SOIL SURVEY OF ELK ISLAND NATIONAL PARK ALBERTA

P. H. CROWN
AGRICULTURE CANADA
RESEARCH BRANCH
SOIL RESEARCH INSTITUTE
SOIL SURVEY, EDMONTON

ALBERTA INSTITUTE OF PEDOLOGY
S-77-38

SOIL SURVEY

of

ELK ISLAND NATIONAL PARK

ALBERTA

P. H. Crown
Agriculture Canada
Research Branch
Soil Research Institute
Soil Survey, Edmonton

Alberta Institute of Pedology
S-77-38

CONTENTS

(cont...)

TABLES

(cont...)

FIGURES

(cont...)

(cont...)

ABSTRACT

The soil survey of Elk Island National Park establishes the subtle complexity of the soils within the Park and provides data for the identification of their attributes and limitations for various uses. The complexity of the soils results from the complex association of various kinds of soil parent materials within the landscape and from changes in vegetative cover that have occurred primarily over the past one hundred years.

Although the dominant soil material in the Park is glacial till, variable thicknesses of glaciofluvial and glaciolacustrine sediments are often found as veneers on the till. Changes in materials often occur with little or no great change in the surface expression of the landform.

The soils of the Park have generally developed under forest vegetation and thus subsurface horizonation is generally similar in almost all of the soils. Surface horizonation is variable especially in terms of color, thickness and organic matter content. This variability relates to changes in vegetative cover over the past one hundred years, from aspen-spruce forest to grasses, to grasses and shrubs and to shrubs and trees. Most of the better drained mineral soils have been classified in the Luvisolic Order of the System of Soil Classification for Canada. Where deep sand deposits occur, soils of the Brunisolic Order have developed. The hummocky and ridged surface expression of the landscape produces many poorly drained, low-lying and depressional areas where Gleysolic soils have developed. In some of these areas where deep accumulations of sedge and moss peats have developed soils of the Organic Order occur. In the area in the immediate vicinity of the soap-holes, on the east side of the Park, the soils contain relatively high concentrations of soluble salts and have been placed in the Solonetzic Order.

Soil units are named using letter symbols for the dominant soil or soils in a delineated soil area. These areas correlate with changes in landform surface expression and vegetation. The locations of soil units are shown on the soil map.

ACKNOWLEDGEMENTS

The soil survey of Elk Island National Park was conducted by Agriculture Canada, Soil Research Institute, Soil Survey, Edmonton with funding for technical assistance and report production by the Department of Indian and Northern Affairs, Parks Branch.

Assistance provided by the Western Regional Office, Parks Branch, in particular Dave Day, Charles Zinkan and Pat Larsen, is acknowledged.

The author wishes to express his appreciation for the cooperation and assistance provided by the personnel located at Elk Island National Park and in particular that provided by Bob Jones and Jack Schick.

Recognition is extended for the able assistance of Peter Gieb in the field work, Dennis Lay in the draughting, Wayne McKean, Alex Schwarzer and Joe Beres in the laboratory analyses, and Cecile Lirette and Pal Foster in the typing of this report.

INTRODUCTION

In recent years various resource inventory projects within the National Parks have been commissioned by Parks Canada, Department of Indian and Northern Affairs. A soil resource inventory of Elk Island National Park was initiated in 1974 by Agriculture Canada, Soil Research Institute, Soil Survey, Edmonton with financial support by the Parks Branch beginning in 1975. The results and conclusions of the soil resource inventory are contained in this report. These are presented in the form of a written text and a soil map which form an integral unit and for best results should be used together.

The written text includes a general description of the area, the survey and analytical procedures employed, generalized descriptions of soil units and interpretations of soil characteristics for selected park uses. Interpretations for all possible uses have not been attempted although they could be made if required.

The soil map is presented on a photo base at a scale of 1:25,000. This base is an enlargement from an original 1:126,720 scale color photograph taken in July 1971. (Note: this photograph is available from the National Air Photo Library, Ottawa by quoting frame no. 82, roll A30336, map reference RS 83H "B", July 13, 1971). The photo base used contains a certain amount of predictable radial distortion especially along the north, west and south park boundaries. Interpretative overlays showing water erosion hazard and soil drainage classes are also included with the soil map.

GENERAL DESCRIPTION OF ELK ISLAND NATIONAL PARK

Location and Extent

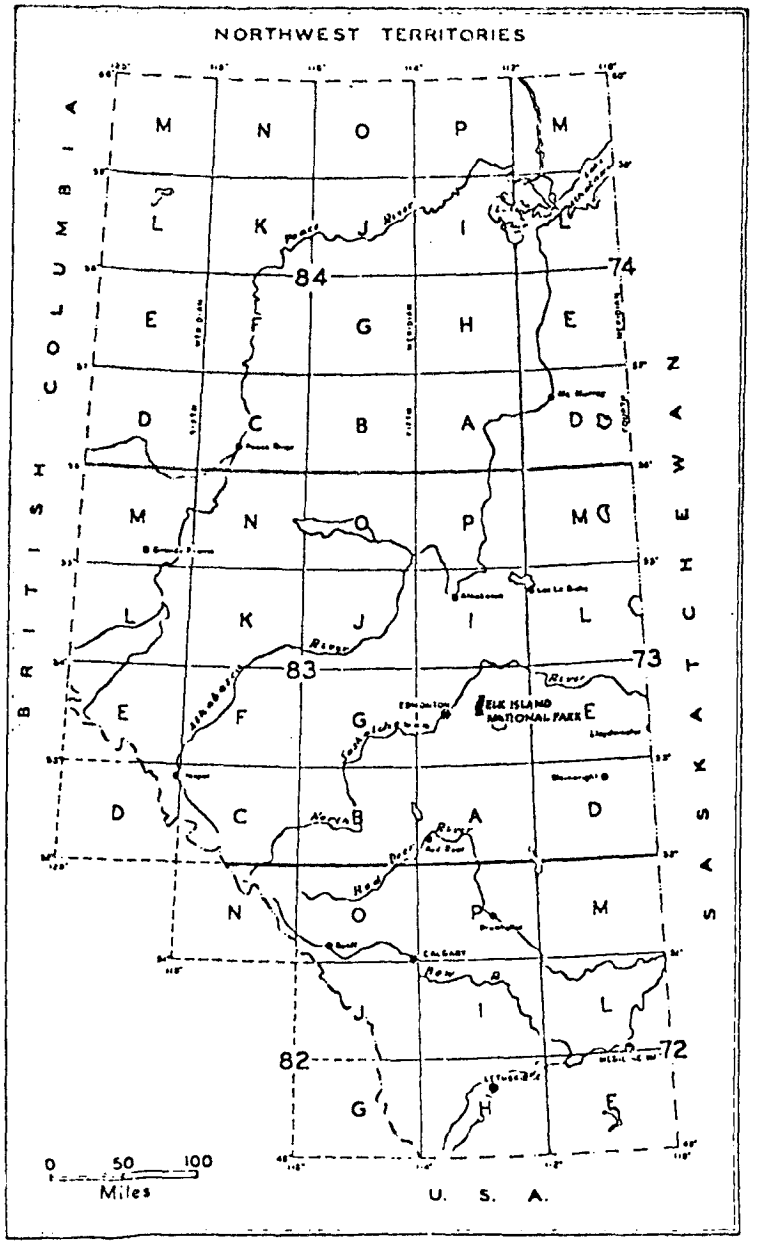
Elk Island National Park is located 37 km (23 miles) east of the city of Edmonton in central Alberta. It is centered around 53° 37' N Latitude and 112° 58' W Longitude extending 22.5 km (14 miles) north-south and 10 km (6 miles) east-west. The park is approximately 19680 hectares (76 square miles) in area (Figure 1).

History, Development and Present Cultural Features

The Beaver Hills provided a rich hunting area for various Indian bands prior to the arrival of Anthony Henday, the first white man in the area, in 1856. After his arrival, and that of various other explorers, an extensive trade in beaver pelts developed. However, by 1870, with the bison herds and beaver populations drastically reduced by over-hunting and trapping, only a few Indians remained in the Beaver Hills.

The 1890's marked the beginning of homesteading in the area, accompanied by tremendous fires that effectively removed most of the forest from the Beaver Hills. In 1906 local Albertans entered into an agreement with the federal government to fence a 4140 hectare (16 square miles) preserve around Astotin Lake for a small band of elk that were native to the area. Bison were introduced into this preserve in 1907, when a herd in transit to a national range at Wainwright were held there pending completion of fences at Wainwright. In the subsequent roundup, in 1909, some of these bison eluded capture and remained within the preserve, which became a Dominion Park in 1913. The size of the park was increased by 36 sections in 1922 and a further 24 sections in 1947, both additions being to the south. In the interim the area became a National Park in 1930.

Although a few families settled within the present area of the park in the late 1890's and early 1900's, there was no extensive agricultural development. These homesteads were sold to the crown over the years as the size of the park increased. This, plus additional information, may be found in unpublished material located in the library at the Administration Centre, Elk Island National Park.



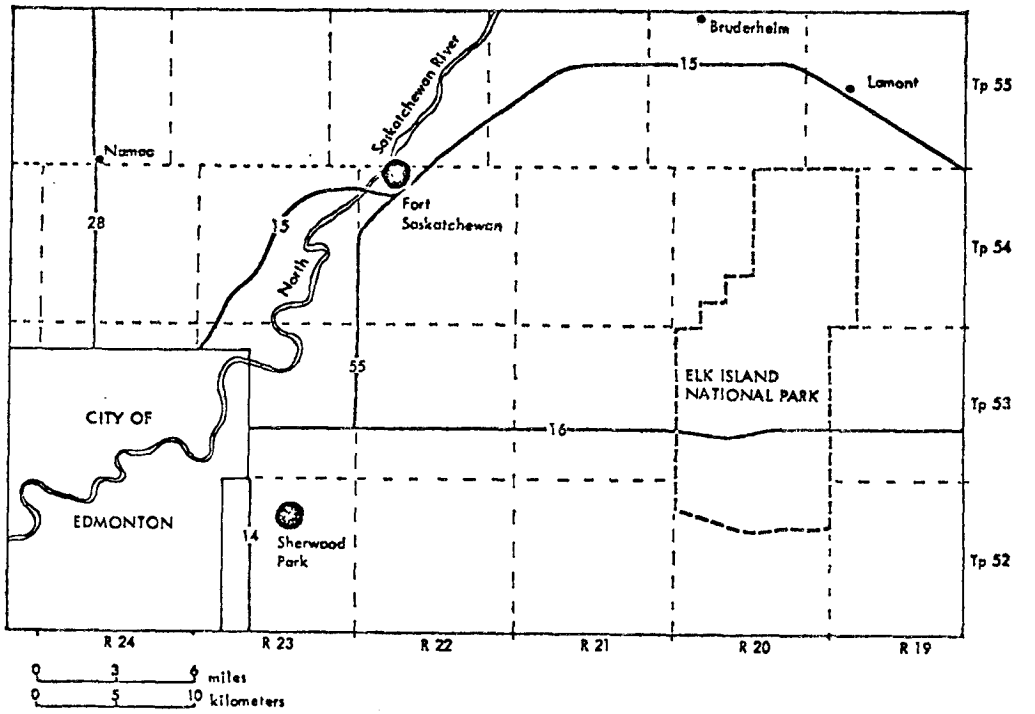


Figure 1. Location of the study area.

Although the park boundary encloses an area of approximately 19680 hectares (76 square miles) a relatively small proportion of the park is utilized by visitors in the summer (Figure 2). Activities are centered at the beach, campground, and golf course all on the southeast side of Astotin Lake. Park administration and staff housing facilities are centered on the northwest side of Astotin. During the summer months, hiking trails in the north half of the park are utilized by group and individual visitors to varying degrees depending on their proximity to the main beach areas. During the winter more extensive use appears to be made of the trails by cross-country skiers. There is essentially no visitation to the portion of the park south of Highway #16.

A relatively large area north of Highway #16 on the east side of the park has been used for the production of hay. A smaller area at the west end of Oster Lake has also been kept in forage crops.

At the present time the portion of the park north of Highway #16 is accessible through three gates, one on Highway #16 2.4 km (1.5 miles) from the east boundary, one on the north boundary 1.6 km (1 mile) from the east boundary, and one on the west boundary near the administration centre, west of Astotin Lake. The only park road accessible to the motorized public runs from the gate on Highway #16 north to the north gate branching south of Astotin Lake with a road to the west gate.

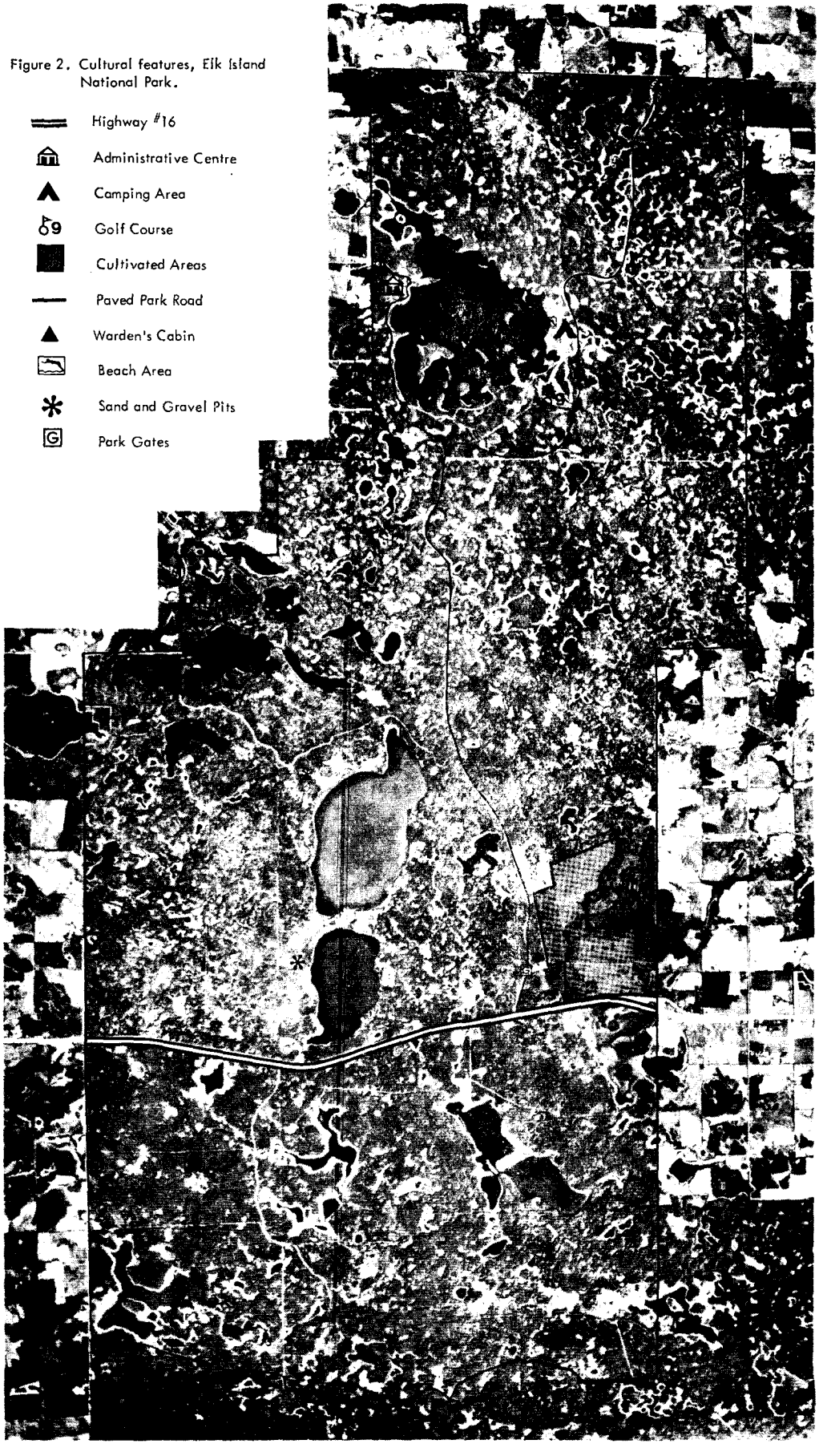
Abandoned sand pits are located east of Moss Lake and two old gravel pits were found west of Tawayik Lake.

Physiography and Topography

Elk Island National Park is situated in southern half of the interior plains of Canada, in the central portion of the Alberta Plateau (Bostock, 1970; Lang, 1974). South of the Athabasca River, the Alberta Plateau has a relatively even surface with a few groups of widely separated, low hills (Bostock, 1970) and the Beaver Hills, east of Edmonton, are one of these. The Beaver Hills, also often referred to as the Cooking Lake Moraine, rise 30 to 60 m (100 to 200 feet) above the general level of the surrounding land surface. The park is located at the north end of the Beaver Hills, a hummocky disintegration moraine in which local relief rarely exceeds 15 metres (50 feet).

Many of the characteristic topographic elements of a hummocky disintegration moraine, such as till knobs and ridges, kettles and prairie mounds, are present in the park as well as areas of more subdued topography. Knob and kettle topography is found along the east side of the park southeast of Astotin Lake and along the west side of the park north of Highway #16. In this latter area the

Figure 2. Cultural features, Elk Island National Park.



highest point in the park is found with an elevation of 760 metres (2490 feet) a.s.l. The rest of the park lies between 710 and 740 metres (2325 and 2425 feet) a.s.l. and is characterized by till ridges often with a circular configuration. More subdued topography is found in the central portion between Moss, Tawayik and Flyingshot Lakes. The lowest point in the park is found on the east boundary, 2.9 km (1.8 miles) north of Highway #16 where the elevation is 704 metres (2310 feet) a.s.l.

Due to the vegetative cover, variations in topography are often difficult to perceive on present day aerial photographs. However relatively "old" oblique aerial photographs, taken in 1924 when the vegetative cover was less dense, illustrate some of the topographic variations to be found (Figure 3).

Geology

The Interior Plains of Canada are composed of nearly horizontal, sedimentary bedrock covered with a relatively thick mantle of glacial drift and underlain by crystalline precambian rocks (Douglas et al. 1970). Elk Island National Park is immediately underlain by bedrock of the Edmonton Formation, Upper Cretaceous non-marine shales and sandstone interbedded with coal seams (Lang, 1974). This may be underlain by marine and non-marine gray shales and sandstone of the Bearpaw Formation. A contact between the two is located at a northwest-southwest trending escarpment immediately northeast of the northeast corner of the park. The area of the park plus the rest of the Beaver Hills represent a topographic high of the preglacial land surface (Carlson, 1967).

According to Lang (1974), Bayrock mapped the surficial geology of the Edmonton area, NTS Sheet 83H and included the area of Elk Island National Park. Except for two small kames (immediately northeast of Moss Lake and 3.2 km (2 miles) north of the "soap holes" on the east park boundary) the entire park was mapped as hummocky moraine with unseparated patches of stratified clay and silt. Scant data from other sources exist on the surficial geology of the area within the park boundary although at the present time Mr. D. Emerson, Department of Geology, University of Albera, Edmonton is conducting a study of the surficial geology of the Cooking Lake Moraine which includes the park.

During the field mapping for soils information it was noted that the surficial deposits within the park form a complex association in many parts of the landscape. For the most part, the park is covered by glacial till that is quite variable in terms of its color, texture, and carbonate content. Within 125 cm of the surface, colors range from yellowish brown to dark brown; textures from

Figure 3. Oblique aerial photograph taken in 1924 showing topography in the southeast corner of the park. Note the circular till ridges and the whitish lowlying areas. Photo courtesy the staff, Elk Island National Park.

silt loam to loam and clay loam; and calcium carbonate equivalent from 2 to 10 percent. These variations may occur over very short lateral distances (2 to 4 metres). The till found along the east side of the park, southeast of Astotin Lake, contains more boulders and coarse fragments than the till in the rest of the park.

Glaciolocustrine sediments are often found on top of the till with thicknesses ranging from 1 to 4 metres. One area of glaciolascustrine sediments lies between Little Tawayik Lake and the Bailey Lakes and extends eastward almost to the park boundary. Glaciolacustrine sediments are also found in a hummocky area southwest of Astotin Lake. In this area the glaciolacustrine sediments were probably deposited in a superglacial lake and "let down" onto the till as the ice melted. It is also quite probable that mudflows of the saturated material occurred in that the till is often exposed at the surface in a completely random pattern over the landscape (ie. no topographic control over where till is or is not exposed). For example topographic highs may be covered with lacustrine material while till is exposed on the middle slopes, or the reverse situation may occur.

Much of the till has a sandy overlay especially north and east of Astotin Lake. It is probable that much of this material is glaciofluvial although the possibility exists that it may be eolian. Glaciofluvial sediments also occur southeast of Astotin Lake. In this area variable thicknesses of coarse textured materials are found with the till. In Lang's (1974) reproduction of Bayrocks' map, one kame is identified immediately northeast of Moss Lake. Another possible kame, not identified by the above, is located 1 mile east of Moss Lake, and east of the old sand pits. This area represents the highest elevation in the park (744 metres a.s.l.) other than that of the west side of the park just north of Highway #16 (760 metres a.s.l.). Deep sand deposits were also found with the till in the area of the park south of Highway #16.

It is possible that within many till areas of the park where sandy overlays occur, cracks in the till have infilled with sand to produce very localized sand deposits. One such feature was found northwest of Oster Lake immediately outside the park boundary (Figure 4). This example probably represents a dilation crack in the till which infilled with sands deposited by ice marginal meltwaters(Emerson 1976). Similar features are probably present within the park although they would be difficult to locate without deep road cuts as in the case above.

Figure 4. LEFT: Probable dilation crack in glacial till infilled with glaciofluvial sand;
RIGHT: Till-sand contact with little noticeable change in topography (location: NE6-Tp54 - R20- W4).

Vegetation

The Cooking Lake moraine, including the area of the park, has been classified as an isolated area of the Mixedwood Section of the Boreal Forest Region surrounded by the Aspen Grove Section of the Boreal Forest Region (Rowe 1972). The Mixedwood Section is characterized by dominant trembling aspen with balsam poplar in wetter sites and inclusions of white birch and white spruce which become dominant in the oldest stands.

No detailed summary of the present vegetation within the park has been published to date although a first draught of a vegetation map of the park was provided by Parks Canada. The most influencial event affecting the present vegetation of the park would have to be the great fires of 1895 that swept the Beaver Hills area. According to records at the park, prior to these fires the area was dominantly spruce forest. At present the vegetation within the park is evolving back to this pre-1895 type of forest. Trembling aspen dominates with some balsam poplar in the northeast corner of the park. Groves of white spruce that probably predate the fires occur on some of the islands in Astotin Lake, along the south side of Astotin Lake and mid-way between Flyingshot and the Bailey Lakes. Shrubby plants include wild rose and beaked hazelnut under the aspen as well as saskatoon, chokecherry and pincherry. On more open, south-facing slopes west of the Tawayik Lakes grasses, wild rose and beaked hazelnut are dominant. Lowlying and depressional areas contain either bogs with black spruce, tamarack, labrador tea, cloudberry, blueberry and sphagnum moss, or fens with sedges, willow and alder. Two areas of the park, southwest of Oster Lake and on the east side, immediately north of Highway #16, have been cultivated in the past and seeded for hay. These remain as areas of grass-legume forage for park animals.

Pettapiece (1969) reviewed the literature and discussed the postglacial environment of the forest-grassland transition zone of the Great Plains of Canada. Of interest are the changes in climate and vegetation that have occurred in this general region since the last glaciation of approximately 10,500 years B.P. (before present). At this time tundra conditions possibly existed in this region which includes Elk Island National Park. This was apparently followed by a rapid warming trend and shift to prairie vegetation until approximately 5000 B.P. During this warming period temperatures are believed to have been 2 to 3 degrees C warmer than maximum temperatures of today. By 4000 years B.P. a cooler, more moist climate, similar to that at present, and a southward shift of boreal forest vegetation is believed to have been attained. From 1500 to 1850 A.D. a cooler climate than present has been indicated and from 1850 to the present there has been a general warming trend.

Drainage

The deranged surface drainage pattern associated with hummocky disintegration moraines is evident in Elk Island National Park. There are few major streams or creeks within the park and most surface drainage occurs in part through very poorly drained organic areas. From a study of the topographic map provided by Parks Canada it appears that the portion of the park south of Highway #16 drains to the southeast through Blackfoot Lake. The National Topographic Series map 83H (1:50,000) shows that the flow from Blackfoot Lake moves north, east of the park boundary and re-enters the park at Goose Lake to move north through the area used for hay before leaving the park on the east side, 3.2 km (2 miles) north of Highway #16.

The Tawayik Lakes, which drain portions of the area west of them, and Oster Lake drain to the east through the creek in the hay area. The area south of and including Adamson Lake appears to drain westward through Trapper Lake. Astotin Lake drains to the northwest through Astotin Creek while the area north and east of Astotin Lake appears to drain eastward with the water leaving the park on the east boundary almost directly east from the golf course (Figure 5).

Due to the hummocky and ridged topography in the park, most of the soils are moderately well to well drained. However, areas of poorly and very poorly drained soils of relatively small size abound throughout the park in depressional and lowlying positions in the landscape. Such areas are most numerous in the hummocky and ridged area west of the Tawayik Lakes, and in the northern half of the park. Many areas have been flooded as a result of beaver dams in low gradient streams (Figure 6).

Climate

The present regional climate of the area that includes the park can be classified as continential with warm summers and cold winters. Unfortunately, long-term meterorological data specific for the park are lacking. The closest recording station at Fort Saskatchewan is situated at a lower elevation than the park and in a more open agricultural area. Data from this or other stations (Table I) would not be directly applicable to the park. However it might be expected that due to the higher elevation of the park and its forest vegetation, daytime summer temperatures may be lower than those reported at the established stations. The frost free period for the Fort Saskatchewan area is approximately 100 days with 40 to 46 cm of precipitation per year, seventy percent of which falls as rain. The probability of over 2.5 cm of rain in a one-hour period is one year in five and the maximum precipitation in a 24 hour period has not exceeded 12.5 cm (Bowser et al. 1962).

Figure 5. Inferred surface drainage, Elk Island National Park, compiled from aerial photographs and topographic maps.

Figure 6. Flooding of low gradient stream by the presence of a beaver dam (location: east of road leading to the south warden's cabin, 0.5 km north of the cabin).

Table 1. Temperature and precipitation data for the period 1941 to 1970 as recorded at Fort Saskatchewan, Alberta (after Atmospheric Environment Service).

Temperature (°C)	J	F	M	A	M	J	J	A	S	O	N	D	Year
mean daily	-16	-12	-7	4	11	15	17	16	11	5	-5	-12	2
mean daily max.	-11	-6	-1	10	18	21	24	22	17	11	0	-7	8
mean daily min.	-22	-18	-13	-2	4	8	10	9	4	-2	-10	-17	-4
extreme max.	9	11	19	24	32	34	36	35	33	27	16	9	36
extreme min.	-44	-37	-46	-17	-8	-3	2	0	-7	-17	-32	-39	-46
number of days with frost	31	28	30	21	6	0	0	0	5	19	29	31	200
Precipitation (mm)													
mean rainfall	1	tr.	1	1	33	73	80	64	39	10	2	1	307
mean snowfall	256	213	160	117	23	tr.	0	0	10	79	168	190	1214
mean total	27	22	16	20	36	74	80	64	40	18	19	29	430
number of days with measurable precip.	8	6	5	5	8	10	11	11	9	5	5	6	89

Soil Formation and Taxonomy

Soils are naturally occurring, three dimensional bodies found at the interface between the biosphere and the less biologically and chemically active geologic material and sediments. The genesis of a soil is the result of the interaction of various soil forming factors which include parent materials, climate, living organisms, topography and time (Canada Department of Agriculture 1970). The relative importance of each factor may vary from place to place and/or from time to time. These parameters control the soil forming processes which through additions or removal of organic matter, translocation of clays or iron and aluminum, and/or other chemical and physical transformations result in the formation of horizons or layers of various kinds within the soil body. Horizons may differ in many properties such as color, texture, structure, consistence, thickness, and chemical and biological activity. Horizons are named according to these properties (Figure 7, Table 2, and Glossary). Soils are classified into taxonomic units on the basis of observed and measured soil properties. For this report soils are classified according to the System of Soil Classification for Canada as revised in 1976 (Canada Soil Survey Committee 1976).

The soils of Elk Island National Park reflect past and present environmental conditions, in particular the changes that have occurred in vegetation. Most of the mineral soils in the park posses relatively strongly developed Bt horizons overlain by leached, acidic, Ae horizons. These indicate soil development under forest vegetation and place the soils into the Luvisolic Order. Removal of the forest vegetation by fire and the subsequent succession from grassland back to forest have altered the physical and chemical composition of the surface horizons but the subsurface Bt horizons remain.

In the aspen-grassland areas west of the Tawayik Lakes, grass vegetation has resulted in the development of Ah horizons that in some cases are similar to those of Chernozemic soils. However, since these Ah horizons are underlain by acid Ae and dense Bt horizons, the soils are classified in the Dark Gray Luvisol Subgroup. On many slopes in this part of the park, as the vegetation changes from grasses to open aspen, the thickness of the Ah horizons decreases and once it is less than 5 cm the soils are placed in the Orthic Gray Luvisol Subgroup. The dominant soils of the park are Orthic Gray Luvisols found under stands of trembling aspen. For a more complete discussion on the soils of the forest-grassland transition areas see Pettapiece (1969).

On some of the islands in Astotin Lake and along the south shore of this lake, small areas of dominantly white spruce are found that presumably escaped the fires of the 1980's. Under this type of vegetation the upper portions of the

Table 2. Definition of soil horizon symbols (Canada Soil Survey Committee 1976)

Organic Layers

Organic layers are found in organic soils and usually at the surface of mineral soils. They contain more than 17 percent organic carbon by weight. Two groups of these layers are recognized.

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

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

Om - The mesic layer is the intermediate state of decomposition with intermediate amounts of fibre, bulk density and water-holding capacity. The material is partially 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 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 a partly decomposed mat permeated by fungal hyphae, as in mor[1].

H - This is an organic layer characterized by an accumulation of decomposed organic matter in which the original structures are indescernible. 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 carbon than that specified for organic layers.

A - This is a mineral horizon formed at or near the surface, in the zone of the removal of materials in solution or suspension or of maximum *in situ* accumulation of organic carbon or both.

Included are:
(1) horizon in which organic matter has accumulated as a result of biological activity (Ah);
(2) horizons that have been eluviated of clay, iron, aluminum or organic matter or all of these (Ae).

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

(1) an enrichment in iron, aluminum and/or humus (Bf, Bhf, Bh);
(2) an accumulation in clay expressed by finer soil textures and by cutans lining peds and pores (Bt);
(3) an alteration by hydroloysis, reduction or oxidation to give a change in color or structure from horizons above or below (Bm and Bg);
(4) an accumulation of clay plus columnar structure with coatings or stainings and significant amounts of exchangeable sodium (Bnt).

C - This is a mineral horizon comparatively unaffected by the pedogenic processes operative in A and B, excepting (i) the process of gleying, and (ii) the accumulation of clacium and magnesium carbonates and more soluble salts (Cca, Csa, Cg, and C). Marl and diatomaceous earth are considered to be C horizons.

Lowercase Suffixes

ca - A horizon of secondary carbonate enrichment in which the concentration of lime exceeds that in the unenriched parent material.

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

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. It is used with A alone (Ah); or with A and E (Ahe).

Ah - A horizon enriched with organic matter that either has a color value at least one unit lower than the underlying horizon or contains 0.5% more organic carbon than the IC, or both. It contains less than 17% organic carbon by weight.

---

[1] B. Bernier. 1968. Soils under forest. Proceedings of the Seventh Meeting of the National Soil Survey Committee of Canada. p. 145 and 147.

Ahe - An Ah horizon that has been degraded as evidenced, under natural conditions, by streaks and splotches and often by platy structure. It may be overlain by a darker-colored Ah and underlain by a higher-colored Ae.

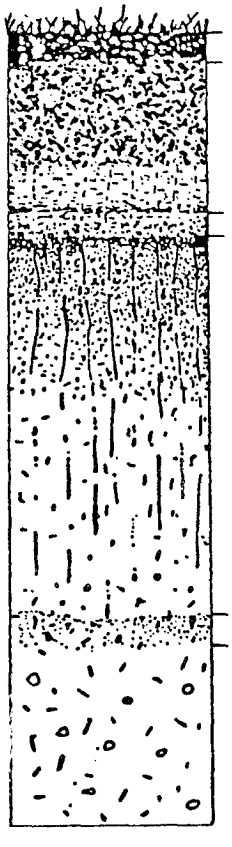
m - A horizon slightly altered by hydrolysis, oxidation, or solution or all three, to give a change in color or structure, or both.

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

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, including gypsum, which may be detected as crystals or veins, as surface crusts of salt crystals, by distressed crop growth, or by the presence of salt-tolerant plants. It is commonly used with C and k (Csk), but can be used with any horizon or combination of horizon and lowercase suffix.

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



L-F-H — Organic horizon, which may be subdivided into: L (raw organic matter), F (partially decomposed organic matter), and H (decomposed organic matter).

A — 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).

AB — Transition horizon.

B — Mineral horizons that (1) may have an enrichment of clay (Bt), iron (Bf), or organic matter (Bh); or (2) may be characterized by a columnar structure and a significant amount of exchangeable sodium (Bn); or (3) may be altered to give a change in color or structure (Bm). Usually lime and salts have been leached out of this horizon. (4) The symbol (j) is used with the above suffixes to denote a failure to meet the specified limits of the suffix.

BC — Transition horizon.

C — 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) and soluble salts (Cs).

Figure 7. Diagram of a soil profile showing various horizons. Some profiles may not have all these horizons clearly developed. Where it is necessary to subdivide a horizon, digits are used; for example, the Bt horizon may be subdivided into Bt1, Bt2, etc.

Ae horizons are often brownish in color due to enrichment with organic matter and iron oxides. These soils are placed in the Brunisolic Gray Luvisol Subgroup.

On deep sand deposits, as are found southeast of Astotin Lake, the clay content of the original material is relatively low. Therefore, well-developed Bt horizons are not usually found although Ae horizons are present. These soils are classified in the Eluviated Eutric Brunisol Subgroup. In a few areas White spruce are found on the deep sands and the soils have strongly acid and leached Ae horizons underlain Bm horizons that are brighter in color than those found in the Eluviated Eutric Brunisols under aspen forest. Under the more acid conditions the Bm horizons contain slightly greater amounts of organic matter and iron oxides.

Poorly drained mineral soils within the park are characterized by acid Ae and Bt horizons and carbonates at depths of 95 to 115 cm. This indicates leaching by the downward movement of water and the groundwater recharge nature of the entire Cooking Lake moraine. These soils have been classified as Humic Luvic Gleysols. The exception to this is the area of the "soap-holes" where groundwater is being discharged carrying soluble salts to the surface. The soils of the "soap-holes" themselves are classified as Rego Gleysols (carbonated, saline). The better drained soils around the "soap-holes" are classified in the Gray Solodized Solonetz Subgroup and are characterized by leached Ae horizons and dense, compact Bnt horizons. The higher amounts of sodium in these soils, as compared to other soils in the park, indicates discharge of groundwater containing high amounts of soluble salts.

A general soils map has been prepared to delineate and emphasize the dominant kinds of soil forming factors found in the different portions of the park (Figure 8).

Figure 8. Generalized soil map, Elk Island National Park.

Symbol	Dominant Soil Subgroup
1	Orthic Gray Luvisol
2	Dark Gray Luvisol
3	Eluviated Eutric Brunisol
4	Brunisolic Gray Luvisol
5	Dark Gray Solonetz
6	Dark Gray Luvisol

METHODOLOGY

Mapping

The original soil survey of the Edmonton area resulted in an unpublished map on which units were separated on the basis of soil surface color and texture (Mather et al. 1930). The Beaver Hills were unmapped and left as a blank area on this map. It is not surprising that there was difficulty in mapping this area using surface texture and color as the criteria for separations due to the extremely complex nature of the surficial deposits found in the moraine.

The results of a reconnaissance soil survey of the Edmonton sheet were published in 1962 (Bowser et al. 1962). The Beaver Hills were included in the mapping. The units employed were complexed to include the variations in materials and soil profile morphology found in the area. This was necessary since the map was published at a scale of 1:126,000 and small areas could not be delineated separately because of cartographic limitations. The area of the park was therefore separated into a relatively small number of map units.

For this project an initial reconnaissance of the soils within the park, along with the unpublished field sheets from the earlier survey (Bowser et al. 1962), were used to prepare a tentative map legend or key to the soils. During this initial phase of the project, soils were described briefly in the field and relationships between soils, landform, landscape position and vegetation patterns were noted. Because of the complex nature of the surficial deposits and the 'recent' history of vegetation changes within the park, it was not possible to predict within reasonable bounds of certainty the kinds of soils to be found in a given area without this prior knowledge obtained from the above mentioned sources.

Aerial photographs taken in the fall of 1973 at a scale of 1: 15,840 and on loan from the chief Naturalist, Elk Island National Park, were the main field tool in locating soil areas. Initially the photographs were used in order to separate the park according to the various topographic elements associated with hummocky disintegration moraines. Further separations were then made on the basis of present vegetation patterns. These units were then named according to the tentative legend. Field checking using soil pits provided additional data used to refine the legend. The final soil map units consist of mappable groups of soils that have defined limits of variability in parent materials, horizonation, texture and drainage.

Once the field survey was completed, representative pedons (soil profiles) for each major map unit were described in detail and sampled for characterization. The locations of the type pedons are given on Figure 9.

Landform Surface Expression

Although major landforms generally have predictable kinds of materials, vegetation and/or climate, drainage (topography) and stability (time), portions of these landforms can vary from the overall prediction. Such is the case in Elk Island National Park. The park itself constitutes the northern end of the Cooking Lake Moraine or Beaver Hills, a hummocky disintegration moraine. Various topographic elements can constitute a hummocky disintegration moraine and these were used as the logical first step in preparing the soil map. Field experience also showed that the kinds of parent materials on which the soils had developed were not necessarily coincident with given topographic elements. Therefore the legend did not incorporate the topographic elements into the soil unit itself but rather this portion of the legend was left open ended. In other words soil units comprised of a given grouping of soils, materials and vegetation, could and often do occur on more than one topographic element.

The topographic elements or landform surface expressions considered in the legend include:

a) level surface expression characterized by few or no prominent surface irregularities with slope gradients less than 2 percent.

b) undulating surface expression characterized by a regular, smooth, wave like pattern of slopes generally with gradients from 1 to 5 percent.

c) ridged surface expression characterized by a generally linear, parallel or intersecting pattern of slopes with generally smooth surfaces, and gradients from 5 to 15 percent.

d) ridged surface expression characterized by a generally circular pattern of slope (i.e. prairie mounds) with smooth surfaces and slope gradients from 5 to 12 percent.

e) hummocky surface expression characterized by a broken, irregular surface with distinct knobs and depressions and slope gradients from 9 to 25 percent.

Figure 9. Locations and identification numbers of type pedons, Elk Island National Park.

Soil Profile Morphology

Descriptions and classifications were made according to the system of Soil Classification for Canada as revised in 1976 (Canada Soil Survey Committee 1976). Classification is at the Subgroup catagory of the system and descriptions include thickness and depth of horizons, soil colors (Munsell color notations), texture, structure, consistence, roots, pores, coarse fragments, horizon boundaries, lime content and other pertinent details. Site characteristics such as vegetation, elevation, aspect, and slope were noted.

Chemical and Physical Analyses

Chemical and physical analyses were conducted using the routine procedures of the Alberta Institute of Pedology. These included:

a) Particle Size Distribution; by the pipet method of Kilmer and Alexander as modified by Toogood and Peters (1953).

b) Liquid Limit, Plastic Limit and Plasticity Index; by the method outlined by ASTM (1970).

c) Soil Reaction; pH was determined using a 2:1 ratio of 0.01M $CaCl_2$ solution to soil (Peech, 1965).

d) Total Nitrogen: by the macro Kjeldahl-Wilforth-Gunning method (A.O.A.C. 1955).

e) Calcium Carbonate Equivalent: by the inorganic carbon manometric method of Bascombe (1961).

f) Organic Carbon: by difference between total carbon and inorganic carbon: total carbon determined by dry combustion using an induction furnace (Allison et al. 1965) with a gasometric detection of evolved CO_2 (Leco Model 577-100).

g) Exchange Capacity; by displacement of ammonium with sodium chloride (Chapman, 1965).

h) Exchangeable Cations: ammonium acetate - pH7 (A.O.A.C. 1955) method and K, Mg, Na, and Ca determined by atomic absorption spectrophotometry.

i) Pyrophosphate - Extractable Aluminum and Iron; organically complexed Al and Fe extracted using O.1M pyrophosphate extraction (McKeague, 1966) and determined by atomic absorption spectrophotometry.

i) Available nutrients determined by methods used at the Alberta Soil and Feed Testing Laboratory: - available nitrogen (N) as nitrate - nitrogen extracted by 0.2N $CuSO_4$ solution; determined photometrically using phenol-disulfonic acid:
- available phosphorous (P) extracted with solution of 0.03N NH4F - 0.03N H_2SO_4; determined by HNO_3 - vanadatemolybdate colorimetric procedure. (Dickman and Bray 1940).
- available potassium (K) extracted with N NH_4OAC solution; determined by flame photometry.

Field Tests

a) Bulk density; by the soil clod method. Samples were waxed, oven dried and weighed. Volume determined by displacement of water. Calculations based on field moist gravel-free volume. Values reported are the arithmetic mean of 5 determinations per horizon.

b) Percolation; by the method suggested by the Alberta Department of Manpower and Labour, Plumbing Inspection Branch (1972). A hole is dug to desired depth, saturation for 24 hours before measuring rate of drop of water level in the hole.

c) Infiltration; by the double ring method (Figure 10) with a constant head apparatus as suggested by Adams (et al. 1957).

Figure 10. Double ring infiltration test apparatus being used in the field.

SOIL UNIT DESCRIPTIONS

This section contains, in alphabetical order, generalized descriptions of the soil units used on the soil map of the park. Each description includes information on parent materials, landform, topography, drainage, soil classification and vegetation, supplemental to that contained in the map legend. Also included is information on some of the more important soil qualities of each unit plus a reference to a more detailed soil description found in Appendix I. Analytical data for selected sampling sites are contained in Appendix II with engineering test data and soil fertility data found in Appendix III and IV respectively.

The letter symbols used for soil units are unique codes for the dominant soil(s) in each unit. Where only one symbol is found, the soils within that unit have developed on one parent material. Where two symbols are found, separated by a hyphen, the soils within that unit have developed on two different parent materials that form a complex grouping within the landscape. Each single or double symbol is followed by a number that identifies a particular soil grouping with the soil(s) identified by the symbol as the dominant member(s).

These letter symbols (Table 3) are shorthand notations for soil names that have been previously established for soils in Alberta and may be found in various reports of the Alberta Soil Survey.

Table 3. Letter symbols used for soil units in Elk Island National Park and the dominant soils they represent.

Symbol	Soil Name	Subgroup	Parent Material
COA	Cooking Lake	Orthic Gray Luvisol	glacial till
DST	Dnister	Gray Solodized Solonetz	glacial till
HDY	Hoadley	Dark Gray Luvisol	glaciofluvial sand over till
LTH	Leith	Dark Gray Luvisol	glaciofluvial sediments
MCO	Macola	Dark Gray Luvisol	glaciolacustrine sediments
MIQ	Miquelon	Orthic Gray Luvisol	glaciolacustrine sediments over till
MPV	Mapova	Humic Luvic Gleysol	glacial till
MYW	Maywood	Orthic Gray Luvisol	glaciolacustrine sediments
NC	Nicot	Eluviated Eutric Brunisol	glaciolacustrine sediments
SB	Stebbing	Typic Fibrisol	moss peat
SL	St. Lina	Terric Mesisol	sedge peat
SWY	Sawfy	Humic Luvic Gleysol	glaciolacustrine sediments
TYK	Tawayik	Dark Gray Luvisol	glaciolacustrine sediments over till
UCS	Uncas	Dark Gray Luvisol	glacial till

An identification key is included (Table 4) to identify the soil units in relation to the soil map and includes general information on soil classification, parent materials, soil horizons and other features considered in the delineation and naming of soil units.

The descriptions of the soil units indicate that the soils of Elk Island National Park possess a range of soil characteristics that affect soil quality, soil characteristics referring to physical and chemical properties such as particle size, structure, acidity and amount of lime and organic matter. Soil quality refers to soil properties that result from combinations of these characteristics such as permeability and erodibility. Variability in soil characteristics and soil quality is mainly the result of variability in parent materials.

Soil Unit COA 2: (Orthic Gray Luvisol)

This soil unit consists of a catenary sequence of soils developed on medium to moderately fine textured till. The landform is dominantly ridged moraine although there are isolated areas where the landform varies to either subdued undulating moraine or to hummocky moraine. Slopes generally range from 7 to 15 percent. Well to moderately well drained Orthic Gray Luvisol soils (Appendix I-1) are dominant and occupy middle and upper slope positions, imperfectly drained Gleyed Gray Luvisol soils are found on lower slope position, and poorly drained Humic Luvic Gleysol soils (Appendix I-6) are found in depressional and interridge areas (Figure 11). A generalized description of the Orthic Gray Luvisol soil developed on till follows:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	5-0	black, relatively undecomposed leaf litter		
Ae	0-12	light brownish gray	loam	strongly acid
AB	12-20	yellowish brown	silt loam	medium acid
Bt	20-60	brown	clay loam	slightly acid
BC	60-77	yellowish brown	loam	neutral
Ck	77-98+	yellowish brown	loam	mildly alkaline

The imperfectly drained soils of this unit have the same horizonation as the better drained soils with the exception that a thin Ah horizon, 1 to 3 cm thick, is often found between the LF and Ae horizons. In addition the imperfectly drained soils exhibit distinct yellowish-red mottling throughout the profile. The depth to free carbonates in both the well and imperfectly drained soils is usually between 75 and 95 cm although the total amount of calcium carbonate is generally low. The

Table 4. Key to the major characteristics of the soil units mapped in Elk Island National Park

SOIL UNIT	PARENT MATERIAL(s)	SUBGROUP CLASSIFICATION	MAJOR HORIZONS	VEGETATION	OTHER FEATURES
COA 2	glacial till	Orthic Gray Luvisol	LF, Ae, Bt, Ck	dense aspen with dense shrub layer	catenary sequence of soils, soils dominantly well drained
COA 3	glacial till	Orthic Gray Luvisol Humic Luvic Gleysol	LF, Ae, Bt, Ck LF, Ah, Aeg, Btg, Ckg	dense aspen with dense shrub layer	as COA2 with significant proportion of poorly drained soils
COA 4	glacial till	Orthic Gray Luvisol Dark Gray Luvisol	LF, Ae, Bt, Ck LF, Ah, Ae, Bt, Ck	aspen less dense than in COA 2	as COA 2 but with variable thickness of Ah horizon
COA 6	glacial till, < 30 cm of glaciofluvial veneer	Orthic Gray Luvisol Dark Gray Luvisol	as above	as above	as above; Ah and Ae horizons developed in coarse textured veneer
(COA-HDY) 1	glacial till, glaciofluvial veneer up to 100 cm thick	Orthic Gray Luvisol Dark Gray Luvisol	LF, Ae, Bt, IIBt, IICk LF, Ah, Bt, IIBt, IICk	as above, isolated clumps of white birch and white spruce	A and B horizons developed in veneer, Bt horizons banded
(COA-HDY) 3	as above	as above Humic Luvic Gleysol	as above Ah, Aeg, Btg, IICg	as above willows	as above; significant proportion of poorly drained soils
(COA-NC) 1	glacial till with veneer or blanket of coarse textured ice contact stratified drift	Orthic Gray Luvisol Eluviated Eutric Brunisol	LF, Ae, Bt, (II)Ck LF, Ae, Bm, C	aspen with clumps of white birch and small stands of white spruce	A and B horizons of Luvisols often developed in coarse textured veneer
DST 4	glacial till	Gray Solodized Solonetz Rego Gleysol, saline	Ah, Ae, Bnt, Cksa Cksa	grasses, clover, sage alkali grass	the soap-holes area the soap-holes
HDY 2	glacial till, up to 50 cm of glaciofluvial veneer	Orthic Gray Luvisol Brunisolic Gray Luvisol	Lf, Ae, Bt, (II)Ck Lf, Ae, Bm, Bt, (II)Ck	white spruce, open shrub layer	A and B horizons usually developed in coarse textured veneer
MCO 3	glaciolacustrine sediments	Dark Gray Luvisol	Ap, Ae, Bt, Ck	tame grasses and legumes	in cultivated areas only, Ae horizon often intermittent
(MIQ-COA) 2	glacial till with variable thickness of glaciolacustrine veneer	Orthic Gray Luvisol Dark Gray Luvisol	LF, Ae, Bt, (II)Ck LF, Ah, Ae, Bt, (II)Ck	aspen with dense shrub layer	A and B horizons usually in glaciolacustrine veneer
(MIQ-COA) 3	as above	as above Humic Luvic Gleysol	as above Ah, Aeg, Btg, (II)Ckg	as above with willows and balsam poplar on wetter sites	as above, significant proportion of poorly drained soils
MPV 3	glacial till	Humic Luvic Gleysol Terric Mesisol Gleyed Gray Luvisol	Ah, Aeg, Btg, Ckg Om1, Om2, Cg LF, Aeg, Btg, Ckg	aspen, willows shrubs willows, sedges aspen, shrubs	subdued topography, dominantly poorly drained soils
MYW 3	glaciolacustrine sediments	Orthic Gray Luvisol Dark Gray Luvisol	LF, Ae, Bt, Ck(g) LF, Ah, Ae, Bt, Ck(g)	dense stands of aspen with dense shrub layer	glaciolacustrine sediments may be varved, aspen generally not as tall as on till units (Coa 4)
(NC-COA) 1	glacial till with a veneer or blanket of coarse textured ice contact stratified drift	Eluviated Eutric Brunisol Orthic Gray Luvisol	LF, Ae, Bm, Ck LF, Ae, Bt, Ck	aspen, white birch and white spruce; dense shrub layer under aspen	similar to unit (COA-NC) 1 except here the deep sandy soils more prevalent
S8 1	moss peat	Typic Fibrisol Mesic Fibrisol	Of1, Of2, Of3 Of1, Of2, Om	mosses, Labrador tea variable amounts of black spruce	bog areas with relatively deep moss peat
S8 2	moss and fen peats			as above with willows and sedges on fen peat	bog areas with inclusions of fen peat

(cont.....)

Table 4. (continued)

SOIL UNIT	PARENT MATERIAL(s)	SUBGROUP CLASSIFICATION	MAJOR HORIZONS	VEGETATION	OTHER FEATURES
SL3	fen peat			sedges, grasses, willows	open wetlands, occur as depressions or low areas for surface drainage
SL4	fen peat	Terric Mesisol Typic Mesisol Humic Gleysol, peaty	Om1, Om2, Cg Om1, Om2, Om3 Om1, Ah, Cg	sedges, willow, alder	shrubby wetlands, occur as depressions or low areas for surface drainage
SL5	fen peat	Terric Mesisol Rego Gleysol, peaty	Om1, Om2, Cg Om1, Cg	*cattails, sedges*	*marshy areas around water bodies*
SL6	fen peat with inclusions of moss peat	Terric Mesisol Typic Mesisol Terric Mesic Fibrisol	Om1, Om2, Cg Om1, Om2, Om3 Of, Om, Cg	sedges and willows on fens with isolated areas of mosses, Labrador tea and black spruce	as unit SB 2 only fen peat is dominant
SWY4	glaciolacustrine sediments often overlain with sedge peat	Humic Luvic Gleysol Terric Mesisol Humic Gleysol, peaty	Ah, Ae, Btg, Cg Om, Cg Om, Ah, Cg	aspen, willow, sedges, grasses	poorly drained areas, aspen short and open
(TYK-UCS)2	glacial till with a veneer of glaciolacustrine sediments	Dark Gray Luvisol Orthic Gray Luvisol	Ah, Ae, Bt, (II)Ck Lf, Ae, Bt, (II)Ck	open aspen, dense shrub layer, frequent shrub and grass covered slopes	similar to unit (MIQ-COA)2 only Dark Gray Luvisol soils dominant and aspen more open
(TYK-UCS)3	as above	as above Humic Luvic Gleysol	as above Ah, Aeg, Btg, Ckg	as above willows, shrubs, aspen	as above, significant proportion of poorly drained soils
UCS3	glacial till	Dark Gray Luvisol Humic Luvic Gleysol Terric Mesisol	Ah, Ae, Bt, Ck Ah, Aeg, Btg, Ckg Om, Cg	open aspen, many grass and shrub covered slopes, sedges and willows	similar to unit COA 3 only aspen more open and many open slopes
UCS4	glacial till	Dark Gray Luvisol Orthic Gray Luvisol	Ah, Ae, Bt, Ck LF, Ae, Bt, Ck	open aspen, dense shrub layer, many grass and shrub covered south facing slopes	*soil-landscape relationships similar to COA 4 only* Dark Gray Luvisols dominant
UCS5	glacial till	Dark Gray Luvisol Humic Luvic Gleysol	Ah, Ahe, Ae, Bt, Ck Ah, Aeg, Btg, Ckg	open grass and shrub covered slopes, open aspen	differs from UCS 3 and 4 in that Ah horizon thickness greater, many open grass covered slopes, significant proportion of poorly drained soils
UCS6	*glacial till, often thin (< 30 cm)* glaciofluvial veneer	Dark Gray Luvisol	Ah, Ahe, Ae, Bt, Ck	as above	similar to UCS 5 but minor proportion of poorly drained soils
UCS8	*glacial till*	Dark Gray Luvisol	Ap, Ae, Bt, Ck	cultivated areas, tame grass	similar to MCO 3 only material is glacial till
(UCS-LTH)2	glacial till with veneer of glaciofluvial sediments	Dark Gray Luvisol	Ap, Ae, Bt, (II)Ck	cultivated areas, tame grass	similar to (COA-HDY)1 but areas are cultivated
(UCS-MCO)2	glacial till with variable thickness of glaciolacustrine veneer	Dark Gray Luvisol	Ap, Ae, Bt, (II)Ck	cultivated areas, tame grass	similar to UCS 8 and MCO 3
(UCS-TYK) 2	glacial till with variable thickness of glaciolacustrine veneer	Dark Gray Luvisol Orthic Gray Luvisol	Ah, Ae, Bt, (II)Ck LF, Ae, Bt, (II)Ck	open aspen with dense shrub layer and open grass and shrub covered slopes	similar to (COA-MIQ)2 only Dark Gray Luvisol soils are dominant

Figure 11. Vegetation and landscape of Soil Unit COA2.

Figure 12. Orthic Gray Luvisol soil developed on glacial till of Soil Unit COA2.

poorly drained Humic Luvic Gleysol soils, as described under Soil Unit MPV3, are usually well leached and free carbonate are seldom found within 100 cm of the surface.

Vegetation is dominantly tall, dense, trembling aspen with a dense understory of shrubs including wild rose, beaked hazelnut, saskatoon and chokecherry. In the poorly drained inter-ridge areas the trembling aspen and understory are less dense and willows are commonly found. The occasional Balsam poplar is also found on these wetter sites.

This unit is located in scattered areas within the park on which the 1924 aerial photographs revealed the presence of aspen stands while surrounding areas were shrub and grass covered. Areas of this unit are found along the south park boundary, northwest of the Bailey Lakes, immediately west of Tawayik Lake and northwest of the "soap holes" area.

Although this soils of this unit exhibit well developed Bt horizons (Figure 12), the result of downward movement and leaching of clays, the structure of the B horizons is well defined with numerous cracks for water and root movement. The surface mineral soil contains relatively low amounts of organic matter and this combined with the loam to silt loam texture and platy structure produces a moderate water erosion hazard where the slopes range from 5 to 9 percent. A low water erosion hazard exists where slopes are less than 5 percent and a high water erosion hazard exists where slopes are greater than 9 percent.

This unit represents the central concept of Orthic Gray Luvisol soils developed on till within the park. Other soil units have been defined on the basis of how they differ from this central concept. For example, Soil Unit COA 3 is very similar to this unit except that the former includes a significant proportion of poorly drained soils. Soil Unit COA 4 includes Dark Gray Luvisol soils developed on till, and the soils of Soil Unit COA 6 have developed in similar till materials but with a thin veneer of sandy material at the surface.

Soil Unit COA 3: (Orthic Gray Luvisol - Humic Luvic Gleysol)

This soil unit consists of a catenary sequence of soils developed on medium to moderately fine textured glacial till in a ridged moraine landform, similar to Soil Unit COA 2. However, the poorly drained soils of the depressional and inter-ridge areas occupy a significant proportion of the landscape, unlike those in Soil Unit COA 2. In addition, ridges in this unit are generally not as high as those in the previous unit although the slopes do range from 5 to 15 percent. The well do moderately well drained Orthic Gray Luvisol soils (Appendix I-1) are dominant and occupy middle and upper slope positions with imperfectly drained Gleyed Gray Luvisol soils on lower slopes and poorly

drained Humic Luvic Gleysol soils (Appendix I-6) in depressional and inter-ridge areas.

The well drained soils have been brie fly described under Soil Unit COA 2. The imperfectly drained soils often exhibit a thin Ah surface horizon I to 3 cm thick which is usually not found in the well drained soils of this unit. The imperfectly drained soils also possess distinct yellowish-red mottling throughout the soil profile. The depth to free carbonates in both the well and imperfectly drained soils is usually between 75 and 100 cm although the total carbonate content is relatively low at this depth. The poorly drained Humic Luvic Gleysol soils, described briefly under Soil Unit MPV 3, are well leached and free carbonates are seldom found within 100 cm of the surface.

Vegetation is dominantly tall, dense, trembling aspen with a dense understory of wild rose, beaked hazelnut and saskatoon. The occasional Balsam poplar is found along with willows in the poorly drained areas.

Major areas of this unit are located along the west park boundary north of Highway #16, around Flyingshot Lake, and along the south park boundary. As with Soil Unit COA 2, the soils of this unit exhibit well developed, blocky and subangular blocky, Bt horizons, the result of downward movement and leaching of clays. The well defined structure provides many cracks for water and root movement. However, the low amounts of organic matter in the mineral surface soil combined with the loam to silt loam texture and platy structure of this surface soil produce a water erosion hazard that increases with slope gradient from low where slopes are less than 5 percent, to moderate where slopes exceed 9 percent. The significant proportion of poorly drained soils in this unit also place some limitation on this unit for uses that require the traversing of a soil unit (ie: hiking trails).

Soil Unit COA 4: (Orthic Gray Luvisol - Dark Gray Luvisol)

The soils of this unit have developed on medium to moderately fine textured till dominantly in a ridged moraine landform although in certain areas the landform is either undulating moraine or hummocky moraine. Slopes range from 7 to 15 percent. Well to moderately well drained Orthic and Dark Gray Luvisol soils (Appendix I-1 and 2 respectively) are found on the middle and upper slope positions, imperfectly drained Gleyed Gray Luvisol soils on the lower slopes and Humic Luvic Gleysol soils (Appendix I-6) in depressional and inter-ridge areas within the landscape. The soil-landscape relationships are similar to those of Soil Unit COA 2 (Figure II). However, in this unit the well to moderately well drained soils have Ah surface horizons which vary in thickness from 2 to 6 cm. Generally the Ah horizons are less than 5 cm thick, thus the Orthic Gray Luvisol soils are

dominant, although a significant proportion of the soils have Ah horizons greater than 5 cm thick (Figure 13).

The soils and soil-landscape relationships of this unit can also be compared to those for Soil Unit COA 6. In Soil Unit COA 6 a thin veneer of sandier material is found overlying the till. This material affects water infiltration rates and other soil qualities to the extent that soil use interpretations are different for the two units. For this reason and the fact that they occupy a significant proporation of the park area, those soils with the sandy veneer over the till have been separated as a different unit, Soil Unit COA 6.

A generalized description of the Orthic Gray Luvisol soil developed on glacial till and dominant in Soil Unit COA 4 follows:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	6-0	black, relatively undecomposed leaf litter		
Ah	0-3	very dark grayish brown	silt loam	strongly acid
Ae	3-13	pale brown	silt loam	strongly acid
Bt	13-80	dark grayish brown	clay loam	medium acid
BC	80-100	dark brown	clay loam	slightly acid
Ck	100-116+	brown	loam	mildly alkaline

The imperfectly drained soils also have thin Ah horizons but exhibit distinct yellowish-red mottling throughout the soil profile. As with the soils developed on till in other units, the till soils of this unit usually have relatively low amounts of calcium carbonate within 100 cm of the surface. The poorly drained soils of this unit are also well leached and free carbonates are seldom found within 100 cm of the surface.

The vegetation is dominantly trembling aspen with an understory of wild rose, beaked hazelnut and saskatoon. The trees on this unit are not as dense or as tall as those on Soil Unit COA 2. Also in this unit, grasses are often found as ground cover on many of the south facing slopes. The occasional Balsam poplar and willow are found in the poorly drained areas.

This unit is found throughout the southern half of the park. As with the other Luvisolic soils developed on till, the well developed Bt horizons containing accumulated clay have well defined, blocky and subangular blocky structure with many cracks for water and root movement. Although the thin Ah horizons at the surface

Figure 13. Dark Gray Luvisol soil developed on glacial till of Soil Unit COA4.

contain more organic matter than the surfaces of the soils in units COA 2 and COA 3, the underlying Ae horizons are low in organic matter, relatively high in silt sized particles and exhibit very platy structure. Therefore, the water erosion hazard for this unit is similar to that for units COA 2 and COA 3. That is, the hazard is low if slopes are less than 5 percent, moderate for slopes from 5 to 9 percent, and high for slopes greater than 9 percent.

Soil Unit COA 6: (Orthic Gray Luvisol - Dark Gray Luvisol)

The soils of this unit have developed on medium to moderately fine textured till in a ridged moraine landform, with the ridges often having a circular configuration (ie: prairie mounds). In some areas this unit is also found in a hummocky moraine landform. Generally, slopes range from 8 to 15 percent. Although the soil subgroups and soil landscape relationships in this unit are similar to those of Soil Unit COA 4, this unit differs in that a thin veneer, usually less than 30 cm thick, of glaciofluvial and/or eolian sand is generally found overlying the till. The well to moderately well drained Orthic and Dark Gray Luvisol soils (Appendix I-5 and 4 respectively) occupy the middle and upper slope positions. These soils have Ah horizons which vary in thickness from 2 to 6 cm with the majority of the soils having Ah horizons less than 5 cm thick. Therefore the Orthic Gray Luvisol soils are dominant (Figure 14). Imperfectly drained Gleyed Gray Luvisol soils are found on lower slopes and poorly drained Humic Luvic Gleysol soils (Appendix I-6) developed on till and very poorly drained Terric Mesisol soils (Appendix I-22) developed in shallow fen peat are found in depressional and lowlying areas between ridges as well as in small depressions formed by the closure of the circular ridges (Figure 15). A generalized description of the Orthic Gray Luvisol soils dominant in this unit follows:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	4-0	black, relatively undecomposed leaf litter		
Ah	0-3	very dark grayish brown	sandy loam	medium acid
Ae	3-15	light gray	sandy loam	medium acid
AB	15-22	yellowish brown	sandy clay loam	medium acid
IIBt	22-65	dark brown	clay loam	medium acid
IIBC	65-90	brown	clay loam	slightly acid
IICk	90-110+	yellowish brown	loam	mildly alkaline

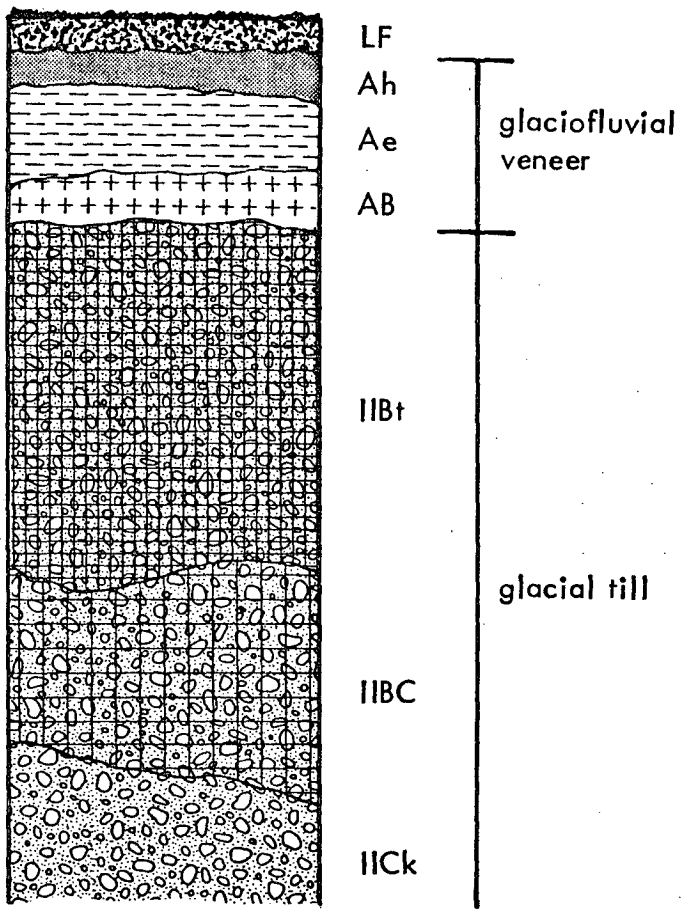


Figure 14. Sketch of the Orthic Gray Luvisol soil developed on glacial till with a thin veneer of glaciofluvial and/or eolian sand.

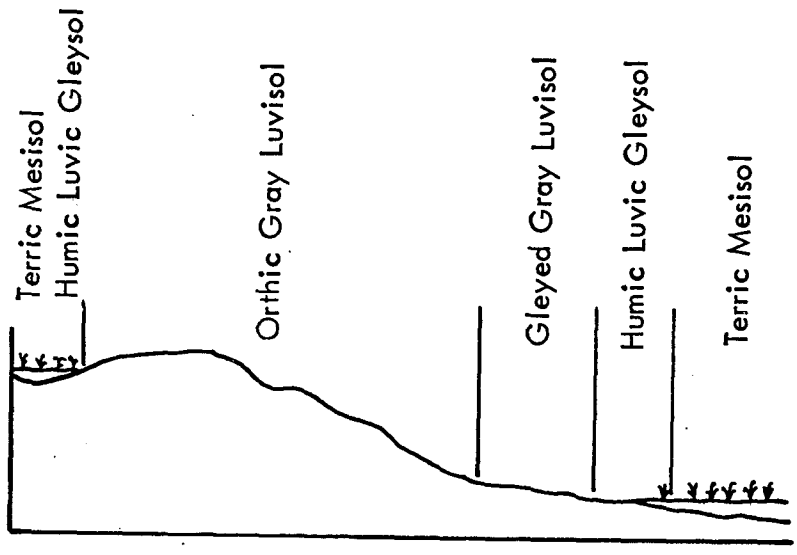


Figure 15. Sketch of the soil-landscape relationships of Soil Unit COA6.

Figure 16. Vegetation of Soil Unit COA6; open aspen with dense shrub layer.

As with other soils developed on till in the park the amount of free carbonates is relatively low. In this unit, Ah and Ae horizons have developed in the sandier veneer. Where the veneer is thicker and B horizons have developed in it, Soil Units (COA-HDY) 1 and (COA-HDY) 3 have been mapped. The textural discontinuity at a depth of 20 to 30 cm affect the downward movement of water. On slopes, much of the infiltrating water meeting this discontinuity probably moves laterally downslope. Although the Bt horizons developed in the till are usually well structured, with cracks for water and root penetration, in level locations downward moving water may be perched at the discontinuity since the infiltration rate through the till is not as great as it is for the sandy veneer.

Vegetation is dominantly trembling aspen with a dense shrub layer of wild rose and beaked hazelnut. The aspen cover is not as dense as in Soil Unit COA 2 and in many areas, especially south facing slopes, grasses are the dominant ground cover beneath the trees and intermixed with the shrubs (Figure 16).

The soils of this unit, excluding those that are poorly and very poorly drained, have slight to moderate limitations for most uses although steep slopes in scattered areas would impose more severe limitations for some uses. The water erosion hazard is not as great as it is for other COA units due to the sandy loam texture of the surface and the higher organic matter content of the Ah horizons. For this unit, the water erosion hazard has been rated as low for slopes up to 9 percent and moderate for slopes from 9 to 15 percent.

Extensive areas of this unit are found northeast and southeast of Astotin Lake.

Soil Unit (COA-HDY) 1: (Orthic Gray Luvisol - Dark Gray Luvisol)

The soils of this unit are dominantly well drained and have developed on a complex association of parent materials, generally medium to moderately fine textured glacial till with a veneer of coarse textured glaciofluvial and/or eolian sediments up to 100 cm thick. The veneer is often thickest at higher elevations, as if the veneer were the result of infilling of cracks in the glacial ice by sediments deposited by superglacial meltwaters. The landform is ridged to hummocky moraine with slope gradients from 6 to 15 percent.

The soil subgroup-landscape relationships of this unit are similar to those of Soil Units COA 4 and COA 6. Where the till occurs at or near the ground surface (less than 30 cm of coarse textured veneer) the soils resemble those of Soil Unit COA 6 (Appendix 1-5 and 4) described previously. Where the coarse textured veneer is thicker than 100 cm, Eluviated Eutric Brunisol soils have often developed (Appendix 1-15) and the soils resemble those described under Soil Unit (COA-NC) 1. In this unit, the dominant case is where the

veneer in which Ah and Ae horizons have developed is less than 30 cm thick. There are also significant areas where the veneer is up to 100 cm thick and Ah, Ae and Bt horizons have developed in the sandy material (Figure 17). Gleyed Gray Luvisols developed in similar materials occupy lower slope positions and poorly drained Humic Luvic Gleysol soils and very poorly drained Terric Mesisol soils occupy lowlying and depressional areas between ridges. The latter soils comprise a minor component in this unit.

The Orthic Gray Luvisol soil developed on glacial till with less than 30 cm of coarse textured veneer is described in general under Soil Unit COA 6 and in detail in Appendix I-5. A generalized description of the Orthic Gray Luvisol soil developed on glacial till with up to 100 cm of glaciofluvial and/or eolian veneer follows, with a detailed description found in Appendix I-18:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	5-0	black, respectively undecomposed leaf litter		
Ah	0-2	very dark gray	loamy sand	medium acid
Ae	2-15	light gray	loamy sand	strongly acid
Bt	15-40	light gray	sandy loam	medium acid
		dark brown	sandy clay loam	medium acid
IIBt	40-70	very dark grayish brown	clay loam	medium acid
IIBC	70-95	yellowish brown	loam	slightly acid
IICk	95-110+	yellowish brown	loam	mildly alkaline

The Bt horizons developed in the sandy veneer occur as bands of dark brown sandy clay loam in a matrix of light gray sandy loam. Each band is approximately 4 cm thick with an equal thickness of matrix separating them. In areas where the textural discontinuity occurs at depths approaching 100 cm, the II Bt horizons, developed in the till, are generally absent.

This unit is found in large areas north of an east-west line through Moss Lake. In the area north and northeast of Astotin Lake, the vegetation is dominantly trembling aspen with a dense understory of wild rose, beaked hazelnut and wild red raspberry (Figure 18). Isolated clumps of white birch also occur in these areas. In the northeast corner of the park this unit is also found under more open trembling aspen with a significant proportion of balsam poplar. Where the forest cover is more open, grasses are found as ground cover intermixed with the shrubs, and many small grass and shrub covered clearings occur, especially on south facing

Figure 17. Orthic Gray Luvisol soil developed on glacial till with a veneer of coarse textured glaciofluvial and/or eolian sediments of variable thickness.

Figure 18. Open aspen with a dense shrub layer of Soil Unit (COA-HDY)1 east of Astotin Lake.

slopes. Along the north boundary in the area of the 1950 fire, this unit is found under open trembling aspen with a dense shrub cover and grasses. In this area the Dark Gray Luvisol soils are more common than in other areas of this unit. South of Astotin Lake and on the larger islands in Astotin Lake, a few isolated stands of white spruce are found, presumably remnants of the original forest before the 1895 fires (Figure 19).

The major limiting factor to the use of the soils in this unit is the surface texture. The loamy sand textured surface material has little binding clay or organic matter to keep the soil mass together should it be exposed. Surface infiltration rates are generally high where the veneer is thickest. The water erosion hazard is considered to be moderate for slopes up to 15 percent. However, there is some variability to the degree of hazard due to the variability in thickness of the sandy veneer.

Soil Unit (COA-HDY) 3: (Orthic Gray Luvisol - Dark Gray Luvisol and Humic Luvic Gleysol)

The soils of this unit are dominantly well drained and have developed on medium to moderately fine textured glacial till with a veneer of coarse textured glaciofluvial and/or eolian sediments up to 100 cm thick. The landform consists of till ridges and knobs with slopes from 8 to 16 percent surrounded by undulating poorly drained areas with slopes ranging from 1 to 3 percent. The well to moderately well drained Orthic and Dark Gray Luvisol soils occupy the till ridges and knobs and are similar to those of Soil Unit (COA-HDY) 1. The major difference between this unit and Soil Unit (COA-HDY) 1 is that in this case, a significant proportion of the soils are poorly drained Humic Luvic Gleysols (Appendix I - 6 and 16). Gleyed Gray and Gleyed Dark Gray Luvisols occupy lower slope positions and very poorly drained Terric Mesisols (Appendix I-22) have developed on sedge peat in depressional areas.

The Orthic and Dark Gray Luvisol soils of this unit have been described briefly under Soil Unit (COA-HDY) 1. The following is a generalized description of the Humic Luvic Gleysol soil of this unit, developed on glacial till with a veneer of coarse textured glaciofluvial sediments.

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
Ah	0-23	very dark gray	loamy sand	slightly acid
Aeg	23-30	gray	loamy sand	medium acid
Btg	30-55	gray	sandy loam	medium acid
		dark gray	sandy clay loam	medium acid
BCg	55-70	gray	loamy sand	slightly acid
IICg	70-95	very dark grey loam		neutral

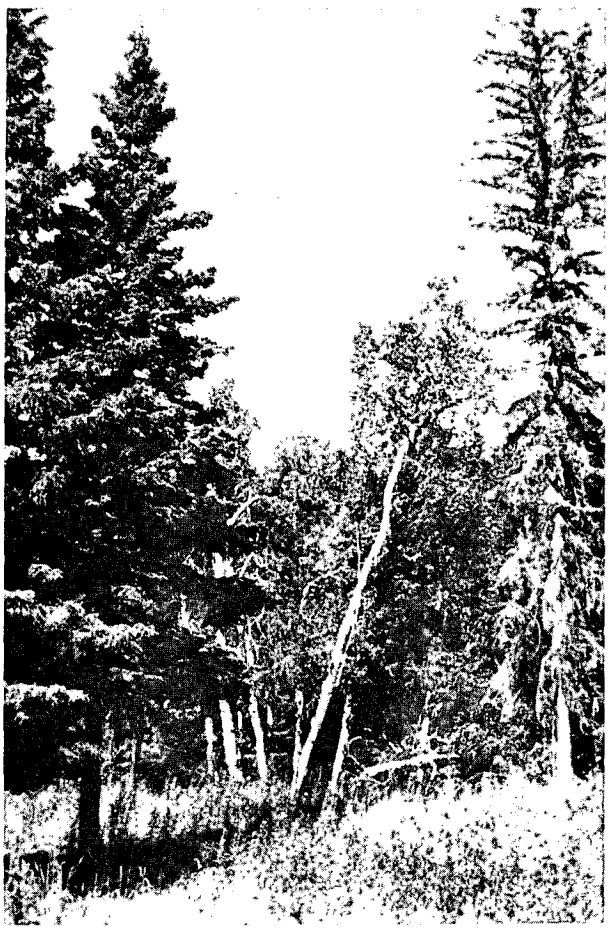


Figure 19. Vegetative cover of Soil Unit (COA-HDY)1 on Elk Island.

Distinct and prominant yellowish red and strong brown mottles occur throughout the solum. The Bt horizon consists of bands of sandy clay loam in a matrix of sandy loam. The fine textured bands are usually 2 to 3 cm thick and separated by an equal thickness of matrix.

Vegetation on this unit is primarily trembling aspen with inclusions of white birch, and dense shrub cover of wild rose, beaked hazelnut and wild red raspberry on the till ridges and knobs. In the poorly drained areas the vegetation includes trembling aspen, balsam poplar, and white birch, with wild rose, beaked hazelnut and willows as shrub cover. This unit is found immediately north of Astotin Lake.

The major limitation for this unit is the significant proportion of poorly drained soils which could affect uses which require the traversing of relatively large areas (ie. hiking trails). The well drained portions of this unit have limitations similar to Soil Unit (COA-HDY) 1.

Soil Unit (COA-NC) 1: (Orthic Gray Luvisol - Eluviated Eutric Brunisol)

The soils of this unit are dominantly well drained and have developed on a complex association of medium to moderately fine textured glacial till with a veneer or blanket of coarse textured ice contact stratified drift of variable thickness. The landform varies from ridged to hummocky moraine with slopes ranging from 10 - 25 percent. Although the percentage of coarse fragments in the till is generally low, in the hummocky area east of Moss Lake the till material contains a relatively high proportion of stones and boulders (Figure 20). It is often difficult to delineate the boundary between till and deep glaciofluvial deposits since the change in materials is often not coincident with a change in topography. Also, the infilling of dilation cracks in the till with coarse textured material can produce small, isolated areas of sand in the till landscape (see Figure 4).

The dominant soils of this unit are Orthic Gray Luvisols. These have developed on glacial till with a veneer of glaciofluvial sediments and resemble those of Soil Unit (COA-HDY) 1. A significant proportion of the soils of this unit are Eluviated Eutric Brunisols (Appendix I-15) that have developed on deep glaciofluvial sediments. It is this significant proportion of Eluviated Eutric Brunisol soils (Figure 21) that differentiates this unit from Soil Unit (COA-HDY)1. These better drained soils are found on the ridges in the areas of this unit. A minor component of this unit is comprised of poorly drained Humic Luvic Gleysol soils as described in Soil Unit (COA-HDY) 3 and very poorly drained Terric Mesisol soils developed on sedge peat. Both occupy lowlying and depressional areas in the landscape.

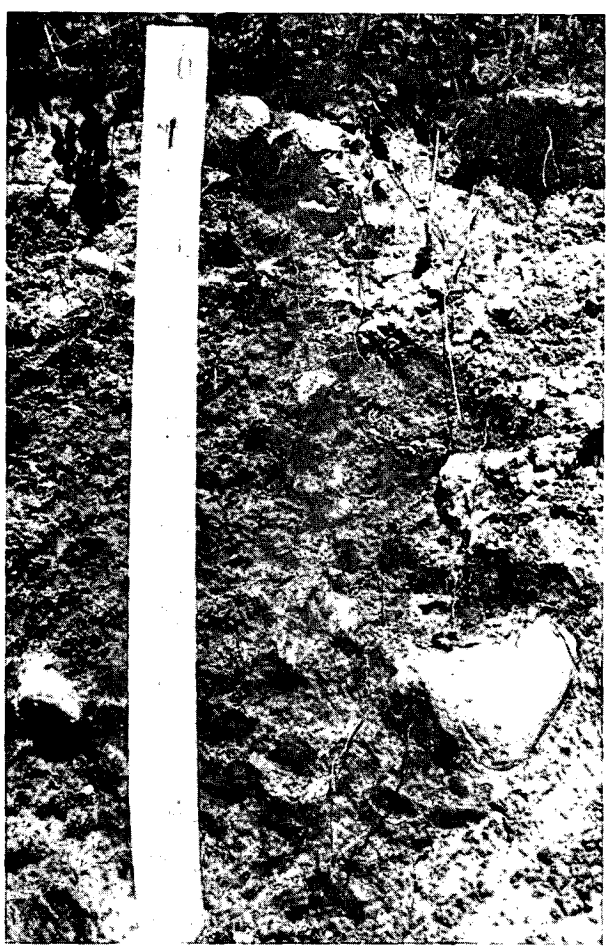


Figure 20. Bouldery glacial till (above) found on the east side of the Park and the Orthic Gray Luvisol soil (left) that has developed on it.

Figure 21. Eluviated Eutric Brunisol soil developed on coarse textured glaciofluvial sediments underlain by glacial till. Knife indicates the sand-till contact.

Since the Orthic Gray Luvisol soils of this unit have been described previously under Soil Units COA 6 and (COA-HDY) 1, the following is a brief description of a Eluviated Eutric Brunisol of this unit developed on deep glaciofluvial sediments:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	7-0	black, relatively undecomposed leaf litter		
Ae	0-6	gray	loamy sand	strongly acid
Bm1	6-20	brown	loamy sand	medium acid
Bm2	20-60	yellowish brown	loamy sand	medium acid
Bm3	60-100	brownish yellow	loamy coarse sand	slightly acid
BC	100-120	pale brown	loamy fine sand	slightly acid
Ck	120-140+	light yellowish brown	coarse sand	mildly alkaline

Vegetation on the ridges is generally trembling aspen with isolated clumps of white birch and a dense shrub layer of wild rose, beaked hazelnut and wild red raspberry. The vegetation in the poorly drained areas includes trembling aspen, white birch, wild rose and willows, and also sedges in the very poorly drained areas. In a few isolated areas, small stands of white spruce are found and under these, Brunisolic Gray Luvisol soils have developed, similar to those of Soil Unit HDY 2 (Appendix I-17).

The major area of this unit is southeast of Astotin Lake extending to the east park boundary. Other areas are found in portions of the park south of Highway #16.

The major limitation to use of the soils in this unit is slope since gradients range from 10 to 25 percent. Surface stones and bounders in the till along the east park boundary may also limit certain uses in that area. The loose nature of the glaciofluvial sediments and the absence of binding material could pose problems with soil movement if the vegetation were to be removed. In most areas of this unit the water erosion hazard is moderate. However, this rating is variable depending on slope gradient and the thickness of the coarse textured veneer over the till.

Soil Unit DST 4: (Gray Solodized Solonetz - Rego Gleysol, saline, carbonated and Solonetzic Gray Luvisol

This unit is found exclusively around and including the "soap holes" on the east side of the park. The soils have developed on moderately fine textured glacial till in an undulating moraine landform with slopes from 4 to 6 percent (Figure 22). Gray Solodized Solonetz soils are dominant and occupy the slope positions closest to the "soap holes". Further from the "soap holes" significant proportions of Solonetzic Gray Luvisol soils are found. Rego Gleysol soils occupy the "soap holes" themselves. This is the only known area in the park where groundwater discharge is occurring with the accumulation of soluble salts at the surface due to evaporation. During drier periods of the year, a thin dry crust forms over the "soap holes". However, during wetter periods, when groundwater discharge is at a maximum, a "quick" condition prevails in that the soil material has little or no bearing capacity, caused by the upward flow of water and a decrease in intergranular pressure. In other poorly drained areas of the park, groundwater recharge is occurring and soluble salts are not present in the solum, having been leached by the downward movement of water. Maclean (1974) discusses the relationships between groundwater and soil moisture regimes in relation to soil gensis.

The Gray Solodized Solonetz soil, dominant in this unit, is described in detail in Appendix I-7. The following is a brief description of this soil:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
Ah	0-4	black	loam	slightly acid
Ae	4-7	gray	loam	neutral
Bntk	7-22	dark grayish brown	clay loam	mildly alkaline
Cksa	22-36+	yellowish brown	loam	moderately alkaline

As seen by the above these soils are characterized by a very shallow solum, the depth to the C horizon usually being less than 25 cm, and a very strongly developed, though thin, Bnt horizon with round topped columnar structure (Figure 23). The extremely dense Bnt and Cksa horizons impede water and root movement. The Solonetzic Gray Luvisols differ in that the B horizons are not as dense, and have less sodium salts and more cracks for water and root penetration. Vegetation on the undulating moraine around the "soap holes" includes grasses, slender sage, feathery yarrow and clover. Further back from the soap holes where the sodium content of the soil is lower, stunted trembling aspen are found. The soap

Figure 22. Landform and vegetation in the area of the "soap holes"; Soil Unit DST4.

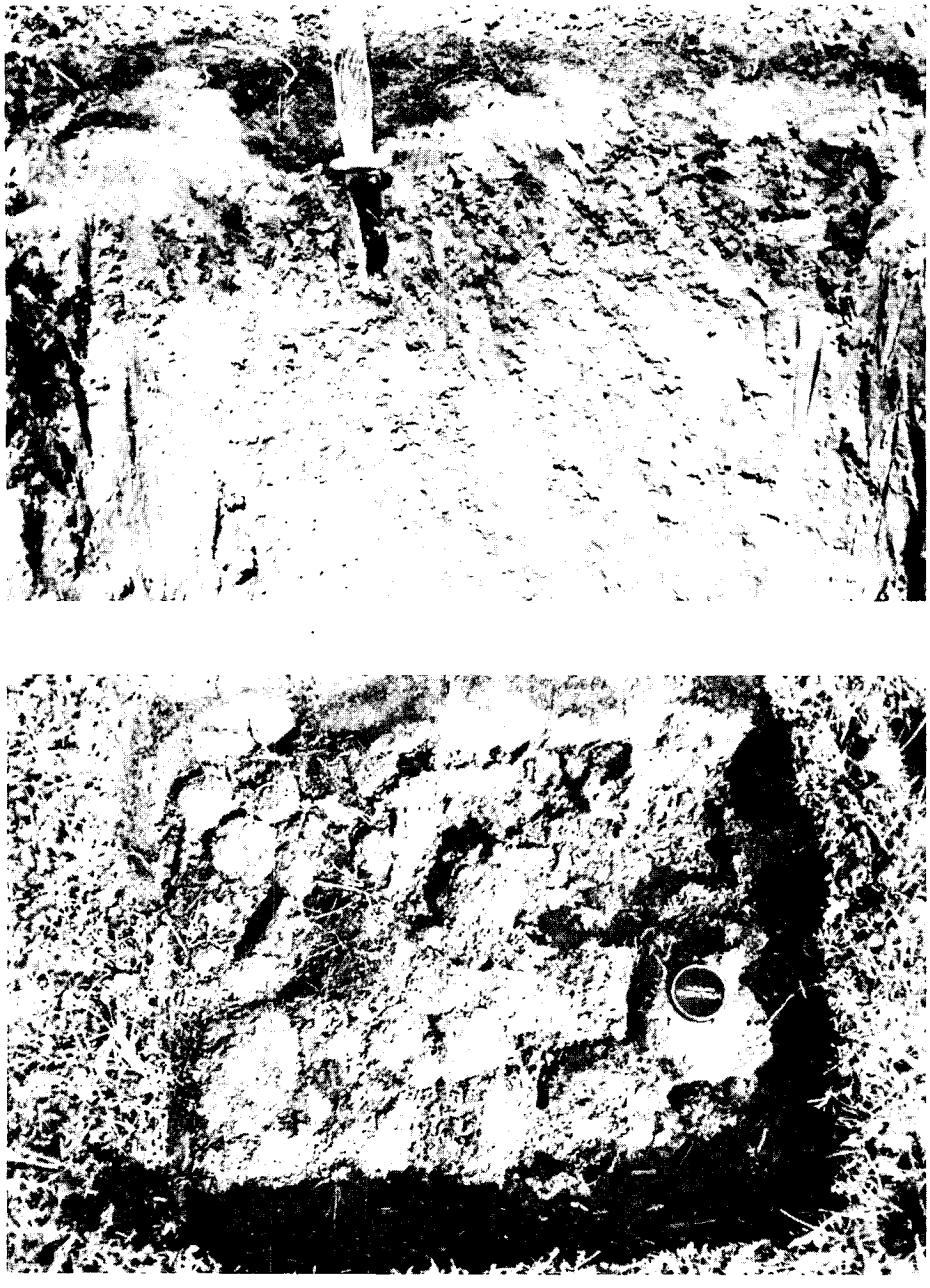


Figure 23. TOP: Soil profile of the Gray Solodized Solonetz soil of Soil Unit DST4.
BOTTOM: Vertical view of round-topped columns of the B horizon of the Gray Solodized Solonetz soils of Soil Unit DST4.

holes themselves are not vegetated except for a few isolated clumps of alkali grass. Soil salinity, through its corrosive effects, produces a limitation to the use of concrete foundations in this area. Although slope gradients are relatively low, infiltration rates are extremely low producing a moderate water erosion hazard for this unit.

Soil Unit HDY 2: (Orthic Gray Luvisol-Brunisolic Gray Luvisol)

The soils of this unit are dominantly well drained and have developed on medium textured glacial till with a veneer of coarse textured glaciofluvial sediments up to 50 cm thick. This unit is found exclusively on Lamont and Crane Islands in Astotin Lake, where the landform is undulating moraine with slopes from 2 to 8 percent.

The Orthic Gray Luvisol soils of this unit are similar to those of Soil Unit (COA-HDY) I that have developed a Bt horizon as bands of finer textured material in the coarse textured matrix of the glaciofluvial veneer. The unique feature of this unit is the occurrence of Brunisolic Gray Luvisol soils (Appendix I-17). These soils represent a further stage in podzolic development beyond that of the Gray Luvisols. Continued acidification of the surface soil has led to the translocation of organic matter, iron and aluminum out of the surface mineral soil to a slightly greater depth but still within the "old" Luvisolic Ae horizon (Figure 24). This has been facilitated by at least two conditions found on Lamont and Crane Islands. The sandy nature of the overlying glaciofluvial sediments allows for the rapid downward movement of water and the subsequent leaching of bases. Secondly, the vegetation on these islands consists almost entirely of white spruce with an open shrub layer of wild roses and wild red raspberry. A carpet of spruce needles covers the ground surface and provides a source of organic acids to increase the acidity of the mineral soil beneath. The following is a generalized description of the Brunisolic Gray Luvisol soil common to this unit:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	5-0	very dark brown layer of needles and twigs		
Ael	0-7	light gray	loamy sand	extremely acid
Bm	7-20	brown	loamy sand	very strongly acid
Ae2	20-24	gray	loamy sand	very strongly acid
Bt	24-35	dark yellowish brown	sandy clay loam	strongly acid
		yellowish brown	loamy sand	strongly acid

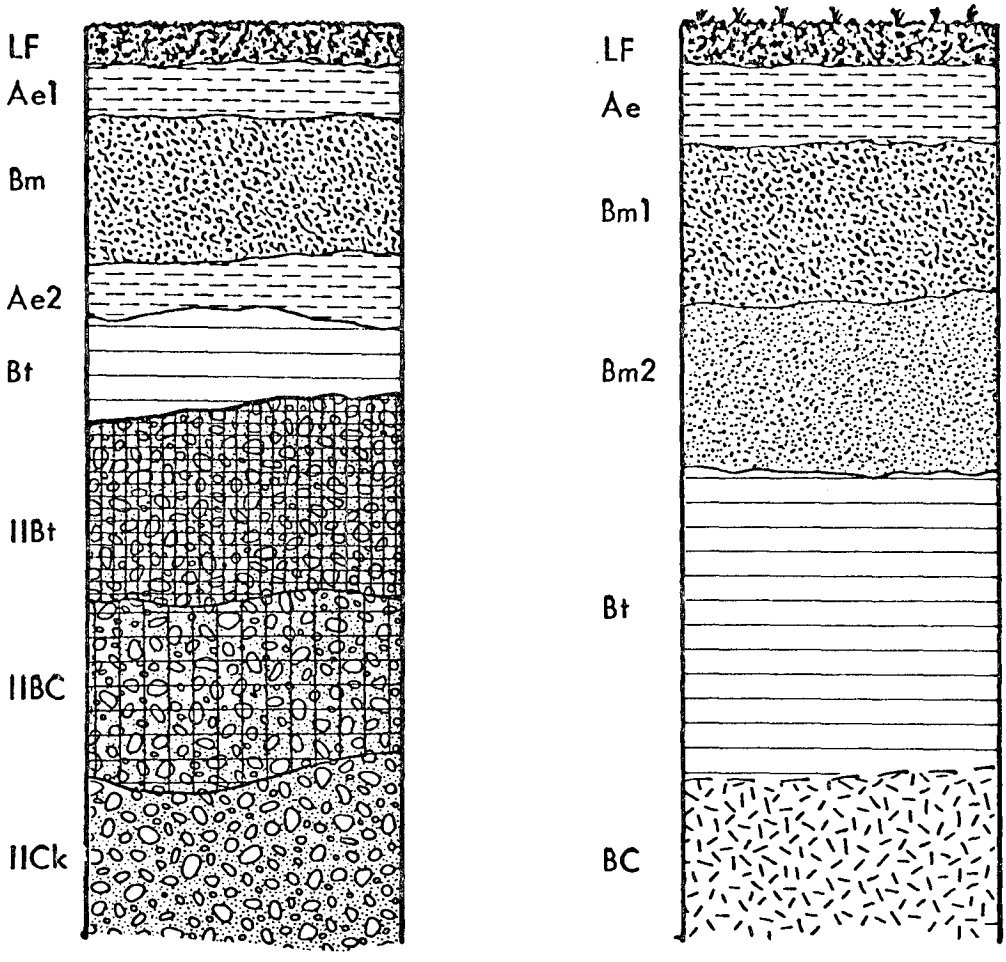


Figure 24. Sketches of the Brunisolic Gray Luvisol soils of Soil Unit HDY2 developed on glacial till with a veneer of coarse textured glaciofluvial sediments (left) and deep glaciofluvial sediments (right).

IIBt	35-80	dark gray	clay loam	medium acid
IIBC	80-100	dark grayish brown	clay loam	mildly alkaline

Similar soils are found in Soil Unit (COA-HDY) I and(COA-NC) I where the vegetation is dense white spruce and the soil materials are coarse textured sediments overthe till. Although it cannot be stated categorically that this kind of soil would occur throughout the park if it were not for the fire history of the area, it is probably that this kind of soil would have developed on most sand-over-till materials.

This unit has only slight limitations for park use. The soils are well drained, slope gradients are relatively low and surface soils are highly permeable. The relatively thick carpet of spruce needles and twigs covering the ground may present a fire hazard if camping and picnicing were to be allowed on these islands.

Soil Unit MCO 3: (cultivated Dark Gray Luvisol)

The soils of this unit are well to moderately well drained and have developed on fine textured glaciolacustrine sediments in an undulating landscape with slopes ranging from 2 to 5 percent. This soil unit has been used exclusively for areas that have been cultivated in the past, and that at present remain under grass-legume vegetation. It is found immediately southwest of Oster Lake (Figure 25) and on the east side of the park just north of Highway #16. The soils are Dark Gray Luvisols (Appendix I-10) in which cultural practices have lead to the formation of relatively deep, organic rich Ap horizons at the surface (Figure 26). If it were not for the continued presence of grass-legume vegetation, and if forests were to invade these areas, the soil would, in time, be similar to those of Soil Unit MYW 3 found adjacent to areas of this unit.

The following is a generalized description of the Dark Gray Luvisol soil of this unit:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
Ap	0-18	black	silty clay	neutral
Ae	18-26	gray	silty clay loam	slightly acid

Figure 25. Cultivated area of glaciolacustrine sediments immediately southwest of Oster Lake; vegetation and landform of Soil Unit MCO3.

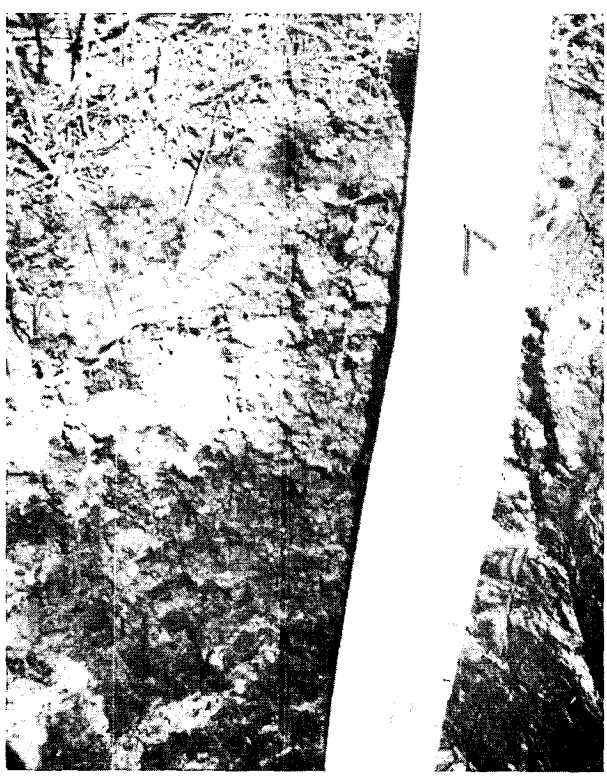


Figure 26. Cultivated Dark Gray Luvisol soil of Soil Unit MCO3.

AB	26-35	dark grayish	silty clay	medium acid
Bt	35-84	dark grayish brown	clay	slightly acid
Ck	84-99+	very dark gray	clay loam	mildly alkaline

Due to variations in the depth of cultivation, the Ae horizon is usually intermittent. The Bt horizon is very dense and compact and impedes the downward movement of roots and water. A moderate limitation would be placed on this unit for most park uses. Although slope gradients are low, the soils have low infiltration rates and low permeability. Also, the high clay content of the surface soil makes it very sticky when it is wet which limits the use of this unit for hiking trails if the vegetation were to be removed.

Soil Unit (MIQ-COA)2: (Orthic Gray Luvisol-Dark Gray Luvisol)

The soils of this unit are dominantly well and moderately well drained and have developed on medium to moderately fine textured glacial till with a veneer of stonefree, fine textured, glaciolacustrine sediments of variable thickness. These materials occur in a complex and often unpredictable association in a landform having a predominantly ridged surface expression, and slope gradients that range from 6 to 14 percent. Most of the soils have developed on 50 to 80 cm of glaciolacustrine sediments underlain by till, while a significant proportion of the soils have developed on the till itself. The till is often found at the surface on the upper slopes of the steeper ridges although it may also be found on the middle slopes of more subdued ridges that have the glaciolacustrine sediments on the upper slopes.

The well and moderately well drained soils of this unit have Ah horizons that are generally less than 5 cm thick, thus the Orthic Gray Luvisol soils are dominant (Appendix 1-12 and 1). A significant proportion of the soils however have Ah horizons greater than 5 cm thick, the Dark Gray Luvisol soils (Appendix 1-13 and 2). These soils occupy middle and upper slope positions in the landscape. Gleyed Dark Gray Luvisol soils occupy lower slopes and poorly drained Humic Luvic Gleysol (Appendix 1-11 and 6) soils are found in low lying interridge areas. The glaciolacustrine sediments are generally thickest (greater than 100 cm) in these poorly drained areas.

Vegetation is dominantly trembling aspen forest with a dense shrub layer. However, the density of the forest stand is variable ranging from dense cover west of Tawayik Lake and west of Astotin Lake, to more open tree cover with shrubby grassland (Figure 27) in the area from Astotin Lake, southwest, to Paul Lake. This unit is very similar to Soil Unit (TYK-UCS) 2 except that

Figure 27. Open aspen cover of Soil Unit (MIQ-COA)2, northeast of Paul Lake.

in the latter case the soils are dominantly Dark Gray Luvisols having Ah horizons greater than 5 cm thick and shrub and grass covered slopes are more numerous.

The following is a generalized description of the dominant Orthic Gray Luvisol soil of this unit, developed on glaciolacustrine sediments underlain by glacial till:

Horizon	Depth(cm)	Moist Color	Texture	Reaction Class
LF	4-0	black, slightly decomposed leaf litter		
Ah	0-4	very dark brown	silt loam	medium acid
Ae	4-12	grayish brown	silt loam	medium acid
AB	12-23	very dark grayish brown	clay loam	slightly acid
Bt	23-85	very dark gray	clay	slightly acid
BC	85-95	very dark gray	clay loam	neutral
IICk	95-110+	dark yellowish brown	loam	mildly alkaline

The BC and C horizons often contain distinct reddish yellow mottles. The Gleyed Dark Gray Luvisol soils exhibit similar horizonation but are generally well mottled through the solum and possess Ah horizon 5 to 7 cm thick.

The glaciolacustrine sediments are very slowly permeable. This, plus the silt loam surface texture, produces a water erosion hazard that is considered to be low for slope gradients less than 5 percent, moderate for slope gradients from 5 to 9 percent and high for slopes greater than 9 percent. Examples of erosion are common on many of the animal trails and steeper slopes in the area of the unit southwest of Astotin Lake.

Soil Unit(MIQ-COA) 3: (Orthic Gray Luvisol-Dark Gray Luvisol and Humic Luvic Gleysol)

The soils of this unit have developed on medium to moderately fine textured glacial till with a veneer of stonefree, fine textured glaciolacustrine sediments of variable thickness. Usually the glaciolacustrine sediments are from 50 to 80 cm thick over the till. This unit occurs in a landscape of subdued ridges with slopes ranging from 4 to 8 percent, surrounded by poorly drained, level areas. The soils resemble those of Soil Unit (MIQ-COA)2 except that in this case the poorly drained Humic Luvic Gleysols (Appendix I-11) comprise a significant proportion of the unit. Also found in depressional areas, are very poorly drained Terric Mesisol soils developed on sedge peat underlain by glaciolacustrine sediments at a depth of approximately 75 cm

(Appendix I-22). Vegetation in the poorly drained areas consists of trembling aspen, a few balsam poplar, willows and sedges.

The significant proportion of poorly drained soils is the major limitation to the use of this unit. Although slopes rarely exceed 8 percent a moderate erosion hazard exists for the better drained soils on slopes greater than 5 percent. This is due to the silty texture of the surface soil, its platy structure and relatively low infiltration rate.

Soil Unit MPV 3: (Humic Luvic Gleysol - Terric Mesisol and Gleyed Gray Luvisol)

The dominant soils of this unit are poorly drained and have developed on medium to moderately fine textured glacial till in a level to undulating moraine landform with slopes less than 5 percent. These poorly drained Humic Luvic Gleysol soils (Appendix I-6) and very poorly drained Terric Mesisol soils (Appendix I-22) occupy lowlying and depressional areas often associated with surface drainage systems. The Terric Mesisols are organic soils that have developed on sedge peat underlain by till at a depth of approximately 75 cm and these comprise a significant proportion of the soils of this unit. Imperfectly drained Gleyed Gray Luvisol soils are found on the lower slopes of subdued ridges while moderately well drained Orthic Gray Luvisol soils are found on the upper slopes of the ridges.

Vegetation on the ridges is dominantly trembling aspen with a dense shrub layer. In the poorly drained areas trembling aspen, willows, and other shrubs are found, and on the very poorly drained areas, willows and sedges comprise the vegetative cover.

The following is a generalized description of the Humic Luvic Gleysol soils found in this unit.

Horizon	Depth(cm)	Moist Color	Texture	Reaction Class
LF	3-0	black, slightly decomposed leaf litter		
Ah	0-8	black	loam	slightly acid
Aheg	8-11	dark gray	silt loam	slightly acid
Aeg	11-21	light brownish gray	silt loam	medium acid
Btg	21-78	very dark gray	loam	medium acid
BCg	78-125	very dark gray	loam	slightly acid
Ckg	125-135+	dark gray	silt loam	midly alkaline

These poorly drained soils are characterized by dull matrix colors and the presence of distinct yellowish-red mottles throughout the solum. Also, the depth to carbonates usually exceeds 100 cm indicating the extensive leaching that has occurred with these soils.

Poor internal soil drainage is the major limiting factor affecting the potential use of this soil unit. The water erosion hazard is low due to the slope gradients. This unit is found in small scattered locations in the south half of the park.

Soil Unit MYW 3: (Orthic Gray Luvisol - Dark Gray Luvisol)

The soils of this unit are dominantly moderately well drained and have developed on fine textured glaciolacustrine sediments in an undulating to gently ridged landscape with slopes ranging from 2 to 5 percent. The better drained soils are characterized by Ah horizons, that range in thickness from 3 to 7 cm, well leached Ae horizons, and dense, compact Bt horizons. Since the thickness of the Ah horizons is generally less than 5 cm, the Orthic Gray Luvisol soils (Appendix I-8) are dominant and the Dark Gray Luvisol soils (Appendix I-9) comprise a significant proportion of the soils in this unit. Poorly drained Humic Luvic Gleysol soils (Appendix I-11) occupy depressional portions of the landscape but comprise only a minor proportion of the soils of the unit.

This unit is found, under dense trembling aspen with a dense shrub layer of wild rose, in areas northwest and southwest of Oster Lake, north of the Bailey Lakes and in the vicinity of the hay fields on the east side of the park north of Highway #16. This unit has also been used for small areas along the north side of Tawayik Lake where the vegetation includes many open areas of grasses, forbes and shrubs interspersed with groves of trembling aspen. In this latter area the proportion of Dark Gray Luvisol soils equals that of Orthic Gray Luvisol soils whereas in the former areas the proportion of Orthic Gray Luvisol soils is greater.

The following is a generalized description of the Orthic Gray Luvisol soil of this unit:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	4-0	black slightly decomposed leaf litter		
Ah	0-4	very dark gray	silt loam	slightly acid
Ae	4-13	gray	silt loam	strongly acid
AB	13-17	dark gray	clay loam	medium acid

BCg	63-78	dark grayish brown	clay	slightly acid
Ckg	78-95+	dark gray	clay loam	mildly alkaline

The depth to carbonates is usually not as great in the glaciolacustrine sediments as it is in the glacial till material. Also, a few yellowish-red mottles are usually found in the lower solum and parent material of these soils. In the area on the east side of the park, north of Highway #16 and southwest of the hay fields, the parent material is varved glaciolacustrine sediments (Figure 28) with alternating layers of dark brown clay loam and light grayish brown silt loam.

The soils of this unit have a relatively low infiltration rate and permeability and combined with the silty texture of the soil surface produce a moderate erosion hazard on slopes greater than 2 percent. These soils also have limitations for other uses since the surface becomes quite sticky when it is wet.

Soil Unit (NC-COA) 1: (Eluviated Eutric Brunisol-Orthic Gray Luvisol)

The soils of this unit are dominantly rapidly to well drained and have developed on a complex association of coarse textured glaciofluvial sediments and medium to moderately fine textured glacial till. Most of the ridged to hummocky landscape is covered by the glaciofluvial sediments that are relatively deep. In many areas, however, these sediments are underlain by glacial till at a depth of 50 to 100 cm and often the till is exposed at the surface. Changes in materials occur in a random and often unpredictable manner across the landscape.

Rapidly to well drained Eluviated Eutric Brunisol soils (Appendix I-14) have developed on the deepest glaciofluvial sediments. Where the till occurs within the solum Eluviated Eutric Brunisols (Appendix I-15 and 19) or Orthic Gray Luvisols (Appendix I-5 and 18) as in Soil Unit (COA-HDY) 1 occur. In general terms, the soils of this unit are similar to those of Soil Unit (COA-NC) 1 except that in this case the Eluviated Eutric Brunisols are dominant.

Vegetation is dominantly trembling aspen with isolated and scattered inclusion of white birch and white spruce. A dense shrub layer is found under the aspen, predominantly beaked hazelnut, wild rose and wild red raspberry. This unit is found in relatively large areas between Flyingshot Lake and the Bailey Lakes. It is also found southeast of Moss Lake where it includes

Figure 28. Varved glaciolacustrine sediments, the C horizon of soils in Soil Unit MYW3, found north of Highway #16 on the east side of the park.

kame-like deposits of poorly sorted, ice contact stratified drift. In this latter area large open areas with dense shrub cover are numerous (Figure 29).

The major limitations to the use of this unit are generally steep slopes and the loose nature of the sandy materials. Extensive areas of erosion can be found in these materials where the vegetation has been removed, the most notable examples being found on the west flank of the high hill, 1.6 km southeast of Moss Lake, and on the trail running east-west just south of the Bailey Lakes, approximately 1.6 km east from the road leading to the south warden's cabin (Figure 30). Susceptibility to water erosion is variable with the hazard increasing as slope gradients increase and as the till is found nearer to the ground surface. Generally the water erosion hazard could be considered moderate to low.

Soil Unit SB 1: (Typic Fibrisol - Mesic Fibrisol)

The soils of this unit are very poorly drained and have developed on fibric organic materials primarily the relatively undecomposed remains of sphagnum and feather mosses. This unit is usually found as bowl bogs that have a slightly concave-shaped surface and hummocky microtopography. In terms of the surface expression and slope descriptions used for mineral soils in the park, this unit is always found in level areas with less than 1 percent slope. For this reason no symbols were placed on the map for surface expression and slope class. These are inherent in the soil unit name.

The dominant soils of the unit are Typic Fibrisols (Appendix I-24) developed on fibric sphagnum moss, more than 160 cm thick. These are usually located towards the centres of the bogs. Towards the edges Mesic Fibrisol soils (Appendix I-23) are found developed on fibric sphagnum and feathermosses with mesic fen peat found at depths of 115 to 150 cm. At the edges of the bogs mineral soil is usually found within 100 cm of the surface overlain by approximately 30 cm of mesic fen peat with fibric moss peat comprising the remainder of the soil up to the surface. These latter soils are Terric Mesic Fibrisols (Appendix I-25).

Vegetation is dominantly sphagnum moss and Labrador tea. Some areas of this unit are treed with dense black spruce while others have only a few scattered black spruce and swamp birch trees.

The following is a generalized description of the Typic Fibrisol dominant in this unit.

Figure 29. Vegetation of Soil Unit (NC-COA)1 in the area east of Moss Lake. Whitish area is a bison wallow in the sandy soil material.

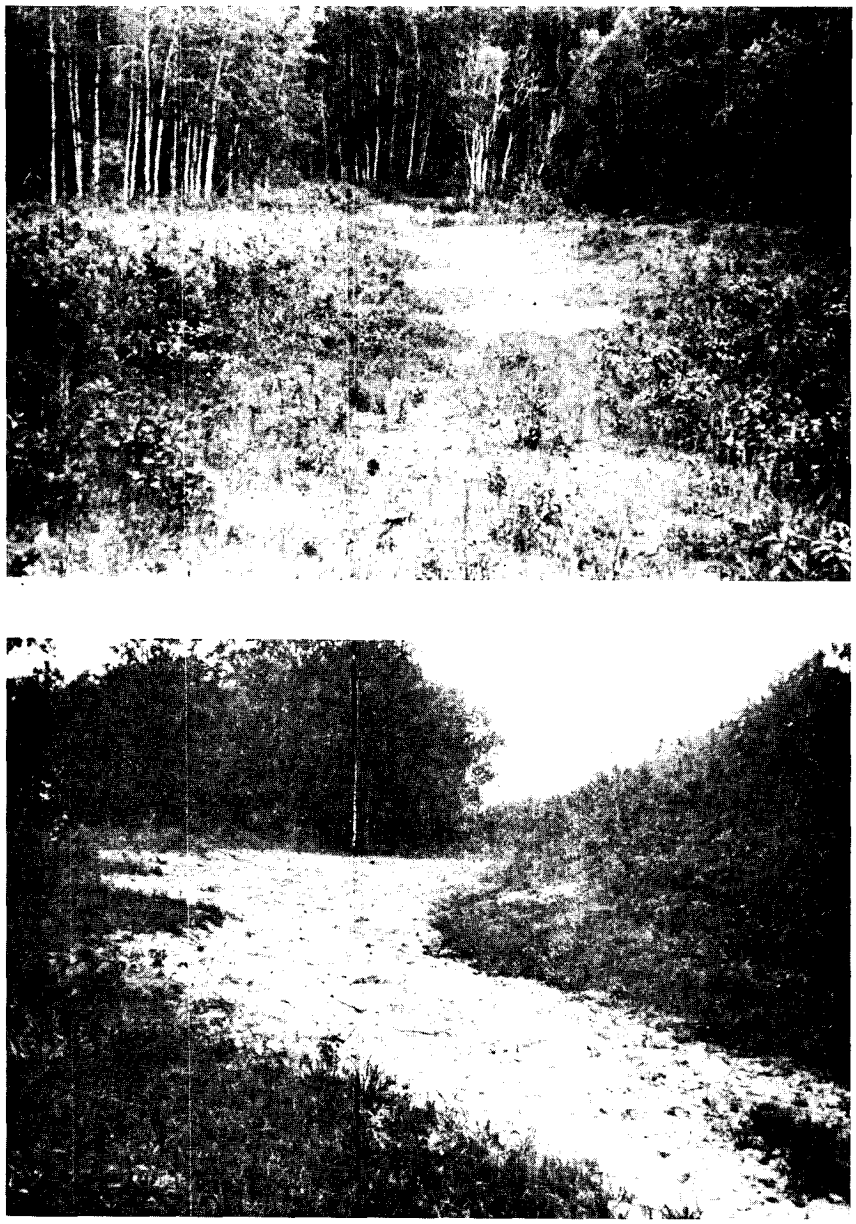


Figure 30. Loose, sandy soil material exposed by removal of vegetation from Soil Unit (NC-COA)1 south of the Bailey Lakes.

Horizon	Depth (cm)	Moist Color	Fiber content		Reaction Class
			unrubbed	rubbed	
Of1	0-20	yellowish brown	92%	84%	extremely acid
Of2	20-50	dark brown	82%	75%	extremely acid
Of3	50-70	dark reddish brown	90%	76%	very strongly acid
Of4	70-160+	very dark brown	88%	65%	very strongly acid

The soil material is generally very strongly to extremely acid in reaction. In the Mesic Fibrisols, the black fen peat found at depths of 115 to 150 cm is neutral in reaction and has an unrubbed and rubbed fiber content of 80 percent and 30 percent respectively. In the Terric Mesic Fibrisols the underlying mineral material is generally medium to moderately fine textured alluvium. This material is usually very dark gray in color and neutral in reaction. During the summer months these soils are usually saturated with water due to the extremely high water holding capacity of the organic soil material. Wetness severely limits the use of this unit which is found in scattered areas particularly in the north half of the park.

Soil Unit SB2: (Typic Fibrisol - Mesic Fibrisol and Terric Mesisol)

The soils of this unit are very poorly drained and have developed on organic materials, dominantly moss peat but with a significant proportion of sedge peat. The Typic Fibrisols and Mesic Fibrisols of this unit are similar to those described in Soil Unit SB1. However, in this unit, a significant proportion of the soils are Terric Mesisols (Appendix I-22) that have developed in sedge peat underlain by medium to moderately fine textured mineral soil within a depth of approximately 100 cm from the surface. These soils are briefly described in Soil Unit SL3.

Vegetation consists of Labrador tea, sphagnum moss, black spruce and swamp birch on the Fibrisols, and willow and sedge on the Mesisols. This unit is found in small and scattered areas throughout the park often associated with surface drainageways and always with level topography. The use of this unit is severely limited by wetness.

Soil Unit SL3: (Terric Mesisol - Typic Mesisol)

The soils of this unit are very poorly drained and have developed on moderately decomposed organic material, primarily derived from sedges and grasses. This unit is found throughout the park and is the most common organic unit in terms of the number of separate areas. It is found in level, lowlying, and depressional areas and much of the surface drainage in the park takes place through areas of this unit.

The dominant soils are Terric Mesisols (Appendix I-22) developed on mesic fen peat underlain by medium to moderately fine textured alluvium at depths ranging from 80 to 140 cm. A significant proportion of the soils are Typic Mesisols (Appendix I-21) developed on deep mesic fen peat that extends to a depth of at least 160 cm. These soils are usually found towards the centre of the area of this unit. A minor component of this unit are Humic Luvic Gleysol soils, poorly drained mineral soils with less than 25 cm of fen peat on the surface, that occur around or along the edges of very poorly drained areas.

Vegetation is dominantly sedges and grasses over most of the unit with willows and other shrubs becoming more prevelant toward the edges. The water table is generally within 75 cm of the surface and standing water is often found on the surface in the spring and early summer.

A generalized description of the Terric Mesisols of this unit follows:

Horizon	Depth(cm)	Moist Color	Fiber Content		Reaction Class
			unrubbed	rubbed	
Oml	0-20	black	76%	20%	neutral
Om2	20-85	very dark gray	82%	18%	neutral
Om3	85-110	black	70%	12%	neutral
Cg	110-160+	dark gray	silt loam		neutral

The potential use of this unit is severely limited by wetness.

Soil Unit SL 4: (Terric Mesisol - Typic Mesisol and Humic Gleysol, peaty)

The soils of this unit are very poorly drained and have developed in moderately decomposed organic material derived primarily from sedges and grasses. This unit is found in lowlying and depressional areas throughout the park. The soils are similar to those of Soil Unit SL 3 except that in this unit there is a significant proportion of poorly drained mineral soils. Also the vegetative cover in this unit is dominantly willow and other shrubs with sedges and grasses beneath and therefore it represents most of the shrubby wetlands in the park (Figure 31).

The dominant Terric Mesisol soils have been briefly described in Soil Unit SL 3. The following is a generalized description of the Typic Mesisol soils of this and the preceding unit:

Horizon	Depth (cm)	Moist Color	Fiber Content		Reaction Class
			unrubbed	rubbed	
Oml	0-28	black	70%	26%	neutral
Om2	28-115	very dark gray	74%	15%	neutral
Om3	115-165+	very dark brown	67%	11%	neutral

The potential use of this unit is severely limited by wetness.

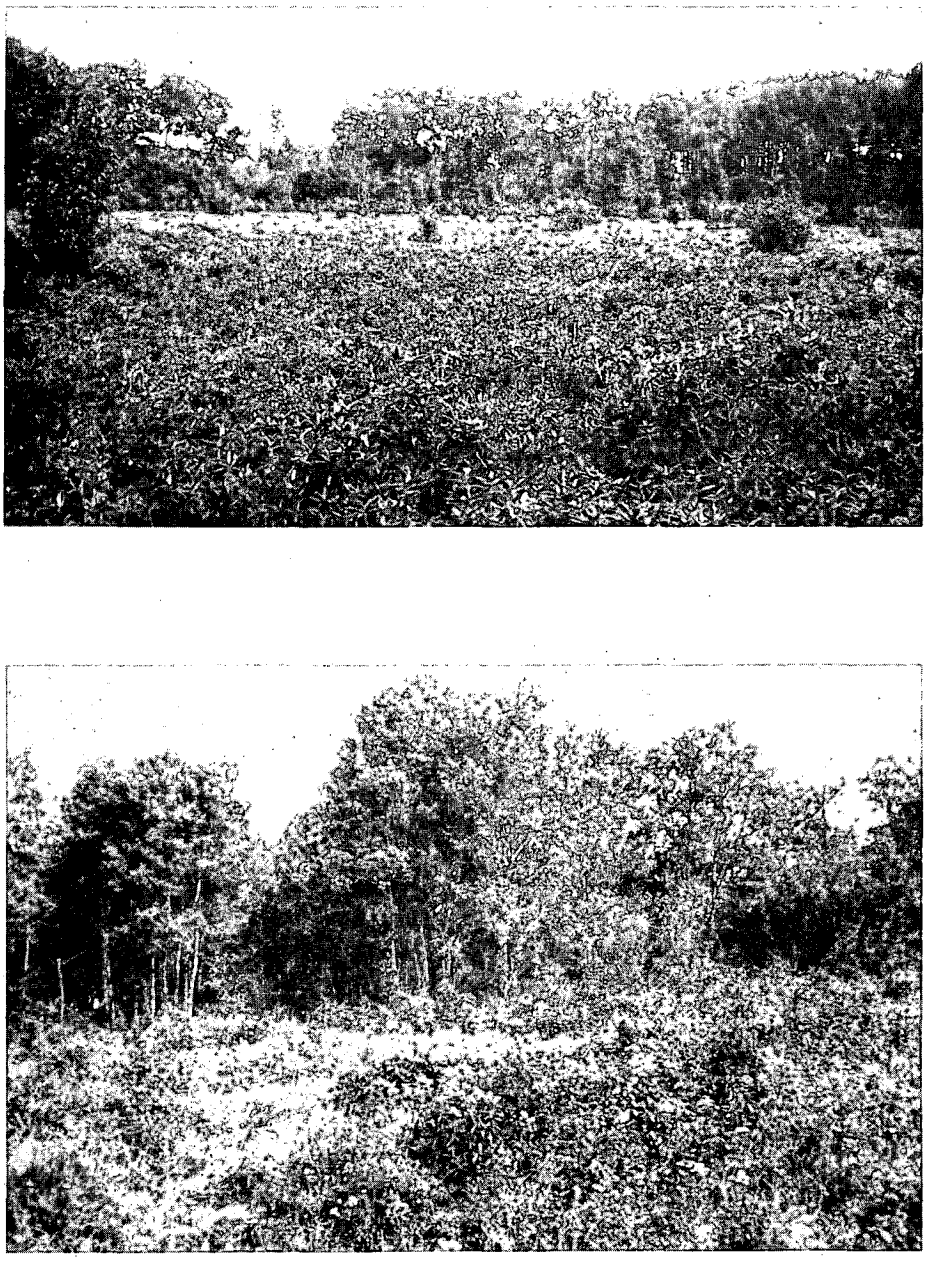


Figure 31. TOP: Vegetation of Soil Unit SB1, mosses, labrador tea, and black spruce.
BOTTOM: Vegetation of Soil Unit SL4, shrubby wetlands.

Soil Unit SL 5: (Terric Mesisol - Rego Gleysol, peaty)

The soils of this unit are very poorly drained and have developed on moderately well decomposed organic material derived primarily from sedges and cattails which is underlain at variable depth by medium to moderately fine textured alluvium. This unit includes the marshy areas around most of the lakes in the park especially Flyingshot, Goose, Blackfoot and the Bailey Lakes where vegetation is primarily cattails and sedges and standing water is usually found on the surface for most of the year (Figure 32).

The Terric Mesisol soils have been described briefly in the discussion of Soil Unit SL 3. The Rego Gleysol soils are characterized by a surface layer of organic material 20 to 30 cm thick underlain by dark gray, silt loam to loam textured mineral soil.

The potential use of this unit is severely limited by wetness.

Soil Unit SL 6: (Terric Mesisol - Typic Mesisol and Terric Mesic Fibrisol)

The soils of this unit are very poorly drained and are dominantly the same as those of Soil Unit SL 3. However this unit includes a significant proportion of Terric Mesic Fibrisol soils as described in Soil Unit SB 2. This unit is found in lowlying areas, that are important for surface drainage, with the Fibrisols occurring as small pockets of sphagnum peat in dominantly sedge peat areas.

Vegetation on the Terric Mesisol soils is dominantly willow, sedge and grass, while the Terric Mesic Fibrisol soils are vegetated with labrador tea and sphagnum moss with a few black spruce, Tamarack and swamp birch.

The use of this unit is severely limited by wetness.

Soil Unit SWY 4: (Humic Luvic Gleysol - Terric Mesisol and Humic Gleysol, peaty)

The soils of this unit are poorly and very poorly drained and have developed on fine textured glaciolacustrine sediments which, in a significant proportion of the soils, are overlain by sedge peat up to 100 cm thick. The topography is level to undulating with slope gradients less than 3 percent.

The Humic Luvic Gleysol soils (Appendix I-11) are dominant and occur on the poorly drained positions in the landscape. In the more depressional areas the thickness of the sedge peat on the surface of the glaciolacustrine sediments increases. Where this organic material is more than 40 cm thick the Terric Mesisol soils (Appendix I-22) occur.

Figure 32. Soil Unit SL5 on the east side of Paul Lake.

In the area just north of Tawayik Lake this unit is vegetated with trembling aspen and an abundance of willow and other shrubs. The same applies to the area of this unit south of Highway #16 on the east side of the park. In this latter area the willows appeared to be very heavily browsed at the time of the field survey (summer 1975). This unit has also been mapped along the creek that meanders through the hay area on the east side of the park north of Highway #16. In this area the peaty phase Humic Gleysols occur as a more significant proportion of the unit than in the other areas.

The following is a generalized description of the Humic Luvic Gleysol soil dominant in this unit.

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	8-0	black slightly decomposed leaf litter		
Ah	0-12	black	silt loam	slightly acid
Aeg	12-20	gray	silt loam	slightly acid
Bg	20-58	grayish brown	clay loam	neutral
Cg	58-85	grayish brown	clay loam	neutral
Ckg	85-100+	grayish brown	clay loam	mildly alkaline

The solum is generally well mottled with more abundant mottling occurring in the Bg horizon. As the internal drainage becomes poorer the thickness of the Aeg horizon decreases and is absent in the peaty phase Humic Gleysol soils. The Terric Mesisol soils are described briefly in Soil Unit SL 3.

Poor soil drainage, low permeability and fine texture combine to place severe limitations on the use of this unit.

Soil Unit (TYK-UCS) 2: (Dark Gray Luvisol - Orthic Gray Luvisol)

The soils of this unit are dominantly moderately well and well drained and have developed on moderately fine textured glacial till with a veneer of stonefree, fine textured glaciolacustrine sediments of variable thickness. These materials occur in a complex and often unpredictable association in a landform having a predominantly ridged surface expression and slope gradients from 3 to 10 percent.

The soils and materials of this unit are similar to those of Soil Unit (MIQ-COA) 2 in terms of landscape position and classification. In this unit

however the Dark Gray Luvisol soils (Appendix I-13 and 2) are dominant while the Orthic Gray Luvisol soils (Appendix I-12 and I) are the significant component. Also, while the general vegetation (ie: trembling aspen with a dense layer of shrubs including wild rose, beaked hazelnut and saskatoon) is the same for both units, open shrub and grass covered slopes are more numerous and the trembling aspen stands are more open in Soil Unit (TYK-UCS) 2.

This unit is found northwest of Tawayik Lake and also occupies a relatively large area between Little Tawayik, Bailey, Flyingshot and Goose Lakes, where the landform is often more subdued with ridged to undulating surface expression. It also occurs in two smaller areas immediately west and north of Tawayik Lake, where the vegetation includes more shrubby grassland. Another area of this unit is found to the south and west of Astotin Lake where the landform has a ridged to hummocky surface expression.

The following is a generalized description of the Dark Gray Luvisol soil of this unit:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	4-0	black slightly decomposed leaf litter		
Ah	0-6	very dark gray	silt loam	medium acid
Ae	6-12	gray	silt loam	medium acid
AB	12-20	dark grayish brown	silty clay	medium acid
Bt	20-55	very dark gray	clay	slightly acid
IIBC	55-90	dark grayish brown	clay loam	neutral
IICk	90-110+	dark brown	clay loam	mildly alkaline

The relatively low permeability and fine texture of the glaciolacustrine sediments are limitations to the use of this unit. The surface soils become very sticky when they are wet. The water erosion hazard for this unit is variable depending on slope gradient, with a low hazard for slopes less than 5 percent, a moderate hazard for slopes between 5 and 9 percent and a high hazard for slopes greater than 9 percent.

Soil Unit (TYK-UCS) 3: (Dark Gray Luvisol - Orthic Gray Luvisol and Humic Luvic Gleysol)

The soils of this unit are dominantly moderately well to well drained and have developed on moderately fine textured glacial till with a veneer of stonefree, fine textured glaciolacustrine sediments of variable thickness. Usually these sediments are 50 to 80 cm thick. This unit occurs in a landform with an undulating surface expression and slope gradients from 2 to 5 percent.

The soils and vegetation of this unit are similar to those of Soil Unit (TYK-UCS) 2 except that poorly drained Humic Luvic Gleysol soils (Appendix I-11) comprised a significant proportion of the soils of this unit. Also found in depressional areas are very poorly drained Terric Mesisol soils (Appendix I-22) developed on sedge peat underlain by fine textured mineral soil at depths from 80 to 100 cm. These are described in Soil Unit SL3.

The water erosion hazard for the unit is low due to the low slope gradients. However the relatively low permeability of the glaciolacustrine sediments, and the fact that they become sticky when wet, place some limitations on the use of this unit. The significant proportion of poorly drained soils also limits the potential use of this unit.

Soil Unit UCS 3: (Dark Gray Luvisol - Humic Luvic Gleysol and Terric Mesisol)

This unit consists of a catenary sequence of soils that have developed on medium to moderately fine textured glacial till in an undulating to ridged moraine landform. The Dark Gray Luvisol soils (Appendix I-2) are dominant and occupy middle and upper slope positions in the landscape. Poorly drained Humic Luvic Gleysol soils developed on glacial till (Appendix I-6) and very poorly drained Terric Mesisol soils developed on sedge peat underlain by moderately fine textured mineral soil (Appendix I-22) occupy lowlying and depressional areas in the landscape and comprise a significant proportion of the unit. Except for the fact that the dominant soils have Ah surface horizons generally greater than 5 cm thick, this unit is very similar to Soil Unit COA 3. Also in this unit, vegetation is primarily open stands of trembling aspen with many shrub and grass covered slopes as compared to the dense aspen stands of unit COA 3.

The significant proportion of poorly drained soils place some limitations on this unit for uses that require the traversing of a soil unit (ie: hiking trails, etc.). Slope gradients range from 3 to 9 percent for the better drained areas within this unit. A low water erosion hazard exists where slopes are less than 5 percent and a moderate hazard exists for slopes between 5 and 9 percent.

Soil Unit UCS 4: (Dark Gray Luvisol - Orthic Gray Luvisol)

The soils of this unit are dominantly well drained and have developed on medium to moderately fine textured glacial till in ridged and hummocky moraine landforms where slopes range from 5 to 12 percent and 15 to 25 percent respectively. This unit is similar to Soil Unit COA 4 in terms of soil-landscape relationships and soil subgroups. In this unit however the Dark Gray

Luvisol soils (Appendix I-2) are dominant while the Orthic Gray Luvisols (Appendix I-1) are the significant soils. The vegetation if open stands of trembling aspen with a dense shrub layer of wild rose, beaked hazelnut and saskatoon intermixed with a groundcover of grasses and forbes. Many slopes that are usually south facing have no trees and are densely covered with shrubs and grasses. Such areas are extensively utilized by the grazing animals in the park. This unit is found west of the Tawayik Lakes.

The following is a generalized description of the Dark Gray Luvisol soils dominant in this unit:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
LF	3-0	black slightly decomposed leaf litter		
Ah	0-6	black	silt loam	slightly acid
Ae	6-17	grayish brown	silt loam	medium acid
Bt	17-80	dark grayish brown	clay loam	slightly acid
BC	80-100	grayish brown	clay loam	neutral
Ck	100-120+	dark yellowish brown	loam	mildly alkaline

The limitations on the use of this unit are similar to those for Soil Unit COA 4. The water erosion hazard is moderate for slopes from 5 to 9 percent and high for slopes above 9 percent. Most of the areas of this unit have a high water erosion hazard.

Soil Unit UCS 5: (Dark Gray Luvisol - Humic Luvic Gleysol)

The soils of this unit have developed on medium to moderately fine textured glacial till in a hummocky to ridged moraine landform with slopes from 7 to 15 percent. The soil subgroups of this unit are similar in classification to those of Soil Unit UCS 3 although the soil morphology is different. The dominant soils of Soil Unit UCS 3 have Ah horizons of minimal thickness for inclusion in the Dark Gray Luvisol subgroup and these soils can be considered to be transitional to the Orthic Gray Luvisol subgroup. The dominant soils of this unit have Ah and Ahe horizons that together have a thickness of from 10 to 16 cm and these soils can be considered to be transitional to the Dark Gray Chernozem subgroup. They are classified as Dark Gray Luvisol soils however because of the presence of well developed Ae and Bt horizons. These soils are found on open slopes where the vegetation is dominantly grasses, forbes and shrubs (Figure 33). Under open stands of trembling aspen in this unit, the

Figure 33. TOP: Vegetation of Soil Unit UCS5.
BOTTOM: Dark Gray Luvisol soil, developed on glacial till, of Soil Unit UCS5.

Ahe horizons are absent and the Ae horizons are generally thicker. The differences in surface horizonation indicate the changes that accompany shifts in vegetation between grassland and forest and these soils are representative of what could be considered the true parkland areas.

The Dark Gray Luvisol soils found under the open stands of trembling aspen are similar to those described in Soil Unit UCS 4. (Appendix I - 2). The following is a generalized description of the Dark Gray Luvisol soils found on the grass and shrub covered slopes in this unit:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
Ah	0-8	black	loam	neutral
Ahe	8-15	dark gray	loam	neutral
Ae	15-20	gray	silt loam	slightly acid
Bt	20-85	dark grayish brown	clay loam	slightly acid
BC	85-100	grayish brown	clay loam	neutral
Ck	100-110+	dark yellowish brown	loam	mildly alkaline

A significant proportion of the soils in this unit are poorly drained Humic Luvic Gleysols (Appendix I - 6) that, along with a minor proportion of Terric Mesisols (Appendix I - 22), have developed in the many depressional and lowlying areas within the hummocky moraine landform. This significant proportion of poorly drained soils is a limitation to land uses that require the traversing of a soil unit. In many of the well drained areas of this soil unit erosion has occurred on the steeper slopes. This was evident during the field mapping by a decrease in the depth to the Bt horizon and an increase in the percentage of coarse fragments on the ground surface. Many animal trails and bison wallows were observed, some of which have eroded to the Bt horizon. The erosion hazard for this unit is moderate for slopes from 5 to 9 percent and high for slopes greater than 9 percent.

Soil Unit UCS 6: (Dark Gray Luvisol)

The soils of this unit are dominantly well drained and have developed on medium to moderately fine textured glacial till and are similar to the soils of Soil Unit UCS 5. In this unit however the landform is more subdued, undulating to ridged moraine, with slopes from 6 to 10 percent, and the proportion of the unit comprised of poorly drained soils is not as great.

This unit is found in two small areas east of Tawayik Lake, in a larger area southwest of Little Tawayik Lake, and in a large area west of Tawayik Lake. In this latter area of hummocky moraine a thin veneer of glaciofluvial sediments, 15 to 25 cm thick is often found overlying the till and imparts to the Ah and Ae horizons a sandy loam rather than a silt loam texture.

The erosion hazard for this unit is moderate for slopes less than 9 percent and high for slopes greater than 9 percent.

Soil Unit UCS 8: (cultivated Dark Gray Luvisol)

The soils of this unit are well drained and have developed on medium to moderately fine textured glacial till in an undulating moraine landform with slopes from 2 to 5 percent. This unit occurs exclusively in the cultivated area used for hay production on the east side of the park immediately north of Highway #16. Although the parent material is glacial till the soil profile is similar to that of the soils in Soil Unit MCO 3. These Dark Gray Luvisol soils (Appendix I-3) have deep, relatively dark colored surface horizons which have resulted from the incorporation of the Ah and Ae horizons by cultivation and the continued grass-legume vegetation.

The following is a generalized description of the Dark Gray Luvisol soil of this unit:

Horizon	Depth (cm)	Moist Color	Texture	Reaction Class
Ap	0-20	very dark gray	loam	neutral
Ae	20-26	gray	silt loam	slightly acid
AB	26-32	grayish brown	loam	slightly acid
Bt	32-86	dark brown	clay loam	slightly acid
BC	89-90	dark yellowish brown	loam	neutral
Ck	90-105+	dark yellowish brown	loam	mildly alkaline

There are no serious limitations to the use of this unit. Slopes are generally gentle and surface infiltration is moderate providing a low water erosion hazard.

Soil Unit (UCS-LTH) 2: (cultivated Dark Gray Luvisol)

The soils of this unit are well drained and have developed on medium to moderately fine textured glacial till with a veneer of coarse textured glaciofluvial sediments up to 100 cm thick. This unit is found exclusively in the cultivated area used for hay on the east side of the park north of Highway #16. The Dark Gray Luvisol soil profile is similar to that of Soil Units MCO 3 and UCS 8 (Appendix I - 3) with a deep, dark colored Ah horizon at the surface. However, in many of the soils of this unit, the solum has a sandy loam texture (Appendix I - 20). Were it not for cultivation, the soils of this unit would be similar to those of Soil Unit (COA-HDY)1.

The landscape has an undulating surface expression and slope gradients vary from 3 to 5 percent. The water erosion hazard is low and there are no major limitations to the use of this unit.

Soil Unit (UCS-MCO)2: (cultivated Dark Gray Luvisol)

The soils of this unit are well to moderately well drained and have developed on medium to moderately fine textured glacial till with a veneer of stonefree, fine textured glaciolacustrine sediments of variable thickness. The glaciolacustrine sediments are generally found on the lower slopes in a landscape with an undulating surface expression and slopes from 2 to 5 percent.

The soil unit covers a relatively small total area, occurring in the cultivated area on the east side of the park north of Highway #16 and in a small area at the north end of Flyingshot Lake. The soils are similar to those of Soil Units UCS 8 and MCO 3 with the exception to the latter being the presence of a glaciolacustrine-till discontinuity in the solum, usually below the Bt horizon.

The water erosion hazard for this unit is low. Potential uses of this unit may be limited to some degree by the fine texture and low permeability of the glaciolacustrine sediments.

Soil Unit (UCS-TYK)2: (Dark Gray Luvisol - Orthic Gray Luvisol)

The soils of this unit have developed on medium to moderately fine textured glacial till with a significant proportion of those on lower slopes developed on glacial till with a veneer of stonefree, fine textured glaciolacustrine sediments. This unit is found along the main park road in the vicinity of the Buffalo Paddock where the landscape has an undulating to ridged

surface expression and is also found in the ridged to hummocky area north of Tawayik Lake. The vegetation is dominantly open stands of trembling aspen with many shrub and grass covered slopes especially in the area north of Tawayik Lake.

The soils of this unit are similar to those of Soil Unit (TYK-UCS) 2 except that in this case the soils developed on glacial till are more prevelant. The water erosion hazard for this unit is variable depending on slope gradient, being low for slopes less than 5 percent, moderate for slopes between 5 and 9 percent and high for slopes greater than 9 percent. The steeper slopes in the area north of Tawayik Lake may also be a limiting factor for some use.

GUIDE FOR ASSESSING SOIL SUSCEPTIBILITY TO WATER EROSION

For the interpretation of map units for susceptibility to water erosion (Table 5) it is assumed that natural geologic water erosion is to be expected and accepted. The water erosion hazard therefore occurs when the vegetation on the surface of the soil is altered or removed by either the activities of man or animals or fire. It is also assumed that for most of the activities within the park the disruption will not be deep enough to affect the C horizon below the solum and therefore the interpretations are for the 25 cm of surface soil. Frequently the soil material below this depth will have a different erosion hazard than that of the surface. The erosion hazard of parent materials can be estimated using data presented in this report plus the method outlined by Rutter (1968).

In order to estimate the susceptibility to water erosion of the various map units a soil-erodibility factor was first estimated using Figure 34 (Wischmeier et al. 1971). The soil erodibility factor and associated slope classes were then used to estimated the susceptibility to erosion from Figure 35.

SOIL DRAINAGE CLASSES

The soil drainage classes as outlined in the Canadian System of Soil Classification (Canada Soil Survey Committee 1976) do not lend themselves directly to the map units employed for this project. The drainage classes as outlined in the above are for individual soil series or soil profiles. The map units employed for this project are groupings of various soils found within a particular area of landscape. Thus more than one drainage class can be found in any one map unit and the following system for delineating soil drainage has been devised:

1. Dominantly rapidly drained soil with a significant proportion of well drained soils: Soil Unit (NC-COA)1.

2a. Dominantly well drained soils: Soil Units COA2, COA4, COA6, HDY2, UCS4, UCS6, UCS8, (COA-HDY)1.

2b. Dominantly well drained soils with a significant proportion of rapidly drained soils: Soil Units (COA-NC)1, (UCS-LTH)2.

2c. Dominantly well drained soils with a significant proportion of moderately well drained soils: Soil Units (UCS-MCO)2, (UCS-TYK)2.

3a. Dominantly moderately well drained soils: Soil Units MCO3, MYW3.

3b. Dominantly moderately well drained soils with a significant proportion of well drained soils: Soil Units (MIQ-COA)2, (TYK-UCS)2.

Table 5. Susceptibility to water erosion for soil map units of Elk Island National Park

Map Unit	Susceptibility: Low	Moderate	High	Variable
COA2				
U3	X			
U4		X		
R4		X		
H4		X		
R5			X	
RC5			X	
H5			X	
H6			X	
COA3				
U3	X			
R3	X			
R4		X		
R5			X	
H5			X	
COA4				
U3	X			
R4		X		
RC4		X		
RU4		X		
RH4-5		X		X[2]
R5			X	
RH5			X	
H5			X	
COA6				
R4	X			
RC4	X			
RC4-5	X			X[1]
R5		X		
RH5		X		
H5		X		
(COA-HDY)1				
R3	X			
R4		X		
RU4		X		X[3]
R5		X		X[4]
RH5		X		X[4]
H5-6			X	
(COA-HDY)3				
R4		X		X[3]
RC4		X		X[3]
RH6			X	X[5]
(COA-NC)1				
R4		X		X[4]
R5		X		X[4]
RH5		X		X[4]
H5		X		X[4]
HR5B		X		X[4]
H5B		X		X[5]
H6B			X	X[5]
DST4				
U3		X		
HDY2				
U3	X			
MCO3				
U3	X			
(MIQ-COA)2				
R3-4	X			X[1]
R3	X			
U4		X		
R4		X		
R5			X	
RH5			X	
(MIQ-COA)3				
RC3	X			
RC4		X		
R4		X		
MPV3				
L2	X			
U2	X			
U3	X			
MYW3				
U2	X			
U3		X		
R3		X		
(NC-COA)1				
HR5		X		X[4]
H5		X		X[4]
SB1	X			
SB2	X			
SL3	X			
SL4	X			
SL5	X			
SL6	X			
SWY4				
U2	X			
U3	X			
(TYK-UCS)2				
U3	X			
R3	X			
R4		X		
U4		X		
R5			X	
RH5			X	
(TYK-UCS)3				
U3	X			
UCS3				
U3	X			
R3	X			
R4		X		
UCS4				
R4		X		
R5			X	
RH5			X	
H5			X	
H6			X	
UCS5				
R4		X		
H5			X	
UCS6				
U4		X		
R4		X		
H5			X	
UCS8				
U3	X			
(UCS-LTH)2				
U3	X			
(UCS-MCO)2				
U3	X			
(UCS-TYK)2				
U3	X			
R3	X			
U4		X		
R4		X		
R5			X	

1. Variability due to complexity of slopes; generally low with a significant proportion of the unit having a moderate susceptibility.
2. Variability due to complexity of slopes; generally moderate with a significant proportion of the unit having a high susceptibility.
3. Variability due to complexity of soil materials and variability in surface texture; generally moderate with a significant proportion of the unit having a low susceptibility.
4. Variability due to complexity of slopes and soil materials; generally moderate with a significant proportion of the unit having a high susceptibility.
5. Variability due to complexity of slopes and soil materials; generally high with a significant proportion of the unit having a moderate susceptibility.

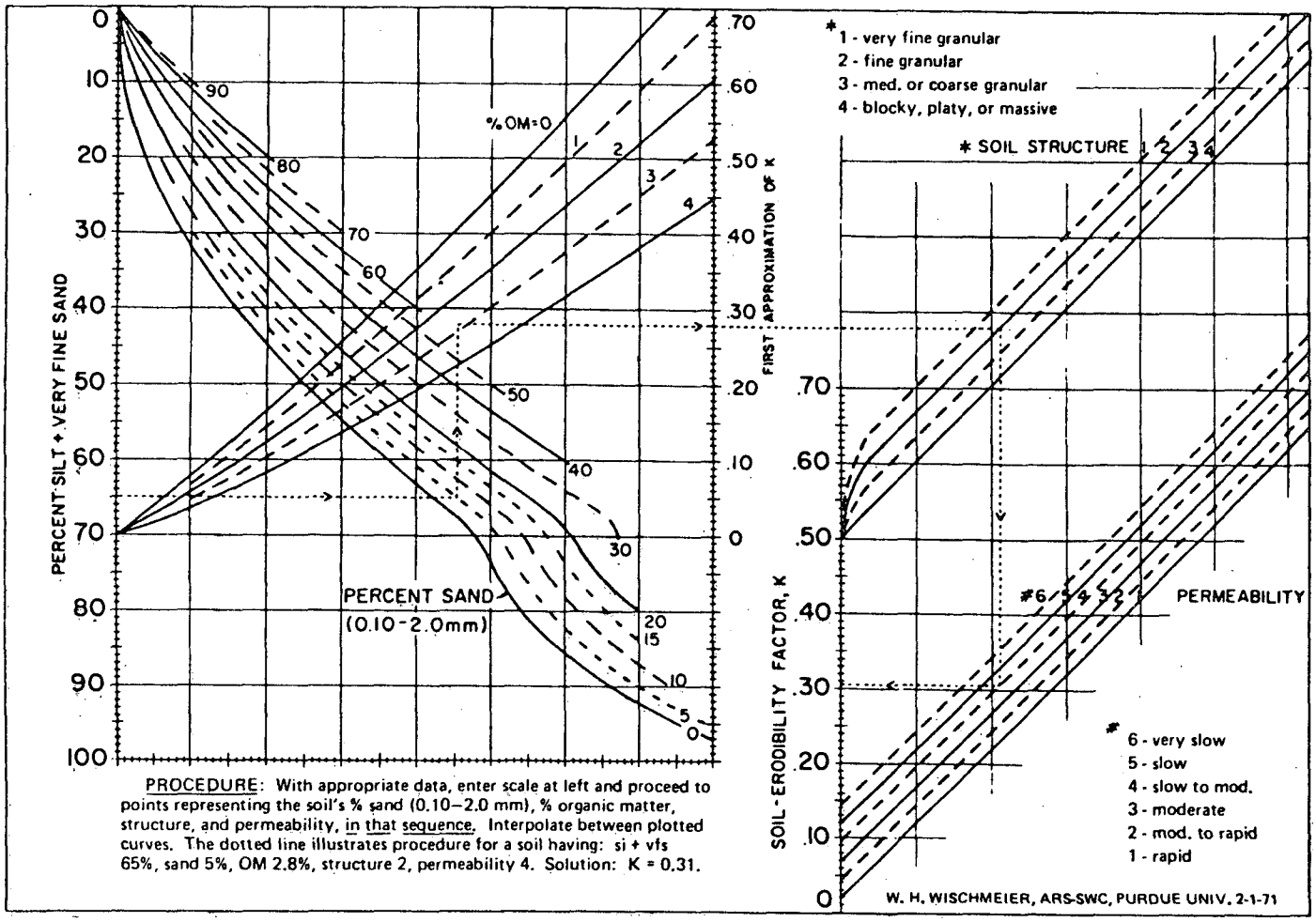


Figure 34. Soil-erodibility nomograph (after Wischmeier, Johnson, and Cross 1971).

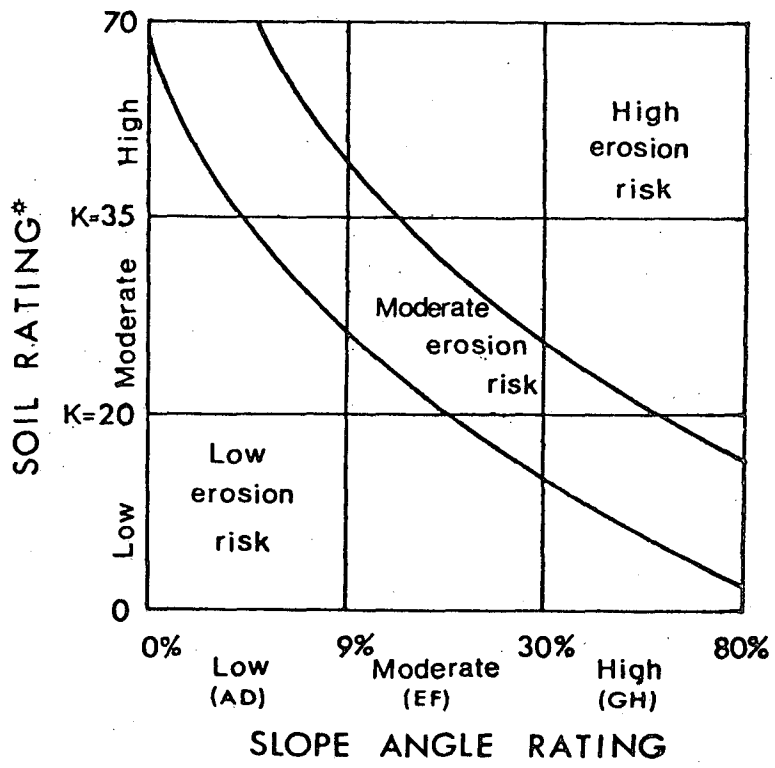


Figure 35. Erosion hazard of soils.

4. Dominantly well and moderately well drained soils with a significant proportion of poorly drained soils: Soil Units COA3, DST4, UCS3, UCS5, (COA-HDY)3, (MIQ-COA)3, (TYK-UCS)3.

5. Dominantly poorly drained soils: Soil Units MPV3, SWY4.

6. Dominantly very poorly drained soils: Soil Units SB1, SB2, SL3, SL4, SL5, SL6.

REFERENCES

REFERENCES

Adams, J. E., Kerkham, D., and Nielson, D. R. 1957. A portable rainfall-simulator infiltrometer and physical measurements of soil in place. Soil Sci. Soc. Am. Proc. 21:473-476.

Allison, L. E., Bollen, W. B. and Moodie, C.D. 1965. Total carbon. In (C. A. Black et al. eds) Methods of Soil Analysis, Part II. Am. Soc. Agron. Monograph No. 9., Madison, Wisconsin.

American Society of Testing and Materials. 1970. Annual Book of A.S.T.M. Standards, Part II. Am. Soc. Testing Mater., Philadelphia.

Association of Official Agricultural Chemists. 1955. Official Methods of Analysis. 8th ed. Washington, D.C.

Atmospheric Environment Service. Temperature and Precipitation, 1941-1970, Prairie Provinces. Environment Canada, Downsview, Ontario. 159 pp.

Bascombe, C. L. 1961. A calcimeter for routine use on soil samples. Chem. Ind., Part II. pp. 1826-1827.

Bostock, H. S. 1970. Physiographic Regions of Canada. Geological Survey of Canada, Ottawa.

Bowser, W. E., Kjearsgaard, A. A., Peters, T. W. and Wells, R.E. 1962. Soil Survey of Edmonton Sheet. Report No. 21. Alta. Soil Survey, Univ. Alta., Edmonton.

Canada Department of Agriculture. 1970. Glossary of terms in Soil Science. Publ. 1459. Information Division, Ottawa.

Canada Soil Survey Committee. 1976. The Canadian System of Soil Classification (Draft copy). Agriculture Canada, Ottawa. 171 pp.

Carlson, V. A. 1967. Bedrock topography and surficial aquifers of the Edmonton district, Alberta. Res. Council Alta., Report 66-3. 21 pp.

Chapman, H. D. 1965. Cation exchange capacity. In (C.A. Black et al. eds.) Methods of Soil Analyses. Am. Soc. Agron. Monograph No. 9, Madison, Wisconsin.

Dickman, S. R. and Bray, R. H. 1940. Colorimetric determination of phosphate. Ind. Eng. Chem. Anal. Ed. 12:665-668.

Douglas, R. J. W. 1970. Geology and Economic Minerals of Canada. Energy Mines and Resources Canada, Econ. Geol. Report No. 1. 838 pp.

Emerson, D. 1976. Personal communication.

Lang, A. H. 1974. Guide to the Geology of Elk Island National Park: The Origin of its Hills and Other Scenery. Geological Survey of Canada Misc. Report 22. 30 pp.

Mather, H., Leahey, A. and Younge, O. 1930. Soils of the Edmonton Region. Unpublished soil map of the Alberta Soil Survey, University of Alberta, Edmonton.

McKeague, J. A. and Day, J. H. 1966. Dithionite - an oxalate-extractable Fe and Al as aids in differentiating various classes of soil. Can. J. Soil Sci. 46:13-22.

Peech, M. 1965. Exchange acidity. In (C. A. Black et al. eds.) Methods of Soil Analysis. Amer. Soc. Agron. Monograph No. 9., Madison, Wisconsin. pp 905-913.

Pettapiece, W. W. 1969. The forest-grassland transition. In S. Pawluk (ed.) Pedology and Quaternary Research. Symposium May 14. Edmonton. p. 103-113

Rowe, J. S. 1972. Forest Regions of Canada. Dept. of Environ., Can. For. Serv., Publ. No. 1300. Ottawa, Canada. 172 pp.

Rutter, N. W. 1968. A method of predicting soil erosion in the Rocky Mountain Forest Reserve, Alberta. Geol. Survey Can. Paper 67-77. Queen's Printer, Ottawa.

Toogood, J. A. and Peters, T. W. 1953. Comparison of methods of mechanical analysis of soils. Can. J. Agr. Sci. 33:159-171.

Wischmeier, W. H., Johnson, C. B., and Cross, B. V. 1971. A soil erodibility nomograph for farmland and construction sites. J. Soil Water Conserv. 26:189-193.

APPENDICES

APPENDIX I: Descriptions of the major soils in Elk Island National Park.

I-1:

Classification	Orthic Gray Luvisol
Parent Material:	fine textured glacial till
Soil Units:	- dominant: C0A2, C0A3, C0A4 - significant: (MIQ-C0A)2, (MIQ-COA)3, UCS4 - minor MPV3, (UCS-TYK)2, (TYK-UCS)2, (TYK-UCS)3.

Pedon Description 1A

Described by:	P. H. Crown
Location:	No. 6; 3.7 km north of Highway #16 on main park road
Landform:	ridged moraine
Slope:	4 percent, crest position
Aspect:	southwest
Elevation:	721 m a.s.l.
Relief:	5.5 m
Estimated Drainage:	well drained
Vegetation:	Dense Populus tremuloides (trembling aspen) with dense shrub cover of Rosa acicularis (wild rose) Corylus cornuta (beaked hazelnut). Herbs include Heracleum lanatum (cow parsnip) and Vicia americana (American vetch).

LF 5 to 0 cm; black (10 YR 2.5/1 m) relatively undecomposed leaf litter with twigs; abundant, very fine to fine, random roots; abrupt, wavy boundary; 2 to 7 cm thick; pH 6.2.

Ae 0 to 12 cm; gray (10YR 5/1 m) loam; moderate, fine platy; friable; plentiful, fine to coarse, oblique roots; many, fine to medium pores; no clay films; no carbonates; estimated 5%, gravelly and angular gravelly coarse fragments; clear, wavy boundary; 7 to 14 cm thick; pH 5.7.

AB 12 to 20 cm; yellowish brown (10YR 5/4 m) loam; moderate, fine to medium, oblique roots; many, fine to medium pores; no clay films; no carbonates; estimated 5% angular gravelly coarse fragments; clear, wavy boundary; 6 to 10 cm thick; pH 5.6.

Bt1 20 to 38 cm; brown (10YR 4/3 m) clay loam; moderate to strong, medium, angular blocky; very firm; plentiful, fine to medium, vertical roots; common, fine pores; continuous, moderately thick, dark grayish brown (10YR 4/2 m) clay films; no carbonates; estimated 5%, angular gravelly coarse fragments; gradual, wavy boundary; 14 to 21 cm thick; pH 5.4.

Bt2 38 to 60 cm; brown to yellowish brown (10YR 4/3.5 m) loam; moderate to strong, coarse angular blocky; very firm; few, fine to medium, vertical roots; few, fine pores; many, moderately thick, dark grayish brown (10YR 4/2 m) clay films; no carbonates; estimated 10%, angular gravelly coarse fragments; gradual wavy boundary; 19 to 26 cm thick; pH 5.5.

BC 60 to 77 cm; yellowish brown (10YR 5/4 m) loam; weak to moderate, medium subangular blocky; friable; few, fine, vertical roots; few, very fine pores; no clay films; no carbonates; estimated 10%, angular gravelly coarse fragments; clear, wavy boundary; 14 to 20 cm thick; pH 6.0.

Ck 77 to 98+ cm; yellowish brown (10YR 5/4 m) silt loam; few, fine, prominent, yellowish red (5YR 5/6) mottles; weak, medium subangular blocky; friable to firm; few, fine vertical roots; few, very fine pores; no clay films; moderately calcareous; moderately effervescent; estimated 10% angular gravelly coarse fragments; pH 7.9.

Comments:

A thin Ah horizon (1 to 4 cm thick) is often found in the surface mineral soil. On lower slope positions with imperfect internal soil drainage a similar pedon is found but with yellowish brown and yellowish red mottles in the Ae, AB, Bt and BC horizons. Depth to carbonates varies between 75 and 105 cm. Estimated coarse fragments ranges from 10 to 20 percent in the C horizon.

Along the east side of the park in more hummocky topography a higher percentage of coarse fragments is found throughout the pedon. These soils have been mapped as a bouldery phase with up to 30% angular cobbly and boulder size coarse fragments as in Pedon Description 1B.

Pedon Description 1B

Described by:	P. H. Crown
Location:	No. 2; 6.4 km south of north boundary, 1.6 km west of east boundary
Landform:	hummocky moraine
Slope:	10 percent, upper slope position
Aspect:	southwest
Elevation:	433 m a.s.l.
Relief:	12 m
Vegetation:	dense Populus tremuloides (trembling aspen) with dense shrub cover of Rosa Acicularis (wild rose) Corylus Cornuta (beaked hazelnut) and Rubus strigosus (wild red raspberry). Herbs include Heracleum lanatum (cow parsnip) and Vicia americana (american vetch).

LF 4 to 0 cm; very dark gray (10YR 3/1 d) relatively undecomposed leaf litter; abundant, very fine to medium, random roots; abrupt, smooth boundary; 3 to 6 cm thick; pH 5.8.

Ae 0 to 13 cm; light gray (10YR 7/1 d) sandy loam; moderate, fine platy; slightly hard; abundant, very fine to medium, oblique roots; many, very fine to fine pores; no clay films; no carbonates; estimated 10% angular gravelly, 10% angular cobbly coarse fragments; clear, wavy boundary; 9 to 17 cm thick; pH 5.8.

AB 13 to 20 cm; gray (10YR 5/1 d) loam; moderate to strong, fine angular blocky; hard; abundant, very fine to medium, vertical roots; common, very fine pores; no clay films; no carbonates; estimated 10% angular gravelly, 10% angular cobbly coarse fragments; clear, wavy boundary; 5 to 9 cm thick; pH 5.8.

Bt 20 to 64 cm; dark grayish brown (10YR 4/2 m) clay loam; strong, coarse angular blocky; very firm; plentiful, fine, vertical roots; few, very fine pores; continuous, moderately thick, very dark grayish brown (10YR 3/2 m) clay films; no carbonates; estimated 10% angular gravelly, 15% angular cobbly coarse fragments; gradual, wavy boundary; 40 to 50 cm thick; pH 6.3.

BC 64 to 104 cm; dark grayish brown (10YR 4/2 m) clay loam; moderate, coarse subangular blocky; very firm; plentiful, very fine to fine, vertical roots; few, very fine pores; few, thin, very dark grayish brown (10YR 3/2 m) clay films in some horizontal ped faces; no carbonates; estimated 10% bouldery coarse fragments; clear, wavy boundary; 25 to 45 cm thick; pH 6.4.

Ck 104 to 120+ cm; dark grayish brown (10YR 4/2 m) loam; common, medium and coarse, distinct, yellowish red (5YR 4/6) mottles; weak, medium subangular blocky; firm; very few, fine, vertical roots; few, very fine pores; no clay films; strongly calcareous; estimated 10% angular gravelly, 10% angular cobbly, 20% bouldery coarse fragments; pH 7.8.

I-2.

Classification: Dark Gray Luvisol
Parent Material: fine textured glacial till
Soil Units:
- dominant: UCS 3, UCS 4, UCS 5, UCS 6, (UCS-TYK)2, (TYK-UCS)2, (TYK-UCS)3
- significant: C0A 4
- minor: (MIQ-C0A)2, (MIQ-C0A)3

Pedon Description:

Described by: P. H. Crown
Location: No. 28; 1.8 km east of west boundary, 2.4 km north of Highway #16

Landform:	hummocky moraine
Slope:	13 percent, upper slope position
Aspect:	southwest
Elevation:	432 m a.s.l.
Estimated Drainage:	well drained
Vegetation:	Rosa acicularis (wild rose), Corylus cornuta (beaked hazelnut), heavily browsed, Populus tremuloides (trembling aspen), Trifolium repens (white clover), Gramineae (grasses) Heracleum lanatum (cow parsnip).

Ah 0 to 2 cm; black (10YR 2/1 m) loam; weak very fine to fine granular; friable; abundant, very fine, vertical roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 1 to 4 cm thick; pH 6.3.

Ahe 2 to 6 cm; very dark gray to dark gray (10YR 3.5/1 m) loam; weak, very fine to fine granular; friable; plentiful, fine, vertical roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 3 to 7 cm thick; pH 6.3.

Ae 6 to 17 cm; pale brown (10YR 6/3 m) loam; moderate, fine platy; friable; plentiful, fine, vertical roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 8 to 13 cm thick; pH 6.4.

II AB 17 to 24 cm; yellowish brown (10YR 5/4) loam; moderate, fine, subangular blocky; firm; plentiful, fine, vertical roots; no clay films; no carbonates; estimated 15% angular cobbly coarse fragments; clear, wavy boundary; 5 to 8 cm thick; pH 6.2.

II Bt1 24 to 53 cm; brown (10YR 5/3 m) clay loam; strong, medium, subangular blocky; very firm; plentiful, fine, vertical roots; continuous, thick, dark grayish brown (10YR 4/3) clay films; no carbonates; estimated 15% angular gravelly and angular cobbly coarse fragments; gradual, wavy boundary; 25 to 30 cm thick; pH 5.1.

II Bt2 53 to 95 cm; brown (10YR 5/3m) clay loam; strong, coarse, subangular blocky; very firm; few, fine, vertical roots; continuous, thick clay films, no carbonates; estimated 15% angular gravelly and angular cobbly coarse fragments; 35 to 40 cm thick; pH 4.8.

II BC1 95 to 110 cm; yellowish brown (10YR 5/4 m) clay loam; few, fine, prominent, dark red (2.5YR 3/6) and reddish yellow (7.5YR 6/8) mottles; weak, very coarse, subangular blocky; firm, very few, fine, vertical roots; no clay films; no carbonates; estimated 20% angular gravelly and angular cobbly coarse fragments; abrupt wavy boundary; 10 to 20 cm thick; pH 6.0.

IIBC2 110 to 125+ cm; yellowish brown (10YR 5/4 m) clay loam; few, fine, prominent, dark red (2.5YR 3/6) and reddish yellow (7.5YR 6/8) mottles; very weak, coarse, angular blocky; firm; no roots; no clay films; weakly calcareous; pH 6.1.

I-3.

Classification:	Dark Gray Luvisol (cultivated)
Parent Material:	fine textured glacial till
Soil Units:	- dominant: UCS 8, (UCS-MCO)2, (UCS-LTH)2

Pedon Description

Described by:	P. H. Crown
Location:	No. 31; 0.8 km north of Highway #16, 0.3 km west of east boundary
Landform:	undulating moraine
Slope:	3 percent, middle slope position
Aspect:	northeast
Elevation:	712 m a.s.l.
Relief:	1.2 m
Estimated Drainage:	well drained
Vegetation:	mixture of Medicago sativa (alfalfa) and Bromus sp (brome) used for hay

Ap 0 to 16 cm; very dark gray (10YR 3.5/1 m) silt loam; weak to moderate, fine, granular; friable; abundant, fine, vertical roots; no clay films; no carbonates; estimated 5% angular gravelly coarse fragments; abrupt, irregular boundary; 14 to 20 cm thick; pH 6.3.

Ae 16 to 24 cm; grayish brown (10YR 5/2 m) silt loam; moderate, fine platy; friable; plentiful, fine, vertical roots; no clay films; no carbonates; estimated 5% angular gravelly coarse fragments; clear broken boundary; 0 to 8 cm thick; pH 6.0.

AB 24 to 30 cm; dark grayish brown (10YR 4/2 m) silty clay loam; moderate, fine angular blocky; firm; no clay films; no carbonates; estimated 10% angular gravelly coarse fragments; clear wavy boundary; 6 to 10 cm thick; pH 6.0.

Bt1 30 to 58 cm; dark grayish brown (10YR 4/2 m) clay; strong, medium, subangular blocky; very firm; few, fine, vertical roots; continuous, thick, dark gray (10YR 4/1) clay films; no carbonates; estimated 15% angular gravelly coarse fragments; gradual; wavy boundary; 25 to 30 cm thick; pH 6.6.

Bt2 58 to 95 cm; dark grayish brown (10YR 4/2 m) clay; strong, coarse, subangular blocky; very firm; very few, fine, vertical roots; common, thick, dark gray (10YR 4/1) clay films; no carbonates; estimated 15% angular gravelly coarse fragments; 36 to 40 cm thick; field 6.8.

Ckg 95 to 115+ dark grayish brown to brown (10YR 4.5/3.5 m) silty clay loam; common fine and medium, yellowish red (5YR 4/6) mottles; weak, medium subangular blocky; firm; no roots; no clay films; weakly calcareous; estimated 15% angular gravelly coarse fragments; pH 7.4.

Comments:

In Soil Unit (UCS-LTH) 2 the Ap horizon has a sandy loam texture.

I-4.

Classification:	Dark Gray Luvisol
Parent Material:	fine textured glacial till with a thin (<30 cm) veneer of glaciofluvial sediments
Soil Units:	- dominant: UCS 7 - significant: C0A 6 - minor: (C0A-HDY)2, (C0A-HDY)3, (C0A-NC)1, (NC-C0A)1

Pedon Description

Described by:	P. H. Crown
Location:	No. 30; west of Tawayik Lake; 2.4 km east of west boundary, north of Highway #16.
Landform:	hummocky moraine
Slope:	8 percent, upper slope position
Aspect:	southwest
Elevation:	738 m a.s.l.
Relief:	13.7 m
Estimated Drainage:	
Vegetation:	open Populus tremuloides (trembling aspen), Rosa acicularis (wild rose), Corylus cornuta (beaked hazelnut); Heracleum lanatum (cow parsnip), Vicia americana (american vetch) and Gramineae (grasses).

Ah 0 to 4 cm; very dark gray (10YR 3/1 m) fine sandy loam; weak, very fine, granular; friable; abundant, fine to medium, vertical roots; no clay films; no carbonates; no coarse fragments; clear wavy boundary; 4 to 7 cm thick; pH 6.5.

Ahe 4 to 20 cm; dark gray (10YR 4/1 m) fine sandy loam; very weak, fine granular; friable; abundant, fine to medium vertical roots; no clay films; no carbonates; no coarse fragments, clear wavy boundary; 12 to 16 cm thick; pH 6.0.

Ae 20 to 27 cm; gray (10YR 5.5/1 m) fine sandy loam; weak, fine, platy, very friable; plentiful fine and medium, vertical roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 6 to 8 cm thick; pH 6.0.

II AB 27 to 32 cm; grayish brown (10YR 5/2 m) sandy clay loam; moderate to strong, fine to medium, angular blocky; firm; no clay films; no carbonates; estimated 5% angular gravelly coarse fragments; clear wavy boundary; 4 to 7 cm thick; pH 6.1.

II Bt 32 to 59 cm; dark grayish brown (10YR 4/2 m) clay loam; strong, medium, subangular blocky; very firm; plentiful, fine, vertical roots; continuous, thick, very dark grayish brown (10YR 3/2) clay films; no carbonates; estimated 10% angular gravelly coarse fragments; gradual, wavy boundary; 26 to 30 cmthick; pH 6.4.

II Btg 59 to 90 cm, dark gray (10YR 4/1 m) clay loam; common, medium, prominent, yellowish red (5YR 5/8) mottles; strong, coarse, subangular blocky; very firm; few fine, vertical roots; continuous, thick, very dark gray (10YR 3/1) clay films; no carbonates; estimated 10% angular gravelly coarse fragments; gradual, wavy boundary; 35 to 40 cm thick; pH 6.3.

II Ckg 90 to 115+; dark grayish brown (10YR 4/2 m) clay loam; common, fine and medium, prominent, yellowish red (5YR 5/8) mottles; very few, fine, vertical roots; no clay films; weakly calcareous; estimated 15% coarse fragments; pH 7.4.

I-5.

Classification:	Orthic Gray Luvisol
Parent Material:	fine textured glacial till with a thin veneer (<30 cm) of glaciofluvial sediments
Soil Units:	- dominant: C0A 6, (C0A-HDY)2, (C0A-HDY)3, (C0A-NC)1 - significant: (NC-C0A)1 - minor: UCS 7

Pedon Description

Described by:	P. H. Crown
Location:	No. 14; 1.1 km west of main park road on White Spruce Trail
Landform:	ridged moraine
Slope:	7 percent, middle to lower slope position
Aspect:	northeast
Elevation:	729 m a.s.l.
Relief:	7.6 m
Estimated Drainage:	moderately well drained

Vegetation: Dense Populus tremuloides (trembling aspen) with some Populus balsamifera (balsam poplar). Shrubs include Rosa acicularis (wild rose), Corylus cornuta (beaked hazelnut), and Rubus strigosus (wild red raspberry). Herbs include Vicia americana (american vetch) and Heracleum lanatum (cow parsnip).

LF 6 to 0 cm; dark reddish brown (5YR 2.5/2 d) relatively undecomposed leaf litter with twigs; abundant, medium, random roots; abrupt, smooth boundary; 4 to 9 cm thick.

Ah 0 to 3 cm; very dark brown (10YR 2/2 m) sandy loam; weak, very fine granular; friable; plentiful, medium, random roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 2 to 4 cm thick; pH 6.3.

Ae 3 to 22 cm; very pale brown (10YR 6/3 m) loamy sand; very weak, fine platy; very friable; plentiful, medium, oblique roots; no clay films; no carbonates; no coarse fragments; abrupt, wavy boundary; 12 to 18 cm thick; pH 5.4.

II Ae 22 to 27 cm; light gray (10YR 6/1 m) loam; moderate to strong, fine platy; friable; few fine to medium vertical roots; no clay films; no carbonates; estimated 5% angular gravelly coarse fragments; clear wavy boundary; 4 to 8 cm thick; pH 5.8.

II AB 27 to 31 cm; gray (10YR 5.5/1 m) loam; moderate to strong, fine angular blocky; firm; few, fine, vertical roots; no clay films; no carbonates; estimated 5% coarse fragments; clear, wavy boundary; 2 to 5 cm thick; pH 5.3.

II Bt 31 to 68 cm; dark grayish brown (10YR 4/2 m) clay loam; strong, coarse subangular blocky; very firm; few, fine, vertical roots; continuous, thick dark gray (10YR 4/1) clay films in all voids, channels and on all ped faces; no carbonates; estimated 10% angular gravelly coarse fragments; gradual, wavy boundary; 35 to 40 cm thick; pH 6.3.

II Btg 68 to 100 cm; dark grayish brown (10YR 4/2 m) clay loam; common, medium, distinct, yellowish red (5YR 4/6) and red (2.5YR 4/8) mottles; strong, coarse, subangular blocky; very firm; few, fine, vertical roots; many, thick, dark gray (10YR 4/1) clay films in many voids, channels and on some ped faces; no carbonates; estimated 10% angular gravelly and angular cobbly coarse fragments; gradual, wavy boundary; 30 to 34 cm thick; pH 6.3.

II BCg 100 to 116 cm; dark grayish brown to brown (10YR 4/2.5) clay loam; common, medium, distinct, yellowish red (5YR 4/6) and red (2.5YR 4/8) mottles; moderate, medium, subangular blocky; firm; few, fine, vertical roots; few moderately thick, dark gray (10YR 4/1) clay films in some voids and channels; no carbonates; estimated 15% angular gravelly coarse fragments; clear, wavy boundary; 14 to 18 cm thick; pH 6.8.

IICkg 116 to 125+ cm; dark grayish brown to brown (10YR 4/2.5 m) clay loam; common, medium, distinct, yellowish red (5YR 4/6) and red (2.5YR 4/8) mottles; moderate medium, subangular blocky; firm; very few, fine, vertical roots; no clay films; weakly calcareous; estimated 15% angular gravelly coarse fragments; pH 7.5.

I-6.

Classification: Humic Luvic Gleysol
Parent Material: fine textured glacial till
Soil Units:
- dominant: MPV 3
- significant: COA 3, UCS 3, UCS 5, (COA-HDY)3, (MIQ-COA)3, (TYK-UCS)3
- minor: COA 2, COA 4, COA 6, (COA-HDY)1, (COA-NC)1, (NC-COA)1, (UCS-MCO)2, UCS4, UCS 6, UCS 7, (UCS-TYK)2

Pedon Description

Described by: P. H. Crown
Location: No. 29; 0.8 km south of Highway #16 on road to south warden's cabin
Landform: ridged moraine
Slope: 0 percent, depression
Aspect: level
Elevation: 723 m a.s.l.
Relief: 10.7 m
Estimated Drainage: poor
Vegetation: Populus tremuloides (trembling aspen), Rosa acicularis (wild rose), Corylus cornuta (beaked hazelnut), Rubus strigosus (wild red raspberry), Vicia americana (american vetch), Aralia nudicaulis (wild sarsaparilla), Ribes triste (wild red currant)

LF 3 to 0 cm; dark reddish brown (5YR 2.5/2 m) relatively undecomposed leaf litter with 20 to 50% soft woody material; abundant, fine to medium, random roots; no coarse fragments; abrupt, smooth boundary; 2 to 6 cm thick; pH 6.3.

Ah 0 to 8 cm; black (10YR 2/1 m) clay loam; weak, fine granular; friable; abundant, fine to medium, random roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 5 to 10 cm thick; pH 6.4.

Aheg 8 to 12 cm; dark gray (10YR 4/1 m) silt loam; common, fine to medium, distinct, strong brown (7.5YR 5/6) mottles; weak, fine platy; friable; plentiful, fine to medium oblique roots; common, fine pores; no clay films; no carbonates; estimated 5% angular gravelly coarse fragments; clear, wavy boundary; 3 to 8 cm thick; pH 5.8.

Aeg 12 to 21 cm; light brownish gray (10YR 6/2 m) silt loam; common, medium, strong brown (7.5YR 5/6) mottles; moderate to strong, fine to medium platy; friable; plentiful, fine and medium, oblique roots; many, fine and medium, vesicular pores; no clay films; no carbonates; estimated 10% angular gravelly coarse fragments; clear, wavy boundary; 7 to 13 cm thick; pH 5.8.

ABg 21 to 30 cm; grayish brown (10YR 5/2 m) loam; many, medium, distinct, strong brown (7.5YR 5/6) and brownish yellow (10YR 6/6) mottles; moderate to strong, fine to medium, subangular bloacky; firm; plentiful, fine and medium, oblique roots; no clay films; no carbonates; estimated 10% angular gravelly and 5% angular cobbly coarse fragments; clear, wavy boundary; 7 to 11 cm thick; pH 5.8.

Btg 30 to 85 cm; grayish brown (10YR 5/2m) clay loam; many, medium and coarse, strong brown (7.5YR 5/6) and brownish yellow (10YR 6/6) mottles; strong, medium to coarse, subangular blocky; very firm; few, fine, vertical roots; continuous, thick, very dark gray (10YR 3/1) clay films; no carbonates; estimated 10% angular gravelly and 10% angular cobbly coarse fragments; gradual, wavy boundary; 40 to 60 cm thick; pH 6.3.

BCg 85 to 115 cm; gray (10YR 5/1 m) loam; many medium and coarse, strong brown (7.5YR 5/6) and brownish yellow (10YR 6/6) mottles; weak to moderate, coarse, subangular blocky; firm; no carbonates; estimated 10% angular gravelly coarse fragments; pH 6.8.

I-7.

Classification:	Gray Solodized Solonetz
Parent Material:	fine textured glacial till
Soil Units:	- dominant: DST 4

Pedon Description

Described by:	P. H. Crown
Location:	No. 27; 0.3 km west of east boundary, 4 km north of Highway #16 ("soap-holes" area)
Landform:	undulating moraine
Slope:	4 percent, middle slope position
Aspect:	south

Elevation: 712 m a.s.l.
Relief: 3.1 m
Estimated Drainage: moderately well to imperfect
Vegetation: Gramineae (grasses), trifolium repens (white clover), Artemisia paberlaris (slender sage), Archillea lanulosa (feathery yarrow)

Ah 0 to 4 cm; black (10YR 2/1 m) loam; weak to moderate, fine granular; firm; abundant, fine, random roots; no clay films; no carbonates;weakly saline; estimated 10% angular gravelly and 5% angular cobbly coarse fragments; clear wavy boundary; 3 to 8 cm thick; pH 6.3.

Ae 4 to 7 cm; gray (10YR 5/1 m) loam; weak to moderate; fine platy; firm; abundant, very fine, random roots; no clay films; no carbonates; weakly saline; estimated 10% angular gravelly coarse fragments; abrupt, wavy boundary; 2 to 5 cm thick; pH 6.7.

Bnt 7 to 22 cm; very dark gray (10YR 3/1 m) clay loam; strong, medium to coarse columnar; very firm; plentiful, very fine, vertical roots along cracks; continuous, thick, black (10YR 2/1) clay films in all voids, channels and on ped faces; no carbonates; moderately saline; estimated 10% angular gravelly coarse fragments; clear , wavy boundary; 8 to 16 cm thick; pH 7.8.

Cskg 22 to 45+ cm; dark grayish brown (10YR 4/1 m) loam; few, fine, prominent, strong brown (7.5YR 5/6) mottles; strong, medium, subangular blocky; very firm; plentiful, very fine, vertical roots; no clay films; very strongly calcareous; strongly saline; estimated 15% angular gravelly coarse fragments; pH 8.2.

Comments:

The "soap-holes" themselves are Rego Gleysols with clumps of Distichlis stricta (alkali grass).

I-8.

Classification: Orthic Gray Luvisol
Parent Material: fine textured glaciolacustrine sediments
Soil Units: - dominant: MYW 3
- minor: (MIQ-COA)2, (MIQ-COA) 3

Pedon Description

Described by: P. H. Crown
Location: No. 19; 0.4 km east of main park road, 0.7 km north of Highway #16

Landform:	undulating glaciolacustrine plain
Slope:	1 percent
Aspect:	level
Elevation:	706 m a.s.l.
Relief:	1.2 m
Estimated Drainage:	moderately well to imperfect
Vegetation:	dense Populus tremuloides (trembling aspen), Roso acicularis (wild rose), Rubus strigosus (wild red raspberry), Heracleum lanatum (cow parsnip), Vicia americana (american vetch)

LF 2 to 0 cm; black (10YR 2/1 m) undecomposed leaf litter; abundant, medium, random roots; abrupt, smooth, boundary; 1 to 4 cm thick; pH 5.3.

Ah 0 to 2 cm; very dark gray (10YR 3/1 m) silt loam, weak, fine granular; friable; abundant, medium, random roots; no clay films; no carbonates; no coarse fragments; abrupt wavy boundary; 0 to 3 cm thick; pH 5.5.

Ae 2 to 12 cm; light brownish gray (10YR 6.2 m) silt loam; moderate to strong, fine to medium platy; firm; plentiful, medium, horizontal roots; no clay film; no carbonates; no coarse fragments; clear, wavy, boundary; 9 to 12 cm thick; pH 5.8.

AB 12 to 15 cm; dark grayish brown (10YR 4/2 m) silt clay loam; moderate to strong, fine, subangular blocky; very firm; plentiful, medium, horizontal roots; no clay films; no carbonates; no coarse fragments; clear wavy boundary; 3 to 5 cm thick; pH 5.8.

Bt1 15 to 34 cm; dark gray (10YR 4/1 m) silty clay; strong, fine to medium, subangular blocky; very firm; plentiful, medium, oblique roots; continuous, thick, dark grayish brown (10YR 4/2) clay films; no carbonates; no coarse fragments; gradual, wavy boundary; 16 to 20 cm thick; pH 5.8.

Bt2 35 to 79 cm; dark gray (10YR 4/1 m) clay; strong, medium to coarse, subangular blocky; very firm; few, fine, oblique roots; continuous, thick, dark grayish brown (10YR 4/2) clay films; no carbonates; no coarse fragments; abrupt, wavy boundary; 40 to 45 cm thick; pH 6.4.

Ckg 79 to 95+ cm; dark gray (10YR 4/1 m) clay; common, fine, distinct, reddish yellow (7.5YR 6/8) mottles; weak to moderate, fine to medium, angular blocky; firm; very few, fine oblique roots; no clay films; weakly calcareous; no coarse fragments; pH 7.8.

Comments:

In the vicinity of the main park gate at Highway #16, the parent material is varied, with alternating silt and clay bands.

I-9.

Classification:	Dark Gray Luvisol
Parent Material:	fine textured glaciolacustrine sediments
Soil Units:	- significant: MYW 3, (TYK-UCS) 2, (TYK-UCS) 3 - minor: (MIQ-COA)2, (MIQ-COA)3, (UCS-TYK)2

Pedon Description

Described by:	P. H. Crown
Location	No. 7; 0.5 km north of Oster Warden's, on west boundary
Landform:	undulating glaciolacustrine plain
Slope:	2 percent
Aspect:	level
Elevation:	721 m a.s.l.
Relief:	0.9 m
Estimated Drainage:	moderately well drained
Vegetation:	dense, Populus tremuloides (trembling aspen), Betula pumila (swamp birch), Rosa acicularis (wild rose), Vicia americana (american vetch), Gramineae (grasses)

LF 5 to 0 cm; black (5YR 2.5/1 m) relatively undecomposed leaf litter with twigs; abundant, fine to medium, random roots; abrupt, smooth boundary; pH 6.3.

Ah 0 to 6 cm; very dark gray (10YR 3/1 m) silty clay; weak to moderate, fine granular; friable; abundant, fine, random roots; many, fine pores; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 2 to 5 cm thick; pH 6.3.

Ae 6 to 13 cm; gray (10YR 5/1 m) silty clay; weak to moderate, fine platy; friable; abundant, fine, horizontal and oblique roots; common, fine pores; no clay films; no carbonates no coarse fragments; clear, wavy boundary; 3 to 9 cm thick; pH 5.3.

AB 13 to 17 cm; dark gray (10YR 4/1 m) silty clay; weak to moderate, fine angular blocky; firm; plentiful, medium, oblique roots; few, fine pores; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 2 to 6 cm thick; pH 5.8.

Bt 17 to 46 cm; very dark grayish brown (10YR 3/2 m) heavy clay; strong, medium to coarse, angular blocky; very firm; few, fine to medium, oblique roots; few, fine pores; continuous, thick, very dark gray (10YR 3/1) clay films on all ped surfaces; no carbonates; no coarse fragments; gradual, wavy boundary; 22 to 30 cm thick; pH 5.3.

BC 46 to 73 cm; dark grayish brown (10YR 4/2 m) heavy clay; few, fine, prominent, reddish yellow (7.5YR 7/6) mottles; weak, medium to coarse subangular blocky; firm; few, fine oblique roots; few, fine pores; common, thin, very dark gray (10YR 3/1) clay films in some voids and channels; no carbonates; no coarse fragments; clear, wavy boundary; 20 to 35 cm thick; pH 6.3.

Ck 73 to 95+ cm; dark gray (10YR 4/1 m) heavy clay; few, fine, prominent, reddish yellow (7.5 YR 7/6) mottles; massive; firm; very few, fine oblique roots; few, fine pores; no clay films; moderately calcareous; no coarse fragments; pH 7.9.

I-10.

Classification:	Dark Gray Luvisol (cultivated)
Parent Material:	fine textured glaciolacustrine sediments
Soil Units:	- dominant: MCO 3
	- significant: (UCS-MCO)2

Pedon Description

Described by:	P. H. Crown
Location:	No. 3; southeast of Oster Lake warden's cabin in hay field
Landform:	undulating glaciolacustrine
Slope:	2 percent, upper slope position
Aspect:	level
Elevation:	723 m a.s.l.
Relief:	1.2 m
Estimated Drainage:	moderately well drained
Vegetation:	Alfalfa-brome hay

Ap 0 to 11 cm; very dark gray (10YR 3/1 m) silty clay loam; weak, fine granular; firm; abundant, very fine to fine, random roots; abundant, fine pores; no clay films; no carbonates; no coarse fragments; abrupt, wavy boundary; 10 to 15 cm thick; pH 6.7.

Ae 11 to 14 cm; grayish brown (10YR 5/2 m) silty clay loam; moderate, fine, platy; firm; plentiful, very fine to fine, random roots; common, very fine to fine pores; no clay films; no carbonates no coarse fragments; clear, broken boundary; 0 to 7 cm thick; pH 6.3.

AB 14 to 18 cm; dark grayish brown (10YR 4/2 m) silty clay peds coated with light gray (10YR 6/1 m) grains; strong, medium, subangular blocky; very firm; plentiful, very fine to fine, vertical roots; few, very fine pores; no clay film; no carbonates; no coarse fragments; clear, wavy boundary; 2 to 6 cm thick; pH 5.8.

Btl 18 to 50 cm; dark grayish brown (10YR 4/2 m) heavy clay; few, medium, distinct, dark reddish brown (5YT 3/3) mottles; strong, coarse, angular blocky; very firm; few, fine, vertical roots; few, very fine pores; many, moderately thick, very dark grayish brown (10YR 3/2) clay films on all ped faces; no carbonates; no coarse fragments; gradual, wavy boundary; 30 to 40 cm thick; pH 5.4.

Bt2 50 to 70 cm; dark grayish brown (10YR 3.5/2 m) clay; few, fine, distinct, dark reddish brown (5YR 3/3) and strong brown (7.2YR 5/6) mottles; strong, coarse angular blocky; very firm; few, very fine, vertical roots; few, very fine pores; common, moderately thick, very dark grayish brown (20YR 3/2) clay films on some vertical ped faces; no carbonates; no coarse fragments; clear, wavy boundary; 17 to 24 cm thick; pH 6.8.

Ck 70 to 90+ cm; dark brown (10YR 4/3 m) clay loam; few, medium and coarse, distinct, dark reddish brown (5YR 3/3) and strong brown (7.5YR 5/6) mottles; very few, very fine, vertical roots; few, very fine pores; no clay films; weakly calcareous; estimated 10% angular gravelly coarse fragments; pH 8.0.

I-11.

Classification: Humic Gleysol
Parent Material: fine textured glaciolacustrine sediments
Soil Units:
- dominant: SWY 4
- significant: (MiQ-COA)3, (TYK-UCS)3
- minor: MYW 3, (MIQ-COA)2, (TYK-UCS)2, (UCS-MCO)3, (UCS-TYK)2

Pedon Description

Described by: P. H. Crown
Location: No. 33; o.3 km north of Oster Lake, 1 km east of west boundary
Landform: undulating glaciolacustrine
Slope: 1%
Aspect: level
Elevation: 720 m a.s.l.
Relief: 0.6 m
Estimated Drainage: poorly drained
Vegetation: Populus tremuloides (trembling aspen), Salix sp. (willows), Rosa acicularis (wild rose), Gramineae (grasses)

LF 8 to 0 cm; black (10YR 2/1 m) relatively undecomposed leaf litter; abundant, fine and medium, random roots; abrupt, smooth boundary; 6 to 8 cm thick.

Ah 0 to 12 cm; black (10YR 2/1 m) silty clay loam; weak, fine granular; friable; abundant, fine and medium, random roots; no clay films; no carbonates; no coarse fragments; abrupt, wavy boundary; 11 to 14 cm thick; pH 6.2.

Aeg 12 to 20 cm; gray (10YR 5.5/1 m) silty clay loam; common, medium, distinct, strong brown (7.5YR 5/6) mottles weak to moderate, fine, platy; firm; no clay films; no carbonates; no coarse fragments; clear wavy boundary; 6 to 9 cm thick; pH 6.1.

Bg 20 to 58 cm; grayish brown (10YR 4.5/2 m) clay loam; many, medium, and coarse, distinct, strong brown (7.5YR 5/6) mottles; weak coarse, subangular blocky; very firm; plentiful, fine, vertical roots; no clay films; no carbonates; no coarse fragments; clear wavy boundary; 35 to 40 cm thick; pH 6.7.

Cg 58 to 85 cm; grayish brown (10YR 5/2 m) clay loam; common, medium, distinct, strong brown (7.5YR 5/6) mottles; massive, firm; few medium, oblique roots; no clay films; no carbonates; no coarse fragments; clear wavy boundary; 26 to 30 cm thick; pH 6.9.

Ckg 85 to 95+ cm; grayish brown (10YR 5/2 m) clay loam; common, medium, distinct, strong brown (7.5YR 5/6) mottles; massive; firm; no roots; no clay films; weakly calcareous; no coarse fragments; pH 7.3.

I-12.

Classification: Orthic Gray Luvisol
Parent Material: fine textured glaciolacustrine veneer over fine textured till
Soil Units: - dominant: (MIQ-COA)2, (MIQ-COA)3
- minor: (TYK-UCS)2, (TYK-UCS)3, (UCS-TYK)2

Pedon Description

Described by: P. H. Crown
Location: No. 34; 0.4 km east of Littel Tawayik Lake, 0.3 km north of Highway #16
Landform: undulating to ridged moraine with glaciolacustrine veneer
Slope: 3 percent, upper slope position
Aspect: northwest
Elevation: 717 m a.s.l.
Relief: 1.5 m
Estimated Drainage: moderately well drained
Vegetation: Populus tremuloides (trembling aspen) with dense shrub cover of Rosa acicularis (wild rose) and Rubus strigosus (wild red raspberry). Herbs include Heracleum lanatum (cow parsnip) and Vicia americana (american vetch) plus Gramineae (grasses)

LF 4 to 0 cm; black (10YR 2/1 m) undecomposed leaf litter; abundant, fine and medium, random roots; abrupt, smooth boundary; 3 to 6 cm thick; pH 5.6.

Ae 0 to 12 cm; grayish brown (10YR 5/2 m) silt loam; moderate, fine platy; friable; abundant, fine and medium, random roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 8 to 13 cm thick; pH 5.5.

AB 12 to 16 cm; dark gray (10YR 4/1 m) clay loam; moderate, fine, angular blocky; firm; plentiful, fine and medium, oblique roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 3 to 6 cm thick; pH 5.8.

Bt 16 to 47 cm; very dark grayish brown (10YR 3/2 m) clay; strong, medium to coarse, angular blocky; very firm, few, fine, vertical roots; continuous, thick, very dark gray (10YR 3/1) clay films on all ped faces; no carbonates; estimated 5 percent angular gravelly coarse fragments; abrupt, smooth boundary; 33 to 44 cm thick; pH 6.4.

11 Bt 57 to 85 cm; dark brown (10YR 3/2 m) clay loam; few, fine, distinct, strong brown (7.5YR 5/6) mottles; strong, medium, subangular blocky; very firm; few, fine, vertical roots; continuous, thick, very dark grayish brown (10YR 3/2) clay films; no carbonates; estimated 15 percent angular gravelly coarse fragments; gradual wavy boundary; 25 to 30 cm thick; pH 6.4.

II BC 85 to 98 cm; brown (10YR 4/3 m) clay loam; few, fine and medium, distinct, strong brown (7.5YR 5/6) and reddish brown (5YR 4/4) mottles; moderate, medium, subangular, blocky; firm; very few, fine, vertical roots; common moderately thick, dark grayish brown (10YR 4/2) clay films on some vertical ped faces; no carbonates; estimated 15 percent angular gravelly coarse fragments; clear, wavy boundary; 12 to 18 cm thick; pH 6.8.

II Ck 98 to 110+ brown (10YR 4/3m) clay loam; few, fine and medium, distinct, strong brown (7.5YR 5/6) and reddish brown (5YR 4/4) mottles; weak, medium, subangular blocky; firm; no roots; no clay films; moderately calcareous; estimated 15 percent gravelly coarse fragments; pH 7.8.

I-13.

Classification:	Dark Gray Luvisol
Parent Material:	fine textured glaciolacustrine veneer over fine textured glacial till
Soil Units:	- dominant: (TYK-UCS)2, (TYK-UCS)3 - significant: (UCS-TYK)2 - minor: (MIQ-COA)2, (MIQ-COA)3

Pedon Description

Described by:	P. H. Crown
Location:	No. 10; 1.1 km south of Highway #16, 0.5 km east of road to south warden's cabin
Landform:	undulating moraine with glaciolacustrine veneer
Slope:	3 percent, middle slope position
Aspect:	northeast
Elevation:	723 m a.s.l.
Relief:	1.2 m
Estimated Drainage:	moderately well drained
Vegetation:	open Populus tremuloides (trembling aspen), Rosa acicularis (wild rose), Vicia americana (american vetch), Heracleum lanatum (cow parsnip), Gramineae (grasses)

LF 3 to 0 cm; very dark brown (10YR 2/2 m) relatively undecomposed leaf litter; abundant, fine and medium, random roots; abrupt, smooth boundary; 2 to 6 cm thick; pH 5.8.

Ah 0 to 7 cm; very dark brown (10YR 2/2 m) silt loam; weak, fine granular; friable; abundant; medium, random roots; many, fine pores; no clay films; no carbonates no coarse fragments; clear, wavy boundary; 5 to 10 cm thick; pH 5.8.

Ae 7 to 13 cm; grayish brown (10YR 5/2 m) silt loam; moderate, fine platy; friable; abundant, fine and medium, oblique roots; many, fine pores; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 5 to 9 cm thick; pH 5.8.

AB 13 to 23 cm; dark grayish brown (10YR 4/1 m) silty clay; moderate, fine, subangular blocky; firm; plentiful, fine, vertical roots; many, very fine, random pores; no clay films; no carbonates; no coarse fragments; clear wavy boundary; pH 5.8.

Bt 23 to 83 cm; dark grayish brown (10YR 4/2 m) silty clay; strong, coarse, subangular blocky; very firm; plentiful, fine, vertical roots; common, very fine pores; continuous, thick, very dark grayish brown (10YR 3/2) clay films; no carbonates; no coarse fragments; clear, abrupt boundary; 45 to 60 cm thick; pH 6.3.

II BC 83 to 97 cm; yellowish brown (10YR 5/4 m) clay loam; moderate, medium to coarse, subangular blocky; very firm; few, fine, vertical roots; common, moderately thick, very dark grayish brown (10YR 4/2) clay films in some channels and on some ped faces; no carbonates; estimated 10% angular gravelly coarse fragments; clear, wavy boundary; 10 to 15 cm thick; pH 6.4.

II Ck 97 to 110+ cm; yellowish brown (10YR 5/4 m) clay loam; few, fine, distinct, strong brown (7.5YR 5/6) mottles; very weak, medium, subangular blocky; firm; very few, fine, vertical roots; no clay films; weakly calcareous; estimated 10% angular gravelly coarse fragments; pH 7.6.

I-14.

Classification:	Brunisolic Gray Luvisol
Parent Material:	Glaciofluvial sediments
Soil Units:	- significant: (COA-NC)1, (NC-COA)1 - minor: (COA-HDY)2, (COA-HDY)3

Pedon Description

Described by:	P. H. Crown
Location:	No. 1; southeast of Astotin Lake, 2.7 km west of east boundary, 5.6 km south of north boundary
Landform:	ridged to hummocky moraine with glaciofluvial sediments
Slope:	10 percent, upper slope position
Aspect:	northwest
Elevation:	732 m a.s.l.

Relief: 9 m
Estimated Drainage: rapidly drained
Vegetation: dense Picea glauca (white spruce), no shrubs, Equisetum arvense (common horsetail), Linnea borealis (twinflower)

LF 6 to 0 cm; very dark grayish brown (10YR 3/2 m) relatively undecomposed mat of needles and twigs; abundant, fine to medium random roots; abrupt, smooth boundary; 4 to 9 cm thick; pH 4.5.

Ae 0 to 10 cm; light brownish gray (10YR 6/2 m) loamy sand; single grain; very friable; plentiful, fine to medium, horizontal roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 7 to 14 cm thick; pH 4.5.

Bm1 10 to 28 cm; yellowish red (5YR 4/6 m) loamy sand; single grain; friable; plentiful, fine to medium, horizontal roots; no clay films; no carbonates; no coarse fragments; gradual, wavy boundary; 12 to 29 cm thick; pH 5.2.

Bm2 28 to 44 cm; brown (7.5YR 5/4 m) sand; single grain; very friable; few, fine to medium, oblique roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 6 to 20 cm thick; pH 6.2.

Bt 44 to 84 cm; pale brown (10YR 6/3 m) sandy loam matrix with brown (7.5YR 4/4 m) sandy clay loam bands, 2 cm thick; stratified, single grain and weak, fine roots; common, thin, brown (7.5YR 4/4 m) clay films in bands as visible bridges between sand grains; no carbonates; no coarse fragments; clear, wavy boundary; 26 to 50 cm thick; pH 6.2.

BC 84 to 100 cm; pale brown (10YR 5/3 m) loamy sand; single grain; friable; very few, fine vertical roots; no clay films; no carbonates estimated 50% gravelly coarse fragments; pH 6.8.

I-15.

Classification: Eluviated Eutric Brunisol
Parent Material: Glaciofluvial blanket over till
Soil Units:
- dominant: (NC-COA) I
- significant: (COA-NC)I
- minor: (COA-HDY)2, (COA-HDY)3

Pedon Description

Described by: P. H. Crown
Location: No. 17; 3.5 km south of Highway #16, 0.2 km east of west boundary
Landform: ridged moraine with glaciofluvial blanket

Slope:	11 percent, upper slope position
Aspect:	east
Elevation:	732 m a.s.l.
Relief:	5.5 m
Estimated Drainage:	rapidly drained
Vegetation:	Populus tremuloides (trembling aspen), Rosa acicularis (wild rose), Corylus cornuta (beaked hazelnut), Rubus strigosus (wild red raspberry), Vicia americana (american vetch), Giamineae (grasses)

LF 8 to 0 cm; black (10YR 2/1 m) partially decomposed leaf litter; abundant, fine and medium, random roots; no coarse fragments; abrupt, smooth boundary; 5 to 9 cm thick; pH 6.1.

Ae 0 to 5 cm; gray (10YR 5/1 m) sand; single grain; loose; abundant, fine to medium, random roots; no clay films; no carbonates; estimated 10% gravelly coarse fragments; abrupt, broken boundary; 0 to cm thick; pH 5.8.

Bm1 5 to 18 cm; brown (10YR 4/3 m) loamy sand; single grain; loose; abundant, fine, vertical roots; no clay films; no carbonates; estimated 15% gravelly coarse fragments; clear, wavy boundary; 10 to 14 cm thick; pH 5.8.

Bm2 18 to 52 cm; yellowish brown (10YR 5/6 d) sand; single grain; loose; plentiful, fine, vertical roots; no clay films; no carbonates; estimated 15% gravelly coarse fragments; clear, wavy boundary; 30 to 38 cm thick; pH 5.8.

II Bm 52 to 112 cm; brownish yellow (10YR 6/6 d) coarse sand; single grain; loose; plentiful, fine, vertical roots; no clay films; no carbonates; no coarse fragments; abrupt, wavy boundary; 50 to 65 cm thick; pH 6.3.

III C 112 to 120 cm; pale brown (10YR 6/3 d) very fine sandy loam; single grain; friable; few, very fine, vertical roots; no clay films; no carbonates; no coarse fragments; abrupt, wavy boundary; 6 to 8 cm thick; pH 6.4.

III Ck 120 to 135+ cm; light yellowish brown (10YR 6/4 d) coarse sand; few, medium, distinct, brownish yellow (10YR 6/8) mottles; single grain; loose; few, very fine, vertical roots; no clay films; weakly calcareous; no coarse fragments; pH 7.8.

I-16.

Classification:	Humic Luvic Gleysol
Parent Material:	Glaciofluvial sediments
Soil Units:	- significant: (COA-NC)1, (NC-COA)1, (COA-HDY)2

Pedon Description

Described by:	P. H. Crown
Location:	No. 24; southeast of Astotin Lake, 2.7 km west of east boundary, 5.5 km south of north boundary
Landform:	level glaciofluvial
Slope:	0 percent, depression
Aspect:	level
Elevation:	726 m a.s.l.
Relief:	3 m
Estimated Drainage:	poorly drained
Vegetation:	tall Populus tremuloides (trembling aspen), a few Picea glauca (white spruce), 5% Betula papyrifea (white birch), Rosa acicularis (wild rose), Rubus strigosus (wild red raspberry), Aralia nudicaulis (wild sarsaparilla), Heracleum lanatum (cow parsnip), Ribes trist (wild red currant)

Om 16 to 0 cm; dark reddish brown (5YR 2.5/2 m) forest peat; abundant, medium and coarse; horizontal roots; abrupt, smooth boundary; 12 to 18 cm thick; pH 5.3.

Aeg 1 0 to 13 cm; light brownish gray (10YR 6/2 m) sandy loam; few, fine, distinct, strong brown (7.5 5/6) mottles, very weak, fine platy; very friable; plentiful, medium and coarse, horizontal roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 10 to 14 cm thick; pH 5.2.

Aeg 2 13 to 25 cm; light gray (10YR 7/1 m) loamy sand; common, coarse, prominent, strong brown (7.5YR 5/6) and reddish brown (5YR 4/4) mottles; single grain; loose; plentiful, medium, horizontal roots; no clay film; no carbonates; no coarse fragments; abrupt, wavy boundary; 10 to 12 cm thick; pH 5.6.

Btg 25 to 43 cm; gray (10YR 5/1 m) sandy loam; common, medium and coarse, prominent, strong brown (7.5YR 5/6) and reddish brown (5YR 4/4) mottles; weak to moderate, fine to medium, subangular blocky; firm; few, medium, horizontal roots; many thin, grayish brown (10YR 5/2) clay films; no carbonates; no coarse fragments; clear, wavy boundary; 15 to 20 cm thick; pH 6.2.

Cg 43 to 70 cm; light gray (10YR 7/2 m) loamy sand; common, coarse, distinct, strong brown (7.5YR 5/6) mottles: single grain; very friable; few, fine, oblique roots; no clay films; no carbonates; no coarse fragments; abrupt, smooth boundary; 25 to 30 cm thick; pH 6.7.

II Ckg 70 to 100 cm; gray (10YR 5/1 m) sandy loam; many, coarse, distinct, strong brown (7.5YR 5/6) mottles; amorphous; very friable; few, fine, oblique roots; no clay films; weakly calcareous; no coarse fragments; pH 7.4.

I-17.

Classification:	Brunisolic Gray Luvisol
Parent Material:	Glaciofluvial veneer over fine textured till
Soil Units:	- dominant: HDY 2 - significant: (COA-HDY)2, (COA-HDY)3 - minor: (COA-NC)1, (NC-COA)1

Pedon Description

Described by:	P. H. Crown
Location:	No. 8; centre of Crane Island, 0.2 km from NW end
Landform:	undulating moraine with glaciofluvial veneer
Slope:	3 percent, middle slope position
Aspect:	northwest
Elevation:	715 m a.s.l.
Relief:	1.5 m
Estimated Drainage:	well drained
Vegetation:	Picea glauca (white spruce), Rosa acicularis (wild rose), Rubus strigosus (wild red raspberry), Equisetum arvense (common horsetail), Linnea borealis (twinflower)

LF 5 to 0 cm; very dark brown (10YR 2/2 m) relatively undecomposed needle litter and twigs; abundant, fine and medium horizontal roots; abrupt, smooth boundary; 3 to 8 cm thick.

Ae 1 0 to 7 cm; grayish brown (10YR 5/2 m) loamy sand; very weak, very fine platy to single grain; very friable to loose; abundant, medium, oblique roots; many fine pores; no clay films; no carbonates; no coarse fragments; clear broken boundary; 0 to 9 cm thick; pH 4.8.

Bm 7 to 20 cm; brown to dark brown (10YR 4/3 m) sandy loam; single grain; very friable; plentiful, fine, oblique roots; common, fine pores; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 10 to 16 cm thick; pH 4.8.

Ae 2 20 to 24 cm; gray (10YR 6/1) sandy loam; weak, fine platy; very friable; plentiful, fine, vertical roots; common, fine pores; no clay films; no carbonates; no coarse fragments; clear wavy boundary, 3 to 6 cm thick; pH 4.8.

Bt 24 to 33 cm; dark yellowish brown (10YR 4/4 m) loam; common, fine to medium, faint, yellowish brown (10YR 5/8) mottles; weak, fine subangular blocky; friable; plentiful, fine, oblique roots; common, fine pores; common, thin, dark grayish brown (10YR 4/2) clay films as visible bridges between sand grains; no carbonates; no coarse fragments; abrupt, smooth boundary; 7 to 12 cm thick; pH 4.8.

II Bt 33 to 57 cm; dark grayish brown (10YR 3/2 m) loam; few, fine, prominent, yellowish red (5YR 5/8) mottles; strong, medium, angular blocky; very firm; few, fine, vertical roots; few, very fine pores; continuous, moderately thick, very dark gray (10YR 3/1) clay films on all ped surfaces and in all voids and channels; no carbonates, estimated 10% angular gravelly coarse fragments; gradual, wavy boundary; 20 to 28 cm thick; pH 6.0.

II BC 57 to 81 cm; dark grayish brown (10YR 4.5/2 m) loam; few, fine, prominent, yellowish red (5YR 5/8) mottles; strong, medium, subangular blocky; firm; few, fine pores; few to common, moderately thick, very dark gray (10YR 3/1) clay films in some voids and channels and on some vertical ped surfaces; no carbonates; fragments; gradual, wavy boundary; 23 to 30 cm thick; pH 6.0.

II Ck 81 to 100+ cm; dark grayish brown to dark brown (10YR 4/2.5 m) loam; few, fine, red (2.5YR 4/8) mottles; weak, medium to coarse angular blocky; firm; very few, fine, vertical roots; few, fine pores; no clay films; weakly calcareous; estimated 15% angular gravelly coarse fragments; pH 7.5.

I-18.

Classification:	Orthic Gray Luvisol - Brunisolic Gray Luvisol
Parent Material:	Glaciofluvial veneer over textured glacial till
Soil Units:	- significant: (COA-HDY)2, (COA-HDY)3 - minor: (COA-NC)1, (NC-COA)1

Pedon Description

Described by:	P. H. Crown
Location:	No. 16; 3 km south of Highway #16 on road to south warden's cabin, 0.2 km east
Landform:	ridged moraine with glaciofluvial veneer
Slope:	4 percent, upper slope position
Aspect:	north
Elevation:	724 m a.s.l.
Relief:	3 m
Estimated Drainage:	well drained
Vegetation:	Populus tremuloides (trembling aspen), Rosa acicularis (wild rose), Corylus cornuta (beaked hazelnut), Ribes triste (wild red currant), Viburnum edule (low bush cranberry), Heracleum lanatum (cow parsnip), Vicia americana (american vetch)

LF 8 to 0 cm; black (10YR 2/1 m) relatively undecomposed leaf litter; abundant, fine and medium, random roots; abrupt, smooth boundary; 5 to 8 cm thick; pH 5.8.

Ael 0 to 5 cm; light brownish gray (10YR 6/2 m) loamy sand; single grain; loose; plentiful, fine and medium, oblique roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 4 to 6 cm thick; pH 5.2.

Bm 5 to 19 cm; yellowish brown (10YR 5/4 m) loamy sand; single grain; loose; plentiful, fine and medium, oblique roots; no clay films; no carbonates; no coarse fragments; clear wavy boundary 10 to 14 cm thick; pH 6.3.

Ae2 19 to 29 cm; pale brown (10YR 6/3 m) very fine sandy loam; single grain; loose; plentiful, fine, vertical roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 8 to 11 cm thick; pH 6.3.

Bt 29 to 62 cm; very pale brown (10YR 7/3 m) sandy loam matrix with brown (10 YR 4/3 m) fine sandy clay loam lamellae; matrix-single grain, lamellae-moderate, fine subangular blocky; matrix-loose, lamellae-friable; few, fine, vertical roots; matrix-no clay films, lamellae-many, thin, clay films as visible bridges between sand grains; no carbonates; coarse fragments; clear, wavy boundary; horizon 30 to 35 cm thick, lamellae - 1 to 2 in thick and 3 to 6 cm apart; pH 6.3.

II BCg 62 to 83 cm; dark yellowish brown (10YR 4/4 m) loam; few, fine, prominent dark red (2.5YR 3/6) and yellowish red (5YR 4/8) mottles; moderate to strong, medium , subangular blocky; firm; few, fine vertical roots; few, thin, dark grayish brown (10YR 4/2) clay films in some voids and channels; no carbonates; estimated 10% angular gravelly coarse fragments; clear, wavy boundary; 20 to 25 cm thick; pH 6.3.

II Ckg 83 to 105+ cm; dark yellowish brown (10YR 4/4 m) silt loam; few, fine, prominent, dark red (2.5YR 3/6) and yellowish red (5YR 4/8) mottles; weak to moderate, medium, subangular blocky; firm; few, fine, vertical roots; no clay films; moderately calcareous; estimated 10% angular gravelly coarse fragments; pH 7.8.

I-19.

Classification: Eluviated Eutric Brunisol
Parent Material: Glaciofluvial veneer over fine textured till
Soil Units: - minor (COA-HDY)2, (COA-HDY)3, (COA-NC)I, (NC-COA)I

Pedon Description

Described by: P. H. Crown
Location: No. 5; south side of Astotin Lake, 0.2 km south of road, 0.6 km east of road to Elk Island

Landform:	ridged moraine with glaciofluvial veneer
Slope:	9 percent, middle slope position
Aspect:	east
Elevation:	715 m a.s.l.
Relief:	9 m
Estimated Drainage:	well drained
Vegetation:	large Picea glauca (white spruce), Populus tremuloides (trembling aspen), Betula papyrifera (white birch), Rosa acicularis (wild rose), Rubus strigosus (wild red raspberry), Fragaria glauca (wild strawberry)

LF 14 to 0 cm; black (5YR 2.5/1 m) relatively undecomposed leaf litter with twigs; abundant fine to coarse, random roots; no coarse fragments; abrupt, smooth boundary; 10 to 16 cm thick; pH 5.6.

Ae 0 to 9 cm; grayish brown (10YR 5/2 m) sandy loam; single grain; loose; plentiful, medium, oblique roots; no clay films; no carbonates; no coarse fragments; clear, wavy boundary; 7 to 13 cm thick; pH 5.6.

Bm 9 to 51 cm; yellowish brown (10YR 5/4 m) sand; single grain; loose; plentiful, medium, oblique roots; no clay films; no carbonates; no coarse fragments; clear, irregular boundary; 37 to 45 cm thick; pH 5.8.

Bmg 51 to 76 cm; pale brown (10YR 6/3 m) sand; common, coarse, prominent, strong brown (10YR 5/6) mottles; single grain; loose; few, fine, oblique roots; no clay films; no carbonates; no coarse fragments; abrupt, smooth boundary; 0 to 30 cm thick; pH 6.0.

II Ck 76 to 95+ cm; dark gray (10YR 4/1 m) clay loam; few, fine, prominent, yellowish red (5YR 4/6) mottled; moderate to strong, medium angular blocky; very firm; very few, fine, vertical roots; few, very fine pores; no clay films; weakly calcareous; estimated 10% angular gravelly coarse fragments; pH 7.9.

I-20.

Classification:	Dark Gray Luvisol (cultivated)
Parent Material:	Glaciofluvial veneer over fine textured till
Soil Unit:	- significant: (UCS-LTH)2

Pedon Description

Described by:	P. H. Crown
Location:	No. 32; 2.6 km north of Highway #16, 1 km west of east boundary
Landform:	undulating moraine with glaciofluvial veneer
Slope:	5 percent, middle slope position

Aspect: east
Elevation: 709 m a.s.l.
Relief: 1.8 m
Estimated Drainage: well drained
Vegetation: alfalfa brome hay mixture

Ap 0 to 20 cm; very dark gray to dark gray (10YR 3.5/1 m) sandy loam; weak, fine granular; friable; abundant, fine, vertical roots; no clay films; no carbonates; no coarse fragments; abrupt, wavy boundary; 18 to 20 cm thick; field pH 6.4.

Ae 20 to 26 cm; grayish brown (10YR 5/2 m) sandy loam; very weak, fine platy; very friable; plentiful, fine vertical roots; no clay films; no carbonates; no coarse fragments; clear, irregular boundary; 0 to 7 cm thick; field pH 6.0.

Bt 26 to 58 cm; dark grayish brown to brown (10YR 4/2.5 m) sandy clay loam; weak, medium, subangular blocky; friable, few, fine, vertical roots; common, thin, dark brown (10YR 3/2) clay films as visible bridges between sand grains; no carbonates; no coarse fragments; abrupt, smooth boundary; 30 to 35 cm thick; field pH 6.6.

II BC 58 to 80 cm; dark yellowish brown (10YR 4/4 m) clay loam; weak to moderate, medium, subangular blocky; firm; few, fine, vertical roots; few, thin, dark grayish brown (10YR 4/2) clay films in some voids and channels; no carbonates; estimated 15% angular gravelly coarse fragments; gradual, wavy boundary; 20 to 25 cm thick; field pH 6.8.

II Ck 80 to 105+ cm; dark yellowish brown (10YR 4/4 m) clay loam; few, fine, prominent, dark red (2.5YR 3/6) and yellowish brown (5YR 4/8) mottles; weak, medium, subangular blocky; firm; no clay films; moderately calcareous; estimated 15% angular gravelly coarse fragments; field pH 7.4.

I-21.

Classification: Typic Mesisol
Parent Material: moderately decomposed fen peat
Soil Units: - significant: SL3, SL4, SL6
- minor: SB2

Pedon Description

Described by: P. H. Crown
Location: No. 22; south of Astotin Lake, 2.2 km east from west park boundary, 5.3 km south from north boundary
Landform: horizontal fen

Slope:	0%
Aspect:	level
Elevation:	711 m a.s.l.
Relief:	slightly mounded microtopography
Estimated Drainage:	very poorly drained, water table at or near the surface
Vegetation:	Carex sp. (sedges), Salix sp. (willows)

Om 1 0 to 30 cm; black (10YR 2/1 m) broken and rubbed organic matter; approximately 70% unrubbed fiber content and 26% rubbed fiber content; pyrophosphate color (10YR 6/1); liquid dark and muddy when wet soil squeezed, the remainder is viscous; diffuse, smooth boundary; pH 5.5.

Om2 30 to 85 cm; very dark gray (10YR 3/2m) broken, dark reddish brown (5YR 2/2m) rubbed organic matter; approximately 75% unrubbed fiber content and 15% rubbed fiber content; pyrophosphate color (10YR 6/1); liquid dark and muddy when wet soil squeezed, the remainder is viscous; clear, smooth boundary; pH 5.5.

Om3 85 to 140 cm; very dark brown (10YR 2/2 m) broken; very dark gray (10YR 3/1.5 m) rubbed organic matter; approximately 65% unrubbed fiber content; pyrophosphate color (10YR 6/2); material appears platelike in structure when broken with plant outlines visible; liquid dark and muddy when wet soil squeezed, the remainder is iscous; pH 5.6.

I-22.

Classification:	Terric Mesisol
Parent Material:	moderately decomposed fen peat underlain by moderately fine textured alluvium
Soil Units:	- dominant: SL3 - significant: SB2

Pedon Description

Described by:	P. H. Crown
Location:	No. 22, south of Astotin Lake, 2.2 km from west boundary, 5.3 km from north boundary
Landform:	horizontal fen
Slope:	0%
Aspect:	level
Elevation:	711 m a.s.l.
Relief:	slightly mounded microrelief
Estimated Drainage:	very poorly drained
Vegetation:	Carex sp. (sedges), Salix sp. (willows)

Om 1 0 to 45 cm; black (10YR 2/1 m) broken and rubbed organic matter; approximately 70% unrubbed fiber content and 30% rubber fiber content; pyrophosphate color (10YR 6/1); liquid dark and muddy when wet soil squeezed, the remainder is viscous; diffuse, smooth boundary; pH 5.5.

Om2 45 to 80 cm; very dark brown (10YR 2.2m) broken, very dark gray (10YR 3/1 m) rubbed organic matter; approximately 60% unrubbed fiber content and 15% rubbed fiber content; pyrophosphate color (10YR 5/2); liquid dark and muddy when wet soil squeezed; the remainder is viscous; abrupt, smooth boundary; pH 5.8.

Cg 80 to 100 cm; very dark gray (10YR 3/1 m) silt loam; amorphous; friable; slightly plastic; pH 6.5.

I-23.

Classification:	Mesic Fibrisol
Parent Material:	undecomposed moss peat underlain by moderately decomposed fen peat
Soil Units:	- dominant: SB1, SB2 - significant: SL6

Pedon Description

Described by:	P. H. Crown
Location:	No. 21; immediately southwest of Astotin Lake, 0.6 km from west boundary, 5.6 km from north boundary
Landform:	flat bog
Slope:	0 percent
Aspect:	level
Elevation:	714 m a.s.l.
Relief:	hummocky microrelief
Estimated Drainage:	very poorly drained
Vegetation:	sphagnum and feather mosses; Ledum groenlandicum (labrador tea); Vaccinium caespitosum (dwarf blueberry); Picea mariana (black spruce); Betula pumila (swamp birch)

Ofl 0 to 20 cm; dark brown (7.5YR 4/2 m) broken, yellowish brown (10YR 5/8 m) rubbed organic matter; approximately 90% unrubbed fiber content and 80% rubbed fiber content; less than 10% woody material by volume; pyrophosphate color (10YR 8/1); liquid weakly yellow brown when wet soil squeezed; clear, smooth boundary; pH 3.5.

Of2 20 to 47 cm; alternating layers, 5 to 8 cm thick, of dark brown (10YR 4/3m) broken, very dark brown (10YR 2/2 m) rubbed and dark brown (7.5YR 4/2 m) broken, yellowish brown (10YR 5/8 m) rubbed organic matter; approximately 80% unrubbed fiber content and 70% rubbed fiber content; 20% hard woody material by volume; pyrophosphate color (10YR 7/2); liquid cloudy brown when wet soil squeezed; clear, smooth boundary; pH 3.4.

Of3 47 to 114 cm; dark reddish brown (5YR 3/2 m) broken, yellowish red (5YR 5/6m) rubbed organic matter; approximately 90% unrubbed fiber content and 70% rubbed fiber content; less than 10% woody material by volume; pyrophosphate color (10YR 8/1); liquid weakly yellow brown when wet soil squeezed; abrupt, smooth boundary; pH 4.2.

Om 114 to 160 cm; black (10YR 2/1 m) broken, very dark gray (10YR 3/2 m) rubbed organic matter; approximately 60% unrubbed fiber content and 20% rubbed fiber content; pyrophosphate color (10YR 5/2); liquid dark and muddy when wet soil squeezed; pH 5.4.

I-24.

Classification:	Typic Fibrisol
Parent Material:	relatively undecomposed moss peat
Soil Units:	- significant: SBl

Pedon Description

Described by:	P. H. Crown
Location:	No. 35; north of Astotin Lake, 1.7 im from west boundary, 0.9 km from north boundary
Landform:	flat bog
Slope:	0%
Aspect:	level
Elevation:	720 m a.s.l.
Relief:	hummocky microrelief
Estimated Drainage:	very poorly drained
Vegetation:	sphagnum and feather mosses; Ledum groenlandicum (labrador tea); Vaccinium sp., Picea mariana (black spruce)

Ofl 0 to 45 cm; dark brown (7.5YR 4/2 m) broken, yellowish brown (10YR 5/5 m) rubbed organic matter; approximately 90% unrubbed fiber content and 80% rubbed fiber content; less than 10% woody material by volume; pyrophosphate color (10YR 8/1); liquid weakly yellow brown when wet soil squeezed; clear smooth boundary; pH 3.2.

Of2 45 to 110 cm; dark brown (10YR 4/3 m, 7.5YR 4/2 m) broken and yellowish brown (10YR 5/8 m) to dark yellowish brown (10YR 4/4 m) rubbed organic matter; approximately 80% unrubbed fiber content and 60% rubbed fiber content; 20% hard woody material by volume; pyrophosphate color (10YR 7/2); liquid yellowish brown when wet soil squeezed; clear wavy boundary; pH 3.5.

Of3 110 to 160 cm; dark reddish brown (5YR 3/2 m) broken, yellowish red (5YR 5/6 m) rubbed organic matter; approximately 90% unrubbed fiber content and 75% rubbed fiber content; 10% hard woody material by volume; pyrophosphate color (10YR 8/1); liquid weakly yellow when wet soil squeezed; pH 3.8.

I-25.

Classification:	Terric Mesic Fibrisol
Parent Material:	relatively undecomposed moss peat underlain by moderately fine textured alluvium
Soil Units:	- significant: SB1, SB2

Pedon Description

Described by:	P. H. Crown
Location:	No. 21; immediately southwest of Astotin Lake, 0.6 km from west boundary, 5.6 km from north boundary
Landform:	flat bog
Slope:	0%
Aspect:	level
Elevation:	714 m a.s.l.
Relief:	hummocky microrelief
Estimated Drainage:	very poorly drained
Vegetation:	sphagnum and feather mosses; Ledum groenlandicum (Labrador tea); Vaccinium sp. (lichens)

Of1 0 to 25 cm; dark brown (7.5YR 4/2 m) broken, yellowish brown (10YR 5/8 m) rubbed organic matter; approximately 90% unrubbed fiber content and 80% rubbed fiber content; less than 10% hard woody material by volume; pyrophosphate color (10YR 8/1); liquid weakly yellow brown when wet soil squeezed; clear smooth boundary; pH 4.2.

Of2 25 to 73 cm; alternating layers, 6 to 10 cm thick, of dark brown (10YR 4/3 m) broken, very dark brown (10YR 2/2 m) rubbed and dark brown (10YR 4/2 m) broken yellowish brown (10YR 5/8 m) rubbed organic matter; approximately 80% unrubbed fiber content; and 70% rubber fiber content; 20% hard woody material by volume; pyrophosphate color (10YR 7/2); liquid light brown when wet soil squeezed; abrupt smooth boundary; pH 4.3.

Om 73 to 95 cm; black (10YR 2/1 m) broken, very dark gray (10YR 3/2 m) rubbed organic matter; approximately 60% unrubbed fiber content and 25% rubber fiber content; pyrophosphate color (10YR 5/2); liquid dark and muddy when wet soil squeezed; abrupt smooth boundary; pH 5.1.

Cg 95 to 140 cm; dark gray (10YR 4/1 m) silt loam; amorphous; friable; slightly plastic; pH 6.2.

APPENDIX II. ANALYTICAL DATA FOR SELECTED SOILS TYPIFYING THE MAJOR SOILS IN ELK ISLAND NATIONAL PARK

Soil Identification						Chemical Analysis (based on fraction <2mm)												Mechanical Analysis					
						pH	%			E.C.*	Exch. Cations (me/100gr)					Pyrophosphate Extrac.(%)			% from fraction <2mm				Textural**	Bulk*
Soil Description	Site No.	Soil Unit	Lab. No.	Horizon	Depth (cm)	($CaCl_2$)	N	Org.C	$CaCO_3$ equiv.		Na	K.	Ca	Mg	Total	Fe	Al	(Fe&Al)	Sand	Silt	Clay	F.Clay	Class	Density
			75,28	Ae	0-12	5.8	0.1	0.8			tr	0.4	7.0	1.5	9.3				41	45	14	4	L	1.66
			75,29	AB	12-20	5.5	0.1	0.5			tr	0.4	8.6	2.2	11.5				40	39	21	10	L	
			75,30	Bt1	20-38	5.4	0.1	0.6			0.1	0.4	13.2	3.6	16.8				36	36	28	16	CL	1.69
1 - 1A	6	COA4	75,31	Bt2	38-60	5.3	tr	0.5			0.1	0.3	10.8	3.1	14.2				36	40	24	13	L	1.67
			75,32	BC	60-77	5.9					0.1	0.2	10.9	3.0	12.4				43	36	21	11	L	
			75,33	Ck	77-98	7.8			6.8										18	61	21	9	SiL	1.52
			75,6	Ae	0-13	6.4	tr	.6			tr	0.1	3.1	0.7	3.9				62	29	9	2	SL	
			75,7	AB	13-20	6.7	tr	.6			tr	0.4	10.5	3.5	7.4				44	29	27	16	L	
1 - 1B	2	(NC-COA)1	75,8	Bt	20-64	6.4	tr	.5			0.1	0.3	13.8	5.5	18.4				43	25	32	20	CL	
			75,9	BC	64-104	7.0					0.1	0.3	13.3	4.6	17.8				40	31	29	17	CL	
			75,10	Ck	104-120	7.9			7.2										49	28	23	13	L	1.56
			75,157	Ah	0-2	6.3	.6	8.6			tr	0.4	28.3	2.6	32.5				44	42	14	4	L	
			75,158	Ahe	2-6	6.3	.1	1.3			tr	0.2	8.3	0.8	9.6				47	43	10	4	L	
			75,159	Ae	6-17	6.4	tr	0.4			tr	0.2	3.8	0.5	4.4				48	43	9	1	L	
			75,160	IIAB	17-24	6.2	tr	0.4			tr	0.4	9.5	3.0	12.4				44	32	24	11	L	
1 - 2	28	UCS6	75,161	IIBt1	24-53	5.1	tr	0.5			0.1	0.6	13.9	6.2	21.3				36	28	36	22	CL	
			75,162	IIBt2	53-95	4.8	tr	0.5		.2	0.1	0.5	12.7	5.6	20.4				36	30	34	19	CL	
			75,163	IIBC1	95-110	6.0				.2	0.1	0.6	14.1	6.2	20.4				36	31	33	18	CL	
			75,164	IIBC2	110-125	6.1				.2	0.1	0.6	14.3	6.4	19.6				35	33	32	18	CL	
			75,74	Ah	0-3	5.9	0.2	2.8		.4	tr	0.7	9.7	1.7	14.9				64	26	10	6	SL	
			75,75	Ae	3-22	6.0	tr	0.2		.2	tr	0.1	1.3	0.2	2.0	0.44	0.34	0.78	81	19	0	0	LS	
			75,76	IIAe	22-27	5.8	tr	0.2		.2	tr	0.2	2.1	0.5	3.2	0.13	0.08	0.21	47	43	10	6	L	1.81
			75,77	IIAB	27-31	5.6	tr	0.4		.2	tr	0.4	8.9	3.4	12.1				40	35	25	13	L	
1 - 5	14	COA3	75,78	IIBt	31-68	6.0	tr	0.4		.2	0.1	0.4	11.9	4.8	16.2				38	32	30	20	CL	
			75,79	IIBtg	68-100	4.9	tr	0.4		.2	0.1	0.3	10.5	5.4	16.2				38	33	29	18	CL	1 90
			75,80	IIBCg	100-116	5.4				.2	0.3	0.3	12.4	6.2	16.2				36	34	30	17	CL	
			75,81	IICkg	116-125	6.9			0.9	.3	0.2	0.3	13.6	6.4	16.2				35	34	31	17	CL	
			75,165	Ah	0-8	5.6	0.2	3.5			tr	1.2	17.1	3.3	29.2				27	43	30	14	CL	
			75,166	Aheg	8-12	5.8	0.1	0.7			tr	0.5	5.2	1.3	9.6				35	54	11	3	SiL	
			75,167	Aeg	12-21	5.8	tr	0.2			tr	0.1	3.2	1.3	4.7				39	53	8	2	SiL	1.65
1 - 6	29	COA4	75,168	ABg	21-30	5.1	tr	0.4			0.1	0.5	8.1	3.8	14.7				34	42	24	14	L	
			75,169	Btg	30-85	5.0	tr	0.4			0.3	0.6	12.1	6.2	21.3				31	40	29	19	CL	1.78
			75,170	BCg	85-115	5.7		0.3			0.8	0.7	14.0	6.7	19.8									1.79
			75,152	Ah	0-4	6.3	0.7	8.8		0.5	2.6	1.6	21.6	6.1	35.0				34	41	25	12	L	
			75,153	Ae	4-7	6.7	0.2	1.6		0.6	2.5	0.3	5.9	2.3	10.0				44	46	10	4	L	
1 - 7	27	DST4	75,154	Bn	7-22	7.8	0.2	1.4	1.7	1.3									29	33	38	24	CL	
			75,155	Cskg	22-45	8.2			7.5	2.7									37	36	27	25	L	
			75,113	Ah	0-2	5.4	0.4	4.9				2.8	13.8	3.2	26.6				15	66	19	7	SiL	
			75,114	Ae	2-12	5.9		0.6				0.8	3.6	1.4	6.7				15	72	13	4	SiL	
			75,115	AB	12-15	5.5	0.1	0.6			0.1	0.9	9.2	6.5	16.9				13	57	30	22	SiCL	
1 - 8	19	MYW3	75,116	Bt1	15-34	5.1	0.1	0.6		0.2	0.4	0.9	14.6	11.1	28.0				13	40	47	31	SiC	1.76
			75,117	Bt2	34-79	5.6		0.7		0.2	0.4	0.6	17.7	13.2	28.9				19	32	49	28	C	1.85
			75,118	Ckg	79-95	7.0			0.6	0.7	0.6	0.7	224	14.2	31.6				1	39	60	31	C	
			75,52	Ah	0-6	5.9	0.3	2.8		0.3	0.3	0.3	18.3	6.5	27.8				4	52	44	15	SIC	
			75,53	Ae	6-13	4.8	0.2	1.6			0.6	0.6	11.3	6.0	22.5				3	52	45	16	SiC	
			75,54	AB	13-17	4.5	0.1	1.3			0.8	0.6	14.4	8.9	29.0				2	40	58	28	SiC	
1 - 9	7	MYW3	75,55	Bt	17-46	4.4	0.1	1.1		0.4	1.3	0.7	19.5	12.3	35.4				1	26	73	39	HC	1.81
			75,56	BC	46-73	5.1				0.7	1.4	0.7	20.4	12.8	31.3				1	32	67	35	HC	1.99
			75,57	Ck	73-95	7.1			0.7	1.4	2.2	0.6	24.2	18.6	27.8				1	32	67	28	HC	1.64
			75,11	Ap	0-11	6.2	0.2	2.2		0.6	0.3	1.2	14.8	5.1	26.1				16	51	33	16	SICL	1.61
			75,12	Ae	11-14	5.7	0.1	1.0		0.4	0.6	0.4	10.6	4.6	19.2				14	51	35	16	SiCL	
			75,13	AB	14-18	5.1	0.1	0.7			1.0	0.5	15.8	7.7	29.6				8	46	46	29	SiC	
1-10	3	MCO3	75,14	Bt1	18-50	4.7	0.1	0.8		0.3	1.4	0.5	20.2	19.2	37.7				7	30	63	37	HC	1.84
			75,15	Bt2	50-70	6.9	0.1	0.6		0.5	2.3	0.4	20.6	10.2	29.5				15	36	49	30	C	1.79
			75,16	Ck	70-90	7.7			3.3										36	32	32	19	CL	1.84

			75,46	Ah	0-7	6.0	0.4	4.7		0.6	tr	1.0	23.6	2.2	26.3				9	64	27	10	SiL	
			,47	Ae	7-13	6.2	0.1	1.4		0.4	tr	0.5	14.1	2.5	16.2				9	64	27	12	SiL	1.61
I - 10	13	MYW3	,48	AB	13-23	6.0	0.1	0.9		0.3	0.1	0.7	20.0	6.0	24.6				3	45	52	33	SiC	
			,49	Bt1	23-83	5.3		0.7			0.1	0.5	18.2	6.4	22.5				5	50	45	29	SiC	1.82
			,50	Bt2	83-97	6.0					0.1	0.4	15.2	5.2	17.5				21	46	33	18	CL	1.63
			,51	Ck	97-110	6.9				0.4	0.1	0.3	16.0	5.4	16.9				21	46	33	18	CL	1.63
			75,1	Ae	0-10	4.7		0.6				0.1	1.2	0.3	3.6	.45	.03	.48	74	23	3	1	LS	
			,2	Bm1	10-28	6.2		0.3				0.1	2.3	0.3	3.6	.05	.02	.07	82	13	5		LS	
I - 14	1	(NC-COA)1	,3	Bm2	28-44	6.4		0.2				0.1	2.3	0.3	3.1	.28	.05	.33	87	8	5	2	S	
			,4	Bt	44-84	6.0		0.2				0.3	4.5	0.1	6.5	.07	.02	.09	72	16	12	7	SL	
			,5	BC	84-100	6.4						0.1	2.0	0.5	2.8	.05	.03	.08	88	6	6	1	LS	
			75,96	Ae	0-5	6.3		0.3				0.1	2.0	0.5	2.8	.05	.03	.08	87	9	4	1	S	
			,97	Bm1	5-18	7.1		0.6	0.4			0.3	6.2	0.5	5.2	.05	.05	.10	85	9	7	3	LS	
I - 15	17	(COA-NC)1	,98	Bm2	18-52	6.3		0.1				0.2	2.0	0.3	2.5	.05	.06	.11	92	5	3	1	S	
			,99	IIBm	52-112	6.5						0.1	1.0	0.1	1.2	.02	.02	.04	98	2	0	0	S	
			,100	IIIC	112-120	4.7						0.2	3.1	0.2	3.4	.10	.06	.16	80	16	4	2	SL	
			,101	IIICk	120-135	7.2			0.1			0.1	2.4	0.6	1.7	.02	.02	.04	96	4	0	0	S	
			75,134	Aeg1	0-13	5.3		0.2				0.1	2.2	0.4	3.6				72	24	4	2	SL	
			,135	Aeg2	13-25	6.0		0.1			tr	0.1	2.2	0.4	3.0				84	12	4	3	LS	
I - 16	24	(NC-COA)1	,136	Btg	25-43	6.3		0.2				0.2	5.8	1.3	7.0				72	17	11	7	SL	
			,137	Cg	43-70	6.8					tr	0.1	3.7	1.0	4.5				87	6	7	4	LS	
			,138	IICkg	70-100	7.4			0.3		0.1	0.2	10.2	3.1	12.2				53	30	17	11	SL	
			75,34	Ael	0-7	4.9	0.1	0.7			tr	0.1	2.2	0.4	6.8				72	20	8	3	LS	
			,35	Bm	7-20	4.9	0.1	1.1			0.1	0.2	4.2	0.4	13.0				62	25	13	5	SL	
I - 17	8	HDY2	,36	Ae2	20-24	4.8	0.1	0.9			0.1	0.1	4.6	0.9	10.9				53	31	16	7	SL	
			,37	Bt	24-33	4.6	0.1	0.6			0.1	0.2	7.9	2.6	16.8				40	31	29	16	L	
			,38	IIBt	33-57	4.5	tr	0.4			0.1	0.3	8.9	4.4	16.8				40	28	32	19	L	
			,39	IIBC	57-81	4.5	tr	0.5			0.1	0.3	9.3	5.0	16.9				39	30	31	18	L	
			75,89	Ael	0-5	5.8	tr	0.6			tr	0.2	3.5	0.3	4.5	.10	.03	.13	72	23	5	1	LS	
			,90	Bm	5-19	5.9	tr	0.4			tr	0.2	3.2	0.4	3.6	.11	.04	.15	72	22	6	1	LS	
I - 18	16	(COA-NC)1	,91	Ae2	19-29	6.2	tr	0.2			tr	0.2	3.2	0.5	3.6	.08	.07	.15	68	24	8	1	SL	1.67
			,92	Bt	29-62	5.1	tr	0.2			tr	0.3	7.8	2.5	10.7	.26	.29	.55	58	23	19	12	SL	1.61
			,94	IIBCg	62-83	7.0					0.1	0.3	13.5	4.8	14.3				41	28	31	16	L	1.86
			,95	IICkg	83-105	7.3					0.1	0.3	14.4	4.8	13.7				10	61	29	15	SiL	
			75,23	Ae	0-9	5.1					tr	.7	3.2	1.1	7.2				72	22	6	4	SL	
			,24	Bm	9-51	5.9					tr	.2	1.4	0.4	2.6				88	10	2	2	S	
I - 19	5	(COA-HDY)2	,25	Bmg	51-76	5.9					tr	.1	1.0	0.2	1.4				93	6	1	1	S	
			,27	IICk	76-95	6.9				0.2	0.1	.3	14.3	6.4	16.8				34	34	32	18	CL	1.78

* Electrical Conductivity (mmhos/cm)

** Soil textures: L-loam; CL-clay loam; SiCl-silty clay loam; SIL-silt loam; SL-sandy loam; LS-loamy sand; S-sand.

*** Bulk Density (gr/cm^3)

Appendix III. Engineering test data for soil materials from selected sites in Elk Island National Park.

Parent Materials	Site No.	Soil Unit	Horizon	Depth (cm)	Mechanical Analysis (% passing)							Liquid Limit (%)	Plasticity Index	Classification		
					1 in	3/4 in	5/8 in	#4	#10	#40	#200			Unified	AASHO	USDA
Glacial	2	(NC-COA)I	Ckg	110	100	100	100	100	99	90	56	27	6	CL-ML	A-4(4)	L
Till	4	COA6	IVCk	100	100	100	100	99	98	91	59	31	13	CL	A-6(6)	L
	6	COA4	Ck	80	100	100	100	100	99	96	66	30	12	CL	A-6(7)	SiL
	11	(COA-HDY)I	11Ck	99	100	100	100	99	98	91	56	27	8	CL	A-4(4)	L
	12	(COA-HDY)I	Ck	110	78	77	77	77	77	74	55	40	16	CL	A-6(6)	L
	13	(COA-HDY)I	BC	95	100	100	100	100	99	94	62	33	14	CL	A-6(6)	L
	14	COA3	11Ck	120	100	100	100	99	98	93	66	37	14	CL	A-6(8)	CL
	15	COA2	Ck	120	96	96	96	95	95	90	63	35	12	CL	A-6(7)	CL
	18	COA4	Ck	110	100	100	100	100	99	94	65	35	17	CL	A-6(9)	CL
	26	COA4	Ckg	95	100	100	100	99	98	94	68	32	9	CL	A-6(6)	L
	28	UCS6	Ckg	120	100	100	100	99	99	94	67	38	15	CL	A-6(8)	CL
Glacio-	3	MCO3	Ck	80	100	100	100	100	100	95	67	39	15	CL	A-6(8)	CL
lacustrine	10	MYW3	Ck	100	100	100	100	100	99	98	76	39	13	ML	A-6(9)	CL
Sediments	7	MYW3	Ck	75	100	100	100	100	100	100	99	72	33	MH	A-7-5(20)	HC
	19	MYW3	Ckg	85	100	100	100	100	100	97	95	68	29	MH	A-7-5(20)	C
Fluvial and/	1	(NC-COA)I	BC	100	100	100	100	100	98	97	12			SM	A-2-4	LS
or Eolian	5	(COA-HDY)I	Bm	50	100	99	98	94	91	84	7			SP-SM	A-3	S
	16	(COA-NC)I	BC	60	100	100	100	99	98	94	16			SM	A-2-4	SL
	17	(COA-NC)I	IIICk	120	100	98	98	87	76	69	4			SW	A-3	S
	24	(NC-COA)I	Cg	60	100	96	96	91	83	70	13			SM	A-2-4	LS

Appendix IV. Nutrient status of selected soil horizons, Elk Island National Park.[1]

Material	Site No.	Soil Unit	Horizon	Depth (cm)	Kg/hectare available N	P	K
Glacial till	2	(NC-COA)I	Ae	10	1	27	131
	6	COA4	AB	15	1	196	395
	14	COA3	Ah	5	2	183	501
			Ae	15	1	121	158
			11Ckg	120	1	7	317
	27	DST4	Ah	4	11	22	832
			Ae	6	4	16	276
	28	UCS6	Ah	2	4	45	217
			Ae	15	1	62	137
	29	COA2	Ah	6	2	93	598
			Aheg	10	1	67	290
Glaciolacustrine	3	MCO3	Ap	8	1	11	361
Sediments	10	MYW3	Ah	6	1	129	526
			Ae	10	1	67	408
	7	MYW3	Ah	6	1	52	936
			Ck	75	1	3	521
	19	MYW3	Ah	2	7	131	1161
			Ae	10	1	16	603
Fluvial and/	1	(NC-COA)I	Ae	8	1	22	78
or Eolian			Bml	15	1	224	139
	5	(COA-HDY)I	Bm	20	1	224	164
	8	HDY2	Ae	10	1	224	116
	16	(COA-NC)I	Ael	10	1	107	127
			Ae2	20	2	165	142
	17	(COA-NC)I	Bm	20	1	224	234
	24	(NC-COA)I	Aegl	10	2	21	84
			Aeg2	20	2	32	75
Organic	22	SL3	Oml	10	3	8	39
			Om2	25	3	11	11
			Om3	40	20	8	56

1. Analyses by the Alberta Soil and Feed Testing Labortary.
The following key provides an evaluation of the data:-

	high	medium	low
N	> 56	24-56	0-24
P	> 80	35-80	0-35
K	> 336	170-336	0-170

APPENDIX V. Generic and common names of frequently observed plants in Elk Island National Park

Generic Name	Common Name
Amelanchier Alnifolia	saskatoon
Aralia nudicaulis	wild sarsaparilla
Archillea lanulosa	feathery yarrow
Artemisia paberlaris	slender sage
Betula paryrifera	white birch
Betula pumila	swamp birch
Bromus sp.	brome grass
Carex sp.	sedge
Corylus cornuta	beaked hazelnut
Distichlis stricta	alkali grass
Equisetum arvense	common horsetail
Fragaria glauca	wild strawberry
Gramineae sp.	grasses
Heracleum lanatum	cow parsnip
Ledum groenlandicum	labrador-tea
Linnea borieālis	twinflower
Medicago sativa	alfalfa
Picea glauca	white spruce
Picea mariana	black spruce
Populus balsamifera	balsam poplar
Populus tremuloides	trembling aspen
Prunus virginiana	chokecherry
Ribes triste	wild red currant
Rosa acicularis	wild rose
Rubus chamaemorous	cloudberry
Rubus strigosus	wild red raspberry
Salix sp.	willow
Tribolium repens	white clover
Vaccinium myrtilloides	blueberry
Viburnum edule	low bush cranberry
Vicia americana	american vetch

APPENDIX VI - Glossary of Terms

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

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

alluvial deposit - material deposited by moving water.

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

Atterberg limits - see plastic limit, liquid limit.

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

bulk density (soil) - the mass of dry soil per unit bulk volume. The bulk volume is determined before the soil is dried to constant weight.

calcareous soil - soil containing sufficient calcium carbonate, often with magnesium carbonate, to effervesce visibly when treated with cold 0.1N hydrochloric acid.

catena - a nontaxonomic grouping of a sequence of soils, derived from similar parent materials, having unlike characteristics because of variations in relief and drainage.

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.

classification (soil) - the systematic arrangement of soils into categories on the basis of their characteristics. Broad groupings are made on the basis of general characteristics, and subdivisions on the basis of more detailed differences in specific properties.

clay - as a particle size; a size fraction less than 0.002 mm in equivalent diameter, or some other limit. As a soil term; a texture class.

clay films - coatings of oriented clays on the surfaces of soil peds and mineral grams, and in soil pores.

coarse fragments - rock or mineral particles greater than 20 mm in diameter.

coarse texture - the texture exhibited by sands, loamy sands and sandy loams; a soil containing large quantities of these textural classes.

consistence - the resistance of a material to deformation or rupture, hence the degree of cohesion or adhesion of the soil mass.

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

eolian deposit - sand, silt or both, deposited by the wind.

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

fine texture - consisting of or containing large quantities of the fine fraction, particularly silt and clay.

glaciofluvial deposits - material moved by glaciers and subsequently sorted and deposited by streams flowing from the melting ice.

glaciolacustrine deposit - material moved by glaciers and subsequently sorted and deposited in standing bodies of water fed by the melting ice.

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

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

horizon - a layer in the soil profile approximately parallel to the land surface with more or less well defined characteristics that have been produced through the operation of soil forming processes. Soil horizons may be organic or mineral.

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

infiltration - the downward entry of water into the soil.

intergrade - a soil that possesses moderately well developed distinguishing characteristics of two or more genetically related taxa.

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

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.

ortstein - a Bhf or Bf horizon that is strongly cemented by iron and aluminum oxides. It is designated Bhfc or Bfc, depending on the organic carbon content.

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

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

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

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

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

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

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

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

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

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

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

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

sand - a soil particle between 0.05 and 2.0 mm in diameter; a soil textural class.

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

silt - a soil separate consisting of particles between 0.05 and 0.002 mm in equivalent diameter.

soap-holes - a local name for an area of groundwater discharge where the evaporation of water leaves a white crust of salts on the surface which may resemble dried soap suds.

soil unit - a defined group of soil bodies occurring together in an individual and characteristic pattern over the land surface.

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.

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

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 clay, silt, sand, and boulders intermingled in any proportion.

toposequence - a sequence of related soils that differ one from the other, primarily because of topography.

varve - a distinct band representing the annual deposit of sedimentary materials. It usually consists of two layers, a light-colored layer of silt and fine sand laid down in the spring and summer, and a dark-colored layer of clay laid down in the fall and winter.

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