SOIL SURVEY OF A PORTION OF THE SYNCRUDE LEASE 17 AREA, ALBERTA

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FOREWORD

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ABSTRACT

A soil survey of a portion of Syncrude No. 17 Lease Area, encompassing an area of about 93 square kilometres, was conducted during the period between June 20 and July 8, 1977. The soils were inspected and described at 413 sites and representative soils were sampled for physical and chemical laboratory analyses. The distribution of the soils is presented on the soils map at a scale of 1:24,000. Soils of the Luvisolic, Brunisolic, Gleysolic, Cryosolic and Organic Orders were recognized and characterized. Moderately well drained Orthic Gray Luvisols developed on fine to very fine textured glaciolacustrine materials predominate, occupying about 49 percent of the study area. Organic and Organic Cryosol soils occupy about 35 percent of the area. The depth of peat in the majority of these soils is less than 80 cm. Both bogs and fens were recognized. Bogs have the larger areal extent occupying about 26 percent of the study area. Permafrost was encountered in some of the deep bogs. No permafrost occurs in any of the fens or shallow bogs.

1. INTRODUCTION

Pedology Consultants was commissioned by Syncrude Canada Ltd. to conduct a soil survey of a portion of the Syncrude No. 17 Lease Area to enable the identification of soil materials for reclamation and construction purposes.

Soil mapping was carried out in June and July, 1977 using recently flown black and white panchromatic aerial photographs at a scale of 1:16,000. The final soils map is presented at a scale of 1:24,000. The soils were inspected and described at 413 sites, the locations of which are indicated on the soils map. Fifteen soil profiles were sampled for chemical and physical laboratory analyses.

The soils are described in terms of landform, parent material, slope, drainage, texture, structure and consistence, according to the System of Soil Classification for Canada (Canadian Department of Agriculture, 1974). The taxonomic soil classification used is the Canadian System of Soil Classification (Canada Soil Survey Committee, 1976).

The appendices provide detailed profile descriptions and analyses of the commonly occurring soils in the area, general descriptions of the inspection sites, and a glossary which defines the more commonly used terms in the report.

2. DESCRIPTION OF THE SYNCRUDE NO. 17 LEASE AREA

2.1 Location and Extent

The study area is located within Syncrude's Lease 17. This region is located in north-eastern Alberta, approximately 37 kilometres north of Fort McMurray and 11 kilometres south of Fort MacKay, Alberta. The area is bounded by the banks of the MacKay River on the west and Highway 63 on the east. The study area encompasses about 93 square kilometres and includes portions of Townships 92 and 93, Ranges 10 to 12, West of the Fourth Meridian.

2.2 Physiography and Drainage

The study area lies within the Clearwater Lowlands Region of the Saskatchewan Plain (Bostock, 1970). The bedrock of this area is composed of Middle Devonian limestones overlain by slightly consolidated and unconsolidated bentonitic shales and sandstones of late Cretaceous Age (Bayrock, 1961). These materials form the large erosional remnants of the Birch and Muskeg mountains, which lie to the north-west and east of the study area, respectively.

The topography is gently undulating with a regional slope from the base of the Birch Mountains towards the Athabasca River. The range in elevation is from 380 metres above mean sea level at the south-western edge of the study area, to 310 metres along Highway 63 at the eastern edge.

The area is drained by tributaries of the Athabasca River system. The MacKay River is found to the west and the Athabasca River to the east of the study area. These rivers have relatively well-incised valleys, which range from 30 metres to 50 metres below the surrounding uplands. Beaver Creek drains the central portion, and varies from a meandering stream in the relatively flat uplands, to a deep gorge near its confluence with the Athabasca River. The relatively flat uplands are drained by a number of small intermittent streams; the majority of which flowed into Beaver Creek before the construction of the interceptor ditch.

Numerous beaver dams along intermittent streams have impeded drainage, resulting in a number of shallow ponds.

2.3 Surficial Geology

The study area was glaciated during Pleistocene times by Continental glaciers advancing southward from the Canadian Shield. The last glaciation is believed to be the Classical Wisconsin glacier, which occurred about 10,000 years ago. The recession of the glacier commenced with a lowering of the ice surface. As the general slope of the land is towards the north, glacial meltwaters were impounded in front of the receding glacier, producing temporary, but very large, ice marginal lakes. The ice marginal lakes received sedimentation directly from the glacier by glacial meltwater streams, from debris-loaded icebergs "calving" into the lake and from non-glacial rivers flowing into the lakes.

A large ice marginal lake formed in front of the glacier or south of the Fort Hills (Bayrock and Reimchen, 1976). This lake covered all of the study area and extended southwards beyond Fort McMurray. Thus, the study area was covered by a more-or-less uniform blanket of ground moraine till which then became covered by glaciolacustrine materials (lacustro-till) during the existence of the ice marginal lake. The glaciolacustrine materials in the study area are no greater than 2 metres in depth. Recession of the glacier from the Fort Hills allowed the ice marginal lake to be drained. Immediately following the drainage, the Athabasca River inundated a portion of the study area. The flowing waters of this ancient Athabasca River did not exceed the 315 metre contour line (Bayrock and Reimchen, 1976). The ancient Athabasca River waters eroded most of the previous glacial deposit existing below an elevation of 315 metres, and in the place of glaciolacustrine materials, fluvial materials of sand composition were laid down. Deeper incision of the Athabasca River produced the present river valley.

Most of the closed depressions and poorly drained terrain in the study area gradually developed organic deposits over the years. The organic material (peat) is up to 3 metres in thickness and is developed from moss or sedge plant material. Both bogs and fens occur in the area. Bogs characteristically consist of a variety of mosses, with Labrador tea, black spruce and sometimes tamarack abounding on the surface (see Plate 1). The surface of bog peatland may be raised (domed) above the surrounding terrain of inorganic materials. Fens are generally wet and are characterized by a predominance of sedge and slough grass. Willow, dwarf birch and alder may be associated with the sedge.

2.4 Vegetation

The study area is within the Mixedwood Section of the Boreal Forest Region (Rowe, 1972). This is a large Forest Section extending from south-western Manitoba to north-eastern British Columbia.

The major determining factor in the composition of the forests in the study area has been widespread forest fires (probably in the late 1940's). The ability of trembling aspen (*Populus tremuloides*) to regenerate rapidly following disturbance has resulted in large pure stands of this species. Paper birch (*Betula papyrifera*) is a minor component as is balsam poplar (*Populus balsamifera*) which usually occurs on sites which have a more favorable moisture regime. White spruce (*Picea glauca*) is generally present in older upland stands, while jack pine (*Pinus banksiana*) is the usual associate on sandy areas. Wetter areas support black spruce (*Picea mariana*) and occasionally tamarack (*Larix laricina*).

Major shrub species of upland areas are saskatoon-berry (*Amelanchier alnifolia*), buffalo-berry (*Shepherdia canadensis*), honeysuckle (*Lonicera* spp.) and green alder (*Alnus crispa*). On moist to wet sites common shrub species are willow (*Salix* spp.), river alder (*Alnus tenuifolia*), dwarf birch (*Betula glandulosa*) and common Labrador tea (*Ledum groenlandicum*).

Throughout the study area there are many wet depressional areas. Most of these areas consist primarily of moss peat and a vegetative community of black spruce, Labrador tea, sometimes tamarack, and a variety of moss species. Other depressional areas consist dominantly of sedge peat. The sedge peat is rarely over 150 cm in thickness and sedges (*Carex* spp.) and slough grass (*Beckmannia* sp.) predominate. Willow, dwarf birch and

Plate 1: Vegetation common to bog peatland areas.
Kenzie soils occur in these areas.

alder are frequently associated with the sedge.

2.5 Climate

The study area lies within the Cool Temperatere climatic zone, which is characterized by short, cool summers and long, cold winters (Longley, 1967).

Long-term records of mean annual precipitation and temperature for the years 1941 to 1970 were obtained from the Fort McMurray Airport reporting station (Environment Canada, 1973). The mean annual temperature is -0.5 C. The highest temperatures occur in July, averaging 16.3 C, and the lowest temperatures in January, averaging -21.5 C. The extreme temperature range is from 36.1 C to -50.6 C illustrating the great seasonal variability in temperature. The average frost-free period is 67 days, with a range of 29 to 101 days.

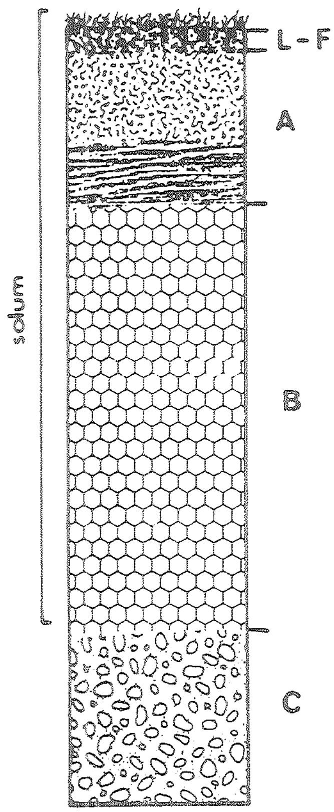
The mean total precipitation is 43.5 cm, of which 30.5 cm is rainfall. The mean annual snowfall is 139.7 cm, which compacts to a mean maximum snow depth of 38.0 cm in February. Maximum compacted snow depths have reached 66 cm within the reporting period.

3. SOIL DEVELOPMENT

Soil development is a complex and continuous process. Soils are natural dynamic bodies on the earth's surface that are an integral part of the environment. Soils display variation both vertically and horizontally and by examining these variations soil individuals may be recognized. Soils have evolved from their geological parent material through the action of environmentally controlled soil forming processes. The soil forming factors, namely parent material, climate, biotic agents and topography, all acting through time, influence the genesis (formation and development) of every soil. The relative importance or dominance of each of these factors varies from area to area. Such processes as the addition and/or removal of organic matter, translocation of clays or iron and aluminum, translocation of lime and salts, and other chemical and physical transformations are expressions of the soil forming factors that result in the formation of soil individuals with distinct, observable profile characteristics (Buol et al., 1973; Coen and Holland, 1976 and Dumanski et al., 1972).

The profile of each soil individual has characteristic horizons or layers that differ from each other in color, structure, texture, consistence and chemical and biological activity. The major or master horizons are designated O for organic layers developed mainly from mosses, coarse grasses and woody materials; L, F and H for organic layers developed mainly from leaves, conifer needles and woody materials; and A, B and C for mineral horizons. The A horizon is the portion of the profile from which the materials are leached by percolating rain water and in which, in most soil profiles, organic matter accumulates. The B horizon is the portion in which the materials carried down from the A horizon are deposited. Taken together, the A and B horizons form the solum, which represents the true soil formed by the soil forming agents. The C horizon is the relatively unaltered parent material. Subdivisions of master horizons are denoted by letters suffixed to the master horizon symbol (see Figure 1 and Table 3 in Appendix C).

Through observation of the soil profile characteristics it is possible to classify soils in accordance with the processes involved in their formation.



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

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

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

-- Mineral horizon comparatively unaffected by the soil forming process operative in the A and B horizons except for the process of gleying (Cg) and the accumulation of calcium and/or magnesium carbonates (Ck).

FIGURE 1. Diagram of a soil profile.

4. METHODS

4.1 Soil Classification

The soils have been classified according to the Canadian System of Soil Classification (Canada Soil Survey Committee, 1976). This scheme classifies the soils in their natural state, and thus indicates relationships between soils and their environment. These relationships are often important for assessing limitations of soils for various uses.

4.2 Soil Mapping

The main objective of a soil survey is to classify and map the soil and land attributes that are found in a defined area. As a main part of the field work the soil surveyor examines soils at various sites (road-cuts, shovel and auger holes) to describe the soil profile and to characterize the landscape, noting landform, parent material, topography, drainage, vegetation and other pertinent features. Forest trails and seismograph cut-lines provided access to the area. These were traversed with an "Argo" supplied by Syncrude Canada Ltd.

The "point" observations are extrapolated to an "area" through aerial photograph interpretation and further field checking. Four hundred and thirteen sites were examined in the study area; the locations of which are presented on the soils map with brief descriptions of each being given in Appendix B. The field investigation log is under separate cover with Syncrude Canada Ltd. Black and white panchromatic photographs (1977) at a scale of 1:16,000 and a prepared aerial photo-mosaic at a scale of approximately 1:20,000 were used as an aid in mapping. The final soils map is presented on a line base map prepared by Syncrude Canada Ltd. at a scale of 1:24,000.

The areas delineated on the final soils map are called map units and, in this survey, consist of two parts; a soil unit in the numerator and a topographic class in the denominator. A name is assigned to the soil group which is distinguished on the basis of parent material and landform, soil development (profile characteristics) and soil moisture characteristics. The soil unit is a subdivision of the soil group and is used mainly for mapping convenience. For example, a notation such as

$$\frac{\text{MRL}}{\text{b}}$$

appearing on the soils map identifies an area of predominantly Mildred Lake (MRL) soils - poorly drained Rego Gleysols developed on fine to very fine textured glaciolacustrine material on class b topography (0 to 2% slopes). Also included with the Rego Gleysols are a significant proportion (15 to 30% of the area) of poorly drained Orthic Luvic Gleysols (see legend on soils map). However, because soil areas are generally characterized by a complex soil pattern, more than one soil unit is frequently used to describe the soils of an area. Thus, most notations on the soils map are combinations of two soil units shown in order of their dominance. For example:

$$\frac{\text{MMY--MRL}}{\text{b}}$$

identifies an area of predominantly McMurray soils - Orthic Gray Luvisols developed on fine to very fine textured glaciolacustrine material with lesser amounts of Mildred Lake soils - poorly drained Rego Gleysols and Orthic Luvic Gleysols developed on similar material on class b topography (0 to 2% slopes). McMurray soils make up at least 70 percent of the area and Mildred Lake soils constitute between 15 and 30 percent of the area. Complexes of soil units are used on the soils map because different soils or different parent materials form a complex pattern within a geographic area such that they cannot be separated even at the scale of mapping used in this survey.

In this survey the mapping phase was frequently used to denote soil characteristics which are considered to be potentially significant to man's use or management of the land. Four mapping phases, stony (s), gleyed (g), peaty (p), and frozen (f) were recognized in this survey. They are defined as follows:

(1) Stony phase - used for soils that have a greater quantity of stones than is defined in the description of the material. It indicates areas of Blackmud soils that have a very stony to moderate stone content.

(2) Gleyed phase - this notation was used for soils which, because of their position in the landscape, are imperfectly drained. They show weak mottling in the B and C horizons. Soils that are strongly mottled throughout are classified in the Gleysolic Order. This phase indicates areas of McMurray soils that are imperfectly drained.

(3) Peaty phase - used where Gleysolic soils have greater than 15cm of surface peat. This phase indicates areas of Gunderson and Mildred Lake soils that have greater than 15 cm of surface peat, but less than 40 cm of mesic and humic peat or less than 60 cm of fibric peat.

(4) Frozen phase - used where Organic soils show discontinuous permafrost. It indicates areas of Kenzie (KNZ3) soils which contain permafrost within a metre of the surface. Such soils are classified as Fibric Organic Cryosols and Mesic Organic Cryosols of the Cryosolic Order.

The topography, textural, drainage and stoniness classes are essentially those used by The System of Soil Classification for Canada (Canada Department of Agriculture, 1974) and are described in Appendix C.

The user must appreciate the non-homogeneity of soils and the scale of mapping. The soil mapping units are described in terms of their dominant soil types and are delineated on the soils map similarly. However, due to variations in soils over short distances, the occurrence of small areas of different soils and frequent associations of different soil types because of topographic and drainage patterns, each mapping unit may have inclusions of some soil types not indicated for the area. The soils map at a scale of 1:24,000 is suitable for semi-detailed planning, but does not eliminate the need for intensive on-site investigations for specific site development and construction.

4.3 Laboratory Analyses

The principal soils of the study area were sampled for physical and chemical analyses. Descriptions and analytical results of the 15 soil profiles sampled are presented in Appendix A. A guide to the location of the sampling sites is provided on the soils map. Analyses were performed by Norwest Soil Research Ltd. according to routine procedures set out by the Soil Research Institute in Ottawa (McKeague, 1976). The analyses include:

1. Particle Size Analysis which provides soil texture information and is related to water holding capacity, erodibility, porosity and bulk density.

2. Soil Reaction (pH) which provides a measure of hydrogen ion concentration and is related to soluble carbonate content and availability of plant nutrients.

3. Total Nitrogen and Organic Carbon which provide a measure of each and the C/N ratio which indicates the stage of decomposition of organic matter. High C/N values (>25) indicate raw organic matter.

4. Electrical Conductivity (E.C.) which provides a measure of soil salinity. Soils with E.C. of less than 4 mmhos/cm are considered to be non-saline.

5. Cation Exchange Analysis which provides a measure of the total exchange capacity of the soil colloids, and the relative amounts of the adsorbed cations. It also indicates percent base saturation and is related to nutrient availability. Calcium is usually the dominant exchangeable cation in the soil.

5. SOILS OF THE SYNCRUDE NO. 17 LEASE AREA

The soils of the study area reflect the cool climatic conditions found in the region. Soils of the Luvisolic, Brunisolic, Gleysolic, Cryosolic and Organic Orders were identified. Moderately well and well drained Gray Luvisols with thin or absent Ah horizons predominate, constituting about 50 percent of the soils in the study area. Surface horizons are typically medium textured with the underlying subsoil being fine to very fine textured in areas of glaciolacustrine (lacustro-till) parent material and coarse textured where fluvial materials are encountered.

Rapidly drained Eluviated Dystric and Eluviated Eutric Brunisols are of limited extent (3% of the study area) and are confined to some of the fluvial areas on the eastern side of the study area. These soils lack an Ah horizon and are very coarse textured.

Gleysolic soils are found in some of the poorly and very poorly drained depressional positions of the landscape. Gleysolic soils are characterized by extensive mottling and gleying. They occupy approximately 11 percent of the area. Rego Gleysols, which lack a Bg horizon, are the dominant Gleysolic soils found in the area. Orthic Luvic Gleysols and Orthic Gleysols, which exhibit a Btg and Bg horizon respectively, were also recognized.

Very poorly drained Organic soils are found throughout the area. Organic soils are characterized by the presence of greater than 40 cm of mesic or humic peat, or greater than 60 cm of fibric peat. Two types of organic deposits were recognized in the study area: those developed on fen peatland, and those developed on bog peatland. The fens are derived mainly from sedge material while the bogs are derived from moss material. Fen peatland consists mainly of Mesisols and Humisols, and bog peatland of Mesisols and Fibrisols. The depth of peat varies considerably in the study area; however, the majority of the peat is less than 80 cm in thickness. Organic soils occupy approximately 33 percent of the study area.

Some deep Organic soils derived from moss material contain discontinuous permafrost within a metre of the surface. These unique soils were classified into the Cryosolic Order. Both Mesic and Fibric Organic Cryosols were recognized. Soils of the Cryosolic Order occupy about 2 percent of the area.

A key to the soils of the study area is presented in Table 1.

Seven soil groups were recognized and characterized. Each of the soil groups, and the soil units used to differentiate soils within each, are described in the following section in the same order as Table 1. Each description of a soil includes its natural setting in terms of classification, parent material, landform, drainage, vegetation, topography, location, stoniness, texture, depth and chemical characteristics.

5.1 Soils Developed on Fine to Very Fine Textured Glaciolacustrine Materials (Lacustro-till)

5.1.1 McMurray Soils (MMY)

Soils of the McMurray soil group consist of moderately well drained Orthic Gray Luvisols developed on fine to very fine textured slightly stony, stratified glaciolacustrine (lacustro-till) materials. These soils are found throughout the area west of Beaver Creek on gently undulating terrain. Native vegetation is mainly trembling aspen and balsam poplar, with lesser amounts of white spruce and willow. Understory species include shrubs such as wild rose, raspberry and dogwood, with a profusion of herbs and some grasses. McMurray soils have the largest areal extent of all the soils mapped, being the dominant soils in approximately 49 percent of the area.

The glaciolacustrine (lacustro-till) material which constitutes the parent material of the McMurray soil group is a friable to firm, brown to yellowish brown stratified clay to heavy clay that is slightly stony and weakly to moderately calcareous. The stone suite consists of quartzites, limestones and crystalline rocks of Keewatin origin. Thickness of the glaciolacustrine material is greater than a metre and probably exceeds two metres in places. It overlies glacial till and may be overlain by coarse textured fluvial materials and/or organic materials.

TABLE 1. Key to the Soils of the Study Area

Soils developed on fine to very fine textured glaciolacustrine materials (lacustro-till)

Moderately well drained
McMurray (MMY) - Orthic Gray Luvisol

Imperfectly drained
McMurray/gleyed (MMY/g) - Gleyed Gray Luvisol

Poorly drained
Mildred Lake (MRL) - Rego Gleysol

Very poorly drained
Mildred Lake/peaty (MRL/p) - Peaty Rego Gleysol

Soils developed on coarse textured fluvial materials

Rapidly drained
Blackmud (BKM1) - Eluviated Dystric Brunsiol

Well drained
Blackmud (BKM2) - Brunisolic Gray Luvisol

Poorly drained
Gunderson (GUN) - Rego Gleysol

Very poorly drained
Gunderson/peaty (GUN/p) - Peaty Rego Gleysol

Soils developed on coarse textured fluvial materials overlying finer textured glaciolacustrine (lacustro-till) materials

Well drained
Lodge (LDG) - Orthic Gray Luvisol

Soils developed on moss peat (bogs)

Very poorly drained
Kenzie (KNZ1) (KNZ2) - Terric Mesisols and Terric Fibrisols
Kenzie (KNZ3) - Mesisols and Fibrisols
Kenzie/frozen (KNZ/f) - Organic Cryosols

Soils developed on sedge peat (fens)

Very poorly drained
Eaglesham (EGL1) (EGL2) - Terric Mesisols and Terric Humisols
Eaglesham (EGL3) - Mesisols and Fibrisols

McMurray soils exhibit strongly developed Orthic Gray Luvisol features (Ae-Bt horizonation, see Plate 2). They may have an Ah horizon up to 5 cm in thickness, but it is often absent. They have a light brownish gray to pale brown Ae horizon which ranges in thickness from 5 to 15 cm and is very strongly acid to slightly acid in soil reaction. The texture of this horizon varies from silt loam to loam. The Ae horizon is underlain by a transitional AB horizon that is moderately to strongly developed and clay loam to clay in texture. At a depth of 15 to 20 cm below the surface the clay to heavy clay textured, firm, Bt horizon is encountered. It is subangular blocky in structure and very strongly acid to slightly acid in soil reaction. At depths of 60 to 90 cm below the surface the Ck horizon or parent material is encountered. Mottling is sometimes present in the lower

Plate 2: A McMurray soil profile. Note the Ae-Bt horizonation and the effective rooting depth (65 cm).

portion of the Ae horizon and the upper AB horizon indicating some restriction of downward movement of water due to the finer textures below the Ae horizon. Effective rooting depth appears to extend down to the bottom of the Bt horizon. Below the B horizon very few roots were observed in the profiles examined (see Plate 2).

Detailed descriptions and analyses of two McMurray soil profiles are presented in Appendix A.

One mapping phase, the gleyed phase (MMY/g), was used occasionally to describe areas of McMurray soils that showed imperfect soil drainage. These soils, because of their position in the landscape, are weakly mottled throughout their B and C horizons.

McMurray soils are frequently mapped in combination with Mildred Lake soils (MMY-MRL). This map unit was used to delineate areas of McMurray soils that contained 15 to 30 percent poorly drained Gleysolic soils. The Mildred Lake soils occur in lower slope and depressional positions of the landscape and are so numerous and small that they could not be separated on the soils map at the scale of mapping used in this survey.

5.1.2 Mildred Lake Soils (MRL)

This group of soils consists of poorly drained Rego Gleysols and lesser amounts of Orthic Luvic Gleysols developed on fine to very fine textured, stone-free to slightly stony glaciolacustrine (lacustro-till) materials. These soils are found in poorly drained positions on level to gently undulating terrain. They are developed and maintained because of groundwater discharge and are often saturated, or nearly saturated, throughout the growing season. Surface drainage is very slow and internal drainage poor. Native vegetation is dominantly willow, black spruce, balsam poplar, birch, sometimes trembling aspen, and a variety of mosses and sedges. Mildred Lake soils are found west of Beaver Creek and occupy about 10 percent of the map area.

Parent material of the Mildred Lake soil group is a brown to grayish brown, fine to very fine textured, stone-free to slightly stony glaciolacustrine (lacustro-till) material. It is intensely mottled and slightly acid to neutral in soil reaction. Stratification and darker colored layers (which may be varves) are evident throughout.

Both Rego Gleysols and Orthic Luvic Gleysols were recognized in this soil group. No attempt was made to differentiate these soils with differing morphology on the soils map; however, the Rego Gleysol appears to be the dominant Subgroup present. Rego Gleysols are characterized by a thin organic horizon (L-H, Oh, Om, Of) overlying a mottled Cg horizon (parent material). A thin Ah horizon may sometimes be present between the organic horizon and Cg horizon. Orthic Luvic Gleysols are characterized by a thin organic surface horizon that rests on a thin, fine textured, very dark gray to black organo-mineral horizon (Ah) that is "shotty" or granular in structure and friable in consistence. The Ah horizon may be absent. Below this a relatively thick, pale brown, iron stained Aeg horizon occurs that is medium to slightly acid in soil reaction. The underlying fine to very fine textured illuvial Btg horizon is dull colored, slightly acid to neutral in soil reaction and shows mottling and gleying features which indicate poor internal soil drainage. Below the Btg horizon, the massive, highly mottled, very fine textured parent material is encountered (Cg horizon).

Two soil profiles common to the Mildred Lake soil group were described and sampled for laboratory analyses. These include a peaty Rego Gleysol and a Rego Gleysol. The descriptions and analytical data of these two profiles are presented in Appendix A.

The peaty phase notation was used to describe more fully some of the areas of Mildred Lake soils. This phase (MRL/p) indicates areas of Mildred Lake soils that have greater than 15 cm, but less than 40 cm of mesic and humic surface peat, or less than 60 cm of fibric surface peat. Such areas are generally very poorly drained. Areas of Mildred Lake soils which have less than 15 cm of surface peat are not designated with the peaty phase.

Mildred Lake soils are sometimes mapped in combination with McMurray soils (MRL-MMY). Such a combination represents an area that consists dominantly of poorly drained Mildred Lake soils (MRL) in association with significant amounts of moderately well drained McMurray soils (MMY). The

McMurray soils constitute between 15 and 30 percent of the area.

Combinations of peaty Mildred Lake and Eaglesham soils (MRL/p-EGL1) or peaty Mildred Lake and Kenzie soils (MRL/p-KNZ1) represent areas in which the depth of peat varies from 15 to 80 cm. The peat is primarily sedge material when Eaglesham is noted and primarily moss material when Kenzie is noted. The underlying mineral material in such areas is fine to very fine textured glaciolacustrine.

5.2 Soils Developed on Coarse Textured Fluvial Materials

5.2.1 Blackmud Soils (BKM)

The Blackmud soil group consists of rapidly drained Eluviated Dystric and Eluviated Eutric Brunisols, and well drained Brunisolic Gray Luvisols developed on coarse textured fluvial deposits that are greater than 50 cm thick. These soils occur on the eastern side of the study area on gently undulating to gently rolling topography and occupy about 4 percent of the map area. Native vegetation is dominantly a sparse growth of jack pine and trembling aspen forest with an understory of low ericaceous shrubs, lichens, a number of herbs and some moss species (see Plate 3).

Parent material of the Blackmud soil group is a light olive brown to yellowish brown colored fluvial material that contains a variable, but low concentration of small pebbles up to 2 cm in diameter. Lenses of interbedded silts and sometimes gravel may also be present. The material is strongly acid to neutral in soil reaction. The fluvial material commonly overlies glaciolacustrine deposits (lacustro-till) and may be overlain by organic materials. There is evidence that some of the fluvial material has been redeposited by wind; however, these were not delineated on the soils map.

The basis for differentiating the soils of the Blackmud soil group is the occurrence of a textural B horizon (Bt). The origin of the textural B may be due either to the high incidence of interbedded clay lenses in the parent material or to the pedological processes of clay translocation. This horizon is sandy loam to sandy clay loam in texture, strongly to slightly acid in soil reaction, weakly developed and finer textured than

Plate 3: A fluvial sand area on the east side of the study area. Note the jack pine in the background and sparse vegetative cover in the foreground. Rapidly drained Blackmud soils are developed on these materials.

the horizons above and below. Due to a higher clay content this horizon has a slower permeability and higher water holding capacity than the horizons above and below and is important in regulating the moisture regime of these soils. Therefore, two soil units were established to differentiate the Blackmud soils: 1) BKM1 with no textural B horizon; and 2) BKM2 with a textural B horizon.

Soils of the BKM1 soil unit are classified as Eluviated Dystric Brunisols with lesser amounts of Eluviated Eutric Brunisols. These soils are characterized by very strongly acid to slightly acid, coarse textured eluvial (Ae) horizons overlying coarse textured Bm horizons that are strongly acid to neutral in reaction. They lack a textural B (Bt) horizon and exhibit rapid internal soil drainage. Soils of the BKM1 soil unit are droughtier than those of the BKM2 unit. The BKM2 unit consists of Brunisolic Gray Luvisols which are characterized by the presence of a textural B horizon.

Three soil profiles common to the Blackmud soil group were sampled for laboratory analyses. The detailed descriptions and analyses are presented in Appendix A. A Blackmud soil profile is illustrated in Plate 4.

One mapping phase, the stony phase, was used to further describe areas of Blackmud soils that have a high concentration of pebbles. The soils in such areas are moderately to very stony.

Blackmud soils are sometimes mapped in combination with Lodge soils (BKM-LDG). Such combinations indicate areas where the thickness of the fluvial material is highly variable and in some cases is less than 50 cm thick. The Lodge unit (thin sand) comprises between 15 and 30 percent of these areas.

A combination of Blackmud and Gunderson (BKM-GUN) was used to delineate areas of Blackmud soils with 15 to 30 percent poorly drained Gleysolic soils (Gunderson) included in the landscape. The Gunderson soils occur in lower slope and depressional positions of the landscape.

Plate 4: An Eluviated Dystric Brunisol developed on fluvial sand (Blackmud soils). Note the thin layer of lacustro-till at depth.

5.2.2 Gunderson Soils (GUN)

Soils of the Gunderson soil group consist of a collection of poorly drained Rego and Orthic Gleysols developed on coarse textured fluvial material. These soils occupy level to depressional positions in the landscape and are commonly found interspersed with Organic soils between sand ridges. Their surface drainage is slow and internal drainage is impeded because of a high water table. Two types of vegetative communities occur on these soils: 1) Sedge, reed-grasses and marsh plants with clumps of willow, paper birch, balsam poplar, alder and black spruce; and 2) black spruce, Labrador tea and a variety of mosses. Gunderson soils are of minor occurrence occupying less than 1 percent of the map area.

Parent material of the Gunderson soil group is a dull colored, coarse textured, stone-free to slightly stony fluvial material which frequently exhibits yellowish brown to reddish brown mottles. It sometimes contains interbedded silts, clay and occasionally gravel. This material is highly variable in depth and overlies glaciolacustrine sediments and commonly is overlain by organic material.

A number of profiles with differing morphology occur in this soil group. The Rego Gleysol (L-H - Cg horizonation) appears to be the dominant Subgroup observed; however, Orthic Gleysols, in which a weakly expressed Bg horizon occurs between the L-H and Cg horizons, are also of significant occurrence. No attempt was made to distinguish the soils with differing morphology on the soils map. Since these soils are of minor occurrence in the study area no samples were collected for laboratory analyses.

One mapping phase, the peaty phase, was used occasionally with the Gunderson soils. This phase (GUN/p) indicates areas of Gunderson soils which have greater than 15 cm, but less than 40 cm, of mesic and humic surface peat or less than 60 cm of fibric surface peat. Such areas are generally very poorly drained.

Gunderson soils are sometimes mapped in combination with units of Blackmud soils (GUN/p-BKM1). Such a combination signifies areas which consist dominantly of very poorly drained peaty Rego and peaty Orthic Gleysols

(GUN/p) in association with significant amounts of rapidly drained Eluviated Dystric and Eluviated Eutric Brunisols (BKM1). The Blackmud soils are found in the better drained uplands and constitute between 15 and 30 percent of these soil areas. The two soils are found so intimately associated in the landscape that they cannot be separated at the scale of mapping used in this survey.

Combinations of peaty Gunderson and Eaglesham soils (GUN/p-EGL1) signifies an area in which the depth of sedge peat varies from 15 to 80 cm. The underlying mineral material in such an area is fluvial sand.

5.3 Soils Developed on Coarse Textured Fluvial Materials Overlying Finer Textured Glaciolacustrine (Lacustro-till) Materials

5.3.1 Lodge Soils (LDG)

Lodge soils consist of well drained Orthic and Brunisolic Gray Luvisols developed on coarse textured, relatively shallow, fluvial material that overlies glaciolacustrine (lacustro-till) material. The depth of this overlying material is between 20 and 50 cm and its composition is quite variable. This thickness was arbitrarily selected as the limit below which texture of the underlying material has a minimal effect on plant growth (Dumanski *et al.*, 1972).

These soils are confined to the eastern portion of the study area on gently undulating to gently rolling landscapes. Native vegetation consists primarily of trembling aspen with lesser amounts of white spruce, balsam poplar and willow. Understory species include wild rose, raspberry, strawberry, bunchberry and a variety of grass species. Surface drainage is rapid to good, but internal drainage may be impeded by the finer textured glaciolacustrine materials beneath. Lodge soils occupy less than 0.2 percent of the map area.

Lodge soils are characterized by a thin L-H horizon overlying a relatively thick, light grayish brown to pale brown colored Ae horizon. A light yellowish brown to brownish yellow Bm horizon may or may not occur below the Ae horizon, but a textural B horizon (Bt) always occurs at a depth of 20 to 50 cm below the surface. The textural B horizon is generally found in the underlying glaciolacustrine material (IIBt horizon) and is characteristically fine to very fine textured and exhibits moderate to strong subangular blocky structure. Soils which have a Bm horizon in the fluvial overlay material are classified as Brunisolic Gray Luvisols. Those which lack a Bm horizon are classified as Orthic Gray Luvisols. The two profiles with differing morphology were not separated on the soils map. Because of their origin, the texture of the upper part of these soils varies widely, with sandy loam being most common. A detailed description and analytical data of a Brunisolic Gray Luvisol, common to the Lodge soil group, are presented in Appendix A. This particular soil profile is illustrated in Plate 5.

Lodge soils are sometimes mapped in combination with McMurray soils (LDG-MMY). Such a combination indicates areas in which thin deposits of fluvial sand may or may not overlie fine to very fine textured glaciolacustrine sediments.

Combinations of Lodge and Blackmud (LDG-BKM) indicate areas with varying thickness of sand overlying glaciolacustrine deposits. The fluvial sand in such an area is generally less than 50 cm thick (LDG), but occasionally is much deeper (BKM).

5.4 Soils Developed on Organic Materials

5.4.1 Kenzie Soils (KNZ)

Kenzie soils consist of a complex of very poorly drained soils developed primarily from moss organic material that is greater than 40 cm thick when dominantly mesic or humic peat and greater than 60 cm thick when dominantly fibric peat. These soils are developed and maintained under the influence of permanent groundwater discharge which manifests itself in the form of seepages, springs, hummocky ground and swamps. Kenzie soils occur throughout the study area on level to depressional landscapes where moss peat accumulates. Frequently the surface of bog peatland may be raised above the surrounding terrain of inorganic materials. The depth of peat varies considerably in the study area. Deeper bogs appear to be restricted to the northern and eastern portions where they approach a depth of 3 metres. Most

Plate 5: A Lodge soil profile. Note the sandy overlay and the Ae-Bm-IIBt horizonation.

bogs in the study area are fairly shallow with less than 80 cm of accumulated moss peat. Kenzie soils occupy approximately 26 percent of the study area.

The native vegetation varies with the water regime or water movement pattern. The most common vegetative association is stunted black spruce forest with an undergrowth of sphagnum moss, feathermosses, Labrador tea, bog cranberry and bearberry (see Plate 1). The water table in such areas is generally below the depth of the organic material. Another vegetative association is tamarack, stunted black spruce, and occasionally stunted birch forest, and a mixture of herbaceous plants, mosses and grasses. Labrador tea may also be present, but is not as abundant as occurs in the other vegetative association. The water table is at or near the surface and the bogs are generally deeper in these areas than in areas of the other vegetative association.

The Kenzie soil group consists of several soil types differentiated on the type and degree of decomposition of the vegetation from which the peat was formed. The material, which is derived primarily from the growth and decomposition of feathermoss and sphagnum moss, is generally raw and undecomposed near the surface, but passes into a zone in which the peat is primarily semi-decomposed. With the exception of individual strata, which can be either raw or highly humified, this state of intermediate decomposition (Mesisols) extends down to the contact with the mineral soil. In other cases relatively undecomposed moss is maintained with depth to the contact with the mineral soil, and Fibrisols were recognized. The darkest and most decomposed layer usually occurs immediately above the mineral layer. The underlying mineral material, which may be derived from fluvial or glaciolacustrine (lacustro-till) deposits, is commonly pale bluish-gray in color and may show faint mottling. A guide to the characteristics of the underlying mineral material is provided by the associated soils in the surrounding area that are indicated on the soils map. It appears that Kenzie soils underlain by fine to very fine textured glaciolacustrine deposits are extremely to strongly acid in soil reaction while Kenzie soils found on the eastern side of the study area, where the underlying material is coarse textured fluvial sand, are medium acid to neutral in soil reaction.

Detailed descriptions and analyses of five soil profiles common to the Kenzie soil group are presented in Appendix A. A Kenzie soil profile is illustrated in Plate 6.

Three soil units, based on the depth of peat, were used to facilitate mapping the distribution of Kenzie soils in the study area. The KNZ1 unit indicates areas in which the moss peat is less than 80 cm in thickness and consists dominantly of Terric Mesisols with significant amounts of Terric Fibrisols. The KNZ2 soil unit describes areas in which the moss peat is greater than 80 cm, but less than 160 cm in depth. The soils are dominantly undifferentiated Terric Mesisols with significant amounts of Terric Fibrisols. The KNZ3 unit signifies areas in which the peat is greater than 160 cm in depth. The peat in some cases may be up to 3 metres in thickness in these areas. The dominant soils are Typic Mesisols with significant amounts of Typic Fibrisols.

Some of the deep Organic soils developed on bogs (KNZ3 unit) contain discontinuous permafrost within a metre of the surface. Such areas are indicated on the soils map with the frozen phase notation (KNZ3/f). The black spruce in such areas is often stunted and tilted giving the forest a "drunken" appearance (see Plate 7). Peat palsas in which the peat is humped up from the surrounding organic material are also characteristic of permafrost areas. These unique soils were classified into the Cryosolic Order. Both Mesic and Fibric Organic Cryosols were recognized and collectively they occupy about 2 percent of the map area.

Kenzie soils are sometimes mapped in combination with Eaglesham soils. Such combinations indicate areas where fen peatland and bog peatland are so closely interrelated that separation is not practical or feasible.

A KNZ1-MRL/p combination indicates areas in which the depth of moss peat varies from 15 to 80 cm. The underlying mineral material is fine to very fine textured glaciolacustrine (lacustro-till) sediments.

A KNZ1-GUN combination signifies an area that consists predominantly of bog peatland in which the organic material is less than 80 cm

Plate 6: A Kenzie soil profile developed on moss organic material.

Plate 7: A characteristic "drunken forest" common to areas of discontinuous permafrost. Kenzie (KNZ3/f) soils are mapped in such areas.

deep and the underlying mineral material is coarse textured fluvial sand. Poorly drained Rego and Orthic Gleysols developed on coarse textured fluvial sands (GUN) occupy between 15 and 30 percent of the soil area.

A KNZ1-BKM1 combination describes areas that are predominantly thin bog peatland (KNZ1), but contain 15 to 30 percent rapidly drained Eluviated Dystric and Eluviated Eutric Brunisols (BKM1) developed on coarse textured fluvial sand ridges between the bogs.

A KNZ1-KNZ2 combination signifies areas of bog peatland in which the peat is generally less than 80 cm in thickness, but occasionally approaches the 160 cm depth.

5.4.2 Eaglesham Soils (EGL)

Eaglesham soils consist of a collection of very poorly drained Organic soils characterized by more than 40 cm of mesic or humic sedge peat, or greater than 60 cm of fibric sedge peat. The sedge peat varies widely with respect to stage of decomposition and depth; however, an intermediate stage of decomposition (Mesisols) appears to be the dominant type of Organic soil present in the study area. Eaglesham soils are developed on fen peatland and occur in the wetter depressional positions of the landscape. They commonly occur along some of the small intermittent streams of the area. Native vegetation includes sedges, reeds and coarse grasses with occasional bluffs of willow and birch. Eaglesham soils constitute about 9 percent of the map area.

The Eaglesham soil profile is separated into horizons on the basis of color and degree of decomposition of the sedge material. Although a number of taxonomic subdivisions of the Eaglesham soils were recognized in the map area, no attempt was made to delineate them on the soils map. The peat seldom exceeds 160 cm in depth, except in the northern portion of the study area where it approaches a depth of 3 metres. The peat is generally medium acid in soil reaction and the darkest and most decomposed layer usually occurs immediately above the mineral layer. Two soil profiles common to the Eaglesham soil group were sampled for laboratory analyses. The detailed descriptions and analytical results of a Terric Mesisol and Terric

Humisol are presented in Appendix A.

Three soil units, differentiated on the basis of the depth of peat, were used to facilitate mapping the distribution of Eaglesham soils in the map area. The Eaglesham 1 (EGL1) soil unit indicates areas which consist dominantly of Terric Mesisols developed on sedge peat which is less than 80 cm in thickness. The EGL2 unit indicates areas of Terric Mesisols developed on sedge peat that is between 80 and 160 cm in thickness. Terric Humisols, in which the peat is darker colored and more decomposed, are also of significant occurrence in both these soil units. The EGL3 soil unit indicates areas that consist predominantly of Typic Mesisols with significant amounts of Typic Fibrisols developed on sedge peat that is greater than 160 cm in thickness. These soils are restricted to the northern portion of the study area where they are mapped in combination with soils of the Kenzie soil group.

Eaglesham 1 (EGL1) soils are frequently mapped in combination with peaty Mildred Lake soils (MRL/p). Such a combination indicates areas in which the depth of sedge peat varies from 15 to 80 cm. The underlying mineral material in these areas is fine to very fine textured glaciolacustrine sediments (lacustro-till).

5.5 Disturbed Land

This miscellaneous land type describes areas within the study area that have been disturbed by clearing and stripping procedures for future open pit mining activities. The soils were not investigated in these areas. Disturbed Land occupies less than 1 percent of the study area.

6. LABORATORY RESULTS OF SOME OF THE SOILS OF THE SYNCRUDE NO. 17 LEASE AREA

Chemical and physical data for the soils are listed in Appendix A. Analyses were performed by Norwest Soil Research Ltd. on particles less than 2 mm in size.

In general most mineral soils within the study area are very strongly acid to slightly acid in soil reaction. Usually the greatest acidity occurs in the Ae horizon or upper portion of the B horizon. Gleysolic soils are not as acidic as other soils because of bases contained in the groundwater. The fens (EGL soils) are medium acid in reaction while many of the bogs (KNZ soils) are extremely acid with a pH of less than 4.0. Thin bogs in which the peat is highly humified are not as acidic as the deeper bogs where the peat is relatively undecomposed or semi-decomposed. However, deep bogs which are saturated are not as acidic (pH 5.8-6.1) as those that are unsaturated because of bases in the groundwater.

Particle size distribution varies according to the nature of the parent material. Soils developed on glaciolacustrine materials contain considerable amounts of clay while soils developed on fluvial materials are high in sand sized particles. The clay and heavy clay soils, those with 40 percent or more of clay size particles, have high moisture holding capacity, high cation exchange capacity, but often low permeability. On the other hand the sandy soils have low moisture holding and cation exchange capacities, but high permeability.

Nitrogen is an important plant nutrient and the amount present in different soils of the area is relatively low. The well decomposed organic matter in the Ah horizon is the main source of nitrogen in a soil. Consequently soils that have the darkest and thickest Ah horizons are generally the most fertile. Most of the soils in the map area do not contain an Ah horizon, or if present, it is very thin. Organic soils contain a considerable amount of nitrogen, but most of this nitrogen is not available to plants until it humifies and mineralizes. Saturated Organic soils (both fens and bogs) and humic organic horizons (Oh) appear to contain the greatest content of total nitrogen.

The determination of organic carbon in soil is considered the best method of estimating the amount of organic matter in the soil. Generally it is assumed that organic matter contains 58 percent carbon and that an estimate of organic matter can be made by multiplying the amount of organic carbon by the factor 1.724. An organic horizon is defined as having greater than 17 percent organic carbon. An indication of the amount of decomposable organic matter contained is provided by the carbon-nitrogen ratio. Thus, it has been considered that a desirable ratio should be less than 15 for Ah horizons and less than 17 for the mixed surface horizons to a depth of 15 cm. Except for the Organic soils, organic matter content is low in the soils found in the map area. Organic soils have high contents of organic carbon, but also have high carbon-nitrogen ratios. Therefore, much of the organic matter is not of an easily decomposable form and is not readily available for plant growth.

Electrical conductivity is a measure of the degree of salinity. Soils with electrical conductivity values of less than 4 mmhos/cm are considered to be non-saline soils. All soils of the map area are non-saline. The highest conductivity values (0.6 mmhos/cm) were recorded in the Ck horizons of a McMurray soil profile. All other soils sampled generally have electrical conductivities of less than 0.4 mmhos/cm.

Cation exchange capacity (CEC) in soil varies with the clay and organic matter contents. Blackmud soils have low CEC due to their coarse textures while McMurray soils have relatively high CEC because of their fine textures. Organic soils have very high values due to a high organic matter content; however, most of the cations are unavailable for plant growth because they are complexed with the organic matter. The higher the exchange capacity the greater is the ability of the soil to retain certain plant nutrients against the action of leaching. A high base saturation usually implies that adequate amounts of calcium, magnesium and potassium are available for plant growth. Despite reactions common to many of the soils of the map area the base saturation is quite high. This suggests that liming may not be necessary for satisfactory plant growth. Some of the extremely acid Organic soils (bogs) probably contain significant amounts of hydrogen and possibly aluminum on the exchange sites thereby blocking them from further cation exchange reactions. Such Organic soils have a low base saturation. Results using buffered ammonium acetate indicate cation exchange sites in most soils are dominated by calcium and magnesium. Sodium and potassium are present only in very low concentration.

7. SUMMARY

The soils of a portion of the Syncrude No. 17 Lease Area were classified and described, and representative soils were sampled for laboratory analyses. The distribution of the soils is presented on the soils map at a scale of 1:24,000. The areal extent of the various soils are indicated in Table 2.

TABLE 2. The Areal Extent of the Soils Found in a Portion of the Syncrude No. 17 Lease Area

Material	Soil Group	Soil Unit	Soils	% of Area
Fine to very fine textured glaciolacustrine (lacustro-till)	McMurray	MMY	Luvisols	48.7
	Mildred Lake	MRL	Gleysols	10.4
Coarse textured fluvial	Blackmud	BKM1	Brunisols	3.2
		BKM2	Luvisols	0.8
	Gunderson	GUN	Gleysols	0.8
Shallow coarse textured fluvial overlying finer textured glaciolacustrine (lacustro-till)	Lodge	LDG	Luvisols	0.2
Organic bog (moss)	Kenzie	KNZ1	Organics (<80cm)	15.6
		KNZ2	Organics (80-160cm)	5.8
		KNZ3	Organics*(>160 cm)	4.8
Organic fen (sedge)	Eaglesham	EGL1	Organics (<80cm)	7.8
		EGL2	Organics (80-160cm)	1.0
		EGL3	Organics (>160 cm)	-
Disturbed Land	Disturbed Land	DL	Undifferentiated	0.9

* Includes those soils which show discontinuous permafrost (KNZ3/f) and are classified in the Cryosolic Order. Cryosols are estimated to occupy about 2 percent of the study area.

Moderately well drained Orthic Gray Luvisols developed on fine to very fine textured glaciolacustrine materials (lacustro-till) are found throughout the area west of Beaver Creek. They occupy about 49 percent of the area.

Rapidly drained Eluviated Dystric and Eluviated Eutric Brunisols and well drained Brunisolic Gray Luvisols developed on coarse textured fluvial materials are confined to the eastern side of the study area.

Gleysolic soils developed on glaciolacustrine and fluvial materials occupy about 11 percent of the area. They occur in the wet depressional positions of the landscape.

Organic soils occupy about 33 percent of the area. The depth of peat in the majority of the Organic soils is less than 80 cm. Both bogs and fens were recognized. Bogs have the larger areal extent, occupying about 26 percent of the area. The fens are generally more decomposed than the bogs. Permafrost was encountered in some of the deep bogs. No permafrost occurs in any of the fens or shallow bogs.

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APPENDIX A

DETAILED PROFILE DESCRIPTIONS AND ANALYSES

OF COMMONLY OCCURRING

SOILS IN THE

STUDY AREA

DESCRIPTION OF A McMURRAY (MMY) SOIL PROFILE

Dig No. 277 on soils map

Classification: Orthic Gray Luvisol

L-H 5 to 0 cm; deciduous leaf litter and grasses; well decomposed in lower portion; abrupt, wavy boundary.

Ae 0 to 8 cm; light brownish gray (10YR 6/2)* loam; moderate, medium platy; very friable; stone-free to slightly stony; clear, wavy boundary.

AB 8 to 20 cm; brown (7.5YR 5/4) clay; moderate, medium to coarse subangular blocky; friable; slightly stony; gradual, wavy boundary.

Bt1 20 to 48 cm; light brown (7.5YR 6/4) clay; moderate, medium subangular blocky; firm; slightly stony; gradual, wavy boundary.

Bt2 48 to 65 cm; brown to dark brown (7.5YR 4/4) clay; moderate, fine subangular blocky; firm; slightly stony; clear, wavy boundary.

BCk 65 to 102 cm; brown to dark brown (10YR 4/3) clay; pseudo, weak, fine subangular blocky; friable; slightly stony; gradual, irregular boundary.

Ck 102 to 170 cm; brown to dark brown (7.5YR 4/4) clay; massive; firm; slightly stony.

* Munsell color notation (moist)

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Ae	AB	Bt1	Bt2	BCk	Ck
Depth (cm):	0-8	8-20	20-48	48-65	65-102	102-170
Particle Size Analysis:						
% Sand	39	27	27	21	27	25
% Silt	38	24	18	24	28	22
% Clay	23	49	55	55	45	53
Textural Class	L	C	C	C	C	C
pH (in water):	6.2	4.9	4.6	5.0	7.6	8.0
Total Nitrogen (%):	-	-	-	-	-	-
Organic Carbon (%):	0.8	1.1	0.8	1.1	1.4	1.1
C/N Ratio:	-	-	-	-	-	-
Electrical Conductivity (mmhos/cm):	0.26	0.16	0.24	0.20	0.43	0.45
Cation Exchange Analysis:						
Ca (me/100 g)	4.2	8.4	9.2	11.5	14.3	27.0
Mg (me/100 g)	0.9	4.6	6.0	7.4	7.4	6.6
K (me/100 g)	0.4	0.5	0.4	0.5	0.4	0.4
Na (me/100 g)	0.2	0.3	0.3	0.4	0.4	0.5
TEC (me/100 g)	3.1	13.2	15.4	18.4	12.4	21.4

DESCRIPTION OF A McMURRAY (MMY) SOIL PROFILE

Dig No. 350 on soils map

Classification: Orthic Gray Luvisol

L-H 8 to 0 cm; deciduous leaf litter and grasses; abrupt, smooth boundary.

Aegj 0 to 5 cm; pale brown (10YR 6/3) silt loam; few, fine faint brownish yellow (10YR 6/6) mottles; moderate, coarse platy; very friable; stone-free to slightly stony; clear, smooth boundary.

ABgj 5 to 15 cm; yellowish brown (10YR 5/4) clay loam; few, coarse, distinct brownish yellow (10YR 6/8) mottles; moderate, coarse subangular blocky; friable to firm; slightly stony; clear, wavy boundary.

Bt1 15 to 42 cm; brown (7.5YR 5/4) clay; moderate, medium subangular blocky; firm; slightly stony; gradual, irregular boundary.

Bt2 42 to 68 cm; brown (7.5YR 5/4) with yellowish brown (10YR 5/4) strata; clay; weak, fine subangular blocky and stratified; firm; slightly stony; gradual, irregular boundary.

BC 68 to 80 cm; brown (7.5YR 5/4) heavy clay; massive; firm; slightly stony to stone-free; gradual, wavy boundary.

Ck1 80 to 100 cm; brown (7.5YR 5/4) heavy clay; massive; firm; slightly stony to stone-free; abrupt, smooth boundary.

Ck2 100 to 125 cm; dark yellowish brown (10YR 4/4) clay; massive; friable; slightly to moderately stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Aegj	Bt1	Bt2	Ck1	Ck2
Depth (cm):	0-5	15-42	42-68	80-100	100-125
Particle Size Analysis:					
% Sand	27	21	29	19	29
% Silt	70	23	21	21	25
% Clay	3	56	50	60	46
Textural Class	SiL	C	C	HC	C
pH (in water):	4.6	4.8	6.2	7.5	7.8
Total Nitrogen (%):	-	-	-	-	-
Organic Carbon (%):	1.1	0.7	1.1	1.0	1.2
C/N Ratio:	-	-	-	-	-
Electrical Conductivity (mmhos/cm):	0.14	0.19	0.54	0.63	0.63
Cation Exchange Analysis:					
Ca (me/100 g)	4.0	12.2	15.2	27.7	26.7
Mg (me/100 g)	2.2	9.4	10.2	7.1	5.5
K (me/100 g)	0.3	0.4	0.4	0.4	0.3
Na (me/100 g)	0.3	0.3	0.5	0.6	0.6
TEC (me/100 g)	9.4	20.5	17.3	20.7	13.4

DESCRIPTION OF A MILDRED LAKE (MRL/p) SOIL PROFILE

Dig No. 351 on soils map

Classification: Peaty Rego Gleysol

Oh 20 to 0 cm; very dark brown (10YR 2/2) about 10 percent unrubbed fibre; non-woody amorphous to granular; matted to felt-like; mainly moss with some sedge material; abrupt, wavy boundary.

Cg 0 to 50 cm; brown (7.5YR 5/4) heavy clay; few, fine distinct strong brown (7.5YR 5/8) mottles; massive; firm; plastic; stone-free to slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Oh	Cg
Depth (cm):	20-0	0-50
Particle Size Analysis:		
% Sand	-	17
% Silt	-	21
% Clay	-	62
Textural Class	-	HC
pH (in water):	5.9	6.4
Total Nitrogen (%):	1.30	-
Organic Carbon (%):	27.6	1.1
C/N Ratio:	21	-
Electrical Conductivity (mmhos/cm):	0.42	0.26
Cation Exchange Analysis:		
Ca (me/100 g)	74.5	18.6
Mg (me/100 g)	19.9	8.6
K (me/100 g)	0.8	0.5
Na (me/100 g)	1.1	0.6
TEC (me/100 g)	92.8	19.8

DESCRIPTION OF A MILDRED LAKE (MRL) SOIL PROFILE

Dig No. 354 on soils map

Classification: Rego Gleysol

Om 15 to 0 cm; dark grayish brown (10YR 4/2) about 30 percent unrubbed fibre; non-woody, moderately decomposed, spongy and layered sedge with some moss; abrupt, smooth boundary.

Ah 0 to 7 cm; black (7.5YR 2/0) clay; moderate, fine granular; friable; stone-free; clear, wavy boundary.

Cg 7 to 47 cm; grayish brown (10YR 5/2) heavy clay; few, fine, distinct strong brown (7.5YR 5/6) mottles; massive; firm; slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Om	Ah	Cg
Depth (cm):	15-0	0-7	7-47
Particle Size Analysis:			
% Sand	-	23	13
% Silt	-	35	13
% Clay	-	42	74
Textural Class	-	C	HC
pH (in water):	5.6	5.6	6.2
Total Nitrogen (%):	1.16	0.41	-
Organic Carbon (%):	34.6	6.2	1.2
C/N Ratio:	30	15	-
Electrical Conductivity (mmhos/cm):	0.25	0.26	0.20
Cation Exchange Analysis:			
Ca (me/100 g)	81.5	28.2	18.8
Mg (me/100 g)	27.3	10.6	7.6
K (me/100 g)	0.9	1.4	0.5
Na (me/100 g)	1.0	0.6	0.5
TEC (me/100 g)	95.9	37.9	24.7

DESCRIPTION OF A BLACKMUD (BKM1) SOIL PROFILE

Dig No. 244 on soils map

Classification: Eluviated Eutric Brunisol

L-H 5 to 0 cm; deciduous leaf litter and grasses; partially decomposed in lower portion; abrupt, wavy boundary.

Ae 0 to 5 cm; brown (10YR 5/3)* loamy sand; single grain; loose; stone-free; clear, smooth boundary.

Bm 5 to 35 cm; strong brown (7.5YR 5/6) loamy sand; single grain; loose; stone-free; clear, wavy boundary.

BC 35 to 80 cm; yellowish brown (10YR 5/6) sand; single grain; loose; stone-free; gradual, irregular boundary.

C 80 to 110 cm; light olive brown (2.5Y 5/4) sand; single grain; loose; stone-free.

* Munsell color notation (moist).

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Ae	Bm	C
Depth (cm):	0-5	5-35	80-110
Particle Size Analysis:			
% Sand	87	87	89
% Silt	9	5	7
% Clay	4	8	4
Textural Class	LS	LS	S
pH (in water):	6.1	6.6	6.6
Total Nitrogen (%):	-	-	-
Organic Carbon (%):	0.9	0.7	0.5
C/N Ratio:	-	-	-
Electrical Conductivity (mmhos/cm):	0.28	0.26	0.20
Cation Exchange Analysis:			
Ca (me/100 g)	3.6	4.8	3.8
Mg (me/100 g)	0.9	1.5	0.8
K (me/100 g)	0.4	0.5	0.3
Na (me/100 g)	0.2	0.2	0.2
TEC (me/100 g)	5.8	6.9	3.2

DESCRIPTION OF A BLACKMUD (BKM1) SOIL PROFILE

Dig No. 311 on soils map

Classification: Eluviated Dystric Brunisol

L-H 10 to 0 cm; deciduous leaf litter; well decomposed in lower portion; abrupt, smooth boundary.

Ae 0 to 18 cm; pale brown (10YR 6/3) loamy sand; single grain; loose; stone-free; clear, wavy boundary.

Bm1 18 to 32 cm; strong brown (7.5YR 5/6) loamy sand; single grain; loose; stone-free; clear, smooth boundary.

Bm2 32 to 62 cm; yellowish brown (10YR 5/6) loamy sand; single grain; loose; slightly stony; gradual, irregular boundary.

BC 62 to 82 cm; light olive brown (2.5Y 5/4) loamy sand; single grain; loose; stone-free; diffuse, wavy boundary.

C 82 to 178 cm; olive brown (2.5Y 4/4) loamy sand; single grain; loose; stone-free.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Ae	Bm1	Bm2	C
Depth (cm):	0-18	18-32	32-62	82-178
Particle Size Analysis:				
% Sand	81	85	87	87
% Silt	14	6	2	4
% Clay	5	9	11	9
Textural Class	LS	LS	LS	LS
pH (in water):	4.9	5.1	5.2	5.3
Total Nitrogen (%):	-	-	-	-
Organic Carbon (%):	1.3	0.8	0.4	0.6
C/N Ratio:	-	-	-	-
Electrical Conductivity (mmhos/cm):	0.23	0.11	0.11	0.12
Cation Exchange Analysis:				
Ca (me/100 g)	1.9	3.1	4.3	4.3
Mg (me/100 g)	0.8	1.1	1.1	1.4
K (me/100 g)	0.4	0.4	0.2	0.2
Na (me/100 g)	0.3	0.3	0.3	0.3
TEC (me/100 g)	4.1	3.8	5.0	4.6

DESCRIPTION OF A BLACKMUD (BKM1) SOIL PROFILE

Dig No. 361 on soils map

Classification: Eluviated Dystric Brunisol

L-H 2 to 0 cm; deciduous leaf litter and conifer needle plant debris; abrupt, smooth boundary.

Ae 0 to 8 cm; pinkish gray (7.5YR 6/2) sand; single grain; loose; slightly stony; clear, smooth boundary.

Bm 8 to 40 cm; strong brown (7.5YR 5/6) sand; single grain; loose; slightly stony; gradual, wavy boundary.

BC 40 to 80 cm; yellowish brown (10YR 5/6) sand; single grain; loose; slightly stony; abrupt, wavy boundary.

IIC 80 to 92 cm; brown (7.5YR 5/4) heavy clay; pseudo, weak, fine subangular blocky and stratified; firm; slightly stony; abrupt, wavy boundary.

IIIC 92 to 100 cm; brownish yellow (10YR 6/6) loamy sand; single grain; loose; slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Ae	Bm	BC	IIC	IIIC
Depth (cm):	0-8	8-40	40-80	80-92	92-100
Particle Size Analysis:					
% Sand	93	93	95	13	81
% Silt	3	3	1	25	12
% Clay	4	4	4	62	7
Textural Class	S	S	S	HC	LS
pH (in water):	4.7	5.6	5.8	4.6	5.6
Total Nitrogen (%):	-	-	-	-	-
Organic Carbon (%):	0.5	0.6	0.3	0.9	0.5
C/N Ratio:	-	-	-	-	-
Electrical Conductivity (mmhos/cm):	0.13	0.14	0.14	0.16	0.10
Cation Exchange Analysis:					
Ca (me/100 g)	0.6	0.9	1.4	9.9	1.8
Mg (me/100 g)	0.2	0.3	0.6	5.0	0.8
K (me/100 g)	0.1	0.1	0.1	0.3	0.2
Na (me/100 g)	0.2	0.3	0.2	0.3	0.3
TEC (me/100 g)	0.8	1.1	1.2	20.2	1.6

DESCRIPTION OF A LODGE (LDG) SOIL PROFILE

Dig No. 162 on soils map

Classification: Brunisolic Gray Luvisol

L-H 5 to 0 cm; deciduous leaf litter, moss and conifer needle plant debris; well decomposed in lower portion; abrupt, wavy boundary.

Ae 0 to 10 cm; light brownish gray (10YR 6/2) sandy loam; single grain; very friable; stone-free; clear, wavy boundary.

Bmg 10 to 22 cm; light yellowish brown (10YR 6/4) sandy loam; many, fine, prominent brown (7.5YR 5/4) mottles; single grain; very friable; stone-free; abrupt, smooth boundary.

IIAB 22 to 30 cm; strong brown (7.5YR 5/6) clay; moderate to strong, coarse subangular blocky; friable to firm; stone-free; gradual, irregular boundary.

IIBt 30 to 65 cm; brown to dark brown (7.5YR 4/4) heavy clay; moderate to strong, fine subangular blocky; firm; slightly stony; gradual, irregular boundary.

IIBC 65 to 100 cm; brown (7.5YR 5/2) heavy clay; weak, fine subangular blocky; firm; slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Bmg	IIBt	IIBC
Depth (cm):	10-22	30-65	65-100
Particle Size Analysis:			
% Sand	72	14	13
% Silt	19	21	14
% Clay	9	65	73
Textural Class	SL	HC	HC
pH (in Water):	5.3	4.8	6.0
Total Nitrogen (%):	-	-	-
Organic Carbon (%):	0.8	0.9	0.7
C/N Ratio:	-	-	-
Electrical Conductivity (mmhos/cm):	0.23	0.20	0.48
Cation Exchange Analysis:			
Ca (me/100 g)	2.2	13.4	12.7
Mg (me/100 g)	1.5	8.8	7.9
K (me/100 g)	0.2	0.5	0.5
Na (me/100 g)	0.2	0.8	1.3
TEC (me/100 g)	4.1	20.5	17.8

DESCRIPTION OF A KENZIE (KNZ2) SOIL PROFILE

Dig No. 129 on soils map

Classification: Terric Mesisol

Of 0 to 75 cm; yellowish brown (10YR 5/6) about 80 percent unrubbed fibre; non-woody fibrous, spongy, compacted and layered sphagnum moss; gradual, smooth boundary.

Om1 75 to 100 cm; very dark brown to dark reddish brown (10YR 2/2 to 5YR 3/3) about 60 percent unrubbed fibre; non-woody, moderately decomposed, compacted and layered mosses; gradual, smooth boundary.

Om2 100 to 132 cm; dark reddish brown (5YR 3/2) about 50 percent unrubbed fibre; slightly woody, moderately decomposed, fine fibred to amorphous, mixed moss and herbaceous material; abrupt, smooth boundary.

Cg 132 to 180 cm; Gray (5Y 5/1) clay; massive; firm; stone-free to slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Of	Om1	Om2	Cg
Depth (cm):	0-75	75-100	100-132	132-180
Particle Size Analysis:				
% Sand	-	-	-	20
% Silt	-	-	-	21
% Clay	-	-	-	59
Textural Class	-	-	-	C
pH (in water):	3.4	3.9	3.9	4.4
Total Nitrogen (%):	0.58	0.41	0.55	-
Organic Carbon (%):	51.4	55.1	48.2	1.2
C/N Ratio:	89	134	88	-
Electrical Conductivity (mmhos/cm):	0.12	0.37	0.20	0.21
Cation Exchange Analysis:				
Ca (me/100 g)	23.9	31.7	44.8	12.7
Mg (me/100 g)	11.1	21.1	14.4	5.5
K (me/100 g)	0.9	0.8	0.6	0.5
Na (me/100 g)	0.4	0.4	0.4	0.5
TEC (me/100 g)	121.2	113.7	114.7	20.6

DESCRIPTION OF A KENZIE (KNZ1) SOIL PROFILE

Dig No. 230 on soils map

Classification: Terric Fibrisol

Of 0 to 68 cm; dark brown (7.5YR 4/4) about 90 percent unrubbed fibre; non-woody fibrous, compacted and layered sphagnum moss; abrupt, smooth boundary.

Cg 68 to 118 cm; brown (7.5YR 5/2) clay; common, medium to coarse, faint dark brown (7.5YR 4/4) mottles; massive; firm; slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Of	Cg
Depth (cm):	0-68	68-118
Particle Size Analysis:		
% Sand	-	19
% Silt	-	22
% Clay	-	59
Textural Class	-	C
pH (in water):	3.8	5.7
Total Nitrogen (%):	0.61	-
Organic Carbon (%):	64.5	0.7
C/N Ratio:	106	-
Electrical Conductivity (mmhos/cm):	0.13	0.31
Cation Exchange Analysis:		
Ca (me/100 g)	24.5	13.0
Mg (me/100 g)	10.8	8.1
K (me/100 g)	0.8	0.6
Na (me/100 g)	0.8	0.4
TEC (me/100 g)	110.0	23.4

DESCRIPTION OF A KENZIE (KNZ3) SOIL PROFILE

Dig No. 270 on soils map

Classification: Typic Fibrisol or Mesic Fibrisol

Of1 0 to 60 cm; brown (7.5YR 5/4) about 95 percent unrubbed fibre; slightly woody, coarse fibred, spongy sphagnum moss; diffuse, wavy boundary.

Of2 60 to 152 cm; reddish yellow (7.5YR 6/6) about 90 percent unrubbed fibre; non-woody, coarse fibred, compacted and layered, spongy moss; diffuse, smooth boundary.

Of3 or Om 152 to 225 cm; brown to dark brown (7.5YR 4/4) about 70 percent unrubbed fibre; non-woody, coarse fibred to moderately decomposed, compacted and layered moss.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Of1	Of2	Of3-Om
Depth (cm):	0-60	60-152	152-225
Particle Size Analysis:			
% Sand	-	-	-
% Silt	-	-	-
% Clay	-	-	-
Textural Class	-	-	-
pH (in water):	3.8	4.1	5.2
Total Nitrogen (%):	0.68	0.98	1.24
Organic Carbon (%):	72.2	65.7	61.2
C/N Ratio:	106	67	49
Electrial Conductivity (mmhos/cm):	0.09	0.09	0.13
Cation Exchange Analysis:			
Ca (me/100 g)	22.5	46.4	93.5
Mg (me/100 g)	11.9	15.2	21.4
K (me/100 g)	2.0	0.6	0.4
Na (me/100 g)	0.6	0.4	0.6
TEC (me/100 g)	98.1	118.8	118.0

DESCRIPTION OF A KENZIE (KNZ3) SOIL PROFILE

Dig No. 371 on soils map

Classification: Typic Mesisol

Om1 0 to 100 cm; dark brown (7.5YR 3/2) about 40 percent unrubbed fibre; slightly woody, moderately decomposed, compacted and layered moss; diffuse, smooth boundary.

Om2 100 to 200 cm; yellowish brown (10YR 5/6) about 40 percent unrubbed fibre; slightly woody, moderately decomposed, layered or matted moss; some thin, dark reddish brown (5YR 2/2) humic layers containing about 20 percent unrubbed fibre; abrupt, smooth boundary.

Cg 200 to 220 cm; light brownish gray (10YR 6/2) loamy sand; single grain; loose; stone-free to slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Om1	Om2
Depth (cm):	0-100	100-200
Particle Size Analysis:		
% Sand	-	-
% Silt	-	-
% Clay	-	-
Textural Class	-	-
pH (in water):	6.1	5.8
Total Nitrogen (%):	1.69	1.64
Organic Carbon (%):	43.7	50.6
C/N Ratio:	26	31
Electrical Conductivity (mmhos/cm):	0.11	0.19
Cation Exchange Analysis:		
Ca (me/100 g)	95.5	131.0
Mg (me/100 g)	17.8	24.8
K (me/100 g)	0.3	0.2
Na (me/100 g)	0.3	0.4
TEC (me/100 g)	114.0	156.0

DESCRIPTION OF A KENZIE (KNZ1) SOIL PROFILE

Dig No. 411 on soils map

Classification: Terric Mesisol

Om 0 to 70 cm; very dark brown (10YR 2/2) about 35 percent unrubbed fibre; non-woody amorphous to granular; matted to felt-like; mainly moss material; abrupt, smooth boundary.

Cg 70 to 120 cm; light olive gray (5Y 6/2) sandy loam; many, medium, distinct strong brown (7.5YR 5/6) mottles; single grain; very friable; slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Om	Cg
Depth (cm):	0-70	70-120
Particle Size Analysis:		
% Sand	-	61
% Silt	-	23
% Clay	-	16
Textural Class	-	SL
pH (in water):	6.8	7.0
Total Nitrogen (%):	1.52	-
Organic Carbon (%):	38.5	0.8
C/N Ratio:	25	-
Electrical Conductivity (mmhos/cm):	0.25	0.19
Cation Exchange Analysis:		
Ca (me/100 g)	136.0	9.8
Mg (me/100 g)	25.5	2.9
K (me/100 g)	0.4	0.1
Na (me/100 g)	0.4	0.1
TEC (me/100 g)	170.0	8.4

DESCRIPTION OF AN EAGLESHAM (EGL2) SOIL PROFILE

Dig No. 223 on soils map

Classification: Terric Humisol

Om 0 to 45 cm; dark brown (7.5YR 3/2) about 50 percent unrubbed fibre; layered or matted, fine rhizomes, grass and wood; abrupt, smooth boundary.

Oh 45 to 108 cm; black (5YR 2/1) about 25 percent unrubbed fibre; compacted or matted felt-like; amorphous granular, fine, slightly woody, humic undiscernible sedges and rhizomes; abrupt, smooth boundary.

Cg 108 to 158 cm; grayish brown (2.5Y 5/2) heavy clay; massive; firm; slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Om	Oh	Cg
Depth (cm):	0-45	45-108	108-158
Particle Size Analysis:			
% Sand	-	-	15
% Silt	-	-	24
% Clay	-	-	61
Textural Class	-	-	HC
pH (in water):	5.4	5.6	5.7
Total Nitrogen (%):	0.93	0.94	-
Organic Carbon (%):	58.3	53.0	1.5
C/N Ratio:	63	56	-
Electrical Conductivity (mmhos/cm):	0.32	0.33	0.41
Cation Exchange Analysis:			
Ca (me/100 g)	107.0	134.0	21.0
Mg (me/100 g)	28.1	26.3	7.2
K (me/100 g)	0.7	0.4	0.6
Na (me/100 g)	2.1	1.4	1.4
TEC (me/100 g)	142.5	147.0	25.0

DESCRIPTION OF AN EAGLESHAM (EGL1) SOIL PROFILE

Dig No. 296 on soils map

Classification: Terric Mesisol

Om 0 to 62 cm; dark brown to very dark brown (10YR 3/3 to 2/2) about 55 percent unrubbed fibre near top of layer to approximately 45 percent unrubbed fibre near bottom of layer; moderately decomposed, medium fibred herbaceous material, matted or felt-like; abrupt, smooth boundary.

Cg 62 to 137 cm; light gray (5Y 6/1) clay; massive; firm; stone-free to slightly stony.

CHEMICAL AND PHYSICAL ANALYSES

Horizon:	Om	Cg
Depth (cm):	0-62	62-137
Particle Size Analysis:		
% Sand	-	21
% Silt	-	24
% Clay	-	55
Textural Class	-	C
pH (in water):	5.9	6.3
Total Nitrogen (%):	1.98	-
Organic Carbon (%):	54.2	1.3
C/N Ratio:	27	-
Electrical Conductivity (mmhos/cm):	0.35	0.25
Cation Exchange Analysis:		
Ca (me/100 g)	100.0	13.9
Mg (me/100 g)	22.4	5.5
K (me/100 g)	0.8	0.4
Na (me/100 g)	1.2	0.4
TEC (me/100 g)	142.0	17.9

APPENDIX B

DESCRIPTION OF INSPECTION SITES

IN THE STUDY AREA

INSPECTION SITES

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
1.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
2.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
3.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
4.	Orthic Gray Luvisol	b	imperfectly	lacustro-till	
5.	Orthic Gray Luvisol	b	well-rapidly	thin fluvial	
6.	Eluviated Dystric Brunisol	b	rapidly	fluvial	
7.	Eluviated Dystric Brunisol	b-c	rapidly	fluvial	
8.	Terric Humisol	b	poorly	organic	55
9.	Terric Mesisol	b	very poorly	organic	70
10.	Orthic Luvic Gleysol	b	poorly	fluvial	
11.	Eluviated Eutric Brunisol	b	rapidly	fluvial	
12.	Peaty Rego Gleysol	b	very poorly	fluvial	30
13.	Peaty Rego Gleysol	b	very poorly	fluvial	22
14.	Terric Fibric Mesisol	b	very poorly	organic	70
15.	Peaty Rego Gleysol	b	poorly	lacustro-till	35
16.	Peaty Rego Gleysol	b	poorly	fluvial	15
17.	Orthic Gleysol	b	poorly	lacustro-till	
18.	Peaty Rego Gleysol	b	poorly	lacustro-till	40
19.	Eluviated Dystric Brunisol	d	rapidly	fluvial	
20.	Orthic Gray Luvisol	b-c	moderately well	lacustro-till	
21.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
22.	Orthic Gray Luvisol	c	moderately well	lacustro-till	
23.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
24.	Eluviated Dystric Brunisol	b-c	rapidly	fluvial	
25.	Typic Mesisol	b	very poorly	organic	72+
26.	Terric Mesisol	b	very poorly	organic	80
27.	Terric Humisol	b	poorly	organic	60
28.	Orthic Gray Luvisol	b-c	moderately well	lacustro-till	
29.	Orthic Gray Luvisol	b-c	moderately well	lacustro-till	
30.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
31.	Orthic Gray Luvisol	b	imperfectly	lacustro-till	
32.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
33.	Terric Mesisol	b	poorly	organic	67
34.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
35.	Orthic Gray Luvisol	b-c	moderately well	thin fluvial	
36.	Orthic Gray Luvisol	c	moderately well	lacustro-till	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
37.	Orthic Gray Luvisol	b-c	moderately well	lacustro-till	
38.	Terric Fibrisol	b	poorly	organic	50
39.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
40.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
41.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
42.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
43.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
44.	Peaty Rego Gleysol	b	poorly	lacustro-till	42
45.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
46.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
47.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
48.	Eluviated Eutric Brunisol	b-c	moderately well	fluvial	
49.	Terric Mesisol	b	poorly	organic	90
50.	Terric Mesisol	b	poorly	organic	100
51.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
52.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
53.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
54.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
55.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
56.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
57.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
58.	Orthic Luvic Gleysol	b	poorly	lacustro-till	
59.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
60.	Orthic Gray Luvisol	b-c	moderately well	lacustro-till	
61.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
62.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
63.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
64.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
65.	Peaty Orthic Luvic Gleysol	b	poorly	lacustro-till	20
66.	Orthic Gray Luvisol	b-c	moderately well	fluvial	
67.	Terric Fibrisol	b	poorly	organic	82
68.	Orthic Gray Luvisol	b-c	moderately well	lacustro-till	
69.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
70.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
71.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
72.	Orthic Gray Luvisol	b	moderately well	lacustro-till	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
73.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
74.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
75.	Peaty Rego Gleysol	b	poorly	lacustro-till	45
76.	Terric Mesisol	b	poorly	lacustro-till	65
77.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
78.	Peaty Rego Gleysol	b	poorly	lacustro-till	30
79.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
80.	Peaty Rego Gleysol	b	poorly	lacustro-till	30
81.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
82.	Terric Fibrisol	b	poorly	organic	62
83.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
84.	Terric Mesisol	b	poorly	organic	67
85.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
86.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
87.	Gleyed Gray Luvisol	b-c	imperfectly	lacustro-till	
88.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
89.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
90.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
91.	Terric Fibrisol	b	poorly	organic	65
92.	Peaty Rego Gleysol	b	poorly	lacustro-till	37
93.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
94.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
95.	Terric Fibrisol	b	poorly	organic	72
96.	Orthic Gray Luvisol	b-c	moderately well	thin fluvial	
97.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
98.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
99.	Orthic Luvic Gleysol	b	poorly	lacustro-till	
100.	Terric Fibrisol	b	poorly	organic	82
101.	Terric Fibrisol	b	poorly	organic	87
102.	Peaty Rego Gleysol	b	poorly	lacustro-till	37
103.	Terric Fibrisol	b	poorly	organic	57
104.	Orthic Gray Luvisol	b-c	well	thin fluvial	
105.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
106.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
107.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
108.	Orthic Gray Luvisol	b	moderately well	lacustro-till	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
109.	Terric Fibrisol	b	poorly	organic	125
110.	Terric Fibrisol	b	poorly	organic	72 +
111.	Fibric Organic Cryosol	b	poorly	organic	67
112.	Terric Humisol	b	poorly	organic	52
113.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
114.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
115.	Terric Mesisol	b	very poorly	organic	62
116.	Terric Mesisol	b	poorly	organic	72
117.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
118.	Orthic Luvic Gleysol	b	poorly	lacustro-till	
119.	Terric Mesisol	b	poorly	organic	45
120.	Terric Mesisol	b	poorly	organic	57
121.	Fibric Mesisol	b	poorly	organic	210
122.	Terric Mesic Humisol	b	very poorly	organic	85
123.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
124.	Terric Mesisol	b	poorly	organic	42
125.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
126.	Peaty Rego Gleysol	b	poorly	lacustro-till	25
127.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
128.	Orthic Gray Luvisol	c	moderately well	lacustro-till	
129.	Terric Mesisol	b	poorly	organic	132
130.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
131.	Terric Humisol	b	poorly	organic	97
132.	Peaty Rego Gleysol	b	poorly	lacustro-till	35
133.	Terric Humisol	b	very poorly	organic	65
134.	Peaty Rego Gleysol	b	poorly	lacustro-till	35
135.	Terric Fibrisol	b	poorly	organic	60
136.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
137.	Orthic Luvic Gleysol	b	poorly	lacustro-till	
138.	Peaty Orthic Luvic Gleysol	b	poorly	lacustro-till	32
139.	Peaty Orthic Luvic Gleysol	b	poorly	lacustro-till	30
140.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
141.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
142.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
143.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
144.	Orthic Luvic Gleysol	b	poorly	lacustro-till	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
145.	Orthic Gray Luvisol	b-c	moderately well	thin fluvial	
146.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
147.	Terric Fibrisol	b	poorly	organic	62
148.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
149.	Gleyed Gray Luvisol	b	poorly	lacustro-till	
150.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
151.	Terric Mesisol	b	poorly	organic	55
152.	Terric Fibrisol	b	poorly	organic	105
153.	Terric Fibric Humisol	b	very poorly	organic	80
154.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
155.	Terric Fibrisol	b	poorly	organic	87
156.	Fibric Organic Cryosol	b	poorly	organic	92+
157.	Terric Fibrisol	b	poorly	organic	55
158.	Terric Fibrisol	b	poorly	organic	70
159.	Terric Fibrisol	b	poorly	organic	70
160.	Terric Fibrisol	b	very poorly	organic	52
161.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
162.	Brunisolic Gray Luvisol	b	moderately well	thin fluvial	
163.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
164.	Peaty Rego Gleysol	b	poorly	lacustro-till	30
165.	Peaty Orthic Luvic Gleysol	b	poorly	lacustro-till	30
166.	Peaty Rego Gleysol	b	poorly	lacustro-till	50
167.	Orthic Luvic Gleysol	b	very poorly	lacustro-till	
168.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
169.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
170.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
171.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
172.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
173.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
174.	Peaty Rego Gleysol	b	poorly	fluvial	40
175.	Peaty Rego Gleysol	b	very poorly	lacustro-till	25
176.	Terric Fibrisol	b	poorly	organic	60
177.	Terric Fibrisol	b	poorly	organic	85
178.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
179.	Peaty Rego Gleysol	b	poorly	lacustro-till	40
180.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
181.	Orthic Gray Luvisol	b-c	moderately well	lacustro-till	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
182.	Orthic Gray Luvisol	c	moderately well	till	
183.	Brunisolic Gray Luvisol	c	well	fluvial	
184.	Peaty Rego Gleysol	b	poorly	fluvial	
185.	Eluviated Eutric Brunisol	b-c	rapidly	eolian	
186.	Orthic Gray Luvisol	b	rapidly	thin eolian	
187.	Terric Mesisol	b	very poorly	organic	70
188.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
189.	Orthic Luvic Gleysol	b	poorly	thin fluvial	
190.	Terric Humisol	b	poorly	organic	70
191.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
192.	Terric Mesisol	b	very poorly	organic	100
193.	Orthic Gray Luvisol	b	imperfectly	lacustro-till	
194.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
195.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
196.	Terric Fibrisol	b	poorly	organic	87
197.	Orthic Gray Luvisol	b-c	well	thin fluvial	
198.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
199.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
200.	Peaty Rego Gleysol	b	poorly	lacustro-till	45
201.	Orthic Luvic Gleysol	b	poorly	lacustro-till	
202.	Peaty Rego Gleysol	b	poorly	lacustro-till	32
203.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
204.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
205.	Peaty Rego Gleysol	b	poorly	lacustro-till	45
206.	Terric Fibrisol	b	poorly	organic	77
207.	Fibric Organic Cryosol	b	poorly	organic	75+
208.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
209.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
210.	Terric Fibrisol	b	poorly	organic	60
211.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
212.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
213.	Terric Mesisol	b	poorly	organic	67
214.	Terric Mesisol	b	poorly	organic	55
215.	Terric Humisol	b	poorly	organic	87
216.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
217.	Terric Fibrisol	b	poorly	organic	87
218.	Terric Mesisol	b	poorly	organic	80

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
219.	Terric Mesisol	b	poorly	organic	50
220.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
221.	Terric Mesisol	b	poorly	organic	45
222.	Typic Fibrisol	b	poorly	organic	160
223.	Terric Humisol	b	very poorly	organic	107
224.	Peaty Rego Gleysol	b	very poorly	lacustro-till	45
225.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
226.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
227.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
228.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
229.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
230.	Terric Fibrisol	b	poorly	organic	67
231.	Brunisolic Gray Luvisol	b	well	thin fluvial	
232.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
233.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
234.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
235.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
236.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
237.	Terric Humic Fibrisol	b	poorly	organic	100
238.	Peaty Rego Gleysol	b	poorly	lacustro-till	37
239.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
240.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
241.	Brunisolic Gray Luvisol	b	rapidly	outwash gravels	
242.	Brunisolic Gray Luvisol	b	rapidly	outwash gravels	
243.	Orthic Gray Luvisol	b	moderately well	fluvial	
244.	Eluviated Eutric Brunisol	d	rapidly	eolian	
245.	Brunisolic Gray Luvisol	b	well	thin fluvial	
246.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
247.	Fibric Organic Cryosol	b	poorly	organic	75+
248.	Peaty Orthic Luvic Gleysol	b	poorly	lacustro-till	35
249.	Terric Humic Mesisol	b	poorly	organic	75
250.	Terric Humic Mesisol	b	poorly	organic	110
251.	Terric Fibrisol	b	poorly	organic	110
252.	Terric Humisol	b	very poorly	organic	45
253.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
254.	Terric Humisol	b	poorly	organic	75
255.	Orthic Gray Luvisol	b	moderately well	lacustro-till	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
256.	Peaty Rego Gleysol	b	poorly	lacustro-till	47
257.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
258.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
259.	Terric Mesisol	b	poorly	organic	80
260.	Mesic Organic Cryosol	b	poorly	organic	120+
261.	Orthic Luvic Gleysol	b	poorly	lacustro-till	
262.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
263.	Terric Humic Mesisol	b	poorly	organic	65
264.	Peaty Rego Gleysol	b	very poorly	lacustro-till	12
265.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
266.	Fibric Organic Cryosol	b	poorly	organic	75+
267.	Fibric Organic Cryosol	b	poorly	organic	65+
268.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
269.	Typic Fibrisol	b	poorly	organic	200
270.	Mesic Fibrisol	b	poorly	organic	225+
271.	Mesic Organic Cryosol	b	poorly	organic	35+
272.	Fibric Mesisol	b	poorly	organic	197
273.	Typic Mesisol	b	very poorly	organic	212
274.	Fibric Mesisol	b	poorly	organic	162
275.	Peaty Orthic Luvic Gleysol	b	poorly	organic	45
276.	Terric Fibric Mesisol	b	poorly	organic	75
277.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
278.	Orthic Gray Luvisol	b	moderately well	laucstro-till	
279.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
280.	Orthic Gray Luvisol	b	moderately well	laucstro-till	
281.	Eluviated Eutric Brunisol	c	well	fluvial	
282.	Peaty Rego Gleysol	b	very poorly	lacustro-till	25
283.	Peaty Orthic Luvic Gleysol	b	very poorly	lacustro-till	15
284.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
285.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
286.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
287.	Peaty Orthic Luvic Gleysol	b	poorly	lacustro-till	30
288.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
289.	Peaty Orthic Luvic Gleysol	b	poorly	lacustro-till	15
290.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
291.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
292.	Orthic Gray Luvisol	b	moderately well	lacustro-till	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
293.	Terric Mesisol	b	poorly	organic	60
294.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
295.	Terric Humisol	b	very poorly	organic	40
296.	Terric Mesisol	b	very poorly	organic	62
297.	Terric Fibrisol	b	poorly	organic	60
298.	Terric Fibrisol	b	very poorly	organic	57
299.	Terric Fibrisol	b	very poorly	organic	110
300.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
301.	Terric Mesisol	b	very poorly	organic	50
302.	Terric Mesisol	b	very poorly	organic	75
303.	Terric Mesisol	b	very poorly	organic	42
304.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
305.	Terric Humisol	b	poorly	organic	70
306.	Terric Mesic Humisol	b	very poorly	organic	107
307.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
308.	Terric Mesic Humisol	b	poorly	organic	62
309.	Peaty Orthic Luvic Gleysol	b	poorly	organic	50
310.	Terric Fibrisol	b	poorly	organic	62
311.	Eluviated Dystric Brunisol	c-d	rapidly	fluvial	
312.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
313.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
314.	Terric Fibrisol	b	poorly	organic	87
315.	Terric Fibric Mesisol	b	poorly	organic	117
316.	Terric Humic Mesisol	b	very poorly	organic	40
317.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
318.	Terric Fibric Mesisol	b	poorly	organic	85
319.	Terric Humisol	b	very poorly	organic	42
320.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
321.	Terric Fibrisol	b	poorly	organic	57
322.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
323.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
324.	Peaty Rego Gleysol	b	very poorly	lacustro-till	27
325.	Terric Fibrisol	b	poorly	organic	60
326.	Terric Fibric Mesisol	b	poorly	organic	115
327.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
328.	Terric Fibrisol	b	poorly	organic	47
329.	Orthic Gray Luvisol	b	moderately well	lacustro-till	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
330.	Terric Mesisol	b	poorly	organic	62
331.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
332.	Brunisolic Gray Luvisol	b	moderately well	thin fluvial	
333.	Peaty Orthic Luvic Gleysol	b	very poorly	lacustro-till	15
334.	Peaty Rego Gleysol	b	very poorly	lacustro-till	35
335.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
336.	Brunisolic Gray Luvisol	b-c	moderately well	thin fluvial	
337.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
338.	Orthic Gray Luvisol	b	moderately-well	lacustro-till	
339.	Gleyed Gray Luvisol	b	imperfectly	lacustro-till	
340.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
341.	Orthic Gray Luvisol	b	moderately well	thin fluvial	
342.	Brunisolic Gray Luvisol	b	moderately well	thin fluvial	
343.	Orthic Gray Luvisol	b	moderately-well	lacustro-till	
344.	Brunisolic Gray Luvisol	b	moderately well	thin fluvial	
345.	Brunisolic Gray Luvisol	b	moderately well	thin fluvial	
346.	Peaty Rego Gleysol	b-c	poorly	lacustro-till	20
347.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
348.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
349.	Rego Gleysol	b	very poorly	lacustro-till	7
350.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
351.	Peaty Rego Gleysol	b	very poorly	lacustro-till	20
352.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
353.	Gleyed Brunisolic Gray Luvisol	b	imperfectly	thin fluvial	
354.	Peaty Rego Gleysol	b	poorly	lacustro-till	15
355.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
356.	Orthic Gray Luvisol	b	moderately well	lacustro-till	
357.	Peaty Rego Gleysol	b	poorly	lacustro-till	35
358.	Terric Humisol	b	poorly	organic	42
359.	Brunisolic Gray Luvisol	b	rapidly	fluvial	
360.	Brunisolic Gray Luvisol	b	rapidly	fluvial	
361.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
362.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
363.	Mesic Organic Cryosol	b	poorly	organic	55+
364.	Terric Humisol	b	poorly	organic	50
365.	Typic Mesisol	b	very poorly	organic	220

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
366.	Typic Mesisol	b	very poorly	organic	225
367.	Brunisolic Gray Luvisol	c	rapidly	fluvial	
368.	Brunisolic Gray Luvisol	c	rapidly	fluvial	
369.	Brunisolic Gray Luvisol	c	rapidly	fluvial	
370.	Fibric Organic Cryosol	b	poorly	organic	60+
371.	Typic Mesisol	b	very poorly	organic	200
372.	Typic Mesisol	b	very poorly	organic	225+
373.	Humic Mesisol	b	very poorly	organic	180
374.	Peaty Rego Gleysol	b	poorly	fluvial	35
375.	Eluviated Dystric Brunisol	c-d	rapidly	fluvial	
376.	Typic Mesisol	b	very poorly	organic	225+
377.	Mesic Organic Cryosol	b	very poorly	organic	35+
378.	Terric Mesisol	b	very poorly	organic	85
379.	Terric Fibric Humisol	b	poorly	organic	75
380.	Typic Mesisol	b	very poorly	organic	182
381.	Orthic Gleysol	b	poorly	fluvial	
382.	Eluviated Eutric Brunisol	c	rapidly	fluvial	
383.	Eluviated Eutric Brunisol	c	rapidly	fluvial	
384.	Orthic Luvic Gleysol	b	poorly	fluvial	
385.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
386.	Peaty Orthic Gleysol	b	poorly	fluvial	20
387.	Terric Mesisol	b	very poorly	organic	62
388.	Typic Mesisol	b	very poorly	organic	200
389.	Typic Mesisol	b	very poorly	organic	125+
390.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
391.	Eluviated Eutric Brunisol	c	rapidly	fluvial	
392.	Terric Mesic Humisol	b	very poorly	organic	100
393.	Terric Humisol	b	very poorly	organic	80
394.	Eluviated Eutric Brunisol	b-c	rapidly	fluvial	
395.	Peaty Rego Gleysol	b	poorly	fluvial	30
396.	Terric Humisol	b	poorly	organic	90
397.	Terric Mesic Humisol	b	very poorly	organic	125
398.	Terric Humisol	b	poorly	organic	100
399.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
400.	Peaty Rego Gleysol	b	poorly	fluvial	30
401.	Eluviated Dystric Brunisol	b	rapidly	fluvial	

INSPECTION SITES (CON'T)

	Soils	Topography	Drainage	Parent Material	Depth of Peat (cm)
402.	Terric Humisol	b	poorly	organic	42
403.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
404.	Orthic Gleysol	b	poorly	fluvial	15
405.	Terric Mesisol	b	very poorly	organic	57
406.	Typic Mesisol	b	very poorly	organic	150
407.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
408.	Peaty Orthic Gleysol	b	poorly	fluvial	35
409.	Peaty Rego Gleysol	b	poorly	fluvial	40
410.	Eluviated Dystric Brunisol	c	rapidly	fluvial	
411.	Terric Mesisol	b	poorly	organic	70
412.	Peaty Rego Gleysol	b	poorly	fluvial	20
413.	Peaty Rego Gleysol	b	poorly	fluvial	35

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 3. Definition of Soil Horizon Symbols (after C.D.A., 1974)

Organic Layers

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

O - This is an organic layer developed mainly from mosses, rushes and woody material.

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

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

Oh - The humic layer is the most highly decomposed of the organic soil materials. It has the least amount of fibre, the highest bulk density and the lowest saturated water-holding capacity. It is very stable and changes very little physically or chemically with time unless it is drained.

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

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

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

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

Master Mineral Horizons and Layers

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

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

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

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

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

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

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

(3) may be characterized by a columnar structure and a significant amount of exchangeable sodium (Bn).

C - This is a mineral horizon or horizons comparatively unaffected by the pedogenic processes operative in A and B, excepting the process of gleying (Cg) and the accumulation of calcium and/or magnesium carbonates (Ck) and soluble salts (Cs).

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

Lowercase Suffixes

b - A buried soil horizon.

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

g - A horizon characterized by gray colors, or prominent mottling, or both, indicative of permanent or periodic intense reduction. Chromas of the matrix are generally 1 or less.

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

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

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.

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

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

s - A horizon with salts which may be detected as crystals or veins, as surface crusts, by distressed crop growth or by presence of salt tolerant plants. It is commonly used with C and k.

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

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)	Sand (S)	2.0 - 1.0
Coarse Sand (CS)	Sand (S)	1.0 - 0.5
Medium Sand (MS)	Sand (S)	0.5 - 0.25
Fine Sand (FS)	Sand (S)	0.25 - 0.10
Very Fine Sand (VFS)	Sand (S)	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 2.

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.

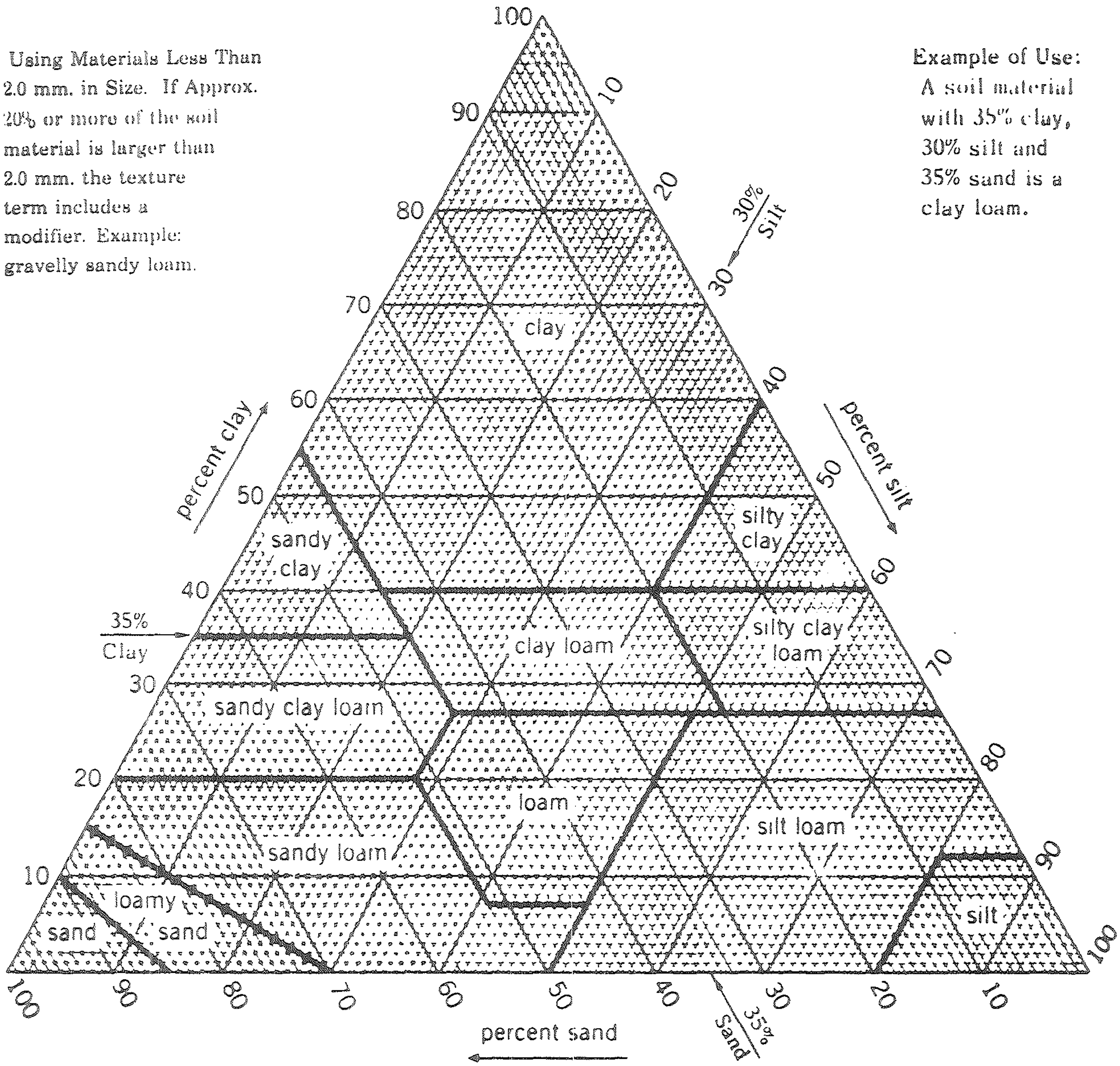


Figure 2. Guide for USDA soil textural classification (after U.S.D.A., 1972)

Soil Drainage Classes

Soil drainage classes are defined in terms of actual moisture content in excess of field moisture capacity and 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 additions.

Well drained - soil moisture content does not normally exceed field capacity in any horizon except possibly the C, for a significant part of the year.

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 sub-surface 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.D.A., 1974)

b: gently undulating - 0 to 2% slopes

c: undulating - 2 to 5% slopes

d: gently rolling - 5 to 9% slopes

Surface Stoniness Classes (after C.D.A., 1974)

S0: non-stony land

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.

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.

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

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

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

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

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.

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.

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

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.

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

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

Infiltration - the downward entry of water into the soil.

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

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.

pH - see soil reaction.

Phase, soil - a subdivision of a soil unit based on soil or land characteristics 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.

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.

Stratified - composed of or arranged in strata or layers as applied to parent material.

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

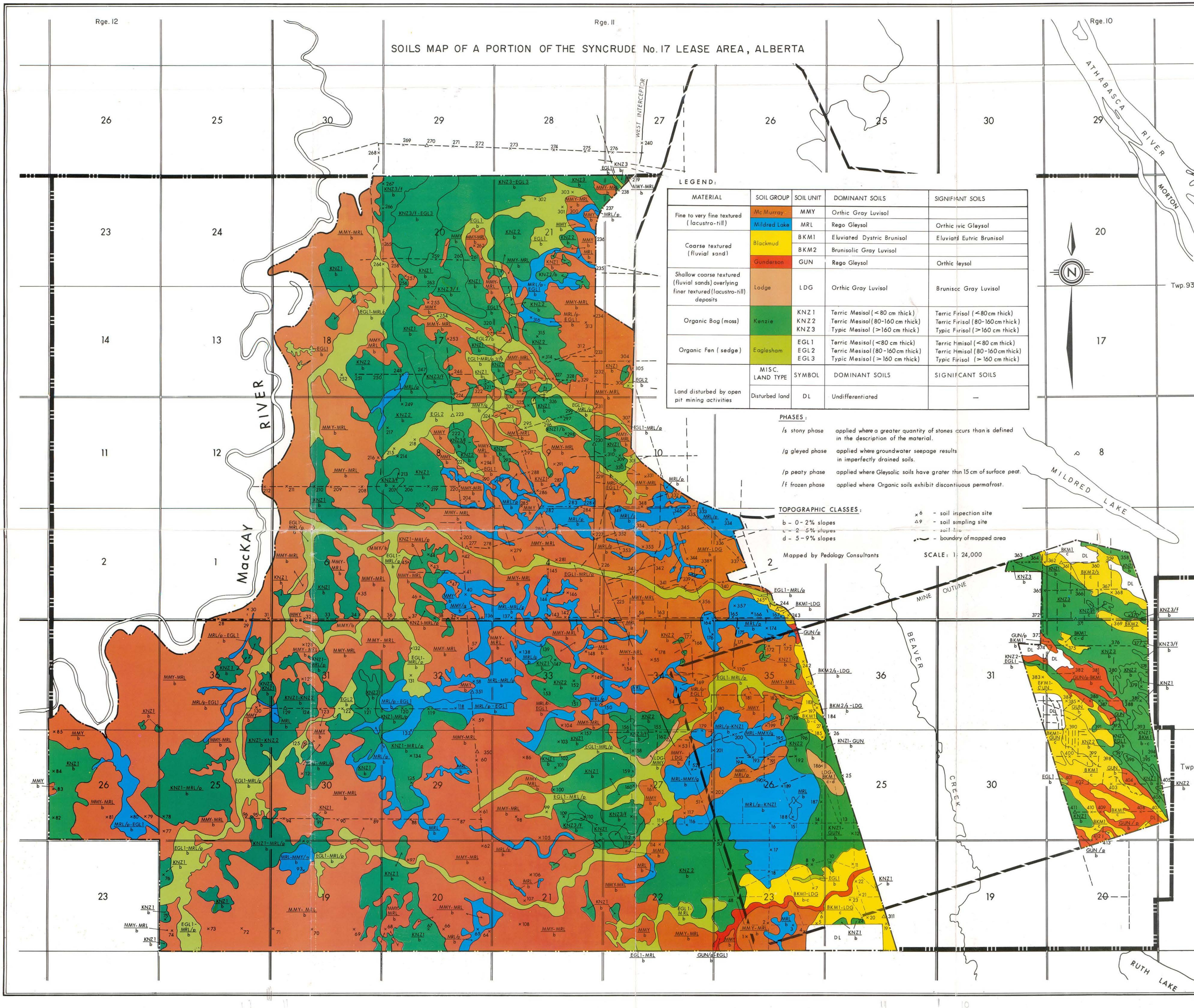
Texture (soil) - the relative proportions of the various-sized soil separates in a soil as described by the textural class names.

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.

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.

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



SOILS MAP OF A PORTION OF THE SYNCRUDE No. 17 LEASE AREA, ALBERTA
Rge. 12
Rge. 11
Rge. 10
Twp. 93
Twp. 92
MacKAY RIVER
ATHABASCA RIVER
MORTON
MILDRED LAKE
BEAVER CREEK
RUTH LAKE
WEST INTERCEPTOR
MINE OUTLINE
LEGEND:
MATERIAL | SOIL GROUP | SOIL UNIT | DOMINANT SOILS | SIGNIFIANT SOILS
Fine to very fine textured (lacustro-till) | Mc Murray | MMY | Orthic Gray Luvisol
Mildred Lake | MRL | Rego Gleysol | Orthic ivic Gleysol
Coarse textured (fluvial sand) | Blackmud | BKM1 | Eluviated Dystric Brunisol | Eluviatd Eutric Brunisol
BKM2 | Brunisolic Gray Luvisol
Gunderson | GUN | Rego Gleysol | Orthic leysol
Shallow coarse textured (fluvial sands) overlying finer textured (lacustro-till) deposits | Lodge | LDG | Orthic Gray Luvisol | Bruniscc Gray Luvisol
Organic Bog (moss) | Kenzie | KNZ1 KNZ2 KNZ3 | Terric Mesisol (<80 cm thick) Terric Mesisol (80-160 cm thick) Typic Mesisol (>160 cm thick) | Terric Firisol (<80 cm thick) Terric Firisol (80-160 cm thick) Typic Firisol (>160 cm thick)
Organic Fen (sedge) | Eaglesham | EGL1 EGL2 EGL3 | Terric Mesisol (<80 cm thick) Terric Mesisol (80-160 cm thick) Typic Mesisol (>160 cm thick) | Terric Hmisol (<80 cm thick) Terric Hmisol (80-160 cm thick) Typic Firisol (>160 cm thick)
MISC. LAND TYPE | SYMBOL | DOMINANT SOILS | SIGNIFCANT SOILS
Land disturbed by open pit mining activities | Disturbed land | DL | Undifferentiated | —
PHASES:
/s stony phase applied where a greater quantity of stones ccurs than is defined in the description of the material.
/g gleyed phase applied where groundwater seepage results in imperfectly drained soils.
/p peaty phase applied where Gleysolic soils have grater thn 15 cm of surface peat.
/f frozen phase applied where Organic soils exhibit discontiuous permafrost.
TOPOGRAPHIC CLASSES:
b - 0-2% slopes
c - 2-5% slopes
d - 5-9% slopes
×6 - soil inspection site
△9 - soil smpling site
- soil line
- boundary of mapped area
Mapped by Pedology Consultants
SCALE: 1: 24,000