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DETAILED SOIL SURVEY
of
THE LAC STE. ANNE AREA,
ALBERTA.

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PREFACE

This report is one of a series describing detailed soil surveys of relatively small areas. These reports are intended to provide soils information to facilitate land use planning at the community level. This survey was requested by the Edmonton Regional Planning Commission.

Detailed surveys provide basic data on soil characteristics and distribution at a scale useful for local planning. Interpretations of soil data are made regarding soil features affecting engineering uses, recreational development, and soil capability for agriculture.

The report consists of a map at a scale of 1:15,840 relative factor (1 inch = 1,320 feet) and a written text which describes the soils, soil mapping methods and the guidelines for the use ratings.

INTRODUCTION

Soil is one of our most important natural resources. Man bases his activities on soils and depends on their productivity. Misuse of land can have drastic environmental, economic and social effects. Soil surveys provide baseline data on the soil resources of an area. This information is essential to land characterization and evaluation which is the natural basis for effective land use and land management policies.

Soils vary widely in their properties and as such their suitability or limitations for different uses also varies. A soil with low agricultural capability may be suitable for road construction and a soil that is unsuitable for road location due perhaps to periodic flooding hazard or high water table may be excellent pasture land. However soils often are suitable for several uses. For example, well drained, level soils that have a high capability for agriculture also are excellent locations for airports, highways and urban development. Soil surveys provide the planner with information useful for making decisions based on predicted soil performance and soil suitability for multiple uses.

USE OF THE REPORT

This report consists of a written text and a map. The written part includes introductory and background information on soils, soil mapping, and soil interpretations and descriptions of the soils, analytical data and interpretations for various uses.

The soil map is presented on an aerial photo-mosaic base. The photo base aids in identification and location of areas, however the linear and spatial distortion inherent in a photo mosaic must be appreciated. The soil-landscape units delineated on the map are described briefly in the map legend and in greater detail in the written report. The map and the report should be used together.

The user must appreciate the non-homogeneity of soils however, and even though the map is at a scale allowing fairly detailed separation of soils, on-site investigations for small site specific uses are still required.

A map providing soil capability for agriculture ratings is also provided.

LOCATION AND EXTENT OF AREA

The study area consists of approximately 57 square miles (153 km^2) located adjacent to Lac Ste. Anne. The land is presently being used for residential development and recreational pursuits along the lake shores and for agricultural production farther from the lake.

SURFICIAL GEOLOGY OF THE AREA

Surficial geology of the area has been described by Collins and Swan (1955). The land surface is comprised mainly of dead ice moraine. Surficial deposits consist of glacial till with lesser amounts of lacustrine and outwash deposits. In the areas of dead ice moraine, lacustrine sediments often overlie the till and appear to have been deposited in super glacial or impounded lakes. Modern fluvial deposits occur adjacent to the Sturgeon River.

THE SOILS

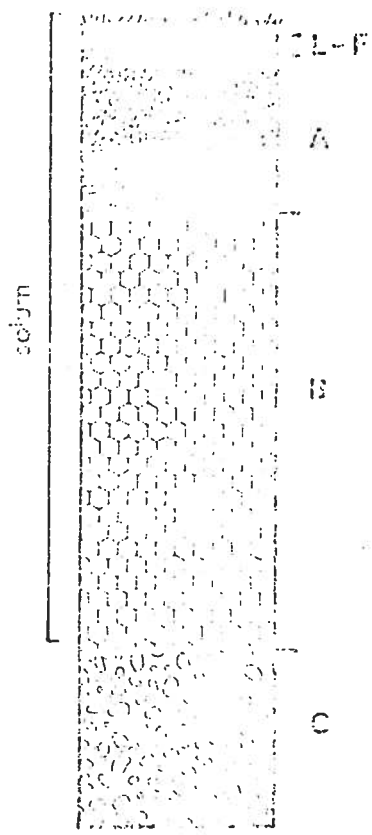
Soil Formation

Soils are natural bodies present on the earth's surface that are an integral part of the environment. Soils display variation both vertically and horizontally and by examining these variations soil individuals may be recognized. Soils have evolved from their geological parent material through the action of a combination of soil forming processes, which are controlled by environmental parameters or "soil forming factors". These soil forming factors are commonly listed as being the parent material, climate, biotic agents and topography all acting through time. The variations in relative importance or dominance of one or more of the soil forming processes such as addition and removal of organic matter, translocation of clays or iron and aluminum, and chemical and physical transformations result in the formation of horizons or layers of various kinds within the soil body. These horizons differ from one another in such properties as color,

texture, structure, consistence, and chemical and biological activity. The major, or master horizons are designated O for organic layers developed mainly from mosses, rushes, and woody materials; L, F and H for organic layers developed from leaves, twigs, woody materials, and a minor component of mosses; and A, B and C for mineral horizons. Subdivisions of the master horizons are denoted by a suffix letter appended to the master horizon symbol (see Figure 1 and Table 17).

Through observation of soil characteristics it is possible to identify and map different soil types.

FIGURE 1. DIAGRAM OF A SOIL PROFILE



-- Organic layer which may be subdivided into L, F, H or Of, Om, and Oh.

-- A mineral horizon at or near the surface. It may be a dark colored horizon in which there is an accumulation of humus (Ah), or a light colored horizon from which clay, iron, and humus have been leached (Ae).

-- Mineral horizon that (1) may be altered to give a change in color or structure (Bm), or (2) may have an enrichment of clay (Bt).

-- Mineral horizon comparatively unaffected by the soil forming process operative in the A and B horizons except for the process of gleying (Cg).

Soil Classification

The soils have been classified according to the System of Soil Classification for Canada (Canada Soil Survey Committee, 1974). This scheme classifies the soils in their natural state and thus indicates relationships between soils and their environment.

These relationships are often important for assessing limitations of soils for various uses. The classification system is described briefly in Table 16 .

Soil Texture

Throughout the report reference is made to soil texture and to soil drainage classes. Soil texture is according to the United States Department of Agriculture (USDA) textural classification which is described below. The soil drainage classes, according to the Canada Soil Survey Committee (1974) are outlined following the textural classification.

Soil Separates (Particle Size) on which Textural Classes are Based.

Separates		Diameter in Millimeters
Very Coarse Sand (VCS)		2.0 - 1.0
Coarse Sand (CS)		1.0 - 0.5
Medium Sand (MS)	Sand (S)	0.5 - 0.25
Fine Sand (FS)		0.25 - 0.10
Very Fine Sand (VFS)		0.10 - 0.05
Silt (Si)		0.05 - 0.002
Clay (C)		less than 0.002

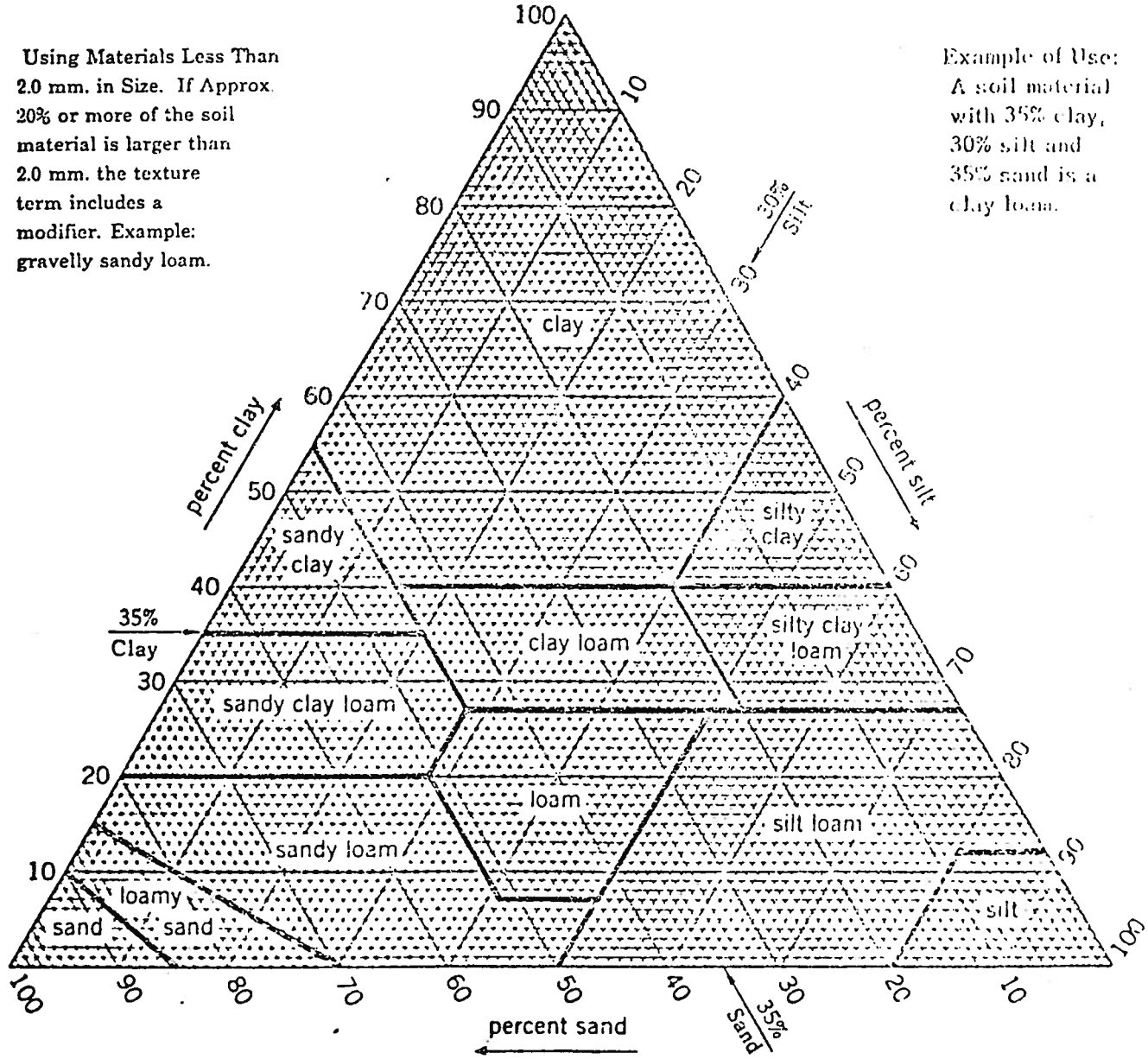
The soil textural classes are grouped according to the Canada Soil Survey Committee as follows:

Very coarse textured:	sands, loamy sands
Moderately coarse textured:	sandy loam, fine sandy loam
Medium textured:	very fine sandy loam, loam, silt loam, silt
Moderately fine textured:	sandy clay loam, clay loam, silty clay loam
Fine textured:	sandy clay, silty clay, clay (40 - 60% clay)
Very fine textured:	heavy clay (more than 60% clay).

GUIDE FOR USDA SOIL TEXTURAL CLASSIFICATION.

Using Materials Less Than 2.0 mm. in Size. If Approx. 20% or more of the soil material is larger than 2.0 mm. the texture term includes a modifier. Example: gravelly sandy loam.

Example of Use: A soil material with 35% clay, 30% silt and 35% sand is a clay loam.



Soil Drainage Classes

Soil drainage classes are defined in terms of (a) actual moisture content in excess of field moisture capacity, and (b) the extent of the period during which such excess water is present in the plant root zone.

Rapidly drained:	soil moisture content seldom exceeds field capacity in any horizon except immediately after water additions.
Well drained:	soil moisture content does not normally exceed field capacity in any horizon except possibly the C, for a significant part of the year.
Imperfectly drained:	soil moisture in excess of field capacity remains in subsurface horizons for moderately long periods during the year.
Poorly drained:	soil moisture in excess of field capacity remains in all horizons for a large part of the year.
Very poorly drained:	free water remains at or within 30 cm of the surface most of the year.

Specific reference to surface drainage may be designated in terms of runoff and described as very rapid, rapid, medium, slow, very slow or ponded. Similarly, specific reference to the characteristics of horizons within the profile may be designated in terms of perviousness and described as rapidly, moderately or slowly pervious.

Soil Mapping

When mapping soils, the fieldman examines the soil at points in the landscape to characterize landscape units. Since soil is a continuum, and adjacent soils seldom have sharp boundaries, soil units are defined as having a certain range of properties. These soil units are based on geologic materials and landforms, soil development, and soil moisture conditions. The soil and land attributes recognized in mapping are important for various land uses.

The soil units recognized are named after the dominant soil series. For example, areas labelled Cooking Lake (COA) soils are dominantly Orthic Gray Luvisols developed on medium to moderately fine textured glacial till materials. Several of the soil names and map units used in this report also appear on the semi-detailed soil survey map of the County of Two Hills (Macyk et al., in preparation). Similarly, many of the soil names used in this report also appear on the reconnaissance soil survey map of the Buck Lake and Wabamun Areas (Lindsay et al., 1968). These names have been retained so that users can extrapolate interpretations of soil performance (on a general basis) to areas outside the detailed survey area using the reconnaissance soil map. Some of the soil names are new and describe soils not recognized at the broader reconnaissance level of mapping.

The notations on the soil map identify a soil unit and topography class. For example:

$$\frac{\text{COA 2}}{\text{C}}$$

identifies an area of predominantly Cooking Lake soils - Orthic Gray Luvisols on medium to moderately fine textured till materials on c topography (2+ to 5% slope). The digit 2 signifies Cooking Lake soil unit 2 which includes a significant proportion (30%) of imperfectly to poorly drained soils (see legend on soil map). The topography classes are those used by the Canada Soil Survey Committee which are as follows:

Topographic Class	% slope
a - nearly level	0 to 0.5
b - gently undulating	0.5+ to 2
c - undulating	2+ to 5
d - gently rolling	5+ to 9
e - moderately rolling	9+ to 15
f - strongly rolling	15+ to 30

The soils were mapped in the field by making observations at selected sites using available exposures or digging with a shovel or hand auger. These point observations are extrapolated on an area basis through the use of aerial photograph interpretation and field checking.

SOILS OF THE LAC STE. ANNE AREA

Gray Luvisolic soils with thin or non-existent Ah horizons and prominent Ae horizons are dominant in the area. The soils are generally moderately well drained with numerous sloughs occurring in depressional areas.

Gleysolic soils, often having relatively thick Ah horizons, occur adjacent to the lake especially along the southern shores.

Gleysolic, Regosolic and Organic soils subject to flooding, occur adjacent to the Sturgeon River.

CODESA SOILS (CO)

This soil association consists of a collection of Brunisolic and Luvisolic soils developed on coarse textured relatively shallow outwash or alluvial deposits that overlie till. The depth of the overlying material is usually greater than 30 cm and less than 100 cm thick.

Topography is undulating to moderately rolling. Surface runoff is medium to rapid, increasing with slope, and the soils are moderately to rapidly pervious.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-F-H	5 - 0	very dark gray	-
Ae	0 - 13	pale brown	silt loam
Bm	13 - 30	brown	sandy loam
IIBt	30 - 55	dark brown	clay loam
IIBC	55 - 80	dark brown	clay loam
IIC	80+	dark grayish brown	clay loam

Soil unit CO1 is made up of approximately 70% Degraded Eutric Brunisols and 30% Orthic Gray Luvisols with sandy materials comprising the overlay. Soil unit CO1/gv is similar to unit CO1 except that gravelly materials comprise the overlay.

CODNER SOILS (COD)

The Codner soils are poorly drained Orthic Humic Gleysols developed on fluvial lacustrine material. The texture ranges from loamy sand to loam. These soils are moderately pervious.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-F-H	5 - 0	very dark brown	-
Ah	0 - 25	very dark grayish brown	sandy loam
Bg	25 - 55	dark brown	sandy loam
Cg	55+	dark grayish brown	sandy loam

The Codner soils occur primarily in areas adjacent to the southern edge of Lac Ste. Anne. They are often associated with Onoway, Uncas and Cooking Lake soils. Codner soils are somewhat limited for use by wetness and high water table. However, they produce excellent yields of coarse grains and forages in years of normal and below normal precipitation levels.

COOKING LAKE SOILS (COA)

Cooking Lake soils are predominantly Orthic Gray Luvisols developed on medium to moderately fine textured glacial till. Topography ranges from undulating to strongly rolling and the soils are slightly to very stony. Surface runoff is medium to rapid, increasing with slope, and the soils are slowly to moderately pervious.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-H	5-0	dark grayish brown	-
Ae	0-20	light brownish gray	very fine sandy loam
AB	20-25	dark grayish brown	sandy loam
Bt1	25-38	dark brown	clay loam
Bt2	38-53	dark brown	clay loam
BC	53-93	dark yellowish brown	clay loam
Ck	93+	olive brown	sandy clay loam

Cooking Lake soils comprise a major portion of the mapped area. They occur on hummocky moraine which is characterized by very irregular knob and kettle topography with numerous undrained depressions. Hummocky moraine is composed largely of till which is essentially the same composition as that of ground moraine. In several exposures however, considerably more ablation material is found in the upper meter or two than in areas of ground moraine. Pockets and lenses of sand and gravel are more abundant than in the ground moraine. Occasionally kames are found that consist of poorly sorted sand and gravel.

Sometimes a thin veneer of lacustrine silts and clays is found mantling the till knobs. These lake deposits are not extensive but are difficult to delineate on a map.

Because the till is relatively non-homogeneous one can expect to find small areas of sands, gravels or lacustrine materials that are not delineated on the soil map.

Seven map units are used to delineate Cooking Lake soil areas. Soil unit COA 1 is comprised of moderately well drained Orthic Gray Luvisols. Soil unit COA 2 is made up of approximately 70% Orthic Gray Luvisols, 20% Gleyed Gray Luvisols and 10% Gleysols. Soil unit COA 3 is made up of 60% Orthic Gray Luvisols and 40% sloughs, Organics and Gleysols. Soil unit COA 4 is made up of

60% Orthic Gray Luvisols, 30% Dark Gray Luvisols and 10% Gleysols and Organics. Soil unit COA 5 is comprised of 40% Orthic Gray Luvisols, 20% Dark Gray Luvisols and 40% sloughs, Organics and Gleysols. Soil unit COA 6 is made up of 60% Orthic Gray Luvisols, 25% Organics and Gleysols and 15% Gleyed Gray Luvisols.

CULP SOILS (CUP)

Culp soils are well drained Orthic Gray Luvisols developed on moderately coarse textured alluvial-aeolian material. Surface runoff is medium to rapid, increasing with slope, and the soils are moderately to rapidly pervious.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-H	5-0	dark grayish brown	-
Ae	0-20	yellowish brown	sandy loam
Bt	20-35	yellowish brown	sandy clay loam
BC	35-70	grayish brown	loamy sand
Ck	70+	light olive brown	loamy sand to sand

Culp soils are of minor occurrence in the mapped area.

HIGHVALE SOILS (HGV)

Highvale soils are well drained Orthic Gray Luvisols developed on stone-free medium textured lacustrine material. They occur mainly on undulating to gently rolling topography. Surface runoff is slow to medium and the soils are slowly to moderately pervious.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-H	5-0	dark grayish brown	-
Ah	0-3	very dark grayish brown	sandy loam
Ae	3-16	light brownish gray	silt loam
Bt	16-40	light yellowish brown	silty clay loam
BC	40-75	light yellowish brown	silty clay loam
Ck	75+	olive brown	silt loam

Highvale soils are of minor occurrence in the mapped area located near the north shore of Lac Ste. Anne.

Soil unit HGV 1 is made up predominantly of Orthic Gray Luvisols. Soil unit HGV 2 consists of 60% Orthic Gray Luvisols, 30% Gleyed Gray Luvisols and 10% Gleysols.

ONOWAY SOILS (OWY)

Onoway soils are poorly drained Orthic Humic Gleysols developed on till. They are frequently found in depressions between the hillocks where surface water is ponded.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-F	8-0	dark grayish brown	-
Ah	0-20	black	loam
Bg	20-45	grayish brown	silty clay loam
BCg	45-70	dark grayish brown	clay loam
Ckg	70+	dark grayish brown	clay loam

Areas of Onoway soils associated with better drained soils are usually cultivated if drainage conditions permit. Onoway soils are suitable for pasture and hay crop production and after drainage, become fair arable soils for coarse grain production.

ORGANIC SOILS

The Organic soils delineated in the area have not been given a soil name. However, soils developed from two major types of peat are differentiated. Organic soils are characterized by more than 30 cm of consolidated or more than 45 cm of unconsolidated peat.

The soil unit OM1 consists primarily of Mesic Fibrisols with lesser amounts of Terric Mesic Fibrisols and Terric Fibrisols. These soils have developed from moss organic material, varying in depth from 0.5 to 2.5 meters in thickness. The most common vegetation association is black spruce and tamarack forest with sphagnum and feather mosses, Labrador tea, bog cranberry and kinnikinnick.

The soil unit OS1 consists primarily of Terric Mesisols with lesser amounts of Mesic Fibrisols. These soils have developed from sedge organic material and are generally about 1 m in thickness in the mapped area. The native vegetation cover includes sedges and coarse grasses with occasional bluffs of willow and dwarf birch.

Organic soils are not cultivated within the mapped area.

STE. ANNE SOILS (SNE)

The Ste. Anne soils are predominantly Regosolic with lesser amounts of Gleysolic soils developed on moderately coarse to coarse textured beach deposits. They occur along the shores of Lac Ste. Anne. Surface runoff is medium to rapid and the soils are rapidly pervious.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-H	10-0	dark grayish brown	-
C	0+	light gray	clayey loamy sand

Soil unit SNE 1 is made up of approximately 70% Gleyed Regosols and 30% Rego Gleysols. This unit is mapped along the perimeter of open water. The topography is nearly level to gently undulating in these areas. Buried mineral-organic layers are commonly found in these soil areas. Soil unit SNE 2 is comprised of 70% Orthic Regosols and 30% Gleyed Regosols. The topography is nearly level to undulating in these areas where beach ridges are the main landform feature.

TOLMAN SOILS (TOM)

Tolman soils consist of well to moderately well drained Orthic Gray Luvisols developed on weakly calcareous, stratified, medium textured lacustrine sediments. Till may be present at 1 to 2 m from the surface. Topography is complex and varies from undulating to moderately rolling. Surface runoff is medium to rapid, increasing with slope, and the soils are slowly to moderately pervious.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-H	5-0	dark grayish brown	-
Ae	0-15	pale brown	silt loam
AB	15-25	yellowish brown	silty clay loam
Bt	25-60	brown	clay loam
BC	60-90	dark brown	loam
Ck	90-115	light olive brown	silt loam
IICk	115+	grayish brown	clay loam

Soil unit TOM 1 is comprised dominantly of Orthic Gray Luvisols. Soil unit TOM 2 is comprised of 90% Orthic Gray Luvisols formed on shallow deposits (25 to 75 cm) of lacustrine material overlying till and 10% Gleysolic soils. TOM 3 is made up of approximately 60% Orthic Gray Luvisols, 30% Dark Gray Luvisols and 10% Gleysolic soils.

Tolman soils, of minor occurrence in the area, are found in the hummocky moraine areas where they occasionally form a thin veneer over the till knobs.

UNCAS SOILS (UCS)

These are moderately well drained Dark Gray Luvisols developed on medium to moderately fine textured till. Topography varies from gently undulating to moderately rolling. Surface runoff is medium to rapid, increasing with slope, and the soils are slowly to moderately pervious. Uncas soils differ from the Cooking Lake soils in that they have an Ah (organo-mineral) horizon which varies from 8 to 15 cm in thickness.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-H	5-0	dark grayish brown	-
Ah	0-10	very dark grayish brown	loam
Ae	10-25	pale brown	silt loam
AB	25-30	grayish brown	silt loam
Bt	30-73	brown	clay loam
BC	73-105	dark grayish brown	clay loam
Ck	105+	grayish brown	clay loam

Soil unit UCS 1 is made up of approximately 90% Dark Gray Luvisols and 10% Gleysols. Soil unit UCS 2 is similar to the above except that about 30% of the unit has the surface horizon (Ap) eroded away. This map unit is limited primarily to areas that are cultivated. Soil unit UCS 5 is made up of approximately 60% Dark Gray Luvisols, 30% Orthic Gray Luvisols and 10% Gleysols. Soil unit UCS 11 is comprised of 60% Gleyed Dark Gray Luvisols, 30% Dark Gray Luvisols and 10% Gleysols.

EGREMONT SOILS (EGO)

Egremont soils are imperfectly drained Gleyed Dark Gray Chernozems developed on till material. They are found in gently sloping areas where surface runoff is often ponded.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-H	5-0	dark grayish brown	-
Ahegj	0-15	very dark gray	clay loam to loam
ABgj	15-20	dark grayish brown	loam
Bm	20-40	dark brown	sandy clay loam
Cca	40+	dark grayish brown	loam

Egremont soils occur to a minor extent in the mapped area. Soil unit EGO 1 is comprised of approximately 70% Gleyed Dark Gray Chernozems and 30% Gleysols.

TAWAYIK SOILS (TYK)

In previously published soil survey reports Tawayik soils are described as moderately well drained Dark Gray Luvisols developed on 35 to 100 cm of lacustrine materials overlying till. In the Lac Ste. Anne area similar soils occur which are imperfectly drained and classified as Dark Gray Luvisols, gleyed phase (TYK/g). Topography is gently undulating and surface runoff is slow.

General Profile Description

Horizon	Depth (cm)	Color	Texture
L-H	5-0	dark grayish brown	-
Ahegj	0-12	very dark grayish brown	sandy clay loam
Aegj	12-18	grayish brown	silt loam
Btgj	18-43	dark grayish brown	clay
BC	43-58	dark grayish brown	clay loam
Ck	58-75	grayish brown	clay loam
IICk	75+	dark brown	clay loam

MISCELLANEOUS LAND TYPES

1) This symbol indicates a marshy area. These areas are generally inundated for a major portion of the year. The vegetation cover consists of slough grass, sedge, willow and cattail.

SOIL AND LAND USE

Soil is our most important continuing natural resource. Man depends on soils for food production; for watershed protection; as a physical site on which to live, work and enjoy recreational pursuits; for building materials; and as a place to dispose of garbage and sewage. Misuse of our soil resource can result in drastic economic, social and environmental consequences.

It is obvious that flood prone soils are unsuitable for housing, that poorly drained soils are unsuited to septic tank absorption fields, and that steeply sloping soils are unsuited to football fields. Somewhat less obvious is the fact that prime agricultural land is being converted to urban and other non-agricultural uses at a fairly rapid rate. This irreversible decision to remove first class farmland from crop production has very important economic and social effects.

Sound land use planning must be based on a knowledge of soil properties, soil performance and soil distribution.

Soil Capability for Agriculture

The soils have been rated for agricultural capability according to the Canada Land Inventory guidelines (Canada Land Inventory, 1965). In this classification system the mineral soils have been grouped into seven classes on the basis of their limitations for dryland farming. The ratings are based on climatic and soil characteristics.

Soil ratings for the general area, based on interpretation of the reconnaissance soil survey data, have already been published (Twardy et al., 1972). As the present

survey is at a much larger map scale, soils are separated at a more detailed level and more detailed ratings can be made. The soil map units recognized in this detailed soil survey are rated for agricultural capability on a separate map.

The Lac Ste. Anne area is located within Agro-climatic Area 2H (Bowser 1967) where the amount of precipitation has usually been adequate and the frost-free period long enough to permit growing of cereal and forage crops. The average frost-free period is 75 to 90 days and precipitation averages about 40 to 45 cm.

Soil Capability Classes

Class 1	Soils in this class have no significant limitation in use for crops.
Class 2	Soils in this class have moderate limitations that restrict the range of crops or require moderate conservation practices.
Class 3	Soils in this class have moderately severe limitations that restrict the range of crops or require special conservation practice.
Class 4	Soils in this class have severe limitations that restrict the range of crops or require special conservation practices or both.
Class 5	Soils in this class have very severe limitations that restrict their capability to produce perennial forage crops, and improvement practices are feasible.
Class 6	Soils in this class are capable of producing only perennial forage crops, and improvement practices are not feasible.
Class 7	Soils in this class have no capability for arable culture or permanent pasture.

Subclasses

Excepting Class 1, the classes are subdivided into subclasses on the basis of kinds of limitation. The subclasses are as follows:

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

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

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

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

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

Subclass M: moisture - a low moisture holding capacity, caused by adverse inherent soil characteristics, limits crop growth. (Not be be confused with climatic drought).

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

* Subclass P: stoniness - Stones interfere with tillage, planting, and harvesting.

* Subclass R: shallowness to solid bedrock - Solid bedrock is less than three feet from the surface.

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

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

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

* Denotes class or subclass not present in this area.

Soils and Urban Development

In selecting sites for housing, schools, parks, shopping centres, sewage disposal and other community developments, soil suitability must be considered so as to avoid costly errors and to prevent waste, abuse and loss of valuable agricultural soils.

Both the report and the map contain information of use to engineers and land use planners. A pedological soil classification, which describes the soil in its natural setting, describes not only the soil material but also the effects of soil climate, drainage, permeability and topography. When planning the construction of roads, airports, residential and other developments which are based on the soil this information can be very useful in predicting performance. Highway engineers make use of soil maps in planning materials investigations and for predicting subgrade and pavement performance (Allemeier 1973). Detailed soil surveys have been used for planning development around several towns in Alberta including Stony Plain, Leduc and Morinville, as well as towns in the southern part of the province (Alberta Soil Survey library). A recent soil survey in the Mill Woods area of Edmonton indicated areas where concrete corosion due to sulfate attack was a potential problem.(Lindsay et al. 1973).

Several terms, such as soil, texture, structure, and consistence differ in usage between pedology and engineering. The pedological meanings are intended in this report and many of the terms are defined in the glossary.

Engineering Properties of the Soils

In the Lac Ste. Anne area, soil samples were not collected for analysis. Because the soils occurring in the area are common to the general region and have been mapped and characterized by others (Lindsay et al. 1968, Greenlee 1974) it was deemed unnecessary to sample and analyze them again.

The engineering test data presented in Table 1 is based on results obtained in other studies. The samples analyzed were taken from subsoils of the map units. A brief description of the significance of each analytical parameter follows.

1. Field Moisture Percentage.

This is a determination of the natural moisture content of the soil as it occurs in the field.

For any potential borrow material, it is essential to know in advance of construction whether, for the compaction procedure likely to be specified, the moisture content in the field is excessive or deficient with respect to the optimum value for that procedure.

2. Mechanical Analysis.

The particle size distribution within a soil is determined by laboratory tests, usually referred to as the mechanical analysis of the soil. The amounts of the gravel and sand fractions are determined by sieving, while the silt and clay contents are determined by sedimentation techniques. The amount of each soil separate contained in a soil determines its texture.

Where soil texture is known, approximations and estimates can be made of soil properties, such as permeability, water holding capacity, shrink-swell potential, bearing value, susceptibility to frost heave, adaptability to soil cement construction, etc.

3. Plasticity.

In soil mechanics, plasticity is defined as that property of a material which allows it to be deformed rapidly, without rupture, without elastic rebound, and without volume change.

Tests have been devised to determine the moisture content of a soil at which it changes from one major physical condition to another. These tests, conducted on

the material passing the number 40 sieve (0.42 mm), have been used as key factors in classifying soils for structural purposes.

The tests used for estimating plasticity are plastic limit, liquid limit, and plasticity index. The plastic limit is the moisture content at which the soil passes from a semisolid to a plastic state. The liquid limit is the moisture content at which the soil passes from a plastic to a liquid state. The plasticity index is the numerical difference between the liquid and plastic limits. This parameter gives the range in moisture content at which a soil is in a plastic condition. A small plasticity index, such as 5, indicates that a small change in moisture content will change the soil from a semisolid to a liquid condition. A large plasticity index, such as 20, shows that a considerable amount of water can be added before a soil changes to a liquid condition.

4. Soil Classification.

In order that soils may be evaluated, it is necessary to devise systems or methods for identifying soils with similar properties and then to follow this identification with a grouping or classification of soils that perform in a similar manner when their densities, moisture contents, textures, etc., are similar. A brief description of three widely used soil classification systems follows.

(a) AASHO Classification System.

The American Association of State Highway Officials system is an engineering property classification based on field performance of highways. In the AASHO system soil material is classified into seven basic groups with each group having about the same general load carrying capacity and service. The groups are designated A-1 to A-7; the best soils for road subgrades are classified as A-1; the next best A-2, etc., with the poorest soils being classified as A-7.

These seven basic groups are further divided into subgroups with a group index devised to approximate within group evaluations. Group indexes range from 0 for the best subgrades to 20 for the poorest.

(b) Unifed Soil Classification System.

In this system, the soils are identified according to their textures and plasticities, and are grouped according to their performance as engineering construction materials. Soil materials are divided into coarse grained soils, fine grained soils, and highly organic soils. The coarse grained soils are subdivided into eight classes; the fine grained soils into six classes; and there is one class of highly organic soils.

Coarse grained soils are those that have 50 percent or less material passing the number 200 sieve; fine grained soils have more than 50 percent of material passing the number 200 sieve. The letters G, S, C, M, and O stand for gravel, sand, clay, silt and organic material respectively. The highly organic soils are designated by the symbol "pt". Additional letters used in the secondary divisions of the coarse grained soils are W and P meaning well graded and poorly graded, respectively. Additional letters used in the secondary divisions of the fine grained soils are L and H, meaning relatively low liquid limit and relatively high liquid limit, respectively.

The designation CL for example, indicated inorganic clays of low to medium plasticity; SW indicates well graded sands; and SC indicates clayey sands and sand-clay mixtures.

(c) United States Department of Agriculture Soil Classification System.

The system of textural soil classification used by Canadian soil scientists is known as the USDA system. It is defined under "soil texture" in the glossary. There is some variation in the particle size limits between the USDA system and the two engineering systems just described, but the differences are not great. A comparison of the different systems is given in the PCA Soil Primer.

TABLE 1. PHYSICAL ANALYSES OF SELECTED MAP UNITS

Map Unit	Depth (cm)	Field Moisture (%)	1 inch	3/4 inch	Mechanical Analysis: Percentage Passing Sieve					Mechanical Analysis: Percentage Smaller than				Liquid Limit	Plasticity Index	Optimum[3] Moisture (%)	Maximum[3] Dry Density (lb/ft)	Classification		
					5/8 inch	#4 (4.7 mm)	#10 (2.0 mm)	#40 (0.42 mm)	#200 (0.074 mm)	0.05 mm	0.005 mm	0.002 mm	0.001 mm					AASHO	Unified	USDA
TYK1[1]	60-90	22	100	100	100	100	100	100	97	91	67	54	44	60	32	29	90.5	A-7-6 (20)	CH	C
UCS[1]	120-150	9	100	100	100	99	99	85	38	37	22	18	16	20	5	12	120.0	A-4 (1)	SMd-SC	SL
HGV[1]	120-150	25	100	100	100	100	100	99	81	69	31	26	23	29	12	16	111.0	A-6 (9)	CL	L
EGO[2]	91-120							91	65	58	39	31	29	34	17	16	112.5	A-6 (8)	CL	CL
COA[2]	91-120							92	62	58	34	25	19	28	12	14	114.0	A-6 (6)	CL	CL
CUP[2]	91-120							95	10	16	12	11	11	NL	NP					S
TOM[2]	91-120							93	76	70	29	24	22	27	10	16	111.0	A-4 (8)	CL	L
TOM[2]	121-150							96	79	68	38	31	27	31	14	16	111.0	A-6 (10)	CL	CL
CO/gv[2]	30-60							20	3	8	6	5	4	NL	NP					S

[1] Analyses data from "Soil Survey of Area Adjacent to Lac Ste. Anne and Interpretations for Recreational Use" by G. M. Greenlee, Alberta Research Council, 1974.

[2] Analyses data from similar soils occurring in Two Hills County #21. Reported in "Soil Survey of Two Hills County #21", T. M. Macyk et al., Alberta Research Council, in preparatior

[3] These values are obtained from charts worked out by the Highways Testing Laboratory, Alberta Department of Highways.

SOIL INTERPRETATIONS

The soils have been evaluated for limitations in use for construction of roads, buildings (with and without basements), sanitary landfills, reservoir sites and for use as septic tank absorption fields (Table 15). They have also been evaluated with regard to their suitability as a source of roadfill, sand and topsoil. These evaluations consider such soil properties as texture - which affects stability and bearing strength for roads and foundations, shrink-swell, risk of frost heaving, and rate of infiltration and internal drainage; soil moisture conditions - which affect location buildings, roads and services; topography - which affects drainage and site location; and flooding hazard - which affects location of buildings and roads. These evaluations are not difficult to make for map units comprised of soils having relatively similar characteristics such as UCS 5 or the complex of COA 2 - TOM 2. However it is difficult to make evaluations of limitations for map units such as COA 3 and COA 5. These units are comprised of moderately well drained mineral soils, in association with extensive areas of sloughs and organic soils. In making evaluations for these areas one has to emphasize the limitations of the poorly drained soils in considering the overall map unit.

In other words, the evaluation is based primarily on the soils having the more severe limitations in map units COA 3 and COA 5. The moderately well drained mineral soil component of the COA 3 and COA 5 units would have less severe limitations and suitabilities similar to COA 1 and COA 2.

The guidelines used in rating the soil limitations are outlined in Tables 2 to 14. These interpretations follow fairly closely the Guide for Interpreting Engineering Uses of Soils published by the United States Department of Agriculture, Soil Conservation Service. Some modifications are made for local conditions.

The soils have also been assigned ARDA capability ratings for agriculture (Map).

Soil interpretations are included so that soils information may be more easily understood. These interpretations should be treated as evaluations of performance, not as recommendations for the use of soils. Many other factors

are involved in the recommended use of soils. Also, because soil boundaries are not precise, soil survey interpretations do not eliminate on-site investigations. They are, however, intended as an aid in planning further investigations, to reduce the amount of investigation, and minimize the cost.

For each use, the soils are rated in terms of degree of limitation - slight, moderate or severe, or in terms of suitability as a source of material - good, fair or poor.

A slight soil limitation is the rating given soils that have properties generally favorable for the use. Good performance and low maintenance can be expected.

A moderate soil limitation is the rating given soils that have properties moderately favorable for the use. This limitation can be overcome or modified by planning, design or maintenance.

A severe soil limitation is the rating given soils that have one or more properties that are seriously unfavorable for the use. This limitation generally requires soil reclamation, special design or intensive maintenance. In most situations, it is difficult and costly to alter the soil or to design a structure so as to compensate for the severe degree of limitation but using these soils without employing corrective measures could result in failure.

Varying degrees of severity exist. Soils that are flooded annually have very severe limitations for housing; whereas a heavy clay soil that has high shrink-swell potential may be less severe but at the same time problems may arise with respect to foundations .

Soil Interpretations for Recreational Uses

The growing demand for outdoor recreation is placing increasing demands on land for public recreational use. There are many factors that determine the recreational potential of an area, one of which is soil.

Soils that flood periodically, or soils that are wet most of the summer, have severe limitations for playing fields, camping areas, picnic sites and trails. Some of the soils in this area have a very high clay content in the layers underlying the

topsoil. If the topsoil is removed these soils will be very sticky when wet and will dry out slowly after a rain.

Slope affects the use of soils for recreation. Steeply sloping areas have severe limitations for most uses but are often desirable for hiking trails and scenic value.

The soils of the Lac Ste. Anne area have been evaluated as sites for playing fields, camp areas, picnic areas and trails in Table 15, using the guidelines shown in Tables 2, 3, 4 and 5. These ratings are based on interpretations of soil performance and are not to be taken as recommendations for use.

TABLE 2. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR CAMP AREAS

This guide applies to soils to be used intensively for trailers and tents 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 soils should be suitable for heavy foot traffic and for limited vehicular traffic. 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.

Item Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Wetness	Rapidly, well and moderately well drained soils. Water table below 75 cm during season of use.	Moderately well and imperfectly drained soils. Water table below 50 cm during season of use.	Imperfectly, poorly and very poorly drained soils. Water table above 50 cm during season of use.
Flooding	None	None during season of use.	Floods during season of use.
Permeability	Very rapid to moderate.	Moderately slow and slow.	Very slow.
Slope	0-9% (AD).	9 to 15% (E).	Greater than 15% (greater than E).
Surface Soil Texture[1]	SL, FSL, VFSL, L.	SiL, CL, SCL, SiCL, LS and sand other than loose sand.	SC, SiC, C, loose sand subject to severe blowing, organic soils.

[1] Surface soil texture influences soil ratings as it affects foot trafficability, dust, soil permeability and erosion hazard.

TABLE 3. GUIDES FOR ASSESSING SOIL LIMITATIONS 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 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.

Item Affecting Use	Degree of Limitation		
	None to Slight	Moderate	Severe
Wetness	Rapidly, well and moderately well drained soils. Water table below 50 cm during season of use.	Moderately well and imperfectly drained soils. Water table during season of use may be less than 50 cm for short periods.	Poorly and very poorly drained soils. Water table above 50 cm and often near surface for a month or more during season of use.
Flooding	None during season of use.	May flood once a year for short period during season of use.	Floods more than once a year during season of use.
Slope	0 - 9% (AD)	9 to 15% (E)	Greater than 15% (greater than E).
Surface Soil Texture[1]	SL, FSL, VFSL, L	SiL, CL, SCL, SiCL, LS and sand other than loose sand.	SC, SiC, C, loose sand subject to severe blowing, organic soil.

[1] Surface soil texture influences soil ratings as it affects foot trafficability, dust, soil permeability and erosion hazard.

TABLE 4. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR PLAYING FIELDS

This guide applies to soils considered for intensive use as playing fields for organized games such as baseball or football. Soil suitability for growing and maintaining vegetation is not a direct consideration in this guide, but is an important item to consider.

Item Affecting Use	Degree of Soil Limitation		
	Slight	Moderate	Severe
Flooding	None during season of use.	Subject to occasional flooding. Not more than once in 3 years.	Subject to more than occasional flooding.
Wetness	Rapidly to moderately well drained.	Imperfectly drained soils subject to occasional ponding.	Poorly and very poorly drained.
Depth to Water Table	More than 75 cm during season of use.	More than 50 cm. during season of use.	Less than 50 cm during season of use.
Permeability	Very rapid to moderate (50 cm/hr to 1.5 cm/hr)	Moderately slow. (1.5 to 0.5 cm/hr)	Slow and very slow. (less than 0.5 cm/hr)
Slope	0 to 2%	2 to 5%	more than 5%
Surface Texture	SL, FSL, VFSL, L	CL, SCL, SiCL, SiL, LS and S other than loose sand.	SC, SiC, C, loose sand, organic.

TABLE 5. GUIDES FOR ASSESSING SOIL LIMITATION FOR TRAILS

This guide applies to soils to be used for trails, assuming no hard surfacing. It is assumed that these areas will be used as they occur in nature and that little or no soil will be moved (excavated or filled). The steeper the slope upon which a trail is to be built the more soil that will have to be moved to obtain a level tread and the more miles of trail needed to cover a given horizontal distance. Severe limitation does not indicate a trail cannot or should not be built. It does suggest higher design requirements, higher cost of construction and maintenance, and often greater potential for environmental impact. Soil features that affect trafficability, dust, design and maintenance of trails are given special emphasis.

Item Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Wetness	Rapidly, well and moderately well drained soils. Water table below 50 cm during season of use.	Imperfectly drained soils. Water table during season of use may be above 50 cm for short period.	Poorly and very poorly drained soils. Water table above 50 cm and often near surface for month or more during season of use.
Flooding	Does not flood.	May flood but not during season of use.	Floods during season of use.
Slope[1]	0 to 15% (a -e).	15 to 30% (f).	Greater than 30%, (greater than f).
Surface Soil Texture	SL, FSL, VFSL, L	SiL, CL, SCL, SiCL, LS	SC, SiC, C, sand, peaty and organic soils.

1 Slope in this context refers to the slope of the ground surface, not the slope of the tread of the trail.

TABLE 6. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR LAWNS AND LANDSCAPING

This guide applies to soils to be used for lawns and landscaping. The soil is rated on the assumption that it will be used for lawn turf, shrubs and trees without need for adding topsoil for good establishment and also that irrigation is provided (Olsen et al.). Soil characteristics affecting this use are flooding hazard, depth to seasonal high water table, slope, stoniness, surface soil texture, depth of topsoil, salinity and depth to bedrock or sand and gravel.

Item Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Flooding	None during growing season.	May flood 1 or 2 times for short periods during growing season.	Subject to flooding more than 2 times during growing season.
Wetness (soil drainage)	Very rapidly, rapidly, well and moderately well drained soils not subject to ponding.	Moderately well drained soils subject to occasional ponding of short duration. Imperfectly drained soils.	Poorly and very poorly drained soils. Imperfectly drained soils subject to ponding for periods of more than 4 weeks during growing season.
Slope	0 to 9% (aA to dD).	9+ to 15% (eE).	Greater than 15% (fF to hH).
Surface stoniness	0 to 1.	2	3,4 and 5.
Rockiness	Rock exposures more than 100 m apart and cover less than 2% of the surface.	Rock exposures 30 to 100m apart and cover about 2 to 10% of the surface.	Rock exposures less than 30 m apart and cover more than 10% of the surface.
Surface Soil Texture	SL, FSL, VFSL, L, SiL and LS with textural B horizon. Not subject to soil blowing.	CL, SCL, SiCL, LS and sand other than loose sand.	SC, SiC, C, sand and LS subject to soil blowing. Organic soils.
Depth of Ah Horizon	Greater than 7.5 cm	0 to 7.5 cm	Lack of Ah horizon not a severe limitation by itself.
Salinity of Topsoil	E.C. 0 to 1.	E.C. 1+ to 3.	E.C. greater than 3.
Depth to Bedrock	More than 100 cm	50 to 100 cm	Less than 50 cm
Depth to Sand or Gravel	More than 100 cm	50 to 100 cm	Less than 50 cm
Permeability	Moderately slow to moderately rapid (0.5 to 15 cm/hr).	Slow (0.15 to 0.5 cm/hr).	Rapid and very rapid (more than 15 cm/hr) and very slow (less than 0.15 cm/hr).

TABLE 7. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR BUILDINGS

This guide provides ratings for undisturbed soils evaluated for single storey buildings and other structures with similar foundation requirements. The emphasis for rating soils for buildings is on foundations; but soil slope, and susceptibility to flooding and other hydrologic conditions, such as seasonal wetness, that have effects beyond those related exclusively to foundations are considered. Also considered are soil properties, which influence excavation and construction costs both for the building itself and for the installation of utility lines. Excluded are limitations for soil corrosivity, landscaping and septic tank absorption fields. On-site investigations are needed for specific placement of buildings and utility lines, and for detailed design of foundations. All ratings are for undisturbed soils based on information gained from observations to a depth of 1 to 3 m.

Item Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Wetness[1]	Rapidly, well and moderately well drained.	Imperfectly drained.	Poorly and very poorly drained.
Depth to Seasonal Water Table	More than 2 m	2 to 4 m	Less than 12 m
Flooding	None	None	Subject to flooding.
Slope	0 to 9% (a-d).	9 to 15% (e).	More than 15% (>e).
Materials:			
a. USDA	SL, LS, SCL	L, CL, SiCL, SiL	C, HC, SiC
b. Unified group	GW, GP, SW, SP, GM, GC, SM, SC	ML, CL	CH, MH, OL, OH, Pt.
c. Shrink-swell Potential	Low	Moderate	High
Sulfate[2] attack on Concrete	Slight 0 to 0.2%	Considerable 0.2 to 0.5%	Severe More than 0.5%

[1] Excess soil moisture is estimated by the soil drainage classes.

[2] % water-soluble sulfate from saturation extract.

TABLE 8. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR SEPTIC TANK ABSORPTION FIELDS

This guide provides ratings for soils evaluated for use as septic tank absorption fields. Successful operation of the system depends upon the ability of the soil to absorb and filter the liquid or effluent passed through the tile field (Olsen et al.). Filter fields are influenced by the ease of downward movement of effluent trhough the soil. Soils with slow permeability are rated severe. Other soil properties that affect septic tank filter fields are flooding hazard, seasonal high groundwater, slope, depth to bedrock, and depth to sand and gravel. Clean sands and gravels with rapid permeability may constitute a hazard for groundwater contamination.

Item Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Flooding	Not subject to flooding.	Not subject to flooding.	Subject to flooding.
Wetness[1] (Soil Drainage)	Very rapidly, rapidly, well and moderately well drained soils not subject to ponding or seepage. Water table below 2 m.	Well and moderately well drained soils subject to occasional ponding or seepage. Imperfectly drained soils not subject to ponding. Water table 1.5 to 2 m.	Imperfectly drained soils subject to ponding. Poorly and very poorly drained soils. Very rapidly and rapidly drained soils if groundwater contamination hazard. Water table < 1.5m.
Slope	0 to 9% (aA to dD).	9+ to 15% (eE).	Greater than 15% (fF to hH).
Permeability[2]	Moderate to very rapid (more than 1.5 cm/hr).	Moderately slow (0.5 to 1.5 cm/hr).	Slow and very slow (less than 0.5 cm/hr). Rapid and very rapid if groundwater contamination hazard (more than 15 cm/hr).
Depth to Bedrock[3]	More than 2 m	1.5 to 2 m	Less than 1.5 m
Depth to[3] Sand or Gravel	More than 2 m	If less than 2 m and a groundwater contamination hazard exists, limitation is severe.	Less than 2 m if groundwater contamination hazard exist.

1 Water table depth is based on the assumption that the tile depth is 0.7 m in the soil.

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

3 Based on the assumption that tile depth is 0.7 m in the soil.

TABLE 9. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR SANITARY LANDFILLS (TRENCH TYPE)

This guide applies to soils considered as disposal areas for trash and garbage. A good sanitary landfill should be usable all year and should operate without contaminating water supplies or causing a health hazard (Olsen et al.). Soil factors considered in rating the limitations for use are flood hazard, seasonal high water table, slope, permeability, depth to bedrock and depth to sand and gravel.

Item Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Flooding	Not subject to flooding.	Not subject to flooding.	Subject to flooding.
Wetness (Soil Drainage)	Very rapidly, rapidly, well and moderately well drained soils. Water table more than 2 m.	Imperfectly drained soils. Water table more than 2 m.	Poorly and very poorly drained soils. Water table less than 2 m.
Slope	0 to 15% (aA - eE).	15+ to 30% (fF).	Greater than 30% (gG - hH).
Permeability[1]	Moderate to very slow (less than 5 cm/hr).	Moderate to very slow (less than 5 cm/hr).	Moderately rapid to very rapid (more than 5 cm/hr).
Soil Texture (dominant to a depth of 1.5m)	SL, FSL, VFSL, L, SiL, SCL	SiCL, CL, SC, LS	SiC, C, S, gravel, peat, muck
Depth to Bedrock	More than 2 m	More than 2 m	Less than 2 m
Depth to Sand or Gravel	More than 2 m	More than 2 m	Less than 2 m if groundwater contamination hazard.
Surface Stoniness	0 to 1	2	3, 4 and 5
Rockiness	Rock exposures more than 100 m apart and cover less than 2% of the area.	Rock exposures more than 100 m apart and cover less than 2% of the area.	Rock exposures less than 100 m apart and cover more than 2% of the area.

[1] Reflects ability of soil to retard movement of landfill leachate. May not be a factor in arid and semiarid areas.

TABLE 10. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR RESERVOIR SITES

Reservoir sites are rated on the adequacy of the soil material to prevent seepage from the reservoir (Olsen et al.). Soil properties most important are slope, permeability, depth to bedrock and depth to sand and gravel. Depth to water table influences the depth of water in dugouts, pits etc. in all kinds of soil materials so is not rated for this use.

Item Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Permeability	Moderately slow to very slow (less than 1.5 cm/hr).	Moderate (1.5 to 5 cm/hr).	Moderately rapid to very rapid (more than 5 cm/hr).
Slope	0 to 2% (aA - bB).	2+ to 9% (cC - dD).	Greater than 9% (eE - hH).
Unified Soil Group	GC, SC, CL and CH	GM, ML, SM and MH	GP, GW, SW, SP, OL, OH and Pt.
Depth to Bedrock	More than 2 m	1.6 to 2 m	Less than 1.6 m
Depth to Sand or Gravel	More than 2 m	1.6 to 2 m	Less than 1.6 m
Coarse Fragments under 25 cm in diameter by % volume	Less than 20	20 to 50	More than 50
Depth to[1] Water Table	More than 2 m	1.6 to 2 m	Less than 1.6 m one month or more during year.
Flooding	Not subject to flooding.	Not subject to flooding.	Subject to flooding.

[1] Depth to water table effects the ease of excavation.

TABLE 11. GUIDES FOR ASSESSING SOIL LIMITATIONS FOR ROADS

Properties that affect design and construction of roads 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, and the shrink-swell potential give an indication of the traffic supporting capacity. Wetness and flooding affect stability. Slope and wetness affect the ease of excavation and the amount of cut and fill to reach an even grade. Soil limitation ratings do not substitute for basic soil data or for on-site investigation.

Item Affecting Use	Degree of Soil Limitation		
	None to Slight	Moderate	Severe
Wetness	Rapidly, well and moderately well drained.	Imperfectly drained.	Poorly and very poorly drained.
Flooding	None	Less than once in 5 years.	More than once in 5 years.
Slope	0 to 9% (a - d).	9 to 15% (e).	More than 15% (>e).
Materials:			
a. Unified group	GW, GP, GM, GC, SW, SM, SC	CL with P.I. less than 15, ML, SP	CL with P.I. 15 or more CH, MH, OL, OH, Pt
b. AASHO Group Index	0 to 4	5 to 8	more than 8
c. USDA texture	LS, SL, SCL	L, CL, SiCL, SiL	C, HC, SiC
Shrink-swell[1] Potential	Low	Moderate	High
Susceptibility to[2] Frost Heave	Low	Moderate	High

[1] Shrink-swell potential is estimated from amount and kinds of clay in the soil.

[2] Susceptibility to frost heave is estimated from soil texture and soil wetness.

TABLE 12. SUITABILITY RATINGS OF SOILS AS SOURCES OF ROADFILL

The ratings in this table indicate the performance of a soil after it is placed in a road embankment and also the degree of difficulty in excavating the fill material. Ratings of the material are the same as for road location, however ratings of factors governing excavation differ.

Item Affecting Use	Degree of Suitability [1]		
	Good	Fair	Poor
Wetness	Rapidly to moderately well drained.	Imperfectly drained.	Poorly and very poorly drained.
Engineering Groups			
Unified Group	GW, GP, GC, SW, SP, SM, SC	ML, CL with P.I. less than 15.	CH, MH, OL, OH, Pt, and CL with P.I. more than 15.
AASHO Group Index	0 to 4	5 to 8	Greater than 8
Slope	0 to 15%	15 to 30%	more than 30%

[1] A rating of unsuitable (U) is used for organic soil materials.

TABLE 13. SUITABILITY RATINGS OF SOILS AS A SOURCE OF TOPSOIL

Topsoil, for these ratings, refers essentially to Ah horizon material. In some cases, the B, and even C horizon materials could be used for dressing disturbed land. These ratings are intended for use by engineers, landscapers, planners and others who make decisions about selecting, stockpiling and using topsoil. These ratings are based on quality of topsoil and ease of excavation. In addition to the Good, Fair, and Poor ratings described below, an Unsuitable (U) rating is used.

Item Affecting Use	Degree of Suitability [1]		
	Good	Fair	Poor
Texture	SL, FSL, VFSL, L, SiL	CL, SCL, SiCL	LS, S, SC, SiC, C, Organic
Depth of Topsoil	More than 15 cm	7.5 to 15 cm	Less than 7.5 cm
Flooding	None	May flood occasionally.	frequently or constantly flooded.
Wetness	Drainage class not determining if better than poorly drained.		Poorly and very poorly drained.
Coarse Fragments (% by volume)	Less than 3%.	3 to 15%.	More than 15%.
Slope	Less than 9%.	9 to 15%.	More than 15%.
Stoniness	None to slightly stony.	Moderately stony.	Very to excessively stony.
Salinity of Topsoil	E.C.[2] 0 to 1	E.C. 1 to 3	E.C. more than 3
Permeability of Upper Topsoil	Moderate	Slow	Very slow

[1] A rating of unsuitable (U) is used for soil and land units that do not have topsoil present.

[2] E.C. = electrical conductivity of a saturation extract in mmhos/cm.

[3] These are the limits suggested by the Alberta Soil and Feed Testing Laboratory when considering lawn growth.

TABLE 14. SUITABILITY RATINGS OF SOILS AS A SOURCE OF SAND OR GRAVEL

A particular area outlined on the soil map may be identified as predominantly sand or predominantly gravel by consulting the soil report for a description of the map unit under consideration. Only the suitability as a source for sand and gravel is rated (Olsen et al.). No attempt is made to rate the quality of the sand and gravel for specific uses such as road base, concrete, etc. Quality determinations should be made at the site of the source, since both grain sizes and shapes of sand and gravel determine suitability for specific uses (Olsen et al.). Soil limitations considered at the site of the source are flooding hazard, wetness, depth to bedrock (influences thickness of sand and gravel deposit), and depth to sand and gravel (determines thickness of overburden that must be removed to reach sand and gravel deposit).

Item Affecting Use	Degree of Suitability		
	Good	Fair	Poor
Unified Soil Group	SW, SP, GW, GP	SW-SM, SP-SM, GW-GM, GP-GM	SM, SW-SC, SP-SC, GM, GW-GC, GP-GC (all other groups unsuitable).
Thickness of Overburden	Less than 0.7 m	0.7 to 1.6 m	More than 1.6 m
Wetness (Soil Drainage)	Drainage class not determining if better than poorly drained.		Poorly and very poorly drained.
Flooding	None	May flood occasionally for short periods.	Frequent flooding or constantly flooded.

TABLE 15. LIMITATIONS AND SUITABILITIES FOR SELECTED USES

Map Symbol[2]	Limitations For: Camp Areas	Picnic Areas	Playing Fields	Paths and Trails	Lawns & Landscaping	Buildings with basement	Buildings without basement	Septic Tank Absorption Fields	Sanitary Landfills-Trench Type	Reservoir Sites	Road Location & Source of Roadfill	Suitability as a Source of: Topsoil[1]	Sand or Gravel
CO1/gv / b	S	S	S	S	V18,24	S	S	V24	M3	V24	S	P18	F
CO1 / f	V3	M3	V3	S	V3,18	V3	V3	V3,24	M3	V3,24	V3	P3,18	U
COA1 / d	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18,3	U
COA1 / f	V3	V3	V3	M3	V3,18	V3	V3	V3,7,11	M3	V3	V3,14	P3,18	U
COA2 / b	S	S	S	S	M18	S	S	M7,11	S	S	M14	P18	U
COA2 / c	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
COA2 / c-d	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
COA2 / d	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18,3	U
COA2 / d-e	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18,3	U
COA2 / e	M3	M3	V3	S	V18,3	M3	M3	M7,11,3	S	V3	M3,14	P18,3	U
COA2 / f	V3	M3	V3	M3	V3,18	V3	V3	V3,7,11	M3	V3	V3,14	P3,18	U
COA2 CUP1 / d	S	S	V3	S	M18	S	S	S	S	M10,3	S	P18,3	U
COA2 CUP1 / e	V3	M3	V3	S	V18,3	V3	V3	M3	S	V3	M3	P18,3	U
COA2 CO1 / d	S	S	V3	M5	M18	S	S	S	S	M3	S	P18,3,5	U

Legend: S - none to slight, M - moderate, V - severe, G - good, F - fair, P - poor, U - unsuitable

1 Topsoil being considered here is Ah horizon or its equivalent (see Glossary)

2 Example: Map unit → COA1 / topography → d

LIMITING SOIL PROPERTIES AND HAZARDS

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10. Moderate Permeability
11. Slow Permeability
12. Groundwater Contamination Hazard
13. High Shrink-Swell Potential
14. Susceptibility to Frost Heave
15. Surface Soil Salinity
16. High Lime Content (Soil Nutrient Imbalance)
17. Shallow Depth to Bedrock
18. Thin Ah Horizon
19. Organic Soil
20. Organic Surface Layer More Than 15 cm Thick
21. Thick Overburden above Gravel or Sand
22. Moderate Shrink-Swell Potential
23. Possible Concrete Corrosion Hazard (Soluble Sulphate)
24. Thin Deposit of Sand or Gravel
25. Erosion Hazard
26. Solonetzic Soil
27. Excessive Coarse Fragments

TABLE 15. LIMITATIONS AND SUITABILITIES FOR SELECTED USES (cont.)

Map[2] Symbol	Limitations For:											Suitability as a Source of	
	Camp Areas	Picnic Areas	Playing Fields	Paths and Trails	Lawns & Land-scaping	Buildings with basement	Buildings without basement	Septic Tank Ab-sorption Fields	Sanitary Landfills-Trench Type	Reservoir Sites	Road Location & Source of Roadfill	Topsoil[1]	Sand or Gravel
COA2-CO1 / f	V3	V3	V3	M5,3	V18,3	V3	V3	V3	M3	V3	V3	P18,3,5	U
COA2-HGV2 / b-c	S	S	M3	S	M18	S	S	M7,11	S	S	M14	P18	U
COA2-HGV1 / c	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
COA2-TOM2 / c	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
COA2-TOM2 / d	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18,3	U
COA2-TOM2 / d-e	M3	M3	V3	S	V18,3	M3	M3	M7,11	S	V3	M3,14	P18,3	U
COA2-TOM2 / e	M3	M3	V3	S	V18,3	M3	M3	M7,11	S	V3	M3,14	P18,3	U
COA2-TOM1 / d-e	M3	M3	V3	S	V18,3	M3	M3	M7,11	S	V3	M3,14	P18,3	U
COA3 / d	M-V2, 3,19	M-V2 3,19	V3,2, 19	M2,19	M-V18, 2,19	M-V2, 3,19	M-V2, 3,19	V7,19, 2,12	M-V2, 19	M-V14, 2,19	M-V14, 2,19	P18	U
COA3 / e	M-V3, 2,19	M-V3, 2,19	V3,2, 19	M-V2, 19	M-V18, 2,19	V-V2, 3,19	M-V2, 3,19	V7,19, 2,12	M-V2, 19	M-V14, 2,19	M-V14, 3,2,19	P18,3	U
COA3 / e-f	V3,2, 19	V3,2, 19	V3,2, 19	M-V2, 19	V18,2, 19	V2,3, 19	V2,3, 19	V7,19, 2,12	M-V2, 19	V3,2, 19	V3,2, 19	P18,3	U
COA3-CUP1 / d	M-V2, 3,19	M-V2, 3,19	V2,3, 19	M-V2, 19	M-V18,2, 19	M-V2, 3,19	M-V2, 3,19	V7,19, 2,12	M-V2, 19	M-V14, 2,19	M-V14, 2,19	P18,3	U
COA3-CUP1 / e	M-V3 2,19	M-V3 2,19	V3,2, 19	M-V2, 19	M-V18, 2,19	M-V2, 3,19	M-V2, 3,19	V7,19,2 12	M-V2, 19	M-V14, 2,19	V-V14,3 2,19	P18,3	U
COA3-CUP1 / e-f	V3,2, 19	V3,2, 19	V3,2, 19	M-V2, 19	V18,2, 19	V2,3, 19	V2,3, 19	V7,19, 2,12	M-V2, 19	V3,2, 19	V3,2, 19	P18,3	U

Legend: S - none to slight, M - moderate, V - severe, G - good, F - fair, P - poor, U - unsuitable

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[2] Example: Map unit → COA1 / topography → d

LIMITING SOIL PROPERTIES AND HAZARDS

1. Flooding hazard (overflow)
2. Seasonally High Groundwater Table or Surface Ponding
3. Excessive slope
4. Surface Stoniness
5. Sandy Surface Texture
6. Slippery or Sticky When Wet
7. High Clay Content
8. Shallow Depth to Sand or Gravel
9. Rapid Permeability (Droughtiness)
10. Moderate Permeability
11. Slow Permeability
12. Groundwater Contamination Hazard
13. High Shrink-Swell Potential
14. Susceptibility to Frost Heave
15. Surface Soil Salinity
16. High Lime Content (Soil Nutrient Imbalance)
17. Shallow Depth to Bedrock
18. Thin Ah Horizon
19. Organic Soil
20. Organic Surface Layer More Than 15 cm Thick
21. Thick Overburden above Gravel or Sand
22. Moderate Shrink-Swell Potential
23. Possible Concrete Corrosion Hazard (Soluble Sulphate)
24. Thin Deposit of Sand or Gravel
25. Erosion Hazard
26. Solonetzic Soil
27. Excessive Coarse Fragments

TABLE 15. LIMITATIONS AND SUITABILITIES FOR SELECTED USES (cont.)

Map[2] Symbol	Limitations For:											Suitability as a Source of	
	Camp Areas	Picnic Areas	Playing Fields	Paths and Trails	Lawns & Land-scaping	Buildings with basement	Buildings without basement	Septic Tank Ab-sorption Fields	Sanitary Landfills-Trench Type	Reservoir Sites	Road Location & Source of Roadfill	Topsoil[1]	Sand or Gravel
COA 3-TOM 1 / c	M2,19	M2,19	M-V3, 2,19	S-M2, 19	M18,2, 19	M18,2, 19	M18,2, 19	M2,19 19	M18,2	M3,2, 19	M14,2,19	P18	U
COA 4 / c	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
COA 4 / c-d	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
COA 4 / d	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18,3	U
COA 4-CUP 1 / d	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18,3	U
COA 4-TOM 3 / d	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18,3	U
COA 5 / c	M2,19	M2,19	V3,2,19	M2,19	M-V18, 2,19	M-V2, 3,19	M-V2, 3,19	V7,19, 2,12	M-V2, 19	M-V14, 2,19	M-V14, 2,19	P18	U
COA 5 / d	M-V2, 3,19	M-V2 3,19	V3,2 19	M2, 19	M-V18, 2,19	M-V2, 3,19	M-V2 3,19	V7,19 2,12	M-V2, 19	M-V14, 2,19	M-V14, 2,19	P18	U
COA 6 / d	S	S	V3,2	S	M18	S	S	M7,11	S	M3	M14	P18	U
COA 6 / d-e	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18,3	U
COA 6 / e	M3	M3	V3	S	V18,3	M3	M3	M7,11,3	S	V3	M13,14	P18,3	U
CUP 1 / c	S	S	S	S	V18	S	S	M12	S	M3	S	P18	F
COD 1 / b	V2	M2	V2	M2	M2	V2	M2	V2,12	V2,12	M10	V2,14	F2	U
COD 1-OWY 1 / a-b	V2	M2	V2	M2	M2	V2	M2	V2,12	V2,12	M10	V2,14	F2	U

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COD1-DWY1 / b	V2	M2	V2	M2	M2	V2	M2	V2,12	V2,12	M10	V2,14	F2	U
COD1-OWY1 UCS11 / b	V2	M2	V2	M2	M2	V2	M2	V2,12	V2,12	M10	V2,14	F2	U
EGO1 / b	S	S	S	S	S	M2	S	V12,2, 7,11	V12,2	S	M2,22, 14	G	U
OS1 / a	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19,2	V19,2, 13,14	U	U
OS1-OWY1 / a	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19,2	V19,2, 13,14	U	U
OS1 OWY1 / b	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19,2	V19,2, 13,14	U	U
OM1 / a	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19,2	V19,2, 13,14	U	U
OM1 / b	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19,2	V19,2, 13,14	U	U
OM1 OWY1 / b	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19,2	V19,2, 13,14	U	U
OM1-COA2 / b-c	V19,2	V19,2	V19,2	V19,2	V19,2, 18	V19,2, 13	V19,2	V19,2, 12	V19,2, 12	V19,2	V19,2, 13,14	U	U
OWY1 / a	V2	M2	V2	M2	M2	V2	M2	V2,12	V2,12	M10	M2,14	F2	U
OWY1 / a-b	V2	M2	V2	M2	M2	V2	M2	V2,12	V2,12	M10	V2,14	F2	U
OWY1 / b	V2	M2	V2	M2	M2	V2	M2	V2,12	V2,12	M10	V2,14	F2	U
OWY1-COD1 / b	V2	V2	V2	M2	M2	V2	M2	V2,12	V2,12	M10	V2,14	F2	U

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[2] Example: Map unit ⟶ COA1 / topography ⟶ d

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OWY1-OS1/b	V2	M2	V2	M2	M2	M2	V2	V2,12	V2,12	M2	V2,14	F2	U
OWY1-OS1/c	V2	M2	V2,3	M2	M2	M2	V2	V2,12	V2,12	V2,3	V2,14	F2	U
SNE1/a	V5,1,2	V5,1,2	V5,8,1,2	V5,1,2	V5,8,1,2,18	V1,2	V1,2	V8,9,12,1,2	V8,9,12,1,2	V8,9,1	V1,2	P18,5,1	F
SNE2/b	V4,1	V4,1	V4,8,1	V4,1	V4,8,1,18	V1,2,4	V1,4	V8,9,12,1,2	V8,9,12,1,2	V8,9,1	V1,2,4	P18,4,1	F
SNE2/b-c	V4,1	V4,1	V4,8,1	V4,1	V4,8,1,18	V1,2,4	V1,4	V8,9,12,1,2	V8,9,12,1,2	V8,9,1,3	V1,2,4	P18,4,1	F
UCS1/c	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
UCS1/d	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18	U
UCS2/c	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
UCS5/b	S	S	S	S	M18	S	S	M7,11	S	S	M14	P18	U
UCS5/c	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U
UCS5/d	S	S	V3	S	M18	S	S	M7,11	S	M3	M14	P18	U
UCS11/b	M2,6	M6,2	M2,6	M6,2	M2,18	V13,2	S	V7,11,2,12	M2,12	S	V7,13,14,2	P18	U
UCS11-OWY1/b	M2,6	M6,2	M2,6	M6,2	M2,18	V13,2	S	V7,11,2,12	M2,12	S	V7,13,14,2	P18	U
TOM1/c	S	S	M3	S	M18	S	S	M7,11	S	M3	M14	P18	U

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TOM2/e	M3	M3	V3	S	M18	M3	M3	M10	S	M3,10	M3	P18,3	U
TYK2/g/b	M2	M2	M2	S	M18	S	S	M12	S	S	S	F	U

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TABLE 16. CANADIAN SOIL CLASSIFICATION SYSTEM

Order	Great Group	Distinguishing Characteristics
1. Chernozemic (Developed under grassland and transitional grassland-forest communities)	Brown	Light Brown Ah horizon
	Dark Brown	Dark Brown Ah horizon
	Black	Black Ah horizon
	Dark Gray	Have L-H surface horizons typical of forest vegetation
2. Solonetzic (Columnar or prismatic B horizon and a saline C horizon; Ca/Na ratio of B horizon is less than 10)	Solonetz	Ah horizon Bnt Horizon
	Solodized Solonetz	Ah Ae Bnt
	Solod	Ah Ae AB Bnt
3. Luvisolic (Developed in forest areas: accumulation of clay in the B horizon)	Gray Brown Luvisol	(L-H) Ah Ae Bt Mull-like Ah horizon
	Gray Luvisol	L-H (Ah) Ae Bt
4. Podzolic (Accumulation of Fe+Al and/or organic matter in the B horizon)	Humic Podzol	Bh > 4" which contains > 1% O.C. < 0.3% Fe
	Ferro-Humic Podzol	Bhf > 4" which contains > 5% O.C. > 6% Fe+Al
	Humo-Ferric Podzol	Bf > 2" which contains < 5% O.C. > 6% Fe+Al
5. Brunisolic (Generally weakly developed B horizons)	Melanic Brunisol	Ah 2", Bm 2"; pH > 5.5
	Eutric Brunisol	Ah 2", Bm 2"; pH > 5.5
	Sombric Brunisol	Ah 2", Bm 2"; pH < 5.5
	Dystric Brunisol	Ah 2", Bm 2"; pH < 5.5
6. Regosolic (Weakly developed or young soils; no B horizon)	Regosol	(L-H) Ah C; no B horizon
7. Gleysolic (Poorly drained and show mottling and gleying)	Humic Gleysol	Ah > 3"
	Gleysol	Ah < 3"
	Luvic Gleysol	Have Aeg and Btg horizons
8. Organic (Contains 30% organic matter; are 24" in depth if dominantly fibric or 16" if dominantly mesic or humic	Fibrisol	Large amount of well preserved fibre
	Mesisol	Partially decomposed fibre
	Humisol	Well decomposed fibre (Black)

TABLE 17. DEFINITION OF SOIL HORIZON SYMBOLS (after C.S.S.C.1974)

Organic Layers

Organic layers are found at the surface of some mineral soils, and may occur at any depth beneath the surface in buried soils, or overlying geologic deposits. They contain more than 17% organic carbon by weight. Two groups of these layers are recognized.

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

Of — The fibric layer is the least decomposed of all the organic soil materials. It has large amounts of well preserved fibre that are readily identifiable as to botanical origin.

Om — The mesic layer is the intermediate stage of decomposition with intermediate amounts of fibre, bulk density and water-holding capacity. The material is partly altered both physically and biochemically. A mesic layer is one that fails to meet the requirements of fibric or of humic.

Oh — The humic layer is the most highly decomposed of the organic soil materials. It has the least amount of fibre, 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.

L-F-H — These organic layers develop primarily from leaves, twigs, woody materials, and a minor component of mosses.

L — This is an organic layer characterized by an accumulation of organic matter in which the original structures are easily discernible.

F — This is an organic layer characterized by an accumulation of partly decomposed organic matter. The original structures in part are difficult to recognize. The layer may be partly comminuted by soil fauna, as in moder[1], or it may be a partly decomposed mat permeated by fungal hyphae, as in mor[1].

H — This is an organic layer characterized by an accumulation of decomposed matter in which the original structures are indiscernible. This material differs from the F layer by its greater humification chiefly through the action of organisms. This layer is a zoogenous humus form consisting mainly of spherical or cylindrical droppings of microarthropods. It is frequently intermixed with mineral grains, especially near the junction with a mineral layer.

[1] Bernier, B. 1968. Soils under forest. Proceedings of the 7th Meeting of the National Soil Survey Committee of Canada, pp 145 and 147.

Master Mineral Horizons and Layers

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

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

(1) horizons in which organic matter has accumulated as a result of biological activity (Ah);

(2) horizons that have been eluviated of clay, iron, aluminum, or organic matter, or all of these (Ae).

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

(1) an enrichment in silicate clay (Bt).

(2) an alteration by hydrolysis, reduction or oxidation to give a change in color or structure from horizons above or below (Bm and Bg).

C This is a mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting the process of gleying.

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

Lowercase Suffixes

b A buried soil horizon.

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

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.

h A horizon enriched with organic matter. When used with A it must show one Munsell unit of value darker than the horizon below, or have 0.5% more organic matter than the IC. It contains less than 17% organic carbon by weight.

k Denotes the presence of carbonate as indicated by visible effervescence when dilute HCl is added.

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

t A horizon enriched with silicate clay. It is used with B (Bt, Btg).

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GLOSSARY

This is included to define terms commonly used in the report; it is not a comprehensive soil glossary.

Aeolian (eolian) deposit - material deposited by wind, includes both loess and dune sand.

aggregate - a group of soil particles cohering so as to behave mechanically as a unit.

alluvial deposit - material deposited by moving water.

aspect - orientation of the land surface with respect to compass direction.

Atterberg limits - see plastic limit, liquid limit.

available plant nutrients - that portion of any element or compound in the soil that can be readily absorbed and assimilated by growing plants.

cation - an ion carrying a positive charge of electricity. The common soil cations are calcium, magnesium, sodium, potassium and hydrogen.

cation-exchange capacity (C.E.C.) - a measure of the total amount of exchangeable cations that can be held by the soil. It is expressed in terms of milliequivalents per 100 grams of soil.

coarse fragments - rock or mineral particles greater than 2 mm in diameter.

colluvium - a heterogeneous mixture of material that has been deposited mainly by gravitational action.

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

edaphic - (i) of or pertaining to the soil, (ii) resulting from, or influenced by, factors inherent in the soil or other substrate rather than by climatic factors.

eluviation - the removal of soil material in suspension or in solution from a layer or layers of the soil.

erosion - the wearing away of the land surface by running water, wind, or other erosive agents. It includes both normal and accelerated soil erosion. The latter is brought about by changes in the natural cover or ground conditions and includes those due to human activity.

gley - gleying is a reduction process that takes place in soils that are saturated with water for long periods of time. The horizon of most intense reduction is characterized by a gray, commonly mottled appearance, which on drying shows numerous rusty brown iron stains or streaks. Those horizons in which gleying is intense are designated with the subscript g.

groundwater - that portion of the total precipitation which at any particular time is either passing through or standing in the soil and the underlying strata and is free to move under the influence of gravity.

horizon - 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. Soil horizons may be organic or mineral.

illuviation - the process of deposition of soil material removed from one horizon to another in the soil, usually from an upper to a lower horizon in the soil profile. Illuviated compounds include silicate clay, iron and aluminum hydrous oxides and organic matter.

infiltration - the downward entry of water into the soil.

lacustrine deposit - material deposited in lake water and later exposed either by a lowering of the water or by uplift of the land.

liquid limit (upper plastic limit) - the water content at which a pat of soil, cut by a groove of standard dimensions, will flow together for a distance of 12 mm under the impact of 25 blows in a standard liquid limit apparatus.

lithic - a soil subgroup modifier that indicates a bedrock contact within 50 cm (20 in.) of the soil surface.

morphology, soil - the makeup of the soil, including the texture, structure, consistence, colour, and other physical, mineralogical and biological properties of the various horizons of the soil profile.

mottles - spots or blotches of different color or shades of color interspersed with the dominant color. Mottling in soils usually indicates poor aeration and drainage.

organic matter - the decomposition residues of plant material derived from: (i) plant materials deposited on the surface of the soil, and (ii) roots that decay beneath the surface of the soil.

parent material - unconsolidated mineral material or peat from which the soil profile develops.

peat - unconsolidated soil material consisting largely of undecomposed to partially decomposed organic matter accumulated under conditions of excessive moisture.

pedology - those aspects of soil science involving the constitution, distribution, genesis and classification of soils.

percolation, soil water - the downward movement of water through soil. Especially the downward flow of water in saturated or nearly saturated soil at hydraulic gradients of the order of 1.0 or less.

permeability - the ease with which gases, liquids, or plant roots penetrate or pass through a bulk mass of soil or a layer of soil. Since different horizons of soil vary in permeability, the particular horizon under question should be designated.

pH - a notation used to designate the relative acidity or alkalinity of soils and other materials. A pH of 7.0 indicates neutrality, higher values indicate alkalinity, and lower values acidity.

phase, soil - a subdivision of a taxonomic class based on soil characteristics or combinations thereof which are considered to be potentially significant to man's use or management of the land.

plastic limit - water content at which a soil will just begin to crumble when rolled into a thread approximately 3 mm in diameter.

plasticity index - the numerical difference between the liquid and the plastic limit.

profile - a vertical section of the soil throughout all its horizons and extending into the parent material.

relief - the elevations or inequalities of the land surface when considered collectively. Minor configurations are referred to as "microrelief".

seepage (groundwater) - the emergence of water from the soil over an extensive area in contrast to a spring where it emerges from a local spot.

solum (plural - sola) - the part of the soil profile that is above the parent material and in which the processes of soil formation are active. It comprises the A and B horizons.

texture (soil) - the relative proportions of the various sized soil separates in a soil as described by the textural class names.

till - unstratified glacial drift deposited directly by ice and consisting of non-sorted clay, silt, sand, and boulders.

watertable - the upper limit of the part of the soil or underlying rock material that is wholly saturated with water.