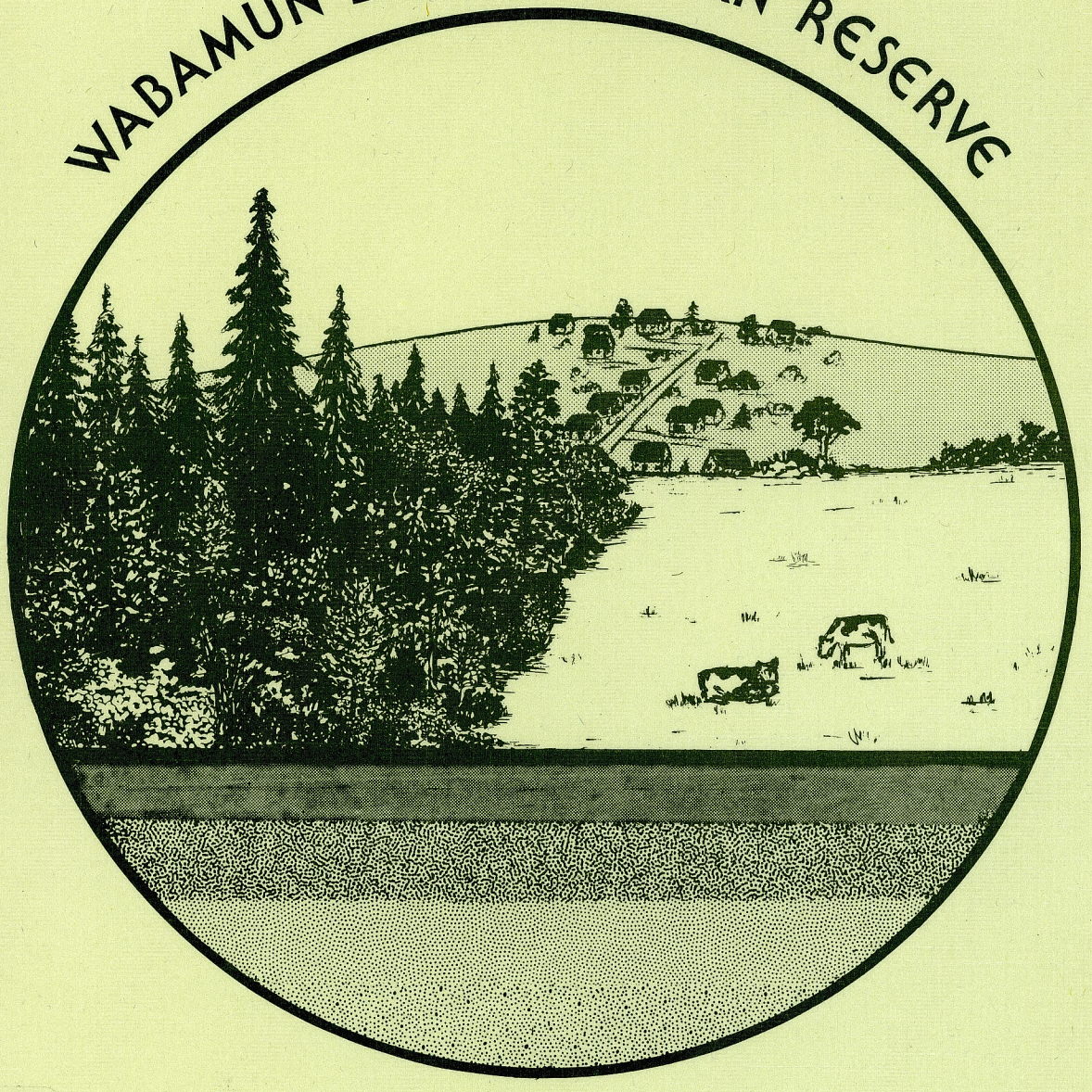
LAND RESOURCE SURVEY

WABAMUN LAKE INDIAN RESERVE



Pedology Consultants

1980

LAND RESOURCE SURVEY

of

WABAMUN LAKE INDIAN RESERVE #133A

1980

Prepared for

Indian and Northern Affairs
Alberta Region

Prepared by

C. G. Heath, M.Sc., P.Ag.
L. A. Leskiw, M.Sc., P.Ag.
L. Nikiforuk, B.Sc., A.I.T.

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1.0 INTRODUCTION

This Land Resource Survey is one of a series covering Alexander, Alexis, Beaver Ranch, Chipewyan, Clearwater River, Gregoire Lake, Sucker Creek and Wabamun Indian Reserves, located throughout Northern Alberta (Figure 1).

The main objectives of these surveys were:

- to map soils of the entire Reserves at a semi-detailed level
- to map the selected Core Area at a detailed level
- to interpret this soils information for settlement and
- agricultural uses
- to prepare, in addition to the Soil Maps, other maps showing

  Present Land Use
  Agricultural Capability
  Settlement Suitability
  Potential Land Use

A report which contains three main sections has been prepared for each of the Reserves. A "GENERAL" section is common to all reports and describes the role of soil investigations in planning, the mapping approach and the soil interpretation procedures. The second section of this report is referred to as "RESERVE" and it describes the geographic setting and key soils of the Wabamun Indian Reserve and discusses the included maps. The "APPENDICES" contain: brief descriptions of sites inspected and profile descriptions of key soils within each Reserve; guidelines used in rating the lands for different uses; definitions of soil sumbols and textural, drainage, topographic and stoniness classes, and a glossary of technical terms.

GENERAL

2.0 GENERAL DESCRIPTION OF MAPPING PROGRAM

2.1 THE ROLE OF LAND RESOURCE SURVEYS IN DEVELOPMENT PLANNING

The soil resources of an area are one of the most important elements of the natural resource base, influencing both rural and urban development. Soil is the natural medium for the growth of plants; its properties and life serve to stabilize wastes and purify water; and it serves as a foundation for buildings, roads, playgrounds and all other man-made land-based structures. Knowledge of the soil resource and its ability to sustain development contribute to reducing development costs and help to avoid misuse of land. Such problems as malfunctioning septic tank sewage disposal systems, flood damages, footing and foundation failures, soil erosion, and stream and groundwater contamination are usually very costly to correct and may create grave personal hardships in comparison to the relatively simple steps required to avoid them. To assist in preventing misuse of the soil resource base, a comprehensive regional planning program is needed to examine how land and soils are presently used and how they can be used and managed better. A first requirement in regional planning, therefore, is having a land resource survey which provides definitive data about the geographic location of various kinds of soils; about the physical, chemical and biological properties of these soils; and about the ability of these soils to support various kinds of rural and urban land uses.

For planning application, the following soils investigations are necessary to permit initial assessment on a uniform, areawide basis of:

- the engineering properties of soils as an aid in locating residential, commercial, agricultural, and recreational developments
- the biological properties of soils, including both agricultural and nonagricultural soil-plant relationships as an aid in establishing distribution patterns for permanent agricultural and recreational greenbelts and open spaces.
- The suitability and limitations of soils for specific settlement applications, such as on-site sewage disposal facilities, foundations for buildings, road location, recreational facilities,

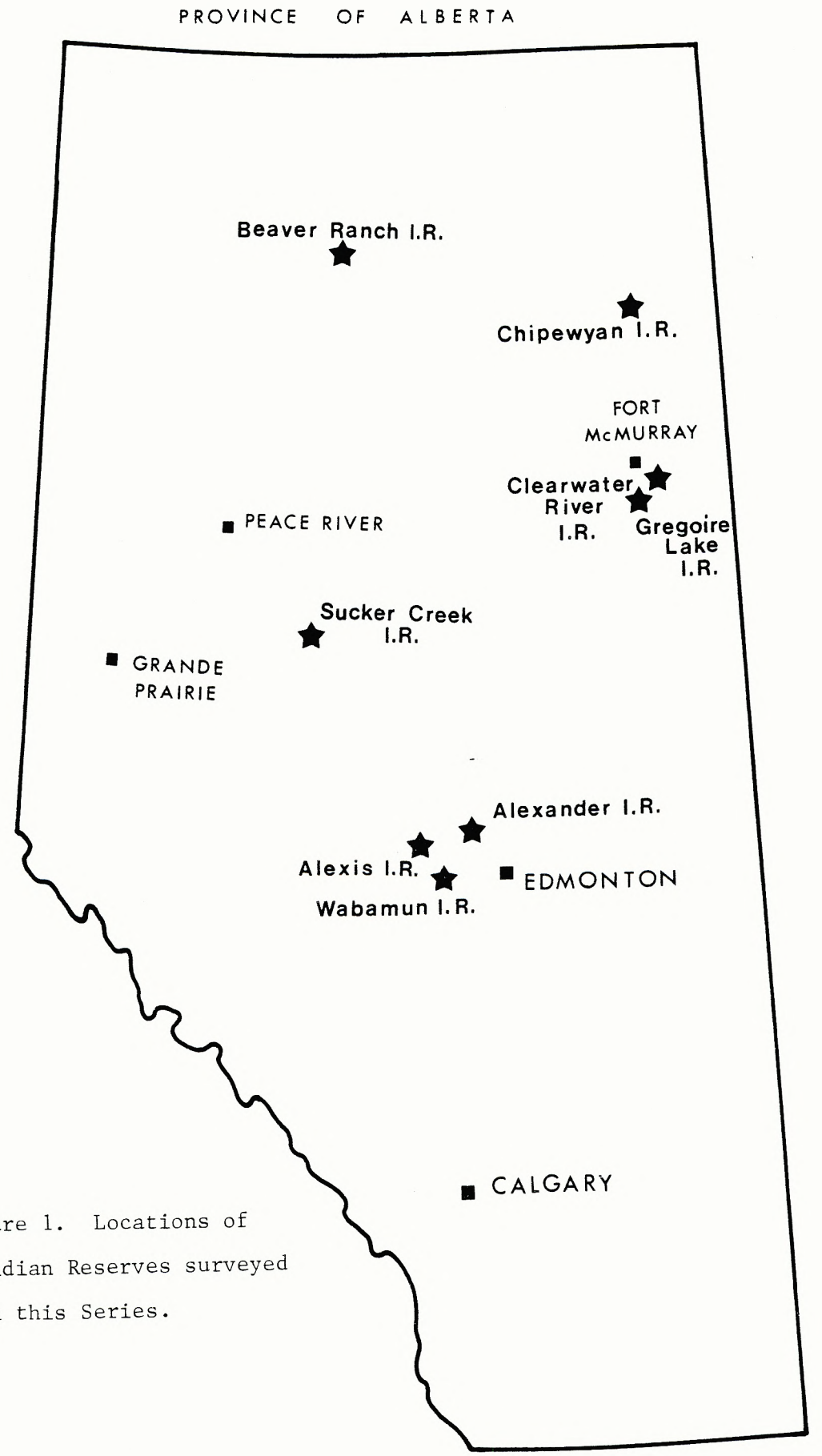

Figure 1. Locations of Indian Reserves surveyed in this Series.

and sewage lagoons and embankments as an aid in the planning and design of specific development proposals and in the application of such land-use plan implementation devices as zoning

- the location of potential sources of sand, gravel, and other soil-related mineral resources

Such an areawide soil resource survey is not intended to, and does not, eliminate the need for on-site engineering foundation investigations or the laboratory testing of soils in connection with the final design and construction of specific engineering works. Such an areawide study is intended to provide the means of predicting the suitability of land areas for various land uses and public works facilities and thereby to permit, during the planning stages, the adjustment of regional development patterns, broadly considered, to one important element of the natural resource base.

2.2 PREVIOUS STUDIES

Reconnaissance soil survey reports and maps published at a scale of 1:126,720 (1 inch to 2 miles) and Soil Capability for Agriculture, Canada Land Inventory Maps at a scale of 1:250,000 cover most Reserves. Both these sources of information have been used earlier, without more detailed field examination, to prepare one volume outlining the general agricultural capability and potential for crop production of all Indian Reserves in Alberta (Takyi and Pluth). Reconnaissance geological, surficial geology and hydrogeological studies have been published for most areas. All these provide valuable background information and they are suitable for land use planning at a broad level.

Other key sources of information include climatic data published by Environment Canada, and various publications, bulletins, pamphlets, etc. about farming prepared by the Provincial and Federal Departments of Agriculture.

In 1979, Pedology Consultants conducted semi-detailed surveys of five entire Indian Reserves, and detailed surveys of Core Areas of these five plus six other Reserves. These reports contain soil maps as well as interpretive maps showing agricultural capability and soil suitability for a number of settlement uses. This information is being used by planners in preparing development plans at a local level for the Reserves. This series of Land Resource Surveys, conducted in 1980, is the result of continuation of the mapping program initiated the year before.

2.3 MAPPING SYSTEMS

2.3.1 Soil Mapping

Soils are natural materials that differ greatly in properties from one location to the next and even within the same area. The purpose of soil survey is to identify, describe and delineate soil patterns in the landscape and to present the information to the user.

The soil surveyor makes point observations of soils and extrapolates the information to areas with the aid of aerial photographs and by using principles of pedology, geomorphology, surficial geology, hydrology, hydrogeology and vegetation pattern indicators. Soil map units are distinguished on the basis of prominent soil features including textures, depths, and kinds of soil parent materials, topography, soil moisture conditions, and soil profile development. Since soils change gradually from one type to another, soil units are described as having a certain range of properties and the attributes recognized in separating soil areas are those considered important for the intended kinds and intensities of land uses.

The soils have been classified and described according to standards established by the Canada Soil Survey Committee (1978). Two levels of mapping are employed and these are described briefly as follows:

1. Semi-detailed mapping of entire Reserves:

   - field mapping scale is 1:20,000 (maps may be reduced for presentation)
   - inspection density ranges from about 8 inspections per square mile on uplands to 2 inspections per square mile in lowlying wet areas
   - map units are given numerical symbols (e.g. 1, 2, 3, etc) and they are described in the Legend
   - map units generally comprise two or more important soil types designated in the Legend as dominant, significant, and inclusions, representing more than 40% of a unit, 10 to 40%, and less than 10%, respectively
   - sampling density is sparse with only key soil parent materials being sampled for laboratory analyses

2. Detailed mapping of selected Core Areas:

- field mapping scale is 1:5,000 (same scale used in presentation)
- field inspection density is a minimum of 40 inspections to a depth of 1 metre or more per square mile
- a limited number of 2 to 3 metre holes have been augered to measure water table levels.
- map units are identified by numbers and letters (e.g. 1a, 2a, 2b, 3a, etc.) and they are described in the Legend
- map units generally comprise one dominant soil type but occassionally they have associated similar soils of significant extent or of minor occurrence
- key parent materials have been sampled for laboratory analyses

The location of the sampling sites is presented on the Soil Maps, profiles are described in the Appendix, and the results of the analyses are tabulated in the reports. Analyses have been conducted on the parent material samples tabulated in the report according to ASTM standards (ASTM, 1970) and include:

1. Soil Reaction (pH) which provides a measure of hydrogen ion activity, and gives an indication of nutrient availability and soluble carbonate content.
2. Soluble Sulphate which provides a measure of potential concrete corrosion hazard is analyzed where saline soils occur.
3. Particle Size Analysis (Hydrometer method) which provides soil texture information and is related to water holding capacity, erodibility, porosity, and bulk density.
4. Sieve Analysis and Atterberg Limits which characterize the engineering properties of the soils.

2.3.2 Present Land Use Mapping

Aerial photographs have been interpreted, and field checks made during the soil survey to determine categories of present land use for all the Reserves. These categories are displayed on the Present Land Use Map accompanying this report and include one or more of the following:

Cleared and cultivated land (C.C.) - These are areas that are presently under cultivation and used for grain and forage production.

Cleared Pasture (C.P.) - These are areas where clearing improvements have taken place but the predominant present use is grazing.

Forested and Rough Pasture (F) - These are areas of either forested land or areas where no improvements have been made.

Bogs (B) - These are poorly drained, frequently ponded areas containing organic soils. Vegetation consists mainly of black spruce, birch, willow, sedges and mosses.

Recreational areas (REC) - These are campgrounds, picnic areas, playgrounds, etc.

As well as the above land uses, Churches, Buildings, Gas Wells, and Trails have been noted on the Present Land Use Map.

The Present Land Use Map is intended as a base to monitor the progression of agricultural and other development projects. By superimposing the capability and suitability maps, areas can be selected with potential for development.

2.4 INTERPRETIVE CLASSIFICATION SYSTEMS

2.4.1 The Soils Input

Growing public awareness of the need for a conservation ethic, increased demand and higher prices for land, and land use conflicts have necessitated rapid development and refinement of land use planning skills. It is very important that in making decisions concerning land use, land suitability information should carry its weight along with political, economic and social factors that are often the major, if not the only, considerations.

For Soil Maps and their associated descriptions of the soils to be most useful, they must be appropriately interpreted and generalized. Two primary steps in technical application of soil survey are:

1. Interpretation of the individual soil types for the desired uses.

   Example: Consider a well drained Orthic Gray Luvisol developed on clay loam till occurring on undulating topography.

   This soil can be assigned definite ratings depending on the specifications (as outlined in Appendix A) required for the desired uses (housing, road location, etc.)

2. Interpretation of map units for the desired uses.

   Example: Consider a map unit which contains dominantly well drained Orthic Gray Luvisols in the uplands and significant extents of poorly drained Orthic Humic Gleysols in depressions, all developed on till with gently rolling topography.

   These two main soil types can be assigned separate ratings which are considerably different; however, for planning purposes one overall rating is often desirable. In such instances, one or more limitations given to a map unit may apply to the different soils occurring within that map unit. The overall rating either coincides with the rating of the dominant soil or it may be downgraded one class if a clearly inferior soil occupies a significant portion of the unit.

It is extremely important that the user of interpretive maps appreciates the significance of the two steps outlined above. In detailed mapping a great effort is made to separate different soil types, in terms of suitability for desired uses, thus making interpretation generally straight-forward. When a soil has characteristics which are borderline between two classes the final rating is determined by judgement.

In semi-detailed and more general mapping, contrasting soil types are often necessarily combined in one map unit. The land use planner or other users must therefore deal with land patterns rather than with individual soils. This is why semi-detailed and more general maps are suited only to "conceptual planning". Design and implementation require detailed mapping as a prerequisite. With this information it is possible to fit land uses to the capabilities of the soil in the most efficient and least destructive manner.

2.4.2 Agricultural Capability Classification

The soils are rated for agricultural capability according to the Canada Land Inventory guidelines (Canada Land Inventory, 1972). In this system, the mineral soils are grouped into seven classes according to their limitations for agricultural use. The first three classes are capable of sustained production of common cultivated crops; the fourth class is considered marginal; the fifth is capable of use for improved pasture and hay production; the sixth is capable of use for unimproved pasture; and the seventh class has no capability or potential for agricultural use.

The classes, the broadest category in the system, are an assessment of the degree or intensity of limitation. For example, a Class 4 soil has limitations which are more severe than a Class 3 soil. The second category, the subclass, describes the kind of limitation responsible for the class designation. Thus, when used together, the class and subclass provide information about the degree and kind of limitation. This information is useful for land use planning, and for determining conservation and management requirements for groups of farms when mapping is at a semi-detailed level.

The seven classes are broadly defined as follows:

Class 1 - these soils have no significant limitations to use for crops.

Class 2 - these soils have moderate limitations that restrict the range of crops or require moderate conservation practices.

Class 3 - these soils have moderately severe limitations that restrict the range of crops or require special conservation practices.

Class 4 - these soils have severe limitations that restrict the range of crops that can be grown or require special conservation practices to overcome, or both.

Class 5 - these soils have very severe limitations that restrict their capability to producing perennial forage crops and improvement practices are feasible.

Class 6 - these soils are capable only of producing perennial forage crops and improvement practices are not feasible.

Class 7 - these soils or land types have no capability for arable culture or permanent pasture.

Organic - Organic soils are not rated in the Soil Capability for Agriculture System, but they have very severe limitations and are considered equivalent to Class 6.

It must be emphasized that soils within a capability class are similar only with respect to the degree or intensity of limitation, and not the kind of limitation. Each class includes many different kinds of soils, and many of the soils within any one class may require different management practices.

The subclass is a grouping of soils with the same kind of limitation. Seven different kinds of limitations are recognized as a result of adverse climate, soil, or landscape characteristics. The limiting effects of the climate are considered first since they affect the initial capability class or degree of limitation on a broad sub-regional basis. Next the soil and landscape limitations are considered.

The limitations, due to unfavourable soil and landscape characteristics, are:

C - adverse climate

D - adverse soil structure

F - low natural fertility

I - inundation (flooding) by streams

M - low available moisture holding capacity

S - a combination of two or more of the subclasses

T - adverse topography because of steepness or pattern of slopes

W - excessive soil moisture

Subclass C: adverse climate

This limitation applies to soil areas where the length of the frost-free period or the shortage of degree days are the major limitations to agriculture.

Subclass D: undesirable soil structure and/or low permeability

Often soils with eluviated (leached) surface horizons and illuviated (clay enriched) subsurface horizons exhibit structural limitations. The degree or intensity of limitation depends largely on the degree of development of these horizons, although the nature of the parent material (texture) provides some modifying effects.

The structure of eluvial horizons is quite unstable, and when cultivated, these horizons tend to pulverize easily. Eluvial horizons, such as the surface horizons of the Gray Luvisolic soils which are low in organic matter content, are the least stable. When wet, these soils tend to flow and "puddle" and are very susceptible to erosion even on gently rolling topography. On drying, these soils are subject to crusting, which tends to inhibit seedling emergence and tillering, and may restrict soil aeration.

The illuvial horizons or subsoil of some soils also present structural limitations that are restrictive to internal drainage and root penetration. These horizons occur in Luvisolic and Solonetzic soils of Alberta. The very compact nature of these horizons restrict root development and penetration, and when near the surface, makes maintenance of good tilth difficult. Root and moisture penetration is severely restricted resulting in a shallow root zone.

Subclass F: low natural fertility

Occassionally the natural fertility of soils is low due to one or more of these conditions: lack of available nutrients, high acidity or alkalinity, low exchange capacity, high levels of calcium carbonate or presence of toxic compounds.

Subclass I: inundation by streams or rivers

This limitation applies to soils subject to inundation (flooding) by streams or rivers, but not to depressional areas subject to ponding. The degree of limitation depends on the frequency of inundation.

Subclass M: low available moisture holding capacity

The available moisture holding capacity of soils is primarily evaluated on the basis of texture. That is, as the amount of clay decreases (sand and silt increases), the moisture holding capacity decreases and the degree of limitation increases. Also, the degree of limitation becomes more severe as climatic moisture decreases, and as the organic matter content of the surface horizon decreases.

Subclass T: adverse topography, both steepness of slopes and pattern

This subclass applies to areas where topography is considered to be a limitation to agricultural use. Assessment of this limitation includes evaluation of the hazards imparted to cultivation by the degree of slope as well as those due to irregularity of field patterns and lack of soil uniformity as a result of complex landform patterns. For example, areas of hummocky terrain with numerous knolls and poorly drained depressions have cumulative limitations which not only affect the ease of cultivation because of steep slopes, but also increase the difficulty of management (seeding and harvesting). The degree or intensity of limitation increases with the slope angle as well as the complexity of the landscape pattern. Generally, long simple slopes are not as restricting to agricultural use as are complex slopes of comparable degree.

Subclass W: excessive moisture

This subclass limitation applies to soils where excess moisture is a limitation, but does not include wetness due to inundation. Excessive moisture may be the result of poor soil drainage, a high water table, seepage, or the collection of run-off from surrounding areas. The degree of limitation is dependent on the duration of the period that these soils remain wet as it affects the timing of cultivation, seeding and harvesting.

2.4.3 Soil Interpretations for Settlements

Soil is the oldest and most used construction material. Information regarding the behavior of soils is of vital importance when selecting and planning new developments to avoid costly errors. The prime function of soil survey interpretations for engineering use is one of providing information on soil character and behavior as an adequate and reliable basis of design and construction (Aandahl). The interpretations can be very useful in predicting performance and identifying problem areas when planning new developments such as roads, airports, residential areas, commercial areas, and parks. The information provided by soil surveys is not intended to be site specific, nor does it serve as a substitute for on-site investigations. The intent is to provide a basis for area planning, to identify problem areas, to reduce the amount of further investigations, and to minimize costs. The interpretations are evaluations of performance, and not recommendations for use.

These interpretations are based on the Guide for Interpreting Engineering Uses of Soils published by United States Department of Agriculture, Soil Conservation Service (1972), and those used by Coen et al (1976). These evaluations consider such soil properties as: texture, which affects the stability and bearing strength for roads and foundations, shrink-swell potential, risk of frost heave, and the rate of infiltration and internal drainage; soil moisture conditions, which affect the location of buildings, roads, and services; and soluble salt content, which affects concrete foundation construction. Several terms used to describe soil such as texture, structure, and consistence differ in meaning between pedology and engineering. The pedological definitions are used in this report, many of which are in the Glossary (Appendix C).

The Soil Map Units recognized in each Reserve and Core Area are grouped into three categories according to their constraints or suitabilities for settlement uses. The categories are:

Low Constraints (Highly Suitable) - These are lands which generally have favourable soil, topographic and drainage conditions for most settlement uses. There are few problems expected since there are few potentially troublesome conditions identified.

Moderate Constraints (Moderately Suitable) - These are lands which have some favourable and some troublesome conditions, largely determined by soil, drainage and topographic conditions. With careful planning, design and management and possibly higher costs, the problems can be overcome.

Severe Constraints (Marginally Suitable to Unsuitable) - These are lands which generally have few favourable conditions and many troublesome conditions. The most common problems are due to wetness (poor drainage, high water tables or flooding), to rugged topography, or to the presence of organic soils. Costs of overcoming these problems, even with careful planning, design and good management, will generally make the proposed use questionable.

In this study, all Soil Map Units are evaluated, in table form, with respect to degree (Low, Moderate, Severe) and kind (flooding, low permeability, excessive slope, etc.) of constraint for various single purpose settlement uses (housing, septic tank field location, road location, etc.).

Settlement Suitability represents the combined evaluation of several single purpose uses which have similar requirements in terms of soils, topographic and drainage conditions. The single purpose uses include housing (with and without basements), subgrade conditions, septic tank field location, road location, and recreational uses (camping and picnic areas, and hiking trails). Key items affecting the different uses are outlined in Table 1 in the form of a checklist. Detailed guidelines for assessing soils for the specific uses are given in Appendix B.

The Settlement Suitability Map shows areas of Low, Moderate and Severe degrees of constraints, as well as the corresponding kinds of constraints, e.g., wetness (W), inundation (I), topography (T), etc.

Evaluations of soils for location for sewage lagoons and as a source of sand and gravel, are given separately in the Legend since requirements for these purposes are considerably different from requirements for the other settlement uses.

Also, the soils are rated as good (G), fair (F), poor (P), or unsuitable (U), sources of sand and gravel.

TABLE 1. Checklist for Assessing Soil Constraints for Settlement Uses.

This checklist indicates which soil and landscape characteristics are considered in evaluating soils for important settlement uses.

The reader is referred to Appendix B for detailed guidelines used in determining degrees of constraints for each use.

Key Items Affecting Use	Settlement Uses				
	Single Family Dwellings	Septic Tank Absorption Fields	Road and Parking Lot Location	Road Subgrade Material	Recreation Uses
Flooding	X	X	X		X
Soil Drainage	X	X	X	X	X
Water Table Depth	X	X			X
Slope	X	X	X	X	X
Volume Change Potential	X		X		
Unified Soil Group	X		X	X	X
AASHO Group Index			X	X	
Permeability		X			X
Frost Heave Potential	X		X		
Depth to Consolidated Bedrock	X	X	X		
Sulphate Content	X				

RESERVE

3.0 DESCRIPTION OF THE WABAMUN INDIAN RESERVE

Location and Extent

The Wabamun Reserve is situated in north-central Alberta approximately 56 kilometers (35 miles) west of Edmonton. The study area encompasses 6,170 hectares (15,233 acres) and borders the south-eastern side of Wabamun Lake. The Reserve occupies portions of Township 52, Ranges 3 and 4, and Townskip 53, Range 3, West of the 5th Meridian.

Physiography and Drainage

The Reserve lies within the western edge of the Edmonton Plain, specifically the subregions of the Lake Edmonton Plain and the Glory Hills (Pettapiece). The topography varies from depressional to strongly rolling.

Three major landforms occur: gently rolling detaic plain in the south-western section, hummocky deltaic materials in the northern and central sections, and gently undulating glaciofluvial materials in the south-east. The elevation of the Wabamun Reserve ranges from 730 m (2,400 feet) to 760 m (2,500 feet) above mean sea level.

Wabamun and Mink Creeks drain into the North Saskatchewan River and eventually into Hudson's Bay.

Geology

The survey area is underlain by white weathering, bentonitic sandstone, clay and silty clay (Whitemud Formation) and purplish black, bentonitic sandstone (Battle Formation)(Green, 1972). These materials have a strong influence on the glacial drift which is generally less than 15 meters thick.

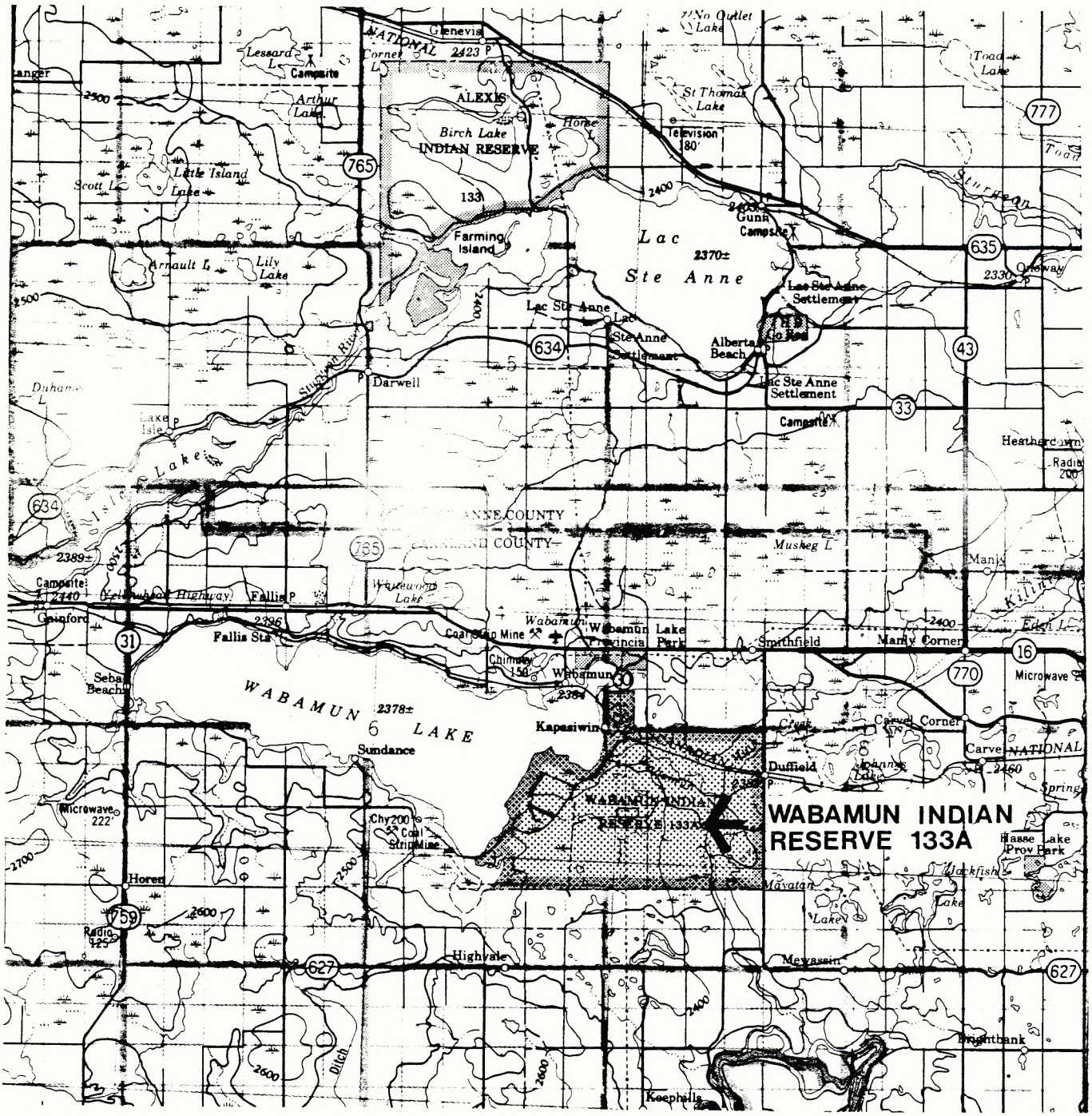

Figure 2.

Location Map of Wabamun Lake Indian Reserve

Scale: 1:250,000

Hydrogeology

Sustained yields of 113 to 455 1/min. (25 - 100 ig/min.) should be obtainable in the south-east section which is underlain by sandstone and sustained yields of 23 to 113 1/min. (5 - 25 ig/min.) should be obtainable throughout the rest of the Reserve which is underlain by sandstone and shale deposits (Ozoray, 1972).

Climate

The climate is characterized by relatively warm summers and long, cold winters with precipitation occurring throughout the year. Bowser (1967) places the Reserve in Climatic Zone 2H. Estimates of mean annual precipitation and mean monthly temperatures from stations representing Climatic Zone 2 are given in Table 2 and Table 3 (Environment Canada, 1975).

Vegetation

The study area lies within the Moist Mixed Wood Subregion of the Boreal Mixed Wood Ecoregion (Strong and Leggat, 1979). The dominant tree species is aspen with smaller quantities of balsam poplar present. Jack pine can also be found on soils of sandy texture.

The understory is diverse and consists of such species as reed grass, wild rye, pea vine, dogwood and willows.

In lower topographical positions and other poorly drained areas, black spruce accompanied by an understory of Labrador tea, cowberry and mosses can be expected.

TABLE 2. MEAN MONTHLY TEMPERATURES (1941 - 1970)*

Station	Elevation (m)	Mean Temperatures J	F	M	A	M	J	J	A	S	O	N	D	Frost Free Period[1/] Days	Dates	Degree Days[2/]
Thorsby	744	-13.9	-11.2	-5.8	3.5	10.2	13.3	16.4	14.6	9.9	4.7	-4.1	-10.3	103	May 31-Sept. 12	1,337
Sion	698						10.9	13.4	12.3	8.1				100	May 31-Sept. 8	1,416

1/ Average based on 1941 - 1970 period of record.

2/ Degree days greater than 5° C.

TABLE 3. MONTHLY AND ANNUAL PRECIPITATION DATA (1941 - 1970)*

Station	Elevation (m)	Precipitation (mm) May	June	July	Aug.	Sept.	May-Sept.	Annual
Thorsby	744	44	84	79	76	37	320	438
Sion	698	44	80	88	68	41	321	488

* Environment Canada, 1975.

4.0 METHODS

A semi-detailed soil survey was conducted on the Wabamun Indian Reserve No. 133A which comprises approximately 24 sections. The soils were inspected at 89 sites (Appendix A). Four samples of the representative parent materials were sampled for laboratory analysis of physical properties. The Soil Map is presented on an uncontrolled air photo mosaic (1977 photos) at a scale of 1:20,000 (back pocket).

A detailed soil survey was conducted on 125 hectares in the vicinity of the present town site. The soils were inspected at 48 sites (Appendix A). Five samples of representative parent materials were sampled for laboratory analysis. The Soil Map is presented on an uncontrolled air photo mosaic (1977 photos) at a scale of 1:5,000 (back pocket).

5.0 PRESENT LAND USE

A Present Land Use Map (page 23) has been compiled. The Legend for this map lists the main types of land use encountered and the Explanation of Legend below describes the units in more detail.

Explanation of Legend

Cleared and Cultivated Land (CC) - These are areas that are presently under cultivation and used for grain and forage production.

Cleared Pasture (CP) - These are areas which have been cleared but not cultivated. The predominant present use is grazing.

Forested and Rough Pasture (F) - These are areas of either forested land or areas where no improvements have been made.

- W Water
- ■ Building
- Railway
- Gravel Road
- .... Dirt Trail
- Slough
- Creek
- .-.- Cut and Power Line

Scale 1:50,000


N
WABAMUN
LAKE
CP/CC
CC
CP
CC
CC
CC
CP
CP
CC
CP
CC
CC
CP
CP
CC
CP
CP
CC
CP

6.0 SOILS

In accordance with standard procedures (CSSS, 1978), important soil characteristics including parent material, texture, drainage, and surface stoniness along with landscape features such as topography (slope expression and pattern), have been recognized.

Field investigations revealed the presence of four major soil forming parent materials separated into 16 map units due to differences in soils, topography and drainage as described below.

Soils on Outwash Deposits

Gravelly sand to sandy clay loam, slightly stony outwash deposits greater than 1 m thick are very limited in extent and found within only two areas in the southcentral portion of the Reserve. The outwash deposits range from GW to CL according to the Unified Classification. They have slow to rapid permeabilities, low shrink/swell potential and low to moderate frost heave potential.

Distinguishing characteristics of the outwash Map Units are:

Map Unit	Dominant Soil Subgroups	Drainage	Slopes
Reserve Area			
1	Gleyed Dark Gray Chernozems	Imperfectly	0 - 2%
Core Area			
(None)			

Soils on Fluvial Deposits

Sandy nonstony fluvial deposits generally greater than 1 m thick occur on the southeastern and northwestern areas of the Reserve. The fluvial materials are expected to be SW according to the Unified Classification. They have rapid permeabilities, low shrink/swell potential, and low frost heave potential.

Distinguishing characteristics of the fluvial Map Units are:

Map Unit	Dominant Soil Subgroups*	Drainage	Slopes
Reserve Area			
2	Orthic Black Chernozems	Rapidly	6 - 9%
3	Orthic Eutric Brunisols	Rapidly	16 - 30%
4	Gleyed Eutric Brunisols	Imperfectly	0 - 2%
Core Area			
(None)			

* Detailed profile descriptions are given in Appendix A.

Soils on Deltaic Deposits

Loamy sand to clayey deltaic deposits greater than 1 m thick occupy the vast majority of the Reserve. The deltaic materials range from SW to CL according to the Unified Classification. Due to the stratified nature of deltaic deposits permeabilities range from slow to rapid, shrink/swell and frost heave potentials range from low to medium.

Distinguishing characteristics of the deltaic Map Units are:

Map Unit	Dominant Soil Subgroups*	Drainage	Slopes
Reserve Area			
5	Gleyed Dark Gray Luvisols	Imperfectly	0 - 2%
6	Orthic Dark Gray Chernozems	Well	6 - 9%
7	Orthic Dark Gray Chernozems	Well	10 - 15%
8	Eluviated Black Chernozems	Well	2 - 5%
9	Gleyed Dark Gray Chernozems	Imperfectly	2 - 5%
10	Gleyed Dark Gray Chernozems	Imperfectly	6 - 9%
11	Orthic Dark Gray Luvisols and Eluviated Black Chernozems	Well	10 - 15%
12	Dark Gray Luvisols and Chernozems (significant Lithic Luvisols)	Well	10 - 15%
13	Dark Gray Luvisols	Well	10 - 15%
14	Dark Gray Luvisols	Well	15 - 30%
15	Orthic and Rego Humic Gleysols	Poorly	2 - 5%

Map Unit	Dominant Soil Subgroups*	Drainage	Slopes
Core Area			
8a	Eluviated Black Chernozems	Well	2 - 5%
8b	Eluviated Black Chernozems	Well	10 - 15%
8c	Eluviated Black Chernozems	Well	16 - 30%
8d	Eluviated Black Chernozems (significant Orthic Dark Chernozems)	Well	2 - 5%
10a	Gleyed Dark Gray Chernozems	Imperfectly	2 - 5%
15a	Orthic and Rego Humic Gleysols	Poorly	0 - 2%
15b	Humic Luvic Gleysols (disturbed lands)	Imperfectly	0 - 2%
15c	Humic Luvic Gleysols	Imperfectly	0 - 2%

* Detailed profile descriptions are given in Appendix A.

Soils on Organic Deposits

Very poorly drained depressions with accumulations of 0.8 to 1.2 m of fen and bog organic materials occur primarily in the western regions of the Reserve. The organic materials vary widely with respect to the stage of decomposition and depth however an intermediate stage of decomposition (Mesisols) is dominant.

All organic soils are grouped into one Map Unit which has the following distinguishing characteristics:

Map Unit	Dominant Soil Subgroups	Drainage	Slopes
Reserve Area			
16	Terric Mesisols	Very poorly	0 - 2%
Core Area			
16a	Terric Mesisols	Very poorly	0 - 2%

Miscellaneous Map Units

Stream Channels (SC and AV)

This Unit includes the banks, meander scares and present channel of Wabamun and Mink Creeks and their tributaries. The banks are commonly steep and in places local relief is 2 to 5 meters. Valley bottoms are narrow and flooding can be expected during the spring thaw and following heavy rains.

A natural vegetative cover should be maintained to minimize soil and geological erosion.

7.0 LABORATORY ANALYSIS

The results of laboratory analysis conducted on representative fluvial, outwash, deltaic and till samples are given in Table 4. This information is used to aid in characterizing the soils and in making soil interpretations.

8.0 AGRICULTURAL CAPABILITY

Soil capability for agriculture is displayed on the Agricultural Capability Map, Wabamun Indian Reserve (page 31) and in Table 5.

The Reserve lies within Agro-Climatic Area 2H, but limitations such as undesirable soil structure (D); flooding (I), low fertility (F), low moisture holding capacity (M); adverse topography (T); and excessive wetness (W) further limit the agricultural capability.

TABLE 4. Laboratory Test Data and Classification of Selected Soils in the Wabamun Study Area.

Soil Unit	Insp. Site#	Depth (cm)	% Passing Sieve #4	#10	#40	#200	% Smaller than #270 (0.05 mm)	0.002 mm	Atterberg Limits Liquid Limit	Plasticity Index (PI)
6	11	100	100	100	99.3	27.2	11.7	9.8		N.P.
14	62	150	100	100	99.6	75.1	62.3	36.8	37.9	18.3
1	84	100	50.5	42.3	17.9	3.9	0.9	0.8		N.P.
1	84	150	99.3	98.2	91.5	60.5	44.9	30.1	28.0	13.6
15a	146	70	100	100	99.5	90.7	89.9	56.3	42.3	16.3
15a	146	120	100	100	99.8	78.3	68.1	39.9	34.0	13.9
15a	146	200	100	100	100	33.0	8.7	5.5		N.P.
8a	147	100	100	100	100	64.5	48.4	31.6	30.6	12.2
8a	147	200	100	100	99.9	84.9	77.3	45.0	32.4	15.3
15a	148	120	100	100	99.8	85.3	65.7	52.9	40.0	20.3

Soil Unit	Insp. Site#	Depth (cm)	Classification UNIFIED	AASHO	USDA	Permeability (1)	Shrink-Swell Potential (2)	Frost Heave Potential (3)
6	11	100	SW-GW	A-2-4(0)	LS	M-R	L	L
14	62	150	CL	A-6(12)	CL	M	L-M	M
1	84	100	SW-GW	A-1-a(0)	GS	R	L	L
1	84	150	CL	A-6(7)	SCL	S	L	M
15a	146	70	ML	A-7-6(11)	C	S	M	M
15a	146	120	CL	A-6(10)	CL	S	L	M
15a	146	200	SMd	A-2-4(0)	LS	M-R	L	L
8a	147	100	CL	A-6(7)	SCL	S	L	M
8a	147	200	CL	A-6(10)	C	S	L	M
15a	148	120	CL	A-6(12)	C	S	M	M

(1) Permeability Classes
S - Slow - less than 0.5 cm/hr.
M - Moderate - 0.5 to 1.5 cm/hr.
R - Rapid - more than 1.5 cm/hr.

(2) Shrink-Swell Potential
L - Low
M - Medium
H - High

(3) *Frost Heave Potential
L - Low - F1 & F2 frost groups
M - Medium - F3 frost group
H - High - F4 frost group

* from U.S. Army Corps of Engineers, 1962.

TABLE 5. AGRICULTURAL CAPABILITY RATINGS OF WABAMUN INDIAN RESERVE

Capability Class	Subclass	Soil Map Units
2	C	8
3	T	6
	W	5,9
	M T	2
	T W	10
4	T M	7
	F	1
	T D	11
4,6	$4^{T}_{D}6W$	13
5	W	15
	M F	4
	M T	3
	T D	12
5,6	$5^{T}_{D}6W$	14
6	6^{W}_{I}	SC & AV
0	-	16

EXPLANATION OF AGRICULTURAL CAPABILITY MAP LEGEND

Agriculture Capability Classes

Class 2 - these soils have moderate limitations that restrict the range of crops or require moderate conservation practises.

Class 3 - these soils have moderately severe limitations that restrict the range of crops or require special conservation practises.

Class 4 - these soils have severe limitations that restrict the range of crops that can be grown or require special conservation practises to overcome or both.

Class 5 - these soils have very severe limitations that restrict their capability to producing perennial forage crops and improvement practises are feasible.

Class 6 - these soils are capable only of producing perennial forage crops and improvement practises are not feasible.

Class 7 - these soils or land types have no capability for arable culture or permanent pasture.

Soil Capability Subclasses

Soil Limitations:

Subclass D - undesirable soil structure and/or slow permeability
F - low fertility
M - low moisture holding capacity

Landscape Limitations:

Scale 1:50,000

Subclass C - climate
I - flooding
T - adverse topography
W - excessive moisture

Notation: 3W Class Subclass


WABAMUN
LAKE
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CORE AREA
4 T D
6W
5W
3 T W
2C
5 M F W
4 T D 6W
5 T D 6W
3W
4 M F
5 D T
5 M T
4T
3T
3M

9.0 SETTLEMENT SUITABILITY

The settlement uses considered in evaluating Settlement Suitability are: single family dwellings (with and without basements), septic tank absorption fields, road and parking lot location, road subgrade material, and recreation uses. In addition, constraints for sewage lagoons and suitability as a source of sand and gravel are assessed since requirements for these uses differ from those for settlement suitability. Ratings for all Soil Map Units and all the above uses are given in Table 6.

Areas of Low, Moderate and Severe Constraints as well as kind of constraints are displayed on the map: Reserve Settlement Suitability Map, page 36, and Core Area Settlement Suitability Map (back pocket).

9.1 Reserve

Low Constraints - Soil Map Units 2, 6 and 8.

Areas of low constraints to settlement occur on rapidly and well drained fluvial and deltaic deposits on topography which is gently undulating to gently rolling.

Although the land is generally favorable for development some site specific problems may be encountered and these should be considered prior to construction. For example since Soil Map Unit 2 contains medium to highly permeable sands adjacent to Wabamun Creek, the hazard of contamination from septic tank disposal units placed on these soils should be addressed before development for settlement.

Moderate Constraints - Soil Map Units 1, 4, 5, 9, 10, 7, 11, 12 & 13.

Constraints to settlement include: imperfect soil drainage, adverse topography and shallowness to bedrock.

Careful site selection and proper design taking into account the constraints should enable successful development of these lands. Development costs will likely be higher than in areas of Low Constraints.

TABLE 6. Degrees and Kinds of Constraints for Various Settlement Uses of all Map Units Occurring in the Wabamun Indian Reserve.

Soil Map Unit	Single Family Dwellings with Basements	Single Family Dwellings without Basements	Septic Tank Absorption Fields	Sewage Lagoons	Road and Parking Lot Location	Source of Road Subgrade Material	Source of Sand and Gravel	Recreation Camp-grounds	Recreation Picnic Areas	Recreation Hiking Trails
Semi-detailed Mapping										
1	S2	M2	M2	S9,4	M2	F	G	M2	M2	M2
2	L	L	L	S9	L	G	G	L	L	L
3	S3	S3	S3	S9,3	S3	F	G	S3	S3	L
4	S2	M2	L	S9,12	M2	F	G	M2	M2	M2
5	S2	M2	M2	M10	M2	F	P	M2	M2	M2
6	L	L	L	M3	L	F	P	L	L	L
7	M3	M3	M3	S3	M3	F	P	M3	M3	L
8	L	L	L	L	L	F	P	L	L	L
9	S2	M2	M2	L	M2	F	P	M2	M2	M2
10	S2	M2	M2	M3	M2	F	P	M2	M2	M2
11	M3	M3	M3	S3	M3	F	P	M3	M3	L
12	S3,17	M2,17	S17	S17	M3	F	P	M3	M3	L
13	M3	M3	M3	S3	M3	F	P	M3	M3	L
14	S3	S3	S3	S3	S3	F	P	S3	S3	M3
15	S2	S2	S2	S2	S2	P	P	S2	S2	S2
16	S19	S19	S19	S19	S19	U	U	S19	S19	S19

(CONTINUED)

TABLE 6. Degrees and Kinds of Constraints for Various Settlement Uses of all Map Units Occurring in the Wabamun Indian Reserve.

Soil Map Unit	Single Family Dwellings with Basements	without Basements	Septic Tank Absorption Fields	Sewage Lagoons	Road and Parking Lot Location	Source of Road Subgrade Material	Source of Sand and Gravel	Recreation Camp-grounds	Picnic Areas	Hiking Trails
Detailed Mapping										
8a	L	L	L	L	L	F	P	L	L	L
8b	M3	M3	M3	S3	M3	F	P	M3	M3	L
8c	S3	S3	S3	S3	S3	F	P	S3	S3	M3
8d	L	L	L	L	L	F	P	L	L	L
10a	S2	M2	M2	M2	M2	F	P	M2	M2	M2
15a	S2	S2	S2	S2	S2	P	P	S2	S2	S2
15b	S2	M2	M2	L	M2	F	P	M2	M2	M2
15c	S2	M2	M2	L	M2	F	P	M2	M2	M2
16	S19	S19	S19	S19	S19	U	U	S19	S19	S19

DEGREE OF CONSTRAINT: L - Low
M - Moderate
S - Severe

SUITABILITY AS SOURCES: G - Good P - Poor
F - Fair U - Unsuitable

KIND OF CONSTRAINTS:
2 - High groundwater table or surface ponding
3 - Excessive slope
4 - Surface stoniness
9 - Rapid permeability (droughtiness)
10 - Moderate permeability
12 - Groundwater contamination hazard
17 - Shallow depth to consolidated bedrock
19 - Organic soil

SETTLEMENT SUITABILITY MAP LEGEND

- Low Constraints

- Moderate Constraints

- Severe Constraints

Type of Constraints

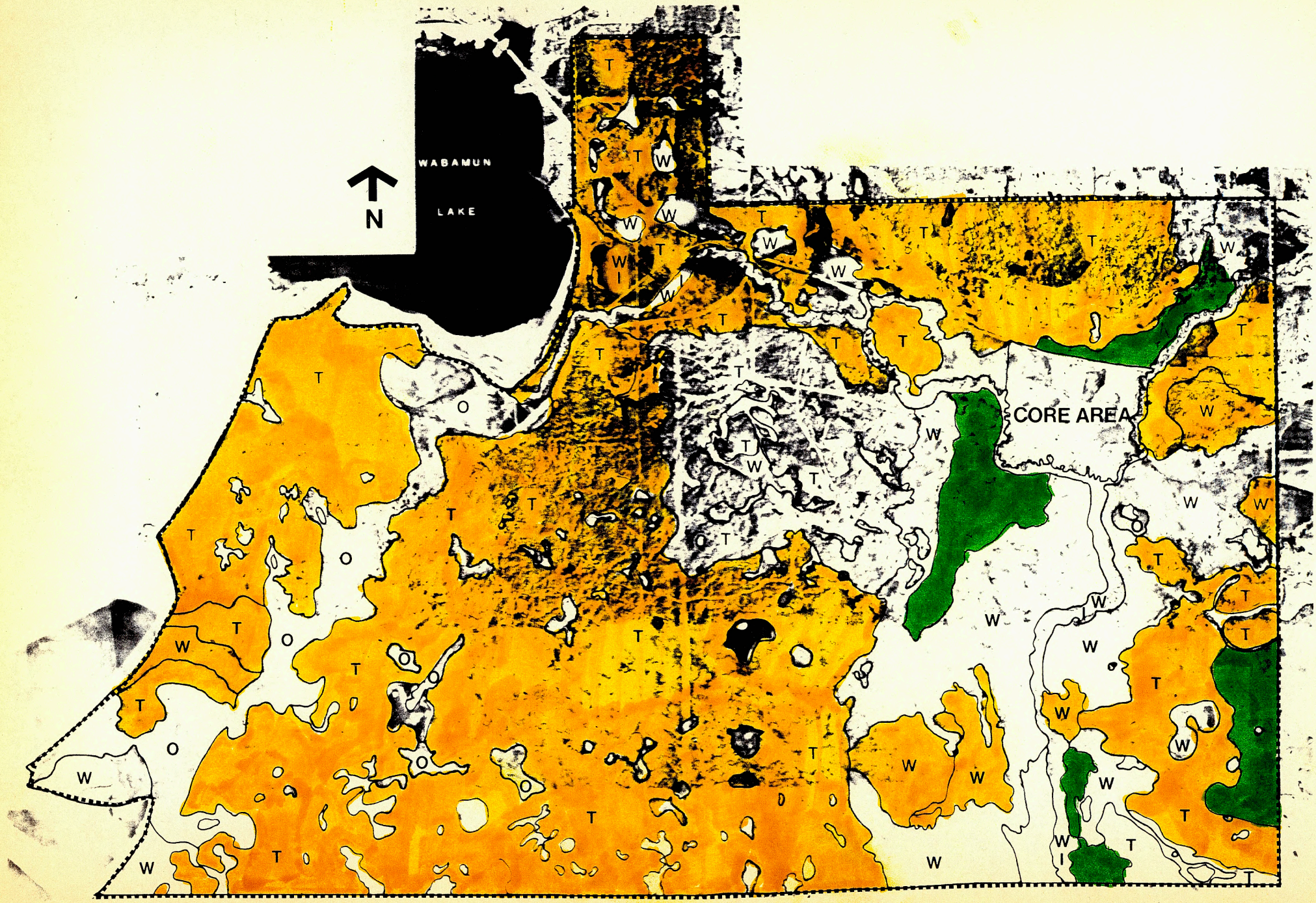
I - Flooding

O - Organic soils

T - Topography

W - Excessive moisture, poor drainage, shallow water tables, run-off

Scale 1:50,000


WABAMUN
LAKE
N
CORE AREA

SETTLEMENT — SUITABILITY

	SOIL MAP UNIT	Physical Characteristics and Qualities: LANDFORM	PERMEABILITY	RUNOFF	WATER TABLE DEPTH	SOIL DRAINAGE	TOPOGRAPHY	UNIFIED TEXTURE	SHRINK/ SWELL POTENTIAL	FROST HEAVE POTENTIAL	Hazards	Settlement Constraints: PERMANENT BUILDINGS WITH BASEMENTS	PERMANENT BUILDINGS WITHOUT BASEMENTS	SUBGRADE CONDITIONS	SEPTIC TANK	CAMPING PICNICKING & HIKING	SEWAGE LAGOONS	SOURCE OF SAND AND GRAVEL
LOW CONSTRAINTS	2	Fluvial sands over deltaic, gently rolling	medium to high	low	1.5m	rapid	6-9% slopes	CL	low	low	possibility of contamination of Wabamun Creek from sewage disposal	Favourable Conditions: Permeability, runoff, water table depth, soil drainage, topography, low shrink/swell potential. Potentially Troublesome Conditions: Contamination of Wabamun Creek from sewage facilities placed on Soil Map Unit 2.					severe (permeability)	good - sand poor - gravel
	6	Deltaic/till, gently rolling	medium	low	>1.5m	well	6-9% slopes	CL	low to moderate	low	till may act as impermeable layer and lead to seepage downslope						moderate (slope)	fair - sand poor - gravel
	8	Deltaic/till, gently undulating	medium	low	>1.5m	well	2-5% slopes	CL	low to moderate	low							none to slight	poor
MODERATE CONSTRAINTS	1	Outwash gravels/till, level to undulating	medium	low	>1 m	imperfect	2-5% slopes	GW-SW	low	low		Favourable Conditions: Permeability, runoff, topography, low shrink/swell potential. Potentially Troublesome Conditions: Water table depth, soil drainage.					severe (coarse fragments)	good
	4	Beach sands, level to undulating	medium	low	>1 m	imperfect	2-5% slopes	SM	low	low	possible contamination of Lake Wabamun from sewage facilities						severe (permeability)	good - sand poor - gravel
	5	Deltaic, level to undulating	low to medium	low	>1 m	imperfect	0-2% slopes	CL	low to moderate	moderate		Favourable Conditions: Runoff, topography, low shrink/swell potential. Potentially Troublesome Conditions: Water table depth, soil drainage, especially of concern for houses with basements and septic tank installations.					moderate (coarse fragments)	fair
	9						2-5% slopes										none to slight	poor
	10	Deltaic, gently rolling					6-9% slopes										moderate (slope)	poor
	7	Deltaic, moderately rolling	low to medium	moderate	>1.5m	well	10-15% slopes	CL	low to moderate	moderate		Favourable Conditions: Drainage, water table depth. Potentially Troublesome Conditions: Topography, runoff.					severe (slope)	fair - sand poor - gravel
	11																	poor
	13																	poor
	12	Deltaic/ bedrock, moderately rolling	very low	moderate	>1.5m	well	10-15% slopes	CL	low to moderate	moderate	presence of bedrock (coal)	Favourable Conditions: Drainage, water table depth. Potentially Troublesome Conditions: Topography, depth to bedrock, especially of concern for foundations and septic tanks.					severe (bedrock)	poor
SEVERE CONSTRAINTS	3	Fluvial sands, strongly rolling	medium to high	moderate	>1.5m	rapid	16-30% slopes	SM	low	low		Favourable Conditions: Drainage. Potentially Troublesome Conditions: Topography, runoff.					severe (slope)	poor
	14	Deltaic, strongly hummocky	low to medium	moderate to high	>1.5m	well	16-30% slopes	CL	low to moderate	moderate								
	15	Deltaic, level to undulating	moderate	low	≈.75m	poor	0-2% slopes	CL	low to moderate	moderate		Favourable Conditions: Topography. Potentially Troublesome Conditions: Drainage, water table depth, organic materials, flooding.					severe (drainage)	poor
	16	Organic, level			≈.75m	poor	0-2% slopes	PT	low		organic soils							
	Sc & Av	Alluvium			≈.75m	poor	0-2% slopes	CL	low	moderate	flooding							

Severe Constraints - Soil Map Units 3, 14, 15, 16 and SC & AV.

Lands in this category are marginally suitable or unsuitable for development due to adverse topography (Units 3 and 14), excessive wetness (Units 15 and SC & AV), and organic soils (Unit 16).

9.2 Core Area

Low Constraints - Soil Map Units 8a and 8d.

Areas of low constraints to settlement occur on well drained, gently undulating deltaic deposits.

Although the land is generally favorable for development some site specific problems may be encountered.

Moderate Constraints - Soil Map Units 8b, 10a, 15b and 15c.

Constraints to settlement include adverse topography (Unit 8b), and imperfectly drained soils (Unit 10a, 15b and 15c).

Careful site selection and proper design taking into account the constraints should enable successful development of these lands. Development costs will likely be higher than in areas of Low Constraints.

Severe Constraints - Soil Map Units 8c, 15a and 16.

Lands in this group are marginally suitable or unsuitable for development due to adverse topography (Unit 8c), excessive wetness (Unit 15a) or organic materials (Unit 16).

10.0 POTENTIAL LAND USE

The various settlement uses and agricultural capability have been considered together in preparing a Potential Land Use Map (page 38). It shows four distinctive Areas in terms of development opportunities as outlined below.

Area A - Soil Map Units 2, 5, 6, 8, 9 and 10.

This is land which has Low to Moderate Constraints to settlement and has the Best Agricultural Capability (Classes 2 and 3) in the region, being limited by climate, low moisture holding capacity, adverse topography and excessive moisture.

Area B - Soil Map Units 1, 4, 7, 11 and 13.

This area has Moderate Constraints to settlement due to excessive wetness (shallow water tables and imperfectly drained soils) and adverse topography. Agricultural Capability is Class 4 and 5. Class 4 areas (Units 1, 7, 11 and 13) are rated as marginal for cultivated crops and Class 5 areas (Unit 4) are suitable for improved pasture.

Area C - Soil Map Units 3, 12 and 14.

This area has Moderate to Severe Constraints to settlement and is predominantly Agricultural Capability Class 5: land that is suitable for improved pasture and forage production, not for cultivated crops.

Adverse topography and the presence of bedrock within Unit 12 are the principal constraints.

Area D - Soil Map Units 15, 16, SC & AV.

Area D contains lands which are generally unsuitable for settlement and agricultural uses due to poor drainage, shallow water tables and organic soils.

LEGEND

POTENTIAL LAND USE

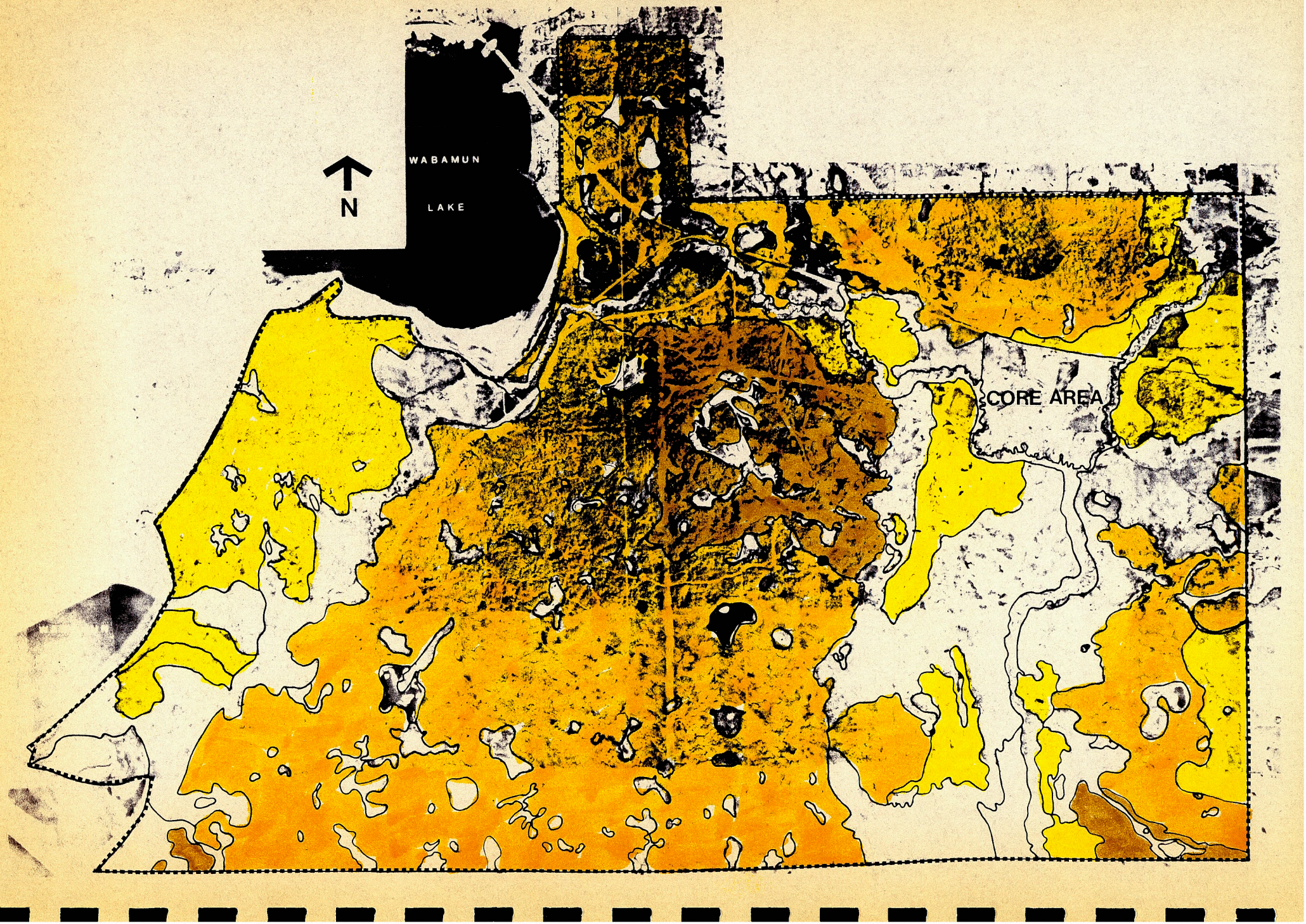
Area A - Suitable for Agriculture (Classes 2 and 3) and Low to Moderate Constraints to Settlement.

Area B - Marginal cultivated cropland, where improvements are feasible (Class 4) and Moderate Constraints to Settlement.

Area C - Suitable for unimproved pasture (Class 5) and Moderate to Severe Constraints to Settlement.

Area D - Unsuitable lands for all uses.

Scale 1:50,000


WABAMUN
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CORE AREA

11.0 SUMMARY

11.1 Reserve

- A Present Land Use Map at a scale of 1:50,000 has been prepared, based on photo-interpretation and field checking during the soil survey.

The great majority of the Reserve remains in the natural forest cover. Smaller parcels of land cleared for pasture and cultivation occur in the eastern regions of the Reserve.

- A semi-detailed soil survey of the Wabamun Indian Reserve was carried out. Soils were inspected at 89 sites and representative materials from 5 sites were sampled and analyzed. Sixteen principal map units have been redognized plus stream channels. These are described in the text and Legend of the Soil Map which is presented on an aerial photo mosaic at a scale of 1:20,000.

- Four parent materials are extensive in the Survey Area: outwash deposits, fluvial deposits, deltaic deposits and organic deposits.

The vast majority of the Reserve is occupied by well drained Orthic Dark Gray Chernozems and Dark Gray Luvisols developed on stratified sands, silts and clays of deltaic origin. Present to a lesser extent on deltaic materials are gleyed members of the foregoing and Gleysols. Soils on fluvial deposits are dominantly well drained sandy texture Orthic Eutric Brunisols. Loamy sand to gravelly textured, imperfectly drained Gleyed Dark Gray Chernozems are dominant on outwash deposits. Very poorly drained Terric Mesisols are dominant in the organic areas.

- An Agricultural Capability Map has been prepared at a scale of 1:50,000. Several areas of good agricultural land exist throughout the Reserve. Limitations of adverse climate (C), adverse topography (T), and excessive moisture (W), restrict the Agricultural Capability to Classes 2 and 3.

Limitations of adverse structure (D), low inherent fertility (F), low moisture holding capacity (M), adverse topography (T), and excessive wetness (W) further restrict the remaining Reserve areas to Class 4 (marginal for cultivated crops), 5 (suitable for improved pasture), and 6 (where improvements are not feasible).

- Soil interpretations or estimates of soil performance have been made using field and laboratory data, published guidelines and other soil surveys. The soil interpretations for settlement suitability include: constraints to family dwellings, road location, septic tank fields, recreation, sewage lagoon location, and sources of sand, gravel and subgrade materials.

These ratings for specific uses have been considered jointly in preparing a Settlement Suitability Map. For each map area, favorable and potentially troublesome conditions are given, emphasizing topography, drainage, wetness, soil physical properties and erosion hazard.

Areas of Low Constraints to settlement are found around the Core Area and in the southeast. Regions of Moderate Constraints to settlement are extensive throughout the Reserve. Potentially troublesome conditions likely to be encountered are adverse topography, excessive wetness and the possibility of flooding. Portions of the Reserve having Severe Constraints to settlement occur in the central and western sections. Troublesome conditions of excessive wetness, flooding, adverse topography, and organic materials make these areas unsuitable for settlement.

- Based on the concerns of agriculture, settlement and recreation, a Potential Land Use Map is provided which delineates four areas. Significant areas of land well suited for all uses (Area A) lie within the Reserve. The greatest portion of the Reserve is marginal cropland and pasture where proper site selection and remedial measures (levelling, drainage systems, etc.) would be required before development (Areas B and C). An appreciable amount of the land is unsuitable for all uses due to high water tables, poor drainage, and organic soils (Area D).

11.2 Core Area

- A detailed soil survey of the Core Area was carried out. Soils were inspected at 48 sites and representative parent materials from six sites were sampled and analyzed. Nine principal map units have been recognized. The Soil Map is presented on an aerial photo mosaic at a scale of 1:5,000.

- The two soil parent materials occurring in the Core Area are deltaic deposits and organic deposits. Well drained, loamy to clayey Eluviated Black Chernozems are dominant on the deltaic deposits. In lower topographical positions, imperfectly drained Gleyed Dark Gray Chernozems and Humic Luvic Gleysols are present. Within the depressional area adjoining Wabamun and Mink Creeks, poorly drained Orthic and Rego Humic Gleysols are dominant. Terric Mesisols occur on the organic deposits.

- Soil interpretations or estimates of soil performance have been made using field and laboratory data, published guidelines and other soil surveys. The soil interpretations for settlement suitability include: constraints to family dwellings, road location, septic tank fields, recreation, sewage lagoon location and sources of sand, gravel and subgrade materials.

These ratings for specific uses have been considered jointly in preparing a Settlement Suitability Map. For each map area, favorable and potentially troublesome conditions are given, emphasizing topography, drainage, wetness, soil physical properties and erosion hazard.

Significant areas having Low Constraints to settlement exist within the Core Area. Portions of the Core Area having potentially troublesome conditions of either adverse topography or imperfectly drained soils are rated as Moderate Constraints to settlement. The remainder of the Core has Severe Constraints to settlement. Troublesome conditions, such as adverse topography, shallowness to the water table, poorly drained soils, organic materials, and the hazard of flooding make these lands unsuitable for development.

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APPENDICES

APPENDIX A

- Soil Inspection Sites -

NOTATIONS:

Soil Subgroups

Brunisolic Soils

OEB	Orthic Eutric Brunisol

Gleysolic Soils

CHG	Carbonated Humic Gleysol
CRHG	Carbonated Rego Humic Gleysol
HULG	Humic Luvic Gleysol
OG	Orthic Gleysol
OHG	Orthic Humic Gleysol
PRHG	Peaty Rego Humic Gleysol
RHG	Rego Humic Gleysol

Organic Soils

TH	Terric Humisol
TM	Terric Mesisol

Chernozemic Soils

EBL	Eluviated Black Chernozem
GLDG	Gleyed Dark Gray Chernozem
LBL	Lithic Black Chernozem
OBL	Orthic Black Chernozem
ODG	Orthic Dark Gray Chernozem

Luvisolic Soils

DGL	Dark Gray Luvisol
GLDGL	Gleyed Dark Gray Luvisol

Solonetzic Soils

BLSS	Black Solodized Solonetz

Topography

Classes		Percent Slope
2	nearly level	0.5 - 2.5
3	very gentle slopes	2 - 5
4	gentle slopes	6 - 9
5	moderate slopes	10 - 15
6	strong slopes	15 - 30
7	very strong slopes	30 - 45

Stoniness Classes

SO	nonstony
S1	slightly stony

Textures

S	Sand
Si	Silt
C	Clay
F/f	Fine
vf	Very fine
O	Organic
L	Loam

INSPECTION SITES - Semi-Detailed Survey

Site	Soil	Parent Material	Drainage	Topo-graphy	Surface Stoni-ness	Dominant Textures (Depths in cm) 0-20	20-50	50-100	100-150
1	OBL	fluvial/sandy	well	4	S0	SL	S	S	
2	ODG	fluvial/sandy	well	3-4	S1	SL	SCL	S	
3	OGL	outwash/gravelly	well	3	S0	SiL	SCL	LS	SCL
4	OEB	outwash/deltaic	well	4	S0	LS	S	S	
5	OBL	fluvial/sandy	well	4	S0	L	SL	SL	S
6	CRHG	alluvial	poor	3	S0	L	S		
7	ODG	fluvial/deltaic	well	5	S0	LS	SCL	S	S
8	ODG	fluvial/deltaic	well	5	S0	L	LS	S	S
9	ODG	fluvial/deltaic	imperfect	5	S0	L	vfSL	S	
10	ODG	fluvial/deltaic	well	5	S0	L	S	SCL	S
11	ODG	fluvial/deltaic	well	4	S0	L	SL	LS	CL
12	OBL	deltaic	well	4	S0	L	L	SiCL	
13	ODG	fluvial/deltaic	well	4	S0	SL	LS	SC	
14	ODG	fluvial/deltaic	well	4	S0	SL	S	SiCL	SiCL
15	ODG	fluvial/deltaic	well	5	S0	SiL	SiCL	SiCL	SiCL
16	DGL	fluvial/deltaic	well	5	S0	SL	LS	SCL	S
17	ODG	fluvial/deltaic	well	5	S0	L	SC	S	
18	OG	deltaic	poor	2	S0	SL	SC		
19	CHG	deltaic	poor	2	S0	SL	SL	SC	SiCL
20	CHG	deltaic	poor	2	S0	CL	CL	CL	
21	CHG	deltaic	poor	2	S0	vfSL	vfSL	SiCL	vfSL
22	BLSS	till	imperfect	3	S0	L	C	CL	
23	OBL	deltaic	imperfect	3	S0	L	CL	S	
24	ODG	deltaic	well	3	S0	L	CL	S	
25	CHG	deltaic	poor	3	S0	C	C	C	C
26	RHG	deltaic	poor	2	S0	L	LS	LS	LS
27	ODG	deltaic	well	3	S0	L	CL		
28	EBL	deltaic	well	3	S0	L	CL	CL	CL
29	EBL	deltaic	well	4	S0	L	CL	CL	
30	ODG	deltaic	well	5	S0	CL	CL	CL	
31	ODG	deltaic	well	5	S0	L	CL	CL	CL
32	DGL	deltaic	well	5	S0	SiCL	SiCL	SiL	

INSPECTION SITES - Semi-Detailed Survey, Continued . . .

Site	Soil	Parent Material	Drainage	Topo-graphy	Surface Stoni-ness	Dominant Textures (Depths in cm) 0-20	20-50	50-100	100-150
33	DGL	deltaic	well	5	S0	SiL	SiCL	SiL	SiL
34	DGL	deltaic	well	5	S0	SiL	CL	CL	CL
35	DGL	deltaic	well	5	S0	SiL	CL	CL	CL
36	DGL	deltaic	imperfect	5	S0	L	CL	CL	
37	LBL	deltaic	imperfect	5	S0	L	CL		
38	DGL	deltaic	well	5	S0	L	SiL	SiCL	SiL
39	OHG	deltaic	poor	2	S0	L	SiL		
40	DGL	deltaic	well	4	S0	SiL	CL	CL	
41	DGL	deltaic	well	4	S0	SiL	CL	CL	
42	DGL	till	well	5	S1	L	CL	CL	CL
43	DGL	deltaic	well	4	S0	SiL	SiCL	SiCL	SiCL
44	DGL	deltaic	well	4	S0	SiL	SiCL	SiCL	
45	OEB	beach sand	well	2	S0	S	S	S	S
46	DGL	deltaic	well	6	S0	SiL	SiCL	SiL	SiL
47	DGL	deltaic	well	6	S0	SiL	CL	SiL	SiL
48	DGL	deltaic	well	4	S0	SiL	SiCL	SiL	SiL
49	DGL	deltaic	well	6	S0	SiL	SiCL	SiCL	
50	DGL	deltaic	well	6	S0	SiL	SiCL	SiCL	
51	DGL	deltaic	well	6	S0	SiL	SiCL	SiCL	
52	ODG	deltaic	well	4	S0	L	SiL	CL	SiCL
53	ODG	deltaic	well	6	S0	L	SC	S	
54	ODG	deltaic	well	6	S0	SiL	CL	SL	
55	DGL	deltaic	well	6	S0	L	CL	SiCL	
56	GLDG	deltaic	imperfect	6	S0	L	SiL	SiL	
57	OEB	deltaic	well	4	S0	SiL	SiL	SiL	
58	OEB	deltaic	well	4	S0	SiCL	SiCL	SiCL	SiCL
59	DGL	deltaic	well	4	S0	SiL	SiCL	SiL	
60	DGL	deltaic	well	5	S1	SiL	CL	CL	
61	OG	deltaic	imperfect	2	S0	L	S	S	S
62	ODG	deltaic	well	6	S0	L	SiL	CL	SiL
63	OEB	beach sand	imperfect	3	S1	LS	S	S	
64	DGL	deltaic	well	5	S0	SiL	CL	CL	CL

INSPECTION SITES - Semi-Detailed Survey, Continued . . .

Site	Soil	Parent Material	Drainage	Topography	Surface Stoniness	Dominant Textures (Depths in cm) 0-20	20-50	50-100	100-150
65	DGL	deltaic	well	4	S0	SiL	CL	CL	
66	EBL	deltaic	well	5	S0	L	CL	SiL	
67	ODG	deltaic	imperfect	4	S0	L	SiCL	SiCL	S
68	DGL	deltaic	well	6	S0	SiL	CL	CL	
69	DGL	deltaic	well	5	S0	SL	CL	CL	
70	DGL	deltaic	well	5	S0	SL	CL	CL	
71	DGL	deltaic	well	4	S0	CL	CL	CL	SiCL
72	DGL	deltaic	well	4	S0	SCL	C	CL	CL
73	DGL	deltaic	well	5	S0	FSL	CL	CL	SCL
74	ODG	deltaic	well	4	S0	L	SiCL	CL	
75	EBL	deltaic	well	5	S0	SiCL	SiCL	CL	
76	EBL	deltaic	well	5	S0	L	SiCL	SiCL	
77	EBL	deltaic	well	5	S0	L	CL	CL	
78	ODG	deltaic	well	5	S0	L	L	SiCL	
79	EBL	deltaic	well	5	S0	L	CL	SiL	
80	OHG	deltaic	poor	2	S0	L	CL		
81	ODG	deltaic	well	5	S0	SL	L		
82	EBL	fluvial/deltaic	well	5	S0	L	CL	SiL	
83	OEB	fluvial/sandy	rapid	5	S0	LS	S	S	S
84	OBL	outwash/gravelly	imperfect	3	S5	LS			
85	DGL	deltaic	imperfect	3	S0	L	SiL	CL	SiCL
86	GLDGL	deltaic	imperfect	3	S0	L	CL	SiCL	
87	DGL	deltaic	imperfect	3	S0	SiL	CL	CL	
88	TM	organic	poor	2	S0	O	O	CL	
89	ODG	deltaic	imperfect	3	S0	L	CL	S	

INSPECTION SITES - Detailed Survey

Site	Soil	Parent Material	Drainage	Topo-graphy	Water Table (m)	Dominant Textures (Depths in cm) 0-20	20-50	50-100	100-150
101	RHG	deltaic	poor	2	>1.2	L	CL	CL	
102	HULG	deltaic	poor	3	≈1	L	CL	CL	
103	TM	organic/deltaic	poor	2	1.3	O	O	O	CL
104	EBL	deltaic	well	3	>1.2	L	CL	SCL	
105	CHG	deltaic	poor	3	>1.2	L	CL	CL	
106	EBL	deltaic	well	3	>1.2	L	SiCL	SCL	
107	EBL	deltaic	well	3	>1.2	L	CL	SiCL	SC
108	GLDG	deltaic	imperfect	3	>1.2	L	CL	SCL	
109	EBL	deltaic	well	3	>1.2	L	CL	SiCL	SCL
110	EBL	deltaic	well	3	>1.2	L	L	CL	SiCL
111	ODG	deltaic	well	3	>1.2	L	CL	CL	
112	GDG	deltaic	imperfect	3	>1.2	L	CL	CL	SiCL
113	EBL	deltaic	well	3	>1.2	L	CL	CL	SiCL
114	EBL	deltaic	well	3	>1.2	L	CL	CL	FS
115	OHG	deltaic	poor	2	>1.2	L	CL	SC	CL
116	TM	organic/deltaic	poor	2	0.1	O	O	CL	
117	TM	organic/deltaic	poor	2	1.0	O	O	O	CL
118	TM	organic/deltaic	poor	2	0.8	O	O	O	CL
119	OHG	deltaic	poor	2	>1.2	L	CL	CL	
120	EBL	deltaic	well	3	>1.2	L	CL	CL	
121	ODG	deltaic	well	6	>1.2	L	CL	CL	
122	HULG	deltaic	poor	3	>1.2	L	CL	CL	
123	ODG	deltaic	well	5	>1.2	L	CL	CL	SiCL
124	PRHG	deltaic	poor	2	≈1.0	O	O	CL	CL
125	OHG	deltaic	poor	2	>1.2	L	CL	CL	
126	ODG	deltaic	well	5	>1.2	L	CL	CL	
127	CHG	deltaic	poor	2	≈1.0	L	CL	CL	
128	TM	organic/deltaic	poor	2	>1.2	O	O	CL	
129	TH	organic/deltaic	poor	2	0.5	O	O	CL	
130	TM	organic/deltaic	poor	2	0.3	O	O	CL	S
131	ODG	deltaic	well	3	>1.2	L	L	CL	CL
132	OHG	deltaic	poor	2	>1.2	L	CL	S	CL

INSPECTION SITES - Detailed Survey, Continued . . .

Site	Soil	Parent Material	Drainage	Topo-graphy	Water Table (m)	Dominant Textures (Depths in cm) 0-20	20-50	50-100	100-150
133	EBL	deltaic	well	3	>1.2	L	CLS	SCL	SCL
134	EBL	deltaic	well	3	>1.2	L	L	CL	
135	EBL	deltaic	well	3	>1.2	L	CL	CL	SCL
136	EBL	deltaic	well	3	>1.2	L	CL	CL	SCL
137	HULG	deltaic	imperfect	2	>1.2	L	L	FSL-C	CL
138	HULG	deltaic	imperfect	2	>1.2	SL	CL	CL	CL
139	RHG/ TM	organic/deltaic	poor	2	>1.2	L	SC		
140	PRHG	deltaic	poor	2	1.0	O	CL	C	
141	PRHG	deltaic	poor	2	>1.2	O	CL	CL	
142	PRHG	deltaic	poor	2	1.0	L	CL	CL	
143	EBL	deltaic	well	3	>1.2	L	CL	CL	
144	HULG	deltaic	poor	2	>1.2	L	FSL	CL	CL
145	HULG	deltaic	poor	2	>1.2	L	FSL	CL	CL
146	CRHG	deltaic	poor	2	0.8	L	CL	CL	
147	EBL	deltaic	well	3	>2.4	L	L	CL	
148	RHG	deltaic	poor	2	≈0.2	L	CL	SCL	
149	Water table hole				1.27				
150	Water table hole				>2.40				

CLASSIFICATION: Rego Humic Gleysol (RHG)

PARENT MATERIAL: Deltaic

DRAINAGE: Poorly

TOPOGRAPHY: Very gently undulating

DOMINANT IN UNIT(S): 15 and 15a

Horizon	cm	Description
Ah	0-30	Black (10YR2/1) loam; moderate medium granular; friable; stone-free.
Ckg	30-120	Grayish brown (10YR5/2) clay loam; massive; sticky; stone-free.

COMMENTS: Where Bg horizon is present between the A and C, profile becomes Orthic Humic Gleysol.

CLASSIFICATION: Orthic Eutric Brunisol (OEB)

PARENT MATERIAL: Fluvial

DRAINAGE: Rapidly

TOPOGRAPHY: Strongly rolling

DOMINANT IN UNIT(S): 3

Horizon	cm	Description
Ah	0-4	Very dark grayish brown (10YR3/2) loamy sand; moderate, medium granular; loose; stone-free.
Bm1	4-30	Brown to dark brown (10YR3/3) loamy sand; single grain; loose; stone-free.
Bm2	30-75	Dark yellowish brown (10YR4/4) sand; single grain; loose; stone-free.
Ck	75 +	Grayish brown (10YR5/2) sand; single grain; loose; stone-free.

COMMENTS: Where faint to distinct mottles (g) are present within upper 50 cm, profile becomes a Gleyed Eutric Brunisol.

CLASSIFICATION: Terric Mesisol (TM)

PARENT MATERIAL: Organic

DRAINAGE: Very poorly

TOPOGRAPHY: Nearly level

DOMINANT IN UNIT(S): 16

Horizon	cm	Description
Om	0-100	Dark brown (7.5YR3/2) layered or matted indiscernable moss peat.
Ckg	100 +	Dark gray (10YR4/1) clay loam; massive; sticky; stone-free.

COMMENTS: Where Om is less than 50 cm, profile becomes a Peaty Rego Gleysol.

Where Om is greater than 160 cm, profile is a Typic Mesisol.

CLASSIFICATION: Orthic Black Chernozem (OBL)

PARENT MATERIAL: Fluvial

DRAINAGE: Well

TOPOGRAPHY: Gently rolling

DOMINANT IN UNIT(S): 2

Horizon	cm	Description
Ah	0-20	Black (10YR2/1) loam; moderate, medium granular; very friable; stone-free.
AB	20-31	Very dark gray (10YR3/1) loam; moderate, medium granular; friable; stone-free.
Bm	31-46	Very dark grayish brown (10YR3/2) sandy loam; weak, fine subangular blocky; friable; stone-free.
Ck	80 +	Grayish brown (10YR5/2) sand; single grain; loose; stone-free.

COMMENTS: Where AB horizon is replaced by Ahe horizon, the profile becomes an Eluviated Black Chernozem.

CLASSIFICATION: Dark Gray Luvisol (DGL)

PARENT MATERIAL: Deltaic

DRAINAGE: Well

TOPOGRAPHY: Moderate to strong

DOMINANT IN UNIT(S): 11, 12, 13 and 14

Horizon	cm	Description
Ah	0-10	Black (10YR2/1) loam; moderate, medium granular; friable; stone-free.
Ae	10-15	Gray (10YR5/1) silt loam; weak, medium platy; friable; stone-free.
Bt	15-50	Dark grayish brown (10YR4/2) clay loam; strong medium subangular blocky; firm; stone-free.
BC	50-120	Brown to dark brown (10YR4/3) clay loam; moderate, fine subangular blocky; firm; stone-free.

COMMENTS: Where Ae is less than 5 cm thick, profile becomes Orthic Dark Gray Chernozem.

Where faint to distinct mottling (horizon suffix g) is present within upper 50 cm, profile becomes Gleyed Dark Gray Luvisol.

CLASSIFICATION: Gleyed Dark Gray Chernozem (GLDG)

PARENT MATERIAL: Outwash and Deltaic

DRAINAGE: Imperfectly

TOPOGRAPHY: Gently undulating to gently rolling

DOMINANT IN UNIT(S): 1, 9, 10 and 10a

Horizon	cm	Description
Ah	0-25	Black (10YR2/1) loam; moderate, medium granular; friable; stone-free.
Ahegj	25-28	Dark grayish brown (10YR4/2) silt loam; weak, fine platy; friable; stone-free.
Btg	28-50	Brown to dark brown (10YR4/3) clay loam; weak, fine subangular blocky; firm; stone-free.
BCg	50-65	Brown to dark brown (10YR4/3) silty clay loam; massive; friable; stone-free.
Ckg	65 +	Brown (10YR5/3) sandy clay loam; massive; soft; stone-free.

COMMENTS: Where evidence of gleying (g) is absent within the top 50 cm, profile becomes an Orthic Dark Gray Chernozem.

CLASSIFICATION: Orthic Dark Gray Chernozem (ODG)

PARENT MATERIAL: Deltaic

DRAINAGE: Well

TOPOGRAPHY: Gently to moderately rolling

DOMINANT IN UNIT(S): 6, 7 and 12

Horizon	cm	Description
Ah	0-16	Black (10YR2/1) loam; moderate, medium granular; friable; stone-free.
Bm	16-22	Dark yellowish brown (10YR4/4) sandy loam; weak, fine subangular blocky; friable; stone-free
Bt	22-50	Brown to dark brown (10YR4/3) sandy clay loam; moderate, medium angular blocky; firm; stone-free.
BC	50-65	Brown to dark brown (10YR4/3) loamy sand; weak, fine subangular blocky; friable; stone-free.
Ck	65-110	Brown (10YR5/3) silty clay loam; massive; friable; stone-free.

COMMENTS: Where color value of Ah is less than 3.5 when dry, profile becomes an Orthic Black Chernozem

CLASSIFICATION: Eluviated Black Chernozem (EBL)

PARENT MATERIAL: Deltaic

DRAINAGE: Well

TOPOGRAPHY: Gently undulating to moderately rolling

DOMINANT IN UNIT(S) 8, 8a, 8b, 8c, 8d and 11

Horizon	cm	Description
Ah	0-25	Black (10YR2/1) loam; moderate, medium granular; friable; stone-free.
Ahe	25-28	Very dark gray (10YR3/1) loam; weak, fine platy; friable; stone-free.
Bt	28-60	Very dark grayish brown (10YR3/2) clay loam; moderate, medium subangular blocky; firm; stone-free.
BC	60-105	Brown to dark brown (10YR4/3) clay loam; massive; stone-free.
Ck	105 +	Brown (10YR5/3) silty clay loam; massive; stone-free.

COMMENTS: Where color of Ah exceeds 3.5 when dry, profile becomes an Orthic Dark Gray Chernozem.

CLASSIFICATION:	Humic Luvic Gleysol (HULG)
PARENT MATERIAL:	Deltaic
DRAINAGE:	Poorly
TOPOGRAPHY:	Nearly level
DOMINANT IN UNIT(S):	15b and 15c

Horizon	cm	Description
Ah	0-20	Black (10YR2/1) loam; moderate, medium granular; friable; stone-free.
Aeg	20 -32	Gray (10YR5/1) fine, sandy loam; moderate, medium platy; friable; stone-free.
Btg	32-60	Brown to dark brown (10YR4/3) clay loam; moderate, medium angular blocky; firm; stone-free.
BCg	60-110	Brown (10YR5/3) clay loam; moderate, medium angular blocky; firm; stone-free.
Ckg	110 +	Brown (10YR5/3) clay loam; massive; firm; stone-free.

COMMENTS: Where Aeg horizon is absent, the profile becomes an Orthic Humic Gleysol.

APPENDIX B

- Guidelines for Soil Interpretations -

Table B1 Guidelines for Assessing Soil Constraints for Single Family Dwellings .. B2

Table B2 Guidelines for Assessing Soil Constraints for On-Site Sewage Disposal .. B3

Table B3 Guidelines for Assessing Soil Constraints for Road and Parking Lot Location B4

Table B4 Guidelines for Assessing the Suitability of Soils as a Source of Road Subgrade Material B5

Table B5 Guidelines for Assessing Soil Constraints for Camping Areas B6

Table B6 Guidelines for Assessing Soil Constraints for Picnic Areas B7

Table B7 Guidelines for Assessing Soil Constraints for Hiking Trails B8

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TABLE B1 Guidelines for Assessing Soil Constraints for Single Family Dwellings[1]

This guide provides ratings for undisturbed soils evaluated for single-family dwellings and other structures with similar foundation requirements. The emphasis for these ratings is on foundations, but slope, susceptibility to flooding, and seasonal wetness are also considered. On-site investigations are needed for specific placement of buildings, and for foundation design. All ratings are for undisturbed soils on information obtained from observations to a depth of 1 to 2 metres.

Items Affecting Use	Degree of Soil Constraint[2]		
	Low	Moderate	Severe
Flooding	None	None	Occasional flooding (once in 5 years).
Wetness[3] (soil drainage)	WITH BASEMENTS: Rapidly and well drained soils. Water-table below 1.5 m. WITHOUT BASEMENTS: Rapidly, well and moderately well drained soils. Water-table below 75 cm.	WITH BASEMENTS: Moderately well drained soils. Water-table 75-150 cm. WITHOUT BASEMENTS: Imperfectly drained soils. Water-table 50-75 cm.	WITH BASEMENTS: Imperfectly, poorly and very poorly drained soils. Water-table above 75 cm 1 month or more during the year. WITHOUT BASEMENTS: Poorly and very poorly drained soils. Water-table above 50 cm 1 month or more during the year.
Slope[4]	0 to 9%	9 to 15%	Greater than 15%
Shrink-swell Potential	Low-Unified Groups GW, GP, SW, SP, GM, GC, SM, SC, and CL with P.I. < 15	Moderate-Unified Groups ML, and CL with P.I. > 15	High-Unified Groups CH, MH, OL, OH and Peat
Frost Heave[5] Potential	Low (F1, F2)	Moderate (F3)	High (F4)
Depth to[6] Consolidated Bedrock	WITH BASEMENTS: More than 1.5 m WITHOUT BASEMENTS: More than 1 m	WITH BASEMENTS: 1 to 1.5 m WITHOUT BASEMENTS: .5 to 1 m	WITH BASEMENTS: Less than 1 m WITHOUT BASEMENTS: Less than .5 m
Sulphate attack on concrete	0 to 1000 p.p.m.	1000 to 2000 p.p.m.	Greater than 2000 p.p.m.

1. By reducing the slope limits 50%, this table can be used for evaluating limitations for buildings with large floor areas, but with foundation requirements not exceeding those of ordinary three-story buildings.
2. Some soils rated as having moderate or severe constraints may be good sites from an aesthetic or use standpoint, but require higher design and/or maintenance standards.
3. For explanation of soil drainage classes, see Appendix C.
4. Reduce slope limits 50% for those soils subject to hillside slippage.
5. Frost heave applies only where frost penetrates to the depth of the footings and soil is moist.
6. If the bedrock is soft enough so that it can be dug with light power equipment, reduce moderate to slight and severe to moderate.

TABLE B2 Guidelines for Assessing Soil Constraints for On-Site Sewage Disposal (Septic Tank Absorption Fields)

This guide applies to soils to be used as an absorption and filtering medium 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. Criteria are based on the ability of the soil to absorb effluent. A severe rating does not mean that a septic system should not be installed in a given soil, but rather indicates the difficulty which can be expected during installation and with subsequent maintenance. All ratings are based on soil information to a depth of 1 to 2 metres.

Items Affecting Use	Degree of Soil Constraint		
	Low	Moderate	Severe
Flooding	Not subject to flooding.	Not subject to flooding.	Subject to occasional flooding (once in 5 years).
Wetness[1] (soil drainage)	Rapidly, well and moderately well drained soils not subject to ponding or seepage. Water-table[3] below 3.0 m.	Imperfectly drained soils and soils subject to occasional ponding or seepage. Water-table 2.4 - 3.0 m.	Imperfectly drained soils subject to ponding. Poorly and very poorly drained soils. Rapidly drained soils if groundwater contamination hazard. Water-table[3] less than 2.4 m.
Slope	0 to 9%	9+ to 15%	Greater than 15%
Permeability[2]	Rapid to moderate (greater than 1.5 cm/hour)	Moderately slow (0.5 to 1.5 cm/hour)	Slow and very slow (less than 0.5 cm/hour). Very rapid and rapid if groundwater contamination hazard exists.
Depth to[3] Consolidated Bedrock	More than 3.0 m	2.4 to 3.0 m[4]	Less than 2.4 m

1. For an explanation of soil drainage classes, see Appendix C. It may, with caution, be possible to make some adjustment for the severity of the water-table constraint in those cases where seasonal use of the facility does not coincide with the period of high water-table.
2. Ratings should be related to the permeability of soil layers below the depth of the tile.
3. Depth to bedrock constraints based on an assumed tile depth of 1.8 metres and the need for at least 1.2 metres of soil below the bottom of the tile trench. The same depth constraints apply to water-table.
4. On slopes greater than 9 percent, a depth to bedrock of 2.4 to 3.0 metres becomes a severe constraint.

TABLE B3 Guidelines for Assessing Soil Constraints for Road and Parking Lot Location

This guide applies to soils evaluated for the location and maintennnce of local roads and parking lots. These are improved roads and parking lots which have some kind of all-weather surfacing, and they are graded to shed water and have ordinary provisions for drainage.

The properties most affecting these ratings are slope, shrink-swell potential, frost heave potential, flooding hazard, and seasonal wetness.

These ratings do not substitute for on-site investigations for specific developments.

Items Affecting Use	Degree of Soil Constraint		
	Low	Modernte	Severe
Flooding	None	Once in 5 years	More than once in 5 years
Wetness[1] (soil drainage)	Rapidly, well and moderateiy well drained	imperfectiy drained	Poorly and very poorly drained
Slope	0 to 9%	9+ to 15%	Greater than 15%
Shrink-swell[2] Potential	Low-very to moderately coarse textured soils	Moderate-medium to moderately fine textured soils	High-moderately fine to very fine textured soils
Unified Groups	GW, GP, SW, SP, GM, GC, SM, SC	CL with P.I. less than 15. ML	CL with P.I. 15 or more. CH, MH, OH, OL, Peat
AASHO group index	0 to 4	5 to 8	More than 8
Frost Heave[3] Potential	Low (F1,F2)	Medium (F3)	High (F4)
Depth to[4] Consolidated Bedrock	More than 1 m	0.5 to 1 m	Less than 0.5 m

1. For explanntion of soil drainage classes, see Appendix C.
2. For explanation of soil texture classes, see Appendix C. P.I. means plasticity index.
3. Frost heave applies where frost penetrates below the improved surface layer and moisture is sufficient to form ice lens at the freezing point.
4. If bedrock is soft enough so that it can be dug with power equipment, reduce moderate to slight and severe to moderate.

TABLE B4 Guidelines for Assessing the Suitability of Soils as a Source of Road Subgrade Material

This guide applies to rating of soils as a source of road subgrade material. The properties that influence these ratings are those that affect the load supporting capacity and stability of the subgrade (Unified and AASHO classification, wetness) and those that affect the workability (slope, wetness).

These ratings do not substitute for on-site investigations.

Items Affecting Use	Degree of Suitability[1]		
	GOOD (G)	FAIR (F)	POOR (P)
Wetness[2] (soil drainage)	Rapidly to moderately well drained	Imperfectly drained	Poorly and very poorly drained
Engineering[3] Groups			
Unified Group	GW, GP, GC,[4] SW, SP, SM, SC[4]	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 fourth degree of soil limitation - Unsuitable (U) - is also defined: slopes greater than 50%; permanently wet and organic soils; soils which flood every year; rock outcrops.
2. For explanation of soil drainage classes, see Appendix C.
3. This item estimates the strength of the soil as it applies to roadbeds and assuming the roads would be surfaced. On unsurfaced roads, very sandy soils may cause rough roads.
4. Downgrade to moderate if content of fines is greater than 30%.

TABLE B5 Guidelines for Assessing Soil Constraints for Camping Areas

This guide provides ratings for soils to be used intensively for tents, truck campers, and small trailers as well as the accompanying activities of outdoor living. It is assumed that little site preparation will be done other than shaping and levelling for tent and parking areas. The soil should be suitable for heavy foot traffic. Soil suitability for growing and maintaining vegetation is not a part of this guide, but is an important consideration in the final evaluation of a specific site.

Items Affecting Use	Degree of Soil Constraint		
	Low	Moderate	Severe
Flooding	None	None during season of use	Subject to flooding during season of use
Wetness[1] (soil drainage)	Rapidly, well and moderately well drained soils with no ponding. Water-table below 1 m during season of use	Moderately well and imperfectly drained soils with no ponding. Water-table below 50 cm during season of use	Imperfectly drained soils with occasional ponding of short duration, poorly and very poorly drained soils. Water-table above 50 cm during season of use
Slope	0 to 9%	9+ to 15%	Greater than 15%
Permeability	Very rapid to moderate inclusive (more than 1.5 cm/hour)	Moderately slow (0.5 to 1.5 cm/hour)	Slow and very slow (less than 0.5 cm/hour)
Surface[2] Stoniness	Classes 0 to 2	Class 3	Classes 4 and 5
Surface[3] soil texture	SL, FSL, VFSL, L and LS with textural B horizon. Not subject to soil blowing	CL, SCL, SiCL, SiL, LS and S other than loose sand	SC, SiC, C, loose sand and soils subject to severe blowing. Organic soils

1. For explanation of soil drainage classes, see Appendix C.
2. For explanation of stoniness classes, see Appendix C.
3. Influences ratings as it affects foot trafficability, dust, and soil permeability. See Appendix C for textural class definitions.

TABLE B6 Guidelines for Assessing Soil Constraints for Picnic Areas

This guide provides ratings for soils to be used as park-type picnic areas that are subject to heavy foot traffic. It is assumed that all vehicular traffic will be confined to access roads and parking lots. 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.

Items Affecting Use	Degree of Soil Constraint		
	Low	Moderate	Severe
Flooding	None during season of use	May flood 1 or 2 times for short periods during season of use	Floods more than 2 times during season of use
Wetness[1] (soil drainage)	Rapidly, well and moderately well drained soils. Water-table below 50 cm during season of use	Moderately well drained soils subject to occasional ponding. Imperfectly drained soils not subject to ponding. Water-table above 50 cm for short periods during season of use	Poorly and very poorly drained soils. Imperfectly drained soils subject to ponding. Water-table above 50 cm and often near the surface for a month or more during season of use
Slope	0 to 9%	9+ to 15%	Greater than 15%
Permeability	Very rapid to moderately slow inclusive (more than 0.5 cm/hour)	Slow (0.2 to 0.5 cm/hour)	Very slow (less than 0.2 cm/hour)
Surface[2] Stoniness	Classes 0 to 2	Class 3	Classes 4 and 5
Surface soil[3] texture	SL, FSL, VFSL, L and LS with textural B horizon. Not subject to soil blowing	CL, SCL, SiCL, SiL, LS and sand other than loose sand	SC, SiC, C, sand and soils subject to severe blowing. Organic soils

1. For explanation of soil drainage classes, see Appendix C.
2. For explanation of stoniness classes, see Appendix C.
3. Influences ratings as it affects foot trafficability, dust, and soil permeability. See Appendix C for textural class definitions.

TABLE B7 Guidelines for Assessing Soil Constraints for Hiking Trails

This guide provides ratings for soils to be used for local and cross country hiking trails. It is assumed that these areas will be used as they occur in nature, and that little or no soil will be moved. The steeper the slope upon which a trail is to be built, requires that more soil be moved to obtain a level tread, and the more miles of trail needed to cover a given horizontal distance. Severe constraint does not mean a trail cannot be built, but indicates high design requirements, costs of construction, and maintenance.

Items Affecting Use	Degree of Soil Constraint		
	Low	Moderate	Severe
Flooding	Not subject to flooding during season of use	May flood 1 or 2 times during season of use	Subject to flooding more than 2 times during season of use
Wetness[1] (soil drainage)	Rapidly, well and moderately well drained soils. Water-table below 50 cm during season of use	Moderately well drained soils subject to occasional seepage or 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 the surface for a month or more during season of use
Slope[2]	0 to 15%	15+ to 30%	Greater than 30%
Surface[3] Stoniness	Classes 0 to 2	Class 3	Classes 4 and 5
Surface soil[4] texture	SL, FSL, VFSL, and L	SiL, SiCL, SCL, CL, and LS	SC, SiC, C, Sand and soils subject to severe blowing. All very gravelly, very cherty, very cobbly and very channery soils. Organic soils

1. For explanation of soil drainage classes, see Appendix C.
2. Slope refers to the slope of the ground surface, and not the slope of the tread of the trail.
3. For explanation of stoniness classes, see Appendix C.
4. Influences ratings as it affects foot trafficability, dust, design, or maintenance. See Appendix C for textural class definitions.

TABLE B8 Guidelines for Assessing the Suitability of Soils as a Source of Sand and Gravel

This guide provides ratings of soils related only to their suitability as a source of sand and/or gravel. These ratings do not relate to the quality of the sand and gravel for specific uses such as road subgrade or concrete aggregate. On-site investigations are required to determine quality.

Items Affecting Use	Degree of Suitability[1]		
	GOOD (G)	FAIR (F)	POOR (P)
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 0.6 m	0.6 to 1.5 m	More than 1.5 m
Wetness[2] (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

1. A fourth degree of soil limitation - Unsuitable (U) - is also defined: organic soils; clayey soils; rock outcrops; steep slopes; permanently flooded soils.
2. For explanation of soil drainage classes, see Appendix C.

TABLE B9 Guidelines for Evaluating Soil Constraints for Sewage Lagoons.

A sewage lagoon (aerobic) is a shallow lake used to hold sewage for the time required for bacterial decomposition. The soils are considered for two functions (1) as a vessel for the impounded area and (2) as soil material for the enclosing embankment. Criteria for each function are given in Charts A and B respectively.

In Chart A the low constraints class includes soils that are effective in functioning as sealed basin floors and that are low in organic matter. Soils in the moderate constraint class are those that require special practices or treatment to modify constraints to their use as sites for sewage lagoons. Soils placed in the severe constraint class are those that are very porous, or that are high in organic matter, or that have other constraints that prevent their use as sites for sewage lagoons.

Chart B indicates properties and major behavior qualities that affect, especially adversely, the performance of soils if used in constructing earthfills intended for holding back water.

Chart A. Soil constraint ratings for sewage lagoons.

Item affecting use	Degree of soil constraint		
	Low	Moderate	Severe
Depth to water table (seasonal or year-round)	More than 150 cm	100-150 cm[1.]	Less than 100 cm[1.]
Permeability	Less than 1.5cm/hr.	1.5-5 cm/hr.	More than 5 cm/hr.
Depth to bedrock	More than 150 cm	100-150 cm	Less than 100 cm
Slope	Less than 5%	5-9%	More than 9%
Coarse fragments, less than 25 cm in diameter; percent, by volume	Less than 20%	20-50%	More than 50%
Percent of surface area covered by coarse fragments more than 25 cm in diameter	Less than 3%	3-15%	More than 15%
Organic matter	Less than 2%	2-15%	More than 15%
Flooding[2.]	None	None	Soils subject to flooding
Soil groups (Unified)[3.] (rated for use mainly as floor of sewage)	GC, SC, CL, and CH	GM, ML, SM and MH	GP, GW, SW, SP, OL, OH, and PT

1. If the floor of the lagoon is nearly impermeable material at least 60 cm thick, disregard depth to watertable.
2. Disregard flooding if it is not likely to enter or damage the lagoon. (low velocity and the depth less than about 1.5 m).
3. For interpretations for material for embankments see "Characteristics of Materials for Compacted Embankments".

Chart B. Characteristics of Materials for Compacted Embankments.

Unified Classification	Shear Strength	Compressibility	Permeability of Compacted Soil	Susceptibility to Piping	Compaction Characteristic
GW	High	Low	High	Low	Good
GP	High	Low	High	Low	Good
GM	High to medium	Low	Medium to low	Medium to low	Fair to good
GC	Medium	Low to medium	Low	Medium to low	Good to fair
SW	High	Low	High	Medium	Good
SP	Medium	Low	High	Medium to high	Good
SM	Medium	Low to medium	Medium to low	Medium to high	Fair to good
SC	Medium to low	Low to medium	Low	Medium to low	Good to fair
ML	Medium to low	Medium	Medium to low	High	Fair to poor
CL	Medium to low	Medium	Low	Low to medium	Fair to good
MH	Low	High	Low to medium	Medium to low	Poor
CH	Medium to low	High	Low	Low	Fair to poor
OL[1.]	Low	High	Low to medium	Medium to high	Fair to poor
OH[1.]	Low	High	Low	Medium to low	Poor
Pt[2.]					

1. Suitable for use in low embankments with very low hazard only.
2. Not suitable for embankments.

APPENDIX C

i. Definition of Soil Horizon Symbols

ii. Soil Textural Classes

iii. Soil Drainage Classes

iv. Topography Classes

v. Surface Stoniness Classes

vi. Glossary of Terms

TABLE C1 Definition of Soil Horizon Symbols (Canada Soil Survey Committee, 1978)

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 C (approximately 30% organic matter) by weight. Two groups of these horizons are recognized, the O horizons and the L, F, and H horizons.

O - This is an organic horizon developed mainly from mosses, rushes, and woody materials. It is divided into the following subhorizons.

Of - This is an O horizon consisting largely of fibric materials that are readily identifiable as to botanical origin. A fibric horizon (Of) 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. Fiber is defined as the organic material retained on a 100-mesh sieve (0.15 mm), except for wood fragments that cannot be crushed in the hand and are larger than 2 cm in the smallest dimension.

Om - This is an O horizon consisting of mesic material, which is at a stage of decomposition intermediate between fibric and humic materials. The material is partly altered both physically and biochemically. It does not meet the requirements of either a fibric or a humic horizon.

Oh - This is an O horizon consisting of humic material, which is at an advanced stage of decomposition. The horizon has the lowest amount of fiber, the highest bulk density, and the lowest saturated water-holding capacity of the O horizons. It is very stable and changes very little physically or chemically with time unless it is drained. The rubbed fiber content is less than 10% by volume and the pyrophosphate index is 3 or less.

L,F, and H - These are organic horizons that developed primarily from the accumulation of leaves, twigs, and woody materials with or without a minor component of mosses. Usually they are not saturated with water for prolonged periods.

L - This is an organic horizon that is characterized by an accumulation of organic matter derived from leaves, twigs, and woody materials in which the original structures are easily discernible.

F - This is an organic horizon that is characterized by an accumulation of partly decomposed organic matter derived mainly from leaves, twigs, and woody materials. Some of the original structures are difficult to recognize. The material 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 that is characterized by an accumulation of decomposed organic matter in which the original structures are indiscernible. This horizon differs from the F by having greater humification due chiefly to the action of organisms. It is frequently intermixed with mineral grains, especially near the junction with a mineral horizon.

Master Mineral Horizon and Layers

Mineral horizons contain 17% or less organic C (about 30% organic matter) by weight.

A - This is a mineral horizon formed at or near the surface in the zone of leaching or eluviation of materials in solution or suspension, or of maximum in situ accumulation of organic matter or both. The accumulation of organic matter is usually expressed morphologically by a darkening of the surface soil (Ah), and conversely the removal of organic matter is usually expressed by a lightening of the soil color usually in the upper part of the solum (Ae). The removal of clay from the upper part of the solum (Ae) is expressed by a coarser soil texture relative to the underlying subsoil layers. The removal of iron is indicated usually by a paler or less red soil color in the upper part of the solum (Ae) relative to the lower part of the subsoil.

B - This is a mineral horizon characterized by enrichment in organic matter, sesquioxides, or clay; or by the development of soil structure; or by a change of color denoting hydrolysis, reduction, or oxidation. The accumulation in B horizons of organic matter (Bh) is evidenced usually by dark colors relative to the C horizon. Clay accumulation is indicated by finer soil textures and by clay cutans coating peds and lining pores (Bt). Soil structure developed in B horizons includes prismatic or columnar units with coatings or stainings and significant amounts of exchangeable sodium (Bn) and other changes of structure (Bm) from that of the parent material.

Color changes include relatively uniform browning due to oxidation of iron (Bm), and mottling and gleying of structurally altered material associated with periodic reduction (Bg).

C - This is a mineral horizon comparatively unaffected by the pedogenic processes operative in A and B, (C), except the process of gleying (Cg), and the accumulation of calcium and magnesium carbonates (Cca) and more soluble salts (Cs, Csa). Marl, diatomaceous earth, and rock no harder than 3 on Mohs' scale are considered to be C horizons.

R - This is a consolidated bedrock layer that is too hard to break with the hands (>3 on Mohs' scale) or to dig with a spade when moist and 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 eluviation of clay, Fe, Al, or organic matter alone or in combination. When dry, it is usually higher in color value by one or more units than an underlying B horizon. It is used with A (Ae).

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.

j - Used as a modifier of 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.

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.

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

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

Soil Texture Classification

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.

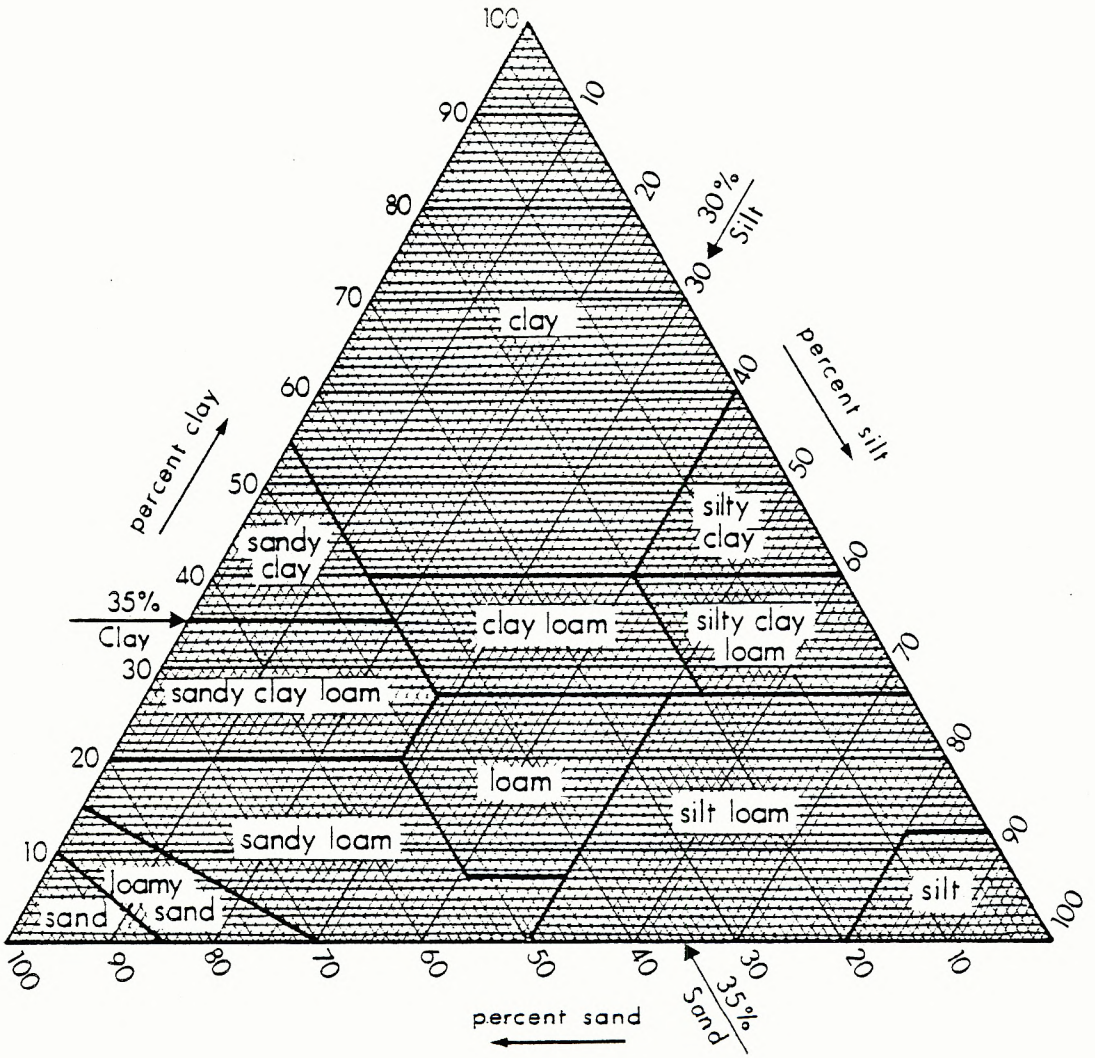
Soil Separates (Particle Size) on which Textural Classes are based:

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

By knowing the particle size distribution of the soil separates one can determine the textural class by using the soil textural triangle shown in Figure 3.

The soil textural classes are grouped according to the Canada Department of Agriculture (1974) 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 to 60% clay).
Very fine textured:	heavy clay (more than 60% clay).



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.

Figure 3. Guide for USDA soil textural classification (after U.S.D.A., 1972)

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 (C.D.A., 1974).

Rapidly drained - soil moisture content seldom exceeds field capacity in any horizon, except immediately after water addition.

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.

Moderately well drained - soil moisture in excess of field capacity remains for a small, but significant period 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.

Topographic Classes (after C.S.S.S., 1978)

1	level	- 0	- 0.5%	slopes
2	nearly level	- 0.5	- 2.0%	slopes
3	very gently undulating	- 2	- 5%	slopes
4	gently rolling	- 5	- 9%	slopes
5	moderately rolling	- 9	- 15%	slopes
6	strongly rolling	- 15	- 30%	slopes
7	hilly	- 30	- 45%	slopes
8	very hilly	- 45	- 70%	slopes
9	steep	-	> 70%	slopes

Surface Stoniness Classes (after C.S.S.S., 1978)

S0: nonstony

S1: slightly stony land - There are some stones, but they offer only slight to no hinderance to cultivation.

S2: moderately stony land - There are enough stones to cause some interference with cultivation.

S3: very stony land - There are enough stones to constitute a serious handicap to cultivation and some clearing is required.

S4: exceedingly stony land - There are enough stones to prevent cultivation until considerable clearing is done.

S5: excessively stony land - This land is too stony to permit any cultivation (Boulder or stone pavement).

GLOSSARY OF TERMS

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

AASHO classification - The official classification of soil materials and soil aggregate mixtures for highway construction used by the American Association of State Highway Transportation officials.

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

Aeration - The process by which air in the soil is replaced by air from the atmosphere.

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

Alkaline soil - a soil having a pH greater than 7.0.

Alluvial deposit - sediments deposited by moving water.

Atterberg Limits - Various moisture contents of a soil at which it changes from one major physical condition to another. The Atterberg limits which are most useful for engineering purposes are liquid limit and plastic limit.

The liquid limit is the moisture content at which a soil passes from a plastic to a liquid state.

The plastic limit is the moisture content at which a soil changes from a semi-solid to a plastic state.

Plasticity index (P.I.) is defined as the numerical difference between liquid limit and plastic limit.

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

Bearing capacity - the average load per unit area that is required to rupture a supporting soil mass.

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

Blanket - Herein used as a term to describe a mantle of unconsolidated materials thick enough to mask minor irregularities in the underlying unit but which still conforms to the general underlying topography.

Bulk density, soil - the mass of dry soil per unit bulk volume.

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.

Compressibility - the susceptibility of a soil to decrease in volume when subjected to a load.

Concretion - a local concentration of a chemical compound, such as calcium carbonate or iron oxide, in the form of a grain or nodule of varying size, shape, hardness and color.

Consistence - (a) the resistance of a material to deformation or rupture;
(b) the degree of cohesion or adhesion of the soil mass.

Control section - the vertical section upon which soil classification is based.

Creep - a 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.

Droughty soil - sandy or rapidly drained soil.

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

Engineering tests - laboratory tests made to determine the physical properties of soils that affect their uses for various types of engineering construction.

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 natural cover or ground conditions and includes those due to human activity.

Fertility - the status of a soil in relation to the amount and availability to plants of elements necessary for plant growth.

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

Fluvial deposits - All sediments, past and present, deposited by flowing water, including glaciofluvial deposits. Wave worked deposits and deposits resulting from sheet erosion and mass wasting are not included.

Frost-free period - season of the year between the last frost of spring and first frost of fall.

Frost heave, in soil - the raising of a surface caused by ice formation in the underlying soil.

Glaciofluvial deposits - Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice. The deposits are stratified and may occur in the form of outwash plains, deltas, kames, eskers, and kame terraces.

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".

Gleysolic soil - soil developed under wet conditions resulting in reduction of iron and other elements and in gray colors and mottles.

Ground moraine - unsorted mixture of rocks, boulders, sand, silt, and clay deposited by glacial ice. Predominantly till with some stratified drift. Ground moraine is usually in the form of undulating plains having gently sloping swells, sags, and enclosed depressions.

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. See Table 14 in Appendix C.

Hummocky dead-ice moraine - a till deposit composed of knobs and depressions with local relief generally in excess of 13 metres. May also include stratified drift.

Humus - that more or less stable fraction of the soil organic matter remaining after the major portion of added plant and animal residues have decomposed. Usually it is dark colored.

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.

Immature soil - a soil having weakly developed horizons.

Infiltration - the downward entry of water into the soil.

Morphology, soil - the makeup of the soil, including the texture, structure, consistence, color, 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.

Ped - a unit of soil structure such as a prism, block, or granule, formed by natural processes (in contrast to a clod, which is formed artificially).

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 - see soil reaction.

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.

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.

Shrink-swell potential - tendency of soils to undergo volume changes with changes in water content.

Soil reaction - the degree of acidity or alkalinity of a soil, usually expressed as a pH value. Descriptive terms commonly associated with certain ranges in pH are: extremely acid, < 4.5; very strongly acid, 4.5-5.0; strongly acid, 5.1-5.5; moderately acid, 5.6-6.0; slightly acid, 6.1-6.5; neutral, 6.6-7.3; slightly alkaline, 7.4-7.8; moderately alkaline, 7.9-8.4; strongly alkaline, 8.5-9.0; and very strongly alkaline, > 9.0.

Soil structure - the combination or arrangement of primary soil particles into secondary particles, units, or peds. The secondary units are characterized and classified on the basis of size, shape, and degree of distinctness into classes, types and grades.

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.

Subsoil - technically, the B horizon; broadly, the part of the profile below plow depth.

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 nonsorted clay, silt, sand and boulders.

Topsoil - (i) the layer of soil moved in cultivation. (ii) the A-horizon. (iii) the Ah-horizon. (iv) presumably fertile soil material used to topdress roadbanks, gardens and lawns.

Trafficability - the capacity of a soil to withstand traffic by people, horses, or vehicles.

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.

Veneer - Herein used as a term to describe a mantle of unconsolidated materials too thin to mask the minor irregularities 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 genesis.

Water-holding capacity - the ability of soil to hold water. The water-holding capacity of sandy soils is usually considered to be low while that of clayey soils is high. Often expressed in mm of water per cm depth of soil.

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

Weathering - the physical and chemical disintegration, alteration, and decomposition of rocks and minerals at or near the earth's surface by atmospheric agents.

WABAMUN LAKE INDIAN RESERVE NO. 133A

CORE AREA SOIL MAP

SCALE 1:5000

PREPARED FOR INDIAN AND NORTHERN AFFAIRS - ALBERTA

BY *Pedology Consultants*
SEPTEMBER 1980

GRAPHICS: HEINE JOHNSON SUSTRONK WEINSTEIN & ASSOCIATES LIMITED

LEGEND

Soil Map Unit	LANDFORM Parent Material and Surface Expression	SOILS Subgroups D= Dominant, S= Significant, I= Inclusions (percentage extent)	Drainage Class	Stoniness	SCHEMATIC CROSS-SECTIONS D= Dominant, S= Significant, I= Inclusions, MU= Map Unit
Soils on Deltaic Deposits					
8a	- 20 to 30 cm of black loam overlying weakly calcareous brown clay loam - very gently undulating, slopes 2-5%	D - Eluviated Black Chernozems	well	nonstony	D
8b	- 25 to 35 cm of black loam overlying weakly calcareous brown clay loam - moderately rolling, slopes 10-15%	D - Eluviated Black Chernozems (70%) S - Orthic Dark Gray Chernozems (30%)	well	nonstony	S D S D
8c	- 25 to 35 cm of black loam overlying weakly calcareous brown clay loam - inclined, slopes 16-30%	D - Eluviated Black Chernozems (80%) S - Orthic Dark Gray Chernozems (20%)	well	nonstony	MU 15a S D
8d	- 20 to 30 cm of black loam overlying weakly calcareous brown clay loam - very gently undulating, slopes 2-5%	D - Eluviated Black Chernozems (70%) S - Orthic Dark Gray Chernozems (30%)	well	nonstony	S D
10a	- 10 to 20 cm of black loam overlying dark brown to dark grayish brown clay loam underlain by brown sandy clay - very gently undulating, slopes 2-5%	D - Gleyed Dark Gray Chernozems (60%) S - Eluviated Black Chernozems (20%) and Orthic Dark Gray Chernozems (20%)	imperfect	nonstony	S D S
15a	- stratified sands, silts and predominantly clay. Pockets of organic soils (Terric Mesisols) are found within the map unit - level to nearly level, slopes 0-2%	D - Orthic and Rego Humic Gleysols (80%) S - Terric Mesisols (20%)	poor	nonstony	D S D S D
15b	- 10 to 30 cm of black loam overlying gray to dark grayish brown fine sandy loam underlain by brown clay loam - level to nearly level, slopes 0-2%	D - Humic Luvic Gleysols	imperfect	nonstony	D
15c	- 10 to 30 cm of black loam overlying gray to dark grayish brown fine sandy loam underlain by brown clay loam - level to nearly level, slopes 0-2%	D - Humic Luvic Gleysols	imperfect	nonstony	MU 8b D MU 8b
Soils on Organic Deposits					
16	- fen and sedge organic materials generally underlain by gray clay at 80 to 120 cm - level to nearly level, slopes 0-2%	D - Terric Mesisols	poor	nonstony	D

+ 7 — Soil inspection site
→ — Flow Direction
WT — Water Table Measurement

WABAMUN LAKE INDIAN RESERVE NO. 133A

SOIL MAP

SCALE 1:20000

PREPARED FOR INDIAN AND NORTHERN AFFAIRS ALBERTA

BY *Pedology Consultants*
SEPTEMBER 1980

GRAPHICS: HEINE JOHNSON SUSTRONK WEINSTEIN & ASSOCIATES LIMITED

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LEGEND

SOIL MAP UNIT	LANDFORM Parent Material and Surface Expression	SOILS Subgroups D=Dominant, S=Significant, I=Inclusions (percentage extent)	Drainage Class	Stoniness	SCHEMATIC CROSS-SECTIONS D= Dominant, S= Significant, I= Inclusions
Soils on Outwash Deposits					
1	- about 40 cm of loamy sand , overlying 110 cm of gravel, underlain by weakly calcareous, clay loam till - level to undulating, slopes 0-2%	D - Gleyed Dark Gray Chernozems (>50%)	imperfect	slightly stony	
		S - Eluviated Black Chernozems (30%)	well	slightly stony	
		I - Humic Gleysols	poor	nonstony	
Soils on Fluvial Deposits					
2	- 20 to 30 cm of sandy loam overlying sand and loamy sand - gently rolling, slopes 6-9%	D - Orthic Black Chernozems (50%)	rapid	nonstony	
		S - Orthic Eutric Brunisols (20-40%)	rapid		
		I - Gleyed Chernozems and Luvisols	imperfect		
3	- greater than 125 cm of weakly calcareous sand and loamy sand - strongly rolling, slopes 16-30%	D - Orthic Eutric Brunisols (>60%)	rapid	nonstony	
		I - Orthic Black Chernozems	well		
4	- beach deposits, weakly calcareous sand - undulating to level, slopes 0-2%	D - Gleyed Eutric Brunisols (>50%)	imperfect	nonstony	
		S - Orthic and Rego Gleysols (20-30%)	poor		
		I - Orthic Eutric Brunisols	well		
Soils on Deltaic Deposits					
5	- about 30 cm of loamy deltaic deposits overlying 20 cm of outwash gravel , underlain by stratified sand, silt and clay of deltaic origin - undulating to level, slopes 0-2%	D - Gleyed Dark Grey Luvisols (50%)	imperfect	slightly stony	
		S - Dark Gray Luvisols (20-40%)	well		
		I - Orthic Gleysols	poor		
6	- 10 to 20 cm of loamy sand to sandy loam, overlying stratified sand , silt and clay . Till is generally encountered at about 1 m in upland positions - gently rolling, slopes 6-9%	D - Orthic Dark Gray Chernozems (>60%)	well	nonstony	
		S - Eluviated Black Chernozems (20-30%)	well		
		I - Gleyed Black Chernozems	imperfect		
7	- 40 cm of loamy sand to loam overlying weakly calcareous stratified sand , silt and clay - moderately rolling, slopes 10-15%	D - Orthic Dark Gray Chernozems (>60%)	well	nonstony	
		S - Dark Gray Luvisols (20-30%)	well		
		I - Gleyed Luvisols and Chernozems	imperfect		
8	- about 30 cm of loam, overlying weakly calcareous, clay loam. Till may be present as shallow as 75 cm - very gently undulating, slopes 2-5%	D - Eluviated Black Chernozems (>60%)	well	nonstony	
		S - Orthic Dark Gray Chernozems (25%)	well		
		I - Gleyed Chernozems and Orthic Gleysols	imperfect and poor		
9	- 20 cm of loam, overlying 40-80 cm of clay loam, underlain by sand - very gently undulating, slopes 2-5%	D - Gleyed Dark Gray Chernozems (>50%)	imperfect	nonstony	
		S - Dark Gray Chernozems (20-40%)	well		
		I - Gleysols	poor		
10	- 10 to 20 cm of loam, overlying 40 to 80 cm of clay loam underlain by sand - gently rolling, slopes 6-9%	D - Gleyed Dark Gray Chernozems (>50%)	imperfect	nonstony	
		S - Orthic Dark Gray Luvisols (20-30%)	well		
		I - Orthic Gleysols	poor		
11	- 10 to 30 cm of loam overlying clay loam - moderately rolling to hummocky, slopes 10-15%	D - Orthic Dark Gray Luvisols and Eluviated black Chernozems (>60%)	well	nonstony	
		S - Dark Gray Chernozems	well		
		I - Sloughs and Gleysols	poor		
12	- 20 cm of loam overlying 40 cm of clay loam. Coal is generally present within 80 cm of the surface - moderately rolling to hummocky, slopes 10-15%	D - Dark Gray Luvisols and Chernozems (>60%)	well	slightly stony	
		S - Lithic Black Chernozems (35%)	well		
		I - Gleysols	poor		
13	- loam to 20 cm of loam to silt loam overlying weakly calcareous clay loam - moderately rolling to hummocky, slopes 10-15%	D - Dark Gray Luvisols (>60%)	well	nonstony	
		S - Sloughs (25%)	- - -		
		I - Dark Gray Chernozems and Gleysols	well and poor		
14	- 10 to 20 cm of loam to silt loam overlying 50 cm of clay loam underlain by weakly calcareous, silt loam - strongly hummocky, slopes 16-30%	D - Dark Gray Luvisols (>60%)	well	nonstony	
		S - Sloughs (25%)	- - -		
		I - Dark Gray Chernozems and Gleysols	well and poor		
15	- stratified sand , silt and predominantly clay. Pockets of shallow organic deposits are found in the interior parts of the map unit - level to undulating, slopes 2 - 5%	D - Orthic and Rego Humic Gleysols (>70%)	poor	nonstony	
		S - Terric Mesisols (15-20%)	poor		
		I - Humic Luvic Gleysols	imperfect		
Soils on Organic Deposits					
16	- fen and bog organic materials generally underlain by gray clay at about 80-120 cm - some gleysols are found around the perimeter of the unit - level to clearly level, slope 0-2%	D - Terric Mesisols	poor	nonstony	
		I - Gleysols	poor		
Miscellaneous Map Units					
Sc & Ar	- represents the area occupied by the stream channels and the meander plain of the Wabamun and Hink Creeks				
	- slough				
+	- soil inspection site