LAND RESOURCE SURVEY

ALEXANDER INDIAN RESERVE

Pedology Consultants

1980

LAND RESOURCE SURVEY

ALEXANDER INDIAN RESERVE 134

1980

Prepared for

Indian and Northern Affairs
Alberta Region

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TABLE OF CONTENTS

		PAGE
1.0	INTRODUCTION	1
2.0	GENERAL DESCRIPTION OF MAPPING PROGRAM	2
2.1	The Role of Land Resource Surveys in Development Planning	2
2.2	Previous Studies	5
2.3	Mapping Systems	6
2.3.1	Soil Mapping	6
2.3.2	Present Land Use Mapping	8
2.4	Interpretive Classification Systems	9
2.4.1	The Soils Input	9
2.4.2	Agricultural Capability Classification ...	10
2.4.3	Soil Interpretaions for Settlements	14
3.0	DESCRIPTION OF THE ALEXANDER INDIAN RESERVE 134	17
	Location and Extent	17
	Physiography and Drainage	17
	Geology	17
	Hydrogeology	19
	Climate	19
	Vegetation	19
4.0	METHODS	21
5.0	PRESENT LAND USE	22
6.0	SOILS	24
7.0	LABORATORY ANALYSIS	28
8.0	AGRICULTURAL CAPABILITY	28
9.0	SETTLEMENT SUITABILITY	32
10.0	POTENTIAL LAND USE	34
11.0	SUMMARY	40
12.0	REFERENCES	42

TABLE OF CONTENTS, Continued . . .

APPENDICES

Appendix A - Soil Inspection Sites

Appendix B - Guidelines for Soil Interpretations

Appendix C - Definitions

LIST OF MAPS

Present Land Use 23
Agricultural Capability 31
Settlement Suitability 36
Potential Land Use 39
Soil Map ..... back pocket

LIST OF TABLES

Table 1. Checklist for Assessing Soil Constraints for Settlement Uses 16
Table 2. Mean Daily Temperatures 20
Table 3. Monthly and Annual Precipitation Data 20
Table 4. Laboratory Test Data and Classification of Typical Materials in the Alexander Indian Reserve 27
Table 5. Agricultural Capability Ratings of the Alexander Indian Reserve 30
Table 6. Degrees and Kinds of Constraints for Various Settlement Uses of all Map Units Occurring in the Alexander Indian Reserve 134 33

LIST OF FIGURES

Figure 1. Locations of Indian Reserves surveyed in this Series 3
Figure 2. Location Map of Alexander Indian Reserve 134, Scale 1:750,000 18
Figure 3. Guide for USDA soil textural classification C7

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 selected Core Areas 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 Alexander 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 symbols and textural, drainage, topographic and stoniness classes, and a glossary of technical terms.

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,

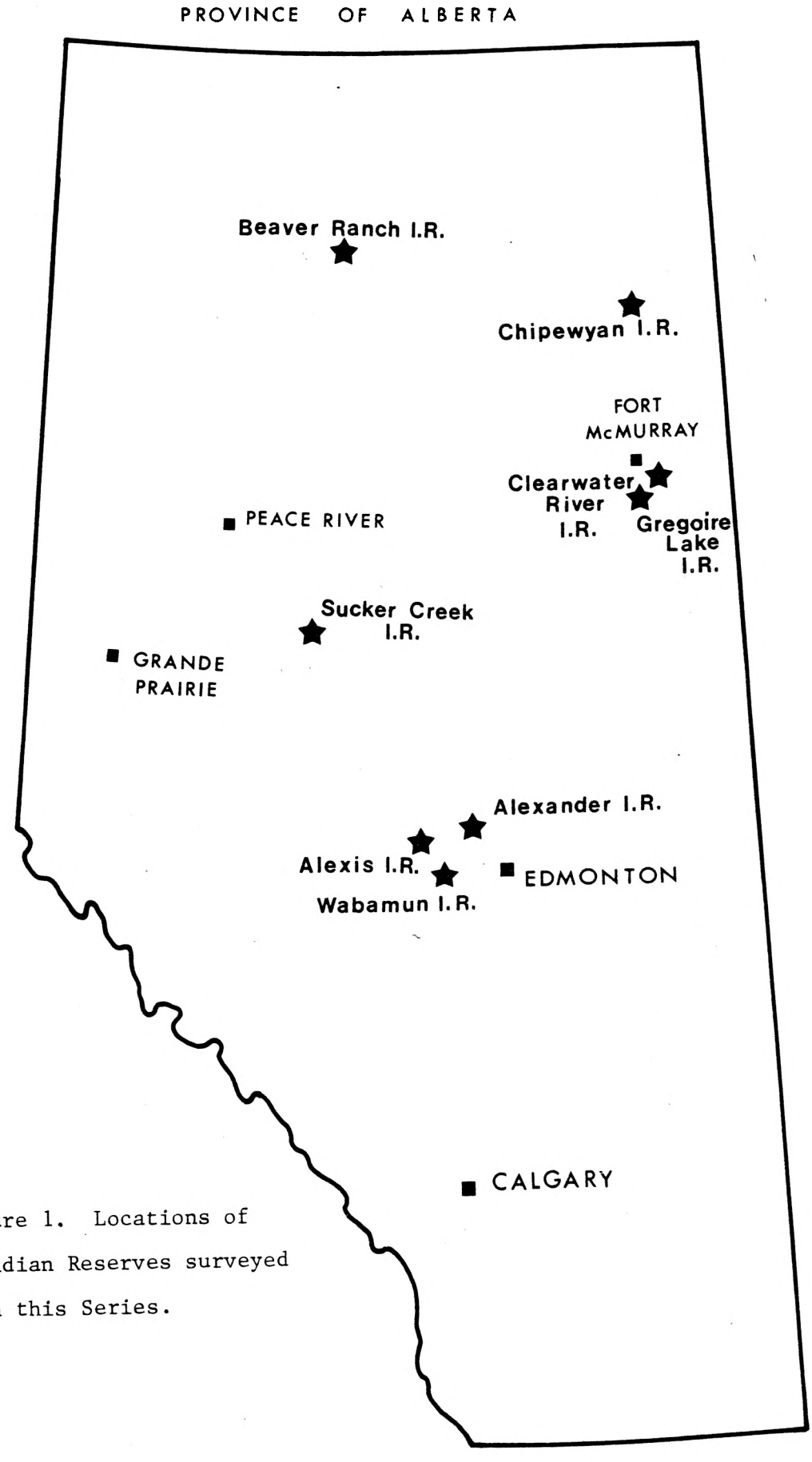


Figure 1. Locations of Indian Reserves surveyed in this Series.

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				

3.0 DESCRIPTION OF THE ALEXANDER INDIAN RESERVE 134

Location and Extent

The Alexander Indian Reserve is located about 30 kilometres northwest of Edmonton, Alberta. The Reserve covers 6,890 hectares (17,024 acres) within Townships 55 and 56, Range 27, West of the 4th Meridian, and Townships 55 and 56, Range 1, West of the 5th Meridian (Figure 2.).

Physiography and Drainage

Most of the landscape is undulating to gently rolling, except for some strongly rolling hills in the south-western part of the Reserve, and there are steep banks along streams. Four major soil parent materials occur: glacio-lacustrine deposits overlying till; till; shallow till and modified residual materials overlying bedrock; and organic deposits (bogs and fens).

Differences in soil characteristics, drainage and local topography resulted in the separation of eleven principal soil map units plus minor units including beach sands, stream channels and sloughs. These are all described in more detail in Section 6.0.

Elevations within the Reserve range from about 655 m (2,150 ft.) to 730 m (2,400 ft.) above sea level.

Sandy Lake borders the south-west corner of the Reserve. Two small lakes, Low Water Lake and the east end of Bard Lake as well as several sloughs occur within the Reserve. Surface drainage is provided by Riviere Qui Barre, and its tributaries, which flows southeastward, eventually to the North Saskatchewan River.

Geology

The Edmonton Formation of Late Cretaceous age underlies the entire Study Area (Green, 1972). This formation is of fresh and brackish water origin

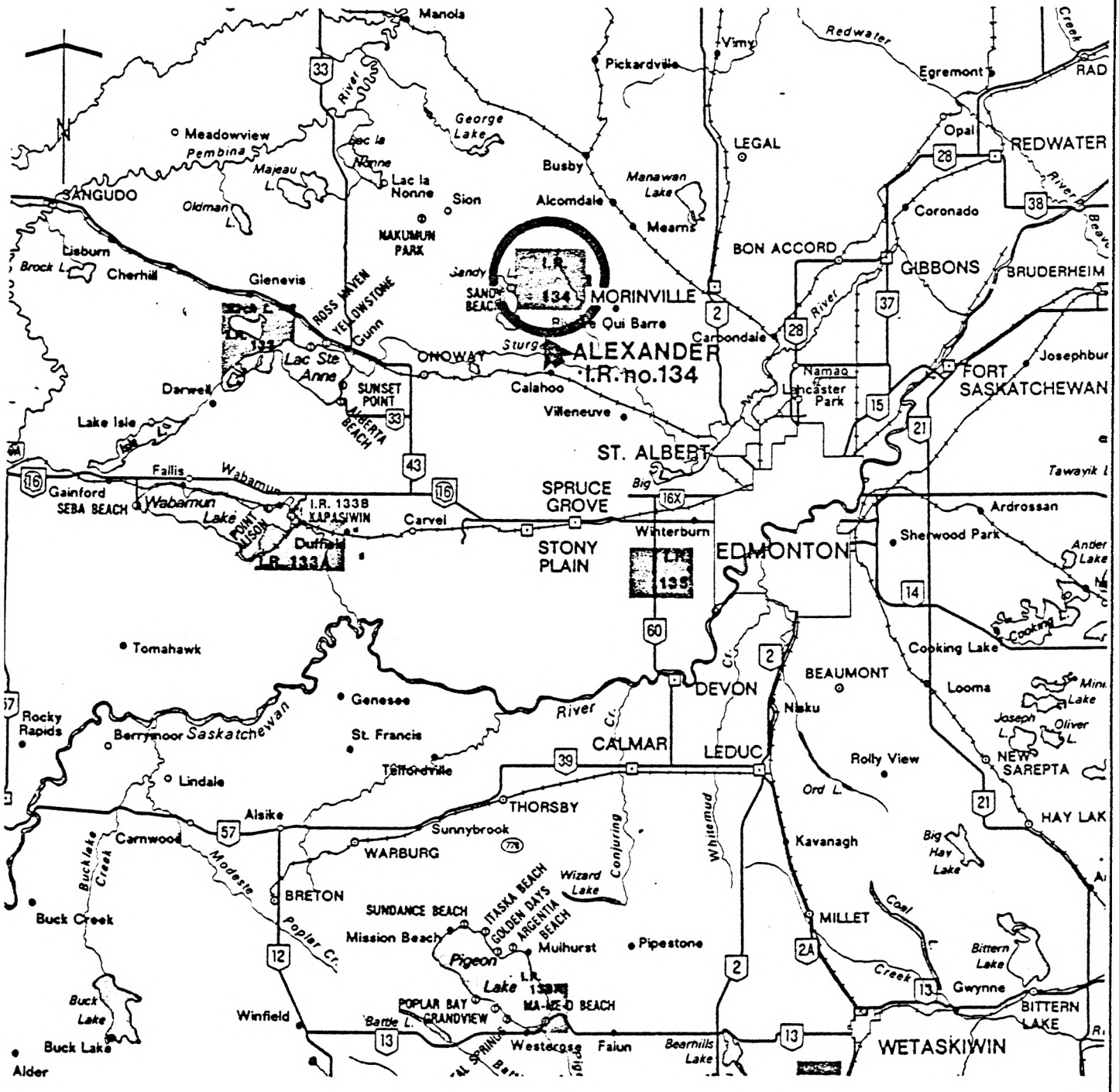


Figure 2. Location Map of Alexander Indian Reserve # 134

Scale: 1:750,000

and is composed of bentonitic sandstones, sandy shales, bentonitic clays and coal seams. Salinity is often associated with the soils developed on or near outcrops of this material.

Hydrogeology

Probable yields of wells in the area are 23 to 113 1/min. (5 to 25 gallons/min.) (Alberta Research Council Reconnaisance Hydrogeological Maps). Total dissolved solids are in the order of 1,000 parts per million with dominant cations being sodium and potassium, and dominant anions being carbonate and bicarbonate.

Climate

The climate of the area is continental, characterized by relatively warm summers and cold winters. Climate recording stations within or near the Study Area indicate the annual precipitation to be approximately 450 mm (Lindsay, et al., 1968). Of this amount about 60 percent falls during the growing season from May to August (Table 3). The rainfall peak is reached early in July, the period of maximum vegetative growth. About one-quarter of the precipitation occurs as snow during the winter months.

The mean annual temperature in the area is approximately 3 degrees Centigrade. January is the coldest month with a mean of -14 degrees Centigrade; July is the warmest month with a mean temperature of 16 degrees Centigrade (Table 2).

The success of any agricultural endeavour is determined to a significant extent by climate. The border between agro-climatic areas 1 and 2H crosses the eastern part of the Reserve. Thus, the frost-free period is expected to average slightly more than 90 days in the eastern part and less than 90 days in the western part.

Vegetation

The Survey Area lies within the Aspen Subregion of the Aspen Parkland Ecoregion (Strong and Leggat, 1980). It is characterized by Moss (1955)

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[2/] Days
Edmonton-Namao	699	-15.3	-11.2	-6.3	3.5	10.4	14.3	17.1	15.6	10.4	4.9	-4.7	-11.2	124	May 15-Sept 17	1,469
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
Edmonton-Namao	699	33	77	78	60	38	286	429
Thorsby	744	44	84	79	76	37	320	438
Sion	698	44	80	88	68	41	321	488

* Environment Canada, 1975.

as "a mosaic of prairie patches and aspen groves, with prairie occupying the drier situations and aspen the more moist and sheltered places."

The natural vegetation of the area, which has not been cleared with the advance of agriculture, is characterized by a vegetative cover similar to the Poplar Association referred to by Moss (1955). Tree cover is dominated by aspen poplar (Populus tremuloides) with lesser amounts of paper birch (Betula papyrifera), white spruce (Picea glauca), willow (Salix spp.), and balsam poplar (Populus balsamifera) in locations of poorer drainage.

The understory vegetation is variable, the following is a partial list of understory species common to the area: raspberry (Rubus Strigosus); choke cherry (Prunus virginiana var. melanocarpa); dogwood (Cornus stolonifera); rose bush (Rosa aciculous); gooseberry (Ribes hirtellum); buffaloberry (Shepherdia canadensis); blueberry (Vaccinium myrtilloides); and strawberry (Fragaria virginiana). The grass species is primarily rough fescue (Festuca scabrella).

Throughout the Reserve there are many peaty wet depressions, fens, that vary from a few hectares to 100 hectares or more in size. These generally contain sedge peat which is rarely over 150 cm in thickness and sedges (Carex spp.) and slough grass (Beckmannia spp.) predominate. Willow, dwarf birch (Betula glandulosa) and alder (Alnus spp.) are usually found on the poorly drained Gleysolic soils forming the outer boundaries. Other depressions, known as bogs, contain moss peat and a different type of vegetative community characterized by black spruce (Picea mariana), tamarack (Larix laricina), Labrador tea (Ledum groenlandicum), sphagnum (Sphagnun spp.) and plume moss (Hypnum spp.).

4.0 METHODS

A semi-detailed soil survey was conducted on Alexander Indian Reserve 134. Soils were inspected at 159 sites as summarized in Appendix A. Ten samples of key parent materials were analyzed in the laboratory.

The Soil Map is presented on an uncontrolled air photo mosaic (1977 photos) at a scale of 1:20,000 (attached in back pocket).

A separate detailed study entitled, "Soil Survey and Land Suitability Evaluation, Alexander Indian Community", was conducted previously by Pedology Consultants (January, 1980) for three Core Areas within the Reserve.

5.0 PRESENT LAND USE

A Present Land Use Map (page 23) has been compiled, at a scale of 1:50,000. The Legend for this map briefly describes the main types of land use encountered.

LEGEND

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

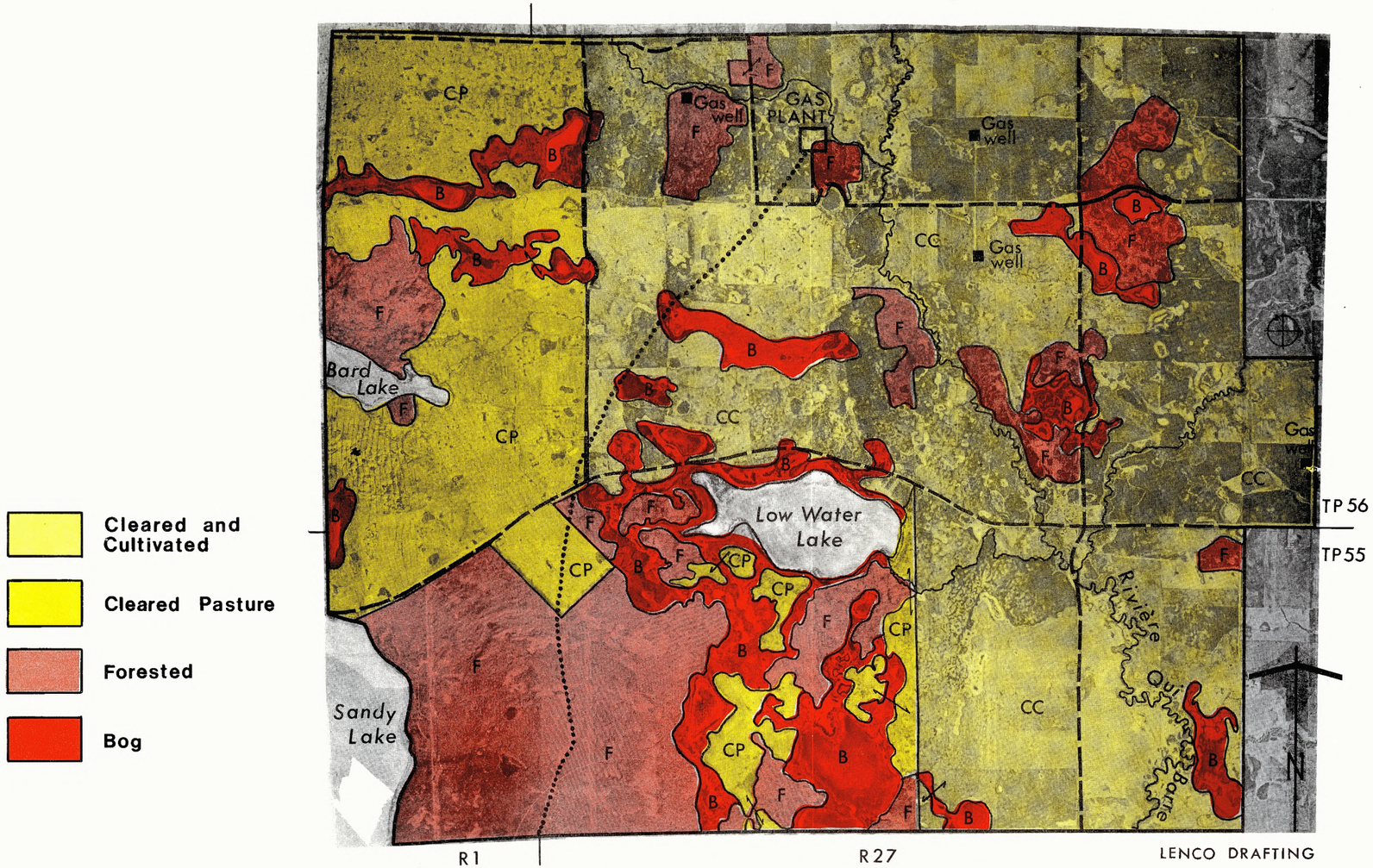
Cleared and Cultivated Land (C.C) - These are areas that are presently under cultivation and used for grain and forage production.

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.

——— - Roads

- - - - - Gas Pipeline



Cleared and Cultivated

Cleared Pasture

Forested

Bog

SCALE : 1 : 50,000

PRESENT LAND USE

ALEXANDER

INDIAN RESERVE

NO. 134

PREPARED FOR

INDIAN AND NORTHERN AFFAIRS ALBERTA

BY

Pedology Consultants

DECEMBER, 1980

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) and depth to bedrock, have been recognized.

Field investigations revealed the presence of four major soil forming parent materials separated into 11 map units due to differences in soils, topography and drainage as described below.

Soils on Glaciolacustrine Deposits over Till

Clayey, nonstony glaciolacustrine deposits about 0.5 to 1 m thick overlying till are widespread on the Alexander Reserve. The lacustrine materials range from CL to CH according to the Unified Classification. They have slow to moderate permeabilities; medium to high shrink-swell potential; and medium frost heave potential. Sulfate content varies from negligible to 0.5 percent.

Distinguishing characteristics of the glaciolacustrine map units are:

Map Unit	Slopes	Dominant Soil Subgroups
Moderately Well Drained		
1	2 to 5%	Solonetzic Black Chernozems*
2	6 to 9%	Eluviated Black* and Dark Gray Chernozems
3	6 to 9%	Black Solodized Solonetz*
Imperfectly Drained		
4	2 to 5%	Gleyed Black Solodized Solonetz*
Poorly Drained		
5	0 to 2%	Orthic and Rego Humic Gleysols*

* Representative detailed profile descriptions are given in Appendix A.

Soils on Till

The till is predominantly clayey and, in terms of physical properties, it is generally similar to the lacustrine materials described above. However, loamy pockets occur within the till areas and these have moderate permeabilities, medium shrink-swell potential; and medium frost-heave potential. Solonetzic soils were not encountered within the till areas; consequently, sulfate content is expected to be negligible throughout.

One Map Unit is recognized and its salient features are:

Map Unit	Slopes	Dominant Soil Subgroups
Moderately Well Drained		
6	6 to 15%	Dark Gray Chernozems*

Soils on Modified Residual Materials and Till

Bedrock outcrops and sizeable areas of shallow bedrock occur in the south-western portion of the Reserve. Soil parent materials include bedrock, modified residual materials (weathered bedrock mixed with shallow till), shallow till over bedrock, and till more than 1 metre deep. Texture of these materials is variable: sandy, loamy and clayey. Clayey materials appear to be most extensive and are therefore considered as representative in making soil interpretations. Permeabilities are slow to moderate; shrink-swell potential is medium to high; and frost heave potential is medium. Sulfate content is estimated to range from 0 to 0.5 percent. Loamy materials are significant in extent and have characteristics similar to those described previously for loamy tills. Four Map Units have been mapped and they have the following features:

* Representative detailed profile descriptions are given in Appendix A.

Map Unit	Slopes	Dominant Soil Subgroups
Well and Moderately Well Drained		
7	16 to 30%	Orthic Gray Luvisols*
8	2 to 5%	Gray Solodized Solonetz*
9	6 to 9%	Gray Solodized Solonetz*
10	10 to 15%	Gray Solodized Solonetz*

Soils on Organic Deposits

Very poorly drained depressions with accumulations of roughly 0.5 to 1 m of organic deposits derived from moss and sedge peat occur throughout the Reserve. The peat varies widely with respect to 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	Slopes	Dominant Soil Subgroup
Very Poorly Drained		
11	0 to 2%	Terric Mesisols

Miscellaneous Units and Symbols

Beach Sands (BS)

These are sandy deposits ranging from 20 to 100 cm in thickness overlying finer materials. Mainly rapidly to imperfectly drained Orthic and Gleyed Regosols have developed since the sands have been exposed due to the relatively recently receded water level of Sandy Lake. These soils are found below the former beach line, on level to undulating topography.

The soils are droughty and unstable, and if disturbed by excessive traffic, it is difficult to maintain a good vegetative cover. Excessive use may result in wind erosion.

Water tables are shallow (less than 1 m) near the shoreline but they

* Representative detailed profile descriptions are given in Appendix A.

TABLE 4. Laboratory Test Data and Classification of Typical Materials in the Alexander Indian Reserve.

Materials	Site Horizon	Depth (cm)	% of 2 mm Passing Sieve No.		Atterberg Limits		Classification			% SO_4
			40	200	Liquid Limit	Plasticity Index	Unified	AASHO	USDA	
Till	5 Cg	60-120	98.8	89.4	52.9	31.3	CH	A-7-6	C	0.03
Bedrock	10 R	100	96.8	76.4	40.9	21.0	CL	A-6	CL-SCL	0.20
Glacio-lacustrine	39 Cs	40-100	97.1	87.2	62.3	37.2	CH	A-7-6	C	0.42
"	51 Cs	40-100	96.8	76.4	45.0	24.7	CL	A-7-6	SL	0.20
"	57 Cks	60-100	97.8	77.7	54.7	32.1	CH	A-7-6	SCL	-
"	88 Ck	100-120	98.5	86.1	50.4	25.3	CH	A-7-6	C	-
"	98 Ckg	80-110	97.1	95.5	67.7	38.1	CH	A-7-6	C	-
"	144 Cskgj	80-110	96.1	73.6	42.3	22.9	CL	A-7-6	L-CL	0.18
"	150 Csk	80-110	94.2	72.4	38.5	20.9	CL	A-6	SCL	0.01
"	157 Ck	80-110	96.7	89.9	47.7	23.3	CL	A-7-6	C	-

gradually deepen as one proceeds inland. Permeability rates are rapid in the sands and moderate to slow in the underlying finer materials.

Stream Channels (SC)

This Unit includes the banks, meander scars and present channel of Riviere Qui Barre and its tributaries. The banks are commonly very steep and in places local relief is 15 to 20 metres. 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 glaciolacustrine, till and bedrock 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, Alexander Indian Reserve (Page 31) and in Table 5.

Those areas of the Reserve dominated by Chernozemic soils are assigned to Agro-Climatic Area 2H. Limitations such as undesirable soil structure (D); low moisture holding capability (M); a combination of low permeability, adverse structure and salinity (S); adverse topography (T); and excessive wetness (W) further limit the agricultural capability.

TABLE 5. AGRICULTURAL CAPABILITY RATINGS OF THE ALEXANDER INDIAN RESERVE.

Capability Class	Subclass	Soil Map Unit
2	$2S^{7}_{}3D^{3}_{}$*	1
3	3^{T}_{D}	2
4	4D	8,9
	4^{D}_{W}	4
	4T	6
	4^{T}_{D}	3
5	5W	5
	5^{T}_{D}	10
	$5^{T}_{D}\,6^{T}_{M}$	7
6	6S	BS
	6^{W}_{T}	SC
0	0	11

* About 70 percent of the unit is Class 2 and 30 percent is Class 3.

AGRICULTURAL CAPABILITY MAP LEGEND

Agriculture Capability Class 2

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

Agriculture capability Class 3

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

Agriculture Capability Class 4

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.

Agriculture Capability Class 5

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

Agriculture Capability Class 6

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

Agriculture Capability Class 7

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

O - Organic Soils - not rated for agriculture.

Soil Capability Subclasses

Soil Limitations:

Subclass D - undesirable soil structure and/or slow permeability.

S - undesirable soil characteristics including soil structure (D), low moisture holding capacity (M), soil salinity (N), low fertility (F).

Landscape Limitations:

Subclass T - adverse topography, both steepness and pattern

W - excessive moisture

Notation 5W Class Subclass

Class 2

Class 3

Class 4

Class 5

Class 6

Classes 7,0

SCALE : 1 : 50,000

AGRICULTURAL CAPABILITY

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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 Settlement Suitability Map, page 36.

Low Constraints - Soil Map Units 1 and 2.

The areas of low constraints to settlement occur on moderately well drained glaciolacustrine deposits, and topography which is very 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, possible low permeabilities will necessitate design of appropriate sewage disposal facilities, and sulfate contents may be high enough to cause concrete corrosion if precautions are not taken.

Moderate Constraints - Soil Map Units 3, 4, 6, 8, 9, 10 and Beach Sands

Constraints to settlement include: rolling topography (Units 3, 6, 10); imperfect soil drainage and water tables within 2 m (Unit 4); low permeability, shallow bedrock, concrete corrosion hazard (Units 8 and 9); and surface erosion hazard and water pollution hazard (Beach Sands).

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 Alexander Indian Reserve No. 134

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
RESERVE - Semi-detailed mapping										
1	M22	M22	M10	L	S13	P	P	M10	L	L
2	M22	M22	M10	M3	S13	P	P	M10	L	L
3	S13,23	S13,23	S11,23	M3	S13	P	P	M10	L	L
4	S13,23	S13,23	S11,23	M2	S13	P	P	M2,10	M2,10	M2
5	S2,13,23	S2,13,23	S2,11,23	S2	S13,2	P	P	S2	S2	S2
6	M3,22	M3,22	M3,10	M3	S13	F	P	M3,10	M3,10	L
7	S3	S3	S3,17	S3,17	M13	F	P	S3	S3	L
8	S13,23	S13,23	S11,17	S17	S13	P	P	M10	L	L
9	S13,23	S13,23	S11,17,23	S17	S13	P	P	M10	L	L
10	S3,13,23	S3,13,23	S3,11,17,23	S3,17	S13	P	P	M3,10	M3	L
11	S19	S19	S19	S19	S19	U	U	S19	S19	S19
BS	L	L	S9,12	S9,12	L	G	G	S5	S5	S5

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

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

KINDS OF CONSTRAINTS:
2. High ground water table or surface ponding
3. Excessive slope
5. Sand surface texture
9. Rapid permeability
10. Moderate permeability
11. Slow permeability
12. Ground water contamination hazard
13. High shrink-swell potential
17. Shallow depth to consolidated bedrock
19. Organic soil
22. Moderate shrink-swell potential
23. Possible concrete corrosion hazard (soluble sulphate)

Severe Constraints - Soil Map Units 5, 7, 11, Stream Channels and Sloughs

Lands in this group are marginally suitable or unsuitable for development due to excessive slopes (Unit 7); excessive wetness (Unit 5 and Sloughs); and wet organic soils (Unit 11). Stream channels having steep banks and flood prone valley bottoms are also in this group.

10.0 POTENTIAL LAND USE

The various settlement uses and agricultural capability have been considered together in preparing a Potential Land Use Map (Page 39). It shows four distinctive Areas in terms of development opportunities as outlined below.

Area A - Soil Map Units 1 and 2.

This is land which has Low Constraints to settlement and High Agricultural Capability (Classes 2 and 3).

Area B - Soil Map Units 3, 4, 6, 8 and 9.

This Area has Moderate Constraints to settlement and it has Marginal Agricultural Capability for cultivated crops (Class 4).

Unfavorable characteristics include one or more of the following: gently rolling topography, imperfect soil drainage, low permeability, salinity, or undesirable soil structure.

Area C - Soil Map Units 5, 7, 10 and Beach Sands.

Constraints to settlement in Area C are Moderate (Unit 10 and Beach Sands) to Severe (Units 5 and 7). Agricultural Capability is Class 5: land that is generally suitable for improved pasture and forage production, not for cultivated crops.

Moderately rolling topography, poor drainage, low moisture holding capacity and undesirable soil structure are the principal constraints.

	SOIL INTERPRETATIONS				SOIL CHARACTERISTICS AND QUALITIES									
	Settlement Uses	Sewage Lagoons	Source of Sand & Gravel	Hazards	Soil Map Unit	Landform	Permeability	Run-off	Water Table Depth	Soil Drainage Class	Topography (slopes)	Unified Texture	Shrink /Swell Potential	Frost Heave Potential
LOW CONSTRAINTS	Favourable Conditions: greater than 1.5 m to the water table, moderately well drained soils Potentially Troublesome Conditions: low permeability, mild to considerable sulphate attack on concrete.	low	poor	concrete corrosion	1	- glaciolacustrine over till - very gently undulating	low	low	>1.5 m	moderately well	2 to 5%	CL-CH	moderate	moderate
		moderate (topography)			2	- glaciolacustrine - gently rolling					6 to 9%			
MODERATE CONSTRAINTS	Favourable Conditions: greater than 1.5 m to the water table, moderately well drained soils. Potentially Troublesome Conditions: low permeability, mild to considerable sulphate attack on concrete, presence of bedrock in Map Units 8 & 9.	moderate (topography)	poor	concrete corrosion	3	- glaciolacustrine over till - gently rolling	low	low	> 1.5 m	moderately well	6 to 9%	CL-CH	moderate	moderate
		severe (bedrock)		concrete corrosion and bedrock	8	- modified residual & till - very gently undulating					2 to 5%			
					9	- modified residual & till - gently rolling					6 to 9%			
	Favourable Conditions: greater than 1.5 m to the water table, moderately well drained soils. Potentially Troublesome Conditions: low permeability, topography, mild but positive sulphate attack on concrete (Map Unit 10).	moderate to severe (topography)	poor		6	- till - gently to moderately rolling	low	moderate	> 1.5 m	moderately well	6 to 15%	CL-CH	moderate	moderate
		severe (topography)		concrete corrosion	10	- modified residual & till - moderately rolling					10 to 15%			
	Favourable Conditions: topography Potentially Troublesome Conditions: low permeability, imperfectly drained soils, mild to considerable sulphate attack on concrete.	moderate (soil drainage)	poor	concrete corrosion	4	- glaciolacustrine over till - very gently undulating	low	low	≈1.5 m	imperfectly	2 to 5%	CL-CH	moderate	moderate
	Favourable Conditions: rapid soil drainage, topography. Potentially Troublesome Conditions: hazard of polluting Sandy Lake, erosion of surface layer.	severe rapid (permeability)	good-sand poor-gravel	pollution of Sandy Lake erosion of sandy textured surface	BS	- beach snad - very gently undulating	high	low	≈1.5 m	rapidly	2 to 5%	-	-	-
SEVERE CONSTRAINTS	Favourable Conditions: topography Potentially Troublesome Conditions: low permeability, shallow depth to water table, poorly drained soils, flooding hazard.	severe (soil drainage)	poor	flooding	5	- glaciolacustrine over till - depressional	low	low	0 to 1.0 m	poorly	2 to 5%	CL-CH	moderate	moderate
	Favourable Conditions: greater than 1.5 m to the water table, well drained soils Potentially Troublesome Conditions: low permeability, topography, erosion hazard.	severe (topography)	poor	erosion	7	- modified residual & till - strongly rolling	low	high	> 1.5 m	well	16 to 30%	CL-CH	moderate	moderate
	Favourable Conditions: topography Potentially Troublesome Conditions: shallow depth to water table, very poorly drained soils, organic soils	severe (organics)	unsuitable	organic materials	11	- organic - nearly level	-	low	0 to 0.5 m	very poorly	0.5 to 2%	PT	-	-
	Potentially Troublesome Conditions: wetness, very poorly drained soils, flooding, stream pollution or topography and erosion.	severe (wetness)	unsuitable	flooding stream pollution	SC	- stream channel	-	-	-	well to very poorly	-	-	-	-
						- slough	-	-	0	-	-	-	-	-
		severe (topography)		erosion		- escarpment	-	high	-	well	> 30%	-	-	-

SETTLEMENT SUITABILITY

Low Constraints

Moderate Constraints

Severe Constraints

TYPE OF CONSTRAINTS

I – Inundation (Flooding)

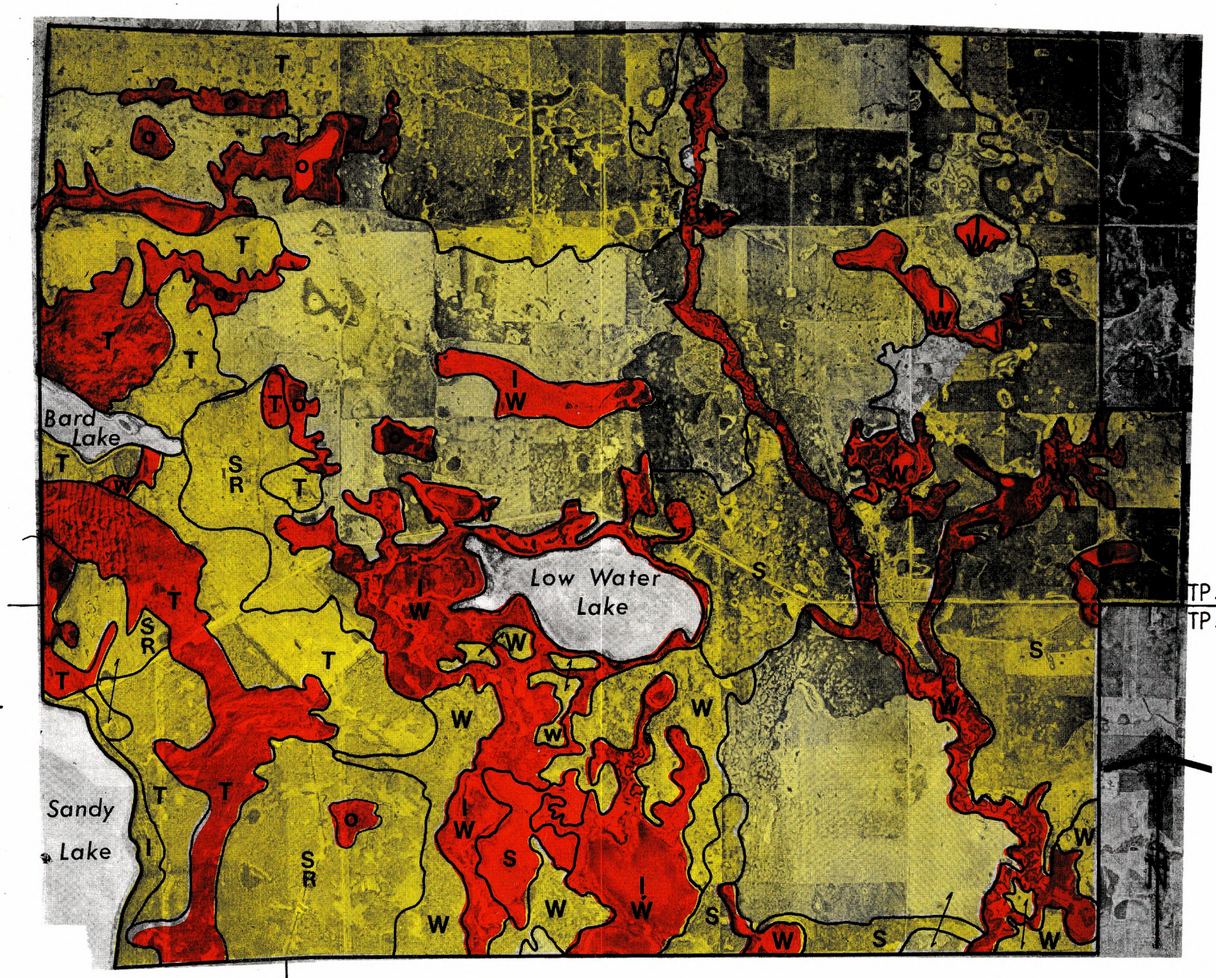
O – Organic Materials

R – Shallowness to Bedrock

S – Unfavourable Soil Characteristics – low permeability, high shrink / swell, salts

T – Topography

W – Wetness - poor soil drainage shallow water table



LENCO DRAFTING

SCALE : 1:50,000

SETTLEMENT SUITABILITY

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Area D - Soil Map Units 11, Stream Channels and Sloughs.

These lands are generally unsuitable for all uses considered. Constraints to settlement are Severe and Agricultural Capabilities are Classes 6 and 7.

Steep slopes and/or excessive wetness preclude development of these lands.

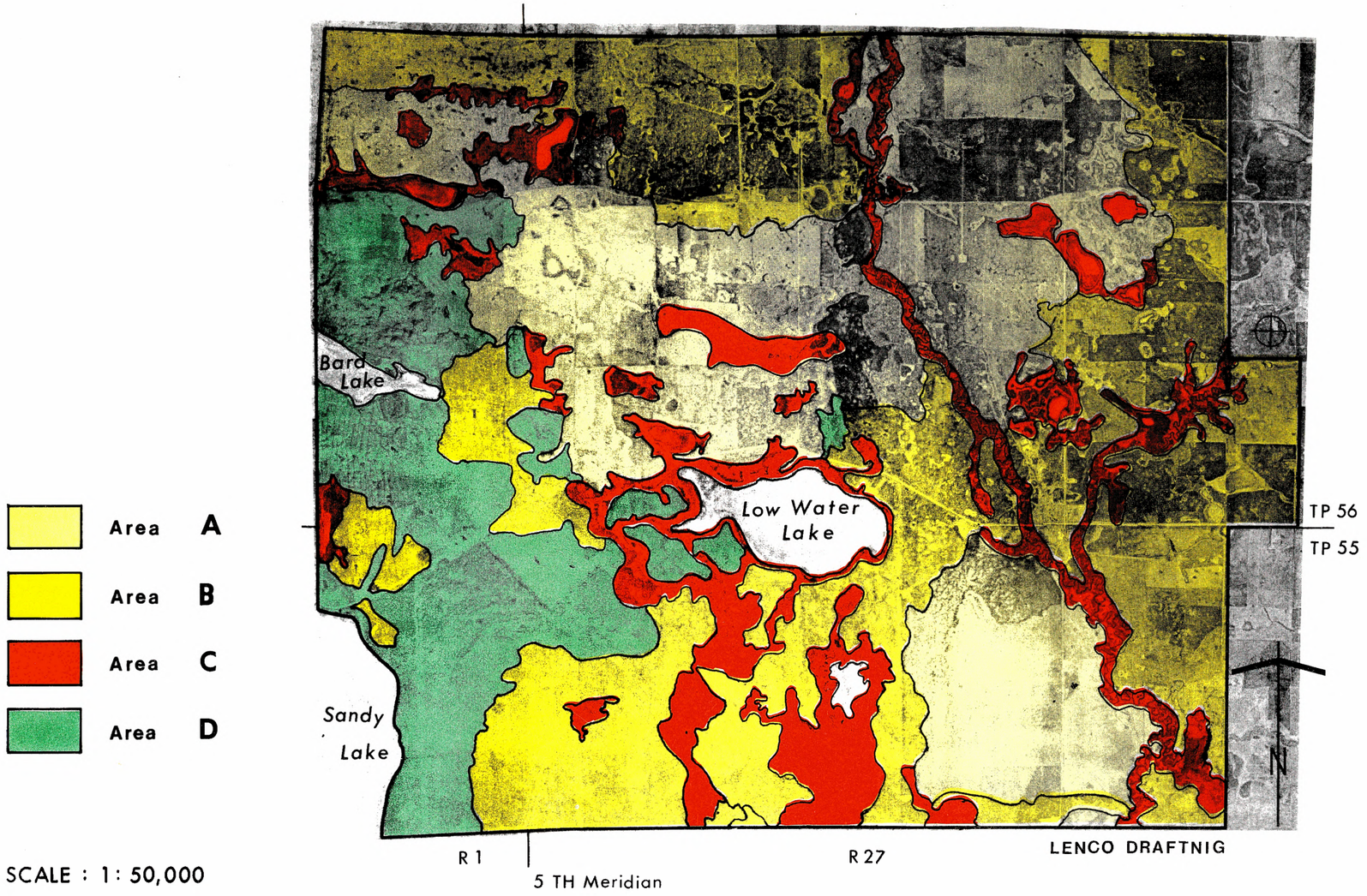
POTENTIAL LAND USE LEGEND

Area A - Low Constraints to Settlement.
Good Agricultural Land.

Area B - Moderate Constraints to Settlement.
Marginal Agricultural Land.

Area C - Moderate to Severe Constraints to Settlement.
Pasture and Forage Land.

Area D - Land that is unsuitable for all types of development.



SCALE : 1: 50,000

POTENTIAL LAND USE

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11.0 SUMMARY

- 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 majority of the Reserve has been cleared for agriculture. Most of these cleared lands are presently under cultivation. The strongly rolling cleared areas of the western portion are presently serving as pasture. The remainder of the Reserve is in native forest or wetland vegetation.

- A semi-detailed soil survey of the Alexander Indian Reserve 134 was carried out. Soils were inspected at 159 sites and representative materials from 10 sites were sampled and analyzed. Eleven principal map units have been recognized plus beach sands and 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: glaciolacustrine deposits over till, till, modified residual materials, and organic deposits. Important soil types found on the mineral materials include Solonetzic and Eluviated Black Chernozems, Black and Gray Solodized Solonetz, Orthic Gray Luvisols, Gleyed subgroups of the foregoing, and Humic Gleysols. Terric Mesisols are dominant in the organic areas.

Clayey moderately well drained Eluviated Black Chernozems, Solonetzic Black Chernozems and Black Solodized Solonetz are dominant on the glaciolacustrine deposits over till. Clayey, moderately well drained Dark Gray Chernozems are dominant on the till deposits of the northern Reserve portions. Soils on modified residual materials and till occur on the western side of the Reserve. Soils found on loamy residual materials are dominantly moderately well drained Orthic Gray Luvisols. Moderately well drained, clayey, Gray Solodized Solonetz dominate areas where the till and residual materials overly bedrock.

- An Agricultural Capability Map has been prepared at a scale of 1:50,000. Significant areas of land well suited to cultivated crops exist throughout the Reserve. Limitations of undesirable structure (D), a combination of unfavorable soil characteristics (S), and adverse topography (T) restrict the Agricultural Capability to Classes 2 and 3.

The remainder of the Reserve contains lands that are more severely restricted by limitations of undesirable structure (D), low moisture holding capacity (M), a combination of unfavorable soil characteristics (S), adverse topography (T), and excessive moisture (W). The Agricultural Capability within these regions are dominantly Class 4, marginally suited for cultivated crops, and Class 5, suitable for improved pasture.

- 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 extensive throughout the Reserve. Potentially troublesome conditions of low permeability, and concrete corrosion will necessitate proper site selection and design.

The majority of the Reserve has Moderate Constraints to settlement. Potentially troublesome conditions likley to be encountered include: low permeability, concrete corrosion, adverse topography, and imperfectly drained soils.

The remainder of the Reserve possesses Severe Constraints to settlement due to one or more of the following: excessive wetness (poorly drained soils and high water tables), organic soils, and adverse topography.

- Finally, based on concerns of agriculture and settlement, a Potential Land Use Map is provided. Four areas are delineated in order of decreasing suitability or opportunities for development.

Large areas of the Reserve (Area A) are well suited for all uses. The majority of the Reserve has Moderate Constraints to settlement and is marginally suitable for cultivated crops (Area B). Within Area C constraints to settlement are Moderate to Severe and the land is suitable for improved pasture. Smaller scattered portions of the Study Area are unsuitable for all uses (Area D).

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APPENDICES

APPENDIX A

- Soil Inspection Sites -

NOTATIONS:

Soil Subgroups

Chernozemic Soils

EBL	Eluviated Black
GLEBL	Gleyed Eluviated Black
GLSZBL	Gleyed Solonetzic Black
GLDG	Gleyed Dark Gray
ODG	Orthic Dark Gray
RBL	Rego Black
SZBL	Solonetzic Black

Organic Soils

TM	Terric Mesisol

Regosolic Soils

OR	Orthic Regosol

Gleysolic Soils

HULG	Humic Luvic Gleysol
OHG	Orthic Humic Gleysol
PRHG	Peaty Rego Humic Gleysol
RHG	Rego Humic Gleysol

Luvisolic Soils

DGL	Dark Gray Luvisol
LGL	Lithic Gray Luvisol
OGL	Orthic Gray Luvisol
SZGL	Solonetzic Gray Luvisol

Solonetzic Soils

BLSO	Black Solod
BLSS	Black Solodized Solonetz
BLSZ	Black Solonetz
GSO	Gray Solod
GSS	Gray Solodized Solonetz

Parent Materials

BR	modified bedrock
BS	beach sand
F	fluvial
Gf	glaciofluvial
Gl	glaciolacustrine
O	organic
T	till (morainal)

Drainage Classes

W	well
MW	moderately well
I	imperfectly
P	poorly
VP	very poorly

Topography

Classes		Percent Slope
2	nearly level	0.5 - 2.5
3	very gentle slopes	2.5 - 5
4	gentle slopes	5 - 9
5	moderate slopes	9 - 15
6	strong slopes	15 - 30
7	very strong slopes	30 - 60

Stoniness Classes

S0	nonstony
S1	slightly stony
S2	moderately stony
S3	very stony

Textures

S	Sand
Si	Silt
C	Clay
L	Loam

INSPECTION SITES - Semi-detailed Survey

Site	Soil Subgroup	Parent Material	Drainage	Topography	Stoniness	cm:	Textures 0-20	20-50	50-100
1	EBL	Gl/T	MW	4	SO		CL	CL	C
2	EBL	T	MW	6	S1		L	C	C
3	DGL	T	MW	4-5	SO		L	C	C
4	DGL	T	W	4	S1		L	SiL	CL
5	RHG	Gl	I	2	SO		L	C	C
6	SZBL	Gl/T	MW	4	SO		L	C	C
7	SZBL	Gl	MW	4	SO		L	SiL	CL
8	RHG	Gl	P	2	SO		L	CL	CL
9	OHG	Gl/T	P	2	SO		CL	C	CL
10	RBL	BR	MW	3	SO		CL	C	hard
11	RHG	Gl	VP	2	SO		L	CL	C
12	SZBL	Gl	MW	3	SO		CL	CL	CL
13	BLSS	T	MW	5	S1		L	CL	CL
14	ODG	T	W	6	SO		L	SiL	CL
15	ODG	T	W	6	S1		L	SiL	L
16	ODG	Gl/T	W	7	S1		L	L	SiL
17	ODG	Gl/T	I	6	SO		L	L	CL
18	PRHG	Gl	P	2	SO		SiL	C	CL
19	TM	O	VP	2	SO		peat		C
20	GSS	T	MW	5	SO		L	L	CL
21	GSS	Gl	I	3	SO		CL	C	CL
22	DGL	Gl	W	5	SO		SL	SCL	S
23	BLSS	Gl	MW	6	SO		CL	C	C
24	GLEBL	Gl	I	3	SO		L	SL	CL
25	GSS	T	MW	5	SO		L	CL	CL
26	GSO	T	MW	6	S1		L	CL	CL
27	BLSS	T	MW	6	SO		L	C	C
28	SZGL	T/BR	MW	4	SO		CL	C	C
29	RHG	Gl	VP	2	SO		SiCL	C	C
30	EBL	Gl	MW	5	SO		L	CL	CL
31	PRHG	Gl	VP	2	SO		L	C	C
32	BLSO	T	MW	4	S1		L	CL	CL
33	OR	BS	MW	2	SO		S	S	S
34	OGL	T/BR	W	5-6	S1		L	SiCL	SiL
35	RGL	BR	MW	5	SO		L		
36	GSS	BR	W	5	SO		L	CL	CL
37	LGL	T	I	5	SO		L	CL	CL
38	LRG	BR	P	3	SO		L	SC	
39	BLSS	Gl	MW	3	SO		CL	C	C
40	BLSS	Gl	MW	4	SO		CL	C	C

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

Site	Soil Subgroup	Parent Material	Drainage	Topography	Stoniness	cm:	Textures 0-20	20-50	50-100
41	SZBL	T	MW	5	S0		L	CL	CL
42	GSS	T	MW	5	S2		CL	C	C
43	BLSO	T	MW	5	S1		CL	C	C
44	PRHG	T	VP	2	S0		CL	CL	
45	GSS	T	MW	4	S3		CL	CL	SCL
46	OGL	T	W	6	S2		L	CL	CL
47	TM	O	VP	2	S0			peat	
48	GSS	T	MW	3	S1		CL	C	C
49	BLSS	T	MW-I	3	S3		CL	CL	CL
50	BLSS	T	MW-I	3	S3		L	CL	CL
51	EBL	Gl	MW	4	S0		L	CL	CL
52	BLSO	T	MW	4	S0		L	CL	CL
53	EBL	Gf/T	W	5	S1		L	SCL	CL
54	OGL	Gl	MW	4-5	S0		SiL	SiCL	SiL
55	BLSZ	T/BR	MW	4	S0		L	CL	CL
56	GSS	T	MW	6	S0		L	C	CL
57	BLSS	Gl	MW	3	S0		L	CL	C
58	GLSBL	Gl	I	3	S0		L	CL	CL
59	SZBL	Gl	I	3	S0		L	CL	CL-C
60	PRHG	Gl	VP	2	S0		peat	CL	CL
61	BLSS	Gl/T	MW	3-4	S0		L	CL	CL
62	PRHG	Gl	P	2	S0		peat	CL	CL
63	EBL	T	W	4-5	S1		L	CL	CL
64	SZBL	T	W	5	S1		L-CL	CL	CL
65	DGL	T	MW	5	S0		L	CL	CL
66	GLDG	T	I	4	S0		CL	CL	CL
67	SZBL	T	MW	4	S0		L	CL	CL
68	SZBL	T	I	4	S2		CL	CL	CL
69	EBL	T	MW	4	S0		L	CL	FSCL
70	GLDG	T	I	4	S1		L	CL	CL
71	TM	O	VP	2	S0			peat	CL
72	SZBL	Gl	MW	4	S0		CL	CL	CL
73	BLSZ	T	MW	3	S0		L	CL	CL
74	EBL	Gl	MW	5	S0		L	CL	CL
75	EBL	Gl	W	4	S0		L	SL	CL-C
76	GLSZBL	Gl/T	I	4	S1		CL	C-CL	C-CL
77	SZBL	Gl	I-MW	4	S0		CL	C	CL
78	GLEBL	Gl	I	4	S0		L	CL	CL
79	BLSS	Gl	MW	4	S0		L	C	CL
80	GLEBL	Gl	I	4	S0		L	C	C

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

Site	Soil Subgroup	Parent Material	Drainage	Topography	Stoniness	cm:	Textures 0-20	20-50	50-100
81	GLEBL	Gl	I	4	S0		L	C	C
82	EBL	Gl/T	MW	4	S0		L	CL	CL
83	SZBL	Gl/T	MW	4	S0		CL	C	C
84	BLSS	Gl/T	MW	4	S0		L	CL	CL
85	EBL	Gl	MW	4	S0		SL	SCL	SL
86	SZBL	Gl	MW	4	S0		L	CL	CL
87	GLEBL	Gl/T	I	4	S0		L	CL	CL
88	GLEBL	Gl	I	4	S0		L	CL	C
89	EBL	Gl	MW	3	S0		L	CL	CL
90	EBL	Gl	MW	4	S0		L	C	C
91	EBL	T	W	4	S1		L	CL	CL
92	GLEBL	T	I	3	S0		L	CL	CL
93	EBL	T	MW	4	S1		L	CL-C	CL
94	GLBSZ	Gl/T	I	3	S1		L	CL-C	CL-C
95	RHG	Gl	P	2	S0		CL	CL	CL
96	GlBLSS	Gl/T	I	3	S0		CL	C	C
97	GlEBL	Gl/T	I	3	S1		L	C	C
98	GlEBL	Gl	I	3	S0		CL	CL	CL
99	EBl	Gl/T	MW	4	S0		L	CL	CL
100	BLSZ	Gl/T	MW	4	S0		L	CL	CL
101	BLSZ	Gl/T	MW	4	S0		L	CL	C
102	GLBLSZ	Gl/T	I	4	S0		L	C	CL
103	GLBLSZ	Gl/T	I	4	S0		L	C	C
104	BLSS	Gl/T	I	3	S0		L	CL	C
105	RHG	Gl/T	VP	2	S0		CL	C	C
106	BLSZ	Gl/T	I	3	S0		L	C	C-CL
107	RHG	Gl	VP	2	S0		L	C	C
108	GLBLSZ	Gl	I	3	S0		L	C	C
109	BLSS	T	I	4	S0		L	C	C
110	EBL	Gl/T	MW	5	S0		L	L	CL
111	SZBL	T	MW	3	S0		L	CL	CL
112	GLBLSZ	T	I	5	S0		L	CL	C
113	ODG	Gl/T	MW	4-5	S0		L	SCL	CL
114	BLSS	Gl/T	I	4	S0		CL	C	C
115	EBL	T	MW	3-4	S0		L	CL	CL
116	BLSZ	T	MW	4	S0		L	C	CL
117	SZBL	Gl/T	MW	3	S0		L	CL-C	CL-C
118	BLSZ	Gl/T	MW	4	S0		L	C	C
119	SZBL	Gl/T	MW	5-6	S0		L	C	C
120	RHG	Gl/T	P	2	S0		L	CL	C

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

Site	Soil Subgroup	Parent Material	Drainage	Topography	Stoniness	cm:	Textures 0-20	20-50	50-100
121	HULG	Gl/T	P	3	SO		L	CL	CL
122	BLSS	Gl	MW	3	SO		L	C	C
123	BLSS	Gl	MW	4	SO		L	C	C
124	SZBL	Gl	MW	3	SO		L	CL-C	CL
125	BLSZ	Gl	MW	4	SO		L	C	C
126	BLSS	Gl	MW	4	SO		L	C	C
127	EBL	Gl	MW	3-4	SO		L	C	C
128	EBL	Gf/T	MW	6	S1		L	LS	LS
129	BLSZ	Gl/T	MW	4	SO		L	C	C
130	EBL	Gl	MW	3	SO		L	L	CL
131	GLSZBL	Gl	MW	4	SO		L	C	C
132	BLSS	Gl	MW	5	SO		L	C	C
133	BLSS	Gl	I	3	SO		L	C	C
134	OHG	Gl/T	P	2	SO		L	CL	CL
135	GLBLSS	Gl/T	I	3	SO		L	C	C
136	SZBL	Gl	MW	3	SO		L	CL	CL
137	BLSS	Gl	MW	3	SO		L	C	C
138	GLSZBL	Gl	I	4	SO		L	C	C
139	BLSZ	Gl	MW	4	SO		L	C	C
140	SZBL	Gl	MW	3	SO		L	C	C
141	BLSS	Gl	MW	5	SO		L	C	C
142	BLSS	Gl	MW	4	SO		L	C	C
143	BLSS	Gl/T	MW	5	S1		L	C	C
144	SZBL	Gl/T	MW	4	SO		L	C	C
145	HULG	Gl	P	3	S1		L	CL	CL
146	HULG	Gl/T	I	3	SO		L	C	C
147	GLGL	Gl/T	I	3	SO		SiL	CL	CL
148	GLSZBL	Gl/T	I	3	SO		L	CL	CL
149	SZBL	Gl/T	MW	3	SO		L	C	C
150	BLSS	Gl	MW	3	SO		L	C	C
151	GLSZBL	Gl	I	4	SO		CL	CL	C
152	SZBL	Gl/T	MW	3	SO		L	CL	CL
153	BLSS	Gl/T	I	3	SO		L	C	C
154	BLSS	T	MW	3	S1		L	CL	CL
155	BLSS	Gl/T	MW	3	SO		L	CL-C	CL
156	GLGL	Gl	I	3	SO		SiL	CL	CL
157	BLSS	Gl/T	MW	3	SO		L	CL	CL
158	GLSZBL	Gl/T	I	4	SO		SiL	C	C
159	BLSS	Gl/T	MW	4	SO		L	C	C

CLASSIFICATION: Eluviated Black Chernozem (EBL)

DOMINANT IN MAP UNIT(S): 2

SIGNIFICANT IN MAP UNIT(S): 3, 6

Profile:

Ah	0 - 25 cm; black (10YR 2/1) loam; moderate, medium granular; friable; stone-free.
Ahe	25 - 28 cm; very dark gray (10YR 3/1) loam; weak, fine platy; friable; stone-free.
Bt	28 - 60 cm; very dark grayish brown (10YR 3/2) clay loam; moderate, medium subangular blocky; firm; stone-free.
BC	60 - 105 cm; brown to dark brown (10YR 4/3) clay loam; massive; stone-free.
Ck	105 cm plus; brown (10YR 5/3) silty clay loam; massive; stone-free; moderately calcareous.

COMMENTS: - where color value of Ah is >3.5 (dry) this profile is a Dark Gray Chernozem.

- If faint to distinct mottles (g) are present within top 50 cm the profile becomes a Gleyed Eluviated Black Chernozem.

CLASSIFICATION: Orthic Dark Gray Chernozems (ODG)

DOMINANT IN MAP UNIT(S): 2, 6

SIGNIFICANT IN MAP UNIT(S):

Profile:

L-H	2 - 0 cm; surface organic debris.
Ah	0 - 12 cm; very dark grayish brown (10YR 3/2 m) silty clay loam; granular; friable.
Ahe	12 - 17 cm; dark grayish brown (10YR 4/2 m) silty clay loam; weak fine platy; friable.
Bt	17 - 50 cm; dark grayish brown (10YR 4/2 m) clay; moderate medium subangular blocky; firm.
BC	50 - 70 cm; dark grayish brown (2.5Y 4/2 m) clay; massive; firm.
IICg	70 - 90 cm; dark grayish brown (10YR 4/2 m) clay loam till; massive; firm; dark yellowish brown (10YR 4/4 m) mottles.
IICkg	90 - 120 cm; dark grayish brown (10YR 4/2 m) clay loam till; massive; firm.

COMMENTS: - If Ah and Ahe are thin and the Ae is prominent the profile becomes a Luvisol.

CLASSIFICATION: Solonetzic Black Chernozem (SZBL)

DOMINANT IN MAP UNIT(S): 1

SIGNIFICANT IN MAP UNIT(S): 6

Profile:

Ap	0 - 22 cm; black (10YR 2/1 m) loam; moderate, medium, granular; friable; nonatony.
Btnj	22 - 60 cm; dark brown (10YR 3/3 m) clay loam, weak medium columnar; firm.
BC	60 - 70 cm; brown (10 YR 4/3 m) clay loam; massive; firm.
Csk	70 - 100 cm; brown (10YR 5/3 m) clay loam; massive; firm; saline and calcareous.

COMMENTS: - Ap horizon includes Ah, Ahe and Ae horizons.

- where salts (S) and columnar structure (n) are absent the profile is an Eluviated Black Chernozem.

- If mottles (g) are present within upper 50 cm the profile is a Gleyed Solonetzic Black Chernozem.

CLASSIFICATION: Black Solodized Solonetz (BLSS)

DOMINANT IN MAP UNIT(S): 3

SIGNIFICANT IN MAP UNIT(S): 1, 4

Profile:

Ap	0 - 20 cm; very dark grayish brown (10YR 4/2 m) silty clay; granular to weak prismatic; firm.
Ae	20 - 22 cm; grayish brown (10YR 5/2 m) silty clay loam; platy; friable.
Bnt	22 - 50 cm; dark grayish brown (10YR 4/2 m) clay; strong, coarse columnar; very firm.
BC	50 - 80 cm; dark grayish brown (2.5Y 4/2 m) clay; massive; very firm.
Cakg	80 - 100 cm; dark grayish brown (2.5Y 4/2 m) clay; massive; very firm; saline and calcareous.

COMMENTS: - where columnar structure (n) ur B horizon is weakly developed or structure is prismatic the prufile is a Solonetzic Black Chernozem.

- where faint to distinct mottles (g) are present within the upper 50 cm the profile is classed a Gleyed Black Solodized Solonetz.

CLASSIFICATION: Gleyed Black Solodized Solonetz (GLBLSS)

DOMINANT IN MAP UNIT(S): 4

SIGNIFICANT IN MAP UNIT(S):

Profile:

Ap	0 - 20 cm; very dark grayish brown (10YR 4/2 m) silty clay; granular to weak prismatic; firm.
Ae	20 - 22 cm; grayish brown (10YR 5/2 m) silty clay loam; platy; friable.
Bntg	22 - 50 cm; dark grayish brown (10YR 4/2 m) clay; strong, coarse columnar; very firm.
BCg	50 80 cm; dark grayish brown (2.5Y 4/2 m) clay; massive; very firm.
Cskg	80 - 100 cm; dark grayish brown (2.5Y 4/2 m) clay; massive; very firm; saline and calcareous.
iiCskg	100 - 120 cm; dark grayish brown (10YR 4/2 m) clay to clay loam till; massive; firm.

COMMENTS: - If gleying (g) is absent within the upper 50 cm the profile is s Black Solodized Solonetz.

CLASSIFICATION: Orthic Humic Gleysols (OHG)

DOMINANT IN MAP UNIT(S): 5

SIGNIFICANT IN MAP UNIT(S):

Profile:

L-H	10 - 0 cm; organic debris and peat.
Ahg	0 - 20 cm; black (10YR 2/1 m) silty clay loam; strong medium granular ("shot-like"); firm.
Bg	20 - 60 cm; dark gray (2.5Y 4/0 m) clay, with prominent, dark yellowish brown (10YR 4/4 m) mottles; weak fine subangular blocky; firm.
BCg	60 - 75 cm; dark gray (2.5Y 4/0 m) clay, with prominent, dark yellowish brown (10YR 4/4 m) mottles; massive; firm.
Ckg	75 - 120 cm; dark gray (5Y 4/1 m) clay; mottled; massive; firm.

COMMENTS: - where the B horizon is absent, the profile is a Rego Humic Gleysol (RHG).

CLASSIFICATION: Gray Solodized Solonetz (GSS)

DOMINANT IN MAP UNIT(S): 8, 9, 10

SIGNIFICANT IN MAP UNIT(S):

Profile:

L-H	5 - 0 cm; very dark grayish brown (10Y R 3/2) mainly deciduous leaf litter and grasses.
Ahe	0 - 2 cm; very dark grayish brown (10YR 3/2) losm; weak, fine granulsr; very friable; slightly stony.
Ae	2 - 5 cm; light gray (10YR 7/1) loam to silt loam; strung, medium platy; very friable; slightly stony.
Bnt	5 - 12 cm; black (10YR 2/1) clay; strong, medium columnar and strong, medium subangulsr blocky; very firm; slightiy stony.
IIBnt	12 - 32 cm; dark graysh brown (10YR 4/2) heavy clsy; moderate, medium prismatic snd strong, fine angular blocky; extremely firm; no stones.
IIBC	32 - 75 cm; dark gray (10YR 4/2) heavy clay; strong, fine angulsr blocky; very firm; no stones.
IICak	75 - 100 cm; graysh brown (10YR 5/2) clay; moderate, fine angular blocky; firm; no stones.

COMMENTS: - where color value of A hurizon is leas than 3.5 dry the profile becomes s Black Solodized Solonetz.

CLASSIFICATION: Orthic Grny Luvisol (OGL)

DOMINANT IN MAP UNIT(S): 7

SIGNIFICANT IN MAP UNIT(S): 8, 9, 10

Profile:

L-H	7 - 0 cm; deciduous leaf litter and grasses, partially decomposed in lower portion.
Ah	0 - 2 cm; very dark gray (10YR 3/2) loam; weak, fine granular; very friable; slightly stony.
Ae	2 - 17 cm; pale brown (10YR 6/3) loam; moderate, medium platy; very friable; moderately stony.
AB	17 - 25 cm; yellowish brown (10YR 5/4) loam to clay loam; moderate, fine subangular blocky; firm; moderately stony.
Bt	25 - 68 cm; dsrk grayish brown (10YR 4/2) clay loam to clay; moderate, medium subangular blocky; firm; moderately stony.
Ck	68 - 150 cm; yellowish brown (10YR 5/4) loam; pseudo, angular blocky; firm; moderately stony.

COMMENTS: - under cultivation with graases and legumes in the rotation Orthic Gray Luvisols develop dark gray, 10 to 15 cm thick Ap horizons which make the soils similar to Dark Cray Luvisols.

CLASSIFICATION: Terric Mesisol (TM)

DOMINANT IN MAP UNIT(S): 11

SIGNIFICANT IN MAP UNIT(S):

Profile:

Om	0 - 100 cm; dark brown (7.5YR 3/2) layered or matted indiscernable moss peat.
Ckg	100 cm plus; dark gray (10YR 4/1) clay loam; massive; sticky; stone-free.

COMMENTS: - variations include thickness of organic layer (55 to 125 cm), and degree of decomposition.

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

Table B8 Guidelines for Assessing the Suitability of Soils as a Source of Sand and Gravel B9

Table B9 Guidelines for Evaluating Soil Constraints for Sewage Lagoons B10

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

This guide provides ratings for undiaturbed soils evsluated for single-family dwellings and other atructures with similar foundation requirements. The emphasis for these ratings is on foundations, but slope, susceptibility to flooding, and seasonal wetneas are also considered. On-site investigations are needed for specific plscement 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).
Wetncss[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: lmperfectly drained soils. Wster-table 50-75 cm.	WITH BASEMENTS: lmperfectly, 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-tsble 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, snd 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 penetrstes 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 syatem 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] balow 3.0 m.	lmperfectly drained soils and soils subject to occasional ponding or seepage. Water-table 2.4 - 3.0 m.	lmperfectly 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 rspid 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 seasonsl 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 maintenance 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	Moderate	Severe
Flooding	None	Once in 5 years	More than once in 5 years
Wetness[1] (soil drainage)	Rapidly, well and moderately well drained	Imperfectly 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 explanation of soil drainage classes, see Appendix C.
2. For explanation of soil texture classes, see Appendix G. 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 he used intensiveiy 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 auitable for heavy foot traffic. Soil suitability for growing and maintaining vegetation is not a part of thia 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] (aoil drainage)	Rapidly, well and moderately well drained aoils 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] Stonineaa	Classes 0 to 2	Class 3	Classes 4 and 5
Surface[3] aoil 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 aoils subject to severe blowing. Organic soils

1. For expianation 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 Conatraints for Picnic Areas

This guide providea ratings for soila 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 acceas 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 timea for short periods during season of use	Floods more than 2 timea during season of use
Wetness[1] (soil drainage)	Rapidly, well and moderately well drained soila. Water-table below 50 cm during season of use	Moderately well drained soils subject to occasional ponding. Imperfectly drained soils not aubject to ponding. Water-table above 50 cm for short perioda 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 durin 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	Classea 4 and 5
Surface soil[3] texture	SL, FSL, VFSL, L and LS with texturai 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 explanatiou of stoniness claases, see Appendix C.
3. Influences ratinga 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 sewsge for the time required for bacterial decomposition. The soils are considered for two functions (1) aa 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 constrainta class includes soils that sre effective in functioning as sealed bssin 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 constrsint class are those that are very porous, or that are high in organic matter, or that have other constraints that prevent their use ss sites for sewage lagoons.

Chart B indicates properties and major behavior qualities that affect, especislly 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 thsn 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 thsn 9%
Coarse frngments, lesa 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 thsn 15%
Flooding[2.]	None	None	Soils subject to flooding
Soil groups (Unified)[3.] (rated for use mainly as floor of sewsge)	GC, SC, CL, and CH	GM, HL, SM and MH	GP, GW, SW, SP, OL, OH, and PT

1. If the floor of the lagoon is nearly impermeable material at lesst 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 Materisls for Compacted Embankments".

Chart B. Characteristics of Materinls for Compacted Embankments.

Unified Classi-fication	Shear Strength	Compress-ibility	Permeability of Compacted Soil	Susceptibility to Piping	Compaction Chsracteristic
GW	High	Low	High	Lnw	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	Gond to fair
SW	High	Low	High	Medium	Good
SP	Medium	Low	High	Medium to high	Good
SH	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	Fiar 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 hazsrd 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.

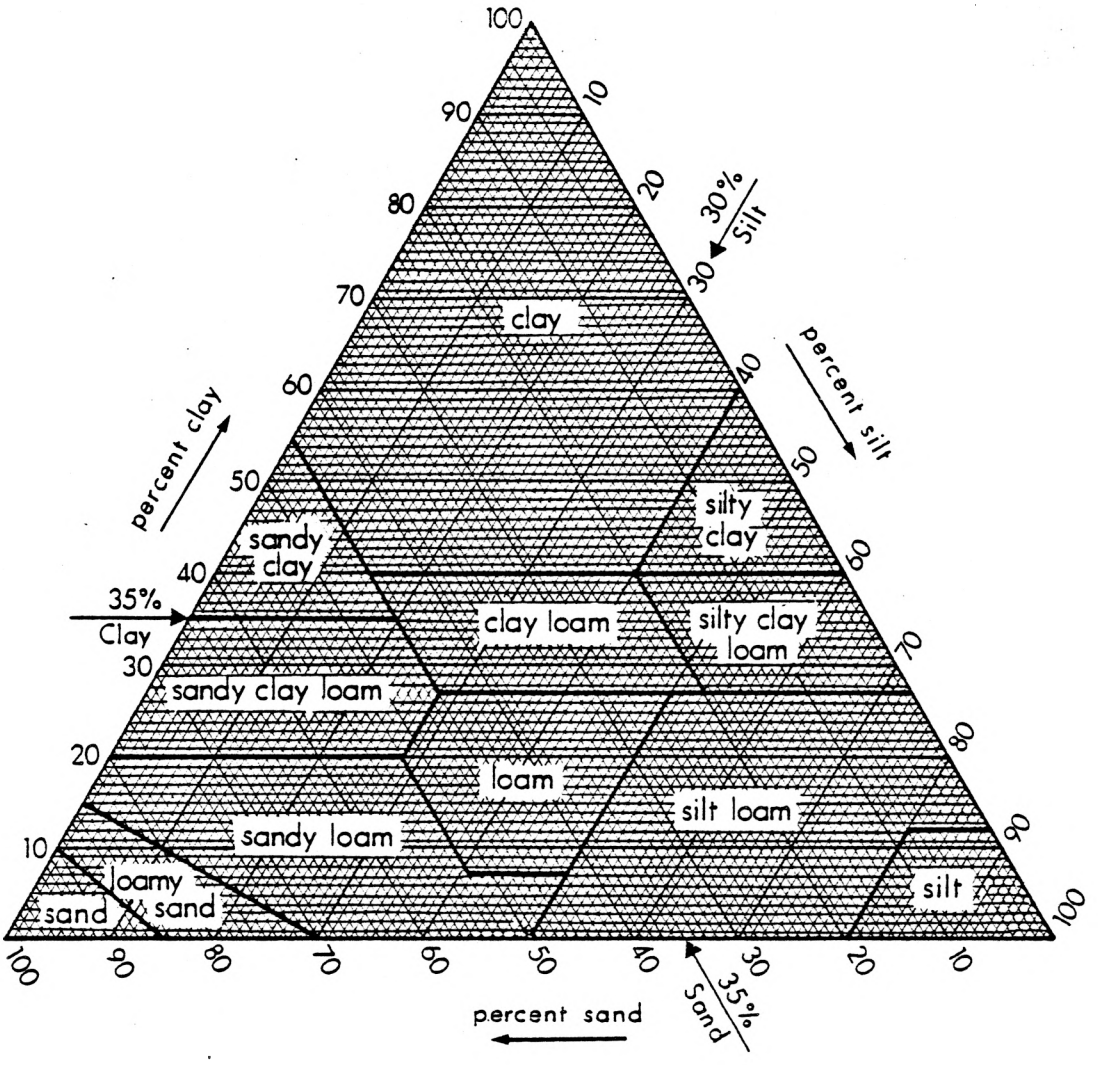
Soil Separates (Particle Size) on which Textural Classes are based:

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 soil 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 underlyin 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.

scale - 1 : 20,000

ALEXANDER INDIAN RESERVE. No. 134

SOIL MAP

SOIL MAP UNIT	LANDFORM: Parent Material and Surface Expression	SOILS: Subgroups (D= Dominant, S= Significant, I= Inclusions)	Drainage Class	Stoniness	SCHEMATIC CROSS-SECTION (D= Dominant, S= Significant, I= Inclusions, MU= Map Unit)
Soils on Glaciolacustrine Deposits over Till					
1	- about 50 to 100 cm of clayey lacustrine deposits overlying clayey till - undulating, very gentle slopes 2 to 5%	D= Solonetzic Black Chernozems	moderately well	nonstony	S I D Glaciolacustrine Till
		S= Black Solodized Solonetz	moderately well to imperfectly		
		I= Eluviated Black Chernozems Humic Luvic Gleysols	moderately well and poorly		
2	- about 50 to 100 cm of clayey lacustrine deposits overlying clayey till - rolling, gentle slopes 6 to 9%	D= Eluviated Black and Dark Gray Chernozems	moderately well	nonstony	D I S D Glaciolacustrine Till
		S= Gleyed Eluviated Black Chernozems	imperfectly		
		I= Black Solodized Solonetz	moderately well to imperfectly		
3	- about 50 to 100 cm of clayey lacustrine deposits overlying clayey till - rolling, gentle slopes 6 to 9%	D= Black Solodized Solonetz	moderately well	nonstony	D I D I D Glaciolacustrine Till
		S= Gleyed Black Solonetz	imperfectly		
		S= Eluviated Black Chernozems	moderately well		
		I= Humic Luvic Gleysols	poorly		
4	- about 50 to 100 cm of clayey lacustrine deposits overlying clayey till - undulating, very gently slopes 2 to 5%	D= Gleyed Black Solodized Solonetz	imperfectly	nonstony	D I D S D Glaciolacustrine Till
		S= Black Solodized Solonetz	moderately well		
		I= Eluviated Black Chernozems	moderately well		
5	- about 50 to 100 cm of clayey lacustrine deposits overlying clayey till - depressional, slopes 0 to 2% - occasionally ponded	D= Orthic and Rego Humic Gleysols	poorly	nonstony	MU6 MU5 MU2 S D S Glaciolacustrine Till
		S= Gleyed Black Solonetz and Peaty Gleysols	imperfectly and very poorly		
Soils on Till					
6	- clayey till deposits - rolling, gentle to moderate slopes 6 to 15%	D= Dark Gray Chernozems	moderately well	slightly stony	S D I D S Till
		S= Eluviated and Solonetzic Black Chernozems	moderately well		
		I= Orthic Humic Gleysols	poorly		
Soils on Modified Residual Materials and Till					
7	- dominantly loamy modified residual deposits overlying bedrock and significant extents of till - rolling, strong slopes 16 to 30%	D= Orthic Gray Luvisols	well	slightly stony	S D D S Residual & Till
		S= Solodic Gray Luvisols	moderately well		
		I= Rego Humic Gleysols and Terric Mesisols	very poorly		
8	- dominantly clayey till and significant extents of loamy residual materials over bedrock - undulating, very gentle slopes 2 to 5%	D= Gray Solodized Solonetz	moderately well	slightly stony	D S D S D Residual & Till
		S= Orthic Gray Luvisols	well		
9	- dominantly clayey till and significant extents of loamy residual materials over bedrock - rolling, gentle slopes 6 to 9%	D= Gray Solodized Solonetz	moderately well	slightly stony	S D D S Residual & Till
		S= Orthic Gray Luvisols	well		
		I= Black Solods	moderately well		
10	- dominantly clayey till and significant extents of loamy residual materials over bedrock - rolling, moderate slopes 10 to 15%	D= Gray Solodized Solonetz	moderately well	slightly stony	S D D S Residual & Till
		S= Orthic Gray Luvisols	well		
		I= Black Solods	moderately well		
Soils on Organic Deposits					
11	- bogs with as much as 100 cm of fen and sedge peat and/or moss peat overlying mineral deposits - nearly level, slopes 0 to 2%	D= Terric Mesisols	very poorly	nonstony	I D S D I Organic Mineral
		S= Typic Mesisols			
		I= Peaty Gleysols			
Miscellaneous Units and Symbols					
BS	- represents areas of beach sand deposits bordering Sandy Lake - undulating, very gentle slopes 2 to 5%	Orthic Regosols and Gleyed Regosols	rapidly and imperfectly	nonstony	MU 10 BS Sandy Lake
SC	- represents the areas occupied by stream channels, their meander plains and banks	Undifferentiated Regosols and Gleysols	well to very poorly	slightly stony	MU2 SC MU2

- intermittent drainage courses
- sloughs
- ×125 - soil inspection site
- DO - dug out
- escarpment

PREPARED FOR

INDIAN AND NORTHERN AFFAIRS ALBERTA

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