils. Minor included areas are mostly Arborg, Garson and Fyala soils.

FIGURE 14

Soil profile of Balmoral Clay loam, a Gleyed Carbonated Rego Black, developed on extremely calcareous lacustrine sediments. This soil has very distinctive tonguing of the Ah horizon into the C horizon.

BALMORAL SERIES

The Balmoral series consists of poorly drained, Carbonated Rego Humic Gleysol soils developed on very strongly to extremely calcareous, moderately fine textured lacustrine sediments. Surface textures vary from very fine sandy loam to clay loam and the clay content usually decreases with depth. These soils occupy a large acreage in the southern part of the map area, in the Fisher River plain. The topography is smooth, level to depressional. In most areas the drainage is poor. The native vegetation consists of meadow grasses, reeds, and sedges with willow, alder, aspen and some balsam poplar on the slightly elevated sites.

The following profile description is representative of the virgin Balmoral soil:

L-H — 4 to 0 inches; abrupt boundary.

Ah — 0 to 4 inches; very dark grey (10YR 2.5/1, moist), silty clay loam; moderately fine granular; friable when moist, hard when dry; moderately alkaline; abrupt, wavy to irregular boundary.

Cg — 4 inches+, light brownish grey (2.5Y 6.5/2, moist), silty clay loam; amorphous; friable when moist, hard when dry; moderately alkaline, strongly calcareous and moderately saline.

Virgin Balmoral soils consist of a thin layer of peat, underlain by a very dark grey Ah horizon that is 3 to 6 inches thick, usually silty clay loam in texture, moderately alkaline and calcareous and may be saline. A thin, grey transitional layer containing some organic matter separates the Ah horizon from the very pale borwn, extremely calcareous parent material. In cultivated areas the peat layer has been partially, or totally, destroyed or incorporated in the mineral soil. Cultivation also has resulted in a mixing of the Ah horizon with the strongly calcareous parent material so that the plow layer is high in lime carbonate content and dry fields often have a light grey color.

Mapping Units

Balmoral series (8,957 acres) The areas consist dominantly of Balmoral soils, but may contain minor included areas of other types, chiefly

TABLE 11
Analysis of Balmoral Silty Clay Loam

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhps/cm	% CaCO3 Equiv.	% Cal-cite	% Dolo-mite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Soluble Salts (meq/L) m.e./100 gms.						
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	Na	Cl	So4	Total Cat.	Total Ani.
L-H	4-0	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Ah	0-4	SiCL	14	53	33	7.73	2.92	4.06	0.98	2.24	3.24	—	—	39.16	10.10	30.80	—	Tr	40.82	46.10	40.82
Cg	4-	SiCL	2	58	40	7.82	5.52	41.18	5.45	32.93	0.23	—	—	13.40	21.00	64.70	—	—	90.15	96.0	90.15

Lakeland, Tarno, and Fyala soils.

Balmoral peaty phase (8,991 acres)

These are areas of Balmoral soils which are overlain by 6 to 16 inches of mesic peat material.

BAYNHAM COMPLEX

The Baynham complex consists of poorly and very poorly drained soils developed on greater than 52 inches of mesic forest peat and may have a thin (0 to 24 inches) surface fibric sphagnum peat layer, underlain by medium to fine textured sediments. The Baynham complex consists dominantly of the following series:

Baynham series (Typic Mesisol) consists of very deep (greater than 52 inches) organic soils with dominantly mesic forest peat in the organic section. These soils may have up to 6 inches of fibric sphagnum peat on the surface.

FIGURE 15

Landscape view of a Balmoral soil area northeast of Hodgson. The level, smooth terrain and poor drainage is characteristic of these soils.

Waskwei series (Typic Mesisol) consists of very deep (greater than 52 inches) organic soils with dominantly mesic forest peat in the organic section. These soils have 6 to 24 inches of fibric sphagnum peat on the surface.

The areas of Baynham soils are nearly level to depressional.

Native vegetation in this soil complex varies with a number of environmental factors, the most important of these being water regime and the thickness of Sphagnum moss on the surface. The most common vegetation associated with these soils is black spruce, the dominant species, larch, alder and swamp birch in the tree layer and Labrador tea, leather leaf, small cranberry and feather moss species in the understory. Sphagnum species, however, are found in very poorly drained, less productive sites. Merchantable dense stands of black spruce occur in this soil complex where the water table is able to recede to some extent. Under this type of vegetation the main peat formers appear to be black spruce, feather mosses, minor amounts of Labrador tea and Sphagnum moss. A representative profile type of Baynham series is described below.

Of — 0 to 6 inches, yellowish brown (10YR 5/6, moist) to very pale brown (10YR 7/4, moist), non-woody fibrous, spongy, compacted and layered sphagnum moss with woody intrusions, medium acid, unrubbed fiber content approximately 76 percent.

Om_1 — 6 to 24 inches, very dark brown to dark reddish brown (10YR 2/2 to 5YR 3/3, moist), moderately decomposed, mixed woody and non-woody fibrous material composed of mosses, shrubby remains and herbaceous remains, becoming more herbaceous near bottom of layer, medium acid, unrubbed fiber content approximately 61 percent.

Om_2 — 24 to 55 inches, dark brown to very dark brown (10YR 3/3 to 2/2, moist) moderately decomposed, medium fibered herbaceous material, matted or felt-like, medium acid, unrubbed fiber content approximately 54 percent near top of layer to approximately 45 percent near bottom of layer.

TABLE 12
Analysis of Baynham Series (Typic Mesisol)

Hor	Depth Inches	Mechanical Analysis				% Un-rubbed Fiber	% Pyro-phos Sol.	% Ash	Bulk Density (gm cc)	% Org. C	% Total N	C/N Ratio	pH in KCl	C.E.C. m.e	Exchangeable Cations m.e./100 gms				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
Of	0-6	—	—	—	—	76	0.2	10.8	0.07	47.2	1.8	26	6.3	179.5	124 2	31.5	0.7	0 6	9 4
Om1	6-24	—	—	—	—	61	0.2	12.3	0 11	49.2	2 4	20.5	6.1	213 8	130 4	34.3	2 3	7 1	11.0
Om21	24-36	—	—	—	—	54	0.3	13.1	0.13	48.7	2.5	19 6	5 9	219.6	127.3	29.7	0.4	0.6	13.1
Om22	36-55	—	—	—	—	45	0.5	16.2		60 8	3 0	16.7	5.8	164 7	100.3	26.0	0.4	0.5	14.2
IIAhg	55-58	C	8	37	55	—	—	83 1	—	5 9	0 4	13 1	6.4	51 2	41.8	16.0	1.0	0 5	1 6

*C.E.C. determined by NH4 distillation.

IIAhg — 55 to 58 inches, black (5Y 3/0, wet) light clay; strong fine granular; sticky and very plastic when wet; neutral; abrupt, wavy lower boundary.

IICg — 58 inches plus, light grey (5Y 5/1, wet), clay; massive; neutral to mildly alkaline.

These soils are low in nutrients and slightly to medium acid.

Mapping Units

Baynham complex (3,329 acres)

The areas consist dominantly of Baynham series and smaller amounts of Waskwei series.

BERRY ISLAND SERIES

The Berry Island series consists of poorly drained, Rego Humic Gleysol soils developed on moderately to strongly calcareous, stratified sand and gravel outwash and beach deposits over extremely calcareous glacial till. These soils occupy level to depressional areas bordering gravelly beach ridges. Runoff is very slow and internal drainage is impeded by a high groundwater table. Vegetation is black and white spruce, tamarack and sedges. Berry Island soils correlate with Sundown till substrate phase soils reported in the Southeastern Lac Du Bonnet and Grahamdale soil survey reports.

The Berry Island soils have a thin (6 to 16 inches) layer of mesic fen peat. This peat surface layer rests on a thin, dark grey, calcerous Ahg horizon. The Ahg horizon is underlain by a strongly calcareous and strongly iron stained, light grey stratified, sand and gravelly Cg horizon. Extremely calcareous till occurs at 6 to 30 inches of the mineral surface.

Mapping Units

Berry Island series (18,067 acres)

The areas consist dominantly of Berry Island soils.

Berry Island peaty phase (12,524 acres)

These areas consist dominantly of Berry Island soils which have 6 to 16 inches of mesic fen peat and minor areas of Berry Island soils.

BIRCH BAY SERIES

The Birch Bay series consists of imperfectly drained Gleyed Degraded Eutric Brunisol soils developed on 20 to 30 inches of extremely calcareous glacial till over limestone bedrock. Birch Bay soils occur on level to gently undulating terrain. These soils have developed under boreal forest cover, dominantly white spruce with aspen and balsam poplar.

Birch Bay soils are characterized by a thin (less than 1 inch), discontinuous, light-colored eluvial Ae horizon or a several inch thick Aej horizon overlying a thin, weakly developed textural Bt horizon that grades sharply into extremely calcareous till. The solum is generally less than 5 to 6 inches thick and limestone bedrock occurs dominantly between 20 to 30 inches of the mineral surface.

Mapping Unit

Birch Bay series (4,429 acres)

The area consists dominantly of Birch Bay soils.

BRADBURY COMPLEX

The Bradbury complex consists of poorly and very poorly drained soils developed on more than 52 inches of mesic forest peat and may have a thin (0 to 24 inches) surface fibric sphagnum peat layer, underlain by extremely calcareous medium textured till.

The Bradbury complex consists dominantly of Bradubry series (Typic Mesisol), Bradbury series, sphagnic phase. These organic soils are very similar to those described under the Baynham complex, but differ from them in having a stony till mineral substrate rather than a medium to fine textured lacustrine substrate.

Native vegetation in this soil complex consists of black spruce, larch, and some alder in the tree layer and Labrador tea, leather leaf, small cranberry, and feather mosses in the understory. Sphagnum species, however, are found in very poorly drained, less productive sites. On consolidated peat soils, where the water table is able to recede to some extent, merchantable black spruce occurs.

Mapping Unit

Bradbury complex (691 acres)

The areas consist dominantly of Bradbury series and smaller amounts of Bradbury series sphagnic phase.

CALIENTO SERIES

The Caliento series consists of imperfectly drained Gleyed Grey Luvisol soils developed on weakly to moderately calcareous, moderately coarse to coarse textured sediments, which are underlain by an extremely calcareous glacial till within 30 inches of the surface. These soils occur on undulating terrain. Surface drainage is negligible and internal drainage is rapid in the upper portion of the solum and impeded in the lower portion. The soils are slightly to moderately stony, the degree of stoniness depending upon depth of the sand deposit over the till. Native vegetation is dominantly aspen and balsam poplar.

A representative profile type is described below:

L-H — 1½ to 0 inches, dark brown (10YR 3/2, dry), partially to well decomposed leaf, twig, herb and grass litter; medium acid; abrupt, wavy, boundary.

Ahe — 0 to 1 inch, dark grey (10YR 4/1, dry), loamy fine sand; structureless; loose when moist or dry; medium acid; abrupt, wavy boundary.

Aegj — 1 to 17 inches, light grey (10YR 7/1, dry) fine sand; structureless; loose when moist or dry; slightly acid; numerous medium sized, reddish brown (5 YR 4/3, dry), iron mottles; clear, wavy, boundary.

IIABgj — 17 to 18½ inches, very pale brown (10YR 7/3, dry), fine sandy loam, weak fine granular; friable when moist, soft when dry; slightly acid; numerous medium sized, weakly cemented, reddish brown (5YR 5/4, dry), iron concretions; abrupt, wavy boundary.

IIBtgj — 18½ to 22 inches, brown (10YR 5/3, dry), clay loam; moderate fine subangular blocky; firm when moist, hard when dry; slightly acid; few medium sized, reddish brown (5YR 5/4, dry), iron mottles; clear, wavy boundary.

IIBCkgj — 22 to 26 inches, very pale brown (10YR 7/3, dry), fine sandy loam; weak fine subangular blocky; friable when moist, slightly hard when dry; mildly alkaline and strongly calcareous; numerous, reddish brown (10YR 5/4, dry) iron mottles; clear, wavy, boundary.

IICcagj — 26 to 28 inches, white (10YR 8/1, dry), silt loam; fine granular structure, friable when moist, weakly cemented when dry; moderately alkaline and extremely calcareous; clear, broken boundary.

IIckgj — 28 inches plus, very pale brown (10YR 7/3, dry), fine sandy loam; fine granular; friable when moist, hard when dry; moderately alkaline and strongly calcareous; numerous, reddish brown (5YR 5/4, dry) iron mottles.

Caliento soils are characterized by L-H, Aeg, IIBtg and IICkg horizon sequences. The iron stained Aeg horizon varies with the thickness of the sand deposit, normally 15 to 20 inches thick, and overlies a weak to moderate Btg horizon developed in the strongly calcareous, sandy loam to silty clay textured glacial till. A weakly to moderately calcareous IICcag horizon sometimes occurs below the solum. In some sites, the solum of this series is contained completely within the sand deposit. Where this occurs, the soil is characterized by L-H, Aeg, Btgj, Ccag, and IICkg horizon sequences.

Mapping Unit

Caliento series (3,858 acres)

The areas consist dominantly of Caliento soils. They occur mainly in small, scattered areas in the southeastern part of the map, in the Black Island area.

CAYER COMPLEX

The Cayer complex consists of very poorly drained soils, developed on 16 to 52 inches of mesic fen peat with little or no Sphagnum moss underlain by moderately to strongly calcareous loam to clay sediments.

The Cayer complex includes the following series:

Cayer series, a Terric Mesisol, developed on 16 to 52 inches of mesic fen peat. Clayey textured lacustrine sediments with a thin, weakly developed

TABLE 13

Analysis of Caliento Fine Sand (Lac Du Bonnet Map Area)

Hor.	Depth Inches	Mechanical Analysis: Text. Class	% Sand	% Silt	% Clay	% Moisture 1/3 Atm	pH	Cond mmhos/cm	% CaCO₃ Equiv	% Org C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100 gms: Ca	Mg	K	Na	H
L-H	1½-0	—	—	—	—	100	5.9	—	—	26.9	1.4	19	—	—	—	—	—	—
Ahe	0-1	LFS	82	12	6	13	5.8	—		2.24	0.16	14	13.2	10.2	2.0	0.1	<0.1	2.6
Aegj	1-17	FS	90	8	2	6	6.2	—	—	0.02	0.01	2	9.4	6.5	3.3	0.1	<0.1	0.3
IIABgj	17-18½	FSL	70	14	16	15	6.0	—	—	0.23	0.02	12	—	—	—	—	—	—
IIBtgj	18½-22	CL	44	27	29	27	6.6	—	—	0.47	0.04	12	20.2	13.1	6.1	0.3	<0.1	0.9
IIBCkgj	22-26	FSL	71	21	8	13	7.7	0.3	16.5	0.44	0.02	22	—	—	—	—	—	—
IICcagj	26-28	SiL	25	64	11	27	7.9	0.3	51.6	—	—	—	—	—	-	—	—	—
IICkgj	28+	FSL	75	18	7	9	7.9	0.3	21.3	--	—	—	2.1	—	1.1	<0.1	<0.1	---

Ahg horizon may occur within 36 inches of the surface (shallow phase) or between 36 and 52 inches of the surface (moderately deep phase).

Volga series, a Terric Humic Mesisol, developed on 16 to 52 inches of dominantly mesic fen peat and sub-dominant humic fen peat. The humic layers usually occur in lower portions of the organic section. Clayey textured sediments may occur within 36 inches of the surface (shallow phase) or between 36 and 52 inches of the surface (moderately deep phase).

Bayton series, a Terric Fibric Mesisol, developed on 16 to 36 inches of mesic fen peat and sub-dominant fibric fen peat. The fibric layers usually occur at the surface of the organic section. Clayey sediments usually occur within 36 inches of the surface.

Wapah series, a Terric Limno Mesisol, developed on 16 to 52 inches of dominantly mesic fen peat in the middle tier with alternating sub-dominant layers of marl in the organic section. Clayey sediments usually occur between 36 and 52 inches of the surface.

Howell series, a Terric Mesisol, developed on 16 to 52 inches of dominantly mesic fen peat. These soils usually have a 6 to 24 inch surface layer of fibric sphagnum peat. Clayey sediments usually occur between 36 to 52 inches of the surface.

The areas of Cayer soils are level to depressional.

Native vegetation is dominantly sedge, reed-grass, but small amounts of willow, swamp birch, and tamarack are also found. These soils, however, usually support open sedge meadow plant communities with patches of scattered tree cover. Under this type of vegetation the main peat formers appear to be sedges, reed-grasses and mosses.

A representative profile of the Howell series is given below:

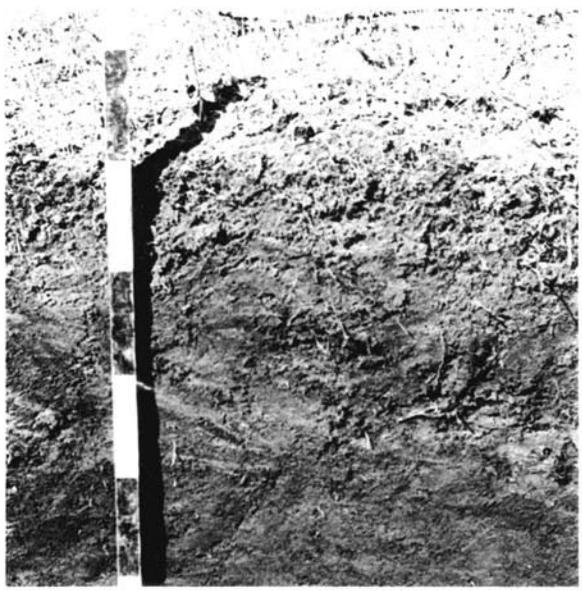


FIGURE 16

Soil profile of Cayer Series, a Terric Mesisol. This organic soil is developed on thin deposits of moderately decomposed fen peat. The surface 6 to 8 inches is usually quite fibrous and yellowish brown. This soil is underlain by lacustrine clay.

Of — 0 to 12 inches, yellowish brown (10YR 5/6, moist) to very pale brown (10YR 7/4, moist), non-woody fibrous, spongy compacted or layered, sphagnum moss with woody intrusions (tamarack roots and stems), medium acid; fiber content approximately 76 percent.

Om_1 — 12 to 24 inches, very dark brown to dark reddish brown (10YR 2/2 to 5YR 3/3, moist) moderately decomposed, mixed woody and non-woody fibrous material composed of mosses, shrubby remains and herbaceous remains, layer becoming more herbaceous near bottom of layer, medium acid, fiber content approximately 61 percent.

Om_2 — 24 to 48 inches, dark brown to very dark brown (10YR 3/3 to 2/2, moist) moderately decomposed, medium fibered herbaceous material, matted or felt-like, medium acid, fiber content approximately 54 percent near top of layer to approximately 45 percent near bottom of layer.

IIAhg — 48 to 51 inches, black (5Y 3/0, wet) light clay; strong fine granular; sticky and very plastic when wet; neutral; abrupt, wavy, lower boundary.

TABLE 14

Analysis of Howell Series (Terric Mesisol)

Hor.	Depth Inches	Mechanical Analysis				% Un-rubbed Fiber	% Pyro-phos. Sol.	% Ash	Bulk Density (gm/cc)	% Org. C	% Total N	C/N Ratio	pH in KCl	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
Of	0-12	—	—	—	—	76	0.2	10.8	0.07	47.2	1.8	26	6.3	179.5	124.2	31.5	0.7	0.6	9.4
Om1	12-24	—	—	—	—	61	0.2	12.3	0.11	49.2	2.4	20.5	6.1	213.8	130.4	34.3	2.3	7.1	11.0
Om2	24-36	—	—	—	—	54	0.3	13.1	0.13	48.7	2.5	19.6		219.6	127.3	29.7	0.4	0.6	13.1
Om3	36-48	—	—	—	—	45	0.5	16.2	0.15	50.2	3.0	16.7	5.8	164.7	100.3	26.0	0.4	0.5	14.2
IIAhg	48-51	C	8	37	55	—	—	83.1	—	5.9	0.4	13.2	6.4	51.2	41.8	16.0	1.0	0.5	1.6

FIGURE 17

Landscape view of a Cayer soil area northeast of Hodgson. The Herbaceous plants, sedges, mosses, willow and birch shrubs are the prevailing vegetation on these soils.

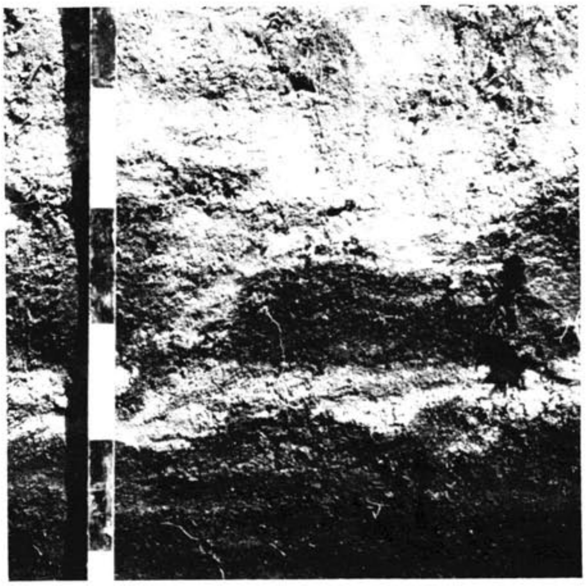


FIGURE 18

Wapah Soil Profile. A Terric Limno Mesisol. These organic soils have thin layers of whitish marl derived from biologically deposited calcium carbonate. They are associated with Cayer soils.

IICg — 51 inches plus, light grey (5Y 5/1, wet) clay; massive; neutral to mildly alkaline.

Mapping Unit

Cayer complex (115,619 acres)

These areas consist dominantly of Cayer series and minor amounts of Bayton series, Wapah series, Volga series and Howell series.

CHITEK SERIES

The Chitek series consists of imperfectly drained Gleyed Degraded Eutric Brunisol soils developed on extremely calcareous glacial till. Surface texture varies widely from fine sandy loam to clay because of the inclusions of soils with a thin lacustrine mantle (less than 6 inches) of moderately fine to fine textured sediments. Chitek soils occur on low, broad ridges and level to gently undulating terrain where surface runoff is slow and internal percolation is moderate to slow. These soils have developed under boreal forest cover, dominantly white spruce with aspen and balsam poplar. The stoniness of these soils ranges from moderate to excessive. A representative profile is described below:

L-H — 2½ to 0 inches, black (5YR 2/1, moist), leaf mat, slightly acid; abrupt, smooth boundary.

Aej — 0 to ½ inches, dark grey (10YR 4/1, moist), light grey (10YR 7/1, dry), sandy clay loam; medium platy; very firm when moist, loose when dry; slightly acid; smooth boundary.

Bmgj — ½ to 5 inches, dark yellowish brown (10YR 4/3, moist), dark greyish brown (10YR 4/2, dry), sandy loam; fine subangular blocky; friable when moist, hard when dry; neutral; iron concretions; abrupt, smooth boundary.

TABLE 15
Analysis of Chitek Loam

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Cal-cite	% Dolo-mite	% Org C	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay								Ca	Mg	K	Na	H
L-H	2½-0	—	—	—	—	6.22	0.63	0.43	—	—	40.66	126.30	—	—	—	—	—
Aej	0-½	SCL	54	24	22	6.84	0.55	1.16	—	—	3.11	14.68	12.50	1.80	0.08	0.11	0.74
Bmgj	½-5	SL	55	27	18	7.24	0.46	10.20	1.88	7.66	1.64	16.48	—	—	—	—	—
	5+	L	47	42	11	7.57	0.42	46.33	12.18	29.04	—	4.36	—	—	—	—	—

Ckgj — 5 inches plus, light brownish grey (2.5Y 6/2, moist), light grey (2.5Y 7/2, dry), loam; medium prismatic; friable when moist, hard when dry; mildly alkaline; iron and calcium carbonate concretions.

Chitek soils are characterized by a thin (less than 1 inch), discontinuous, light-colored eluvial Ae horizon or a several inch thick Aej horizon, overlying a thin, weakly developed textured Bt horizon that grades sharply into extremely calcareous till. The light-colored Aej horizon is slightly acid and the Btj horizon is neutral. The solum is generally less than 5 to 6 inches thick. These soils are found in the northern sections of the map areas and are similar to Inwood soils (Figure 11).

Mapping Units

Chitek series (27,028 acres)

The areas consist dominantly of Chitek soils.

CRANE COMPLEX

The Crane complex consists of very poorly drained organic soils developed on 16 to 52 inches of mesic fen peat (sedges, reed-grasses and brown mosses). In some areas a member of this complex may have a thin (6 to 24 inches) surface layer of fibric sphagnum moss. All soils in this complex are underlain by very stony, extremely calcareous, medium textured till.

The Crane Complex includes the following series:

Crane series, a Terric Mesisol, developed on 16 to 52 inches of mesic fen peat. The very stony, extremely calcareous glacial till usually occurs between 36 and 52 inches of the surface.

Shiel series, a Terric Limno Mesisol, developed on mesic fen peat with subdominant alternating layers of creamy white, marl in the organic section. The organic section is usually 36 to 52 inches thick. The Shiel soils are commonly found adjacent to areas of limestone bedrock or upland sites underlain by bedrock.

Waterhen series, a Terric Humic Mesisol, developed on mesic fen peat with subdominant layers of humic peat in the organic section. While depth of the organic section can vary from 16 to 52 inches, it usually ranges from 16 to 36 inches in thickness.

Carscallen series, a Terric Fibric Mesisol, developed on mesic fen peat with a subdominant layer of fibric fen peat. The fibric layer usually occurs at the surface of the organic section. The organic section is usually quite shallow ranging from 16 to 36 inches in thickness.

Halcrow series, a Terric Mesisol, developed on mesic fen peat usually 36 to 52 inches thick. A distinguishing characteristic of this series is the occurence of a thin (6 to 24 inches thick) fibric Sphagnum moss surface layer. This soil is also found in association with and may sometimes be included in the Kilkenny organic soil complex, a group of soils marked by thick surface layers of fibric sphagnum moss.

The soils of Crane complex are very similar to those of the Cayer complex differing from them only in having a stony till mineral substrate rather than a medium to fine textured lacustrine substrate.

Native vegetation is dominantly sedge, reedgrass, with a small amount of willow, swamp birch, and tamarack is also being found.

Mapping Unit

Crane complex (44,335 acres)

These areas consist dominantly of Crane series and Crane series deep phase. Minor amounts of Shiel series, Waterhen series, Carscallen series and Halcrow series.

DAVIS POINT SERIES

The Davis Point series consists of imperfectly drained, Gleyed Dark Grey soils developed on moderately to strongly calcareous clay till. The topography is level to gently undulating. Runoff and internal drainage are slow. Vegetative cover on this soil is mainly aspen and white spruce. The Davis Point soils are moderately stony. A representative profile of Davis Point clay is described below:

L-H — 2 to 0 inches, leaf mat; neutral; abrupt, smooth boundary.

Ahe — 0 to 2 inches, very dark greyish brown (10YR 3/2, moist), clay; fine granular, firm when moist, slightly hard when dry; slightly acid; abrupt, smooth boundary.

Btjgj — 2 to 6 inches, black (10YR 2/1, moist), clay; medium granular; firm when moist, hard when dry; neutral; diffuse, wavy boundary.

BCgj — 6 to 10 inches, very dark greyish brown (10YR 3/2, moist), clay; medium granular; friable when moist, hard when dry; neutral; clear and sometimes broken, wavy boundary.

Ckgj — 10 inches +, greyish brown (10YR 5/2, moist), clay; structureless to weak fine subangular blocky; firm when moist, hard when dry; mildly alkaline.

The Davis Point soils are slightly degraded, as evidenced by the thin, slightly leached Ahe horizon and the presence of a dark greyish brown, Btj horizon. This soil is slightly acid in the A horizon and neutral in B horizon. Tongues of the dark greyish brown A horizon commonly extend down through the B horizon and into the parent material.

Mapping Units

Davis Point series (5,477 acres)

The areas consist dominantly of Davis Point soils and minor areas of Fyala soils.

TABLE 16

Analysis of Davis Point Clay

Hor	Depth inches	Mechanical Analysis: Text Class	% Sand	% Silt	% Clay	pH	Cond. mmhos cm	% $CaCO_3$ Equiv	% Calcite	% Dolomite	% Org C	% Total N	C/N Ratio	C.E.C. m.e	Exchangeable Cations m.e. 100 gm: Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	6.0	0.58	0.21		—	38.90	1.73	22.5	--	—	—	—	—	—
Ahe	0-2	C	23	27	50	6.51	0.35	0.21	—	—	3.04	0.23	13.2	36.52	22.75	13.86	0.92	0.29	1.58
Btjgj	2-6	C	26	24	50	7.06	0.38	6.30	0.0	7.18	1.17	--	—	22.68	—	—	—	—	—
BCgj	6-10	C	18	34	48	7.24	0.30	--	--	--	0.76	—	—	—	—	—	—	—	—
Ckgj	10+	C	8	33	59	7.45	0.27	28.63	10.81	16.32	—	—	—	--	—	—	—	—	—

DENBEIGH COMPLEX

The Denbeigh complex consists of poorly to very poorly drained soils developed on deep (greater than 24 inches) sphagnum peat overlying forest and/or fen peat, or from very deep (greater than 64 inches) sphagnum peat. The total organic section very often ranges from 5 to 10 feet in thickness. These organic soils are underlain by very stony, extremely calcareous medium textured till.

The Denbeigh complex includes the following series:

Denbeigh series, a Mesic Fibrisol, developed on moderately deep, fibric Sphagnum moss usually 3 to 4 feet thick overlying mesic forest peat. Mesic forest peat is moderately decomposed material derived from spruce litter, feather mosses and ericaceous shrubs. It is usually acidic and layered with woody debris and logs. Feathermosses, the dominant peat former in these soils, decomposes much more rapidly and completely than other materials and is usually very dark brown to black in color. The very stony, extremely calcareous till that underlies these organic deposits, the very strongly acid sphagnum moss surface layer, and the very woody, layered forest peat all contribute considerable limitations to development of these organic soils for agriculture.

Mason series, a Sphagno-Fibrisol, developed on very deep, thicker than 5 feet, fibric sphagnum moss peat. These very strongly to extremely acid, organic deposits are usually light yellowish brown in color and very uniform. Woody logs and other coarse debris are usually not found in these soils. The underlying extremely calcareous till appears not to have affected the properties of the major portion of the organic section of these soils.

These soils are very similar to those described under the Julius complex, but differ from them in having a stony till mineral substrate rather than a medium to fine tectured lacustrine substrate.

Native vegetation is dominantly stunted black spruce and tamarack with an understory of Sphagnum mosses and ericaceous shrubs.

Mapping Unit

Denbeigh complex (297 acres)

These areas consist dominantly of Denbeigh series and smaller amounts of Mason series.

DENCROSS SERIES

The Dencross series are imperfectly drained Gleyed Rego Black soils developed on 6 to 30 inches of moderately to strongly calcareous lacustrine clay, underlain by very strongly to extremely calcareous silty sediments. They frequently occur on silt bars which were subsequently covered by lacustrine clay. Surface textures range from light clay to heavy clay and are mildly alkaline. The subsurface horizons range from silt loam to silty clay in texture and are moderately alkaline.

The native vegetation consists of open stands of white spruce, and aspen in the tree layer with some alder and white birch also being present. A description of a representative profile in this series follows:

L-H — 2 to 0 inches, black (5YR 2/1.5, moist), leaf mat, neutral; abrupt, smooth boundary.

Ahgj — 0 to 4 inches, black (10YR 2/1, moist), dark grey (10YR 4/1, dry), clay; moderate, coarse granular; firm when moist, very hard when dry; mildly alkaline; abrupt, smooth boundary.

ACgj — 4 to 6 inches, very dark grey (10YR 3/1, moist), grey (10YR 5/1, dry); clay; moderate, medium granular; firm when moist, very hard when dry; many small iron stains; moderately alkaline; abrupt, smooth boundary.

IICgj — 6 inches +, pale olive (5Y 6/3, moist), light grey (5Y 7/1, dry), silty clay loam; weak fine granular; firm when moist, hard when dry; numerous iron stains and mottles; moderately alkaline; calcium carbonate concretions.

The Ah horizon of the Dencross soils is usually very dark grey to black, strongly granular and neutral in reaction. The C horizon is light brownish grey to light grey and strongly calcareous.

TABLE 17
Analysis of Dencross Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% CaCO3 Equiv.	% Calcite	% Dolomite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Soluble Salts (meq/L)						
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	Na	Cl	SO4	Total Cat.	Total Ani.
L-H	2-0	—	—	—	—	7.12	1.03	6.98	0.54	5.94	17.61	0.63	28	72.40	—	—	—	—	—	—	—
Ahgj	0-4	C	6	39	55	7.62	0.65	14.6	1.8	11.7	3.18	0.14	23	27.40	—	—	—	—	—	—	—
ACgj	4-6	SiC	2	41	57	7.95	0.46	39.9	14.7	23.2	0.35	—	—	7.24	—	—	—	—	—	—	—
IICgj	6-	SiCL	6	67	27	7.95	4.47	64.6	7.8	52.4	0.20	—	—	17.08	21.24	41.78	11.42	0.93	71.78	75.44	72.71

Mapping Units

Dencross series (2,299 acres)

These are areas of dominantly Dencross soils but small amounts of Framnes and Tarno soils may also be included.

DEVILS LAKE SERIES

The Devils Lake series consists of well to moderately well drained, Orthic Grey Luvisol soils, developed on 20 to 30 inches extremely calcareous glacial till over limestone bedrock. The topography is gently undulating to undulating. Surface runoff is moderate, permeability is medium, and these soils are very to exceedingly stony. The native vegetation is mainly aspen and white spruce with jack pine. Devils Lake soils correlate with Garson rock substrate phase soils reported in previous, published soil survey reports.

The Devils Lake soils have the typical Orthic Grey Luvisol profile characteristics, but the horizons are very thin.

Thin, neutral to slightly acid L-H horizon overlies a 1 to 3 inch thick light greyish brown Ae horizon that is neutral to slightly acid in reaction. The thin Bt is well developed and the transitional BC horizon separates the extremely calcareous C horizon. Limestone bedrock dominantly occurs within 20 to 30 inches of the mineral surface.

Mapping Unit

Devils Lake series (717 acres)

These are areas of Devils Lake soils. Minor amounts of bare limestone bedrock outcroppings occur in these map units. These soils are significantly more stony than associated Garson soils.

EGG ISLAND SERIES

The Egg Island series consists of well drained Orthic Grey Luvisol soils, developed on moderately to strongly calcareous fine textured lacustrine deposits underlain by extremely calcareous till. Limestone bedrock usually occurs with 20 to 30 inches of the surface. The Egg Island soils correlate with Kinwow rock substrate phase soils reported in previously published soil survey reports.

The Egg Island soils have a dark greyish brown Ae horizon and moderately developed columnar structured B horizon.

Mapping Unit

Egg Island series (2,340 acres)

These areas consist of normal Egg Island soils. These soils are stonier than associated Kinwow soils and limestone bedrock occasionally outcrops in these map units.

FAIRFORD SERIES

The Fairford series consists of well drained Degraded Eutric Brunisol soils, developed on extremely calcareous glacial till. Surface texture varies from loam to clay loam. These soils occupy much of the well drained land in the Interlake Till Plain. They occur commonly with Garson soils. The topography is gently undulating to undulating. The native vegetation is aspen, jack pine, and white spruce. The Fairford soils are very to excessively stony. A representative profile is described below:

L-H — 1 to 0 inches, black (10YR 2/1, moist), leaf mat; neutral; abrupt boundary.

Aej — 0 to 2 inches, dark greyish brown (10YR 4/2, moist), clay loam; medium granular; friable when moist, soft when dry; neutral; abrupt, broken, wavy boundary.

Btj — 2 to 4 inches, very dark greyish brown (10YR 3/3, moist), clay loam; medium subangular blocky; firm when moist, hard when dry; neutral; clear, smooth boundary.

BC — 4 to 6 inches, dark greyish brown (10 YR 4/2, moist), silty clay loam; medium granular; friable when moist, slightly hard when dry; neutral; clear boundary.

Ck1 — 6 to 10 inches, greyish brown (10YR 5/2, moist), silt loam; structureless, friable when moist, hard when dry; mildly alkaline; diffuse boundary.

Ck2 — 10 inches+, greyish brown (10YR 5/2, moist), silt loam, structureless; friable when moist, hard when dry; mildly alkaline.

FIGURE 19

Aerial view of the southwestern portion of the Peguis Indian Reserve in Township 26, Range 2W, showing a pattern of very prominent drumlins, ridges (A) and intervening swales or depressions (B). A complex pattern of such soils as Fairford, Inwood, Arnes and Peguis occur on the ridges, while such soils as Cayer, Fyala and Tarno are found in the depressions.

TABLE 18
Analysis of Fairford Silt Loam

Hor.	Depth Inches	Mechanical Analysis: Text Class	% Sand	% Silt	% Clay	pH	Cond. mmhos cm	% $CaCO_3$ Equiv	% Calcite	% Dolomite	% Org. C	% Total N	C:N Ratio	CEC m.e.	Exchangeable Cations m.e. 100gms. Ca	Mg	K	Na	H
L-H	1-0	—	—	—	—	7.00	0.53	3.07	—	—	17.73	1.24	14.3	—	—	—	—	—	—
Aej	0-2	C	28	30	42	6.70	0.38	0.15	—	—	1.46	0.15	9.7	27.51	18.29	7.83	1.35	0.23	0.55
Btj	2-4	C	19	35	46	6.96	0.36	6.69	—	—	2.60	0.26	10.0	32.52	21.51	7.29	1.40	0.29	0.39
BC	4-6	SiCL	13	57	30	7.21	0.39	29.96	0.0	27.62	2.37	0.22	10.8	—	—	—	—	—	—
Ck1	6-19	SiL	14	66	20	7.41	0.28	65.45	16.06	45.48	—	—	—	—	—	—	—	—	—
Ck2	10+	SiL	25	60	15	7.56	0.25	66.66	18.87	44.02	—	—	—	—	—	—	—	—	—

The solum of Fairford soil is generally less than 8 inches, characterized by a thin (less than 1 inch) broken light-colored eluvial Ae horizon or a several inch thick Aej horizon overlying a thin, weakly developed textural B horizon (see Figure 11). The Aej horizon is slightly acid or neutral, and the B horizon is neutral.

Mapping Unit

Fairford Series (139,845 acres)

The areas consist dominantly of Fairford soils. Minor amounts of Garson and Inwood soils can also be found in these map units.

FAULKNER SERIES

The Faulkner series consists of imperfectly drained Gleyed Dark Grey soils developed on 20 to 30 inches of extremely calcareous glacial till over limestone bedrock. The topography is level to gently undulating and the vegetation is dominantly aspen, white spruce and balsam poplar. The Faulkner soils correlate with Inwood rock substrate phase reported in previously published soil survey reports.

Faulkner soils are characterized by a thin A horizon overlying a thin, weakly developed, textural B horizon that grades sharply into extremely calcareous till. The solum is generally less than 6 to 8 inches thick.

Mapping Unit

Faulkner Series (7,070 acres)

These areas consist of normal Faulkner soils. Minor amounts of associated Inwood soils and limestone bedrock outcroppings occur in these map units.

FISHER SERIES

The Fisher series consists of imperfectly drained, Gleyed Orthic Regosol soils on medium to moderately fine textured, strongly calcareous, stratified recent alluvial deposits. These immature soils occur on the nearly level, meander flood plain and levee deposits of the Fisher River. Native vegetation on this soil is aspen, white spruce, balsam poplar, and willow. A representative profile of this series is given below:

L-H — 2 to 0 inches, leaf mat; neutral; abrupt, smooth boundary.

Ahjgj — 0 to 4 inches, very dark grey (10YR 2.5/1, moist), dark grey (10YR 4/1, dry), silty clay; medium subangular blocky structure, breaking to fine granular; friable when moist, slightly hard when dry; mildly alkaline; clear, smooth boundary.

ACgj — 4 to 8 inches, very dark grey (10YR 3/1, moist), grey (10YR 5.5/1, dry), silty clay; weak medium subangular blocky structure, breaking to fine granular; firm when moist, hard when dry; mildly alkaline; clear, smooth boundary.

Ckgj — 8 to 17 inches, grey (10YR 4.5/1, moist), light grey (10YR 6.5/2, dry), silty clay; weak; fine granular; firm when moist, hard when dry; mildly alkaline; clear, smooth boundary.

Ckgj2 — 17 to 21 inches, light brownish grey (2.5Y 6/2, moist), silty clay loam; weak, fine platy; firm when moist, hard when dry; mildly alkaline; clear, smooth boundary.

Ckgj3 — 21 inches +, dark grey (10YR 3.5/1, moist), silty clay; weak, fine granular; firm when moist, hard when dry; mildly alkaline.

The soil profile development on these alluvial sediments is restricted to a thin, weakly expressed Ah horizon that grades sharply into the stratified parent material. The A horizon has fine subangular blocky structure, very dark grey color, neutral reactions and may be weakly calcareous. The C horizon is strongly calcareous, weakly iron stained, and may contain bands of darker material representing former surfaces which have been covered by deposition of fresh alluvium. Surface textures are usually silty clay and the underlying material varies from sandy clay to silty clay.

Mapping Unit

Fisher series (1,250 acres)

Areas of normal Fisher soils.

TABLE 19
Analysis of Fisher Silty Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond mmhos cm	% $CaCO_3$ Equiv.	% Cal-cite	% Dolo-mite	% Org. C	% Total N	C/N Ratio	C E C m e
		Text. Class	% Sand	% Silt	% Clay									
L-H	2-0	—	—	—	—	—	—	—	—	—	—	—	—	—
Ahgj	0-4	SiC	6	48		7.15	0.45	6.21	—	—	6.70	0.35	19.1	39.96
ACgj	4-8	SiC	4	50	46	7.40	0.42	37.28	—	—	1.98	0.35	5.7	26.96
Ckgj1	8-17	SiC	5	54	41	7.65	0.38	44.54	12.00	29.97	—	—	—	14.04
Ckgj2	17-21	SCL	7	66		7.70	0.30	52.45	9.46	39.60	—	—		11.24
Ckgj3	21+	SiC	1	47	52	7.55	0.34	23.94	7.23	15.32	—	—	—	24.12

FISHERTON SERIES

The Fisherton series consists of imperfectly drained, Gleyed Dark Grey soils developed on 6 to 30 inches of very strongly to extremely calcareous, medium to moderately fine textured sediments over extremely calcareous till. The topography is level to very gently sloping and the vegetation is dominantly aspen and white spruce. The Fisherton soils correlate with Ledwyn till substrate phase soils reported in previously published soil survey reports.

The Fisherton soils are weakly degraded. They have a thin dark grey Ahej horizon and weakly developed Bt horizon. The solum is generally shallow (less than 10 inches thick) and fine sandy loam to silty clay loam in texture. A thin gravel or cobble lens may occur between the surface layer and the glacial till. Imperfect drainage in these soils is indicated by numerous iron stains in the B and C horizons.

Mapping Unit

Fisherton series (2,674 acres)

These are areas of normal Fisherton soils. Minor amounts of associated Ledwyn soils will occur in these map units.

FOLEY SERIES

The Foley series consists of poorly drained, Carbonated Rego Humic Gleysol soils developed on very strongly and extremely calcareous, medium textured lacustrine sediments. Surface textures are very fine sandy loam, loam and silt loam and subsurface textures generally become coarser with depth. Only a few small areas of this soil occur in the Red Rose-Washow Bay map area. They are level to depressional and have very slow surface runoff. While the soils are very permeable, internal drainage is impeded by a high groundwater table. Foley soils are mostly stone free but, where the underlying glacial till comes near the surface, scattered stones occur on the surface.

Native vegetation consists of sedges, reedgrasses, with clumps of willow and alder on the very poorly drained sites. In the slightly better drained sites, where the water is able to move off slowly, the dominant species are mixed stands of aspen and balsam poplar with some black spruce and larch. A description of a representative profile of this series is given below:

Om — 5 to 0 inches, dark brown (10YR 3/3, moist), moderately decomposed fen peat; netural; abrupt, smooth boundary.

Ahg — 0 to 4 inches, black (5YR 2/1, moist), very dark grey (10YR 3/1, dry), clay loam; weak, fine granular; plastic and sticky when wet, hard when dry; mildly alkaline; clear, smooth boundary.

ACg — 4 to 8 inches, grey (5YR 4.5/1, moist), grey (10YR 5/1, dry), clay loam; weak, fine granular; plastic and sticky when wet, hard when dry; moderately alkaline; iron concretions; abrupt, smooth boundary.

Cg — 8 inches+, pale olive (5Y 6/3, moist), pale yellow (5Y 6/3, dry), silt loam; weak, fine granular; plastic and sticky when wet, hard when dry; moderately alkaline; iron concretions.

These soils usually have a thin layer of moderately decomposed sedge peat, underlain by a thin, very dark grey Ahg horizon that is iron stained, weakly granular, moderately alkaline and weakly calcareous. The Cg horizon is clay loam, iron stained, extremely calcareous and moderately alkaline. The productivity of this soil is limited by poor drainage.

Mapping Units

Foley series (695 acres)

These areas consist dominantly of normal Foley soils, but in some areas minor amounts of Balmoral soils are associated with them.

Foley Peaty Phase (1,469 acres)

These are areas of Foley soils which have a 6 to 16 inch surface layer of moderately decomposed fen peat.

TABLE 20

Analysis of Foley Clay Loam

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Calcite	% Dolomite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Soluble Salts (meq/L)						
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	Na	Cl	SO4	Total Cat.	Total Ani.
Om	5-0	—	—	—	—	7.20	2.18	—	—	—	36.31	2.52	14.4	96.10	9.50	19.10	6.30	1.76	20.20	34.90	29.79
Ahg	0-4	CL	24	43	33	7.65	3.11	24.56	0.0	22.62	8.30	0.75	11.1	42 7	11.50	28.20	12.58	2.13	37.60	52.28	46.04
ACg	4-8	CL	27	41	32	8.04	6.01	43.27	7.08	33.32	1.07	0.10	10 7	12.60	23.00	57 60	21.21	2.05	93.90	101.81	100.51
Cg	8+	CL	23	50	27	8.20	4.80	54.82	5.54	45.38	—	—	—	6.80	19.60	36.20	18.37	1.85	72.70	74.14	76.51

FRAMNES SERIES

The Framnes series consists of imperfectly drained, Gleyed Dark Grey soils developed on 6 to 30 inches of moderately to strongly calcareous lacustrine clay underlain by very strongly to extremely calcareous silty sediments. These soils occur on smooth, nearly level topography, where the surface drainage and internal drainage is moderately slow to slow.

The native vegetation consists of aspen, balsam poplar, ash, raspberry, bracken fern, dogwood, and grass species. A representative Framnes soil profile is described below:

L-H — 2 to 0 inches, leaf mat; neutral; abrupt, smooth boundary.

Ahegj — 0 to 2 inches, very dark grey (10YR 3/1, moist), dark grey to grey (10YR 4/1 to 5/1, dry), clay; moderate fine to medium granular; very firm when moist, very hard when dry; neutral; abrupt, smooth boundary.

Btjgj — 2 to 11 inches, black (10YR 2/1 and 2/2, moist), clay; strong fine to medium granular; very firm when moist, very hard when dry; neutral; clear, wavy boundary.

BCgj — 11 to 15 inches, greyish brown (10YR 5/2, moist), clay; strong fine to medium granular; very firm when moist, very hard when dry; mildly alkaline; clear, wavy boundary.

IICgj — 15 inches+, light grey (10YR 7/2, moist), silt loam to silty clay; moderate, fine to medium blocky to subangular blocky; firm when moist, hard when dry; moderately alkaline.

These soils have a thin, slightly acid leaf mat underlain by a very dark Ah horizon that may contian blotches of lighter colored, slightly leached material. The Ahe horizon is 2 to 6 inches thick and frequently tongues into the B horizon to a depth of 10 to 15 inches. The B horizon has a coarse granular to medium blocky structure and contains a slight clay accumulation. It is neutral to slightly acid in reaction. The B horizon, developed in the clay mantle, usually extends down to the underlying silty sediments. The thickness of the solum varies with the depth of the clay, to the strongly calcareous substrate. A portion of the Cg horizon may occur in the clay layer where the clay exceeds 20 inches in thickness.

Mapping Unit

Framnes series (1,204 acres)

Areas of normal Framnes soils and minor amounts of Arborg soils are associated with them.

TABLE 21

Analysis of Framnes Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Calcite	% Dolomite	% Org. C	% Total N	C N Ratio	C E C m e	Exchangeable Cations m e /100gms				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	6.89	0.59	0.37	—	—	16.97	0.90	19	—	—	—	—	—	—
Ahegj	0-2	C	25	26	49	7.15	0.57	0.28	—	—	4.10	—	—	36.56	20 35	16.55	1.13	0 29	0.60
Btjgj	2-11	C	25	20	55	7.17	0.33	0.46	—	—	1.09	—	—	28.52	11.75	14.55	1.06	0.27	0.34
BCgj	11-15	C	13	32	55	7.75	0.41	59.70	6.36	48.48	0.18	—	—	—	—	—	—	—	—
IICgj	15+	Sil	7	71	22	8.03	0.44	22.77	3.35	19.90	0.60	—	—	—	—	—	—	—	—

FYALA SERIES

The Fyala series consists of poorly drained Rego Humic Gleysol soils developed on moderately to strongly calcareous, lacustrine clay. Surface texture of these cultivated soils is clay, but usually a high percentage of peaty material has been incorporated with the mineral material. These soils are widespread in the Red Rose-Washow Bay area. They occur adjacent to the numerous, poorly drained areas of organic soils. Internal drainage in these soils is impeded by fine textures and a high ground water table.

Native vegetation in the depressional areas is dominantly wetland vegetation. The most common plant species are sedges, with willow, alder, black spruce, and larch.

A representative soil profile is described below:

Ap — 0 to 6 inches, black (10YR 2/1, moist), clay; weak fine granular; very plastic and very sticky when wet, very hard when dry; medium acid; abrupt, irregular boundary.

ACg — 6 to 10 inches, very dark grey (10YR 3/1, moist), clay; weak coarse granular; very plastic and very sticky when wet, very hard when dry; neutral; clear, broken boundary.

Cg — 10 to 18 inches, dark greyish brown (2.5Y 4/2, moist), clay; massive; very plastic and very sticky when wet, very hard when dry; neutral; clear, smooth boundary.

Ckg — 18 inches+, greyish brown (2.5Y 4.5/2, moist), clay; massive; very plastic and very sticky when wet, very hard when dry; neutral.

The Fyala soils are stone-free. These soils have a surface layer of mesic, medium acid to neutral, moderately decomposed peat that is 6 to 16 inches thick and is underlain by a thin, very dark grey Ah horizon, high in organic matter and neutral to mildly alkaline in reaction. The Ah horizon is from 2 to 6 inches thick but frequently tongues down into the Cg horizon to depths of 8 to 12 inches. The Cg horizon is greyish brown to olive grey, contains numerous large concretions of lime carbonate, and is iron stained.

FIGURE 20

Fyala clay, peaty phase. A Rego Humic Gleysol developed on deep lacustrine clay sediments.

Mapping Units

Fyala series (4,263 acres)

Areas of dominantly normal Fyala soils but may contain minor included areas of Tarno and Partridge Creek soils.

Fyala peaty phase (45,207 acres)

These are areas of Fyala soils which have a 6 to 16 inch overlay of moderately decomposed fen peat.

GARSON SERIES

The Garson series consists of well to moderately well drained, Orthic Grey Luvisol soils developed on extremely calcareous glacial till. The plow layer generally ranges from sandy loam to clay, and consists of a mixture of materials from the thin A, B and C horizons. This wide range of texture is due to the inclusion in the series of soils developed on a

TABLE 22
Analysis of Fyala Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Calcite	% Dolomite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Soluble Salts (meq/L)						
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	Na	Cl	SO4	Total	Total
Ap	0-6	C	3	25	72	5.90	1.97	—	—	—	5.82	0.42	13.9	—	7.80	17.7	2.5	0	17.6	28.0	17.6
ACg	6-10	C	1	12	87	6.60	3.41	0.37	—	—	0.76	—	—	—	14.2	28.5	4.6	0	46.6	47.3	46.6
Cg	10-18	C	1	13	86	7.15	3.30	0.34	0.34	2.77	—	—	—	—	17.5	27.7	5.9	0	48.9	51.1	48.9
Ckg	18+	C	1	19	80	7.30	3.62	2.77	0.0	0.0	—	—	—	—	22.3	27.4	5.5	0	55.2	52.2	55.2

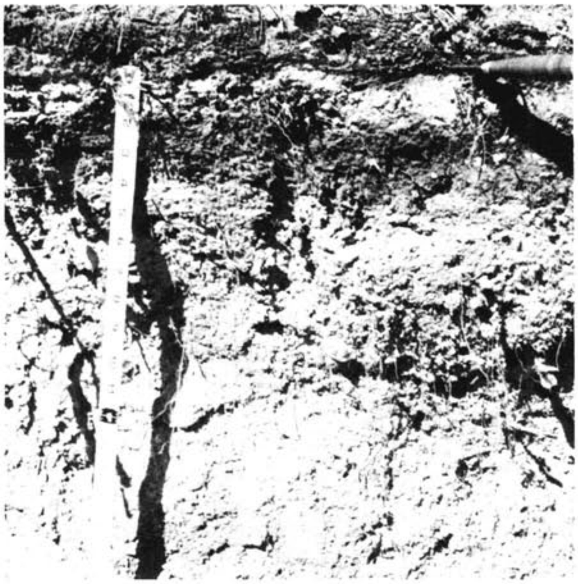


FIGURE 21

Garson loam. An Orthic Grey Luvisol developed on very stony, extremely calcareous glacial till. Note the well developed, but very thin, horizons in this soil.

very thin (less than 6 inches) lacustrine mantle over the glacial till. These soils occupy the higher till ridges and are scattered throughout the Interlake Till Plain. The topography is gently undulating to undulating, commonly in the form of broad low ridges. Surface runoff is moderate, permeability is medium. These soils are very to exceedingly stony.

The native vegetation is mainly aspen and white spruce with minor occurrences of jack pine, balsam poplar, and willow. A representative profile of the Garson series is described below:

L-H — 4 to 0 inches, leaf and sod mat; abrupt, smooth boundary.

Ae — 0 to 3 inches, greyish brown (10YR 5/2, moist), sandy loam; fine to medium platy; friable when moist, soft when dry; neutral; abrupt, smooth boundary.

Bt — 3 to 8 inches, very dark greyish brown (10YR 3/2, moist), sandy clay loam; moderately fine blocky; hard when dry; firm when moist, neutral; abrupt, smooth boundary.

BC — 8 to 10 inches, dark greyish brown (10YR 4/2, moist), loam; medium granular; hard when dry, firm when moist; mildly alkaline; clear, smooth boundary.

Ck — 10 inches+, greyish brown (10YR 5/2, moist), clay loam till; moderate to strongly, fine to medium blocky-structure; firm when moist, hard when dry; mildly alkaline and extremely calcareous.

The Garson soils have the typical Orthic Grey Luvisol profile characteristics, but the horizons are very thin. The entire solum is normally less than 10 inches thick from the surface. On virgin sites a thin, neutral to slightly acid L-H horizon overlies a 1 to 3 inch thick light greyish brown Ae horizon that is neutral to slightly acid in reaction. The thin Bt horizon is well developed and it consists of 2 to 5 inches of brown to dark greyish brown, blocky structured aggregates. The BC transitional horizon is thin and usually separates the Bt from the extremely calcareous C horizon. Very often the BC horizon occurs within a gravelly to cobbly lense. In such cases, its texture is very coarse, its consistence very loose and quite often organic debris fills the interstices between the larger particles. The cultivated Garson soils are neutral to mildly alkaline in the plow layer and generally contain free calcium carbonate.

Mapping Units

Garson series (9,014 acres)

These are areas consisting dominantly of normal Garson soils, but containing minor areas of Fairford and Inwood soils.

GOOSE ISLAND COMPLEX

The Goose Island complex consists of imperfectly drained Goose Island series (Gleyed Rego Dark Grey), Louis Island series (Gleyed Dark Grey) and Matheson series (Gleyed Dark Grey Luvisol) soils, developed on 6 to 30 inches of stratified sand and gravel outwash and beach deposits over extremely

TABLE 23
Analysis of Garson Loam

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Cal-cite	% Dolo-mite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100gms.				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
L-H	4-0	—	—	—	—	5.45	0.50	—	—	—	60.42	1.06	47.6	—	—	—	—	—	—
Ae	0-3	SL	59	26	15	6.85	0.44	—	—	—	2.00	0.06	33.3	12.68	9.85	1.66	0.25	0.17	0.82
Bt	3-8	C	36	23	41	7.20	0.42	4.99	0.0	4.60	1.57	0.12	13.08	—	—	—	—	—	—
BC	8-10	L	49	31	20	7.45	0.40	30.65	9.09	19.85	2.04	0.18	11.30	—	—	—	—	—	—
Ck	10+	L	39	37	24	7.50	0.39	48.51	23.19	23.33	—	—	—	—	—	—	—	—	—

calcareous till. The topography is very gently sloping. The vegetation is dominantly aspen, black and white spruce, some jack pine and sedges. Goose Island soils correlate with Spearhill till substrate phase soils reported in previously published soil survey reports.

The Goose Island soils are leached but the degree of degradation varies. The Gleyed Dark Grey member has a dark colored surface horizon blotched with lighter colored areas and underlain by a weakly developed Bt horizon. The Gleyed Dark Grey Luvisol member also has a dark surface horizon and a thin, greyish brown Ae horizon underlain by a moderately developed Bt horizon. Iron stains and mottles are common to all soils in this complex.

Mapping Unit

Goose Island Complex (5,694 acres)

These are areas of Goose Island soils which may include minor amounts of Inwood and Gunton soils.

GRINDSTONE COMPLEX

The Grindstone complex consists of poorly to very poorly drained soils developed on 16 to 52 inches of mesic forest peat which may have a thin (0 to 24 inches) surface layer of fibric Sphagnum moss peat. These soils are underlain by very stony, extremely calcareous medium textured till.

The Grindstone complex includes the following series:

Grindstone series, a Terric Mesisol, developed on 16 to 52 inches of mesic forest peat (moderately decomposed organic material derived from spruce and tamarack litter, feathermosses and ericaceous shrubs). The material is usually strongly acidic and layered with woody logs and debris. Feathermosses, the dominant peat former in these soils, decomposes very rapidly and more completely than other materials and usually imparts a very dark brown to black color to the matrix. These soils do not have a surface layer of Fibric Sphagnum moss peat. These soils are not suitable for agricultural development because the very stony, glacial till underlying the organic deposits is too close to the surface.

Mistatim series, a Terric Fibric Mesisol, developed on shallow, 2 to 3 feet, dominantly mesic forest peat. A subdominant fibric Sphagnum moss peat layer occurs at the surface of these soils. The organic section of these soils is usually much thinner than that of the Grindstone series.

Kanusk series, a Terric Mesic Fibrisol, developed on shallow, 2 to 3 feet, dominantly fibric Sphagnum moss peat and a subdominant layer or layers of mesic forest peat. These, like the Mistatim, are not suitable for agricultural development because of their thinness and the presence of a significant surface layer of Sphagnum.

Laronde series, a Terric Fibrisol, developed on fibric Sphagnum moss peat. A nonsignificant layer or layers of mesic forest peat may or may not be present. As in the case of the Mistatim and Kanusk series, these soils are not suitable for agricultural development because of the thin organic layer over very stony till and the rather thick surface layer of fibric Sphagnum peat.

These organic soils are very similar to those described under the Okno complex, but differ from them in having a stony till mineral substrate rather than a medium to fine textured lacustrine substrate.

In the tree layer the most common vegetation associated with this soil complex is black spruce and some larch. In the understory, Labrador tea, leather leaf and feather mosses are found. Sphagnum species, however, are found in some very poorly drained less productive sites. Merchantable dense stands of black spruce occur on sites where the water table is able to recede to some extent.

Mapping Unit

Grindstone complex (9,972 acres)

Areas consisting dominantly of Grindstone series and smaller amounts of Mistatim series, Kanusk series and Laronde series.

GUNTON COMPLEX

The Gunton complex consists of rapidly to well drained Gunton series (Orthic Dark Grey) and Gull series (Dark Grey Luvisol) soils developed on 6 to 30 inches of stratified strongly calcareous, outwash and beach deposits over extremely calcareous till. The topography is gently undulating to undulating mostly in the form of low, narrow ridges. Vegetation is dominantly jack pine and aspen. Gunton soils correlate with Leary till substrate phase soils reported in previously published soil survey reports.

These soils occur on thin outwash and beach deposits bordering the beach ridges and at scattered locations in the Interlake Till Plain. The substrate of loam to clay loam till impedes internal drainage, rendering these soils less arid than the associated Leary soils.

Mapping Unit

Gunton Complex (5,075 acres)

These are areas of Gunton soils with minor included areas of Leary soils.

HARWILL SERIES

The Harwill series consists of moderately well drained, Orthic Dark Grey soils developed on strongly to extremely calcareous, moderately fine textured sediments. The topography is smooth to gently sloping. Native vegetation is dominantly aspen, white spruce and balsam poplar. These soils are free of stones.

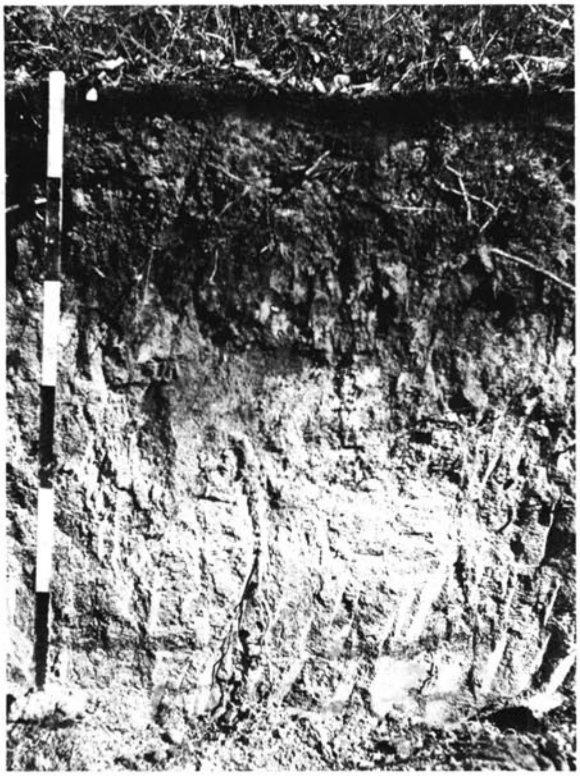


FIGURE 22
Harwill clay loam. An Orthic Dark Grey developed on very strongly calcareous, clay loam textured lacustrine sediments.

A representative profile of the Harwill series is described below:

L-H — 2 to 0 inches, leaf mat; abrupt, smooth boundary.

Ahe — 0 to 2 inches, very dark greyish brown (10YR 2.5/2, moist), dark grey (10YR 4/1, dry), silty clay loam; weak medium granular; friable when moist, slightly hard when dry; neutral; clear, smooth boundary.

Bm — 2 to 6 inches, dark greyish brown (10YR 4/2, moist), greyish brown (10YR 5/2, dry), silty clay; moderate medium granular; friable to firm when moist, slightly hard when dry; neutral; clear, smooth boundary.

Ck — 6 inches plus, light brownish grey (2.5Y 6/2, moist), light grey (2.5Y 7/2, dry), silty clay; moderate medium granular; friable when moist, slightly hard when dry; mildly alkaline.

The solum of the Harwill soils is characterized by a weakly developed, thin Ahe horizon that is usually neutral in reaction. The Bm horizon is usually granular and neutral in reaction. The C horizon is usually light grey to white in color, moderately to strongly alkaline and extremely calcareous. These soils are better drained than the associated Ledwyn soils.

Mapping Unit
Harwill series (4,769 acres)
Areas consist dominantly of normal Harwill soils with minor amounts of Ledwyn soils.

HODGSON SERIES

The Hodgson series consists of moderately well drained Orthic Regosol soils developed on medium to moderately fine textured strongly clacareous, stratified recent alluvial deposits, ranging in texture from very fine sandy clay loam to silty clay loam. These soils occur on flood plain deposits bordering the Fisher River, mainly in the vicinity of Hodgson. The topography is smooth, gently sloping. Native vegetation is aspen, white spruce, and balsam poplar. The soils are free of stones. A representative soil profile is described below:

L-H — 2 to 0 inches, dark reddish brown (5YR 2/2, moist), leaf mat; neutral; abrupt, clear boundary.

Ahj — 0 to 3 inches, very dary greyish brown (10YR 2.5/2, moist), grey (10YR 4.5/1, dry), silt loam; weak fine granular structure, friable when moist, hard when dry; neutral; clear, smooth boundary.

AC — 3 to 5 inches, dark greyish brown (10YR 4/2, moist), grey (10YR 5/1, dry), silt loam; weak, medium granular; friable when moist, hard when dry; mildly alkaline; abrupt, wavy boundary.

Cl — 5 to 24 inches, pale olive (5Y 6/3, moist), light grey (5Y 7/2, dry), silty clay loam; weak, fine granular; friable when moist, hard when dry; mildly alkaline; clear, wavy boundary.

TABLE 24
Analysis of Harwill Silty Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Cal-cite	% Dolo-mite	% Org. C	% Total N	C#N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100gms.				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
L-H	2-0																		
Ahe	02-	SiCL	14	47	39	6.86	0.39	0.67	—	—	3.96	0.38	10.4	39.39	26.10	6.70	1.52	0.22	0.54
Bm	2-6	SiC	11	44	45	6.84	0.28	2.04	—	—	2.10	0.31	6.8	33.60	22.79	7.27	1.28	0.14	0.69
Ck	6+	SiC	1	51	48	7.70	1.17	43.41	8.38	32.14	—	—	—	—	—	—	—	—	—

TABLE 25

Analysis of Hodgson Silt Loam

Hor	Depth Inches	Mechanical Analysis Text Class	% Sand	% Silt	% Clay	pH	Cond. mmhos/cm	% $CaCO_3$ Equiv	% Calcite	% Dolomite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100gms Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	6.95	0.53	5.06	0.00	4.83	24.51	1.60	15.3	84.30	—	—	—	—	—
Ahj	0-3	SiL	13	69	18	7.00	0.43	14.90	0.00	14.37	6.51	0.57	11.4	41.47	18.25	24.55	1.11	0.15	0.08
AC	3-5	SiL	7	67	26	7.40	0.37	40.47	7.88	29.04	2.36	0.29	8.1	22.24	—	—	—	—	-
C1	5-24	SiCL	1	65	34	7.70	0.24	49.84	8.24	29.30	—	0.03	—	13.24	—	—	—	—	—
C2	24+	SiCL	0.6	60	39.4	7.67	0.27	38.20	5.73	31.02	—	—	—	14.64	—	—	—	—	—

C2 — 24 inches plus, pale olive (5Y 6/3, moist), silty clay loam; weak, fine granular; friable when moist, hard whey dry; mildly alkaline.

Soil profile development on these recent alluvial deposits is limited to a thin, weakly developed Ah horizon. This surface layer is 2 to 3 inches thick, fine granular and neutral in reaction. The underlying material is stratified, strongly calcareous and may contain dark colored bands representing some soil development on former surfaces. These soils are better drained than the very similar Fisher soil series.

Mapping Unit

Hodgson series (2,122 acres)

Areas consisting dominantly of normal Hodgson soils and minor amounts of very similar Fisher soils.

HOLDITCH COMPLEX

The Holditch complex consists of very poorly drained organic soils developed on 16 to 54 inches of mesic herbaceous (sedge) peat with little (less than 6 inches) or no sphagnum deposits, underlain by limestone bedrock.

The Holditch complex consists dominantly of the following series: Holditch series, a Lithic Mesisol developed on 16 to 52 inches of fen peat. The underlying, dolomitic limestone usually occurs between 3 and 4 feet of the surface. There often is rocky debris on the surface of the bedrock.

Flathouse series, a Lithic Limno Mesisol. The organic section of this soil is comprised mainly of mesic or moderately decomposed fen peat with subdominant layers of whitish colored marl. The organic section can range from 16 to 52 inches in depth. These soils usually occur where limestone bedrock also is found in upland sites.

Primes series, a Lithic Humic Mesisol, developed on 16 to 52 inches of mesic fen peat and subdominant layers of humic fen peat that usually occur in the lower portion of the organic control section.

Meskenau, a Lithic Fibric Mesisol, dominantly comprised of mesic fen peat and subdominant layers of fibric fen peat. The fibric layers usually occur at the surface of the organic section and the total depth of the organic section is usually quite shallow ranging in depth from 16 to 36 inches.

These organic soils are very similar to those described under the Cayer complex, but differ from them in having a limestone bedrock substrate rather than a medium to fine textured lacustrine substrate.

Native vegetation is dominantly sedges, reed grasses, and some moss species. Clumps of willow, swamp birch, and tamarack are also found.

Mapping Unit

Holditch complex (1,493 acres)

These areas consist dominantly of Holditch series with minor but significant amounts of Holditch series deep phase (3 to 5 feet deep), Flathouse series, Primes series, Primes series deep phase, and Meskenau series deep phase.

HOMEBROOK SERIES

The Homebrook series consists of Orthic Dark Grey soils developed on moderately to strongly calcareous clay till. Numerous randomly distributed pockets of loamy textured, stony, extremely calcareous, light grey till occurs in the dark colored clayey matrix of this till. Surface textures are clay. The topography is gently undulating to undulating. These soils also are well drained and moderately stony. Native vegetation consists of mixed aspen, white spruce, and balsam poplar. A representative soil profile of the Homebrook series is described below:

L-H — 2 to 0 inches, very dark brown (10YR 2/2, moist), grey (10YR 4.5/1, dry), leaf mat; neutral; abrupt, smooth boundary.

Ahe — 0 to 4 inches, very dark brown (10YR 2/2, moist), dark grey (10YR 4.5/1, dry), clay; moderate, fine granular; firm when moist, hard when dry; neutral; clear, smooth boundary.

TABLE 26
Analysis of Homebrook Clay

Hor.	Depth Inches	Mechanical Analysis Text. Class	% Sand	% Silt	% Clay	pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Cal-cite	% Dolo-mite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100gms. Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	7.00	0.54	2.04	—	—	18.79	1.45	13.0	—	—	—	—	—	—
Ahe	0-4	C	6	28	66	6.54	0.28	0.40	—	—	3.05	0.33	9.2	43.49	30.41	6.07	1.30	0.23	1.62
AB	4-10	C	7	18	75	6.43	0.39	—	—	—	1.34	—	—	40.45	25.53	0.65	0.95	0.34	1.87
Bt	10-18	C	5	17	78	6.14	0.18	0.46	—	—	1.48	—	—	39.08	29.07	6.62	1.09	0.27	2.18
BC	18-22	C	4	36	60	7.36	0.25	7.51	3.10	4.07	0.96	—	—	—	—	—	—	—	—
IIC	22+	C	14	36	50	7.57	0.28	38.76	24.38	13.26	—	—	—	—	—	—	—	—	—

AB — 4 to 10 inches, very dark grey (10YR 3/1, moist), grey (10YR 5/1, dry), clay; moderate, medium granular; very firm when moist, very hard when dry; slightly acid; clear, wavy boundary.

Bt — 10 to 18 inches, very dark greyish brown (10YR 3/2, moist), dark greyish brown (10YR 4/1.5, dry), clay; moderate, coarse columnar structures breaking into strong, medium to coarse subangular blocky aggregates; very firm when moist, very hard when dry; slightly acid; abrupt, wavy boundary.

BC — 18 to 22 inches, olive brown (2.5Y 4/4, moist), greyish brown (2.5Y 5/2, dry), clay; weak, coarse columnar structures breaking into moderate, fine to medium subangular blocky aggregates; firm when moist, hard when dry; neutral; calcium carbonate concretions; abrupt, wavy boundary.

IIC — 22 inches plus, light olive brown (2.5Y 5/4, moist), light grey (2.5Y 7/2, dry), mixed loam and clay textured stony till; moderate, coarse granular; firm when moist, hard when dry; mildly alkaline.

The Homebrook soils have a thin, very dark Ahe horizon and a weakly columnar structured B horizon which breaks readily into medium to coarse subangular blocky aggregates. The solum is moderately well developed, clay in texture and neutral to slightly alkaline in reaction (see Figure 11).

Homebrook is somewhat stonier than the very similar, clay textured Arnes soil series; is finer textured, less friable and less permeable than the similar loamy textured Harwill soils or the gravelly textured Leary, Gunton and Lynx Bay soils.

Mapping Units

Homebrook series(6,461 acres)

Areas consisting dominantly of Homebrook soils. Minor included areas are predominantly Davis Point and Fyala soils.

HARCUS SERIES

These are well drained, Orthic Grey Luvisol soils developed on 1 to 2 feet of sandy, coarse textured sediments underlain by stony, extremely calcareous glacial till. Limestone bedrock usually occurs within 20 to 30 inches of the surface. Harcus soils have thin, partially humified L-H horizons; a fairly thick, greyish weakly developed, medium acid Ae; a thin textural B horizon developed in the stony glacial till. The stony, extremely calcareous, light grey, loamy textured C horizon is usually very thin varying in thickness from several inches to several feet. Contact to the light grey, gractured, limestone bedrock is very sharp.

Mapping Units

Harcus series (63 acres)

Areas of Harcus soil series.

HILBRE SERIES

The Hilbre series consists of well drained Degraded Eutric Brunisol soils, developed on 20 to 30 inches of extremely calcareous glacial till over limestone bedrock. The topography is gently un-

FIGURE 23

Hilbre Loam. A Degraded Eutric Brunisol developed on thin glacial till deposits overlying limestone bedrock.

dulating to undulating. The vegetation is aspen, jack pine and white spruce.

The solum of Hilbre soils is generally less than 8 inches, characterized by a thin light colored eluvial Ae horizon or several inch thick Aej horizon overlying a thin, weakly developed B horizon. The Hilbre soils correlate with Fairford rock substrate phase soils in previously published soil survey reports.

Mapping Unit

Hilbre Series (37,309 acres)

Areas of normal Hilbre soils with minor amounts of Fairford soils.

INWOOD SERIES

The Inwood series consists of imperfectly drained, Gleyed Dark Grey soils developed on extremely calcareous glacial till. Surface texture varies widely from fine sandy loam to clay because of the inclusions of soils with a thin lacustrine mantle (less than 6 inches) of moderately fine to fine textured sediments. Inwood soils occur on level to irregular, gently undulating terrain where surface runoff is slow and internal percolation is moderate to slow. The native vegetation is dominantly aspen with lesser amounts of white spruce and balsam poplar. All the soils are moderately to excessively stony. A representative profile is described below:

L-H — 2 to 0 inches, black (5YR 2/1, moist), leaf and sod mat; neutral; abrupt, smooth boundary.

Ahe — 0 to 4 inches, black (10YR 2/1, moist), loam, fine granular; friable when moist, slightly hard when dry; neutral; abrupt, smooth boundary.

Bmgj — 4 to 8 inches, dark brown (10YR 3.5/3, moist), sandy loam; fine granular; friable when moist, slightly hard when dry; mildly alkaline; clear, smooth boundary.

BCgj — 8 to 11 inches, pale olive (5Y 6/3, moist), loam; fine granular; moderately friable when moist, slightly hard when dry; mildly alkaline; clear, smooth boundary.

Ckgj1 — 11 to 15 inches, light grey (5Y 7/2, moist), loam; weak fine granular; moderately friable when moist, slightly hard when dry; mildly alkaline; clear, smooth boundary.

Ckgj2 — 15 inches plus, pale yellow (7Y 7/3, moist), silty loam; weak fine granular; moderately friable when moist, slightly hard when dry; mildly alkaline; iron stained (10YR 6/8).

Inwood soils are characterized by a very thin A horizon overlying a thin, weakly developed, textural B horizon that grades sharply into extremely calcareous till. The solum is generally less than 6 to 8 inches thick and, although the soil is slightly leached, the surface horizons are usually alkaline or neutral due to frequent recharging with carbonates from the limy groundwater. The plow layer of cultivated soils contains a mixture of the A and B horizons and the extremely calcareous parent material. The surface thus appears grey when dry.

Inwood soils are stonier, more permeable and more friable than the similar, clayey textured Davis Point, Ledwyn, Faulkner, Fisherton, Framnes and Peguis soils. They are much more stony and much less permeable than the Kergwenan soils (see Figure 11).

Mapping Units

Inwood series (83,094 acres)

These areas consist dominantly of normal Inwood soils.

JANORA COMPLEX

The Janora complex consists of poorly to very poorly drained organic soils developed on 16 to 52 inches of mesic forest peat or thin (0 to 24 inches) fibric Sphagnum moss peat overlying mesic forest peat. These soils are underlain by limestone bedrock.

The Janora complex consists dominantly of the following series:

The Janora series, a Lithic Mesisol, developed on 16 to 52 inches of mesic forest peat (moderately

TABLE 27

Analysis of Inwood Loam

Hor	Depth Inches	Mechanical Analysis: Text. Class	% Sand	% Silt	% Clay	pH	Cond mmhos/cm	% $CaCO_3$ Equiv	% Calcite	% Dolomite	% Org C	% Total N	C/N Ratio	C E C m e	Exchangeable Cations m e/100gms.: Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	7 37	1 05	3.17	—	—	30.43	1.41	21.6	—	—	—	—	—	—
Ahe	0-4	L	49	34	17	7 25	0.45	1.52	—	—	8.73	0.53	16.5	51.61	45.45	6.55	0 34	0 20	0.50
Bmgj	4-8	SL	61	24	15	7.52	0.37	17 06	—	—	0.84	—	—	—	—	—	—	—	—
BCgj	8-11	L	42	37	21	7.40	0.34	47.82	0 0	44 08	0.40	—	—	—	—	—	—	—	—
Ckgj	11-15	SiL	30	51	19	7 57	0 29	58 44	26 62	32 09	—	—	—	—	—	—	—	—	—
Ckgj	15+	SiL	32	54	14	7.68	0.27	61 68	19 80	38 60	—	—	—	—	—	—	[illegible]	—	—

decomposed organic material derived from spruce and tamarack litter, feathermosses and ericaceous shrubs). This organic material is usually strongly acidic, and layered with woody logs and other fibrous woody debris. Feathermosses, the dominant peat former in these soils, decompose very rapidly and more completely than other material and usually imparts a very dark brown to black color to the non-woody portion of the organic section. These soils usually do not have a surface layer of fibric sphagnum moss. These soils have a severe limitation to agricultural development because the bedrock underlying the organic section is too close to the surface.

Whiteway series, a Lithic Fibric Mesisol, developed on shallow, usually 2 to 3 feet, of dominantly mesic forest peat. A significant but subdominant thickness of fibric Sphagnum moss peat occurs as a surface layer in these soils. The organic section overlying limestone bedrock is usually much thinner than that of the Janora series.

Atim series, a Lithic Mesic Fibrisol is very similar to the Whiteway series, differing only in having a thicker more dominant layer of fibric Sphagnum on the surface. A subdominant layer of mesic forest peat underlies the Sphagnum. The total thickness of the organic section usually much thinner than that of the Janora series, is usually about 2 feet thick. These soils are also not suitable for agricultural development because of the thinness of the organic section, the presence of bedrock near the surface and because of the extremely acid sphagnum surface layer.

Highrock series, a Lithic Fibrisol developed on 2 to 3 feet of fibric Sphagnum moss peat. A non-significant layer or layers of mesic forest peat may or may not be present in the organic section. As in the case of the Whiteway and Atim series, these soils are not suitable for agriculture because of their thin organic section over bedrock and the presence of an extremely acid surface layer of Sphagnum moss.

These organic soils are similar to those described under the Okno complex but differ from them in having a limestone bedrock substrate rather than a medium to fine textured lacustrine substrate.

The native vegetation is black spruce with some larch in the overstory. In the understory, Labrador tea, leather leaf, and feather mosses were found. Sphagnum moss species, however, are associated with the very poorly drained, less productive sites.

Mapping Unit

Janora complex (489 acres)

These areas consist dominantly of Janora series with significant minor amounts of Janora series deep phase, Whiteway series, Atim series and Highrock series.

JULIUS COMPLEX

The Julius complex, consisting of soils developed on deep (24 to 51 inches) sphagnum peat overlying forest and/or fen peat, or from very deep (more than 51 inches) sphagnum peat. These organic soils are underlain by moderately to strongly calcareous, medium to fine textured sediments.

The Julius complex consists dominantly of the following series:

Julius series, a Sphagno-Fibrisol, developed on extremely acid, uniform deposits of fibric Sphagnum mosses more than 5 feet deep. A representative soil profile is described below:

Of1 — 0 to 8 inches, light yellowish brown to very pale brown (10YR 6/4 to 7/3, wet), non-woody, coarse fibered, spongy Sphagnum moss; extremely acid; spongy, Sphagnum moss; unrubbed fiber content is about 98 percent.

Of2 — 8 to 59 inches, reddish yellow (7.5YR 6/6, wet), non-woody, moderately coarse fibered, spongy, somewhat compacted, extremely acid, Sphagnum moss; unrubbed fiber content is about 90 percent.

Of3 — 59 to 134 inches, reddish yellow (7.5YR 6/6, wet), non-woody, moderately coarse fibered, compacted, extremely acid Sphagnum moss; unrubbed fiber content is about 80 percent. A significant (100 to 134 in-

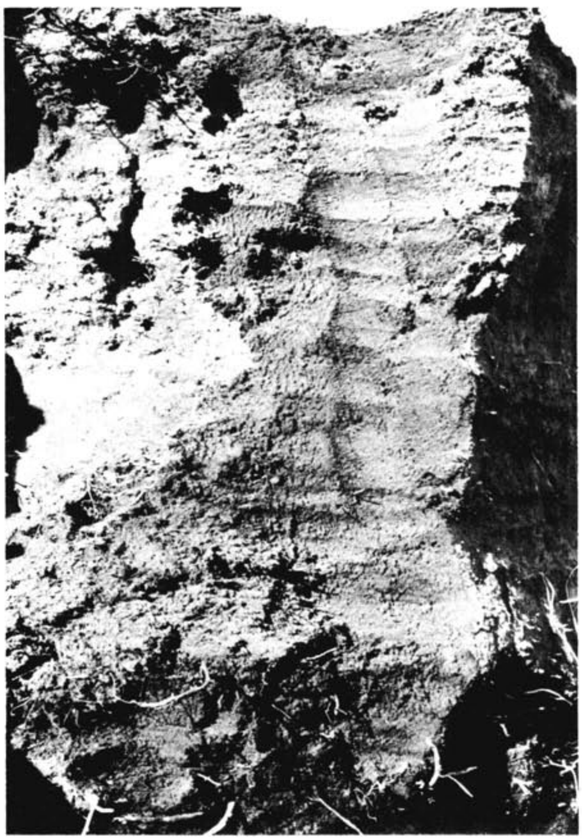


FIGURE 24

Julius Series. A Sphagno Fibrisol developed on deep, fibric, Sphagnum moss. A typical profile found on extensive domed peatlands in the Washow Bay area.

TABLE 28

Analysis of Julius Series (Sphagno-Fibrisol)

Hor.	Depth Inches	Mechanical Analysis: Text. Class	% Sand	% Silt	% Clay	% Un-rubbed Fiber	% Pyro-phos Sol.	% Ash	% Org C	% Total N	C/N Ratio	pH in KCl	C.E.C. m.e.	Exchangeable Cations m.e./100 gms: Ca	Mg	K	Na	H
Of1	0-8	—	—	—	—	98.4	0.10	4.4	53.76	0.59	91	2.80	103.0	9.1	8.4	1.0	2.5	89.6
Of2	8-59	—	—	—	—	89.3	0.13	2.6	55.56	0.83	67	2.85	116.3	9.1	2.2	1.2	0.5	101.6
Of3	59-134	—	—	—	—	80.4	0.09	4.7	56.00	1.37	42	4.10	122.3	38.5	25.5	1.0	0.3	54.8
IICg	134-138	C	—	—	—	—	—	91.7		—	—	—	24.8	14.3	11.8	0.5	1.2	5.0

ches thick) very dark brown to dark reddish brown (10YR 2/2 to 5YR 3/2, wet), fine fibered, amorphous herbaceous peat occurs above the mineral soil contact.

IICg — 134 to 138 inches, light grey (5Y 5/1, wet), clay; massive, very sticky and very plastic; neutral to mildly alkaline in reaction.

Whithorn series, a Mesic Fibrisol, developed on dominantly extremely acid, fibric Sphagnum moss peat with a subdominant layer or layers of mesic forest peat that occurs at 3 to 5 feet of the surface. Very often thin layers of fibric Sphagnum peat alternate with thin layers of strongly acid, woody, mesic forest peat in this portion of the organic section. More uniform mesic forest peat and/or mesic fen peat usually occurs below 5 feet in the organic section. Total depth of the organic section in these soils usually ranges from about 6 to 12 feet in thickness. The underlying clayey lacustrine mineral sediments are usually strongly gleyed, stone-free and calcareous.

Santon series, a Typic Mesisol, sphagnic phase. These soils are formed on mesic or moderately decomposed forest peat capped with a 2 to 3 feet thick fibric, non-woody, coarse fibered, spongy, Sphagnum moss surface layer.

Mapping Units

Julius complex (236,042 acres)

These areas consist dominantly of Julius series with significant amounts of Whithorn and Santon soil series.

KERRY SERIES

The Kerry series consists of poorly drained, Rego Gleysol soils developed on siliceous sandy deposits. They occupy small level to depressional areas where surface drainage is very slow and internal drainage is impeded because of a high water table. Native vegetation is dominantly alder, willow, swamp birch, sedges, reeds, and some black spruce. A representative profile is described below:

L-H — 6 to 0 inches, dark brown to black (10YR 3/2 to 2/1, dry) partially to well decomposed sedges, reed grasses and forbs; neutral; abrupt, smooth boundary.

Ahg — 0 to 2 inches, very dark grey (10YR 3/1, dry) fine sandy loam; weak, fine granular; very friable when moist, soft when dry; neutral; horizon is often discontinuous.

Cg1 — 2 to 14 inches, light grey (2.5Y 7/2, dry) fine sand; loose; mildly alkaline; numerous iron mottles; gradual, smooth boundary.

TABLE 29

Analysis of Kerry Fine Sand

Hor.	Depth Inches	Mechanical Analysis: Text. Class	% Sand	% Silt	% Clay	% Moisture 1/3 Atm	pH	Cond. mmhos/cm	% $CaCO_3$ Equiv	% Org C	% Total N	C/N Ratio	$NaHCO_3$ Extract P(PPM)	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.: Ca	Mg	K	Na	H
L-H	6-0	—	—	—	—	14.2	7.0	0.5	2.9	37.1	1.7	22	28.6	—	—	—	—	—	—
Ahg	0-2	FSL	61	22	17	67.8	7.2	0.4	1.4	6.5	0.7	9	2.2	59.3	59.4	6.8	0.2	0.3	—
Cg1	1-14	FS	93	4	3	2.8	7.7	0.2	—	—	—	—	0.2	2.1	1.4	0.7	0.03	0.1	—
Cg2	14-30	FS	92	4	4	3.6	7.8	0.2	—	—	0.4	—	—	2.6	0.8	1.9	0.07	0.08	—

FIGURE 25

Aerial view of the extensive peatlands found in Sections 22, 23, 26 and 27, Twp. 26, Rge. 5E in the Washow Bay Area. A, mineral soil; B, a raised, teardrop shaped, bog plateau; C, Flat treed bog; D, Patterned fen.

Cg2 — 14 to 30 inches, pale yellow to light grey (2.5Y 7/4 to 7/2, dry) fine sand; loose; mildly alkaline; strongly iron stained.

Kerry soils are characterized by a thin, acid, fibrous to mucky peat surface layer which is underlain by a strongly iron stained Cg horizon. Some profiles have a thin (less than 2 inches) Ah horizon, others have a thin leached surface horizon below the organic layer. Frequently, in very wet sites, the Cg horizon is strongly gleyed and lacks mottling.

Mapping Unit

Kerry series (81 acres)

Areas consisting of normal Kerry series.

KILKENNY COMPLEX

The Kilkenny complex consists of poorly to very poorly drained soils developed on 24 to 65 inches of fibric Sphagnum moss peat which may by underlain by significant amounts of mesic sedge or forest peat. These organic soils are underlain by extremely calcareous, medium textured till.

The Kilkenny complex consists dominantly of the following series:

Kilkenny series, a Terric Mesic Fibrisol, developed on 3 to 4 feet of very strongly acid, light yellowish brown, fibric Sphagnum moss peat that is usually underlain by several feet of strongly acid, woody, very dark brown to black, mesic forest peat grading to stony, extremely calcareous loam textured glacial till deposits. Total depth of the organic section is usually 3 to 5 feet thick. The soils are not suitable for agricultural development because of the shallow organic section overlying very stony, mineral soil and presence of the extremely acid surface layer of fibric Sphagnum moss.

Ferland series, a Terric Fibric Mesisol, developed on 2 to 3 feet of very strongly acid, light yellowish brown, fibric Sphagnum moss peat overlying 2 to 3 feet of strongly acid, woody, mesic forest peat. Unlike the Kilkenny series, the mesic forest peat is dominant in the organic section. Total depth of the organic section tends to be shallower than that of the Kilkenny series. Like Kilkenny series, these soils are not suitable for agricultural development because of the shallow strongly acid organic section over stony glacial till.

Elmore series, a Terric Fibrisol on shallow, 2 to 5 feet of extremely acid, fibric Sphagnum moss overlying little or no mesic forest and/or fen peat. These soils usually have thicker sphagnum surface layers than the other two members of this soil complex. Similarily, these soils are not suitable for agricultural development.

These organic soils are very similar to those described under the Molson complex, but differ from them in having a stony till mineral substrate rather than a medium to fine textured lacustrine substrate.

The native vegetation is stunted black spruce and tamarack in the tree layer. The understory consists dominantly of Sphagnum mosses and Labrador tea. These soils are very low in nutrients and medium to strongly acid.

Mapping Unit

Kilkenny complex (9,391 acres)

These areas consist dominantly of Kilkenny series with significant amounts of Ferland series and Elmore series.

KINWOW SERIES

The Kinwow series consists of well drained Orthic Grey Luvisol soils developed on 6 to 36 inches of moderately to strongly calcareous, fine textured lacustrine deposits underlain by extremely calcareous loamy till. The topography is gently undulating to undulating. The native vegetation consists of mixed aspen, white spruce, balsam fir, and balsam poplar. These soils are moderately to slight stony, but the stoniness, however, varies with the thickness of the clay mantle over the till. A representative soil profile is described below:

L-H — 2 to 0 inches, very dark brown (10YR 2/2, dry), leaf mat; neutral; abrupt, smooth boundary.

TABLE 30

Analysis of Kinwow Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond mmhos/cm	% $CaCO_3$ Equiv.	% Calcite	% Dolomite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100gms.				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	7.22	1.17	3.53	—	—	—	1.31	—	—	—	—	—	—	—
Ae	0-2	CL	37	32	31	6.57	0.34	0.46	—	—	1.37	0.10	13.7	17.17	15.06	2.26	0.84	0.53	0.92
AB	2-4	C	12	12	76	6.27	0.19	0.21	—	—	1.05	—	—	44.21	30.46	7.07	1.67	0.20	1.86
Bt	4-11	C	4	25	71	6.85	0.51	0.82	—	—	1.00	—	—	44.50	33.71	90.6	1.21	0.31	0.76
BC	11-18	C	3	34	63	6.97	0.45	14.78	10.93	3.50	0.84	—	—	—	—	—	—	—	—
C	18-24	C	2	24	74	7.51	0.40	16.89	16.89	0.60	—	—	—	—	—	—	—	—	—
IIC	24+	L	33	50	17	7.66	0.21	66.16	35.88	27.91	—	—	—	—	—	—	—	—	—

Ae — 0 to 2 inches, dark greyish brown (10YR 5/2, moist), light grey (10YR 7/1, dry), clay loam; fine platy; friable when moist, slightly hard when dry; neutral; clear, smooth boundary.

AB — 2 to 4 inches, very dark greyish brown (10YR 3/2, moist), greyish brown (10YR 5/2, dry), clay; moderate fine subangular blocky; firm when moist, hard when dry; slightly acid; clear, smooth boundary.

Bt — 4 to 11 inches, dark greyish brown (10YR 3.5/2, moist), greyish brown (10YR 4.5/2, dry), clay; weak columnar structures break into moderate fine to coarse subangular blocky aggregates; firm when moist, hard when dry; neutral; clear, wavy boundary.

BC — 11 to 18 inches, very dark greyish brown (2.5Y 3/2, moist), light brownish grey (2.5Y 6/2, dry), clay; moderately coarse granular; firm when moist, hard when dry; neutral; calcium carbonate concretions; clear, wavy boundary.

C — 18 to 24 inches, very dark greyish brown (2.5Y 3/2, moist), light brownish grey (2.5Y 6/2, dry), clay; moderately coarse granular; firm when moist, hard when dry; mildly alkaline; iron concretions; abrupt, wavy boundaries.

IIC — 24 inches plus, light grey to yellow (2.5Y 7/2 to 7/6, moist) silt loam; weak fine granular; friable when moist, hard when dry; mildly alkaline; few small iron mottles.

The Kinwow soils have a thin, dark greyish brown Ae horizon and weakly to moderately developed columnar structured B horizon. The solum is clay in texture, neutral in reaction (see Figure 11).

Kinwow soils differ from the very similar Egg Island soils in not having limestone bedrock occurring within 3 feet of the surface. They are also less friable and less permeable to water than the loamy textured Devils Lake or Garson soils and the sandy, gravelly textured Long Point, McArthur, St. Labre and Woodridge soils.

Mapping Units

Kinowo series (25,687 acres)

Areas consisting dominantly of normal Kinwow soils.

KIRCRO COMPLEX

The Kircro complex consists of very poorly drained soils developed on 16 to 52 inches of mesic fen peat. Little or no Sphagnum moss occurs as a surface layer on these soils. They are underlain by coarse and moderately coarse textured sediments. The Kirco complex consists dominantly of the following series:

Kircro series, a Terric Mesisol developed on 16 to 52 inches of dark brown to very dark brown, medium acid to neutral, mesic fen peat. A very thin (10 to 12 inches thick), fibric fen peat layer usually occurs at the surface. The organic section of Kircro series is usually thicker than that of the other members of this complex; its total depth usually ranges between 3 and 5 feet in thickness. These soils, because of their desireable reaction, moderate decomposition, uniform composition or lack of woody layers, and smooth, permeable, sandy mineral substrates are suitable for agricultural development.

Grey Point series, a Terric Humic Mesisol, developed on 2 to 3 feet of mesic fen peat grading gradually to 1 or 2 feet of acidic to neutral, black colored, humic peat. While the moderately decomposed, mesic fen peat is dominant in the organic section of this soil, the humic subsurface layers are significant. The humic layer is usually more dense, contains more ash or mineral elements and holds more water more strongly on a volume basis than the less decomposed surface layers. Like the Kircro series, these soils are suitable for agricultural development.

Loon Bay series, a Terric fibric Mesisol, developed on thin, usually less than 3 feet thick, fen peat (sedges, reed grasses and mosses). While the mesic layer or layers in this soil are dominant, a significant acidic to neutral, fibric fen peat layer occurs as a surface layer. The total depth of the organic section can vary from 16 to 52 inches, however, it does tend to be about 2 to 3 feet thick, which is significantly shallower than other members in this complex.

These organic soils are very similar to those described under the Cayer complex, but differ from them in having a coarse and moderately coarse sustrate rather than a medium to fine textured lacustrine substrate. The areas of Kircro soils are level to depressional. The native vegetation is dominantly sedges, reed grasses, willow, swamp birch, and tamarack.

Mapping Unit

Kircro complex (428 acres)

The areas consists dominantly of Kircro series with smaller amounts of Grey Point series and Loon Bay series.

LAKELAND SERIES

The Lakeland series consists of imperfectly drained, Gleyed Carbonated Rego Black soils developed on very strongly to extremely calcareous, moderately fine textured lacustrine deposits with textures ranging from loam to silty clay. The topography is level to very gently sloping. Native vegetation is meadow grases, aspen, balsam poplar, and willow. Runoff is slow while internal percolation is moderate to slow and impeded by a high water table during wet seasons. A representative soil profile is described below:

Ah — 0 to 5 inches, very dark grey (10YR 3/1, dry), clay loam; moderate fine granular; friable when moist, slightly hard when dry; mildly alkaline and weakly calcareous; clear, smooth boundary.

TABLE 31
Analysis of Lakeland Clay Loam

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay								Ca	Mg	K	Na	H
Ah	0-5	CL	25	45	30	7.5	0.71	5.4	6.95	0.56	12.4	43.2	43.2	18.3	0.8	0.4	—
AC	5-10	L	36	39	25	7.9	0.42	13.5	0.95	0.11	8.6	21.3	—	—	—	—	—
Ckg	10-16	—	—	—	—	8.2	0.38	58.9	0.32	0.03	10.7	—	—	—	—	—	—
Ckg 2	16.22	SiL	7	70	23	8.2	0.37	58.3	0.13	0.02	—	—	—	—	—	—	—
Ckgj3	22-36	—	—	—	—	8.2	0.35	55.7	0.07	0.02	—	—	—	—	—	—	—

AC — 5 to 10 inches, greyish brown (10YR 5/2, dry), loam; weak fine granular; friable when moist, plastic and sticky when wet; moderately alkaline and calcareous; clear, irregular boundary.

Ckgj — 10 to 16 inches, light grey (10YR 7/2, dry), silt loam; weak fine granular; friable when moist, plastic and sticky when wet; moderately alkaline and strongly calcareous; iron stained; diffuse, irregular boundary.

Ckgj2 — 16 to 22 inches, very pale brown (10YR 7/3, dry), silt loam; weak, fine granular; friable when moist; moderately alkaline and strongly calcareous; iron stained.

Ckgj3 — 22 to 36 inches, very pale brown (10YR 7/4, dry), silt loam; weak, fine granular; friable when moist, weakly cemented when dry; moderately alkaline and strongly calcareous; iron stained.

Profile development in the Lakeland soils has been strongly influenced by both the high lime content of the parent material and the imperfect drainage. The very dark grey Ah horizon is 5 to 10 inches thick, alkaline in reaction, and calcareous in at least the lower portion. This surface horizon is separated from the parent material by a thin transitional horizon that is moderately calcareous and contains a moderate amount of organic matter. These soils are clay loam to silty clay at the surface but commonly become coarser with depth, so that the C horizon may be in the loam to silt loam classes.

Mapping Units

Lakeland series (7,187 acres)

These areas consist dominantly of Lakeland soils. Small included areas are principally Balmoral, Plum Ridge and Lakeland till substrate phase soils.

LEARY COMPLEX

The Leary complex consists of rapidly to well drained Leary series (Orthic Dark Grey) and Venlaw series (Orthic Dark Grey Luvisol). These soils are developed on stratified, strongly calcareous, outwash and beach deposits. There is commonly a thin, sandy, surface mantle over the coarser material and surface textures range from loamy fine sand to sand. The topography is gently undulating to undulating, mostly in the form of low, narrow ridges. There is little surface runoff as the soils are very permeable and rainfall enters and percolates through the soil rapidly. Water holding capacity is low. Native vegetation is dominantly jack pine with aspen and bur oak.

A description of a cultivated Venlaw series (Orthic Dark Grey Luvisol) soil is given below:

Ap — 0 to 6 inches, dark greyish brown (10YR 4/2, dry), loamy fine sand; structureless; single grained; very friable when moist, soft when dry; slightly acid; abrupt, smooth boundary.

Ahe — 6 to 11 inches, brown (10YR 5/3, dry), fine sand; structureless; single grained; very friable when moist; soft when dry; slightly acid; gradual, smooth boundary.

Ae — 11 to 15 inches, pale brown (10YR 6/3, dry), fine

FIGURE 26

Leary Complex. These well drained soils are developed on stratified, calcareous outwash and beach deposits.

TABLE 32
Analysis of Venlaw Fine Sand

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCo_3$ Equiv.	% Calcite	% Dolomite	% Org. C	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay								Ca	Mg	K	Na	H
Ap	0-6	LFS	86	2	12	6.2	0.2	—	—	—	1.1	7.4	5.9	1.2	0.1	0.1	0.5
Ahe	6-11	FS	90	4	6	6.5	0.1	—	—	—	0.2	3.9	2.8	0.8	0.1	0.1	0.2
Ae	11-15	FS	90	4	6	6.5	0.1	—	—	—	0.0	3.5	2.6	1.0	0.1	0.1	0.1
Bt	15-19	LFS	89	2	9	6.8	0.2	—	—	—	0.2	6.0	4.7	1.6	0.1	0.1	0.1
BCk	19-22	FS	91	4	5	7.3	0.2	7.0	0.0	6.4	—	—	—	—	—	—	—
Ck	22-36	M-CS	93	3	4	7.5	0.2	12.3	1.8	9.6	—	—	—	—	—	—	—

sand; structureless, single grained; loose when moist and dry; slightly acid; gradual, smooth boundary.

Bt — 15 to 19 inches, dark brown (7.5YR 4/4, dry) loamy fine sand; structureless; single grained; friable when moist; soft when dry; neutral; abrupt, smooth boundary.

BCk — 19 to 22 inches, brown (10YR 5/3, dry), fine sand; structureless; single grained; loose when moist and dry; neutral; moderately calcareous; abrupt, smooth boundary.

Ck — 22 to 36 inches, very pale brown (10YR 7/4, dry), medium and coarse sand; structureless; single grained; loose when moist and dry; mildly alkaline; moderately calcareous.

All Leary soils show some leaching under forest cover but the degree of degradation varies within small areas. Orthic Dark Grey soils with dark grey A horizons and weakly developed textural B horizons occur intermixed with Orthic Dark Grey Wooded soils having thin, greyish brown Ae horizons and better developed illuvial B horizons.

Leary Complex soils differ from other similar coarse textured soils in profile and parent material characteristics. They have more organic matter in the A horizon and usually a less strongly developed B horizon than Woodridge soils. The very similar Gunton soils have a stony, loam textured, calcareous till substrate within 30 inches of the surface.

Mapping Units

Leary complex (4,896 acres)

These areas consist dominantly of Leary and Venlaw soils.

LEDWYN SERIES

The Ledwyn series consists of imperfectly drained, Gleyed Dark Grey soils developed on very strongly to extremely calcareous, medium to moderately fine textured sediments. Surface textures range from very fine sandy loam to silty clay loam and the soils commonly become slightly coarser with depth and are often stratified with layers of very fine sand. The topography is level to very gently sloping. Runoff is slow and internal drainage is medium to moderately rapid but may be impeded by a high water table. Native vegetation is dominantly aspen and white spruce. A representative profile is described below:

L-H — 1 to 0 inches, very dark brown (10YR 2/2, dry), leaf mat of partially decomposed aspen leaves; mildly alkaline; abrupt, smooth boundary.

Ahej — 0 to 3 inches, very dark grey (10YR 3/1, dry), with blotches of grey (10YR 5/1, dry), clay loam; moderate fine granular; friable when moist, slightly hard when dry; mildly alkaline; gradual, smooth boundary.

Btgj — 3 to 6 inches, greyish brown (10YR 5/2, dry), silty clay loam; moderate fine granular; friable when moist, slightly hard when dry; mildly alkaline; iron stained; gradual, smooth boundary.

BCgj — 6 to 9 inches, light brownish grey (2.5Y 6/2, dry), silty clay loam; weak fine crumb; friable when moist, slightly hard when dry; moderately alkaline and calcareous; iron stained; gradual, smooth boundary.

Cg — 9 to 36 inches, light grey (2.5Y 7/2, dry), stratified very fine sandy loam to silty clam loam; friable when moist, weakly cemented when dry; moderately alkaline and strongly calcareous; iron stained.

The Ledwyn soils are weakly degraded. They have a thin, dark grey Ahej horizon that may be blotched with grey patches in the lower portion. The B horizon has a slight clay accumulation and is iron stained. The solum is generally less than 10 inches thick. Occasional flooding by lime-charged water causes these soils, in many areas, to be mildly alkaline to the surface and some to be limy in the A and B horizons.

Ledwyn soils are more friable and more permeable than the similar, clayey textured, Peguis, Davis Point and Faulkner soils. They are less stony than the Inwood soils. The very similar Fisherton soils are underlain by very stony till within 30 inches of the surface.

Mapping Unit

Ledwyn series (2,517 acres)

These areas consist dominantly of Ledwyn soils. Minor included soils are principally Lakeland, Balmoral, Tarno and Framnes soils.

LEE LAKE SERIES

The Lee Lake series consists of poorly drained, Carbonated Rego Humic Gleysol soils developed on 20 to 30 inches of extremely calcareous glacial till over limestone bedrock. These soils occupy level or depressional areas. The vegetation is dominantly willows, meadow grasses and sedges.

Lee Lake soils are stonier, less friable and less permeable than the similar, coarser textured Berry Island, Foley, Malonton, Sprague and Sundown soils. They are stonier and more friable than the similar, clayey textured Balmoral, Fyala, Partridge Creek, Pineimuta, Tarno and Thickwood soils.

The Lee Lake soils consist dominantly of a thin layer of mesic fen peat overlying a thin, dark grey Ah horizon that grades into the gleyed, extremely calcareous C horizon.

Lee Lake soils correlate with Meleb rock substrate phase soils in previously published soil survey reports.

Mapping Unit

Lee Lake peaty phase (2,754 acres)

These are areas of Lee Lake soils having 6 to 16 inches of mesic peat materials.

LETTONIA SERIES

The Lettonia series consists of well drained Solodic Grey Luvisol soils developed on moderately to strongly calcareous lacustrine clay. Topography is level to undulating. Surface drainage is moderate, while internal drainage is impeded because of texture and poor structure. The native vegetation is dominantly aspen and white spruce with smaller amounts of balsam fir and balsam poplar.

A representative profile is described below:

L-H — ½ to 0 inches, sod mat; abrupt, smooth boundary.

Ae1 — 0 to 2 inches, dark grey (10YR 4/1, moist), grey (10YR 6/1, dry), silty clay; weak fine to medium granular; friable when moist, slightly hard when dry; medium acid; clear, wavy boundary.

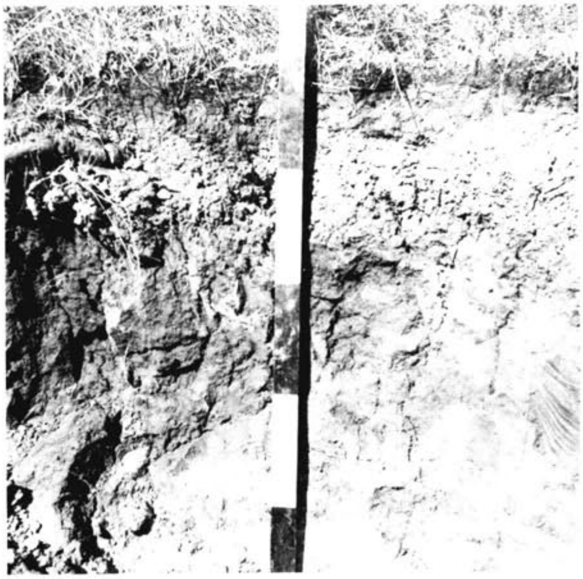


FIGURE 27

Lettonia clay. An Orthic Grey Luvisol developed on thick lacustrine clay sediments.

Ae2 — 2 to 3 inches, black (10YR 2/1, moist), grey (10YR 5/1, dry), silty clay; moderate, fine platy; friable when moist, slightly hard when dry; medium acid; clear, smooth boundary.

AB — 3 to 6 inches, very dark greyish brown (10YR 3/2, moist), dark greyish brown (10YR 4/2, dry), clay; strong coarse columnar structure, breakes into strong, coarse subangular blocky structure; very firm when moist, very hard when dry; slightly acid; clear, wavy boundary.

Bt — 6 to 12 inches, very dark greyish brown (10YR 3/2, moist), dark greyish brown (10YR 4/2, dry), clay; massive breaking to strong, fine subangular blocky; very firm when moist, very hard when dry; mildly alkaline; abrupt, smooth boundary.

BC — 12 to 18 inches, very dark greyish brown (2.5Y 3/2, moist), clay; massive; very firm when moist, very hard when dry; mildly alkaline; clear, smooth boundary.

Csk — 18 inches plus, dark greyish brown (2.5Y 4/2, moist), clay; weak, fine granular; mildly alkaline; gypsum crystals.

TABLE 33

Analysis of Lettonia Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos cm	% $CaCO_3$ Equiv.	% Cal-cite	% Dolo-mite	% Org. C	% Total N	C/N Ratio	C.E.C. m.e.	Soluble Salts (meq/L)						
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	Na	Cl	SO4	Total	Total
L-H	½-0	—	—	—	—	6.20	1.70	—	—	—	14.10	1.25	11.3	—	5.4	11.7	1.4	0	5.3	18.5	5.3
Ae_1	0-2	SiCL	6	41	53	5.70	0.54	—	—	—	8.20	0.61	13.4	45.24	—	—	—	—	—	—	—
Ae_2	2-3	SiCL	4	41	55	5.75	0.75	—	—	—	5.72	0.44	13.0	41.60	—	—	—	—	—	—	—
AB	3-6	C	2	28	70	6.20	2.29	—	—	—	1.99	0.16	12.4	—	6.1	20.3	5.0	0	29.5	31.4	29.5
Bt	6-12	C	1	38	61	7.40	7.50	0.06	—	—	0.68	—	—	43.57	19.6	93.2	16.6	0	127.6	129.4	127.6
BC	12-18	C	1	40	59	7.40	6.73	0.21	0.21	0.27	0.90	—	—	37.85	20.7	79.6	16.3	0	116.0	116.9	116.0
Csk	18+	C	0.3	14	85.7	7.35	5.71	0.27	0.0	0.0	0.25	—	—	27.11	22.1	62.4	14.6	0	96.4	99.1	96.4

A characteristic feature of the Lettonia soil profile is the columnar structure of the AB horizon. A very thin light grey coating occurs on the upper portion of the columns. A thin, light grey A horizon overlies the B horizon. The columnar aggregates grade into massive clay in the lower part of the B horizon. Gypsum crystals are often present in the BC or upper part of the C horizon.

Lettonia soils are better drained, have less organic matter and a more strongly developed Ae horizon than the similar Arborg soils. The colors of the Lettonia soil profiles are distinctly brownish while those of the Arborg are distinctly greyish.

Mapping Units

Lettonia series (24,789 acres)

Areas consisting dominantly of normal Lettonia soils.

LONESAND SERIES

The Lonesand series consists of imperfectly drained Gleyed Degraded Dystric Brunisol soils developed on acidic siliceous sandy deposits. the topography is level to undulating. Surface drainage is slow and internal drainage is impeded by a high water table.

Native vegetation is dominantly aspen, balsam poplar, and jack pine. A representative porfile is described below:

L-H — 2 to 0 inches, dark greyish brown to very dark brown (10YR 4/2 to 2/2, dry), partially to well decomposed to well decomposed litter; strongly acid; abrupt, smooth boundary.

Aegj — 0 to 3 inches, light grey (10YR 7/1, dry) fine sand; loose; very strongly acid; numerous small iron stains; clear, wavy boundary.

Bmgj — 3 to 7 inches pale brown (10YR 6/3, dry), fine sand; loose; very strongly acid; many yellowish red (5YR 5/6, dry), mottles; gradual wavy boundary.

Cgj1 — 7 to 17 inches, very pale brown (10YR 7/3, dry), fine sand; loose; slightly acid; many small blotches of yellowish brown (5YR 5/6, dry), iron mottles.

Cgj2 — 17 to 36 inches, same as Cgj1 except that the parent material at this depth is medium acid.

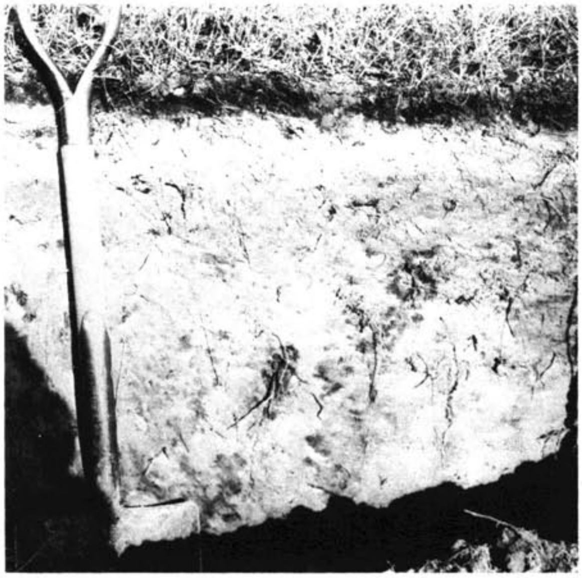


FIGURE 28

Lonesand sand. A Gleyed Degraded Dystric Brunisol developed on acidic siliceous sand deposits.

The Lonesand soil profile has a light grey, iron stained, strongly acid, Aeg horizon and a loose to very friable, brown, strongly acid, iron stained B horizon with a weak concentration of iron and organic matter.

The Lonesand soil profiles are less well drained and consequently much less droughty than the similar Sandilands soils.

Mapping Unit

Lonesand series (2,035 acres)

These areas consist dominantly of normal Lonesand soils with minor areas of Sandilands and Kerry series.

LONG POINT COMPLEX

The Long Point complex consists of rapidly to well drained Long Point series (Orthic Grey Luvisol), Pim Lake series (Orthic Eutric Brunisol),

TABLE 34

Analysis of Lonesand Fine Sand

Hor.	Depth Inches	Mechanical Analysis: Text. Class	% Sand	% Silt	% Clay	% Mois-ture ⅓ Atm	pH	% Org. C	% Total N	C/N Ratio	$NaHCO_3$ Extract P(PPM)	C.E.C.	Exchangeable Cations m.e./100 gms.: Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	98.0	5.1	37.0	2.0	18	21.4	—	—	—	—	—	—
Aegj	0-3	FS	92	6	2	4.1	4.6	0.2	0.03	7	0.8	1.1	0.5	0.6	0.1	0.1	1.6
Bmgj	3-7	FS	94	3	3	2.1	4.7	0.3	0.02	15	6.8	1.4	0.6	0.1	<0.1	0.1	1.6
Cgj1	7-17	FS	97	2	1	1.3	6.5	0.1	—	—	—	—	—	—	—	—	—
Cgj2	17-36	FS	97	2	1	0.5	5.9	0.1	—	—	—	1.0	0.5	0.1	<0.1	<0.1	0.4

and Soul Lake series (degraded Eutric Brunisol). These soils are developed on 6 to 30 inches of stratified sand and gravelly outwash and beach deposits over extremely calcareous glacial till. The topography is gently undulating to undulating. Vegetation consists of jack pine and some aspen.

Long Point soils contain less clay and organic matter than the finer textured Devils Lake, Egg Island, Garson, Kinwow and McArthur soils and consequently are not as suitable for plant growth. They are, however, less droughty than the Woodridge soils.

The Long Point soils are characterized by a thin L-H and a pale brown Ae horizon. The textural Bt horizon is dark yellowish brown, clay loam in texture and neutral in reaction.

Long Point soils correlate with Woodridge till substrate phase soils in previously published soil survey reports.

Mapping Unit

Long Point Complex (2,600 acres)

Areas consisting dominantly of normal Long Point soils.

LUNDAR SERIES

The Lundar series are imperfectly drained Gleyed Carbonated Rego Black soils developed on extremely calcareous glacial till. The topography is level to gently undulating. Native vegetation is dominantly aspen, willow, and grasses. A representative profile is described below:

Ah — 0 to 3 inches, dark grey to grey (10YR 4/1 to 5/1, dry), clay loam; moderate, fine granular; friable when moist, soft when dry; moderately alkaline and calcareous; clear, irregular boundary.

ACkgj — 3 to 6 inches, light grey (5Y 6/1, dry), clay loam; moderate, fine granular; friable when moist, soft to weakly cemented when dry; moderately alkaline and very strongly calcareous; clear, irregular boundary.

Ckgj — 6 to 18 inches, light grey to white (5Y 7/2 to 8/2, dry), loam; moderate, fine granular-like structure; sticky when wet, cemented when dry; moderately alkaline and extremely calcareous.

The Lundar soils have a thin, very dark grey to black A horizon. The A horizon grades through a thin transitional horizon into the gleyed extremely calcareous parent material. Tongues of the A horizon frequently extend a few inches into the light grey parent material (see Figure 11).

Lundar soils are much more stony and more permeable than the similar clay textured Dencross soils. They are much more stony than the very similar loamy textured Lakeland and McCreary soils.

Mapping Unit

Lundar series (333 acres)

These areas consist dominantly of Lundar soils with small areas of Meleb series.

MACAWBER COMPLEX

The Macawber complex consists of very poorly drained organic soils developed on greater than 52 inches of mesic fen peat. Little or no sphagnum moss occurs as a surface layer on these soils. These soils are underlain by extremely calcareous medium textured till.

The Macawber complex consists of:

The Macawber Series, a Typic Mesisol, developed on more than 52 inches of mesic fen peat (moderately decomposed peat derived from sedges, reed grasses and mosses). The organic section of this soils is characterized by a thin (usually less than 12 inches), dark yellowish brown, fibric fen peat layer that is usually medium acid to neutral in reaction. This surface layer grades clearly into a rather thick (5 to 8 feet), very dark brown to black, medium acid to neutral, moderately decomposed, mesic fen layer that is usually weakly granular

TABLE 35

Analysis of Lundar Clay Loam

Hor.	Depth Inches	Mechanical Analysis				% Moisture 1/3 Atm	pH	Cond mmhos cm	% $CaCO_3$ Equiv	% Org C	% Total N	C N Ratio	$NaHCO_3$ Extract P(PPM)	C.E.C. m.e.	Exchangeable Cations m.e./100 gms				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
Ah	0-3	CL	33	37	30	36.0	8.1	0.6	31.8	3.0	0.6	5	2.3	36.8	25.2*	10.9	0.3	0.4	—
ACkgj	3-6	CL	40	31	29	27.4	8.1	0.7	31.9	1.3	0.2	6	1.4	16.9	10.6*	.61	0.2	0.1	—
Ckgj	6-18	L	31	45	24	18.9	8.1	1.9	68.9	..	—		—	8.4	4.0*	4.2	0.1	0.1	—

* Exchangeable calcium determined by difference.

and slightly sticky. This layer in turn grades gradually into a thin (approximately 12 inches), black, slightly acid to midly alkaline, well decomposed, humic fen peat layer. Total depth of this very uniform organic section usually ranges from 5 to 8 feet in thickness. These soils are suitable for agricultural development. However, stones may be a problem should the organic layer subside or for other reasons be reduced substantially becuase of very stony, extremely calcareous glacial till underlying the peat.

The Wanke series, a Limnic Mesisol formed chiefly in dark yellowish brown to very dark brown herbaceous mesic fen peat more than 52 inches thick with one or more significant layers of greyish marl. The organic layers are moderately decomposed or mesic and typically contains free carbonates (caCO_3) in all parts. These soils are neutral to moderately alkaline throughout. These soils associated with Macawber Series are usually found in watertracks, flowages and adjacent to minor stream channels in the central portion of treeless fens. They quite often occur under open water. The organic section of these soils are about as thick as those of the Macawber series. They are more poorly drained than Macawber soils.

These soils are not suitable for agricultural development because of marly layers at or near the surface.

These organic soils are similar to those described under the Stead complex, but differ from them in having a till mineral substrate rather than a medium to fine textured lacustrine substrate. The topography is depressional to level and the native vegetation is dominantly sedges, reeds, and clumps of willow, swamp birch, and tamarack.

Mapping Unit

Macawber complex (13,116 acres)

These areas consist dominantly of Macawber series with significant amounts of Wanke series.

MALONTON SERIES

The Malonton series consists of poorly drained, Rego Humic Gleysol soils developed on moderately to strongly calcareous, coarse to moderately coarse sediments. The topography is depressional to level. The ground water table is at, or near the surface for a considerable part of the summer season. Native vegetation is dominantly meadow grasses, sedges, and some clumps of willow and balsam poplar.

A representative profile is described below:

L-H — 6 to 0 inches, dark reddish brown (5YR 2/2, dry), fen peat; slightly acid; clear, smooth boundary.

Ahg — 0 to 3 inches, very dark grey (10YR 3/1, dry), fine sandy loam; weak fine granular; very friable when moist, soft when dry; moderately alkaline and calcareous; iron stained; gradual, smooth boundary.

Cg1 — 3 to 12 inches, light grey (2.5Y 7/2, dry), loamy fine sand; structureless; loose; moderately alkaline and strongly calcareous; iron stained; clear, smooth boundary.

Cg2 — 12 to 24 inches, pale yellow (2.5Y 8/4, dry), with mottles of brownish yellow (10YR 6/6, dry), fine sand; structureless; loose; moderately alkaline and strongly calcareous; iron stained.

Malonton soils have a thin, mesic fen peat surface organic layer. A very dark grey, alkaline, and calcareous Ahg horizon underlies the surface layer of peat. The underlying Cg horizon is strongly mottled with iron and is strongly calcareous.

Malonton soils are more friable and more permeable than the finer, clayey textured Balmoral, Foley, Fyala, Lee Lake, Meleb, Partridge Creek, Pineimuta, Tarno and Thickwood soils. They are less permeable than the gravelly Sundown soils.

Mapping Unit

Malonton peaty phase (415 acres)

These areas consist dominantly of Malonton soils having 6 to 16 inches of mesic surface peat material.

TABLE 36
Analysis of Malonton Fine Sandy Loam

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Org. C	% Total N	C/N Ratio	C.E.C m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay								Ca	Mg	K	Na	H
L-H	6-0	—	—	—	—	6.2	—	2.6	39.86	1.50	26.6	—	—	—	—	—	—
Ahg	0-3	SL	72.5	16.0	11.5	7.8	0.40	11.6	4.75	0.33	14.4	29.3	21.2	7.9	0.1	0.1	—
Cg_1	3-12	LS	78.6	13.1	8.2	8.2	0.34	27.6	0.45	0.04	11.3	—	—	—	—	—	—
Cg_2	12-24	S	87.7	9.4	2.8	8.3	0.24	30.6	0.17	0.01	17.0	—	—	—	—	—	—

MANTAGAO SERIES

Mantagao series are imperfectly drained Gleyed Grey Luvisol soils developed on 6 to 30 inches of moderately to strongly calcareous lacustrine clay overlying extremely calcareous medium textured till. The topography is gently undulating. The native vegetation is dominantly aspen, willow, and sedges. A representative profile is described below:

L-H — 2 to 0 inches, dark reddish brown (5YR 2/2, moist), leaf mat; abrupt, smooth boundary.

Aegj — 0 to 2 inches, light brownish grey (10YR 6/2, moist), fine sandy loam; moderate fine platy; friable when moist, soft when dry; slightly acid; clear, smooth boundary.

ABgj — 2 to 3 inches, greyish brown (10YR 5/2, moist), clay; moderately fine subangular blocky to coarse granular; firm when moist, hard when dry; slightly acid; clear, smooth boundary.

Btgj — 3 to 15 inches, dark brown (10YR 4/2, moist), clay; massive breaking to weak to moderate columnar; very firm when moist, very hard when dry; very strongly acid; clear, smooth boundary.

BCgj — 15 to 18 inches, dark greyish brown (10YR 4/2, moist), clay; moderate fine subangular blocky to coarse granular; firm when moist, hard when dry; neutral; clear, smooth boundary.

Cgj — 18 inches plus, dark greyish brown to light grey (10YR 4/2 to 7/2, moist), clay and clay loam; weak fine subangular blocky; firm when moist, hard when dry; mildly alkaline.

The Montagao soils have a thin, light brownish grey, slightly acid Ae horizon. The A horizon grades through a thin, transitional horizon into the well developed Bt horizon. The C horizon is clay in texture and mildly alkaline.

Mantagao soils are much less permeable and friable and much less stony than the similar coarser textured Pinawa and Caliento soils. They have more strongly developed Ae and Bt horizons than the similar clay textured Peguis soils. They are not as well drained as the Kinwow soils.

Mapping Unit

Mantagao series (1,587 acres)

These areas consist dominantly of normal Mantagao soils with small areas of Kinwow series.

MARSH COMPLEX

The Marsh complex consists of very poorly drained, Carbonated Rego Gleysol soils developed on lacustrine clay or thin mucky loam deposits over extremely calcareous till and/or moderately calcareous clay. These soils occur on level to depressional areas that are covered with water and are usually saturated for most of the year. The native vegetation consists entirely of reeds and sedges. A representative profile of the Marsh complex is described below:

F-H — 3 to 0 inches, black (10YR 2/1, moist), muck; mildly alkaline and calcareous; clear, smooth boundary.

Ahg — 0 to 1 inch, black (5Y 2/1, moist), silty clay; weak fine granular; very plastic and very sticky when wet, friable when moist; moderately alkaline and calcareous; iron stained, clear, smooth boundary.

Cg — 1 to 24 inches, grey (5Y 5/1, moist), with mottles of light grey (5Y 7/1), dark grey (5Y 4/1) and strong brown (7.5YR 5/8), silty clay till; granular-like structure; very plastic and very sticky when wet, strongly cemented when dry; moderately alkaline and strongly calcareous; iron stained.

These soils have a thin surface layer of either muck or mineral material high in muck content and are underlain by strongly gleyed, olive grey mineral materials. A very thin Ahg horizon, less than 1 inch thick, may be present below the muck surface layer.

Marsh soils are undifferentiated with respect to texture and composition of their parent material. They also are much more poorly drained than other Gleysolic soils.

Mapping Unit

Marsh complex (14,214 acres)

These areas consist dominantly of Marsh soils.

McARTHUR SERIES

The McArthur series consists of well drained, Orthic Grey Luvisol soils developed on very stony, moderately coarse to medium textured, moderately calcareous, glacial till. The topography is gently sloping and the native vegetation consists of aspen,

TABLE 37

Analysis of Mantagao Clay

Hor	Depth Inches	Mechanical Analysis				pH	Cond. mmhos cm	% $CaCO_3$ Equiv	% Calcite	% Dolomite	% Org. C	% Total N	C N Ratio	C.E.C m.e.	Exchangeable Cations m.e. 100gms				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	4.87	0.60	—	—	—	42.45	1.65	25.7	—	—	—	—	—	—
Aegj	0-2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
ABgj	2-3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Btgj	3-15	C	4	12	84	4.75	0.12	—	—	—	0.71	—	—	34.52	25.49	6.42	0.71	0.33	6.65
BCgj	15-18	C	7	24	69	6.86	0.32	—	—	—	0.66	—	—	30.16	24.95	9.58	0.64	0.29	0.48
Cgj	18+	C	15	28	57	7.35	0.29	18.93	3.79	13.95	—	—	—	—	—	—	—	—	—

FIGURE 29

McArthur sand. An Orthic Grey Luvisol developed on very stony, sandy textured till.

birch, balsam fir, and white spruce. A representative profile of the McArthur series is described below:

L-H — 2 to 0 inches, brown to very dark brown (10YR 4/3 to 2/2, dry), partially to well decomposed leaf and forb litter; slightly acid; abrupt, smooth boundary.

Ae — 0 to 3 inches, light grey (10YR 7/1 to 7/2, dry), very fine sandy loam; moderate, fine platy; very friable when moist, soft when dry; slightly acid; clear, smooth boundary.

Bt — 3 to 9 inches, brown (10YR 4/3 to 5/3, dry), very fine sandy clay loam; moderate, coarse granular; firm when moist, hard when dry; slightly acid; gradual, smooth boundary.

BC — 9 to 16 inches, light brownish grey (10YR 6/2, dry) fine sandy loam; moderate, coarse granular; friable when moist, soft when dry; netural; a few small iron mottles; gradual, smooth boundary.

Ck — 16 to 35 inches, light grey to white (2.5Y 7/2 to 8/2, dry) loam; moderately strong, medium subangular blocky-like structure, firm when moist, hard when dry; mildly alkaline; mottled, strongly calcareous.

These soils have a thin, medium to strongly acid, grey Ae horizon and a moderately well developed, textural B horizon grading into a very stony, iron stained C horizon.

McArthur soils are much more permeable, stony and friable than the similar clayey textured Egg Island and Kinwow soils. They are less permeable than the St. Labre and Woodridge soils.

Mapping Unit

McArthur series (7,348 acres)

These areas consist dominantly of normal McArthur series and occur dominantly in the Washow Bay and Black Island areas.

McCREARY SERIES

The McCreary series consists of imperfectly drained, Gleyed Carbonated Rego Black soils developed on 6 to 30 inches of very strongly to extremely calcareous, medium fine textured lacustrine deposits. The topography is level to very gently sloping. The vegetation is meadow grasses, aspen, balsam poplar, and willow.

Profile development in this soil has been strongly influenced by both the high lime content of the parent material and the imperfect drainage. The very dark grey Ah horizon is alkaline in reaction, and calcareous in at least the lower portion. This surface horizon is separated from the parent material by a moderately calcareous transitional horizon. These soils are usually recognizable by the presence of scattered small stones on the surface. A thin gravel or cobble lens may occur at the contact of the two materials.

TABLE 38

Analysis of McArthur Very Fine Sandy Loam

Hor.	Depth Inches	Mechanical Analysis				% Moisture 1/3 Atm	pH	Cond. mmhos/cm	% CaCO3 Equiv.	% Calcite	% Dolomite	% Org. C	% Total N	C/N Ratio	NaHCO3 Extract P(PPM)	C.E.C.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay												Ca	Mg	K	Na	H
L-H	2-0	—	—	—	—	97.5	6.4	0.6	—	—	—	33.8	1.5	23	30.0	—	—	—	—	—	—
Ae	0-3	VFSL	70	20	10	12.3	6.3	0.2	—	—	—	1.0	0.04	25	4.3	6.1	5.3	1.1	0.2	0.1	0.6
Bt	3-9	VFSCL	62	14	24	14.0	6.6	0.3	—	—	—	1.1	0.04	25	2.5	13.6	11.6	3.4	0.5	0.1	0.7
BC	9-16	FSL	59	22	19	17.7	7.1	0.3	1.2	—	—	0.6	0.03	20	—	—	—	—	—	—	—
Ck	16-30	L	43	33	24	19.0	7.6	0.3	20.7	—	—	0.3	0.02	15	—	5.7*	6.4	1.4	0.2	0.2	—

*C.E.C. and exchangeable cations were determined by using a 1:1 ethanol to netural, in ammonium acetate extracting.

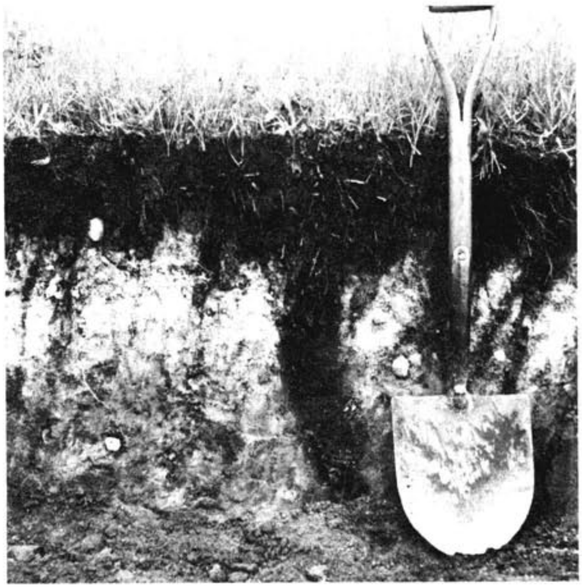


FIGURE 30

McCreary clay loam. A Gleyed Rego Black developed on thin, calcareous clay loam textured sediments overlying glacial till.

McCreary soils correlate with Lakeland till substrate phase soils in previously published soil survey reports. McCreary soils are somewhat stonier, more friable and more permeable than the very similar Dencross soils. They are not as permeable as Lakeland soils, nor nearly as stony as the Lundar soils.

Mapping Unit

McCreary series (3,243 acres)

Areas consisting of normal McCreary soils.

MELEB SERIES

The Meleb series consist of poorly drained, Carbonated Rego Humic Gleysol soils developed on extremely calcareous galcial till. These soils occupy level or depressional areas. The native vegetation is dominantly aspen, willow, meadow grasses, sedges and black spruce. A description of a representative profile of the Meleb series follows:

L-H — 8 to 0 inches, dark greyish brown to black (10YR 4/2 to 2/1, dry), moderately to well decomposed peat; neutral; abrupt, smooth boundary.

Ah — 0 to 4 inches, very dary grey (10YR 3/1, dry), fine sandy loam; moderate medium granular; friable when moist, sticky when wet; mildly alkaline; clear, wavy, lower boundary.

ACg — 4 to 7 inches, greyish brown (10YR 5/2, dry), fine sandy loam; moderate medium to coarse granular; friable when moist; sticky when wet; moderately alkaline and strongly calcareous; mottled; clear, wavy boundary.

Cgl — 7 to 9 inches, white (2.5Y 8/2, dry) fine sandy loam; massive to weak, coarse granular-like structure; friable when moist, sticky when wet; moderately alkaline and very strongly calcareous; mottled; clear, wavy boundary.

Cg2 — 9 inches plus, pale yellow (2.5Y 8/4, dry) loam; massive to weak, medium granular-like structure; friable when moist, sticky when wet; moderately alkaline and very strongly calcareous; mottled.

The Meleb soils consist dominantly of a thin layer of mesic fen peat overlying a thin, dark grey Ah horizon that grades through a thin, transitional layer into a gleyed, light grey, extremely calcareous C horizon (see Figure 11).

Meleb soils are very stony and are more friable and permeable than the very similar, finer textured, clayey Balmoral, Fyala, Partridge Creek, Pineimuta, Tarno and Thickwood soils. They are much less friable and permeable than the coarser textured Foley, Malonton, Sprague and gravelly Sundown soils.

Mapping Units

Meleb series (3,128 acres)

These areas consist dominantly of normal Meleb series with small amounts of Meleb series, peaty phase soils.

Meleb peaty phase (27,060 acres)

These areas consist dominantly of Meleb soils having 6 to 16 inches of mesic peat materials.

TABLE 39

Analysis of Meleb Loam

Hor.	Depth Inches	Mechanical Analysis				% Moisture 1/3 Atm	pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Org C	% Total N	C/N Ratio	$NaHCO_3$ Extract P(PPM)	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
L-H	8-0	—	—	—	—	157.2	7.1	0.4	1.5	19.8	1.8	11	13.4	—	—	—	—	—	—
Ah	0-4	FSL	65	18	17	20.0	7.4	0.5	7.6	2.9	0.2	14	1.6	19.6*	17.3	4.2	0.2	0.1	—
ACg	4-7	FSL	67	20	13	13.2	7.7	0.5	20.6	0.8	0.1	8	0.6	8.1*	9.3	1.9	0.1	0.1	—
Cg	7+	FSL	52	34	14	12.3	7.8	0.5	37.8	0.5	0.2	—	—	3.8*	7.4	0.9	0.1	0.1	—

*C.E.C. and exchangeable cations were determined using a 1:1 ethanol to neutral, in ammonium acetate extracting solution.

MOLSON COMPLEX

The Molson complex consists of poorly drained organic soils developed on 24 to 64 inches of fibric Sphagnum moss which may be underlain by significant amounts of mesic forest and/or sedge peat. Moderately to strongly calcareous, loam to clay textured sediments occur within 64 inches of the surface. The Molson complex consists of the following series:

Sisib Series, a Terric Fibric Mesisol, developed on 2 to 3 feet of extremely acid, light yellowish brown, fibric or relatively undecomposed Sphagnum moss. This overlies 2 to 3 feet of strongly to very strongly acid, woody, mesic, very dark brown to black, mesic or moderately decomposed forest peat (peat derived from feathermosses, ericaceous shrubs, spruce needles, twigs, branches and roots). Unlike the closely related Molson Series, the mesic forest peat is dominant in the organic section. Total depth of the organic section tends to range from 3 to 5 feet in thickness. The combination of acid fibric Sphagnum surface layer and significant content of coarse woody fragments in the mesic layer imposes some limit to agricultural suitability.

Sadlow Series, a Terric Fibrisol, on shallow, 2 to 5 feet of extremely acid, fibric Sphagnum moss overlying little or no mesic forest and/or fen peat. These soils usually have thicker Sphagnum surface layers than the two other members of this complex. Similarly, the extremely acid, fibric Sphagnum surface layer imposes some limitation to agricultural suitability.

Molson Series, a Terric Mesic Fibrisol, developed on dominantly 3 to 4 feet of very strongly to extremely acid, light yellowish brown, fibric or undecomposed Sphagnum moss peat that is usually underlain by 1 to 2 feet of strongly acid, woody, very dark brown to black, mesic forest peat grading abruptly to a calcareous, loam to clay textured, mildly alkaline, dark greyish colored lacustrine sediments. Total depth of the organic section normally ranges from 3 to 5 feet in thickness. These are limited in their usefulness for agriculture because of the extremely acid, fibric Sphagnum moss peat on the surface and the occurrence of significant amounts of coarse woody debris in the mesic organic layer. The smooth, stone-free, lacustrine mineral soil substrate enhances their suitability for development. A representative profile of the Molson series is described below:

FIGURE 31

Molson Series. This organic soil is a Terric Mesisol developed on thin, fibric, Sphagnum moss peat overlying lacustrine clay.

- Of — 0 to 24 inches, light yellowish brown; non-woody; coarse fibered; spongy, Sphagnum moss, extremely acid; about 99 percent fiber.
- Om — 24 to 36 inches, amorphous; non-woody; about 69 percent fiber; medium acid; lower portion of this layer contains a high portion of mesic herbaceous peat.
- IIAhg — 36 to 40 inches, clay; massive, breaking to granular; very sticky and very plastic; neutral.
- IICg — 40 inches plus, clay; massive; very sticky and very plastic; neutral.

TABLE 40

Analysis of Molson Series (Terric Mesic Fibrisol)

Hor.	Depth Inches	Text. Class	% Un-rubbed Fiber	% Pyro-phos. Sol.	% Ash	% Org. C	% Total N	C/N Ratio	pH in KCl	C.E.C. m.e.	Exchangeable Cations m.e./100 gms. Ca	Mg	K	Na	H
Of	0-24	—	99.7	0.08	4.1	57.90	0.52	111	2.95	126.7	12.5	8.8	0.7	2.3	110.7
Om	24-36	—	69.5	0.40	13.3	54.48	1.32	14	5.65	180.7	123.0	19.8	0.3	0.2	27.0
IIAhg	36-40	C	—	—	91.2	—	—	—	7.30	—	—	—	—	—	—
IICg	40+	C	—	—	95.9	—	—	—	7.20	—	—	—	—	—	—

The areas of Molson soils are level to depressional. Native vegetation is dominantly stunted black spruce and tamarack with an understory of Sphagnum mosses and ericaceous shrubs.

Mapping Unit

Molson complex (179,877 acres)

These areas consist dominantly of Molson series with significant amounts of Sisib and Sadlow series.

OKNO COMPLEX

The Okno complex consists of poorly to very poorly drained organic soils developed on 16 to 52 inches of mesic forest peat. A thin (0 to 24 inches) fibric sphagnum moss peat, in some cases, overlies the mesic forest peat. These soils are underlain by medium to fine textured sediments. Okno Complex consists of the following series:

Okno Series, a Terric Mesisol, developed on 16 to 52 inches of mesic forest peat (moderately decomposed plant residues derived from black spruce, ericaceous shrubs and a continuous carpet of feathermosses and patches of Sphagnum moss). A description of a representative Okno profile is given below.

Of — 0 to 6 inches, pale brown to brown (10YR 5/3 to 6/3) fibric Sphagnum moss that is strongly acid, coarse fibered, non-woody and spongy; unrubbed fiber content is usually 90 percent.

Om — 6 to 36 inches, very dark brown to dark reddish brown (10YR 2/2 to 5YR 3/2) mesic forest peat that is slightly acid to neutral in reaction; fine fibered with considerable coarse woody fibers, branches and logs; unrubbed fiber content approximately 60 percent.

IIAhg — 36 to 39 inches, black (2.5Y 3/0) clay; strong, fine granular; sticky, very plastic when wet; neutral in reaction; abrupt, smooth boundary.

IICg — 39 inches plus, light grey (5Y 5/1) clay; massive structure; very sticky and very plastic; neutral grading to moderately alkaline in reaction.

Kalevala Series, a Terric Fibric Mesisol, developed on dominantly mesic forest peat with a subdominant (10 inches or more) but significant surface layer of fibric Sphagnum moss. This surface fibric layer is usually from 12 to 18 inches in thickness, yellowish brown to pale brown in color, is strongly acid in reaction and usually is non-woody (lacks coarse fibered organic debris, spruce branches, stems and roots). The dominant mesic forest peat layer, as in the Okno Series, is very dark brown, medium to strongly acid in reaction and usually contains a very considerable amount of coarse, woody debris, stems, branches and roots. As in the Okno series, the mineral soil substrate is usually massive clay and is neutral grading to moderatley alkaline in reaction.

The Baden Series, a Terric Mesic Fibrisol. This soil is very similar in profile characteristics to the Kalevala Series, except that the fibric, very strongly acid Sphagnum surface layer is dominant and the underlying mesic forest peat layer is subdominant in the organic section. The total organic section of the Baden soils tends to be somewhat shallower than that of the Kalevala Series. A representative profile of the Baden Series is described below:

Of — 0 to 20 inches, pale brown to brown (10YR 5/3 to 6/3, moist), coarse fibered; non-woody; spongy; strongly acid; Sphagnum moss; about 80 percent fiber.

Om — 20 to 30 inches, very dark brown to dark reddish brown (10YR 2/2 to 5YR 3/2, moist), fine fibered to amorphous granular with considerable coarse woody material at contact between the two layers; neutral to slightly acid; mixed moss, woody and herbaceous material, moderately to strongly decomposed; about 58 percent fiber.

IIAhg — 30 to 33 inches, black (2.5Y 3/0, moist), clay; strong fine granular; sticky and very plastic when wet; neutral to slightly acid; abrupt, wavy boundary.

IICg — 33 inches plus, light grey (5Y 5/1, wet), clay; massive, breaking to fine granular; sticky and very plastic when wet; neutral to mildly alkaline.

The Hoctor Series, a Terric Fibrisol. This soil is dominated by a fibric Sphagnum surface layer. Other organic layers such as the mesic forest peat layers common to the Baden, Kalevala and Okno soils are either not significant or are virtually ab-

TABLE 41

Analysis of Baden Series (Terric Mesic Fibrisol)

Hor.	Depth Inches	Mechanical Analysis: Text. Class	% Sand	% Silt	% Clay	% Unrubbed Fiber	% Pyrophos Sol	% Ash	Bulk Density (gm/cc)	% Org C	% Total N	C/N Ratio	pH in CKI	C.E.C. m.e.	Exchangeable Cations m.e./100 gms: Ca	Mg	K	Na	H
Of	0-20	—	—	—	—	80	0.15	13.7	0.05	27.6	1.8	27	5.8	127.3	40.6	13.3	1.3	0.8	69.4
Om	20-30	—	—	—	—	58	0.20	14.2	0.12	45.2	1.4	33	6.9	201.0	147.0	24.5	0.4	0.6	6.2
IIAhg	30-33	C	2	15	83	—	—	87.3	—	3.4	0.3	13	5.6	60.2	39.3	11.9	1.3	0.5	3.9
IICg	33+	C	1	11	88	—	—	92.2		0.7	0.1	7	5.7	46.0	30.0	11.7	1.4	0.6	3.3

sent in these soils. The total organic section in these soils like the Baden soils, tend to be quite shallow, usually less than 3 feet in depth.

The areas of Okno soils are level to depressional. The native vegetation is dominantly black spruce in the overstory and feathermosses, ericaceous shrubs, and Sphagnum moss in the understory.

Mapping Unit

Okno complex (84,172 acres)

These areas consist dominantly of Okno series with significant amounts of Kalevala series, Baden series and Hoctor series.

PARTRIDGE CREEK SERIES

The Partridge Creek series consists of poorly drained Rego Humic Gleysol soils developed on 6 to 30 inches of moderately calcareous, lacustrine clay over extremely calcareous till. The topography is depressional to level. Native vegetation is dominantly sedges, with willow, alder and black spruce.

The Partridge Creek soils have a thin surface layer of very dark brown, slightly acid, moderately decomposed peat derived from sedges, hydrophytic herbaceous plants and mosses. This organic layer is usually underlain by a thin, neutral to mildy alkaline, very dark grey Ah horizon. The Cg horizon is greyish brown, contains numerous large concretions of lime carbonate, is iron stained and is moderately alkaline in reaction.

The Partridge Creek soils correlate with Fyala till substrate phase soils in previously published soil survey reports. They are also much less permeable and friable than the similar, coarser textured Balmoral, Foley, Lee Lake, Malonton, Meleb, Pineimuta, Tarno and the gravelly Berry Island and Sundown soils.

Mapping Units

Partridge Creek series (25,193)

Areas of normal Partridge Creek soils

Partridge Creek peaty phase (31 acres)

These are areas of Partridge Creek soils which have 6 to 16 inches overlay of mesic fen peat.

PEGUIS SERIES

The Peguis series consists of imperfectly drained Gleyed Dark Grey soils developed on moderately to strongly calcareous lacustrine clay underlain by extremely calcareous till within 30 inches of the surface. The topography is level. Native vegetation consists mainly of aspen and white spruce. A representative profile of Peguis clay is described below:

L-H — 1 to 0 inches, muck; mildly alkaline; abrupt, smooth boundary.

Ahegj — 0 to 1 inches, very dary grey (5Y 3/1, moist), silty clay; moderate, medium granular; friable when moist, hard when dry; mildly alkaline; abrupt, smooth boundary.

Btjgj — 1 to 7 inches, dark grey (5Y 4/1, moist), clay; moderate, medium granular; friable when moist, hard when dry; mildly alkaline; iron concretions; clear, smooth boundary.

Cgj — 7 inches plus, grey (5Y 5/1, moist), silty clay; weak, fine granular; firm when moist, very hard when dry; moderately alkaline; iron concretions.

IICgj — 18 inches plus, pale yellow (7Y 7/3, moist), silty loam; weak, fine granular; moderately friable when moist, slightly hard when dry; mildly alkaline; iron stained (10YR 6/8).

The Peguis soils are slightly degraded, as evidenced by blotching in the A horizon. The dark grey Btjgj is moderately developed, massive breaking to granular structure and usually neutral to mildly alkaline in reaction.

The Peguis soils are somewhat less stony and more permeable than the very similar Davis Point soils. They are much less permeable and less friable that the coarser Fisherton, Inwood and Ledwyn soils. They are stonier than the Framnes and Ledwyn soils but not as stony as the very stony Inwood soils.

TABLE 42

Analysis of Peguis Clay

Hor.	Depth Inches	Mechanical Analysis				pH	Cond mmhos/cm	% $CaCO_3$ Equiv	% Calcite	% Dolomite	% Org C	% Total N	C/N Ratio	C E C m e	Exchangeable Cations m.e./100gms				
		Text. Class	% Sand	% Silt	% Clay										Ca	Mg	K	Na	H
L-H	1-0	—	—	—	—	7.4	0.83	2.28	—	—	5.71	0.71	10.6	—	—	—	—	—	—
Ahegj	0-1	SiC	10	47	43	7.4	0.71	1.10	—	—	3.61	0.30	12.0	40.62	15.65	25.90	0.82	0.41	0
Btjgj	1-7	C	8	40	52	7.5	1.33	4.14	—	—	1.94	0.15	12.9	—	—	—	—	—	—
Cgj	7-18	SiC	8	46	46	8.2	1.46	53.15	34.42	17.27	0.51	—	—	—	—	—	—	—	—
IICgj	18+	SiL	32	54	14	7.7	0.30	60.9	20.0	38.1	—	—	—	—	—	—	—	—	—

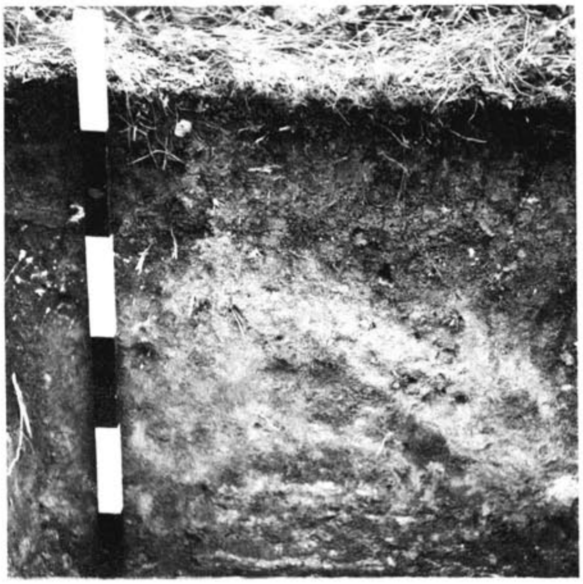


FIGURE 32
Peguis clay. A Gleyed Dark Grey soil developed on thin, lacustrine clay overlying stony, glacial till.

Mapping Unit

Peguis series (117,051 acres)

These areas consist dominantly of Peguis soils.

PINAWA SERIES

The Pinawa series consists of imperfectly drained, Gleyed Grey Luvisol soils developed on moderately coarse to medium textured, very stony, moderately calcareous, glacial till. The topography is gently sloping and the native vegetation consists dominantly of aspen, spruce, and some balsam fir.

These soils have a thin, medium acid Ae horizon and a gleyed, moderately well developed Bt horizon grading into a very stony, gleyed and iron stained C horizon.

The Pinawa soils are considerably more stony and more uniform in texture than the similar, clayey textured Mantagao soils or the sandy Caliento soils.

Mapping Unit

Pinawa series (1,360 acres)

These areas consist of normal Pinawa series.

PINEIMUTA SERIES

The Pineimuta series consists of poorly drained Carbonated Rego Humic Gleysol soils developed on 6 to 30 inches of extremely calcareous, moderately fine textured sediments over extremely calcareous till. The topography is depressional to level. The vegetation consists of meadow grasses, reeds, sedges, willow, alder, aspen and some balsam poplar on the slightly elevated sites.

The Pineimuta soils correlate with Balmoral till substrate phase soils in previously published soil survey reports. They are more permeable, more friable and more stony than the similar, finer textured, clayey Fyala and Tarno soils. They are not as permeable and friable as the similar coarser textured Foley, Sprague or the gravelly Sundown soils.

Pineimuta soils consist of a thin layer of peat, underlain by a very dark grey Ah horizon. A thin, grey transitional layer containing some organic matter separates the Ah horizon from the very pale brown, strongly calcareous parent material.

Mapping Units

Pineimuta series (93 acres)

These are areas of normal Pineimuta soils.

Pineimuta peaty phase (485 acres)

These are areas of Pineimuta soils which are overlain by 6 to 16 inches of moderately decomposed, very dark brown fen peat.

PINE RIDGE SERIES

The Pine Ridge series consists of well drained, Degraded Eutric Brunisol soils developed on moderately calcareous sand deposits. Surface textures are loamy fine sand to sand. The topography is very gently to gently sloping. The native vegetation is dominantly jack pine, aspen, and some white spruce. A representative profile is described below:

L-H — 1 to 0 inches, brown to very dark brown (10YR 4/3 to 2/2, dry) partially to well decomposed pine needles and forb litter; strongly acid; abrupt, smooth boundary.

Ahe — 0 to 2 inches, greyish brown to light greyish brown (10YR 5/2 to 6/2, dry) fine sand; loose, slightly acid; abrupt, wavy, lower boundary.

Aej — 2 to 7 inches, light yellowish brown (10YR 6/4, dry), fine sand; loose; neutral; clear, wavy boundary.

Bm — 7 to 11 inches, yellowish brown (10YR 5/4, dry), fine sand; weak, fine blocky; very friable when moist, soft when dry; neutral; clear, wavy boundary.

BC — 11 to 15 inches, brown (10YR 5/3, dry), fine sand; loose; mildly alkaline; clear, irregular boundary.

CK — 15 to 36 inches, white (10YR 8/2, dry), fine sand; loose; moderaetly alkaline and strongly calcareous.

The parent material of Pine Ridge soils has a very small amount of clay and, consequently, the accumulation of clay in the B horizon is usually very low. Frequently the B horizon is developed in a thin gravel lens comprised of decomposing dolostones coated with a film of silt and clay. The Aej horizon is thick, often extending to 10 or more inches below the surface. The solum is slightly to medium acid in reaction and the C horizon is calcareous.

Pine Ridge soils are less acid in solum and have slightly more clay in the B horizon than the similar Sandilands soils. These stone-free soils are much

TABLE 43

Analysis of Pine Ridge Fine Sand

Hor.	Depth Inches	Mechanical Analysis				% Moisture 1/3 Atm.	pH	% $CaCO_3$ Equiv.	% Org. C	% Total N	C/N Ratio	NaHCO3 Extract P(PPM)	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay									Ca	Mg	K	Na	H
L-H	1-0	—	—	—	—	—	5.1	—	—	—	—	34.9	—	—	—	—	—	—
Ahe	0-2	Fs	90	6	4	5.7	6.3	—	0.8	16	0.05	5.9	5.0	4.7	0.6	0.2	0.1	2.2
Aej	2-7	Fs	92	4	4	4.5	6.8	—	0.6	20	0.03	21.9	4.0	3.2	0.7	0.1	0.1	1.7
Bm	7-11	Fs	88	5	7	5.5	7.1	—	0.3	—	0.06	13.4	5.2	6.1	1.5	0.1	0.1	0.8
BC	11-15	FS	92	6	2	3.6	7.9	10.4	—	—	—	4.9	2.3	6.9	0.8	0.1	0.1	—
Ck	15-36	FS	97	2	1	1.0	8.2	20.1	—	—	—	—	—	—	—	—	—	—

coarser in texture and more permeable than the very stony Fairford and Hilbre soils.

Mapping Unit

Pine Ridge series (125 acres)

These areas consist dominantly of Pine Ridge soils with minor included areas of Woodridge and Sandilands soils.

PUNK SERIES

The Punk series consists of well drained, Degraded Eutric Brunisol soils developed on 20 to 30 inches of moderately calcareous sand deposits over limestone bedrock. The topography is very gently to gently sloping. The vegetation is dominantly jack pine, aspen and some white spruce.

The parent material is these soils has a very small amount of clay and, consequently the accumulation of clay in the B horizon is usually very low. Frequently the B horizon is developed in a thin gravel lens comprised of decomposing dolostones coated with a film of silt and clay.

The Punk soils correlate with Pine Ridge rock substrate phase soils in previously published soil survey reports.

Mapping Unit

Punk series (69 acres)

Areas consisting of Punk soils.

RAT LAKE SERIES

The Rat Lake series consists of well drained Solodic Grey Luvisol soils developed on 20 to 30 inches of moderately to strongly calcareous lacustrine clay over limestone bedrock. Topography is level to undulating. The native vegetation is dominantly aspen and white spruce.

The dominant feature of the Rat Lake soil profile is the very tough columnar structure of the B horizon. The columnar aggregates grade into massive clay in the lower part of the B horizon. The B horizon in some cases, occurs at the contact of the clay and bedrock.

The Rat Lake soils correlate with Lettonia rock substrate phase soils in previously published soil survey reports.

Mapping Unit

Rat Lake series (144 acres)

Areas consisting of normal Rat Lake soils.

RAT RIVER COMPLEX

The Rat River complex consists of poorly to very poorly drained organic soils developed on 16 to 52 inches of mesic forest peat. A thin (0 to 24 inches) fibric sphagnum moss peat, in some cases, overlies the mesic forest peat. These soils are underlain by calcareous, coarse and moderately coarse, sandy textured sediments.

The Rat River complex consists of the following series:

The Rat River Series, a Terric Mesisol, developed on mesic forest peat (moderately decomposed plant residues derived from black spruce trees, ericaceous shrubs, feathermosses and patches of Sphagnum moss). The total depth of the organic section usually ranges from 2 to 5 feet in depth. The profile is normally characterized by a very dark brown, slightly to medium acid, mesic forest peat layer containing a large amount of coarse woody debris, stems, branches and roots. In some instances, a very thin, usually less than 6 inches in thickness, discontinuous, pale brown, extremely to strongly acid, spongy, fibric Sphagnum moss layer overlies the mesic peat layer. The greyish brown lacustrine substrate is usually neutral grading to moderately alkaline in reaction, and ranges from coarse to moderately coarse in texture.

The Pigeon Point Series, a Terric Fibric Mesisol. This soil is developed dominantly on mesic forest peat with a subdominant but significant surface layer of fibric Sphagnum moss. This continuous surface fibric layer usually ranges from 1 to 2 feet in thickness, is yellowish brown to pale brown in color, is strongly to very strongly acid in reaction and usually is free of coarse fibered organic debris, dead trees, stems and roots. The dominant mesic forest peat layer, as in the Rat River Series, is very dark brown to dark reddish brown in color, medium acid in reaction and contains a considerable volume of coarse woody material. The total depth of the organic section of these soils tends to be somewhat shallower, usually less than 3 feet, than the Rat River Series.

The Catfish Point Series, a Terric Mesic Fibrisol. This soil is very similar in profile characteristics to the Pigeon Point Series, except that the fibric, very strongly acid Sphagnum surface layer is dominant and the mesic layer is subdominant in the organic section. The total organic section usually ranges from 2 to 3 feet in thickness.

The Flour Point, a Terric Fibrisol. This soil is dominanted by a fibric Sphagnum surface layer. Other organic layers, such as the mesic forest peat layers common to the Catfish Point, Pigeon Point and the Rat River soils are either not significant or are virtually absent in this soil. The total depth of the organic section of this soil, like the Catfish Point and Pigeon Point soils, is quite shallow, usually less that 3 feet.

The areas of Rat River soils are level to depressional. The native vegetation is dominantly black spruce in the overstory and feathermosses, ericaceous shrubs, and some sphagnum moss in the understory.

These organic soils are similar to those described under the Okno complex, but differ from them in having a coarse and moderately coarse substrate rather than a medium to fine textured lacustrine substrate.

Mapping Unit

Rat River complex (306 acres)

These areas consist dominantly of Rat River series with significant amounts of Pigeon Point, Catfish Point and Flour Point series.

ROCK

Areas of limestone and dolostone bedorck with less than 4 inches of rapidly drained unconsolidated mineral material over consolidated limestone were mapped as Rock Outcrop. These are flat bedded rocks of Paleozoic Age. Large areas of limestone outcroppings occur just south of Mantagao Lake, the area between Hodgson and Koostatak and in the Biscuit Bay area. A small area of Precambrian, igneous and gneiss rocks is exposed about 1 mile north of Highrock Lake.

These areas have only a sparse growth of grasses and herbs and occasional stunted jack pine on the portions of the areas with a few inches of soil material over the rock.

Mapping Unit

Rock Outcrop (9,891 acres)

Rock outcroppings occur alone and in varying proportions with Hilbre, Fairford, Faulkner and Birch Bay soils.

ROSENBURG SERIES

Rosenburg series consists of imperfectly drained Gleyed Solonetzic Dark Grey soils developed on 20 to 30 inches of moderately to strongly calcareous lacustrine clay over limestone bedrock. Topography is level and the native vegetation is dominantly aspen, black poplar and spruce.

The dominant feature of Rosenburg soils is the very tough columnar structure of the upper Bt horizon. The Ae horizon is thin, light grey in color and platy-structured. The soil is slightly to medium acid in the Ae horizon, medium to neutral in the B horizon and moderately alkaline below.

The Rosenburg soils correlate with Arborg rock substrate phase soils in previously published soil survey reports.

Mapping Unit

Rosenburg series (1,158 acres)

These areas of normal Rosenburg soils.

SANDILANDS SERIES

The Sandilands series are rapidly to well drained Degraded Dystric Brunisol soils developed on siliceous, sandy outwash deposits. The topography is usually irregular, gently to moderately sloping. Internal drainage is very rapid and runoff is negligible. Native vegetation is dominantly jack pine. A representative profile is described below.

L-H — ½ to 0 inches, brownish grey to very dark brown (10YR 5/2 to 2/2, dry), partially to well decomposed pine needle and forb litter; very strongly acid; abrupt, broken boundary.

Aej — 0 to 2 inches, light brownish grey to light grey (10YR 6/2 to 7/1, dry), sand; loose; medium acid; clear, smooth boundary.

AB — 2 to 4 inches, very pale brown (10YR 7/3, dry) fine sand; loose; medium acid; gradual, smooth boundary.

Bm — 4 to 18 inches, very pale brown (10YR 8/4, dry), fine sand; loose; medium acid; gradual, smooth boundary.

C — 18 to 60 inches, very pale brown (10YR 8/3, dry), fine sand; loose; medium acid.

Sandilands soils have very weakly developed horizons distinguished by faint changes in color and reaction. They have a very thin, light brownish grey to light grey Aej horizon and an indefinite Bm horizon that grades gradually into very pale brown, fine sand which may contain slight amounts of lime carbonate 4 or 5 feet below the surface.

Sandilands soils contain less clay and are more strongly acid than the very similar Pine Ridge soils.

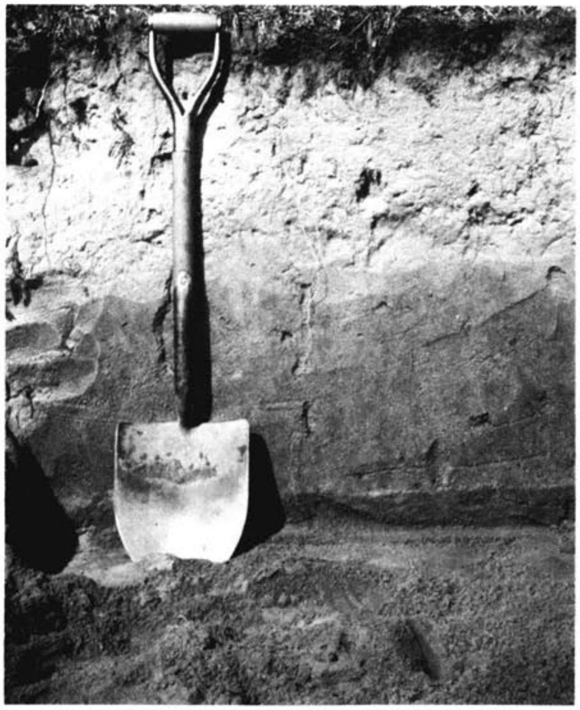


FIGURE 33
Sandilands Series. A Degraded Dystric Bunisol developed on acidic siliceous sand.

Mapping Unit
Sandilands series (5,717 acres)
Areas consisting of normal Sandilands soils with minor included areas of Pine Ridge series.

SAND BEACHES (91,404 acres)

Sand beaches are rapidly to imperfectly drained, low sandy beach ridges presently being formed along the shores of Lake Winnipeg. These areas have no agricultural or forestry value, but they provide excellent recreational sites in the Washow Bay area and many summer resorts have been developed in their vicinity.

SAND RIVER COMPLEX

The Sand River complex consists of poorly to very poorly drained organic soils developed on 24 to 64 inches of fibric Sphagnum moss and are usually underlain by significant amounts of mesic forest and/or sedge peat. Coarse and moderately coarse textured sediments occur within 36 to 64 inches of the surface.

The Sand River Complex consists of the following series:

The Sand River Series, a Terric Mesic Fibrisol, developed on 2 to 4 feet of strongly to very strongly acid, pale brown, fibric or undecomposed, spongy to somewhat compacted Sphagnum moss peat. This continuous layer of Sphagnum is usually underlain by subdominant mesic forest or fen peat layer that is usually 1 to 2 feet thick, very dark brown and strongly to mildly acid. When underlain by forest peat this mesic material contains a considerable volume of coarse, woody debris, dead trees, stems, branches and roots. When underlain by mesic fen peat, the material is uniform and non-woody. Very often, both types of mesic material will occur in the organic section of this soil. Total depth of the organic section usually ranges from 3 to 5 feet. The underlying, coarse textured sandy sediments are usually moderately calcareous, mildly to moderately alkaline and stone-free.

The Turnberry Series, a Terric Fibric Mesisol. This soil has similar profile characteristics as the Sand River Series. The significant difference is that the surface fibric Sphagnum layer is thinner and subdominant to the subsurface mesic forest and/or fen peat layer. The total depth of the organic section of this soil tends to be somewhat thicker than the Sand River soils, ranging from 4 to 5 feet.

The Monkman Series, a Terric Fibrisol. The organic section of this soil is dominated by a fibric Sphagnum surface layer. Other organic layers, such as the mesic forest or fen peat layer common to the Sand River and Turnberry soils, are either not

TABLE 44
Analysis of Sandiland Fine Sand

Hor.	Depth Inches	Mechanical Analysis				% Moisture ⅓ Atm	pH	% Org. C	% Total N	C/N Ratio	$NaHCO_3$ Extract P(PPM)	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay								Ca	Mg	K	Na	H
L-H	½-0	—	—	—	⅞	32.6	4.5	—	—	—	14.7	—	—	—	—	—	—
Aej	0-2	S	92	6	2	6.8	5.7	1.7	0.1	17	5.0	5.6	2.5	0.9	0.2	0.2	1.7
AB	2-4	FS		4	2	4.3	6.1	0.8	0.1	—	—	—	—	—	—	—	—
Bm	4-18	FS	97	3	—	2.4	6.2	< 0.1	0.1	—	—	2.0	1.0	0.4	0.1	0.1	0.8
C	18-60	FS	100	—	—	0.9	6.1	—	—	—	—	0.8	0.2	0.2	< 0.1	0.1	0.3

significant or are virtually absent in this soil. The total depth of the organic section of this soil tends to be somewhat shallower than the Turnberry soil, ranging from 2 to 5 feet.

The areas of Sand River soils are level to depressional. Native vegetation is dominantly stunted black spruce and tamarack with an understory of Sphagnum mosses and ericaceous shrubs.

These organic soils are very similar to those described under the Molson complex, but differ from them in having a coarse to moderately coarse mineral substrate rather than a medium to fine textured lacustrine substrate.

Mapping Unit

Sand River complex (4,519 acres)

These areas consist dominantly of Sand River series with significant amounts of Turnberry and Monkman series.

SPEARHILL COMPLEX

The Spearhill complex consists of imperfectly drained gravelly soils developed on strongly calcareous, stratified sand and gravel outwash and beach deposits. The topography is very gently sloping. Native vegetation is dominantly aspen, black and white spruce, some jack pine, shrubs and grasses. The complex consists of the Spearhill Series, a Gleyed Rego Dark Grey, the Kergwenan Series, a Gleyed Orthic Dark Grey and the Makinak Series, a Gleyed Dark Grey Wooded. All of these soils occur in close association with one another; the differences between them being significant differences in the degree of development of their respective soil profiles.

The Spearhill Series, a Gleyed Rego Dark Grey, is the dominant series in the complex and is marked by a lack of horizon development except for a thin organic L-H layer underlain by a dark grey Ah horizon that is blotched with lighter grey colored patches. This iron stained horizon is usually neutral in reaction and grades clearly through a thin transitional horizon into a light grey to pale brown, iron stained, strongly calcareous C horizon consisting of stratified sand and gravel.

The Kergwenan Series, a Gleyed Orthic Dark Grey, differs from the Spearhill in having a dark brownish grey, neutral in reaction Bm horizon below the Ahe.

The Makinak Series, a Gleyed Dark Grey Luvisol, has a dark grey surface Ah horizon, a thin, greyish brown, iron stained Ae horizon and a moderately developed Bt horizon.

These soils are found in association with the more common Goose Island Complex soils. The Goose Island soils differ from Spearhill soils in having a substrate of strongly calcareous till between 6 and 30 inches of the surface.

Mapping Units

Spearhill complex (74 acres)

These areas consist dominantly of Spearhill soils with significant inclusions of Kergwenan and Makinak soils.

SPRAGUE SERIES

The Sprague series consists of poorly drained, Rego Humic Gleysol soils developed on 6 to 30 inches of moderately to strongly calcareous, coarse to moderately coarse sediments over extremely calcareous till. The topography is depressional to level. Native vegetation is dominantly meadow grasses, sedges and some willow.

These soils are much more stony, more permeable and more friable than the similar, finer textured, clayey Balmoral, Foley, Fyala, Meleb, Partridge Creek and Tarno soils. They are also less permeable than the gravelly Sundown soils.

Sprague soils have a thin, mesic fen peat surface organic layer. A very dark grey, alkaline and calcareous Ahg horizon underlies the surface layer of peat. The Cg horizon is strongly mottled with iron and is strongly calcareous.

The Sprague soils correlate with Malonton till substrate phase soils in previously published soil survey reports.

Mapping Unit

Sprague series (173 acres)

These are areas of normal Sprague soils.

Sprague peaty phase (452 acres)

These areas consist dominantly of Sprague soils having 6 to 16 inches of mesic surface peat material.

SPROULE COMPLEX

The Sproule complex consists of poorly to very poorly drained organic soils developed on deep (24 to more than 64 inches) sphagnum peat overlying mesic forest and/or fen peat. These soils are underlain by coarse and moderately coarse sediments.

The Sproule Complex consists of the following series:

The Sproule, a Mesic Fibrisol. This soil is developed on 3 to 4 feet of extremely acid to very strongly acid, pale brown, fibric Sphagnum moss. This surface layer is underlain by woody, very dark brown mesic forest peat and/or fen peat. Very often, thin layers of pale brown fibric Sphagnum peat alternate with thin layers of very dark brown woody, mesic forest peat occur at about 3 or 4 feet in the organic section. More uniform, woody mesic forest peat usually extends downward for 2 to 4 feet in the organic section and in turn grading abruptly into very dark brown non-woody, mesic fen peat. The total depth of the organic section of this soil ranges from about 5 to 12 feet. The un-

FIGURE 34

Section through the surface layer of fibric Sphagnum moss peat. Note the stunted 15 to 20 year old black spruce tree. The rapidly growing Sphagnum has covered over the lower branches of this tree.

derlying coarse to moderately coarse textured, sandy lacustrine sediments are usually moderately calcareous, grade from mildly to moderately alkaline in reaction, are iron stained and stone-free.

The Caldon Series, a Sphagno-Fibrisol. This soils is developed on deep, usually more than 5 feet thick, extremely acid, uniform deposits of pale brown, fibric Sphagnum moss peat. This surface layer of Sphagnum is usually underlain by a variable depth of woody, very dark brown mesic forest or fen peat. Very often, both types will occur in the soil profile. The total depth of the organic section of this soil ranges from about 5 to 12 feet in thickness.

The Erskine Series, a Typic Mesisol, Sphagnic phase. This soil is similar in profile characteristics to the Sproule Series. The major difference is that the fibric Sphagnum surface layer of the Erskine soils is thinner, ranging from 2 to 3 feet, than that of the Sproule Series. Otherwise, total depth of the organic section and the characteristics of the mesic subsurface organic layers and mineral substrate are the same as those of the Sproule Series.

These soils are very similar to those described under the Julius complex, but differ from them in having a coarse and moderately coarse substrate rather than a medium to fine textured lacustrine substrate. The topography is depressional to level and the native vegetation is dominantly stunted black spruce and tamarack with an understory of Sphagnum mosses and ericaceous shrubs.

Mapping Unit

Sproule complex (1,377 acres)

These areas consist dominantly of Sproule series with significant amounts of Caldon series. Minor amounts of Erskine soils also occur.

ST. LABRE SERIES

The St. Labre series are well drained Orthic Grey Luvisol soils developed on 6 to 30 inches of weakly to moderately calcareous sand underlain by medium textured, very stony, extremely calcareous glacial till. These soils occur on gently undulating to undulating topography. Native vegatation is dominantly aspen, jack pine, and birch. A representative porfile is described below:

L-H — 1 to 0 inches, pale brown to very dark brown (10YR 6/3 to 2/2, dry) partially to well decomposed leaf, twig and herb litter; medium acid; abrupt, smooth boundary.

TABLE 45

Analysis of St. Labre Fine Sand

Hor.	Depth Inches	Mechanical Analysis: Text. Class	% Sand	% Silt	% Clay	% Moisture 1/3 Atm	pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Org. C	% Total N	C/N Ratio	$NaHCO_3$ Extract P(PPM)	C.E.C. m.e.	Exchangeable Cations m.e./100 gms. Ca	Mg	K	Na	H
L-H	1-0	—	—	—	—	88.8	5.7	—	—	33.0	1.3	25	31.7	—	—	—	—	—	—
Ae_1	0-2	FS	95	3	2	3.2	5.5	—	—	0.7	0.02	35	7.6	3.8	2.1	0.8	0.1	0.1	2.3
Ae_2	2-17	FS	95	3	2	2.2	6.6	—	—	0.1	0.01	10	21.0	2.0	1.4	0.9	0.1	0.1	1.0
AB	17-26	FS	94	2	4	3.5	6.7	—	—	0.1	0.01	10	11.8	2.6	1.5	1.1	0.1	0.1	1.8
Bt	26-28	LFS	89	4	7	6.4	7.5	0.4	3.1	0.3	0.03	10	18.9	5.3*	5.3	1.0	0.2	0.1	—
IIC	28-36	L	37	38	25	16.9	7.9	0.3	43.3	0.2	—	—	6.2	6.4*	7.5	3.1	0.2	0.1	—

*C.E.C. and exchangeable cations determined by using a 1:1 ethanol to neutral, in ammonium acetate.

FIGURE 35

St. Labre sand. An Orthic Grey Luvisol developed on a thin mantle of sand underlain by stony glacial till.

Ae1 — 0 to 2 inches, light grey (10YR 7/2, dry) fine sand; loose; strongly acid; clear, smooth boundary.

Ae2 — 2 to 17 inches, very pale brown (10YR 7/3, dry), fine sand; loose; slightly acid; clear, wavy boundary.

AB — 17 to 26 inches, light yellowish brown (10YR 6/4, dry) fine sand; weak, fine granular; very friable when moist, soft when dry; neutral; abrupt, smooth boundary.

Bt — 26 to 28 inches, dark yellowish brown (10YR 5/4 to 6/4, dry) gravelly loamy fine sand; weak, medium subangular blocky; friable when moist, soft to slightly hard when dry; mildly alkaline; abrupt, smooth boundary.

IIC — 28 to 36 inches, light brownish grey (2.5Y 6/2, dry), loam; strong, fine blocky-like structure; firm when moist, hard to somewhat cemented when dry; moderately alkaline and extremely calcareous.

St. Labre soils have a thick, light grey to grey Ae horizon within the sand overlay and a thin, moderately developed, textural B horizon in the finer textured substrate. The C horizon usually consists of light grey, very stony, extremely calcareous loam to clay loam textured till.

Mapping Units

St. Labre series (4,331 acres)

These areas consist dominantly of St. Labre series with minor areas of Pine Ridge series.

STEAD COMPLEX

The Stead complex consists of very poorly drained organic soils developed on greater than 52 inches of mesic fen (herbaceous) peat. Little (less than 24 inches) or no sphagnum peat occurs as a surface layer on these soils. These soils are underlain by medium to fine textured, moderately to strongly calcareous, lacustrine sediments.

The Stead Complex consists of the following Series:

The Stead Series, a Typic Mesisol. This soil is developed on greater than 52 inches of mesic or moderately decomposed, very dark brown, medium acid, non-woody, very uniform fen peat (moderately decomposed peat derived mainly from sedges, reed grasses, brown mosses and other herbaceous plants). Occasionally, these soils may have a very thin, discontinuous fibric Sphagnum surface layer. The total depth of the organic section normally ranges from about 5 to 10 feet. The underlying, greyish colored lacustrine clay sediments are usually very strongly calcareous and moderately alkaline in reaction. A representative profile of the Stead Series is described below:

Of — 0 to 12 inches, very dark brown (10YR 2/2, moist), fine, non-woody fibrous, with about 74 percent fiber content; neutral; dominantly sedge and significant amounts of mosses.

Om — 12 to 59 inches, brown (7.5YR 4/2, moist) to very dark brown (10YR 2/2, moist) medium fibered; moderately decomposed; matted to felt-like; medium acid; herbaceous material; about 54 percent (near top) to 32 percent (near bottom) fiber content.

TABLE 46

Analysis of Stead Series (Typic Mesisol)

Hor.	Depth Inches	Mechanical Analysis				% Un-rubbed Fiber	% Pyro-phos. Sol.	% Ash	% Org. C	% Total N	C/N Ratio	pH in CKl	C.E.C. m.e.	Exchangeable Cations m.e./100 gms.				
		Text. Class	% Sand	% Silt	% Clay									Ca	Mg	K	Na	H
Of	0-12	—	—	—	—	74.8	0.11	8.8	60.05	2.07	29	6.30	113.4	60.5	38.5	1.1	1.0	9.3
Om_1	12-20	—	—	—	—	54.2	0.28	10.2	—	—	—	—	132.2	80.9	46.9	1.5	0.3	<0.1
Om_2	20-40	—	—	—	—	59.1	0.39	14.8	55.56	3.22	17	5.75	128.2	80.0	43.5	1.2	0.3	7.2
Om_3	40-59	—	—	—	—	32.0	0.50	33.9	41.53	2.41	17	5.75	114.3	68.5	30.5	1.1	0.4	5.3
Oh	59-71	—	—	—	—	20.0	0.65	56.4	—	—	—	7.2	76.7	51.3	28.3	0.8	0.6	v0.1
IIAhg	71-75	SiCL	1	65	34	—	—	89.3	—	—	—	7.25	—	—	—	—	—	—
IICg	75+	SiCL	3	61	36	—	—	96.5	—	—	—	7.25	—	—	—	—	—	—

Oh — 59 to 71 inches, very dark brown to black (10YR 2/2 to 2/1, moist), amorphous-granular; matted to felt-like; medium acid; herbaceous material; about 20 percent fiber.

IIAhg — 71 to 75 inches, black (5Y 2/1, wet), clay; massive, breaking to fine granular; sticky and very plastic when wet; mildly alkaline.

IICg — 75 inches plus, light grey, (5Y 2/1, wet), clay; massive, sticky and very plastic; mildly alkaline.

These organic soils usually have a very dark brown, fibrous, suface layer. This grades into a thick, medium fibered, matted, mesic layer. A thin, well decomposed, black humic layer is also present. These soils are medium acid to neutral in reaction (see Figure 11).

The Jackhead Series, a Limno Mesisol. This soil is developed on 5 to 10 feet of dominantly, very dark brown non-woody, mesic fen peat. They have alternating, subdominant layers of whitish colored, marl (composed of precipitated and biologically deposited calcium carbonate) with mesic fen peat layers below a thin (8 to 10 inches thick) layer of fibric fen peat. Occasionally, a thin (less than 12 inches) marl layer occurs at the surface of these soils.

Mapping Unit

Stead complex (104,849 acres)

These areas consist dominantly of Stead series with minor amounts of Jackhead and Kitimik series.

SUNDOWN SERIES

The Sundown series consists of poorly drained, Rego Humic Gleysol soils developed on moderately to strongly calcareous, stratified sand and gravel outwash and beach deposits. These soils occupy level to depressional areas bordering gravelly beach ridges. Runoff is very slow and internal drainage is impeded by a high ground water table. Native vegetation is black and white spruce, tamarack and sedges.

The Sundown soils have a thin (6 to 16 inches) layer of mesic fen peat. This peaty surface layer rests on a thin, dark grey, calcareous Ahg horizon. The Ahg horizon is developed in a thin, finer textured mantle and is underlain by a strongly calcareous and strongly iron stained, light grey, stratified, sandy and gravelly Cg horizon.

Mapping Units

Sundown peaty phase (4,808 acres)

These areas consist dominantly of Sundown soils having 6 to 16 inches of mesic fen peat and minor inclusions of Rat River and Sand River complexes.

TARNO SERIES

The Tarno series are poorly drained, Rego Humic Gleysol soils developed on a thin (6 to 30 inches) lacustrine clay over strongly calcareous silty sediments. These soils occur in depressional to level clay plain areas. Surface runoff is very slow and internal drainage is also slow. The native vegetation is dominantly sedges and meadow grasses with scattered groves of of black spruce, willow and balsam poplar. A representative profile of the Tarno peaty phase is described below.

L-H1 — 16 to 8 inches, dark olive (5Y 3/3, moist), coarse fibered sedge peat; medium acid; clear, smooth boundary.

L-H2 — 8 to 0 inches, dark olive (5Y 3/3, moist), moderately decomposed sedge peat; strongly acid; abrupt, smooth boundary.

Ahg — 0 to 3 inches, dark olive grey (5Y 3/2, moist), clay to clay loam; moderate medium granular; firm when moist, very hard when dry; neutral; iron concretions; abrupt, smooth boundary.

ACg — 3 to 6 inches, very dark grey (5Y 3/1, moist), clay; moderate medium granular; firm when moist, very hard when dry; mildly alkaline; iron and calcium carbonate concretions; clear, smooth boundary.

IICg — 6 inches plus, olive grey (5Y 5/2, moist), sandy loam to clay loam; friable when moist, very hard when dry; mildly alkaline; iron and calcium carbonate concretions.

Tarno soils have a thin surface layer of fibrous to moderately decomposed sedge peat, underlain by a thin, granular Ahg horizon. The Ahg horizon

TABLE 47
Analysis of Tarno Clay Loam

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/cm	% $CaCO_3$ Equiv.	% Calcite	% Dolomite	% Org. C	% Total	C/N Ratio	Soluble Salts (meq/L)						
		Text. Class	% Sand	% Silt	% Clay									Ca	Mg	Na	Cl-	SO_4^{2-}	Total Cat.	Total Ani.
L-H1	16-8	—	—	—	—	5.75	4.04	—	—	—	36.38	2.50	14.6	15.2	49.6	3.7	—	63.4	68.5	63.4
L-H2	8-0	—	—	—	—	5.34	4.77	—	—	—	51.41	2.56	20.1	19.9	44.2	6.3	—	67.6	70.4	67 6
Ahg	0-3	CL	26	35	39	6.90	5.83	13.51	0.00	12.24	4.35	0.40	10.9	21.5	96.0	8.6	—	116.2	126.1	116.2
ACg	3-6	C	21	37	42	7.55	2.50	22.11	7.37	13.32	—	—	—	12.3	15.3	3.8	—	29.4	31.4	29.4
IICg	6+	CL	44	27	29	7.78	1.38	35.61	6.31	25.08	—	—	—	—	—	—	—	—	—	—

grades through a transitional horizon of clay into the greyish colored, strongly calcareous C horizon.

Mapping Units

Tarno series (1,779 acres)

These areas consist dominantly of normal Tarno series with minor inclusions of Balmoral and Fyala soils.

Tarno peaty phase (374 acres)

These areas consist of Tarno soils having 6 to 16 inches of mesic fen peat layer and minor inclusions of Okno and Cayer soils.

THICKWOOD SERIES

The Thickwood series consists of poorly drained Rego Humic Gleysol soils developed on 20 to 30 inches of moderately to strongly calcareous, lacustrine clay over limestone bedrock. The topography is depressional to level. Native vegetation is dominantly sedges, willow, alder and black spruce. Thickwood soils usually have a 6 to 16 inch thick surface layer of mesic fen peat and is underlain by a thin, very dark grey Ahg horizon. The Cg horizon is greyish brown to olive grey, contains numerous large concretions of lime carbonate, and is iron stained.

The Thickwood soils correlate with Fyala rock substrate phase soils in previously published soil survey reports.

Mapping Unit

Thickwood peaty phase (1,129 acres)

These are areas of Thickwood soils which have a 6 to 16 inch overlay of mesic fen peat.

WOODRIDGE COMPLEX

The Woodridge complex consists of rapidly to well drained gravelly soils. The Woodridge series, an Orthic Grey Luvisol, the Kawinaw series, an Orthic Eutric Brunisol, the Freshford series, a Degraded Eutric Brunisol. These soils are developed on calcareous sand and gravel beach and outwash deposits. These areas are usually in the form of narrow, elongated, gently undulating to undulating beach ridges. Surface runoff is moderate and internal drainage is rapid. Native vegetation consists dominantly of jack pine and some aspen.

All soils of the Woodridge Complex exhibit profile characteristics common to soils developed in forested regions. The degree of leaching or soil profile development under such conditions is variable depending on slight differences in parent material characteristics and the position on beach ridges, that each soil in the complex occupies. The summit of most ridges is usually occupied by the Kawinaw Series, an Orthic Eutric Brunisol. This soil has a very thin, dark brown, often discontinuous, L-H organic layer underlain by a dark brown Bm horizon lacking any significant clay accumulation. This Bm horizon usually is found in gravelly material. The C horizon is usually stratified and ranges from pale brown to light grey in color. The profile of this soil is the least developed of the three in the complex.

The dominant soil in the complex is the Woodridge Series, an Orthic Grey Luvisol. This soil is usually found on the intermediate slopes of the ridges and occasionally at the apex of the ridges where a thin sandy mantle, usually 4 to 10 inches thick, may occur. These soils have a thin, greyish brown Ae horizon and a well developed Bt horizon.

Between the Kawinaw and the Woodridge soils are areas of Freshford soil, a Degraded Eutric Brunisol. This soil also has profile characterisitcs intermediate between those of the Kawinaw and Woodridge soils. The profile usually has a thin L-H horizon underlain by a weak Ae horizon and in turn by a weakly developed Btj or Bm horizon.

A description of the representative dominant Woodridge Series follows.

L-H · — 1 to 0 inches, very dark brown (10YR 2/2, moist), leaf mat, slightly acid; abrupt, smooth boundary.

TABLE 48
Analysis of Woodridge Sand

Hor.	Depth Inches	Mechanical Analysis				pH	Cond. mmhos/ cm	% $CaCO_3$ Equiv.	% Org C	% Total N	C/N Ratio	C.E.C. m.e.	Exchangeable Cations m.e./100 gms				
		Text Class	% Sand	% Silt	% Clay								Ca	Mg	K	Na	H
L-H	1-0	—	—	—	—	6.45	0.41	0.30	20.46	0.58	35	—	—	—	—	—	—
Ae	0-3½	LS	81	15	4	6.45	0.42	0.0	0.66	—	—	4.80	3.85	1.44	0.20	0.11	0.30
Bt	3½-6	SCL	50	22	28	6.82	0.38	20.51	1.72	—	—	26.69	19.60	4.40	0.61	0.18	0.16
C	6-24	S	94	1	5	7.75	0.22	48.33	—	—	—	—	—	—	—	—	—

Ae — 0 to 3½ inches, light brownish grey (10YR 6/2, moist), light grey (10YR 6.5/2, dry), loamy sand; loose, slightly acid; abrupt, smooth boundary.

Bt — 3½ to 6 inches, dark yellowish brown (10YR 3.5/4, moist), yellowish brown (10YR 4.5/4, dry), sandy clay loam; weak, medium granular; friable when moist, hard when dry; neutral; clear, smooth boundary.

C — 6 to 24 inches, pale brown to light grey (10YR 6/3 to 10YR 7/2, dry), sand, gravel, and limestone pebbles; mildly alkaline, strongly calcareous; clear, smooth boundary.

Mapping Units

Woodridge complex (15,377 acres)

These areas consist dominantly of normal Woodridge soils with significant inclusions of Kawinaw and Freshford soils.

PART IV
AGRICULTURE

Agricultural interpretations of soil survey information contained in this section of the report are made to provide a better understanding of soils and their land use potential under dryland farming systems. These interpretations are based mainly on extensive field observations, soil analyses, and to a limited extent on experimental data provided by research workers in soils and crops.

A. THE MINERAL SOIL CAPABILITY CLASSIFICATION FOR AGRICULTURE*

The capability classification is one of a number of interpretive groupings for agriculture that can be made from soil survey data. In this classification the mineral soils are grouped into seven classes on the basis of their limitations for dryland farming. The first three classes are considered capable of sustained production of common field crops, the fourth class is marginal for sustained arable agriculture, the fifth class is capable of use only for improved permanent pasture, the sixth class is capable of use only for native pasture, while the seventh class is for soils and land types considered incapable of use for arable agriculture or permanent pasture. While the soil areas in classes one to four are capable of use for cultivated field crops they are also capable for use for permanent pasture. Soil areas in all classes may be suitable for forestry, wildlife and recreational uses. For purposes of this classification, trees, shrubs and ornamental plants that require little cultivation are not considered.

The soil capability classification is based on the assumption that:

1. It is an interpretive classification based on the effects of combinations of climate and soil characteristics and their general productive capacity for common field crops.

2. Soils will be well managed and cropped, using a largely mechanized system of culture.

3. Soils within a capability class are similar with respect to degree but not kind of limitation. Each class includes many different kinds of soils and many soils within any one class require unlike management.

4. Soils considered economically feasible for improvement by drainage, by irrigating, by removing stones, by altering soil structure, or by protecting from overflow are classifed according to their continuing limitations or hazards after improvements have been made.

5. The capability classification of the soils in an area may be changed when major reclamation works are installed that permanently change the limitations in use for agriculture.

6. Distance to market, kind of roads, location, size of farms, characteristics of land-ownership, cultural patterns and the skill or resources of individual operators are not criteria for capability groupings.

7. Capability groupings are subject to change as new information about the behavior and responses of the soils become available.

The capability classification consists of three categories:

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

2. The *capability subclass* is a grouping of soils with similar kinds of limitations and hazards. These limitations are: adverse climate for crop production (c); undesirable soil structure and/or low permeability (d); erosion damage (e); low fertility (f); inundation by streams or lakes (i); moisture limitation, soils affected by droughtiness owing to coarse soil texture (m); salinity (n); stoniness (p); consolidated rock near the surface (r); two or more adverse soil characteristics such as d, f, m and n (s); adverse topography, either steep slopes or frequently and pattern of slopes in different directions (t); excess water, other than that brought about by inundation (w); cumulative minor adverse characteristics (x).

3. The *unit* is a subdivision within the subclass category that groups together soils that will respond similarly to management.

B. CAPABILITY GROUPINGS OF MINERAL SOILS IN THE RED ROSE-WASHOW BAY AREA

The majority of the soils of the Red Rose-Washow Bay occur in the north-eastern extremity of what is considered the median climate of the agricultural region of Western Canada. Soils north of a line running from the center of Hecla Island on the east, through Ramsay Pt., the southern tip of Fisher Bay, Lake Andrew, Lake St. George, Lake St. David and northwesterly to about the center of

* The Canada Land Inventory Report No. 2, 1965. Soil Capability Classification for Agriculture. Canada Department of Forestry.

Township 33 in Range 5W are affected by a significant departure from this median climate with respect to cooler mean temperatures and shorter growing season. This difference in climate is taken into account when the soils in this area are evaluated for their suitability for agriculture. However, most of the soils in this region have other limiting characteristics that more significantly affect their usefulness for agriculture than climate. In most cases, the severity of these other limitations is the dominant factor in determining capability and override the effects of adverse climate.

Approximately 50 percent of the Red Rose-Washow Bay area is comprised of mineral soils, 46 percent organic soils and about 4 percent enclosed small bodies of water and lakes, excluding Lake Winnipeg. Table 49 shows the distribution of mineral soil capability classes, subclasses and units in the map area.

Approximately 12 percent of the soils of the map area are in Class 2. The major limitations of these moderately well to imperfectly drained Black Chernozemic soils are a continuing problem of wetness due to inadequate natural drainage and internal permeability and to a lesser degree problems with surface stones on cultivated fields.

Class 3 soils comprise approximately 10 percent of the area. The soils of this group are clay textured, poorly structured, well to imperfectly drained Gray Luvisol soils and poorly drained Humic Gleysols ranging from sandy loam to clay in texture. The Gleysol soils are moderately severely limited because of inadequate natural drainage, high water table conditions and poor internal drainage.

Approximately 17 percent of all soils in the area are in Class 4. The major portion of this group consists of very thin, imperfectly drained Chernozemic Dark Grey and Degraded Eutric Brunisol soils developed on extremely calcareous, very stony, wave-washed, glacial till. Their occurence in areas of choppy ridge and swale or drumlinoid topography increases management difficulties and costs of cultivation. Uniformity of crop growth and crop maturity decreases.

The dominant soils in Class 5, about 3 percent of all soils, are poorly drained and stony, suited only for improvable pasture. A significant group of imperfectly to rapidly drained gravelly and sandy soils are severely limited by lack of moisture holding capacity.

Class 6 soils which comprise about 6.5 percent of the total are either very thin soils developed on stony, water-worked glacial till underlain by limestone bedrock at shallow depths or are very rapidly drained gravelly and sandy soils or are too wet to develop for pasturage or forage.

About 1.5 percent of the Red Rose-Washow Bay area consists of such miscellaneous land types as recent gravel and sand beaches, bare rock outcroppings and flooded marshlands. Such land types have no potential for agriculture and are placed in Class 7.

Descriptions of the various classes, subclasses and units, together with the soils contained within each are presented as follows:

CLASS 1. Soils in this class have no significant limitations in use for crops. They are level or have very gentle slopes and are deep, well to imperfectly drained with a good water-holding capacity. They are easily maintained in good tilth and productivity, and damage from erosion is slight. They are moderately high to high in productivity for a wide range of field crops.

No soils of the Red Rose-Washow Bay Area are listed in this capability class.

CLASS 2. Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices. These soils have good water-holding capacity and are either naturally well supplied with plant nutrients or are highly responsive to inputs of fertilizer. They are moderately high to high in productivity for a fairly wide range of field crops adapted to the region. The limitations are not severe and good soil cropping practices can be applied without serious difficulty.

Limitations may include any one of the following: climate; accumulation of undesirable soil characteristics; low fertility; poor soil structure or slow permeability; topography; overflow and wetness. The capability units in this class are described below.

2p — These soils are moderately well drained and occur on level to very gently sloping terrain. They are moderately stony so that some interference is caused with cultivation.
Arnes Series
Homebrook Series

2w1 — These are imperfectly drained, moderately fine and medium-textured soils on level to very gently sloping terrain. Surface runoff is slow and internal drainage is impeded by a high water table in the spring.
Fisher Series
Lakeland Series
Ledwyn Series

2w2 — These soils are imperfectly drained and water moves slowly through them due to their fine texture and poor structure. As the soils in this unit are level to very gently sloping, adequate surface drainage is required to reduce the moderate limitation of wetness to crop production.
Davis Point Series
Dencross Series
Framnes Series
Peguis Series

2w3 — These imperfectly drained, clay loam textured soils are on level to very gently sloping terrain. Surface runoff is slow and internal drainage by a high seasonal water table and by slow permeability of the sediments.
Fisherton Series
McCreary Series

TABLE 49

Distribution of Mineral Soil Capability Classes, Subclasses and Units in the Red Rose-Washow Bay Map Area

Land Class, Subclass, Unit		Soil Name	Acres	Percent of Total Map Area
2P	An	Arnes	60,290	3.42
	Hb	Homebrook	6,461	0.36
			66,751	3.78
2W1	La	Lakeland	7,187	0.41
	Le	Ledwyn	2,517	0.14
	Fi	Fisher	1,250	0.07
			10,954	0.62
2W2	Dp	Davis Point	5,477	0.31
	Dc	Dencross	2,299	0.13
	Fr	Framnes	1,204	0.07
	Pe	Peguis	117,051	6.65
			126,031	7.16
2W3	My	McCreary	3,243	0.18
	Ft	Fisherton	2,674	0.15
			6,891	0.39
2X	Ha	Harwill	4,769	0.27
	H	Hodgson	2,122	0.12
			6,981	0.39
Total Class 2			**216,544**	**12.28**
3D	Ab	Arborg	51,547	2.93
	Ki	Kinwow	25,687	1.46
	Lt	Lettonia	24,789	1.41
	Mg	Mantagao	1,587	0.09
			103,610	5.89
3W	Ba	Balmoral	8,957	0.51
	Ba(P)	Balmoral, Peaty Phase	8,991	0.51
	Fo	Foley	695	0.04
	Fo(P)	Foley, Peaty Phase	1,469	0.08
	Fy	Fyala	4,263	0.24
	Fy(P)	Fyala, Peaty Phase	45,207	2.57
	Mn	Malonton	415	0.02
	Ta	Tarno	1,779	0.10
	Ta(P)	Tarno, Peaty Phase	374	0.02
			72,150	4.27
Total Class 3			175,760	10.16
4M	Spx	Spearhill	74	—
4MP	Sl	St. Labre	4,331	0.25
4RD	Rk	Rat Lake	144	0.01
	Rs	Rosenburg	1,158	0.07
			1,302	0.08

TABLE 49 Cont'd.

Distribution of Mineral Soil Capability Classes, Subclasses and Units in the Red Rose-Washow Bay Map Area

Land Class, Subclass, Unit		Soil Name	Acres	Percent of Total Map Area
4TP	Ci	Chitek	27,028	1.54
	Fd	Fairford	139,845	7.94
	Ga	Garson	9,014	0.51
	In	Inwood	83,094	4.72
	Lu	Lindar	333	0.02
			259,314	14.73
4WP	Pc	Partridge Creek	25,193	1.43
	Pc(P)	Partridge Creek, Peaty Phase	31	—
	Pi	Pineimuta	93	0.01
	Pi(P)	Pineimuta, Peaty Phase	485	0.03
	Co	Caliento	3,858	0.22
	Cb	Colby	12	—
			29,672	1.69
Total Class 4			294,693	16.75
5M	Lo	Lonesand	2,035	0.12
	Lyx	Leary	4,896	0.28
			6,931	0.40
5MP	Gux	Gunton	5,075	0.29
		Goose Island	5,694	0.32
			10,769	0.61
5PR	Ei	Egg Island	2,340	0.13
5W	Su	Sundown, Peaty Phase	4,808	0.27
5WP	Ml	Meleb	3,128	0.18
	Ml(P)	Meleb, Peaty Phase	27,060	1.54
	Sr	Sprague	173	0.01
	Sr(P)	Sprague, Peaty Phase	452	0.03
			30,813	1.76
5WR	Tk(P)	Thickwood	1,129	0.06
Total Class 5			56,790	3.23
6M	Pr	Pine Ridge	125	0.01
	S	Sandilands	5,717	0.32
	Wx	Woodridge	15,377	0.87
			21,219	1.20
6MP	Lpx	Long Point	2,600	0.15
6MR	Pk	Punk	69	—
	Lbx	Lynx Bay	576	0.03
			645	0.03
6P	Mc	McArthur	7,348	0.42
	Pa	Pinawa	1,360	0.08
			8,708	0.50

TABLE 49 Cont'd.
Distribution of Mineral Soil Capability Classes, Subclasses and Units in the Red Rose-Washow Bay Map Area

Land Class, Subclass, Unit		Soil Name	Acres	Percent of Total Map Area
6RP	Bc	Birch Bay	4,429	0.25
	Dl	Devils Lake	717	0.04
	Fk	Faulkner	7,070	0.40
	Hc	Harcus	63	—
			49,588	2.81
6W	Ky	Kerry	81	—
6WP	By	Berry Island	18,067	1.03
	By(P)	Berry Island, Peaty Phase	12,524	0.71
	Lk(P)	Lee Lake	2,754	0.16
			33,345	1.90
Total Class 6			116,186	6.59
7M	Sb	Sand Beaches	1,404	0.08
7R	R	Rock Outcrop	9,891	0.56
7W	Mh	Marsh	14,214	0.81
Total Class 7			25,509	1.45
Total Area of Mineral Soils			885,482	50.28

2x — These are well to moderately well drained soils developed on loam to clay loam textured lacustrine and alluvial sediments that are smooth and very gently sloping. These friable, permeable soils have a few cumulative minor adverse characteristics such as thin profile, moderately low organic matter content and vertical textural variation which affect water movement to some extent.
Harwill Series
Hodgson Series

CLASS 3. Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practices. They are medium to moderately high in productivity for a range of crops. These soils have more severe limitations than those in Class 2. These limitations affect one or more of the following farm practices: timing and ease of tillage, planting and harvesting, the choice of crops, the application and maintenance of conservation practices. The limitations also include one of the following: moderate climatic limitation including frost pockets, erosion, structure or permeability, low fertility, topography, overflow, wetness, low water-holding capacity or slowness in release of water to plants, stoniness, depth of soil to consolidated bedrock. The capability units in this class are described below.

3d — These well-drained fine-textured soils are moderately stony. They occur in a region which has a climatic subclass rating of 2c. Adverse structure provides enough interference to cultuvation to lower the subclass rating from 2c.
Arborg Series
Kinwow Series
Lettonia Series
Mantagao Series

3w — These poorly drained moderately coarse to fine-textured soils are nonarable (Class 5w) unless adequate surface drainage is supplied. Where adequate drainage is provided these soils will be subject to a moderately severe limitation of wetness.
Balmoral Series
Balmoral Series, Peaty Phase
Foley Series
Foley Series, Peaty Phase
Fyala Series
Fyala Series, Peaty Phase
Malonton Series
Tarno Series
Tarno Series, Peaty Phase

CLASS 4. Soils in this class have severe limitations that restrict the range of crops or require special conservation practices or both. These soils have such limitations that they are only suitable for a few crops, or the yield for a range of crops is low, or the risk of crop failure is high. The limitation may seriously affect such farm practices as the timing and ease of tillage, planting, harvesting and the application and maintenance of conservation practices. These soils are low to medium in productivity for a narrow range of crops, but may have higher productivity for a specially adapted crop. The limitations include the adverse effects of one or more of the following: moderately severe climate, very low water-holding capacity, low fertility difficult or unfeasible to correct, strong slopes, severe past erosion, poor structure or extremely slow permeability, frequent overflow, severe salinity, extreme stoniness, very restricted rooting zone and poor drainage resulting in crop failures in some years. The capability units in this class are described below:

4m — These imperfectly drained coarse-textured soils are low in natural fertility and have low waterholding capacity. These soil are only moderately affected by droughtiness, as they have a high water table in the spring.
Spearhill Complex

4mp — These well drained, sandy textured soils are stony and have low water-holding capacity in the surface 1 to 2 feet. The underlying very stony glacial till is slowly permeable and restricts the movement of water in the lower portion of the profile.
St. Labre Series

4rd — These are moderately and imperfectly drained, poorly structured, clay textured soils developed on very thin clay sediments overlying limestone bedrock. Both the impermeable, poor structured clay and the bedrock impede root and water penetration.
Rat Lake Series
Rosenburg Series

4tp — These well to imperfectly drained soils are very stony to exceedingly stony. Extensive surface stone removal is necessary for continuous cultivation. These soils are also found in areas of choppy ridge and swale or drumlinoid topography. This increases management difficulties and costs of cultivation. Uniformity of crop growth and maturity is affected.
Chitek Series
Fairford Series
Garson Series
Inwood Series
Lundar Series

4wp — These are dominantly poorly drained soils developed on thin deposits of lacustrine clay overlying very stony glacial till. They are limited by inadequate surface and internal drainage and by a moderate surface stone condition.
Partridge Creek Series
Partridge Creek Series, Peaty Phase
Pineimuta Series
Pineimuta Series, Peaty Phase
Caliento Series
Colby Series

CLASS 5. Soils in this class have very severe limitations that restrict their capability to produce perennial forage crops, but improvement practices are feasible. These soils have such serious soil, climatic, or other limitations that they are not capable of use for sustained production of annual field crops. However, they may be improved by the use of farm machinery for the production of native or tame species of perennial forage plants. Feasible improvement practices include clearing of bush, cultivation, seeding, fertilizing and water control. The limitations include the adverse effects of one or more of the following: severe climate; low water-holding capacity; severe past erosion; steep slopes; very poor drainage; very frequent overflow; severe salinity permitting only salt tolerant forage plants to grow; stoniness or shallowness to bedrock that make annual cultivation impractical. The capability units in this class are:

5m — These coarse-textured soils occur on irregular, very gently to moderately sloping topography in the form of low ridges. They are well drained and are low in water-holding capacity. As a result of rapid runoff and permeability these soils are moderately severly affected by droughtiness.
Leary Complex
Lonesand Series

5mp — These coarse-textured, gravelly and stony soils occur on irregular gently sloping areas in the form of low ridges. They are well and imperfectly drained soils and are low in water holding capacity in their surface horizons. The underlying glacial till is very stony which imparts an additional limitation on these soils. However, they are not as droughty as 5m soils.
Gunton Series
Goose Island Series

5pr — These are moderately well drained clayey textured soils developed on thin clay sediments overlying very stony glacial till which in turn overlies limestone bedrock. Both the fine surface texture and the bedrock impede root and water penetration. The rather stony condition of the surface of these soils imposes an additional limitation to cultivation.
Egg Island Series

5w — These coarse-textured gravelly soils occur in depressional areas that are covered with water part of the year and are influenced by a high water table throughout much of the year. When drainage is carried out, or in the case of drier years they may be subject to droughtiness due to low moisture holding capacity.
Sundown Series, Peaty Phase

5wp — These soils occur in level to depressional areas and are normally saturated with water for a considerable portion of the growing season. They are moderately stony to excessively stony and if adequate drainage is supplied they will be subject to severe limitation of stoniness (Class 4wp).
Meleb Series
Meleb Series, Peaty Phase
Sprague Series
Sprague Series, Peaty Phase

5wr — These poorly drained clayey soils are underlain by limestone bedrock at very shallow depths. They also occur in level to depressional areas and are normally saturated with water for most of the growing season.
Thickwood Series

CLASS 6. Soils in this class are capable only of producing perennial forage crops and improvement practices are not feasible. Class 6 soils have some natural sustained grazing capacity for farm animals, but have such serious soil, climate, or other limitations as to make impractical the application of improvement practices that can be carried out on Class 5 soils. Soils may be placed in this class because their physical nature prevents improvement through the use of farm machinery, or the soils are not responsive to improvement practices or because of a short grazing season or because stock-watering facilities are inadequate. Such improvement as may be affected by seeding and fertilizing by hand or by aerial methods shall not change the classification of these soil areas.

The limitations include the adverse effects of one or more of the following: very severe climate; very low water-holding capacity; very steep slopes; very severely eroded land; severely saline land producing only edible, salt tolerant native plants; very frequent overflow; water on the soil surface for most of the year and stoniness or shallowness to bedrock that makes annual cultivation impractical. The capability units in this class are:

6m — These are rapidly drained, sandy and gravelly soils that have low organic matter content, low natural fertility and low water-holding capacity.
Pine Ridge Series
Sandilands Series
Woodridge Series

6mp — These are rapidly drained gravelly soils that are underlain by extremely calcareous, stony till at shallow depths. These soils lack water-holding capacity and are usually moderately to very stony.
Long Point Complex

6mr — These are rapidly drained, gravelly and sandy soils that are underlain by limestone bedrock at shallow depth. The surface horizons of these soils are low in organic matter, low in fertility and seriously lack water-holding capacity. The underlying limestone bedrock impedes water and root penetration.
Lynx Bay Complex
Punk Series

6p — These are well to imperfectly drained, very stony to excessively stony soils. These soils require extensive initial stone removal before cultivation is possible and would also require annual maintenance as stones from subsurface horizons work to the surface.
McArthur Series
Pinawa Series

6rp — These well and imperfectly drained soils are exceedingly to excessively stony and are underlain at shallow depths by consolidated limestone bedrock. The bedrock impedes water and root penetration.
Birch Bay
Faulkner
Harcus

6w — These sandy, poorly drained soils occur in depressional areas and are affected by a high, seasonal water table and are naturally saturated for most of the growing season.
Kerry Series

6wp — These poorly drained, coarse and medium textured, stony soils occur in level to depressional areas and are naturally saturated for most of the growing season.
Berry Island Series
Berry Island Series, Peaty Phase
Lee Lake Series

CLASS 7. Soils in this class have no capability for arable culture or permanent pasture. The Class 7 soils have limitations so severe that they are not capable of use for arable culture or permanent pasture. These lands may or may not have a high capability for trees, native fruits, wildlife and recreation. The capability units in this class are:

7m — These are well- to imperfectly-drained coarse textured areas of very gently sloping sand beach deposits or narrow well-drained gravelly and cobbly ridges bordering many of the lakes of the area.
Sand Beaches

7r — These are areas of numerous limestone bedrock outcrop and shallow soils over bedrock in which there is not enough soil to support any useful native vegetation.
Rock Outcrop

7w — These are very poorly drained level to depressional areas which are covered with water or are saturated most of the year.
Marsh Complex

C. ORGANIC SOIL CAPABILITY FOR AGRICULTURE

The organic soils in the Red Rose-Washow Bay Area have been rated for: (a) "potential" agricultural capability, and (b) degree of development difficulty involved in achieving this potential, after the method of Leeson, 1969*. This twofold approach to classifying organic soils recognizes that the agricultural suitability of most of these soils requires reclamation or development from their native state and that most organic soils in their native state have little or no value for agriculture. Rating degree of development difficulty takes into consideration intrinsic characteristics of the soils affecting development and also associated costs required for development.

The capability classes of organic soils established not only reflect potential for agricultural use but also identify the continuing limitation of these soils for agriculture after reclamation has been implemented or is assumed to have been implemented.

To date, in Canada, no national system has been adopted for classifying organic soils for agricultural capability. The system and approach taken in Manitoba is basically a modification of the mineral soil capability classification for agriculture as described in Section A.

The Canada Land Inventory seven class soil capability classification system provides a suitable framework wherein various kinds of organic soils may be placed in order to show their relative value for agriculture along with mineral soils. This single framework for evaluating organic and mineral soils is very important in view of the potentially large sums of public funds normally required to reclaim and develop organic soils. The development of mineral soils of equivalent agricultural capability normally does not require such expenditures and their management problems are usually such that they are within the capability of individual operators to overcome. A single

* Leeson, Bruce, et al. 1969. An Organic Soil Capability Classification for Agriculture and a study of the soils of Simcoe County. Soil Sci. Dept., Ont. Agric. College, Guelph, Ont.

framework embracing both groups of soils makes evaluations and recommendations for development of either group of soils more relevant.

While the above system may provide a framework for evaluating organic soils, it does not provide the guidelines and criteria necessary for adequate interpretive judgements. Leeson (1969)* outlines a system of rating organic soils, used in Ontario, reflecting their value for crop production and their relative degree of difficulty of development. These guidelines and criteria have been adopted and modified to more adequately suit conditions in Manitoba and more specifically in the Red Rose-Washow Bay Area.

Water table control is the major reclamation requirement for the agricultural development of organic soils. Optimum water table control is necessary both for successful crop production as well as the long term maintenance of the soil itself. Improper manipulation of the water regime of an organic soil area can result in loss of the organic soil base through increased rates of subsidence, potential irreversible physical damage to the soil and increased hazards of wind erosion and fire damage. With water control at optimum levels (usually 18 to 36 inches below the surface) for both crop production and minimal subsidence rates, soil loss through subsidence can continue at rates of ¾ inch to 2 inches annually. In consideration of eventual loss of the organic soil base, the capability ratings, therefore, reflect the continuing use-capability of such areas based on the character of underlying mineral substrates. Shallow organic soil areas underlain by unsuitable mineral substrates would preclude their long term utilization as a productive land base and should not be reclaimed for agricultural use.

The evaluation of organic soils for agriculture is carried out in two steps. Firstly, the organic soils are placed in "Capability Classes". This rating indicates the agricultural potential of the soil according to any hazards which reclamation is unable to remove and which, therefore, constitute a continuing limitation to agricultural production. The second step recognizes that the agricultural use of most organic soils necessitates reclamation or development from the native state with varying degree of difficulty and associated economic costs. The relative degree of difficulty of carrying out development is expressed in a "Development Difficulty Rating" that is assessed in terms of those properties and qualities of organic soils that significantly influence reclamation. For example, the presence or absence of trees; the content of large wood fragments; the permeability, density, and degree of decomposition of peat; and natural water table conditions all exert a very significant influence on reclamation of peatlands.

Recommendations for the development of organic soils is, therefore, based on both the Development Difficulty Rating and their continuing suitability after reclamation.

The Capability Classification of Organic Soils for agriculture is based on certain assumptions which must be understood by those using Capability maps or making Capability Ratings for various crops.

1. Capability ratings for drained conditions assumes continued subsidence rates of ¾ inch to 2 inches annually; hence, depth of the organic layer and the nature of underlying mineral substrate is taken into account in evaluating organic soils for agriculture.

2. The organic capability grouping is an interpretive classification designed to assess the limitation of individual organic soils to development for an production of cereal grains, forage and pasturage.

3. Good soil management, including drainage, control of subsidence, wind erosion, crop growing and conservation practices that are feasible under a mechanized system of agriculture are assumed.

4. The soils within a capability class are similar with respect to the degree of soil limitation but not necessarily similar with respect to the kind of limitation. The subclass provides information on the kind of limitation or hazard and the class indicates the intensity of the limitation. Organic soils in Class 1 have the least limitations and Class 7 have the most severe.

5. Organic soils which have been reclaimed and developed for agriculture are classified according to any continuing limitations which may affect the production of agricultural crops. Soils in the natural state are classified not only for the agriculture capability but also according to the apparent degree of difficulty in reclamation and development.

6. The location, distance to market, efficiency of transport, financial state of the market, farm size and sociological influences do not constitute criteria for capability groupings.

7. Capability classes and capability definitions are subject to change as new information and methods concerning the manipulation of organic soils become available. At the present time, capability groupings do not have the benefit of extensive regional research and management experience in their use for agriculture as in the case of mineral soils.

* Leeson, Bruce, et al. 1969. An organic soil capability classification for agriculture and a study of the organic soils of Simcoe County. Soil Sci. Dept., Ontario Agricultural College, Guelph, Ont.

D. THE CAPABILITY CLASSES AND SUBCLASSES OF ORGANIC SOILS

The seven Capability Classes for organic soils, together with guide numbers to aid in the proper placement of the soils, are given below:

Class 01 (85-100) — Organic soils of this group have no water, topographical or pH limitations, and are deep and level. They are located in areas having mild or warmer soil temperatures.

Class 02 (70-80) — Organic soils in Class 02 have one limitation which restricts their use in a minor way. The limitation may be soil temperature, coarse fragments, wood layers, salinity, depth or slope.

Class 03 (55-65) — Organic soils in this class have moderately severe limitations that restrict the range of crops or that require special management practices.

Class 04 (40-50) — Organic soils in this class have limitations which severely restrict the range of crops or which require special development and management practices.

Class 05 (25-35) — Organic soils of this class have severe limitations that restrict the production of

TABLE 50
Soil Properties Utilized to Determine the Capability Classification of Organic Soils

Symbol	Soil Property and Guidlines to Use		PenaltyValue
C	THERMAL REGIME — soil temperature classes as defined in the Revised System of Soil Classification for Canada (1973)		
	Mild	MAST 8-15°C, MSST 15-22°C	0
	Cool	MAST 5-8°C, MSST 15-18°C	0
	Cold	MAST 2-8°C, MSST 8-15°C	35
	Very Cold	MAST -7-2°C, MSST 5-8°C	60
	Extremely Cold	MAST<-7°C, MSST<5°C	90
W	EXCESS WATER — refers to groundwater level and flooding		
	Adequate:	drainage provided for optimum crop yields and a water table sufficiently high to prolong the life of the soil (18 to 36 inches).	0
	Marginal:	less than adequate; yields reduced and choice of crops reduced (water table 12 to 18 inches or 36 to 48 inches).	35
	None:	no control measures (water table <12 inches or >48 inches)	55
L	COARSE WOOD FRAGMENTS (Wood >4" dia., volume % within depths of 51").		
	None	Fen peat, <1%	0
	Moderate	Forest-Fen and Sphagnum peats, 1-5%	10
	High	Forest peat, >5%	25
H	DEGREE OF DECOMPOSITION — as related to permeability		
		Mesic forest-fen and forest peat	0
		Mesic to humic forest peat	10
		Fibric sphagnum peat and humic aquatic peat	20
F	NATURE OF SURFACE MATERIALS — fertility as related to soil reaction		
		Forest, forest-fen and fen peats, pH 4.5 to 7.5	0
		Sphagnum peats, pH <4.5	20
		Fen peats with pH>7.5	10
N	SALINITY		
	None	— conductivity 0-4 mmhos/cm	0
	Slight	— conductivity 4-8 mmhos/cm	20
	Moderate	— conductivity 8-12 mmhos/cm	50
	High	— conductivity 12-16 mmhos/cm	75
	Excessive	— conductivity >16 mmhos/cm	80
D	DEPTH OF ORGANIC MATERIALS AND NATURE OF UNDERLYING SUBSTRATE*		
	Deep to very deep deposits underlain by sandy, loamy or clayey stone-free lacustrine sediments		0
	Shallow deposits underlain by loamy lacustrine sediments		0
	Shallow deposits underlain by clayey lacustrine sediments		10
	Shallow deposits underlain by sandy lacustrine sediments		20
	Shallow to very deep deposits underlain by skeletal loamy till, marl or diatomaceous earth		30
	Shallow to very deep deposits underlain by bedrock		50

* Penalty values for shallow depth of organic materials relates to the eventual loss of the land resource through subsidence. Shallow organic soils underlain by clays, sands, stony till, marl or bedrock have varying capability for agriculture when the organic layer has disappeared. These soils are therefore downgraded for the nature of the underlying mineral material, as well as for shallow depth.

perennial forage or other specially adapted crops. Large scale reclamation is not feasible*.

Class 06 (10-20) — Organic soils in Class 06 are capable of producing only indigenous crops and improvement practices are not feasible.

Class 07 (Less than 10) — Organic soils of this class have no potential for agricultural.

To determine the capability rating for organic soils, the relative penalty values assigned to the applicable soil features as indicated in Table 50 are added together. This total is subtraced from 100 to arrive at the guide numbers utilized for placement of the soil in the appropriate Capability Class.

The Capability Subclasses indicate the kind of problem limiting suitability for agriculture, Table 50. For example, if the only limitation a soil had was climate, a designation of 2c could be used of if depth was the limiting factor, 2d or 3d could be used to indicate that depth was the limitation. Usually, no more than two subclass limitations are used to describe a soil. If the cumulative severity of more than two limiting features necessitates placement in Capability Class 04 or lower, only the two major limiting factors are indicated.

E. DEVELOPMENT DIFFICULTY RATINGS FOR ORGANIC SOILS

In addition to evaluation of potential capability, an attempt was made to rate relative degree of difficulty of carrying out reclamation or development on organic soils. These ratings are based on evaluations of the present or natural state of organic soils. The Degree of Development Difficulty ratings are important in priorizing areas of organic soils for reclamation. Three relative degrees of difficulty in overcoming limitations or hazards to use are recognized.

1. *Minor Development Difficulty*

Only minor reclamation is required to overcome limitations to use. Minor reclamation is considered to be those operations which can be carried out be a single operator and which do not require cooperation between adjoining operators. Such operations would include leveling rough surfaces, removal of surface woody layers and land clearing.

2. *Major Development — Reclamation Warranted*

Major reclamation is required but is warranted when soil potential is high. Major reclamation is that requiring cooperation between adjoining operators or outside financial assistance or both. Major reclamation operations include drainage, construction of water control works or correction of very low pH or very high pH.

3. *Major Development Difficulty — Reclamation Seldom Warranted*

These organic soils can be developed only by bery large reclamation projects. Major reclamation is seldom warranted here because the hazards are so serious that they constitute some continuing limitation which reduces the agricultural capability.

Many features of organic soils which affect their agricultural capability also affect the degree of development difficulty experienced in reclaiming organic soils and the relative costs associated with maintaining their productive capacity. The relative importance of these soil properties may be adjusted when considering development difficulty. In addition, factors such as vegetative cover, inundation and surface roughness must be evaluated. The features of organic soils important to the evaluation of degree of development difficulty ratings are listed in Table 51. The relative limitation of each feature to reclamation is often related to organic materials and soil types; in other cases, the relationship is with the physiographic position of the soil area relative to other organic and mineral soils. In all cases, the applicable feature is ranked by means of penalty values as to its relative effects on development difficulty.

To determine the relative degree of development difficulty the penalty values for the features applicable to each soil are added together and subtracted from 100. This figure is used as a guide by comparing with the following ranges for each degree of development difficulty group. The following ranges of penalty values for each group were used in the Red Rose-Washow Bay:

Minor	>70
Major - Reclamation Warranted	25-69
Major - Reclamation Seldom Warranted	<24

F. THE AGRICULTURE CAPABILITY AND DEGREE OF DIFFICULTY RATINGS FOR THE ORGANIC SOILS IN THE RED ROSE-WASHOW BAY AREA

Class 03 — Organic soils in this class have moderately severe limitations that restrict the range of crops that can be grown or that require special development and management practices.

03W — These are poorly to very poorly drained soils that are derived from moderately decomposed fen peat. These, smooth, level organic deposits range in depth from 2 feet to more than 10 feet in places. They are normally very uniform with respect to degree of decomposition and nature of plant residues from which the peat has been derived. They usually range from medium acid to neutral in reaction and have a high water holding capacity. Movement of water in these organic soils is moderately slow and is similar to that in a

* In the foregoing definitions the term feasible implies that it is within present day economic and technological possibility for an individual farmer to make such improvement and it does not require a major reclamation project to do so.

TABLE 51
Physical Features Utilized to Determine Development Difficulty Rating of Organic Soils

Symbol	Physical Features and Guidelines to Use		Penalty Value
V	Vegetative Cover		
		Light, grasses, reeds	0
		Moderate, brush, small trees	10
		Heavy, numerous large trees	20
W	Excess Water — Underground seepage and surface runoff from surrounding highlands into drained depressional organic soil areas.		
		Upper slope, marginal sites and raised central portion of peatlands	10
		Depressional catchments	20
		Floating peatlands	40
I	Inundation — Overflow from nearby large bodies of water or poorly defined rivers		
		None	0
		Slight	10
		Severe	20
T	Surface Roughness — Mounds, hummocks, ridges and holes		
		None	0
		Holes & mounds 1-2 feet microrelief	10
		Holes and mounds >2 feet microrelief	20
L	Coarse Wood Wood>10 cm diameter, percent by volume Fragments within depths of 130 cm		
		< 1% — Fen peat	0
		1-5% — Forest-Fen peat, Sphagnum peat	10
		> 5% — Forest peat	20
H	Degree of Decomposition — permeability and hydraulic conductivity		
	Mesic	Fen peat	0
	Mesic to Humic	Forest Peat	10
	Fibric	Sphagnum Peat	20
	Humic	Aquatic Peat	20
D	Depth of Organic Materials		
		Shallow to deep 30 to 130 cm	0
		Very deep >130 cm	20

uniform, medium textured mineral soil. They are usually underlain by calcareous, clay textured lacustrine sediments.

The shallow members of this group, the Cayer and Kircro soils, have a minor degree of development difficulty rating. In the case of these soils lowering and controlling the water table between 18 and 36 inches of the surface is not a major reclamation problem.

The deeper Stead soils have a major degree of development difficulty rating. Most of these soils normally occur in the central section of large peatland areas and usually serve as catchment to adjacent shallow Cayer soils and upland mineral soils. Because of this, major reclamation is required to remove large volumes of water. The soils in this subclass are:

Cayer Complex
Kircro Complex
Stead Complex

Class 04 — Organic soils have severe limitations which restrict the range of crops or which require special development and management practices.

04WD — These are poorly to very poorly drained soils derived from moderately decomposed fen peat. These soils in their organic section are very similar to the Stead Complex soils. They differ from them in having a very stony, extremely calcareous glacial till substrate rather than a fine textured lacustrine substrate. These smooth, level organic deposits are 5 to 10 feet thick, are uniform in terms of the nature of the plant residues from which the peat is derived, the degree of decomposition, its medium acid to neutral reaction and its high water holding capacity. Water movement within these soils is moderately slow. While the organic section of these soils is uniform and suitable for agriculture development, they are nevertheless underlain by very stony to exceedingly stony till that can contribute to management problems should the organic layer be lost through subsidence or other causes.

As in the case of Stead soils, Macawber soils have a major degree of development difficulty rating. These soils occur in the central, depressional portions of peatlands and serve as catchment to adjacent shallow organic soils and upland mineral soils. Major reclamation, therefore, is required to remove large volumes of water to remove water not only from the peat itself but also the runoff received from surrounding uplands. The soils in this subclass are:

Macawber Complex

4WL — These poorly drained organic soils are derived from moderately well to well decomposed forest peat. These densely tree covered, hummocky surfaced, woody organic deposits range in depth from several feet to more than 10 feet in thickness. The deposits dominantly exceed 5 feet in thickness. They are found on slightly better drained, upslope or very gently sloping to nearly level sites near the margins of peatlands.

TABLE 52

Distribution of Organic Soil Capability Classes, Subclasses and Degree of Development Difficulty Ratings in the Red Rose-Washow Bay Map Area

Land Class, Subclass and Degree of Development Difficulty Rating	Soil Name	Acres	Percent of Total Map Area
O3W-1	Cayer	115,619	6.57
O3W-1	Kircro	428	0.02
O3W-2	Stead	104,849	5.95
Total Class 3		220,896	12.54
O4WL-2	Baynham	3,329	0.19
O4WD-1	Macawber	13,116	0.74
O4WL-2	Okno	84,172	4.78
O4WL-2	Rat River	306	0.02
Total Class 4		100,923	5.73
O5WL-2	Bradbury	691	0.04
O5WD-1	Crane	44,335	2.52
Total Class 5		45,026	2.56
O6WF-2	Denbeigh	297	0.02
O6WD-2	Grindstone	9,972	0.57
O6WF-2	Julius	236,042	13.40
O6WF-2	Kilkenny	9,391	0.53
O6WF-2	Molson	179,877	10.21
O6WF-2	Sand River	4,519	0.26
O6WF-2	Sproule	1,377	0.08
Total Class 6		451,447	25.07
O7W-3	Holditch	1,493	0.08
O7W-3	Janora	489	0.03
Total Class 7		1,982	0.11
Total Area of Organic Soils		810,302	46.01

Forest peat is derived from black spruce, some tamarack, feathermosses, some ericaceous shrubs and other herbaceous plants. The peat material is usually very dark brown to nearly black in color, amorphous in structure with variable layers of coarse, woody fragments, black spruce and tamarack roots, stems and branches. The peat is usually strongly acid to netural in reaction. Water movement in these soils is variable, being moderately slow to slow in the dense well decomposed layers and very rapid in the coarse, woody, less well decomposed layers. The underlying fine textured lacustrine soils are smooth and usually moderately calcareous.

These soils have a major degree of development difficulty rating because of the dense forest cover, excess water from surrounding uplands, their hummocky surface, and most important the rather high content of coarse woody material in the material itself. This woody material is much more resistant to decomposition than herbaceous material and contributes significantly to rough and uneven seedbed. The high degree of decomposition in some layers of these soils contribute to poor water movement in these soils and consequently impart a further limitation to the control of water table at 18 to 36 inches of the surface. The soils in this subclass are:

Baynham Complex
Okno Complex
Rat River Complex

Class O5 — Organic soils of this class have severe limitations that restrict use of these soils to production of perennial forage or other specially adapted crops.

O5WD — These poorly drained organic soils are derived from thin deposits of fen peat that overlie very stony to excessively stony, extremely calcareous glacial till. These organic soils, usually 2 to 5 feet thick, have similar agronomic and degree of development difficulty as the Cayer and Kircro soils. However, because stones from the underlying till can contribute significantly to management input should the organic section of these soils be lost due to subsidence or other causes, their suitability for agriculture is further limited.

Their degree of development difficulty is minor. However, if the organic deposit is very shallow, less than two feet thick, the underlying stony till would significantly increase the difficulty of implementing adequate drainage and water control in these soils. The soils in this subclass are:

Crane Complex

O5WL — These poorly drained organic soils are derived from forest peat that overlie very stony to excessively stony, extremely calcareous glacial till. These organic soils, usually 5 to 10 feet thick, have similar agronomic properties and degree of development difficulty rating as the Baynham and

Rat River soils. The stony glacial till underlying the organic layers of these soils, however, decreases their suitability for agricultural use and development. The soils in this subclass are:

Bradbury Complex

Class 06 — Organic soils in this class are capable only of producing indigenous crops and improvement practices are usually not feasible.

06WD — These poorly drained organic soils are derived from thin, usually 2 to 5 feet thick, forest peat that overlie very stony to excessively stony, extremely calcareous glacial till. These soils have similar agronomic characteristics and degree of development difficulty rating as the Bradbury, Baynham and Okno soils. However, because stony glacial till usually occurs close to the surface, their value for agricultural use and development is considerably decreased. The soils in this subclass are:

Grindstone Complex

06WF — These poorly drained organic soils are derived from thick layers of extremely acid, relatively undecomposed Sphagnum moss that commonly overlie smooth, clay textured, calcareous sediments. These organic deposits are usually found on sites that are isolated from mineral influenced ground water. These soils occur under open stands of stunted black spruce and tamarack. Sphagnum mosses and ericaceous shrubs such as bearberry and Labrador tea form the dominant vegetation.

Sphagnum moss peat is usually found in a well preserved or fibric state. It is usually light yellowish brown in color, loose in the near surface layers and entire Sphagnum plants are readily identified. The material is usually extremely acid to very strongly acid. At lower depths, Sphagnum peat becomes reddish yellow to dark brown in color, extremely to strongly acid, compacted, horizontally layered and has a very low volume weight. This material contains some woody material. In thick deposits, those ranging from 5 to more than 10 feet, the Sphagnum is often underlain by forest and/or fen peat. Nutrient supply for plant growth is very low in these soils. Water movement, particularly in the surface layers, is very rapid.

The degree of development difficulty rating is major and normally is not feasible since the value of these soils for agriculture is not high. The soils in this subclass are:

Denbeigh Complex
Julius Complex
Kilkenny Complex
Molson Complex
Sand River Complex
Sproule Complex

Class 07 — Organic soils of this class have no potential for agriculture.

07WD — These poorly drained organic soils are derived from shallow, usually 2 to 5 feet of fen or forest peat and underlain by limestone bedrock. The occurrence of bedrock at very shallow depths percludes the use and development of these soils for agriculture. The loss of the organic layers of these soils through subsidence or other causes would result in the total loss of suitable base for plant growth. The degree of development difficulty rating for these soils is major and development is not justified. The soils in this subclass are:

Holditch Complex
Janora Complex

PART V
FORESTRY

A. FOREST HISTORY

In the early days of the fur trade, before the late eighteenth century, there was little activity on Lake Winnipeg. After 1790 Northwest Company began to use Lake Winnipeg as their main route between the Saskatchewan and Athabaska posts and Montreal. In 1821, after union with Hudson's Bay Company, all the trade from the prairies went through Lake Winnipeg to York Factory.

The Lake Winnipeg area was naturally the first place to be exploited for lumber and records show the presence of sawmills at the mouth of the Brokenhead and Winnipeg Rivers around 1870. Somewhat later, the timber operations extended as far north as the Fisher, Kinwow and Sturgeon Bays (Anon. 1956).

The Canadian Pacific Railway was completed to Arborg in 1910 and to Riverton in 1914, while Canadian Northern lines reached Hodgson in 1914, providing a route of transport for forest products from the Red Rose-Washow Bay map area. Small sawmills, utilizing local timber, such as spruce and pine, provided building materials for the neighboring farm areas.

Development of the pulp and paper industry in the 1920's opened a market for black spruce which, although mature, was too small for use as lumber. More recently, the development of road systems opened new areas as did the forest access road which leads to Lake St. George on the west side of Fisher Bay.

In the late 1940's and early 1950's ten or more sawmills were operating with most being south of Lake St. George and Washow Bay areas. In 1959 only three small sawmills were operating (Anon. 1961), two of them in Hodgson and one on Hecla Island. These sawmills were generally small, probably in the 5,000 - 10,000 bd. ft. range.

Pulpwood is the main forest product now produced in the map area. The wood used is spruce and it is shipped to the market by rail or truck. Fuelwood and fence posts are also produced.

Forest fires, 90 percent of them caused by man, have destroyed large areas. The area south of Mantagao Lake was burned approximately 30 years ago.

Constructing lookout towers and fireguard roads were necessary. Considerable progress has been made on construction of the road between Washow Bay and Ashern to act as a fireguard road. Six fire lookout towers have been built in the area in recent times.

Some reforestation has been started in the Mantagao Lake area. With this and successive management techniques and fire protection, productive forests can be produced in this area.

B. FOREST CONDITIONS

1. Area and Volume of Forests

Hodgson Management Unit 41, Riverton Management Unit and Pulpwood Berth No. 1, Block No. 3 are located in the Red Rose-Washow Bay map area (Figure 36), but cover an area larger than the soil map. Forest statistics are available for Hodgson and Riverton Management Units, but for Pulpwood Berth No. 1, Block No. 3, an area of 165,248 acres, there is no specific data available. The area classification is shown in Table 53 and the distribution of merchantable value in Table 54 and 55.

2. Forest Utilization

The forests are utilized at the present time to produce a small amount of pulpwood and lumber. In areas around the Indian reserves fence post and fuelwood cutting is carried out for local use only. White spruce, jackpine and hardwoods are the most common species for use as lumber, black spruce is used for pulpwood, and spruce and tamarack are used for fence posts.

3. Ecological Conditions

The Red Rose-Washow Bay map area lies within the southern part of the boreal forest. The distribution of vegetation is shown in Figure 8 and the major ecological conditions have been described in Part II, Section D under Vegetation.

C. ESTIMATED PRODUCTIVITY AND REPRODUCTION OF FOREST TREE SPECIES

1. Estimated Potential Productivity

The method used to obtain the potential productivity was the same as that described in previous soil survey reports. "The productivity figures represent the growth of tree species, expressed in ranges of gross merchantable volume increment per acre per year. These figures were obtained from measurements of the best observed stands and individual trees on each particular soil series within the map area or in the immediate vicinity"*.

The estimated potential productivity of each soil series and complex for the commonly occurring tree species is given in Table 56.

* S.C. Zoltai. 1967. Part V, Forestry. Soils in the Lac du Bonnet Area, Manitoba Soil Survey. p. 103.

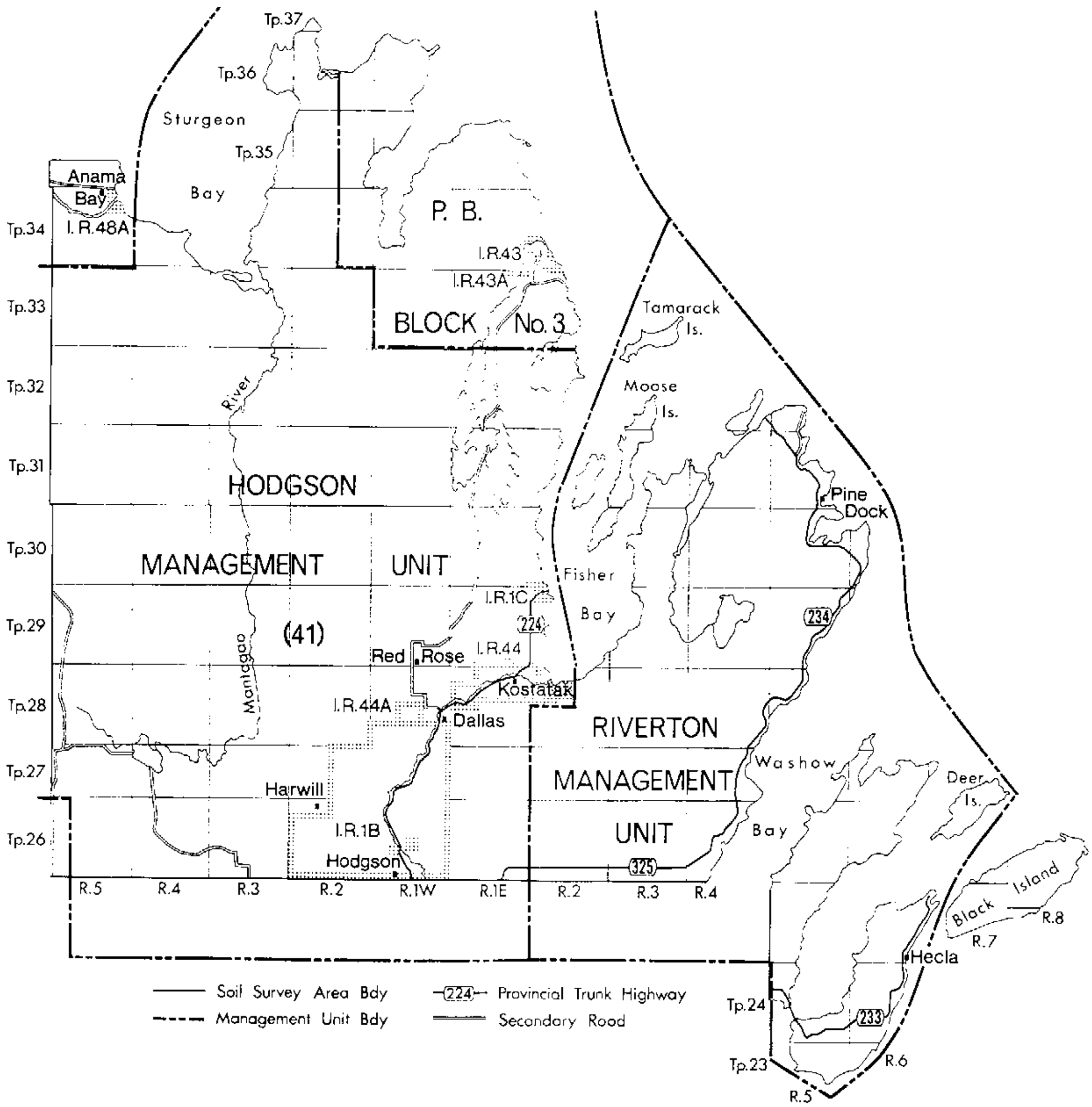


FIGURE 36
Forestry Management Units and Pulpwood Berths
Located in the Red Rose-Washow Bay Areas

2. Reproduction Practices

Reforestation accomplished without regard to the productive potential of the site (soil, moisture, air and nutrients) often represents pseudo-constructive effort, creating negative values. In order to avoid these negative values attention must be given to these important factors and so the selected site must offer the planted trees a fair chance to withstand the attacks of parasites and maintain their vigour against competing vegetation, hence favouring the production of high-grade timber at a reasonably rapid rate.

In recent years a number of studies have been carried out in various parts of Manitoba, to determine the factors influencing the reproduction and growth of regeneration (Rowe 1955, Jarvis et al 1966, Jarvis and Cayford 1967, Jarvis and Tucker 1968). Based on the results of these studies, regeneration practices will be described briefly for each commercially important tree species.

White spruce regenerates naturally from seed. In general, scarification of the humus layer has favoured regeneration. Logging, especially winter logging on fresh sites, creates unfavourable conditions for reproduction of white spruce and thus seedbed preparation is necessary. On moist sites, however, regeneration proceeds naturally (Rowe 1955), but vegetation competition is greater. If all of the seed source is removed by logging or is destroyed by fire, the area has to be seeded or planted. Planting is probably the most successful method of establishing white spruce after clear cutting or fire.

Favourable seedbeds for black spruce are usually present on wet and very wet sites. In some stands, however, particularly those that are very dense and where large amount of slash is left after cutting, modified clear cutting and broadcast burning is necessary to remove slash. If a seed source is lacking on these sites, the black spruce may be planted on overturned furrows. On moderately fresh to very moist sites favourable seedbeds are lacking, and thus seedbed treatment has to be undertaken. In these cases scalping provides the most favourable seedbeds for germination, seedling survival, and growth (Jarvis and Cayford 1967).

Balsam fir is more abundant on moist than on dry sites and thus the species show very good natural regeneration on the moist sites. The moist feather moss sites under dense spruce canopies provide conditions which are unfavourable for spruce regeneration but favourable for balsam fir reproduction. Balsam fir seedlings are heavily browsed by deer and elk where there are concentrations of these animals the browsing may be severe enough to kill seedlings and saplings.

Jack pine germinates best on mineral soil and, because of its intolerance to shade, must be clear cut for all sites. Seedbed preparation is recommended for all but the very driest sites because there is danger of wind erosion on these sites. Following seedbed preparation on dry and fresh sites natural regeneration, seeding or planting methods are suggested. On very dry sites, following logging, conebearing slash should be scattered on an unprepared seedbed. On moist sites, either seedling or planting is recommended with planting being preferable because of severe vegetation competition.

Aspen reproduces vigorously from root suckers (Jarvis et al 1966; Strothman and Zasada, 1957). Studies indicate that soil temperature is the most important factor in the formation of suckers. In general, high burning on heavily cut areas increases the number of suckers, because of the increased heat absorption of the blackened surface. Severe fires weaken the species and eliminate the aspen entirely, resulting in weed and grass vegetation. If all new suckers are destroyed by cutting or heavy grazing, the food materials in the roots become exhausted and the suckering usually ceases. Reproduction from cuttings is less important, and that from seeds is very delicate and requires great care.

Balsam poplar, like aspen, regenerates well from suckers (Roe, 1958). The suckering habit of this species is somewhat the same as that of the aspen. Suckers, after clear cutting, appear late in the summer and grow very rapidly, sometimes outgrowing those of aspen. Reproduction from seed is important in the colonization of areas such as recently deposited alluvium where it did not occur before. Stump sprouting is not very effective. The tree can be propagated easily from root or stem cuttings.

D. FOREST LAND USE CAPABILITY

All mineral and organic soils in the Red Rose-Washow Bay area are classified in one of seven classes, according to their inherent capability to grow commercial timber (McCormack, 1967). The best forest lands are those capable of producing the greatest volume of timber per acre per year. The factors which limit tree growth are shown as subclasses as has been defined by Canada Land Inventory (McCormack, 1967), with some modification. These subclasses are seen below:

M- deficiency of soil moisture during at least part of the growing season. Deficient moisture is generally due to the coarse texture of the soil, shallowness of soil over bedrock, or slope pattern.

W- excess of soil moisture during at least part of the growing season. Moisture excess is generally due to the slow internal drainage caused by the fine texture of the soil, either on the surface or in layers, high water table in depressions, or low surface slope gradients.

R- restriction of rooting by bedrock.

D- restriction of rooting by dense soil horizons or by compacted layers other than bedrock.

L- limitation to tree growth due to nutrition problems associated with high levels of carbonates.

F- Low fertility.

V- severe competition by vegetation. Soils with this limitation can support vegetation that would limit the establishment and growth of tree species, necessitating special management practices to favour trees.

C- adverse effects of regional climate, relative within the map area. Tree growth is limited by low rainfall, low temperatures or short growing season. Climatic conditions may favour vegetation other than trees.

I- periodic inundation by rivers or lakes.

U- exposure.

A description of forest land capability classes and subclasses occuring within the Red Rose-Washow Bay map area follows.

CLASS 1

Lands in this class have no important limitations to the growth of commercial forests. The productivity is greater than 111 cubic feet per acre per year.

No soils in the Red Rose-Washow Bay area are listed in this class.

CLASS 2

Lands in this class have slight limitations to the growth of commercial forests. The productivity is between 91 to 110 cubic feet per acre per year. No soils in the Red Rose-Washow Bay are listed in this class.

CLASS 3

Lands in this class have level to gently sloping topography, are imperfectly drained, have good water-holding capacity and are high in inherent fertility. The productivity is between 71 to 90 cubic feet per acre per year.

Subclass 3V

The soils in this subclass developed on well to imperfectly drained, moderately to strongly calcareous thin lacustrine clay, moderately calcareous clay till or sand textured materials. These soils are well suited to white spruce, trembling aspen and balsam poplar. Control of shrub and herb vegetation is necessary in the young stands. The soils in this subclass are:

Davis Point clay
Peguis clay
Caliento fine sand

Subclass 3C

Soils in this subclass developed on imperfectly drained sandy materials. These soils are well suited to trembling aspen, but regional vegetation trends do not favour coniferous species. The soils in this subclass are:

Colby sand

CLASS 4

Lands in this class have level to gently sloping topography and are poorly to well drained. Conditions due to slight excess or lack of soil moisture, severe vegetation competition and insufficient nutrient supply limit tree growth. The productivity is between 51 to 70 cubic feet per acre per year.

Subclass 4WF

The soils in this subclass developed on well to imperfectly drained, extremely calcareous clay loam till materials. These soils are well suited to white spruce and trembling aspen. The soils in this subclass are:

Inwood loam
Faulkner

Subclass 4VW

The soils in this subclass developed on imperfectly drained calcareous clay or clay loam materials. Control of shrub and herb vegetation is necessary in the young white spruce stands. These soils are well suited for white spruce, trembling aspen and balsam poplar. The soils in this subclass are:

Homebrook clay	Lakeland clay loam
Framnes clay	Mantagao clay
Ledwyn clay loam	Dencross clay
Pinawa sandy loam	Lonesand sand
Fisherton clay loam	McCreary clay loam

Subclass 4MW

The soils in this subclass developed on well drained clay or loam soils and on well to imperfectly drained sandy soils. Periodic lack of soil moisture may limit tree growth and control of shrub and herb vegetation is necessary in the young stands. These soils are well suited to white spruce and trembling aspen. The soils in this subclass are:

Arnes clay	St. Labre fine sand
Kinwow clay	McArthur sandy loam
Harwill clay loam	Harcus fine sand
Egg Island clay	

Subclass 4VD

The soils in this subclass developed on well to imperfectly drained, lacustrine clay. The dense B horizon may limit tree growth and control of vegetation is necessary in the young stands. These soils are suited to white spruce and trembling aspen. The soils in this subclass are:

Lettonia clay	Rat Lake clay
Arborg clay	Rosenburg clay

Subclass 4W

The soils in this subclass developed on poorly drained clay, loam and sand. Good white and black spruce, balsam fir and balsam poplar can be grown on these sites. The main limitation is the periodic excess of moisture. The soils in this subclass are:

Fyala clay	Pineimuta clay
Tarno clay	Partridge Creek clay
Balmoral clay	Thickwood clay
Spearhill sand and gravel	Goose Island sand and gravel
Sundown sand	Berry Island sand

CLASS 5

Lands in this class have level to gently sloping and low ridge topography and are well to poorly drained. Serious limitation to tree growth are imposed by low nutrient levels of the soil and seasonal lack or excess of soil moisture. The productivity is between 31 and 50 cubic feet per acre per year.

Subclass 5MF

The soils in this subclass developed on well to imperfectly, extremely calcareous loam material. The lack of moisture and low nutrient content limit the tree growth. Moderately good white spruce and aspen can be grown on these soils. The soils in this subclass are:

Garson loam	Hilbre loam
Fairford loam	Devils Lake loam

Subclass 5FV

The soils in this subclass developed on well drained, strongly calcareous, moderately fine to medium textured materials. Vegetation competition and low nutrient content limits the tree growth. Moderately good trembling aspen and white spruce can be grown on these soils. The soils in this subclass are:

Hodgson silt loam

Subclass 5M

The soils in this subclass developed on excessively drained, moderately clacareous or siliceous sandy deposits and gravel beach or outwash deposits. Seasonal lack of soil moisture limits tree growth. Moderately good jack pine can be grown on these soils. The soils in this subclass are:

Sandilands sand	Woodridge sand and gravel
Pine Ridge sand	Gunton sand and gravel
Punk sand	Lynx Bay sand and gravel
Leary sand and gravel	
Long Point sand and gravel	

Subclass 5WF

Soils in this subclass developed on imperfectly to poorly drained, extremely calcareous loam. Tree growth is limited by seasonal excess of moisture and by the low nutrient content of the soil. Moderately good white spruce and trembling aspen grow on these soils. The soils in this subclass are:

Lundar loam
Chitek loam
Birch Bay loam

CLASS 6

Lands in this class have level topography and are poorly drained. Severe limitation to tree growth are imposed by excess of soil moisture. The production is between 11 to 30 cubic feet per acre per year.

Subclass 6W

The soils in this subclass developed on poorly drained, deep mesic forest peat materials. Moderately good black spruce and tamarack can be grown on these soils, but severe limitations are imposed by excess moisture. The soils in this subclass are:

Baynham mesic peat
Bradbury mesic peat

Subclass 5W

The soils in this subclass developed on poorly drained medium textured till or sand deposits and mesic forest peat materials. Moderately good white and black spruce, balsam fir, trembling aspen and balsam poplar can be grown on the mineral soils, but tree growth is limited to black spruce and tamarack on the organic soils. The soils in this subclass are:

Kerry fine sand	Okno mesic peat
Malonton fine sand	Rat River mesic peat
Foley very fine sandy loam	Grindstone mesic peat
Meleb loam	Janora mesic peat
Lee Lake loam	Sprague fine sand

TABLE 53

Area Classification, Hodgson and Riverton Management Units (in acres)

	Crown Land		Patented Land		Indian Reserve	
Type	Acres	% of land	Acres	% of land	Acres	% of land
Hodgson Management Unit (41) [1]						
Softwood	171,579	14.0	1,891	1.7	2,370	2.4
Mixedwood (Softwood)	36,947	3.0	60	0.0	383	0.4
Mixedwood (Hardwood)	25,494	2.0	892	0.8	465	0.5
Hardwood	273,258	22.0	40,202	36.3	38,334	38.9
Total forest productive	507,278	41.0	43,045	38.8	41,552	42.2
Total potential productive	241,355	19.1	9,716	8.8	7,222	7.3
Total Productive	748,633	60.1	52,761	47.6	48,774	49.5
Total Non Productive	187,791	14.9	2,395	2.2	2,373	2.4
Total Non Forested	258,724	20.5	5 54,990	49.7	46,783	47.5
Total Land	1,195,160	95.5	110,146	99.5	97,930	99.4
Total Water	60,489	4.5	553	0.5	640	0.6
Grand Total	1,255,637	100.0	110,679	100.0	98,570	100.0
Percent	85.7		7.6		6.7	
Riverton Management Unit [2]						
Softwood	94,276	19.8	2,963	9.2		
Mixedwood	71,970	15.1	3,050	9.7		
Hardwood	38,728	8.1	3,136	9.7		
Total forest productive	204,974	43.0	9,149	28.6		
Total potential productive	22,250	4.7	4,303	14.7		
Total Productive	227,224	47.7	13,452	43.3		
Total Non Productive	155,889	32.7	3,742	11.0		
Total Non Forested	84,262	17.7	14,885	45.5		
Total Land	467,375	98.1	32,079	99.8		
Total Water	9,725	1.9	63	0.2		
Grand Total	477,100	100.0	32,142	100.0		
Percent	93.7		6.3			

1 Working Plan for Management Unit 41, Dept. of Mines and Natural Resources, Forest Management Branch, Province of Manitoba, 1965.

2 Michigan State Univeristy, Revision of the Working Plan for the Riverton Management Unit., Dept. of Mines and Natural Resources, Forest Service Management Division, Province of Manitoba. Aug., 1963.

CLASS 7

Lands in this class have level or irregular topography and are very poorly or rapidly drained. Very severe limitations to tree growth are presented by excess of soil moisture, periodic inundation, exposure, lack or rooting zone over bedrock. The production is less than 10 cubic feet per acre per year.

Subclass 7MR

The soils in this subclass developed on gently sloping limestone bedrock. The lack of unconsolidated mineral materials make these lands extremely dry. Tree growth is very severely limited by lack of moisture and lack of rooting medium. A few scattered jack pine, trembling aspen and white birch may grow on these rocks. The soils in this subclass are:

Rock outcrop

Subclass 7WI

The soils in this subclass developed on level areas of loamy or silty materials where the permanent water table is near the surface. The excess moisture and frequent flooding inhibits tree growth. The soils in this subclass are:

Marsh Complex

TABLE 54

Distribution of Gross Merchantable Volume, in 100 cubic feet

Hodgson Management Unit 41[1]

Species / Cover type	Softwood	Mixedwood (Softwood)	Mixedwood (Hardwood)	Hardwood	Grand Total	Percent
Softwoods						
Jack Pine	189,141	16,153	7,563	6,072	218,929	10.0
Black spruce	523,522	69,737	20,546	2,461	616,266	27.9
White spruce	56,041	77,283	40,782	10,019	184,125	8.3
Balsam fir	77,527	115,747	30,688	4,857	288,819	10.3
Tamarack	29,213	1,686	307	498	31,704	1.4
Total softwoods	875,444	280,606	99,886	23,907	1,279,843	57.9
Hardwoods						
Trembling aspen	35,313	79,162	131,289	430,094	675,858	30.6
Balsam poplar	21,146	19,058	17,182	50,534	107,920	4.9
White birch	16,736	77,888	31,541	18,315	144,480	6.6
Other hardwoods	—	—	—	822	822	0.0
Total hardwoods	73,195	176,108	180,012	499,765	929,080	42.1
Grand Total	948,639	456,714	279,898	523,672	2,208,923	100.0

[1] Working Plan for Management Unit 41, Dept. of Mines and Natural Resources, Forest Management Branch, Province of Manitoba, 1965.

TABLE 55

Distribution of Gross and Net Merchantable Volume, in 100 cubic feet

Riverton Management Unit [2]

	4" - 9"		10"+		Total	
Species	Gross	Net	Gross	Net	Gross	Net
Softwoods						
White spruce	72,558	68,932	57,857	54,966	130,415	123,898
Black spruce	333,542	316,864	25,125	23,870	358,667	340,734
Balsam fir	181,724	127,208	220,126	14,008	201,850	141,296
Jack pine	51,189	43,512	16,908	14,373	68,097	57,885
Tamarack	10,313	9,282	440	397	10,753	9,679
Total softwoods	649,326	565,798	120,456	107,694	769,782	673,492
Hardwoods						
Trembling aspen	192,545	154,035	115,517	46,207	308,062	200,242
Balsam poplar	45,129	36,103	21,827	8,730	66,956	44,833
Ash	8,354	5,848	1,569	786	9,923	6,634
White birch	46,020	32,215	31,160	15,585	77,180	47,800
Oak	7	6	0	0	7	6
Total hardwoods	292,055	228,207	170,073	71,308	462,128	299,515
Total Wood Volume	941,381	794,005	290,529	179,002	1,231,910	973,007

[2] Michigan State University, Revision of the Working Plan for the Riverton Management Unit. Department of Mines and Nat. Resources, Forest Serivce Management Division, Province of Manitoba, Aug., 1963.

TABLE 56
Forest Productivity* of Soils

Parent Material	Moisture Class	Soil Name	Softwood jP+	wS	bS	bF	tL	Hardwood tA	bP	wB	As	bO	W	mM	wE
Extremely calcareous glacial till	fresh	Garson	5	5	—	—	—	5	—	—	—	—	—	—	—
	fresh	Devils Lake	5	5	—	—	—	5	—	—	—	—	—	—	—
	fresh	Fairford	5	5	—	—	—	4	5	—	—	—	—	—	—
	fresh	Hilbre	5	5	—	—	—	4	5	—	—	—	—	—	—
	moist	Inwood	5	4	5	—	—	4	4	5	—	—	—	—	—
	moist	Faulkner	5	4	5	—	—	4	4	5	—	—	—	—	—
	moist	Lundar	—	5	—	—	—	4	5	5	—	—	—	—	—
	moist	Chitek	—	5	—	—	—	5	6	5	—	—	—	—	—
	moist	Birch Bay	—	5	—	—	—	5	6	5	—	—	—	—	—
	wet	Meleb	—	5	6	—	5	5	4	—	—	—	7	—	—
	wet	Lee Lake	—	5	6	—	5	5	4	—	—	—	7	—	—
Moderately to strongly calcareous lacustrine clay	fresh	Lettonia	—	4	—	—	—	4	5	5	—	—	—	—	—
	fresh	Rat Lake	—	4	—	—	—	4	5	5	—	—	—	—	—
	moist	Arborg	—	3	—	—	—	4	6	5	—	—	—	—	—
	moist	Rosenburg	—	3	—	—	—	4	6	5	—	—	—	—	—
	wet	Fyala	—	4	4	6	5	4	5	6	—	—	7	—	—
	wet	Partridge Creek	—	4	4	6	5	4	5	6	—	—	7	—	—
	wet	Thickwood	—	4	4	6	5	4	5	6	—	—	7	—	—
6 to 36 inches moderately to strongly calcareous, fine textured lacustrine deposits underlain by extremely calcareous loamy till	fresh	Arnes	—	4	—	—	—	4	4	—	—	—	—	—	—
	fresh	Kinwow	—	4	—	—	—	4	5	6	—	—	—	—	—
	fresh	Egg Island	—	4	—	—	—	4	5	6	—	—	—	—	—
	moist	Mantagao	—	4	4	—	5	4	5	5	—	—	—	—	—
	moist	Peguis	—	4	5	—	5	4	4	—	—	—	—	—	—
Moderately to strongly calcareous clay till	fresh	Homebrook	—	4	—	—	—	4	4	—	—	—	—	—	—
	moist	Davis Point	—	3	5	—	5	3	4	—	—	—	—	—	—
6 to 36 inches of moderately to strongly calcareous lacustrine clay underlain by very strongly calcareous silty sediments	moist	Framnes	—	4	—	5	—	3	4	4	—	—	—	—	—
	moist	Dencross	—	4	—	5	—	3	4	4	—	—	—	5	—
	wet	Tamo	—	4	5	—	4	5	5	4	—	—	7	—	—
Very strongly to extremely calcareous, moderately fine textured lacustrine sediments	fresh	Harwill	—	4	—	—	—	5	5	—	—	—	—	—	—
	moist	Lakeland	—	4	—	—	6	4	4	5	—	—	—	—	—
	moist	McCreary	—	4	—	—	6	4	4	5	—	—	—	—	—
	moist	Ledwyn	—	4	—	—	—	4	5	—	—	—	—	—	—
	moist	Fisherton	—	4	—	—	—	4	5	—	—	—	—	—	—
	wet	Balmoral	—	4	5	—	4	4	4	—	—	—	7	—	—
	wet	Pineimuta	—	4	5	—	4	4	4	—	—	—	7	—	—
Very strongly to extremely calcareous, medium textured lacustrine sediments	wet	Foley	—	5	—	—	4	5	5	—	—	—	7	—	—
Weakly to moderately calcareous, moderately coarse to coarse textured sediments underlain by extremely calcareous till within 30 inches	fresh	St. Labre	4	4	—	—	—	4	—	4	—	—	—	—	—
	fresh	Harcus	4	4	—	—	—	4	—	4	—	—	—	—	—
	moist	Caliento	4	3	—	4	—	3	—	4	3	—	—	—	—
	moist	Colby	—	—	—	—	—	2	4	5	6	6	—	—	6
	wet	Malonton	—	5	5	—	6	5	6	—	—	—	7	—	—
	wet	Sprague	—	5	5	—	6	5	6	—	—	—	7	—	—
Moderately to strongly calcareous sandy deposits more than 36 inches thick	fresh	Pine Ridge	5	—	—	—	—	5	—	5	—	—	—	—	—
	fresh	Punk	5	—	—	—	—	5	—	5	—	—	—	—	—
Siliceous sandy deposits	dry	Sandilands	5	—	—	—	—	6	—	4	—	—	—	—	—
	moist	Lonesand	4	4	—	—	4	4	4	4	—	—	—	—	—
	wet	Kerry	—	—	5	—	5	5	6	—	—	—	7	—	—
Strongly calcareous stratified sand and gravel beach and outwash deposits	fresh	Leary	4	5	—	5	—	4	—	4	—	5	—	—	—
	fresh	Gunton	4	5	—	5	—	4	—	4	—	5	—	—	—
	fresh	Lynx Bay	4	5	—	5	—	4	—	4	—	5	—	—	—
	fresh	Woodridge	4	5	—	—	—	5	—	5	—	—	—	—	—
	fresh	Long Point	4	5	—	—	—	5	—	5	—	—	—	—	—
	moist	Spearhill	4	4	5	—	4	4	4	6	—	—	—	—	—
	moist	Goose Island	4	4	5	—	4	4	4	6	—	—	—	—	—
	wet	Sundown	—	4	5	—	4	4	5	5	—	—	7	—	—
	wet	Berry Island	—	4	5	—	4	4	5	5	—	—	7	—	—

TABLE 56 Cont'd.
Forest Productivity* of Soils

Parent Material	Moisture Class	Soil Name	Softwood					Hardwood							
			jP+	wS	bS	bF	tL	tA	bP	wB	As	bO	W	mM	wE
Moderately coarse to medium textured, moderately calcareous, stony till	fresh	McArthur	4	3	—	4	—	3	—	3	—	—	—	—	—
	moist	Pinawa	4	3	—	—	—	5	—	5	—	—	—	—	—
Recent alluvium	fresh	Hodgson	—	5	—	—	—	5	6	—	6	—	—	5	—
	moist	Fisher	—	5	—	—	—	3	3	—	5	—	—	5	—
Thin mucky loam deposits	saturated	Marsh	—	—	—	—	—	—	—	—	—	—	7	—	—
Limestone and dolostone rock outcrop	dry	Rock Outcrop	—	—	—	—	—	7	—	7	—	7	—	—	—
Recent beach deposit	dry to moist	Sand Beaches	—	—	—	—	—	—	—	—	—	—	—	—	—
Dominantly moderately decomposed forest peat, less than 52 inches thick	wet	Okno	—	—	5	—	5	—	—	—	—	—	—	—	—
	wet	Rat River	—	—	5	—	5	—	—	—	—	—	—	—	—
	wet	Grindstone	—	—	5	—	5	—	—	—	—	—	—	—	—
	wet	Janora	—	—	5	—	5	—	—	—	—	—	—	—	—
Dominantly fibric Sphagnum peat less than 64 inches thick	wet to saturated	Molson	—	—	7	—	7	—	—	—	—	—	—	—	—
	wet to saturated	Sand River	—	—	7	—	7	—	—	—	—	—	—	—	—
	wet to saturated	Kilkenny	—	—	7	—	7	—	—	—	—	—	—	—	—
Dominantly mesic sedge peat, less than 52 inches thick	saturated	Cayer	—	—	—	—	—	—	—	—	—	—	7	—	—
	saturated	Kircro	—	—	—	—	—	—	—	—	—	—	7	—	—
	saturated	Crane	—	—	—	—	—	—	—	—	—	—	7	—	—
	saturated	Holditch	—	—	—	—	—	—	—	—	—	—		—	—
Dominantly moderately decomposed forest peat, greater than 52 inches thick	wet	Baynham	—	—	6	—	6	—	—	—	—	—	—	—	—
	wet	Bradbury	—	—	6	—	6	—	—	—	—	—	—	—	—
Dominantly fibric Sphagnum peat, greater than 64 inches thick	wet to saturated	Julius	—	—	7	—	7	—	—	—	—	—	—	—	—
	wet to saturated	Sproule	—	—	7	—	7	—	—	—	—	—	—	—	—
	wet to saturated	Denbeigh	—	—	7	—	7	—	—	—	—	—	—	—	—
Dominantly mesic sedge peat, greater than 52 inches thick	saturated	Stead	—	—	—	—	—	—	—	—	—	—	—	—	—
	saturated	Macawber	—	—	—	—	—	—	—	—	—	—	—	—	—

* Productivity is gross mean annual increment of merchantable volume

1 over 100 cu. ft./acre
2 91-110 cu. ft./acre
3 71-90 cu. ft./acre
4 51-70 cu. ft./acre
5 31-50 cu. ft./acre
6 11-30 cu. ft./acre
7 less than 10 cu. ft./acre

\+ Species abbreviation as in Table 57.

Subclass 7W

The soils in this subclass developed on level, poorly or very poorly drained mesic sedge peat deposits, where the permanent water table is very near to the surface. The excess moisture effectively limits tree growth. The soils in this subclass are:

Cayer mesic peat	Kircro mesic peat
Crane mesic peat	Holditch mesic peat
Stead mesic peat	Macawber mesic peat

Subclass 7WF

The soils in this subclass are developed on level, poorly or very poorly drained fibric sphagnum moss peat deposits. The growth is very severely limited by excess of soil moisture and low nutrient content, allowing the growth of stunted black spruce and tamarack. The soils in this subclass are:

Molson fibric peat	Sand River fibric peat
Kilkenny fibric peat	Julius fibric peat
Sproule fibric peat	Denbeigh fibric peat

Subclass 7U

The soils in this subclass developed on active lake beaches. Exposure to wind and blowing sand inhibits tree growth. The soils in this subclass are:

Sand beach

TABLE 57

Common and Scientific Names of Tree Species Used in the Text

Common name	Abvr.	Scientific Name
Aspen, trembline	tA	Populus tremuloides Michx.
Ash, green	As	Fraxinus pennsylvanica Marsh.
Birch, white	wB	Betula papyrifera Marsh.
Elm, white	wE	Ulmus americana L.
Fir, balsam	bF	Abies balsamea (L.) Mill.
Larch, tamarack	tL	Larix laricina (Du Roi) K. Koch
Maple, Manitoba	mM	Acer Negundo L.
Oak, bur	bO	Quercus macrocarpa Michx.
Pine, jack	jP	Pinus banksiana Lamb.
Poplar, balsam	bPo	Populus balsamifera L.
Spruce, black	bS	Picea mariana (Mill.) BSP
Spruce, white	wS	Picea glauca (Moench) Voss
Willow	W	Salix sp.

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F. GLOSSARY

Clear cutting — The removal of an entire forest stand in one cut. In its usual application only the merchantable timber is removed.

Conifer — Cone-bearing tree species. The term softwood is a synonym.

Cover type — A descriptive term used to group together softwood (coniferous), hardwood (deciduous), or mixedwood (a mixture of softwoods and hardwoods) stands.

Gross mean annual increment — Total growth of trees in a stand up to a given age, divided by that age.

Hardwood — Deciduous, broadleaved tree species.

Maturity — The approximate age beyond which growth falls off or the rate of decay increases.

Merchantable volume — Volume of wood of a size and quality suitable for marketing and utilization.

Modified clear cutting — A clear cutting system in which the size and shape of the cut areas are varied to provide a source of seed for the cut areas from timber margins.

Moisture regime — Annual moisture status of the unconsolidated soil material, expressing the moisture available to trees in descriptive terms. The broad classes used are given below with the approximate equivalent terms used by soil surveyors.

Dry — periodic to prolonged lack of soil moisture (excessively drained).

Fresh — adequate soil moisture supply, without prolonged lack or excess of soil moisture (well drained).

Moist — periodic excess of soil moisture (imperfectly drained).

Wet — prolonged to permanent excess to soil moisture (poorly drained).

Saturated — permanent excess of soil moisture at the surface (very poorly drained.

Partial cutting — A system of cutting in which only a portion of the stand is removed during the first cut. The remainder of the stand is used as a seed source and to provide shade for seedlings, and is ordinarily removed following the successful establishment of reproduction.

Site — An area of land characterized by regional and local climate, soil material, relief, soil moisture and nutrients which influence the development of the biotic communities on that land.

Sucker — Shoots that arise from the lower portion of a stump, especially from the root, following cutting of the original stem.

PART VI
ENGINEERING AND LAND USE PLANNING

The objective of this chapter is to supplement the engineering information given on the soil maps of the Red Rose-Washow Bay areas with additional data; to present interpretations of this data and to form a guide to the use of both the Soils Map and the Soils Report.*

A. HOW TO USE THE SOILS REPORT

Both the report and the map contain information which can be of great value to engineers, land use planners and others interested in these aspects. However, because there are likely to be many different types of people (both professional and non-professional) included under this general heading it is difficult to write a report of a general nature to suit everyone. To make this easier it has been necessary to group potential users into the following categories:

1. Conservation and transportation Engineers
2. Land Use Planners
3. Geotechnical Engineers and Geologists

1. Conservation and Transportation Engineers

Engineers involved with Soil Conservation and with the pavement design aspects of transportation engineering can probably make most direct use of the Soils Map (they might be better termed Pedological Maps) than any of the other groups.

For instance, transportation routes (whether they be highways, airstrips or even railroads) may for long stretches be constructed directly on "the soil", as defined in pedology, and the soil profile often represents the foundations for these pavement structures. The pedological classification system considers the soil "in situ" and takes into account not only the parent materials but also the effects of soil climate, topography, drainage, capillarity, etc. Specilaists in such fields as pavement design thus often find the pedological classification system preferable to most engineering systems for their particular needs.

Many specialists in this field of engineering are already familiar with the science of pedology, but for those not so fortunate, Section F of this chapter should be consulted.

Generally, it may be found that the performance of highway (or airstrip) pavements can be correlated with the Soil Series. This is normally done by plotting the existing highway (or airstrip) locations on the Soils Map (or alternatively transferring the map data to the general layout plans). The performance data, if available, is then added and analyses made to determine to what degree performance can be related to the mapping units shown. An excellent method of predicting performance elsewhere on the map is thus provided because all conditions pertaining to the soil should be the same, wherever a particular Soil Series is shown. Likewise, the performance of pavements in all areas marked by the same map symbol should be the same.

Similar types of "performance correlations" are often applied to soil stabilization (e.g. by soil cement application), runoff and infiltration characteristics (in the U.S.A. those are termed Hydrological Soil Factors), etc. Still further relationships have yet to be established.

For those interested in establishing this type of performance correlation the following procedure could be followed:

(i) Become familiar with the engineering significance of pedology as given in Section F.

(ii) Identify the Soil Series in the particular area of interest by their names.

(iii) Consult Part III, "Soils" in this report; identify the type of terrain and soil profile from the photographs and descriptions of these particular Soil Series; selected those parts of the detailed descriptions of the mapping units which are of engineering significance.

(iv) Tabulate all of this data and add the relevant engineering test data included in Tables 58 and 59 in this chapter.

(v) Visit the site to identify the terrain characteristics and dig test holes to identify the soil profiles as given in the report.

(vi) Verify that these are definitely characteristic of that particular mapping unit as described.

(vii) Apply the performance date available and extrapolate this known performance to the project sites.

The pedological Soil Map can then become an excellent base on which to store performance data; the pedological report becomes a handy reference document.

Of most interest to specialists in this category will be the tables of typical soil properties given in Section C, Engineering Properties of the Soils.

2. Land Use Planners

For specialists in the field, the interpretive type of information may be the most relevant. It is assumed that the information is preferred in the form of recommendations rather than as data for design.

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* Much of the explanation on how soil survey information can be useful for engineering and land use planning is drawn from the chapter on "Engineering and Land Use Planning" by G. Wilson, Soil Mechanics Engineer, Soil Research Institute, Ottawa, from Manitoba Soil Survey Report No. 18, 1973.

The Section D, "Soils and Community Developments" and E, "Soils and Recreation" should be consulted for this type of information.

This information can be used either as described or it can be reinterpreted.

Thus, for use of soils for community development with septic tanks, for example, special coloured plans can be drawn up showing areas which have "severe limitations" and "slight limitations", for disposal fields according to the recommendations given.

Alternatively after studying the interpretations in detail the planner can reinterpret this data and (in conjunction with other factors) adapt it to convey a particular planning philosophy as desired.

3. Geotechnical Engineers and Geologists

For specialists in foundation engineering, site investigations and supply of construction materials, the pedological classification system itself may not be directly applicable for the majority of every day problems. This is mainly because the system was conceived for the surface layers of surficial deposits, i.e. for the soil defined as being "earth that can be plowed and planted".

Nevertheless, people interested or engaged in the above fields of specilaization may find soil surveys of the pedological type of great value for two main reasons:

(i) There are special engineering problems which are definitely concerned with the altered and unaltered soil material within 1 to 2 meters of the surface.

(ii) While making the soil survey, the pedologist is himself also very much interested in the underlying materials, including the bedrock.

For those engineering problems which definitely do concern the upper layers of the soil, the reader is referred to the previous section (written for Conservation and Transportation Engineers). Typical examples of such problems include:

Urban Engineering — shallow foundations, septic tanks

Hydraulic Engineering — watershed control of runoff and drainage

Corrosion Engineering — pipelines, concrete foundations

Construction Engineering — search for sand and gravel, topsoil.

A brief outline of the interaction of pedology and engineering is given in Section F and this should be consulted.

For those engineering problems which concern more than just the upper layers of soil, valuable information can be obtained from the soil map by inference. The interpreted grid sections which accompany some of the map sheets have also been prepared especially for this purpose.

For example, by inference, when (dense) glacial till deposits are given as the parent material, one is not likely to find soft alluvial clay deposits at depth. Similarly, where soft alluvial clay deposits are shown as the parent material, one could expect deeper drilling for adequate exploration and more expensive foundations.

4. Differences between "Pedological" and "Engineering" soils

There are a number of terms and concepts used by pedologists which are similar in name but rather different in meaning to those used by Soil Engineers. This is a "pedological" report and the terms used should generally be interpreted in the pedological sense.

Figure No. 37 below shows the comparison between the Textural classes used in the Canadian

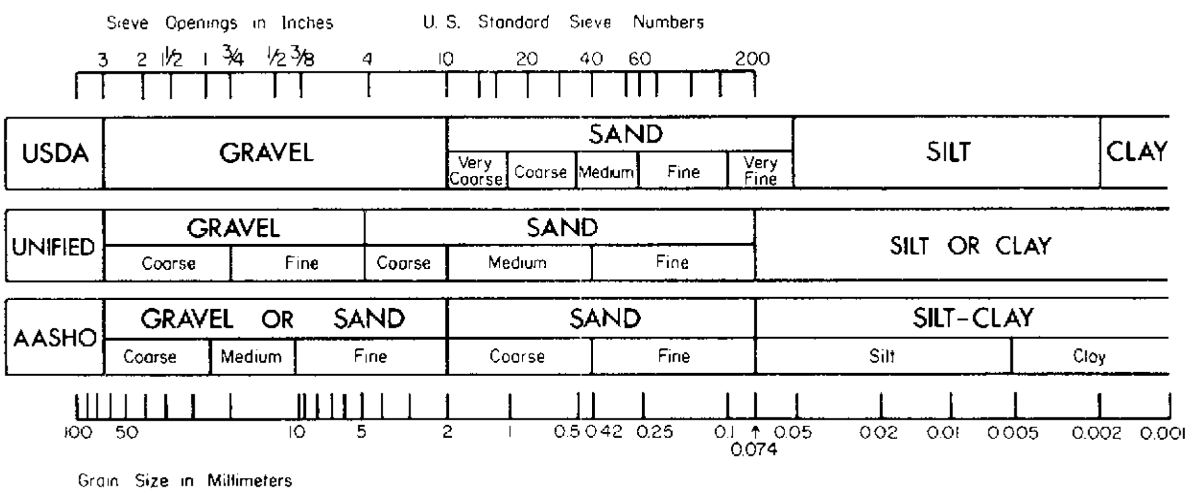

FIGURE 37
Comparison of Soil Particle Sizes for the USDA, Unified and AASHO Systems of Textural Classification Commonly Used in Canada.

System of (pedological) Soil Classification and a typical engineering textural soil classification chart. Again, note the differences, for example the "engineers clay" starting at clay contents in excess of 30 percent compared to the "pedologists clay" which starts at 40 percent (Figure 37).

There are also definitions of some words which have significant differences when used in the two disciplines — "consistence" is one. This is not misspelling of the soil engineers term "consistency" and it is not synonymous. Most of these differences are covered in the Glossary.

5. Limitations

The reader is reminded that the data given in this report were never intended and never could be used in place of a site investigation. This point is more fully discussed in the section dealing with the soil map.

However, for certain types of problems, for example in "pavement design", the time and money spent on site exploration can be much more effectively used by using the Soil Series as a base. It would thus be preferable to soil test within the boundaries of the Soil Series than to drill holes at specified intervals regardless of this information.

B. THE SOIL MAP

1. Purpose and Scale

The Red Rose-Washow Bay soil maps were made at a scale of 1:125,000 or 1 inch equals 2 miles. It is, therefore, readily apparent that the map will fail to show many important local soils because they were too small in areal extent or too intimately mixed with other types to show separately. However, the map legend and report indicate occurrence of dominant Soil Series and significant inclusions of other local types. The predictive value of these maps, because of scale, will not be as good as those made at large scales where local soils can be shown separately.

Regardless of the limitations imposed by scale the map serves as a bridge to identify properties of soils important to plant growth and to engineering uses. Each soil has a unique combination of profile characterisitcs, texture, moisture retention, consistence, mineralogical and chemical composition; each of them is found in a unique landscape setting in terms of such environmental elements as climate, vegetation, topography, slope and drainage regime. All of them, to some varying degree, have unlike management requirements regardless of use.

The map provides a geographical framework for organizing and extending available knowledge about soils to specific locations. New discoveries and relationships derived from research and in-the-field testing can be extended to other areas of similar soils.

2. Current Status of Soil Mapping in Manitoba

Figure No. 1, on the cover of this report, shows the published soil reports in Manitoba and the areas covered by various kinds of surveys is indicated.

It also shows the users where some soil mapping has been carried out and for which (unpublished) data is available.

3. How to Use the Soils Map

The soils maps of the Red Rose-Washow Bay areas included at the end of the report are prepared directly from field sheets. The legend included with the map should normally make the map self-explanatory. However, rather specialized concepts are involved in this type of mapping and some additional explanations are necessary to indicate clearly what is being portrayed.

All areas outlined on the map and marked with the same symbols are characterized by soils of the same Soil Series, the same Soil Types or the same Phases. This does not mean that the only soil profiles existing in that area belong to the Soil Series or types which are typified by those names.

At this point the philosophy of pedological mapping comes into the picture. Soil Series as a "mapping unit" is not synonymous with Soil Series as a soil profile, landform or taxonomic unit. The difference is that in the mapping unit there may be (in fact, there generally are) inclusions of other soil "individuals" or even on "non-soil" (i.e. bedrock, etc.).

It is thus, first of all necessary to read carefully the definitions of what constitutes the "mapping unit". This may refer to the degree to which the area outlined contains inclusions of other soils, i.e. the unit may actually be a "complex" of more than one Soil Series' or it may be relatively uniform or it may be entirely transitional between one Soil Series and another.

Even if it is relatively uniform, it is only implied that, in the estimation of the pedologist, at least 85 percent of the area outlined should be truly representative of the Soil Series named. Thus, small localized pockets of unlike soil may be known to occur inside the boundaries of a certain Soil Series and yet it it is too small to be shown on that map scale, it will not be indicated but becomes part of the "untypical" 15 percent for the mapping unit in which it occurs.

Thus, the map was never intended to show site specific data and it never could be used in lieu of site investigations.

The reader is referred to page 28 for further details concerning the mapping procedures used and, in particular, to the "Descriptions of the Soil Series and Mapping Units". Each Soil Series is described in alphabetical order.

When using the Soil Map in the field it should thus be borne in mind that if inclusions of other soils or "non-soils" are found within Soil Series boundaries, this does not necessarily indicate lack of accuracy. The definitions used for that particular "mapping unit" should be studied and the remarks given above noted carefully.

4. Limitations:
In the Use of This Map

Neither the data given on the map nor that given on the interpreted sections can be used in place of site investigations. This has been fully discussed in the text above.

For design purposes, therefore, a site investigation by specialists in this field should always be made.

The information given here, however, can be used for general assessment and, for the specialist, it should prove to be an excellent guide for planning effective investigations.

C.ENGINEERING PROPERTIES OF THE SOILS

1. Geotechnical Setting

The geotechnical setting could be defined as the total three dimensional model encompassing an area of geotechnical interest. Thus, for a detailed site investigation the specific area of geotechnical interest may be the top of the first soil layer which is adequately strong to take the bearing loads imposed by building projects. The boundaries of this area of interest would thus appear to be within the limits of the particular building project and the "setting" would thus be the three dimensional model bounded by these areal boundaries and limited in depth to the top of this bearing soil layer.

Detailed knowledge of a very limited model such as this may yield poor predictive results in engineering. For instance, the major problem for this particular project may not be the properties of this top soil layer but the presence of very soft and unstable soils at some depth. Alternatively, the major problem may not even be within the boundaries of the project site; in landslide-prone areas it could be the condition of a hillside which may be at a considerable distance from the project.

For the engineer, knowledge of the general setting of the area is thus of first priority, before a detailed site investigation gets underway. As it happens, there is a parallel with pedological survey because knowledge of this general setting is generally necessary for an adequate understanding of the soil, the landscape and for realistic predictions of soil productivity. Thus, a number of sketch maps have been prepared for the various chapters of this report. These illustrate the role in pedology of such factors as the bedrock geology, the surficial geology and geohydrology. In fact, for the engineer, these general sketch maps have a dual role; they also portray the geotechnical setting of the area (see Part II).

2. Engineering Description of the Soils

Engineering properties have been estimated for the significant soil series mapped in the Red Rose-Washow Bay area (Table 58). The estimated classification according to the USDA, AASHO and the Unified classification systems is given for each important layer. These estimates are based on soil test data and on information contained in other sections of the report. Some of the more significant properties of these soils are discussed below.

(a) Particle Size Distribution

Particle size distribution was determined by employing a combined sieve and pipette method developed by V.J. Kilmer and L.T. Alexander*.

Approximately 20 percent of the mineral soils in the Red Rose-Washow Bay area are comprised of very stony to excessively stony, medium to moderately fine textured, extremely calcareous glacial till. The percent of rock fragments and stones larger than 4 inches in diamter is usually less than 15 percent by weight. The fine earth fraction of these soils is comprised of 15 to 30 percent of montmorilonitic clay <0.0002 mm, about 30 to 50 percent of silt and very fine sand and about 20 to 30 percent of fine to medium sand. These soils usually group into the CL and ML textural classes in the Unified System.

About 13 percent of the mineral soils are characterized by a thin (usually 2 to 3 feet thick) clay layer high in montmorillonitic clay content (60 to about 80 percent with diameters <0.002 mm), that overlie the dominant glacial till in the map area.

Approximately 7 percent of the mineral soils consist of deep (usually more than 4 feet thick) clay deposits having a high content (usually 60 to 80 percent) of high shrink-swell potential clay.

Medium to moderately fine textured, that is ML and CL soils, comprise about 2.5 percent of the land area.

Thick deposits of sand and gravelly deposits, usually in the form of long, low, beach ridges comprise about 1.5 percent. Approximately 3.0 percent of the land consists of thin (ranging from 6 to 30 inches in thickness) sand and gravel that overlie the regional glacial till.

By far, the most extensive deposits in the map area are the deep organic soils. These soils comprise approximately 46 percent of the terrain in the area. These deposits are dominantly moderately decomposed, range in depth from 2 to more than 10 feet and are usually underlain by lacustrine clay. These clayey soils have a high fine clay content ranging from 60 to 80 percent by weight of particles <0.002 mm in diameter.

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* Kilmer, V.J. and L.T. Alexander. 1949. Methods of making mechanical analysis of soils. Soil Sci. 68: 15-24.

TABLE 58
Estimated Engineering Properties of Soils of the Red Rose-Washow Bay Map Area

Map Symbol	Soil name and dominant texture	Depth from Surface (inches)	Classification			Percentage Passing Sieve-			Permeability[1] (inches per hr.)	Reaction	Sulphate hazard[2]	Shrink-swell potential
			USDA	AASHO	Unified	No. 4 (4.7 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				
Ab	Arborg clay	0-12	C	A-7-6(20)	CH	100	100	97	0.02-0.05	7.0-7.5	Low	High
		12-24	C	A-7-6(20)	CH	100	100	97	0.01-0.03	7.0-7.5	Mod.	High
		24-48	C	A-7-6(20)	CH	100	100	97	0.01-0.03	7.5-8.0	High	High
An	Arnes clay	0-12	C	A-7-6(20)	CH	100	95-100	95-100	0.02-0.05	7.0-7.5	Low	High
		12-24	C	A-7-6(20)	CH	100	95-100	95-100	0.01-0.03	7.5-8.0	Mod.	High.
		24-48	L-CL Till	A-4	ML-CL	90-100	80-90	60-80	0.5-1.0	7.5-8.0	High	Mod. to High
Ba(P)	Balmoral clay loam, peaty phase	6-0	Mesic Peat	—	Pt	—	—	—	—	—	—	—
		0-6	SiC	A-7-6	CH	100	100	80-95	0.05-0.6	7.0-8.0	Mod.	Mod. to High
		6-36	SiL	A-4 or A-5	ML or CL	100	100	80-95	0.6-1.0	7.5-8.0	Severe	Moderate
Bc	Birch Bay loam	0-12	L-CL	A-4 to A-6	CL-ML	90-100	70-90	50-70	0.5-2.0	7.0-7.5	None	Moderate
		12-24	A-4 to A-6		CL-ML	90-100	70-90	50-70	0.3-1.5	7.5-8.0	Mod.	Moderate
		24+	Rock	—	—	—	—	—	—	—	—	—
Bdx	Bradbury Complex	0-8	Fibric Peat	—	—	—	—	—	—	5.0-5.5	None	—
		8-52	Mesic Peat	—	—	—	—	—	—	5.5-7.0	None	---
		52+	L-CL Till	A-4 to A-6	CL-ML	90-100	70-90	50-70	0.3-1.5	7.5-8.0	Mod.	Moderate
Bmx	Baynham Complex	0-6	Fibric Peat	—	Pt	—	—	—	—	5.0-5.5	—	—
		6-52	Mesic Peat	—	Pt	—	—	—	—	5.5-7.0	—	—
		52-60	L - Clay	A-4 to A-7-6	ML to CH	100	100	70-90	0.05-2.0	7.5-8.0	None	Mod. to High
By(P)	Berry Island sand and gravel	0-24	S + Gr	A-1	Sp, SW, GP	40-60	10-20	0-10	10+	7.5-8.0	Low	Low
		24-48	L-CL Till	A-4 to A-6	CL, ML	90-100	70-90	50-70	0.3-1.5	7.5-8.0	Mod.	Moderate
Cax	Cayer Complex	0-40	Mesic Peat	—	Pt	—	—	—	—	6.0-7.0	—	—
		40+	Clay	A-4 to A-7-6	MI-CH	100	100	70-90	0.05-2.0	7.5-8.0	None	High
Cb	Colby sand	0-30	S	A-2	SP	100	70-80	10-20	7.0-10.0	7.0-7.5	Low	Low
		30-48	L-CL Till	A-4 to A-6	CL - ML	80-90	70-80	50-70	0.5-1.5	7.5-8.0	Low	Mod
Ci	Chitek loam	0-12	L-CL Till	A-4 to A-6	CL - ML	80-90	70-80	50-70	0.5-1.5	7.0-7.8	Low	Mod.
		12-48	L-CL Till	A-4 to A-6	CL - ML	80-90	70-80	50-70	0.3-1.0	7.5-8.0	Low	Mod.
Co	Caliento sand	0-36	S	A-2	SP	100	70-80	10-20	7.0-10.0	6.0-7.0	None	Low
		36-48	L-CL Till	A-4 to A-6	CL - ML	80-90	70-90	50-70	0.3-1.0	7.5-8.0	Low	Mod.
Cx	Crane Complex	0-40	Mesic Peat	—	Pt	—	—	—	—	6.0-7.0	—	—
		40+	CL Till	A-4	ML - CL	80-90	60-80	50-70	0.6-1.0	7.5-8.0	None	Mod.
Dc	Dencross clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.02-0.05	7.0-7.5	None	High
		24-48	A-4 to A-6		CL	100	90-100	70-90	0.3-1.0	7.5-8.0	Low	Mod.
Dl	Devils Lake loam	0-24	L-CL	A-4 to A-6	CL	80-90	70-80	50-70	0.5-1.5	7.0-7.5	None	Mod.
		24+	Rock	—	—	—	—	—	—	—	—	—

TABLE 58 Cont'd.

Estimated Engineering Properties of Soils of the Red Rose-Washow Bay Map Area

Map Symbol	Soil name and dominant texture	Depth from Surface (inches)	Classification			Percentage Passing Sieve-			Permeability1 (inches per hr.)	Reaction	Sulphate hazard2	Shrink-swell potential
			USDA	AASHO	Unified	No. 4 (4.7 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				
Dp	Davis Point clay	0-5	C	A-7-6	CH - MH	100	100	85-95	0.05-0.6	6.5-7.0	None	High
		5-15	C	A-7-6	CH - MH	100	100	85-95	0.05-0.6	6.5-7.0	None	High
		15-36	C	A-7-6	CH - MH	100	100	85-95	0.05-0.6	7.0-7.5	Low	High
		(pockets)	SiCL	A-4 to A-6	ML	100	100	70-80	0.5-1.0	7.5-8.0	Low	Mod.
Dx	Denbeigh Complex	0-36	Fibric Peat	—	Pt	—	—	—	—	3.0-4.5	None	—
		36-60	Fibric to Mesic Peat	—	Pt	—	—	—	—	4.0-5.o	None	—
		60-120	Mesic Peat	—	Pt	—	—	—	—	—	—	—
		120+	L-CL Till	A-4 to A-6	CL - ML	80-90	70-80	50-70	0.5-1.0	7.5-8.0	Low	Mod.
Ei	Egg Island clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.03-0.1	6.5-7.5	None	High
		24+	Rock	—	—	—	—	—	—	—	—	—
Fd	Fairford loam	0-5	L-CL	A-4	CL - ML	90-100	80-90	50-70	0.6-2.0	6.5-7.0	None	Mod.
		5-36	L	A-4	CL - ML	80-90	70-80	50-70	0.6-1.0	7.5-8.0	Low	Mod.
Fi	Fisher clay loam	0-18	Stratified	A-4 to A-6	ML or CL	100	90-100	50-80	1.0-6.0	7.0-7.5	Low	Mod.
		18-36	SiL and CL	—	—	—	—	—	—	—	—	—
Fk	Faulkner loam	0-20	L-CL	A-4 to A-6	CL - ML	90-100	80-90	50-70	0.6-2.0	6.5-8.0	Low	Mod.
		20-40+	Rock	—	—	—	—	—	—	—	—	—
Fo	Foley very fine sandy loam	0-24	VFSC	A-3	SW	100	100	20-30	6.0-8.0	7.0-7.5	Low	Mod.
		24-48	VFS	A-3	SW	100	100	10-20	4.0-6.0	7.5-8.0	Low	Mod.
Fr	Framnes clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.02-0.2	7.0-7.5	Low	High
		24-48	CL	A-4 to A-6	CL-CH	100	100	80-90	0.2-1.0	7.5-8.0	Mod.	Mod. to High
Ft	Fisherton clay loam	0-30	CL	A-4 to A-6	CL - CH	100	100	80-90	0.2-1.0	7.0-7.5	None	Mod. to High
		30-60	L-CL Till	A-4 to A-6	CL - ML	90-100	80-90	60-80	0.5-1.5	7.5-8.0	Low	Mod.
Fy	Fyala clay	0-24	C	A-7-6(20)	CH	100	100	95-100	0.02-0.05	7.0-7.5	Low	High
		24-48	C	A-7-6(20)	CH	100	100	95-100	0.01-0.03	7.5-8.0	Mod.	High
Ga	Garson loam	0-12	L-C	A-6 to A-7-6	CL-CH	90-100	70-90	50-70	0.6-20.	6.5-7.0	None	Mod.
		12-36	L	A-4	CL	90-100	70-90	50-70	0.6-1.0	7.5-8.0	Low	Low to Mod.
Gdx	Grindstone Complex	0-52	Mesic Peat	—	Pt	—	—	—	—	4.5-5.0	None	—
		52+	L-CL Till	A-4 to A-6	CL-CH	90-100	80-90	50-70	0.5-1.5	7.5-8.0	Mod.	Mod.
Gox	Goose Island Complex	0-30	Sand Gr	A-1	SP, GP	30-70	30-40	0-10	10+	7.0-7.8	Low	Low
		30+	L-CL Till	A-4 to A-6	CL, ML	80-90	60-80	50-70	0.5-1.5	7.5-8.0	Mod.	Mod.
Gu	Gunton Complex	0-30	Sand Gr	A-1	SP, GP	30-70	30-40	0-10	10+	7.0-7.8	Low	Low
		30+	L-CL Till	A-4 to A-6	CL, ML	80-90	60-80	50-70	0.5-1.5	7.5-8.0	Mod.	Mod.
H	Hodgson silt loam	0-24	L-CL	A-4 to A-6	CL, ML	80-90	60-80	50-70	0.3-1.0	7.0-7.8	Low	Mod.
		24-48	L-CL	A-4 to A-6	CL, ML	80-90	60-80	50-70	0.3-1.0	7.5-8.0	Mod.	Mod.

TABLE 58 Cont'd.

Estimated Engineering Properties of Soils of the Red Rose-Washow Bay Map Area

Map Symbol	Soil name and domin-ant texture	Depth from Surface (inches)	Classification			Percentage Passing Sieve-			Permea-bility1 (inches per hr.)	Reaction	Sulphate hazard2	Shrink-swell potential
			USDA	AASHO	Unified	No. 4 (4.7 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				
Ha	Harwill clay loam	0-24	CL	A-4 to A-6	CL	100	90-100	70-90	0.05-1.0	7.0-7.5	None	Mod.
		24-48	L-CL	A-4	CL-ML	90-100	80-90	60-80	0.5-1.5	7.5-8.0	Low	Mod.
Hb	Homebrook clay	0-5	C	A-7-6	CH-MH	100	95-100	90-95	< 0.05	7.0-7.5	None	High
		5-16	C	A-7-6	CH-MH	100	95-100	90-95	< 0.05	7.0-7.5	Low	High
		16-36	C	A-7-6	CH-MH	100	95-100	90-95	< 0.05	7.5-8.0	Low	High
Hc	Harcus fine sand	0-24	S	A-1	SP	95-100	50-70	10-20	6.0-10.0	6.0-7.0	None	Low
		24-36	L-CL Till	A-4 to A-6	CL	90-100	80-90	60-80	0.5-1.5	7.0-7.5	Now	Mod.
		36+	Rock	—	—	—	—	—	—	—	—	—
Hdx	Holditch Complex	0-40	Mesic Peat	—	Pt	—	—	—	—	6.0-7.5	None	—
		40+	Rock	—	—	—	—	—	—	—	—	—
Hi	Hilbre loam	0-24	L-CL	A-4 to A-6	CL	90-100	80-90	60-80	0.5-1.5	7.0-7.5	Low	Mod.
		24+	Rock	—	—	—	—	—	—	—	—	—
In	Inwood loam	0-8	L	A-6	CL	90-100	80-90	60-80	0.6-2.0	7.0-7.5	Low	Mod.
		8-36	L	A-4	ML	90-100	80-90	60-80	0.6-1.0	7.5-8.0	Low	Mod.
Jaz	Janora Complex	0-40	Mesic Peat	—	Pt	—	—	—	—	5.5-7.0	None	—
		40+	Rock	—	—	—	—	—	—	—	—	—
Jx	Julius Complex	0-50	Fibric Peat	—	Pt	—	—	—	—	3.5-5.0	None	—
		50-64	Mesic Peat	—	Pt	—	—	—	—	5.0-6.5	None	—
		64+	C	A-7-6	CH	100	100	70-90	0.02-0.3	7.5-8.0	Low	High
Kcx	Kircro Complex	0-52	Mesic Peat	—	Pt	—	—	—	—	—	—	—
		52+	S	A-3	SP	100	90-100	10-20	6.0-10.0	7.5-8.0	Low	Low
Ki	Kinwow clay	0-18	C	A-7-5	MH-CH	100	100	100	< 0.05	6.5-7.5	None	High
		18-30	C	A-7-5	CH	100	100	100	< 0.05	7.0-7.5	None	High
		30+	L Till	A-4	ML-CL	90-100	80-90	60-80	0.6-1.0	7.5-8.0	Low	Mod. to High
Kx	Kilkenny Complex	0-30	Fibric Peat	—	Pt	—	—	—	—	3.5-5.0	None	—
		30-50	Mesic Peat	—	Pt	—	—	—	—	5.0-6.5	None	—
		50+	L Till	A-4	ML-CH	90-100	80-90	60-80	0.6-2.0	7.5-8.5	Low	Low to Mod.
Ky	Kerry sand	0-24	FS-S	A-2	SP	100	60-90	0-10	6.0-10.0	4.5-6.5	None	Low
		24-48	FS-S	A-2	SP	100	60-90	0-10	6.0-10.0	5.0-6.0	None	Low
La	Lakeland clay loam	0-18	CL	A-4 or A-6	CL	100	90-100	70-90	0.05-1.0	7.5-8.0	None	Mod.
		18-36	SiL	A-4	ML	100	90-100	70-90	0.6-1.0	8.0-8.6	Low to Mod.	Mod.
Lbx	Lynx Bay Complex	0-24	S or F Gr	A-1	SP, SW, GP or GW	40-60	15-30	0-15	10.0+	6.5-7.0	None	Low
		24+	Rock	—	—	—	—	—	—	—	—	—

TABLE 58 Cont'd.

Estimated Engineering Properties of Soils of the Red Rose-Washow Bay Map Area

Map Symbol	Soil name and dominant texture	Depth from Surface (inches)	Classification			Percentage Passing Sieve-			Permeability 1 (inches per hr.)	Reaction	Sulphate hazard2	Shrink-swell potential
			USDA	AASHO	Unified	No 4 (4 7 mm)	No. 40 (0 42 mm)	No 200 (0.074 mm)				
Le	Ledwyn clay loam	0-24	CL	A-4 to A-6	CL	100	100	70-90	0.5-1.0	7.0-7.5	Low	Mod.
		24-48	CL	A-4	CL, ML	100	80-90	70-90	0.3-1.0	7.5-8.0	Low	Mod.
Lk(P)	Lee Lake loam	0-12	Mesic Peat	—	—	—	—	—	—	6.5-7.0	None	—
		12-24	L-CL	A-4 to A-6	CL	90-100	80-90	50-80	0.5-1.5	7.5-8.0	Low	Mod.
		24+	Rock	—	—	—	—	—	—	—	—	—
Lo	Lonesand fine sand	0-24	FS	A-3	SP	100	60-90	0-10	6.0-10.0	4.5-6.0	None	Low
		24-48	FS	A-3	SP	100	60-90	0-10	6.0-10.0	5.5-6.5	None	Low
Lp	Long Point sand and gravel	0-24	Sand Gr	A-1, A-3	SP, GP	50-70	20-30	0-10	7.0-10.0	6.5-7.0	None	Low
		24-48	L-CL	A-4 to A-6	CL	90-100	80-90	50-70	0.5-1.5	7.5-8.0	Low	Mod.
Lt	Lettonia clay	0-24	C	A-7-6(20)	CH	100	100	80-90	0.02-0.05	7.0-7.5	None	High
		24-48	C	A-7-6(20)	CH	100	100	80-90	0.01-0.03	7.5-8.0	Low	High
Lu	Lundar loam	0-10	L-CL	A-4 to A-6	ML-CL	90-100	80-90	50-80	0.5-1.5	7.5-8.0	None	Mod.
		10-36	L	A-4	ML	90-100	80-90	50-80	0.3-1.0	8.0-8.5	Low to Mod.	Mod.
Lyx	Leary Complex	0-8	SL	A-1	SP-GP	50-70	20-30	0-15	10.0+	6.5-7.0	None	Low
		8-36	S and F Gr	A-1	GW-GP	30-50	30-50	0-10	10.0+	7.5-8.0	Low	Low
Mc	McArthur sandy loam	0-24	SL	A-3	SC, SM	60-80	30-50	10-20	6.0-8.0	6.5-7.0	None	Low
		24-48	SL	A-3	SC, SM	60-80	30-50	10-20	6.0-8.0	7.0-8.0	None	Low
Mcx	Macawber Complex	0-52	Mesic Peat	—	—	—	—	—	—	—	—	—
		52+	L-CL Till	A-4 to A-6	CL	90-100	80-90	60-80	0.5-1.5	7.0-7.5	Low	Mod.
Mg	Mantagao clay	0-24	C	A-7-6(20)	CH	100	100	95-100	0.02-0.2	7.0-7.5	None	High
		24-48	L-CL Till	A-4 to A-6	CL, ML	90-100	80-90	60-80	0.5-1.0	7.5-8.0	Low	Mod.
Mh	Marsh Complex	0-10	Muck & Sil	A-4	OL	100	100	80-100	1.0-2.0	7.5-8.0	Mod.	Mod.
		10-20	SiL	A-4	ML	100	100	80-100	1.0-2.0	7.5-8.0	Mod.	Mod.
		20+	L Till	A-4 to A-6	ML-CL	90-100	70-90	50-70	0.5-2.0	8.0-8.5	Mod.	Low to Mod.
Ml	Meleb loam	0-6	L-CL	A-4 to A-6	ML-CL	80-100	70-80	50-70	0.6-2.0	7.0-7.5	Low	Mod.
		6-36	L	A-4	ML	80-100	70-80	50-70	1.0-2.0	7.5-8.5	Mod.	Mod.
Ml(P)	Meleb loam, peaty phase	10-0	Mesic Peat	—	Pt	—	—	—	6.5-7.0	—	None	—
		0-8	L-CL	A-4 to A-6	ML-CL	80-100	70-80	50-70	0.6-2.0	7.0-7.5	Low	Mod.
		8-36	L	A-5	ML	80-100	70-80	50-70	0.6-1.0	7.5-8.5	Low	Mod.
Mn(P)	Malonton sand, peaty phase	12-9	Mesic Peat	—	Pt	—	—	—	—	6.5-7.0	None	—
		0-36	VFS	A-3	SW	90-100	50-70	15-35	6.0-10.0	7.0-8.0	None	Low
Mn(P) /T	Malonton sand, till substrate peaty phase	12-0	Mesic Peat	—	Pt	—	—	—	—	6.5-7.0	None	—
		0-24	VFS	A-3	SW	90-100	50-70	15-35	6.0-10.0	7.0-8.0	None	Low
		24+	L Till	A-4	ML	80-100	70-80	50-70	0.6-2.0	8.0-8.5	None	Low to Mod.

TABLE 58 Cont'd.

Estimated Engineering Properties of Soils of the Red Rose-Washow Bay Map Area

Map Symbol	Soil name and dominant texture	Depth from Surface (inches)	Classification			Percentage Passing Sieve-			Permeability1 (inches per hr.)	Reaction	Sulphate hazard2	Shrink-swell potential
			USDA	AASHO	Unified	No. 4 (4.7 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				
Mx	Molson Complex	0-30	Fibric Peat	—	Pt	—	—	—	—	3.5-5.5	None	—
		30-50	Mesic Peat	—	Pt	—	—	—	—	5.5-7.0	None	—
		50+	L-C	A-4 to A-7	ML-CH	100	100	70-90	0.6-2.0	7.0-8.5	None	Mod. to High
My	McCreary clay loam	0-24	CL	A-5 to A-7	ML-CL	100	100	90-100	0.2-1.0	7.0-7.5	Low	High
		24-48	L-CL Till	A-4 to A-6	CL	80-90	70-80	50-70	0.5-1.5	7.5-8.0	Mod.	Mod.
Ox	Okno Complex	0-12	Fibric Peat	—	Pt	—	—	—	—	5.5-6.0	None	—
		12-48	Mesic Peat	—	Pt	—	—	—	—	6.0-7.0	None	—
		48+	C	A-7	CH	100	100	90-100	0.02-0.3	7.5-8.0	Low	High
Pa	Pinawa sandy loam	0-24	FSL	A-3	SC, SM	60-80	50-70	20-30	6.0-8.0	6.5-7.0	None	Low
		24-48	FSL	A-3	SC, SM	60-80	50-70	20-30	6.0-8.0	7.0-8.0	None	Low
Pc	Partridge Creek clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.03-0.3	7.0-7.5	None	High
		24-48	L-CL Till	A-4 to A-6	CL	90-100	70-80	50-70	0.5-1.5	7.5-8.0	Mod.	Mod.
Pe	Peguis clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.03-0.3	7.0-7.5	None	High
		24-48	L-CL Till	A-4	CL	90-100	70-80	50-70	0.5-1.5	7.5-8.0	Mod.	Mod.
Pi	Pineimuta clay loam	0-24	CL	A-4 to A-6	CL, CH	90-100	70-80	60-70	0.2-1.0	7.0-7.5	None	Mod. to High
		24-48	L-CL	A-4	CL, ML	90-100	70-80	50-70	0.5-1.5	7.5-8.0	Low	Mod.
Pi(P)	Pineimuta clay loam, peaty phase	0-24	CL	A-4 to A-6	CL, CH	90-100	70-80	60-70	0.2-1.0	7.0-7.5	None	Mod. to High
		24-48	L-CL	A-4	CL, ML	90-100	70-80	50-70	0.5-1.5	7.5-8.0	Low	Mod.
Pk	Punk fine sand	0-30	FS	A-3	SP	90-100	70-80	0-10	8.0-10.0	7.0-7.5	None	Low
		30+	Rock	—	—	—	—	—	—	—	—	—
Pr	Pine Ridge fine sand	0-24	FS	A-3	SP	90-100	70-80	0-10	8.0-10.0	6.0-6.5	None	Low
		24-48	FS	A-3	SP	90-100	70-80	0-10	8.0-10.0	7.0-7.5	None	Low
R	Rock Outcrop	—	—	—	—	—	—	—	—	—	—	—
Rk	Rat Lake clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.02-0.3	7.0-7.5	None	High
		24+	Rock	—	—	—	—	—	—	—	—	—
Rs	Rosenburg clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.02-0.3	7.5-8.0	Low	High
		24+	Rock	—	—	—	—	—	—	—	—	—
Rr	Rat River Complex	0-52	Mesic Peat	—	—	—	—	—	—	—	—	—
		52+	FS	A-3	SP	90-100	70-80	10-20	6.0-10.0	7.5-8.0	Low	Low
S	Sandiland fine sand	0-24	FS	A-3	SP	90-100	70-80	0-10	8.0-10.0	5.5-6.5	None	Low
		24-48	FS	A-3	SP	90-100	70-80	0-10	8.0-10.0	6.5-7.0	None	Low
Sb	Sand Beaches	0-36	Strat S and Ge	A-1 ro A-2 or SM	SP, GP, GM	50-100	15-50	0-15	10.0+	7.0-8.0	None	Low

TABLE 58 Cont'd.

Estimated Engineering Properties of Soils of the Red Rose-Washow Bay Map Area

Map Symbol	Soil name and dominant texture	Depth from Surface (inches)	Classification			Percentage Passing Sieve-			Permeability1 (inches per hr.)	Reaction	Sulphate hazard2	Shrink-swell potential
			USDA	AASHO	Unified	No. 4 (4.7 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)				
Sdx	Stead Complex	0-60	Mesic Peat	—	Pt	—	—	—	—	6.5-7.0	None	—
		60+	C	A-7-6	CH	100	100	90-100	0.02-0.3	7.5-8.0	Low	High
Sl	St. Labre fine sand	0-24	FS	A-3	SP	100	70-80	0-10	6.0-8.0	6.5-7.0	None	Low
		24-48	L-CL Till	A-4 to A-6	CL, ML	90-100	70-80	50-70	0.5-1.5	7.5-8.0	Low	Mod.
Slx	Sproule Complex	0-36	Fibric Peat	—	—	—	—	—	>10.0	3.5-4.5	None	—
		0-60	Fibric Peat	—	—	—	—	—	>10.0	4.5-5.5	None	—
		60-120	Mesic Peat	—	—	—	—	—	4.0-6.0	5.5-7.0	None	—
		120+	FS	A-3	SP	80-90	70-80	10-20	6.0-8.0	7.0-8.0	Low	Low
Spx	Spearhill sand and gravel	0-36	S and Gr	A-1, A-3	SP, GP, GM, SM	50-100	20-50	0.10	>10.0	7.0-7.5	None	Low
		36+	S and Gr	A-1, A-3	SP, GP, GM, SM	50-100	20-50	0.10	>10.0	7.5-8.0	None	Low
Sr(P)	Sprague sand	0-12	Mesic Peat	—	Pt	—	—	—	4.0-6.0	6.5-7.5	None	⅞
		12-36	FS	A-3	SP	90-100	70-80	10-20	6.0-8.0	7.5-8.0	None	Low
		36+	L-CL	A-4 to A-6	CL, ML	80-90	70-80	50-70	0.5-1.5	7.5-8.0	Low	Mod.
Srx	Sand River Complex	0-52	Mesic Peat	—	—	—	—	—	4.0-6.0	4.5-6.0	None	—
		52+	FS	A-3	SP	80-90	70-80	10-20	6.0-8.0	7.0-8.0	None	Low
Su(P)	Sundown sand and gravel	0-12	Mesic Peat	—	Pt	—	—	—	4.0-6.0	6.5-7.5	—	—
		12-36	S and Gr	A-1, A-3	SP, GP, GM, SM	50-90	20-50	0-10	>10.0	7.5-8.0	Low	Low
Ta	Tarno clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.02-0.3	7.0-7.5	Low	High
		24-48	SiCL-SiC	A-4 to A-7	CL, ML, CH	90-100	90-100	80-90	0.5-1.0	7.5-8.0	Low	Mod.
Ta(P)	Tarno clay, peaty phase	10-0	Mesic Peat	—	Pt	—	—	—	—	6.5-7.0	None	—
		0-24	C	A-7-6	CH	100	100	90-100	< 0.05	7.0-7.5	None to Low	High
		24-36	SiCL-SiC	A-5 to A-7	ML-CL	100	100	90-100	0.6-1.0	7.5-8.0	Low to Mod.	Mod. to Low
Tk(P)	Thickwood clay	0-24	C	A-7-6(20)	CH	100	100	90-100	0.02-0.3	7.0-7.5	None	High
		24-28	Rock	—	—	—	—	—	—	—	—	—
Wx	Woodridge Complex	0-12	MSL	A-1	SP-GP	30-70	20-30	0-15	10.0+	6.5-7.0	None	Low
		12-36	S and F Gr	A-1	GW-GP	30-50	30-50	0-10	10.0+	7.5-8.0	None	Low

1. The permeability of horizons or layers is expressed in inches per hour. The classes of permeability are as follows:

	Inches per hour		Inches per hour
very rapid	10.0+	moderately slow	0.6-1.0
rapid	6.0 - 10.0	slow	0.05 - 0.6
moderately rapid	2.0 - 6.0	very slow	v0.05
moderate	1.0 - 2.0		

2. Sulphate hazard — relative degree of sulphate attack based on criteria established by U.S. Bureau of Reclamation.

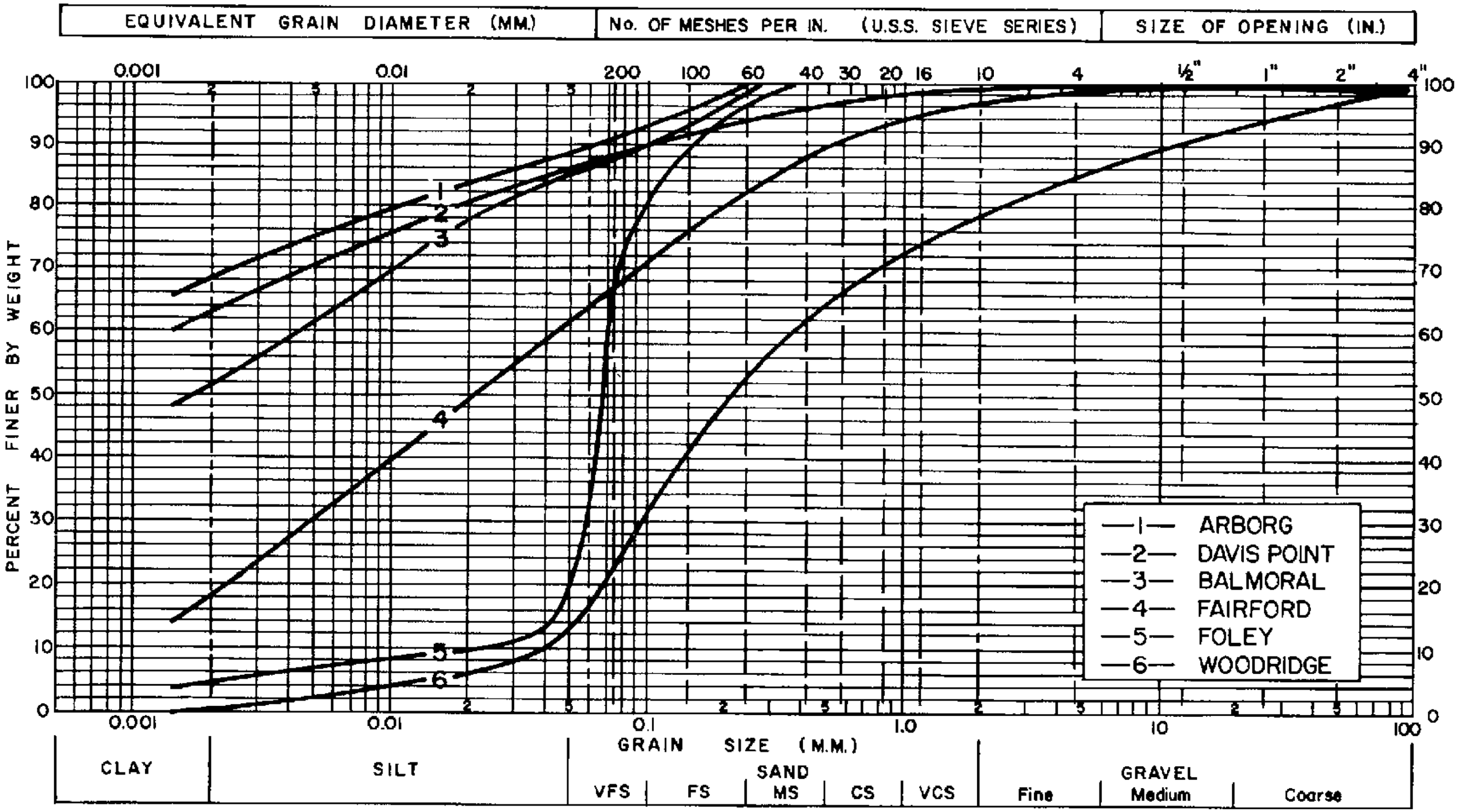

FIGURE 38
Particle Size Distribution Curves for the Major Kinds of Soils in the Red Rose-Washow Bay Map Area.

Particle size distribution curves for the major soils in the map area are shown in Figure 38.

(b) Soil permeability.

That property of soil allowing it to transmit water. It depends on the size and number of continuous soil pores which in turn varies with such factors as particle size distribution or texture, void ratio, soil structure, degree of cementation in certain kinds of soil horizons and degree of saturation. It will also vary with degree of compaction since this greatly influences the size of soil pores. Loosely packed soil will be more permeable than the same soil tightly packed.

In the absence of measurement, permeability is inferred from such morphological features of soil horizons, as texture, structure, consistence, presence of natural cracks, root channels and faunal burrows. Estimates of permeability are determined in the laboratory by measuring the quantity of water that will seep through a given cross-section of distributed soil in a given time (inches per hour) and distance under a known head of water. This estimate of permeability is referred as disturbed hydraulic conductivity (D.H.C.).

In general, D.H.C. varies from very rapid in such soils as the Woodridge, Spearhill, Leary and Gunton soils to very slow in such clayey soils as the Arborg, Lettonia, Fyala and Kinwow series.

(c) Reaction (pH) of the soil was estimated from analysis of selected profiles and parent materials in the map area. All soils in the map area, with the exception of the extremely to very strongly acid, fibric, Sphagnum moss peats, range from slightly acid to strongly alkaline, pH 6.5 to pH 8.0. Thus, corrosion problems related to acidic condition is confined to the fibric Sphagnum deposits.

(d) Sulphate Hazard refers to the relative degree of attack on concrete by soil and water containing various amounts of sulphate ions. This is estimated from electrolyte measurements of soil samples (conductivity measured in mmhos per cubic centimeter) and by visual examination for free gypsum, calcium sulphate within the soil profile during the course of field mapping.

(e) The *Shrink-Swell Potential* is an indication of the volume change to be expected of the soil material with change in moisture content. It is estimated on the basis of the amount of clay with a high-shrink-swell potential in the soil layers. In general, soils classified as A-7 and Ch have a high shrink-swell potential. Clean sands and gravels and those having a small amount of non-plastic to slightly plastic fines have low shrink-swell potential.

3. Engineering Interpretations for Various Uses

Soil interpretations for engineering uses involve relating relevant soil and landscape qualities and characteristics to specific uses. Estimated suitability or limitations of soils in the Red Rose-Washow Bay area for various engineering uses are given in Table 59.

1. Suitability as source of topsoil

The term "topsoil" includes materials used to cover barren surfaces exposed during construction, and materials used to improve soil conditions on lawns, gardens, flower beds, etc. The factors considered include not only characteristics of the soil itself, but also the ease or difficulty of excavation and where removal of topsoil is involved, accessibility to the site. The soil and landscape properties important to this use are texture or engineering class, organic matter content, thickness of surface layer and reaction, degree of salinity, degree of stoniness, slope, degree of wetness, risk of flooding.

2. Suitability as a source of sand and gravel

The purpose of this interpretation is to provide guidance on the probable supply as well as quality of the sand and gravel for use as road base material and concrete. The interpretation pertains mainly to the characteristics of the soil substratum to a depth of 5 to 6 feet, augmented by observations in deep cuts as well as geological knowledge. The important soil and landscape criteria for this interpretation are texture or engineering class, thickness of layers, depth to water table, ease of excavation.

3. Suitability as a source of fill material

Fill material for buildings or roads are included in this use. Performance of material when removed from its original location and placed under load at the building site or road bed are considered. Since surface materials are generally removed during road or building construction, their properties are usually ignored. The whole soil to a depth of 5 to 6 feet is evaluated. Parameters of importance include texture or engineering class, soil drainage class, depth to water table, depth to bedrock, slope, plasticity index, susceptibility to flooding, and ease of excavation.

4. Soil features affecting location of roads and highways

Soil and landscape properties that affect design, construction and performance of highways and all weather roads are considered here. It is not the intention to suggest that soil maps possess adequate information to conduct engineering design; however, the soil map and interpretations are an invaluable aid in planning and conducting an engineering soil survey for design purposes.

Aside from the organic enriched surface horizon which is generally removed in construction, the entire soil profile in its undisturbed state was evaluated for this use. Those properties of importance are texture or engineering class, thickness of significantly different layers, soil drainage class, depth to water table, permeability, depth to bedrock, type of bedrock, slope, stoniness, mineralogy, atterberg limits, susceptibility to flooding.

5. *Soil features affecting foundation construction*

These interpretations apply to those features of soil and landscape influencing the support and construction of foundations suitable for low buildings, generally less than three stories high. As foundations are placed in the substratum below the average depth of penetration of frost, properties of the subsoil to a depth of at least 5 to 6 feet are considered. Properties influencing foundation support are those affecting bearing strength and settlement under load. Important parameters include density, wetness, flooding, plasticity, texture and shrink-swell potential, susceptibility to frost heaving. Properties affecting ease of excavation and cost of foundation construction are wetness, risk of flooding, slope, depth to bedrock, stoniness and rockiness.

6. *Soil features affecting reservoir areas*

Factors affecting ability of undisturbed soils to impound water and prevent seepage are considered for evaluating soil suitability for reservoir areas. As impounded liquids could be potential sources of contamination of nearby water supplies, e.g. sewage lagoons, the landscape position of the reservoir as it affects risk of flooding must also be considered. Important characteristics include depth to water table, risk of flooding, soil permeability, texture, slope, depth to bedrock, nature of bedrock, thickness of slowly permeable layers.

7. *Soil features affecting embankments*

Evaluation of soil suitability for embankment materials including dikes and levees is based on the ability of disturbed soil to restrain water flow when compacted. Important soil qualities affecting evaluation for this use are shear strength, compressibility, compaction characteristics, permeability of compacted material and susceptibility to piping.

8. *Suitability for septic tank disposal fields*

Criteria employed for rating soils for this use are based on their ability to absorb effluent. Effluent should move through soil at a moderate rate. Severe limitations may exist where rapid permeability might permit contamination of water supplies and restricted effluent movement, as a consequence of impermeable materials or high water table, result in surface overflow. Soils with slope gradients that contribute to side hill seepage of effluent also are considered to have severe limitations even though other charactersitics are favorable. When evaluating the significance of fluctuating water table levels for septic fields, the seasonal high level is considered in order to express soil suitability in the most limiting situation. Important soil and landscape features for effluent absorption fields include soil permeability, depth to water table, risk of flooding, slope, depth to bedrock, nature of bedrock, stoniness and rockiness.

D. SOILS AND COMMUNITY DEVELOPMENT

The purpose of this section is to present soil and landscape information in a form that can be more readily understood by urban planners. The demand for land suitable for housing, schools, shopping centers, parks, golf courses and other development is constantly increasing. In selecting sites for such needs, suitability of soils must be considered to avoid costly errors and to prevent waste, abuse and loss for all time the valuable agricultural soils of this area.

The following paragraphs bring together, in a generalized descriptive form, an evaluation of the soils for such uses. For purposes of discussion, all soils in this area have been placed into 11 groups on the basis of common characteristics affecting their use for residential area development. These general evaluations consider such properties of soil as *texture,* a property affecting sewage absorption, rate of internal drainage, stability and bearing strength for foundations, and risk of frost heaving; *natural soil drainage,* a feature of soil and landscape affecting location of residences, roads, services and sewage disposal fields; *topography* or percentage slope, a feature of landscape that determines drainage and site location; *flooding hazard,* soils on flood plains of streams are subject to flooding and should not be used as sites for residences.

GROUP 1

This group consists of deep, well drained, coarse textured soils with very gently undulating to undulating topography. The surface layer ranges from sand to loamy sand and is underlain by deep deposits of stratified sand and gravel. The soils in this group include:

	Acres	Percent of Total Area
Leary Complex	4,896	0.28
Pine Ridge	125	0.01
Sandilands	5,717	0.37
Sand Beaches	1,404	0.08
Woodridge	15,377	0.87
	27,519	1.61

The soils in this group are fairly droughty and are only fairly good for a narrow range of agricultural crops.

All of the soils in this group provide good building sites. They have moderate runoff and a low water table. The suitability of these soils for foundations for low buildings is good. The soils have good internal drainage, high bearing capacity

TABLE 59

Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability		Soil Features Affecting —						Soil Limitations for use as septic tank filter field
								Water Retention Structures		
		Topsoil	Sand and Gravel	Road fill	Road Location	Foundation Construction	Agricultural Drainage	Reservoir Area	Embankment	
Arborg	Ab	Poor, clayey textures	Not suitable	Poor, high shrink-swell potential, lacks strength when wet	Severe limitation; highly plastic clay; poor stability when wet, highly compressible; poor subgrade	Severe limitation; low bearing strength; very high shrink-swell potential	Surface drainage required	Slight limitation; very slow seepage rates	Poor compaction properties; high shrink-swell potential	Severe limitation; very slow effluent absorption rates
Arnes	An	Poor, clay texture	Not suitable	Poor surface, shrink-swell potential, lacks strength when wet. Fair subsurface, moderate shrink-swell potential, very stony	Poor surface, low bearing strength when wet. Subsurface very stony, fair to poor compaction, fair subgrade	Severe limitation, low bearing strength when wet, high shrink-swell potential. Fair subsurface, low strength when wet	Good surface drainage	Good surface, impermeable when compacted. Subsurface fair to good because of slow seepage rates when compacted	Poor to fair, high compressibility, low seepage, fair to poor compaction	Severe — very slow effluent absorption rates
Balmoral	Ba(P)	Fair	Not suitable	Poor	High water table, fair to poor bearing capacity, and low shear strength	High water table, fair to poor bearing capacity, low shear strength, high risk of frost heaving	Surface drainage and lowering of water table needed	High water table, slow seepage rate, suited for dugouts	Slow permeability, material is variable, poor compaction properties	Severe; high water table, slowly permeable material within 24 inches of surface
Birch Bay	Bc	Fair	Not suitable	Fair to poor, mod. to high shrink-swell,	Fair; moderate limitation because of depth to bedrock, mod-	Fair; wide range of limitations due to seasonal high water	Surface drainage required	Severe; moderately slow permeability; bedrock 20 to 30 inches from	Fair to good; fair to poor compaction; slow permeability;	Severe; high seasonal water table; slow effluent absorption;

				very stony, mod. to high suscept-ibility to frost	erate clay content; mod-erate suscep-tibility to frost; moder-ate stoniness	table; moder-ate shrink-swell poten-tial; very stony; depth to bedrock		surface; very stony	medium com-pressibility; moderate to low shear strength	shallow to bedrock; very stony
Bradbury Complex	Bdx	Fair if mixed with mineral soil	Not suitable	Poor; organic soil	Poor; severe limitation because of poor drainage and very com-pressible material	Poor; severe limitation due to poor bear-ing strength; high compres-sibility	Surface drain age and lower ing of water table required	Severe; organic soil; moder-ately slow seepage	Not suitable; organic soil	Severe; high water table for most of the year
Baynham Complex	Bmx	Poor; fair if mixed with mineral material	Not suitable	Not suitable	High water table, organic material is unstable and should be removed	High water table, unstable organic mater-ial; very high compres-sibility	Controlled drainage desired, mater-ial subject to subsidence if over-drained	High water table, rapid seepage rate, suited for dugouts substratum slowly per-meable	Not suitable	Severe; high water table
Berry Island	By(P)	Poor, sand and gravel texture	Fair to poor, shallow depth of sand and gravel (6 to 30 inches)	Fair to good sur-face; fair sub-surface; moderate shrink-swell, Cl tex-ture, very stony	Severe; high water table and poor drainage; very stony	Severe; high water table	Surface draing-age and lower-ing of water table required	Severe; high water table; surface has rapid permea-bility; sub-surface very stony, moder-ate permea-bility	Fair to good surface 2 feet; fair to poor subsoil; mod-erate shrink-swell-; mod-erate suscep-tibility to piping	Severe; depth to water table at or near surface for long periods in spring and early summer; very stony subsoil
Cayer	Cax	Fair if mixed with mineral material	Not suitable	Organic layers not suitable; under-lying mineral soil is fair to poor	High water table, organic lay-ers are not suitable as a road base and should be removed	Low bearing strength in upper 16 to 52 inches and medium below; high water table	Drainage needed to lower water table; open ditches can be used	High water table, suited for dugouts, substratum slowly per-meable	Organic layers are unsuitable substratum is slowly per-meable	Severe; high water table

TABLE 59 Cont'd.
Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability: Topsoil	Suitability: Sand and Gravel	Soil Features Affecting — Road fill	Road Location	Foundation Construction	Agricultural Drainage	Water Retention Structures: Reservoir Area	Water Retention Structures: Embankment	Soil Limitations for use as septic tank filter field
Colby	Cb	Fair surface 30 inches	Poor for sand from 0 to 24 inches	Good for surface 0 to 24 inches; fair subsurface; moderate shrink-swell	Moderate surface due to high water table; moderate subsoil, somewhat poor drainage	Moderate limitation due to imperfect drainage	Surface drainage and lowering of water table required	Moderate; high water table, rapid permeability in surface layer	Moderate; surface rapidly permeable and good compaction; subsurface slowly permeable, fair compaction characteristics	Moderate; seasonal high water table subsoil slow effluent absorption
Chitek	Ci	Poor; thin stony surface horizons.	Not suitable	Fair; difficult to compact at all moisture contents, stony	Unstable road bed at high moisture contents, risk of frost heaving; seasonally high water table, moderately stony to exceedingly stony	Medium bearing strength and shrink-swell potential; high risk of frost heaving	Needed in places to lower water table	Moderately slow seepage rate	Moderately slow seepage rate; fair compaction properties	Severe; moderately slow permeability; seasonal high water table
Caliento	Co	Poor	Poor for sand from 0 to 24 inches	Fair to good surface; poor to fair subsurface	Moderate; somewhat poorly drained; subsurface unstable at high moisture content and very stony	Moderate due to drainage, subsurface has moderate shrink-swell potential; very stony; moderate frost heave	Needed to lower water table	Severe; surface rapid permeability; subsurface very stony and moderately slow seepage rate	Fair compaction properties in surface, poor in subsoil; moderate permeability	Moderate; seasonal high water table; subsoil has slow effluent absorption rate
Crane	Cx	Fair if mixed with mineral material	Not suitable	Organic layers not suitable; underlying till is fair	High water table, organic layers are not suitable as a road base and should be removed	Low bearing strength in upper 16 to 52 inches and medium below; high water table	Drainage needed to lower water table, open ditches can be used, the mineral soil is moderately stony	High water table, suitable for dugouts, substratum has moderately slow permeability	Organic layers are unsuitable; substream has moderately slow permeability	Severe; high water table

Dencross	Dc	Fair, clayey texture affects tilth	Not suitable	Poor; very compressible, poor workability	Severe; high shrink-swell potential; high susceptibility to frost action	Severe, high shrink-swell potential; very compressible, poor strength when wet	Surface drainage required	Slight, impermeable when compacted	Fair to poor compaction; low seepage rate, high compressibility, medium to low strength	Severe; slow to very slow effluent absorption rate
Devils Lake	Dl	Poor	Not suitable	Fair material between 20 to 30 inches of surface	Shallow to bedrock; rock is likely to interfere with cuts and fills, excessively stony	Medium bearing strength and shrink-swell potential, very low risk of frost heaving	Not needed	Shallow to bedrock; topographic position unsuitable, cannot be excavated	Unsuitable due to shallow depth of material and extreme rockiness	Severe; bedrock at a depth of 20 to 30 inches
Davis Point	Dp	Poor for clayey textures, fair for sandy soils	Not suitable	Poor; low shear strength & bearing strength, poor workability	Plastic clayey material is unstable and slippery when wet, fair to poor bearing strength and low shear strength, moderately stony	Fair to poor bearing strength, high volume change and compressibility	Not needed	Slow seepage rate, suited for dugouts	Good; slow seepage rates; high shrink-swell and poor compaction properties	Severe; seasonal high water table, slowly permeable material
Denbeigh Complex	Dx	Poor; fibrous sphagnum moss peat	Not suitable	Not suitable; 5 to more than 10 feet of organic soil	Severe; high water table, organic layers very compressible; subsurface moderate strength but very stony	Sever: high water table, very compressible organic soils	Required to lower water table 18 to 36 inches from surface, subsoil very stony	Severe; high water table, unstable, very compressible organic soil; seepage moderately slow to slow	Unsuitable	Severe; high water table
Egg Island	Ei	Fair surface if mixed with organic matter	Not suitable	Poor, clay to 2 feet, bedrock	Severe; high shrink-swell potential; rock at 2 feet would interfere with cut and fill	Severe; clay surface has poor strength and high shrink-swell potential; very compressible; bedrock near surface adds strength	Not required	Severe; depth to bedrock is very shallow, surface impermeable when compacted	Unsuitable due to shallow depth of clay over bedrock	Severe; slow effluent absorbtion rate and bedrock near surface

TABLE 59 Cont'd.
Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability		Soil Features Affecting —						Soil Limitations for use as septic tank filter field
								Water Retention Structures		
		Topsoil	Sand and Gravel	Road fill	Road Location	Foundation Construction	Agricultural Drainage	Reservoir Area	Embankment	
Fairford	Fd	Poor	Not suitable	Fair; difficult to compact; unstable when wet, stony	At high moisture contents has low stability and bearing strength; risk of frost heaving, very stony to excessively stony	Medium bearing strength and shrink-swell potential; high risk of frost heaving	Not needed	Moderately slow permeability	Fair compaction; moderately slow permeability	Moderate: moderately slow permeability
Fisher	Fi	Fair	Poor	Poor	Flooding, high water table	Variable	Drainage needed but of little value unless areas are protected from flooding	Coarser strata can cause seepage	Variable material	Severe: high water table and periodic hazard of flooding
Faulkner	Fk	Poor	Not suitable	Fair material between 20 to 30 inches os surface	Shallow to bedrock; rock is likely to interfere with cuts and fills, excessively stony	Medium bearing strength and shrink-swell potential, very low risk of frost heaving	Not needed	Shallow to bedrock, topographic position not suitable, cannot be excavated	Unsuitable due to shallow depth of material and extreme rockiness	Severe: bedrock at a depth of 20 to 30 inches
Foley	Fo	Poor	Good for sand	Good	High water table, no volume change, difficult to compact, organic surface layer is unstable	Good bearing strength when confined; high risk of frost heaving	Needed to remove surface water and lower water table, open ditches can be used	High water table, rapid Permeability, occurs in depressions	Rapid seepage rate	Severe: high water table, rapid permeability

Framnes	Fr	Fair, clay surface texture affects tilth	Not suitable	Poor; very compressible poor workability	Severe; high shrink-swell potential very compressible; susceptible to frost heave	Severe; high shrink-swell; bearing strength low when wet; very compressible	Surface drainage	Slight, impermeable when compacted	Fair to poor compaction; low seepage, high compressibility, medium to low strength	Severe; slow effluent absorption rate
Fisherton	Ft	Fair	Not suitable	Fair to poor; moderate shrink-swell potential, high susceptibility to frost heave	Moderate; shrink-swell moderate; high susceptibility to frost	Moderate; somewhat poorly drained, CI to CH Unified group, very stony below 2 to 3 feet of the surface	Surface drainage required	Moderate; permeability moderately slow; compressible	Fair compaction, low permeability medium compressibility, medium strength	Moderate: moderate effluent absorption rate, very stony below 2 to 3 feet
Fyala	Fy	Poor; clay texture	Not suitable	Poor; very plastic clay, very compressible, low strength when wet	Severe; high water table; high shrink-swell potential	Poor; high water table very compressible; low strength when wet	Required to lower water table	Slight, very impermeable when compact	Poor to fair compaction characteristics; low strength when wet; high compressibility	Severe; high water table very slow absorption rate
Garson	Ga	Poor	Not suitable	Fair difficult to compact, unstable at high moisture content, stony	At high moisture content has low stability and bearing strength; risk of frost heaving, very stony to excessively stony	Medium bearing strength and shrink-swell potential; high risk of frost heaving	Not needed	Moderately slow permeability	Fair compaction; moderately slow permeability	Moderate; moderately slow permeability
Grindstone	Gdx	Poor; fair if mixed with mineral material	Not suitable	Not suitable	High water table; organic material is unstable and should be removed	High water table, unstable organic material; high compressibility	Controlled drainage; material is subject to subsidence if overdrained; underlying material soil is stony	High water table, rapid seepage rate; suited for dugouts, substrata moderately permeable	Not suitable	Severe; high water table

TABLE 59 Cont'd.
Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability			Soil Features Affecting —					Soil Limitations for use as septic tank filter field
		Topsoil	Sand and Gravel	Road fill	Road Location	Foundation Construction	Agricultural Drainage	Water Retention Structures: Reservoir Area	Water Retention Structures: Embankment	
Goose Island	Gox	Poor	Good for gravel	Good material for depths up to 30 inches	Periodic high water table but solid bed; underlying material is moderately stony	High bearing strength; low shrink-swell potential; high risk of frost heaving in substrata	Needed in places to lower water table	Rapid permeability high loss from seepage	Rapid seepage	Severe; seasonal high water table; rapid permeability
Gunton Complex	Gux	Poor	Good for a depth of 6 to about 30 inches	Good material for depths up to 30 inches	Upper material is highly stable to wheel loads, underlying material is unstable and stony	High bearing strength, low shrink-swell potential, material with moderate shrink-swell potential underlies sand and gravel	Not needed	Very rapid seepage in surface mater-ials; subsur-face material has moderately slow permea-bility	Very rapid permeability	Moderate: very rapid permeability in surface materials moderately permeable in lower material
Hodgson	H	Fair	Not suitable	Poor, variable textures, in CI in CH group, moderate to high shrinkswell potential, variable strength	Severe; low bearing strength when wet; suscept-ible to frost heave; moder-ate to high shrink-swell potential	Poor; fair to poor bearing strength and shrink-swell potential is moderate to high	Not required	Moderate; variable seepage ratio due to vertical stratification of the material	Fair compac-tion; medium to low bearing strength, medium to high compressibility	Moderate; moderate effluent absorption rate
Harwill	Ha	Fair	Not suitable	Fair; moderate bearing strength; moderate to high shrink-swell potential	Severe; un-stable when wet; low bear-ing strength with high mois-ture content; high risk of frost heave	Fair to Poor: very compressible; medium to low strength	Not required	Good; slow permeability when wet	Fair; fair compaction characteristics; compressible	Moderate; moderately slow effluent absorption rate

Homebrook	Hb	Poor because of clayey textures, fair for sandy soils	Not suitable	Poor shear strength, workability and bearing strength at high moisture contents	Plastic clayey material is unstable and slippery when wet, fair to poor bearing and shear strength, difficult to compact, moderately stony	Fair to poor bearing strength, high volume change and compressibility	Not needed	Slow seepage rates; suitable for dugouts	Slow seepage rate, poor compaction properties at high moisture contents, high shrink-swell potential	Severe; very slowly permeable material
Holditch	Hdx	Fair if mixed with mineral material	Not suitable	Not suitable	High water table, organic layers unstable and should be removed	High water table, low bearing strength and unstable in upper 16 to 52 inches	Drainage needed to lower water table; underlying rock is unsuitable	High water table; suitable for dugouts; underlying rock may be permeable due to cracks	Unsuitable	Severe; high water table
Harcus	Hc	Poor, low organic matter content	Fair for sand, top several feet	Good; top several feet consists of SP fine sand	Good to Fair; shallow depth of sand to bedrock	Good; high bearing strength; low compressibility, low shrink-swell-potential	Not required	Poor; rapid seepage	Poor to not suitable because of bedrock near surface	Severe; surface two feet rapidly permeable; bedrock a severe limitation to installation
Hilbre	Hi	Not suitable	Not suitable	Shallow to bedrock, excessively stony	Shallow to bedrock; rock is likely to interfere with cuts and fills, exceedingly stony	Medium bearing strength and shrink-swell potential; very low risk of frost heaving	Not needed	Topography not suited; too shallow to bedrock, cannot be excavated	Shallow depth of material to bedrock	Severe; bedorck within 20 to 30 inches of surface
Inwood	In	Poor due to thin surface horizon and stones	Not suitable	Fair, difficult to compact, stony	Unstable road bed at high moisture contents; high risk of frost heaving; seasonally high water table, moderately stony to exceedingly stony	Medium bearing strength and shrink-swell potential; high risk of frost heaving	Needed in places to lower water table	Moderately slow seepage rate	Moderately slow seepage rate, fair compaction	Severe; seasonal high water table, moderately slow permeability

TABLE 59 Cont'd.
Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability			Soil Features Affecting —					Soil Limitations for use as septic tank filter field
								Water Retention Structures		
		Topsoil	Sand and Gravel	Road fill	Road Location	Foundation Construction	Agricultural Drainage	Reservoir Area	Embankment	
Janora	Jax	Poor; fair if mixed with mineral material	Not suitable	Not suitable	High water table, organic material is unstable and should be removed	High water table, unstable organic material; very high compress-ibility	Controlled drainage; material is subject to subsidence if overdrained; underlying bed-rock is not suitable	High water table; rapid seepage rate; suited for dug-outs; underlying rock may be permeable due to cracks	Not suitable	Severe: high water table
Julius	JX	Not suitable, material is fibrous and resis-tant to decompo-sition	Not suitable	Not suitable	High water table, organic material is unstable and should be removed	High water table	Drainage needed to control water table; organic material is highly acid and not suit-able for normal agriculture	High water table; rapid seepage rate	Not suitable	Severe: high water table
Kircro	Kcx	Poor, fibric sphagnum moss peat	Not suitable	Not suitable, 5 to more than 10 ft. of very com-pressible organic acid over-lying SP to SC material	Severe; very compresible, high water table; sandy mineral soil substrate good bearing strength and low compress-ibility	Severe; high water table, very compress-ible organic soil	Required to lower water table 18 to 36 inches from surface	Severe; high water table; seepage very rapid	Not suitable; highly com-pressible	Severe; high water table
Kilkenny	Kx	Not suitable, organic material is fibrous and resis-tant to decomposition	Not suitable	Not suitable	High water table; organic material is unstable and highly compress-ible and should be removed	High water table, material is very com-pressible	Drainage needed to control water table; organic material is highly acid; underlying material is stony	High water table; rapid seepage rate	Not suitable	Severe; high water table

Kinwow	Ki	Poor	Not suitable	Poor shear strength, work ability and bearing strength at high moisture contents	Upper 6 to 30 inches of clayey material is unstable and slippery when wet; it has fair to poor bearing and shear strength, is difficult to compact; underlying material has fair to good construction properties, moderately stony	Fair to poor bearing strength, high volume change and compress-ibility in upper 6 to 30 inches; under-lying material has medium bearing strength and shrink-swell potential	Not needed	Slow seepage rate in sur-face material; moderately slow seepage rate in under-lying material	Upper material has slow seepage rate but poor com-paction prop-erties at high moisture content; under-lying material has a moderately slow seepage rate and fair workability	Moderate: upper 6 to 30 inches is very slowly permeable; material below this has moderately slow permea-bility
Kerry	Ky	Poor, low organic matter content	Fair for sand	Good, good bearing strength; low com-pressi-bility	Poor, high water table	Poor, high water table	Required to lower water table	Poor, high water table, rapid seepage rate	Fair to good, good compaction characteristics, low compress-ibility	Severe: high water table
Lakeland	La, La(sa)	Fair, the saline phase soils are poor	Not suitable	Poor, upper material is plastic	Occasional high water table, soil material has low bearing strength, high risk of frost heaving	Occasional high water table, low bearing strength and medium shrink-swell poten-tial, high risk of frost heaving	Needed in places to lower water table; some surface drainage needed	Moderately slow permea-bility; moderate seepage at lower depths	Material at lower depths usually has moderate seepage	Severe: seasonal high water table, moderately slow permeability
Lynx Bay	Lbx	Poor, gravelly	Good, top 1 to 2 feet	Good, top 1 to 2 feet	Fair; shallow depth to lime-stone bedrock	Slight; top 2 feet SP, GP, low shrink-swell potential good bearing strength	Not required	Poor, rapid seepage rate in surface material, bed-rock at shallow depths	Good surface 2 feet, bedrock at shallow depths	Severe: bedrock at shallow depth
Ledwyn	Le	Fair	Not suitable	Poor; low bearing strength unstable when wet	Fair to poor, low bearing strength when wet, compress-ible; risk of frost heaving high	Moderate to severe; medium strength; com-pressible; moderate to high shrink-swell potential	Surface drainage required	Good, slow seepage ratio	Fair to poor compaction characteristics	Severe: slow effluent absorption rate, seasonal high water table

TABLE 59 Cont'd.
Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability		Soil Features Affecting —						Soil Limitations for use as septic tank filter field
		Topsoil	Sand and Gravel	Road fill	Road Location	Foundation Construction	Agricultural Drainage	Water Retention Structures: Reservoir Area	Water Retention Structures: Embankment	
Lee Lake	Lk(P)	Poor	Not suitable	Fair to poor material for depth of 20 to 30 inches	Poor, high water table; shallow to bedrock, moderately stony to exceedingly stony	Severe, high water table, medium bearing strength and shrink-swell potential	Drainage needed to remove surface water and lower water table	Poor, shallow to bedrock, underlying rock may be permeable due to cracks	Poor, moderately slow seepage rate; shallow depth of material	Severe: high water table; bedrock at 20 to 30 inches
Lonesand	Lo	Poor, low organic matter content	Good for sand	Good; good bearing strength; low shrink-swell; low susceptibility to frost heave	Fair; good bearing strength; low compressibility	Moderate; high seasons water table; low shrink-swell potential	Needed to lower water table in places	Poor, high water table; rapid seepage rate	Good compaction characteristics, low compressibility	Severe: high water table
Long Point	Lp	Poor	Good	Good	Slight, soil properties are generally favourable; upper material is highly stable; underlying material is unstable	Slight, high bearing strength; low shrink-swell potential, material with moderate shrink-swell potential underlies sand and gravel	Not needed	Poor, very rapid permeability	Good compaction characteristics, low compressibility	Moderate: very rapid permeability in surface material, moderate permeability in lower material
Lettonia	Lt	Poor, clay texture	Not suitable	Poor, plastic clay; high shrink-swell; high susceptibility to frost heave	Severe, high shrink-swell potential; high susceptibility to frost heave	Severe, high shrink-swell potential; low bearing strength when wet	Not required	Good, very slow seepage rate	Poor compaction properties, very compressible	Severe: slow effluent absorption rate

Lundar	Lu	Poor, very stony	Not suitable	Fair, medium strength; moderate shrink-swell potential and suscept-ible to frost heave	Moderate, very stony; med-ium strength; moderate shrink-swell	Moderate; medium strength and shrink-swell potential	Needed to lower water table	Good, slow seepage	Fair compac-tion properties, moderate com-pressibility very stony	Severe: seasonal high water table, slow effluent absorption rate
Leary	Lyx	Poor	Good	Good	Gravelly soils, highly stable under wheel loads	High bearing strength, low shrink-swell potential; very low risk of frost heaving	Not needed	Very rapid permeability, excessive seepage	Rapid permeability	Slight: very rapid permeability, some contamina-tion hazard by effluent
McArthur	Mc	Poor, low organic matter content	Not suitable	Fair, medium to good bearing strength, low suscept-ibility to frost heave	Moderate; very stony, good bearing strength, low shrink-swell potential	Moderate; very stony, good bearing strength, low shrink-swell	Not required	Poor, rapid seepage	Good compac-tion proper-ties, low compressibility, very stony	Moderate: very stony
Macawber	Mcx	Fair when mixed with mineral soil	Not suitable	Not suitable	Severe, high water table, organic material is highly compress-ible and should be removed	Severe, high water table, limestone bed-rock between 24 to 64 inches of the surface	Drainage needed to control water table, underlying rock substrate is not suited to agriculture	Poor, high water table, moderate seepage rate	Not suitable, very compress-ible	Severe: high water table
Mantagao	Mg	Poor, clay texture	suitable	Poor, clay surface is com-pressible; substrate is very stony, suscept-ible to frost heave	Severe, high shrink-swell; high suscept-ibility to frost heave	Severe, low bearing strength when wet, very stony	Needed to lower water table	Good, very slow seepage rate	Poor compac-tion, very compressible, very stony	Severe: very slow effluent absorption rate

TABLE 59 Cont'd.
Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability: Topsoil	Suitability: Sand and Gravel	Suitability: Road fill	Soil Features Affecting — Road Location	Soil Features Affecting — Foundation Construction	Soil Features Affecting — Agricultural Drainage	Water Retention Structures: Reservoir Area	Water Retention Structures: Embankment	Soil Limitations for use as septic tank filter field
Marsh	Mh	Poor	Not suitable	Not suitable	Not suitable, unstable due to high organic and silt content; high water table	Severe, high water table, unstable material	Not suited to agriculture	Poor, high water table; can be used as natural wildlife marshes without improvement	Material is not stable	Severe: high water table
Meleb	Ml Ml(P)	Poor	Not suitable	Fair to poor, silty materials are unstable; stony	Severe; high water table, very high risk of frost heaving; organic surface layer is unstable, moderately stony to exceedingly stony	Severe; high water table; medium bearing strength and shrink-swell potential; high risk of frost heaving	Drainage needed to remove surface water and lower water table	Fair, moderately slow seepage rate; occurs in natural depressions	Fair to good compaction; silty lenses and unstable in places, very stony	Severe: high water table, moderately slow permeability
Malonton	Mn(P)	Poor	Good for sand	Good	Severe, high water table, no volume change, organic surface layer is unstable	Severe, good bearing strength when confined; high water table	Needed to remove surface water and lower water table	Severe, high water table, rapid permeability; occurs in depressions	Good compaction properties	Severe: high water table rapid permeability
Molson	Mx	Not suitable	Not suitable	Not suitable	Severe, high water table; organic material is unstable and highly compressible and should be removed	Severe, high water table; material is very compressible	Drainage needed to control water table; organic material is highly acid	Severe, high water table; organic material has rapid seepage rate; underlying material slow to very slow permeability	Organic material not suited	Severe: high water table

McCreary	My	Fair	Not suitable	Poor, upper material is plastic; underlying lying is fair to good	Moderate; occasional high water table; high risk of frost heaving; upper material has low bearing strength; lower material is unstable at high moisture contents but has medium bearing strength and is moderately stony	Moderate; occasional high water table; high risk of frost heaving; upper material has low bearing strength and medium shrink-swell potential; underlying material has medium bearing strength and shrink-swell potential	Needed in places to lower water table; some surface drainage needed	Moderate; moderately slow permeability	Fair; has fair compaction properties; upper material is plastic and very compressible	Severe: seasonal high water table; moderately slow permeability
Okno	Ox	Poor; fair if mixed with mineral material	Not suitable	Not suitable	Severe; high water table; organic material is unstable and should be removed	Severe; high water table; unstable organic material with high compressibility	Controlled drainage to avoid subsidence, underlying mineral material is suitable	Not suitable; high water table; rapid seepage rate; substrata moderately permeable	Not suitable	Severe: high water table
Pinawa	Pa	Poor, low organic matter content	Not suitable	Fair, very stony, good bearing strength	Moderate; very stony, good bearing strength; low susceptibility to frost heave	Moderate; very stony, good bearing strength; low shrink-swell potential	Required to lower water table	Poor; rapid seepage; seasonal high water table	Good compaction properties; low compressibility	Severe: very stony, seasonal high water table
Partridge Creek	Pc Pc(P)	Poor because of clayey textures	Not suitable	Poor; low shear strength and bearing strength, poor workability	Severe; high water table fair to poor bearing strength, low shear strength high volume change	Severe; high water table, fair to poor bearing strength, high volume change, high risk of frost heaving	Drainage needed to lower water table; open ditches can be used	Severe; high water table, slow seepage rate suited for dugouts	Poor compaction properties, slow seepage rate, high volume change	Severe: high water table, very slowly permeable material
Peguis	Pe	Fair	Not suitable	Poor; clay texture	Severe, high shrink-swell potential; poor workability, susceptible to frost heave	Severe, high shrink-swell; medium bearing strength; subsoil very stony	Surface drainage required	Good, very slow seepage rate	Poor, very stony; very compressible, poor compaction	Severe: very slow effluent absorption rate; seasonal high water table

TABLE 59 Cont'd.
Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability			Soil Features Affecting —					Soil Limitations for use as septic tank filter field
								Water Retention Structures		
		Topsoil	Sand and Gravel	Road fill	Road Location	Foundation Construction	Agricultural Drainage	Reservoir Area	Embankment	
Pineimuta	Pi Pi(P)	Fair	Not suitable	Poor	Severe; high water table, poor bearing capacity to 24 inches, fair bearing capacity and shear strength beyond 24 inches of surface	Severe; high water table, fair to poor bearing capacity and shear strength, high risk of frost heaving	Surface drainage and lowering of water table needed	Fair, high water table, slow seepage rate, suited for dugouts	Poor, surface 2 feet is variable and has poor compaction properties	Severe: high water table and slowly permeable material
Punk	Pk	Poor, low organic matter content	Poor, shallow over bedrock	Poor, shallow over bedrock	Moderate; shallow sand over bedrock, good bearing strength	Moderate; shallow sand over bedrock	Not required	Poor; rapid seepage, shallow over bedrock	Poor, shallow over bedrock	Moderate: shallow over bedorck
Pine Ridge	Pr	Poor, low organic matter content	Good for sand	Good, low shrink-swell; low susceptibility to frost heave; good bearing strength	Slight; low shrink-swell; good bearing strength	Slight; low shrink-swell; good bearing strength	Not required	Poor; very rapid seepage	Good compaction properties; low compressibility	Slight: rapid effluent absorption rate
Rock	R	Not suitable	Not suitable	Not suitable	Usually well drained; suitable fill for road base required; some cuts are needed	Not suitable if excavation required for basements	Not suitable for agriculture	Not suitable	Not suitable	Severe: bedrock at the surface
Rat Lake	Rk	Poor, clay texture	Not suitable	Poor, shallow clay over bedrock	Severe; shallow clay over bedrock	Severe; shallow clay over bedrock	Not required	Poor; shallow over bedrock	Poor; shallow clay over bedorck	Severe: very slow effluent absorption, shallow to bedrock

Rosenburg	Rs	Poor, clay texture	Not suitable	Poor, shallow over bedrock	Severe; shallow clay over bedrock	Severe; shallow clay over bedrock	Surface drainage required	Poor, shallow clay over bedrock	Poor, shallow plastic clay over bedrock	Severe: very slow effluent absorption; shallow to bedrock
Rat River	Rr	Good if mixed with mineral soil	Not suitable	Not suitable; organic soil	Not suitable; highly com- pressible organic soil; underlain by SP mineral substrate	Not suitable; highly com- pressible; very low bearing strength	Required to lower water table	Not suitable; seepage rate moderately slow; high water table	Not suitable; very compress- ible; low bearing strength	Severe: high water table
Sandilands	S	Poor, low organic matter content	Good for sand	Good; low com- press- ibility; low shrink- swell; low suscept- ibility to frost heave	Slight; good bearing strength, low shrink-swell potential	Slight; low shrink-swell potential; low compressibility; good bearing strength	Not required	Poor, rapid seepage rate	Good compac- tion; low compressibility	Slight: rapid effluent absorption rate
Sand Beaches	Sb	Poor	Good for sand	Good, low compress- ibility; low shrink- swell potential; low frost heave potential	Slight; good bearing strength; low shrink-swell potential; low susceptibility to frost heave	Slight; low shrink-swell potential; low compressibility	Not required	Poor; rapid seepage rate	Good compac- tion; low compressibility	Slight: rapid effluent absorption rate
Stead	Sdx	Fair if mixed with mineral matter	Not suitable	Organic material not suitable	High water table; organic material is not suitable as a road base and should be removed; under- lying mineral material is fair to poor	Not suitable; low bearing strength; high compressibility unstable	Controlled drainage needed to lower water table; material subject to subsidence	Poor; high water table; rapid seepage rate, suited for dugouts	Not suitable; organic soil highly com- pressible	Severe: high water table

TABLE 59 Cont'd.
Engineering Interpretations of Soils of the Red Rose-Washow Bay Area

Soil Name	Map Symbol	Suitability: Topsoil	Suitability: Sand and Gravel	Suitability: Road fill	Soil Features Affecting — Road Location	Soil Features Affecting — Foundation Construction	Soil Features Affecting — Agricultural Drainage	Soil Features Affecting — Water Retention Structures: Reservoir Area	Soil Features Affecting — Water Retention Structures: Embankment	Soil Limitations for use as septic tank filter field
St. Labre	Sl	Poor	Poor for sand, Shallow SP material over stony till	Good; surface has good bearing strength; subsurface moderate strength but is very stony	Slight; good bearing strength; low to moderate shrink-swell; very stony subsoil	Slight; good bearing strength; low to moderate shrink-swell potential; stony subsoil	Not required	Poor surface; moderate sub-soil soil; seepage rates vary from rapid to slow	Good to fair compaction properties; moderate strength; low to moderate compressibility	Moderate: rapid to slow effluent absorption rate; very stony subsoil
Sproule	Slx	Fair when mixed with mineral soil	Not suitable, organic soil	Not suitable, 5 to more than 10 feet of organic soil over SP to ML material	Not suitable; high water table; highly compressible; low bearing strength	Not suitable; high water table; highly compressible; low bearing strength	Required to lower water table	Not suitable; organic soil	Not suitable; highly com-pressible organic soil	Severe: high water table
Spearhill Complex	Spx	Poor	Good	Good	Moderate; high seasonal water table; low stress	Moderate; high seasonal water table	Required to lower water table	Poor; rapid seepage rate	Good compac-tion properties; low compres-sibility	Moderate; high seasonal water table
Sprague	Sr Sr(P)	Poor	Poor for sand	Poor; poorly drained; thin sand layer over moderate strength CL, very stony, till	Severe; high water table; moderate bearing strength; high susceptibility to frost heave	Severe; high water table; low strength when wet; very stony subsoil	Required to lower table table	Poor; high water table; rapid seepage rate in surface soil	Fair to poor compaction; moderate to low com-pressibility	Severe; high water table; very stony subsoil

Sand River	Srx	Poor	Not suitable 2 to 5 feet organic soil over SP to ML mineral soil	Not suitable, organic soil	Not suitable; highly compressible organic soil; low bearing strength	Not suitable; highly compressible organic soil; low bearing strength	Required to lower water table	Not suitable organic soil	Not suitable; highly compressible organic soil	Severe: high water table
Sundown	Su(P)	Poor	Fair for gravel; poorly drained	Fair for road fill, high water table, poorly drained	Severe; poorly drained, high water table; good bearing strength	Severe; poorly drained; high water table; good bearing strength; low compressibility	Required to lower water table	Poor, high water table; rapid seepage rate	Good compaction properties, low compressibility	Severe: high water table
Tarno	Ta Ta(P)	Poor, clay texture	Not suitable	Poor; high shrink-swell potential, poor compaction properties, low strength when wet	Severe; poorly drained; high shrink-swell potential; highly susceptible to frost heave	Severe; poorly drained; high shrink-swell potential; low strength when wet	Required to lower water table and surface runoff	Good; very slow seepage rates	Poor compaction characteristics, very compressible; low strength when wet	Severe: very slow effluent absorption rate and high water table
Thickwood	Tk(P)	Poor, clay texture	Not suitable	Poor, poorly drained, shallow clay deposit over limestone bedrock	Severe; poorly drained; surface has high shrink-swell potential; shallow to bedrock	Severe; poorly drained; shallow to bedrock	Required to lower water table	Poor; shallow to bedrock	Poor compaction properties in the surface; shallow to bedrock	Severe: high water table; slow permeability; shallow to bedrock
Woodridge	Wx	Poor	Good for gravel	Good; low compressibility, low frost heave potential	Slight; gravelly soils highly stable under wheel loads	Slight; high bearing strength, low shrink-swell potential, very low risk of frost heaving	Not needed	Poor; very rapid permeability, exessive seepage, topography not suitable	Good compaction properties; low compressibility	Slight: very rapid permeability, contamination hazard by effluent

and shear strength and low shrink-swell potential. Susceptibility to frost action is low.

These soils are also suitable as fields for septic tanks because they have good permeability, are not affected by a high water table and absorb sewage effluent fairly rapidly. As these gravelly soils may permit inadequately filtered sewage effluent to travel considerable distances, care must be used to keep the effluent from contaminating nearby water supplies.

In landscaping these soils, a top dressing of loamy material is needed before seeding grass or sodding. Some irrigation may be necessary to overcome seasonal droughtiness.

GROUP 2

This group consists of deep, imperfectly drained, coarse to moderately coarse textured soils. These soils are level to gently undulating and have a seasonal high water table. The depth of the sandy sediments generally ranges from three to about five or six feet. These sediments are usually underlain by moderately permeable glacial till. The soils in this group include:

	Acres	Percent of Total Area
Lonesand	2,035	0.12
Spearhill Complex	74	—
	2,109	0.12

Soils in this group are only fair for building sites because of the seasonal high water table. They have rapid permeability, low shrink-swell potential and compact readily. These soils become unstable and have a low bearing strength when saturated. Adequate drainage must be provided to avoid wet basements and improper functioning of on-site sewage disposal systems.

The soils in this group are not suitable for use as sepic tank filter fields because of the seasonal high water tahle. If used for this purpose, the distribution lines would be below water for significant periods, particularly in seasons of high rainfall.

These soils are good for landscaping, but would benefit from a top dressing of loamy textured soil or addition of manure.

GROUP 3

This group consists of well drained, medium textured, very stony glacial till soils; stony, clay textured glacial till soils; thin, clay textured soils that overlie the medium textured, stony till; and thin, sandy and gravelly soils that overlie the stony glacial till. While the surface texture of this group of soils ranges from loamy gravel to clay their subsurface soils are, on the other hand, rather uniform.

They are quite hard when dry and firm when moist. Workability as construction materials varies from fair to poor with degree of stoniness. Permeability is moderately slow to slow. High water table is not a problem in these soils. The soils included in this group are:

	Acres	Percent of Total Area
Arnes	60,290	3.42
Fairford	139,845	7.94
Garson	9,014	0.51
Gunton	5,075	0.29
Homebrook	6,461	0.37
Kinwow	25,687	1.46
Long Point	2,600	0.15
McArthur	7,348	0.42
St. Labre	4,331	0.25
	260,651	14.81

The agricultural suitability of these soils ranges from good to poor for the till soils depending on the degree of surface stoniness. The thin gravelly deposits over the till are somewhat droughty. The clayey soils have variable problems of tilth and stoniness.

The soils in this group have fair bearing capacity when used as foundations for buildings. These soils have a moderately high to high shrink-swell potential and have a moderately high susceptibility to frost action.

These well drained soils have moderate to severe limitations for septic tank filter fields because of moderately slow to slow rate of effluent absorption in their subsurface layers. The soils having the sandy to gravelly textured surface hosrizons would be somewhat more suitable than those having clayey textured surface horizons.

Most of the soils in this group are fairly good for landscaping where surface stones have been removed. Soils having the clay textured surface horizons may be somewhat more difficult to work. The soils having the sandy and gravelly textured surfaces are somehwat droughty and less fertile and would benefit from a dressing of black, loamy textured, topsoil.

GROUP 4

The soils in this group are comprised of imperfectly drained, medium textured, very stony, glacial till soils; stony clay textured, glacial till soils; and medium textured, glacial till soils having a thin veneer of lacustrine and outwash sediments that range in texture from clay to sand and gravel. While surface texture of this group of soils vary widely, their subsurface horizons are on the other hand, rather uniform, ranging from loamy sand to clay in texture and in being very stony. The soils included in this group are:

	Acres	Percent of Total Area
Caliento	3,858	0.22
Colby	12	—
Chitek	27,028	1.54

Davis Point	5,477	0.31
Fisherton	2,674	0.15
Goose Island	5,694	0.32
Inwood	83,094	4,72
Lundar	333	.02
Mantagao	1,587	.09
McCreary	3,243	.18
Peguis	117,051	6.65
Pinawa	1,360	.08
	251,411	14.28

They are quite hard when dry and firm when moist. Workability as construction material varies from fair to poor with the degree of stoniness. Permeability varies from rapid to moderately slow in the surface materials and is moderately slow in all the subsurface materials. All the soils of this group have a seasonal high water table.

The agricultural suitability of these soils ranges from good to poor for the till soils depending on the amount of surface stoniness. The David Point, Fisherton, Mantagao, McCreary and Peguis soils, characterized by thin, clayey textured surface veneers are good agricultural soils. The Caliento, Colby and Goose Island soils have droughty, gravelly and sandy surface horizons and are not as suitable for agriculture.

Soils in this group make fair to poor sites for buildings because of seasonal high water table and slow runoff of meltwater in the spring. If these soils are used as building sites, some fill should be provided to raise the foundations above the spring water level and some artificial drainage should be provided. The subsurface material in all these soils has fair bearing capacity for foundations. They have a moderately high shrink-swell potential and have a high susceptibility to frost action.

These soils are not generally suitable for septic tank filter fields because of their high water table during spring runoff and the moderately slow permeability of the substrate materials.

The very stony Chitek, Inwood, Lundar and Pinawa soils require extensive stone removal in order to landscape. A loamy top dressing is needed for grass seeding and sod on all soils, but in particular, on the droughtier, less fertile sandy Caliento and gravelly Goose Island soils. Drainage must be improved on these soils to ensure runoff during the spring thaw period and after heavy summer rains.

GROUP 5

This group consists of well drained soils developed on stone-free, medium textured, lacustrine and alluvial sediments. All of the soils in this group occupy gently sloping terrain. The Harwill soils are usually found on upper and mid-slope positions in the ridged drumlin field in the southern section of the Red Rose map area. The Hodgson soils are found on well drained sites along the Fisher River. The soils included in this group are:

	Acres	Percent of Total Area
Harwill	4,769	0.27
Hodgson	2,122	0.12
	6,891	0.39

The depth of the sediments on which these soils have formed are rather shallow ranging from 3 or 4 feet to about 6 or 10 feet in thickness. These soils and their parent materials have moderately slow permeability, have moderate to moderately high shrink-swell potential, have low to medium bearing strength when wet and are fairly compressible.

These are good agricultural soils.

They provide fair to good sites for residences and other buildings because of their good natural drainage, moderate permeability and fair bearing strength.

All of these soils are very susceptible to frost heaving if they are wet.

The soils of this group have moderate limitation for use as filter fields for septic tanks because of their moderately slow to slow rate of effluent absorption.

Both the Harwill and Hodgson soils are very good for landscaping. Their soil profiles are, however, rather shallow and consequently are not very suitable as a source of topsoil for other soils.

GROUP 6

This group consists of imperfectly drained, medium to moderately fine textured soils of the Lakeland,Dencross, Framnes, Ledwyn and Fisher soils. All of the soils in this group occupy level to very gently sloping terrain and are affected by seasonal high water table. The depth of these deposits generally ranges from four to about six or seven feet. The soils included in this group are:

	Acres	Percent of Total Area
Dencross	2,299	0.13
Fisher	1,250	0.07
Framnes	1,204	0.07
Lakeland	7,187	0.41
Ledwyn	2,517	0.14
	14,457	0.82

These soils have moderately slow permeability and good to poor bearing strength.

They are good agricultural soils.

These soils provide only fair sites for residences and other buildings because of their moderately slow permeability, seasonal high water table and slow surface runoff of meltwater in the spring. The general suitability of these soils for foundations for low buildings is fair. Bearing capacity of the soils in this group is fair.

Susceptibility to frost action in all of these soils is high. If they are used for low building foundations, granular fill material should be used to raise the foundations above the water table.

The soils in this group are not suitable as fields for septic tanks. If they are used for this purpose, the distribution lines will be below the water table for significant periods during spring runoff.

All soils in this group are good for landscaping, although the clayey Dencross and Framnes may present some tilth problems because of their clayey textured surface horizons.

GROUP 7

This group consists of the deep, well drained, clay textured lacustrine soils of the Lettonia Series. They comprise 24,789 acres or about 1.41 percent of the map area. They occur on gently sloping terrain, have slow to very slow permeability, very high shrink-swell potential, low to moderate risk of drainage to concrete due to presence of sulphate salts in their subsoils and have a high moisture retention capacity. The water table in these soils is usually quite deep.

They are good agriculture soils having a tilth problem due to their clayey texture.

They are, on the other hand, only fair for building sites because of their low bearing strength when wet, their high shrink-swell potential depending on moisture content.

They have moderately severe limitations for septic tank filter fields because of their very slow effluent absorption rates.

The Lettonia soils are fair to good for landscaping, including grass seeding and sodding and the planting of shrubs and trees. They are, however, very plastic and very sticky when wet and must be worked only when they are moist.

GROUP 8

The soils in this group consist of deep, imperfectly drained, lacustrine clay soils of the Arborg Series. These soils comprise 51,547 acres or 2.93 percent of the map area. These soils occur on level terrain, have slow to very slow permeability and high moisture retention capacity. Runoff is very slow and some ponding in the spring and after heavy summer rains is common. The groundwater table is high in spring and gradually recedes to below six or eight feet by fall.

The Arborg soils are good agriculture soils, their main limitation being rather poor tilth characteristics when they are either too dry or too wet.

These soils only provide poor sites for buildings due to their very high shrink-swell potential, their rather low bearing strength when wet, their very slow permeability and their rather high compressibility characteristics.

They are unsuitable, or rather, have severe limitations for septic tank filter fields because of their impermeable nature and seasonal high water table. If these soils are used for residential sites, granular fill material should be used to raise the foundation above the water table. Artificial drainage must be provided.

These soils are only fair for landscaping as they become plastic and very sticky when wet and very hard and cloddy when dry.

GROUP 9

The soils in this group are well to imperfectly drained, very stony, soils that are underlain by relatively impermeable, flat-lying limestone bedrock at very shallow depths. The dominant soils in this group are the Devils Lake, Hilbre, Faulkner and Birch Bay soils that are developed on very stony to excessively stony glacial till. Other soils include the gravelly Egg Island and clayey Rosenburg soils. The distribution of these soils in the map area is indicated below·

	Acres	Percent of Total Area
Birch Bay	4,429	0.29
Devils Lake	717	0.04
Egg Island	2,340	0.13
Faulkner	7,070	0.40
Horcus	63	—
Hilbre	37,309	2.12
Lynx Bay	576	0.03
Punk	69	—
Rat Lake	144	.01
Rock Outcrop	9,891	0.56
Rosenburg	1,158	0.07
	63,766	3.61

Depth of unconsolidated mineral material over bedrock usually ranges from several inches to several feet but normally from 1 to 2 feet in thickness.

Workability as construction material varies with depth of material over the rock, degree of stoniness and texture of the material.

Permeability of the medium textured soils, the dominant group, is moderately slow to slow; rapid to very rapid in the thin gravelly Egg Island soils, to very slow in the case of the thin clayey Rosenburg soils.

The soils of this group may have a high water table during periods of abnormally high precipitation due to impedance of the groundwater flow by the impervious rock substrate.

The agriculture suitability of these soils is very low due to extreme stoniness and the inclusion of terrain with a distribution of rock outcropping at the surface. The thin soils over the bedrock are somewhat droughty and the gravel overlying bedrock is very droughty.

All of the soils in this group have fair bearing capaicty and low risk of frost heaving when used as foundations for buildings. These soils have a limitation for foundation construction because of shallow depth to bedrock if excavation for basements is required.

The soils in this group are not suitable for use as septic tank filter fields because of the shallow depth to bedrock.

These soils are generally poor for landscaping purposes due to their excessive stoniness and rockiness and in some cases the lack of adequate depth of soil material to establish grass, trees or shrubs.

GROUP10

The mineral soils in this group are characterized by poor to very poor natural drainage. They range in texture from loamy gravel to heavy clay. Some are very stony, others are stone-free and some are developed on very thin deposits overlying bedrock. Members in this group occur in depressional to level terrain, have a high water table and are saturated over most of the year. Unless artificially drained, they are subject to ponding after spring runoff and after heavy summer rains. The soils included in this group are:

	Acres	Percent of Total Area
Blamoral	8,957	0.51
Balmoral, peaty phase	8,991	0.51
Berry Island	18,067	1.03
Berry Island, peaty phase	12,524	0.71
Foley	695	0.04
Foley, peaty phase	1,469	0.08
Fyala	4,263	0.24
Fyala, peaty phase	45,207	2.57
Kerry	81	—
Lee Lake	2,754	0.16
Malonton, peaty phase	415	0.02
Marsh	14,214	0.81
Meleb	3,128	0.18
Meleb, peaty phase	27,060	1.54
Partridge Creek	25,193	1.43
Partridge Creek, peaty phase	31	—
Pineimuta	93	0.01
Pineimuta, peaty phase	485	0.03
Sprague	173	0.03
Sprague, peaty phase	452	0.03
Sundown, peaty phase	4,808	0.27
Tarno	1,779	0.10
Tarno, peaty phase	374	0.02
Thickwood	1,129	0.06
	182,342	10.36

The bearing strength, permeability, shrink-swell potential and workability are all dependent upon clay content, degree of wetness and degree of stoniness. The sandy and gravelly soils are more permeable, more stable and less subject to volume change with changing moisture content than the other members of this group.

These soils are poor for building sites because of wetness. Suscpetibility to frost heaving is high because of wetness. If used for building sites, granular fill material should be used to keep foundations above the water table. Additional surface drainage must be provided.

These soils are not suitable for sewage disposal fields because of high water table and very slow effluent absoprtion rates. Distribution lines will be below the water table for long periods.

Most of the soils in this group are not very suitable for landscaping because of poor drainage and in many cases, undesirable soil characteristics such as stoniness in the case of the till soils, poor workability of the moderately fine and fine textured lacustrine soils or because of natural fertility of the gravelly soils.

GROUP 11

This group consists of the poorly to very poorly drained shallow to very deep organic soils that are underlain dominantly by clay textured lacustrine sediments. They comprise by far the largest single group of soils in the map area. The shallow organic soils include:

	Acres	Percent of Total Area
Cayer clay	115,619	6.57
Molson clay	179,877	10.21
Okno clay	84,172	4.78
Kircro sand	428	0.02
Rat River sand	306	0.02
Sand River sand	4,519	0.26
Crane stony, loam till	44,335	2.52
Grindstone stony, loam till	9,972	0.57
Kilkenny stony, loam till	9,391	0.53
Holditch limestone rock	1,493	0.08
Janora limestone rock	489	0.03
	450,601	25.59

The deep organic soils include:

	Acres	Percent of Total Area
Baynham clay	3,329	0.19
Julius clay	236,042	13.40
Stead clay	104,849	5.95
Bradbury stony, loam till	691	0.04
Sproule sand	1,377	0.08
Macawber stony, loam till	13,116	0.74
Denbeigh stony, loam till	297	0.02
	359,701	20.42

These soils are unsuitable for most building sites due to their very poor natural drainage, high water table, their very low bearing strength and their very high compressibility under load. If these soils are to be used for permanent service buildings, commercial buildings, the planned and controlled replacement of all peat material with stable backfill is strongly recommended. This is certainly feasible in the case of the shallow soils that range in depth from several feet to about five feet in thickness. The advantage of this method of treatment lies in the opportunity of obtaining a stable foundation for structures. Disadvantages are the cost of the large amount of backfill required and the possibility of differential settlement of fill if pockets of peat remain unexcavated.

These soils are not suitable as fields for spetic tank effluent. If used for this purpose the distribution lines would be below water for long periods.

Areas of these soils are better utilized as nature study areas and as habitat for wildlife.

E. SOILS AND RECREATION

This section is designed to help determine the suitability of the various soils in the map area for recreational development. All soils can be used for recreational activities of some kind. Some soils are well suited for campsites, picnic areas, cabin sites, play areas or natural study areas, whereas other soils are poorly suited for these uses.

Soils and their properties determine to a large degree, the type and location of recreational facilities. Wet soils are not suitable for campsites, roads, playgrounds or picnic areas. Soils that pond and dry out slowly after heavy rains present problems where intensive use is contemplated. It is difficult to establish and maintain grass cover for playing fields and golf courses on droughty soils. Soils which are subject to frequent floodings have severe limitations for use as campsites and most recreational buildings. Such soils would be used better as parks or open space for hiking and nature study areas. The feasibility of many kinds of outdoor activities are determined by other basic soil properties such as depth to bedrock, stoniness, topography or land pattern, and the ability of a soil to support vegetation of different kinds as related to its natural fertility.

In Table 60 each soil in the map area is rated according to its soil features for a specific recreational use. The various features of each soil which are limitations affecting recreational use are listed in the last column. The ratings are based on soil features alone, and do not include aesthetic, economic or other physical considerations that may be important in selecting an area for the purpose stated[1]. A rating of *none to slight* means the soil is very suitable for the particular use; a rating of *moderate* indicates that the soil has limitations in use but that it can be used under good management; a rating of *severe* means that the soil has limiting characteristics that make its use for recreation purposes unsound or very expensive. Use of these soils often requires major soil reclamation work. In the following paragraphs, some limitations of soils for selected recreational uses are given.

Soil limitations for intensive play areas:

The ratings for this recreation purpose apply to areas to be developed for playgrounds, fields for baseball, football, tennis and similar organized games. These areas generally require a nearly level surface, good drainage, freedom from flooding and a soil texture and consistence that give a firm surface and will support intensive foot traffic.

Soil limitations for picnic areas subject to intensive use:

These ratings are based on soil features only and do not consider other features such as shade trees and the number of lakes in an area which may affect the desirability of a site. The most desirable soil areas for this use have good drainage, not subject to flooding and are reasonably level and provide good footage.

Soil limitations for buildings in recreational areas:

The ratings in Table 60 give preliminary information on the suitability of the soils for building sites. Detailed investigations are usually required for selection of a specific building site. More information about the suitability of the soils for building purposes is given in Section C, Engineering Interpretations, and Section D, Soils and Community Developments. Soils that are most desirable for building sites in recreational areas have good drainage, are nearly level to gently sloping and are not subject to flooding.

Soil limitations for paths and trails:

These soil ratings apply to areas that are to be used for trails, cross country hiking, bridle paths and nonintensive uses that allow for random movement of people. It is assumed that for these uses, the soil areas are to remain as they occur in nature. Characteristics considered are degree of wetness, degree of slope, soil texture and susceptibility to flooding. Soils such as swamps, marshes, peat bogs and other poorly drained areas are considered to have a very severe limitation for this use.

Soil limitations for intensive camp areas:

The ratings used apply to the suitability of soils as campsites for tents and trailers. The accompanying activities for outdoor living are also considered. These areas should require little site preparation to be made suitable for unsurfaced parking of cars and trailers and for heavy traffic by people and vehicles. The most desirable sites for intensive camp areas are level to gently sloping, have good drainage not subject to flooding, provide good footage in all kinds of weather and are not subject to blowing.

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1. Guidelines and criteria used in this interpretive classification are taken from Chapter 10, "Use of Soil Surveys in Planning for Recreation", by P.H. Montgomery and F.C. Edminster in *Soil Surveys and Land Use Planning,* Bartelli, L.J., (ed) et al., Soil Science Society of America and American Society of Agronomy, 1966.

TABLE 60

Ratings and Limitations of Soils of the Red Rose-Washow Bay Map Area for Recreational Purposes

Soil name and dominant texture	Map Symbol	Intensive play areas	Picnic areas subject to intensive use	Building sites in recreational areas	Paths and Trails	Intensive camp areas	Soil features affecting use
Arborg (clay)	Ab	severe	severe	severe	severe	severe	Somewhat poorly drained; very sticky and slippery when wet.
Arnes (clay)	An	mod.	mod.	mod.	slight	mod.	Slow permeability; very sticky when wet
Balmoral (clay loam)	Ba, Ba(P)	severe	severe	severe	severe	severe	Poorly drained, high water table for long periods, subject to ponding.
Birch Bay (loam)	Bc	severe	severe	severe	slight	severe	Excessive stoniness; shallow depth to bedrock.
Baynham complex	Bmx	severe	severe	severe	severe	severe	Very poorly drained, high water table throughout the year, poor trafficability, organic soil.
Bradbury complex	Bdx	severe	severe	severe	severe	severe	Same as Baynham; a poorly drained organic soil.
Berry Island (gravel)	By, By(P)	severe	severe	severe	severe	severe	Poorly drained, subject to ponding after heavy rain, stony subsoil.
Cayer complex	Cax	severe	severe	severe	severe	severe	Very poorly drained, high water table; poor trafficability, organic soil.
Colby (fine sand)	Cb	mod.	mod.	mod.	slight	mod.	Seasonal high water table, somewhat poorly drained; somewhat stony.
Chitek (loam)	Ci	severe	severe	mod.	slight	severe	Very excessively stony, somewhat poorly drained, sticky and slippery when wet.
Caliento (fine sand)	Co	mod.	mod.	mod.	slight	mod.	Seasonal high water table, somewhat poorly drained, somewhat stony.
Crane complex	Cx	severe	severe	severe	severe	severe	Very poorly drained, high water table throughout the year, poor trafficability, organic soil.
Dencross (clay)	Dc	severe	severe	severe	mod.	severe	Somewhat poorly drained, very slippery and very sticky when wet.
Devils Lake (loam)	Dl	severe	severe	severe	slight	severe	Very to excessively stony; shallow to bedrock.
Davis Point series (clay)	Dp	severe	severe	severe	mod.	severe	Slow permeability, seasonal high water table, very sticky and slippery when wet.
Denbeigh complex	Dx	severe	severe	severe	severe	severe	Poorly drained, high water table, poor trafficability, organic soil.
Egg Island (gravel)	Ei	mod.	mod.	slight	slight	mod.	Somewhat stony, gravelly soil, shallow to stony subsoil.
Fairford series (loam)	Fd	mod.	mod.	mod.	none to slight	mod.	Very stony to excessively stony, sticky and slippery when wet.

TABLE 60 Cont'd.

Ratings and Limitations of Soils of the Red Rose-Washow Bay Map Area for Recreational Purposes

Soil name and dominant texture	Map Symbol	Intensive play areas	Picnic areas subject to intensive use	Building sites in recreational areas	Paths and Trails	Intensive camp areas	Soil features affecting use
Fisher (loam)	Fi	mod.	mod.	mod.	slight	mod.	Somewhat poorly drained, sticky and slippery when wet.
Faulkner (loam)	Fk	severe	severe	severe	none to slight	severe	Excessively stony, sticky and slippery when wet, shallow depth to bedrock.
Foley (loamy very fine sand)	Fo, Fo(P)	severe	severe	severe	severe	severe	Poorly drained, subject to ponding after heavy rain.
Framnes (clay)	Fr	severe	severe	severe	severe	severe	Somewhat poorly drained, very sticky and slippery when wet, seasonal high water table.
Fisherton (clay loam)	Ft	mod.	mod.	mod.	slight	mod.	Somewhat poorly drained, sticky and slippery when wet, stony subsoil.
Fyala (clay)	Fy, Fy(P)	severe	severe	severe	severe	severe	Poorly drained subject to ponding, very sticky and slippery when wet.
Garson series (loam)	Ga	mod.	mod.	mod.	none to slight	mod.	Very stony to excessively stony at the surface, sticky and slippery when wet.
Grindstone complex	Gdx	severe	severe	severe	severe	severe	Poorly drained organic soil, high water table, poor trafficability.
Goose Island (gravel)	Gox	mod.	mod.	mod.	slight	mod.	Somewhat poorly drained gravelly soil, shallow to stony glacial till.
Gunton (gravel)	Gux	slight	slight	slight	slight	slight	Well drained gravelly soil, somewhat stony.
Hodgson (loam)	H	slight	slight	slight	slight	slight	Well drained, somewhat sticky and slippery after rain.
Harwill (clay loam)	Ha	slight	slight	slight	slight	slight	Well drained, somewhat sticky and slippery after rain.
Homebrook series (clay)	Hb	mod.	mod.	mod.	none to slight	mod.	Slow permeability, very sticky and slippery when wet.
Harcus (fine sand)	Hc	slight	slight	mod.	slight	slight	Well drained fine sand, shallow to bedrock.
Holditch complex	Hdx	severe	severe	severe	severe	severe	Very poorly drained, high water table throughout the year, poor trafficability, organic soil.
Hilbre (loam)	Hi	severe	severe	severe	none to slight	severe	Excessively stony, sticky and slippery when wet, shallow depth to bedrock.
Inwood series (loam)	In	mod.	severe	severe	none to slight	severe	Very stony to excessively stony at the surface, seasonal high water table, sticky and slippery when wet.

TABLE 60 Cont'd.
Ratings and Limitations of Soils of the Red Rose-Washow Bay Map Area for Recreational Purposes

Soil name and dominant texture	Map Symbol	Intensive play areas	Picnic areas subject to intensive use	Building sites in recreational areas	Paths and Trails	Intensive camp areas	Soil features affecting use
Janora complex	Jax	severe	severe	severe	severe	severe	Very poorly drained, high water table throughout the year, poor trafficability, organic soil.
Julius complex	Jx	severe	severe	severe	severe	severe	Very poorly drained, high water table throughout the year, poor trafficability, organic soil.
Kircro	Kcx	severe	severe	severe	severe	severe	Poorly drained organic soil, high water table, poor trafficability.
Kilkenny complex	Kx	severe	severe	severe	severe	severe	Very poorly drained, high water table throughout the year, poor trafficability, organic soil.
Kinwow series (clay)	Ki	mod.	mod.	mod.	none to slight	mod.	Slow permeability, very sticky and slippery when wet.
Kerry	Ky	severe	severe	severe	severe	severe	Poorly drained sand, high water table, subject to ponding after heavy rain.
Lakeland series (clay loam)	La	mod.	mod.	mod.	none to slight	mod.	Moderately slow permeability, seasonal high water table, sticky and slippery when wet.
Lynx Bay	Lbx	slight	slight	mod.	none to slight	slight	Well drained gravelly soil, shallow to bedrock, somewhat stony.
Ledwyn	Le	mod.	mod.	mod.	slight	slight	Somewhat poorly drained, somewhat sticky and slippery after rains.
Lee Lake	Ll	severe	severe	severe	severe	severe	Poorly drained, subject to ponding, shallow to bedrock.
Lonesand	Lo	mod.	mod.	mod.	slight	mod.	Somewhat poorly drained fine sand.
Long Point	Lp	mod.	none to slight	mod.	none to slight	mod.	Well drained gravelly soils, shallow to stony subosil.
Lettonia	Lt	mod.	mod.	mod.	none to slight	mod.	Well drained clay, sticky and slippery after rains.
Lundar series (loam)	Lu	mod.	severe	severe	mod.	none to slight	Very stony to excessively stony at the surface, seasonal high water table, sticky and slippery when wet.
Leary complex (coarse sand and gravel)	Lyx	mod.	none to slight	none	none	none to slight	Well drained, no ponding, very rapid permeability, gently undulating.

TABLE 60 Cont'd.
Ratings and Limitations of Soils of the Red Rose-Washow Bay Map Area for Recreational Purposes

Soil name and dominant texture	Map Symbol	Intensive play areas	Picnic areas subject to intensive use	Building sites in recreational areas	Paths and Trails	Intensive camp areas	Soil features affecting use
McArthur (sandy loam)	Mc	severe	severe	mod.	mod.	severe	Very to excessively stony.
Macawber complex	Mcx	severe	severe	severe	severe	severe	Poorly drained organic soil, poor trafficability, high water table.
Mantagao (clay)	Mg	severe	severe	severe	severe	severe	Somewhat poorly drained clay, subject to ponding, very sticky when wet.
Marsh complex	Mh	severe	severe	severe	severe	severe	Very poorly drained, water table at or near the surface throughout the year.
Meleb series (loam)	Ml, Ml(P)	severe	severe	severe	severe	severe	Poorly drained, high water table for long periods, subject to ponding, moderately to excessively stony at the surface.
Malonton (fine sand)	Mn(P)	severe	severe	severe	severe	severe	Poorly drained, high water table for long periods, subject to ponding.
Molson complex	Mx	severe	severe	severe	severe	severe	Very poorly drained, high water table throughout the year, poor trafficability, organic soil.
McCreary (clay loam)	My	mod.	mod.	mod.	none to slight	mod.	Moderately slow permeability, seasonal high water table, sticky and slippery when wet, stones in subsurface layers could affect workability.
Okno complex	Ox	severe	severe	severe	severe	severe	Very poorly drained, high water table throughout the year, poor trafficability, organic soil.
Pinawa (sandy loam)	Pa	severe	severe	mod.	mod.	severe	Very to excessively stony, somewhat poorly drained.
Partridge Creek (clay)	Pc, Pc(P)	severe	severe	severe	severe	severe	Poorly drained, high water table for long periods, subject to frequent ponding, very slow permeability.
Peguis (clay)	Pe	severe	severe	mod.	severe	severe	Somewhat poorly drained, moderately stony, very sticky and slippery when wet.
Pineimuta (clay loam)	Pi, Pi(P)	severe	severe	severe	severe	severe	Poorly drained, subject to ponding, sticky and very slippery when wet.
Punk (sand)	Pk	mod.	mod.	mod.	none to slight	mod.	Well drained sand, shallow to bedrock.
Pine Ridge (sand)	Pr	none to slight	none to slight	none to slight	none to slight	none to slight	Well drained sand.
Rock	R	severe	severe	severe	mod.	severe	Lack of soil to support vegetation, level to undulating topography.
Rat Lake (clay)	Rl	severe	severe	severe	severe	severe	Poorly drained, subject to ponding, shallow to bedrock.

TABLE 60 Cont'd.
Ratings and Limitations of Soils of the Red Rose-Washow Bay Map Area for Recreational Purposes

Soil name and dominant texture	Map Symbol	Intensive play areas	Picnic areas subject to intensive use	Building sites in recreational areas	Paths and Trails	Intensive camp areas	Soil features affecting use
Rosenburg (clay)	Rs	severe	severe	severe	severe	severe	Very slow permeability, subject to ponding, shallow to bedrock.
Rat River complex	Rrx	severe	severe	severe	severe	severe	Poorly drained organic soil; high water table, poor trafficability.
Sandilands (sand)	S	mod.	mod.	none to slight	none to slight	none to slight	Rapidly drained sand, droughty, difficult to establish vegetation.
Sand Beaches (sand and cobbles)	Sb	severe	severe	severe	mod.	severe	Difficult to establish vegetation, some areas subject to blowing, subject to flooding.
Stead complex	Sdx	severe	severe	severe	severe	severe	Poorly drained deep organic soil, high water table, poor trafficability.
St. Labre (fine sand)	Sl	none to slight	none to slight	mod.	none to slight	none to slight	Well drained, shallow fine sand over stony subsoil.
Sproule complex	Slx	severe	severe	severe	severe	severe	Poorly drained organic soil, high water table, poor trafficability.
Spearhill (sand and gravel)	Spx	mod.	mod.	mod.	mod.	mod.	Somewhat poorly drained thin gravelly soil, stony subsoil.
Sprague (fine sand)	Sr, Sr(P)	severe	severe	severe	severe	severe	Poorly drained, high water table, subject to ponding, somewhat stony.
Sand River complex	Srx	severe	severe	severe	severe	severe	Poorly drained organic soil, high water table, poor traffciability.
Sundown (sand and gravel)	Su(P)	severe	severe	severe	severe	severe	Poorly drained, high water table, subject to ponding.
Tarno series (clay)	Ta, Ta(P)	severe	severe	severe	severe	severe	Poorly drained, high water table for long periods, subject to frequent ponding, very slow permeability.
Thickwood (clay)	Tk(P)	severe	severe	severe	severe	severe	Poorly drained clay, subject to ponding, very sticky and slippery when wet, shallow to bedrock.
Woodridge complex (coarse sand and gravel)	Wx	mod.	none to slight	none	none	none to slight	Well drained, no ponding, very rapid permeability, gently undulating topography.

F. THE ENGINEERING SIGNIFICANCE OF PEDOLOGY*

Both Geological and Pedological Sciences identify soil deposits and soil profiles as they exist in the field. The nomenclature used in Surficial Geology defines the general characteristics of the sedimentary materials overlying the bedrock, that of Pedology further subdivides those sediments which constitute the parent material, primarily on the basis of chemical composition, and drainability.

Thus, the geological terms for a certain deposit may be "lacustrine silt", whereas the pedological designation for soil developed on this same deposit may recognize "Lettonia Series — lacustrine, fine textured, moderately calcareous, well drained", or "Arborg Series — lacustrine, fine textured, moderately calcareous, imperfectly drained".

There is no conflict here between geology and pedology; rather, one science compliments the other and for the engineer concerned with the soil, pedology provides a very useful additional tool. To show how this can be effectively used, some of the fundamentals of the science as it can be applied to engineering are discussed below.

1. *The Pedological Concept*

Of greatest consequence to the engineer is the face that the science of pedology identifies the "in-place" soils profile — the texture and composition of the materials in situ and their variation with depth.

The pedological concept is based on the premise that similar parent materials, if subjected to identical environmental conditions of climate, biological activity, topography and time, will develop identical soil profiles. (Some idea of the complex processes involved in soil formation is given earlier in this report in Part III, "Soils").

Now, instead of trying to separately evaluate each different factor in soil formation (i.e. the effect of the parent material and the separate effects of each of the environmental factors), the pedologist has fortunately recognized their combined effects and got around this problem. He identifies the "in-place" soils profile which exhibits the effects of each of these environmental factors and these are then automatically included within the classification system.

2. *The Soil Profile*

It is this end product of the pedologist — the identified soil profile — which can be used as a very effective tool in engineering soil exploration, planning and design.

The Soil Profile is a vertical section of the soil through all its horizons and extending into the parent material. The figure (Figure 10) shows in a simplified form how many variations may be recognized in soil profiles. The science has developed over the years and the figure shows the nomenclature currently in use in Canada.

Despite considerable developments in this field the three major or master soil horizons A, B and C can generally be recognized. The surface layer (A horizon) is the zone of maximum removal of material in solution or maximum in situ accumulation of organic matter; the next layer, the B horizon is a transitional zone just below the A. The next horizon is C or the relatively unaltered parent material.

The A and B horizons are termed the 'soil solum' and they reflect the effects of the climate, topography and vegetation. By the action of percolating water and many other factors, materials can be removed from the A horizon and deposited in the B horizon. Such transfers may occur as chemical solutions or as mechanical movements of soil particles. For example, in humid environments where the B horizon may be characterized by its compactness, this may be primarily due to filling of the voids with the fine particles carried mechanically from the A horizon. Such filling increases the percentage of fine-grained materials in the B horizon, often with an increase in plasticity and a decrease of permeability. The activity of clay horizons may be affected and cemented agents may produce hardpan layers.

While knowledge concerning the A and B horizons can be of great value to the engineer, in certain specialized fields, e.g. estimating rainfall runoff in watersheds, pavement design, etc., it is the C horizon and materials below this that are of more general significance. It should be noted that the C horizon refers to the parent (mineral) soil which is comparatively unaffected by the pedogenic processes. Now, the following definitions may be confusing to engineers and should be noted carefully. The symbol C is used for the true parent material, the material in which the soil was formed. The next underlying material which is lithologically or geologically different from the C material is termed IIC and subsequent contrasting (geologically) materials are termed IIIC, IVC, etc. The IIC layer is therefore not parent material, but it may have significance on the solum development.

In certain profiles, however, the C layer may be missing and, therefore, the profile may exhibit an A and B horizon directly overlying a IIC (non parent material) layer. It should also be noted that all single horizons may be subdivided by consecutive Arabic numerals for purposes of sampling; for example, Ck1, Ck2, and so on. Unlike

* Extracted from the chapter dealing with "Engineering and Land Use" by G. Wilson, Soil Mechanics Engineer, Soil Research Institute, Ottawa, contained in the "Soils of the Morden-Winkler Area" by R.E. Smith and W. Michalyna. Soil Report No. 18, 1973.

Roman numeral prefixes, these symbols do not indicate major lithological discontinuities but rather accommodate minor differences that may or may not be apparent in the horizon.

Bedrock is denoted by R and particular attention should be paid to the pedologist's definition of a rock — "too hard to break with the hands or to dig with a spade when moist and greater than 3 on the mohs scale". The boundary between the R layer and any overlying unconsolidated material is termed a "lithic contact".

If the bedrock (R) or the IIC horizons exist at depths considered to be beyond the zone of their influence on the soil, then the pedologist may not record these horizons. The total depth of soil materials considered to constitute the "Soil Profile" in the Pedoligical sense, is normally less than 80 inches (2M).

3. *Pedological Classification*

The primary purpose of soil classification as far as the engineer is concerned is to make the soil recognizeable. If then, correlations with engineering properties can be made, engineering performance on similar soils can be predicted.

Highway engineers, expecially those trained in Michigan, U.S.A. or similar schools have found that the pedological system can be adapted to their needs. This is because in areas of gentle relief where there are few deep cuts and fills, a subgrade on a particular soil series will perform the same wherever the location because such important factors as rainfall, freeze-thaw, capillarity, etc. are all factors in the identification and classification. In no other system in use, are all these factors employed directly as part of the system. In this way, quite accurate pavement design and performance data can be exchanged between engineers in different parts of the country (and even in different countries).

Direct applications such as this are obviously not restriced to pavement design engineers — the hydrologic soil factors used in the U.S.A. in Soil Conservation Engineering and soil cement stabilization are other examples.

The Canadian System of Soil Classification is partly described in Chapter III, "Soils", and some coverage is given in the Glossary of this report. However, as the science of pedology has developed over the years, the system is now quite complex and for full treatment of the subject, the reader is referred to "The System of Soil Classification for Canada, Canada Agriculture, 1970".

The following brief resume should, meanwhile, permit the reader to better understand the pedological approach.

The Canadian System is hierarchial and in descending order, we have:

(i) Order
(ii) Great Group
(iii) Subgroup
(iv) Family
(v) Series
(vi) Type

("Soil Phase" is not a category in this system and it can be used to subdivide any of the other classes).

It is the complete "Soil Profile" which is identified and classified and as we go from Order down to Type, the required number of differentiating characteristics in the profile increases.

For example, in the Podzolic Order — No. 4, this requires that soil profile, among other things, must have a podzolic B horizon (i.e. accumulation products of iron Bf or organic Bh, etc); a light colored A horizon (Ae eluviated) and the soil must be acid.

In the Humo-Ferric-Podzol, Great Group, further criteria must be satisfied, e.g. they must have developed under mixed or coniferous forest cover, a moist cool region, on coarse, non-calcareous materials, etc.

In the Gleyed Humo-Ferric Podzol Subgroup still further criteria must be met. The profile must exhibit "mottling due to periodic wetness in the Ae or B horizons".

There are eight Orders, 22 Great Groups and 189 Subgroups in the Canadian System and every soil profile in the country must be fitted into this grouping. Soil maps may be prepared at the level of the Order, the Great Group or the Subgroup, but these usually are generalizations on very small scales (1/1,000,000; 1/10,000,000, etc.).

To most people not well acquainted with the science, this is as far as pedology goes. In fact, it is just the beginning. In practise, pedological classification might be said to begin at the Soil Series level.

The Soil Family and Soil Type are respectively above and below the Soil Series in the hierarchial system. However, the "Soil Type" is a division of the series, which is definitely based on the texture of the Plow layer. "Soil Family" is a grouping of Soil Series units which also have certain definite similarities, some of which are not applicable to engineering problems. Thus, for engineering and planning purposes, and incidentally, also for pedological reasons, the "Soil Series" is the most significant unit.

4. *The Significance of the Soil Series*

The concept of the Soil Series has changed considerably since soils were first mapped and classified. With recent development, the soil series is now recognized as a three-dimensional body occupying a geographical position on the landscape.

As the science develops, revisions must necessarily occur in the definitions of what exactly a certain Soil Series represents and new Soil Series are being recognized in previously unsurveyed areas. There are at present over 3,000 recognized Soil Series, in Canada and the number increases as more work is being done. The reader is, therefore, warned that, when referring to a number of different soil maps, there may be significant differences in the terminology, depending on the dates of the surveys.

Perhaps the most difficult concept for the engineer (and planner) to fully appreciate, is the three-dimensional nature of the Soil Series. The vertical dimension and the depth limitations, have been discussed under the heading, Soil Profile. The horizontal aspects have been implied with reference to the soil series as "a landscape unit". The areal boundaries of the soil series on the landscape are determined, mostly by experience, to be ". . . wide enough to permit reasonable uniformity of all criteria over a practical-sized area". The three-dimensional body is thus defined and this is represented on the soils map by its areal boundaries.

For sampling purposes, however, the minimum size of a soil body representing a Soil Series had recently been defined as the "pedon". This varies, but may often be one $metre^2$ in areal extent. As a mapping unit, however - in contrast to a sampling unit — the "pedon" is too small to be represented on a map and the Soil Series Mapping Unit can therefore, be regarded as being composed of several contiguous pedons or polypedons. In fact, the polypedon corresponds really to a Soil Individual and there may be, on the landscape, one or several Soil Individuals, whose properties may be individually different but all may be within the range defined for a given Soil Series.

There are, thus, differences between taxonomic units, sampling units and mapping units. Each may be termed "Soil Series". The taxonomic unit really is the "soil profile" — it is two dimensional in that it can be represented as a "profile", as a vertical slice through all the soil layers at one point on the landscape. The "pedon" is the sampling unit which really is the "test pit" used to define the "in situ" characteristics of that profile, to obtain samples for laboratory testing and to adequately express these characteristics as an average for a specified volume, also at one point on the landscape. The third unit, the "mapping unit", is also three dimensional but instead of representing one point on the landscape, it actually represents that landscape. But it is also implied, to a greater or lesser extent, that everywhere in that demarcated landscape unit, the actual sequence of soil layers are the same as those exhibited in the test pit (or "pedon") and the same as those described and classified in the "Soil profile". The whole purpose of this of course, is to predict the behaviour or performance of these same demarcated landscape units when subjected to given sets of conditions. These conditions are primarily, (but not necessarily only), of an "agricultural" nature. The pedological concept was conceived initially, out of necessity, as a method by which soil and land performance could be predicted for its agricultural use, using deductive reasoning.

This predictive aspect of pedological mapping is rarely fully appreciated or understood by specialists in other disciplines because it is probably unique as far as earth sciences are in this respect. First of all a prediction is made that, within the boundaries shown as a mapping unit, the sequence of soil layers should be the same as those exhibited in the "pedon" and described under the heading "soil profile" — to a greater or lesser extent. In pedological terms, the latter phrase is partly covered by the term "accuracy" and partly covered by the description of the "mapping unit". Thus, the mapping unit may simply be a Soil Series and the "accuracy 85 percent".

This means that the pedologist has enough confidence to predict that if one digs a test pit anywhere in that area, there is an 85 percent chance of revealing a soil profile as given for that Soil Series. It also means that even if he knows the location of a soil deposit quite different from that series described, he will *not* show it on the published map if it is less than 15 percent of the area.

In mapping, therefore, the individual pedologist may set up broader more generalized mapping units. Undoubtedly in this sense the "accuracy" of the survey as far as the mapping unit itself is concerned, may be very high. For the same area using very detailed mapping units, much greater effort would be required to obtain the same mapping "accuracy".

However, the predictive nature of pedological mapping does not refer only to the quality of the mapping process in the field but also to the degree to which the interpretations concerning the use of the soil and the landscape are realistic. This can only be done if the scope of the mapping units are sufficiently detailed.

In addition to detailed mapping units, the interpretive specialist must also be knowledgeable of more than just the top few feet of soil. Movement of moisture through the soil is but one example. To really understand this a general knowledge of the hydrology and geohydrology of the whole area is required. The mapping and interpretive process thus becomes progressively more interdisciplinary. At the same time, as more detailed work is done, the greater becomes the potential use of the survey and other disciplines like engineering and land use planning can be catered for.

But at the same time, as more and more data is collected it becomes progressively more difficult to communicate this to others.

APPENDIX

GLOSSARY

AASHO classification (soil engineering) — the official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway Officials.

Alluvium — A general term for all deposits of modern rivers and streams.

Available nutrient — That portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants.

Available soil moisture — The portion of water in a soil that can be readily absorbed by plant roots; generally considered to be that water held in the soil up to approximately 15 atmospheres pressure.

Boulders — Stones which are larger than 24 inches in diameter.

Bulk density — The weight of overdry soil (105°C) divided by its volume at field moisture conditions, expressed in grams per cubic centimeter.

Calcareous soil — Soil containing sufficient calcium carbonate (often with magnesium carbonate) to effervesce visibly when treated with hydrochloric acid.

Calcium Carbonate Equivalent — Refers to the percent of carbonates in the soil expressed on the basis of calcium carbonate. Terms used to express the carbonate contents of soils are:

noncalcareous	1%
weakly calcareous	1-5%
moderately calcareous	6-16%
strongly calcareous	16-25%
very strongly calcareous	26-40%
extremely calcareous	40%

Carbon-nitrogen ratio (C/N ratio) — The ratio of the weight of organic carbon to the weight of total nitrogen in a soil or in a organic material.

Catena — A sequence of soils of about the same age, derived from similar parent materials, and occurring under similar climatic conditions but having different characteristics due to variation in relief and in drainage.

Cation Exchange Capacity (CEC) — A measure of the total amount of exchageable cations that can be held by a soil. Expressed in milliequivalents per 100g of soil.

Clay — As a soil separate, the mineral soil particles less than 0.002 mm in diameter; usually consisting largely of clay minerals. As a soil textural class, soil materials that contain 40 or more percent clay, less than 45 percent sand and less than 40 percent silt.

Cobbles — Rock fragments 3 to 10 inches in diameter.

Colour — Soil colours are compared with a Munsell color chart. The Munsell system specifies the relative degrees of the three simple variables of colour: hue, value and chroma. For example: 10YR 6/4 means a hue of 10YR, a value of 6, and a chroma of 4.

Complex (soil) — Two or more soil series that are so intimately intermixed in an area that it is impractical to separate them at the scale of mapping used.

Conductivity, electrical — A physical quantity that measures the readiness with which a medium transmits electricity. It is expressed as the reciprocal of the electric resistance (ohms) or mmhos per cm at 25° C of a conductor which is one cm long with a cross sectional area of one square cm. It is used to express the concentration of salt in irrigation water or soil extracts.

Consistence (soil) — The mutual attraction of the particles in a soil mass, or their resistence to separation or deformation. It is described in terms such as loose, soft, friable, firm, hard, sticky, plastic or cemented.

Continental climate — A general term for the typical climate of great land masses where wide ranges in temperature and other weather conditions occur, because the area is not under the influence of large bodies of water.

Contour — An imaginary line connecting points of equal elevation on the surface of the soil.

Decile portion — A one-tenth portion. As used in this report the map symbol Fd^7In^3 means that the Fairford soils cover seven tenths and the Inwood soils cover three tenths of the map unit.

Delta — An alluvial or glaciofluvial deposit at the mouth of a river that empties into a lake or sea.

Deflocculate — To separate or to break up soil aggregates into individual particles.

Degradation (of soils) — The changing of a soil to a more highly leached and more highly weathered condition, usually accompanied by morphological changes such as the development of an eluviated light coloured (Ae) horizon.

Drainage (soil) — (1) The rapidity and extent of the removal of water from the soil by runoff and flow through the soil to underground spaces. (2) As a condition of the soil, it refers to the frequency and duration of periods when the soil is free of saturation.

Drift — Material of any sort deposited by geological processes in one place after having been removed from another. Glacial drift includes unstratified glacial till and stratified glacial outwash materials.

Eluvial horizon — A horizon from which material has been removed in solution or in water suspension.

Erosion —.The wearing away of the land surface by detachment and transport of soil and rock material through the action of moving water, wind or other geological processes.

Field Moisture Equivalent — The minimum moisture content at which a drop of water placed on a smoothed surface of the soil will not be absorbed immediately by the soil, but will spread out over the surface and give it a shiny appearance.

Friable — Soil aggregates that are soft and easily crushed between thumb and forefinger.

Glaciofluvial deposits — Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. These deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers and kame terraces.

Gleyed soil — An imperfectly or poorly drained soil in which the material has been modified by reduction or alternating reduction and oxidation. These soils have lower chromas or more prominent mottling or both in some horizons than the associated well-drained soil.

Gravel — Rock fragments 2 mm to 3 inches in diameter.

Ground Moraine — An unsorted mixture of rocks, boulders, sand, silt and clay deposited by glacial ice. The predominant material is till, though stratified drift is present in places. Resorting and modification may have taken place to some extent by wave-action of glacial melt waters. The topography is most commonly in the form of undulating plains with gently sloping swells and depressions.

Groundwater — Water in the soil beneath the soil surface, usually under conditions where the pressure in the water is greater than the atmospheric pressure and the voids are completely filled with water.

Horizon (soil) — A layer in the soil profile approximately parallel to the land surface with more or less well-defined characteristics that have been produced through the operation of soil forming processes.

ORGANIC HORIZONS — May be found at the surface of mineral soils or at any depth beneath the surface in buried soils or overlying geologic deposits. They contain more than 30 percent organic matter. Two groups of these layers are recognized:

O— An organic layer or layers developed under poorly drained conditions, or under conditions of being saturated most of the year or on wet soils that have been artificially drained.

Of— Fibric layer, an organic layer which is the least decomposed of all the organic soil materials. It has large amounts of well-preserved fiber that is readily identifiable as to botanical origin.

Om— Mesic layer, an organic layer which is intermediate in decomposition between the less decomposed fibric and the more decomposed humic materials. This material has intermediate values for fiber content, bulk density and water contents. The material is partly altered boty physically and biochemically.

Oh— Humic layer, an organic layer which is the most decomposed of all the organic soil materials. It has the least amount of plant fiber, the highest bulk density values and the lowest saturated water content. This material is relatively stable having undergone considerable change from the fibric state primarily because of oxidation and humification.

L-F-H— These are organic layers developed under imperfectly to well drained conditions.

L— An organic layer characterized by the accumulation of organic matter in which the original structures are easily discernible.

F— An organic layer characterized by the accumulation of partly decomposed organic matter. The original structures are discernible with difficulty. Fungi mycelia are often present.

H— An organic layer characterized by an accumulation of decomposed matter in which the original structures are indiscernible.

MASTER MINERAL HORIZONS AND LAYERS — Mineral horizons are those that contain less organic matter than that specified for organic horizons.

A— A mineral horizon or horizons formed at or near the surface in the zone of removal of materials in solution and suspension and/or maximum accumulation of organic matter. Included are: (1) horizons in which organic matter has accumulated as a result of biologic activity (Ah); (2) horizons that have been eluviated of clay, iron, aluminum, and/or organic matter (Ae); (3) horizons having characteristics of (1) and (2) above but transitional to underlying B or C (AB or A and B); (4) horizons markedly disturbed by cultivation or pasture (Ap).

B— A mineral horizon or horizons characterized by one or more of the following: (1) an enrichment in silicate clay, iron, aluminum or humus, alone or in combination (Bt, Bf, Bfh, and Bh); (2) an alteration by hydrolysis, reduction or oxidation to give a change in colour or structure from horizons above and/or below and does not meet the requirements of (1) and (2) above (Bm, Bmg).

C— A mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting (1) the process of gleying, and (2) the accumulation of calcium and magnesium carbonates and more soluble salts (Cca, Csa, Cg and C).

R— Underlying consolidated bedrock, such as granite, sandstone, limestone, etc. The boundary between the R layer and any overlying unconsolidated material is called a lithic contact.

LOWER CASE SUFFIXES

b— *Buried* soil horizon.

c— A *cemented* (irreversible) pedogenic horizon.

ca— A horizon with secondary *carbonate* enrichment where the concentration of lime exceeds that present in the unenriched parent material. It is more than four inches thick and if it has a $CaC0^{3}$ equivalent of less than 15 percent it should have at least 5 percent more $CaC0^{3}$ equivalent than the parent material (IC). If it has more than 15% $CaC0^{3}$ equivalent, it should have ⅓ more $CaC0^{3}$ equivalent than IC.

cc— Cemented (irreversible) pedogenic *concretions.*

e— A horizon characterized by removal of clay, iron, aluminum or organic matter alone or in combination. It is higher in colour value by one or more units when dry than an underlying B horizon.

f— A horizon enriched with hydrated iron. It usually has a chroma of three or more. The criteria for an f horizon (excepting Bgf) are that the oxalate-extractable Fe and Al exceeds that of the IC horizon by 0.8 percent or more ((Fe+Al) 0.8%) and the ratio of organic matter to oxalate-extractable iron is less than 20. The horizons are differentiated on the basis of organic matter content into: Bf, less than 5 percent organic matter; Bfh, 5 to 10 percent organic matter; Bhf, more than 10 percent organic matter.

g— A horizon characterized by grey colours and/or prominent mottling indicative of permanent or periodic intense reduction. Chromas of the matrix are generally one or less.

h— A horizon enriched with organic matter. When used with A alone, it refers to the accumulation of organic matter and must contain less than 30 percent organic matter. It must show one Munsell unti of value darker than the horizon immediately below or have one percent more organic matter that the IC. When used with A and e it refers to an Ah horizon which has been degraded as evidenced, under natural conditions, by streaks and splotches and often by platy structure.

j— Used as a modifier of e, g, n, and t to devote an expression of, but failure to meet the specified limits of the suffix it modifies.

k— Presence of carbonate as indicated by visible effervescence with dilute HC1.

m— A horizon slightly altered by hydrolysis, oxidation or solution, or all of them to give a change in colour or structure or both. The suffix is used with B to denote a B horizon that is greater in chroma by one or more units than the parent material or that has granular, blocky or prismatic structure without evidence of strong gleying and has (Fe+Al) 0.8%. It may not be used under an Ae horizon but may be used under an Aej horizon. This suffix can bu used as Bm or Bmgh.

p— A layer disturbed by man's activities, i.e. by cultivation and/or pasturing. To be used only with A.

s— A horizon with salts including gypsum which may be detected as crystals or veins, or as surface crusts of salt cyrstals, or by distressed crop growth, or by the presence of salt tolerant plants.

sa— A horizon secondary enrichment of salts more soluble than calcium and magnesium carbonates where the concentration of salts exceeds that present in the unenriched parent material. The horizon is four inches or more thick. The conductivity of the saturation extract must be at least 4 mmhos/cm and must exceed that of the C horizon by at least one-third.

t— A horizon enriched with silicate clay. It is used with B alone (Bt, Btg, etc.).

Horizon boundary — Boundaries in distinctness and in surface topography. The distinctness depends partly on the contrast between the horizons and partly on the width of the boundary itself. The width of boundaries between soil horizons is described as follows:

abrupt — less than one inch wide
clear — one to 2.5 inches wide
gradual — 2.5 to 5 inches wide
diffuse — more than 5 inches wide

The topography of horizon boundaries is described as follows:

smooth — nearly plain
wavy — pockets are wider and deeper
irregular — pockets are deeper than wide
broken — parts of the horizon are unconnected with other parts

Hydraulic Conductivity — Refers to the effective flow velocity or discharge velocity in soil at unit hydraulic gradient. It is an approximation of the permeability of the soil and is expressed in inches per hour.

Illuvial horizon — A soil horizon in which material carried from an overlying layer has been precipitated from solution or deposited from suspension. The layer of accumulation.

Lacustrine deposits — Material deposited by or settled out of lake waters and exposed by lowering of the water levels of elevation of the land. These sediments range in texture from sand to clay and are usually varved (layered annual deposits).

Liquid limit (upper plastic limit) — The water content corresponding to an arbitrary limit between the liquid and plastic states of consistency of a soil. The water content at this boundary is defined as that at which a pat of soil cut by a groove of standard imensions will flow together for a distance of half inch under the impact of 25 blows in a standard liquid limit apparatus.

Marl — Soft and unconsolidated calcium and/or magnesium carbonate, often shells, usually mixed with varying amounts of clay or other impurities.

Milliequivalent (me) — One-thousandth of an equivalent. An equivalent is the weight in grams of an iron or compound that combines with or replaces one gram of hydrogen. The atomic or formula weight divided by valence.

Mottles — Irregularly marked spots or streaks, usually yellow or orange but sometimes blue. They are described in order of abundance (few, common, many), size (fine, medium, coarse) and contrast (faint, distinct, prominent). Mottling in soils indicates poor aeration and lack of good drainage.

Parent material — The unaltered or essentially unaltered mineral or organic material from which the soil profile develops by pedogenic processes.

Ped — An individual soil aggregate such as granule, prism or block formed by natural processes (in contrast with a clod which is formed artificially).

Pedology — Those aspects of soil science involving constitution, distribution, genesis and classification of soils.

Percolation — The downward movement of water through soil.

Permeability — The ease with which water and air pass through the soil to all parts of the profile. It is described as rapid, moderate or slow.

pH — The intensity of acidity and alkalinity, expressed as the logarithm of the reciprocal of the H + concentration. pH 7 is neutral, lower values indicate acidity and higher values alkalinity.

Plastic Limit — The water content corresponding to an arbitrary limit between the plastic and the semisolid states of consistency of a soil.

Plasticity Index — The numerical difference between the liquid and the plastic limit. The plasticity index gives the range of moisture contents within which a soil exhibits plastic properties.

Profile, soil — A vertical section of the soil through all its horizons and extending into the parent material.

Reaction, soil — The acidity or alkalinity of a soil.

Acid reactions are characterized as follows:

extremely acid . . . . pH below 4.5
very strongly acid . . . . pH 4.5. to 5.0
strongly acid. . . . . pH 5.1 to 5.5
medium acid. . . . . pH 5.6 to 6.0
slightly acid . . . . pH 6.1 to 6.5

Neutral reactions are from pH 6.6 to 7.3

Alkaline reactions are characterized as follows:

mildly alkaline. . . . . pH 7.4 to 7.8
moderately alkaline . . . . pH 7.9 to 8.4
strongly alkaline. . . . . pH 8.5 to 9.0
very strongly alkaline . . . . pH above 9.0

Regolith — The unconsolidated mantle of weathered rock and soil material on the earth's surface.

Relief — The elevation of inequalities of the land surface when considered collectively.

Saline Soil — A nonalkali soil containing soluble salts in such quantities that they interfere with the growth of most crop plants. The conductivity of the saturation extract is greater than 4 mmhos/cm.

Approximate limits of salinity classes are:

non-saline . . . . 0 to 4 millimhos/cm
slightly saline. . . . . 5 to 8 millimhos/cm
moderately saline . . . . 9 to 15 millimhos/cm
strongly saline . . . . . . more than 15 millimhos/cm

Sand — A soil particle between 0.05 and 2.0 mm in diameter. The textural class name for any soil containing 85 percent or more of sand and not more than 10 percent of clay.

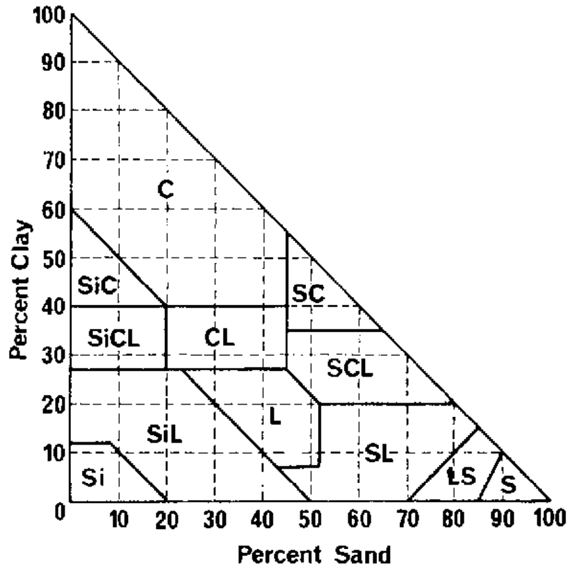

FIGURE 39

Soil textural classes. Percentages of clay and sand in the main textural classes of soils; the remainder of each class is silt.

Series, soil — The second category in the Canadian Classification System. This unit of classification consists of soils that have soil horizons similar in their differentiating characteristics and arrangement in the profile, except for surface texture and are formed from a particular type of parent material.

Silt — Soil mineral particles ranging between 0.05 and 0.02 mm in equivalent diameter. Soil of the textural class silt contains 80 percent silt and less than 12 percent clay.

Soil — The unconsolidated mineral material on the immediate surface of the earth that serves as a natural medium for the growth of land plants. Soil has been subjected to and influenced by genetic and environmental factors of: parent material, climate (including moisture and temperature effects), macro- and micro-organisms, and topography, all acting over a period of time.

Solum — The upper horizons of a soil above the parent material and in which the peocesses of soil formation are active. It usually comprises the A and B horizons.

Stones — Rock fragments over 10 inches in diameter.

Stoniness — The relative proportion of stones in or on the soil. The classes of stoniness are defined as follows:

Slightly stony land — some stones that offer only slight or no hindrance to culitvation

Moderately stony land — enough stones to cause some interference with cultivation

Very stony land — sufficient stones to constitute a serious handicap to cultivation, some clearing required

Exceedingly stony land — sufficient stones to prevent cultivation until considerable clearing is done

Excessively stonly land — too stony to permit any cultivation (boulder or stone pavement)

Stratified materials — Unconsolidated sand, silt and clay arranged in strata or layers.

Structure — The combination or arrangement of primary soil particles into secondary soil particles, units or peds, which are separated from adjoining aggregates by surfaces of weakness. Agreggates differ in grade (distinctness) of development. Grade is described as structureless (no observable aggregation or do definite orderly arrangement: amorphous if coherent, single-grained if noncoherent), weak, moderate, and strong. The aggregates vary in class (size) and are described as fine, medium, coarse, and very coarse. The size classes vary according to the type (shape) of structure. The types of structure mentioned in this report are:

Granular — having more or less rounded aggregates without smooth faces and edges

Platy — having thin, plate-like aggregates with faces mostly horitontal

Blocky — having blocklike aggregates with sharp, angular corners

Subangular blocky — having blocklike aggregates with rounded and flattened faces and rounded corners

By convention an aggregate is described in the order of grade, class and type, e.g. strong, medium, blocky and moderate, coarse, granular. In the parent material of soils the material with structural shapes may be designated as pseudoblocky, pseudoplaty, etc. In stratified materials a *bed* is a unit layer distinctly separable from other layers and is one more cm thick, but a *lamina* is a similar layer less than 1 cm thick.

Soil texture — The relative proportions of the various soil separates in a soil as described by the classes of soil texture. (See Figure 39 page 154).

For convenience, soil textures are grouped together into five classes as follows:

Coarse textured — sands, loamy sands, loamy fine sand

Moderately coarse textured — loamy very fine sand, sandy loam, fine sandy loam

Medium-textured — very fine sandy loam, loam, silt loam, silt, sandy clay loam (light)

Moderately fine-textured — clay loam, silty clay loam, sandy clay loam (heavy)

Fine-textured — sandy clay, silty clay, clay

Tier — The classification of organic soils in dependent on the presence of certain diagnostic organic layers and their arrangement with respect to one another in an arbitrarily selected control section. This control section is divided into a surface, middle and bottom tier (See Figure 40).

Till, glacial — Unstratified glacial drift deposited directly by the ice and consisting of clay, sand, gravel, and boulders intermingled in any proportion.

Tilth — The physical condition of soil as related to its east of tillage, fitness as a seedbed, and its impedance to seedling emergency and root penetration.

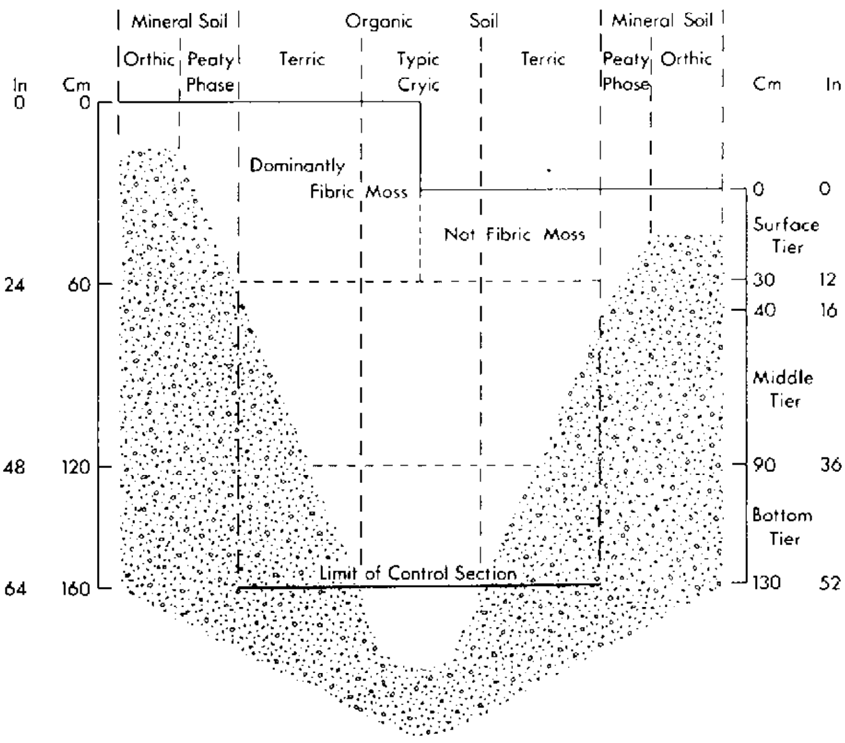

FIGURE 40
A diagrammatic representation of depth relationships of tiers and control sections for Typic and Terric subgroups of Organic soils and of Mineral soils

Topography — The shape of the ground surface such as hills, mountains or plains. The soil slopes may be smooth or irregular. The slope classes used in this report are defined as follows:

depressional to nearly level	0 to 0.5%
very gently sloping or gently undulating	0.5 + to 2%
gently sloping or undulating	2+ to 5%
moderately sloping or gently rolling	5+ to 9%

Type, soil — The lowest unit in the natural system of soil classification. It is a subdivision of the soil series based on significant variations in the properties of the plow layer.

Unified Soil Classification System (engineering) — A classification system based on the identification of soils according to their particle size, gradation, plasticity index and liquid limit.

Water table — The upper limit of the part of the soil or underlying rock material that is wholly saturated with water.

Water-holding capacity — The ability of a soil to hold water. The Water-holding capacity of sandy soils is usually considered to be low, while that of clayey soils is high. It is often expressed in inches of water per foot depth of soil.

Weathering — The physical and chemical disintegration, alteration and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.