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REPORT ON

TERRESTRIAL VEGETATION BASELINE FOR PROJECT MILLENNIUM

Submitted to:

Suncor Energy Inc., Oils Sands

April 1998

972-2205

Golder Associates Ltd.

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April 27, 1998

Proj. No. 972-2205

Mr. Martin Holysh
Senior Environmental Specialist
Sustainable Development
Suncor Energy Inc., Oil Sands
P.O. Box 4001
Fort McMurray, AB
T3H 3E3

RE: Final Report on the Terrestrial Vegetation Baseline for Project Millennium

Dear Martin:

Attached are five copies of the Terrestrial Vegetation Baseline Conditions for Project Millennium.

This report describes the terrestrial vegetation within the local and regional study areas at different levels of generalization in terms of species composition and coverage, physical structure, diversity, rare plants, and plants with traditional uses.

If you have any additional questions about the report, please contact either Greg Sutor at 299-4655 or me at 299-5640.

Yours very truly,

GOLDER ASSOCIATES LTD.

Shaw-McKeown

for John R. Gulley, M.Sc., P. Biol.
Oil Sands Project Director

attachments (5)

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EXECUTIVE SUMMARY

This document details the baseline for Terrestrial Vegetation within the Local and Regional Study Areas for Suncor Energy Inc. (Suncor) Project Millennium in support of an Environmental Impact Assessment (EIA). Terrestrial vegetation is defined as uplands forest communities where the soil is not saturated for extended periods.

The objective of the study was to describe the terrestrial vegetation in the Local and Regional Study Areas at different levels of generalization in terms of:

- species composition and coverage;
- physical structure;
- age structure;
- diversity;
- rare plants; and
- plants with traditional uses.

The terrestrial vegetation classification system process was based on the following sources of information:

- Alberta Vegetation Inventory mapping;
- the Field Guide to Ecosites of Northern Alberta (Beckingham and Archibald 1996);
- field data reported in the Terrestrial Baseline Report for the Steepbank Mine (Golder 1996); and
- field data collected for the Project Millennium EIA.

There are seven general terrestrial vegetation types classified in the Regional Study Area (RSA). Terrestrial vegetation comprises 32% of the RSA or 781,654 ha. The most dominant type is the mixedwood class (blueberry Aw-Sw, low-bush cranberry Aw-Sw, dogwood Pb-Sw), which occurs on 323,026 ha or 13% of the RSA. Thirty-five percent or 5,704 ha of the Local Study Area (LSA) is covered with uplands vegetation. The most dominant type is the low-bush cranberry Aw with 3,348 ha or 21% of the LSA. Collectively, the mixedwood classes of blueberry Aw-Sw, low-bush cranberry Aw-Sw and dogwood Pb-Sw cover 4% or 711 ha of the LSA.

Community level diversity can be assessed by examining community richness, diversity and polygon size. The ranges of these parameters are an expression of heterogeneity in the vegetation types, as mapped by ecosite phase polygons.

EXECUTIVE SUMMARY

Rare plants, by definition, have restricted spatial ecological and temporal distributions in a variable or diverse environment. Previous studies (Golder 1996) documented the existence of four species of vascular plants listed as rare within the LSA. Within the RSA, 25 rare species have been previously documented. During the 1997 field studies, four rare plants were found within the LSA.

Traditional Plants occur throughout the LSA and RSA. These plants are collected for medicinal, spiritual and consumptive purposes. An investigation previously conducted by the Fort McKay community was used to develop a list of plants used for such purposes.

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1. INTRODUCTION

1.1 OBJECTIVES FOR BASELINE ASSESSMENT

This Terrestrial Vegetation Baseline report provides a summary of the terrestrial vegetation resources found within the Project Millennium local study area (LSA). Specifically, the following information is provided in this report:

- descriptions and maps of vegetation communities in the LSA and the status of any rare, threatened or endangered plant species;
- evaluation of the forest resources according to the standards outlined in the Alberta Vegetation Inventory Standards Manual (AVI) Version 2.2; and
- description of plants used by aboriginal people in the area.

Terrestrial vegetation, as defined here, corresponds to uplands vegetation. Uplands are defined as areas where the soil is not saturated for extended periods; areas which are vegetated almost exclusively by forest stands in the study area. Wetlands vegetation is discussed in a Wetlands Baseline Report for Project Millennium (Golder 1998a).

The main objective of the study was to describe the terrestrial vegetation of the LSA and RSA at different levels of generalization in terms of:

- species composition and coverage;
- physical structure;
- age structure;
- diversity;
- rare plants; and
- plants with traditional uses.

This description of baseline terrestrial vegetation conditions provides the basis for the subsequent assessment of the potential impacts of Project Millennium on vegetation resources.

Scientific names of the plant species listed in this report are provided in Appendix I.

1.2 STUDY AREAS

Project Millennium (the Project) local study area (LSA) is located in the Boreal Mixedwood Natural Subregion of Alberta (Figure 1). The vegetation that characterizes this area includes aspen as the dominant overstorey tree, but balsam poplar, black spruce, white spruce and jack pine are also common (Beckingham and Archibald 1996). Balsam fir, tamarack and white birch occur occasionally, while lodgepole pine occurs rarely. The understorey is characterized by beaked hazelnut, prickly rose, low-bush cranberry, saskatoon, Canada buffaloberry, twin-flower, green alder, bunchberry, wild sarsaparilla and dewberry.

1.3 APPROACH

The existing vegetation conditions reflect the dynamic inter-relationships between landform, soils, drainage and vegetation development over time. The vegetation classification used a hierarchical system developed by Beckingham and Archibald (1996) as documented in the Field Guide to Ecosites of Northern Alberta.

In general, vegetation resources were described according to three main parameters: vegetation composition; vegetation structure; and vegetation function. Within the ELC hierarchy, each of these parameters were described at the landscape level of generalization according to ELC units (i.e., Ecosites, Ecosite Phases), the Plant Community level and also at the individual plant species level. This approach to vegetation description and analysis is shown in Table 1.

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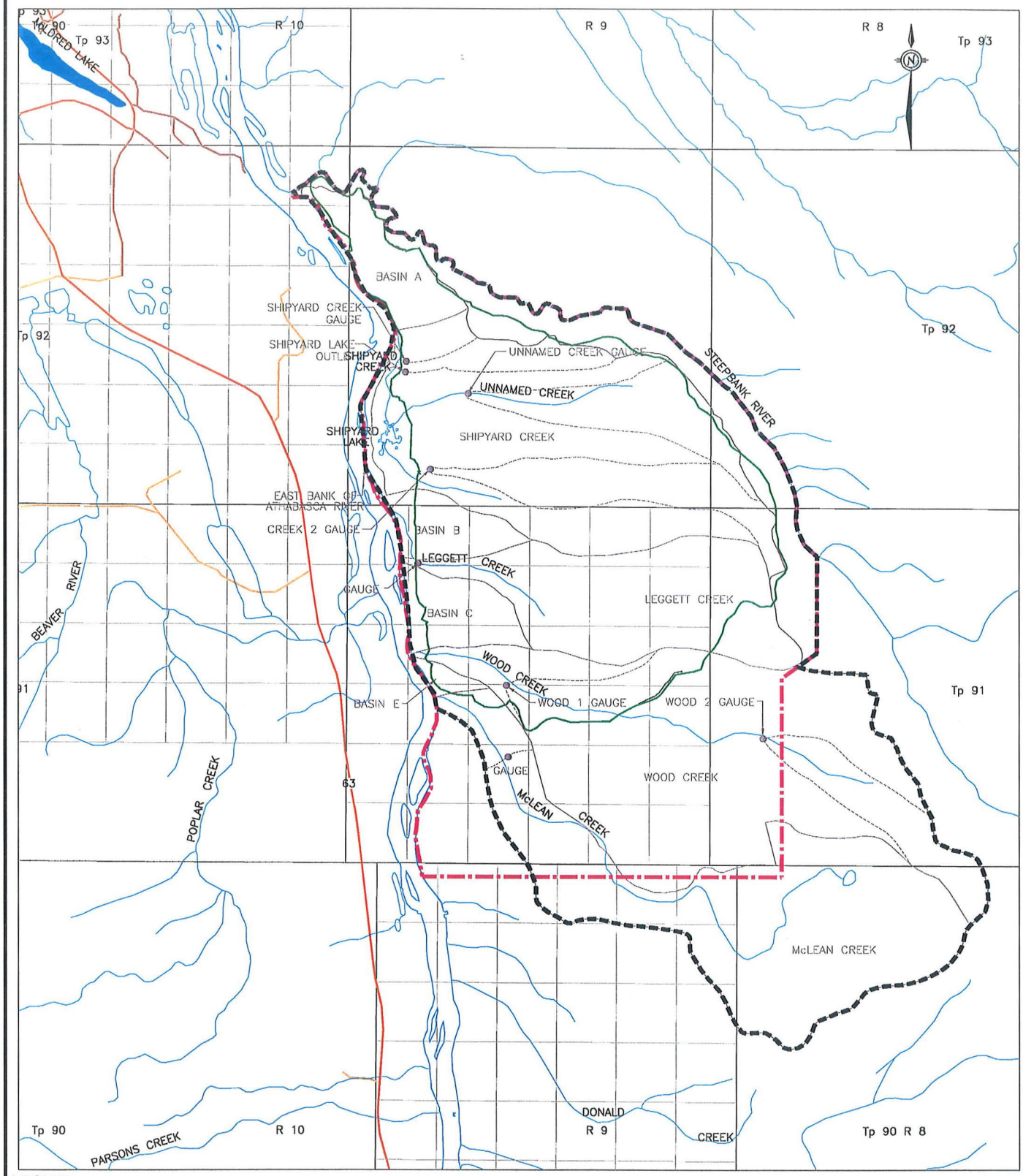


LEGEND

- EAST BANK MINING AREA
- LOCAL DRAINAGE BASIN
- LOCAL DRAINAGE SUB BASIN
- LOCAL BASIN GAUGE
- LOCAL STUDY AREA FOR TERRESTRIAL
- LOCAL STUDY AREA FOR AQUATICS

REFERENCE

DIGITAL DATA SETS 74D AND 74E RESOURCE DATA DIVISION, ALBERTA ENVIRONMENTAL PROTECTION, 1997.
MINE PLAN SUPPLIED BY SUNCOR ENERGY, MAR 1998.
DATUM IS IN NAD83 UTM

0 1 2 3 4 5km

SCALE 1:150,000

SUNCOR ENERGY

Project Millennium
Taking Suncor into the 21st Century

LOCAL STUDY AREA FOR PROJECT MILLENNIUM WETLANDS/TERRESTRIAL BASELINE

06 Apr. 1998	Figure 1	DRAWN BY: CG/TM

Table 1 Vegetation Parameters and Levels of Analysis Used in the Description of Baseline Conditions for Project Millennium

Levels Of Analysis	Vegetation Parameter		
	Composition	Structure	Function
Landscape	ELC unit vegetation composition, relative proportions and distribution	ELC unit structural complexity; serial stage; relative proportion and distribution	landscape function, watersheds, wildlife habitat
Plant Community	species composition; species richness and diversity	tree heights and vegetation cover, proportion of dead standing and fallen tree numbers	plant biomass and productivity
Plant Species	abundance of rare plants; medicinal and spiritual plant use	tree, shrub or herb layer	potential to support rare species, medicinal plants.

1.3.1 Vegetation Description

Vegetation plots were used to survey representative study locations. The vegetation plot provided the framework for the measurement of vegetation composition and structure on the forest floor, and in the herb, shrub and tree layers. The percent cover, and heights of live and dead standing trees were measured in large (20 x 20 m) plots. For each dead fallen tree, the species, length and diameter was recorded. Shrub heights and percent cover, for each species, were determined within smaller (10 x 10 m) shrub plots. The percent cover and height of individual herbs were measured in the herb layer within survey plots. All vegetation survey plots were distributed in a manner that ensured sufficient information was collected to fully characterize the various plant communities, or ELC units within the Project Millennium area.

1.3.2 ELC Linkage

ELC provides a means of integrating the diversity of vegetation types with that of landforms, soils and other ecosystem components. It also provides a means to assess different types of diversity at various scales. The ELC units therefore describe landscape scale diversity. This Terrestrial Vegetation Report addresses diversity at the community and species level. Baseline information for ELC are provided in the Ecological Land Classification for Project Millennium (Golder 1998b).

1.4 DISTRIBUTION OF PLANT SPECIES

The distribution and abundance of plant species varies along a moisture gradient from wetlands, to riparian areas, to uplands. For the purpose of this study, plant communities were grouped according to their general distribution with respect to landform, soil and drainage condition (i.e., within the three main categories: Uplands, Riparian and Wetlands). The uplands consist of the above forest types which were identified during the forest inventory. Uplands are defined as areas where the soil is not saturated for extended periods.

Riparian areas are defined as wetlands associated with running water systems found along rivers, streams and drainageways. Riparian wetlands areas occupy a unique position in the landscape and life of the Boreal Forest. Their importance far exceeds that implied by their relatively small area. The riparian area is the interface or linkage between the terrestrial and aquatic area. Riparian ecosystems are important islands of diversity within the extensive upland ecosystem and play a significant role in maintaining structure and functionality of the ecosystem. Riparian areas have the following characteristics: 1) they create well-defined habitat zones: 2) they make up a minor proportion of the overall area: 3) they are generally more productive in terms of total biomass than the remainder of the area: and 4) they are a critical source of biological diversity. Both density and diversity of plant species tend to be higher in riparian areas than in adjacent uplands. Baseline information on riparian and wetlands are provided in the Wetlands Baseline for Project Millennium (Golder 1998a).

Wetlands are defined as areas that are saturated with water long enough to promote wetlands or aquatic processes as indicated by hydric soil, hydrophytic vegetation and various kinds of biological activity which are adapted to the wet environment. Baseline information on wetlands are provided in the Wetlands Baseline for Project Millennium (Golder 1998a).

1.4.1 Uplands Plant Communities

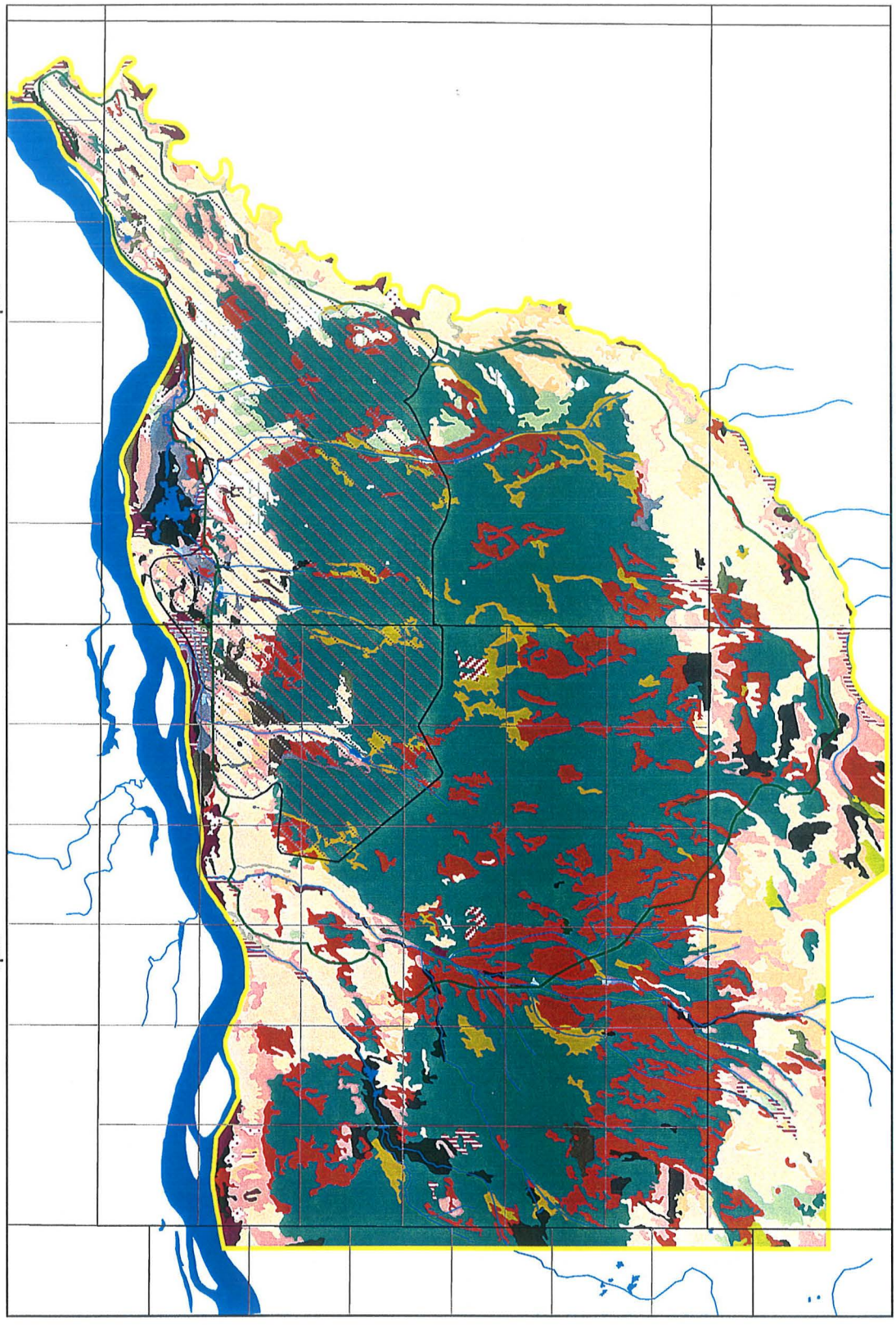
Uplands differ primarily from lowlands (i.e., riparian and wetlands areas) based on the saturation of the soil and the presence of a treed canopy. Uplands may be distinguished from other plant communities on the basis of moisture and nutrient regimes, as well as on the dominant tree species, or tallest vegetation layer. The specific uplands plant community type may be determined based on the understorey species composition and abundance.

A typical Boreal Mixedwood forest on uplands sites consists of a canopy of white spruce, jack pine and/or trembling aspen. The understorey may be composed of ericaceous shrubs, such as bearberry, blueberry or Labrador tea.

Peat moss is uncommon in uplands, although other types of moss, such as feathermoss, are common.

Uplands forests can be divided into ecosites according to their vegetation composition and soil properties (Beckingham and Archibald 1996). In Alberta, there are eight uplands ecosites. Within the Boreal Mixedwood, each ecosite may be subdivided into ecosite phases, and each ecosite phase may be subdivided further into component plant community types. A general discussion is provided on the characteristics of each of the ecosites, ecosite phases, and plant communities observed in the uplands of Project Millennium LSA and RSA. For mapping purposes, the vegetation in the LSA was classified to the ecosite phase level (Figure 2).

Vegetation was also examined at the scale of the individual plant species. Special attention was given to rare plants and the potential impacts that the Project will have on them. In addition, plants that are used for medicinal and spiritual purposes by aboriginal peoples are examined as part of the vegetation assessment.



LEGEND

- Terrestrial Local Study Area
- Steepbank Mine
- East Bank Mining Area
- Open Water

Vegetation Classification

- Lichen (Pj)
- Blueberry (Pj-Aw)
- Blueberry (Aw-Sw)
- Blueberry (Aw-Pj)
- Labrador Tea (Pj-Sb)
- Labrador Tea (Sb-Pj)
- Labrador Tea / Horsetail (Swj-Sb)
- Low-bush Cranberry (Aw)
- Low-bush Cranberry (Aw-Sw)
- Low-bush Cranberry (Sw)
- Dogwood (Pb-Aw)
- Dogwood (Pb-Sw)
- Dogwood (Sw)
- Black Spruce-Tamarack (Sb/Lt)
- Shrubland (shrub)
- Graminoid Cutblock
- Wooded Bog
- Wooded Fen
- Shrubby Fen
- Graminoid Fen
- Wooded Swamp
- Shrubby Swamp
- Marsh (graminoid / shrub)
- Shallow Open Water
- Flooded Area
- Cutbank
- Cultural Features and Disturbed Lands

West of Fourth Meridian

N

1000 0 1000 2000 3000

Metres

Scale 1:100,000

SOURCES: Suncor
Golder
The Forestry Corp
Klohn-Crippen

Map Projection: UTM 12
Datum: NAD 83

SUNCOR ENERGY

Project Millennium

LOCAL STUDY AREA VEGETATION CLASSIFICATION

27 Apr. 1998	Figure 2	PRODUCED BY: JS REVIEWED BY:

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2. VEGETATION MAPPING METHODOLOGY

2.1 REGIONAL MAPPING AND CLASSIFICATION

Vegetation was mapped using Landsat imagery and a geographical information system (GIS) to allow the relative abundance of plant communities to be compared within the RSA. The classification for the RSA is at a coarser scale than completed for the LSA, resulting in slight differences in area calculations for baseline and impact values for Project Millennium.

Landsat Thematic Mapper Satellite imagery was collected for two areas ("scenes") July 1994 and July 1996 respectively. The majority of the RSA was covered by the more recent 1996 imagery; however, due to cloud cover constraints small portions in the north and south of the RSA were covered by the 1994 imagery. A supervised classification of the imagery was undertaken that included the selection of a number of "training" or test areas determined from information collected from aerial photographs, Alberta Phase 3 Forest Inventory Maps (AENR 1983), Alberta Vegetation Inventory (AVI) Maps (Nesby 1997), Vegetation Maps produced for oil sands projects, Soil Inventory Maps of the Alberta Oil Sands Environmental Research Program (AOSERP) (Turchenek and Lindsay 1982) and a 1997 field investigation. An accuracy assessment of the classified imagery based on field data collected in July and August 1997 indicated a final overall accuracy of approximately 80%.

2.2 LOCAL STUDY AREA MAPPING AND CLASSIFICATION

The terrestrial vegetation classification process for the Project LSA was based on the following sources of information:

- Alberta Vegetation Inventory (AVI) mapping (Nesby 1997), which uses a forestry-based vegetation classification system;
- vegetation classification using the system from the Field Guide to Ecosites of Northern Alberta (Beckingham and Archibald 1996), which is based on the principles of ecological land classification (ELC);
- field data reported in the Terrestrial Baseline Report for the Steepbank Mine (Golder 1996); and
- field data collected for the Project Millennium EIA.

There were four steps in the terrestrial vegetation classification process:

1) AVI polygons were selected as mapping units.

2) AVI polygons were classified using Beckingham and Archibald's system to provide an initial delineation of ecosite phase.

3) Ground-truthing data were collected from plots located on the basis of the preliminary delineation.

4) The preliminary delineation was finalized as necessary using field data. Polygons and plots that did not fit Beckingham and Archibald's system were defined either as complexes of Beckingham units or as new vegetation units.

2.2.1 Beckingham and Archibald's Classification System

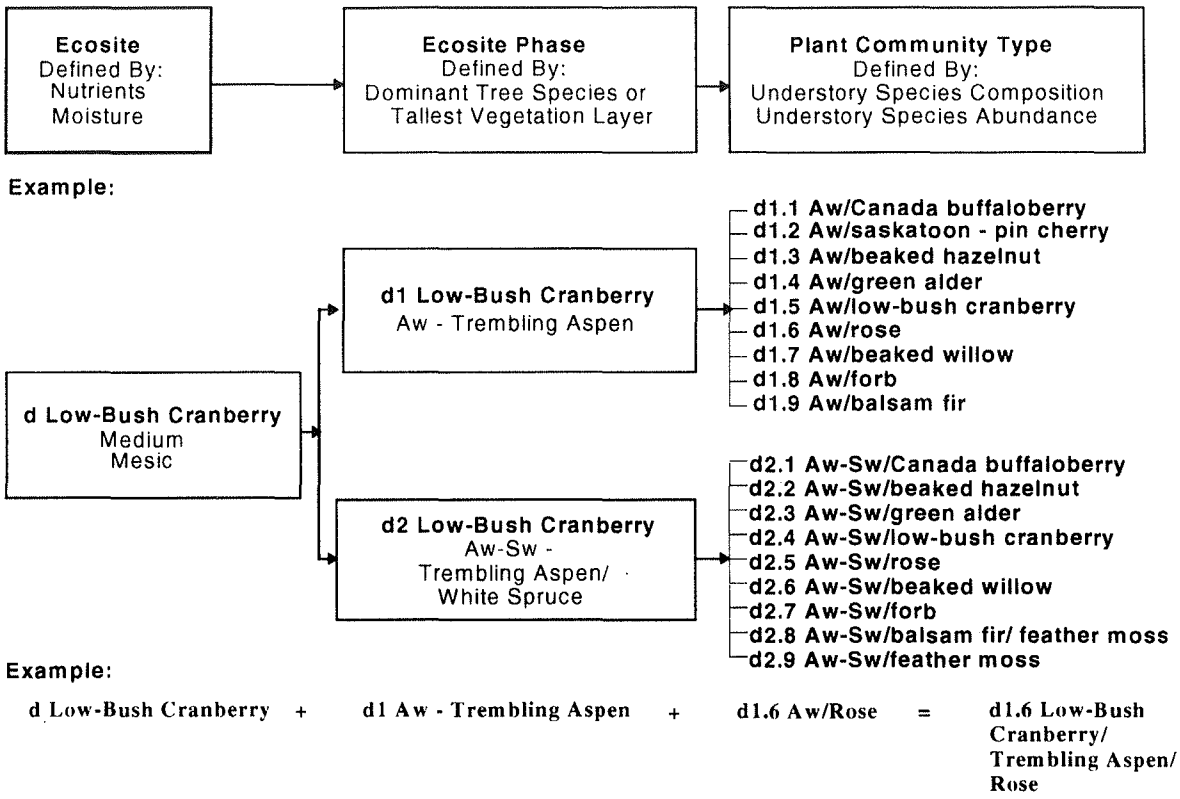
Beckingham and Archibald's 1996 system, as expressed in their Field Guide to Ecosites of Northern Alberta (1996), uses a mixture of biotic and abiotic variables to create a hierarchical, or nested, ecological classification structure. At the coarsest level of classification, ecological areas and subregions are defined on the basis of broad ecoclimatic factors. At this level of generalization the entire study area is within the boreal mixedwood forest. Differences in soil nutrient and moisture regimes are then used to differentiate ecosites. Beckingham and Archibald recognized eight uplands ecosites in the boreal mixedwood forest. Ecosites are subdivided into ecosite phases according to the dominant species in the forest canopy or tallest vegetation layer. At the finest level of classification, ecosite phases are in turn subdivided into plant community types on the basis of differences in species composition within the understorey vegetation (typically the shrub layer). Figure 3 summarizes the classification process, starting at the ecosite level, and works through an example for one ecosite.

Only polygons that were field verified with understorey classified to the plant community level were included in the final classification. Therefore, the vegetation classification for the LSA was completed only to the ecosite phase level.

Figure 4 is an edatropic grid showing the ecological relationships, as defined by gradients of moisture and nutrient supply, of the 17 uplands ecosite phases described by Beckingham and Archibald (1996). The eight wetlands ecosite phases are included for comparison. Moisture conditions, on the vertical (y) axis, range from hydric (wettest) to xeric (driest). Nutrient conditions, on the horizontal (x) axis, range from very poor to very rich. The positions of the ecosite phases shown in Figure 4 represent the mid-points of the ranges of moisture and nutrient regime reported by Beckingham and Archibald.

One of the end products of the AVI mapping exercise was a detailed vegetation map at a scale of 1:20,000 based on the 1997 aerial photography (Figure 2).

Figure 3 Ecosite Classification Steps



2.2.2 Plant Community Assessment Field Methods

Plot locations for the uplands plant community assessment were determined using the initial delineation of plant communities. Plots of 20 x 20 m were randomly located in separate map polygons representative of each ELC unit. Species composition and structural data were collected within each plot as follows:

- tree layer (>5 m high) - entire 20 x 20 m plot
  - % coverage for each species
  - average tree height
  - dbh (diameter at breast height) for all living. dead and downed trees
  - age of 3 largest trees
- shrub layer (0.5-5 m high) - 10 x 10 m subplot in one corner of 20 x 20 m plot
  - % coverage for each species
  - height of shrubs

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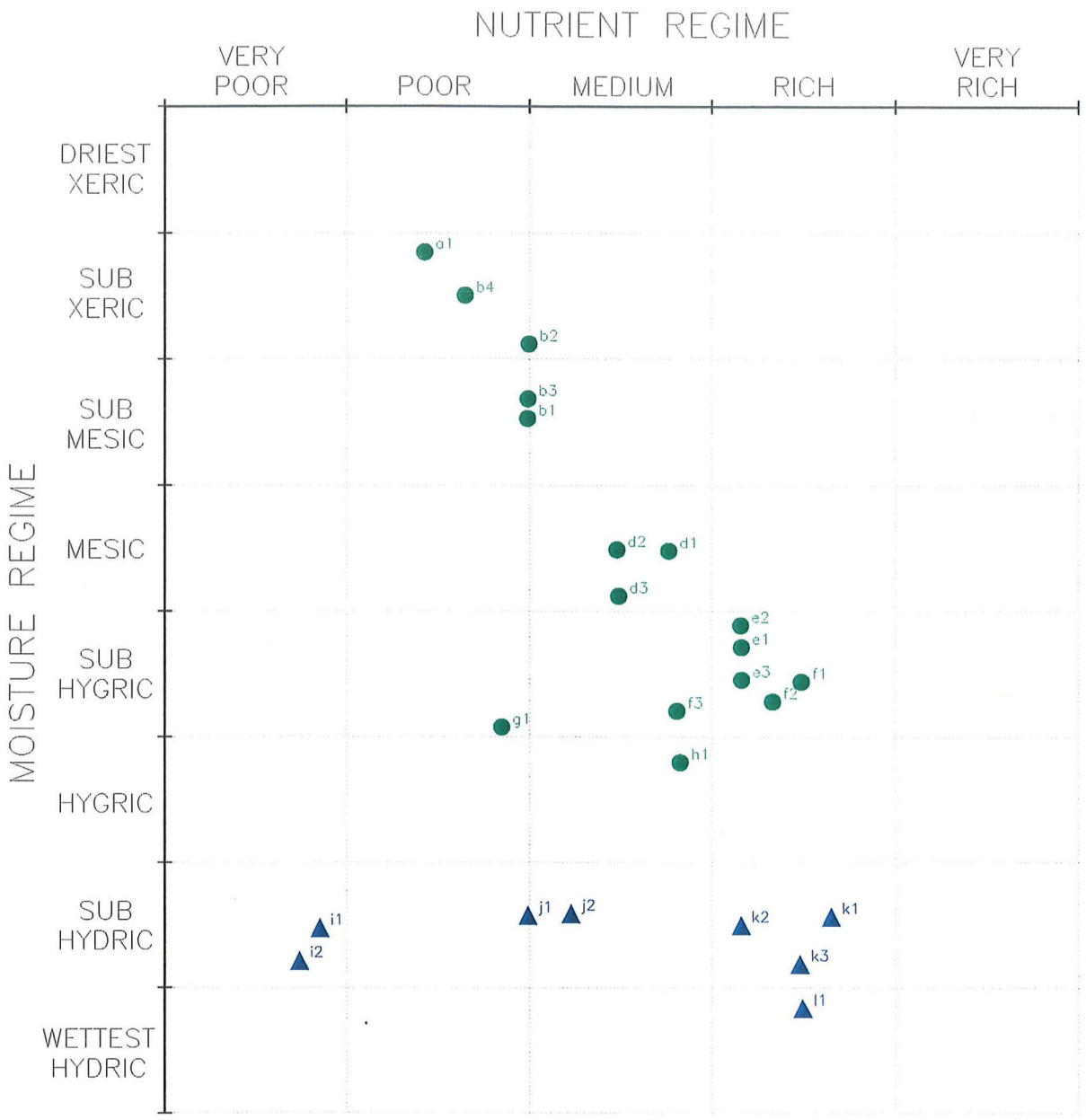

LEGEND

- TERRESTRIAL ECOSITE PHASES
- WETLANDS ECOSITE PHASES

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Taking Suncor into the 21st Century

MOISTURE: NUTRIENT RELATIONSHIPS OF ECOSITE PHASES

05 Apr. 1998	Figure 4	DRAWN BY: CG/TM

- herb layer (<0.5 m high) - 7, 1 x 1 m plots within 10 x 10 m subplot
  - % cover for each herb, moss and lichen species

Standard field techniques were used throughout. Field taxonomy followed Flora of Alberta (Moss 1983) and Packer and Bradley (1984). Specimens of plants that could not be identified in the field were collected for herbarium identification.

2.2.3 Community Diversity

Community level diversity was assessed examining vegetation polygon or patch dynamics. Patch dynamics examines vegetation communities as mosaics of different areas (patches) in which disturbances and biological interactions proceed. A patch habitat therefore is an environment within which there are significant variations in size and quality of habitat available for particular species. Higher variability (range) in patch size provides some indication of diversity at the landscape and community level. The number and size of vegetation polygon (patches) within the LSA are quantified in hectares.

2.2.4 Species Richness and Diversity

Compositional biodiversity is commonly described using measures of richness (species number), and eveness (relative abundance). Species richness is the total number of species present in an area (Krebs 1989). Species richness was calculated for herb, shrub and tree layers in each plot surveyed. Community richness was calculated by averaging the species richness recorded for each community type. Species diversity was measured using the Shannon Index. This Index is a measure of equitability (H) calculated to incorporate the sum of the proportional contributions of an individual species to the total population of a community (Krebs 1989). Minimal values occur when one species has a disproportionate dominance, whereas maximum values occur when all species share equally in the dominance of the community.

Accordingly, the Shannon Index, H, can be expressed as

$$H = \sum_{i=1}^{k} P_i \log P_i$$

where k is the number of categories (i.e., species) and P_i is the proportion of the observations found in category i. In this case, the percent coverage of the plot area, expressed as a decimal, was used to approximate P_i.

The mean and range of numbers of species for the ecosite phases surveyed have been presented, both for the unit (ecosite phase) as a whole and for each of the tree, shrub and herb layers.

2.2.5 Rare Plants

A list of rare plant species potentially present in the Project Millennium study area was prepared from existing literature sources. The known habitat associations of these species were considered in selecting the field plot locations. During the field studies, each rare plant occurrence was documented using the rare native plant survey form provided by the ANHIC (1996). Rare plants were photographed twice and specimens were collected.

In addition, areas surveyed within the LSA were scored according to their rare plant habitat potential using the following ratings:

- no potential;
- low potential;
- moderate potential;
- high potential; and
- rare plant habitat.

2.2.6 Plants With Traditional Uses

Plants traditionally used by local aboriginal people for food, medicine or spiritual purposes were identified using published literature and results from previous interviews with community members (Fort McKay 1997).

3. RESULTS AND DISCUSSION

3.1 REGIONAL VEGETATION CLASSIFICATION

There are seven general terrestrial vegetation types classified in the RSA (Table 2). Terrestrial vegetation comprise 32%, or 781,654 ha of the RSA. The most dominant type is the mixedwood class (blueberry Aw-Sw; low-bush cranberry Aw-Sw, dogwood Pb-Sw) which occurs on 13%, or 323,026 ha of the RSA. Lichen jack pine comprises approximately 5.4% of the RSA. Mixedwood deciduous vegetation types, including blueberry Aw (Bw), low-bush cranberry (Aw), dogwood (Pb-Aw) ecosite phases cover 7%, or 180,410 ha of the RSA. Mixedwood coniferous vegetation types, including low-bush cranberry (Sw), dogwood (Sw) ecosite phases occupy 5%, or 113,366 ha of the RSA. Blueberry Sw-Pj, Labrador tea-mesic Pj-Sb, and Labrador tea-subhygric Sb-Pj ecosite phases occupy less than 1%, or 15,081 ha of the RSA. Detailed information on each ecosite phase represented in the LSA and RSA are provided in the following sections.

3.2 VEGETATION CLASSIFICATION FOR LSA

3.2.1 Uplands Plant Communities

Beckingham and Archibald (1996) defined eight uplands ecosites and 17 associated ecosite phases within the boreal mixedwood forest. Table 3 gives the baseline areas of the uplands ecosite phases and complexes of ecosite phases mapped within the LSA. Included are two uplands vegetation types that do not fit into Beckingham and Archibald's classification, shrublands and black spruce-tamarack forest. In total, uplands forest vegetation units comprise 36% of the LSA.

The ecosites and ecosite phases are described below. The average cover of characteristic species of the ecosite phases are summarized in Table 4. No floristic data are available for the shrubland and black spruce-tamarack vegetation types.

Table 2 Regional Vegetation Classification

Land Cover Classes	Map Codes	Boreal Mixedwood	Boreal Highlands	Subarctic	AWI
Open Pine Lichen	Open Pine Lichen	Lichen (Pj) a1	Bearberry/lichen a1	Bearberry (Pl) a1	
Mixedwood Deciduous (Aspen Dominant)	Mixedwood Deciduous (Aw dominant)	Blueberry Aw (Bw) b2 Low-bush cranberry (Aw) d1 Dogwood (Pb-Aw) e1 <10% Horsetail (Pb-Aw) f1 <10%	Blueberry Aw (Bw) b2 Low-bush cranberry (Aw) d1	Bearberry (Aw) a3 Canada buffaloberry (Aw) b2 Horsetail (Pb-Bw) d1 <10%	
Mixedwood (White Spruce- Aspen Dominant)	Mixedwood (Sw-Aw dominant)	Blueberry (Aw-Sw) b3 Low-bush cranberry (Aw-Sw) d2 Dogwood (Pb-Sw) e2 <10% Horsetail (Pb-Sw) f2 <10%	Low-bush cranberry (Aw-Sw-Sb) d2	Canada buffaloberry (Aw-Sw-Sb) b3 Horsetail (Aw-Sw) d2	
Mixedwood Coniferous (White Spruce Dominant)	Mixedwood Coniferous (Sw dominant)	Low-bush cranberry (Sw) d3 Dogwood (Sw) e3<10% Horsetail (Sw) f3<10%	Low-bush cranberry (Sw) d3	Canada buffaloberry (Sw) b4 Horsetail (Sw) d3	
Mixedwood Coniferous (White Spruce- Pine Dominant)	Mixedwood Coniferous (Sw-Pj/Pl dominant)	Blueberry (Sw-Pj) b4	Blueberry (Sw-Pj) b3	Labrador tea-hygric (Pl-Sb) e1	
Mixedwood Coniferous (Pine Dominant)	Mixedwood Coniferous (Pj/Pl dominant)	Blueberry (Sw-Pj) b4 Labrador tea -mesic (Pj-Sb) c1 Labrador tea-subhygric (Sb-Pj) g1	Blueberry (Sw-Pj) b3 Labrador tea-mesic (Pj-Sb) c1 Labrador tea-subhygric (Sb-Pj) g1	Labrador tea-mesic (Pl-Sb) c1 Labrador tea-hygric (Pl-Sb) e1	
Mixedwood Coniferous (Black Spruce Tamarack)	Mixedwood Coniferous (Sb-Lt)	Non-wetlands Sb-Lt	Non-wetlands Sb-Lt	Non-wetlands Sb-Lt	
Wet Closed Coniferous (Black Spruce)	Wet Closed Coniferous (Sb)	Treed poor fen j1 Treed rich fen k1 Treed bog i1	Treed poor fen i1 Treed rich fen j1 Treed bog h1	Treed bog f1 Treed poor fen g1 Treed rich fen h1	FTNN/FFNN
Wet Open Coniferous (Black Spruce)	Wet Open Coniferous (Sb)	Treed poor fen j1 Treed rich fen k1 Treed bog i1	Treed poor fen i1 Treed rich fen j1 Treed bog h1	Treed bog f1 Treed poor fen g1 Treed rich fen h1	FTNN/FFNN
Pine Recolonization (Pine <2m)	Pine Recolonization (Pine <2m)	shrubland dominated by Pine	shrubland dominated by Pine	shrubland dominated by Pine	
Shrubland (low shrub recolonization no pine)	Shrubland (low shrub recolonization no pine)			shrubland (upland dry-mesic moisture regime)	
Bog (sphagnum around edges of graminoid fens)	Bog (sphagnum around edges of graminoid fens)	Shrubby bog i2	Shrubby bog h2	Shrubby bog f2	BTNN, BTNI
Low Shrub wetland (bog)	Bog (shrub dominant)			Shrubby bog f2	BONS
Shrubby Fen	Shrubby Fen	Shrubby poor fen j2 Shrubby rich fen k2	Shrubby poor fen i1 Shrubby rich fen j2	Shrubby poor fen g2 Shrubby rich fen h2	FONS
Graminoid Fen	Graminoid Fen	Graminoid rich fen k3	Graminoid rich fen j3	Graminoid rich fen h3	FONG/MONG
Marsh emergent	Marsh emergent	marsh l1	marsh	marsh	MONG
Forestry Cutblocks	Forestry Cutblocks				
Natural or Human Disturbance	Natural or Human Disturbance				
Water	Water				WONN, NWL, NWF, NWR

Table 3 Baseline Areas of Ecosite Phases Within the LSA

Ecosite Phase	Code	Area (ha)	Percent Cover
lichen jack pine	a1	1	<1
blueberry Pj-Aw	b1	226	1
blueberry Aw (Bw)	b2	28	<1
blueberry Aw-Sw	b3	60	<1
blueberry Sw-Pj	b4	50	<1
Labrador Tea-mesic Pj-Sb	c1	1	<1
low-bush cranberry Aw	d1	3,348	21
low-bush cranberry Aw-Sw	d2	588	4
low-bush cranberry Sw	d3	941	6
dogwood Pb-Aw	e1	212	1
dogwood Pb-Sw	e2	63	<1
dogwood Sw	e3	127	1
Labrador tea - subhygric Sb-Pj	g1	1	<1
Labrador tea/horsetail Sw-Sb	h1	59	<1
shrubland	-	131	1
black spruce-tamarack	-	20	<1
Total, uplands ecosite phases		5,856	36
Total, wetlands vegetation units		9,994	
Existing disturbances and water		331	
TOTAL LSA		**16,181**	

3.2.2 Upland Communities Occuring in the LSA

3.2.2.1 Lichen Ecosite (a)

The soils of the lichen ecosite are well-to rapidly-drained, with submesic to xeric moisture regimes. The nutrient regime is typically poor. This ecosite has only one phase, the lichen jack pine, which occupies 1 ha or less than 1% of the LSA.

The shrub understorey of the lichen jack pine ecosite phase typically consists of blueberry, bearberry, green alder, bog cranberry, Labrador tea, twin-flower, jack pine and sand heather.

Wild lily-of-the-valley is the only common forb. On the forest floor, reindeer lichen is dominant, while Schreber's moss, awned hair-cap moss and brown-foot cladonia are also found.

Table 4 Mean Cover (%) of Characteristic Species Which Show up in 50% or More of the Sample Sites

Layer	Species	b1	b2	b3	b4	d1	d2	d3	e1	e2	e3
Tree	balsam fir										38
Tree	balsam poplar									10	
Tree	black spruce	4									
Tree	jack pine	21		7	49						
Tree	paper birch									27	
Tree	tamarack	4									
Tree	trembling aspen	11	70	42	4	49	33	3			
Tree	white spruce	12		21	9	10	27	58		26	
Shrub	alder-leaved buckthorn								10		
Shrub	balsam fir									5	10
Shrub	balsam poplar								5	13	
Shrub	black gooseberry									2	
Shrub	bog cranberry	13			10						
Shrub	buckbrush									3	
Shrub	buffaloberry	10		15	6	9	14				
Shrub	common bearberry	5	3	5							
Shrub	dwarf blueberry	15									
Shrub	green alder		10								
Shrub	jack pine				1						
Shrub	Labrador tea	15	5	10	18						
Shrub	low-bush cranberry					17	11	12		5	
Shrub	myrtle-leaved willow	1									
Shrub	prickly rose	7	5	10	14	15	11	6		8	10
Shrub	pussy willow								20		
Shrub	red-osier dogwood								15	10	12
Shrub	river alder								80	8	28
Shrub	shrubby cinquefoil	1									
Shrub	tamarack	2									
Shrub	trembling aspen	2	25		4	4	3	1		3	
Shrub	twin flower	5	10		9	6	9			3	
Shrub	velvet-leaved blueberry	15	30	30							
Shrub	white spruce	15		25	26	5	3	3	3	4	
Shrub	wild red currant								5	5	7
Shrub	wild red raspberry								10		12
Forb	American milk-vetch	1									
Forb	bishop's-cap						4	4			3
Forb	bunchberry	20	15	40	8	13	14	12		5	10
Forb	common horsetail	1			2				5	5	13
Forb	common pink wintergreen		2	5				2		2	
Forb	cow-wheat	2									
Forb	dewberry		3			7	7			20	9
Forb	dwarf scouring-rush	2									
Forb	fireweed	1	7								
Forb	fringed aster	1		10							
Forb	northern bedstraw					2				1	
Forb	northern water-horehound								5		
Forb	palmate-leaved coltsfoot	1								3	
Forb	red and white baneberry		25								
Forb	Siberian yarrow			2							
Forb	spinulose shield fern								10		

Layer	Species	b1	b2	b3	b4	d1	d2	d3	e1	e2	e3
Forb	spotted touch-me-not								5		
Forb	tall lungwort			10							
Forb	three-leaved false Solomon's-seal		5								
Forb	three-toothed cinquefoil	1		3							
Forb	water-hemlock								15		
Forb	wild lily-of-the-valley					3					
Forb	wild sarsaparilla					11		6		3	
Forb	wild strawberry			5		4					
Graminoid	bluejoint	1	1	15					5		
Graminoid	mud sedge		1								
Graminoid	northern ricegrass	2									
Moss	big red stem			70	23		26	51		35	25
Moss	juniper moss	3			13						
Moss	moss species		15						5	3	
Moss	pigtail moss									5	
Moss	Sphagnum	15									
Lichen	Cladonia	40									
Lichen	hair lichens										85
Lichen	monk's hood lichen										63
	Total Number of Sites	**2**	**1**	**1**	**4**	**12**	**9**	**7**	**1**	**2**	**3**

3.2.2.2 Blueberry Ecosite (b)

The soils of the blueberry ecosite are moderately well-to rapidly-drained. The moisture regime is usually submesic to subxeric, and the nutrient regime is poor to medium. The four ecosite phases occur in the LSA and occupy 364 ha (Table 3).

The canopy of the blueberry jack pine-trembling aspen (b1) ecosite phase is dominated by jack pine and aspen. White birch, white spruce and black spruce may also be found in the canopy. The shrub layer is diverse, typically consisting of bog cranberry, blueberry, green alder, bearberry, Labrador tea, twin-flower, Canada buffaloberry, aspen, white spruce and prickly rose. Herbs may include bunchberry, fireweed and cream-colored vetchling. Hairy wild rye is also present. Schreber's moss, stair-step moss and reindeer lichen are the characteristic non-vascular species.

Figure 5 Blueberry Ecosite with Jack Pine - Trembling Aspen Canopy

Besides the plant species noted in the blueberry jack pine-trembling aspen (b1) ecosite phase, there were other species observed when performing the plant survey. They included willow, shrubby cinquefoil, dwarf blueberry, cow-wheat (figwort), fringed aster, western wood lily, northern green bog-orchid, common horsetail, woodland horsetail and northern rice grass. Within this ecosite phase there is nearly no forb cover. A picture of a jack pine-trembling aspen ecosite phase is shown in Figure 5. The picture was taken from a jack pine-trembling aspen ecosite phase in the Muskeg River Mine Project (Golder 1997o).

The blueberry trembling aspen (white birch) (b2) ecosite phase is dominated by aspen and white birch. White spruce may also be found in the canopy. The shrub layer is sparse when compared to that of b1. Species composition differs only in that black spruce is not common in b2. The herbaceous layer contains three main species; bunchberry, wild lily-of-the-valley and cream-colored vetchling. The most common grasses, mosses and lichens include marsh reed grass, hairy wild rye, Schreber's moss, stair-step moss and reindeer lichen.

Figure 6 Blueberry Ecosite with Trembling Aspen - White Spruce Canopy

Aspen and white spruce dominate the canopy of the blueberry trembling aspen-white spruce (b3) ecosite phase (Figure 6). White birch and jack pine may also be present in the canopy. The shrub layer is denser than in b2, but species composition differs only in that Canada buffaloberry is not common in b3. Bunchberry, fireweed, wild lily-of-the-valley, wild strawberry and cream-colored vetchling are characteristic of the herb layer. The dominant grasses, mosses and lichens are the same as in b2, with higher percent coverages.

The canopy of the blueberry white spruce-jack pine (b4) ecosite phase is dominated by white spruce and jack pine, although white birch and aspen are usually present as well. The shrub layer is similar to that of b3, with slightly lower average per cent cover.

The herb layer is characterized by bunchberry, wild lily-of-the-valley and bastard toad-flax. Hairy wild rye is the characteristic graminoid. The reindeer lichen is also present. The moss layer is better developed than in the other blueberry ecosite phases, with >30% coverage, but the species are the same.

3.2.2.3 Labrador Tea-Mesic Ecosite (c)

The soils of the Labrador tea ecosite are usually moderately-well to well-drained. The moisture regime is subhygric to submesic, and the nutrient regime is typically poor. A picture of a Labrador tea-mesic jack pine-black spruce (c1) ecosite phase is shown in Figure 7. The picture was taken from a

jack pine-black spruce ecosite phase in the Muskeg River Mine Project (Golder 1997o). This ecosite phase occupies 1 ha or less than 1% of the LSA.

Figure 7 Jack Pine-Black Spruce Forest with Labrador Tea Understorey

The canopy of the Labrador tea-mesic jack pine-black spruce ecosite phase is dominated by jack pine and black spruce. The shrub layer typically consists of Labrador tea, bog cranberry, black spruce, blueberry, green alder and twin-flower. Bunchberry is the only characteristic species in the poorly developed herb layer. The forest floor is dominated by Schreber's moss, with average ground coverage exceeding 40%. Stair-step moss, knight's plume moss and reindeer lichen are also characteristic.

3.2.2.4 Low-Bush Cranberry Ecosite (d)

The central moisture-nutrient concept of this ecosite is mesic-medium, although moisture regimes may vary from submesic to subhygric and nutrient regimes from poor to rich. Three low-bush cranberry ecosite phases occur in the LSA and occupy 4,877 ha (Table 3).

Figure 8 Trembling Aspen Canopy with Low-Bush Cranberry Understorey

The tree layer of the low-bush cranberry aspen (d1) ecosite phase is usually dominated by a closed canopy of aspen (Figure 8), although white birch may be locally dominant.

Balsam poplar and white spruce are the other characteristic tree species. Additionally, balsam fir may be present in the canopy. Prickly rose and low-bush cranberry are dominant in the shrub layer. Other typical shrubs are beaked hazelnut, green alder, Canada buffaloberry, saskatoon, willow, twin-flower, pin and choke cherry, wild red raspberry, snowberry, white spruce and aspen. The herb layer is well-developed and is characterized by wild sarsaparilla, fireweed, bunchberry, dewberry, cream-colored vetchling, showy aster, common pink wintergreen and northern bedstraw. Marsh reed grass and hairy wild rye are abundant and characteristic. Stair-step moss and knight's plume moss may also be present.

The low-bush cranberry (d1) ecosite phase is found on the Uplands within the LSA. This vegetation type is most common on the Athabasca and Steepbank River floodplain. Within the low-bush cranberry ecosite phase there are community types that do not correspond best with Beckingham's

ecosite phase d1. This diversity is a function of different moisture regimes, flooding history, surficial soils and successional stage. The dogwood Sw (e3) is present on the terraces on the Steepbank River floodplain. The stand is dominated by balsam fir (90% cover). White birch is also present in the canopy (10%). The shrub layer is dominated by river alder, dogwood and wild red currant. The herb layer is diverse and of high biomass, and is dominated by common horsetail, tall lungwort, dewberry, bishop's-cap, northern starflower, common pink wintergreen and fringed aster. A moss layer is also present which is characterized by big red stem and stair-step moss.

There is a low-bush cranberry (d1) ecosite phase dominated by aspen, white spruce and balsam fir. In addition, white birch is present in the canopy (<10%). The shrub layer included balsam fir, Alaska birch, white spruce, low-bush cranberry and wild red currant. Bunchberry, dewberry, wild sarsaparilla, tall lungwort, wild lily-of-the-valley, northern starflower, common wintergreen and fringed aster are the most characteristics forbs, with palmate-leaved coltsfoot, bishop's-cap and kidney-leaved violet being less characteristic. Fireweed, woodland horsetail, dwarf scouring-rush and marsh reed grass was observed outside the plot. Indian pipe was seldom observed, but was found in several patches. Monk's hood lichen, horsehair and old man's beard was found on balsam fir, white spruce and birch.

Figure 9 Low-Bush Cranberry with White Birch - White Spruce Canopy

The canopy of the low-bush cranberry aspen-white spruce (d2) ecosite phase is typically dominated by aspen and white spruce; however, balsam fir, black spruce, white birch and balsam poplar may all be locally dominant. The species composition of the shrub layer is the same as that of d1, except for the addition of balsam fir. The herb layer is less diverse than in d1, but grass coverage is essentially the same. Unlike d1, a moss layer is present. It is characterized by stair-step moss, Schreber's moss and knight's plume moss.

In the low-bush cranberry aspen white spruce (d2) ecosite phase there is a plant community dominated by white birch (Figure 9). White spruce is also present in the canopy (<20%). River alder, white spruce, dogwood and prickly rose are the most dominant shrub species. In the herb layer the most dominant species are wild sarsaparilla, while dewberry, bunchberry, common horsetail and bishop's-cap are less common. Ground coverage by red-stemmed feathermoss and pigtail moss is <70%. This stand relates best to a dogwood Pb-Sw ecosite phase, however, the community type surrounding it corresponds to a d2 ecosite.

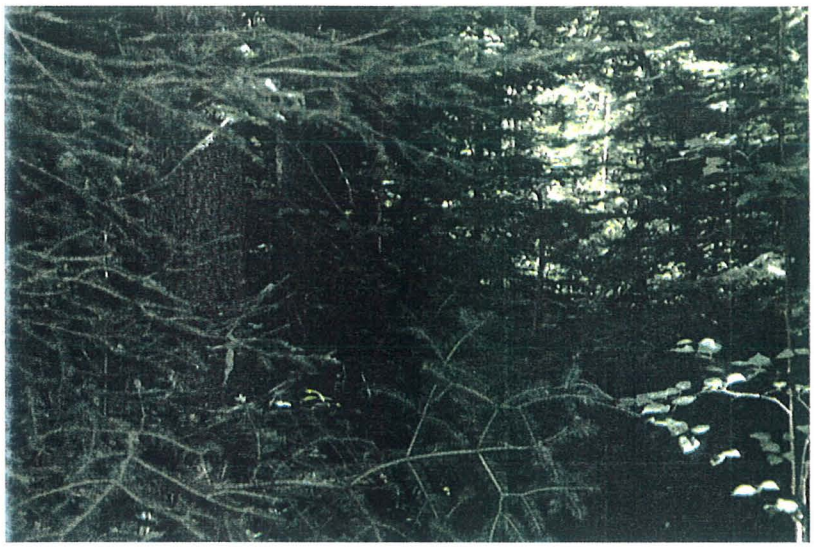
In the low-bush cranberry aspen-white spruce (d2) ecosite phase there is a plant community dominated by balsam fir. Trembling aspen and/or white birch was also characteristic in the canopy, with canopy coverage dominated by balsam fir (>70%). Low-bush cranberry, green alder and prickly rose are the most dominant shrubs. Dewberry, bunchberry, twin-flower, tall bluebell, common horsetail and bishop's-cap are the most abundant in the herb layer, with wild lily-of-the-valley, pink wintergreen, fringed aster, northern bedstraw, hairy wild rye and star-flower being less common. There is a moss layer with approximately 60% ground coverage. It is dominated by red-stemmed feathermoss and step moss. Hooded tube lichen, horsehair lichen and powdery old man's beard occurs on balsam fir, while oak fern is found under the balsam fir. Common witch's hair and powdery old man's beard was noticed on all deadwood. In addition, Indian pipe is found on the ground in small patches.

Figure 10 Low-Bush Cranberry with Trembling Aspen - White Spruce Canopy

Within the low-bush cranberry aspen-white spruce (d2) ecosite phase there is a plant community dominated by aspen, balsam poplar, balsam fir and white spruce (Figure 10). River alder, low-bush cranberry and wild red currant are dominant in the shrub layer. Other shrubs observed are skunk currant, dogwood and twin-flower. The herb layer is characterized by dewberry, red and white baneberry, oak fern, tall lungwort, bishop's-cap, common horsetail, palmate-leaved coltsfoot and sweet-scented bedstraw. Northern rice grass was observed. Red-stemmed feathermoss, old man's beard, horsehair and Monk's hood lichen are also present. Other species

observed outside the study plot were black gooseberry, one-sided wintergreen and northern grass-of-parnassus. The floristic data for this plant community was taken on the south side of the Steepbank River. The low-bush cranberry aspen-white spruce is densely forested to the edge of the river. On the occasional sandy spit, next to the forested edge, there was mostly small-fruited bulrush and marsh reed grass.

Figure 11 Low-Bush Cranberry with White Spruce Canopy



The canopy of the low-bush cranberry white spruce (d3) ecosite phase is dominated by white spruce. Balsam fir, aspen, black spruce, white birch and balsam poplar are also characteristic (Figure 11). The shrub layer typically contains low-bush cranberry, twin-flower, prickly rose, green alder, Canada buffaloberry, balsam fir, currant, white birch, balsam poplar and black spruce. Sarsaparilla, bunchberry, dewberry, bishop's-cap, sweet-scented bedstraw, fireweed and tall lungwort characterize the herb layer, along with hairy wild rye. Ground coverage by moss is usually >50%. The species are as in d2, with stair-step moss dominating.

Within the low-bush cranberry white spruce (d3) ecosite phase there are also additional plant species that are not listed by Beckingham and Archibald (1996). Such plant species, observed during the 1997 plant survey, included bracted honeysuckle, common snowberry, tall lungwort, one-sided wintergreen, common pink wintergreen, wild vetch, northern starflower, fringed aster, sweet-scented bedstraw, common yarrow, Canada goldenrod and drooping wood reed.

3.2.2.5 Dogwood Ecosite (e)

Drainage conditions in the soils of the dogwood ecosite vary widely. Moisture regimes range from mesic to hygric and nutrient regimes from medium to rich, although the central concept of the ecosite is subhygric-rich. All three dogwood ecosite phases occur in the Project Millennium study area and occupy an area of 402 ha (Table 3).

The tree canopy of the dogwood balsam poplar-trembling aspen (e1) ecosite phase is usually dominated by aspen and balsam poplar, although white spruce may be locally dominant. In addition, white birch may be present. Dogwood, low-bush cranberry and prickly rose are the most abundant shrub species. Other characteristic shrubs are bracted honeysuckle, green and river alder, willow, saskatoon, currant, twin-flower, balsam poplar, wild red raspberry and white spruce. In the herb layer, wild sarsaparilla, dewberry, marsh reed grass and fireweed are the most abundant, with bunchberry, woodland horsetail and tall lungwort being less common. Ferns are also characteristic, but typically have cover values <2%.

Figure 12 Dogwood with Balsam Poplar - Trembling Aspen Canopy

The dogwood balsam poplar-aspen (e1) ecosite phase can also include a plant community dominated by trembling aspen (90%), with some balsam poplar (10%) (Figure 12). Saskatoon, willow, aspen, low-bush cranberry and prickly rose are dominant in the shrub layer. Other shrubs observed are high bush-cranberry, choke cherry, wild black currant, five-leaved bramble, wild red currant, common snowberry and dogwood. The herb layer is dominated by dewberry, wild sarsaparilla, wild lily-of-the-valley, wild vetch, creamy peavine, fringed aster, northern bedstraw, common pink wintergreen, woodland strawberry and one-sided wintergreen. Other less common herbs are Canada goldenrod, snakeroot and three-leaved false Solomon's-seal. Drooping wood reed is present, but not very abundant (<3%). Monk's hood lichen and old man's beard are also present. The dogwood balsam poplar-aspen (e1) is found near the Athabasca River of the LSA.

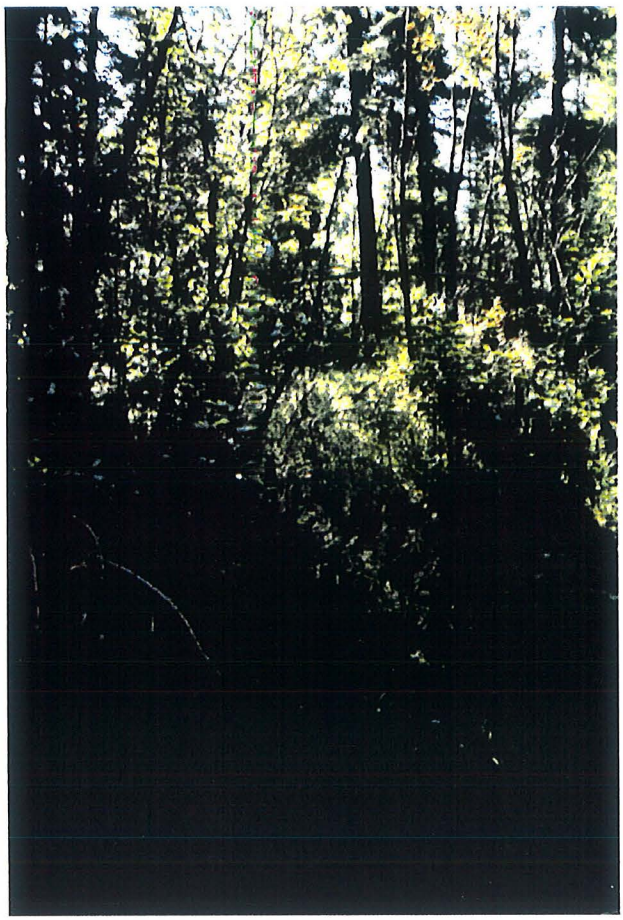
Figure 13 Dogwood with Balsam Poplar - White Spruce Plant Community

White spruce, aspen and balsam poplar dominate the tree canopy of the dogwood balsam poplar-white spruce (e2) ecosite phase (Figure 13). White birch and balsam fir are also usually present in the canopy. The schrub species are similar to e1 with the exception of white birch replacing white spruce. The herb layer is also the same except that bunchberry and bishop's-cap replace fireweed. Other less common herbs are sweet-scented bedstraw,

palmate-leaved coltsfoot and common horsetail. There is a moss layer with approximately 20% ground coverage. It is dominated by stair-step moss.

The dogwood white spruce (e3) ecosite phase usually occurs on wetter sites than e1 and e2. The dominant tree species is white spruce, with canopy coverage averaging about 40%. Balsam fir is typically present and all three deciduous species are occasionally present. Low-bush cranberry, prickly rose, green and river alder, dogwood, twin-flower, currant, white birch, bog cranberry, Labrador tea, aspen, balsam fir and bracted honeysuckle are the characteristic shrub species. Woodland horsetail, wild sarsaparilla, bishop's-cap, dewberry, bunchberry and tall lungwort are the most characteristic forbs, with common and meadow horsetail being less characteristic. Marsh reed grass is abundant. The well-developed moss layer consists of stair-step moss, Schreber's moss and knight's plume moss.

Figure 14 Dogwood with White Spruce Plant Community



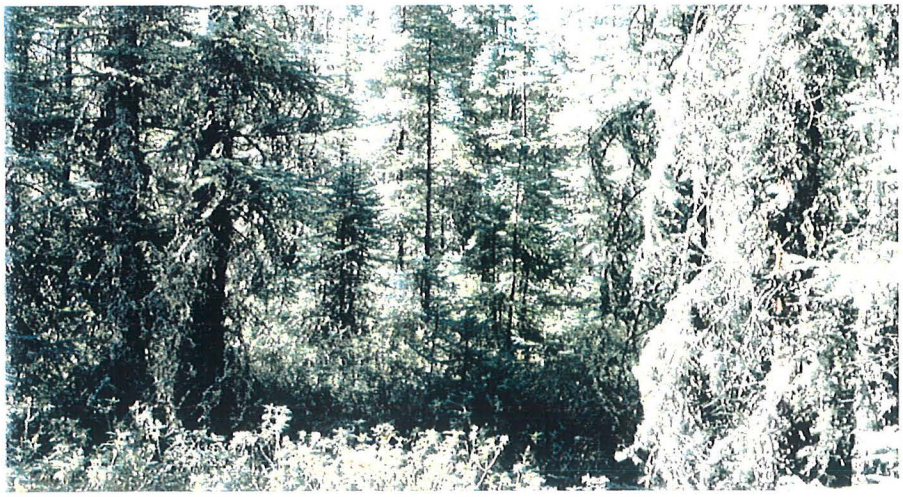
A plant survey was completed on the dogwood white spruce (e3) ecosite phase (Figure 14) located north of McLean Creek and adjacent to the

Athabasca River. White spruce is the dominant tree species at 60% canopy coverage. Balsam poplar and white birch are also present, with canopy coverage at 30 and 10%. Balsam poplar, balsam fir, aspen, white spruce, prickly rose, low-bush cranberry, dogwood and buckbrush are dominant in the shrub layer. Black gooseberry and twin-flower are less common. The herbaceous layer contains dewberry, wild sarsaparilla, palmate-leaved coltsfoot, common horsetail, northern bedstraw, wild vetch, bishop's-cap and common wintergreen. Other less common herbs observed are tall lungwort, Canada goldenrod, common yarrow and common blue lettuce. The mosses and lichens observed include Monk's hood lichen, horsehair and old man's beard. The grasses observed include marsh reed grass and drooping wood reed. In the area outside the plot the following species are observed: bracted honeysuckle, common snowberry, choke cherry, wild vetch, bishop's-cap, sweet-scented bedstraw, fringed aster, red and white baneberry, bunchberry and fireweed.

3.2.2.6 Labrador Tea-Subhygric Ecosite (g)

The soils of the Labrador tea-subhygric ecosite are imperfectly to very poorly drained, with subhygric to hydric moisture regimes. The nutrient regime is typically poor. There is only one ecosite, the Labrador tea-subhygric black spruce-jack pine (g1) ecosite phase. A picture taken from a black spruce-jack pine ecosite phase in the Muskeg River Mine Project (Golder 1997o) is shown in Figure 15. This ecosite occupies an area of 1 ha or less than 1% of the LSA.

Figure 15 Jack Pine-Black Spruce Forest With Labrador Tea Understorey



The canopy of the Labrador tea-subhygric black spruce-jack pine ecosite phase is usually dominated by black spruce. Jack pine, the other characteristic tree species, may be locally dominant. Labrador tea is the dominant shrub. The other characteristic species in the shrub layer are bog

cranberry, black spruce, blueberry, prickly rose and twin-flower. Only two species, bunchberry and woodland horsetail, are characteristic of the poorly expressed herb layer. Moss cover is quite high, usually >50%. Stair-step moss and Schreber's moss dominate, but knight's plume moss, peat moss and tufted moss also are typically present. Reindeer lichen is usually present as well.

3.2.2.7 Labrador Tea/Horsetail Ecosite (h)

The soils of the Labrador tea/horsetail ecosite are imperfectly to very poorly drained. Moisture regimes vary widely, from mesic to hydric, although most sites are in the subhygric-hygric range. Nutrient regimes range from rich to poor. There is one ecosite phase, the Labrador tea/horsetail white spruce-black spruce (h1). A picture taken from a white spruce-black spruce ecosite phase in the Muskeg River Mine Project (Golder 1997o) is shown in Figure 16. This ecosite occupies an area of 59 ha or less than 1% of the LSA.

Figure 16 White Spruce Canopy With Labrador Tea and Horsetail Understorey

The canopy of the Labrador tea/horsetail white spruce-black spruce ecosite phase is dominated by white spruce, with black spruce typically being subdominant. White birch is usually present. Labrador tea is the most abundant shrub. The other species characteristic of the shrub layer are bog cranberry, willow, prickly rose, twin-flower, black spruce, aspen and white birch. Common horsetail, meadow horsetail, woodland horsetail, bunchberry and dwarf scouring rush are the only common forbs. Marsh reed grass and sedges are typically present at low cover values. The moss layer is very well-developed, with cover values averaging 70% or more. Stair-step moss and Schreber's moss dominate; tufted moss and knight's plume moss are also characteristic.

3.2.3 Uplands Plant Communities Species Richness, Diversity, and Tree Measurements

3.2.3.1 Community Diversity

Community level diversity can be assessed by assessing the number of vegetation polygons (patches) within the LSA (Table 5). The most extensive ecosite phase, the low-bush cranberry Aw (d1), has a mean patch size of 32 ha. The blueberry Aw (Bw) (b2) ecosite phase has a mean patch size of 27 ha and the blueberry Aw-Sw (b3) ecosite phase, 20 ha. The dogwood Pb-Aw (e1) ecosite phase has a mean patch size of 5 ha; for the dogwood Pb-Sw (e2) ecosite phase, 3 ha; and for the dogwood Sw (e3) ecosite phase, 4ha. The lichen Pj (a1), Labrador tea-mesic Pj-Sb (c1) and Labrador tea-subhygric Sb-Pj (g1) ecosite phase has a mean patch of 1 ha. The black spruce-tamarack complex has a mean patch size of 10 ha and the shrubland has 8 ha. Low-bush cranberry Aw (d1) has the largest patch size at 678 ha.

Table 5 Mean, Minimum and Maximum Vegetation Polygon or Patch Size

Map Code	Eco Site Phase (Vegetation Types)	Number of Vegetation Polygons	Baseline		
			Min. Patch Size (ha)	Max. Patch Size (ha)	Mean Patch Size (ha)
a1	lichen Pj	1	1	1	1
b1	blueberry Pj-Aw	26	1	47	9
b2	blueberry Aw(Bw)	1	27	27	27
b3	blueberry Aw-Sw	3	3	36	20
b4	blueberry Sw-Pj	7	1	16	7
c1	Labrador tea-mesic Pj-Sb	1	1	1	1
d1	low-bush cranberry Aw	104	<1	678	32
d2	low-bush cranberry Aw-Sw	55	<1	150	10
d3	low-bush cranberry Sw	123	<1	114	8
e1	dogwood Pb-Aw	45	<1	44	5
e2	dogwood Pb-Sw	23	<1	7	3
e3	dogwood Sw	28	<1	18	4
g1	Labrador tea-subhygric Sb-Pj	1	1	1	1
h1	Labrador tea/horsetail Sw-Sb	15	<1	10	4
-	black spruce-tamarack	2	9	11	10
-	shrubland	17	1	24	8

Average Richness and Diversity

Composition

Composition is assessed by examining the total number of different species present in all of the plots in each of the ecosite phases (Table 6), as well as the total number of species present in each of the three structural layers (tree, shrub and herb). These data represent overall species richness in each

ecosite phase when taken as a whole. The sum of the species present in each of the layers does not necessarily equal the total for the ecosite phase because of species duplications between layers. Using the Shannon Index, the low-bush cranberry Aw (d1) ecosite phase exhibits the greatest species richness both overall and in the shrub layer. The highest herb species richness, is in low-bush cranberry Aw (d1) and low-bush cranberry Sw (d3), while the highest tree species richness is in blueberry Pj-Aw (b1). The dogwood Pb-Sw (e2) ecosite phase has the fewest species among ecosite phases surveyed.

Table 6 Species Richness for Ecosite Phases

	Total Vascular Species			Tree Layer			Shrub Layer			Herb Layer		
Phase	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
b1	17.5	17	18	3.5	2	5	8.5	8	9	6.0	5	7
b2	15.0	15	15	1.0	1	1	7.0	7	7	8.0	8	8
b3	16.0	16	16	3.0	3	3	6.0	6	6	8.0	8	8
b4	13.3	11	17	2.5	2	3	8.5	8	9	3.8	1	7
d1	20.7	16	26	2.5	1	4	10.2	7	13	9.1	5	13
d2	18.3	10	26	2.3	1	4	10.0	4	18	7.1	5	12
d3	18.7	12	27	2.7	2	4	7.6	3	11	9.4	6	17
e1	14.0	14	14	0.0	0	0	8.0	8	8	6.0	6	6
e2	12.0	7	17	2.5	2	3	7.5	4	11	3.5	2	5
e3	15.3	10	21	1.7	1	2	7.7	4	10	6.7	5	9

Species Richness

The total richness indicator includes the entire set of observed species for each vegetation type. However, since an exhustive survey was not complete, these values are conservative estimates which cannot be compared. Thus, the average per plot richness is used to make comparisons. It is, however, affected by low sample sizes in some types but is the best unbiased estimate for comparison. In addition, total richness indicates the species numbers likely to be encountered in a vegetation phase, whereas, plot average richness indicates how many are expected at any one location.

Richness of species is determined by counting the number of different classified units or species within a given landscape or community unit. For species, the richness is determined from samples, so a mean is determined. Species richness may be split among taxonomic or functional groups such as trees, shrubs and herbs.

The mean and range of species richness values for individual plots within the ecosite phases are also shown in Table 6. These data provide an indication of the species richness that is characteristic of small areas within ecosite phases. The highest mean and maximum of total species richness are found in the low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2),

and low-bush cranberry Sw (d3) ecosite phases. The minimum number of total species richness for individual plots within the ecosite phases occur in dogwood Pb-Sw (e2). The highest mean richness in the tree layer is in blueberry Pj-Aw (b1) and blueberry Aw-Sw (b3): in the shrub layer it is in low-bush cranberry Aw (d1) and low-bush cranberry Aw-Sw (d2): and in the herb layer it is in low-bush cranberry Aw (d1) and low-bush cranberry Sw (d3). The lowest mean richness in the tree layer is in dogwood Pb-Aw (e1). The lowest mean richness in the shrub layer is in blueberry Aw-Sw (b3). The lowest mean richness in the herb layer is in dogwood Pb-Sw (e2).

The minimum number of total species within the tree layer is one species (b2, d1, d2, e3) and the maximum number of tree species is 5 (b1). The minimum number of shrub species is 3 (d3) and the maximum number is 18 (d2). The minimum number of herb species is one (b4) and the maximum number is 17 (d3). Overall, shrub and herb species comprise the most species for individual plots within the ecosite phases surveyed.

Structure

In terms of structure, species richness is highest in the shrub layer and lowest in the tree layer for all ecosite phases surveyed. Structurally, both mean and maximum richness are lowest in the tree layer in each ecosite phase surveyed. Generally, mean and maximum richness are higher in the shrub layer than in the herb layer. The differences in relative species richness among ecosite phases, may result from differences in internal compositional variability among ecosite phases.

The use of structure also aids in describing the appearance of the community. Structure relates to the vertical spacing and height of the plants making up the community. Table 7 shows the percentage of stands with multilayered structure (i.e., overstorey and understorey). Lichen Pj (a1) and Labrador tea-mesic Pj-Sb (c1) have only single layered structured stands. Blueberry Aw (Bw) (b2) also has a single layered structured stand. The dogwood ecosites (e1, e2, and e3) have a higher percentage of single layered structured stands, whereas the low-bush cranberry ecosites (d1, d2, and d3) have higher percentage of multilayered structured stands.

Table 7 Percentage of Stands in the LSA With Multilayered Structure (i.e., Overstorey and Understorey)

Phase	Multilayered Stand Percentage	Single Layer Stand Percentage
a1	0.0	100.0
b1	44.0	56.0
b2	100.0	100.0
b3	61.2	38.8
b4	76.1	23.9
c1	0.0	100.0
d1	65.5	34.5
d2	61.6	38.4
d3	55.2	44.8
e1	13.7	86.3
e2	24.2	75.8
e3	42.7	57.3

Species Diversity

Diversity refers to the numbers of species in given areas, the ecological roles that these species play, the way that the composition of species changes across a region and the groups of species (ecosystems) that occur in particular areas, together with the processes and interactions that take place within and between these systems (UNEP 1995).

The Shannon Index is used to measure species diversity. This Index combines the number of types (species) and the frequency distribution of the two types. The more types and the more evenly distributed they are, the higher the index value. The Index is generally used on random samples drawn from a large community, where there is less likely a chance to randomly select the same sample twice.

Table 8 gives the mean and range of species diversity values for individual plots within the ecosite phases. The blueberry Pj-Aw (b1) and blueberry Aw-Sw (b3) blueberry and the low-bush cranberry Aw (d1) and low-bush cranberry Aw-Sw (d2) ecosite phases have the highest mean among ecosite phases surveyed. The highest mean for the shurb layer are in blueberry Pj-Aw (b1), blueberry Sw-Pj (b4), low-bush cranberry Aw (d1) and low-bush cranberry Aw-Sw (d2). For the tree layer, the highest mean are in blueberry Pj-Aw (b1) and blueberry Aw-Sw (b3). The lowest mean diversity in the tree layer is in dogwood Pb-Aw (e1) and dogwood Sw (e3). The lowest mean diversity in the shrub layer is in dogwood Pb-Aw (e1). The lowest mean diversity in the herb layer is in blueberry Sw-Pj (b4) and dogwood Pb-Sw (e2). There is little difference in mean diversity between the shrub and herb layers in many of the ecosite phases and there is no discernible overall trend to higher diversity in either layer. Mean diversity is lowest in the tree layer for all ecosite phases surveyed.

Table 8 Species Diversity

Phase	Total Vascular Species			Tree Layer			Shrub Layer			Herb Layer		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
b1	1.08	1.04	1.12	0.40	0.14	0.65	0.80	0.76	0.84	0.52	0.47	0.57
b2	0.84	0.84	0.84	0.00	0.00	0.00	0.72	0.72	0.72	0.69	0.69	0.69
b3	1.05	1.05	1.05	0.39	0.39	0.39	0.71	0.71	0.71	0.72	0.72	0.72
b4	0.94	0.88	1.02	0.21	0.09	0.45	0.85	0.83	0.87	0.40	0.00	0.75
d1	1.11	0.95	1.20	0.25	0.00	0.53	0.89	0.77	1.02	0.78	0.54	0.97
d2	1.07	0.75	1.29	0.29	0.00	0.58	0.86	0.53	1.17	0.72	0.53	0.87
d3	0.96	0.64	1.14	0.16	0.03	0.31	0.73	0.37	0.93	0.83	0.60	1.13
e1	0.91	0.91	0.91	0.00	0.00	0.00	0.65	0.65	0.65	0.73	0.73	0.73
e2	0.89	0.73	1.05	0.30	0.22	0.39	0.76	0.55	0.96	0.43	0.22	0.64
e3	0.94	0.77	1.07	0.08	0.00	0.14	0.75	0.58	0.90	0.60	0.54	0.68

Total Cover

Cover is defined as the vertical projection of the crown or shoot area of a plant species to the ground surface expressed as a fraction or percent of a reference area. Cover is generally evaluated separately for each height layer or vegetation stratum. Nearly all plant life forms, from trees to mosses, can be evaluated by cover and thereby in comparable terms (Mueller-Dombois and Ellenberg 1974).

Table 9 gives total cover for the tree layer, shrub layer and herb layer within the ecosite phases. The highest total mean for the tree layer are in the low-bush cranberry Aw-Sw (d2) and low-bush cranberry Sw (d3) ecosite phases. The highest total mean for the shrub layer are in the blueberry Pj-Aw (b1), blueberry Sw-Pj (b4), low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2) and dogwood Sw (e3) ecosite phases. The highest total mean for the herb layer are in the blueberry Aw-Sw (b3) and dogwood Sw (e3) ecosite phases. The minimum total cover in the tree layer is in the dogwood Sw (e3) ecosite phase and for the shrub layer it is in the low-bush cranberry Aw-Sw (d2) ecosite phase. The minimum total cover in the herb layer is in the blueberry Sw-Pj (b4) ecosite phases.

The highest mean for total cover for vascular species are in the blueberry Aw-Sw (b3), low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2), low-bush cranberry Sw (d3) and dogwood Sw (e3) ecosite phases. The maximum total cover of vascular species for individual plots within the ecosite phases are 373% cover for low-bush cranberry Sw (d3). The minimum total cover of vascular species for individual plots within the ecosite phases are 139% cover for low-bush cranberry Sw (d3). These are additive covers for each species in each vegetative layer. The analysis was not constrained to 100%, which is why the totals can be greater than 100%.

Table 9 Total Cover for Vascular Species

Phase	Total Vascular Species			Tree Layer			Shrub Layer			Herb Layer		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
b1	185	183	187	50	30	70	104	87	121	31	30	32
b2	217	217	217	70	70	70	88	88	88	59	59	59
b3	255	255	255	70	70	70	95	95	95	90	90	90
b4	193	158	236	63	50	100	114	80	136	17	6	28
d1	250	163	313	70	30	100	113	46	170	67	27	99
d2	236	165	313	74	24	100	105	26	155	57	34	98
d3	211	139	373	73	61	81	76	30	173	62	21	130
e1	193	193	193	0	0	0	148	148	148	45	45	45
e2	166	145	186	63	60	65	66	35	96	38	25	50
e3	219	163	283	45	15	60	99	50	160	75	53	109

Total Richness and Diversity

Total richness is the total number of species found in each ecosite phase. Likewise, total diversity is the Shannon Index value calculated with total richness and average cover per plant species. Community diversity and richness was calculated for vascular plants only because these were the only plant types completely surveyed at any site. Total diversity and richness were determined from the combined set of sites which were classed within the same ecosite phase. However, each ecosite phase did not have the same number of sample sites. The number of species will likely increase with the number of sites sampled. Thus, total richness for undersampled ecosite phases is a conservative estimate of the total species richness.

The highest number of total species found in each site are the low-bush cranberry Aw (d1) and low-bush cranberry Aw-Sw (d2) ecosite phase (Table 10). The lowest number of total species found in each site are the dogwood Pb-Aw (e1), blueberry Aw (Bw) (b2) and blueberry Aw-Sw (b3) ecosite phases. The highest number of species in the tree layer are in the low-bush cranberry Aw (d1) and low-bush cranberry Aw-Sw (d2) ecosite phase; in the shrub layer it is in low-bush cranberry Aw (d1) and low-bush cranberry Aw-Sw (d2); and in the herb layer it is in low-bush cranberry Aw (d1), low-bush cranberry Aw-Sw (d2) and low-bush cranberry Sw (d3). Total species are lowest in the dogwood Pb-Aw (e1) among all ecosite phases surveyed. It should be noted that some tree species are also measured as shrubs, consequently the total richness is often less than the sum of trees, shrubs and herbs (i.e., some species are in two categories).

The highest diversity was found within the low-bush cranberry Aw (d1) and low-bush cranberry Aw-Sw (d2) ecosite phases particularly in the shrub layer (Table 11). The blueberry Aw (Bw) (b2) and dogwood Pb-Aw (e1)

ecosite phase have the lowest diversity among all ecosite phases surveyed. The highest diversity for the tree layer was found in the low-bush cranberry Aw-Sw (d2) ecosite phase. The lowest diversity for the tree layer was found in the blueberry Aw (Bw) (b2) and dogwood Pb-Aw (e1) ecosite phases. The highest diversity for the herb layer was found in the low-bush cranberry Aw (d1) and low-bush cranberry Aw-Sw (d2) ecosite phase.

Table 10 Total Diversity and Richness for Ecosite Phases Sampled

	Richness					Diversity				
Phase	Trees	Shrubs	Herbs	Total	Number of Ecosites Sampled	Trees	Shrubs	Herbs	Total	Number of Ecosites Sampled
b1	5	13	11	26	2	.61	0.99	0.63	1.19	2
b2	1	7	8	15	1	0.0	0.72	0.69	0.84	1
b3	3	6	8	16	1	0.39	0.71	0.72	1.05	1
b4	3	14	13	27	4	0.28	0.99	0.84	1.07	4
d1	6	38	33	72	12	0.34	1.31	1.22	1.43	12
d2	7	34	28	63	9	0.56	1.29	1.21	1.45	9
d3	5	26	28	54	7	0.20	1.11	1.18	1.23	7
e1	0	8	6	14	1	0.00	0.65	0.73	0.91	1
e2	3	12	7	20	2	0.44	1.01	0.63	1.10	2
e3	3	14	14	29	3	0.23	0.96	0.91	1.20	3

Tree Measurements

Stand height is the average height in meters of the dominant and co-dominant trees of the leading species in a stand (Nesby 1997). The heights of standing trees are usually estimated indirectly by instruments called hypsometers. such as an Abney level or a clinometer. Each type of hypsometer has advantages and disadvantages that depend on the topography and density of trees. In general. the measurement is obtained from a position where both the top and base of the tree can be seen. The weighted mean heights by ecosite phase are shown in Table 11. The means and standard deviation were weighted by stand area.

The ecosite phase with the highest mean height was the dogwood Sw (e3). The Labrador tea/horsetail Sw-Sb (h1) ecosite phase has the lowest mean height. The maximum height of standing trees was found in three ecosite phases: the low-bush cranberry Sw (d3); the dogwood Pb-Aw (e1): and the dogwood Pb-Sw (e2).

Table 11 Weighted Mean Heights by Ecosite Phase from AVI Data

Ecophase	Number of Stands	Mean Height	Standard Deviation	Minimum Height	Maximum Height
a1	1	20.0	0.0	20	20
b1	32	16.0	14.5	11	31
b2	1	17.0	0.0	17	17
b3	4	15.1	0.4	14	16
b4	9	15.2	0.3	15	17
c1	1	12.0	0.0	12	12
d1	338	17.6	4.8	8	30
d2	72	18.7	23.3	8	27
d3	172	19.3	29.8	5	32
e1	54	22.5	37.8	13	31
e2	23	21.0	31.6	10	31
e3	29	24.3	28.0	11	30
g1	1	10.0	0.0	10	10
h1	15	10.1	7.6	7	20

The age of trees are measured by increment borers. A typical increment borer consists of a hollow auger that is bored into the tree until it intersects the growing center of the tree in a plane perpendicular to the longitudinal axis of the tree. The auger is carefully turned backwards a fraction of a turn to break the wood core and then the sample core is removed for counting growth rings and measuring the width of each ring. The age of the tree is estimated from the number of growth rings (Bonham 1989). The mean stand ages by ecosite phase are shown in Table 12 (raw age data was determined by subtracting the vegetation sample year (1997) from year of origin classes. consequently all raw values end in the digit 7).

The ecosite phase with the highest mean age was the dogwood Sw (e3). The "oldest" trees were found in three ecosite phases: the low-bush cranberry Sw (d3); the dogwood Pb-Sw (e2); and the dogwood Sw (e3). The ecosite phases with the lowest mean age were the blueberry ecosites (b1. b2. b3 and b4) and Labrador tea/horsetail (h1).

Table 12 Mean Stand Ages by Ecosite Phases

Phase	Number of stands	Mean Age	Standard Deviation	Minimum Age	Maximum Age
a1	1	87	0	87	87
b1	32	69	41	57	97
b2	1	67	0	67	67
b3	4	67	0	67	67
b4	9	67	0	67	67
c1	1	77	0	77	77
d1	338	70	109	17	117
d2	72	91	444	57	137
d3	172	104	1437	57	207
e1	54	84	121	67	137
e2	23	102	1083	67	207
e3	29	142	2144	67	207
g1	1	77	0	77	77
h1	15	69	76	67	117
Sb/Lt	2	130	234	117	147

Canopy closure can be used as a basis for comparison among tree species of different ecosite phases. Crown closure is the percentage of ground area covered by a vertical projection of tree crown areas onto the ground (Nesby 1997). Canopy closure can be measured directly in percentage, but more often it is estimated according to crown closure classes. The mean canopy closure by ecosite phase are shown in Table 13 (determined from the total stand area representing each class within each ecosite phase).

When examining the crown closure classes, the ecosite phases are well distributed among the various crown closure classes accept for the lichen Pj (a1); Labrador tea-mesic Pj-Sb (c1); Labrador tea-subhygric Sb-Pj (g1) and the black spruce/tamarack complex. These ecosite phases occur in one crown closure class. The lichen Pj (a1), for example, occurs in the B (31-50%) crown closure class. The ecosite phase with the highest percentage (71-100%) of ground area covered was the Labrador tea-subhygric Sb-Pj (g1). This means that the g1 ecosite phase occurring within the LSA have closed canopies and are very dense. The ecosite phase with the lowest percentage (6-30%) of ground area covered was the blueberry Aw-Sw (b3). Sixty-one percent of blueberry Aw-Sw (b3) ecosite phases occurring within the LSA are in the A (6-30%) crown closure class. This means that the b3 ecosite phase is open and not very dense.

Table 13 Mean Canopy Closure by Ecosite Phase

Phase	A (6 - 30 %)	B (31 - 50 %)	C (51 - 70 %)	D (71 - 100 %)	Open (0 - 5 %)
a1	0.0	100.0	0.0	0.0	0.0
b1	5.8	49.3	42.0	2.9	0.0
b2	0.0	0.0	100.0	0.0	0.0
b3	61.2	33.9	4.9	0.0	0.0
b4	20.3	55.8	23.9	0.0	0.0
c1	0.0	0.0	100.0	0.0	0.0
d1	17.2	11.6	61.9	9.3	0.0
d2	33.3	13.0	53.2	0.4	0.0
d3	20.5	32.3	43.2	3.9	0.0
e1	9.2	17.4	72.3	1.2	0.0
e2	29.3	35.2	34.1	1.5	0.0
e3	19.4	26.6	54.1	0.0	0.0
g1	0.0	0.0	0.0	100.0	0.0
h1	0.0	0.0	66.0	34.0	0.0
Sb/Lt	0.0	0.0	100.0	0.0	0.0

Composition of vegetation implies a list of plant species that occur in a particular vegetation type (Bonham 1989). All species, woody and herbaceous, can be measured for composition, although methods may differ for various lifeforms. For example, when measuring tree composition it is the individual species that contribute to the overall species composition of a patch or polygon that are measured (Nesby 1997).

The mean tree species composition by ecosite phase are shown in Table 14 (the AVI interpretation did not distinguish balsam fir or white birch). Tree species composition for each ecosite phase generally relates to those Beckingham and Archibald (1996) have classified in their Field Guide to Ecosites of Northern Alberta. For example, the dominant tree species in the lichen Pj (a1) ecosite phase is jack pine. For the low-bush cranberry Aw-Sw (d2) ecosite phase the dominant tree species are white spruce and aspen. The only vegetation type not described by Beckingham and Archibald (1996) are the black spruce/tamarack complex, where the tree species composition is 64% for black spruce and 36% for tamarack.

Table 14 Mean Tree Species Composition by ecological phase in the LSA from AVI

Phase	Jack Pine	White Spruce	Black Spruce	Tamarack	Aspen	Balsam Poplar	Total
a1	100	0	0	0	0	0	100
b1	46	11	0	0	34	10	100
b2	10	0	0	0	80	10	100
b3	15	28	0	0	53	3	100
b4	63	28	4	0	5	0	100
c1	80	0	20	0	0	0	100
d1	0	4	0	0	92	3	100
d2	0	54	1	0	42	3	100
d3	1	85	2	0	9	3	100
e1	0	5	0	0	20	75	100
e2	0	47	2	0	6	45	100
e3	0	90	0	0	0	10	100
g1	0	0	100	0	0	0	100
h1	0	53	34	0	7	6	100
Sb/Lt	0	0	64	36	0	0	100

3.3 RARE PLANTS

3.3.1 Rare Plant Species

A rare plant species is any native species that, because of it's biological characteristics, or because it occurs at the fringe of it's range, or for some other reason, exists in low numbers or in very restricted areas in Alberta or in Canada (ANPC 1997). Their distributions are dependent upon functional processes such as succession, which is the sequential establishment of plant communities over time, following disturbance (i.e., mining). This changing, or variable, environment influences rarity by creating microhabitats that provide the specific habitats often required by rare plant species.

Plant rarity is determined by three factors: plant range, habitat specificity and plant abundance (Drury 1974, Rabinowitz 1981). Plants can be found over wide-ranging areas, but may still be considered rare because they are not abundant within the range. These plants would typically have less specific, or more general, habitat requirements. Conversely, rare plants may be locally abundant, but in very specific habitat types which tend to be less abundant.

Specifically, rarity refers to the reduced abundance or numbers of plants within a range. However, the number within a local area is also important. For example, a plant may be locally common and yet rare on a provincial level. Additionally, a plant may be considered rare locally, even

provincially, but is considered common on a national scale. Thus, it is necessary to preserve the species that appear on national lists prepared by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1997), as well as, the Alberta provincial lists (ANHIC 1996) relevant to the project area. The project area may represent the extremity of the plants range, specialized habitat, or a localized distribution of a plant outside of its normal range.

3.3.2 Rare Plant Classification Systems

Rarity is typically defined for a specific range and is associated with a list for that area. The COSEWIC and the Alberta Natural Heritage Information Centre Plant Species of Special Concern (ANHIC 1996) lists were used for the rare plant study of Project Millennium LSA.

National Committee on the Status of Endangered Wildlife in Canada List

The nationally developed list (COSEWIC 1997) for Canada denotes five rarity definitions or classes for plant and animal species:

- **Vulnerable**, any indigenous species of fauna or flora that is particularly at risk because of low or declining numbers, occurrence at the fringe of its range or in restricted areas, or for some other reason, but is not a threatened species;
- **Threatened**, any indigenous species of fauna or flora that is likely to become endangered in Canada if the factors affecting its vulnerability do not become reversed;
- **Endangered**, any indigenous species of fauna or flora whose existence in Canada is threatened with immediate extinction through all or a significant portion of its range, owing to the action of man;
- **Extirpated**, any indigenous species of fauna or flora no longer existing in the wild of Canada but existing elsewhere; and
- **Extinct**, any species of fauna or flora formerly indigenous to Canada but no longer existing anywhere.

Alberta Rare Plant Classification

The Alberta Native Plant Council (ANPC) defines rare plants as "[a] native species which, due to biological or geographical characteristics, is found in restricted areas, or at the edge of its range, or for other reasons is found in low numbers within the province of Alberta or in Canada" (ANPC 1997). The Alberta Natural Heritage Information Centre (ANHIC) has developed a list of rare plant species for Alberta. This list includes both a rare plant tracking list for Alberta, and the national list produced by the national

Committee on the Status of Endangered Wildlife in Canada (COSEWIC 1997).

The ANHIC's tracking list denotes seven ranks of rarity for vascular plants, where the plants are evaluated and ranked on their status (globally and provincially). Ranking is generally based on the number of occurrences, since that is the only information available. Information, such as population size and trend, life history and reproductive strategies and current threats are used when available. The ANHIC (1996) ranks are defined as:

RANK (G = global; S = Alberta)

- **S1 G1**: ≤5 occurrences or only a few remaining individuals or may be imperiled because some factor of its biology makes it especially vulnerable to extirpation.
- **S2 G2**: 6-20 occurrences or with many individuals in fewer occurrences; or may be susceptible to extirpation because of some factor of its biology.
- **S3 G3**: 21-100 occurrences, may be rare and local throughout its range, or in a restricted range (may be abundant in some locations or may be vulnerable to extirpation because of some factor of its biology).
- **S4 G4**: apparently secure under present conditions, typically >100 occurrences but may be fewer with many large populations; may be rare in parts of its range, especially peripherally.
- **S5 G5**: demonstrates secure under present conditions, >100 occurrences, may be rare in parts of its range, especially peripherally.
- **SU GU**: status uncertain often because of low search effort or cryptic nature of the element; possibly in peril, unrankable, more information needed.
- **SH GH**: historically known, may be relocated in the future.

For simplicity, all of the plants in the above classes will be referred to as "rare" in the following text.

Other codes are:

- E: exotic species established, may be native to nearby regions;
- HYB: hybrid taxon that is recurrent in the landscape;
- P: potentially exists; may have occurred historically (but having not been persuasively documented);

- Q: taxonomic questions or problems;
- R: reported but lacking sufficient documentation to accept or reject;
- RF: reported falsely;
- T_: rank for a subspecific taxon;
- X: believed to be extirpated;
- G? or S?: not yet ranked; and
- _?: rank questionable.

3.3.2.2 Rare Plants in the LSA and RSA

Previous studies (Golder 1996) documented the existence of 4 species of rare vascular plants within the LSA (Table 15). Within the RSA, 25 species have previously been documented. During the 1997 field studies, 4 species of rare plants were documented within the LSA (Table 15). None of the rare plants occurring within the LSA or RSA is considered to be rare nationally (COSEWIC 1997).

Table 15 Rare Plants Observed Within the LSA During 1995 and 1997 Field Surveys

Common Name	Botanical Name	Status	Habitat Type	Location	
				1995 Steepbank Mine Study	1997 Project Millennium LSA Study
cyperus-like sedge	Carex pseudocyperus	S2G5	bogs and fens	sedge fen on west side of Athabasca River	n/o [b]
turned sedge	Carex retrorsa	S2S3	swampy woods and wet meadows	n/o	gravel bar on east side of Athabasca River
stemless lady's-slipper	Cypripedium acaule [a]	S2G5	jack pine forests	east-facing escarpment slope of Steepbank river	n/o
small water-lily	Nymphaea tetragona	S1G5T5	ponds and quiet waters	floodplain marsh immediately north of Steepbank-Athabasca confluence	2 locations; lake at end of McLean Creek and Shipyard Lake
pitcher-plant	Sarracenia purpurea	S2G5	bogs and fens	sedge fen on west side of Athabasca River	n/o
wool-grass	Scirpus cyperinus	S2G5	marshy areas	n/o	2 locations; cutline in Steepbank Mine area and Upland forest above Athabasca River
prairie cord grass	Spartina pectinata	S2G5	saline shores and marshes	n/o	2 locations; along edge of Athabasca River and north of Leggett Creek (southeast of Shipyard Lake)

[a] Denotes rare plants found primarily in uplands (terrestrial) ecosite phases, the remainder are primarily found in wetlands.
[b] n/o = not observed.

Within the RSA, a number of rare plant species, have been identified (Alberta Environmental Protection 1995, Alberta Energy/Forestry, Lands and Wildlife 1992, Argus and Pryer 1990, Cottonwood Consultants 1987, ANHIC 1996, Moss 1983). These rare plant species are listed in Table 12. There are currently no nationally rare plants listed for either the LSA or the RSA (COSEWIC 1997).

3.3.3 Rare Plant Habitat Potential

Rare plants can require specific and infrequent habitat types. Therefore, any disturbance likely to remove or substantially alter rare plant habitat will have a negative impact on local populations. These negative impacts can also reduce the genetic variability within the entire species population, by reducing gene flow, especially in the case of highly isolated colonies or colonies with restricted gene pools (Drury 1974, Schaffer 1981).

The mixedwood boreal uplands ecoregion has evolved under a natural disturbance regime dominated by fire (White and Bratton 1981, Elliot-Fisk 1988). Rare plants, because of their specific habitat requirements, are especially vulnerable to habitat loss through such large scale disturbances. Fire creates open forests, which negatively affect the plant species that require closed and shaded forest (Hurtt and Pacala 1995). Fire has been documented to increase the variety of plant species, but this does not necessarily assist those rare plants with highly specific habitat requirements (Harper 1981). Conversely, disturbance can provide habitat for rare plants in some cases (Bratton and White 1981).

Rare plants often require unique habitat types, a number of which were observed in Project Millennium LSA. Rare plants are found in uplands locations within a variety of habitat types, depending upon the species requirements. Riparian areas, which were also surveyed, provide a number of unique microhabitats for rare plants, ranging from the associated bogs and fens along the shoreline to the cliff faces exposed by erosion. As previously mentioned, habitats found within the LSA ranged from marshes to wooded bogs and fens. Each of these habitats provide the unique microhabitats required by rare plant species.

Within the LSA, plant communities visited during the 1997 survey were scored using the following rating codes: 0, No Potential; 1, Low Potential; 2, Moderate Potential; 3, High Potential; and 4, Rare Plant Potential. The terms are defined in Table 16.

Table 16 Rare Plant Potential Rating System

Rating	Potential	Description
0	No Potential	Habitat characteristics do not favor the establishment of rare plants. These areas often have dense, highly competitive and established communities or are areas under cultivation.
1	Low Potential	These areas were generally parts of large tracts of land with vegetation communities and ecological settings.
2	Moderate Potential	Habitats altered by natural forces such as eroded slopes or exposed rock outcrops. Also, areas with different slope aspects in rolling terrain. These areas often have sparse vegetation cover, less aggressive or competitive species and soil conditions that make plant establishment difficult.
3	High Potential	Habitats that were different from those in the same general area - alkaline sloughs, stream crossings or islands of native vegetation within large tracts of cultivated land which contain associations of uncommon or unusual plant species.
4	Rare Plant Potential	Habitats where rare plants were found.

Objective of a Rare Plant Surveys

Rare plant surveys are undertaken to determine the presence and location of all rare plant species and botanically significant plant assemblages on a survey site. A rare plant survey can confirm the presence of rare species on a site, but it cannot rule out the existence of rare species on a site (ANPC 1997).

Minimum Requirements for a Rare Plant Survey

Minimum requirements for a rare plant survey are to survey the site:

- with reasonable geographic coverage of each representative plant community; and
- when potential rare species are most visible (when diagnostic features such as flowers or fruiting structures can confirm the identity of potential rare species). A floristic survey must be conducted through at least one flowering period (based on the blooming dates of local species) and with reasonable coverage of the project area (ANPC 1997, Nelson 1986).

The potential rare plant species in the Fort McMurray area are listed in Table 17.

Table 17 Potential Rare Plant Species of the Fort McMurray Area

Species	Rank [a]	Habitat
Arctagrostis arundinacea[b]	S1G?	marshy ground
Artemisia tilesii	S2?G5	open woods and river flats p177BF, p106NBC
Asclepias viridiflora[c]	S1G5	dry hillsides
Aster pauciflorus	S2G4	alkaline flats
Astragalus bodinii	S2G4	gravelly banks and moist sandy meadows p143BF
Barbarea orthoceras	S1S2G5	stream banks and moist woods p108BF
Boschniakia rossica[b]	S1G5	open woodland and scrub
Botrychium multifidum	S2?G5T4?	moist sandy areas
Brachythecium erythrorrhizon[b]	S2G5	Picea glauca stand
Bryoria nadvornikiana[b]	S?G?	Picea mariana bog forest
Bryum pallens[b]	S2G4G5	Picea glauca-Abies balsamea stand
Cardamine pratensis	S1S2G5	bogs and swamps
Cardamine pratensis[c]	S1S2G5	moist meadows and swamps
Carex adusta	S2G5	dry soil
Carex arcta	S2G5	moist woods p235BF, p274NBC
Carex houghtoniana	S2G5	dry sandy or gravelly places p241BF
Carex lacustris	S2G5	marshes and swampy woods
Carex lacustris[c]	S2G5	marshes and swampy woods
Carex loliacea	S2G5	marshes and moist banks p234BF, p260NBC
Carex oligosperma	S1G4	wet meadows and bogs
Carex pauciflora[c]	S2G5	sphagnum bogs
Carex pseudo-cyperus	S2G5	swamps and marshes
Carex retrorsa	S2S3G5	swampy woods and wet meadows p242BF
Carex retrorsa[b]	S2S3G5	shallow backwater
Carex rostrata	S2G5	marshy places p241BF, p268-9NBC
Carex umbellata[c]	S2G5	dry open areas, often sandy
Chenopodium leptophyllum[b]	SUG5	open lightly disturbed sandy areas
Coptis trifolia	S2G5	damp mossy woods p125BF
Cypripedium acaule	S2G5	Pinus banksiana stand on limestone
Danthonia spicata	S1S2G5	dry to moist open areas and open woodland
Dermatocarpon moulinsii[b]	S?G?	on rock outcrop
Drosera anglica	S2G5	swamps and bogs p209BF, p208NBC
Drosera linearis	S2G4	bogs p209BF
Epilobium lactiflorum[c]	S2G5	streambanks, moist slopes
Gaultheria hispidula	S2S3G5	bogs and wet woods p72BF, p88NBC
Hypericum majus	S2S2G5	shores and marshes
Isoetes echinospora	S1?G5?	ponds and lakes
Juncus brevicaudatus	S2G5	shores and marshes
Juncus filiformis	S2G5	bogs and marshes p251BF, p278NBC
Lobelia dortmanna[b]	S1G4	shallow water at margins of ponds, lakes
Lomatogonium rotatum	S2G5	wet meadows and saline flats
Luzula acuminata[c]	S1G5	disturbed moist woodland
Lycopodium inundatum[b]	S1G5	bogs
Lycopodium selago	SUG5	damp mossy ledges p288NBC
Lycopodium sitchense[c]	S2G5	open woods and barrens
Malaxis monophylla[c]	S2G5	damp woods, banks and bogs
Monotropa hypopitys[c]	S2G5	coniferous woods
Najas flexilis	S2G5	ponds and streams
Nymphaea tetragona	S1G5T5	acidic lakes and ponds, deep water p226BF
Oryzopsis canadensis	S2G5	open woods and hillsides
Oryzopsis micrantha	S2G5	dry open areas and rocky slopes
Physostegia parviflora	S2S3G4G5	moist woods and streambanks
Plantago maritima[b]	S1G5	saline marshes
Polygala paucifolia	SS2G5	moist coniferous woods p197BF
Potamogeton foliosus	S2G5	boreal water
Potamogeton obtusifolius	S2G5	boreal water
Potamogeton praelongus	S2G5	deep water
Potamogeton strictifolius[c]	S2G5	water
Primula mistassinica	S2G5	marshy ground and shores, often calcareous p159BF

Species	Rank [a]	Habitat
Primula stricta	S1S2G4	moist alpine slopes p159BF
Puccinellia distans	SG3G4	moist alkaline areas
Puccinellia hauptiana[b]	S1G3G4	marshy areas
Pyrola grandiflora	S2G5	alpine slopes and tundra p158BF, p185NBC
Rhynchospora capillacea[c]	S2G5	calcareous bogs
Sarracenia purpurea	S2G5	peat bogs and muskegs p210BF
Scirpus cyperinus	S2G5	marshy areas p249BF
Scirpus rufus	S1G5	marshy areas
Selaginella rupestris	S?G?	dry open areas
Seligeria calcarea[b]	S1G3G4	along exposed calcareous rock outcrop
Spartina pectinata	S2G5	saline shores and marshes
Spergularia marina[c]	S2G4G5Q	tufa dune
Utricularia cornuta[b]	S1G5	bogs and muddy shores

[a] For ranking system see Section 3.3.2.
[b] Potential rare plant species north of Fort McMurray.
[c] Potential rare plant species south of Fort McMurray.
Note: The entire ANHIC list was used as a reference when surveying for rare species. The above list identifies species most likely to be found during the survey.
Sources: Alberta Energy/Forestry, Lands and Wildlife (1992), Cottonwood Consultants Ltd. (1987), ANHIC (1996), Alberta Environmental Protection (1995) and Moss (1983).

Conducting Field Surveys

The purpose of the field survey is to:

- describe the natural communities of the study site:
- search for rare plant populations; and
- document rare plant populations that are found within the study area.

The areas surveyed for the rare plant survey included:

- the areas most likely to be impacted by the Project:
- the locations of previously sighted rare plants; and
- geographic coverage of each representative plant community.

The size of the project area and inaccessibility to some sites, precluded a detailed survey of the entire area. Therefore, searches were concentrated on high potential habitats while still sampling each plant community represented in the study area.

In addition, there are situations when even the best plant survey will not reveal a rare plant occurring on a site. The relative abundance of any species can vary annually. Some species have the ability to withstand stresses by storing seed for extended periods. Thus, in unfavorable seasons, some rare species may not be apparent at all. Because of these uncertainties, it is fair to say that the intent of this rare plant survey is to determine rare plant

habitat potential and the presence of rare plants. Absence of a rare plant species does not preclude the potential for it's occurrence at that location. Since climatic fluctuations, may not allow the species to produce flowers, making them difficult to spot and identify.

Rare plants were observed in the area of Project Millennium in 1997 at the following sites:

- uplands forest above Athabasca River (d1; low-bush cranberry Aw);
- floodplain, Athabasca River (e1; dogwood Pb-Aw);
- along edge of Athabasca River (e1; dogwood Pb-Aw);
- large lake, end of McLean Creek (marsh);
- Shipyard Lake (marsh); and
- wooded fen in Steepbank Mine area (Ftnn).

In the 1997 survey of the Project area, small water-lily was observed again as well as some additional species (turned sedge, wool-grass, prairie cord grass) not observed in the 1995 survey. The additional species will contribute to the provincial database. The ANPC (1997) mentions that unless contracted to maintain privacy of the information, all rare plant findings should be reported to a Conservation Data Center (CDC). In some cases the abundance of the species shows an affinity for specific habitat conditions and this was documented, even if only in a qualitative sense.

An understanding of habitat requirements can facilitate prediction of the occurrence of the microhabitats preferred by rare plant species. Also, an assessment of the area coverage of the preferred habitat facilitates the assessment of impacts. The general habitats preferred by the observed rare plants varied from uplands through to wetlands habitat. Some of the rare species observed preferred river and lakeshore edges, marshy areas, and fens. A review of the habitats of the observed rare plants highlights, riparian areas, wooded fens, and marshes as areas with high rare plant potentials in the project area.

Riparian habitats provide a variety of microhabitats for rare plants. These microhabitats are produced as a result of the varied moisture regime that occurs along riparian slopes, and areas that are repeatedly flooded. Microhabitats are also provided by the variation in the topography that is observed along river or stream banks. This variation alters the moisture availability which in turn contributes to the variation in the microhabitat, allowing rare plants to become established. Of the plots surveyed in 1997, four plots represented this habitat type, and two were inhabited by rare plant

species. Prairie cord grass and turned sedge were observed along the edge of the Athabasca River in a dogwood Pb-Aw (e1) community.

A fen is a peatland with the water table usually at or just below the surface. Fens are generally nutrient-rich and dominated by either shrubs, trees and graminoids. Of all the wetlands, fens display the greatest diversity of plant species and contain the greatest number of rare plants and therefore are considered to be unique communities. Of the fens surveyed, one rare plant species was encountered (wool-grass).

As mentioned, a number of rare plants tend to inhabit bogs, or areas with highly restricted drainage patterns. These habitat types are moist year round and are characterized by a high water table, poor drainage and an acidic substrate. Bogs are generally dominated by plant species tolerant of the acidic, poor nutrient environment. Rare plants are often found in these areas due to the specialized nature of the habitat. Of the bogs surveyed, no rare plants were observed.

Boggy forest is much like the previous habitat, and can also support rare plant species. Like the two previous habitat types, this habitat is a moisture rich habitat type. The increase in moisture level here results from drainage imperfections and from reduced evapotranspiration. This increased moisture provides favourable microhabitats for rare plant species. However, during the 1997 field survey no rare plants were observed in forested bogs.

The last of the common habitats for rare plant occurrences, on Project Millennium LSA, is the marsh habitat. Marshes are characterized by a high and fluctuating water table which creates unique habitat characteristics, further promoting the establishment of rare plant species. These wet environments promote the development of a specially adapted community of partially to fully submerged vegetation. Five of the plots surveyed fall into this habitat type. Small-water lily was observed in one of the marshes.

These locally observed rare plants could potentially be observed across the regional study area. The ELC units of the LSA were assigned a rare plant habitat potential (Table 18). Those ELC units in which rare plants were observed were given higher ratings than those without. Those ecosite phases that are characteristic rare plant habitat, but were not inhabited by rare plants, were assigned higher ratings than those that are not typical rare plant habitat. The general habitat types that were identified and the more specific habitats presented above were assigned rare plant habitat potentials ranging from "low potential" to "rare plant habitat".

Table 18 Rare Plant Habitat Potentials for the 1997 Survey Plots

Plant Community Type	Rare Plant Habitat Potential [a]
lichen Pj (a1)	M
blueberry Pj-Aw (b1)	H
blueberry Aw(Bw) (b2)	M
blueberry Aw-Sw (b3)	M
blueberry Sw-Pj (b4)	H
Labrador tea-mesic Pj-Sb (c1)	L
low-bush cranberry Aw (d1)	L
low-bush cranberry Aw-Sw (d2)	M
low-bush cranberry Sw (d3)	H
dogwood Pb-Aw (e1)	H
dogwood Pb-Sw (e2)	H
dogwood Sw (e3)	H
Labrador tea-subhygric Sb-Pj (g1)	M
Labrador tea/horsetail Sw-Sb (h1)	M
Btnn/Bfnn	H
Ftnn/Fftn/Ffnn	H
Fong	H
Fons	H
Mong/Mons	H
Stnn/Sfnn	H
Sons	M

[a] H = High, M = Moderate, L = Low.

In the 1997 survey, rare plants were observed in the following sites: upland forest (low-bush cranberry ecosite); Athabasca River floodplain (dogwood ecosite); large lake at end of McLean Creek (marsh-Mong); and wooded fen (Ftnn) in Steepbank Mine area. Consequently, the ecosite phases and AWI Classes in which rare plants were observed were given higher ratings than those without. For example, the 1995 and 1997 rare plant surveys and other rare plant surveys have linked rare plants with fens (Westworth 1990). As such, all fens were ranked as having high rare plant potential, regardless of whether rare plants were identified within these wetlands. In addition, riparian areas and marsh areas were documented as having rare plant occurrences. Therefore, riparian and marsh areas were ranked as having high rare plant potential. Those ecosite phases that are characteristic rare plant habitat, but were not inhabited by rare plants, were assigned higher ratings than those ecosites that are not typical rare plant habitat.

3.4 TRADITIONAL PLANT USE

This report includes an account of the traditional and current uses of the forest vegetation on Project Millennium area. Many aboriginal people still gather a considerable quantity of plants from the forest for use as food and medicine as well as for spiritual uses. The plant species that are currently

being used for food, and medicinal and spiritual purposes are discussed below.

Aboriginal peoples occasionally utilize the area for gathering of food and medicine plants. The plants that provide these resources occupy a variety of habitat types. Thus, all of the habitats within the forest are valued because each has unique characteristics and supplies the aboriginal people with a variety of important resources. These plants have been used for generations and provide a link with the past by connecting the aboriginal communities with their culture as well as with the forest.

A variety of plants within the boreal forest traditionally have been collected. While meat and fish were traditionally the primary source of food for many aboriginal peoples (95 to 97%), berries were the primary vegetation consumed (Johnson et al. 1995). Other plants that are still in use as a source of food include cattail, rose hips, beaked hazelnut and white birch. The aboriginal people who live in the area of Project Millennium also harvest a number of plants for their medicinal properties such as rat root or sweet flag, mint and Labrador tea (Fort McKay 1997).

3.4.1 Traditional Use Plant Species

A variety of plants common to the oil sands development area, including Project Millennium area, are used for medicinal, spiritual and consumptive purposes. A number of reports prepared for the Fort McKay community were used to develop a list of such plants. This information was used to create a summary table of plant species that are commonly used (Table 19).

Balsam fir has been used by aboriginal peoples primarily for medicinal purposes (Willard 1992). The multipurpose resin has been used to make ointments and decoctions to relieve symptoms ranging from colds, asthma, tuberculosis and other pulmonary ailments. The resin has been described to have stimulant, diuretic, laxative and diaphoretic properties (Johnson et al. 1995, PMAPC 1997). Resin from this species has been used by aboriginal peoples to treat a variety of ailments.

Bearberry still maintains its traditional use as a treatment for cystitis and pyelitis. New uses for the plant have been discovered. For instance, it can be used to treat diarrhea and dysentery (PMAPC 1997). Bearberry may also be used as a food. Its mealy berries are not flavourful, but improve upon being cooked (Willard 1992). Medicinal purposes include the healing of the kidneys, bladder and urinary tract. Spiritual uses of this mixture involve smoking the plant in conjunction with various other plants.

There are several species of berry in the boreal forest that are used by aboriginal people. Traditionally, blueberries were the most important fruits gathered by indigenous people (Willard 1992). Berries were preserved by cooking them in lard or drying and then eating them over the winter. They are an excellent source of vitamins A, B and C and contain calcium, phosphorus and iron (Johnson et al. 1995). The berries are prepared as sauces or incorporated into dough in the preparation of bread or muffins.

Table 19 Plants Gathered for Food, Medicine, and Spiritual Purposes in the Oil Sands Development Area

Plant	Food	Medicine	Spiritual	Habitat	Score
Balsam Fir		x		Mixedwood boreal forest; moist woods [a]	high
Bearberry	x		x	Open woods, sandy soils and on gravel terraces; moist to dry woods	high
Black Poplar (balsam poplar)		x		Riparian; boreal forest, river banks and alluvial flats [a]	high
Blueberry	x			Primarily found in moist wood; dry woods, sandy ground [a]	high
Cranberry (low-bush and bog)	x			Found in a variety of forest habitats; mossy bogs; moist woods [a]	high
Labrador Tea		x		Found in acidic bogs, swamps and moist woods	high
Mint	x	x		Boreal forest species; most commonly occur in wet places, including, bogs, marshes, lakeshores and fields	high
Moss		x		A variety of habitats but abundant in bogs	high
Rose hips (prickly rose)	x	x		Found in open forest and on river banks	high
Senega Snakeroot		x		Limestone soils in the dry woods or rocky slopes of the boreal forest	high
Spruce (White and Black)	x	x		Common throughout boreal forest; well-drained, moist soils; black spruce common in bogs and swamps [a]	high
Strawberry	x	x		Open areas, meadows; woods [a]	high
Sweet flag (ratroot)		x		Found in swampy, marshy areas or where there is still water	high
Sweet Grass		x	x	Open meadows and moist areas	high
Tamarack		x		Bogs and moist forest areas; fens swamps [a]	high
Birch (White and Bog)	x	x		Well drained but moist sites; bogs and seepage areas [a]	high-medium
Buffaloberry	x	x		Sparsely wooded areas; shores [a]	low
Common Juniper	x	x		Throughout the boreal forest; woods and open slopes [a]	low
Red currant and Black gooseberry	x	x		Moist woods; streambanks and swamps [a]	low
Twisted Stalk	x			Moist woods; thickets [a]	low
Dogwood	x			Common in wooded areas; moist woods, riverbanks [a]	medium
Frying Pan Plant		x		Muskeg [b]	medium
Green Frog Plant (Pitcher plant)		x		Muskeg [b]; bogs and fens [a]	medium
Hazelnuts	x			Found in thickets and woods with well drained soils	medium
Nettles	x	x		Disturbed areas; moist shady woodland; streambanks [a]	medium
Pin- and Chokecherry	x	x		Often found on dry and exposed sites with sandy soils; woods and clearings [a]	medium
Raspberry (Dwarf and Trailing)	x	x		Shady woods; boggy woods and marshes; moist woods [a]	medium
Saskatoon (berry)	x	x		Found in dry to moist forests in thickets and on open hillsides with well drained soils; open woodlands [a]	medium
Fungi (Puffball)		x		Found in variety of forest habitats	medium-high
Cattail	x			Found in marshes, ponds, lakes and along the edges of slow moving streams	high
Willow		x	x	Found in variety of forest habitats	medium-high

[a] Moss, E.H. 1983. Flora of Alberta.

[b] Fort McKay First Nations 1994. There Is Still Survival Out There?
Information from Fort McKay Environment Services 1996.

There are several types of cranberries within the boreal forest: low-bush cranberry, high-bush cranberry, small bog cranberry and bog cranberry. Traditionally each of these species has been part of the Cree and Chipewyan diet and today they are used to make jams, jellies and pies (Johnson et al. 1995).

Labrador tea leaves are widely used to make tea. This tea is used in moderation because it contains andromedotoxin, which can cause headaches, cramps and indigestion if taken in too high of a dose. The Cree use this tea as a sedative and to treat stomachaches, headaches, colds and fevers. Chipewyan people used the tea made from this plant to relieve stomach flu and diarrhea. It can also be used to clean wounds and relieve itchiness (Johnson et al. 1995).

Mint has been used by all of the northern aboriginal peoples. Mint has various medicinal uses depending on the species. It is important as a medicine and is used to make tea and to flavour foods. Mint tea is used to treat several maladies including bad breath, upset stomachs, headaches and fevers, as well as being used as a calmative agent. It is also prepared in various forms to wash the pus from infected gums, relieve toothaches and stop nosebleeds (Johnson et al. 1995).

Mosses, such as peat moss, serve in medicinal uses such as in bandaging wounds. These mosses are absorbent and will readily soak up fluids. Peat moss has traditionally been used as chicken litter, an insulator and a soil conditioner. More recently, horticultural uses have increased. Moss is also used as packing material for fruit and vegetables, and as a natural deodorant (Johnson et al. 1995).

Traditionally, rose hips were an emergency food that was important for survival in the winter. They are an excellent source of vitamins A, B, C, E and K and can be eaten raw or used in jam, jelly or syrup. The liquid that remains after rose hips are boiled is used as a beverage and the juice extracted from them can be made into wine (Johnson et al. 1995).

Senega snakeroot is used as a medicinal plant. It contains saphonins, which are toxic in large doses, but in small doses can be helpful in treating pleurisy, pneumonia, asthma and most commonly, snakebites (Stark 1996).

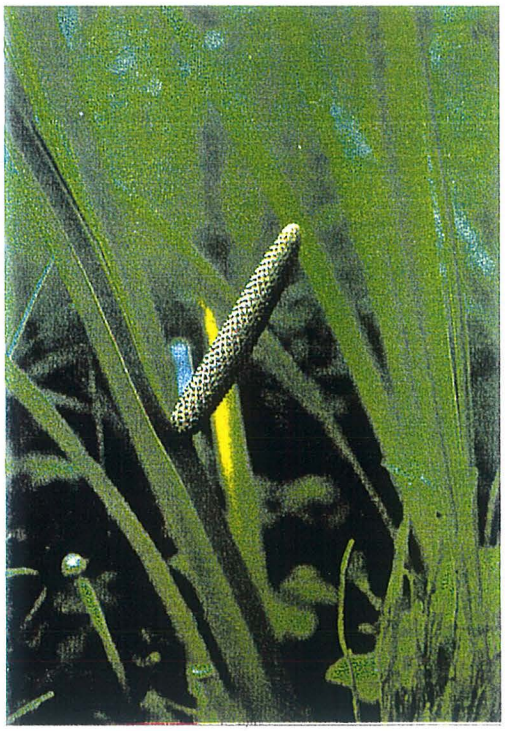
An oil extracted from black spruce is anti-spasmodic, anti-infectious, anti-inflammatory and anti-fungal. It produces effects in the body similar to hormones and cortisone and will benefit bronchitis, acne and eczema, rheumatic pain and immune depression. It can also kill fungus like candida (PMAPC 1997). Spruce gum has been used to heal cuts, but can be boiled

and ingested to treat colds or the vapours can be inhaled to treat bronchitis (Willard 1992).

Strawberries are highly palatable berries that are primarily used as a food source. Strawberry leaves and roots, however, may be boiled and used for medicinal purposes, such as an astringent, diuretic, tonic or to relieve diarrhea (Willard 1992).

The herb rat root or sweet flag (Figure 17) is used as a medicine for several ailments including, colds, coughs, stomach disorders, fevers and burns. It is also used by some tribes to induce abortion (Stark 1996). Sweet flag contains a hallucinogenic chemical called asarone (Bucher and Kuhlemeier 1993). Rhizomes of this plant were so widely used as medicine by indigenous people, that they became a medium of exchange between some groups (Johnson et al. 1995).

Figure 17 Rat Root or Sweet Flag



Source: Stark 1996

The sweet smelling perennial, sweet grass is important to indigenous people for holy ceremonies and as a medicine (Willard 1992). The grass is woven and burned as an offering in ceremonies. The Blackfoot Indians would gather it in late summer to be used as incense. The smoke was used as a

spiritual cleanser and medicine men were said to have burned it twice a day. It can also be chewed to prolong fasting. As a medicine it is used to relieve coughing, vomiting, bleeding, saddle sores and hair loss. A tea made from this plant was used to treat sore throats. The stems were soaked to create an eyewash that could also be used to treat wind burn.

The inner bark of red osier dogwood is also an important ceremonial plant and is used for tobacco.

The gum and bark of tamarack are used for medicinal purposes (Willard 1992). For instance, the gum may be chewed to soothe indigestion and to treat liver ailments (e.g., enlarged or hardened liver). The bark can be used to make a poultice that will alleviate skin disorders such as eczema, psoriasis and bruises.

White birch is considered by most aboriginal people to be the most useful of all trees. Its hard wood is used to build several useful items and its paper-like bark has a multitude of uses. In spring this tree species can be tapped in a fashion similar to a maple tree. Birch sap is collected and used as a syrup. Traditionally this syrup was used on bannock and fish.

Buffaloberries may be eaten, but taste bitter. The berries can be whipped to produce a foaming pudding. However, it is believed to serve as a blood thinner and is therefore consumed in small quantities.

Juniper can be used for food or medicinal purposes. The edible berries can be eaten or dried and added to meat for flavour. The berries may also be used as a diuretic or to produce a disinfectant tea that was used to treat sore throats, colds and tuberculosis.

Currants (i.e., red and black gooseberries) are edible and have been used as a food source, however, they also have medicinal purposes (Willard 1992). A liquid extracted from the plant roots, by the Blackfoot Indians, was used to treat kidney ailments and uterine problems. The juice of black currants can be used to soothe sore throats and as a diuretic.

Twisted stalk is gathered as a food source. Specifically, the red berries can be eaten, but also serve as a laxative (Willard 1992).

Bunchberry is another food that has medicinal properties (Willard 1992). The berries may be eaten raw or cooked. Ingested berries have been claimed to reduce the potency of poisons.

Beaked hazelnut nuts are either eaten raw or roasted, or ground into flour and used for baking (Johnson et al. 1995). They were also easy to store for use later.

Despite their stinging hairs, nettles can be used for food as well as for medicinal purposes (Willard 1992). Young leaves can be boiled and eaten like spinach; or they can be used to make tea, wine or beer. The stinging effect is completely removed by cooking. The tea made from the nettles can actually be used to alleviate the sting as well as a diuretic, astringent and antispasmodic. It has also been used to stop internal bleeding. Older nettle plants become tough and fibrous, and the fibers can be used to make rope, paper or a very durable cloth.

Chokecherries traditionally were added to pemmican, or were cooked with meat or stew. Today they are harvested for use in making jellies, syrups, sauces and wine (Johnson et al. 1995).

Raspberries are used as food. They may also be used as a medicine in the treatment of diarrhea, nausea and vomiting (Willard 1992).

Saskatoon berries are spread out and dried separately or mashed and formed into blocks for drying. Once dried, they were eaten raw, rehydrated or pounded into meat to make pemmican. Today, they are still a popular fruit and are used for pies, pancakes, muffins, sauces, syrups, jellies or eaten raw on deserts and cereals (Johnson et al. 1995). Saskatoon berries may also be dried, and thus preserved to last several years for incorporation into soups, puddings or vegetable dishes (Willard 1992). The juice has been used medicinally as a laxative, to soothe upset stomachs and as eye and ear drops. The bark was also used medicinally; a disinfectant was boiled from the inner bark.

Cattails have been used as a source of food for generations. In the spring, new shoots can be eaten raw, but, later in the year when shoots become tough, they have to be boiled or roasted. The rhizomes can be peeled and eaten raw or roasted and ground into a powder for use as flour or to make porridge. When they are young, cattail flowers can also be used for food. Pollen from the male flowers can be mixed with flour and used for baking and the female flower, when green, can be eaten off the spike (Johnson et al. 1995).

3.4.2 Traditional Use Plant Habitat Potential

A literature review and past interviews with aboriginal peoples were used to identify the traditional use of plants in the area. Plants identified included those used for food, medicinal or spiritual purposes. Each plant species was

ranked as high (H), high-medium (MH), medium (M) or low (L), according to importance (Table 20). Ranking was based on a review of traditional land use completed by the Fort McKay community (Fort McKay 1994). High, medium or low were assigned to each species based on the number of times a species was indicated within a specific region of the traditional land use area.

Beckingham and Archibald's (1996) classification system was used to assign ecosites to each identified traditional use plant species (Table 17). The ecosites listed for each traditional plant are based on the list of dominant vegetation species for each ecosite. As such, a traditional plant species may not always be found in the assigned ecosites, although the probability is high that they will. Conversely, traditional plant species may be found outside of the assigned ecosites. In short, assigning ecosites to each plant species is a tool to approximate the area where traditional plants may be found.

Most of the traditional use plants identified can be found in multiple ecosite phases within the LSA. Accordingly, many of the plants can potentially be found over large areas within the LSA. For example, rose hips (prickly rose), which are used for food or medicinal purposes, may be found in 84% of the LSA. A few traditional plants, including mint, nettle, hazelnut, pin- and chokecherry and cattail are found in only one or two ecosites. In addition, two of the plants are only found in a small area (<5%) of the LSA (Table 20).

Table 20 Traditional Plant Species and Associated Ecosites Within Millennium Project LSA

Plant	Importance[a]	Ecosite	Baseline LSA/Steepbank			
			Area (ha)	% LSA	Area (ha)	% Area
balsam fir	H	d1, d2, d3, e2, e3	5,004.2	30.9	1,220.1	32.3
beaked hazelnut	M	d1	3,348.1	20.7	932.2	24.5
balsam poplar	H	d1, d2, d3, e1, e3	5,216.1	32.2		
black gooseberry	L	d1, d3, e3	4,416.3	27.3	1,160.2	30.7
black spruce	H	b1, d1, FONS, FTNN, SFNN, STNN	12,056.8	74.5	2,873.0	76.1
bog birch	H	d1, FTNN, SFNN, STNN	11,404.4	70.5	2,665.1	70.6
bog cranberry	H	b1, b4, d3, FTNN, SFNN, STNN	12,621.9	78.0	3,011.7	79.8
buffaloberry	L	b1, b4, d1, d2, d3, e1, FTNN	11,375.6	70.3	2,886.2	76.4
choke cherry	M	d3	940.8	5.8	212.1	5.6
common bearberry	H	b1, b4, d2, d3	5,153.4	31.8	1,329.6	35.2
common blueberry	H	b4, d3	990.9	6.1	248.9	6.6
common cattail	H	Ftnn, Mons, Sfnn	6,908.2	42.7	1,601.5	42.4
dwarf blueberry	H	b1, b4, d1, d2, FTNN, SFNN, STNN	12,268.9	75.8	2,859.3	75.7
dwarf raspberry	M	d1, FONS, FTNN, STNN	11,143.1	68.9	2,723.8	72.1
Labrador tea	H	b1, b4, d1, d2, d3, e3, FONS, FTNN, SFNN, STNN	13,763.0	85.1	3,206.3	84.9
low-bush cranberry	H	d1, d2, d3, e1, e3	5,216.1	32.2	1,248.2	33.1
moss species	H	d1, d3, e1, e3, FONS, FTNN, SFNN	11,751.6	72.6	2,878.1	76.2
pin cherry	M	d1	3,348.1	20.7	923.2	24.5
pitcher plant (greenfrog plant)	M	FONS, FONG, FFNN, FTNN, BTNN				
prickly rose	H	b1, b4, d1, d2, d3, e1, e3, FTNN, SFNN, STNN	13,549.0	83.7	3,124.5	82.8
red-osier dogwood	M	d1, d2, d3, e1, e3	5,216.1	32.2	1,248.2	33.1
saskatoon	M	d1, d2, e1	4,147.8	25.6	1,011.3	26.8
stinging nettle	M	FONS, MONG	532.7	3.3	122.0	3.2
sweet flag	H	MONG				
tamarack	H	b1, d1, FONS, FTNN, SFNN, STNN	12,056.8	74.5	2,873.0	76.1
velvet-leaved blueberry	H	b1, b4, d1, d2, d3	5,153.4	31.8	1,329.6	35.2
white birch	M	d1, d2, d3, e1, e3	5,216.1	32.2	1,248.2	33.1
white spruce	H	b1, b4, d1, d2, d3, e1, e3, FTNN	11,502.9	71.1	2,911.0	77.1
wild mint	H	FONS, MONG	532.7	3.3	122.0	3.2
wild strawberry	H	b4, d1, d2, d3, e3, FONS, FTNN, SFNN, STNN	13,536.5	83.7	3,108.5	82.3

[a] H = high, MH - medium-high, M = Medium, L = Low.

4. CLOSURE

We trust that this report presents the information that you require. Should any portion of the report require clarification, please contact the undersigned.

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APPENDIX I

PLANT SPECIES SCIENTIFIC NAMES

APPENDIX I

PLANT SPECIES SCIENTIFIC NAMES

Common Name	*Scientific Name*
VEGETATION	
Club-moss Family	**LYCOPODIACEAE**
Stiff Club-moss	*Lycopodium annotinum*
Running Club-moss	*L. clavatum*
Tree Club-moss	*L. obscurum*
Little Club-moss Family	**SELAGINELLACEAE**
Little Club-moss	*Selaginella selaginoides*
Horsetail Family	**EQUISETACEAE**
Common Horsetail	*Equisetum arvense*
Swamp Horsetail	*E. fluviatile*
Meadow Horsetail	*E. pratense*
Woodland Horsetail	*E. sylvaticum*
Dwarf Scouring Rush	*E. scirpoides*
Adder's-tongue Family	**OPHIOGLOSSACEAE**
Grape Fern	*Botrychium virginianum*
Fern Family	**POLYPODIACEAE**
Narrow Spinulose Shield Fern	*Dryopteris carthusiana*
Oak Fern	*Gymnocarpium dryopteris*
Ostrich Fern	*Matteuccia struthiopteris*
Cypress Family	**CUPRESSACEAE**
Ground Juniper	*Juniperus communis*
Pine Family	**PINACEAE**
Balsam Fir	*Abies balsamea*
Larch	*Larix laricina*
White Spruce	*Picea glauca*
Black Spruce	*P. mariana*
Jack Pine	*Pinus banksiana*
Cattail Family	**TYPHACEAE**
Common Cattail	*Typha latifolia*
Bur-reed Family	**SPARGANIACEAE**
Narrow-Leaved Bur-reed	*Sparganium angustifolium*
Giant Bur-reed	*S. eurycarpum*
Pondweed Family	**POTAMOGETONACEAE**
Various-leaved Pondweed	*Potamogeton gramineus*
Pondweed	*P. obtusifolius*
Clasping-leaf Pondweed	*P. richardsonii*
Arrow-grass Family	**JUNCAGINACEAE**
Arrow-grass	*Triglochin maritima*
Slender Arrow-grass	*T. palustris*
Scheuchzeria Family	**SCHEUCHERIACEAE**

Common Name	*Scientific Name*
Scheuchzeria	*Scheuchzeria palustris*
Water-plantain	**ALISMATACEAE**
Arrowhead	*Sagittaria cuneata*
Grass Family	**GRAMINEAE**
Tickle Grass	*Agrostis scabra*
Macoun's Wild Rye	*Agrohordeum macounii*
Slender Wheat Grass	*Agropyron trachycaulum*
Water Foxtail	*Alopecurus aequalis*
Slough Grass	*Beckmannia syzigachne*
Fringed Brome	*Bromus ciliatus*
Awnless Brome	*B. inermis*
Marsh Reed Grass	*Calamagrostis canadensis*
Northern Reed Grass	*C. inexpansa*
Narrow Reed Grass	*C. stricta*
Drooping Wood Reed	*Cinna latifolia*
Tufted Hair Grass	*Deschampsia cespitosa*
Canada Wild Rye	*Elymus canadensis*
Hairy Wild Rye	*E. innovatus*
Northern Rough Fescue	*Festuca saximontana*
Tall Manna Grass	*Glyceria grandis*
Sweet Grass	*Hierochloe odorata*
Foxtail Barley	*Hordeum jubatum*
Rough-leaved Rice Grass	*Oryzopsis asperifolia*
Northern Rice Grass	*O. pungens*
Reed Canary Grass	*Phalaris arundinacea*
Common Reed Grass	*Phragmites australis*
Wood Blue Grass	*Poa interior*
Fowl Bluegrass	*P. palustris*
Kentucky Bluegrass	*P. pratensis*
False Melic	*Schizachne purpurascens*
Cord Grass	*Spartina pectinata*
Slender Wedge Grass	*Sphenopholis intermedia*
Needle Grass	*Stipa curtiseta*
Sedge Family	**CYPERACEAE**
Silvery-flowered Sedge	*Carex aenea*
Water Sedge	*C. aquatilis*
Golden Sedge	*C. aurea*
Bebb's Sedge	*C. bebbii*
Brownish Sedge	*C. brunnescens*
Hair-Like Sedge	*C. capillaris*
Beautiful Sedge	*C. concinna*
Short Sedge	*C. curta (in. C. brunnescens group)*
Dewey's Sedge	*C. deweyana*
Two-stamened Sedge	*C. diandra*

Common Name	*Scientific Name*
Two-seeded Sedge	*C. disperma*
Northern Bog Sedge	*C. gynocrates*
Sand Sedge	*C. houghtoniana*
Inland Sedge	*C. interior*
Lakeshore Sedge	*C. lacustris*
Bristle-stalked Sedge	*C. leptalea*
Hairy-fruited Sedge	*C. lasiocarpa*
Mud Sedge	*C. limosa*
Norway Sedge	*C. norvegica*
Beacked Sedge	*C. utriculata*
Few-fruited Sedge	*C. oligosperma*
Bog Sedge	*C. paupercula*
Peck's Sedge	*C. peckii*
Meadow Sedge	*C. praticola*
Raymond's Sedge	*C. raymondii*
Ross' Sedge	*C. rossii*
Turned Sedge	*C. retrorsa*
Sartwell's Sedge	*C. sartwellii*
Sprengel's Sedge	*C. sprengellii*
Hay Sedge	*C. siccata*
Twin-flowered Sedge	*C. tenuiflora*
Sheathed Sedge	*C. vaginata*
Needle Spike-rush	*Eleocharis acicularis*
Creeping Spike-rush	*E. palustris*
Close-sheathed Cotton-grass	*Eriophorum brachyantherum*
Slender Cotton -grass	*E. gracile*
Tall Cotton-grass	*E. polystachion*
Sheathed Cotton-grass	*E. vaginatum*
Tufted Bulrush	*Scirpus cespitosus*
Small-fruited Bulrush	*S. microcarpus*
Arum Family	**ARACEAE**
Sweet Flay	*Acorus americanus*
Water Arum	*Calla palustris*
Duckweed Family	**LEMNACEAE**
Common Duckweed	*Lemna minor*
Ivy Duckweed	*L. trisulca*
Rush Family	**JUNCACEAE**
Wire Rush	*Juncus balticus*
Toad Rush	*J. bufonius*
Chestnut Rush	*J. castaneus*
Slender Rush	*J. tenuis*
Big-head Rush	*J. vaseyi*
Small-flowered Wood Rush	*Luzula parviflora*
Lily Family	**LILIACEAE**

Common Name	*Scientific Name*
Fairybells	*Disporum trachycaulum*
Rough-fruited Fairybells	*D. trachycarpum*
Western Wood Lily	*Lilium philadelphicum*
Wild Lily-of-the-valley	*Maianthemum canadense*
Star-flowered Solomon's-seal	*Smilacina stellata*
Three-leaved Solomon's-seal	*S. trifolia*
Twisted-stalk	*Streptopus amplexifolius*
Sticky False Asphodel	*Tofieldia glutinosa*
Iris Family	**IRIDACEAE**
Common Blue-eyed Grass	*Sisyrinchium montanum*
Orchid Family	**ORCHIDACEAE**
Pale Coral-root	*Corallorhiza trifida*
Yellow Lady's-slipper	*Cypripedium calceolus*
Lesser Rattlesnake-plantain	*Goodyera repens*
Northern Green Orchid	*Habenaria hyperborea*
Blunt-leaved Orchid	*H. obtusata*
Round-leaved Orchid	*H. orbiculata*
Bracted Orchid	*H. viridis*
Round-leaved Orchid	*Orchis rotundifolia*
Ladies'-tresses	*Spiranthes romanzoffiana*
Willow Family	**SALICACEAE**
Balsam Poplar	*Populus balsamifera*
Trembling Aspen	*P. tremuloides*
Little-tree Willow	*Salix arbusculoides*
Beaked Willow	*S. bebbiana*
Hoary Willow	*S. candida*
Pussy Willow	*S. discolor*
Satin willow	*S. drummondiana*
Sandbar Willow	*S. exigua*
Grey-leaved Willow	*Salix glauca*
Shinning Willow	*S. lucida*
Yellow Willow	*S. lutea*
Myrtle-leaved Willow	*S. myrtillifolia*
Bog Willow	*S. pedicellaris*
Basket Willow	*S. petiolaris*
Flat-leaved Willow	*S. planifolia*
Mountain Willow	*S. pseudomonticola*
Balsam Willow	*S. pyrifolia*
Scouler's Willow	*S. scouleriana*
Autumn Willow	*S. serissima*
Sweet Gale Family	**MYRICACEAE**
Sweet Gale	*Myrica gale*
Birch Family	**BETULACEAE**
Green Alder	*Alnus crispa*

Common Name	*Scientific Name*
River Alder	*A. tenuifolia*
Bog Birch	*Betula glandulosa*
Alaska Birch	*B. neoalaskana*
White Birch	*B. papyrifera*
Dwarf Birch	*B. pumila*
Beaked Hazelnut	*Corylus cornuta*
Nettle Family	**URTICACAEAE**
Common Nettle	*Urtica dioica*
Sandalwood Family	**SANTALACEAE**
Bastard Toad-flax	*Comandra umbellata*
Northern Bastard Toad-flax	*Geocaulon lividum*
Mistletoe Family	**LORANTHACEAE**
Dwarf Mistletoe	*Arceuthobium americanum*
Buckwheat Family	**POLYGONACEAE**
Water Smartweed	*Polygonum amphibium*
Striate Knotweed	*P. erectum*
Pale Persicaria	*P. lapathifolium*
Alpine Bistort	*P. viviparum*
Western Dock	*Rumex occidentalis*
Narrow-leaved Dock	*R. triangulivalis*
Goosefoot Family	**CHENOPODIACEAE**
Strawberry Blite	*Chenopodium capitatum*
Pink Family	**CARYOPHYLLACEAE**
Nodding Chickweed	*Cerastium nutans*
Blunt-leaved Sandwort	*Moehringia lateriflora*
Long-leaved Chickweed	*Stellaria longifolia*
Long-stalked Chickweed	*S. longipes*
Water-lily Family	**NYMPHAEACEAE**
Yellow Pond-lily	*Nuphar variegatum*
Hornwort Family	**CERATOPHYLLACEAE**
Hornwort	*Ceratophyllum demersum*
Crowfoot Family	**RANUNCULACEAE**
Red and White Baneberry	*Actaea rubra*
Canada Anemone	*Anemone canadensis*
Cut-leaved Anemone	*A. multifida*
Small Wood Anemone	*A. parviflora*
Prairie Crocus	*A. patens*
Blue Columbine	*Aquilegia brevistyla*
Marsh Marigold	*Caltha palustris*
Floating Marsh-marigold	*Caltha natans*
Goldthread	*Coptis trifolia*
Tall Larkspur	*Delphinium glaucum*
Small-flowered Crowfoot	*Ranunculus abortivus*
Seaside Crowfoot	*R. cymbalaria*

Common Name	*Scientific Name*
Yellow Water Crowfoot	*R. gmelinii*
Boreal Buttercup	*R. hyperboreus*
Lapland Buttercup	*R. lapponicus*
Macoun's Buttercup	*R. macounii*
Bristly Buttercup	*R. pensylvanicus*
Cursed Buttercup	*R. sceleratus*
Flat-fruited Meadow Rue	*Thalictrum sparsiflorum*
Veiny Meadow Rue	*T. venulosum*
Fumitory Family	**FUMARIACEAE**
Golden Corydalis	*Corydalis aurea*
Pink Corydalis	*C. sempervirens*
Mustard Family	**CRUCIFERAE**
Hairy Rock Cress	*Arabis hirsuta*
Lyre-leaved Rock Cress	*A. lyrata*
Pennsylvanian Bitter Cress	*Cardamine pensylvanica*
Green Tansy Mustard	*Descurainia pinnata*
Grey Tansy Mustard	*D. richardsonii*
Annual Whitlow-grass	*Draba nemorosa*
Wormseed Mustard	*Erysimum cheiranthoides*
Common Peppergrass	*Lepidium bourgeauanum*
Common Peppergrass	*L. densiflorum*
Yellow Cress	*Rorippa palustris*
Pitcher-plant Family	**SARRACENIACEAE**
Pitcher-plant	*Sarracenia purpurea*
Sundew Family	**DROSERACEAE**
Sundew	*Drosera rotundifolia*
Saxifrage Family	**SAXIFRAGACEAE**
Golden Iowense	*Chrysosplenium iowense*
Bishop's-cap	*Mitella nuda*
Grass-of-Parnassus Family	**PARNASSIACEAE**
Northern Grass-of-Parnassus	*Parnassia palustris*
Currant or Gooseberry Family	**GROSSULARIACEAE**
Skunk Currant	*Ribes glandulosum*
Wild Black Currant	*R. hudsonianum*
Bristly Black Currant	*R. lacustre*
Wild Gooseberry	*R. oxyacanthoides*
Wild Red Currant	*R. triste*
Rose Family	**ROSSACEAE**
Saskatoon	*Amelanchier alnifolia*
Woodland Strawberry	*Fragaria vesca*
Wild Strawberry	*F. virginiana*
Yellow Avens	*Geum macrophyllum*
Silverweed	*Potentilla anserina*
White Cinquefoil	*P. arguta*

Common Name	*Scientific Name*
Plains Cinquefoil	*Potentilla bipinnatifida*
Shrubby Cinquefoil	*P. fruticosa*
Graceful Cinquefoil	*P. gracilis*
Rough Cinquefoil	*P. norvegica*
Marsh Cinquefoil	*P. palustris*
Three-toothed Cinquefoil	*P. tridentata*
Pin Cherry	*Prunus pensylvanica*
Choke Cherry	*P. virginiana*
Prickly Rose	*Rosa acicularis*
Dwarf Raspberry	*Rubus arcticus*
Cloudberry	*R. chamaemorus*
Wild Red Raspberry	*R. idaeus*
Dewberry	*R. pubescens*
Pea Family	**LEGUMINOSAE**
American Milk Vetch	*Astragalus americanus*
Yukon Milk Vetch	*A. bodinii*
Canadian Milk Vetch	*A. canadensis*
Pretty Milk Vetch	*A. eucosmus*
Wild Licorice	*Glycyrrhiza lepidota*
Alpine Hedysarum	*Hedysarum alpinum*
Northern Hedysarum	*H. boreale*
Creamy Pea Vine	*Lathyrus ochroleucus*
Showy Loco-weed	*Oxytropis splendens*
Wild Vetch	*Vicia americana*
Geranium Family	**GERANIACEAE**
Bicknell's Geranium	*Geranium bicknellii*
Flax family	**LINACEAE**
Wild Blue Flax	*Linum lewisii*
Milkwort Family	**POLYGALACEAE**
Fringed Milkwort	*Polygala paucifolia*
Touch-me-not Family	**BALSAMINACEAE**
Spotted Touch-me-not	*Impatiens capensis*
Water-starwort Family	**CALLITRICHACEAE**
Vernal Water-starwort	*Callitriche verna*
Crowberry Family	**EMPETRACEAE**
Crowberry	*Empetrum nigrum*
Buckthorn Family	**RHAMNACEAE**
Alder-leaved Buckthorn	*Rhamnus alnifolia*
Rockrose Family	**CISTACEAE**
Sand Heather	*Hudsonia tomentosa*
Violet Family	**VIOLACEAE**
Early Blue Violet	*Viola adunca*
Western Canada Violet	*V. canadensis*
Marsh Violet	*V. palustris*

Common Name	*Scientific Name*
Kidnet-leaved Violet	*V. renifolia*
Oleaster Family	**ELAEAGNACEAE**
Wolf Willow	*Elaeagnus commutata*
Canadian Buffaloberry	*Shepherdia canadensis*
Evening Primrose Family	**ONAGRACEAE**
Small Enchanter's Nightshade	*Circaea alpina*
Fireweed	*Epilobium angustifolium*
Northern Willowherb	*E. ciliatum*
Purple-leaved Willowherb	*E. glandulosum*
Narrow-leaved Willowherb	*E. leptophyllum*
Mare's-tail Family	**HIPPURIDACEAE**
Common Mare's-tail	*Hippuris vulgaris*
Ginseng Family	**ARALIACEAE**
Wild Sarasparilla	*Aralia nudicaulis*
Carrot Family	**UMBELLIFERAE**
Bulb-bearing Waterhemlock	*Cicuta bulbifera*
Water-hemlock	*C. maculata*
Cow Parsnip	*Heracleum lanatum*
Water Parsnip	*Sium suave*
Dogwood Family	**CORNACEAE**
Bunchberry	*Cornus canadensis*
Red-osier Dogwood	*C. stolonifera*
Wintergreen Family	**PYROLACEAE**
One-flowered Wintergreen	*Moneses uniflora*
One-sided Wintergreen	*Orthilia secunda*
Common Pink Wintergreen	*Pyrola asarifolia*
Greenish-flowered Wintergreen	*P. chlorantha*
Indian-pipe Family	**MONOTROPACEAE**
Indian Pipe	*Monotropa uniflora*
Heath Family	**ERICACEAE**
Bog Rosemary	*Andromeda polifolia*
Alpine Bearberry	*Arctostaphylos rubra*
Common Bearberry	*A. uva-ursi*
Leather-leaf	*Chamaedaphne calyculata*
Creeping Snowberry	*Gaultheria hispidula*
Northern Bog-laurel	*Kalmia polifolia*
Common Labrador Tea	*Ledum groenlandicum*
Northern Labrador Tea	*L. palustre*
Small Bog Cranberry	*Oxycoccus microcarpus*
Bog Cranberry	*O. quadripetalus*
Dwarf Blueberry	*Vaccinium caespitosum*
Blueberry	*V. myrtilloides*
Bog Cranberry	*V. vitis-idaea*
Primrose Family	**PRIMULACEAE**

Common Name	*Scientific Name*
Shooting Star	*Dodecatheon pulchellum*
Tufted Loosestrife	*Lysimachia thyrsiflora*
Northern Starflower	*Trientalis borealis*
Arctic Starflower	*T. europaea*
Gentian Family	**GENTIANACEAE**
Felwort	*Gentianella amarella*
Spurred Gentian	*Halenia deflexa*
Buck-bean Family	**MENYANTHACEAE**
Buck-bean	*Menyanthes trifoliata*
Dogbane Family	**APOCYNACEAE**
Spreading Dogbane	*Apocynum androsaemifolium*
Indian Hemp	*A. cannabinum*
Dogbane	*A. x medium*
Phlox Family	**POLEMONIACEAE**
Collomia	*Collomia linearis*
Jacob's-ladder	*Polemonium acutiflorum*
Borage Family	**BORAGINACEAE**
Beggar-ticks	*Lappula occidentalis*
Tall Mertensia	*Mertensia paniculata*
Mint Family	**LABIATAE**
Giant Hyssop	*Agastache foeniculum*
American Dragonhead	*Dracocephalum parviflorum*
Western Water Horehound	*Lycopus asper*
Northern Water Horehound	*L. uniflorus*
Wild Mint	*Mentha arvensis*
Marsh Skullcap	*Scutellaria galericulata*
Marsh Hedge Nettle	*Stachys palustris*
Figwort Family	**SCROPHULARIACEAE**
Purple Paint-brush	*Castilleja raupii*
Cow-wheat	*Melampyrum lineare*
Labrador Lousewort	*Pedicularis labradorica*
Swamp Lousewort	*P. parviflora*
Yellow Rattle	*Rhinanthus minor*
American Brooklime	*Veronica americana*
Hairy Speedwell	*V. peregrina*
Marsh Speedwell	*V. scutellata*
Bladderwort Family	**LENTIBULARIACEAE**
Common Butterwort	*Pinguicula vulgaris*
Common Bladderwort	*Utricularia vulgaris*
Madder Family	**RUBIACEAE**
Northern Bedstraw	*Galium boreale*
Labrador Bedstraw	*G. labradoricum*
Small Bedstraw	*G. trifidum*
Sweet-scented Bedstraw	*G. triflorum*

Common Name	*Scientific Name*
Honeysuckle Family	**CAPRIFOLIACEAE**
Twin-flower	*Linnaea borealis*
Fly Honeysuckle	*Lonicera caerulea*
Twining Honeysuckle	*L. dioica*
Bracted Honeysuckle	*L. involucrata*
Snowberry	*Symphoricarpos albus*
Buckbrush	*S. occidentalis*
Low-bush Cranberry	*Viburnum edule*
High-bush Cranberry	*V. opulus*
Moschatel Family	**ADOXACEAE**
Moschatel	*Adoxa moschatellina*
Valerian Family	**VALERIANACEAE**
Northern Valerian	*Valeriana dioica*
Bluebell Family	**CAMPANULACEAE**
Bluebell	*Campanula rotundifolia*
Lobelia Family	**LOBELIACEAE**
Kalm's Lobelia	*Lobela kalmii*
Composite Family	**COMPOSITAE**
Common Yarrow	*Achillea millefolium*
Many-flowered Yarrow	*A. sibirica*
Small-leaved Pussytoes	*Antennaria parvifolia*
Leafy Arnica	*Arnica chamissonis*
Biennial Sagewort	*Artemisia biennis*
Plains Wormwood	*A. campestris*
Dragonwort	*A. dracunculus*
Marsh Aster	*Aster borealis*
Fringed Aster	*A. ciliolatus*
Showy Aster	*A. conspicuus*
Creeping White Prairie Aster	*A. falcatus*
Western Willow Aster	*A. hesperius*
Smooth Aster	*A. laevis*
Purple-stemmed Aster	*A. puniceus*
Nodding Beggar-ticks	*Bidens cernua*
Northern Daisy Fleabane	*Erigeron acris*
Horseweed	*E. canadensis*
Philadelphia Fleabane	*E. philadelphicus*
Common Tall Sunflower	*Helianthus nuttallii*
Narrow-leaved Hawkweed	*Hieracium umbellatum*
Artic Coltsfoot	*Petasites frigidus*
Palmate-leaved Coltsfoot	*P. palmatus*
Arrow-leaved Coltsfoot	*P. sagittatus*
Vine-leaved Coltsfoot	*P. vitifolius*
Marsh Ragwort	*Senecio congestus*
Rayless Ragwort	*S. indecorus*

Common Name	*Scientific Name*
Balsam Groundsel	*S. pauperculus*
Canada Goldenrod	*Solidago canadensis*
Flat-topped Goldenrod	*S. graminifolia*
Northern Goldenrod	*S. multiradiata*
Mountain Goldenrod	*S. spathulata*
Perennial Sow Thistle	*Sonchus arvensis*