CANADA–MANITOBA
Soil Survey

Soils of the Duck Mountain Area

Report D–42

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SOILS OF THE DUCK MOUNTAIN AREA

by

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HOW TO USE THIS SOIL REPORT

This report on the Soils of the Duck Mountain Area contains considerable information about the soils, their origin and formation, their classification and their potential for various uses such as dryland agriculture, engineering and recreation. The report is divided into four parts: Part 1 provides a general description of the area; Part 2 describes the methodology used in the study; Part 3 discusses the development, scientific classification and morphological characteristics of the soils in the study area and Part 4 provides an interpretation of soil properties and associated landscape features as they affect soil capability or suitability for various uses.

The soil map of the study area is compiled on an uncontrolled air photo base which is included in a pocket of the report folder. The map shows the distribution of soil types and associated landscape features that are significant for potential use as field management units. It provides a linkage from landscapes within the study area to the information contained in the report.

To assist the user in retrieving soil information quickly, the following steps are suggested:

Step 1 Consult the soil map in pocket of report folder. Locate the area(s) of interest on the map and identify the pertinent map unit symbols. Arabic numerals placed as superscripts following map symbols indicate the approximate proportion of each soil type within the map unit.

Step 2 Consult extended legend accompanying the soil map for an alphabetical listing of soil symbols giving soil name, classification and drainage and related information concerning landform, nature and depth of materials, and dominant vegetation.

Step 3 For interpretive information about the soils, consult the appropriate Table in Part 4. Criteria utilized as guidelines in making these interpretations are provided in Appendix E.

Step 4 Further information concerning the morphological properties and extent of the soils is presented in Part 3 where the soils are described alphabetically according to soil name.

Step 5 Additional site-specific information not contained in this report is available on request from the Canada-Manitoba Soil Survey, Ellis Building, University of Manitoba.

PREFACE

This interim report and map of the detailed field and laboratory study of the soils of the Duck Mountain area is one in a new series of such soil survey reports covering special interest areas in southern Manitoba. These reports are in response to a growing concern by various government agencies that support the Canada-Manitoba Soil Survey, that a knowledge of the development and distribution of the soils of Manitoba is the key to understanding their properties, behaviour and response to management. This concern requires that soils be described both in terms of their basic properties and the nature of the environmental setting in which they are found. Thus, development of an area such as the Duck Mountain Provincial Park for recreation and related uses requires delineation of land of high or low suitability for such uses which in turn depends on an accurate and reliable soil map as a basic reference document.

The land resource information included in this resurvey covers approximately 3 100 ha of land surrounding selected lakes in the Duck Mountain Provincial Park. The projected intensive use of the soils of this area for recreation has created a need for more up-to-date, more accurate and more detailed soil information. Increased examination of soils in the field, the use of current aerial photography, the use of improved methods of studying soils in the laboratory and the accumulated knowledge of the properties and uses of soils over the years, have all contributed to the additional information contained in this new series of reports and maps.

During the course of the resurvey, a large volume of site specific data for the soils mapped in the Duck Mountain area was generated that for practical reasons cannot be included in this interim report. These data are archived in the Canada Soil Information System (CanSIS) data bank. This computerized system of data management permits automated manipulation and statistical evaluation of large volumes of data for soil characterization and interpretations. These data are available on request. In addition the Cartographic File of CanSIS provides a capability to produce derived maps of various kinds quickly and inexpensively. The types of derived maps that can be generated from the basic soil map include the sixteen interpretations that are provided in tabular form in this report as well as a number of single feature maps such as drainage, texture of surface deposits, slope, stoniness and salinity. A package of interpretive maps and single feature derivative maps can be made available on request to the Canada-Manitoba Soil Survey, Ellis Building, University of Manitoba.

The Canada-Manitoba Soil Survey trusts that this report and accompanying map will be of value to all individuals and agencies involved with the use of land within the map area.

ACKNOWLEDGEMENTS

Grateful acknowledgement is made to the following persons:

The staff of the Parks Division in the Duck Mountain Region for the excellent cooperation received during the field mapping program. Provision of a boat and motor was essential to completion of the field mapping program in the study areas.

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J. Madden, J. Yeung, and R. Mirza for laboratory analysis, carried out under the supervision of P. Haluschak.

The soils were mapped by W.R. Fraser and assisted by N. McKay, D. Swidinsky and B.E. Halstead.

SUMMARY

The detailed soil mapping areas described in this report are located within Duck Mountain Provincial Park in west central Manitoba. Detailed soil mapping was conducted on a total area of 3 090 ha surrounding five major lakes of high recreational potential.

The study area occurs within the Duck Mountain Uplands, a physiographic subdivision of the Saskatchewan Plain. This upland area is an undulating to hummocky till plain with an average elevation of approximately 660 m ASL.

The principal surface deposits consist of loamy, moderately calcareous glacial till. Overlying these morainal deposits in selected areas are clayey glaciolacustrine veneers and blankets, sandy glaciofluvial blankets, and organic materials.

The Duck Mountain area has a cold humid continental climate with distinct seasonal variations in temperature. The frost-free period is less than 100 days.

The irregular hummocky morainal topography lacks a well developed drainage network, resulting in numerous, small undrained depressions and lakes. Soils are, therefore, dominantly well drained on the slopes with a sudden transition to very poorly drained positions in the depressions.

The soil parent materials consist mainly of glacial till (50 percent of the total surface area); clayey blankets and veneers overlying till (19 percent); loamy glaciolacustrine blankets (1 percent); sandy glaciofluvial deposits (6 percent); gravelly glaciofluvial deposits (2 percent); loamy alluvial deposits (0.5 percent); and organic peat deposits (20 percent).

The dominant soils (67 percent) in the study area are Gray Luvisols occurring in the well and imperfectly drained positions. Moderately decomposed Typic Mesisols, Terric Mesisols, Typic Fibric Mesisols, and Terric Fibric Mesisols are the most common organic soil subgroups, occupying 20 percent of the area. Rego and Rego Humic Gleysols (6 percent of the area) are the predominant poorly drained mineral soil types. Brunisolic and Regosolic soils comprise the remainder of the map area (less than 4 percent).

The agricultural potential of soils in the Duck Mountain area ranges from class 2 to class 7. Class 2 and 3 soils are limited to a few small selected localities. Topography, poor drainage, and climate are the major adverse soil conditions affecting soil capability. The extensive areas of organic soils have little or no value for agriculture in their native state.

The predominant soil conditions which present problems for engineering and recreational development are: a) large areas of organic soils that are very highly compressible and lack bearing strength; b) the high seasonal water table which affects Organic and Gleysolic soils; and c) the slow permeability and low to moderate bearing strength of the clayey glaciolacustrine materials. Approximately 2 percent of the soils in the area are sufficiently granular to provide good aggregate.

The five selected study areas all have a good potential for recreational development and interpretation. A knowledge of the soil resources provided in this report will serve to enhance the planning and developmental process.

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PART 1

GENERAL DESCRIPTION OF AREA

1.1 LOCATION AND EXTENT

This report describes the detailed soil survey of selected shoreline areas bordering lakes within the Duck Mountain Provincial Park. The park is located in western Manitoba (Figure 1) between Townships 29 and 33 and Ranges 24 to 26W. The five study areas are the Wellman-Glad Lake area, Singush Lake, East and West Blue Lakes, and portions of the shoreline areas bordering Childs Lake and Laurie Lake (Figure 2). The total land area surveyed at 1:20,000 scale was approximately 3 090 ha.

1.2 PRESENT LAND USE

The present land use is outdoor recreation and natural wildlife habitat. Prior to the establishment of the Duck Mountain Provincial Park, the productive forests of the regions were an important source of timber for very extensive logging operations. This remains a major industry in the area, mainly utilizing the Duck Mountain Provincial Forest lands surrounding the provincial park.

1.3 PHYSIOGRAPHY

The map area lies within the Duck Mountain physiographic subdivision, which is one of a series of upland areas denoting the eastern edge of the Saskatchewan Plain (Figure 3). The Riding Mountain Uplands to the south and the Porcupine Mountain Uplands to the north also have similar physiography and surficial deposits.

The Duck Mountain Upland is hummocky to rolling and hilly moraine. Several hills in the area are over 750 m in elevation; Baldy Mountain, at 831 m, is the highest point in Manitoba. The majority of the area, including the five map areas, can be considered as an undulating to hummocky till plain with an elevation of approximately 680 m.

1.4 GEOLOGY AND SURFICIAL DEPOSITS

Bedrock underlying the Duck Mountain area is dominantly Cretaceous marine shale of the Riding Mountain Formation (Manitoba Mineral Resources Division, 1979). The Manitoba escarpment denotes the eastern edge of the extent of these Cretaceous deposits.

Pleistocene glaciation covered these uplands, resulting in the deposition of extensive end moraine and stagnant ice morainal deposits. These glacial till deposits, up to 260 m in thickness in the uplands area, and the erosion of the exposed Cretaceous bedrock formations along the escarpment, result in a steep eastern face to the uplands.

The composition of the till reflects the nature of the bedrock over which the glacial ice has moved. Glaciation from the north and east has incorporated much of the local shale bedrock, resulting in a medium to fine textured till matrix. Paleozoic dolomite materials from the Interlake area and igneous cobbles and boulders from the Precambrian Shield are present in the till in lesser amounts. These materials are much more resistant to abrasion than the shales, and therefore, constitute nearly all of the cobble to boulder size fragments in the till. The glacial till is generally loam textured, slightly to moderately stony, and moderately to strongly calcareous.

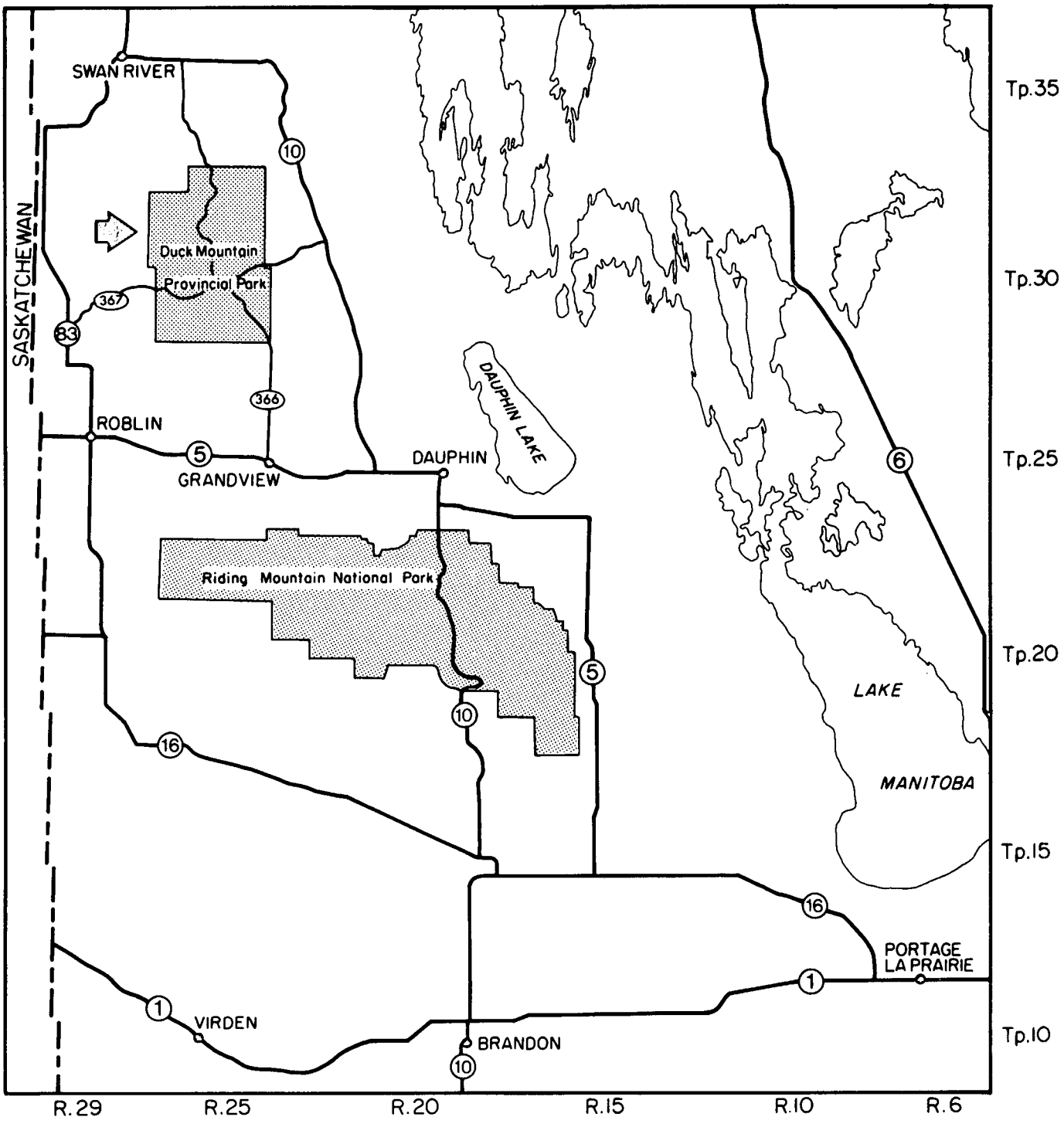


Figure 1: Location of the Duck Mountain Area

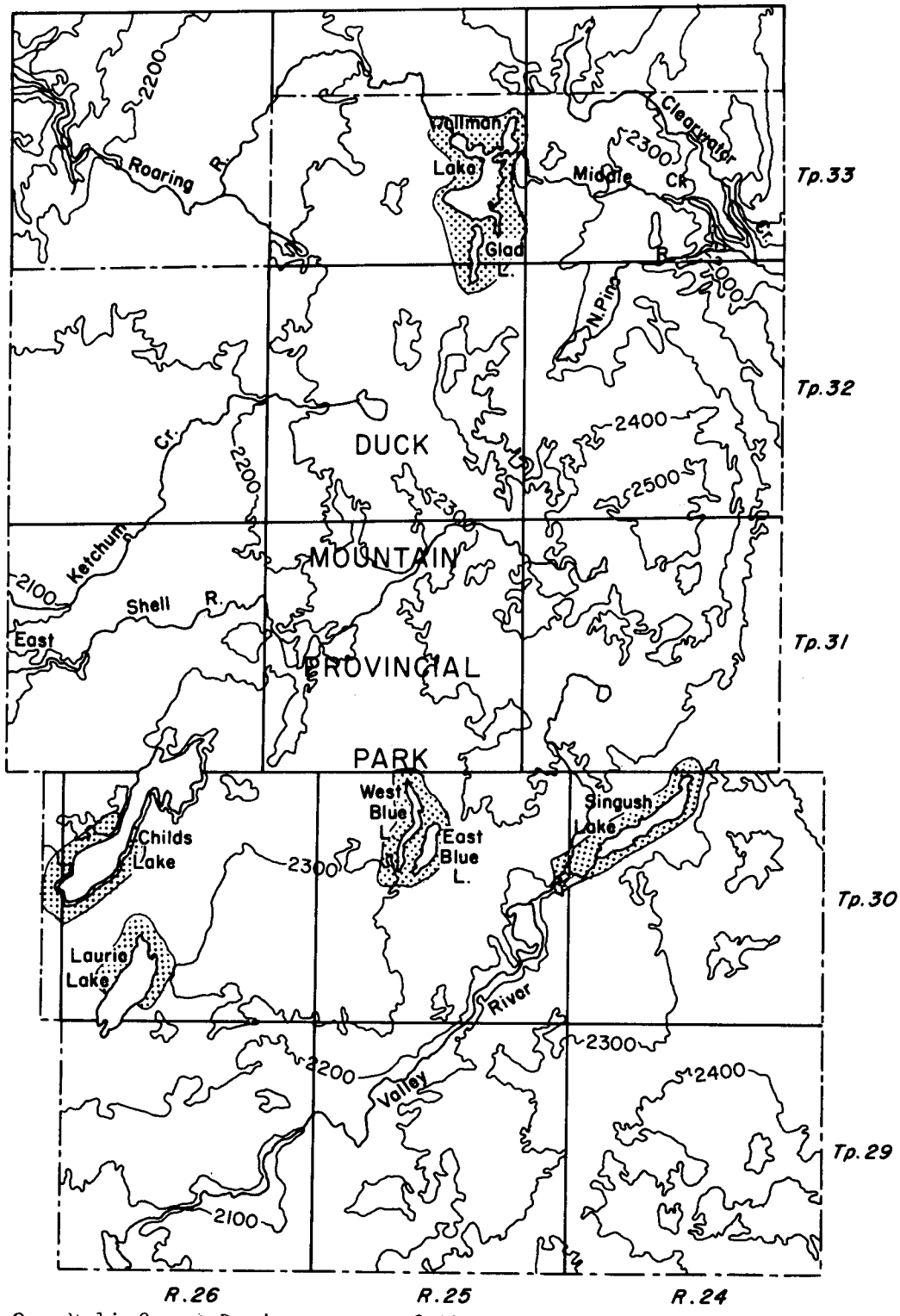
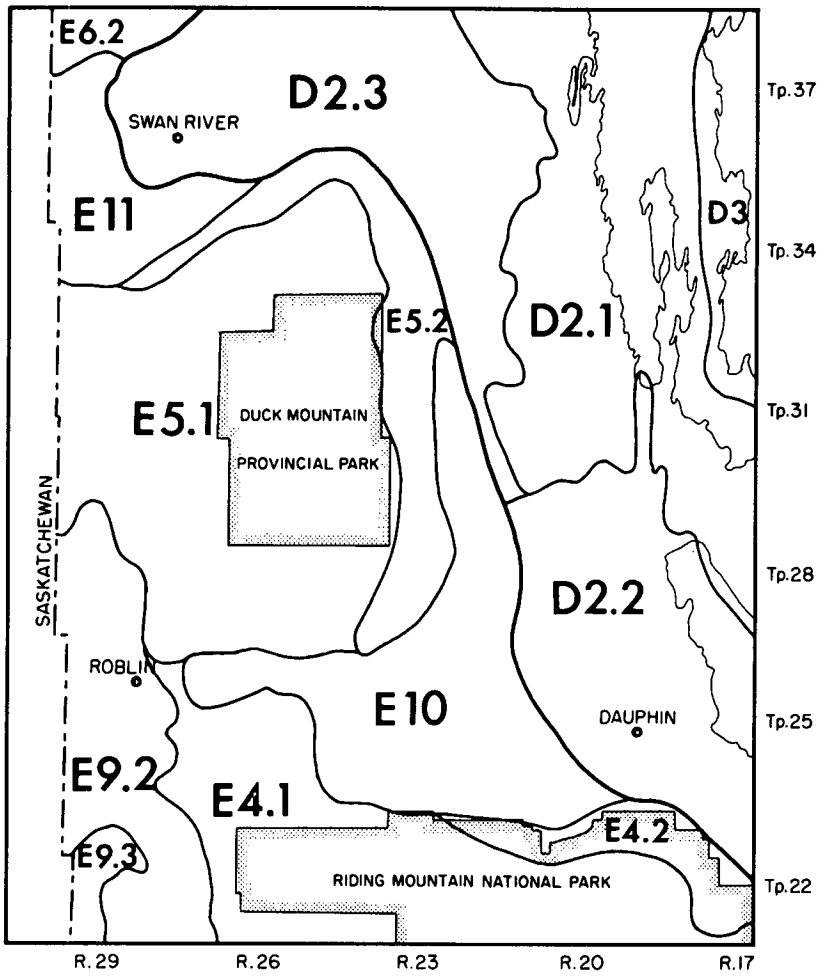


Figure 2: Relief and Drainage Map of the Duck Mountain Study Area



DIVISION	SECTION	SUBSECTION
D Manitoba Plain	D2 Westlake Plain	.1 Westlake Till Plain .2 Dauphin Lake Plain .3 Armit River – Swan Lake Plain
	D3 Interlake Plain	
E Saskatchewan Plain	E4 Riding Mountain Upland	.1 Riding Mountain .2 Riding Mountain Escarp.
	E5 Duck Mountain Upland	.1 Duck Mountain
	E6 Porcupine Hills	.2 Porcupine Escarpment
	E9 Assiniboine River Plain	.2 Newdale Plain .3 St. Lazare Plain
	E10 Valley River Plain	
	E11 Swan River Plain	

Figure 3: Physiographic Regions in the Duck Mountain Area (Can.-Man. Soil Survey, unpublished data)

The higher elevations of these uplands inhibited ice sheet advance and withdrawal, resulting in large areas of stagnant ice in the uplands upon retreat of glaciation towards the close of the Pleistocene Epoch. The melting rates of this stagnant ice with its incorporated till materials was highly irregular due to slumping and differences in surface cover. This results in typically irregular hummocky morainal topography, as illustrated in Figure 4. Large meltwater channels formed in several areas, where the runoff carved out channels within the ice and till material and also left coarse textured glaciofluvial deposits in small terraces as well as relatively flat outwash plains (Klassen, 1966). Ice contact glaciofluvial materials are extremely variable in texture and degree of sorting over small distances. In several road cuts to the south and west of Glad Lake, for example, glaciofluvial sands and gravels, glaciolacustrine silts and clays, and glacial till occur in close proximity. Small ice walled lakes filled with fine textured glaciolacustrine sediments were also common. The resulting topography is often quite undulating to hummocky over most of the Duck Mountain Uplands.

The distribution of surface deposits in the five detailed study areas is indicated in Figures 5 and 6. The predominant soil parent material in the area is unsorted glacial till, which comprises almost half of the land area (Table 3). However, large areas of fine textured, stone-free, silty clay to clay textured glaciolacustrine deposits are also common, often exhibiting the same topographic expression as surrounding till areas. Extensive ground truth is required to delineate these materials separately. In some locations the glaciolacustrine materials have been deposited as a veneer or thin blanket overlying the till, and are restricted to the lower topographic positions.

Several of the areas mapped in detail for this study surround lakes occupying portions of former glacial meltwater channels. These include Glad Lake, Singush Lake, and East and West Blue Lakes. As a result, these areas have a more complex distribution of soil parent materials than the majority of the Duck Mountain area.

Extensive deposits of organic materials occur in many poorly drained positions, both in small localized depressions within areas of hummocky topography, and in extensive flat-lying areas. In the wettest regions, commonly bordering bodies of open water, non-woody fen peat materials predominate. Woody forest peat deposits are the predominant organic materials in the area. Organic soils are commonly underlain by fine textured glaciolacustrine sediments or glacial till.

1.5 SURFACE AND SUBSURFACE HYDROLOGY

The principal relief and drainage features of the Duck Mountain area are shown in Figure 2. The area is an upland till plain with an undulating to hummocky local relief. As a result of this morainal topography, many areas lack a developed drainage network. Consequently, water is ponded in many small undrained depressions and lakes. Several small creeks and rivers originate within the uplands area, which flow radially off the upland through incised valleys or former meltwater channels. These include the Roaring River, flowing north into the Swan River Valley, the Pine and Fork Rivers, flowing eastwards off the Manitoba Escarpment, the Valley River draining to the south, and the Shell River and its tributaries flowing to the southwest.

The soils of the Duck Mountain area are dominantly well drained as a result of the hummocky morainal topography. This changes abruptly to poorly drained conditions in the many localized depressions. Soils in these depressional areas vary from Gleysols to shallow and deep organic soils. Imperfectly drained soils have been mapped in only a few localities in the study area, usually on fine textured glaciolacustrine or morainal deposits with level to gently sloping topography.

A few poorly drained seepage areas were mapped, normally occurring on relatively impermeable parent materials possessing a sandy surface layer. Water moves laterally through the more permeable surface layers, resulting in seepage conditions downslope. The high water table often results in Gleysolic soils with a peaty surface layer, despite the slopes of up to 7 percent in some instances. These soils, mapped as the Sinnott or Flood Lake series, occur in localized areas to the south of Regatta Bay on Wellman Lake, and near the southeast shore of Singush Lake.

Regionally, the Duck Mountain uplands is a major recharge area, characterized by a net downward flow of groundwater which originates through the numerous lakes and poorly drained depressions.

Figure 4: Irregular hummocky morainal topography typical of the Duck Mountain Study Area.

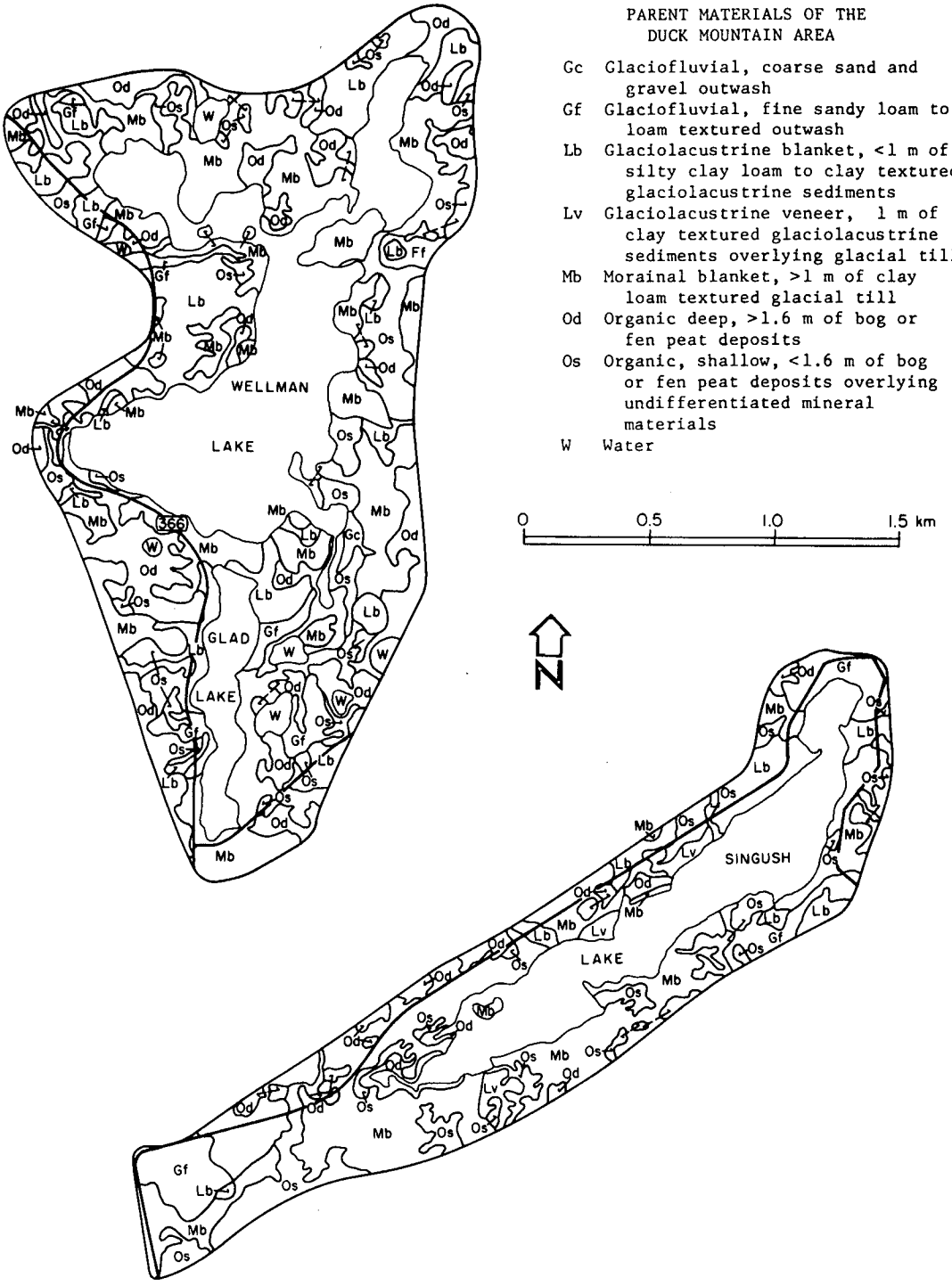


Figure 5: Distribution of Surficial Deposits in the Wellman Lake and Singush Lake Study Areas

PARENT MATERIALS OF THE
DUCK MOUNTAIN AREA

Gc Glaciofluvial, coarse sand and gravel outwash
Gf Glaciofluvial, fine sandy loam to loam textured outwash
Lb Glaciolacustrine blanket, <1 m of silty clay loam to clay textured glaciolacustrine sediments
Lv Glaciolacustrine veneer, 1 m of clay textured glaciolacustrine sediments overlying glacial till
Mb Morainal blanket, >1 m of clay loam textured glacial till
Od Organic deep, >1.6 m of bog or fen peat deposits
Os Organic, shallow, <1.6 m of bog or fen peat deposits overlying undifferentiated mineral materials
W Water

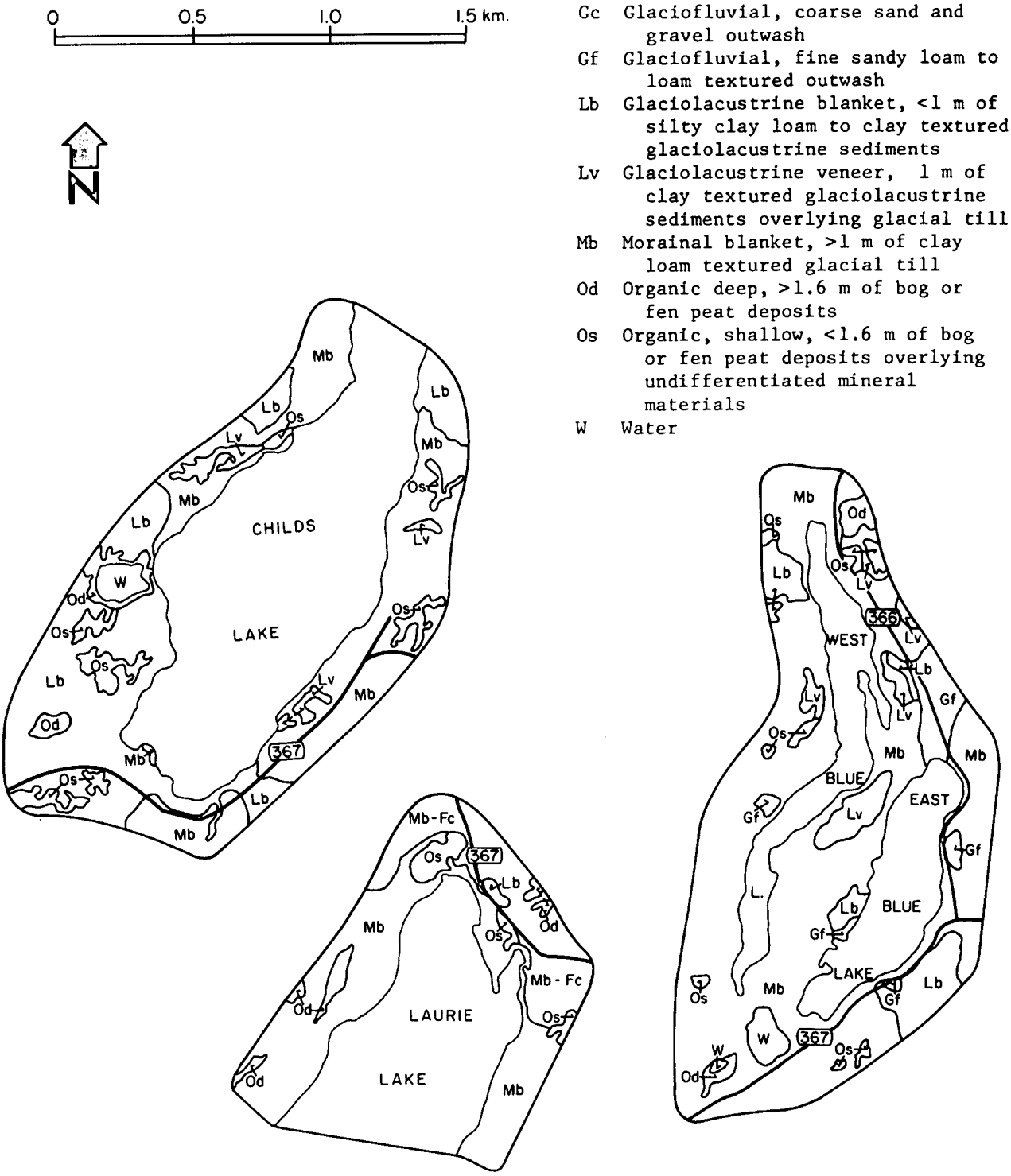


Figure 6: Distribution of Surficial Deposits in the Childs Lake, Laurie Lake, and Blue Lake Study Areas

1.6 CLIMATE

In relation to worldwide climatic conditions, the Duck Mountain area is within the region classified as Dfb(1). This is a humid continental climate, with lower winter temperatures and higher summer temperatures than the world average for the same latitude.

Within Manitoba, the Duck Mountain area is considered to be within the Cold Cryoboreal climatic region(2) (LB2), as illustrated in Figure 7. The higher elevations of the Duck Mountain Uplands results in cooler temperatures, a more humid moisture regime, and a shorter growing season than the surrounding physiographic regions. The mean annual air temperature is estimated to be between -1.0 and -0.5 degrees C. The frost free period is less than 100 days, while the degree days greater than 5.5 degrees C, from May 1 to September 30, is less than 1300. Degree days, sometimes referred to as "heat units", are the accumulation of daily mean air temperatures above a base value of 5.5 degrees C, generally considered to be the minimum level for significant plant growth.

Annual precipitation is approximately 500 mm, approximately two-thirds of which falls as rain from April to October, and the remaining one-third as snow during the winter months.

Soil climate is closely related to aerial climate, and has a direct influence on most biological, chemical, and physical processes in the soil. In the Duck Mountain region, well drained mineral soils have a mean annual soil temperature (MAST) of 2.0 degrees C, and a mean summer soil temperature of approximately 8 degrees C. Gleysolic and Organic soils have slightly cooler soil temperature regimes; however, no evidence of permafrost conditions were encountered in the course of this soils study.

1.7 VEGETATION

The Duck Mountain Uplands lies within the southern portion of the Boreal Forest region. More specifically, it has been classified as belonging to the southeastern extension of the Mixedwood section (B18a) of the Boreal Forest, as delineated by Rowe(3).

The characteristic forest cover is, as the name implies, a mixture of various tree species including trembling aspen (Populus tremuloides -Michx.), balsam poplar (Populus balsamifera L.), white birch (Betula papyrifera Marsh. var. commutata (Reg.) Fern.), white spruce (Picea glauca (Moench) Voss), black spruce (Picea mariana (Mill.) B.S.P.), balsam fir (Abies balsamea (L.) Mill.), and jack pine (Pinus banksiana Lamb.).

The dominant tree types on the well drained mineral upland sites are trembling aspen and white spruce. Common shrubs in this environment include hazel (Corylus spp.), snowberry (Symphoricarpos occidentalis Hook.), currant (Ribes spp.), and cranberry (Viburnum edule (Michx.) Raf. and Viburnum trilobum Marsh). Common ground cover species consist dominantly of various feathermosses, along with bunchberry (Cornus canadensis), bishop's cap (Mitella nuda), twinflower (Linnaea borealis), colt's foot (Petasites palmatus) and sarsaparilla (Aralia nudicaulus).

Disturbance due to fires, logging or clearing has resulted in the establishment of many weed species and dense shrubs in some areas. Formerly burned areas undergoing regeneration have jack pine as a common tree species, along with aspen and spruce. Some areas, particularly more moist, imperfectly drained sites, often have a very dense cover uniform spruce or jack pine with a feathermoss blanket ground cover and very little or no understory.

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(1) Koppen, W. and Geiger, Handbuck der Klimatologie, Bond 1, Teil C. Gebuder Borntraeger, Berlin, 1936.

(2) Mills, G.F., C. Tarnocai, and C.F. Shaykewich. 1977. Characteristics and distribution of soil temperature regimes in Manitoba. Twenty-first Annual Man. Soil Science Meetings Proc., Dec. 7 and 8, 1977, pp. 56-77.

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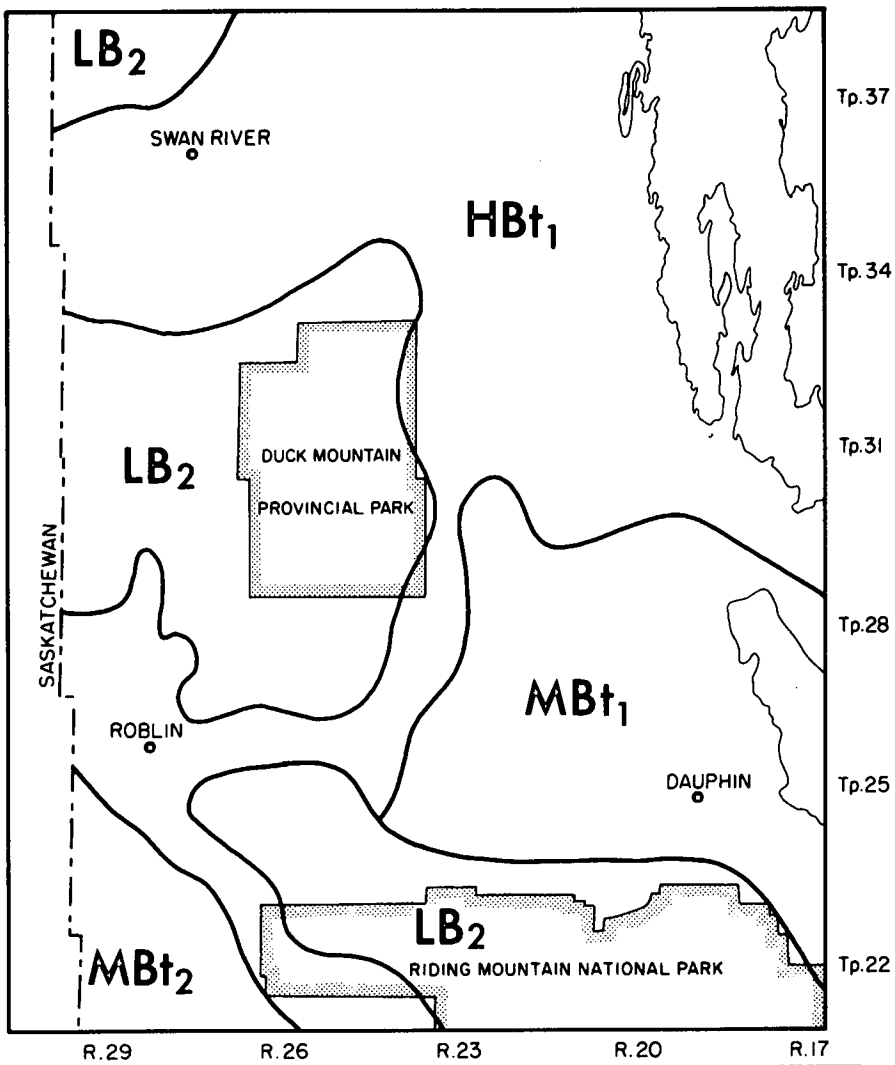
(3) Rowe, J.S. 1972. Forest Regions of Canada. Department of the Environment, Can. Forestry Service. Publication No. 1300.



Soil Climatic Classification				Dominant Soil Orders	Vegetation Zones
Region Name	Subregion Symbol	Temperature Class	Moisture Subclass		
Low Boreal	LB_2	Cryboreal, cold	humid	Luvisolic, Gleysolic, Organic	Mixed deciduous coniferous forest
High Boreal-Temperate	HBt_1	Cryboreal, cold to moderately cold	subhumid	Chernozemic (Dark Gray), Brunisolic, Organic	Grassland-forest transition
Mid Boreal-Temperate	MBt_1, MBt_2	Cryboreal, moderately cold, to Boreal, cool	subhumid	Chernozemic (Black), Gleysolic	Grassland and aspen parkland

Figure 7: Ecological Regions and Subregions in West Central Manitoba

Areas of sandy glaciofluvial deposits commonly exhibit an open stand of jack pine with a ground cover of cinquefoil (Potentilla fruiticosa), snowberry, and various grasses

Depressional areas have a variety of moisture conditions and therefore possess a variety of vegetation types. Some of these Gleysolic soil areas exhibit dense black spruce and feathermoss vegetation, some have balsam poplar, alders (Alnus spp.) and grasses, while others are completely open with grass and sedge vegetation.

Bogs in the Duck Mountain area are normally characterized by stunted black spruce with an understory of labrador tea (Ledum groenlandicum), leatherleaf (Chamaedaphne calyculata), swamp cranberry (Vaccinium oxycoccus), cloudberry (Rubus chamaemorus), and occasionally alders (Alnus spp.) and marsh marigold (Caltha patustris). The ground cover is an almost continuous feathermoss and/or Sphagnum moss blanket.

Organic fen areas have sedges (Carex spp.) and grasses as the key vegetation types, often in association with stunted black spruce, tamarack (Larix laricina) and shrubs such as swamp birch (Betula glandulosa), willow (Salix spp.) and alders.

PART 2

METHODS

2.1 FIELD INVESTIGATIONS

This project was initiated in response to a request from the Parks Branch, Manitoba Department of Mines, Resourses, and Environment, for soils information in five key areas in Duck Mountain Provincial Park. These areas, comprising a total of 3090 ha, surround the shoreline of seven major lakes. A knowledge of soils information for local planning purposes is of prime importance for present and future recreational development and preservation.

In accordance with these requirements, detailed soil mapping was conducted at survey intensity level 2, and a publication scale of 1:20,000 was selected(4). At this scale, the minimum practical size of delineations of significant soil areas is approximately one hectare.

In most of the areas the soils were examined at intervals along available roads, trails, and also along selected traverses. Access to shoreline areas around portions of Wellman, Childs, West Blue, and Singush Lakes was by boat, with ground truth sites examined along short traverses made perpendicular to the shoreline. A total of 365 soil inspections were made, at the locations indicated on the inset diagram accompanying the soils map. This corresponds to an average inspection density of one inspection per 8.3 ha of map area. At each location, detailed information was recorded as to landform, drainage, parent material, and soil profile characteristics for the site and the surrounding terrain. This data, recorded on daily field forms, was later input into the Canada Soil Information System (CanSIS) data bank(5). The use of aerial photointerpretation techniques aided in the initial selection of ground truth sites and traverses, and was also used to extrapolate soil conditions and boundaries between inspection sites.

In addition, 7 representative soil profiles were sampled in detail for chemical and physical analysis. These sites, representing the major soil parent material groups in the area, were used for site characterization and correlation, and to provide data for the various engineering and recreational interpretations contained in this report.

All site specific soils information obtained during the course of this survey project, is available on request from the Canada-Manitoba Soil Survey, Ellis Building, University of Manitoba.

2.2 MAP UNITS

The basic unit of mapping in the Duck Mountain study area is the soil series. It is defined as a naturally occurring soil body such that any profile within that body has a sequence of horizons whose color, texture, structure, consistence, thickness, reaction and composition are within a narrowly defined range. Soil series, assigned local geographic names and represented on the soils map by three-letter alphabetical codes, also have parent material, drainage, and climatic parameters defined within narrow ranges.

Additional features of the landscape or surface expression which may affect land use interpretations are expressed as phases. Topographic phases are used to indicate the most significant limiting slope class in each map unit delineation. These are indicated in the denominator portion of the map symbol.

Delineated areas that are homologous in soil properties and external features are labelled as simple or pure mapping units.

Where different soils or external properties occur in intricate patterns or in such small areas that it is not practical to delineate them

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(4) Mapping Systems Working Group (K.W.G. Valentine, ed.). 1981. A Soil Mapping System for Canada, Revised. Land Resource Research Inst., Agriculture Canada, Ottawa, Ont.

(5) Canada Soil Survey Committee. 1978. Manual for describing soils in the field. Canada Soil Information System (CanSIS), Canada Dept. of Agriculture, Ottawa.

separately because of map scale, they are combined to form compound map units. The soil series and phases that occur in such units are indicated by their individual symbols and the relative extent of each is indicated by percentile proportions. For example:

$$\frac{WTV^{7} - CAY^{3}}{f}$$

This symbol indicates a compound map unit consisting of 70 percent Waitville series with dominantly f topography (15-30 percent slopes) and 30 percent Cayer series with level topography. Map symbols with no topographic designation are understood to have a to b topography (i.e. less than 2 percent slope).

The delineation of map units, whether they be single soil series or soil series complexes, is not an exact science. The decision to outline and label any given area is based on interpretation and extrapolation of observed soil and landscape features. These observations are usually the combined result of field investigations and air photointerpretation. The delineation and extension of soil boundary lines serve as guides for separating soil properties and conditions that are significantly different. Soil boundaries, therefore, are not exact lines but rather are approximations of the areas of significant changes in soil condition, soil properties and profile distributions.

PART 3

SOIL DESCRIPTIONS

3.1 SOIL DEVELOPMENT

The principal factors affecting soil formation are climate, vegetation, parent material, relief, and drainage. The type of soil found 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 soil that comes into equilibrium with its environment develops characteristics and morphology unique to itself and is considered a mature soil. When viewed in vertical cross-section, a mature soils is seen to consist of various layers called soil horizons. The main or master horizons have been designated by the letters O, L, F, H for organic layers and A, B, C for mineral horizons(6). Lower case suffixes are used to indicate the type of master horizons and arabic numerals are used when further subdivision into subhorizons are required. If the soil profile is developed from nonconforming parent materials, common numeral prefixes are used to indicate lithologic changes. Table 1 presents a hypothetical soil profile showing all principle horizons. The master horizon symbols and lower case letter suffixes are defined in more detail in the Glossary.

The A and B horizons are a reflection of the genetic forces operating on the parent material and together they are termed the solum of the soil. No simple definition of master horizons is possible since there are so many different kinds. In general, A horizons or surface layers are subjected to the greatest amount of weathering and leaching and/or organic matter accumulation. The B horizons, lying immediately below the A horizon, contain most of the material leached from the A horizons or have been otherwise altered by soil forming processes. The C horizons represent the relatively unweathered parent material from which the solum has developed.

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(6) The Canadian System of Soil Classification. 1978, Research Branch. Canada Dept. of Agriculture, Ottawa.

The relatively cool, humid regional climate of the Duck Mountain area has produced growing conditions conducive to the development of a mixed woods forest vegetation. As a result of this, well drained soils developed on calcareous glaciolacustrine and morainal parent materials are Gray Luvisols. These soils have a characteristic leaf mat, a leached zone (Ae horizon) and an accumulation zone (Bt horizon) dominantly of translocated clay and organic matter.

Poor drainage associated with depressional areas imparts restrictions on normal soil development. The long saturation period minimizes the downward leaching of material, and the soil environment is altered from an oxidative state to a depleted oxygen or reductive state. The characteristics with the restrictive drainage of these Gleysolic soils are dull (gleyed) soil colors, the development of mottles of iron and manganese, the presence of lime carbonate near the surface, and a high water table. Poorly drained mineral soils in the Duck Mountain area are dominantly Rego Humic Gleysols, having a thin, dark colored A horizon (Ahg) with an accumulation of organic matter, and no B horizon. They frequently have an accumulation of peat on the surface.

Very poorly drained depressional sites result in areas of accumulation of shallow and deep organic materials, dominantly Terric Mesisol and Typic Mesisol soils respectively. The most common organic parent material is moderately decomposed (mesic), woody forest peat. In depressional areas where sedges and grasses predominate, non-woody mesic fen peat is the main organic parent material.

3.2 DESCRIPTION OF SOIL MAP UNIT COMPONENTS

A key to the soils of the Duck Mountain study area is presented in Table 2. A more comprehensive grouping of soils, parent materials, and their estimated areal extent is presented in Table 3. The estimated area occupied by each soil type is given (in hectares), as well as the percent of the total map area it represents.

Table 1. A Hypothetical Soil Profile Showing All Principal Horizons+.

L, F, H Organic debris lodged on soil developed under forest, usually absent on soils developed under grasses.	L	Loose leaves and organic debris, largely undecomposed
	F	Organic debris, partially decomposed or matted
	H	Well decomposed organic matter, original structures indiscernible
A Horizons of maximum biological activity and maximum eluviation (removal of materials dissolved or suspended in water, or both).*	Ah	A dark colored horizon with a high content of organic matter mixed with mineral matter
	Ae	A light colored horizon of maximum eluviation. Prominent in Luvisolic and Podzolic soils; faintly developed or absent in Chernozemic and Brunisolic soils
	AB	Transitional to B, but more like A than B. Sometimes absent
B Horizons of illuviation (of accumulation of suspended material from A) or of maximum clay accumulation, or of blocky or prismatic structure, or both.*	BA	Transitional to A, but more like B than A. Sometimes absent
	Bm	Alteration due to hydrolysis or oxidation to give a change in color or structure as in Chernozemic soils
	Bmy	Like Bm but strongly disrupted by frost action
	Bt	Maximum enrichment of clay minerals as in Luvisolic soils
	Btj	Insufficient clay enrichment to qualify for Bt
	Bn	Maximum development of prismatic structure as in Solonetzic soils
	Bfh	Maximum enrichment of iron and organic matter as in Podzolic soils
	BC	Transitional to C
C The soil parent material. Occasionally absent, i.e. soil building may have extended to a stratum other than bedrock, and of distinctly different character from that in which the solum is found.	Cg	Denotes strongly gleyed horizons as in Gleysolic soils
	Cca	Accumulation of calcium carbonate
	Csa	Accumulation of soluble salts other than calcium carbonate
	Ck	Denotes presence of carbonate
	Cz	Frozen layer
Consolidated bedrock.	R	

+ It should be noted that not all of these horizons occur in any one soil profile.
* A and B represent the Solum, the genetic soil developed by soil-forming processes.
Source: Principles and Practices of Commercial Farming, 1977.

Table 2. Key to Soils of the Duck Mountain Study Area Arranged According to Drainage, Subgroup Classification and Genetic Origin of Their Parent Materials.

DRAINAGE	SUBGROUP	FLUVIAL	GLACIOFLUVIAL		GLACIOLACUSTRINE			MORAINAL
		Loamy alluvium, mod. calcareous	Sand and Gravel Outwash, strongly calcareous	Sand to sandy loam Outwash, mod. calcareous	Loamy, mod. to strongly calcareous	Clayey, mod. calcareous	Clay veneer overlying loamy till	Loamy till, strongly calcareous
Well	O.GL		Woodridge (WOG)	Copernicus (COPX)	Rackham (RKH)	Blackstone (BCS)	Duck Mountain (DKM)	Waitville (WTV)
Imperfect	GL.GL					Verrall Lake (VRL)	Singush (SGU)	Tee Lake (TEK)
Poor	R.G(C.)	Big Lake (BGA, BGAp)		Flood Lake (FOD, FODp)				
	R.HG				Proven Lake (PVK)	Breckon (BKO, BKOp)	Whitefish (WFS, WFSp)	Sinnott (SNT, SNTp)

DRAINAGE	SUBGROUP	Mesic forest peat over sand	Mesic forest peat over clay	15 to 65 cm of Fibric Sphagnum peat over mesic forest peat over clay	Mesic fen peat over clay	Deep mesic forest peat	15 to 65 cm of Fibric Sphagnum peat over deep mesic forest peat	Deep mesic fen peat	15 to 65 cm of Fibric Sphagnum peat over deep mesic forest peat
Poor to Very Poor	T.M	Rat River (RTVX)	Okno (OKOX)	Orok (OOKX)	Cayer (CAY)				
	TY.M					Baynham (BYHX)	Waskwei (WKWX)	Stead (STD)	Katimik (KMK)

Table 3. Soils and Parent Materials and Their Estimated Areal Extent

		Area (ha)	Percent of Map Area
1.	Soils developed on loamy, moderately calcareous alluvium.		
	BGA Big Lake series (Rego Gleysol)	15.8	0.5
2.	Soils developed on moderately calcareous sand and gravel glaciofluvial deposits.		
	WOG Woodridge series (Orthic Gray Luvisol)	73.1	2.4
3.	Soils developed on sandy, moderately calcareous glaciofluvial deposits.	190.5	6.2
	COPX Copernicus complex (Orthic Gray Luvisol)	167.1	5.4
	FOD Flood Lake series (Rego Gleysol)	23.4	0.8
4.	Soils developed on loamy, moderately calcareous glaciolacustrine sediments.	33.4	1.1
	RKH Rackham series (Orthic Gray Luvisol)	29.5	1.0
	PVK Proven Lake series (Rego Humic Gleysol)	3.9	0.1
5.	Soils developed on clayey, moderately calcareous glaciolacustrine sediments.	476.5	15.5
	BCS Blackstone series (Orthic Gray Luvisol)	327.1	10.6
	VRL Verrall Lake series (Gleyed Gray Luvisol)	78.0	2.5
	BKO Breckon series (Rego Humic Gleysol)	71.4	2.3
6.	Soils developed on a 25 to 100 cm clayey glaciolacustrine veneer overlying loamy, moderately calcareous till.	99.5	3.2
	DKM Duck Mountain series (Orthic Gray Luvisol)	73.3	2.4
	SGU Singush series (Gleyed Gray Luvisol)	10.0	0.3
	WFS Whitefish series (Rego Humic Gleysol)	16.2	0.5
7.	Soils developed on loamy, moderately calcareous glacial till.	1 536.9	49.7
	WTV Waitville series (Orthic Gray Luvisol)	1 456.8	47.1
	TEK Tee Lake series (Gleyed Gray Luvisol)	25.9	0.8
	SNT Sinnott series (Rego Humic Gleysol)	54.2	1.8
8.	Soils developed from shallow (40 to 160 cm) organic materials.	297.0	9.6
	a) Shallow mesic forest peat soils underlain by:		
	i) Sandy glaciolacustrine sediments		
	RTVX Rat River complex (Terric Mesisol)	3.4	0.1
	ii) Clayey glaciolacustrine sediments		
	OKOX Okno complex (Terric Mesisol)	178.0	5.8

Table 3 (concluded)

	Area (ha)	Percent of Map Area
b) Shallow mesic forest peat with a thin (less than 65 cm) surface layer of fibric Sphagnum peat. These are underlain by clayey glaciolacustrine sediments.		
OOKX Orok complex (Terric Mesisol)	34.5	1.1
c) Shallow mesic fen peat underlain by clayey glaciolacustrine sediments.		
CAY Cayer series (Terric Mesisol)	81.1	2.6
9. Soils developed from deep (greater than 160 cm) organic materials.	371.2	12.0
a) Deep mesic forest peat		
BYHX Baynham series (Typic Mesisol)	196.7	6.4
b) Deep mesic forest peat with a thin (less than 65 cm) surface layer of fibric Sphagnum peat.		
WKWX Waskwei complex (Typic Mesisol)	34.9	1.1
c) Deep mesic fen peat		
STD Stead series (Typic Mesisol)	103.3	3.3
d) Deep mesic fen peat with a thin (less than 65 cm) surface layer of fibric Sphagnum peat.		
KMK Katimik series (Typic Mesisol)	3.9	0.1
10. Exposed shoreline and backfill.	32.4	1.1
TOTAL	3 094	100

Soil type (either soil complex, soil series, or phase) descriptions are presented in alphabetical order in the remainder of this section. These descriptions include profile type, texture, parent material, topography, drainage, typical vegetation, and associated soil types.

Blackstone Series (BCS)

The Blackstone series comprises well to moderately well drained Orthic Gray Luvisol soils developed from weakly to moderately calcareous, stone-free, clayey glaciolacustrine sediments. Topography varies from gently sloping to hummocky. Permeability is slow due to the fine texture of the parent material. The origin of these deposits has been described in previous soil reports (West Lake Soils Report No. 8, Grandview Soils Report No. 10) as a boulder clay till derived from local shale outcrops in areas along the margins of the escarpment. In the morainal upland environment of the Duck Mountain study areas this parent material appears to be of glaciolacustrine origin. No shale or other rock fragments are incorporated within the massive, silty clay to clay textured matrix.

Blackstone soils exhibit a Luvisolic profile with a solum consisting of a thin leaf mat (LFH) 5 to 10 cm thick, a loamy sand textured eluvial (Ae) horizon 10-15 cm in thickness, and a well developed clay textured illuvial Bt horizon. The unaltered silty clay textured C horizon is dark in color and normally begins at a depth of 40 to 50 cm. This characteristic color of the parent material imparts a relatively dark color to the A and B horizons as well. The lower C horizon frequently exhibits light colored varves, and occasionally, has a concentration of small pebbles which increase with depth, likely indicating a proximity to unaltered glacial till at depths greater than one meter.

Blackstone soils usually support a mixed woods vegetation similar to that of the regional till.

Blackstone soils occur throughout the map areas, most notably towards the north end of Wellman Lake, east of Glad Lake, and along the southwestern shoreline of Childs Lake. These soils are often found in association with the imperfectly drained Verrall Lake series and the poorly drained Breckon series, all of which are developed from the same parent material.

Big Lake Series (BGA)

The Big Lake series consists of poorly to very poorly drained Rego Gleysol, carbonated phase soils developed on alluvial sediments of recent origin. The texture of the solum varies from very fine sandy loam to sandy clay loam, with moderate amounts of lime carbonates. These soils occur in level to depressional channels and flood plains in the Singush Lake area. Vegetation consists largely of sedges, reeds and willows.

Big Lake, peaty phase soils have a thin (15 to 40 cm) layer of mesic fen peat on the surface, and occur in the Valley River flood plain to the southwest of Singush Lake. These soils are mapped in association with the Cayer and Stead series, which are shallow and deep organic soils, respectively. All three series in this map unit exhibit a very gradual increase in the amount of alluvial mineral material with increasing profile depth.

Breckon Series (BKO)

The Breckon series consists of Rego Humic Gleysol soils developed under poor to very poorly drained conditions in deep, weakly to moderately calcareous, clay textured glaciolacustrine sediments. The topography is depressional to level, resulting in very slow to negligible amounts of surface runoff. Native vegetation is dominantly alder, willow and grasses, although some areas have mature balsam poplar.

Breckon soils typically have a thin, dark colored Ah horizon with a silty clay loam to clay texture. This is underlain by a mottled, clayey Ckg horizon, or occasionally, a weakly developed Bg horizon.

Breckon, peaty phase soils occur mainly in very poorly drained positions and possess a thin (15 to 40 cm) layer of mesic peat on the surface.

Breckon soils normally occupy depressional positions within regions of clayey glaciolacustrine deposits.

Baynham Complex (BYHX)

The Baynham complex consists of poorly to very poorly drained, deep organic soils developed on greater than 160 cm of moderately decomposed forest peat. These soils are underlain by undifferentiated mineral materials, usually loam to clay

textured morainal or glaciolacustrine sediments.

A thin layer (0 to 65 cm) of fibric Sphagnum moss peat may cover the surface of these soils. The Baynham series, a Typic Mesisol with little or no (less than 15 cm) fibric Sphagnum moss peat on the surface, is the dominant member of this complex. The Waskwei series, a Typic Mesisol, sphagnic phase, with 15 to 65 cm of fibric Sphagnum moss peat overlying mesic forest peat, is the subdominant member of the Baynham complex.

Topography of Baynham areas is depressional to level, with a hummocky micro-topography. Waskwei soils occur under the hummocks of Sphagnum peat; the Baynham soils are found in the intra-hummock areas.

Figure 8: Baynham soil area.

This figure illustrates typical stunted black spruce, Labrador tea, and feathermoss vegetation.

Native vegetation is predominantly black spruce, with an understory of ericaceous shrubs, feathermoss, and Sphagnum. A typical Baynham soil area is illustrated in Figure 8.

Baynham soils are the most extensive organic soils in the Duck Mountain study area, occurring in large depressional to level areas, particularly surrounding Wellman and Glad Lake.

Cayer Series (CAY)

The Cayer series consists of Terric Mesisol soils developed on 40 to 160 cm of mesic fen peat overlying moderately calcareous, silty clay loam to clay textured glaciolacustrine sediments. These soils occur in high nutrient (eutrophic), poorly to very poorly drained depressional areas. Dominant vegetation consists of sedges, aquatic mosses and grasses, with slumps of willow, alder, and swamp birch occurring in some localities.

The non-woody, moderately decomposed fen peat is reddish brown to dark brown near the surface, becoming dark brown with depth. A thin, black Ah horizon is frequently present at the mineral contact, and is underlain by reduced, calcareous sediments. In some localities the transition from organic to mineral is very diffuse, with the organic matter content gradually decreasing with depth.

Cayer soils occur throughout the map area, in isolated depressions, surrounding deeper fen peat deposits, and along lakeshores.

Cayer series, drained phase soils occur in two map units along the north shore of Laurie Lake. Here the lake level has been lowered by several meters, resulting in lowered water tables within the Cayer soils which were deposited in former lagoon areas bordering the shoreline.

Copernicus Complex (COPX)

The Copernicus complex consists of well to moderately well drained, Orthic Gray Luvisol soils developed on moderately calcareous, sandy, glaciofluvial outwash deposits. The parent material is usually stratified with quite variable, non pedogenic layers in evidence. A typical Copernicus soil has a solum consisting of a thin leaf mat, 3 to 5 cm thick, a light gray, a sand textured Ae horizon approximately 5 to 15 cm thick,

and a loamy sand to sandy clay loam IIBt horizon of about 20 cm thickness. These are underlain by a transitional BC and a IICk or IIICk horizon which is dominantly loamy fine sand to coarse sand in texture. The Blue Wing series, a Dark Gray Luvisol soil with a thin, dark colored Ah or Ahe surface horizon, also occurs as an inclusion in some areas of level topography or south facing slopes.

Ridged and hummocky topography are typical of small areas of Copernicus soils, generally considered as ice contact deposits with frequent inclusions of unmodified till and sorted glaciolacustrine materials. These are common map units surrounding Glad Lake and along the east end of Singush Lake. Larger map units representing areas of nearly level to gently undulating outwash plains occur north of East Blue Lake and also southwest of Singush Lake.

Surface runoff from Copernicus soils is moderate to rapid. Permeability is rapid in the surface areas and moderate to rapid in subsurface layers.

Native vegetation is generally an open stand of jack pine with lesser amounts of aspen and white spruce, and an understory of grasses and shrubs.

The variable, stratified nature of the dominantly sandy outwash material, and the presence of unspecified minor proportions of inclusions of till and glaciolacustrine materials, is indicated by the mapping of these areas as Copernicus complex rather than as pure series map units.

Duck Mountain Series (DKM)

The Duck Mountain series consists of moderately well drained, Orthic Gray Luvisol soils developed on 20 to 100 cm of clayey, stone-free glaciolacustrine sediments overlying moderately calcareous, loamy glacial till. Topography is generally gently sloping to undulating. The fine textured surficial material appears to have been deposited as a glaciolacustrine veneer in the Duck Mountain study area. Surface drainage is somewhat impeded by the fine textured surface material.

Duck Mountain soils have a thin leaf mat on the surface, a light gray, slightly acid Ae horizon, and a dark grayish brown illuvial Bt horizon with well developed blocky aggregates of very hard consistence when dry and high plasticity when wet. The solum extends to a depth of 40 to 50 cm, frequently coinciding with the contact with the underlying till. The IIC horizon is light colored, loam textured, moderately calcareous, and moderately alkaline in reaction. Figure 9 illustrates a typical Duck Mountain soil profile.

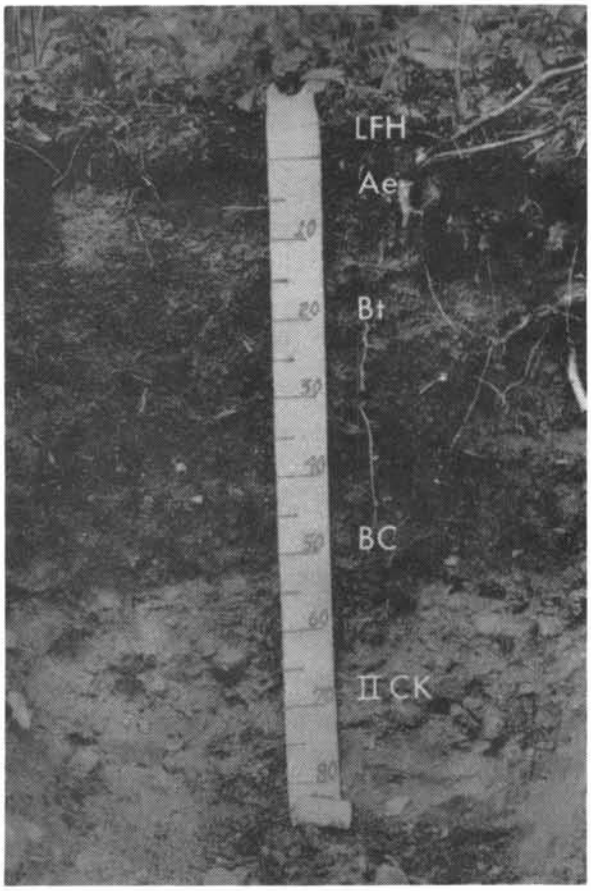

Figure 9: Duck Mountain series.

This soil is characterized by an Orthic Gray Luvisol profile developed on approximately 50 cm of stone-free, clayey glaciolacustrine sediments overlying loamy glacial till.

Dominant vegetation is white spruce and aspen with a sparse understory of balsam fir and a ground cover of feathermoss and bunchberry.

Duck Mountain soils are of minor extent, occurring as constituents in several map units in the Singush Lake and Blue Lake map areas. Duck Mountain soils often occur in transitional areas between units of Waitville till soils and Blackstone soils de-

veloped on deep glaciolacustrine clayey materials.

Exposed Shoreline

This map unit borders the current shoreline of Laurie Lake, due to a recent lowering of the lake level by several meters. As shown in Figure 10, the shoreline consists of a gently sloping apron of recently exposed, loamy regional till. The soil is classified as a Gleyed Regosol, as no soil profile development has occurred. Vegetation consists of immature Balsam fir and grasses.

Flood Lake Series (FOD)

The Flood Lake series consists of Rego Gleysol soils developed under poorly drained conditions from moderately calcareous, sand to very fine sandy loam textured glaciofluvial outwash. These soils occur in gently sloping to level areas as well as depressional channels. A high groundwater level is typical due to lateral seepage or topographic position. These soils are usually very pervious, although stratification of the parent material may limit permeability in some layers.

Soils of the Flood Lake series generally exhibit minimal profile development, often possessing only a very thin, dark colored Ahg horizon overlying a mottled, gleyed Ckg horizon.

Flood Lake, peaty phase soils are similar, except for a thin 15 to 40 cm layer of mesic to fibric peat on the surface.

Vegetation in Flood Lake soil areas is dominantly black spruce with an understory of Labrador tea and feathermoss. These soils occur as map units in the Singush Lake area. Two areas mapped as Flood Lake series occur in similar materials having a recent lacustrine origin and here, vegetation consists of grasses and willows. These areas occur southwest of East Blue Lake.

Katimik Series (KMK)

The Katimik series consists of very poorly drained Typic Mesisol, sphagnic phase soils developed on mesic fen peat. These very deep organic soils are underlain by undifferentiated materials, usually loam to clay textured sediments, at depths below 160 cm. A thin, 15 to 65 cm layer of fibric Sphagnum moss peat occurs on the surface. Katimik soils occur in areas of level to depressional topography and have a hummocky micro relief due to the Sphagnum mounds.

Vegetation consists of an open stand of stunted black spruce and tamarack underlain by Sphagnum, feathermosses, sedges and reed grasses.

Katimik soils occur in only two small map units in the map area, to the west of Singush Lake.

Figure 10: Recently exposed shoreline map unit bordering Laurie Lake.

Okno Complex (OKOX)

The Okno complex is composed of a group of poorly to very poorly drained organic soils developed on woody, moderately decomposed (mesic) forest peat, or thin (0 to 65 cm) fibric Sphagnum moss peat overlying mesic forest peat. Moderately calcareous clay loam to clay textured till, or more commonly, clayey glaciolacustrine sediments occur within 160 cm of the surface. Okno complex soils are considered as depressional to level flat bogs.

The dominant soil within the Okno complex is the Okno series, a Terric Mesisol with less than 15 cm of fibric Sphagnum peat at the surface. The soils of the Orok complex are commonly associated with the Okno complex. This is due to the hummocky nature of the Sphagnum moss layer overlying the mesic forest peat. As a result, the Orok series, a Terric Mesisol, sphagnic phase, which possesses a thicker (15 to 65 cm) fibric Sphagnum peat surface layer, is a subdominant constituent of the Okno complex. Other minor constituents are the Kalevala series, a Terric Fibric Mesisol, and the Baden series, a Terric Mesic Fibrisol.

Native vegetation is black spruce with an understory of Labrador tea and other ericaceous shrubs, and a ground cover of feathermoss and Sphagnum.

Okno soils are the most common shallow organic soils within the study area, occurring in numerous map units within the Singush Lake and Wellman Lake map areas.

Orok Complex (OOKX)

The Orok complex consists of essentially the same group of poor to very poorly drained organic soils as the Okno complex, differing from the latter in the dominance of specific member series. The areas represented by the Orok complex have a thicker and more continuous layer of Sphagnum moss overlying the mesic forest peat. Moderately calcareous, clay loam to clay textured till, or more commonly, glaciolacustrine sediments occur within 160 cm of the surface. The topography of Orok areas is depressional.

Native vegetation associated with Orok areas is stunted black spruce with an understory of ericaceous shrubs and Sphagnum moss.

The dominant soil within the complex is the Orok series, a Terric Mesisol, sphagnic phase, with a significant layer (15 to 65 cm) of fibric Sphagnum moss peat at the surface. Minor significant soils include the Okno series, a Terric Mesisol, the Baden series, a Terric Mesic Fibrisol, and the Kalevala series, a Terric Fibric Mesisol.

Orok soils occur in only a few small map units within the Childs Lake, Wellman Lake, and Singush Lake map areas.

Proven Lake Series (PVK)

The Proven Lake series consists of Rego Humic Gleysol soils developed under poorly to very poorly drained conditions on deep, moderately calcareous, loam to silty loam textured glaciolacustrine sediments. The topography is generally depressional or gently sloping with poorly drained conditions due to seepage.

Native vegetation consists of either black spruce and feathermoss, or more open stands of balsam poplar with sedges and meadow grasses.

The soil profile consists of a mesic peat surface layer, a thin dark gray to black Ah horizon, grading through a thin transitional AC horizon to a strongly mottled, light colored Ckg horizon. In some sites, the peaty layer may be thicker, ranging from 15 to 40 cm, and is designated as a peaty phase.

Proven Lake soils are of very limited extent in the map area, representing only a few small poorly drained map units in transitional areas where till, outwash, and glaciolacustrine sediments occur in close conjunction.

Rackham Series (RKH)

The Rackham series consists of moderately well to well drained Orthic Gray Luvisol soils developed on deep, moderately to strongly calcareous, loam to silty clay loam textured glaciolacustrine sediments. The landscape varies from gently to moderately sloping. Runoff and infiltration is moderately rapid. Native vegetation is a mixture of aspen, white spruce and birch, with an understory of hazel, rose, and dogwood.

The Rackham soil profile is characterized by a partially decomposed leaf mat about 5 cm thick, a light

gray, very fine sandy loam textured Ae horizon, 5 to 15 cm thick, which grades into a well developed clay textured Bt horizon. The Bt horizon is blocky structured, dark brown in color, and ranges in thickness from 20 to 30 cm. This is underlain by a transitional BC horizon and a light colored, moderately calcareous silt loam to silty clay loam textured Ck horizon. Non-pedogenic layers of variable texture are common within Rackham parent materials.

Rackham soils occur in several localities in the Wellman-Glad Lake area, often bordering on sandy glaciofluvial and clayey glaciolacustrine sediments of the Copernicus complex and Blackstone series, respectively.

Rat River Complex (RTVX)

The Rat River complex consists of poorly to very poorly drained organic soils developed on mesic forest peat with a thin or absent (0 to 65 cm) fibric Sphagnum moss peat surface layer. The mesic forest peat is very dark brown, slightly acid, fine fibered material with variable amounts of woody debris. Moderately calcareous, sand to sandy loam textured sediments occur within 160 cm of the surface. Rat River soils occupy level to very gently sloping areas, often receiving runoff from higher surrounding areas by means of lateral seepage.

The dominant vegetation is black spruce, Labrador tea, feathermoss and Sphagnum.

The dominant soil within the complex is the Rat River series, a Terric Mesisol with less than 15 cm of fibric Sphagnum peat at the surface. The soils of the Guy Hill series, a Terric Mesisol, sphagnic phase, occupy the deeper Sphagnum hummocks. The Pigeon Point series, a Terric Fibric Mesisol, and the Catfish Point series, a Terric Mesic Fibrisol are also minor constituents.

Soils of the Rat River complex are similar to those described as Okno complex, differing from them in the nature of the underlying mineral sediments.

Rat Lake complex soils occur in only two map units, located at the east end of Singush Lake.

Singush Series (SGU)

The Singush series consists of imperfectly drained, Gleyed Gray Luvisol soils developed on 20 to 100 cm of silty clay textured, stone-free glaciolacustrine sediments overlying moderately calcareous, loam textured glacial till. Topography is depressional to very gently sloping. Surface drainage is impeded by the fine textured solum.

Singush soils have a leaf mat (LFH) approximately 10 cm thick, a light gray Ae horizon, a slightly gleyed, silty clay to clay textured illuvial Bt or Btg horizon. The underlying IICkg is strongly gleyed, mottled glacial till.

Dominant vegetation is white spruce and aspen with a ground cover of feathermoss and bunchberry. The white spruce reach a height of 25 meters or more in Singush map units in the Childs Lake and Blue Lake areas.

Singush soils are of minor extent in the map area, occupying only a few map units in conjunction with well and poorly drained soils developed from similar parent materials, the Duck Mountain and Whitefish series, respectively.

Sinnott Series (SNT)

The Sinnott series consists of poorly to very poorly drained Rego Humic Gleysol soils developed on deep, slightly stony, loam textured glacial till. The soils normally occupy level to depressional areas, although a few areas of Sinnot, peaty phase soils occur under gently to moderately sloping (c-d) topography under lateral seepage conditions.

These soils normally have a 15 to 40 cm layer of fibric to mesic peat on the surface and are designated as Sinnot series, peaty phase. This is underlain by a dark colored, humus rich Ahg horizon and a mottled, moderately calcareous, loam textured Ckg horizon.

Extreme variability of drainage conditions can exist between different depressional areas, or within different zones in a single depression. As a result, several similar but non limiting soil profiles were observed as inclusions within depressional areas mapped as the Sinnott series. These include Rego Gleysols, which are similar except for the lack of an Ahg horizon more than 10 cm thick, and the Boughton series, an Orthic Luvic Gleysol with an eluvial

Ahe or Ae horizon overlying a clay textured Btg horizon.

Vegetation normally consists of dense black spruce, Labrador tea, and feathermoss. In a few areas, Sinnot soils occur in open areas with meadow grass, sedge, and scattered willow and alder vegetation.

Sinnott soils occur throughout the map area, particularly in closed depressions and channels within areas of hummocky glacial till deposits.

Stead Series (STD)

The Stead series consists of very poorly drained, Typic Mesisol, organic soils developed on greater than 160 cm of mesic fen peat. The peat is very dark brown, medium acid to neutral, non-woody, very uniform fen peat, derived mainly from moderately decomposed sedges, reed grasses, and aquatic mosses. Stead soils have a peraquic moisture regime, indicating that the water table is very close to the surface throughout the year. These soils are underlain by undifferentiated materials, usually loam to clay textured morainal or glaciolacustrine sediments.

Vegetation typically consists of sedges and reed grasses, with a few scattered willow or swamp birch clumps.

The Overflowing series, a Hydric Mesisol composed of a floating mat of fen peat over water, is a frequent inclusion in Stead map units bordering small lakes.

Stead soils are located in closed depressional areas, in very poorly drained channels, or surrounding lakes or small water bodies throughout the map area. A portion of a typical Stead map unit is illustrated in Figure 11.

Tee Lake Series (TEK)

The Tee Lake series consists of imperfectly drained, Gleyed Gray Luvisol soils developed on deep, loam textured glacial till. Topography is level or very gently sloping to depressional. Tee Lake soils normally occupy lower slope positions in areas of hummocky glacial till landforms, or in level to shallow depressional areas where internal drainage is impeded by the slow permeability of the parent material and a high groundwater table.

These soils generally have a leaf mat (LFH) approximately 6 cm thick, a light gray Ae or Aegj horizon, 5 to 10 cm thick, and a gleyed, clay loam textured Btgj horizon extending to 25 to 30 cm below the surface. This is underlain by a thin transitional BC horizon and a gleyed, mottled, moderately to strongly calcareous Ckg horizon.

Dominant vegetation is dense, white or black spruce, with an understory of balsam fir and a ground cover of feathermoss.

Tee Lake soils occur in small map units of level to gently sloping topography throughout the individual map areas.

Verrall Lake Series (VRL)

The Verrall Lake series consists of imperfectly drained, Gleyed Gray Luvisol soils developed on deep, fine textured glaciolacustrine sediments. These soils occur in areas of level to gently sloping topography, often in close association with glaciolacustrine sediments of the Blackstone series in higher, well drained positions and the Brekon series in poorly drained depressions.

Verrall Lake soils generally have a 5 to 10 cm thick leaf mat (LFH) on the surface, a light gray Ae horizon of similar thickness, and a gleyed, silty clay to clay textured Btgj horizon approximately 25 cm in thickness. These horizons are underlain by a thin transitional BC horizon and a gleyed, mottled, moderately to strongly calcareous, silty clay to clay textured Ckg horizon.

Vegetation on Verrall Lake soils consists mainly of white spruce and aspen, with an understory of alders, bunchberry, sarsaparilla and feathermosses.

Verrall Lake soils occur primarily in the Childs Lake and Wellman Lake portions of the Duck Mountain study area.

Figure 11: Stead map unit bordering small lake, southwest of Glad Lake.

Waitville Series (WTV)

The Waitville series comprises well drained Orthic Gray Luvisol soils developed on deep, loamy glacial till. This regional till is of mixed shale, limestone, and granitic rock origin and is the predominant parent material in the Duck Mountain area. Waitville soils occupy the mid to upper slope positions in areas of typically undulating to hummocky glacial till landforms.

Waitville soils are characterized by a 5 to 10 cm thick leaf mat (LFH), underlain by a light brownish gray, fine sandy loam textured Ae horizon with fine to medium platy structure. The underlying dark brown Bt horizon is generally 20 to 30 cm in thickness and contains significant clay accumulations, resulting in clay loam to sandy clay loam textures and a medium subangular blocky structure. This is followed by a thin transitional BC horizon and a light grayish brown Ck horizon. A typical Waitville soil profile is shown in Figure 12.

The unaltered parent material is moderately to strongly calcareous and contains a higher percentage of pebble-size coarse fragments than are found in the solumn. This regional till is predominantly loam textured within the Duck Mountain study area, although this may grade to a clay loam texture in adjacent upland areas.

Native vegetation on areas of Waitville soils is typically a mixture of white spruce and aspen, with an understory of hazel, currant and dogwood, and a ground cover of bunchberry, grasses and feathermosses.

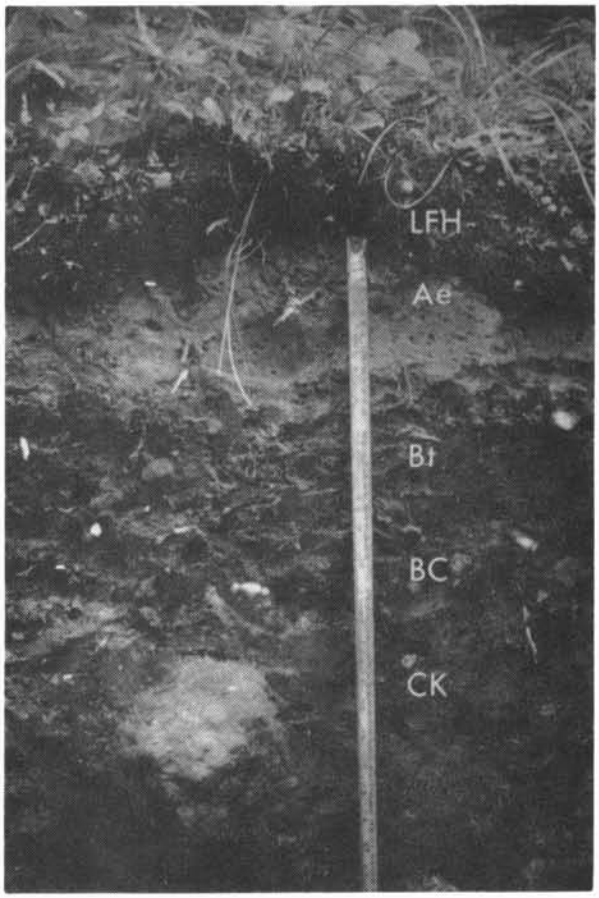

Figure 12: Waitville series, an Orthic Gray Luvisol soil developed on loamy regional till.

Waskwei Complex (WKWX)

The Waskwei complex consists of very poorly drained, deep (greater than 160 cm) organic soils, developed on woody, moderately decomposed forest peat capped by a thin layer of fibric Sphagnum moss peat. These soils are underlain by undifferentiated mineral materials, generally moderately calcareous loamy to clayey morainal or glaciolacustrine sediments.

The Waskwei series, a Typic Mesisol, sphagnic phase soil, is the dominant member of the complex. This series has a 15 to 65 cm surface layer of strongly acid, pale brown, fibric Sphagnum moss peat. This is underlain by a dark brown, slightly to medium acid, moderately decomposed forest peat which extends to below the 160 cm deep control section. The Baynham series, a Typic Mesisol with less than 15 cm of Sphagnum peat at

the surface, is the subdominant member of the complex.

Vegetation of Waskwei soils consist of black spruce with an understory of Labrador tea and a ground cover of cloudberry, feathermoss, and Sphagnum.

Soils of the Waskwei complex occur as flat bogs in small depressions, mainly in the Singush Lake and Wellman Lake map areas.

Whitefish Series (WFS)

The Whitefish series consists of Rego Humic Gleysol soils developed on aa thin veneer of clayey, stone-free glaciolacustrine sediments overlying loamy glacial till. These soils occur in small depressional areas with poor to very poor drainage and a high seasonal water table.

Whitefish soils are characterized by a dark coloured, humus rich Ahg horizon of silty clay to silty clay loam texture. This is underlain by a gleyed, calcareous Ckg horizon of similar texture. A IICkg horizon, consisting of stony, loam textured, moderately to strongly calcareous glacial till occurs within 1 meter. These soils also possess a thin leaf mat (LFH) at the surface. Whitefish, peaty phase soils (WFSp) are similar, but possess a thicker, 15 to 40 cm layer of organic material on the surface.

Native vegetation of Whitefish soils is commonly balsam poplar, willow, and grasses.

Whitefish soils occur as map units in small depressional areas, mainly in the Childs Lake area.

Woodridge Series (WOG)

The Woodridge series consists of Orthic Gray Luvisol soils developed on rapidly to well drained, coarse textured glaciofluvial deposits. This parent material consists of sand and gravel of predominantly limestone and granitic origin; shale fragments are uncommon due to their lack of resistance to weathering in the depositional environment.

Woodridge soils are characterized by a very thin, 1 to 2 cm leaf mat, underlain by a light gray, gravelly loamy sand to sand textured Ae horizon from 5 to 20 cm in thickness. This is in turn underlain by a weakly developed, gravelly loamy sand to gravelly sandy loam textured Bt horizon. The Ck horizon is strongly calcareous, stratified, sand and gravel. In some areas where very coarse textured cobbly materials predominate to the surface, soil profile development is limited and Orthic Eutric Brunisol and Eluviated Eutric Brunisol soils may occur.

Native vegetation on Woodridge soils consists of jack pine with lesser amounts of white spruce and aspen, and an understory of shrubs and grasses.

Woodridge soils occasionally occur in close association with water-worked glacial till and sandy glaciofluvial deposits of the Waitville series and Copernicus complex, respectively. Woodridge soils occur as map unit components in a few locations in the eastern portion of the wellman Lake area, the western portion of the Singush Lake area, and along the northern end of Laurie Lake.

PART 4

USE AND MANAGEMENT INTERPRETATIONS OF SOILS

4.1 INTRODUCTION

This section provides predictions of performance or soil suitability ratings for various uses of soils based on field observations of soil and landscape characteristics, laboratory data, and on observations of soil behaviour under specified conditions of land use and management. Suitability ratings or interpretations are intended only to serve as guides for planners and managers. Caution, with an understanding of the limitations of the soil map must be exercised when applying suitability ratings to soil map units. The value of any rating or interpretation depends upon the nature and composition of individual map unit delineations which in turn depends on the scale of mapping and intensity of ground truthing employed in the survey.

There are two kinds of mapping units employed in the resurvey of soils in Manitoba. They are simple mapping units and compound mapping units.

Simple mapping units are usually occupied by one kind of soil series, the properties of which vary within very narrow limits. Often as not they contain minor inclusions of related but unlike soil types. The proportion of such unlike soils tends to increase as the intricacy of soil pattern increases or as the intensity of ground truthing decreases. In any event, such mapping units are usually named after the dominant soil series and any available information about the soil series is applicable to the entire mapping unit. Predictions concerning soil conditions and behaviour can be done confidently.

Compound mapping units on the other hand, usually contain significant proportions of two or more unlike soil series. These soils are related geographically but can not be mapped or delineated separately because of a combination of such factors as the intricacy of soil pattern, map scale and survey effort. In many compound map units, differences in soil types and other characteristics are strongly contrasting. Dominant, subdominant and minor (if strongly contrasting) soil series are identified and the relative proportion that each occupies within a single map delineation is specified. In compound map units, interpretation or suitability ratings can only be applied to that portion of the mapping unit occupied by each identified soil series. In order to apply interpretations to field conditions, it is essential that users determine where each identified soil series in the mapping unit occurs in the landscape. Information contained in the legend accompanying the soil map and other sections of the report is useful for this purpose.

A second type of compound mapping unit is called a soil complex. This compound mapping unit usually contains two or more related but unlike soil series which occur in unspecified proportions. In most cases, the differences in soil profile and other characteristics are not strongly contrasting. Soil complexes are often employed in the mapping of outwash deposits and organic soil areas. In such areas soil profile variability occurs over such short intervals of distance that the proportions of constituent soil series within each map unit delineation is not possible to determine without excessive ground truth effort. Interpretations applied to such units cannot be employed with the same degree of confidence as in the case of simple or more specifically defined compound mapping units.

In this section, interpretive soil information is provided for the following land-use evaluations:

1. Agriculture

   a) dryland farming capability

2. Engineering Uses

3. Recreation Uses

4.2 SOIL CAPABILITY FOR AGRICULTURE

Dryland Agriculture

Soil capability classification for dryland agriculture is based on evaluation of both internal and external soil characteristics that influence soil suitability and limitations for agricultural use. In this classification, mineral soils are grouped into capability classes and subclasses based on their limitations for dryland farming, risk of damage when the soils are used and the way they respond to management(7). There are seven capability classes, each of which groups soils together that have the same relative degree of limitation or 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 agriculture. The first three classes are considered capable of sustained production of common field crops, the fourth is marginal for sustained arable culture, the fifth is suitable only for improved permanent pasture, the sixth 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.

Organic soils within the map area are rated for "potential" agricultural capability after the method of Leeson(8). Capability ratings of organic soils for agriculture must recognize that most organic soils have little or no value for agriculture in their native state and their potential is only achieved through reclamation or development implemented with varying degrees of difficulty. Capability class definitions for organic soils are the same as for mineral soils. They are however identified on maps and tables with the prefix "O".

Soil capability subclasses are divisions within classes which group soils with similar kinds of limitations and hazards for agricultural use. The various kinds of limitations recognized at the subclass level are defined in Table 4.

A summary of the soils in the Duck Mountain area showing their major characteristics and their interpretive classification for dryland agriculture is presented in Table 5.

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(7) ARDA. 1965. Land capability classification for agriculture Report No. 2 Canada Land Inventory, Canada Dept. Regional Economic Expansion, Ottawa. 16 pp.

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(8) 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, Ontario.

TABLE 4

Agricultural Capability Subclass Limitations

C- Adverse climate: This subclass denotes a significant adverse climate for crop production as compared to the "median" climate which is defined as one with sufficiently high growing-season temperatures to bring field crops to maturity, and with sufficient precipitation to permit crops to be grown each year on the same land without a serious risk of partial or total crop failures.

D- Undesirable soil structure and/or low permeability: This subclass is used for soils difficult to till, or which absorb water very slowly or in which the depth of rooting zone is restricted by conditions other than a high water table or consolidated bedrock.

E- Erosion: Subclass E includes soils where damage from erosion is a limitation to agricultural use. Damage is assessed on the loss of productivity and on the difficultires in farming land with gullies.

F- Low fertility: This subclass is made up of soils having low fertility that either is correctable with careful management in the use of fertilizers and soil amendments or is difficult to correct in a feasible way. The limitation may be due to lack of available plant nutrients, high acidity or alkalinity, low exchange capacity, high levels of carbonates or presence of toxic compounds.

I- Inundation by streams or lakes: This subclass includes soils subjected to inundation causing crop damage or restricting agricultural use.

L- Coarse wood fragments: In the rating of organic soils, woody inclusions in the form of trunks, stumps and branches (>10 cm diameter) in sufficient quantity to significantly hinder tillage, planting and harvesting operations.

M- Moisture limitation: This subclass consists of soils where crops are adversely affected by droughtiness owing to inherent soil characteristics. They are usually soils with low water-holding capacity.

N- Salinity: Designates soils which are adversely affected by the presence of soluble salts.

P- Stoniness: This subclass is made up of soils sufficiently stony to significantly hinder tillage, planting, and harvesting operations. Stony soils are usually less productive than comparable non-stony soils.

R- Consolidated bedrock: This subclass includes soils where the presence of bedrock near the surface restricts their agricultural use. Consolidated bedrock at depths greater than 1 meter from the surface is not considered as a limitation, except on irrigated lands where a greater depth of soil is desirable.

T- Topography: This subclass is made up of soils where topography is a limitation. Both the percent of slope and the pattern or frequency of slopes in different directions are important factors in increasing the cost of farming over that of smooth land, in decreasing the uniformity of growth and maturity of crops, and in increasing the hazard of water erosion.

W- Excess water: Subclass W is made up of soils where excess water other than that brought about by inundation is a limitation to their use for agriculture. Excess water may result from inadequate soil drainage, a high water table, seepage or runoff from surrounding areas.

X- Cumulative minor adverse characteristics: This subclass is made up of soils having a moderate limitation caused by the cumulative effect of two or more adverse characteristics which singly are not serious enough to affect the class rating.

Table 5. Interpretations for Agricultural Use of the Soils in the Duck Mountain Area.

Map Symbol and Phase	Soil Name	Agricultural Capability Class
BCS	Blackstone	3D
BCS/xcxx	Blackstone	3D
BCS/xdxx	Blackstone	3TD
BCS/xexx	Blackstone	4T
BCS/xfxx	Blackstone	5T
BGA	Big Lake	5WI
BGAp	Big Lake	5WI
BKO	Breckon	6W
BKOp	Breckon	6W
BYHX	Baynham	04WL
CAY	Cayer	05WL
CAYd	Cayer	03W
COPX/xcxx	Copernicus	4M
COPX/xdxx	Copernicus	4M
COPX/xexx	Copernicus	4MT
COPX/xfxx	Copernicus	5MT
DKM	Duck Mountain	3D
DKM/xcxx	Duck Mountain	3D
DKM/xdxx	Duck Mountain	3TD
FOD	Flood Lake	5WI
FODp	Flood Lake	5WI
KMK	Katimik	06W
OKOX	Okno	05WL
OOKX	Orok	04WL
PVK	Proven Lake	6W
PVK/xdxx	Proven Lake	6W
PVKp	Proven Lake	6W
RKH	Rackham	2C
RKH/xcxx	Rackham	2T
RKH/xdxx	Rackham	3T
RKH/xexx	Rackham	4T
RTVX	Rat River	5WL
SGU	Singush	3WD
SNT	Sinnott	6W
SNTp	Sinnott	6W
SNTp/xcxx	Sinnott	6W
SNTp/xdxx	Sinnott	6W
STD	Stead	04W
TEK	Tee Lake	3W
TEK/xcxx	Tee Lake	3W
VRL	Verrall Lake	3WD
VRL/xcxx	Verrall Lake	3WD

Table 5 (cont'd).

Map Symbol and Phase	Soil Name	Agricultural Capability Class
WFS	Whitefish	6W
WFSp	Whitefish	6W
WKWX	Waskwei	05WL
WOG/xcxx	Woodridge	5M
WOG/xexx	Woodridge	5M
WOG/xfxx	Woodridge	5MT
WTV	Waitville	3X
WTV/xcxx	Waitville	3X
WTV/xdxx	Waitville	3T
WTV/xexx	Waitville	4T
WTV/xfxx	Waitville	6T
WTV/xgxx	Waitville	6T
WTV/xhxx	Waitville	7T

4.3 SOIL SUITABILITY FOR SELECTED ENGINEERING USES

This section provides information which can be used by engineers and land use planners concerned with engineering and related geotechnical aspects of soil. It is intended to supplement the information on the soil map with additional data on engineering properties of soils.

The criteria used to evaluate soil suitability for selected engineering and related recreational uses are adopted from guides found in Coen et al(9), and from guidelines developed by the Soil Conservation Service, United States Department of Agriculture(10) and the Canada Soil Survey Committee(11).

Definition of Soil Suitability Classes

Evaluation of soil suitability for engineering and recreation uses is based on both internal and external soil characteristics. Four soil suitability classes are used to evaluate both mineral and organic soils and hence, mapping units for selected uses. These ratings express relative degrees of suitability or limitation for potential uses of natural or essentially undisturbed soils. The long-term effects of the potential use on the behaviour of the soil are considered in the rating.

The four suitability class ratings are defined as follows:

Good- Soils in their present state have few or minor limitations that would affect the proposed use. The limitations would easily be overcome with minimal cost.

Fair- Soils in their present state have one or more moderate limitations that would affect the proposed use. These moderate limitations would be overcome with special construction, design, planning or maintenance.

Poor- Soils in their present state have one or more severe limitations that would severely affect the proposed use. To overcome these severe limitations would require the removal of the limitation or difficult and costly alteration of the soil or of special design or intensive maintenance.

Very poor- Soils have one or more features so unfavourable for the proposed use that the limitation is very difficult and expensive to overcome or the soil would require such extreme alteration that the proposed use is economically impractical.

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(9) Coen et al, 1977. Soil Survey of Yoho National Park, Canada. Alberta Soil Survey Report No. 37. 208pp. Alberta Institute of Pedology, University of Alberta, Edmonton, Alberta.

(10) USDA, 1971. Guide for Interpreting Engineering Uses of Soils. Soil Conservation Service USDA. SCS-45. 87pp.

(11) CSSC, 1973. Proceedings of the Ninth Meeting of the Canada Soil Survey Committee, University of Saskatchewan, Saskatoon. 357pp.

Soil Suitability Subclasses

The basic soil properties that singly or in combination with others commonly affect soil suitability for selected engineering properties and recreation uses are provided in Table 6. These subclass designations serve to identify the kind of limitation or hazard for a particular use.

TABLE 6

Codes utilized to identify limitations in evaluating soil suitability for selected uses (Tables 8 and 9).

a subgrade properties

b thickness of topsoil

c coarse fragments on surface

d depth to bedrock

e erosion or erodibility

f susceptibility to frost hazard

g contamination hazard of groundwater

h depth to seasonal water table

i flooding or inundation

j thickness of slowly permeable material

k permeability or hydraulic conductivity

l shrink-swell properties

m moisture limitations or deficit

n salinity or sulphate hazard

o organic mater

p stoniness

q depth to sand or gravel

r rockiness

s surface texture

t topographic slope class

u moist consistence

w wetness or soil drainage class

z permafrost

Guides for Assessing Soil Suitability

Guides for assessing soil suitability for ten engineering related uses are given in Appendix D, (Tables 1 through 10). These tables provide as specifically as possible, definitions of the soil properties which result in the specific suitability or degree of limitation. In assessing soil suitability for various engineering uses, the degree of suitability is determined by the most restrictive or severe rating assigned to any one of the listed soil properties. For example, if the suitability is "Good" for all but one soil property and it is estimated to be "Very poor", then the overall rating of the soil for that selected use is "Very poor". Suitability of individual soil properties, if estimated to be "Fair" or "Poor", can be accumulative in their effect for a particular use. Judgement is required to determine whether the severity of the combined effects of several soil properties on suitability for a particular use will result in downgrading an evaluation. This is left to the discretion of the interpreter. It is incorrect to assume that each of the major soil properties influencing a particular use has an equal effect. Class limits established for rating the suitability of individual soil properties take this into account. For a selected use, therefore, only those soil properties which most severely limit that use are specified.

Engineering test data for several key soils in the study area are provided in Table 7.

Engineering description of the soils and their estimated properties significant to engineering are provided in Table 8. These data, in addition to information contained in other sections of the report have been used to rate the soils according to their suitability for ten selected engineering uses in Table 9. When using these interpretations consideration must be given to the following assumptions:

1. Interpretations are based on predictions of soil behavior under defined conditions of use and management as specified in the preamable to each of Tables 1 through 14 (Appendix D). When conditions of use and management are not the same as those defined here, new guides should be established and appropriate revisions made in Table 9.

2. Soil ratings do not include site factors such as nearness to towns and highways, water supply, aesthetic values, etc.

3. Soil ratings are based on natural, undisturbed soil.

4. Soil suitability ratings are usually given for the entire soil, but for some uses, they may be based on the limitations of an individual soil horizon or other earthy layer, because of its overriding importance. Ratings rarely apply to soil depths greater than 1 to 2 meters, but in some kinds of soils, reasonable estimates can be given for soil material at greater depths. It should be noted here that the term "soil" has been used throughout the report in the pedologic sense and differs in concept from that commonly used by engineers.

5. Poor and very poor soil ratings do not imply that a site cannot be changed to remove, correct or modify the soil limitations. The use of soils rated as poor depends on the nature of the limitations, whether or not the soil limitation can be altered successfullly and economically, and on the scarcity of good sites.

6. Interpretations of map units do not eliminate the need for on-site evaluation by qualified professionals. Due to the variable nature of soils, and the scale of mapping, small, unmappable inclusions of soils with different properties may be present in an area where a development is planned. The need for or importance of on-site studies depends on the use to be made of the soil and the kinds of soil and soil problems involved.

Table 7. Engineering Test Data for Several Key Soils in the Duck Mountain Study Area.

Soil Code and Name	Horizon	Depth (cm)	% Passing Sieve (2 mm) No. 10	(0.42 mm) No. 40	(0.074 mm) No. 200	% Smaller Than .05 mm	.002 mm	Liquid Limit	Plasticity Index (P.I.)	Shrinkage Limit %	Ratio	Lineal %	Sat. %	Textural Classification USDA	AASHO	Unified
BCS Blackstone	Bt	24-48	100	99	97	90	54	54	30	14	2.0	25	82	C	A-7-6 (33)	CH
	Ck	48-100	100	99	97	94	36	41	22	16	1.9	22	75	SiCL	A-7-6 (23)	CL
COP Copernicus	Ck	50-100	93	63	14	9	5	-	-	-	-	-	19	S	A-2-4	SM
DKM Duck Mountain	Bt	18-44	100	100	96	87	45	50	26	13	2.0	24	79	SiC	A-7-6 (28)	CL
	IICk	50-100	92	82	57	45	16	24	8	16	1.9	11	40	L	A-4 (2)	CL
FOD Flood Lake	Cg1	0-10	100	92	45	41	17	22	3	24	1.8	5	32	FSL	A-4 (0)	SM
	Cg2	10-60	100	92	20	13	9	-	-	-	-	-	25	LS	A-2-4	SM
RKH Rackham	Bt2	24-38	100	99	95	88	66	52	27	15	1.9	25	83	C	A-7-6 (28)	CH
	Ckgj	44+	100	99	91	83	19	29	11	16	1.9	16	53	SiL	A-6 (9)	CL
VRL Verrall Lake	Btgj	8-30	100	99	97	96	52	53	28	15	2.0	25	84	SiC	A-7-6 (32)	CH
	Ckgj	50-100	100	100	96	95	41	19	27	16	2.0	24	83	SiC	A-7-6 (28)	CL
WTV Waitville	Bt	10-30	94	82	53	47	28	37	20	15	1.9	20	64	SCL	A-6 (7)	CL
	Ck	36-100	83	73	48	41	16	26	11	14	1.9	16	48	L	A-6 (2)	SC

Table 8. Engineering Description of the Soils and Their Estimated Properties Significant to Engineering Uses.

Map Symbol	Soil Name	Depth (cm)	Textural Classification			% Passing			Permea-bility cm/hr	Reaction	Sulfate Hazard	Dis-persion	Shrink-Swell Potential	Depth to Water Table
			USDA	AASHO	Unified	No. 10 2 mm	No. 40 0.42 mm	No. 200 0.074 mm						
BCS	Blackstone	0-20	FSL-L	A-4	SM, SC	100	90-95	70-80	2.5-5	5.0-6.5	low	low	low	>1.5 m
		20-50	C	A-7-6	CH	100	95-100	95-100	<2.5	6.0-7.0	low	low	high	
		50-100	SiC-SiCL	A-7-6	CL	100	95-100	95-100	<2.5	7.0-8.0	low	low	mod.-high	
BGA	Big Lake	0-100	VFSL-SiCL	A-4 to A-6	ML-CL	75-95	50-85	35-70	0.13-2.5	7.0-8.0	low	low	mod.	at or near the surface
BGAp	Big Lake, peaty phase	30-0	mesic peat	-	Pt	-	-	-	>25	6.0-7.5	-	-	-	at or near the surface
		0-100	VFSL-SiCL	A-4 to A-6	ML-CL	75-95	50-85	35-70	0.13-2.5	7.0-8.0	low	low	mod.	
BKO	Breckon	0-100	SiC	A-7-6	CL	100	95-100	95-100	<0.13	7.0-8.0	low	low	mod.-high	at or near the surface
BKOp	Breckon peaty phase	30-0	mesic peat	-	Pt	-	-	-	>25	6.0-7.5	-	-	-	at the surface
		0-100	SiC	A-7-6	CL	100	95-100	95-100	<0.13	7.0-8.0	low	low	mod.-high	
CAY	Cayer	0-100	mesic peat	-	Pt	-	-	-	-	7.3-7.8	low	-	-	at the surface
		100+	L	A-6, A-7	CL	80-100	70-80	40-50	0.13-5.0	7.0-8.0	low	low	low-mod.	
COP	Copernicus	0-20	FS-LFS	A-2-4, A-4	SM	100	60-75	15-35	15-25	6.8-7.4	none	low	low	>1.5 m
		20-70	LFS-SCL	A-4, A-6	SM, SC	100	60-80	30-55	5-15	6.8-7.4	none	low	low-mod.	
		70-100	FS-LFS	A-2-4, A-4	SM	90-100	60-80	15-35	15-25	7.4-7.8	none	low	low	
DKM	Duck Mountain	0-50	SiCL-C	A-7-6	CL-CH	100	95-100	85-95	<2.5	5.0-7.0	-	low	mod.-high	>1.5 m
		50-100	L	A-6	CL	80-85	70-75	45-50	0.13-5	7.0-8.0	none	low	low	
FOD	Flood Lake	0-100	FS-LFS	A-2-4	SM	90-100	70-95	15-35	15-25	7.4-7.8	none	low	low	at or near the surface
FODp	Flood Lake, peaty phase	30-0	mesic peat	-	Pt	-	-	-	>25	6.0-7.5	-	-	-	at the surface
		0-100	FS-LFS	A-2-4	SM	90-100	70-95	15-35	15-25	7.4-7.8	none	low	low	
KMK	Katimik	0-40	fibric peat	-	Pt	-	-	-	>25	5.5-6.5	-	low	-	at the surface
		30-160+	mesic peat	-	Pt	-	-	-	>25	6.5-7.5	-	low	-	

Table 8 (continued)

Map Symbol	Soil Name	Depth (cm)	Textural Classification			% Passing			Permea-bility cm/hr	Reaction	Sulfate Hazard	Dis-persion	Shrink-Swell Potential	Depth to Water Table
			USDA	AASHO	Unified	No. 10 2 mm	No. 40 0.42 mm	No. 200 0.074 mm						
OKO	Okno	0-120	mesic peat	-	Pt	-	-	-	>25		-	low	-	at the surface
		120+	L	A-6, A-7	CL	80-100	70-80	40-50	0.13-5	7.0-8.0	low	low	low-mod.	
OOK	Orok	0-40	fibric peat	-	Pt	-	-	-	>25	5.0-6.0	-	-	-	at the surface
		40-120	mesic peat	-	Pt	-	-	-	>25	6.0-7.0	-	-	-	
		120+	L	A-6, A-7	CL	80-100	70-80	40-50	0.13-5	7.0-8.0	low	low	low-mod.	
PVK	Proven Lake	0-100	SiL	A-6, A-7	CL	100	90-100	75-95	5-10	7.4-7.8	low	low	mod.	at or near the surface
PVKp	Proven Lake, peaty phase	30-0	mesic peat	-	Pt	-	-	-	>25	7.3-7.8	-	-	-	at the surface
		0-100	SiL	A-6, A-7	CL	100	90-100	75-95	5-10	7.4-7.8	low	low	mod.	
RKH	Rackham	0-20	L-SiCL	A-4, A-6	CL	100	85-95	50-75	10-20	6.8-7.4	low	low	low-mod.	>1 m
		20-50	C	A-6, A-7	CL, CH	100	95-100	85-95	>2.5	6.8-7.4	low	low	high	
		50+	SiL	A-6, A-7	CL	100	90-100	75-95	5-10	7.4-7.8	low	low	mod.	
RTV	Rat River	0-100	mesic peat	-	Pt	-	-	-	>25	6.0-7.5	low	low	-	at the surface
		100+	LFS	A-2, A-4	SW to SP	100	85-95	5-35	15-25+	7.5-8.0	low	low	low	
SGU	Singush	0-50	SiCL-C	A-7-6	CL-CH	100	95-100	85-95	<2.5	5.0-7.0	low	low	mod.-high	0.5-1.5 m
		50-100	L	A-6	CL	80-85	70-75	45-50	0.13-5	7.0-8.0	low	low	low	
SNT	Sinnott	0-20	L	A-6	CL	80-90	70-80	45-55	-	7.0-7.6	low	low	low-mod.	at or near the surface
		20+	L	A-6	CL	80-90	70-75	45-50	-	7.0-8.0	low	low	low-mod.	
SNTp	Sinnott, peaty phase	30-0	mesic peat	-	Pt	-	-	-	-	6.0-7.5	-	-	-	at the surface
		0-20	L	A-6	CL	80-90	70-80	45-55	.13-5	7.0-7.6	low	low	low-mod.	
		20+	L	A-6	CL	80-90	70-75	45-50	.13-5	7.0-8.0	low	low	low-mod.	
STD	Stead	0-160+	mesic peat	-	Pt	-	-	-	>25	6.5-7.5	-	-	-	at the surface
TEK	Tee Lake	0-15	FSL-L	A-4	CL	80-85	-	-	0.13-5.0	-	low	low	low	0.5-1.5 m
		20-35	SCL	A-6	CL	85-95	75-85	50-55	0.13-5.0	6.0-7.5	low	low	mod.	
		35+	L	A-6	CL	80-85	70-75	45-50	0.13-5.0	7.0-8.0	low	low	low-mod.	

Table 8 (concluded)

Map Symbol	Soil Name	Depth (cm)	Textural Classification			% Passing			Permea-bility cm/hr	Reaction	Sulfate Hazard	Dis-persion	Shrink-Swell Potential	Depth to Water Table
			USDA	AASHO	Unified	No. 10 2 mm	No. 40 0.42 mm	No. 200 0.074 mm						
VRL	Verrall Lake	0-30	SiC	A-7-6	CH	100	95-100	95-100	<2.5	5.5-7.0	low	low	high	0.5-1.5 m
		30-100	SiCL-SiC	A-7-6	CL	100	95-100	95-100	<2.5	7.0-8.0	low	low	mod.-high	
WFS	Whitefish	0-50	SiC	A-7-6	CL	100	95-100	95-100	<2.5	-	low	low	mod.-high	seasonally at or near the surface
		50-100	L	A-6	CL	80-85	70-75	45-50	0.13-5.0	7.0-8.0	low	low	low-mod.	
WFSp	Whitefish, peaty phase	30-0	mesic peat	-	Pt	-	-	-	>25	6.0-7.5	-	-	-	at the surface
		0-50	SiC	A-7-6	CL	100	95-100	95-100	0.13-5.0	7.0-8.0	low	low	mod.-high	
		50-100	L	A-6	CL	80-85	70-75	45-50	0.13-5.0	-	low	low	low-mod.	
WKW	Waskwei	0-50	fibric peat	-	Pt	-	-	-	>25	4.5-5.5	low	-	-	at or near the surface
		50-160+	mesic peat	-	Pt	-	-	-	>25	5.5-7.0	low	-	-	
WOG	Woodridge	0-100+	GrLS-FGr	A-1	GW to GP	20-75	-	0-5	>25	7.0-8.0	low	low	none	>2 m
WTV	Waitville	0-15	FSL-L	A-4	CL	80-85	-	-	2.5-5.0	4.5-6.5	low	low	low	>2 m
		20-35	SCL-C	A-6, A-7	CL, CH	85-95	75-85	50-55	0.13-2.5	6.0-7.5	low	low	mod.-high	
		35+	L	A-6	CL	80-85	70-75	45-50	0.13-5.0	7.0-8.0	low	low	low-mod.	

TABLE 9. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil [1]	Sand & Gravel [2]	Road Fill [3]	Permanent Bldgs. With Basements [4]	Local Roads and Streets [5]	Sanitary Trench [6]	Landfill Area [7]	Cover Material [8]	Sewage Lagoons [9]	Septic Fields [10]
BCS	Blackstone	Ps	Va	Pal	Paf	Pa	Ps	G	Ps	G	Pk
BCS /xcxx	Blackstone	Ps	Va	Pal	Paf	Pa	Ps	G	Ps	Ft	Pk
BCS /xdxx	Blackstone	Ps	Va	Pal	Paf	Pa	Ps	G	Ps	Pt	Pk
BCS /xexx	Blackstone	Pst	Va	Pal	Paf	Pa	Ps	Ft	Ps	Vt	Pk
BCS /xfxx	Blackstone	Vts	Va	Pal	Paf	Pat	Ps	Pt	Pst	Vt	Pkt
BGA	Big Lake	Pi	Va	Pw	Vwi	Vwi	Vwi	Vwi	Pw	Vi	Vhi
BGAp	Big Lake	Pi	Va	Pw	Vwi	Vwi	Vwi	Vwi	Pw	Vi	Vhi
BKO	Breckon	Ps	Va	Pwl	Vwf	Pwf	Vw	Pw	Psw	G	Vkh
BKOp	Breckon	Ps	Va	Pwl	Vwf	Pwf	Vw	Pw	Psw	G	Vkh
CAY	Cayer	Pw	Va	Va	Vaw	Vaw	Vws	Vwh	Vsw	Vah	Vhg
CAYd	Cayer	G	Va	Va	Va	Va	Vs	Vk	Vs	Va	Vg
COPX/xcxx	Copernicus	Ps	Fa	G	G	G	Vsk	Vk	Ps	Vk	Gg
COPX/xdxx	Copernicus	Ps	Fs	G	G	G	Vsk	Vk	Ps	Vk	Gg
COPX/xexx	Copernicus	Pst	Fa	G	Ft	Ft	Vsk	Vk	Ps	Vkt	Ftg
COPX/xfxx	Copernicus	Vt	Fa	Ft	Pt	Pt	Vsk	Vk	Pst	Vkt	Ptg
DKM	Duck Mountain	Ps	Va	Pa	Fa	Pa	Fs	G	Fs	Fk	Fk
DKM /xcxx	Duck Mountain	Ps	Va	Pa	Fa	Pa	Fs	G	Fs	Ftk	Fk
DKM /xdxx	Duck Mountain	Ps	Va	Pa	Fa	Pa	Fs	G	Fs	Ptk	Fk
FOD	Flood Lake	Vw	Ph	Pw	Vw	Pw	Vws	Vk	Vsw	Vkh	Phg
FODp	Flood Lake	Vw	Ph	Pw	Vw	Pw	Vws	Vk	Vsw	Vkh	Phg
KMK	Katimik	Pws	Va	Va	Vaw	Vaw	Vws	Vwh	Vsw	Vah	Vhg
OKOX	Okno	Pws	Va	Va	Vaw	Vaw	Vws	Vwh	Vsw	Vah	Vhg
OOKX	Orok	Pws	Va	Va	Vaw	Vaw	Vws	Vwh	Vsw	Vah	Vhg
PVK	Proven Lake	Fb	Va	Pwa	Pw	Pw	Vw	Pw	Pw	Ph	Va
PVK /xdxx	Proven Lake	Fb	Va	Pwa	Pw	Pw	Vw	Pw	Pw	Ph	Va
PVKp	Proven Lake	Fb	Va	Pwa	Pw	Pw	Vw	Pw	Pw	Ph	Va
RKH	Rackham	Fs	Va	Pa	Fa	Fa	Fs	G	Fs	Fk	G
RKH /xcxx	Rackham	Fs	Va	Pa	Fa	Fa	Fs	G	Fs	Fk	G
RKH /xdxx	Rackham	Fst	Va	Pa	Fa	Fa	Fs	G	Fs	Pt	G
RKH /xexx	Rackham	Pt	Va	Pa	Fat	Fat	Fs	Ft	Fst	Vt	Ft

TABLE 9. SUITABILITY RATINGS OF SOILS FOR SELECTED ENGINEERING USES

Map Symbol and Phase	Soil Name	Top Soil [1]	Sand & Gravel [2]	Road Fill [3]	Permanent Bldgs. With Basements [4]	Local Roads and Streets [5]	Sanitary Trench [6]	Landfill Area [7]	Cover Material [8]	Sewage Lagoons [9]	Septic Fields [10]
RTVX	Rat River	Pws	Va	Va	Vaw	Vaw	Vws	Vwh	Vsw	Vah	Vhg
SGU	Singush	Ps	Va	Pa	Pwa	Pa	Pw	Fw	Fs	Fhk	Fkh
SNT	Sinnott	Fs	Va	Pwa	Pwa	Pwa	Vw	Pw	Pw	Fk	Vh
SNTp	Sinnott	Fs	Va	Pwa	Pwa	Pwa	Vw	Pw	Pw	Ph	Vh
SNTp/xcxx	Sinnott	Vw	Va	Pwa	Vw	Pwa	Vw	Pw	Pw	Vh	Vh
SNTp/xdxx	Sinnott	Vw	Va	Pwa	Vw	Pwa	Vw	Pw	Pw	Vh	Vh
STD	Stead	Vws	Va	Va	Vaw	Vaw	Vws	Vwh	Vsw	Vah	Vhg
TEK	Tee Lake	Fs	Va	Pa	Pwa	Faw	Pw	Fw	Fs	Fk	Fkh
TEK /xcxx	Tee Lake	Fs	Va	Pa	Pwa	Faw	Pw	Fw	Fs	Fkt	Fkh
VRL	Verrall Lake	Ps	Va	Paf	Pwa	Paf	Psw	Fw	Ps	G	Pkh
VRL /xcxx	Verrall Lake	Ps	Va	Paf	Pwa	Paf	Psw	Fw	Ps	G	Pkh
WFS	Whitefish	Ps	Va	Pwa	Pwa	Pwa	Vw	Pw	Pw	Ph	Vh
WFSp	Whitefish	Ps	Va	Pwa	Pwa	Pwa	Vw	Pw	Pw	Ph	Vh
WKWX	Waskwei	Psw	Va	Va	Vaw	Vaw	Vws	Vwh	Vsw	Vah	Vhg
WOG /xcxx	Woodridge	Vc	G	G	G	G	Vsk	Vk	Vs	Vak	Gg
WOG /xexx	Woodridge	Vc	G	G	Ft	Ft	Vsk	Vk	Vs	Vak	Ftg
WOG /xfxx	Woodridge	Vct	G	G	Pt	Pt	Vsk	Vkt	Vs	Vak	Ptg
WTV	Waitville	Fs	Va	Pa	Fa	Fa	Fs	G	Fs	Fk	Fk
WTV /xcxx	Waitville	Fs	Va	Pa	Fa	Fa	Fs	G	Fs	Fkt	Fk
WTV /xdxx	Waitville	Fs	Va	Pa	Fa	Fa	Fs	G	Fs	Pt	Fk
WTV /xexx	Waitville	Pt	Va	Pa	Fat	Fat	Fs	Ft	Fst	Vt	Fkt
WTV /xfxx	Waitville	Vt	Va	Pa	Pt	Pw	Fst	Pt	Pt	Vt	Pt
WTV /xgxx	Waitville	Vt	Va	Pat	Vt	Vt	Pt	Vt	Vt	Vt	Vt
WTV /xhxx	Waitville	Vt	Va	Vt	Vt	Vt	Vt	Vt	Vt	Vt	Vt

4.4 SOIL SUITABILITY FOR SELECTED RECREATION USES

This section provides interpretations of the soil suitability for recreational development. All kinds of soil can be used for recreational activities of some kind.

Soils and their properties determine to a large degree, the type and location of recreational facilities. Wet soils are not suitable for campsites, roads, play grounds or picnic areas. Soils that pond and dry out slowly after heavy rains present problems where intensive use is contemplated. It is difficult to maintain grass cover for playing fields and golf courses on droughty soils. 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 the soil to support vegetation of different kinds as related to its natural fertility.

The suitability of the various soil series and phases for selected recreation uses is shown in Table 10 according to four classes, Good, Fair, Poor and Very poor defined previously in the section on Engineering Uses. Subclasses are employed to identify the kind of limitation or hazard for a particular use. An explanation of subclass symbols are provided in Table 4.

The guidelines for various recreation uses are presented in Appendix D, Tables 6 and 11 through 14.

TABLE 10. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground [11]	Picnic Area [12]	Camp Area [13]	Path And Trails [14]	Permanent Bldgs. Without Basements [4]
BCS	Blackstone	Fs	Fs	Fs	Fs	Pa
BCS /xcxx	Blackstone	Fst	Fs	Fs	Fs	Pa
BCS /xdxx	Blackstone	Pt	Fs	Fs	Fs	Pa
BCS /xexx	Blackstone	Vt	Fst	Fts	Fs	Pa
BCS /xfxx	Blackstone	Vt	Pt	Pt	Fst	Pta
BGA	Big Lake	Vwi	Vwi	Vwi	Pw	Viw
BGAp	Big Lake	Vwi	Vwi	Vwi	Pw	Viw
BKO	Breckon	Vwi	Vwi	Vwi	Psw	Viw
BKOp	Breckon	Vwi	Vwi	Vws	Vsw	Viw
CAY	Cayer	Vsw	Vsw	Vsw	Vsw	Vaw
CAYd	Cayer	Vs	Vs	Vs	Vs	Va
COPX/xcxx	Copernicus	Fst	Fs	G	G	G
COPX/xdxx	Copernicus	Pt	Fs	G	G	G
COPX/xexx	Copernicus	Vt	Fst	Ft	G	Ft
COPX/xfxx	Copernicus	Vt	Pt	Pt	Ft	Pt
DKM	Duck Mountain	Fs	Fs	Fs	Fs	Fa
DKM /xcxx	Duck Mountain	Fst	Fs	Fs	Fs	Fa
DKM /xdxx	Duck Mountain	Pt	Fs	Fs	Fs	Fa
FOD	Flood Lake	Vwi	Vwi	Vws	Vsw	Viw
FODp	Flood Lake	Vwi	Vwi	Vws	Vsw	Viw
KMK	Katimik	Vsw	Vsw	Vsw	Vsw	Vaw
OKOX	Okno	Vsw	Vsw	Vsw	Vsw	Vaw
OOKX	Orok	Vsw	Vsw	Vsw	Vsw	Vaw
PVK	Proven Lake	Vw	Vw	Vwi	Pw	Pwf
PVK /xdxx	Proven Lake	Vw	Vw	Vwi	Pw	Pwf
PVKp	Proven Lake	Vw	Vw	Vws	Vsw	Viw
RKH	Rackham	Fs	Fs	Fs	Fs	Fa
RKH /xcxx	Rackham	Fst	Fs	Fs	Fs	Fa
RKH /xdxx	Rackham	Pt	Fs	Fs	Fs	Fa
RKH /xexx	Rackham	Vt	Fst	Fst	Fs	Fat
RTVX	Rat River	Vsw	Vsw	Vsw	Vsw	Vaw
SGU	Singush	Psw	Psw	Psw	Ps	Fwf
SNT	Sinnott	Pw	Vwi	Vwi	Pw	Viw
SNTp	Sinnott	Vw	Vsw	Vws	Vsw	Viw
SNTp/xcxx	Sinnott	Vw	Vsw	Vws	Vsw	Vwh
SNTp/xdxx	Sinnott	Vwt	Vsw	Vsw	Vsw	Vwh
STD	Stead	Vsw	Vsw	Vsw	Vsw	Vaw
TEK	Tee Lake	Fws	Fws	Fws	Fsw	Fwf
TEK /xcxx	Tee Lake	Fws	Fws	Fws	Fsw	Fwf
VRL	Verrall Lake	Psw	Psw	Psw	Ps	Pa

TABLE 10. SUITABILITY RATINGS OF SOILS FOR RECREATIONAL USES

Map Symbol and Phase	Soil Name	Play Ground [11]	Picnic Area [12]	Camp Area [13]	Path And Trails [14]	Permanent Bldgs. Without Basements [4]
VRL /xcxx	Verrall Lake	Psw	Psw	Psw	Ps	Pa
WFS	Whitefish	Psw	Vwi	Vwi	Psw	Viw
WFSp	Whitefish	Vw	Vsw	Vws	Vsw	Viw
WKWX	Waskwei	Vsw	Vsw	Vsw	Vsw	Vaw
WOG /xcxx	Woodridge	Psc	Fc	Fc	Fc	G
WOG /xexx	Woodridge	Vt	Ftc	Ftc	Fc	Ft
WOG /xfxx	Woodridge	Vt	Pt	Pt	Fct	Pt
WTV	Waitville	Fs	Fs	Fs	Fs	Fa
WTV /xcxx	Waitville	Fst	Fs	Fs	Fs	Fa
WTV /xdxx	Waitville	Pt	Fs	Fs	Fs	Fa
WTV /xexx	Waitville	Vt	Fst	Fst	Fs	Fat
WTV /xfxx	Waitville	Vt	Pt	Pt	Fst	Pt
WTV /xgxx	Waitville	Vt	Vt	Vt	Pt	Vt
WTV /xhxx	Waitville	Vt	Vt	Vt	Vt	Vt

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Appendix A

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.

Acid soil - A soil having a pH less than 7.0.

Acidity - (Alkalinity) - The degree of acidity of the soil expressed in pH values. See Reaction, soil.

Alluvium - A general term for all deposits of rivers and streams.

Arable soil - Soil suitable for plowing and cultivation.

Association - A sequence of soils of about the same age, derived from similar parent material, and occuring under similar climatic conditions but showing different characteristics due to variations in relief and in drainage.

1/3 Atmosphere Moisture - The moisture percentage on dry weight basis of a soil sample that has been air dried, screened, saturated and subjected to a soil moisture tension of 345 cm of water through a permeable membrane for a period of 48 hours. It approximates the soil moisture retention capacity.

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.

Bearing capacity - Capacity of soil (in moist to wet conditions) to support loads such as buildings, people, vehicles, and animals.

Bedrock - The solid rock that underlies soil and regolith or that is exposed at the surface.

Boulders - Stones which are larger than 60 cm in diameter.

Bulk density - The weight of oven dry soil (105 degrees C) divided by its volume at field moisture conditions, expressed in grams per cubic centimeter.

Buried soil - Soil covered by an alluvial, loessial, or other deposit, usually to a depth greater than the thickness of the solum.

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 . .	6-15%
strongly calcareous . .	16-25%
v. strongly calcareous.	26-40%
extremely calcareous. . .	>40%

Capillary fringe - A zone of essentially saturated soil just above the water table. The size distribution of the pores determines the extent and degree of the capillary fringe.

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 an organic material.

Cation Exchange Capacity (CEC) - A measure of the total amount of exchangeable 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 8 to 25 cm in diameter.

Color - Soil colors are compared with a Munsell color chart. The Munsell system specifies the relative degrees of the three simple variables of color: 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) - A mapping unit used in detailed and reconnaissance soil surveys where 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.

Concretions - Hard grains, pellets or nodules from concentration of compounds in the soil that cement soil grains together.

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 millisiemens per cm at 25 degrees 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.

Consumptive use factor (CU) - The ratio of consumptive use of water by a crop to potential evapotranspiration. and transpiration. An actively growing crop that completely covers the soil over a large area and that has an ample supply of readily available soil water has a consumptive use factor of 1.0.

Consumptive use of water - The sum of the depths of water transpired by the plants and evaporated from the soil surface and from intercepted precipitation. It may be less or greater than potential evapotranspiration.

Contour - An imaginary line connecting points of equal elevation on the surface of the soil.

Cover - This term generally has one of the following meanings:

1. Vegetation or other material providing protection

2. In forestry, low growing shrubs and herbaceons plants under trees (i.e., ground cover vrs. tree cover)

3. Any vegetation producing a protective mat on or just above the soil surface.

Creep (soil) - Slow mass movement of soil and soil material down rather steep slopes primarily under the influence of gravity, but aided by saturation with water and by alternate freezing and thawing.

Decile portion - A one-tenth portion. As used in this map symbol A7 B3 means that the A soils cover seven tenths and the B soils cover three tenths of the map unit.

Delta - An alluvial or glaciofluvial fan shaped 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 by chemical or physical means or both.

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 colored (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.

Drainage in soil reports is described on the basis of actual moisture content in excess of field capacity (that moisture retained after soil is allowed to drain) and length of the saturation period within the plant root zone. The terms are as follows:

Very rapidly drained - Water is removed from the soil very rapidly in relation to supply. Excess water flows downward very rapidly if underlying material is perviious. There may be very rapid subsurface flow during heavy rainfall provided there is a steep gradient. Soils have very low available water storage capacity (usually less than 2.5 cm)

within the control section and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Rapidly drained - Water is removed from the soil rapidly in relation to supply. Excess water flows downward if underlying material is pervious. Subsurface flow may occur on steep gradients during heavy rainfall. Soils have low available water storage capacity (2.5-4 cm) within the control section, and are usually coarse in texture, or shallow, or both. Water source is precipitation.

Well drained - Water is removed from the soil readily but not rapidly. Excess water flows downward readily into underlying pervious material or laterally as subsurface flow. Soils have intermediate available water storage capacity (4-5 cm) within the control section, and are generally intermediate in texture and depth. Water source is precipitation. On slopes subsurface flow may occur for short durations but additions are equaled by losses. These soils are usually free of mottles within 100 cm of the surface but may be mottled below this depth. Soil horizons are usually bright colored.

Moderately well drained - Water is removed from the soil somewhat slowly in relation to supply. Excess water is removed somewhat slowly due to low perviousness, shallow water table, lack of gradient, or some combination of these. Soils have intermediate to high water storage capacity (5-6cm) within the control section and are usually medium to fine in texture. Soils are commonly mottled in the 50 to 100 cm depth. Colors are dull brown in the subsoil with stains and mottles.

Imperfectly drained - Water is removed from the soil sufficiently slowly in relation to supply to keep the soil wet for a significant part of the growing season. Excess water moves slowly downward if precipitation is major supply. If subsurface water or groundwater, or both, is main source, flow rate may vary but the soil remains wet for a significant part of the growing season. Precipitation is main source if available water storage capacity is high; contribution by subsurface flow or groundwater flow, or both, increases as available water storage capacity decreases. Soils have a wide range in available water supply, texture, and depth, and are gleyed phases of well drained subgroups. These soils generally have mottling below the surface layers and generally have duller colors with depth, generally brownish gray with mottles of yellow and gray.

Poorly drained - Water is removed so slowly in relation to supply that the soil remains wet for a comparatively large part of the time the soil is not frozen. Excess water is evident in the soil for a large part of the time. Subsurface flow or groundwater flow, or both, in addition to precipitation are main water sources; there may also be a perched water table, with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, texture, and depth, and are gleyed subgroups, Gleysols, and Organic soils.

Very poorly drained - Water is removed from the soil so slowly that the water table remains at or on the surface for the greater part of the time the soil is not frozen. Excess water is present in the soil for the greater part of the time. Groundwater flow and subsurface flow are major water sources. Precipitation is less important except where there is a perched water table with precipitation exceeding evapotranspiration. Soils have a wide range in available water storage capacity, Texture, and depth, and are either Gleysolic or Organic.

Dryland farming - The practice of crop production in low rainfall areas without irrigation.

Eluvial horizon - A horizon from which material has been removed in solution or in water suspension.

Eolian - Soil material accumulated through wind action.

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. The ratings of erosion are:

Erosion 1 slightly eroded - soil with a sufficient amount of the A horizon removed that

ordinary tillage will bring up and mix the B horizon or other lower lying horizons with surface soil in the plow layer.

Erosion 2 moderately eroded - soil with all of the A horizon and a part of the B or other lower lying horizons removed. The plow layer consists mainly of the original horizons below the A or below the original plow layer.

Erosion 3 severely eroded - soils have practically all of the original surface soil removed. The plow layer consists mainly of C horizon material, especially on knolls and steep upper slope positions.

Evapotranspiration - The combined loss of water from a given area, and during a specific period of time, by evaporation from the soil surface and transpiration from plants.

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.

Flood plain - The land bordering a stream, built up of sediments from overflow of the stream and subject to innundation when the stream is at flood stage.

Fluvial deposits - All sediments past and present, deposited by flowing water, including glaciofluvial deposits.

Frost heave - The raising of the surface caused by ice in the subsoil.

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.

Gleysolic - An order of soils developed under wet conditions and permanent or periodic reduction. These soils have low chromas or prominent mottling or both, in some horizons.

Granular Structure - Soil structure in which the individual grains are gouped into small block-like aggregates with indistinct or round edges (spheriodal).

Gravel - Rock fragments 2 mm to 7.5 cm in diameter.

Ground Moraine - An unsorted mixture of rocks, boulders, sand, silt and clay deposited by glacial ice. The predominant material is till, most of till is thought to have accumulated under the ice by lodgment, but some till has been let down from the upper surface of the ice by oblation. 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 sells and enclosed depressions.

Groundwater - Water beneath the soil surface, usually under conditions where the voids are completely filled with water (saturation).

Halophytic vegetation - vegetation that grows naturally in soils having a high content of various patts. It usually has fleshy leaves or thorns and resembles desert vegetation.

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.

Horizon boundary - The lower boundary of each horizon is described by indicating its distinctness and form. The distinctness depends on the abruptness of vertical change (thickness). The Form refers to the variation of the boundary plane.

Distinctness -
abrupt - less than 2 cm

clear - 2 to 5 cm
gradual - 5 to 15 cm
diffuse - more than 15 cm

Form -
smooth - nearly plain
wavy - pockets are wider than deep
irregular - pockets are deeper than wide
broken - parts of the horizon are unconnected with other parts

Humic layer - A layer of highly decomposed organic soil material containing little fibre.

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 cm. per hour.

Hydrologic cycle - The conditions through which water naturally passes from the time of precipitation until it is returned to the atmosphere by evaporation and is again ready to be precipitated.

Hydrophyte - Plants growing in water or dependent upon wet or saturated soil conditions for growth.

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.

Immature soil - A soil having indistinct or only slightly developed horizons. Also called juvenile soil.

Impeded drainage - A condition that hinders the movement of water by gravity through the soils.

Inclusion - Soil type found within a mapping unit that is not extensive enough to be mapped separately or as part of a complex.

Infiltration - The downward entry of water into the soil

Irrigation - The artificial application of water to the soil for the benefit of growing crops.

Irrigation requirement (IR) - Refers to the amount of water exclusive of effective precipitation that is required for crop production.

Lacustrine deposits - Material deposited by or settled out of lake waters and exposed by lowering of the water levels or elevation of the land. These sediments range in texture from sand to clay and are usually varved (layered annual deposits).

Landforms - See Appendix C.

Landscape - All the natural features such as fields, hills, forest, water, etc., which distinguish one part of the earth's surface from another part.

Leaching - The removal from the soil of materials in solution.

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 dimensions will flow together for a distance of 1.25 cm under the impact of 25 blows in a standard liquid limit apparatus.

Lineal shrinkage - This is the decrease in one dimension expressed as a percentage of the original dimension of the soil mass when the moisture content is reduced from a stipulated percentage (usually field moisture equivalent) to the shrinkage limit.

Mapping Unit - Any delineated area shown on a soil map that is identified by a symbol. A mapping unit may be a soil unit, a miscellaneous land type, or a soil complex.

Marsh - Periodically flooded or continually wet areas having the surface not deeply submerged. It is covered dominently with sedges, cattails, rushes or other hydrophytic plants.

Mature soil - A soil having well-developed soil horizons produced by the natural processes of soil formation.

Mesophyte - Plants requiring intermediate moisture conditions and are not very resistant to drought.

Microrelief - Small-scale, local differences in relief including mounds, swales or hollows.

Milliequivalent (me) - One-thousandth of an equivalent. An equivalent is the weight in grams of an ion 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). Mottles in soils indicate poor aeration and lack of good drainage.

Outwash - Sediments "washed out" beyond the glacier by flowing water and laid down in thin beds or strata. Particle size may range from boulders to silt.

Ovendry soil - Soil that has been dried at 105 degrees C until it has reached constant weight.

Parent material - The unaltered or essentially unaltered mineral or organic material from which the soil profile develops by pedogenic processes.

Particle size, soil - The grain size distribution of the whole soil including the coarse fraction. It differs from texture, which refers to the fine earth (less than 2mm) fraction only. In addition, textural classes are usually assigned to specific horizons whereas soil family particle-size classes indicate a composite particle size of a part of the control section that may include several horizons.

The particle-size classes for family groupings are as follows:

Fragmental Stones, cobbles and gravel, with too little fine earth to fill interstices larger than 1 mm.

Sandy-skeletal Particles coarser than 2 mm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the sandy particle-size class.

Loamy-skeletal Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the loamy particle-size class.

Clayey-skeletal Particles 2 mm-25 cm occupy 35% or more by volume with enough fine earth to fill interstices larger than 1 mm; the fraction finer than 2 mm is that defined for the clayey particle-size class.

Sandy The texture of the fine earth includes sands and loamy sands, exclusive of loamy very fine sand and very fine sand textures; particles 2 mm- 25 cm occupy less than 35% by volume.

Loamy The texture of the fine earth includes loamy very fine sand, very fine sand, and finer textures with less than 35% clay; particles 2 mm-25 cm occupy less than 35% by volume.

Coarse-loamy. A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-loamy. A loamy particle size that has 15% or more by weight of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Coarse-silty. A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has less than 18% clay in the fine earth fraction.

Fine-silty. A loamy particle size that has less than 15% of fine sand (0.25-0.1 mm) or coarser particles, including fragments up to 7.5 cm, and has 18-35% clay in the fine earth fraction.

Clayey. The fine earth contains 35% or more clay by weight and particles 2mm-25 cm occupy less than 35% by volume.

Fine-clayey. A clayey particle size that has 35-60% clay in the fine earth fraction.

Very-fine-clayey. A clayey particle size that has 60% or more clay in the fine earth fraction.

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. specifically, the downward flow of water

in saturated or nearly saturated soil at hydraulic gradients of 1.0 or less.

Permafrost -

1. Perennially frozen material underlying the solum.

2. A perennially frozen soil horizon.

Permafrost table - The upper boundary of permafrost, usually coincident with the lower limit of seasonal thaw (active layer).

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.

Phase, soil - A soil phase is a unit of soil outside the system of soil taxonomy. It is a functional unit and is used at any categorical level from Order to Series. It is used to characterize soil and landscape properties that are not used as criteria in soil taxonomy. The major phase differentiae are: slope, erosion, deposition, stoniness, texture, salinity, and calcareousness.

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.

Potential evapotranspiration (PE) - The maximum quantity of water capable of being lost as water vapor, in a given climate, by a continuous stretch of vegetation covering the whole ground and well supplied with water.

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. Soil reaction classes are characterized as follows:

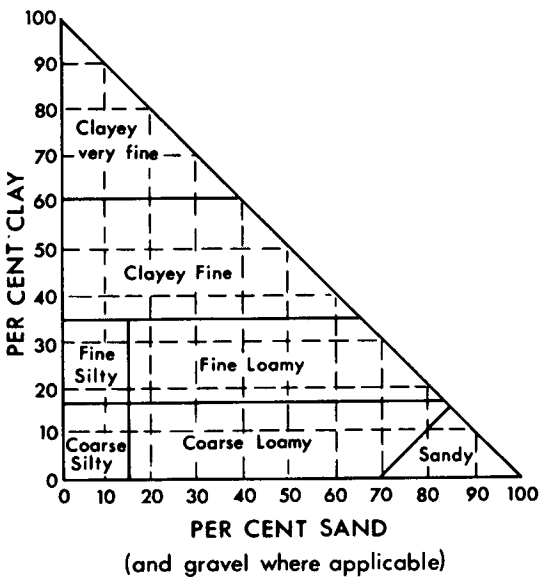


Figure 13: Family particle-size classes

extremely acid. . . . pH < 4.5
very strongly acid. 4.5 to 5.0
strongly acid . . . 5.1 to 5.5
medium acid . . . . 5.6 to 6.0
slightly acid . . . 6.1 to 6.5
mildly alkaline . . 7.4 to 7.8
mod. alkaline . . . 7.9 to 8.4
strongly alkaline . 8.5 to 9.0
very strongly alkaline. .> 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.

Runoff - The portion of the total precipitation on an area that flows away through stream channels. Surface runoff does not enter the soil. Groundwater runoff or seepage flow from groundwater enters the soil before reaching the stream.

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 milli Siemens/cm (mS/cm), the exchangeable-sodium percentage is less than 15, and the pH is usually less than 8.5. Approximate limits of salinity classes are:

non-saline. . . . 0 to 4 mS/cm
slightly saline . 5 to 8 mS/cm
mod. saline . . .9 to 15 mS/cm
strongly saline . . > 15 mS/cm

Salinization - The process of accumulation of salts in the soil.

Salt-Affected Soil - Soil that has been adversely modified for the growth of most crop plants by the presence of certain types of exchangeable ions or of soluble salts. It includes soils having an excess of salts, or an excess of exchangeable sodium or both.

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.

Saturation Percentage - The moisture percentage of a saturated soil paste, expressed on an oven dry weight basis.

Seepage -

1. The escape of water downward through the soil.
2. The emergence of water from the soil along an extensive line of surface in contrast to a spring where water emerges from a local spot.

Series, soil - A category in the Canadian System of Soil Classification. It 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.

Shrinkage limit - This is the moisture content at which an equilibrium condition of volume change is reached and further reduction in moisture content will not cause a decrease in the volume of the soil mass.

Shrinkage ratio - This is the ratio between the volume change and a corresponding change in moisture content. It equals the apparent specific gravity of the dried soil.

Silt - (a) Individual mineral particles of soil that range in diameter between 0.05 to .002 mm. (b) Soil of the textural class silt contains greater than 80 percent silt and less than 12 percent clay.

Slickenside - Smoothed surfaces along planes of weakness resulting from the movement of one mass of soil against another in soils dominated by swelling clays.

Sodium-Adsorption Ratio (S.A.R.) - A ratio for soil extracts and irrigation waters used to express the relative activity of sodium ions in exhange reactions with soil. Where the ionic concentrations are expressed as milliequivalents per litre.

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 processes of soil formation are active. It usually comprises the A and B horizons.

Stones - Rock fragments greater than 25 cm in diameter.

Stoniness - The relative proportion of stones in or on the soil. The classes of stoniness are defined as follows:

Stones 0. Nonstony -- Land having less than 0.01% of surface occupied by stones.

Stones 1. Slightly stony -- Land having 0.01-0.1% of surface occupied by stones. Stones 15-30 cm in diameter, 10-30 m apart. The stones offer only slight to no hindrance to cultivation.

Stones 2. Moderately stony -- Land having 0.1-3% of surface occupied by stones. Stones 15-30 cm in diameter, 2-10 m apart. Stones cause some interference with cultivation.

Stones 3. Very stony -- Land having 3-15% of surface occupied by stones. Stones 15-30 cm in diameter, 1-2 m apart. There are sufficient stones to constitute a serious handicap to cultivation.

Stones 4. Exceedingly stony -- Land having 15-50% of surface occupied by stones. Stones 15-30 cm in diameter, 0.7-1.5 m apart. There are sufficient stones to prevent cultivation until considerable clearing has been done.

Stones 5. Excessively stony -- Land having more than 50% of surface occupied by stones. Stones 15-30 cm in diameter, less than 0.7 m apart. The land is too stony to permit cultivation.

Storage Capacity - Refers to the maximum amount of readily available water that can be stored within the rooting zone of a crop in a given soil. For practical irrigation purposes, 50 percent of the total soil water between field capacity and wilting point may be considered as readily available.

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. Aggregates differ in grade (distinctness) of development. Grade is described as structureless (no observable aggregation or no 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 are:

Granular - Having more or less rounded aggregates without smooth faces and edges

Platy - Having thin, plate-like aggregates with faces mostly horizontal

Blocky - Having block-like aggregates with sharp, angular corners

Subangular blocky - Having block-like 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 pseudo-blocky, pseudo-platy, etc. In stratified materials, a bed is a unit layer distinctly separable from other layers and is one or more cm thick but a lamina is a similar layer less than 1 cm thick.

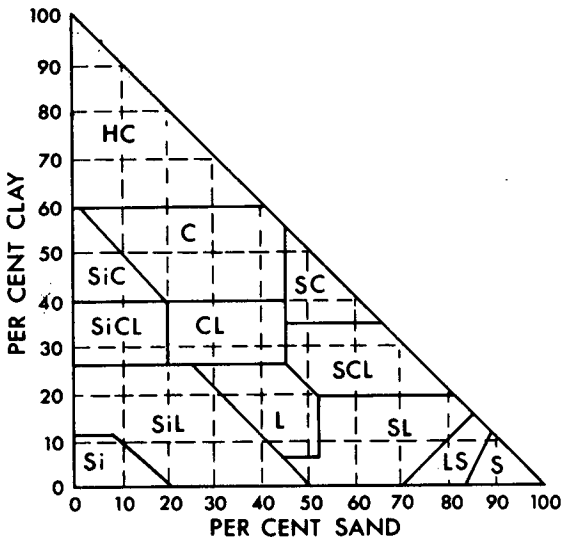
Soil Survey - The systematic examination, description, classification, and mapping of soil in an area.

Swamp - See Appendix C

Texture, soil - The relative proportions of the fine earth (less than 2 mm.) fraction of a soil. Textural classes are usually assigned to specific horizons whereas family particle size classes indicate a composite particle size of a portion of the control section that may include several horizons.

The size range of the constituent primary particles are as follows:

	Diameter (mm)
Very coarse sand	2.0-1.0
Coarse sand	1.0-0.5
Medium sand	0.5-0.25
Fine sand	0.25-0.10
Very fine sand	0.10-0.05
Silt	0.05-0.002
Clay	< 0.002
Fine clay	< 0.0002



Texture Group	Class Symbol	Class Name
Coarse	S	Sand
	LS	Loamy sand
Moderately coarse	SL	Sandy loam
	FSL	Fine sandy loam
Medium	Si	Silt
	SiL	Silt loam
	L	Loam
	VFSL	Very fine sandy loam
Moderately fine	SCL	Sandy clay loam
	CL	Clay loam
	SiCL	Silty clay loam
Fine	SC	Sandy clay
	C	Clay
	SiC	Silty clay
Very fine	HC	Heavy clay

Figure 14: Soil Textural Classes

Till, glacial - Unstratified glacial deposits consisting of clay, sand, gravel, and boulders intermingled in any proportion.

Tilth - The physical condition of soil as related to its ease of tillage, fitness as a seedbed, and its impedance to seedling emergency and root penetration.

Topography - Refers to the percent slope and the pattern or frequency of slopes in different directions. A set of 10 slope classes are used to denote the dominant but not necessarily most abundant slopes within a mapping unit. Letters are used for multiple slopes (irregular surface).

Slope Class	Slope Name	Percent slope	Approx. degrees
1	level	0-0.5	0
2	nearly level	.5-2.5	.3-1.5
3	very gentle	2-5	1-3
4	gentle	6-9	3.5-5
5	moderate	10-15	6-8.5
6	strong	16-30	9-17
7	very strong	31-45	17-24
8	extreme	46-70	25-35
9	steep	71-100	35-45
10	very steep	>100	>45

Underground runoff - (or seepage)-water flowing towards stream channels after infiltration into the ground.

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.

Urban Land - Areas so altered or obstructed by urban works or structures that identification of soils is not feasible.

Variant, soil - A soil whose properties are believed to be sufficiently different from other known soils to justify a new series name, but comprising such a limited geographic area that creation of a new series is not justified.

Varve - A distinct band representing the annual deposit in sedimentary materials regardless of origin and usually consisting of two layers, one thick light colored layer of silt and fine sand laid down in the spring and summer, and the other a thin, dark colored layer of clay laid down in the fall and winter.

Water balance, soil - Is the daily amount of readily available water retained by the soil. The daily

soil-water balance is decreased by the amount that the daily consumptive use exceeds the daily rainfall. When daily rainfall exceeds the consumptive use, the daily balance increases by the amount of the difference unless the soil-water balance is at storage capacity, in which case the excess is assumed to be lost by runoff or deep percolation.

Water table - (groundwater surface; free water surface; groundwater elevation) Elevation at which the pressure in the water is zero with respect to the atmospheric pressure.

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 cm of water per 30 cm 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.

Xerophyte - Plants capable of surviving extended periods of soil drought.

Appendix B

SOIL HORIZON DESIGNATIONS

ORGANIC HORIZONS

Organic horizons are found in Organic soils, and commonly at the surface of mineral soils. They may occur at any depth beneath the surface in buried soils, or overlying geologic deposits. They contain more than 17% organic carbon (approximately 30% organic matter) by weight. Two groups of these horizons are recognized, O horizons and the L, F, and H horizons.

O This is an organic horizon developed mainly from mosses, rushes, and woody materials.

- Of The fibric horizon is the least decomposed of all the organic soil materials. It has large amounts of well-preserved fiber that are readily identifiable as to botanical origin. A fibric horizon has 40% or more of rubbed fiber by volume and a pyrophosphate index of 5 or more. If the rubbed fiber volume is 75% or more, the pyrophosphate criterion does not apply.
- Om The mesic horizon is the intermediate stage of decomposition with intermediate amounts of fiber, bulk density and water-holding capacity. The material is partly altered both physically and biochemically. A mesic horizon is one that fails to meet the requirements of fibric or of humic.
- Oh The humic horizon is the most highly decomposed of the organic soil materials. It has the least amount of fiber, the highest bulk density, and the lowest saturated water-holding capacity. It is very stable and changes very little physically or chemically with time unless it is drained. The humic horizon has less than 10% rubbed fiber by volume and a pyrophosphate index of 3 or less.

LFH These organic horizons developed primarily from leaves, twigs, woody materials and a minor component of mosses under imperfectly to well drained forest conditions.

- L This is an organic horizon characterized by an accumulation of organic matter in which the original structures are easily discernible.
- F This is an organic horizon characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The horizon may be partly comminuted by soil fauna as in moder, or it may be a partly decomposed mat permeated by fungal hyphae as in mor.
- H This is an organic horizon characterized by an accumulation of decomposed organic matter in which the original structures are indiscernible. This material differs from the F horizon by its greater humification chiefly through the action of organisms. It is frequently intermixed with mineral, grains, especially near the junction with the mineral horizon.

MASTER MINERAL HORIZONS

Mineral horizons are those that contain less than 30% organic matter by weight as specified for organic horizons.

A This is a mineral horizon or horizons formed at or near the surface in the zone of leaching or 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.

W This is a layer of water in Gleysolic, Organic, or Cryosolic soils. It is called a hydric layer in Organic soils.

LOWER-CASE SUFFIXES

b Buried soil horizon.

c A cemented (irreversible) pedogenic horizon. The ortstein of a Podzol, and 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 10cm 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 eluviation 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 and Fe combined with organic matter. It usually has a hue of 7.5YR or redder or its hue 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 (less than 0.0002mm) is more than 0.05 and organic C exceeds 0.5%. Pyrophosphate-extractable Fe is at least 0.3%, or the ratio of organic C to pyrophosphate-extractable Fe is less than 20, or both are true. 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) color 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, Bhfg, 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% or more. Pyrophosphate-extractable Al + Fe is less than the minimum limit specified for 'f' horizons. This horizon occurs in Fera Gleysols and Fera Humic Gleysols, and possibly below the Bfg of gleyed Podzols. It is distinguished from the Bfg of gleyed 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 ferrous 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 undergone eluviation as evidenced, under natural conditions, by streaks and splotches of differing shades of gray and often by platy structure. It may be overlain by a darker-colored Ah and underlain by a lighter-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.

Bhf Defined under 'f'.

j Used as a modifier of the suffixes e, f, 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. For example Bfgj means a Bf horizon with weak expression of gleying; Bfjgj means a B horizon with weak

expression of both 'f' and 'g' features.

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 Bg.

Bfj It is a horizon with some accumulation of pyrophosphate-extractable Al and Fe but not enough to meet the limits of Bf.

Bntj or Bnj horizons in which development of solonetzic B properties is evident but insufficient to meet the limits for Bn or Bnt.

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 or Ap (Ahk, Apk), or organic horizons (Ofk, Omk).

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. Evidence of alteration in one of the following forms:

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

   b) Removal of carbonates, either partially (Bmk) or completely (Bm).

2. Illuviation, if evident, too slight to meet the requirements of a Bt or a podzolic B.

3. Some weatherable minerals.

4. No cementation or induration and lacks a brittle consistence when moist. This suffix 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. 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. It is used with B, as Bn or Bnt.

p A horizon disturbed by man's activities, such as cultivation, logging, habitation, etc. It is used with A and O.

s A horizon with salts, including gypsum, which may be detected as crystals or veins, as surface crusts of salt crystals, by depressed crop growth, or by the presence 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, in which 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 ms/cm and must exceed that of the C horizon by at least one-third.

t An illuvial horizon enriched with silicate clay. It is used with B alone (Bt), with B and g (Btg), with B and n (Bnt), etc.

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 horizons, as follows:

   a) If any part of the eluvial horizon has less than 15% total clay in the fine earth fraction (2mm) 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, e.g. Ae 50% clay; Bt at least 58% clay.

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, as viewed in thin 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 Btj and Btg are defined under j and g.

u A horizon that is markedly disrupted by physical or faunal processes other than cryoturbation. Evidence of marked disruption such as the inclusion of material from other horizons, absence of the horizon, etc. must be evident in at least half of the cross section of the pedon. Such turbation can result from blowdown of trees, mass movement of soil on slopes, and burrowing animals. It can be used with any horizon or subhorizon with the exception of A or B alone; e.g. Aeu, Bfu, BCu.

x A horizon of fragipan character. A fragipan is a loamy subsurface horizon of high bulk density and very low organic matter content. When dry, it has a hard consistence and seems to be cemented. When moist, it has moderate to weak brittleness. It frequently has bleached fracture planes and is overlain by a friable B horizon. Air dry clods of fragic horizons slake in water.

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

z A frozen layer. It may be used with any horizon or layer, e.g. Ohz, Bmz, Cz, Wz.

Appendix C

DESCRIPTION OF LANDFORMS

C.1 GENETIC MATERIALS

Unconsolidated mineral component

The unconsolidated mineral component consists of clastic sediments that may or may not be stratified, but whose particles are not cemented together. They are essentially of glacial or post-glacial origin but include poorly consolidated and weathered bedrock.

Anthropogenic - Man-made or man-modified materials, including those associated with mineral exploitation and waste disposal.

Colluvial - Massive to moderately well stratified, nonsorted to poorly sorted sediments with any range of particle sizes from clay to boulders and blocks that have reached their present position by direct, gravity-induced movement.

They are restricted to products of mass-wasting whereby the debris is not carried by wind, water, or ice (excepting snow avalanches).

Eolian - Sediment, generally consisting of medium to fine sand and coarse silt particle sizes, that is well sorted, poorly compacted, and may show internal structures such as cross bedding or ripple laminae, or may be massive. Individual grains may be rounded and show signs of frosting.

These materials have been transported and deposited by wind action.

Fluvial - Sediment generally consisting of gravel and sand with a minor fraction of silt and clay. The gravels are typically rounded and contain interstitial sand. Fluvial sediments are commonly moderately to well sorted and display stratification, but massive, nonsorted fluvial gravels do occur. These materials have been transported and deposited by streams and rivers. Finer textured Fluvial deposits of modern rivers are termed Alluvium.

Lacustrine - Sediment generally consisting of either stratified fine sand, silt, and clay deposited on the lake bed; or moderately well sorted and stratified sand and coarser materials that are beach and other nearshore sediments transported and deposited by wave action.

These are materials that either have settled from suspension in bodies of standing fresh water or have accumulated at their margins through wave action.

Marine - Unconsolidated deposits of clay, silt, sand, or gravel that are well to moderately well sorted and well stratified to moderately stratified (in some places containing shells). They have settled from suspension in salt or brackish water bodies or have accumulated at their margins through shoreline processes such as wave action and longshore drift.

Morainal - Sediment generally consisting of well compacted material that is nonstratified and contains a heterogeneous mixture of particle sizes, often in a mixture of sand, silt, and clay that has been transported beneath, beside, on, within and in front of a glacier and not modified by any intermediate agent.

Saprolite - Rock containing a high proportion of residual silts and clays formed by alteration, chiefly by chemical weathering.

The rock remains in a coherent state, interstitial grain relationships are undisturbed and no downhill movement due to gravity has occurred.

Undifferentiated - A layered sequence of more than three types of genetic material outcropping on a steep erosional escarpment.

Volcanic - Unconsolidated pyroclastic sediments. These include volcanic dust, ash, cinders, and pumice.

Qualifying Descriptors

These have been introduced to qualify the genetic materials and to supply additional information about the mode of formation or depositional environment.

Glacial - Used to qualify nonglacial genetic materials or process modifiers where there is direct evidence that glacier ice exerted a strong but secondary or indirect control upon the mode of origin of the materials or mode of operation of the process. The use of this qualifying descriptor implies that glacier ice was close to the site of the deposition of a material or the site of operation of a process.

Glaciofluvial - Fluvial materials showing clear evidence of having been deposited either directly in front of or in contact with glacier ice.

Glaciolacustrine - Lacustrine materials deposited in contact with glacial ice.

Glaciomarine - Materials of glacial origin laid down in a marine environment, as a result of settling from melting, floating ice and ice shelves.

Organic component

The organic component consists of peat deposits containing >30% organic matter by weight that may be as thin as 10 cm if they overlie bedrock but are otherwise greater than 40 cm and generally greater than 60 cm thick. The classes and their definitions follow.

B	Bog
N	Fen
S	Swamp

Bog - A bog is a peat-covered or peat-filled area, generally with a high water table. Since the surface of the peatland is slightly elevated, bogs are either unaffected or partly affected by nutrient-rich groundwaters from the surrounding mineral soils. The groundwater is generally acidic and low in nutrients (ombrotrophic). The dominant peat materials are sphagnum and forest peat, underlain, at times, by fen peat.

Fen - A fen is a peat-covered or peat-filled area with a high water table, which is usually at the surface. The dominant materials are shallow to deep, well to moderately decomposed fen peat. The waters are mainly rich in nutrients (minerotrophic) and are derived from mineral soils. The peat materials are therefore higher in both nutrients and pH than the peats associated with bogs.

Swamp - A swamp is a peat-covered or peat-filled area. The peat surface is level or slightly concave in cross section. The water table is frequently at or above the peat surface. There is strong water movement from margins or other mineral sources. The microrelief is hummocky, with many pools present. The waters are neutral or slightly acid. The dominant peat materials are shallow to deep mesic to humic forest and fen peat.

C.2 GENETIC MATERIAL MODIFIERS

Material modifiers are used to qualify unconsolidated mineral and organic deposits. Particle-size classes serve to indicate the size, roundness, and sorting of unconsolidated mineral deposits. Fiber classes indicate the degree of decomposition and fiber size of organic materials.

Particle size classes for unconsolidated mineral materials

Blocky: An accumulation of angular particles greater than 256 mm in size.

Bouldery: An accumulation of rounded particles greater than 256 mm in size.

Clayey: An accumulation of particles where the fine earth fraction contains 35% or more clay (<0.002 mm) by weight and particles greater than 2 mm are less than 35% by volume.

Cobbly: An accumulation of rounded particles having a diameter of 64-256 mm.

Gravelly: An accumulation of rounded particles ranging in size from pebbles to boulders.

Loamy: An accumulation of particles of which fine earth fraction contains 35% or more clay (<0.002 mm) by weight and particles greater than 2 mm are less than 35% by volume.

Pebbly: An accumulation of rounded particles having a diameter of 2-64 mm.

Rubbly: An accumulation of angular fragments having a diameter of 2-256 mm.

Sandy: An accumulation of particles of which the fine earth fraction contains more than 70% by weight of fine sand or coarser particles. Particles greater than 2 mm occupy less than 35% by volume.

Silty: An accumulation ofparticles of which the fine earth fraction contains less than 15% of fine sand or coarser particles and has less than 35% clay. Particles greater than 2 mm occupy less than 35% by volume.

Fiber classes for organic materials

The amount of fiber and its durability are important characterizing features of organic deposits in that they reflect on the degree of decomposition of the material. The prevalence of woody materials in peats is also of prime importance.

Fibric: The least decomposed of all organic materials; there is a large amount of well-preserved fiber that is readily identifiable as to botanical origin. Fibers retain their character upon rubbing.

Mesic: Organic material in an intermediate stage of decompostion; intermediate amounts of fiber are present that can be identified as to their botanical origin.

Humic: Highly decomposed organic material; small amounts of fiber are present that can be identified as to their botanical origin. Fibers can be easily destroyed by rubbing.

Woody: Organic material containing more than 50% of woody fibers.

C.3 SURFACE EXPRESSION

The surface expression of genetic materials is their form (assemblage of slopes) and pattern of forms. Form as applied to unconsolidated deposits refers specifically to the product of the initial mode of origin of the materials. When applied to consolidated materials, form refers to the product of their modification by geological processes. Surface expression also indicates the manner in which unconsolidated genetic materials relate to the underlying unit.

Consolidated and Unconsolidated mineral surface classes

Apron - A relatively gently slope at the foot of a steeper slope and formed by materials from the steeper, upper slope.

Blanket - A mantle of unconsolidated materials thick enough to mask minor irregularities in the underlying unit but still conforming to the general underlying topography.

Fan - A fan-shaped form similar to the segment of a cone and having a perceptible gradient from the apex to the toe.

Hummocky - A very complex sequence of slopes extending from somewhat rounded depressions or kettles of various sizes to irregular to conical knolls or knobs. There is a general lack of concordance between knolls or depressions. Slopes are generally 9-70% (5-35 degrees).

Inclined - A sloping, unidirectional surface with a generally constant slope not broken by marked irregularities. Slopes are 2-70% (1-35 degrees). The form of inclined slopes is not related to the initial mode of origin of the underlying material.

Level - A flat or very gently sloping, unidirectional surface with a generally constant slope not broken by marked elevations and depressions. Slopes are generally less than 2% (1 degree).

Rolling - A very regular sequence of moderate slopes extending from rounded, sometines confined concave depressions to broad, rounded convexities producing a wave-lake pattern of moderate relief. Slope length is often 1.6 km or greater and gradients are greater than 5% (3 degrees).

Ridged - A long, narrow elevation of the surface, usually sharp crested with steep sides. The ridges may be parallel, suoparallel, or intersecting.

Steep - Erosional slopes, greater than 70% (35 degrees), on both consolidated and unconsolidated materials. The form of a steep erosional slope on unconsolidated materials is not related to the initial mode of origin of the underlying material.

Terraced - Scarp face and the horizontal or gently inclined surface (tread) above it.

Undulating - A very regular sequence of gentle slopes that extends from rounded, sometines confined concavities to broad rounded convexities producing a wavelike pattern of low local relief. Slope length is generally less than 0.8 km and the dominant gradient of slopes is 2-5% (1-3 degrees).

Veneer - Unconsolidated materials too thin to mask the minor irrigularities of the underlying unit surface. A veneer will range from 10 cm to 1 m in thickness and will possess no form typical of the materials's genesis.

Organic surface classes

Blanket - A mantle of organic materials that is thick enough to mask minor irregularities in the under-lying unit but still conforms to the general under-lying topography.

Bowl - A bog or fen occupying concave-shaped depressions.

Domed - A bog with an elevated, convex, central area much higher than the margin. Domes may be abrupt (with or without a frozen core) or gently sloping or have a stepped surface.

Floating - A level organic surface associated with a pond or lake and not anchored to the lake bottom.

Horizontal - A flat peat surface not broken by marked elevations and depressions.

Plateau - A bog with an elevated, flat, central area only slightly higher than the margin.

Ribbed - A pattern of parallel or reticulate low ridges associated with fens.

Sloping - A peat surface with a generally constant slope not broken by marked irregularities.

Veneer - A thin (40 to 100 cm) mantle of organic materials which generally conforms to the underlying topography. They may or may not be associated with discontinuous permafrost.

Appendix D

GUIDES FOR EVALUATING SOIL SUITABILITY FOR SELECTED USES

Table 1. Guide for assessing soil suitability as source of topsoil.

The term "topsoil" includes soil materials used to cover barren surfaces exposed during construction, and materials used to improve soil conditions on lawns, gardens, flower beds, etc. The factors to be considered include not only the characteristics of the soil itself, but also the ease or difficulty of excavation, and where removal of topsoil is involved, accessibility to the site.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
u	Moist Consistence[2/]	Very friable, friable	Loose, firm	Very firm	Cemented
i	Flooding	None	May flood occasionally for short periods	Frequent flooding	Constantly flooded
w	Wetness[2/]	Wetness is not determining if better than very poorly drained.			Very poorly drained and permanently wet soils
t	Slope	0-5%	5-9%	9-15%	>15%
p	Stoniness[2/]	Stones 10 m apart (Class 0 and 1)	Stones 2-10 m apart (Class 2)	Stones 0.1-2 m apart (Class 3 and 4)	Stones 0.1 m apart (Class 5)
c	Coarse fragments[2/]: percent, by volume	<3%	3-15%	15-35%	>35%
s	Texture[2/]	FSL, VFSL, L, SiL, SL, SC if 1:1 clay is dominant	CL, SCL, SiCL, SC if 2:1 clay is dominant; c and sic if 1:1 clay is dominant	S, LS, C and SiC if 2:1 clay is dominant. organic soils[3/]	Marl, diatomaceous earth
b	Depth of Topsoil[4/]	>40 cm	15-40 cm	8-15 cm	<8 cm
n	Salinity of Topsoil[5/]	E.C. 0-1	E.C. 1-4	E.C. 4-8	E.C. >8

1/ The symbols are used to indicate the nature of the limitation.

2/ For an explanation of texture, consistence, stoniness, coarse fragments and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

3/ Non-woody organic materials are assessed as good sources for topsoil if mixed with or incorporated into mineral soil.

4/ The remaining soil material (at least 8 cm) must be reclaimable after the uppermost soil is removed.

5/ E.C. = Electrical Conductivity (millisiemens/cm).

Table 2. Guide for assessing soil suitability as source of sand and gravel.

The purpose of this table is to provide guidance for assessing the probable supply as well as quality of the sand or gravel for use as road base material and in concrete. The interpretation pertains mainly to the characteristics of the soil substratum to a depth of 150 cm, augmented by observations made in deep cuts as well as geological knowledge where available.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
a	Unified Soil Group	SW SP GW GP	SW-SM SP-SM GP-GM GW-GM	SM SW-SC SP-SC GM GP-GC GW-GC	All other groups and bedrock
h	Depth to Seasonal Water Table	Not class determining if deeper than 50 cm		50 cm	
q	Depth to Sand and Gravel	<25 cm	25-75 cm[2/]	>75 cm[2/]	
p	Stoniness[3/]	Not class determining if stones >.5 m apart (Class 0, 1, 2 and 3)		Stones 0.1-0.5 m apart (Class 4)	Stones <0.1 m apart (Class 5)
d	Depth to Bedrock	>100 cm	50-100 cm	<50 cm	

1/ The symbols are used to indicate the nature of the limitation.

2/ Rated good if it is known that the underlying gravel or sand deposit is thick (>100 cm).

3/ For an explanation of stoniness and rockiness, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

Table 3. Guide for assessing soil suitability as source of roadfill.

Fill material for buildings or roads are included in this use. The performance of the material when removed from its original location and placed under load at the building site or road bed are to be considered. Since surface materials are generally removed during road or building construction their properties are disregarded. Aside from this layer, the whole soil to a depth of 150-200 cm should be evaluated. Soil materials which are suitable for fill can be considered equally suited for road subgrade construction.

Symbol[1]	Items Affecting Use[2]	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
a	Subgrade[3]				
	a. AASHO group index[4]	0-4	5-8	>8	
	b. Unified soil classes	GW, GP, SW, SP, SM, GC[5] and SC[5]	CL (with P.I.[6] <15) and ML	CL (with P.I.[6] of 15 or more), CH and MH[7]	OL, OH and Pt
l	Shrink-swell potential	Low	Moderate	High	
f	Susceptibility to frost action[8]	Low	Moderate	High	
t	Slope	0-15%	15-30%	30-45%	>45%
p	Stoniness[9]	Stones >2 m apart (Class 0, 1 and 2)	Stones 0.5-2 m apart (Class 3)	Stones 0.1-0.5 m apart (Class 4)	Stones <0.1 m apart (Class 5)
r	Rockiness[9]	Rock exposures >35 m apart and cover <10% of the surface	Rock exposure 10-35 m apart and cover 10-25% of the surface	Rock exposure 3.5-10 m apart and cover 25-50% of the surface	Rock exposures <3.5 m apart and cover 50-90% of the surface
w	Wetness[9]	Excessively drained to moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained or permanently wet soils
d	Depth to Bedrock	>100 cm	50-100 cm	20-50 cm	<20 cm
h	Depth to Seasonal Water Table	>150 cm	75-150 cm	50-75 cm	<50 cm

1/ The symbols are used to indicate the nature of the limitation.

2/ The first three items pertain to soil after it is placed in a fill; the last six items pertain to soil in its natural condition before excavation for road fill.

3/ This item estimates the strength of the soil material, that is, its ability to withstand applied loads.

4/ Use AASHO group index only where laboratory data are available for the kind of soil being rated; otherwise, use Unified soil groups.

5/ Downgrade suitability rating to fair if content of fines is more than about 30 percent.

6/ P.I. means plasticity index.

7/ Upgrade suitability rating to fair if MH is largely kaolinitic, friable, and free of mica.

8/ Use this item only where frost penetrates below the paved or hardened surface layer and where moisture transportable by capillary movement is sufficient to form ice lenses at the freezing front.

9/ For an explanation of stoniness, rockiness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

Table 4. Guide for assessing soil suitability for permanent buildings[1/].

This guide applies to undisturbed soils to be evaluated for single-family dwellings and other structures with similar foundation requirements. The emphasis for rating soils for buildings is on foundation requirements; but soil slope, susceptibility to flooding and other hydrologic conditions, such as wetness, that have effects beyond those related exclusively to foundations are considered too. Also considered are soil properties, particularly depth to bedrock, which influence excavation and construction costs for the building itself and for the installation of utility lines. Excluded are limitations for soil corosivity, landscaping and septic tank absorption fields.

Symbol[2/]	Items Affecting Use	Degree of Soil Suitability[3/]			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[4/]	With Basements: Very rapidly, rapidly and well drained. Without Basements: Very rapidly, rapidly, well and moderately well drained.	With Basements: Moderately well drained. Without Basements: Imperfectly drained.	With Basements: Imperfectly, poorly, and very poorly drained. Without Basements: Poorly and very poorly drained.	With Basements: Permanently wet soils. Without Basements: Permanently wet soils.
h	Depth to Seasonal Water Table	With Basements: >150 cm Without Basements: >75 cm	With Basements: 75-150 cm Without Basements: 50-75 cm	With Basements: 25-75 cm Without Basements: 25-50 cm	With Basements: <25 cm Without Basements: <25 cm
i	Flooding	None	None	Occasional flooding (once in 5 years)	Frequent flooding (every year)
t	Slope[5/]	0-9%	9-15%	15-30%	>30%
a	Subgrade[6/]				
	a. AASHO group index[7/]	0-4	5-8	>8	
	b. Unified soil classes	GW, GP, SW, SP, SM and GC and SC	CL (with P.I.[8/] <15) and ML	CL (with P.I.[8/] of 15 or more), CH and MH	OH, OL and Pt
f	Potential Frost Action[9/]	Low (F1, F2)	Moderate (F3)	High (F4)	
p	Stoniness[4/]	Stones >10 m apart (Class 0 to 1)	Stones 2-10 m apart (Class 2[10/])	Stones 0.1-2 m apart (Class 3[10/] to 4)	Stones <0.1 m apart (Class 5[10/])
r	Rockiness[4/,11/]	Rock exposures >100 m apart and cover <2% of the surface	Rock exposures 30-100 m apart and cover 2-10% of the surface	Rock exposures <30 m apart and cover >10% of the surface	Rock exposures too frequent to allow location of permanent buildings
d	Depth to Bedrock[11/]	With Basements: >150 cm Without Basements: >100 cm	With Basements: 100-150 cm Without Basements: 50-100 cm	With Basements: 50-100 cm Without Basements: <50 cm	With Basements: <50 cm

1/ By halving the slope limits, this table can be used for evaluating soil suitability for buildings with large floor areas, but with foundation requirements not exceeding those of ordinary three-storey dwellings.

2/ The symbols are used to indicate the nature of the limitation.

3/ Some soils assessed as fair or poor may be good sites from an aesthetic or use standpoint, but they will require more site preparation and/or maintenance.

4/ For an explanation of rockiness, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Reduce the slope limits by one half for those soils subject to hillside slippage.

6/ This item estimates the strength of the soil, that is, its ability to withstand applied loads. When available, AASHO Group Index values from laboratory tests were used; otherwise the estimated Unified classes were used.

7/ Group index values were estimated from information published by the Portland Cement Association (PCA, 1962), pp. 23-25.

8/ P.I. means plasticity index.

9/ Frost heave only applies where frost penetrates to the assumed depth of the footings and the soil is moist. The potential frost action classes are taken from the United States Army Corps of Engineers (1962), pp. 5-8.

10/ Rate one class better for buildings without basements.

11/ Rate one class better if the bedrock is soft enough so that it can be dug with light power equipment such as backhoes.

Table 5. Guide for assessing soil suitability for local roads and streets[1/].

This guide applies to soils to be evaluated for construction and maintenance of local roads and streets. These are improved roads and streets having some kind of all-weather surfacing, commonly asphalt or concrete, and are expected to carry automobile traffic all year. They consist of: (1) the underlying local soil material (either cut or fill) called the subgrade; (2) the base material of gravel, crushed rock, or lime or soil cement stabilized soil called the subbase; and (3) the actual road surface or pavement, either flexible or rigid. They also are graded to shed water and have ordinary provisions for drainage. With the probable exception of the hardened surface layer, the roads and streets are built mainly from the soil at hand, and cuts and fills are limited, usually less than 2 meters. Excluded from consideration in this guide are highways designed for fast-moving, heavy trucks.

Properties that affect design and construction of roads and streets are: (1) those that affect the load supporting capacity and stability of the subgrade, and (2) those that affect the workability and amount of cut and fill. The AASHO and Unified Classification give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope, depth of hardrock, stoniness, rockiness, and wetness affect the ease of excavation and the amount of cut and fill to reach an even grade.

Symbol[2/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[3/]	Very rapidly, rapidly, well and moderately well drained	Imperfectly drained	Poorly and very poorly drained	Permanently wet soils
i	Flooding	None	Infrequent (once in 5 years)	Occasional (once in 2-4 years)	Frequent (every year)
t	Slope	0-9%	9-15%	15-30%	>30%
d	Depth to Bedrock[4/]	>100 cm	50-100 cm	<50 cm	
a	Subgrade[5/]				
	a. AASHO group index[6/]	0-4	5-8	>8	
	b. Unified soil classes	GW, GP, SW, SP, SM, GC[7/] and SC[7/]	CL (with P.I.[8/] <15) and ML	CL (with P.I.[8/] of 15 or more), CH and MH	OH, OL and Pt
f	Susceptibility to Frost Heave[9/]	Low (F1, F2)	Moderate (F3)	High (F4)	
p	Stoniness[3/]	Stones >2 m apart (Class 0 to 2)	Stones 0.5-2 m apart (Class 3)	Stones 0.1-0.5 m apart (Class 4)	Stones <0.1 m apart (Class 5)
r	Rockiness[3/]	Rock exposures >100 m apart and cover <2% of the surface	Rock exposures 30-100 m apart and cover 2-10% of the surface	Rock exposures <30 m apart and cover >10% of the surface	Rock exposures too frequent to permit location of roads and streets

1/ These guidelines, with some adjustment of slope and rockiness limits, will also be useful for assessing soils for use as parking lots.

2/ Symbols are used to indicate the nature of the limitation.

3/ For an explanation of stoniness, rockiness and soil drainage classes, see the Canada Soil Information System (Canada Soil Survey Committee, 1978).

4/ Rate one class better if the bedrock is soft enough so that it can be dug with light power equipment and is rippable by machinery.

5/ This item estimates the strength of soil materials as it applies to roadbeds. When available, AASHO Group Index values from laboratory tests were used; otherwise, the estimated Unified classes were used. The limitations were estimated assuming that the roads would be surfaced. On unsurfaced roads, rapidly drained, very sandy, poorly graded soils may cause washboard or rough roads.

6/ Group index values were estimated from information published by the Portland Cement Association (PCA, 1962) pp. 23-25.

7/ Downgrade to moderate if content of fines (less than 200 mesh) is greater than about 30 percent.

8/ P.I. means plasticity index.

9/ Frost heave is important where frost penetrates below the paved or hardened surface layer and moisture transportable by capillary movement is sufficient to form ice lenses at the freezing point. The susceptibility classes are taken from the United States Army Corps of Engineers (1962) pp. 5-8.

Table 6 . Guide for assessing soil suitability for trench-type sanitary landfills[1/].

The trench-type sanitary landfill is a sanitary landfill, in which dry garbage and trash is buried daily in an open trench and covered with a layer of soil material. Suitability of the site is dependent upon the potential for pollution of water sources through groundwater contact with the refuse, or leachate arising from the site. Those properties affecting ease of excavation of the site must be supplemented with geological and hydrological knowledge to provide subsurface soil and groundwater data to a depth of at least 3 to 4.5 m, a common depth of landfills.

Symbol[2/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G[3/]	Fair - F	Poor - P	Very Poor - V
h	Depth to Seasonal High Water Table	Not class determining if more than 180 cm		100-180 cm	<100 cm
w	Wetness[4/]	Not class determining if better than imperfectly drained		Imperfectly drained	Poorly and very poorly drained or permanently wet soils
i	Flooding	None	Rare	Occasional	Frequent
k	Permeability[5/]	<5 cm/hr	<5 cm/hr	5-15 cm/hr	>15 cm/hr
t	Slope	0-15%	15-30%	30-45%	>45%
s	Soil Texture[4/,6/] (dominant to a depth of 150 cm)	SL, L, SiL, SCL	SiCL[7/], CL, SC, LS	SiC, C	Muck, peat, gravel, sand
d	Depth to Hard Bedrock Rippable	>150 cm >150 cm	>150 cm 100-150 cm	100-150 cm 100-150 cm	<100 cm <100 cm
p	Stoniness[4/]	Stones >10 m apart (Class 0 and 1)	Stones 2-10 m apart (Class 2)	Stones 0.1-2 m apart (Class 3 and 4)	Stones <0.1 m apart (Class 5)
r	Nature of Bedrock	Impermeable			Highly permeable, fractured, easily soluble

1/ Based on soil depth (120 cm) commonly investigated in making soil surveys.

2/ The symbols are used to indicate the nature of the limitation.

3/ If probability is high that the soil material to a depth of 3 to 4.5 m will not alter a rating of good or fair, indicate this by an appropriate footnote, such as "Probably good to a depth of 3.5 m", or "Probably fair to a depth of 3.5 m".

4/ For an explanation of stoniness, texture and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Reflects ability of soil to retard movement of leachate from the landfills; may not reflect a limitation in arid and semiarid areas.

6/ Reflects ease of digging and moving (workability) and trafficability in the immediate area of the trench where there may not be surfaced roads.

7/ Soils high in expansive clays may need to be given a suitability rating of poor.

Table 7. Guide for assessing soil suitability for area-type sanitary landfills.

In the area-type sanitary landfill refuse is placed on the surface of the soil in successive layers. The daily and final cover material generally must be imported. A final cover of soil material at least 60 cm thick is placed over the fill when it is completed.

The soil under the proposed site should be investigated so as to determine the probability that leachates from the landfill can penetrate the soil and thereby pollute water supplies.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
h	Depth to Seasonal Water Table[2/]	>150 cm	150-100 cm	50-100 cm	<50 cm
w	Wetness[2/,3/]	Rapid to moderately well drained	Imperfectly drained	Poorly drained	Very poorly drained or permanently wet soils
i	Flooding	None	Rare	Occasional	Frequent
k	Permeability[4/,5/]	Not class determining if less than 5 cm/hr		5-15 cm/hr	>15 cm/hr
t	Slope	0-9%	9-15%	15-30%	>30%

1/ The symbols are used to indicate the nature of the limitation.

2/ Reflects influence of wetness on operation of equipment.

3/ For an explanation of drainage, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

4/ Reflects ability of the soil to retard movement of leachate from landfills; may not reflect a limitation in arid and semiarid areas.

5/ Due to possible groundwater contamination, impermeable bedrock is considered poor and permeable bedrock is rated very poor for area-type sanitary landfills.

Table 8. Guide for assessing soil suitability as cover material for area-type sanitary landfills.

The term cover material includes soil materials used to put a daily and final covering layer on refuse in area-type sanitary landfills. This cover material may be derived from the area of the landfill or may be brought in from surrounding areas.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
u	Moist Consistence[2/]	Very friable, friable	Loose, firm	Very firm	Cemented
s	Texture[2/,3/]	SL, L, SiL, SCL	SiCL, CL, SC, LS	SiC, C	Muck, peat, sand, gravel
d	Depth to bedrock[4/]	>150 cm	100-150 cm	50-100 cm	<50 cm
c	Coarse fragments[2/]	<15%	15-35%	>35%	
p	Stoniness[2/]	Stones >10 m apart (Class 0 and 1)	Stones 2-10 m apart (Class 2)	Stones 0.1-2 m apart (Class 3 and 4)	Stones < 0.1 m apart (Class 5)
t	Slope	<9%	9-15%	15-30%	>30%
w	Wetness[2/]	Not class determining if better than poorly drained		Poorly drained	Very poorly drained or permanently wet soils

1/ The symbols are used to indicate the nature of the limitation.

2/ For an explanation of consistence, texture, coarse fragments, stoniness and soil drainage classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

3/ Soils having a high proportion of non-expansive clays may be given a suitability rating one class better than is shown for them in this table.

4/ Thickness of material excluding topsoil, which will be stockpiled (see guide for topsoil).

Table 9. Guide for assessing soil suitability for reservoirs and sewage lagoons.

Factors affecting the ability of undisturbed soils to impound water or sewage and prevent seepage are considered for evaluating soils on their suitability for reservoir and lagoon areas. This evaluation considers soil both as a vessel for the impounded area and as material for the enclosing embankment. As the 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.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
h	Depth to Water Table[2/]	>150 cm	100-150 cm	50-100 cm	<50 cm
i	Flooding[3/]	None	None	Subject to infrequent flooding (once in 50 years)	Subject to frequent high level flooding
k	Soil Permeability	0-0.5 cm/hr	0.5-5 cm/hr	5-15 cm/hr	>15 cm/hr
t	Slope	0-2%	2-5%	5-9%	>9%
o	Organic Matter	<2%	2-10%	10-30%	>30%
c	Coarse Fragments[4/] <25 cm in diameter, % by volume	<20%	20-35%	>35%	
p	Stoniness[4/], >25 cm diameter, percent of surface area	<3% (Class 0, 1 and 2)	3-15% (Class 3)	15-50% (Class 4)	>50% (Class 5)
d	Depth to Bedrock[5/]	>150 cm	100-150 cm	50-100 cm	<50 cm
j	Thickness of Slowly Permeable Layer	>100 cm	50-100 cm	50-25 cm	<25 cm
a	Subgrade Unified Soil Classes	GC, SC, CL, & CH	GM, ML, SM & MH	SW & SP	OL, OH & Pt GP, GW

1/ The symbols are used to indicate the nature of the limitation.

2/ If the floor of the lagoon has nearly impermeable material at least 50 cm thick, disregard depth to water table.

3/ Disregard flooding if it is not likely to enter or damage the lagoon (flood waters have low velocity and depth less than 150 cm).

4/ For an explanation of coarse fragments and stoniness classes, see the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Surface exposures of non rippable rock are rated very poor. If underlying bedrock is impermeable, rating should be one class better.

Table 10. Guide for assessing soil suitability for septic tank absorption fields.

This guide applies to soils to be used as an absorption and filtering medium for effluent from septic tank systems. A subsurface tile system laid in such a way that effluent from the septic tank is distributed reasonably uniformly into the natural soil is assumed when applying this guide. A rating of poor need not mean that a septic system should not be installed in the given soil, but rather, may suggest the difficulty, in terms of installation and maintenance, which can be expected.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
k	Permeability[2/]	Rapid to moderately rapid	Moderate	Slow	Very slow
	Percolation Rate[3/] (Auger hole method)	About 8-18 min/cm[3/]	18-24 min/cm	Slower than 24 min/cm	
h	Depth to Seasonal Water Table[4/]	>150 cm[5/]	100-150 cm	50-100 cm	<50 cm
i	Flooding	Not subject to flooding	Not subject to flooding	Subject to occasional flooding (once in 5 years)	Floods every year
t	Slope	0-9%	9-15%	15-30%	>30%
d	Depth to Hard Rock, bedrock or other impervious materials	>150 cm	100-150 cm[6/]	50-100 cm	<50 cm

1/ The symbols are used to indicate the nature of the limitation.

2/ The suitability ratings should be related to the permeability of soil layers at and below depth of the tile line.

3/ Soils having a percolation rate less than about 8 min/cm are likely to present a pollution hazard to adjacent waters. This hazard must be noted, but the degree of hazard must, in each case, be assessed by examining the proximity of the proposed installation to water bodies, water table, and related features. The symbol g is used to indicate this condition. Refer to U.S. Dept. of Health, Education and Welfare (1969) for details of this procedure.

4/ Seasonal means for more than one month. It may, with caution, be possible to make some adjustment for the severity of a water table limitation in those cases where seasonal use of the facility does not coincide with the period of high water table.

5/ A seasonal water table should be at least 100 cm below the bottom of the trench at all times for soils rated Good (U.S. Dept. of Health, Education and Welfare, 1969). The depths used to water table are based on an assumed tile depth of 50 cm. Where relief permits, the effective depth above a water table or rock can be increased by adding appropriate amounts of fill.

6/ Where the slope is greater than 9%, a depth to bedrock of 100-150 cm is assessed as poor.

Table 11 Guide for assessing soil suitability for playgrounds.

This guide applies to soils to be used intensively for playgrounds for baseball, football, badminton, and for other similar organized games. These areas are subject to intensive foot traffic. A nearly level surface, good drainage, and a soil texture and consistence that gives a firm surface generally are required. The most desirable soils are free of rock outcrops and coarse fragments.

Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[2/]	Rapidly, well and moderately well drained soils with no ponding or seepage. Water table below 75 cm during season of use.	Moderately well drained soils subject to occasional seepage or ponding of short duration and imperfectly drained soils. Water table below 50 cm during season of use.	Imperfectly drained soils subject to seepage or ponding, and poorly drained soils. Water table above 50 cm during season of use.	Very poorly drained and permanently wet soils.
i	Flooding	None during season of use.	Occasional flooding. May flood once every 2-3 years during season of use.	Floods every year during season of use.	Prolonged flooding during season of use.
k	Permeability	Very rapid to moderate.	Moderately slow and slow.	Very slow.	
t	Slope	0-2%	2-5%	5-9%	>9%
d	Depth to Bedrock	>100 cm	50-100 cm[3/]	<50 cm[3/]	
c	Coarse fragments on surface[2/]	Relatively free of coarse fragments.	<20% coarse fragments.	>20% coarse fragments.	
p	Stoniness[2/]	Stones >10 m apart. (Class 0 to 1)	Stones 2-10 m apart. (Class 2)	Stones 0.1-2 m apart. (Class 3, 4)	Stones <0.1 m apart. (Class 5)
r	Rockiness[2/]	Rock exposures >100 m apart and cover <2% of the surface.	Rock exposures 30-100 m apart and cover about 2-10% of the surface.	Rock exposures <30 m apart and cover >10% of the surface.	Rock outcrops too frequent to permit playground location.
s	Surface Soil Texture[2/,4/]	SL, FSL, VFSL, L	SiL, CL, SCL, SiCL, LS	SC, SiC, C[5/]; S, Si	Peaty soils; S and LS subject to blowing.
q	Depth to Sand or Gravel[6/]	>100 cm	50-100 cm	<50 cm	
m	Useful Moisture[7/]	Water storage capacity[8/] >15.0 cm and/or adequate rainfall and/or low evapotranspiration.	Water storage capacity[8/] 7.5-15 cm and/or moderate rainfall and/or moderate evapotranspiration.	Water storage capacity[8/] <7.5 cm and/or low rainfall and/or high evapotranspiration.	

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).
Coarse fragments for the purpose of this table include gravels and cobbles.

3/ Downgrade to a very poor suitability rating if the slope is greater than 5%.

4/ Surface soil texture influences soil ratings as it affects foot trafficability, surface wetness, dust, and maintenance. Adverse soil textures may be partially or completely overcome with the addition of topsoil.

5/ Moderately well and well drained SC, SiC and C soils may be rated fair.

6/ Depth to sand or gravel is considered a limitation in that levelling operations may expose sand or gravel, thereby bringing about adverse surface textures and undesirable amounts of coarse fragments. The addition of topsoil after the levelling process would overcome this limitation.

7/ This item attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration, and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.

8/ Consult glossary for definitions of terms used.

Table 12 Guide for assessing soil suitability for picnic areas.

This guide applies to soils considered for intensive use as park-type picnic areas. It is assumed that most vehicular traffic will be confined to the access roads. Soil suitability for growing and maintaining vegetation is not a part of this guide, except as influenced by moisture, but is an important item to consider in the final evaluation of site.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[2/]	Very rapidly, rapidly, well and moderately well drained soils not subject to seepage or ponding. Water table below 50 cm during season of use.	Moderately well drained soils subject to occasional seepage or ponding and imperfectly drained soils not subject to ponding or seepage. Water Table above 50 cm for short periods during season of use.	Imperfectly drained soils subject to seepage or ponding. Poorly drained soils. Water table above 50 cm and often near surface for a month or more during season of use.	Very poorly drained and permanently wet soils.
i	Flooding	None during season of use.	May flood 1 or 2 times per year for short periods during season of use.	Floods more than 2 times during season of use.	Prolonged flooding during season of use.
t	Slope	0-9%	9-15%	15-30%	>30%
s	Surface Soil Texture[2/,3/]	SL, FSL, VFSL, L	SiL, CL, SCL, SiCL, LS, and sand other than loose sand.	SC, SiC, C[4/]; Si	Peaty soils; loose sand subject to blowing.
c	Coarse Fragments on Surface[2/]	0-20%	20-50%	>50%	
p	Stoniness[2/]	Stones >2 m apart (Class 0 to 2)	Stones 1-2 m apart (Class 3)	Stones 0.1-1 m apart (Class 4)	Stones <0.1 m apart (Class 5)
r	Rockiness[2/,5/,6/]	Rock exposures roughly 30-100 or more m apart and cover <10% of the surface.	Rock exposures roughly 10-30 m apart and cover 10-25% of the surface.	Rock exposures <10 m apart and cover >25% of the surface.	Rock exposures too frequent to permit location of picnic areas.
m	Useful Moisture[7/]	Water storage capacity[8/] >15 cm and/or adequate rainfall and/or low evapotranspiration.	Water storage capacity[8/] 7.5-15 cm and/or moderate rainfall and/or moderate evapotranspiration.	Water storage capacity[8/] <7.5 cm and/or low rainfall and/or high evapotranspiration.	

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978). Coarse fragments for the purpose of this table, include gravels and cobbles. Some gravelly soils may be rated as having a slight limitation if the content of gravel exceeds 20% by only a small margin providing (a) the gravel is embedded in the soil matrix, or (b) the fragments are less than 2 cm in size.

3/ Surface soil texture influences soil ratings as it affects foot trafficability, dust and soil permeability.

4/ Moderately well and well drained SC, SiC and C soils may be rated fair.

5/ Very shallow soils are rated as having severe or very severe limitations for stoniness or rockiness.

6/ The nature and topography of the bedrock exposures may significantly alter these ratings. As such, on-site investigations will be necessary in map units containing bedrock when these are considered as possible sites.

7/ This item attempts to evaluate the adequacy of moisture for vegetative growth. It incorporates the concept of supply through rainfall, loss through evapotranspiration, and storage within the rooting zone. In soils where the water table is within rooting depth for a significant portion of the year, water storage capacity may not significantly influence vegetation growth.

8/ Consult glossary for definitions of terms used.

Table 13 Guide for assessing soil suitability for camp areas.

This guide applies to soils to be used intensively for tents and camp trailers and the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and levelling for campsites and parking areas. The soil should be suitable for heavy foot traffic by humans and limited vehicular traffic. Soil suitability for growing and maintaining vegetation is not a part of this guide, but is an important item to consider in the final evaluation of site.

Back country campsites differ in design, setting and management but require similar soil attributes. These guides should apply to evaluations for back country campsites but depending on the nature of the facility the interpreter may wish to adjust the criteria defining a given degree of limitation to reflect the changed requirement. For example, small tentsites may allow rock exposures greater than 10 m apart to be considered a slight limitation.

Symbol[1/]	Items Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
w	Wetness[2/]	Very rapidly, rapidly, well and moderately well drained soils with no seepage or ponding. Water table below 75 cm during season of use.	Moderately well drained soils subject to occasional seepage or ponding and imperfectly drained soils with no seepage or ponding. Water table below 50 cm during season of use.	Imperfectly drained soils subject to seepage or ponding and poorly drained soils. Water table above 50 cm during season of use.	Very poorly drained and permanently wet soils.
i	Flooding	None	Very occasional flooding during season of use. Once in 5-10 years.	Occasional flooding during season of use. Once in 2-4 years.	Flooding during every season of use.
k	Permeability	Very rapid to moderate inclusive.	Moderately slow and slow.	Very slow.	
t	Slope	0-9%	9-15%	15-30%	>30%
s	Surface Soil Texture[2/,3/]	SL, FSL, VFSL, L	SiL, SCL, CL, SiCL, LS, and sand other than loose sand.	SC, SiC, C[4/]; Si	Peaty soils; loose sand subject to blowing.
c	Coarse Fragments on Surface[2/,5/]	0-20%	20-50%	>50%	
p	Stoniness[2/,6/]	Stones >10 m apart (Class 0 and 1)	Stones 2-10 m apart (Class 2)	Stones 0.1-2 m apart (Class 3 and 4)	Stones < 0.1 m apart (Class 5)
r	Rockiness[2/,6/]	No rock exposures	Rock exposures >10 m apart and cover <25% of the area.	Rock exposures <10 m apart and cover >25% of the area.	Rock exposures too frequent to permit campground location.

1/ The symbols are used to indicate the nature of the limitation.

2/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

3/ Surface soil texture influences soil ratings as it affects foot trafficability, dust, and soil permeability.

4/ Moderately well and well drained SC, SiC and C soils may be rated fair.

5/ Coarse fragments for the purpose of this table include gravels and cobbles. Some gravelly soils may be rated as having slight limitations if the content of gravel exceeds 20% by only a small margin, providing (a) the gravel is embedded in the soil matrix, or (b) the fragments are less than 2 cm in size.

6/ Very shallow soils are rated as having a limitation for rockiness and/or stoniness.

Table 14 Guide for assessing soil suitability for paths and trails.

It is assumed that the trails will be built at least 45 cm wide and that obstructions such as cobbles and stones will be removed during construction. It is also assumed that a dry, stable tread is desirable and that muddy, dusty, worn or eroded trail treads are undesirable. Hiking and riding trails are not treated separately, but as the design requirements for riding trails are more stringent, a given limitation will be more difficult to overcome. Poor or very poor suitability does not indicate that a trail cannot or should not be built. It does, however, suggest higher design requirements and maintenance to overcome the limitations.

Symbol[1/]	Items[2/] Affecting Use	Degree of Soil Suitability			
		Good - G	Fair - F	Poor - P	Very Poor - V
s	Texture[3/,4/]	SL, FSL, VFSL, LS, L	SiL, CL, SiCL, SCL	SC, SiC, C[5/]; Sand, Si	Peaty soils; loose sand subject to blowing
c	Coarse Fragment Content[4/,6/]	0-20%	20-50%	>50%	
p	Stoniness[4/]	Stones >2 m apart (Class 0 to 2)	Stones 1-2 m apart (Class 3)	Stones 0.1-1 m apart (Class 4)	Stones <0.1 m apart (Class 5)
w	Wetness[4/]	Very rapidly, rapidly well, and moderately well drained soils. Water table below 50 cm during season of use.	Moderately well drained soils subject to occasional seepage and ponding and imperfectly drained soils. Water table may be above 50 cm for short periods during season of use.	Poorly and very poorly drained soils. Water table above 50 cm and often near surface for a month or more during season of use.	Permanently wet soils.
r	Rockiness[4/,7/]	Rock exposures >30 m apart and cover <10% of the surface.	Rock exposures 10-30 m apart and cover 10-25% of the surface.	Rock exposures <10 m apart and cover >25% of the surface.	Rock exposures too frequent to permit location of paths and trails.
t	Slope[8/]	0-15%	15-30%	30-60%	>60%
i	Flooding	Not subject to flooding during season of use.	Floods 1 or 2 times during season of use.	Floods more than 2 times during season of use.	Subject to prolonged flooding during season of use.

1/ The symbols are used to indicate the nature of the limitation.

2/ The items affecting use listed in this table are those which have been shown to cause significant differences in trail response. Elevation, aspect, position on slope, and snow avalanching may have slight affects or influence trail management and should be considered in the final site evaluation. Items such as vegetation, fauna, and scenic value are not considered in the guidelines (Epp, 1977).

3/ Texture refers to the soil texture which will form the tread texture. This is the surface texture on level areas but may be a subsurface texture on slopes. Textural classes are based on the less than 2 mm soil fraction. Texture influences soil ratings as it influences foot trafficability, dust, design or maintenance of trails, and erosion hazards.

4/ See also definitions for coarse fragments, rockiness, stoniness, textural and soil drainage classes in the Manual for Describing Soils in the Field (Canada Soil Survey Committee, 1978).

5/ Moderately well and well drained SC, SiC and C soils may be rated fair.

6/ Coarse fragments for the purpose of this table, include gravels and cobbles. Gravels tend to cause unstable footing when present in high amounts, and are also associated with increased erosion. Cobbles (and stones) must be removed from the trail tread, increasing construction and maintenance difficulties. Some gravelly soils may be rated as having a slight limitation if the content of gravel exceeds 20% by only a small margin providing (a) the gravel is embedded in the soil matrix or (b) the fragments are less than 2 cm in size.

7/ The type of rock outcrop (flat lying vs cliffs), and the orientation of the structure (linear cliffs vs massive blocks) can greatly alter the degree of the limitation. Each site with a Rockiness limitation based on the percent rock outcrop above should be evaluated on its own merits and the degree of limitation should then be modified appropriately if necessary.

8/ Slope in this context refers to the slope of the ground surface, not the slope of the tread.

APPENDIX E

DETAILED SOIL DESCRIPTIONS OF SELECTED PROFILE TYPES SAMPLED WITHIN THE DUCK MOUNTAIN AREA*

Soil Symbol	Soil Name	Profile Number
BCS	Blackstone	6
COP	Copernicus	7
DKM	Duck Mountain	8
FOD	Flood Lake	9
RKH	Rackham	10
VRL	Verrall Lake	11
WTV	Waitville	12

* Profile descriptions have been computer generated from detailed sample sites and analytical information stored in the Canada Soil Information System (CanSIS) data bank.

Analytical Methodology:

Field samples were collected from representative sites. Samples were air-dried and ground, and the less than 2 mm size fraction was used for subsequent analysis.

pH:	(1) 0.01 M $CaCl_2$
Organic Carbon:	Wet oxidation (Walkley-Black)
Total Nitrogen:	Macro-Kjeldahl; NO2 and NO3 not included
Calcite, Dolomite, and $CaCO_3$ Equivalent:	Pressure method
Extractable Acidity:	BaCl2 - Triethanolamine, pH 8.0
Cation Exchange Capacity:	Buffered NH4Ac; pH 7.0 solution, done by atomic absorption procedure
Electrical Conductivity:	saturated paste, using conductivity cell-cup
Particle Size Analysis:	Pipette method. Pretreatment removal of organic matter and salts. Dispersion with sodium hexameta-phosphate
Water Content:	Pressure membrane method. Samples are ground, sieved, and oven-dried
Atterberg Limits:	A.S.T.M. Designation D423-54T, "Procedures for Testing Soils", pages 94-101
Shrinkage Limit:	Evaporation method

BCS MANITOBA 1981 PROFILE NO. 6

IDENTIFICATION: SURVEYED BY WF, FOR THE PURPOSE OF DETAILED SURVEY; FEDERAL SOIL SURVEY, WINNIPEG,MAN. STATUS: NODAL; LIMITED EXTENT; SURVEY REPORT NO. D42.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ORTHIC GRAY LUVISOL. MINERAL SOIL FAMILY: FINE CLAYEY, MONTMORILLONITIC, ALKALINE, STRONGLY CALCAREOUS, COLD, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES.

LOCATION: LAT: 51 DEG 50 MIN LONG: 100 DEG 54 MIN ; MILITARY GRID REF. 14 ULN 6919 4308; NTS MAP AREA 62N 15W; 33 25 W.

CLIMATE: 2375 FEET ABOVE MEAN SEA LEVEL. STATION AT SWAN RIVER HAS POOR RELEVANCE TO THE SOIL SITE.

VEGETATION: FOREST,MIXED, REGENERATING. KEY SPECIES LISTING: 1 PINUS BANKSIANA - JACK PINE, 2 PIGL, 3 POPULUS TREMULOIDES - TREMBLING ASPEN. GROUNDCOVER OF FEATHERMOSS, LINBO PETPA CORCA VAC, SOME LEDUM GROEN. TO SW..

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, CLAYEY (>35% CLAY), MODERATELY TO VERY STRONGLY CALCAREOUS (6-40% CACO3), GLACIOLACUSTRINE, MIXED; LANDFORM CLASSIFICATION: LACUSTRINE, CLAYEY, BLANKET; SLOPE: 6% SIMPLE SLOPE OF CLASS 4 (6-9%), FACING NORTHWEST, SITE AT MIDDLE POSITION, LEVEL MICROTOPOGRAPHY,300 M LONG; SOIL MOISTURE AND DRAINAGE: HUMID, MODERATELY WELL DRAINED, SLOWLY PERVIOUS, MODERATE SURFACE RUNOFF, SEEPAGE ABSENT; NONSTONY; NONROCKY; PRESENT LAND USE: OUTDOOR RECREATION.

SPECIAL NOTES: WELLMAN LAKE; APPROX 100M NE OF CATHOLIC CHURCH CAMP GATE.AREA 10M TO EAST HAS BEEN LOGGED FOLLOWING 1961 TORNADO. SOME MINOR PONDING AND SEEPAGE MAY ACCOUNT FOR MOTTLES IN AEBLACKSTONE SERIES

LF: 7 TO 2 CM, RANGE 4 TO 6 CM; HORIZON MOIST; ORGANIC; NONSTICKY, LOOSE, NONPLASTIC CONSISTENCE; MANY, COARSE, RANDOM, CONTINUOUS, DENDRITIC PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

H: 2 TO 0 CM, RANGE 1 TO 2 CM; HORIZON MOIST; MATRIX DRY 10YR 3/1; ORGANIC; NONSTICKY, LOOSE, NONPLASTIC CONSISTENCE; MANY, COARSE, RANDOM, CONTINUOUS, DENDRITIC PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

AHE: 0 TO 3 CM, RANGE 0 TO 5 CM; HORIZON MOIST; MATRIX DRY 10YR 3.5/1, MATRIX MOIST 10YR 3/1; FINE SANDY LOAM; VERY WEAK, FINE TO MEDIUM, PLATY STRUCTURE; NONSTICKY, VERY FRIABLE, SLIGHTLY HARD, NONPLASTIC CONSISTENCE; SMOOTH, CLEAR HORIZON BOUNDARY.

AE: 3 TO 16 CM, RANGE 10 TO 17 CM; HORIZON MOIST; MATRIX DRY 10YR 7/2, MATRIX MOIST 10YR 5/3; LOAMY FINE SAND; COMMON, FINE, PROMINENT, 10YR 5/6 MOTTLES; WEAK, FINE TO MEDIUM, PLATY STRUCTURE; NONSTICKY, VERY FRIABLE, SLIGHTLY HARD, NONPLASTIC CONSISTENCE; SMOOTH, ABRUPT HORIZON BOUNDARY.

AB: 16 TO 24 CM, RANGE 9 TO 12 CM; HORIZON MOIST; MATRIX DRY 10YR 5/3.5, MATRIX MOIST 10YR 5/4; CLAY LOAM; WEAK TO MODERATE, FINE, PLATY STRUCTURE; MODERATE, VERY FINE TO FINE, SUBANGULAR BLOCKY SECONDARY STRUCTURE; SLIGHTLY STICKY, FRIABLE, SLIGHTLY HARD, SLIGHTLY PLASTIC CONSISTENCE; SMOOTH, CLEAR HORIZON BOUNDARY.

BT: 24 TO 48 CM, RANGE 22 TO 26 CM; HORIZON MOIST; MATRIX DRY 10YR 2.5/2, MATRIX MOIST 10YR 3.5/3; CLAY AND HEAVY CLAY; FEW, FINE, PROMINENT, 10YR 5/6 MOTTLES; STRONG, FINE, SUBANGULAR BLOCKY STRUCTURE; VERY STICKY, FIRM, HARD, VERY PLASTIC CONSISTENCE; CONTINUOUS, THICK CLAY FILMS IN ALL VOIDS/CHANNELS AND ON ALL VERTICAL AND HORIZONTAL PED FACES, 10YR 2/2; SMOOTH, CLEAR HORIZON BOUNDARY.

CK: 48 CM; MATRIX DRY 10YR 5.5/3, MATRIX MOIST 10YR 4/3; SILTY CLAY LOAM; FEW, FINE, FAINT MOTTLES; STRUCTURELESS, MASSIVE STRUCTURE; STRONG, FINE TO MEDIUM, ANGULAR BLOCKY SECONDARY STRUCTURE; VERY STICKY, FRIABLE, SLIGHTLY HARD, VERY PLASTIC CONSISTENCE; MANY, THIN CLAY FILMS IN MANY VOIDS/CHANNELS AND ON SOME VERTICAL AND HORIZONTAL PED FACES; MODERATE EFFERVESCENCE; VERY STRONGLY CALCAREOUS.

BCS MANITOBA 1981 PROFILE NO. 6

CHEMICAL DATA (SURVEY)

HORIZON	PH 1	ORG C (%)	TOTAL N (%)	CALC CARB EQU.%	CAL-CITE (%)	DOLO-MITE (%)	EXTR ACID	C.E.C. (ME/100G) BUFF.	C.E.C. (ME/100G) PERM. CHARG	EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA	MG	NA	K
LF	5.2	53.28	1.18				22.7	80.2		45.0	9.5	0.3	3.8
H	5.5	19.23	0.60				15.7	53.3		29.6	6.4	0.1	1.9
AHE	5.3	2.80	0.14				4.8	17.0		8.3	2.9	0.1	0.3
AE	6.3	0.20	0.03				1.3	3.4		1.9	0.6	0.1	0.2
AB	4.8	0.61	0.08				6.8	22.4		7.9	4.1	0.1	0.4
BT	6.2	0.78	0.10				6.3	33.9		16.9	8.6	0.1	0.9
CK	7.5			32.8	9.4	21.5		20.3		26.8	5.9	0.1	0.6

CHEMICAL DATA (SURVEY)

HORIZON	ELEC COND (MMHOS/CM)	% H2O AT SATUR
LF	0.7	550.0
H	0.7	182.0
AHE	0.4	48.7
AE	0.2	29.5
AB	0.2	39.1
BT	0.4	57.9
CK	0.5	47.3

PHYSICAL DATA (SURVEY)

HORIZON	% PASSING 3" SIEVE	.75" SIEVE	NO.4 SIEVE	NO.10 SIEVE	PARTICLE SIZE ANALYSIS % OF SAMPLE V.C. SAND	C. SAND	MED. SAND	F. SAND	V.F. SAND	TOT. SAND	70-2U SILT	50-2U SILT	2U CLAY	0.2U CLAY
LF														
H														
AHE					1	1	1	45	22	70		16	14	
AE					1	1	1	50	34	87		9	4	
AB								6	31	37		30	33	
BT										10		37	53	
CK										6		58	36	

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BCS MANITOBA 1981 PROFILE NO. 6

PHYSICAL DATA

	SURVEY (CON'T)					ENGINEERING							
	MOISTURE STATUS (%)												
HORIZON	0.1 ATM	0.33 ATM	15 ATM	HYGR. MOIST	FIELD MOIST	ATTERBURG PLASTIC LIMIT (%)	ATTERBURG LIQUID LIMIT (%)	SHRINKAGE LIMIT (%)	OPT MOIST CONTENT (%)	MAX DRY DENSITY (G/CC)	COLE VALUE	AASHO CLASS	UNIFIED CLASS
LF													
H													
AHE													
AE													
AB													
BT						24.0	54.0	14.0				76	13
CK			8.2			19.0	41.0	16.0				76	10

COP MANITOBA 1981 PROFILE NO. 7

IDENTIFICATION: SURVEYED BY WF, FOR THE PURPOSE OF DETAILED SURVEY; FEDERAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; LIMITED EXTENT; SURVEY REPORT NO. D42.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ORTHIC GRAY LUVISOL. MINERAL SOIL FAMILY: SANDY, MIXED NONCLAY, NEUTRAL, WEAKLY CALCAREOUS, COLD, HUMID. SOIL MAP UNIT: COMPLEX.

LOCATION: MILITARY GRID REF. 14 ULN 7727 1875; NTS MAP AREA 62N 10; 30 24 W.

CLIMATE: 2250 FEET ABOVE MEAN SEA LEVEL. STATION AT GRANDVIEW HAS POOR RELEVANCE TO THE SOIL SITE.

VEGETATION: FOREST,MIXED, REGENERATING. KEY SPECIES LISTING: 1 PINUS BANKSIANA - JACK PINE, 2 PLEUROZIUM - FEATHERMOSS, 3 CORNUS CANADENSIS - BUNCH BERRY. OTHER FEATHERMOSSES,TWINFLOWER, LYCOPODIUM. BLACK SPRUCE IN SURROUNDING LOWER AREA.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, SANDY, MODERATELY TO VERY STRONGLY CALCAREOUS (6-40% CACO3), GLACIOFLUVIAL, MIXED; LANDFORM CLASSIFICATION: GLACIO FLUVIAL, SANDY, HUMMOCKY; SLOPE: COMPLEX SLOPE OF CLASS 5 (10-15%), FACING SOUTHEAST, SITE AT UPPER SLOPE POSITION, LEVEL MICROTOPOGRAPHY,; SOIL MOISTURE AND DRAINAGE: HUMID, WELL DRAINED, RAPIDLY PERVIOUS, SEEPAGE ABSENT; NONSTONY; NONROCKY; PRESENT LAND USE: OUTDOOR RECREATION, PRODUCTIVE WOODLAND.

SPECIAL NOTES: SOUTHEAST OF N-S CUTLINE AND FORESTRY TRAIL INTERSECTION,SOUTHEAST END OF SINGUSH LAKE. TYPICAL POORLY SORTED OUTWASH DEPOSIT WITH NUMEROUS SMALL ROUNDED PEBBLES AND SOME SILTYMATERIAL. COPERNICUS SERIES.

LF: 6 TO 0 CM, RANGE 4 TO 7 CM; MATERIAL COMPOSITION 50 AND 50% NEEDLES AND FEATHERMOSS; ORGANIC; STRUCTURELESS STRUCTURE; NONSTICKY, NONPLASTIC CONSISTENCE; HIGHLY POROUS; SMOOTH, CLEAR HORIZON BOUNDARY.

AE: 0 TO 5 CM, RANGE 4 TO 6 CM; MATRIX MOIST 10YR 5.5/2.5; SAND; STRUCTURELESS, SINGLE GRAIN STRUCTURE; NONSTICKY, LOOSE, LOOSE, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MANY, VERY FINE, RANDOM PORES; SMOOTH, CLEAR HORIZON BOUNDARY.

BT1: 5 TO 36 CM, RANGE 35 TO 38 CM; MATRIX MOIST 7.5YR 4/5; GRITTY LOAMY COARSE SAND; STRUCTURELESS, MASSIVE STRUCTURE; NONSTICKY, VERY FRIABLE, SOFT, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MANY, VERY FINE, RANDOM PORES; SMOOTH, GRADUAL HORIZON BOUNDARY.

BT2: 36 TO 50 CM, RANGE 48 TO 52 CM; MATRIX MOIST 10YR 5/8; LOAMY SAND; STRUCTURELESS, MASSIVE STRUCTURE; NONSTICKY, VERY FRIABLE, SOFT, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MANY, VERY FINE, RANDOM PORES; SMOOTH, CLEAR HORIZON BOUNDARY.

CK: 50 TO 100 CM; MATRIX MOIST 10YR 5/4; LOAMY COARSE SAND; STRUCTURELESS, SINGLE GRAIN STRUCTURE; NONSTICKY, LOOSE, LOOSE, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MANY, VERY FINE, RANDOM PORES; MODERATE EFFERVESCENCE; VERY STRONGLY CALCAREOUS.

CHEMICAL DATA (SURVEY)

HORIZON	PH 1	ORG C (%)	TOTAL N (%)	CALC CARB EQU.%	CAL-CITE (%)	DOLO-MITE (%)	EXTR ACID	C.E.C. (ME/100G) BUFF.	C.E.C. (ME/100G) PERM. CHARG	EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA	MG	NA	K
LF	4.8	42.55	1.09				31.5	58.4		27.3	9.5	0.1	3.5
AE	4.9	1.38	0.07				5.8	9.5		2.9	0.7	0.1	0.2
BT1	4.9	0.21	0.03				3.8	8.2		2.4	1.3	0.1	0.2
BT2	5.2	0.18	0.03				3.0	7.8		3.0	1.5	0.1	0.1
CK	7.3			36.7	18.3	16.9		4.4		13.9	1.0	0.1	0.1

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CHEMICAL DATA (SURVEY)

HORIZON	ELEC COND (MMHOS/CM)	% H2O AT SATUR
LF	0.5	450.0
AE	0.3	30.7
BT1	0.1	18.5
BT2	0.1	21.0
CK	0.3	19.1

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

HORIZON	% PASSING 3" SIEVE	.75" SIEVE	NO.4 SIEVE	NO.10 SIEVE	V.C. SAND	C. SAND	MED. SAND	F. SAND	V.F. SAND	TOT. SAND	% OF SAMPLE 70-2U SILT	50-2U SILT	2U CLAY	0.2U CLAY
LF														
AE					6	16	28	25	12	87		9	4	
BT1		96	95	92	10	16	29	21	8	84		7	9	
BT2		98	97	96	6	9	23	31	15	84		7	9	
CK		93	91	86	10	15	29	27	9	90		5	5	

PHYSICAL DATA

SURVEY (CON'T)

MOISTURE STATUS (%)

HORIZON	0.1 ATM	0.33 ATM	15 ATM	HYGR. MOIST	FIELD MOIST
LF					
AE					
BT1			3.5		
BT2					
CK			2.2		

JUL 15, 1982

DKM MANITOBA 1981 PROFILE NO. 8

IDENTIFICATION: SURVEYED BY WF, FOR THE PURPOSE OF DETAILED SURVEY; FEDERAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; VERY LIMITED EXTENT; SURVEY REPORT NO. 042.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ORTHIC GRAY LUVISOL. MINERAL SOIL FAMILY: CLAYEY/LOAMY, MONTMORILLONITIC, ALKALINE, STRONGLY CALCAREOUS, COLD, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES.

LOCATION: MILITARY GRID REF. 14 ULN 6889 4361; NTS MAP AREA 62N 15W; 33 25 W.

CLIMATE: 2375 FEET ABOVE MEAN SEA LEVEL. STATION AT SWAN RIVER HAS POOR RELEVANCE TO THE SOIL SITE.

VEGETATION: FOREST,MIXED, REGENERATING. KEY SPECIES LISTING: 1 POPULUS TREMULOIDES - TREMBLING ASPEN, 2 PIGL. VIBED, BANEBERRY,DENSE ARLNU GROUNDCOVER, CORCA RHUBUS GRASSES LINBO MITNA.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, CLAYEY (>35% CLAY), MODERATELY TO VERY STRONGLY CALCAREOUS (6-40% CACO3), GLACIOLACUSTRINE, MIXED; PARENT MATERIAL 2: WEAK CHEMICAL WEATHERING, FINE LOAMY AND FINE SILTY (18 TO 35% CLAY), MODERATELY TO VERY STRONGLY CALCAREOUS (6-40% CACO3), MORAINAL (TILL), MIXED; SLOPE: 5.5% SIMPLE SLOPE OF CLASS 4 (6-9%), FACING NORTHWEST, SITE AT LOWER SLOPE POSITION, LEVEL MICROTOPOGRAPHY,; SOIL MOISTURE AND DRAINAGE: HUMID, MODERATELY WELL DRAINED, SLOWLY PERVIOUS, MODERATE SURFACE RUNOFF, SEEPAGE ABSENT; NONSTONY; NONROCKY; PRESENT LAND USE: OUTDOOR RECREATION.

SPECIAL NOTES: DAILY FORM 80/09/16-5 RECORDED FOR THIS SITE. THIS IS ONLYA NARROW TRANSITIONAL ZONE BETWEEN WTV 5M UPSLOPE AND BCS 5MDOWNSLOPE. MORE COBBLES IN 2CK THAN NORMAC; SUSPECT CONTACTSURFACE WAS WATER WORKED SLIGHTLY. NUMEROUS REDDISH PATCHES DUE TO WEATHERING OF IGNEOUS ROCKS IN SITU. ONEPHOTO OF PIT AREA AND THREE OF PROFILE. DUCK MOUNTAIN SERIES.

LFH: 5 TO 0 CM, RANGE 4 TO 9 CM; HORIZON DRY; MATRIX MOIST 10YR 2.5/2; ORGANIC; STRUCTURELESS STRUCTURE; NONSTICKY, LOOSE, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MANY, MEDIUM AND COARSE PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

AE: 0 TO 6 CM, RANGE 5 TO 10 CM; HORIZON DRY; MATRIX MOIST 10YR 6.5/2, MATRIX DRY 10YR 3.5/2; SILT LOAM; WEAK, VERY FINE TO FINE, PLATY STRUCTURE; NONSTICKY, FRIABLE, NONPLASTIC CONSISTENCE; MANY, MICRO AND VERY FINE AND FINE PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

BT1: 6 TO 18 CM, RANGE 10 TO 20 CM; HORIZON MOIST; EXPED MOIST 10YR 3.5/3, CRUSHED MOIST 10YR 4/3; SILTY CLAY; MODERATE TO STRONG, FINE, ANGULAR BLOCKY STRUCTURE; VERY STICKY, FIRM, VERY PLASTIC CONSISTENCE; COMMON, VERY FINE AND FINE PORES; MANY, CLAY FILMS IN ALL VOIDS/CHANNELS AND ON ALL VERTICAL AND HORIZONTAL PED FACES; SMOOTH, GRADUAL HORIZON BOUNDARY.

BT2: 18 TO 44 CM, RANGE 24 TO 28 CM; HORIZON MOIST; EXPED MOIST 10YR 3/3, CRUSHED MOIST 10YR 3.5/3; SILTY CLAY; WEAK TO MODERATE, MEDIUM, PRISMATIC STRUCTURE; STRONG, FINE, ANGULAR BLOCKY SECONDARY STRUCTURE; VERY STICKY, FIRM, VERY PLASTIC CONSISTENCE; COMMON, VERY FINE AND FINE PORES; CONTINUOUS, CLAY FILMS IN ALL VOIDS/CHANNELS AND ON ALL VERTICAL AND HORIZONTAL PED FACES, 10YR 2/2; SMOOTH, ABRUPT HORIZON BOUNDARY.

BC: 44 TO 50 CM, RANGE 4 TO 8 CM; HORIZON MOIST; MATRIX DRY 10YR 5/4, MATRIX MOIST 10YR 4/3; LOAM; WEAK TO MODERATE, FINE TO MEDIUM, PLATY STRUCTURE PSEUDO; MODERATE, FINE, ANGULAR BLOCKY SECONDARY STRUCTURE; SLIGHTLY STICKY, SLIGHTLY PLASTIC CONSISTENCE; MANY, VERY FINE AND FINE PORES; COMMON, CLAY FILMS IN MANY VOIDS/CHANNELS AND ON SOME VERTICAL AND HORIZONTAL PED FACES; VERY WEAK EFFERVESCENCE; STRONGLY CALCAREOUS; 10% COARSE FRAGMENTS; SMOOTH, CLEAR HORIZON BOUNDARY.

2CK: 50 CM; HORIZON MOIST; MATRIX DRY 10YR 5/4; LOAM; WEAK TO MODERATE, FINE TO MEDIUM, PLATY STRUCTURE PSEUDO; MODERATE, FINE, ANGULAR BLOCKY SECONDARY STRUCTURE; SLIGHTLY STICKY, SLIGHTLY PLASTIC CONSISTENCE; MANY, VERY FINE AND FINE PORES; MODERATE EFFERVESCENCE; VERY STRONGLY CALCAREOUS; 30% GRAVELLY AND COBBLY COARSE FRAGMENTS.

DKM MANITOBA 1981 PROFILE NO. 8

CHEMICAL DATA (SURVEY)

HORIZON	PH 1	ORG C (%)	TOTAL N (%)	CALC CARB EQU.%	CAL-CITE (%)	DOLO-MITE (%)	EXTR ACID	C.E.C. (ME/100G) BUFF.	C.E.C. (ME/100G) PERM. CHARG	EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA	MG	NA	K
LFH	6.0	42.55	1.44				21.9	94.0		68.2	11.3	0.1	2.5
AE	5.2	1.92	0.18				9.2	20.6		4.5	3.1	0.1	0.4
BT1	4.8	0.85	0.11				8.4	28.3		10.5	6.4	0.1	0.5
BT2	5.6	0.77	0.10				7.0	32.4		15.2	9.0	0.1	0.6
BC	7.6			24.2	4.7	18.0		20.4		14.2	5.3	0.1	0.3
2CK	7.6			32.6	12.8	17.3		12.4		14.3	3.5	0.1	0.3

CHEMICAL DATA (SURVEY)

HORIZON	ELEC COND (MMHOS/CM)	% H2O AT SATUR
LFH	1.3	340.0
AE	0.4	42.3
BT1	0.3	47.5
BT2	0.4	57.1
BC	0.9	45.9
2CK	0.8	32.3

PHYSICAL DATA (SURVEY)

HORIZON	% PASSING 3" SIEVE	.75" SIEVE	NO.4 SIEVE	NO.10 SIEVE	PARTICLE SIZE ANALYSIS % OF SAMPLE V.C. SAND	C. SAND	MED. SAND	F. SAND	V.F. SAND	TOT. SAND	70-2U SILT	50-2U SILT	2U CLAY	0.2U CLAY
LFH														
AE					1	3	8	12	7	31		52	17	
BT1										9		46	45	
BT2								1	10	11		44	45	
BC				99				3	24	27		48	25	
2CK				92	4	5	8	12	22	51		32	17	

JUL 15, 1982

DKM MANITOBA 1981 PROFILE NO. 8

PHYSICAL DATA

	SURVEY (CON'T)					ENGINEERING							
	MOISTURE STATUS (%)												
HORIZON	0.1 ATM	0.33 ATM	15 ATM	HYGR. MOIST	FIELD MOIST	ATTERBURG PLASTIC LIMIT (%)	ATTERBURG LIQUID LIMIT (%)	SHRINKAGE LIMIT (%)	OPT MOIST CONTENT (%)	MAX DRY DENSITY (G/CC)	COLE VALUE	AASHO CLASS	UNIFIED CLASS
LFH													
AE													
BT1													
BT2						24.0	50.0	13.0				76	10
BC													
2CK			5.9			16.0	24.0	16.0				40	10

FOD MANITOBA 1981 PROFILE NO. 9

IDENTIFICATION: SURVEYED BY WF, FOR THE PURPOSE OF DETAILED SURVEY; FEDERAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; VERY LIMITED EXTENT; SURVEY REPORT NO. D42.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: REGO GLEYSOL. MINERAL SOIL FAMILY: SANDY, MIXED NONCLAY, NEUTRAL, WEAKLY CALCAREOUS, COLD, SUBAQUIC. SOIL MAP UNIT: TAXONOMIC SERIES. SOIL PHASES: PEATY.

LOCATION: MILITARY GRID REF. 14 ULN 7700 1864; NTS MAP AREA 62N 10; 30 24 W.

CLIMATE: 2235 FEET ABOVE MEAN SEA LEVEL. STATION AT GRANDVIEW HAS POOR RELEVANCE TO THE SOIL SITE.

VEGETATION: FOREST,SOFTWOOD, MATURE. KEY SPECIES LISTING: 1 PCMA, 2 PLEUROZIUM - FEATHERMOSS, 3 CORNUS CANADENSIS - BUNCH BERRY. UNIFORM BLACK SPRUCE15CMX18M,FEW TAMARACK/FEATHERMOSS BLANKET, CORNUS CANADENSIS.

SOIL SITE: PARENT MATERIAL 1: WEAK CHEMICAL WEATHERING, COARSE LOAMY AND COARSE SILTY (<18% CLAY) AND SANDY, WEAKLY CALCAREOUS (1 TO 6% CACO3), GLACIOFLUVIAL, MIXED; LANDFORM CLASSIFICATION: GLACIO FLUVIAL, SANDY, LEVEL; SLOPE: SIMPLE SLOPE OF CLASS 1 (0-0.5%), FACING LEVEL, SITE AT MIDDLE POSITION, SLIGHTLY MOUNDED MICROTOPOGRAPHY,; SOIL MOISTURE AND DRAINAGE: SUBAQUIC, POORLY DRAINED, RAPIDLY PERVIOUS, PONDED SURFACE RUNOFF, SEEPAGE PRESENT, 0.7 M TO APPARENT WATERTABLE; NONSTONY; NONROCKY; PRESENT LAND USE: OUTDOOR RECREATION.

SPECIAL NOTES: SOUTHEAST CORNER OF SINGUSH LAKE, SOUTH OF BEND IN NEWCOTTAGE ROAD. DAILY FORM 80/07/24-16 ALSO DESCRIBES SITE. COMPLEX GLACIOFLUVIAL AREA. WATERTABLE AT 0.7 METERS.CGI HAS BLACK CONTORTED LAYERS OF FINER TEXTURE IN COARSER MATRIXSMALL ROUNDED PEBBLES AND SANDY LAYERS OCCUR IN CGZ, CKG.CLAYEY RIDGE 20M TO SOUTH EAST. MOST MOTTLES IN CGZFLOOD LAKE SERIES.

OF: 20 TO 12 CM, RANGE 15 TO 25 CM; HORIZON MOIST; MATERIAL COMPOSITION 90 AND 10% FEATHERMOSS AND WOOD FRAGMENTS, SLIGHT DECOMPOSITION; 10-20% BY VOLUME; VON POST SCALE 02; ORGANIC; STRUCTURELESS STRUCTURE; NONSTICKY, LOOSE, NONPLASTIC CONSISTENCE; ABUNDANT, HORIZONTAL AND RANDOM ROOTS; HIGHLY POROUS, VERY FINE AND FINE AND MEDIUM AND COARSE, RANDOM, INTERSTITIAL PORES; WAVY, CLEAR HORIZON BOUNDARY.

OM: 12 TO 0 CM, RANGE 10 TO 15 CM; HORIZON MOIST; MATERIAL COMPOSITION 90 AND 10% FEATHERMOSS AND WOOD FRAGMENTS, MODERATE DECOMPOSITION; VON POST SCALE 05; ORGANIC; STRUCTURELESS STRUCTURE; NONSTICKY, LOOSE, NONPLASTIC CONSISTENCE; ABUNDANT, HORIZONTAL AND RANDOM ROOTS; HIGHLY POROUS, VERY FINE AND FINE AND MEDIUM, RANDOM, INTERSTITIAL PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

CG1: 0 TO 10 CM, RANGE 2 TO 18 CM; HORIZON MOIST; MATRIX MOIST 2.5Y 5/2, MATRIX MOIST 2.5Y 2/0; MUCKY FINE SANDY LOAM; COMMON, COARSE, FAINT MOTTLES; STRUCTURELESS, MASSIVE STRUCTURE; SLIGHTLY STICKY, VERY FRIABLE, SLIGHTLY PLASTIC CONSISTENCE; FEW, HORIZONTAL AND RANDOM ROOTS; HIGHLY POROUS, MICRO AND VERY FINE AND FINE, RANDOM, INTERSTITIAL PORES; IRREGULAR, CLEAR HORIZON BOUNDARY.

CG2: 10 TO 60 CM, RANGE 55 TO 65 CM; HORIZON WET; MATRIX MOIST 5Y 5.5/1; LOAMY SAND; MANY, COARSE, PROMINENT, 10YR 5/8 MOTTLES; STRUCTURELESS, MASSIVE STRUCTURE; NONSTICKY, LOOSE, NONPLASTIC CONSISTENCE; VERY FEW ROOTS; HIGHLY POROUS, MICRO AND VERY FINE, RANDOM, INTERSTITIAL PORES; WEAK EFFERVESCENCE; WEAKLY CALCAREOUS; SMOOTH, GRADUAL HORIZON BOUNDARY.

CKG: 60 TO 100 CM, RANGE 55 CM; HORIZON WET; MATRIX MOIST 5Y 5.5/1; LOAMY SAND; MANY, COARSE, PROMINENT, 10YR 5/8 MOTTLES; STRUCTURELESS, MASSIVE STRUCTURE; SLIGHTLY STICKY, VERY FRIABLE, SLIGHTLY PLASTIC CONSISTENCE; HIGHLY POROUS, MICRO AND VERY FINE, RANDOM, INTERSTITIAL PORES; MODERATE EFFERVESCENCE; MODERATELY CALCAREOUS; HORIZONTAL, HOMOGENEOUS AND STREAKED BANDED .

JUL 15, 1982

FOD MANITOBA 1981 PROFILE NO. 9

CHEMICAL DATA (SURVEY)

HORIZON	PH 1	ORG C (%)	PYRO EXTR C-%	TOTAL N (%)	CALC CARB EQU.%	CAL-CITE (%)	DOLO-MITE (%)	EXTR ACID	C.E.C. (ME/100G) BUFF.	C.E.C. (ME/100G) PERM. CHARG	EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA	MG	NA	K
OF	4.4	53.11	18.7	1.22				42.9	93.4		37.2	12.9	0.2	1.9
OM	5.5	44.94	99.9	1.67				38.5	182.2		106.9	30.6	0.1	0.6
CG1	6.3	2.45		0.24				4.9	23.6		13.4	5.0	0.1	0.2
CG2	7.2				2.8	0.0	2.6	0.5	8.8		4.9	3.1	0.1	0.2
CKG	7.4				12.0	4.3	7.1		5.2		39.2	1.3	0.1	0.1

CHEMICAL DATA (SURVEY)

HORIZON	ELEC COND (MMHOS/CM)	% H2O AT SATUR
OF	0.4	517.0
OM	0.3	314.0
CG1	0.2	32.9
CG2	0.2	24.5
CKG	0.3	21.7

PHYSICAL DATA (SURVEY)

HORIZON	RUB FIB %	UNRUB FIBRE %	% ASH	% PASSING 3" SIEVE	.75" SIEVE	NO.4 SIEVE	NO.10 SIEVE	PARTICLE SIZE ANALYSIS V.C. SAND	C. SAND	MED. SAND	F. SAND	V.F. SAND	TOT. SAND	% OF SAMPLE 70-2U SILT	50-2U SILT	2U CLAY	0.2U CLAY
OF	74	99	20														
OM	14	56	22														
CG1								2	4	11	33	9	59		25	16	
CG2								1	3	22	48	13	87		4	9	
CKG								2	6	18	47	13	86		5	9	

JUL 15, 1982

FOD MANITOBA 1981 PROFILE NO. 9

PHYSICAL DATA

	SURVEY (CON'T)					ENGINEERING							
	MOISTURE STATUS (%)												
HORIZON	0.1 ATM	0.33 ATM	15 ATM	HYGR. MOIST	FIELD MOIST	ATTERBURG PLASTIC LIMIT (%)	ATTERBURG LIQUID LIMIT (%)	SHRINKAGE LIMIT (%)	OPT MOIST CONTENT (%)	MAX DRY DENSITY (G/CC)	COLE VALUE	AASHO CLASS	UNIFIED CLASS
OF													
OM													
CG1						19.0	22.0	24.0				40	07
CG2			3.4										
CKG													

JUL 15, 1982

RKH MANITOBA 1981 PROFILE NO. 10

IDENTIFICATION: SURVEYED BY WF, FOR THE PURPOSE OF DETAILED SURVEY; FEDERAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; VERY LIMITED EXTENT; SURVEY REPORT NO. 042.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ORTHIC GRAY LUVISOL. MINERAL SOIL FAMILY: FINE LOAMY, MONTMORILLONITIC, ALKALINE, STRONGLY CALCAREOUS, COLD, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES.

LOCATION: MILITARY GRID REF. 14 ULN 6980 4100; NTS MAP AREA 62N 15W; 33 25 W.

CLIMATE: 2350 FEET ABOVE MEAN SEA LEVEL. STATION AT SWAN RIVER HAS POOR RELEVANCE TO THE SOIL SITE.

VEGETATION: FOREST,MIXED, REGENERATING. KEY SPECIES LISTING: 1 POPULUS TREMULOIDES - TREMBLING ASPEN, 2 PIGL, 3 ALNUS - ALDER. DENSE REGENERATION,VIBED, ARLNU, BANEBERRY, GRASSES, FRAGARIA.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, FINE LOAMY AND FINE SILTY (18 TO 35% CLAY), MODERATELY TO VERY STRONGLY CALCAREOUS (6-40% CACO3), GLACIOLACUSTRINE, MIXED; LANDFORM CLASSIFICATION: LACUSTRINE, CLAYEY, HUMMOCKY; SLOPE: SIMPLE SLOPE , SITE AT MIDDLE POSITION, LEVEL MICROTOPOGRAPHY,; SOIL MOISTURE AND DRAINAGE: HUMID, MODERATELY WELL DRAINED, MODERATELY PERVIOUS, VERY SLOW SURFACE RUNOFF, SEEPAGE ABSENT; NONSTONY; NONROCKY; PRESENT LAND USE: OUTDOOR RECREATION.

SPECIAL NOTES: SOUTH EAST OF WELLMAN LAKE CAMPGROUND. AREA WAS HEAVILYDAMAGED AND LOGGED FOLLOWING 1961 TORNADO. PLATEAU-LIKEUPLAND AREA WITH NEARLY LEVEL PORTIONS MAINLY IMPERFECTLYDRAINED. ORANGE, SANDY LAYERS AT 55, 66, AND 75 CM.RACKHAM SERIES

LFH: 5 TO 0 CM, RANGE 2 TO 8 CM; HORIZON DRY; ORGANIC; STRUCTURELESS AND MODERATE TO STRONG STRUCTURE; NONSTICKY, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MEDIUM AND COARSE, RANDOM, INTERSTITIAL PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

AE: 0 TO 7 CM, RANGE 5 TO 10 CM; HORIZON DRY; MATRIX DRY 10YR 7/2, MATRIX MOIST 10YR 5/3; LOAM; VERY FINE TO FINE, PLATY STRUCTURE; NONSTICKY, FRIABLE, VERY HARD, NONPLASTIC CONSISTENCE; MODERATELY POROUS, COMMON, VERY FINE, INTERSTITIAL PORES; WAVY, CLEAR HORIZON BOUNDARY.

AB: 7 TO 13 CM, RANGE 4 TO 14 CM; HORIZON MOIST; CRUSHED MOIST 10YR 4/3, EXPED MOIST 10YR 4/4; CLAY LOAM; STRONG, MEDIUM TO COARSE, ANGULAR BLOCKY STRUCTURE; SLIGHTLY STICKY, FIRM, EXTREMELY HARD, SLIGHTLY PLASTIC CONSISTENCE; MODERATELY POROUS, COMMON, VERY FINE PORES; SMOOTH, CLEAR HORIZON BOUNDARY.

BT1: 13 TO 24 CM, RANGE 10 TO 12 CM; HORIZON MOIST; CRUSHED MOIST 10YR 3.5/3, EXPED MOIST 10YR 3/3; SILTY CLAY; STRONG, VERY FINE TO FINE, ANGULAR BLOCKY STRUCTURE; VERY STICKY, FRIABLE, VERY HARD, PLASTIC CONSISTENCE; SLIGHTLY POROUS, COMMON, VERY FINE PORES; COMMON, THIN CLAY FILMS ON PED FACES-UNSPECIFIED; SMOOTH, CLEAR HORIZON BOUNDARY.

BT2: 24 TO 38 CM, RANGE 12 TO 16 CM; HORIZON MOIST; EXPED MOIST 10YR 2.5/2, CRUSHED MOIST 10YR 3/4; CLAY; COMMON, MEDIUM, PROMINENT, 7.5YR 5/8 MOTTLES; WEAK TO MODERATE, MEDIUM, PRISMATIC STRUCTURE; MODERATE TO STRONG, FINE TO MEDIUM, ANGULAR BLOCKY SECONDARY STRUCTURE; STICKY, FIRM, VERY HARD, PLASTIC CONSISTENCE; SLIGHTLY POROUS, COMMON, VERY FINE PORES; CONTINUOUS, MODERATELY THICK CLAY FILMS IN ALL VOIDS/CHANNELS AND ON ALL VERTICAL AND HORIZONTAL PED FACES, 10YR 2/2; SMOOTH, CLEAR HORIZON BOUNDARY.

BC: 38 TO 44 CM, RANGE 4 TO 8 CM; HORIZON MOIST; EXPED MOIST 10YR 4/4, CRUSHED MOIST 10YR 4/3; SILT LOAM; COMMON, MEDIUM, PROMINENT, 5YR 5/8 MOTTLES; WEAK TO MODERATE, FINE TO MEDIUM, PLATY STRUCTURE PSEUDO; WEAK TO MODERATE, FINE, SUBANGULAR BLOCKY SECONDARY STRUCTURE; SLIGHTLY STICKY, FRIABLE, HARD, SLIGHTLY PLASTIC CONSISTENCE; MODERATELY POROUS, COMMON, VERY FINE AND FINE PORES; COMMON, THIN CLAY FILMS IN VOIDS AND/OR CHANNELS ONLY; WEAK EFFERVESCENCE; STRONGLY CALCAREOUS; SMOOTH, CLEAR HORIZON BOUNDARY.

CKGJ: 44 CM; HORIZON MOIST; 10YR 5/4; SILT LOAM; MANY, FINE AND MEDIUM, DISTINCT, 7.5YR 5/8 MOTTLES; MEDIUM TO COARSE STRUCTURE LAMINATED; WEAK TO MODERATE, FINE TO MEDIUM, ANGULAR BLOCKY SECONDARY STRUCTURE; SLIGHTLY STICKY, VERY FRIABLE, HARD, SLIGHTLY PLASTIC CONSISTENCE; MODERATELY POROUS, COMMON, FINE PORES; STRONG EFFERVESCENCE; VERY STRONGLY CALCAREOUS.

RKH MANITOBA 1981 PROFILE NO. 10

CHEMICAL DATA (SURVEY)

HORIZON	PH 1	ORG C (%)	TOTAL N (%)	CALC CARB EQU.%	CAL-CITE (%)	DOLO-MITE (%)	EXTR ACID	C.E.C. (ME/100G) BUFF.	C.E.C. (ME/100G) PERM. CHARG	EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA	MG	NA	K
LFH	5.2	24.68	1.20				18.9	71.4		43.3	7.9	0.3	3.8
AE	4.6	0.78	0.09				5.4	11.9		3.1	1.2	0.1	0.3
AB	4.6	0.64	0.10				7.9	23.7		8.9	3.9	0.1	0.5
BT1	4.9	0.70	0.10				7.6	28.9		12.5	6.0	0.1	0.4
BT2	6.1	0.74	0.11				7.7	31.2		14.7	8.7	0.1	0.5
BC	7.5			22.4	0.0	20.6		21.7		14.8	6.8	0.1	0.3
CKGJ	7.6			33.3	11.7	20.0		15.6		22.1	4.1	0.1	0.3

CHEMICAL DATA (SURVEY)

HORIZON	ELEC COND (MMHOS/CM)	% H2O AT SATUR
LFH	1.0	262.0
AE	0.3	32.2
AB	0.3	42.3
BT1	0.2	44.8
BT2	0.5	63.8
BC	0.6	51.4
CKGJ	0.6	41.4

PHYSICAL DATA (SURVEY)

HORIZON	% PASSING 3" SIEVE	.75" SIEVE	NO.4 SIEVE	NO.10 SIEVE	PARTICLE SIZE ANALYSIS V.C. SAND	C. SAND	MED. SAND	F. SAND	V.F. SAND	TOT. SAND	% OF SAMPLE 70-2U SILT	50-2U SILT	2U CLAY	0.2U CLAY
LFH														
AE					1	2	2	7	27	39		48	13	
AB							1	4	15	20		49	31	
BT1							1	1	14	16		43	41	
BT2								1	11	12		22	66	
BC							1	3	10	15		58	27	
CKGJ						1	1	3	12	17		64	19	

JUL 15, 1982

RLH MANITOBA 1981 PROFILE NO. 10

PHYSICAL DATA

	SURVEY (CON'T)					ENGINEERING							
	MOISTURE STATUS (%)												
HORIZON	0.1 ATM	0.33 ATM	15 ATM	HYGR. MOIST	FIELD MOIST	ATTERBURG PLASTIC LIMIT (%)	ATTERBURG LIQUID LIMIT (%)	SHRINKAGE LIMIT (%)	OPT MOIST CONTENT (%)	MAX DRY DENSITY (G/CC)	COLE VALUE	AASHO CLASS	UNIFIED CLASS
LFH													
AE													
AB													
BT1						21.0	41.0	13.0				76	10
BT2						25.0	52.0	15.0				76	13
BC													
CKGJ			11.6			18.0	29.0	16.0				60	10

VRL MANITOBA 1981 PROFILE NO. 11

IDENTIFICATION: SURVEYED BY WF, FOR THE PURPOSE OF DETAILED SURVEY; FEDERAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; LIMITED EXTENT; SURVEY REPORT NO. 042.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: GLEYED GRAY LUVISOL. MINERAL SOIL FAMILY: FINE CLAYEY, MIXED CLAY, ALKALINE, STRONGLY CALCAREOUS, COLD, PERHUMID. SOIL MAP UNIT: TAXONOMIC SERIES.

LOCATION: MILITARY GRID REF. 14 ULN 6955 4345; NTS MAP AREA 62N 15W; 33 25 W.

CLIMATE: 2375 FEET ABOVE MEAN SEA LEVEL. STATION AT SWAN RIVER HAS POOR RELEVANCE TO THE SOIL SITE.

VEGETATION: FOREST,MIXED, MATURE. KEY SPECIES LISTING: 1 PIGL, 2 POPULUS TREMULOIDES - TREMBLING ASPEN, 3 CORNUS CANADENSIS - BUNCH BERRY. FEW ALNUS, OTHERWISENO SHRUBS. PETPA LINDO MITNU FRAGARIA CORCA F.MOSS GROUNDCOVER.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, CLAYEY (>35% CLAY), MODERATELY TO VERY STRONGLY CALCAREOUS (6-40% CACO3), GLACIOLACUSTRINE, MIXED; LANDFORM CLASSIFICATION: LACUSTRINE, BLANKET; SLOPE: 2.5% SIMPLE SLOPE OF CLASS 3 (2-5%), FACING EAST, SITE AT MIDDLE POSITION, LEVEL MICROTOPOGRAPHY,; SOIL MOISTURE AND DRAINAGE: PERHUMID, IMPERFECTLY DRAINED, SLOWLY PERVIOUS, SLOW SURFACE RUNOFF, SEEPAGE ABSENT; NONSTONY; NONROCKY; PRESENT LAND USE: OUTDOOR RECREATION.

SPECIAL NOTES: AREA IS MARKED FOR WELLMAN LAKE COTTAGE DEVELOPMENT. DAILYFORM 80/09/18-3 IS APPROX 50 PACES TO NORTHEASTCKGZ HAS NUMEROUS LIGHT COLOURED, STRONGLY CACCAREOUS BANDS.AE IS INDISTINCT WHEN MOIST.VERRALL LAKE SERIES

LF: 5 TO 1 CM, RANGE 3 TO 5 CM; HORIZON MOIST; MATRIX MOIST 10YR 2/2; ORGANIC; STRUCTURELESS STRUCTURE; FINE TO MEDIUM, ANGULAR BLOCKY SECONDARY STRUCTURE; NONSTICKY, LOOSE, LOOSE, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MANY, FINE AND MEDIUM AND COARSE PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

H: 1 TO 0 CM, RANGE 0 TO 2 CM; HORIZON MOIST; MATRIX MOIST 10YR 2/1; ORGANIC; STRUCTURELESS STRUCTURE; NONSTICKY, LOOSE, LOOSE, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MANY, FINE AND MEDIUM AND COARSE PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

AH: 0 TO 3 CM, RANGE 1 TO 5 CM; HORIZON MOIST; MATRIX MOIST 10YR 2/1; CLAY LOAM; VERY FINE TO FINE, SUBANGULAR BLOCKY STRUCTURE; SLIGHTLY STICKY, VERY FRIABLE, SLIGHTLY PLASTIC CONSISTENCE; MODERATELY POROUS, COMMON, MICRO AND VERY FINE PORES; WAVY, ABRUPT HORIZON BOUNDARY.

AE: 3 TO 8 CM, RANGE 0 TO 6 CM; HORIZON MOIST; MATRIX MOIST 10YR 4/2; LOAM; WEAK, MEDIUM, PLATY STRUCTURE; SLIGHTLY STICKY, VERY FRIABLE, SLIGHTLY PLASTIC CONSISTENCE; MODERATELY POROUS, COMMON, MICRO AND VERY FINE PORES; SMOOTH, CLEAR HORIZON BOUNDARY.

BTGJ: 8 TO 30 CM, RANGE 20 TO 28 CM; HORIZON MOIST; MATRIX MOIST 10YR 3/2; SILTY CLAY; FEW, FINE, FAINT, 10YR 5/6 MOTTLES; STRUCTURELESS, MASSIVE STRUCTURE; MODERATE, VERY FINE TO FINE, SUBANGULAR BLOCKY SECONDARY STRUCTURE; VERY STICKY, VERY FRIABLE, VERY PLASTIC CONSISTENCE; SLIGHTLY POROUS, FEW, EXPED PORES; MANY, THIN CLAY FILMS ON PED FACES-UNSPECIFIED; SMOOTH, ABRUPT HORIZON BOUNDARY.

CKG1: 30 TO 50 CM; HORIZON MOIST; MATRIX MOIST 10YR 4.5/2.5; SILTY CLAY LOAM; MANY, FINE AND MEDIUM, DISTINCT, 10YR 5/6 MOTTLES; STRUCTURELESS STRUCTURE; WEAK TO MODERATE, VERY FINE, SUBANGULAR BLOCKY SECONDARY STRUCTURE; VERY STICKY, VERY FRIABLE, VERY PLASTIC CONSISTENCE; SLIGHTLY POROUS, VERY FEW, EXPED PORES; WEAK EFFERVESCENCE; VERY STRONGLY CALCAREOUS; SMOOTH, GRADUAL HORIZON BOUNDARY.

CKG2: 50 TO 100 CM; HORIZON MOIST; MATRIX MOIST 10YR 5/2; SILTY CLAY; MANY, FINE AND MEDIUM, PROMINENT, 10YR 5/6 MOTTLES; STRUCTURELESS STRUCTURE; VERY STICKY, VERY FRIABLE, VERY PLASTIC CONSISTENCE; SLIGHTLY POROUS, VERY FEW, EXPED PORES; MODERATE EFFERVESCENCE; VERY STRONGLY CALCAREOUS.

VRL MANITOBA 1981 PROFILE NO. 11

CHEMICAL DATA (SURVEY)

HORIZON	PH 1	ORG C (%)	TOTAL N (%)	CALC CARB EQU.%	CAL-CITE (%)	DOLO-MITE (%)	EXTR ACID	C.E.C. (ME/100G) BUFF.	C.E.C. (ME/100G) PERM. CHARG	EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA	MG	NA	K
LF	5.3	48.65	1.58				23.9	93.6		49.2	13.1	0.3	3.8
H	5.5	27.32	1.02				28.5	89.8		50.8	12.3	0.3	1.7
AH	5.4	6.24	1.75				10.4	45.9		24.2	9.7	0.1	0.6
AE	6.2	1.28	0.12				4.3	21.8		11.4	5.5	0.1	0.2
BTGJ	6.7	0.73	0.11				5.4	29.8		18.8	11.3	0.1	0.5
CKG1	7.5			27.7	6.5	19.5		24.9		24.0	7.4	0.1	0.5
CKG2	7.6			32.5	14.4	16.6		24.3		30.1	6.9	0.1	0.4

CHEMICAL DATA (SURVEY)

HORIZON	ELEC COND (MMHOS/CM)	% H2O AT SATUR
LF	0.8	465.0
H	0.6	274.0
AH	0.6	77.7
AE	0.6	41.2
BTGJ	0.5	63.2
CKG1	0.8	51.9
CKG2	0.7	58.3

PHYSICAL DATA (SURVEY)

HORIZON	PARTICLE SIZE ANALYSIS % PASSING 3" SIEVE	.75" SIEVE	NO.4 SIEVE	NO.10 SIEVE	V.C. SAND	C. SAND	MED. SAND	F. SAND	V.F. SAND	TOT. SAND	% OF SAMPLE 70-2U SILT	50-2U SILT	2U CLAY	0.2U CLAY
LF														
H														
AH					1	2	4	10	6	23		45	32	
AE						4	10	21	7	42		38	20	
BTGJ										4		44	52	
CKG1										3		61	36	
CKG2										5		54	41	

JUL 15, 1982

VRL MANITOBA 1981 PROFILE NO. 11

PHYSICAL DATA

	SURVEY (CON'T)					ENGINEERING							
	MOISTURE STATUS (%)												
HORIZON	0.1 ATM	0.33 ATM	15 ATM	HYGR. MOIST	FIELD MOIST	ATTERBURG PLASTIC LIMIT (%)	ATTERBURG LIQUID LIMIT (%)	SHRINKAGE LIMIT (%)	OPT MOIST CONTENT (%)	MAX DRY DENSITY (G/CC)	COLE VALUE	AASHO CLASS	UNIFIED CLASS
LF													
H													
AH													
AE													
BTGJ						25.0	53.0	15.0				76	13
CKG1			12.2										
CKG2						19.0	46.0	16.0				76	10

JUL 15, 1982

WTV MANITOBA 1981 PROFILE NO. 12

IDENTIFICATION: SURVEYED BY WF, FOR THE PURPOSE OF DETAILED SURVEY; FEDERAL SOIL SURVEY, WINNIPEG,MAN. STATUS: MODAL; EXTENSIVE; SURVEY REPORT NO. D42.

CLASSIFICATION: TAXONOMIC SYSTEM OF THE YEAR 1978, SUBGROUP: ORTHIC GRAY LUVISOL. MINERAL SOIL FAMILY: LOAMY, ALKALINE, STRONGLY CALCAREOUS, COLD, HUMID. SOIL MAP UNIT: TAXONOMIC SERIES.

LOCATION: MILITARY GRID REF. 14 ULN 6950 4342; NTS MAP AREA 62N 15W; 33 25 W.

CLIMATE: FEET ABOVE MEAN SEA LEVEL. STATION AT SWAN RIVER HAS POOR RELEVANCE TO THE SOIL SITE.

VEGETATION: FOREST,MIXED, REGENERATING. KEY SPECIES LISTING: 1 POPULUS TREMULOIDES - TREMBLING ASPEN, 2 PICEA GLAUCA - WHITE SPRUCE, 3 BETULA POPYRIFERA - WHITE BIRCH. REGENERATING SPRUCEAND ASPEN/ARLNU,PETPA,RHUBUS LINBO LYCOPODIUM, F.MOSS CORCA.

SOIL SITE: PARENT MATERIAL 1: CHEMICAL AND PHYSICAL WEATHERING, MODERATELY TO VERY STRONGLY CALCAREOUS (6-40% CACO3), MORAINAL (TILL), MIXED; LANDFORM CLASSIFICATION: MORAINAL, LOAMY, HUMMOCKY; SLOPE: 12% COMPLEX SLOPE OF CLASS 5 (10-15%), FACING SOUTHWEST, SITE AT UPPER SLOPE POSITION, LEVEL MICROTOPOGRAPHY,; SOIL MOISTURE AND DRAINAGE: HUMID, WELL DRAINED, MODERATELY PERVIOUS, MODERATE SURFACE RUNOFF, SEEPAGE ABSENT; MODERATELY STONY; NONROCKY; PRESENT LAND USE: OUTDOOR RECREATION, PRODUCTIVE WOODLAND; HUMUS-FORM: FIBRIMOR.

SPECIAL NOTES: 10M WEST OF ROADCUT DESCRIBED BY YELLOW FORM 80/6/24-7.NO MOTTLES, BUT NUMEROUS COLOUR STAINS DUE TO WEATHERINGOF ROCK FRAGMENTS IN SITU.WAITVILLE SERIES.

F: 6 TO 0 CM, RANGE 5 TO 12 CM; HORIZON MOIST; MATRIX DRY 10YR 4/2; ORGANIC; STRUCTURELESS STRUCTURE; STRUCTURELESS SECONDARY STRUCTURE; NONSTICKY, LOOSE, NONPLASTIC CONSISTENCE; HIGHLY POROUS, MANY, FINE AND MEDIUM, RANDOM, CONTINUOUS PORES; SMOOTH, ABRUPT HORIZON BOUNDARY.

AE1: 0 TO 4 CM, RANGE 0 TO 8 CM; HORIZON DRY; MATRIX DRY 10YR 6.5/3, MATRIX MOIST 7.5YR 4.5/3; FINE SANDY LOAM; WEAK TO MODERATE, MEDIUM TO COARSE, PLATY STRUCTURE; NONSTICKY, VERY FRIABLE, SLIGHTLY HARD, NONPLASTIC CONSISTENCE; MODERATELY POROUS, MANY, MICRO AND VERY FINE, HORIZONTAL AND RANDOM, INPED, CONTINUOUS, SIMPLE, INTERSTITIAL AND TUBULAR AND CRACKS AND FISSURE PORES; 10% GRAVELLY AND COBBLY COARSE FRAGMENTS; BROKEN, CLEAR HORIZON BOUNDARY.

AE2: 4 TO 10 CM, RANGE 5 TO 12 CM; HORIZON DRY; MATRIX DRY 10YR 5.5/4, MATRIX MOIST 7.5YR 4/3; FINE SANDY LOAM; MODERATE, MEDIUM TO COARSE, PLATY STRUCTURE; SLIGHTLY STICKY, HARD, SLIGHTLY PLASTIC CONSISTENCE; MODERATELY POROUS, MANY, VERY FINE, HORIZONTAL AND RANDOM, INPED, CONTINUOUS, SIMPLE, INTERSTITIAL AND TUBULAR AND CRACKS AND FISSURE PORES; 10% GRAVELLY AND COBBLY COARSE FRAGMENTS; WAVY, CLEAR HORIZON BOUNDARY.

BT: 10 TO 30 CM, RANGE 18 TO 22 CM; HORIZON DRY; EXPED DRY 7.5YR 3/3, MATRIX MOIST 10YR 3/4; SANDY CLAY LOAM; STRONG, COARSE, ANGULAR BLOCKY STRUCTURE; STRONG, FINE, ANGULAR BLOCKY SECONDARY STRUCTURE; STICKY, HARD, PLASTIC CONSISTENCE; MODERATELY POROUS, MANY, VERY FINE, RANDOM, INPED, CONTINUOUS, SIMPLE, INTERSTITIAL AND TUBULAR AND CRACKS AND FISSURE PORES; CONTINUOUS, THICK CLAY FILMS IN ALL VOIDS/CHANNELS AND ON ALL VERTICAL AND HORIZONTAL PED FACES, 10YR 2/2; 10% GRAVELLY AND COBBLY COARSE FRAGMENTS; WAVY, CLEAR HORIZON BOUNDARY.

BC: 30 TO 36 CM, RANGE 4 TO 8 CM; HORIZON DRY; MATRIX DRY 10YR 3.5/4, MATRIX MOIST 10YR 4/3; FINE SANDY LOAM; WEAK, FINE, SUBANGULAR BLOCKY STRUCTURE; SLIGHTLY STICKY, HARD, SLIGHTLY PLASTIC CONSISTENCE; MODERATELY POROUS, MANY, VERY FINE, RANDOM, CONTINUOUS, SIMPLE, INTERSTITIAL AND TUBULAR AND CRACKS AND FISSURE PORES; COMMON, THIN CLAY FILMS IN VOIDS AND/OR CHANNELS ONLY; CLAY FILMS 10YR 3/3; VERY WEAK EFFERVESCENCE; STRONGLY CALCAREOUS; 20% GRAVELLY AND COBBLY COARSE FRAGMENTS; WAVY, GRADUAL HORIZON BOUNDARY.

CK: 36 CM; HORIZON DRY; MATRIX DRY 10YR 4/3, MATRIX MOIST 10YR 4.5/3; LOAM; WEAK, COARSE, PLATY STRUCTURE PSEUDO; WEAK, FINE, ANGULAR BLOCKY SECONDARY STRUCTURE; SLIGHTLY STICKY, HARD, SLIGHTLY PLASTIC CONSISTENCE; MODERATELY POROUS, MANY, VERY FINE, RANDOM, CONTINUOUS, SIMPLE, INTERSTITIAL AND TUBULAR AND CRACKS AND FISSURE PORES; MODERATE EFFERVESCENCE; VERY STRONGLY CALCAREOUS; 20% GRAVELLY AND COBBLY COARSE FRAGMENTS.

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CHEMICAL DATA (SURVEY)

HORIZON	PH 1	ORG C (%)	TOTAL N (%)	CALC CARB EQU.%	CAL-CITE (%)	DOLO-MITE (%)	EXTR ACID	C.E.C. (ME/100G) BUFF.	C.E.C. (ME/100G) PERM. CHARG	EXCHANGEABLE CATIONS BUFFERED (ME/100G) CA	MG	NA	K
F	5.5	32.00	1.18				28.1	79.0		40.8	11.9	0.3	4.4
AE1	5.2	0.89	0.07				3.9	8.7		2.6	0.9	0.1	0.1
AE2	4.6	0.68	0.06				5.9	12.8		2.7	1.4	0.1	0.1
BT	6.5	0.58	0.08				4.6	21.5		9.7	5.7	0.1	0.3
BC	7.5			15.8	0.0	14.6		14.2		11.7	3.5	0.1	0.3
CK	7.6			29.7	14.1	14.4		12.0		13.3	2.6	0.1	0.3

CHEMICAL DATA (SURVEY)

HORIZON	ELEC COND (MMHOS/CM)	% H2O AT SATUR
F	1.2	337.0
AE1	0.6	25.7
AE2	0.4	23.1
BT	0.6	39.2
BC	0.7	33.5
CK	0.7	29.4

PHYSICAL DATA (SURVEY)

PARTICLE SIZE ANALYSIS

HORIZON	% PASSING 3" SIEVE	.75" SIEVE	NO.4 SIEVE	NO.10 SIEVE	V.C. SAND	C. SAND	MED. SAND	F. SAND	V.F. SAND	TOT. SAND	% OF SAMPLE 70-2U SILT	50-2U SILT	2U CLAY	0.2U CLAY
F														
AE1		98	94	93	4	7	11	22	19	63		28	9	
AE2		99	95	94	7	6	13	19	13	58		27	15	
BT		98	95	93	4	6	9	17	14	50		20	30	
BC		99	92	89	7	8	10	17	14	56		27	17	
CK		94	88	83	5	5	9	18	14	51		30	19	

JUL 15, 1982

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PHYSICAL DATA

	SURVEY (CON'T)							ENGINEERING					
	MOISTURE STATUS (%)												
HORIZON	0.1 ATM	0.33 ATM	15 ATM	HYGR. MOIST	FIELD MOIST	ATTERBURG PLASTIC LIMIT (%)	ATTERBURG LIQUID LIMIT (%)	SHRINKAGE LIMIT (%)	OPT MOIST CONTENT (%)	MAX DRY DENSITY (G/CC)	COLE VALUE	AASHO CLASS	UNIFIED CLASS
F													
AE1													
AE2													
BT						17.0	37.0	15.0				60	10
BC													
CK			6.2			15.0	26.0	14.0				60	08