Appendix B

Ecological Land Classification

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Ecological Land Classification Report

Kami Iron Ore Mine and Rail Infrastructure, Labrador

Prepared for

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Final Report

File No. 121614000.416

Date: November 16, 2012

EXECUTIVE SUMMARY

In 2011, Stassinu Stantec Consulting Ltd. (Stassinu) was contracted by Alderon Iron Ore Corp (Alderon) to develop an Ecological Land Classification (ELC) for an area encompassing the Kamistiatusset (Kami) Iron Ore Mine and Rail Infrastructure (the "Project"), in western Labrador.

An ELC was undertaken to describe the local ecological context of the Study Area, such that interactions between biota, the physical environment and the Project can be assessed within the context of the specific ecology of the area. The Project ELC was completed to identify, compile and summarize information on vegetation and vegetation communities, and wildlife habitat in the vicinity of the proposed Project as environmental information for use in the environmental impact statement (EIS). ELC is a hierarchical and holistic approach that integrates a broad range of physical and biotic characteristics into discrete and ecologically unique units. These ecosystem units provide the basis for understanding how the Project may affect local ecological function. This Study Area ELC was developed at the Ecotype level, at a scale of 1:35,000. Ecotypes are defined on the basis of a uniformity of parent material, soils, vegetation and hydrology, as expressed by slope, position, aspect and exposure.

This report describes the methodology and results of the ELC field program, summarizing the objectives, methods, and findings of the field studies that were used to produce detailed ecosystem mapping of the proposed Project area. Additionally, the report considered wildlife and wildlife habitat in the area of the Project, enabling the thematic mapping and quantification of ecological map units (i.e., ecotypes) / wildlife habitat types (i.e., primary, secondary or tertiary habitat) for select species or species groups, including species of special conservation status.

High-resolution satellite images and aerial photographs were incorporated into a computer-based geographic information system (GIS) and used to define and delineate ecotypes. This imagery provided the basis for the delineation of geological, vegetation and hydrological attributes across the Study Area. Digital imagery was complimented with extensive field studies (114 sites) conducted between July 25 to July 30, 2011 and September 28 to October 4, 2011 undertaken to further characterize surficial geology, geomorphology, vegetation and soils within the Study Area. ArcGIS software was used to manage all spatial data collected for the ELC.

A total of 14 vegetated and 3 sparsely or non-vegetated ecotypes were identified within the Study Area, described from 114 sample plots, and based on the ecosystem classification system adapted for use with this and other similar projects completed throughout Labrador. Of these, 11 are vegetated ecotypes, Alpine Heath (<1 percent); Hardwood Forest (<2 percent); Mixedwood Forest (<5 percent); Black Spruce-Labrador Tea-Feathermoss (24 percent); Black Spruce Lichen (5 percent); Black Spruce / Tamarack Sphagnum Woodland (13 percent); Tamarack / Black Spruce-Feathermoss (Water Track) (8 percent); Riparian Thicket (<1 percent); Riparian Marsh / Fen (<1 percent); Patterned Shrub Fen (<1 percent); and Non-Patterned Shrub Fen (includes Graminoid Fen (GF) (3 percent). Two of these, Black Spruce-Labrador Tea-Feathermoss and Black Spruce-Lichen, also had corresponding burned subtypes

(i.e., Hardwood Burn / Regeneration [9 percent], Mixedwood Burn / Regeneration [<2 percent] and Softwood Burn / Regeneration [<10 percent]) which were large enough to be mapped seperately, resulting in a total of 14 vegetated map units. Additionally, three sparsely vegetated, non-vegetated and/or anthropogenically altered / disturbed ecosystem units were also mapped including Shallow Open Water with Vegetation, Exposed Earth/Anthropogenic and Open Water. These ecotypes accounted for approximately 21 percent of the mapped ELC. These ecotypes included open water (i.e., lake, pond, river), shallow open water with vegetation, and exposed earth /anthropogenic. Non-ELC areas, including Cloud and Shadow, account for <3 percent of the mapped ELC areas.

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ABBREVIATIONS

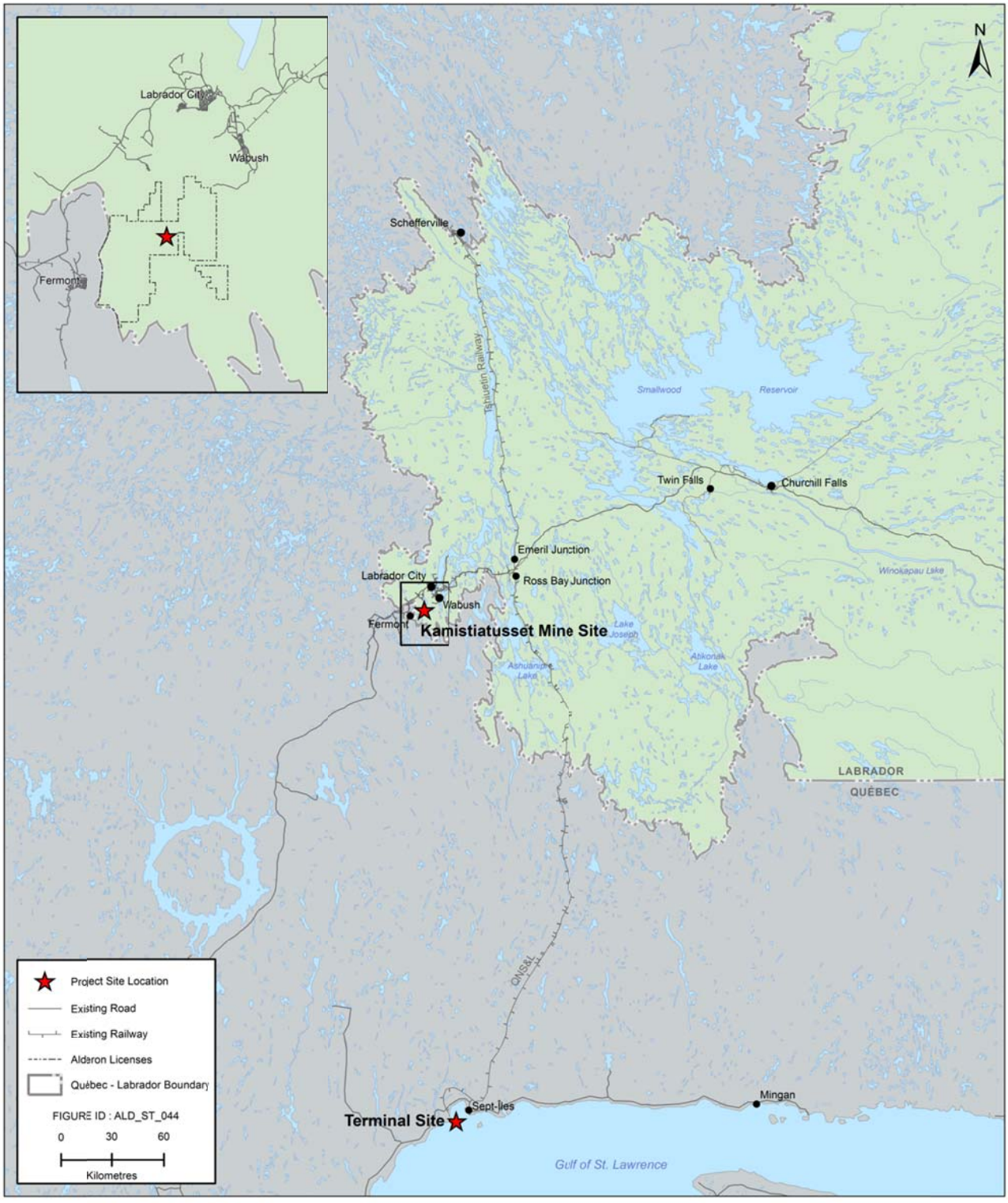
ACCDC	Atlantic Canada Conservation Data Centre
Alderon	Alderon Iron Ore Corp
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
DMS	Data Management Systems
EA	Environmental Assessment
EIS	Environmental Impact Statement
ELC	Ecological Land Classification
FNA	Flora of North America
Footprint	Areas where project related infrastructure and alternatives are proposed
GIS	Geographic Information System
ISO	International Organization for Standardization
ITIS	Integrated Taxonomic Information System Database
MSF	Mid Subarctic Forest (Michikamau) Ecoregion
NLDEC	Newfoundland and Labrador Department of Environment and Conservation
NLEPA	*Newfoundland and Labrador Environmental Protection Act*
NLESA	*Newfoundland and Labrador Endangered Species Act*
QMS	Quality Management System
S Rank	Sub-national (provincial) rarity ranking for a species
SARA	*Species at Risk Act*
SMR	Soil Moisture Regime
SNR	Soil Nutrient Regime
UTM	Universal Transverse Mercator
VASCAN	Database of Canadian Vascular Plants

1.0 INTRODUCTION

Alderon Iron Ore Corp. (Alderon) is proposing to develop an iron ore mine in western Labrador, and build associated infrastructure at the Port of Sept-Îles, Québec. The mine Property is located in the vicinity of the towns of Wabush, Labrador City and Fermont (Figure 1.1). The Kamistiatusset (Kami) Iron Ore Mine and Rail Infrastructure (the Project) is located entirely within Labrador, and includes construction, operation, and rehabilitation and closure of an open pit, waste rock disposal areas, processing infrastructure, a tailings management facility, ancillary infrastructure to support the mine and process plant, and a rail transportation component. The mine will produce up to 16 million metric tonnes of iron ore concentrate per year. Concentrate will be transported by existing rail to the Port of Sept-Îles, where Project-related components will be located on land within the jurisdiction of the Port Authority of Sept-Îles.

The Labrador Project components will require approvals from the Government of Newfoundland and Labrador and are subject to environmental assessment (EA) under the *Environmental Protection Act* (NLEPA) and associated *Environmental Assessment Regulations*. Federal approvals will also be required, which trigger the requirement for a federal EA under the *Canadian Environment Assessment Act* (CEAA), at the comprehensive study level. The Project was registered in accordance with the NLEPA and CEAA in October 2011. This environmental study was conducted in support of the EA process for the Kami Iron Ore Mine and Rail Infrastructure.

Figure 1.1 Project Location for the Kamistiatusset (Kami) Iron Ore Mine Project



1.1 Kami Iron Ore Project Overview

The Kami Iron Ore Project in Labrador includes construction, operation, and closure / decommissioning of the following primary components.

- Open pit (Rose Pit);
- Waste rock disposal areas (Rose North and Rose South);
- Processing infrastructure includes crushing, grinding, spiral concentration, magnetic separation, and tailings thickening areas;
- Tailings management facility (TMF);
- Effluent treatment facility;
- Ancillary infrastructure to support the mine and process plant (gate and guardhouse, reclaim water pumphouse, truck wash bay and shop, electrical substation, explosives magazine storage, administration / office buildings, maintenance offices, warehouse area and employee facilities, conveyors, load-out silo, stockpiles, sewage and water treatment units, mobile equipment, access road and transmission lines);
- A rail transportation component to connect the mine site to the Québec North Shore & Labrador (QNS&L) Railway; and
- Electrical transmission line to be located by Nalcor Energy.

1.2 Ecological Land Classification Overview

Ecological Land Classification (ELC) is an integrated approach to the surveying and classifying of land resources. The goal of such a classification scheme is to identify recurring ecological patterns on the landscape in order to reduce complex natural variation to a reasonable number of meaningful ecosystem units (Bailey et al. 1978). ELC is perhaps the most appropriate tool used to classify and integrate a broad range of physical and biotic characteristics into discrete and ecologically unique units, providing an understanding of ecosystem form and function by linking abiotic and biotic components of each system. Classification is contained within a nested, hierarchical framework which allows for different levels of generalization (and scale) when describing ELC units. In this framework the ELC provides a description of the physical and biological environment affecting the ecological structures and processes and the biodiversity of ecosystems. Within an ELC an appropriate level of ecosystem information and representation can be used to identify, describe, and map progressively smaller areas of land with increasingly uniform ecological features.

In the context of the proposed Project, the ELC is an important tool for examining the interactions between the Project and the surrounding physical environment by interpreting key issues that may result from the Project in the context of the ecosystem properties identified in the ELC. While ELC describes the ecological mosaic of the Project, it is also important in the understanding of other components of the existing environment, such as the identification and

evaluation of existing wildlife habitat, and provides a basis for understanding the potential effects of the Project in relation to the surrounding environment.

In setting the regional boundaries for the ELC, existing developments including Rio Tinto's Iron Ore Company of Canada (IOC), Wabush Mines; the municipalities of Labrador City and Wabush, Labrador and Fermont, Québec; and infrastructure (nearby sections of the Trans Labrador Highway) were incorporated. Key species for habitat consideration included major ungulates such as caribou (*Rangifer tarandus*) and moose (*Alces alces*), key predators such as lynx (*Lynx canadensis*) and raptors, economically important species such as furbearers, migratory species, songbirds and songbird guilds, and species of conservation concern such as the Harlequin Duck (*Histrionicus histrionicus*). The size of the regional project areas also includes key areas for resource development (primarily mining operations), as well as recreation and cultural activities.

The classification of vegetation into ecological units or ecotypes was achieved using standard and validated methodology (Marshall and Schutt 1999) for describing vegetation communities. Using an iterative approach, a variety of data formats including satellite imagery (Landsat 7 and Spot 5), forestry vector data (for Newfoundland), air photos, elevation and field survey data were compiled, forming the foundation of the ELC study. This combination of data formats resulted in a field survey program designed to support a systematic remote-sensing-based mapping program. The combination of these two separate, but interrelated programs provided the best combination for the acquisition of ecological information relevant to the Project and mapping accuracy over the geographic area crossed by the Project.

The ELC Study was completed in order to identify, compile, summarize and present information on vegetation and vegetation communities, and wildlife habitat in the vicinity of the proposed Project, and which may interact with it. This information will be used as supporting information for use in the EIS.

1.3 Study Team

The ELC Study was conducted by Stassinu. The Study Team included a Study Manager and Field Lead, Senior Reviewer, Scientific Authority, Field Observers, and IM / GIS Specialists (Table 1.1). All team members have in-depth knowledge and experience in their fields of expertise and a broad general knowledge of the work conducted by other experts in related fields. Brief biographical statements, highlighting project roles and responsibilities and relevant education and employment experience, are provided below.

Table 1.1 Study Team – Ecological Land Classification Study

Role	Personnel
Study Manager and Field Lead	Sean Bennett
Senior Review	Michael Crowell

Role	Personnel
Field Team	Sean Bennett (Vegetation and Soils)
	Rich LaPaix (Vegetation)
	Tina Newbury (Wildlife)
Data Analysis and Report Preparation	Sean Bennett
	Rich LaPaix
	Tina Newbury
Scientific Authority (Vegetation)	Sue Meades
Information Management / GIS	Chris Shupe (GIS Team Lead), Amber Frickleton

Sean Bennett, B.Sc., P.Biol., R.P.F., is a Professional Biologist (ASPB) and Professional Forester (CAPF) in Stantec's St. John's, Newfoundland and Labrador, office, with over 14 years experience in the area of environmental consulting. A technical professional with focus on the assessment and characterization of terrestrial ecosystems, Mr. Bennett has provided expertise and coordinated projects throughout Canada in accordance with applicable federal and provincial (Yukon, North West Terrritories, Nunavut, British Columbia, Alberta, Saskatchewan, and Newfoundland and Labrador) regulatory requirements. Proficient in botanical / vegetation inventories (including taxonomy and species identification), soil classification (Canadian System of Soil Classification), and the application of ELC principles, he has conducted baseline environmental studies evaluating a variety of habitats to identify site-specific constraints (i.e., environmentally sensitive areas) and developing appropriate mitigative measures for proposed developments. Mr. Bennett served in the capacity of Study Manager and Field Lead for this Study.

Michael Crowell, M.Sc., is a terrestrial ecologist in Stantec's Dartmouth, Nova Scotia office with over 27 years experience in plant taxonomy, plant ecology, wetland ecology and wildlife ecology. He has also conducted a number of vascular plant and ecological land classification studies in Newfoundland and Labrador including work in the Lower Churchill Hydroelectric Generation Project, Voisey's Bay, Labrador City, the DND practice bombing range in southern Labrador and the Trans-Labrador Highway. Mr. Crowell served in the capacity of Senior Reviewer for the Project.

Rich LaPaix, M.Sc., is a terrestrial ecologist for Stantec's office in Dartmouth, Nova Scotia, and has over five years professional experience in the field. He is an experienced botanist and vegetation ecologist, having conducted numerous botanical surveys and plant community studies in a wide range of ecotypes within both eastern and western North America. Rich is experienced in wetland delineation, classification, and functional assessment and also has expertise as a wildlife ecologist. Rich was a field researcher for this Project and has been involved in similar projects within Newfoundland and Labrador, including development of an ELC for the Labrador-Island Transmission Link project.

Susan J. Meades, M.Sc., is a field botanist with over 25 years experience. She has a B.A. (Botany) from Rutgers University-NCAS and a M.Sc. (Botany) from Eastern Illinois University. Ms. Meades is an adjunct professor in the Biology Deptartment of Algoma University College, where she teaches Principles of Ecology, Diversity of Vascular Plants, and Plant Systematics.

She lived in Newfoundland and Labrador for 17 years, where she worked as a consultant and was instrumental in the establishment of Burnt Cape Ecological Reserve. She is the senior author of the *Annotated Checklist of the Vascular Plants of Newfoundland and Labrador* and the author of *Natural Regions of Newfoundland and Labrador (1990)*. Ms. Meades is also the botanical illustrator for the *Forest Site Classification Manual: A Field Guide to the Damman Forest Types of Newfoundland and Indicator Plant Species in Canadian Forests*. She is currently working on an illustrated guide to the wildflowers of Newfoundland and Labrador, a checklist of the Vascular and Non-Vascular Plants of northern Ontario and is the project leader of the Northern Ontario Plant Database project. Ms. Meades was responsible for verifying the identity of potentially rare or unconfirmed vascular plant species collected from the Project Study Area.

Tina Newbury, M.Sc., is a terrestrial ecologist with the Stantec office in Corner Brook, Newfoundland and Labrador and has over 18 years of professional experience in the field. She graduated from Trent University (1992) with a B.Sc. (Biology and Environmental and Resource Sciences), and more recently completed her M.Sc. in Natural Resource Sciences from McGill University (2006). Tina's experience includes various large-scale projects associated with military activities and proposed mining and hydroelectric development projects in the province. Her work in Labrador includes wildlife investigations of small mammals, forest songbirds, waterfowl, raptors, woodland caribou and other species in the region, as well as various habitat characterization studies. Tina was a wildlife observer and also conducted the forest songbird surveys and several of the waterfowl surveys for this Project. She has been involved in similar projects within Newfoundland and Labrador, including development of an ELC for the Labrador-Island Transmission Link project.

Chris Shupe, Ad. Dip Remote Sensing, Dip. Cartography is Team Leader for GIS / Information Management Services in Nova Scotia and Newfoundland and Labrador. Chris is responsible for preparation, interpretation and analysis of satellite and air photo data to support various disciplines in preparing environmental assessments. He performs land cover identification and land use and disturbance classification to identify the impact of disturbances on the landscape. Chris has played a key role in the project planning, spatial analysis and mapping on key projects including Imperial Oil's Mackenzie Gas pipeline, Cold Lake and Kearl Lake SAGD projects and Altalink's Heartland 500kV transmission line project.

Amber L. Frickleton, Ad. Dip GIS, B.A. Environmental Studies, is a GIS Technician with Stantec in St. John's, Newfoundland and Labrador. She manages and maintains geographic and related attribute data for the creation of maps and datasets for internal staff and clients to support the implementation of environmental assessments. Her role includes map design and production, data manipulation and analysis and the maintenance of databases through editing and adding new features in accordance with standard formats and procedures. Ms. Frickleton's multifaceted educational experience includes relational database design and management, spatial and statistical analysis, quality assurance / quality control, data dissemination, data analysis and map creation and reporting.

2.0 RATIONALE AND OBJECTIVES

This ELC Report forms one aspect of Alderon's environmental study program for the Project. The purpose of this and other such environmental studies has been to gather and present information on key aspects of the environment, and thus, provide an appropriate understanding of the existing environmental conditions within and near the Study Area for use in the EIS.

The objectives for the Project ELC and wildlife habitat studies were:

- To provide descriptions of vegetation at various levels of generality using a complete taxonomic vegetation hierarchy (e.g., ecozones, ecoregions, ecodistricts and ecotypes) using standardized criteria and nomenclature. Classification is based on floristic, ecological, and physiognomic criteria, with ecotype used as the basic unit of classification;
- To establish a field sampling program that effectively examined and evaluated ecotypes on the basis of vegetation characteristics that can be objectively measured and delineated in the field using consistent sampling methods and ecosystem mapping standards;
- To collect high-quality, ground-verified plot data used to support satellite-based ecosystem mapping (e.g., a combination of ground verification and remote-sensing industry analytical tools to identify and delineate similar areas of ground vegetation cover) of ecotypes;
- To compile ecological data for use in the preparation and development of a comprehensive GIS database and map products. These database and map products will serve as the basis for understanding ecological relationships at a variety of scales and will enable the analysis of the effects of the Project on the natural environment;
- To develop preliminary wildlife species-habitat models, consisting of species descriptions and habitat capability and suitability ratings (primary, secondary, tertiary), for a representative list of wildlife species within and in the vicinity of the Study Area; and
- To collect and present environmental information for use in future vegetation monitoring and follow-up programs, if required.

In summary, the study approach to the Project ELC will serve as an essential and integral component of the EA, and provides key and core information that will be used in assessing and quantifying the Project's potential interactions with aspects of the terrestrial environment (soil, vegetation, wildlife and wildlife habitat). Information provided through this and other associated supporting studies prepared for the Project is considered appropriate and adequate for these purposes.

To achieve this objective Stassinu defined and delineated ecological units within the Study Area at varying organizational scales on the basis of climate, physiography, bedrock, surficial geology, soils and corresponding vegetation. Specifically, the ELC investigated the distribution and grouping of plant species according to ecosystem patterns and processes. ELC is widely considered a useful tool in the inventory and evaluation of wildlife habitat.

Information presented herein will provide valuable information about the distribution of ecosystem units across the land base and is intended to support and/or supplement that contained in associated environmental studies prepared for the Project. These studies will be used collectively to guide on-going Project planning, as well as to support and inform the environmental assessment for the Project.

3.0 STUDY AREA

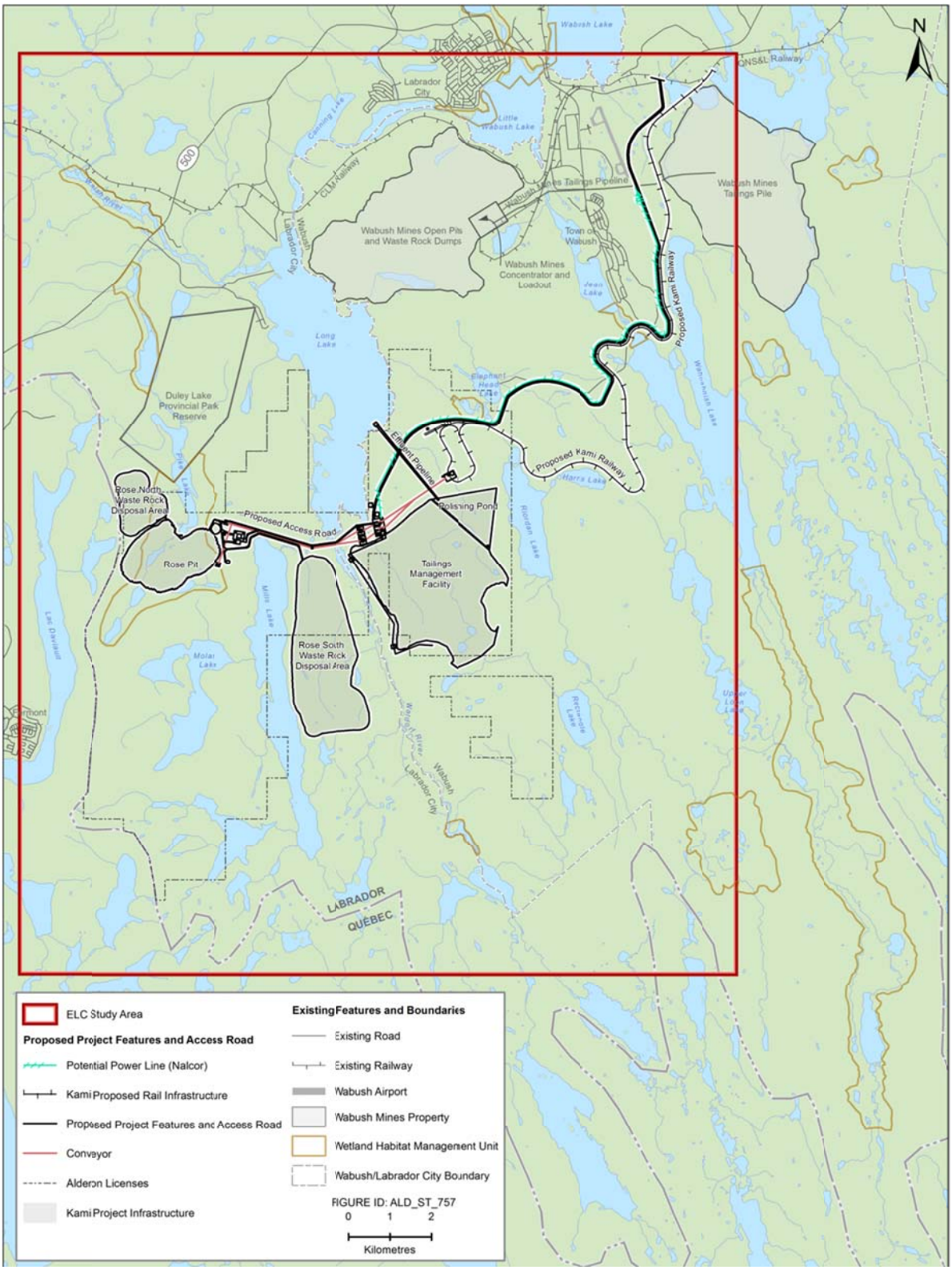
The boundaries of the Project ELC, along with the proposed principal Project components, are shown in Figure 3.1. The boundaries of the ELC Study Area are similar to that used for other environmental studies relating to the Project (e.g., the Rare Plant Study Area) and was selected to encompass all existing and proposed developments associated with the Kami mine site.

Boundaries of the ELC Study Area were selected using the following criteria:

- All features and infrastructure associated with the Kami mine site will be within the ELC Study Area;
- The Study Area will include habitat of key wildlife species which could potentially interact with the proposed Project;
- Accommodate the routes and habitat for major migratory species within Habitat Stewardship Protection Areas within and in the vicinity of the Kami mine site; and
- The ELC Study Area encompasses key areas used for resource harvesting, recreation and cultural activities Encompass key areas used for resource harvesting, recreation and cultural activities.

The ELC Study Area comprises an area of 396 km^2 and fully encompasses the proposed mine site, access road, and rail transportation components, and therefore the zone which is proposed to be directly affected by the construction and operation of the mine (Figure 3.1). Ecosystem mapping at this scale over the entire Study Area is considered appropriate and will provide very detailed information on ecosystem composition and structure, which can in turn be used to assess potential effects of the Project in the EIS.

Figure 3.1 Kami Project ELC and Wildlife Habitat Study Area



4.0 ECOLOGICAL LAND CLASSIFICATION

4.1 Ecological Land Classification in Canada

ELC uses climate, physical land features, and vegetation to identify and classify regional terrestrial ecosystems into a hierarchy of nested units at progressively smaller scales.

Marshall and Schutt (1999) describe a hierarchical framework for ELC in Canada that forms the basis of this ELC. This framework provides a consistent, national spatial context within which ecosystems, at various levels of generalization, can be described, classified and monitored. Using this framework, the Project ELC incorporates a standard and well-validated methodology for describing ecological units, thereby facilitating comparisons of ELCs undertaken in other jurisdictions, including those undertaken in Newfoundland and Labrador.

The national ecological framework for Canada is a nested hierarchy that describes regional ecological units at multiple scales, in which larger ecological units encompass successively smaller ones.

4.2 Ecological Land Classification Framework

4.2.1 Ecozones

At the top of the hierarchy, Ecozones are defined on the basis of generalized characteristics and global and continental climate. There are 15 Ecozones delineated for Canada (Natural Resources Canada 2007), of which two overlap with western Labrador: the Boreal Shield Ecozone and the Taiga Shield Ecozone. They differ from one another on the basis of climate, geomorphology, terrain, soils, and vegetation species composition and growth pattern.

The ELC Study Area is located entirely within the Boreal Shield Ecozone, Canada's largest ecozone. This ecozone stretches in a broad, u-shape pattern from northeastern Alberta to the eastern tip of Newfoundland covering an area of more than 1.8 million km^2, or approximately 20 percent of Canada's land mass and 10 percent of its fresh water (Environment Canada 2005). The Boreal Shield Ecozone in Labrador is primarily contained within southeastern Labrador where it is primarily coastal extending north to Hamilton Inlet and the area around Lake Melville. A massive rolling plain of ancient bedrock blanketed with gravel, sand and other glacial deposits, its topography is comprised of broadly rolling uplands that form poorly drained depressions covered by lakes, ponds and wetlands. The climate of the Boreal Shield Ecozone is generally continental, with long, cold winters, short, warm summers and abundant precipitation. Cool temperatures and a short growing season, along with acidic soils, reduces productivity, although most of the area is forested, primarily coniferous species, intermixed with hardwoods, mixed with bogs and other wetlands. Lichens and shrubs are common on areas of exposed rock (Wilkin 1986).

4.2.2 Ecoregions and Ecodistricts

These two Ecozones are further divided into a number of Ecoregions. Ecoregions are smaller land units within Ecozones that have distinctive, recurring patterns of vegetation and soil that are determined and controlled by local climate and geology (Stantec Consulting Ltd. 2010). Ecoregions also differ from each other in their combinations of plant communities, landscapes, geology and other features (Marshall and Schutt 1999; Parks and Natural Areas Division 2008). For practical purposes, they are effectively mapped at a scale of 1:750,000 or less. Ecoregions identify areas of the landscape with characteristic regional climate and landform, as expressed in typical vegetation physiognomy and composition, landforms, soils and topography. ELC has been conducted in Labrador at the Ecoregion scale by Lopoukhine (1978) and Meades (1990). Following Meades (1990), the Study Area occupies but one of these ecoregions: the Mid Subarctic Forest (Michikamau). A description of the Mid Subarctic Forest (Michikamau) Ecoregion from Meades (1990) is presented below.

> *The Mid Subarctic Forest (Michikamau) ecoregion encompasses the upland plateaus of central and western Labrador. Eskers and drumlin ridges are characteristic. The region has a very continental, subarctic climate with cool, short summers and long, severe, cold winters. The growing season is 100 to 120 days. Black spruce is the dominant trees species, except in the most northern areas, where white spruce dominates. Trembling aspen reaches its northern limit here and the only native population of jack pine occurs in this ecoregion. Open lichen woodlands are characteristic of this ecoregion. Extensive ribbed fen-string bog complexes, bordered by black spruce-sphagnum forest stands, dominate areas with little relief.*

Ecodistricts are the next level of division in the ELC framework. Ecodistricts, or sub-units of the ecoregions, and are characterized by distinctive assemblages of topography, landform, geology, soil, vegetation, water bodies, and fauna. This unit is best mapped at a scale of 1:500,000 or less. The Study Area is located entirely within Ecodistrict ED432 (Figure 4.1). No general descriptions of these Ecodistricts have been published (Marshall and Schut 1999).

4.2.3 Ecosections and Ecotypes

The national ELC system described by Marshall and Schutt (1999) does not map units smaller than Ecodistricts. However, ELC systems often include smaller units such as Ecosections, with scales generally between 1:50,000 to 1:100,000, and Ecotypes, with approximate scales of 1:10,000 to 1:50,000. The most detailed level of classification used in the development of the Project ELC was that of the Ecotype, mapped at scales of 1:35,000. Focusing at this scale was a practical decision based on the scale of mapping and imagery, the regional focus of a project of this size, and cost for value considerations.

Figure 4.1 Ecodistricts of Western Labrador and Eastern Québec

For this study, Ecotypes were classified using the concept of plant communities and/or plant associations, characterizing vegetation on the basis of successional relationships and the probable climax or “near-climax” plant communities present at the end of succession. Individual species tend to occur in a predictable pattern within a particular area based on the microenvironment that exists there. Plant associations likewise will tend to occupy predictable positions in a landscape based on habitat features (specific species of plants grow in specific soil moisture and soil nutrient conditions with a defined set of environmental tolerances) favorable to support the climax community. Ecotypes are generally defined by their relative soil nutrient and soil moisture regimes which are influenced by local climate, surficial geology, and topography. These soil nutrient and moisture regime combinations often dictate the type of ecotypes which can be expected to naturally develop under these conditions. Therefore, an ecotype is generally a group of related ecosystems physically and biologically similar enough that they have or would have similar vegetation at maturity.

The following definitions and examples may provide assistance in better understanding the categorizations given to vegetation in the Study Area and used to develop classification process for the Project ELC.

The plant community is a general term given to an assemblage of plant species living together and interacting among themselves in a common spatial arrangement. It is not considered a taxonomic unit, has no successional status, and may not be recognized in all standardized guides. The purpose of this classification is to augment the moisture-nutrient gradient through recognition of indicative plant species in such a way as to provide easier recognition of similar environments across the landscape. In the analysis of plot data, certain plant communities were undersampled or did not provide adequate representation in the geographic area encompassed by the classification.

A plant association is "a recurring plant community with a characteristic range in species composition, specific diagnostic species, and a defined range in habitat conditions and physiognomy or structure" (Winthers et al. 2001). Plant associations are named after commonly occurring tree, shrub, and herb species. As a combination of similar or compensating environmental factors are repeated across the landscape, a predictable plant community will occupy those sites given time and the lack of disturbance. Plant associations are considered the basic unit of the vegetation classification hierarchy.

The identifiable stages of vegetation preceding potential natural communities are termed "seral stages." In the development of this classification, plots representing various seral stages were used to define "plant community types" and/or "plant associations" in the Study Area. In general, very early and early seral stages (e.g., Burn / Regeneration) were grouped into plant community types; while mid and late seral stages were grouped to define plant associations (e.g., Black Spruce-Labrador Tea-Feathermoss), as they depict the least change over time and therefore have a more stable composition and structure over time.

It is important to recognize that plant communities or associations are not always clearly defined entities with abrupt boundaries, and that a given plant species may well inhabit two or more different such communities. Plant communities and/or plant associations are typically dependent on or affected by a variety of factors, including geographic location, elevation, precipitation, microclimates, orientation of slopes, soil types, and successional considerations, and thus it is not uncommon to find a particular plant or grouping of plants growing outside what would be thought of as its customary habitat if some of the above factors are advantageous to that growth.

5.0 METHODS

5.1 Pre-Survey Planning

Project planning and initial data compilation included defining the objectives and the purpose of the work; conducting a review of the prior vegetation and ecosystem classification studies performed within the Study Area and the region; and developing a field sampling plan and appropriate survey intensity. Additional details are provided in Sections 5.2 to 5.5.

5.2 Ecosystem Classification

At present, no standardized system for the classification and delineation of vegetation in Labrador exists. Therefore, as part of the ecosystem mapping strategy for the Project, ecosystem mapping within the Study Area was guided by the British Columbia Terrestrial Ecosystem Mapping (TEM) inventory standards and mapped at a scale of 1:35,000 (Resource Inventory Committee [RIC] 1998). This system provides a uniform method of describing vegetation, soil, and terrain characteristics based on air photo interpretation and field data collection, and is designed to be scientifically accurate and efficient, particularly when collecting field data in remote locations (RIC 1998).

The detailed ecosystem classification / mapping presented herein were derived from a review of existing literature and relevant reports, supplemented with field surveys. In the interest of consistency with other recent mapping projects in the region (e.g., Lower Churchill Hydroelectric Generation Project, Labrador-Island Transmission Link), ecosystem units (i.e., ecotypes) conformed as much as possible to existing ecosystem classification systems used to identify and provide standardized names for ecotypes as part of other similar ecosystem mapping projects completed in Labrador. Where applicable, those that included ecotypes and species lists for the region were used to develop vegetation descriptions and to focus field investigations.

The application of this classification system and all ecological data has been reviewed for quality assurance.

5.3 Map Platform Selection / Ecosystem Mapping

An iterative approach using a variety of data formats including satellite imagery (RapidEye 5m multispectral), aerial ortho-photos, elevation and field survey data serve as the foundation for the ELC study. This combination of data formats resulted in a field survey program (Section 5.4) designed to support a systematic remote-sensing-based mapping program. The combination of these two separate but interrelated programs provided the best combination for the acquisition of ecological information relevant to the Project and mapping accuracy over the geographic area involved.

The satellite imagery data served as foundation for the selection of survey site locations. Field surveys were designed to provide information on vegetation abundance and community composition, which was used to assess overall plant species distribution and wildlife habitat ratings. Surveyed sites were also used to identify specific locations and the distribution of defined Ecotype units.

The field surveys are a key requirement in the development of the remote-sensing, supervised classification algorithm, which is a procedure or formula for effectively solving a problem using a sequence of instructions. The degree of coverage chosen for the field survey (114 plots in total) was to allow for adequate “training” of the supervised classification algorithm, allowing it to accurately build spectral statistics for land class type and ensure the development of a high quality ELC product. The ground-verified plot locations are presented in Figure 5.1.

A computer-based algorithm was developed using satellite images to delineate the habitats identified in the field program for the entire Study Area. The field survey data were used to train (refine and clarify) the algorithm. The use of satellite images and remote sensing technologies allowed for a systematic and consistent identification and delineation of large scale vegetation patterns throughout the geographic extent of the Study Area. Therefore, the use of remote sensing technologies and satellite images was preferred over manual interpretation due to the large geographic extent of the Study Area. The output of the computer-based algorithm is a raw classification grid that is further processed to identify areas / classes of confusion and then generalized for mapping presentation.

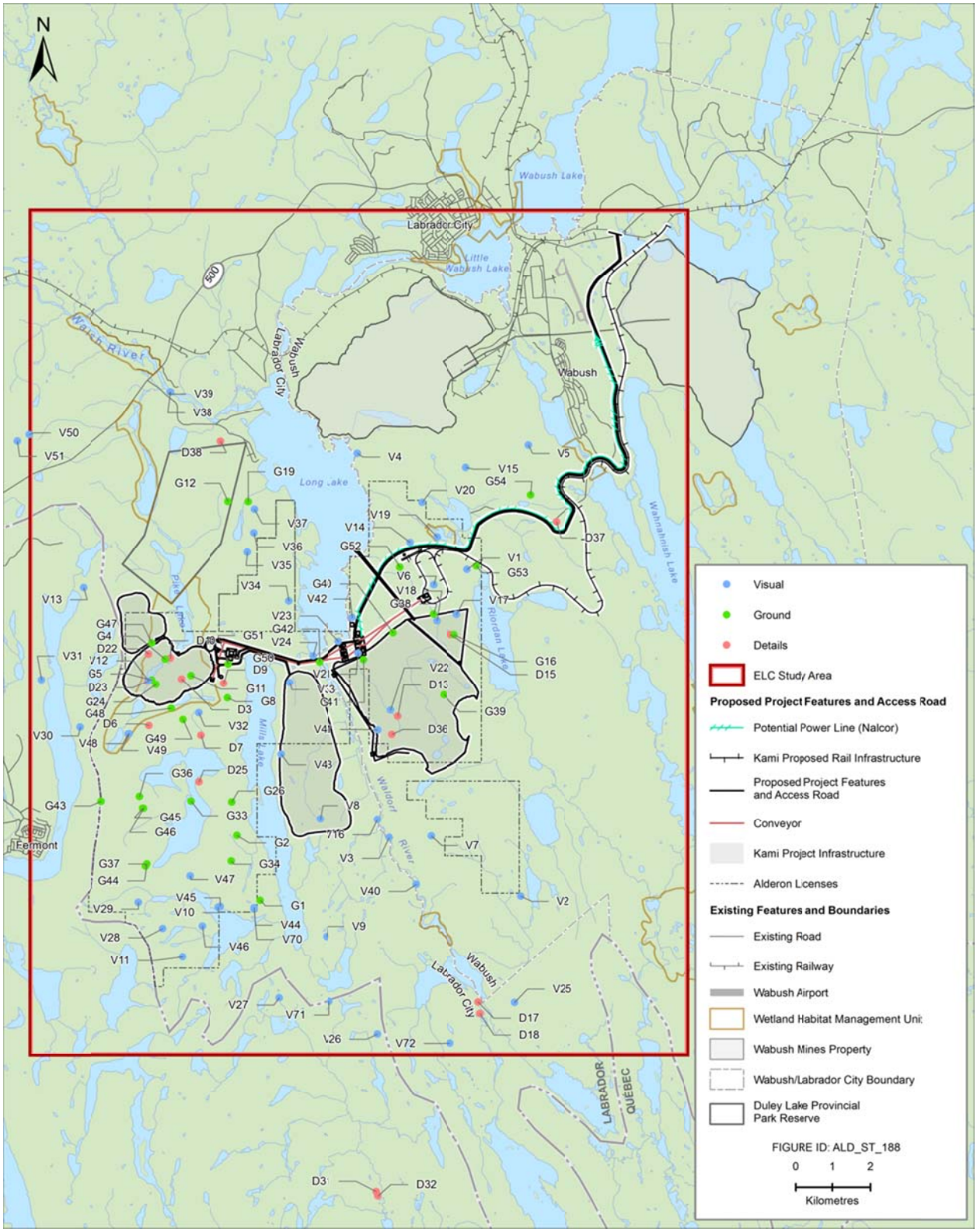
The resultant maps were not designed to provide detailed site-specific information, but rather, an appropriate representation of the regional landscape. A similar approach to ELC mapping has been used for other projects and in support of EAs including the Labrador-Island Transmission Link Project (Stantec 2010), and the Lower Churchill Hydroelectric Generation Project (Minaskuat 2008a, 2008b).

5.3.1 Satellite-based Ecological Land Classification

Satellite-based ELC programs use a combination of ground-verified areas and remote-sensing industry analytical tools to identify and delineate areas of similar ground vegetation cover. Individual satellite images often differ from each other due to the difference in environmental conditions at the time of acquisition (e.g., differences in time of year, time of day or amount of cloud cover). As a result of these differences, each image used in a mapping program requires specific processing and analysis. Additionally, satellite images are rich in information that must be summarized prior to final use.

The Study Area was covered by RapidEye’s 5 band, 5 metre, multispectral imaging platform. To cover the entire Study Area, the analysis required 12 separate RapidEye scenes. Although RapidEye images were used as the primary mapping platform, high resolution ortho-corrected air photos (captured during the summer of 2011) were also acquired and used to verify and adjust the algorithm for areas of specific interest.

Figure 5.1 Sample Plot Locations within the Study Area



5.3.1.1 Background and Technical Information

Image-based classifications are used to automatically aggregate pixel values within an image into predefined land cover classes. Pixels are placed into classes based on their spectral signature / reflectance pattern across all multispectral bands used in the analysis of the image. The available multispectral bands vary depending on the remote-sensing platform used to capture the imagery. Classes (ELC ecotypes) are defined differently between the supervised and unsupervised systems.

A supervised classification relies on user-delineated “training” areas to define example reflectance patterns and spectral characteristics of each ELC ecotype desired in the final output. Training areas are collected with the aid of existing reference data, such as field surveys and regional vector data. The classification algorithm then analyzes the reflectance value for each pixel analyzed across all spectral bands input by the analyst and places it into the class, as defined by the training areas, to which it is most similar.

In addition, an unsupervised classification was undertaken. This was supported by an algorithm that looks at each pixel (analyzed across all spectral bands input by the analyst) and places them into clusters / natural collections called spectral classes. These classes are based on similarities in reflectance patterns. This works on the assumption that values belonging to the same class will be similar or close in proximity in the measurement space, and pixels that do not belong together will not. Reference data are then required by the analyst to compare the spectral classes and assign each an appropriate ELC ecotype. This type of classification is preferred when working with a large number of classes, rendering a supervised classification and adequate training impossible.

5.3.1.2 Data Specifications and Sources

Satellite-based multispectral imagery was used for this classification. The imagery was captured by RapidEye’s constellation of five earth observation satellites. This unique “constellation” of sattelites allows RapidEye to provide complete coverage of current data over any location in a very short period of time. Each identical satellite is equipped with a five band, multi-spectral “push broom” imaging platform. This platform collects high resolution imagery with a pixel resolution of 5 metres from an orbit 630 km above the earth. Each satellite provides image data in the Blue, Green, Red, Red Edge and Near Infra- Red portions of the electromagnetic spectrum. All 12 images used to cover the Study Area were captured in one pass on September 8th, 2010.

5.3.1.3 Extent of Satelite Imagery

As previously mentioned, 12 scenes provided by RapidEyes satellite constellation were required to cover the Study Area with seemless, multi-spectral imagery.

The process used for this land cover classification involved the use of both supervised and non-supervised classification methods. A supervised algorithm was used to extract vegetated ELC Ecotypes. A non-supervised algorithm was used to extract non-vegetated portions of the images

within the Study Area. The output data from each algorithm were then combined to create one seamless land cover dataset for each scene. All image data processing was completed using PCI's Geomatica 10.3 computer software.

5.3.1.4 Image Processing

Each of the 12 scenes required a considerable amount of pre-processing before any classifications were run. Each scene's spectral bands (five in total) were imported and combined into one, multi-band image file. The 12 scenes were then mosaicked into one seamless image of the entire Study Area. A "Normalized Difference Vegetation Index" (NDVI) analysis was performed to assist in the classification. The following six channels were used to build the foundation of the classification:

- RapidEye Multi-Spectral Band 1 (Blue);
- RapidEye Multi-Spectral Band 2 (Green);
- RapidEye Multi-Spectral Band 3 (Red);
- RapidEye Multi-Spectral Band 4 (Red Edge);
- RapidEye Multi-Spectral Band 5 (Near-IR); and
- RapidEye Multi-Spectral Band 6 (NDVI).

5.3.1.5 Classification of Vegetated Areas

The next step was to create masks to isolate the vegetated areas of the image and perform a supervised image classification. The "vegetation" mask was created through a logical function by subtracting the "non-vegetation" mask (described below) from a previously created mask of the Study Area. This mask isolated the vegetated areas and allowed them to be analyzed separately from the rest of the image.

The first step in the supervised classification process was the collection of training areas. In this exercise, training areas were collected as vector polygons in Environmental Systems Research Institute's (ESRI) ArcGIS 10.1. Training areas were based on a number of reference datasets, including field sample points collected in the summer of 2011 and high-resolution aerial photography from the same time. A non-supervised classification grid was used to assist with the training in areas where sample points and imagery were inconclusive. The classification grid of the vegetated areas helped identify ELC Ecotypes through patterns created by the spectral clusters. This also helped identify homogeneous areas in which to digitize training polygons. At least 15 training sites were collected per scene for each ELC class. Each training area was comprised of no less than 10 pixels.

A supervised classification was established for the vegetated areas being analyzed. The previously collected training sites were imported to create spectral signatures for each ELC Ecotype trained. These signatures were needed in order for the Gaussian Maximum Likelihood algorithm to determine which ELC Ecotype pixel should be assigned. The accuracy of the output dataset depended entirely on the training areas and the algorithm's ability to build a

comprehensive spectral signature for each of the classes. The output was an 8-bit grid image illustrating the dispersion of ELC classes across the image.

5.3.1.6 Classification of Non-Vegetation Areas

Within the Study Area, non-vegetated areas were identified, masked and classified separately from the vegetated areas. To identify the non-vegetated portions of the image, the NDVI channel was used. A NDVI is a numerical scale that allows the analyst to determine if the matter found within a pixel contains live green vegetation. Through manual visual comparison, a threshold NDVI value was determined as the point at which a pixel turns from non-vegetated to vegetated. The 8-bit NDVI channel provided a scale from 0 to 255. In most cases, the threshold value fell between 95 and 110. Once this value was determined, a “Non-Veg” mask was created in order to mask all pixels that fell beneath the determined NDVI threshold value.

A non-supervised classification was then run on the masked, non-vegetated areas. The process created 20 unassigned spectral classes. Through a manual aggregation process, each of the 20 spectral classes were assigned to one of the 5, predetermined, non-vegetated ELC classes:

- Exposed Earth / Anthropogenic
- Open Water;
- Shallow Water with Vegetation;
- Cloud; and
- Shadow.

5.3.1.7 Post-processing

The majority of the post-processing work involved the visual identification of errors (areas classed incorrectly), masking and then re-classing them manually. A common example of this occurred when the algorithm mistakenly grouped the highly reflective, understory of Black Spruce Lichen forests with Alpine Heath. These two classes were spectrally similar enough that it was common for areas of Black Spruce Lichen forest to be misclassified as Alpine Heath particularly when black spruce cover was sparce in the Black Spruce Lichen forest and the understory of lichen was the predominant factor in its spectral signature. These types of issues were identified and corrected manually.

To complete the classification, ELC grids (Non-Vegetated and Vegetated channels) were combined into one continuous grid. This ensured there were no “No-Data” areas and gaps in the data. PCI allowed for simple channel aggregation using its modeling scripting utility.

Once the final, seamless ELC grid (containing both vegetated and non-vegetated data) was created, a majority filter was run to help reduce the “speckle” effect within the dataset. This effect is common in supervised classifications and can be described as a “speckle” of erroneously classed individual pixels across the dataset. This can usually be attributed to an

isolated incident / condition on the ground causing this pixel to reflect differently than its surrounding neighbors.

The majority filter function replaces cell values according to the cell value of neighboring cells based on contiguous neighborhoods. There are two criteria that must be met before replacement values can occur. At least half of the neighboring cells must have the same value (that is, four out of eight cells have the same value) and the cells must be contiguous to the centre of the specified filter (a nine-cell filter kernel was used) to ensure spatial connectivity and minimize the corruption of spatial patterns. If these parameters are met, the cell value is changed to the majority value of surrounding cells; otherwise, the cell retains its value.

The final step was to export the finalized ELC Grid. All final mapping for this ELC was done in ArcGIS 10.1 and required compatible grids. PCI's Geomatic 10 allowed for the export of image channels to ASCII grid format. These ASCII grids were then converted (using ArcGIS "ASCII to Raster" function) to ESRI grid format.

Additionally, data derived from the field program was used in the development of habitat models for each of the ecotypes found within the Study Area. Information used to map those modeled ecotypes included:

- Feature height and slope statistics derived from LIDAR data;
- Surficial material and geomorph type;
- Drainage, geoprocess derived from terrain mapping;
- Dominant forest types derived from digital forestry maps;
- Wetland classifications derived from the wetland field program; and
- ELC field sample locations and high resolution digital aerial photographs.

5.4 Wildlife and Wildlife Habitat

Wildlife habitat ratings define the relative importance of various ecosystem units to wildlife. The ratings reflect a habitat's potential to support a particular species by comparing it to the best available habitat for that particular species. Habitat suitability ratings are defined as the ability of the habitat in its current condition to provide the life requisites of a species.

Ecosystem mapping is the framework for applying habitat ratings. Standardized ecosystem classification and inventory methods are employed, to prepare habitat suitability maps.

The objective of assigning wildlife habitat suitability ratings is to define the relative importance of various ecosystem units to wildlife populations and provide information on how various management activities may affect those populations. Ecosystem mapping stratifies the land base into map units which are displayed as polygons and the data (attributes) associated with each polygon. A GIS is used to produce a digital map from all the associated databases. Interpretive products (such as habitat suitability maps) use ecosystem attributes for assigning values to a polygon.

Wildlife habitat mapping portrays the potential importance of each ecotype to specific animal species through a species-habitat model. A review of the habitat requirements of these species for certain life requisites (e.g., food, cover, and breeding) and seasonal usage was completed and habitats assessed based on their ability to meet these requirements. The model assigned ratings to different ecosystem units (ecotypes) from the Project ELC based on the needs of the species for particular life requisites. These ratings reflect the habitat's potential to support a particular species by comparing it to the best habitat available for that particular species within the region.

Digital map products produced through the Project ELC serve as the basis for the application of wildlife habitat capability and suitability mapping, thereby enabling the generation of interpretive, thematic wildlife map products for each ecosystem unit occurring within the Study Area. Map products reflect habitat quality and indicate the percentage of primary, secondary and tertiary habitat available within the Study Area. Primary habitat provides all the main habitat requirements of a species (e.g., abundance of food, protection, resting, spatial separation from predators and/or other habitat such as that utilized for breeding, denning or other activities). Secondary habitat provides an abundance of one or more of the three elements (or marginal amounts of all). Tertiary habitat is considered marginal habitat providing few or no habitat requirements, may be used as a corridor and/or avoided.

Preliminary wildlife habitat interpretations and associated mapping themes were developed for the following ten species: moose, caribou, beaver (*Castor canadensis*), lynx (*Lynx canadensis*), porcupine (*Erethizon dorsatum*), snowshoe hare (*Lepus americanus*), Spruce Grouse (*Dendragapus canadensis*), Short-eared Owl (*Asio flammeus*), Rusty Blackbird (*Euphagus carolinus*), and Canada Goose (*Branta canadensis*). The life requisites for these species are summarized in Table 5.1.

Table 5.1 Life Requisites for Select Wildlife Species in the Study Area

Wildlife Species	Life Requisite
Large Mammals	
Moose (*Alces alces*)	Winter habitat: mature forests with high canopy cover and rich understorey; winter browse of willow and white birch in 20-30 yr old stands (preferably). Summer habitat: open wetlands and riparian areas; summer forage- aquatic vegetation (e.g., yellow water lily, horsetail), fireweed and sedges (Dodds 1960; Irwin 1985; Newbury et al. 2007; Peek 1997).
Caribou (*Rangifer tarandus caribou*)	Winter habitat: forested / wetland habitat types – reduced snow depth for foraging; winter forage of lichens; open habitats (COSEWIC 2002; Schmelzer et al. 2004). Spring / summer habitat: mosaic of open coniferous forests and open / semi open habitat types for calving, avoiding predators; summer forage of forbs, sedges, lichens.
Small / Medium Mammals	
Beaver (*Castor canadensis*)	Year-round Habitat: slow-moving / still water. Summer forage of herbaceous plants and willow; winter forage of aspen, willow, alder (Novak 1987; Aleksiuk 1970; Northcott 1971).
Snowshoe Hare (*Lepus americanus)*	Year-round Habitat: coniferous forests with dense understory. Forage of white birch, low-bush cranberry, blueberry and willow spp. Forbs and herbs in summer (Newbury and Simon 2005).

Wildlife Species	Life Requisite
Porcupine (*Erethizon dorsatum)*	Year-round Habitat: highly variable but predominantly coniferous and mixedwood forests. Require a minimum threshold of coniferous tree maturity and density for resting, predator avoidance and forage. Forage of seedlings, shrubs and herbaceous plants (Griesemer et al. 1998; Stricklan et al. 1995; Sweitzer and Berger 1992).
Lynx (*Lynx canadensis)*	Year-round Habitat: mature, coniferous forests; prey-closely follow snowshoe hare cycles, mice, voles and birds.
Avifauna	
Spruce grouse *(Dendragapus canadensis)*	Habitat: conifer dominated forests at young successional stage; breeding habitat requires overhead cover. Forage largely conifer needles, but also forbs, fruits, arthropods, fungi (Boag and Schroeder 1992).
Short-eared Owl (*Asio flammeus)*	Habitat: large open areas such as heathlands, coastal barrens and tundra; breeding habitat grasses and herbs <0.5m in height. Prey on small mammals, predominantly voles and sometimes other birds (Wiggins et al. 2006).
Rusty Blackbird (*Euphagus carolinus)*	Habitat: wet coniferous and mixedwood forests; breeding habitat- dense vegetation near water. Forage opportunistically on both animal and plant matter including invertebrates, seeds and fruits (Avery 1995).
Canada Goose (*Branta canadensis*)	Habitat: wet hummocky area, tundra, heathland, with scattered, stunted black spruce; breeding habitat slightly elevated sites near water (e.g., islands). Note: much variation in Canada Goose habitat preferences. Spring / summer forage of grasses and sedges, fall forage of seeds and berries (Mowbray et al 2002).

5.5 Field Sampling

5.5.1 Terrain and Soils

Terrain types were identified on the basis of the parent materials associated with the formation of the landform and the steepness of the representative slopes (e.g., upland soils formed on terrain with noticeable relief that is a result of glacial till material or glaciofluvial veneer over glacial till). Terrain types include:

- Morainal Till (till) – slopes from 0.5 to 5 percent, landforms described as low and high relief undulating.
- Glaciofluvial veneer overlying till – slopes from 0.5 to 30 percent, landforms range from undulating to hummocky to hummocky ridged.
- Glaciofluvial (water laid deposits) – slopes from 0.5 to 2.5 percent, low relief nearly level landforms.
- Fluvial – slopes from 0 to 2.5 percent, relatively recent fluvial deposits, located adjacent to active stream channels and are often comprised of former floodplains.
- Organic – slopes from 0 to 2.5 percent, nearly level landforms covered by an accumulation of peat material (parent materials underlying peat are predominantly bedrock dominated).

Soils were classified within the Study Area as part of the ELC for the Project. Field methodologies followed *The Manual for Describing Soils in the Field* (Agriculture Canada Expert Committee on Soil Survey, 1983) and the *Field Manual for Describing Terrestrial Ecosystems* (MoELP-MoF 1998). Soils were classified according to the *Canadian Soil Information System* (Agriculture Canada Expert Committee on Soil Survey, 1983), the *Canadian System of Soil Classification* (Soil Classification Working Group 1998), and the classification of humus forms described by Green et al. (1993). Ground plot descriptions were based on those found in the *Field Manual for Describing Terrestrial Ecosystems* (MoELP-MoF 1998).

Sites chosen for soil description and classification were mainly based on assessments of landform and vegetation units to provide descriptions of the range of soil and humus conditions within the Study Area. Where necessary, unique sites identified through aerial reconnaissance were also targeted for sampling.

Soil pits were excavated to a depth of approximately 1 m, unless restrictions were encountered. Soil profiles were photographed as well as described. All soil and humus form classifications were based on field assessments only.

5.5.2 Vegetation

To support satellite-based classification of ecotypes and the development of mapping products, field surveys / ground-truthing of the Study Area was conducted between July 25 and 31 and between September 28 and October 4, 2011. Field crews consisted of a single, three-person team comprised of a vegetation ecologist, wildlife biologist and soil specialist. Detailed sampling of dominant ecotypes was performed at representative sites throughout the Study Area. Data collected in the field provided information on local species distributions and occurrence patterns as required to characterize ecosystem units, refine the classification of ecotypes, as well as to verify ecotype map unit designations and confirm accuracy of preliminary vegetation mapping. Sampling effort was directed at inspecting as many biotic habitats, plant communities and biophysical features as possible. Consequently, ground truthing or verification of ecotypes was achieved at three levels of detail: full (detailed) plots, ground, and visual inspections. Each sample plot was located with a global positioning system (GPS). Plot boundaries encompassed a homogeneous vegetation community and varied in shape to ensure homogeneity.

Full plots provide the most comprehensive ecological data for a point sample. They are used to support development of ecosystem unit (ecotype) descriptions and summary statistics. Ground inspections are abbreviated plots that provide basic ecological data and are intended for confirmation of the identified ecosystem unit as well as to provide some data for characterizing ecosystem attributes. Full plots used FS882 and GIFs used FS212 field forms to record site, soil and vegetation information. A list of minimum data collected for full and GIF plots is listed in Standard for Terrestrial Ecosystem Mapping in British Columbia (RIC, 1998). Notes describing the plot, in context and variability within the polygon, were recorded. Photographs were taken at each plot. To characterize soils, soil pits were dug to a minimum 60 cm or to the C layer.

Visual inspections are the least detailed type of field data collection. Visual checks involved recording brief point or area characteristics made from the air (helicopter) or ground, and were used to note the basic ecosystem unit, vegetation, and other key features. The primary function of visual plots was to aid in the delineation of polygon labels and to confirm the placement of polygon boundaries during the photo interpretation and mapping phases of the work in advance of final map preparation.

Field sampling for ecosystem mapping aimed to achieve recommended survey intensity levels (SIL) as outlined in the TEM standards (RIC 1998). Each SIL represents the proportion of polygons to be checked in the field compared to the total number of polygons mapped. A Level 4 SIL (RIC 1998) in the Study Area and consequently proposed Project footprint was used as a basis for the sampling program. Mapping of the Study Area for the ELC was conducted at a scale of 1:35,000. In addition, the regional area was mapped at 1:50,000. The number of inspections is based on the hectares encompassed by the Project, which is estimated at approximately 50 percent of the Study Area and 50 percent of the total regional area.

5.5.3 Wildlife and Wildlife Habitat

Wildlife habitat assessments were completed to evaluate habitat suitability for selected species and to identify wildlife use of various ecosystem units based on animal sign. These surveys were designed to provide information for the development of the wildlife habitat mapping and assist with characterizing Project effects on wildlife habitat.

Field sampling of wildlife habitat data was conducted during the summer / fall of 2011 (July 25 to 31 and September 28 to October 4, 2011) in conjunction with vegetation and ecosystem field work.

The acquisition of rare fauna data from the Atlantic Canada Conservation Data Centre (ACCDC) included listed species within and adjacent to the Study Area. A wildlife habitat assessment field data sheet was developed to collect general information on wildlife habitat at each sample location. Information on signs of use, and general habitat features were recorded to establish wildlife suitability ratings.

Sample plots were selected based on ecosystem mapping for the area, aerial photography, data and accessibility. Remote sample locations were accessed via helicopter. Wildlife habitat assessments were performed in juxtaposition with that of the ELC, with a total of thirty-eight assessments (corresponding with ELC detailed and ground plots 1 to 38) completed. Waypoints and digital images were recorded at each sample location. As well, basic habitat data such as forest cover, shrub layer and ground vegetation was recorded. The biologist walked throughout the habitat recording any evidence of tracks, trails, scat, browse and species observed and/or heard (Table 5.2). As well, notes were made on suitability of the habitat for foraging, shelter and breeding.

Table 5.2 Protocols for Recording Large / Medium / Small Mammal Evidence during Field Surveys

Species / Sign	Observations
Moose	Each group of droppings was recorded as one incident. Likewise, each track was counted individually, unless following a trail, in which case it was counted only once. Browse was recorded as a separate incident for each distinct plant affected. Leaders were encouraged to identify the species browsed in the notes and indicate the intensity of browsing (light to heavy). Flattened vegetation used as beds were noted as “other‟ evidence of use by moose.
Caribou	Protocol similar to that for moose. Other signs of presence included antlers and other bones.
Black Bear	Droppings and tracks were recorded as for moose. Evidence of digging for food was recorded as an incident of browse.
Porcupine	Each porcupine-stripped tree was recorded as an incident of browse (unlike woodpeckers, porcupines debark trees down to the cambium, rather than just flaking off outer bark or drilling holes). Droppings and tracks were recorded as for moose.
Wolf and Red Fox	Droppings and tracks were recorded as for moose. Any kills that could be identified to predator were recorded as browse.
Beaver	Droppings, tracks and browse recorded as for moose. Lodges and dams were recorded under “other” and their UTM coordinates were recorded in the notes section. Lodges consisted primarily of branches as opposed to aquatic plants as used by muskrat.
River Otter / Mink / Muskrat /Pine Marten / Fisher	Droppings and tracks were recorded as for moose and were photographed when possible to confirm identification. Otter and mink are known to use “slides” to enter the water, with mink slides being narrower. Muskrat lodges consist of mud and aquatic plants and were recorded as “other‟. Marten and fisher are secretive and evidence was not expected to be found; the protocol for both was as for otter, mink, and muskrat. However, fisher is the only eastern animal that preys on porcupine (Rezendes 1999), so evidence of this would indicate fisher presence.
Snowshoe Hare	Droppings, tracks and browse were recorded as for moose. Trails were also detected as narrow tracks through the ground vegetation, with no clearing of vegetation above to indicate use by larger mammals.
Red Squirrel	Individual tracks were not seen at this time of year, but „squirrel trails‟ in lichen or other ground cover between trees were recorded as single tracks. Each feeding site (pile of eaten cones) was recorded as one incident of browse.
Rodent trails / holes	Each small trail was recorded; some of these may have been made by red squirrels, but most were likely sign of smaller rodents. Each hole or potential burrow observed was also recorded in this category.
Game Trails	Each large, heavily-used trail was recorded in this category; it is likely that such trails are created and used primarily by caribou, moose and/or black bear.

Protocols for recording evidence of avifauna include species observations, vocalizations (bird calls), as well as sign (in terms of spruce grouse scat).

5.6 Data Management and Analysis

5.6.1 Soil, Vegetation and Wildlife Databases

Data management systems (DMS) assist in promoting data validation and integrity for data entry tasks. A DMS verifies that information entered conforms to Project standards through the enforcement of rules and restrictions for entry of data. Soils, vegetation and wildlife field data were stored in shapefiles and exported to an MS Excel spreadsheet for quality control,

manipulation and analysis. Finalized data were re-incorporated and stored in a personal geodatabase.

5.6.2 Analysis of Vegetation Data

Field data from sample plots were entered into a database(s) (i.e., Microsoft Excel / Microsoft Access) for summary and analysis. The database was subsequently queried to pull out relevant information for further analyses. Preliminary maps were then revised to show the range of vegetation resources (including wetlands and rare plants) within the Study Area. As well, the area of each ecotype within the Study Area was determined, and a map was produced showing the distribution of each.

Vegetation data were visually analyzed to verify trends in plant communities observed in the field. To determine plant diversity, sample plots located within each identified ecotype were treated as replicates and assumed to reflect the average and range in species richness and abundance for the whole ecotype within the Study Area. Only those sample locations with abundance values (percent cover) for each species were used to calculate plant diversity, as only these plots represented discrete sample locations and size.

The data were subjected to queries and analysis to obtain numbers used in the calculation of species richness for ecotypes within the Study Area. Species richness is the simplest measure of biodiversity, and is simply a count of the number of different species in a given area. Species richness is commonly used, along with other factors, as a measure for determining the overall health and/or trophic status of different biological ecosystems. Total species richness is simply a count of all species found within a particular vegetation community (based on the total species recorded within all sample plot locations in that community), whereas mean species richness provides an indication of the average number of species found within a certain vegetation community. Where a single species occurred in more than one strata within the same plot (trees and shrubs), abundance data (percent cover) were combined for the calculations of species diversity. High species richness for a given area indicates a high level of ecosystem stability, thus allowing the ecosystem to better withstand natural or anthropogenic disturbance (i.e. fires, floods, disease, deforestation, etc.). Therefore, high levels of species richness in ecosystems typically characterize these ecosystems as healthy and robust.

Descriptions of ecotypes were also prepared based on characteristics that were easily observable in the field. Once the descriptions were complete, the site photos were analyzed for representative examples to illustrate each category.

5.6.3 Taxonomic Nomenclature

Plant taxonomy has in the past few years become an issue for conducting vegetation baseline studies in northern regions. Until recently, many studies were able to use *Gray's Manual of Botany* (Fernald 1970) and *Flora of Canada* (Scoggan 1978) as the “authority” for all nomenclature of vascular plants, keeping identification very simple. However, there have been so many taxonomic changes since the publication of these documents that they are now outdated.

For this study, the taxonomy for all plants collected in 2011 was checked using two major authorities, the Database of Canadian Vascular Plants (VASCAN), the Integrated Taxonomic Information System Database (ITIS, 2009), and in select cases available volumes of the *Flora of North America* (FNA) (1993 to 2010). Taxonomy was checked and validated during report preparation.

Identification of potentially rare plant species ultimately requires both the use of taxonomic keys, and follow-up confirmation of the identification by a recognized taxonomic expert. These specialists are aware of any new developments in their particular areas of expertise. Taxonomic expertise for the Project was provided by Sue Meades (field botanist).

The plants listed in this report are generally referred to using their widely accepted common names. Within the document, the scientific species name is used the first time a plant name appears in the text. A common name is used thereafter, unless there is a possibility of confusion, in which case the scientific name is used. Some plants have no common names, in which case only the scientific name is used. Where there is a list of several species in the same genus, this report follows the commonly used procedure of using the genus name first, and only the initial for that genus in the rest of the text (e.g., "*Salix uva-ursi*, *S. discolor* and *S. pedicellaris*").

5.6.4 ArcGIS

ArcGIS software was used to manage all spatial data collected for the Project ELC. All data were stored in personal geodatabase format in accordance with the established Project information management standards. Data were stored in a Geographic NAD 83 system, while mapping was created using UTM NAD 83. Sampling location databases, ELC polygons, and associated base map information and imagery were all managed in ArcGIS. ArcGIS was also used for all data analysis and cartographic output.

5.6.5 Quality Assurance / Quality Control Procedures

To ensure consistent delivery of high quality products and services, Stassinu has developed and implemented a Quality Management System (QMS) within its operations. The QMS is registered to International Organization for Standardization (ISO) 9001:2000 (QMS - Requirements) by QMI Management Systems. Registration (CERT-0011312:026332).

A quality assurance / quality control (QA/QC) review of the mapping was performed by comparing a number of ground-truthed sampling locations with that of the mapped vegetation types. This accuracy assessment assigns a measure of validity to the map product and allows users to understand the reliability with which the mapped vegetation classes capture conditions on the ground. Knowing the accuracy of the map will enable potential users to determine the suitability of the map for any particular application (ESRI et al. 1994).

The map accuracy was assessed by comparing the mapped vegetation type to the field verified vegetation type at various evaluation points. Accuracy was calculated for each individual map class, as well as for all map classes combined.

6.0 STUDY OUTPUTS

6.1 Terrain and Soils

6.1.1 Glacial Deposits

All of Labrador was covered with ice during the last glaciation. The products of glaciation can thus be seen at all elevations; however, glacial deposits are thinner and less bouldery at higher elevations. These deposits formed during or shortly after the last glaciation. They make up the majority of surficial deposits within the Study Area and dominantly consist of glacial till.

Till

Till is the most common surficial material in the Study Area. Till is deposited directly by ice, with no subsequent meltwater or other erosive action affecting it. It is usually found in close association with bedrock or organic veneers. Till can exhibit all types of drainage; however, it is generally well or moderately-well drained. On the upland surfaces, till can be found as mantles and veneers on the undulating, bedrock-controlled terrain. Weathered bedrock is often complexed with till in these locations and the sites are typically well drained. In some low-lying, level areas, till is often partially or wholly covered by organics. Till found in depressions is moderately to imperfectly-drained. Till texture observed at field sampling sites was generally a sand matrix with variable gravel, silt and minor clay components. Generally the upper and mid slopes are moderately well to well drained. Lower slopes may be moderately-well drained. The fine-textured matrix of till could be problematic for soil erosion and sediment transport if exposed where it could be transported to streams.

Glaciofluvial Deposits

Glaciofluvial deposits are limited in extent and generally in close association with till deposits. Other subglacial deposits are the thin (<1 m thick) sand and gravelly sand units found overlying or within till. Undulating and hummocky glaciofluvial deposits are likely subglacial as well. Glaciofluvial deposits were found primarily at low elevations, generally in close association with till deposits. Sand and gravelly sand are the dominant components. With few exceptions, these deposits are well drained and matrix-supported.

Subglacial glaciofluvial deposits were observed in the southern portion of the Study Area. Esker(s) and associated glaciofluvial deposits were found in close association with hummocky till deposits at low elevation and till blankets and veneers at elevations above the complex.

6.1.2 Non-Glacial Deposits

Non-glacial deposits began forming in the Holocene Period and continue to form and evolve today.

Organic

Organic deposits (wetlands, bogs, fens) form where decaying plant material accumulates. They vary in thickness and are always very poorly drained. Organic sediments, including peatlands and organic material form a large portion of the Study Area. Organic deposits form veneers, blankets and plains that are highly variable in areal extent. They are commonly associated with till and bedrock, but can overlie most any type of deposit. Organic accumulations generally consisted of mesic to fibric materials. They are typically mapped on the upland or transitional surfaces in depressions overlying bedrock and till or at the base of slopes.

Fluvial

Fluvial deposits are limited in extent as there are no large rivers in the area. Fluvial materials have been deposited by post-glacial streams on the narrow floors of stream valleys in the Study Area. These sediments are loose, non-cohesive and highly porous and permeable. Associated landforms, such as floodplains and parts of fans that are close to stream-level, have high water tables and are moderately to imperfectly drained. Floodplains are subject to periodic inundation during high flows. Fluvial deposits are found at all elevations adjacent to bedrock, till or organic deposits. These deposits form a very small portion of the overall materials observed in the Study Area.

Colluvium

Colluvial deposits are generally small and uncommon, as slopes in the region are rarely steep. Colluvial materials have accumulated during post-glacial time as a result of gravity-induced slope movement such as soil creep. The physical characteristics of colluvium are closely related to its source and mode of accumulation. There are three processes that generally create deposits of colluvial soils in this area. These are rockfall from bedrock bluffs, soil creep in weathered bedrock and till and mass movement processes in gullies (debris flows and debris slides). Rockfall is the main type of colluvial deposit. Colluvial veneers and blankets, which develop where weathered bedrock has been moved downslope by gravitational processes such as soil creep, are mainly found on middle and upper slopes associated with steep hillsides, and are the most common type of colluvium. Colluvium is loosely packed and usually well drained and its soil characteristics relate to the material from which it was derived.

6.1.3 General Description of Terrain and Soils

In the Study Area, soil parent material consisted mainly of bedrock, moraine (till), and organic deposits, with glaciofluvial deposits found in association with a narrower band (esker-like formation) to the south of the Study Area. Bedrock, till, and colluvium derived soils are common at mid to high elevations. Alluvium deposits, though infrequent, originate from glaciofluvial sands and silts, and are found sporadically near the shoreline of Long Lake and on small islands associated with river systems in the area.

Bedrock, till, and colluvium derived soils have textures ranging from sandy loam to sand and are often stony or rocky. Texture classes associated with glaciofluvial and alluvium deposits range from silt loam to sand, but sandy textures predominant.

Drainage associated with bedrock and moraine derived soils range from rapid to poor depending on slope position and soil depth. In upland areas drainage is mainly rapid to well; however, in some cases, in particular Humo-Ferric and Ferro-Humic Podzols drainage may be slowed by cemented (Ortstein) variants of these soils and/or sub-surface horizons of massive structure. Where this occurs, drainage may change to moderately well, imperfect, or even poor. Colluvium derived soils are generally associated with steeper slopes where drainage is mainly well to imperfect depending on slope position and seepage inputs. Alternatively, at lower slope positions drainage may be moderately well to imperfect due to seepage inputs from above. Drainage on level areas is often bedrock-controlled, with only minor elevation differences between poorly drained wetlands and associated uplands. Drainage associated with glaciofluvial deposits is mainly rapid to well, but can also be moderately well to imperfect at lower slope positions.

Humo-Ferric and Ferro-Humic Podzols are the dominant soils in upland areas. Cemented (Ortstein) variants of these soils are also common. Gleyed Podzols are found where drainage is imperfect. Soils are dominantly acidic throughout (pH 4 to 5 or less), but values can be higher (pH 5 to 6) where seepage inputs collect on long slopes. Orthic Gleysols and Organic soils predominate in poorly drained areas (fens and bogs). Drainage is restricted in these areas due to bedrock (or basal till) and a lack of slope. Folisols (upland organic soils) can also be found where bedrock is close to the surface. Humus forms are dominated by hemimors.

6.2 Vegetation

6.2.1 Ecological Context

The Mid Subarctic Forest / Michikamau (MSF) Ecoregion extends across central and western Labrador and is marked by cool, short summers and severe, cold winters. The mean annual temperature is approximately -3.5°C. The mean summer temperature is 9°C and the mean winter temperature is -16°C. Mean annual precipitation ranges from 700 mm in the north to 1,000 mm near the Quebec / Labrador border in the southwest. The Ecoregion is classified as having a low subarctic ecoclimate. The growing season is short, lasting between 100 and 120 days. Its open coniferous forests are transitional, both to tundra and alpine tundra vegetation communities to the north, and to the closed cover of typical coniferous boreal forests to the south. The pedological soil types and range of natural habitats and wildlife found in the Study Area are well characterized. There are few tree species, predominantly black spruce (*Picea mariana*); with secondary occurrence of balsam fir (*Abies balsamea*), tamarack (*Larix laricina*), white birch (*Betula papyrifera*) and white spruce (*Picea glauca*). Trees are 6 to 23 m in height; with an average of about 10 m. Forests are restricted to locally rich and protected sites between high, rounded rock ridges.

6.2.2 Overview of Ecosystems in the Study Area

Ecosystems in the Study Area were defined during the development of the Project ELC. Lower elevation forests were dominated by black spruce, with balsam fir as a minor component on sites with mineral substrates. Forested areas with organic soils were dominated by stands of tamarack and black spruce. Shrub and graminoid-dominated wetlands occupy depressional areas where increasingly poor drainage and high water tables persist. On well-drained upland sites hardwood and/or mixedwood stands often include white spruce and white birch as co-dominants, especially on south-facing slopes. White birch stands are infrequently distributed on moist and rich soils on north-facing slopes and in drainage channels where moister conditions reduce the incidence of fire. At higher elevations, black spruce dominates the forested areas but becomes increasingly stunted (krummholz form) with increased elevation.

Shrub communities consisting mainly of dwarf birch (*Betula glandulosa*) and willows (*Salix* spp.) dominate the landscape from low to high elevations. Historic incidence of fire across the Study Area has contributed to an increase in shrub-dominated communities in previously forested areas. At higher elevations, willow and scrub-birch become reduced in size and species composition expands to include a variety of dwarf alpine shrubs.

Alpine communities were generally small and patchy in their distribution and were dominated by dwarf willows, dwarf birch, crowberry (*Empetrum nigrum*), alpine bearberry (*Arctostaphylos alpina*), bog bilberry (*Vaccinium uliginosum*) and lichen species (*Cladina* spp.).

Burns, particularly from fires in or around the mid to late 1990's, cover large expanses (approximately 77 km^2) of the Study Area, particularly at the southern end of the section. The vast majority of these areas are now the site of post-fire shrub regeneration. Thus there are many young regenerating stands, both coniferous, mixed coniferous, and deciduous (i.e., young white birch and trembling aspen). Between 15 and 20 years after a fire, average regenerated cover is anticipated to reach 25 to 75 percent depending on the landscape and site conditions. Between 25 and 50 years after a fire, regeneration density will likely increase and conifer species become increasingly dominant. After 50 years the landscape can be classified as forest.

6.2.3 Description of Ecosystem Units (Ecotypes)

Ecosystem units or ecotypes for the Study Area were defined on the basis of site (orientation of the slope, form of the site and topography), soil (drainage, humus form, texture, soil depth and coarse fragment content) characteristics and vegetation structure and composition.

Plant species abundance, organic matter thickness, and soil moisture vary across the landscape as one ecological unit grades into another. There is considerable natural variability in the landscape with ecotones being common. Thus, not every site encountered is easily classified into the ecological units described herein.

In the Study Area, forested (upland) ecosystem units are generally characterized by xeric to subhygric moisture regimes with rapidly to imperfectly drained soils typically not saturated with water for extended periods of time. Riparian and transitional ecosystem units are characterized

by subhygric to hygric moisture regimes, imperfectly to poorly drained soils and fluctuating water tables. Wetland (lowland) ecosystem units, consisting of fens and bogs, in which soils are saturated for all or part of the year, are typically characterized by hygric to hydric moisture regimes and poor to very poor drainage. Areas of naturally, non-vegetated land; waterbodies and lands altered as a result of human activity were classified accordingly.

6.2.4 How to Read and Interpret the Factsheets

The site, soil and vegetation ecological descriptors that describe each ecotype are summarized using a factsheet format that is designed to provide a concise synopsis of the important ecological characteristics of each ecotype. A sufficient number of sample plots (minimum three, where possible) were targeted within these ecosystem units (ecotypes) to capture enough variation to be described for the Study Area as a whole. As such, each fact sheet represents a composite or average representation of ecotypes determined by averaging all plot data for a particular ecotype. The Study Area contains some 17 ecotypes / subtypes or ecosystem units. A total of 17 different factsheets, describing 14 vegetated ecotypes and 3 sparsely vegetated, non-vegetated and/or anthropogenically altered / disturbed ecosystem units, are presented in this report.

A brief explanation of each of the fact sheet components is provided below.

- **Ecotype Heading:** Ecotypes are named using the potential dominant one or two “near-climax species” followed by the indicative subordinate species of a different growth form (e.g., tree / shrub / moss) for the plant community or association on which they are based. An example is Black Spruce-Labrador Tea-Feathermoss. The growth forms of different "layers" are separated by a dash (-). When plants are used to name a vegetation type from the same layer and growth form, a slash (/) is used. An example is Black Spruce / Tamarack-Sphagnum Woodland.

  The names of the vegetation (plant community) types are provided in three formats:

  - By common names (Black Spruce-Labrador Tea-Feathermoss);
  - By scientific names (Picea mariana-Rhododendron groenlandicum-Pleurozium schreberi); and
  - By ecotype codes (BF).

- **General Ecotype Description:** A general description of the ecotype, including the geographic location, elevational range, slope percentage, aspect, microtopography, slope orientation from sampled plots.

- **Edatopic Grid:** The edatopic grid arranges all ecotypes that occur within an area into a two-way matrix of estimated soil moisture regime (SMR), and soil nutrient regime (SNR) status and communicates information on the plant communities typically associated with combinations these grid classes, including the proportion of sampling sites within each of these classes. SMR and SNR in the edatopic grids are estimated from site and soil properties such as vegetation community and indicator plant species, as well as site (slope position, site shape, and topography), and soil (drainage, humus form, texture,

depth and coarse fragment content) characteristics.The grid class occupied by each ecotype represents the approximate distribution of plots belonging to each specific ecotype.

- **Photos:** Representative images (aerial, ground, detailed vegetation cover and soil profile) of the various plant associations / plant communities were selected from photographs taken at the Project site by Stassinu Field Team members for most major ecotypes.
- **Summary of Ecological Condition:** A summary table of key environmental information (site and soil characteristics, and vegetation structure and composition), as well as other important environmental / physical parameters associated with a site that may assist in the preliminary identification of each described ecotype.

Ecotype Name	
Site Information	
Ecoregion:	1
Ecotype:	2
General Location:	3
Inventory Numbers	4
Number of Sample Plots (n):	5
Site Characteristics	
Surface Expression:	6
Topographic Position:	7
Slope:	8
Aspect:	9
Soil Nutrient Regime:	10
Soil Moisture Regime:	11
Successional Status:	12
Structural Stage:	13
Soil Characteristics	
Organic Thickness / LFH Thickness (cm):	14
Humus Form:	15
Surface (Topsoil) Texture:	16
Average Topsoil Thickness (cm) :	17
Seepage:	18
Drainage:	19
Depth to Water Table:	20
Depth to Mottles / Gleying:	21
Effective Rooting Depth (cm)	22
Coarse Fragment Percent / Type:	23
Depth to Bedrock:	24
Parent Material:	25
Soil Classification (CSSC):	26
Vegetation	
Overstory Descriptor:	27

Ecotype Name	
Understory Descriptor:	28
Dominant Shrub Species (% cover):	29
Dominant Herb / Forb Species (% cover):	30
Dominant Graminoid Species (% cover):	31
Dominant Mosses, Liverwort, Lichen Species (% cover):	32
Dominant Aquatic / Wetland Species (% cover):	33
Plant Indicator Species:	34
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	35
Species At Risk / Species of Conservation Concern:	36

Site Information

1. **Ecoregion:** ecoregion in which the ecotype is located.

2. **Ecotype:** ecotype name.

3. **General location:** an overview of the geographical location of the ecotype within the Study Area.

4. **Inventory numbers:** present all plot numbers associated with specific field sampling sites.

5. **Number of Sample Plots (n):** the total number of field sampling sites (detailed, ground and visual) for the ecotype.

Site Characteristics

6. **Surface Expression:** refers to the shape and form of the land surface (e.g., level, inclined, rolling, undulating, hummocky, ridged, steep) associated with the ecotype. Varying terrain will often have gradients of ecological condition.

7. **Topographic/Slope Position:** presents the position of the site relative to the localized catchment area (i.e., crest, upper slope, middle slope, lower slope, toe, depression or level). Indirectly relates to several other ecological factors, including wind exposure, depth of unconsolidated surficial materials, degree of soil development, erosion potential and moisture status.

8. **Slope:** approximation of the percent slope associated with the ecotype.

9. **Aspect:** approximation the orientation of the slope associated with the ecotype. Aspect differences can influence site temperatures and soil moisture regime. Northern aspects are generally cooler, while south and southwesterly aspects warmer and drier.

10. **Soil moisture regime (SMR):** presents the soil moisture regime (a synopsis of site and soil characteristics that effect soil hydrology) range encompassed by the ecotype.

11. **Soil nutrient regime (SNR):** presents the soil nutrient regime (a synopsis of site, soil, and soil humus characteristics that determine soil nutrient availability) range encompassed by the ecotype.

12. **Successional status:** presents the successional status (i.e., non-vegetated, pioneer seral, young seral, mature seral, overmature seral, young climax, young climatic climax, young edaphic climax, maturing climax, maturing climatic climax, maturing edaphic climax and disclimax) for the ecotype. Generally applies to ecotypes where forest sucession is expected to occur.

13. **Structural stage:** presents the structural development (sparse/bryoid, herb, shrub/herb, pole/sapling, young forest, mature forest or old forest) for the ecotype.

Soil Characteristics

14. **Organic thickness / LFH thickness:** is the depth of organic layer overlying the mineral substrate. It is considered and important source of macronutrients and water for plant growth.

15. **Soil humus form:** presents the typical soil humus forms (Green et al. 1993) for the ecotype forest floor. Sites with high quality litter and a rapid turnover of nutrients are potentially more productive for plant growth than sites with acidic litter.

16. **Surface texture:** is the proportion of different-sized mineral particles (sand, silt and clay) that a soil contains. Soil texture influences plant community development by effecting water- and nutrient-holding capacity, and root penetration.

17. **Average topsoil thickness:** is the depth of uppermost layer of soil (Ah, Ae, Ahe or Ap horizons) and contains the highest concentration of organic matter, microorganisms and nutrients.

18. **Seepage:** groundwater seepage represents an enhanced and stable supply of soil moisture than associated upland sites, often resulting in more productive plant growth.

19. **Drainage:** describes the speed and extent to which water is removed from a mineral soil in relation to inputs and indicates the general availability of moisture. Drainage class codes follow MoELP-MoF 1998: very rapidly drained, rapidly drained, well drained, moderately-well drained, imperfectly drained, poorly drained and very poorly drained.

20. **Depth to water table:** indicates where the groundwater table currently occurs. The occurrence of water at or near the ground surface is indicative of imperfectly to very poorly drained soils.

21. **Depth to mottles / gleying:** depth and degree of mottle development indicates how wet a soil may be at varying times during the year even in absence of water at the time of assessment. Where gleying occurs it indicates that soil is saturated with moisture for most of the year.

22. **Effective rooting depth:** the volume of soil that a plant community can exploit, measured as the rooting depth range and average in cm. A deep effective rooting zone can allow plants to exploit a broader range of moisture and nutrient resources.

23. **Coarse fragment cover percentage:** gives the average in percent for the coarse fragments (gravel to boulders) in a soil. Coarse fragments reduce the volume of sand, silt and clay in the soil, which can reduce water- and nutrient-holding capacity, and root depth potential.

24. **Depth to bedrock:** indicates how much unconsolidated material occurs over bedrock. Sites with less than 25 cm of unconsolidated material over bedrock represent severe limitations to plant growth.

25. **Parent material:** presents surficial geology deposits associated with the ecotypes. Provides a general indication of the physical characteristics and variability of substrates on which vegetation will grow.

26. **Soil classification:** presents the various soil subgroups (follows the Canadian System of Soil Classification, 1998) associated with the ecotype.

Soil Characteristics

27. **Overstory Descriptor:** presents the general tree composition of the forest overstorey associated with the ecotype.

28. **Understory Descriptor:** presents the general composition of the understorey associated with the ecotype.

29. **Dominant Shrub Species:** identifies the dominant vegetation associated with the ecotype. Abundant species are potentially more reliable indicators of site conditions thatn those with low abundance.

30. **Dominant Herb/Forb Species:** identifies the dominant vegetation associated with the ecotype. Abundant species are potentially more reliable indicators of site conditions thatn those with low abundance.

31. **Dominant Mosses, Liverwort, Lichen Species:** identifies the dominant vegetation associated with the ecotype. Abundant species are potentially more reliable indicators of site conditions thatn those with low abundance.

32. **Dominant Aquatic/Wetland Species:** identifies the dominant vegetation associated with the ecotype. Abundant species are potentially more reliable indicators of site conditions than those with low abundance.

33. **Plant indicator species:** reflects the interpretive value of some plant species as "good" indicators of a particular site condition.

34. **Plant species richness:** is the diversity of species in a community measured as the number of species compared with the number of individuals in the community.

35. **Listed/Status Species:** identifies occurrences of *SARA*-listed or ACCDC ranked species associated with the ecotype.

- **Plant Community Diversity:** A table used to depict characteristic plant species, including scientific and common names (grouped into tree, shrub, herb, and moss / lichen layers), from the complete list of plant species found at the site. Mean coverage values in percentages and the average percent coverage by species, are provided. Constancy values are given in percentages as well. Constancy refers to the percentage of frequency of occurrence of a species in the total number of plots used for describing the ecotype. These tables are intended as general guides to the identification of the dominant and indicator plant species used to characterize each described ecotype.

Ecotype							
Latin Name 1	Common Name 2	Growth Form 3	Minimum Cover (%) 4	Maximum Cover (%) 5	Number of Sites* 6	Average Cover (%) 7	Constancy (%) 8

1. **Latin names:** the Latin name for each plant species recorded in the ecotype.
2. **Common names:** the most well known common plant names for each species recorded in the ecotype.
3. **Growth form:** each plant species is assigned to one of the following vegetation layers (i.e., tree, tall shrub, low shrub, dwarf shrub, herb, moss, lichen).
4. **Minimum cover:** the minimum percent cover for each plant species recorded in the ecotype. Percent cover is estimated as the percentage of the ground surface covered when the crowns are projected vertically.
5. **Maximum cover:** the maximum percent cover for each plant species recorded in the ecotype.
6. **Number of sample sites:** the number of sampling sites, both detailed and ground, from which plant species information was recorded per ecotype.
7. **Average plant cover:** the percent cover for each plant species recorded in the ecotype.

8. **Constancy (%):** the frequency in percent, (plant was present in x plots/total number of plots in the ecotype) X 100.

- **Rarity:** Rare elements under the protection of SARA or the *Newfoundland and Labrador Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the Atlantic Canada Conservation Data Centre (ACCDC) have been identified from vascular plant species found within each ecotype.
- **Succession / Disturbance Ecology:** A brief narrative of the successional dynamics of key ecotypes and their environmental requirements. The response to disturbance by plants and the community. The principal natural and anthropogenic disturbances influencing the vegetation in the Study Area have been fire, insects and disease, and human activity.
- **Wildlife and Wildlife Habitat:** Provides a brief overview of area wildlife and their relationship to habitat components comprising each of the identified ecotypes.

The mapping of ecosystem units shows the distribution of each ecotype within the Study Area (Appendix A). An extensive ArcGIS database of polygon attributes is associated with each mapped ecotype, which further describes the polygons mapped in Appendix A.

6.2.4.1 Alpine / Subalpine Ecosystem Units

MSF 01 Ecotype: Alpine Heath

Map Code:	AH	**Name:**	Alpine Heath	**Ecotype:**	01
Total Area (km^2):	1.0			**Percentage of Study Area:**	0.2

General Site Description

The Alpine Heath (AH) ecotype is typically associated with the highest elevations in the Study Area. These sites generally occupy exposed, windswept ridges above treeline; experience colder and windier conditions than surrounding upland / lowland areas, and can be subject to discontinuous alpine permafrost conditions. The dominant parent material is typically bedrock (either weathered or as exposed pavement) and rocky colluvium or morainal (till). These sites range in moisture regime from fairly xeric in exposed areas to subhygric in sheltered or protected areas (often over short distances) and have poor to very poor fertility (Figure 6.1). This ecotype is limited in its extent and currently occupies approximately 0.25 percent (0.98 km^2) of the Study Area (Table 6.1).

Plant community diversity is summarized in Table 6.2. Tree cover is often absent or infrequent. Scrub birch (*Betula glandulosa*) dominates the shrub layer, with low growing evergreen shrubs and a sparse to moderately developed cover of herbs scattered among boulders or in bedrock pockets in this open alpine setting. Lapland diapensia (*Diapensia lapponica*), an arctic-alpine species which forms “cushions” on exposed rocky ridges kept free from snow by high winds, is a dominant feature of these ecotypes, with black crowberry and bog bilberry (*Vaccinium uliginosum*) also common. Additional arctic-alpine species characteristic of this habitat include alpine bearberry, mountain sandwort (*Minuartia groenlandica*), Bigelow’s sedge (*Carex bigelowii* subsp. *bigelowii*), and crinkled snow lichen (*Flavacetraria nivalis*). Other lichen species forming the dominant ground cover associated with these sites, in decreasing order of dominance, include star-tipped reindeer lichen (*Cladina stellaris*), grey reindeer lichen (*Cladina rangiferina*), witches hair lichen (*Alectoria ochroleuca*), and Easter lichen (*Stereocaulon paschale*). The mean species richness was 14.5 for vascular plant species and 10.0 for non-vascular plant species.

Soils associated with this ecotype are typically shallow to bedrock, and can vary between rapidly drained upland Organic Folisols to imperfectly drained cryoturbated Melanic Brunisols and Eutric Brunisols, particularly in areas where soil temperatures are not consistently cold enough to promote Cryosol formation. This variability reflects the importance of bedrock control over soil depth and water flow in alpine ecotypes, as well as soil temperature regimes. Mineral soil texture (when found) is medium to coarse (silt loam to sand) and coarse fragment content is variable. Potential rooting depth typically ranges from 0 to 30 cm, depending on depth to bedrock or high water levels. Humus forms are dominated by Hemimors and Humimors on drier sites, and by Fibrimors and Mesimors on wetter sites.

Figure 6.1 Edatopic Grid for Alpine Heath Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
	A	B	C	D	E
0					
1					
2					
3	50%	50%			
4					
5					
6					
8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

***Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class**

Photo 1 Alpine Heath Ecotype – Aerial View

Photo 2 Alpine Heath Ecotype – Ground View

Photo 3 Alpine Heath Ecotype – Typical Vegetation

Photo 4 Alpine Heath Ecotype – Typical Soil Profile

Table 6.1 Summary of Ecological Condition for Alpine Heath Ecotype

Alpine Heath Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Alpine Heath (AH)
General Location:	On exposed morainal veneers and eroded bedrock on ridge and crest slope positions at upper elevations within the Study Area.
Inventory Numbers	G12, D27, V35, V51
Number of Sample Plots (n):	n=4
Site Characteristics	
Surface Expression:	Undulating
Topographic Position:	Ridge, crest, upper slope
Slope:	Level (slopes <2%); depression
Aspect:	Variable
Soil Nutrient Regime:	Very Poor (A) to Poor (B) nutrient status
Soil Moisture Regime:	Xeric (1)
Successional Status:	Maturing climax
Structural Stage:	Herb (H)
Soil Characteristics	
Organic Thickness / LFH Thickness (cm):	5
Humus Form:	Hemimor, humimor
Surface (Topsoil) Texture:	Silt loam to sand
Average Topsoil Thickness (cm) :	10
Seepage:	N/A
Drainage:	Very Rapid to Imperfect
Depth to Water Table:	Absent
Depth to Mottles / Gleying:	None
Effective Texture	Sand
Effective Rooting Depth (cm)	10-30
Coarse Fragment Percent / Type:	50% / angular to subangular cobbles and boulders
Depth to Bedrock:	0-60+
Parent Material:	Bedrock, morainal (till)
Soil Classification (CSSC):	Melanic Brunisols and Eutric Brunisols
Vegetation	
Overstory Descriptor:	N/A
Understory Descriptor:	N/A
Dominant Shrub Species (% cover):	*Betula glandulosa, Empetrum nigrum*

Alpine Heath Ecotype	
Dominant Herb / Forb Species (% cover):	*Diapensia lapponica*
Dominant Graminoid Species (% cover):	*Carex bigelowii* subsp. *bigelowii*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Cladina stellaris*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	*Diapensia lapponica, Arctostaphylos alpina*
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	15/10
Species At Risk / Species of Conservation Concern:	None

Plant Community Diversity

Table 6.2 Plant Community Diversity for Alpine Heath Ecotype

Alpine Heath Ecotype							
Latin Name	**Common Name**	**Growth Form**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Shrub Layer							
Picea mariana	black spruce	tall shrub	1	1	2	0.50	0.50
Picea mariana	black spruce	low shrub	0.5	0.5	2	0.25	0.50
Rhododendron groenlandicum	common Labrador tea	low shrub	0.5	0.5	2	0.25	0.50
Betula glandulosa	dwarf birch	low shrub	0.5	0.5	2	0.25	0.50
Empetrum nigrum	black crowberry	dwarf shrub	6	6	2	3.00	0.50
Picea mariana	black spruce	dwarf shrub	0.5	0.5	2	0.25	0.50
Vaccinium uliginosum	bog bilberry	dwarf shrub	3.25	3.25	2	1.63	0.50
Rhododendron groenlandicum	common Labrador tea	dwarf shrub	8.6	10	2	9.30	1.00
Gaultheria hispidula	creeping snowberry	dwarf shrub	0.5	0.5	2	0.25	0.50
Betula glandulosa	dwarf birch	dwarf shrub	3.8	10	2	6.90	1.00
Diapensia lapponica	Lapland diapensia	dwarf shrub	10	10	2	5.00	0.50
Vaccinium vitis-idaea subsp. minus	partridgeberry	dwarf shrub	0.5	10	2	5.25	1.00
Herb Layer							
Minuartia groenlandica	mountain sandwort	forb	1.45	1.45	2	0.73	0.50

Alpine Heath Ecotype							
Latin Name	**Common Name**	**Growth Form**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Gramnoid Layer							
Carex bigelowii subsp. bigelowii	bigelow's sedge	graminoid	5	5	2	2.50	0.50
Moss / Lichen Layer							
Pleurozium schreberi	Schreiber's moss	moss	7	9.5	2	8.25	1.00
Dicranum spp.	a broom moss	moss	0.5	0.5	2	0.25	0.50
Polytrichum spp.	a haircap moss	moss	1	2	2	1.50	1.00
Moss spp.	unknown moss	moss	1	1	2	0.50	0.50
Cladonia spp.	cladonia lichen	lichen	1	70	2	35.50	1.00
Flavacetraria nivalis	crinkled snow lichen	lichen	4.7	10	2	7.35	1.00
Crustose lichen spp.	crustose lichen	lichen	0.9	0.9	2	0.45	0.50
Stereocaulon paschale	Easter lichen	lichen	0.5	0.5	2	0.25	0.50
Cladina rangiferina	grey reindeer moss	lichen	3.4	7	2	5.20	1.00
Cetraria islandica	Iceland moss	lichen	0.5	0.5	2	0.25	0.50
Cladina mitis	lesser green reindeer moss	lichen	1.55	5	2	3.28	1.00
Cladina arbuscula	reindeer lichen	lichen	3	3	2	1.50	0.50
Cladina stellaris	star-tipped reindeer lichen	lichen	0.5	0.5	2	0.25	0.50
Alectoria ochroleuca	witches hair lichen	lichen	0.5	0.5	2	0.25	0.50

** Detailed and ground inspection field sampling sites only.*

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Disturbance and Succession Ecology

The main ecological process associated with this ecotype is the effect of the harsh subarctic climate on the development of vegetation and soil processes. Most sites are on hill crests, steep colluvium and/or the windward side of ridges. These sites are generally too harsh (exposed, cold, windy) for the establishment of any sort of true tree cover. Krumholtz spruce is the only tree species able to persist on these sites.

Wildlife and Wildlife Habitat

The general limited amount of cover found in Alpine Heath limits species that may find the necessary cover and forage requirements.

Caribou may use Alpine Heath sites to selectively forage on plants high in nutrients such as willows, lichens, forbs, and graminoids (Barten et al. 2001).

This ecotype would provide little to no cover for snowshoe hare. However, this species may use Alpine Heath sites for both summer and winter forage (Dodds 1960; Wolff 1978; Newbury and Simon 2005).

In the absence of extensive ground cover (e.g., tuckamoor) Spruce Grouse may find limited suitable cover and forage and therefore Alpine Heath was rated as secondary habitat for this species.

A summary of wildlife habitat use and potential for the Alpine Heath Ecotype is presented in Table 6.3.

Table 6.3 Summary of Wildlife Habitat Use and Potential for the Alpine Heath Ecotype

Alpine Heath Ecotype				
Species	**Habitat Potential**			**Occurrence %**
	Primary	**Secondary**	**Tertiary**	
Moose			•	0
Caribou		•		0
Beaver			•	0
Snowshoe hare		•		0
Spruce Grouse	•			0
Short-eared Owl			•	0
Porcupine			•	0
Lynx		•		0
Rusty Blackbird			•	0
Canada Goose			•	0

6.2.4.2 Forested Ecosystem Units

MSF 02 Ecotype: Hardwood Forest

Map Code:	HW	**Name:**	Hardwood Forest	**Ecotype:**	02
Total Area (km^2):	5.4			**Percentage of Study Area:**	1.4

General Site Description

The Hardwood Forest (HW) ecotype represents an early successional stage of the MSF04 ecotype. The current extent of the HW ecotype is low; generally occurring as open stands of deciduous forest on steep slopes, often in hilly terrain, and with some northern exposure. The ecotype is typically found on upper slope and crest positions on steep slopes and ridges, with shallow soils resulting in a submesic to subhygric moisture regime. Parent materials are often derived from colluvium or morainal (till) deposits. It may occur in a wide range of soil nutrient conditions but is most frequently encountered in areas with moderate to rich soil nutrients (Figure 6.2). This ecotype is limited in its extent and currently occupies approximately 1.4 percent (5.4 km^2) of the Study Area (Table 6.4).

Plant community diversity is summarized in Table 6.5. Tree species comprising the partial forest canopy associated with this ecotype include paper birch (*Betula papyrifera*) and heart-leaved paper birch (*Betula cordifolia*), with the latter often as a sub-canopy. White spruce (*Picea glauca*) are occasionally present, but conifers comprise only a small proportion (<10 percent) of the canopy. The species composition of the Hardwood Forest ecotype is quite variable. Differences in species composition appear to be related to microclimate, aspect, slope position, soil type, soil fertility, and availability of soil moisture. Moist rich sites found on seepage slopes or adjacent seasonal or intermittent drainage channels are often dominated by paper birch. In most instances there is a tall shrub layer under the open tree canopy composed of mountain alder (*Alnus viridis* subsp. *crispa*), heart-leaved paper birch, and Bartram's shadbush (*Amelanchier bartramiana*). Canopy openings are occupied by a regenerating shrub layer of heart-leaved paper birch, balsam fir, and white spruce. Mountain wood-fern (*Dryopteris campyloptera*) was often the dominant plant species in the herb layer. Characteristic species of the shrub layer include skunk currant (*Ribes glandulosum*), mountain alder, Bartram's shadbush, and red raspberry (*Rubus idaeus*). Herbaceous species, typical of somewhat enriched sites, include large-leaf goldenrod (*Solidago macrophylla*), Green false hellebore (*Veratrum viride* var. *viride*), fireweed (*Chamerion angustifolium*), bristly clubmoss (*Lycopodium annotinum*), goldthread (*Coptis trifolia*), woodland horsetail (*Equisetum sylvaticum*), and bunchberry (*Cornus canadensis*). The predominant graminoid is bluejoint (*Calamagrostis canadensis*). The moss layer, consisting mainly of a low cover of *Dicranium* spp., is typically found interspersed within a well-developed leaf litter layer. The mean species richness was 35.0 for vascular plant species and 4.0 for non-vascular plant species.

Figure 6.2 Edatopic Grid for Hardwood Forest Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
	A	B	C	D	E
0					
1					
2					
3					
4					
5				100%	
6					
7					
8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

*Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class

Photo 5 Hardwood Forest Ecotype – Aerial View

Photo 6 Hardwood Forest Ecotype – Ground View

Photo 7 Hardwood Forest Ecotype – Typical Vegetation

Photo 8 Hardwood Forest Ecotype – Typical Soil Profile

Table 6.4 Summary of Ecological Condition for Hardwood Forest Ecotype

Hardwood Forest Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Hardwood Forest (HW)
General Location:	Infrequently encountered. Occupies steep slopes and ridges in the northern portion of the Study Area
Inventory Numbers	D28, V20, V72
Number of Sample Plots (n):	N=3
Site Characteristics	
Surface Expression:	Hummocky
Topographic Position:	Upper slope, crest
Slope:	Variable
Aspect:	Southerly, southwesterly
Soil Nutrient Regime:	Moderate to rich
Soil Moisture Regime:	Submesic to subhygric
Successional Status:	Young seral
Structural Stage:	Mature forest
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	8
Humus Form:	Hemimors, humimors, and mormoders
Surface (Topsoil) Texture:	Loam
Average Topsoil Thickness (cm) :	19
Seepage:	Yes
Drainage:	Well to imperfect
Depth to Water Table:	>50
Depth to Mottles / Gleying:	19
Effective Texture	Loamy sand
Effective Rooting Depth (cm)	25-50
Coarse Fragment Percent and Type:	50% boulders
Depth to Bedrock:	>100
Soil Characteristics	
Parent Material:	Colluvium, morainal (till)
Soil Classification (CSSC):	Humo-Ferric and Ferro-Humic Podzols with Gleyed variants
Vegetation	
Overstory Descriptor:	*Betula papyrifera*
Understory Descriptor:	*Betula cordifolia*

Hardwood Forest Ecotype	
Dominant Shrub Species (% cover):	*Alnus viridis subsp. crispa*
Dominant Herb / Forb Species (% cover):	*Dryopteris campyloptera*
Dominant Graminoid Species (% cover):	*Calamagrostis canadensis*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Dicranium spp*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	*Dryopteris campyloptera*
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	35/4
Species At Risk / Species of Conservation Concern:	None observed

Plant Community Diversity

Table 6.5 Plant Community Diversity for Hardwood Forest Ecotype

Hardwood Forest Ecotype							
Latin Name	**Common Name**	**Growth Form**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Picea glauca	white spruce	tree	7	7	1	7.00	1.00
Picea mariana	black spruce	tree	7	7	1	7.00	1.00
Betula papyifera	white birch	tree	30	30	1	30.00	1.00
Betula papyrifera var. cordifolia	heartleaf paper birch	tree	30	30	1	30.00	1.00
Shrub Layer							
Salix humilis	prairie willow	tall shrub	20	20	1	20.00	1.00
Amelanchier bartramiana	Bartram's shadbush	low shrub	0.5	0.5	1	0.50	1.00
Alnus viridis subsp. crispa	mountain alder	low shrub	0.8	0.8	1	0.80	1.00
Salix humilis	prairie willow	low shrub	0.5	0.5	1	0.50	1.00
Rubus idaeus	red raspberry	low shrub	0.5	0.5	1	0.50	1.00
Ribes glandulosum	skunk currant	low shrub	13.5	13.5	1	13.50	1.00
Betula papyifera	white birch	low shrub	0.5	0.5	1	0.50	1.00
Linnaea borealis subsp. longiflora	twinflower	dwarf shrub	0.7	0.7	1	0.70	1.00

Hardwood Forest Ecotype							
Latin Name	**Common Name**	**Growth Form**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Herb Layer							
Lycopodium annotinum	bristly clubmoss	forb	15.4	15.4	1	15.40	1.00
Clintonia borealis	Clinton lily	forb	0.5	0.5	1	0.50	1.00
Cornus canadensis	dwarf dogwood	forb	8.6	8.6	1	8.60	1.00
Rubus pubescens	dwarf red raspberry	forb	0.5	0.5	1	0.50	1.00
Chamerion angustifolium	fireweed	forb	0.5	0.5	1	0.50	1.00
Coptis trifolia	goldthread	forb	0.5	0.5	1	0.50	1.00
Veratrum viride var. viride	Green false hellebore	forb	0.5	0.5	1	0.50	1.00
Solidago macrophylla	Large-leaf goldenrod	forb	15.7	15.7	1	15.70	1.00
Dryopteris campyloptera	mountain wood-fern	forb	38	38	1	38.00	1.00
Petasites frigidus var. palmatus	sweet coltsfoot	forb	0.5	0.5	1	0.50	1.00
Equisetum sylvaticum	woodland horsetail	forb	1.2	1.2	1	1.20	1.00
Gramnoid Layer							
Carex brunnescens	brownish sedge	graminoid	0.5	0.5	1	0.50	1.00
Calamagrostis canadensis	Canada reedgrass	graminoid	1.5	1.5	1	1.50	1.00
Cinna latifolia	slender wood reedgrass	graminoid	0.5	0.5	1	0.50	1.00
Moss / Lichen Layer							
Dicranum spp.	a broom moss	moss	0.5	0.5	1	0.50	1.00
Pleurozium schreberi	Schreiber's moss	moss	0.5	0.5	1	0.50	1.00
Moss spp.	unknown moss	moss	1.1	1.1	1	1.10	1.00
Cladonia spp.	cladonia lichen	lichen	0.5	0.5	1	0.50	1.00

** Detailed and ground inspection field sampling sites only.*

Soils associated with this ecotype consist mainly of Humo-Ferric and Ferro-Humic Podzols along with Gleyed variants. Soils are generally thin, with high coarse fragment content and surface stoniness and well to imperfectly-drained. Soil texture varies greatly by site including, but not limited to, sandy loam, sand, loamy sand sandy loam to sand. Drainage usually ranges from well to imperfect. Moisture and nutrient levels are often enhanced in these soils as a result of seepage inputs or perched water, occasionally promoting development of thin Ahe or Ah horizons. Potential rooting depth generally ranges from 0.25 to 0.5 m. Humus forms are dominated by both Mors and Moders. These soils are similar to those associated with the MSF 03 ecotypes.

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Disturbance and Succession Ecology

Fires, early growing-season snow press, insect epidemics, and browsing ungulates reflect the primary disturbances that affect these communities.

The HW ecotype is considered a mid seral plant community for the MSF ecoregion and usually precedes the establishment of canopy forming trees following stand replacement burns. Given enough time between disturbances, sites characterized by the HW ecotype would be expected to succeed to MSF 03 sites then to MSF 04 sites.

Wildlife and Wildlife Habitat

White birch, alder and willow provide are present in this ecotype and are preferred forage for moose (Newbury et al. 2007). Evidence of moose was detected (tracks and browse) in all of the sites visited.

Early successional Hardwood sites provide year round forage and cover for snowshoe hare. Snowshoe hare scat was found in all of the sites visited. It is well documented that lynx favor snowshoe hare as prey and their cycles follow closely. Although no evidence of lynx was found in the site surveyed, the habitat potential for this species has been rated as secondary because of this connection.

Although no evidence of Spruce Grouse was found during the surveys of this one site within this ecotype, this species would likely find summer forage in Hardwood sites, including leaves, flowers, berries, seeds, and some insects (Soule et al. 1992).

Although no evidence of porcupine was found in Hardwood sites during field surveys, habitat potential was still rated as secondary. Hardwood trees and tall shrubs (alders and willows) offer both resting spots and winter forage. Porcupine may also forage on berries during fall and early winter (Morin et al. 2005).

A summary of wildlife habitat use and potential for the Hardwood Forest Ecotype is presented in Table 6.6.

Table 6.6 Summary of Wildlife Habitat Use and Potential for the Hardwood Forest Ecotype

Hardwood Forest Ecotype					
Species	**Habitat Potential**			**Occurrence %**	**Comments**
	Primary	**Secondary**	**Tertiary**		
Moose	•			100	
Caribou			•	0	
Beaver			•	0	
Snowshoe hare	•			100	
Spruce Grouse			•	0	
Short-eared Owl			•	0	
Porcupine		•		0	
Lynx		•		0	Cover and prey (snowshoe hare) found here
Rusty Blackbird			•	0	
Canada Goose			•	0	

MSF 03 Ecotype: Mixedwood Forest

Map Code:	MW	**Name:**	Mixedwood Forest	**Ecotype:**	03
Total Area (km^2):	17.5			**Percentage of Study Area:**	4.4

General Site Description

The Mixedwood Forest ecotype represents an early to mid-successional stage of the MSF04 ecotype and is intended to characterize stands with a mixture of coniferous and deciduous forest species. Depending on the type and severity of disturbance, the MSF 03 ecotype may originate soon after disturbance, or succeed from MSF 02 sites. As with the MSF 02 ecotype, the current extent of this ecotype in the Study Area is low. This ecotype is typically found on a

range of slope positions, often on substrates derived from colluvial, morainal (till) and fluvial deposits with submesic to mesic moisture regimes (Figure 6.3). This ecotype is limited in its extent and currently occupies approximately 4.4 percent (17.5 km^2) of the Study Area (Table 6.7).

Plant community diversity is summarized in Table 6.8. The Mixedwood Forest ecotype is characterized by a dense, even-aged tree canopy of early and mid-successional stage species composed of a mixture of paper birch, balsam fir and black spruce. The species composition of the understory is limited and largely shaped by canopy structure and soil attributes. In most instances there is a tall shrub layer composed of regenerating canopy species and mountain alder, with canopy openings comprised of an increasing abundance of those same species. Characteristic species of the low and dwarf shrub layers include balsam fir, black spruce (often through layering), mountain alder, common Labrador tea, partridgeberry, lowbush blueberry, and twinflower. Herbaceous species include large-leaf goldenrod, fireweed (*Chamerion angustifolium*), bristly clubmoss (*Lycopodium annotinum*), and bunchberry (*Cornus canadensis*). Graminoids are all but absent on the majority of sites, with crinkled hairgrass (*Deschampsia flexuosa*) and bluejoint occurring in very low cover. The extent of moss cover depends on canopy structure, the abundance of hardwood species and the related loss of suitable sites within the leaf litter layer. The moss layer, consisting of Schreber's moss and stair-step moss, is typically more abundant in areas of softwood (coniferous) canopy cover. The mean species richness was 22.0 for vascular plant species and 5.0 for non-vascular plant species.

Soils associated with this ecotype are very similar to those of the MSF 02 ecotypes. They are typically comprised of Humo-Ferric and Ferro-Humic Podzols along with their Gleyed variants. Ortstein subgroups (fully or partially cemented B-horizons (Bfc, Bhfc)) are also possible. Textures are dominantly sandy loam to sand; however, silt loam and silty clay loam horizons are often interspersed with coarser horizons in areas of high coarse fragment content and surface stoniness. Drainage is variable and can range from imperfect to rapid. It may occur in a range of soil nutrient conditions but is most frequently encountered in areas with moderate soil fertility. Moisture and nutrient levels are often enhanced in these soils as a result of seepage inputs or perched water, occasionally promoting development of thin Ahe or Ah horizons. Potential rooting depth generally ranges from 0.3 to 0.5 m. Humus forms are dominated by Hemimors and Humimors, but Mormoders can also occur as a result of hardwood litter inputs.

Figure 6.3 Edatopic Grid for Mixedwood Forest Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→				
	A	B	C	D	E
0					
1					
2					
3					
4		100%			
5					
6					
7					
8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

*Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class

Photo 9 Mixedwood Forest Ecotype – Aerial View

Photo 10 Mixedwood Forest Ecotype – Ground View

Photo 11 Mixedwood Forest Ecotype – Typical Vegetation

Photo 12 Mixedwood Forest Ecotype – Typical Soil Profile

Table 6.7 Summary of Ecological Condition for Mixedwood Forest Ecotype

Mixedwood Forest Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Mixedwood Forest (MW)
General Location:	On slopes derived from colluvial and morainal (till), and on floodplains associated with fluvial deposits
Inventory Numbers:	D36, V4, V37, V38, V41
Number of Sample Plots (n):	n=5
Site Characteristics	
Surface Expression:	Hummocky
Topographic Position:	Upper slope, mid slope
Slope:	Variable
Aspect:	Northwesterly
Soil Nutrient Regime:	Moderate to rich
Soil Moisture Regime:	Submesic to subhygric
Successional Status:	Mid sere
Structural Stage:	Mature forest
Soil Characteristics	
Organic Thickness / LFH Thickness (cm):	
Humus Form:	Hemimors and humimors
Surface (Topsoil) Texture:	Sandy Loam to loam
Average Topsoil Thickness (cm) :	-
Seepage:	Yes
Drainage:	Well to imperfect
Depth to Water Table:	>100 cm
Depth to Mottles / Gleying:	None
Effective Texture	Loam
Effective Rooting Depth (cm)	25-50
Coarse Fragment Percent and Type:	50+% boulders
Depth to Bedrock:	>100
Parent Material:	Colluvium, morainal (till), fluvial
Soil Classification (CSSC):	Humo-Ferric and Ferro-Humic Podzols
Vegetation	
Overstory Descriptor:	*Betula papyifera, Picea mariana, Abies balsamea*
Understory Descriptor:	*Betula papyifera*
Dominant Shrub Species (% cover):	*Alnus viridis subsp. crispa*

Mixedwood Forest Ecotype	
Dominant Herb / Forb Species (% cover):	*Cornus canadensis*
Dominant Graminoid Species (% cover):	*Deschampsia flexuosa*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Pleurozium schreberi*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	-
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	22/5
Species At Risk / Species of Conservation Concern:	None observed

Plant Community Diversity

Table 6.8 Plant Community Diversity for Mixedwood Forest Ecotype

Mixedwood Forest Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Abies balsamea	balsam fir	tree	5	5	1	5.00	1.00
Picea mariana	black spruce	tree	30	30	1	30.00	1.00
Betula papyifera	white birch	tree	15	15	1	15.00	1.00
Shrub Layer							
Picea mariana	black spruce	tall shrub	2	2	1	2.00	1.00
Alnus viridis subsp. crispa	mountain alder	tall shrub	30	30	1	30.00	1.00
Picea mariana	black spruce	low shrub	2	2	1	2.00	1.00
Rhododendron groenlandicum	common Labrador tea	low shrub	20	20	1	20.00	1.00
Alnus viridis subsp. crispa	mountain alder	low shrub	1.4	1.4	1	1.40	1.00
Vaccinium angustifolium	lowbush blueberry	dwarf shrub	3.3	3.3	1	3.30	1.00
Vaccinium vitis-idaea subsp. minus	partridgeberry	dwarf shrub	0.85	0.85	1	0.85	1.00
Linnaea borealis subsp. longiflora	twinflower	dwarf shrub	2.25	2.25	1	2.25	1.00
Herb Layer							
Lycopodium annotinum	bristly clubmoss	forb	1.25	1.25	1	1.25	1.00

Mixedwood Forest Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Cornus canadensis	dwarf dogwood	forb	2.15	2.15	1	2.15	1.00
Solidago macrophylla	large-leaf goldenrod	forb	0.5	0.5	1	0.50	1.00
Gramnoid Layer							
Deschampsia flexuosa	crinkled hairgrass	graminoid	0.5	0.5	1	0.50	1.00
Moss / Lichen Layer							
Ptillium crista-castrensis	feathermoss	moss	6.75	6.75	1	6.75	1.00
Dicranum spp.	a broom moss	moss	0.95	0.95	1	0.95	1.00
Pleurozium schreberi	Schreiber's moss	moss	55.3	55.3	1	55.30	1.00
Moss spp.	unknown moss	moss	0.5	0.5	1	0.50	1.00
Cladonia spp.	cladonia lichen	lichen	0.5	0.5	1	0.50	1.00

** Detailed and ground inspection field sampling sites only.*

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Disturbance and Succession Ecology

Fires, early growing-season snow press, insect epidemics, and browsing ungulates reflect the primary disturbances that affect these communities.

The MW ecotype is considered a mid to late seral plant community for the MSF ecoregion and usually precedes the establishment of canopy forming trees following stand replacement burns. Given enough time between disturbances, sites characterized by the MW ecotype would be expected to succeed to MSF 04 sites.

Wildlife and Wildlife Habitat

Mixedwood sites provide year round habitat for moose, with ample forage in spring and summer (Newbury et al. 2007), and thermal cover and forage in winter. This species was detected in all of the sites surveyed.

Snowshoe hare may find year round habitat in Mixedwood sites, providing there is abundant understory. Dense understory is a preferred habitat requirement for this species providing both cover and forage. This species was detected in all of the sites surveyed. It is well documented that lynx favor snowshoe hare as prey and their cycles follow closely. Although no evidence of lynx was found in the sites surveyed, the habitat potential for this species has been rated as secondary because of this connection.

Although Spruce Grouse inhabit a wide range of habitat types, Soule et al. (1992) found that this species has two main habitat requirements: a short needle tree component, and trees with live branches to the ground, both of which may be found in Mixedwood habitat. Spruce Grouse were detected in the site surveyed within this ecotype.

Habitat selection by porcupine is very much seasonally dependent. The variety of trees species found in Mixedwood sites would provide forage and resting sites for this tree dweller in summer. Also, fall and winter berries are an important food source (Morin et al. 2005), as is bark and conifer needles (Olson and Lewis 1999). Evidence of porcupine was not found in the site surveyed but habitat was rated as secondary.

A summary of wildlife habitat use and potential for the Mixedwood Forest Ecotype is presented in Table 6.9.

Table 6.9 Summary of Wildlife Habitat Use and Potential for the Mixedwood Forest Ecotype

Mixedwood Forest Ecotype					
Species	**Habitat Potential**			**Occurrence %**	**Comments**
	Primary	**Secondary**	**Tertiary**		
Moose	•			100	
Caribou			•	0	
Beaver			•	0	
Snowshoe hare	•			100	
Spruce Grouse		•		100	
Short-eared Owl			•	0	
Porcupine		•		0	
Lynx		•		0	Cover and prey (snowshoe hare) found here
Rusty Blackbird			•	0	
Canada Goose			•	0	

MSF 04 Ecotype: Black Spruce-Labrador Tea-Feathermoss

Map Code:	BF	**Name:**	Black Spruce-Labrador Tea-Feathermoss	**Ecotype:**	04
Total Area (km^2):	91.5			**Percentage of Study Area:**	23.1

General Site Description

The BF is the zonal site series for the MSF ecoregion, and is one of the more common sites in the Study Area. The zonal sites occur mainly at mid to level slope positions, on a wide range of substrates derived from relatively deep morainal deposits, or with shallow soil veneers over bedrock or colluvium. This ecotype occupies approximately 23 percent (91.5 km^2) of the Study Area (Table 6.10).

Plant community diversity is summarized in Table 6.11. This ecotype is characterized by a moderately dense tree canopy composed of black spruce, with minor components of balsam fir and occasionally white spruce dispersed throughout the overstory and understory. The shrub layer is also moderately dense and dominated by small black spruce, common Labrador tea, lowbush blueberry, and partridgeberry. The moss / lichen layer is very well developed, consisting of a moss carpet composed mainly of Schreber's moss, knight's plume (Ptilium crista-castrensis), grey (*Cladina rangiferina*) and star-tipped (*Cladina mitis*) reindeer lichen. Other common ground vegetation species, in lesser abundance, include dwarf dogwood, crinkled hairgrass, and twinflower (*Linnaea borealis*). The mean species richness was 28.5 for vascular plant species and 7.3 for non-vascular plant species.

Soils associated with this ecotype are mainly Humo-Ferric and Ferro-Humic Podzols derived from glaciofluvial, colluvium, or glacial till deposits. Fully or partially cemented B-horizons (Bfc, Bhfc) can also be found, but these are less frequent than with the MSF 05 Black Spruce Lichen ecotype. Soil texture varies greatly by site including, but not limited to, sandy loam, sand, loamy sand or organic-fibric and typically has distinct mottling within the top 25 cm of the mineral soil surface. Organic / LFH layer thicknesses are usually in the 14-20 cm range, but have been found as deep as 40 cm or more. Humus forms are dominated by Hemimors. This forested ecotype is generally nutrient-poor and soil moisture regime can be mesic to subhygric (Figure 6.4). Drainage ranges from rapid to moderately well-drained, but is usually well drained. Potential rooting depth generally ranges from 50 to 100 cm. Site productivity is typically poor-moderate.

Figure 6.4 Edatopic Grid for Black Spruce-Labrador Tea-Feathermoss Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
	A	B	C	D	E
0					
1					
2					
3		14%			
4		29%	57%		
5					
6					
7					
8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

*Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class

Photo 13 Black Spruce-Labrador Tea-Feathermoss Ecotype – Aerial View

Photo 14 Black Spruce-Labrador Tea-Feathermoss Ecotype – Ground View

Photo 15 Black Spruce-Labrador Tea-Feathermoss Ecotype – Typical Vegetation

Photo 16 Black Spruce-Labrador Tea-Feathermoss Ecotype – Typical Soil Profile

Table 6.10 Summary of Ecological Condition for Black Spruce-Labrador Tea-Feathermoss Ecotype

Black Spruce-Labrador Tea-Feathermoss Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Black Spruce-Labrador Tea-Feathermoss (BF)
General Location:	Abundant throughout study area. The MSF04 ecotype is considered the zonal site for the MSF ecoregion.
Inventory Numbers	D7, D22, D25, D37, G11, G26, V5, V9, V11, V14, V15, V17, V25, V28, V30, V33, V46, V47
Number of Sample Plots (n):	n=19
Site Characteristics	
Surface Expression:	Flat, gently sloping
Topographic Position:	Mid to lower slope positions
Slope:	Variable
Aspect:	Variable
Soil Nutrient Regime:	Poor (B) to medium (C) nutrient status, with the majority of sites classed as medium
Soil Moisture Regime:	Submesic (3) to subhygric (5)
Successional Status:	Typically as stable forest communities in the maturing seral stage, although extensive areas of burned forest are present where pioneer and young seral communities of the MSF04 ecotype exist
Structural Stage:	Maturing seral
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	16
Humus Form:	Hemimor and humimor
Surface (Topsoil) Texture:	Sand, loamy sand
Average Topsoil Thickness (cm) :	12
Seepage:	None observed
Drainage:	Rapid to subhygric
Depth to Water Table:	>100
Depth to Mottles / Gleying:	>50
Effective Texture	Loamy sand
Effective Rooting Depth (cm)	15
Coarse Fragment Percent and Type:	<5% gravels
Depth to Bedrock:	>100
Parent Material:	Morainal (Till), Colluvium

Black Spruce-Labrador Tea-Feathermoss Ecotype	
Soil Classification (CSSC):	Orthic and Orstein Humo-Ferric and Ferro-Humic Podzols with gleyed variants
Vegetation	
Overstory Descriptor:	*Picea mariana, Abies balsamea*
Understory Descriptor:	*Picea mariana*
Dominant Shrub Species (% cover):	*Vaccinium angustifolium*
Dominant Herb / Forb Species (% cover):	*Cornus canadensis*
Dominant Graminoid Species (% cover):	*Deschampsia flexuosa*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Pleurozium schreberi*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	-
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	28.5/7.3
Species At Risk / Species of Conservation Concern:	*Veratrum viride* var. *viride*

Plant Community Diversity

Table 6.11 Plant Community Diversity for Black Spruce-Labrador Tea-Feathermoss Ecotype

Black Spruce-Labrador Tea-Feathermoss Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Abies balsamea	balsam fir	tree	4	20	6	7.33	0.83
Picea mariana	black spruce	tree	20	50	6	33.33	1.00
Shrub Layer							
Salix spp.	a willow	tall shrub	7	7	6	1.17	0.17
Abies balsamea	balsam fir	tall shrub	2	15	6	7.00	1.00
Picea mariana	black spruce	tall shrub	4	7	6	5.33	1.00
Alnus viridis subsp. crispa	mountain alder	tall shrub	2	15	6	2.83	0.33
Abies balsamea	balsam fir	low shrub	0.5	7.9	6	3.50	0.83
Amelanchier bartramiana	Bartram's shadbush	low shrub	0.5	0.5	6	0.08	0.17
Picea mariana	black spruce	low shrub	1	5.1	6	3.85	1.00

Black Spruce-Labrador Tea-Feathermoss Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Rhododendron groenlandicum	common Labrador tea	low shrub	1.15	11.9	6	6.98	1.00
Betula glandulosa	dwarf birch	low shrub	0.5	0.5	6	0.08	0.17
Betula minor	dwarf white birch	low shrub	0.5	0.5	6	0.08	0.17
Larix laricina	larch	low shrub	0.5	0.5	6	0.08	0.17
Vaccinium angustifolium	lowbush blueberry	low shrub	0.5	1	6	0.25	0.33
Salix humilis	prairie willow	low shrub	0.5	2.25	6	0.46	0.33
Ribes glandulosum	skunk currant	low shrub	0.5	0.5	6	0.08	0.17
Viburnum edule	squashberry	low shrub	1.1	1.1	6	0.18	0.17
Abies balsamea	balsam fir	dwarf shrub	0.5	0.5	6	0.08	0.17
Empetrum nigrum	black crowberry	dwarf shrub	0.5	1.1	6	0.27	0.33
Vaccinium uliginosum	bog bilberry	dwarf shrub	0.5	0.5	6	0.08	0.17
Kalmia polifolia	bog laurel	dwarf shrub	0.5	0.5	6	0.08	0.17
Gaultheria hispidula	creeping snowberry	dwarf shrub	1	10	6	3.57	0.83
Vaccinium caespitosum	dwarf blueberry	dwarf shrub	0.5	2.4	6	0.84	0.83
Vaccinium angustifolium	lowbush blueberry	dwarf shrub	0.5	11.35	6	4.44	0.83
Vaccinium vitis-idaea subsp. minus	partridegeberry	dwarf shrub	0.5	1.9	6	0.65	0.83
Linnaea borealis subsp. longiflora	twinflower	dwarf shrub	0.5	4.45	6	1.61	0.67
Herb Layer							
Mitella nuda	bishop's-cap	forb	0.5	0.5	6	0.08	0.17
Lycopodium annotinum	bristly clubmoss	forb	0.5	5	6	1.13	0.67
Streptopus amplexifolius	clasping-leaf twisted-stalk	forb	0.5	0.5	6	0.08	0.17
Clintonia borealis	Clinton lily	forb	1	1	6	0.17	0.17

Black Spruce-Labrador Tea-Feathermoss Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Rubus chamaemorus	cloudberry	forb	2	2.1	6	0.68	0.33
Gymnocarpium dryopteris	common oak fern	forb	1.3	1.3	6	0.22	0.17
Cornus canadensis	dwarf dogwood	forb	0.9	5	6	3.33	1.00
Rubus pubescens	dwarf red raspberry	forb	1	1	6	0.17	0.17
Chamerion angustifolium	fireweed	forb	2.5	2.5	6	0.42	0.17
Coptis trifolia	goldthread	forb	0.5	0.5	6	0.08	0.17
Listera cordata var. cordata	heartleaf twayblade	forb	0.5	0.5	6	0.25	0.50
Veratrum viride var. viride	green false hellebore	forb	0.5	0.6	6	0.18	0.33
Solidago macrophylla	largeleaf goldenrod	forb	0.5	0.5	6	0.17	0.33
Dryopteris campyloptera	mountain wood-fern	forb	1	1	6	0.17	0.17
Geocaulon lividum	northern comandra	forb	2	2	6	0.33	0.17
Moneses uniflora	one-flowered wintergreen	forb	0.5	0.5	6	0.25	0.50
Orthilia secunda	one-side wintergreen	forb	0.5	0.5	6	0.17	0.33
Geum rivale	purple avens	forb	0.5	0.5	6	0.08	0.17
Platanthera obtusata	small northern bog-orchid	forb	0.5	0.5	6	0.17	0.33
Dryopteris carthusiana	spinulose woodfern	forb	1	1	6	0.17	0.17
Petasites frigidus var. palmatus	sweet coltsfoot	forb	0.5	1.75	6	0.46	0.50
Equisetum sylvaticum	woodland horsetail	forb	3.3	6	6	1.55	0.33
Calamagrostis canadensis	Canada reedgrass	graminoid	0.5	0.5	6	0.08	0.17
Deschampsia flexuosa	crinkled hairgrass	graminoid	0.5	0.5	6	0.17	0.33
Carex canescens	silvery sedge	graminoid	1	1	6	0.17	0.17

Black Spruce-Labrador Tea-Feathermoss Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Moss / Lichen Layer							
Dicranum spp.	a broom moss	moss	4.2	6.5	6	1.78	0.33
Dicranum spp. (midget) - C2	a broom moss	moss	0.9	7	6	2.15	0.50
Polytrichum spp.	a haircap moss	moss	0.5	0.5	6	0.25	0.50
Ptilidium ciliare	ciliated fringewort	moss	0.5	0.5	6	0.17	0.33
Ptillium crista-castrensis	feathermoss	moss	9.55	48.5	6	25.09	1.00
Pleurozium schreberi	Schreber's moss	moss	12.55	65	6	49.38	1.00
Sphagnum spp.	sphagnum moss	moss	2	65	6	12.83	0.50
Hylocomium splendens	stair-step moss	moss	0.5	4	6	0.75	0.33
Peltigera spp.	a peltigera lichen	lichen	0.7	4	6	1.21	0.50
Cladonia spp.	cladonia lichen	lichen	0.5	0.5	6	0.17	0.33
Stereocaulon paschale	Easter lichen	lichen	1.25	1.25	6	0.21	0.17
Peltigera aphthosa	freckle pelt	lichen	0.9	0.9	6	0.15	0.17
Cladina rangiferina	grey reindeer moss	lichen	0.75	1.35	6	0.65	0.67
Cladonia amaurocraea	quill lichen	lichen	0.5	0.5	6	0.08	0.17
Cladonia gracilis	smooth cladonia	lichen	0.5	0.75	6	0.21	0.33
Cladina stellaris	star-tipped reindeer lichen	lichen	1.2	2.1	6	0.88	0.50

** Detailed and ground inspection field sampling sites only.*

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Green false hellebore (*Veratrum viride* var. *viride*) was identified during field surveys of the MSF04 ecotype. Green false hellebore is considered "May Be At Risk" by NLDEC indicating they are vulnerable to extirpation. It has been assigned a ranking of "S1" by the ACCDC indicating that the species is considered extremely rare throughout Labrador and of long term concern.

Disturbance and Succession Ecology

The natural disturbance regime of Black Spruce-Labrador Tea-Feathermoss ecotype is characterized by frequent, small and intermediate-scale wind events and infrequent, medium to high-severity fire regimes, with estimated return intervals ranging from 10 to 80 years. Insect epidemics and early growing-season snow press are also important disturbance factors.

Black spruce ultimately achieves dominance after stand replacing disturbance events lead to the recruitment of pioneering hardwood species. The black spruce and balsam fir component initiates in the latter part of the early seral stage and achieves dominance in late seral stage of stand development.

Wildlife and Wildlife Habitat

Moose sign was not observed in this ecotype during these surveys but this species may find good cover and forage in this ecotype in both summer and winter (Dodds 1960; Irwin 1985; Schwab and Pitt 1991; Newbury et al. 2007).

Snowshoe hare presence was detected in 83.3 percent of the sites in this ecotype, which provides vegetation that is suitable for both cover and forage year round for this species (Dodds 1960; Wolff 1978; Newbury and Simon 2005). It is well-documented that lynx favor snowshoe hare as prey and their cycles follow closely. Although no evidence of lynx was found in the sites surveyed, the habitat potential for this species has been rated as secondary because of this connection.

Short needle trees and trees with live branches near the ground are two important habitat requirements for Spruce Grouse. Providing these are met Spruce Grouse may be found in a wide range of habitat type (Soule et al. 1992). These habitat requirements are found in Black Spruce-Labrador Tea-Feathermoss sites and evidence of Spruce Grouse was detected in 33.3 percent of sites visited.

A summary of wildlife habitat use and potential for the Black Spruce-Labrador Tea-Feathermoss Ecotype is presented in Table 6.12.

Table 6.12 Summary of Wildlife Habitat Use and Potential for the Black Spruce-Labrador Tea-Feathermoss Ecotype

Black Spruce-Labrador Tea-Feathermoss Ecotype				
Species	**Habitat Potential**			**Occurrence %**
	Primary	**Secondary**	**Tertiary**	
Moose		•		0
Caribou		•		0
Beaver			•	0
Snowshoe hare	•			83
Spruce Grouse		•		33
Short-eared Owl			•	0
Porcupine			•	0
Lynx		•		0
Rusty Blackbird			•	0
Canada Goose			•	0

MSF 05 Ecotype: Black Spruce-Lichen

Map Code:	BL	**Name:**	Black Spruce-Lichen	**Ecotype:**	05
Total Area (km^2):	19.7			**Percentage of Study Area:**	5.0

General Site Description

Less extensive than the BF ecotype, though well distributed throughout the MSF ecoregion, the Black Spruce-Lichen (BL) ecotype is found on gently sloping to flat terrain, primarily on deep substrates originating from glacio-fluvial, fluvial, and morainal (till) deposits. Within the Study Area this ecotype is commonly associated with glacial features such as eskers (south of Long Lake) and drumlins. This ecotype occupies approximately 5 percent (19.7 km^2) of the Study Area (Table 6.13).

Plant community diversity is summarized in Table 6.14. The BL ecotype vegetation is characterized by a patchy distribution of black spruce imbedded in an expansive carpet of Cladina lichens. Shrub cover on these sites consists mainly of stunted black spruce and various ericaceous shrub species. Small, scrub spruce are largely restricted to the patches of mature black spruce, while common Labrador tea, lowbush blueberry, partridgeberry and black crowberry are generally widely distributed but with relatively low cover. The dominance of reindeer lichen composed largely of grey (*Cladina rangiferina*) and star-tipped (*C. stellaris*) reindeer lichen indicates a mature condition and a greater period between stand replacing, natural disturbance events (e.g., fire). Schreber's moss is also abundant, but is typically

restricted to the understory of the black spruce patches. The mean species richness was 22.0 for vascular plant species and 8.2 for non-vascular plant species.

Within the MSF ecoregion, the BL ecotype may be subdivided into two subtypes, Black Spruce-Cladina Forest and Black Spruce-Lichen Woodland. The Black Spruce-Cladina Forest subtype is characterized by a higher cover of black spruce, common Labrador tea and Schreber's moss and a lower cover of grey and star-tipped reindeer moss. Black spruce cover is more evenly distributed in this subtype. It is often found on dry slopes rather than in flat areas. The Black Spruce-Lichen Woodland subtype is typically found on flatter terrain and is most frequently encountered on sandy soils. Reindeer moss cover is very high and black spruce and Schreber's moss covers are low. Black spruce cover is very patchy in this subtype.

Soils associated with this ecotype are mainly Humo-Ferric and Ferro-Humic Podzols derived from glaciofluvial or morainal (till) deposits. Textures are dominantly sandy loam to sand and drainage is rapid to well on most sites. Partially or fully cemented B-horizons (Bfc, Bhfc) are common (Ortstein soils). Potential rooting depth ranges from 0.5 m or less on some upland soils to well over 1 m in areas of glaciofluvial deposition. Inputs of water are generally fast moving or deep where seepage occurs on sloped sites, which allows little access by shallow rooted vegetation. Organic / LFH layer thicknesses are usually in the 5-10 cm range, but have been found as deep as 40 cm or more. Humus forms are dominated by Hemimors. This ecotype is generally nutrient-poor and soil moisture regime can be very xeric to subhygric, with the majority of sites in the Study Area classed as submesic to mesic (Figure 6.5). Potential rooting depth generally range from 20 to 40 cm. Site productivity is typically poor.

Figure 6.5 Edatopic Grid for Black Spruce-Lichen Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
	A	B	C	D	E
0					
1					
2		20%			
3		40%			
4		40%			
5					
6					
7					
8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

***Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class**

Photo 17 Black Spruce-Lichen Ecotype – Aerial View (Woodland Subtype)

Photo 18 Black Spruce-Lichen Ecotype – Ground View

Photo 19 Black Spruce-Lichen Ecotype – Typical Vegetation

Photo 20 Black Spruce-Lichen Ecotype – Typical Soil Profile

Table 6.13 Summary of Ecological Condition for Black Spruce-Lichen Ecotype

Black Spruce-Lichen Ecotype	
Site Informatiom	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Black Spruce-Lichen Ecotype (BL)
General Location:	Scattered throughout Study Area, particularly as the Black Spruce-Cladina Forest subtype, often in association with areas of glaciofluvial deposition south and east of Long Lake.
Inventory Numbers	D17, D29, D38, G1, G8, V26, V34, V36, V50, V52, V71
Number of Sample Plots (n):	n=11
Site Characteristics	
Surface Expression:	Hummocky
Topographic Position:	Level to moderate slopes
Slope:	Variable
Aspect:	Variable
Soil Nutrient Regime:	Very poor (A) to poor (B), with the majority of sites classed as having a poor nutrient status.
Soil Moisture Regime:	Xeric to mesic
Successional Status:	Typically as stable forest communities in mature seral stage, although extensive areas of burned forest are present in upland areas where pioneer and young seral communities of MSF05 ecotype exist.
Structural Stage:	Mature forest
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	5
Humus Form:	Hemimor
Surface (Topsoil) Texture:	Sand
Average Topsoil Thickness (cm) :	9
Seepage:	N/A
Drainage:	Rapid to Subhygric
Depth to Water Table:	>100
Depth to Mottles / Gleying:	>50
Effective Texture	Sand
Effective Rooting Depth (cm)	15
Coarse Fragment Percent and Type:	<5% gravels
Depth to Bedrock:	>100
Parent Material:	Morainal (Till), Glacio-fluvial, and Fluvial
Soil Classification (CSSC):	Orthic and Orstein Humo-Ferric and Ferro-Humic Podzols

Black Spruce-Lichen Ecotype	
Vegetation	
Overstory Descriptor:	*Picea mariana*
Understory Descriptor:	*Picea mariana*
Dominant Shrub Species (% cover):	*Vaccinium spp.*
Dominant Herb / Forb Species (% cover):	*Cornus canadensis*
Dominant Graminoid Species (% cover):	*Deschampsia flexuosa*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Cladina stellaris*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	*Cladina* spp.
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	22/8.2
Species At Risk / Species of Conservation Concern:	*Pinus banksianna, Hedysarum alpinum, Epigaea repens*

Plant Community Diversity

Table 6.14 Plant Community Diversity for Black Spruce-Lichen Ecotype

Black Spruce-Lichen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Abies balsamea	balsam fir	tree	2	2	6	0.33	0.17
Picea mariana	black spruce	tree	10	35	6	23.33	1.00
Larix laricina	larch	tree	1	3	6	1.00	0.50
Shrub Layer							
Salix spp.	a willow	tall shrub	1	1	6	0.17	0.17
Abies balsamea	balsam fir	tall shrub	2	5	6	1.17	0.33
Picea mariana	black spruce	tall shrub	5	10	6	5.33	0.83
Betula glandulosa	dwarf birch	tall shrub	1	5	6	2.17	0.67
Larix laricina	larch	tall shrub	0.5	0.5	6	0.08	0.17
Salix humilis	prairie willow	tall shrub	4	4	6	0.67	0.17
Salix spp.	a willow	low shrub	0.5	1	6	0.25	0.33
Abies balsamea	balsam fir	low shrub	1.6	1.6	6	0.27	0.17
Amelanchier bartramiana	Bartram's shadbush	low shrub	0.5	0.5	6	0.08	0.17

Black Spruce-Lichen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Picea mariana	black spruce	low shrub	1.2	5	6	1.80	0.67
Vaccinium uliginosum	bog bilberry	low shrub	0.5	3	6	0.75	0.67
Rhododendron groenlandicum	common Labrador tea	low shrub	1.5	15	6	8.23	1.00
Betula glandulosa	dwarf birch	low shrub	0.55	7	6	2.95	0.83
Larix laricina	larch	low shrub	0.5	0.5	6	0.08	0.17
Empetrum nigrum	black crowberry	dwarf shrub	0.5	1	6	0.35	0.50
Vaccinium uliginosum	bog bilberry	dwarf shrub	0.5	0.5	6	0.17	0.33
Rhododendron groenlandicum	common Labrador tea	dwarf shrub	0.7	0.7	6	0.12	0.17
Gaultheria hispidula	creeping snowberry	dwarf shrub	4.9	4.9	6	0.82	0.17
Betula glandulosa	dwarf birch	dwarf shrub	0.5	0.5	6	0.08	0.17
Vaccinium caespitosum	dwarf blueberry	dwarf shrub	0.5	5	6	2.06	0.67
Vaccinium angustifolium	lowbush blueberry	dwarf shrub	4.2	25	6	14.10	1.00
Vaccinium vitis-idaea	partridegeberry	dwarf shrub	0.5	0.65	6	0.44	0.83
Herb Layer							
Diphasiastrum sitchense	Alaskan clubmoss	forb	0.5	0.5	6	0.17	0.33
Lycopodium annotinum	bristly clubmoss	forb	0.5	2.1	6	0.43	0.33
Cornus Canadensis	dwarf dogwood	forb	0.5	2.1	6	0.63	0.67
Geocaulon lividum	northern comandra	forb	1	1	6	0.17	0.17
Equisetum sylvaticum	woodland horsetail	forb	0.5	0.5	6	0.08	0.17
Deschampsia flexuosa	crinkled hairgrass	graminoid	0.5	0.55	6	0.43	0.83

Black Spruce-Lichen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Moss / Lichen Layer							
Dicranum spp.	a broom moss	moss	0.5	5.5	6	1.00	0.33
Dicranum spp.	a broom moss	moss	0.55	2	6	0.59	0.50
Polytrichum spp.	a haircap moss	moss	0.5	3.3	6	0.82	0.50
Ptilidium ciliare	ciliated fringewort	moss	0.5	0.9	6	0.23	0.33
Ptillium crista-castrensis	knight's plume	moss	0.5	11.95	6	2.08	0.33
Pleurozium schreberi	Schreber's moss	moss	9.95	62.5	6	31.63	1.00
Sphagnum spp.	sphagnum moss	moss	12.2	12.2	6	2.03	0.17
Peltigera spp.	a peltigera lichen	lichen	1	3.7	6	0.78	0.33
Cladonia spp.	cladonia lichen	lichen	0.5	1	6	0.42	0.67
Stereocaulon paschale	Easter lichen	lichen	0.5	2	6	0.42	0.33
Cladina rangiferina	grey reindeer moss	lichen	0.5	19.4	6	6.63	1.00
Cladina mitis	lesser green reindeer moss	lichen	0.5	16	6	2.92	0.50
Cladina arbuscula	reindeer lichen	lichen	0.65	14.15	6	2.80	0.50
Cladina spp.	reindeer lichen	lichen	0.5	0.5	6	0.08	0.17
Cladonia gracilis	smooth cladonia	lichen	0.5	0.5	6	0.25	0.50
Cladina stellaris	star-tipped reindeer lichen	lichen	30.1	76.5	6	43.60	0.83
Cladonia rei	wand lichen	lichen	0.5	0.5	6	0.08	0.17

** Detailed and ground inspection field sampling sites only.*

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*) have been identified from this ecotype.

During field surveys of the MSF 05 ecotype, three vascular plant species, whose populations are considered by NLDEC to be either “Sensitive” or “Undetermined” were identified as potential “Species of Conservation Concern” as a result of being assigned ACCDC ranks SH, S1 or S2 indicating that their populations are considered to be extremely rare to uncommon within the province. Two of those species, Jack pine (*Pinus banksianna*) and alpine sweet-vetch (*Hedysarum alpinum*) are considered “May be at Risk” by NLDEC; assigned ACCDC ranks of S1 and S2, respectively, and are therefore considered here to be of high conservation concern within the province.

Of note, the occurrence of Jack pine, at the site of an old burn along the south end of Long Lake, does not appear to be natural. Rather, its presence and distribution at the site may be attributed to planting of the species, owing to its evenly spaced distribution. Also, the large majority of occurrences of alpine sweet-vetch encountered were typically associated with ecotones of the MSF05 ecotype, restricted to transitional sites at the edge of the ecotype and found in association with coarse-textured sandy soils, in areas that were more readily influenced by local site conditions (i.e., it appeared to be restricted to a rather specific moisture regime).

The remaining species, trailing arbutus (*Epigaea repens*) has been assigned a “Sensitive” ranking by NLDEC indicating they are potentially susceptible to human activities or natural events, and a status rankings of “S2S3” by the ACCDC indicating that they are uncommon throughout the province and may be of long term concern.

Disturbance and Succession Ecology

The natural disturbance regime of Black Spruce-Lichen Woodland ecotype is characterized by frequent, small and intermediate-scale wind events and infrequent, medium to high-severity fire regimes, with estimated return intervals ranging from 10 to 80 years. Prevalence of cup and spike lichens is indicative of recent stand-replacing disturbance while dominance of reindeer lichens indicates a more mature condition and a greater time-since disturbance (i.e., fire). Insect epidemics and early growing-season snow press are also important disturbance factors. With regular fire-return intervals, black spruce would dominate overstory and understory tree layers.

Wildlife and Wildlife Habitat

Moose may find good cover and forage in this ecotype in both summer and winter (Dodds 1960; Irwin 1985; Schwab and Pitt 1991; Newbury et al. 2007). Evidence of moose was recorded in 16.7 percent of sites surveyed.

Caribou have a pattern of lowland habitat use, in combination with varying use of lichen-rich stands of black spruce (Morton and Wynes 1997). No evidence of caribou was recorded during the surveys.

Spruce Grouse scat was found in 50 percent of sites surveyed in this ecotype. Although Spruce Grouse inhabit a wide range of habitat types, Soule et al. (1992) found that this species has two main habitat requirements: a short needle tree component, and trees with live branches to the ground, both of which may be found in this ecotype.

This ecotype also provides cover and winter forage for snowshoe hare (Dodds 1960; Wolff 1978; Newbury and Simon 2005). Scat was found in 50 percent of the sites surveyed. It is well documented that lynx favor snowshoe hare as prey and their cycles follow closely. Although no evidence of lynx was found in the sites surveyed, the habitat potential for this species has been rated the same as hare because of this connection.

Porcupine would lack summer forage in pure conifer forest, but stony patches within this ecotype may be selected for denning sites (Morin et al. 2005).

A summary of wildlife habitat use and potential for the Black Spruce-Lichen Ecotype is presented in Table 6.15.

Table 6.15 Summary of Wildlife Habitat Use and Potential for the Black Spruce-Lichen Ecotype

Black Spruce-Lichen Ecotype					
Species	**Habitat Potential**			**Occurrence %**	**Comments**
Common Name	**Primary**	**Secondary**	**Tertiary**		
Moose		•		17	
Caribou		•		0	
Beaver			•	0	
Snowshoe hare	•			50	
Spruce Grouse	•			50	
Short-eared Owl			•	0	
Porcupine	•			0	
Lynx	•			0	Cover and prey (snowshoe hare) found here
Rusty Blackbird			•	0	
Canada Goose			•	0	

MSF 06 Ecotype: Black Spruce / Tamarack-Sphagnum Woodland

Map Code:	BS	**Name:**	Black Spruce / Tamarack-Sphagnum Woodland	**Ecotype:**	06
Total Area (km^2):	49.6			**Percentage of Study Area:**	12.5

General Site Description

The Black Spruce / Tamarack-Sphagnum Woodland (BS) ecotype tends to occur at lower topographic positions on seepage slopes, level sites, and in poorly drained peat-filled depressions (basins), on substrates derived from till deposits or in areas of scoured bedrock. On

these landforms, underlying impermeable layers minimize groundwater movement through peat. Depressions are typically located in small watersheds and receive minimal surface water input. Drainage is poor. Within the Study Area, it is considered a transitional ecosystem unit between that of the BF ecotype and bogs or fens and is often found around the margins of these wetlands. The moisture regime is imperfect to poor, with a poor to medium nutrient regime (Figure 6.6). This ecotype is the second most common in the Study Area and occupies approximately 49.6 percent (12.5 km^2) (Table 6.16).

Plant community diversity is summarized in Table 6.17. Vegetation is composed primarily of bog species (see below) adapted to the nutrient poor conditions which exist there. Overall species diversity is high, with areas bordering the margins of other wetland types (i.e., FE ecotypes) potentially elevating the species richness for this ecotype. Tree cover is often sparse, consisting mainly of black spruce with the scattered tamarack. Ground vegetation is dominated by ericaceous shrubs and a sphagnum moss (*Sphagnum* spp.) carpet with micro-hummocks punctuated by fine-leaved graminoids (e.g., *Carex* spp.). The shrub layer is well developed and dominated by scrub black spruce, common Labrador tea, leather-leaf (*Chamaedaphne calyculata*), creeping snowberry (*Gaultheria hispidula*) and small bog cranberry (*Vaccinium oxycoccos*). Forb / herb cover is limited, but may include Canada burnet (*Sanguisorba canadensis*), cloudberry (*Rubus chamaemorus*), and three-leaf false Solomon's-seal (*Maianthemum trifolium*). Common fine-leaved graminoids include sheathed sedge (*Carex vaginata*), three-seeded sedge (*Carex trisperma*), and few-seeded sedge (*Carex oligosperma*). The moss layer is prominent, consisting of a *Sphagnum* moss carpet with moderately high micro-hummocks, usually occurring where tree cover has established. Screber’s moss is often abundant on micro-hummocks in drier areas where it is interspersed with *Dicranum* species. The mean species richness was 43.8 for vascular and 5.4 for non-vascular.

Figure 6.6 Edatopic Grid for Black Spruce / Tamarack-Sphagnum Woodland Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6		60%	40%		
7					
8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

*Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class

Photo 21 Black Spruce / Tamarack-Sphagnum Woodland Ecotype – Aerial View

Photo 22 Black Spruce / Tamarack-Sphagnum Woodland Ecotype – Ground View

Photo 23 Black Spruce / Tamarack-Sphagnum Woodland Ecotype – Typical Vegetation

Photo 24 Black Spruce / Tamarack-Sphagnum Woodland Ecotype – Typical Soil Profile

Table 6.16 Summary of Ecological Condition for Black Spruce / Tamarack-Sphagnum Woodland Ecotype

Black Spruce / Tamarack-Sphagnum Woodland Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Black Spruce / Tamarack-Sphagnum Woodland Ecotype (BS)
General Location:	Widely distributed. Restricted to areas with imperfect drainage. Transitional between coniferous forest and bog or fen types and often found around the margins of these wetlands where drainage is poor
Inventory Numbers:	D18, D21, G19, G36, G51,
Number of Sample Plots (n):	n=5
Site Characteristics	
Surface Expression:	Depression
Topographic Position:	At toe of slope positions with excessive seepage input, in level areas, or depressions
Slope:	2-5%
Aspect:	Variable
Soil Nutrient Regime:	Typically classed as having very poor (A) to poor (B) nutrient status, with the majority of sites classed as poor (A).
Soil Moisture Regime:	Subhygric (5) to subhydric (7)
Successional Status:	Maturing seral
Structural Stage:	Mature Forest
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	80 to100
Humus Form:	Humimor, fibrimor, mesimor
Surface (Topsoil) Texture:	N/A
Average Topsoil Thickness (cm) :	N/A
Seepage:	N/A
Drainage:	Poor to very poor
Depth to Water Table:	40
Depth to Mottles / Gleying (cm):	50
Effective Texture	N/A
Effective Rooting Depth (cm):	20
Coarse Fragment Percent and Type:	N/A
Depth to Bedrock (cm):	>100
Parent Material:	Organic, Morainal (Till)
Soil Classification (CSSC):	Terric and Typic Fibrisols, Terric and Typic Mesisols, Orthic and Fera Gleysols, Gleyed Podzols

Black Spruce / Tamarack-Sphagnum Woodland Ecotype	
Vegetation	
Overstory Descriptor:	*Picea mariana, Larix laricina*
Understory Descriptor:	*Picea mariana, Larix laricina*
Dominant Shrub Species (% cover):	*Chamaedaphne calyculata*
Dominant Herb / Forb Species (% cover):	*Sanguisorba canadensis*
Dominant Graminoid Species (% cover):	*Carex vaginata*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Sphagnumspp.*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	*Rubus chamaemorus*
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	43.8/5.4
Species At Risk / Species of Conservation Concern:	*None*

Plant Community Diversity

Table 6.17 Plant Community Diversity for Black Spruce / Tamarack-Sphagnum Woodland Ecotype

Black Spruce / Tamarack-Sphagnum Woodland Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Picea mariana	black spruce	tree	5	30	5	13.40	1.00
Larix laricina	larch	tree	5	10	5	5.00	0.60
Abies balsamea	balsam fir	tree	5	5	5	1.00	0.20
Shrub Layer							
Picea mariana	black spruce	tall shrub	5	15	5	8.60	1.00
Larix laricina	larch	tall shrub	0.5	8	5	2.90	0.80
Salix pedicellaris	bog willow	tall shrub	2	2	5	0.40	0.20
Salix spp.	a willow	tall shrub	0.5	0.5	5	0.10	0.20
Chamaedaphne calyculata	leatherleaf	low shrub	2.5	30	5	10.12	0.80
Rhododendron groenlandicum	common Labrador tea	low shrub	5	14.5	5	8.14	1.00
Picea mariana	black spruce	low shrub	2.4	10	5	7.54	1.00
Larix laricina	larch	low shrub	1	10	5	4.94	0.80

Black Spruce / Tamarack-Sphagnum Woodland Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Myrica gale	sweet gale	low shrub	0.5	7	5	2.10	1.00
Salix pedicellaris	bog willow	low shrub	1.5	5	5	1.30	0.40
Betula glandulosa	dwarf birch	low shrub	0.5	3	5	1.12	0.60
Kalmia polifolia	bog laurel	low shrub	0.5	2	5	0.70	0.60
Vaccinium uliginosum	bog bilberry	low shrub	0.5	1	5	0.30	0.40
Salix spp.	a willow	low shrub	1.3	1.3	5	0.26	0.20
Lonicera villosa	mountain fly honeysuckle	low shrub	0.9	0.9	5	0.18	0.20
Abies balsamea	balsam fir	low shrub	0.8	0.8	5	0.16	0.20
Linnaea borealis subsp. longiflora	twinflower	dwarf shrub	1	5	5	1.40	0.60
Gaultheria hispidula	creeping snowberry	dwarf shrub	0.6	3.4	5	1.20	0.80
Empetrum nigrum	black crowberry	dwarf shrub	0.7	3	5	0.94	0.60
Vaccinium angustifolium	lowbush blueberry	dwarf shrub	1	2.9	5	0.78	0.40
Chamaedaphne calyculata	leatherleaf	dwarf shrub	3	3	5	0.60	0.20
Kalmia polifolia	bog laurel	dwarf shrub	1	1	5	0.40	0.40
Andromeda polifolia	bog rosemary	dwarf shrub	0.5	1	5	0.40	0.60
Vaccinium uliginosum	bog bilberry	dwarf shrub	0.5	0.5	5	0.30	0.60
Vaccinium oxycoccos	small cranberry	dwarf shrub	0.5	0.5	5	0.30	0.60
Vaccinium caespitosum	dwarf blueberry	dwarf shrub	0.6	0.6	5	0.24	0.40
Vaccinium vitis-idaea subsp. minus	partridegeberry	dwarf shrub	0.5	0.5	5	0.10	0.20

Black Spruce / Tamarack-Sphagnum Woodland Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Herb Layer							
Sanguisorba canadensis	Canada burnet	forb	1	28	5	9.80	0.60
Rubus chamaemorus	cloudberry	forb	1	20	5	7.14	1.00
Equisetum sylvaticum	woodland horsetail	forb	5	6.3	5	2.26	0.40
Maianthemum trifolium	three-leaf false Solomon's-seal	forb	0.5	5.5	5	2.00	1.00
Equisetum arvense	field horsetail	forb	0.5	4.3	5	0.96	0.40
Eurybia radula	rough-leaved aster	forb	0.5	1.7	5	0.64	0.60
Geocaulon lividum	northern comandra	forb	1	2.1	5	0.62	0.40
Viola spp.	a violet	forb	1	1.3	5	0.46	0.40
Mitella nuda	bishop's-cap	forb	0.5	1	5	0.46	0.60
Solidago uliginosa	bog goldenrod	forb	1	1	5	0.40	0.40
Coptis trifolia	goldthread	forb	0.5	0.7	5	0.34	0.60
Lycopodium annotinum	bristly clubmoss	forb	0.5	1	5	0.30	0.40
Platanthera spp.	an orchid	forb	0.5	0.5	5	0.20	0.40
Rubus arcticus	northern blackberry	forb	0.5	0.5	5	0.20	0.40
Petasites frigidus var. palmatus	sweet coltsfoot	forb	1	1	5	0.20	0.20
Solidago macrophylla	large-leaf goldenrod	forb	0.9	0.9	5	0.18	0.20
Cornus canadensis	dwarf dogwood	forb	0.7	0.7	5	0.14	0.20
Pyrola spp.	a wintergreen	forb	0.5	0.5	5	0.10	0.20
Listera cordata var. cordata	heartleaf twayblade	forb	0.5	0.5	5	0.10	0.20
Ranunculus lapponicus	Lapland buttercup	forb	0.5	0.5	5	0.10	0.20

Black Spruce / Tamarack-Sphagnum Woodland Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Platanthera dilatata var. dilatata	leafy white orchis	forb	0.5	0.5	5	0.10	0.20
Orthilia secunda	one-side wintergreen	forb	0.5	0.5	5	0.10	0.20
Fragaria virginiana	Virginia strawberry	forb	0.5	0.5	5	0.10	0.20
Selaginella selaginoides	low spike-moss	forb	0.5	0.5	5	0.10	0.20
Graminoid Layer							
Carex vaginata	sheathed sedge	graminoid	15	19.5	5	6.90	0.40
Carex leptalea	bristly-stalk sedge	graminoid	10	10	5	2.00	0.20
Carex limosa	mud sedge	graminoid	10	10	5	2.00	0.20
Trichophorum cespitosum	deergrass	graminoid	2	3.7	5	1.14	0.40
Carex pauciflora	few-flowered sedge	graminoid	0.5	3	5	0.90	0.60
Calamagrostis canadensis	Canada reedgrass	graminoid	1	2	5	0.60	0.40
Carex oligosperma	few-seeded sedge	graminoid	0.6	2	5	0.52	0.40
Carex trisperma	three-fruited sedge	graminoid	2.1	2.1	5	0.42	0.20
Carex lachenalii	Arctic hare's-hoot sedge	graminoid	1.85	1.85	5	0.37	0.20
Juncus filiformis	thread rush	graminoid	0.6	1	5	0.32	0.40
Glyceria striata	fowl manna-grass	graminoid	0.5	1	5	0.30	0.40
Carex magellanica subsp. irrigua	boreal bog sedge	graminoid	0.5	0.5	5	0.20	0.40
Carex rostrata	bottle sedge	graminoid	1	1	5	0.20	0.20
Carex tenuiflora	sparse-flowered sedge	graminoid	0.7	0.7	5	0.14	0.20
Schizachne purpurascens	purple oatgrass	graminoid	0.6	0.6	5	0.12	0.20
Deschampsia flexuosa	crinkled hairgrass	graminoid	0.5	0.5	5	0.10	0.20
Eriophorum viridicarinatum	green keeled cottongrass	graminoid	0.5	0.5	5	0.10	0.20
Carex	inflated edge	graminoid	0.5	0.5	5	0.10	0.20

Black Spruce / Tamarack-Sphagnum Woodland Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
vesicaria							
Carex gynocrates	northern bog sedge	graminoid	0.5	0.5	5	0.10	0.20
Elymus trachycaulus	slender wheatgrass	graminoid	0.5	0.5	5	0.10	0.20
Moss / Lichen Layer							
Sphagnum spp.	sphagnum moss	moss	37.5	100	5	66.66	1.00
Pleurozium schreberi	Schreiber's moss	moss	1	46.5	5	22.98	1.00
Hylocomium splendens	stair-step moss	moss	15	15	5	3.00	0.20
Ptillium crista-castrensis	feathermoss	moss	0.7	5	5	1.14	0.40
Tomenthypnum nitens	tomenthypnum moss	moss	2	2.7	5	0.94	0.40
Drepanocladus revolvens	limprichita moss	moss	3	3	5	0.60	0.20
Aulacomnium palustre	ribbed bog moss	moss	1	1.5	5	0.50	0.40
Dicranum spp.	a broom moss	moss	0.5	0.5	5	0.10	0.20
Cladina rangiferina	grey reindeer moss	lichen	0.5	1	5	0.44	0.60
Peltigera spp.	a peltigera lichen	lichen	2.1	2.1	5	0.42	0.20
Cladina stellaris	star-tipped reindeer lichen	lichen	0.5	1	5	0.30	0.40
Cladonia spp.	cladonia lichen	lichen	1	1	5	0.20	0.20

** Detailed and ground inspection field sampling sites only.*

Soils associated with this ecotype include Fibrisols, Mesisols, Orthic Gleysols, and Fera Gleysols. They are typically deep organics; depth of organics can be less in areas of scoured bedrock. Gleyed Podzols are also found where these sites grade into dryer ecotypes. Surface horizons are usually dominated by poorly decomposed sphagnum mosses regardless of soil type. Mineral soil textures can vary between silt loam and sand. Drainage is usually poor to very poor, but is imperfect on transitional sites. Potential rooting depth is usually shallow due to high water levels and in some cases near-surface bedrock. Humus forms are dominated by Fibrimors and Mesimors on wet sites, and by Humimors on imperfectly drained sites. The water table is usually at or near the surface, particularly in hollows between micro-hummocks, but can vary by landform. This ecotype is generally nutrient-poor, with a subhygric to subhydric soil moisture regime. Site productivity is typically poor.

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Bog willow (*Salix pedicellaris*) was identified during field surveys of the MSF06 ecotype. This species is considered "Sensitive" by NLDEC indicating they are potentially susceptible to human activities or natural events. It has been assigned a ranking of "S2S4" by the ACCDC indicating that the species is considered rare to fairly common throughout Labrador and of long term concern. A second vascular plant species, purple oatgrass (*Schizachne purpurascens*), is listed as status "Undetermined" by NLDEC but has similarly been assigned ACCDC status rankings of "S2S4".

Disturbance and Succession Ecology

The BS ecotype is principally dependent on a relatively stable hydrologic regime, maintained by winter and spring precipitation and runoff via surface flow from adjacent uplands. Hydroperiod (the length of time and portion of year a wetland holds ponded water), water table depth and duration, is the primary driver of community composition with slope gradient determining the relative width of these ecotonal plant associations.

Wildlife and Wildlife Habitat

Moose sign was observed in this ecotype in 25 percent of the sites surveyed. This species may find adequate cover and forage in this ecotype in both summer and winter (Dodds 1960; Irwin 1985; Schwab and Pitt 1991; Newbury et al. 2007). Habitat was ranked as secondary.

Although caribou presence was not detected during field surveys, Black Spruce / Tamarack-Sphagnum Woodland ecotypes were rated as secondary for this species. Caribou home ranges encompass a wide variety forests, providing adequate cover and forage requirements are met.

Snowshoe hare presence was detected in this ecotype in each of the sites surveyed (75 percent), which provides vegetation that is suitable for both cover and forage year round for this species (Dodds 1960; Wolff 1978; Newbury and Simon 2005). It is well-documented that lynx favor snowshoe hare as prey and their population cycles closely followthose of snowshoe hare. Although no evidence of lynx was found in the sites surveyed, the habitat potential for this species has been rated as secondary due to the presence of hare as prey species.

Short needle trees and trees with live branches near the ground are two important habitat requirements for Spruce Grouse. Providing these are met Spruce Grouse may be found in a

wide range of habitat type (Soule et al. 1992). Evidence of Spruce Grouse was detected in 50 percent of the sites surveyed.

Black Spruce / Tamarack-Sphagnum Woodland sites are secondary habitat for porcupine because of the extensive tree cover and variety of forage available. Porcupine evidence was detected in 25 percent of the survey sites in this ecotype.

A summary of wildlife habitat use and potential for the Black Spruce / Tamarack-Sphagnum Woodland Ecotype is presented in Table 6.18.

Table 6.18 Summary of Wildlife Habitat Use and Potential for the Black Spruce / Tamarack-Sphagnum Woodland Ecotype

Black Spruce / Tamarack-Sphagnum Woodland Ecotype					
Species	**Habitat Potential**			**Occurrence %**	**Comments**
Common Name	**Primary**	**Secondary**	**Tertiary**		
Moose		•		25	Cover and forage available
Caribou		•		0	Cover and forage available
Beaver			•	0	
Snowshoe hare	•			75	Cover and forage available
Spruce Grouse	•			50	Cover and forage available
Short-eared Owl			•	0	
Porcupine		•		25	Cover and forage available
Lynx		•		0	adequate cover and prey available
Rusty Blackbird		•		0	
Canada Goose			•	0	

MSF 07 Ecotype: Tamarack / Black Spruce-Feathermoss (Water Track)

Map Code:	TF	**Name:**	Tamarack / Black Spruce-Feathermoss (Water Track)	**Ecotype:**	07
Total Area (km^2):	49.6			**Percentage of Study Area:**	12.5

General Site Description

The Tamarack / Black Spruce-Feathermoss (Water Track) (TF) ecotype typically occupies lower topographic positions in poorly drained depressions, often along shallow valley bottoms in areas of rolling, rocky terrain, within the floodplain of slow-moving rivers and streams. These sites usually have very high surface stoniness which reflects their deposition history. The water table is generally maintained at or near the level of the adjacent river or stream, and plays a substantial role in the development of this ecosystem unit. The moisture regime is imperfect to poor, with poor to medium and occasionally rich nutrient regimes (Figure 6.7). This ecotype occupies approximately 13 percent (49.6 km^2) of the Study Area (Table 6.19).

Plant community diversity is summarized in Table 6.20. Tree cover is often patchy and interspersed, comprising a sparse canopy of tamarack and black spruce or occasionally a pure canopy of tamarack. The shrub layer has variable cover and is dominated by tall-shrubs, including stunted tamarack and black spruce, dwarf birch, sweet gale (*Myrica gale*), bog willow and pussy willow (*Salix discolor*). Shrubby cinquefoil (*Dasiphora fruticosa*) and ericaceous species, especially Labrador tea, bog rosemary (*Andromeda polifolia*), blueberry (*Vaccinium* spp.), and creeping snowberry (*Gaultheria hispidula*), dominate the low-shrub layer. Forb / herb cover is also variable, and may include Canada burnet, woodland horsetail (*Equisetum sylvaticum*), bog goldenrod (*Solidago uliginosa*), and three-leaf false Solomon's-seal. Forb species, wood valerian (*Valeriana dioica*) and Green false hellebore (*Veratrum viride* var. *viride*), each with an S Rank of S1 as ranked by the Atlantic Canada Conservation Data Centre (ACCDC 2011), are also commonly associated with this ecotype. Graminoids are sparse, yet diverse, comprised of various fine-leaved graminoids, typically including deergrass (*Trichophorum cespitosum*), alpine cotton-grass (*Trichophorum alpinum*), sheathed sedge (*Carex vaginata*), lesser panicled sedge (*Carex diandra*) and ticklegrass (*Agrostis hyemalis*). The moss layer is prominent and characterized mainly by sphagnum mosses, interspersed by the micro-topographical hummock-forming moss *Tomenthypnum nitens*; along with ribbed bog moss (*Aulacomnium palustre*), and feathermosses, including Schreber's moss and stair-step moss (*Hylocomium splendens*). Water-filled hollows were occupied primarily by star campylium moss (*Campylium stellatum*). The mean species richness was 45.3 for vascular plant species and 3.8 for non-vascular plant species.

Figure 6.7 Edatopic Grid for Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6			25%	50%	
7			25%		
8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

*Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class

Photo 25 Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype – Aerial View

Photo 26 Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype – Ground View

Photo 27 Tamarack / Black Spruce-Feathermoss (Water Track)– Typical Vegetation (ACCDC Ranked *Veratrum viride* var. *viride* (S1))

Photo 28 Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype – Typical Soil Profile

Table 6.19 Summary of Ecological Condition for Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype

Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Tamarack / Black Spruce-Feathermoss (Water Track)
General Location:	Widely distributed. Restricted to areas with imperfect drainage. Transitional between coniferous forest and bog / fen types. Also in association with watercourses or seepage tracks, where seasonal flooding is prevalent.
Inventory Numbers:	G2, G41, G46, G52, V21, V27, V44, V45
Number of Sample Plots (n):	n=8
Site Characteristics	
Surface Expression:	Depression
Topographic Position:	Toe slope positions with excessive seepage input or in depressions
Slope:	2-5%
Aspect:	Variable
Soil Nutrient Regime:	Range from medium (C) to rich (D) nutrient status.
Soil Moisture Regime:	Range from subhygric (5) to subhydric (7)
Successional Status:	Maturing climax
Structural Stage:	Mature forest
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	10-278
Humus Form:	Humimor, fibrimor, mesimor
Surface (Topsoil) Texture:	N/A
Average Topsoil Thickness (cm) :	N/A
Seepage:	Yes
Drainage:	Very poor to Poor
Depth to Water Table:	10 to 20 cm
Depth to Mottles / Gleying:	>100 cm
Effective Texture	Mesisol
Effective Rooting Depth (cm)	0 to 50 cm
Coarse Fragment Percent and Type:	N/A
Depth to Bedrock:	>100 cm
Parent Material:	Fluvial, Organic, Morainal (Till),
Soil Classification (CSSC):	Terric and Typic Fibrisols, Terric and Typic Mesisols, Orthic and Fera Gleysols, Gleyed Podzols

Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype	
Vegetation	
Overstory Descriptor:	*Larix laricina, Picea mariana*
Understory Descriptor:	*Picea mariana*
Dominant Shrub Species (% cover):	*Dasiphora fruticosa, Betula glandulosa*
Dominant Herb / Forb Species (% cover):	*Sanguisorba canadensis*
Dominant Graminoid Species (% cover):	*Carex vaginata, Carex diandra, Trichophorum alpinum*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Tomenthypnum nitens, Sphagnum spp.*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	*Valeriana dioica*
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	45.3/3.8
Species At Risk / Species of Conservation Concern:	*Veratrum viride var. viride, Valeriana dioica, Primula mistassinica, Platanthera aquilonis, Ranunculus lapponicus, Packera aurea, Carex diandra , Salix pedicellaris*, *Schizachne purpurascens, Cirsium muticum, Pyrola asarifolia*

Plant Community Diversity

Table 6.20 Plant Community Diversity for Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype

Plant Community Diversity for Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Picea mariana	black spruce	tree	1	15	4	6.25	1.00
Larix laricina	larch	tree	5	15	4	10.00	1.00
Shrub Layer							
Abies balsamea	balsam fir	tall shrub	2	2	4	0.50	0.25
Picea mariana	black spruce	tall shrub	2	7	4	4.00	1.00
Betula glandulosa	dwarf birch	tall shrub	15	15	4	3.75	0.25
Larix laricina	larch	tall shrub	5	15	4	8.75	1.00
Salix discolor	pussy willow	tall shrub	5	5	4	1.25	0.25
Salix spp.	a willow	low shrub	0.5	1	4	0.38	0.50
Picea mariana	black spruce	low shrub	0.5	2	4	0.63	0.50
Vaccinium uliginosum	bog bilberry	low shrub	0.5	0.5	4	0.13	0.25
Kalmia polifolia	bog laurel	low shrub	0.5	0.5	4	0.13	0.25

Plant Community Diversity for Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Salix pedicellaris	bog willow	low shrub	1	5	4	2.75	0.75
Rhododendron groenlandicum	common Labrador tea	low shrub	15	15	4	3.75	0.25
Betula glandulosa	dwarf birch	low shrub	0.5	0.5	4	0.25	0.50
Juniperus communis	ground juniper	low shrub	0.5	0.5	4	0.13	0.25
Larix laricina	Larch	low shrub	10	10	4	7.50	0.75
Chamaedaphne calyculata	leatherleaf	low shrub	2	2	4	0.50	0.25
Lonicera villosa	mountain fly honeysuckle	low shrub	1	1	4	0.25	0.25
Salix discolor	pussy willow	low shrub	1	1	4	0.25	0.25
Dasiphora fruticosa	shrubby cinquefoil	low shrub	20	20	4	5.00	0.25
Myrica gale	sweet gale	low shrub	5	5	4	1.25	0.25
Empetrum nigrum	black crowberry	dwarf shrub	1	1	4	0.25	0.25
Vaccinium uliginosum	bog bilberry	dwarf shrub	1	1	4	0.25	0.25
Andromeda polifolia	bog rosemary	dwarf shrub	3	5	4	2.75	0.75
Gaultheria hispidula	creeping snowberry	dwarf shrub	1	1	4	0.50	0.50
Vaccinium caespitosum	dwarf blueberry	dwarf shrub	5	5	4	1.25	0.25
Vaccinium angustifolium	lowbush blueberry	dwarf shrub	2	2	4	0.50	0.25
Lonicera villosa	mountain fly honeysuckle	dwarf shrub	0.5	0.5	4	0.13	0.25
Vaccinium vitis-idaea subsp. minus	partridegeberry	dwarf shrub	0.5	0.5	4	0.13	0.25
Dasiphora fruticosa	shrubby cinquefoil	dwarf shrub	0.5	1	4	0.63	0.75
Vaccinium oxycoccos	small cranberry	dwarf shrub	0.5	0.5	4	0.25	0.50
Linnaea borealis subsp. longiflora	twinflower	dwarf shrub	1	1	4	0.25	0.25

Plant Community Diversity for Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Herb Layer							
Viola spp.	a violet	forb	1	1	4	0.25	0.25
Pyrola spp.	a wintergreen	forb	7	7	4	1.75	0.25
Platanthera spp.	an orchid	forb	0.5	0.5	4	0.25	0.50
Primula mistassinica	bird's-eye primrose	forb	1	1	4	0.25	0.25
Mitella nuda	bishop's-cap	forb	0.5	0.5	4	0.38	0.75
Solidago uliginosa	bog goldenrod	forb	1	2	4	1.00	0.75
Lycopodium annotinum	bristly clubmoss	forb	1	1	4	0.25	0.25
Sanguisorba canadensis	Canada burnet	forb	20	25	4	17.50	0.75
Clintonia borealis	Clinton lily	forb	1	1	4	0.25	0.25
Rubus chamaemorus	cloudberry	forb	1	1	4	0.25	0.25
Taraxacum ceratophorum	common dandelion	forb	0.5	0.5	4	0.13	0.25
Cornus canadensis	dwarf dogwood	forb	1	1	4	0.25	0.25
Packera aurea	golden groundsel	forb	1	2	4	0.75	0.50
Coptis trifolia	goldthread	forb	0.5	1	4	0.38	0.50
Veratrum viride var. viride	green false hellebore	forb	2	2	4	0.50	0.25
Viola labradorica	Labrador violet	forb	0.5	0.5	4	0.13	0.25
Ranunculus lapponicus	Lapland buttercup	forb	0.5	0.5	4	0.13	0.25
Platanthera dilatata var. dilatata	leafy white orchis	forb	1	1	4	0.25	0.25
Rhinanthus minor	little yellow-rattle	forb	0.5	0.5	4	0.13	0.25
Selaginella selaginoides	low spike-moss	forb	0.5	0.5	4	0.13	0.25
Epilobium palustre	marsh willowherb	forb	0.5	0.5	4	0.25	0.50
Rubus arcticus	northern blackberry	forb	0.5	1	4	0.63	0.75

Plant Community Diversity for Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Stellaria borealis	northern stitchwort	forb	1	1	4	0.25	0.25
Eurybia radula	rough-leaved aster	forb	2	2	4	0.50	0.25
Triglochin palustris	slender bog arrowgrass	forb	0.5	0.5	4	0.13	0.25
Petasites frigidus var. palmatus	sweet coltsfoot	forb	1	1	4	0.50	0.50
Maianthemum trifolium	three-leaf false Solomon's-seal	forb	1	5	4	2.75	1.00
Equisetum variegatum subsp. variegatum	variegated horsetail	forb	0.5	0.5	4	0.13	0.25
Fragaria virginiana	Virginia strawberry	forb	2	2	4	0.50	0.25
Equisetum sylvaticum	woodland horsetail	forb	0.5	5	4	1.63	0.75
Trichophorum alpinum	alpine cotton-grass	graminoid	5	15	4	6.25	0.75
Carex atratiformis	black sedge	graminoid	0.5	0.5	4	0.13	0.25
Carex magellanica subsp. irrigua	boreal bog sedge	graminoid	1	2	4	0.75	0.50
Carex rostrata	bottle sedge	graminoid	5	5	4	1.25	0.25
Carex leptalea	bristly-stalk sedge	graminoid	2	4	4	1.50	0.50
Carex brunnescens	brownish sedge	graminoid	0.5	0.5	4	0.13	0.25
Calamagrostis canadensis	Canada reedgrass	graminoid	0.5	2	4	0.88	0.75
Deschampsia flexuosa	crinkled hairgrass	graminoid	0.5	5	4	1.38	0.50
Trichophorum cespitosum	deergrass	graminoid	20	20	4	5.00	0.25
Glyceria striata	fowl manna-grass	graminoid	1	1	4	0.25	0.25
Eriophorum viridicarinatum	green keeled cottongrass	graminoid	1	5	4	1.50	0.50
Carex interior	inland sedge	graminoid	4	4	4	1.00	0.25

Plant Community Diversity for Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Carex diandra	lesser panicled sedge	graminoid	25	25	4	6.25	0.25
Carex limosa	mud sedge	graminoid	1	3	4	1.00	0.50
Carex gynocrates	northern bog sedge	graminoid	1	2	4	0.75	0.50
Carex vaginata	sheathed sedge	graminoid	0.5	15	4	6.38	0.75
Carex canescens	silvery sedge	graminoid	0.5	5	4	1.38	0.50
Elymus trachycaulus	slender wheatgrass	graminoid	0.5	2	4	1.13	0.75
Juncus filiformis	thread rush	graminoid	2	2	4	0.50	0.25
Agrostis hyemalis	ticklegrass	graminoid	0.5	10	4	2.63	0.50
Danthonia intermedia	vasey oatgrass	graminoid	0.5	0.5	4	0.13	0.25
Carex aquatilis	water sedge	graminoid	0.5	1	4	0.38	0.50
Carex flava	yellow sedge	graminoid	5	5	4	1.25	0.25
Moss / Lichen Layer							
Aulacomnium palustre	ribbed bog moss	moss	2	5	4	2.50	0.75
Pleurozium schreberi	Schreiber's moss	moss	20	20	4	5.00	0.25
Sphagnum spp.	sphagnum moss	moss	20	60	4	35.00	1.00
Hylocomium splendens	stair-step moss	moss	20	20	4	5.00	0.25
Campylium stellatum	star campylium moss	moss	10	10	4	5.00	0.50
Tomenthypnum nitens	tomenthypnum moss	moss	45	60	4	38.75	0.75

** Detailed and ground inspection field sampling sites only.*

Soils associated with this ecotype are mainly organic Fibrisols and Mesisols, dominated by organic layers in early to moderate stages of decomposition (Of and Om horizons). Organic soils may grade into mineral Gleysols at the edges of these sites. Humo-Ferric and Ferro-Humic Podzols, along with Gleyed subgroups are also possible. In many cases, soils also have surface O-horizons derived from sphagnum moss. These sites usually have very high surface stoniness which reflects their deposition history, but which may also be promoted by loss of finer material over time. Mineral soil texture is medium to coarse (silt loam to sand) and drainage is imperfect to poor on most sites. Potential rooting depth is variable, but is typically 30 cm or less because of high water and/or stone content. Humus forms are dominated by Hemimors and Humimors on imperfectly drained sites, and by Fibrimors and Mesimors on poorly drained sites. The water

table is usually at or near the surface, particularly in hollows between micro-hummocks, but can vary by landform. The ecotype is nutrient-medium to rich, with subhygric to subhydric soil moisture regimes. Drainage is very poor to poor and potential rooting depth is shallow due to high water levels. Site productivity is typically high in relation to the surrounding landscapes.

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*) have been identified from this ecotype.

Overall species richness was among the highest within the TF ecotype. Of all vascular plant species recorded, this ecotype supported the highest number of unique species with 11 species deemed of regional importance by the NLDEC, and ranked SH, S1 or S2 by the ACCDC. Three of those species, Green false hellebore (*Veratrum viride* var. *viride*), wood valerian (*Valeriana dioica*), and leafy northern green orchis (*Platanthera aquilonis*) are considered "May be at Risk" by NLDEC; assigned ACCDC ranks of S1, S1 and S2/S3, respectively, and are therefore considered here to be of high conservation concern within the province. Three other species, bird's-eye primrose (*Primula mistassinica*), Lapland buttercup (*Ranunculus lapponicus*), and bog willow (*Salix pedicellaris*) are considered "Sensitive" by NLDEC and have been assigned ranks of S2, S2S3, and S2S4, respectively, by the ACCDC.

The NLDEC considers the remaining five species, golden groundsel (*Packera aurea*), lesser panicled sedge (*Carex diandra*), purple oatgrass (*Schizachne purpurascens*), swamp thistle (*Cirsium muticum*), and pink wintergreen (*Pyrola asarifolia*) to be "Undetermined". Each of these species carries with it an ACCDC status ranking of "S2S4".

Disturbance and Succession Ecology

These sites are relatively stable. Fire frequency is low, and fire severity is low owing to their position in moist areas of low relief. Seasonal inundation, over-the-bank flooding, transport and deposition of sediment lead to the development of a patchy, sparse ground layer. Additionally, water levels are typically highest in the late winter and spring, creating many vernal pools commonly associated with many of these sites. Strong water level fluctuations over the growing season favor the establishment species otherwise typical of river and stream floodplains.

The TF ecotype is generally considered a later sere in vegetation succession on fluvial deposits. As water flows associated with these rivers or stream systems decreases, so does the frequency and severity of flooding within adjacent landscapes. As the thickness of organic and mineral soil deposits increases, small micro-hummocks form rising above the water table to provide sufficiently aerated conditions within the plant rooting zone from which woody and

herbaceous plants can become established. Although the accumulation of organic material can lead to the development of acidic, nutrient poor conditions, lateral flow of mineral-rich groundwater maintains these sites in a moderately nutrient rich condition. Over time a shrub thicket establishes to form the Riparian Thicket Ecotype. Eventually, shrub cover will be largely replaced by trees tolerant of a high water table resulting in the establishment of open larch / black spruce forests and succession to the Tamarack / Black Spruce-Feathermoss ecotype.

Wildlife and Wildlife Habitat

Tamarack / Black Spruce-Feathermoss provide nutrient rich herbaceous forage for moose (Newbury et al. 2007). There was no moose evidence in the sites surveyed in this ecotype.

Snowshoe hare sign was not detected in this ecotype although the shrub layer in Tamarack / Black Spruce-feathermoss may provide year round habitat for snowshoe hare. A dense understory is the preferred habitat for hare, providing both cover and forage. It is well documented that lynx favor snowshoe hare as prey and their population cycles follow each other closely. Although no evidence of lynx was found in the sites surveyed, the habitat potential for this species has been rated the same as hare because of this connection.

Although Spruce Grouse inhabit a wide range of habitat types, Soule et al. (1992) found that this species has two main habitat requirements: a short needle tree component, and trees with live branches to the ground, both of which may be found in Tamarack / Black Spruce-Feathermoss. This species was not detected in the sites surveyed.

Porcupine would likely use this Tamarack / Black Spruce-Feathermoss for various seasonal forage needs. Their presence was not found in the sites surveyed.

A summary of wildlife habitat use and potential for the Tamarack / Black Spruce-Feathermoss (Water Track) Ecotype is presented in Table 6.21.

Table 6.21 Summary of Wildlife Habitat Use and Potential for the Tamarack / Black Spruce-Feathermoss Ecotype

Tamarack / Black Spruce-Feathermoss Ecotype				
Species	**Habitat Potential**			**Occurrence %**
Common Name	**Primary**	**Secondary**	**Tertiary**	
Moose		•		0
Caribou		•		0
Beaver			•	0
Snowshoe hare		•		0
Spruce Grouse		•		0
Short-eared Owl			•	0
Porcupine		•		0
Lynx		•		0
Rusty Blackbird		•		0
Canada Goose			•	0

MSF 08 Ecotype: Softwood Burn / Regeneration

Map Code:	SB	**Name:**	Softwood Burn / Regeneration	**Ecotype:**	08
Total Area (km^2):	37.5			**Percentage of Study Area:**	9.5

General Site Description

As its name implies, the Softwood Burn / Regeneration (SB) ecotype represents post-fire sites in which tree cover has been greatly reduced or eliminated as a result of varied stand-replacing, natural disturbance events. Stand-replacement fires occur as mixed- and high-severity fire regimes, but as infrequent events across the MSF ecoregion. Such fires are usually wind-driven, with large, high severity fires capable of creating medium to large burned over patches on the landscape. Many recent (10 to 20 years) stand-replacing fires have occurred in black spruce dominated stands on upland sites throughout the Study Area (Photo 29). Black spruce is slow to establish after fire, and is typically replaced by post-fire tree and shrub species that have evolved mechanisms for rapid regeneration within these burn patches. Depending on site conditions and the severity of the fire regime, burned sites may succeed to Hardwood (HW) and/or Mixedwood (MW) ecotypes before returning to mature conifer cover, presumably Black Spruce-Labrador Tea-Feathermoss (BF) or Black Spruce-Lichen (BL). This ecotype occupies approximately 10 percent (37.5 km^2) of the Study Area (Table 6.22).

At this stage, tree cover generally consists of isolated patches of trees which survived the fire (mainly black spruce), with a sparse cover of regenerating trees of the same species. The shrub layer is dominated by ericaceous species including common Labrador tea, dwarf birch, late lowbush blueberry, dwarf blueberry, bog bilberry and prairie willow (*Salix humilis*). Ground vegetation is sparse and composition is quite variable. Some of the more common species include fireweed, large-leaf goldenrod, and crinkled hairgrass. The moss / lichen layer, where not removed by high-severity fire regimes, is typically dominated by Schreber's moss, hair-cap moss, cladonia lichens and cladina lichens. Plant community diversity is summarized in Table 6.23. The mean species richness was 27.0 for vascular plant species and 8.5 for non-vascular plant species.

For the most part, soils are the same as those which existed prior to the stand-replacing, natural disturbance event and described for Black Spruce-Labrador Tea-Feathermoss or Black Spruce-Lichen sites, except that forest floor horizons are thinner on burned sites. An edatopic grid for this ecotype is presented in Figure 6.8.

Figure 6.8 Edatopic Grid for Softwood Burn / Regeneration Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
		A	B	C	D	E
	0					
	1					
	2		25%			
	3		25%			
	4		50%			
	5					
	6					
	7					
	8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

*Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class

Photo 29 Softwood Burn / Regeneration Ecotype – Aerial View

Photo 30 Softwood Burn / Regeneration Ecotype – Ground View

Photo 31 Softwood Burn / Regeneration Ecotype – Typical Vegetation

Photo 32 Softwood Burn / Regeneration Ecotype – Typical Soil Profile

Environmental Information

Table 6.22 Summary of Ecological Condition for Softwood Burn / Regeneration Ecotype

Softwood Burn / Regeneration Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Softwood Burn / Regeneration (SB)
General Location:	Large burn patches are present throughout study area
Inventory Numbers	D3, D31, G24, G37B, V1, V2, V3, V13, V29, V31, V48
Number of Sample Plots (n):	n=11
Site Characteristics	
Surface Expression:	Variable
Topographic Position:	Lower slope, mid slope, upper slope and crest
Slope:	Variable
Aspect:	Variable
Soil Nutrient Regime:	Typically classed as having poor (B) to medium (C) nutrient status.
Soil Moisture Regime:	Subxeric (2) to Mesic (4)
Successional Status:	Extensive areas of burned forest are present in upland areas where pioneer seral and young seral communities exist
Structural Stage:	Young forest
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	4 (forest floor horizons typically thinner on burned sites than unburned)
Humus Form:	Hemimor
Surface (Topsoil) Texture:	Sand, loamy sand
Average Topsoil Thickness (cm) :	14
Seepage:	N/A
Drainage:	Rapid to well
Depth to Water Table:	>100
Depth to Mottles / Gleying:	>50
Effective Texture	Loamy sand
Effective Rooting Depth (cm)	15
Coarse Fragment Percent and Type:	<5% gravels
Depth to Bedrock:	>100
Parent Material:	Morainal (Till), Colluvium
Soil Classification (CSSC):	Orthic and Orstein Humo-Ferric and Ferro-Humic Podzols

Softwood Burn / Regeneration Ecotype	
Vegetation	
Overstory Descriptor:	*Picea mariana*
Understory Descriptor:	N/A
Dominant Shrub Species (% cover):	*Rhododendron groenlandicum*
Dominant Herb / Forb Species (% cover):	*Cornus canadensis*
Dominant Graminoid Species (% cover):	*Deschampsia flexuosa*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Pleurozium schreberi*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	27.0/8.5
Species At Risk / Species of Conservation Concern:	None observed

Plant Community Diversity

Table 6.23 Plant Community Diversity for Softwood Burn / Regeneration Ecotype

Softwood Burn / Regeneration Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Picea mariana	black spruce	tree	2	30	4	8.00	0.50
Abies balsamea	balsam fir	tree	3	5	4	2.00	0.50
Larix laricina	larch	tree	2	2	4	0.50	0.25
Shrub Layer							
Betula glandulosa	dwarf birch	tall shrub	10	10	4	2.50	0.25
Salix humilis	prairie willow	tall shrub	8	8	4	2.00	0.25
Alnus viridis subsp. crispa	mountain alder	tall shrub	7	7	4	1.75	0.25
Abies balsamea	balsam fir	tall shrub	0.5	6	4	1.63	0.50
Picea mariana	black spruce	tall shrub	0.5	2	4	0.88	0.75
Salix spp.	a willow	tall shrub	2	2	4	0.50	0.25
Betula minor	dwarf white birch	tall shrub	1	1	4	0.25	0.25
Amelanchier bartramiana	Bartram's shadbush	tall shrub	0.5	0.5	4	0.13	0.25

Softwood Burn / Regeneration Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Sorbus decora	showy mountain-ash	tall shrub	0.5	0.5	4	0.13	0.25
Rhododendron groenlandicum	common Labrador tea	low shrub	3	45	4	13.33	0.75
Betula glandulosa	dwarf birch	low shrub	0.5	36.5	4	10.80	0.75
Salix humilis	prairie willow	low shrub	7.1	8	4	3.78	0.50
Vaccinium angustifolium	lowbush blueberry	low shrub	15.05	15.05	4	3.76	0.25
Vaccinium uliginosum	bog bilberry	low shrub	0.5	5	4	1.38	0.50
Vaccinium caespitosum	dwarf blueberry	low shrub	0.5	1	4	0.38	0.50
Abies balsamea	balsam fir	low shrub	0.5	0.5	4	0.25	0.50
Picea mariana	black spruce	low shrub	0.5	0.5	4	0.25	0.50
Rubus idaeus	red raspberry	low shrub	0.5	0.5	4	0.13	0.25
Vaccinium angustifolium	lowbush blueberry	dwarf shrub	1	10	4	4.38	1.00
Vaccinium caespitosum	dwarf blueberry	dwarf shrub	2	14.7	4	4.18	0.50
Vaccinium vitis-idaea subsp. minus	partridegeberry	dwarf shrub	0.5	3.65	4	1.54	0.75
Vaccinium uliginosum	bog bilberry	dwarf shrub	0.5	2	4	0.63	0.50
Empetrum nigrum	black crowberry	dwarf shrub	0.5	1	4	0.38	0.50
Gaultheria hispidula	creeping snowberry	dwarf shrub	1	1	4	0.25	0.25
Linnaea borealis subsp. longiflora	twinflower	dwarf shrub	1	1	4	0.25	0.25
Rhododendron groenlandicum	common Labrador tea	dwarf shrub	0.5	0.5	4	0.13	0.25
Betula glandulosa	dwarf birch	dwarf shrub	0.5	0.5	4	0.13	0.25
Salix humilis	prairie willow	dwarf shrub	0.5	0.5	4	0.13	0.25
Herb Layer							
Cornus canadensis	dwarf dogwood	forb	5	5	4	1.25	0.25

Softwood Burn / Regeneration Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Diphasiastrum sitchense	Alaskan clubmoss	forb	4.8	4.8	4	1.20	0.25
Diphasiastrum complanatum	trailing clubmoss	forb	4.1	4.1	4	1.03	0.25
Chamerion angustifolium	fireweed	forb	0.5	2	4	0.63	0.50
Solidago macrophylla	large-leaf goldenrod	forb	2	2	4	0.50	0.25
Coptis trifolia	goldthread	forb	0.5	1	4	0.38	0.50
Rubus pubescens	dwarf red raspberry	forb	0.5	0.5	4	0.13	0.25
Deschampsia flexuosa	crinkled hairgrass	graminoid	0.5	15	4	5.48	1.00
Piptatherum canadense	Canada mountain ricegrass	graminoid	1.9	1.9	4	0.48	0.25
Carex spp.	a sedge	graminoid	0.5	0.5	4	0.13	0.25
Moss / Lichen Layer							
Pleurozium schreberi	Schreber's moss	moss	2	50	4	23.25	0.75
Polytrichum spp.	a haircap moss	moss	1.85	11	4	7.71	1.00
Aulacomnium palustre	ribbed bog moss	moss	0.5	7.5	4	2.00	0.50
Dicranum spp. - C2	a broom moss	moss	5	5	4	1.25	0.25
Cladonia spp.	cladonia lichen	lichen	0.5	35	4	15.13	1.00
Cladina arbuscula	reindeer lichen	lichen	3	31	4	10.93	0.75
Crustose lichen spp.	crustose lichen	lichen	10	16	4	6.50	0.50
Cladina mitis	lesser green reindeer moss	lichen	3	10.1	4	4.53	0.75
Cladina rangiferina	grey reindeer moss	lichen	1	7.5	4	2.13	0.50
Peltigera spp.	a peltigera lichen	lichen	0.5	5.9	4	1.60	0.50
Cladonia gracilis	smooth cladonia	lichen	0.5	5	4	1.38	0.50
Cladonia spp. - C14	cladonia lichen	lichen	5	5	4	1.25	0.25
Cladonia spp. - C0	cladonia lichen	lichen	3	3	4	0.75	0.25

Softwood Burn / Regeneration Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Cladina stellaris	star-tipped reindeer lichen	lichen	0.8	0.8	4	0.20	0.25
Cladonia rei	wand lichen	lichen	0.5	0.5	4	0.13	0.25
Cladonia botrytes	wooden soldiers	lichen	0.5	0.5	4	0.13	0.25

** Detailed and ground inspection field sampling sites only.*

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Disturbance and Succession Ecology

These sites are relatively stable and less prone to natural disturbance regimes. Fire frequency is low, and fire severity is also low owing to a lack of flash fuels (woody debris) and sometimes rocky, gravelly nature of the sites. Insect epidemics and early growing-season snow press may be important disturbance factors.

Early seral stages are represented by a dominance of ericaceous shrubs where stand-replacing fires have occurred; and a mix of patchily distributed black spruce, ericaceous and deciduous shrubs where mixed-severity burns have occurred. In stand-replacement burns, black spruce is often slow to re-establish. Ericaceous shrubs, including common Labrador tea, lowbush blueberry, bog bilberry and partridgeberry, usually precedes the establishment of canopy forming trees following stand replacement burns until the site has regained warmer, moister conditions and less exposure to frost. Succession advances very slowly owing to the short growing season, deep lingering snows, and cold temperatures.

Wildlife and Wildlife Habitat

Moose browse was observed in 25 percent of the sites in this ecotype during these surveys. This species may find good cover and forage in this ecotype in both summer and winter (Dodds 1960; Irwin 1985; Schwab and Pitt 1991; Newbury et al. 2007).

Snowshoe hare presence was detected in 50 percent of the sites in this ecotype, which provides vegetation that is suitable for both cover and forage year round for this species (Dodds 1960; Wolff 1978; Newbury and Simon 2005). It is well-documented that lynx favour snowshoe hare as prey and their population cycles follow each other closely. Although no evidence of lynx was found in the sites surveyed, the habitat potential for this species has been rated as secondary because of this connection.

Short needle trees and trees with live branches near the ground are two important habitat requirements for Spruce Grouse. Providing these are met Spruce Grouse may be found in a wide range of habitat type (Soule et al. 1992). These habitat requirements are found in Softwood Burn / Regeneration ecotype sites and evidence of Spruce Grouse was detected in 50 percent of sites visited.

A summary of wildlife habitat use and potential for the Softwood Burn / Regeneration Ecotype is presented in Table 6.24.

Table 6.24 Summary of Wildlife Habitat Use and Potential for the Softwood Burn / Regeneration

Summary of Wildlife Habitat Use and Potential for the Softwood Burn / Regeneration					
Species	**Habitat Potential**			**Occurrence %**	**Comments**
Common Name	**Primary**	**Secondary**	**Tertiary**		
Moose		•		25	Cover and forage available
Caribou			•	0	
Beaver			•	0	
Snowshoe hare		•		50	Cover and forage available
Spruce Grouse		•		50	Cover and forage available
Short-eared Owl			•	0	
Porcupine			•	0	
Lynx		•		0	Adequate cover and prey available
Rusty Blackbird			•	0	
Canada Goose			•	0	

MSF 09 Ecotype: Hardwood Burn / Regeneration

Map Code:	HB	**Name:**	Hardwood Burn / Regeneration	**Ecotype:**	09
Total Area (km^2):	5.4			**Percentage of Study Area:**	1.4

General Site Description

As per the SB ecotype, the Hardwood Burn / Regeneration (HB) ecotype reflects post-fire sites in which tree cover has been greatly reduced or eliminated as a result of varied stand-replacing, natural disturbance events (e.g., fire). Similarly, depending on site conditions and the severity of the fire regime, burned sites may succeed to a mid-seral community of Hardwood (HW) before returning to mature conifer or mixed conifer cover, presumably Black Spruce-Labrador Tea-Feathermoss (BL), Black Spruce-Lichen (BL) or Mixedwood (MW) ecotypes during late successional stages of development. This ecotype occupies approximately 1.4 percent (5.4 km^2) of the Study Area (Table 6.25).

Succession of post-fire plant communities is linked to a change in substrate, available nutrients (i.e., increase SNR) and microenvironment. Plant community diversity is summarized in Table 6.26. Where suitable conditions exist, a variety of late successional canopy trees may be recruited immediately after the stand replacement event starting with pioneering herbs and grasses, followed by intolerant hardwoods (white birch, heartleaf paper birch, trembling aspen (*Populus tremuloides*)), and finally by understory black spruce and occasionally balsam fir which will establish gradually over time. At this stage, tree cover generally consists of isolated patches of trees which survived the fire (mainly black spruce), with a sparse cover of regenerating black spruce. Shrub communities dominate the HB ecotype with a diffuse cover of mountain alder (*Alnus viridis* subsp. *crispa*), heartleaf paper birch, dwarf white birch and Salix spp. Ground vegetation is sparse and composition is quite variable. Some of the more common species include large-leaf goldenrod, fireweed, dwarf dogwood, and bristly clubmoss (*Lycopodium annotinum*). The moss / lichen layer, where not removed by high-severity fire regimes, is typically dominated by knight's plume moss (*Ptillium crista-castrensis*), cladonia lichens and cladina lichens. The mean species richness was 35.0 for vascular plant species and 4.0 for non-vascular plant species.

For the most part, soils are the same as those which existed prior to the stand-replacing, natural disturbance event and described for Black Spruce-Labrador Tea-Feathermoss or Black Spruce-Lichen sites, except that forest floor horizons are thinner on burned sites. An edatopic grid for this ecotype is presented in Figure 6.9.

Figure 6.9 Edatopic Grid for Hardwood Burn / Regeneration Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→ A	B	C	D	E
0					
1					
2					
3					
4		33%	67%		
5					
6					
7					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

***Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class**

Photo 33 Hardwood Burn / Regeneration Ecotype – Aerial View

Photo 34 Hardwood Burn / Regeneration Ecotype – Ground View

Photo 35 Hardwood Burn / Regeneration Ecotype – Typical Vegetation

Photo 36 Hardwood Burn / Regeneration Ecotype – Typical Soil Profile

Table 6.25 Summary of Ecological Condition for Hardwood Burn / Regeneration Ecotype

Hardwood Burn / Regeneration Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Hardwood Burn / Regeneration (HB)
General Location:	Large burn patches are present throughout study area
Inventory Numbers	D5, D6, G20, V7, V8, V32
Number of Sample Plots (n):	n=6
Site Characteristics	
Surface Expression:	Variable
Topographic Position:	Lower slope, mid slope, upper slope and crest
Slope:	Variable
Aspect:	Variable
Soil Nutrient Regime:	Typically classed as having poor (B) to medium (C) nutrient status, with the majority of sites classed as medium.
Soil Moisture Regime:	Mesic (4)
Successional Status:	Extensive areas of burned forest are present in upland areas where pioneer and young seral communities exist.
Structural Stage:	Young forest
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	7 (forest floor horizons thinner on burned sites than unburned sites)
Humus Form:	Hemimor
Surface (Topsoil) Texture:	Sandy loam to loamy sand
Average Topsoil Thickness (cm) :	8
Seepage:	N/A
Drainage:	Rapid to well
Depth to Water Table:	>100
Depth to Mottles / Gleying:	>50
Effective Texture	Sandy loam
Effective Rooting Depth (cm)	15
Coarse Fragment Percent and Type:	<5% gravels
Depth to Bedrock:	>100
Parent Material:	Morainal (Till), Colluvium
Soil Classification (CSSC):	Orthic and Orstein Humo-Ferric and Ferro-Humic Podzols

Hardwood Burn / Regeneration Ecotype	
Vegetation	
Overstory Descriptor:	*Betula papyrifera* var. *cordifolia,*
Understory Descriptor:	*Picea mariana*
Dominant Shrub Species (% cover):	*Alnus viridis* subsp. *crispa*
Dominant Herb / Forb Species (% cover):	*Solidago macrophylla*
Dominant Graminoid Species (% cover):	*Deschampsia flexuosa*
Dominant Mosses, Liverwort, Lichen (% cover):	*Ptillium crista-castrensis*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	29.7/9.0
Species At Risk / Species of Conservation Concern:	None observed

Plant Community Diversity

Table 6.26 Plant Community Diversity for Hardwood Burn / Regeneration Ecotype

Hardwood Burn / Regeneration Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Betula papyrifera var. cordifolia	heartleaf paper birch	tree	0.5	0.5	3	0.17	0.33
Shrub Layer							
Betula glandulosa	dwarf birch	tall shrub	7	30	3	20.67	1.00
Alnus viridis subsp. crispa	mountain alder	tall shrub	20	20	3	6.67	0.33
Salix spp.	a willow	tall shrub	2	10	3	5.67	1.00
Betula papyrifera var. cordifolia	heartleaf paper birch	tall shrub	7	10	3	5.67	0.67
Betula minor	dwarf white birch	tall shrub	2	3	3	1.67	0.67
Abies balsamea	balsam fir	tall shrub	0.5	0.5	3	0.17	0.33
Picea mariana	black spruce	tall shrub	0.5	0.5	3	0.17	0.33
Larix laricina	larch	tall shrub	0.5	0.5	3	0.17	0.33
Betula glandulosa	dwarf birch	low shrub	0.5	25	3	10.17	1.00
Rhododendron groenlandicum	common Labrador tea	low shrub	1	10	3	5.83	1.00
Vaccinium uliginosum	bog bilberry	low shrub	1	15	3	5.33	0.67

Hardwood Burn / Regeneration Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Vaccinium angustifolium	lowbush blueberry	low shrub	15	15	3	5.00	0.33
Ribes glandulosum	skunk currant	low shrub	2	2.6	3	1.53	0.67
Amelanchier bartramiana	Bartram's shadbush	low shrub	0.5	1	3	0.50	0.67
Rubus idaeus	red raspberry	low shrub	1	1	3	0.33	0.33
Viburnum edule	squashberry	low shrub	1	1	3	0.33	0.33
Vaccinium angustifolium	lowbush blueberry	dwarf shrub	20	30	3	24.77	1.00
Vaccinium uliginosum	bog bilberry	dwarf shrub	14.1	14.1	3	4.70	0.33
Vaccinium caespitosum	dwarf blueberry	dwarf shrub	1	4.8	3	1.93	0.67
Vaccinium vitis-idaea subsp. minus	partridegeberry	dwarf shrub	0.5	2	3	0.83	0.67
Linnaea borealis subsp. longiflora	twinflower	dwarf shrub	0.5	0.5	3	0.17	0.33
Herb Layer							
Cornus canadensis	dwarf dogwood	forb	2	21.5	3	9.50	1.00
Lycopodium annotinum	bristly clubmoss	forb	1	14.2	3	5.07	0.67
Chamerion angustifolium	fireweed	forb	1.2	5	3	2.07	0.67
Solidago macrophylla	large-leaf goldenrod	forb	5	5	3	1.67	0.33
Geocaulon lividum	northern comandra	forb	1	2	3	1.33	1.00
Lycopodium dendroideum	prickly tree-clubmoss	forb	2	2	3	0.67	0.33
Diphasiastrum sitchense	Alaskan clubmoss	forb	0.5	0.5	3	0.17	0.33
Deschampsia flexuosa	crinkled hairgrass	graminoid	2	5	3	3.30	1.00
Calamagrostis canadensis	Canada reedgrass	graminoid	0.5	0.5	3	0.17	0.33
Luzula parviflora	small flowered woodrush	graminoid	0.5	0.5	3	0.17	0.33

Hardwood Burn / Regeneration Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Moss / Lichen Layer							
Pleurozium schreberi	Schreiber's moss	moss	0.5	47	3	16.17	1.00
Ptillium crista-castrensis	knight's plume	moss	16.25	16.25	3	5.42	0.33
Polytrichum spp.	a haircap moss	moss	2.7	5	3	3.90	1.00
Crustose lichen spp.	crustose lichen	lichen	1	20	3	7.00	0.67
Cladonia spp. (brown) - C14	cladonia lichen	lichen	15	15	3	5.00	0.33
Cladonia gracilis	smooth cladonia	lichen	1	7	3	3.85	1.00
Cladina arbuscula	reindeer lichen	lichen	0.5	10	3	3.83	1.00
Cladina mitis	lesser green reindeer moss	lichen	5	5.15	3	3.38	0.67
Cladonia spp.	cladonia lichen	lichen	1	5	3	2.77	1.00
Cladonia sulphurina	cladonia lichen	lichen	5	5	3	1.67	0.33
Cladina rangiferina	grey reindeer moss	lichen	0.5	1	3	0.73	1.00
Peltigera spp.	a peltigera lichen	lichen	0.5	0.5	3	0.17	0.33
Cetraria islandica	Iceland moss	lichen	0.5	0.5	3	0.17	0.33

** Detailed and ground inspection field sampling sites only.*

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Disturbance and Succession Ecology

These sites are relatively stable and less prone to natural disturbance regimes. Fire frequency is low, and fire severity is also low owing to a lack of flash fuels (woody debris) and sometimes rocky, gravelly nature of the sites. Insect epidemics and early growing-season snow press may be important disturbance factors.

Early seral stages are represented by a dominance of ericaceous shrubs where stand-replacing fires have occurred; and a mix of patchily distributed black spruce, ericaceous and deciduous where mixed-severity burns have occurred. In stand-replacement burns, black spruce is often slow to re-establish. In the absence of a tree overstory, deciduous shrub communities usually precede the establishment of canopy forming trees following stand replacement burns. Succession advances very slowly owing to the short growing season, deep lingering snows, and cold temperatures. Sucession of hardwoods that re-establish naturally and dominate after disturbance is likely a function of the initial competitive interactions of plant species and the relative shade tolerances of those species. Other ecological variables potentially contributing to the early establishment of hardwoods on the site may include the composition of the pre-disturbance forest community, soil properties (e.g., SMR, SNR), slope and aspect.

Wildlife and Wildlife Habitat

Moose sign (winter scat) was observed in 33 percent of the sites within this ecotype during these surveys. This species may find good cover and forage in this ecotype in both summer and winter (Dodds 1960; Irwin 1985; Schwab and Pitt 1991; Newbury et al. 2007).

Snowshoe hare presence was detected in 33 percent of the sites in this ecotype, which provides vegetation that is suitable for both cover and forage year round for this species (Dodds 1960; Wolff 1978; Newbury and Simon 2005). It is well-documented that lynx favour snowshoe hare as prey and their population cycles follow each other closely. Although no evidence of lynx was found in the sites surveyed, the habitat potential for this species has been rated as secondary because of this connection.

Short needle trees and trees with live branches near the ground are two important habitat requirements for Spruce Grouse. Providing these are met Spruce Grouse may be found in a wide range of habitat type (Soule et al. 1992). These habitat requirements are found in Hardwood Burn / Regeneration sites and evidence of Spruce Grouse was detected in 33 percent of sites visited.

A summary of wildlife habitat use and potential for the Hardwood Burn / Regeneration Ecotype is presented in Table 6.27.

Table 6.27 Summary of Wildlife Habitat Use and Potential for the Hardwood Burn / Regeneration

Hardwood Burn / Regeneration					
Species	**Habitat Potential**			**Occurrence %**	**Comments**
Common Name	**Primary**	**Secondary**	**Tertiary**		
Moose		•		33	Cover and forage available
Caribou		•		0	Some cover and forage available
Beaver			•	0	
Snowshoe hare	•			33	Cover and forage available
Spruce Grouse		•		33	Cover and forage available
Short-eared Owl			•	0	
Porcupine			•	0	
Lynx		•		0	Adequate cover and prey available
Rusty Blackbird			•	0	
Canada Goose			•	0	

6.2.4.3 Riparian Ecosystem Units

MSF 10 Ecotype: Riparian Thicket

Map Code:	RT	**Name:**	Riparian Thicket	**Ecotype:**	10
Total Area (km^2):	0.3			**Percentage of Study Area:**	0.1

General Site Description

The Riparian Thicket (RT) ecotype is most often associated with fluvial and lacustrine deposits, with drainage ranging from poor to well-drained. They are typically found along the shores of large lakes and rivers, along stream margins and/or on slopes with groundwater discharge and subsurface water flow, often occupying areas where sediments have been deposited. Though similar in their occurrence, the RT ecotype is often found in drier areas than the Riparian Marsh (Fen) ecotype (Figure 6.10). This ecotype is limited in its extent and currently occupies approximately 0.1 percent (0.3 km^2) of the Study Area (Table 6.28).

Plant community diversity is summarized in Table 6.29. The vegetation of the RT ecotype is characterized by a dense shrub thicket composed of a mixture of tall and low shrub species. They are rich, diverse sites typically lacking an overstory. The tree layer, if present, is composed of scattered coniferous and deciduous species comprised of scattered heart-leaved paper birch, white spruce and balsam fir. The shrub layer is well-developed but can be quite variable, ranging from northern willow (*Salix argyrocarpa*) dominated thickets to more diverse mixtures of tall and low shrub species, with willow spp., sweet gale (*Myrica gale*) silky dogwood (*Cornus sericea*) and red raspberry (*Rubus idaeus*) occurring in descending order of abundance. Owing to a high cover of tall and low shrub species, the herb layer, if present, is often very poorly

developed. However, in areas with moist, rich site conditions, the herb layer is often well developed and tends to support a relatively high diversity of herbaceous species. Similarly, a thick, nutrient rich layer of fallen leaves (litter) largely precludes the occurrence of cryptogams. Dominant graminoids occurring under the willow canopies as well as standing alone and in various combinations include water sedge (*Carex aquatilis*) and silvery sedge (*Carex canescens*). The mean species richness was 10.0 for vascular plant species and 11.0 for non-vascular plant species.

Within the Study Area, the RT ecotype is limited in extent and distribution, with beaver activity and free-flowing streams considered important to the development and persistence of this non-forested riparian ecosystem. Extensive willow-dominated thickets have generated behind beaver dams on waterbodies (i.e., ponds) located to the north of Rose Pit.

Figure 6.10 Edatopic Grid for Riparian Thicket Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
		A	B	C	D	E
	0					
	1					
	2					
	3					
	4					
	5					
	6			100%		
	7					
	8					

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

***Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class**

Photo 37 Riparian Thicket Ecotype – Aerial View

Photo 38 Riparian Thicket Ecotype – Ground View

Photo 39 Riparian Thicket Ecotype – Typical Vegetation

Photo 40 Riparian Thicket Ecotype – Typical Soil Profile

Table 6.28 Summary of Ecological Condition for Riparian Thicket Ecotype

Riparian Thicket Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Riparian Thicket Ecotype (RT)
General Location:	Narrowly distributed. Restricted primarily to riparian areas along the margins of larger rivers and streams, subject to seasonal flooding
Inventory Numbers:	D32, V16, V39
Number of Sample Plots (n):	n=3
Site Characteristics	
Surface Expression:	Level
Topographic Position:	Level (slopes <2%); depression
Slope:	<2%
Aspect:	Variable
Soil Nutrient Regime:	Medium (C) to rich (D) nutrient status
Soil Moisture Regime:	Hygric (6) to Hydric (8)
Successional Status:	Young edaphic climax
Structural Stage:	Shrub / herb (SH)
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	7
Humus Form:	Fibrimor, Mesimor
Surface (Topsoil) Texture:	Sandy loam
Average Topsoil Thickness (cm) :	9
Seepage:	N/A
Drainage:	Poor to Very Poor
Depth to Water Table:	0 to 10 cm
Depth to Mottles / Gleying:	10+ cm
Effective Texture	Loamy sand
Effective Rooting Depth (cm)	0 to 50 cm
Coarse Fragment Percent and Type:	<5%
Depth to Bedrock:	>100 cm
Parent Material:	Fluvial, Lacustrine, Morainal (till)
Soil Classification (CSSC):	Fluvial / Lacustrine: Orthic Regosols, Gleyed Regosols, and Gleyed Humic Regosols; Morainal (till): Gleysols, Gleyed Podzols
Vegetation	
Overstory Descriptor:	N/A
Understory Descriptor:	N/A

Riparian Thicket Ecotype	
Dominant Shrub Species (% cover):	*Salix argyrocarpa*
Dominant Herb / Forb Species (% cover):	*Viola spp.*
Dominant Graminoid Species (% cover):	*Carex aquatilis*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Polytrichum spp.*
Dominant Aquatic / Wetland Species (% cover):	N/A
Plant Indicator Species:	*Salix argyrocarpa*
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	10.0/11.0
Species At Risk / Species of Conservation Concern:	Not detected

Plant Community Diversity

Table 6.29 Plant Community Diversity for Riparian Thicket Ecotype

Riparian Thicket Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Shrub Layer							
Salix argyrocarpa	northern willow	low shrub	47.2	47.2	1	47.20	1.00
Betula glandulosa	dwarf birch	low shrub	0.5	0.5	1	0.50	1.00
Herb Layer							
Viola spp.	a violet	forb	0.5	0.5	1	0.50	1.00
Carex aquatilis	water sedge	graminoid	8.9	8.9	1	8.90	1.00
Carex canescens	silvery sedge	graminoid	4.4	4.4	1	4.40	1.00
Poa spp.	a bluegrass	graminoid	0.5	0.5	1	0.50	1.00
Carex brunnescens	brownish sedge	graminoid	0.5	0.5	1	0.50	1.00
Agrostis hyemalis	ticklegrass	graminoid	0.5	0.5	1	0.50	1.00
Moss / Lichen Layer							
Polytrichum spp.	a haircap moss	moss	44.8	44.8	1	44.80	1.00
Aulacomnium palustre	ribbed bog moss	moss	17	17	1	17.00	1.00
Dicranum spp. (midget) - C2	a broom moss	moss	5.5	5.5	1	5.50	1.00

Riparian Thicket Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Pleurozium schreberi	Schreiber's moss	moss	4.2	4.2	1	4.20	1.00
Moss spp.	unknown moss	moss	1	1	1	1.00	1.00
Climacium dendroides	tree moss	moss	0.5	0.5	1	0.50	1.00
Cladina spp.	reindeer lichen	lichen	0.65	0.65	1	0.65	1.00
Cladonia gracilis	smooth cladonia	lichen	0.6	0.6	1	0.60	1.00
Peltigera spp.	a peltigera lichen	lichen	0.5	0.5	1	0.50	1.00
Cladina mitis	lesser green reindeer moss	lichen	0.5	0.5	1	0.50	1.00
Cladina stellaris	star-tipped reindeer lichen	lichen	0.5	0.5	1	0.50	1.00

** Detailed and ground inspection field sampling sites only.*

Soils associated with this ecotype are mainly Orthic, Gleyed, or Cumulic Regosols. Dystric Brunisols are also possible on older sites that are no longer subject to flooding and sedimentation. Mineral soil texture can be fine to coarse depending on parent material type and/or deposition event. Sandy textures predominate, though silt loam textures are also possible. Drainage is generally moderately well to imperfect, however, sandy and gravelly sites located far from current shorelines or river channels may be well to rapidly-drained. Potential rooting depth is variable, but tends to be less than 50 cm due to high water levels. Humus forms vary depending on drainage conditions and vegetation sources, with mulls dominant. Moder humus forms are also possible on sites with intermittent flooding. This ecotype is generally nutrient-medium to rich, with a subhygric to subhydric soil moisture regime (Figure 6.10). Site productivity is typically medium-rich.

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Succession and Disturbance Ecology

RT ecotypes occur predominantly along watercourses (large and small rivers, and streams) in the Study Area, where a range of communities dominated by shrubs and small trees of the Salicaceae family, typically willow (*Salix* spp.) tend to occur. These sites are often prone to severe flooding and scour by ice during spring break-up. Other disturbances include damage as a result of overbrowsing; especially in areas where larger animals (i.e., moose) tend to frequent these sites in high numbers due to the availability of food, water and shade, and level terrain.

Although some of these plant communities may be disclimaxes induced through disturbance, most are undisturbed, natural (climax) vegetation for which willow thickets (of various forms) appears to be the riparian climax on developing fluvial/lacustrine deposits. As the thickness of these deposits increases, the frequency and severity of flood events and scouring by ice decreases, allowing shrubs and some trees to become established. Over time, a dense shrub thicket establishes to form the Riparian Thicket ecotype. Eventually, the shrub cover will be largely replaced by trees, resulting in the establishment of MW or BF ecotypes. Although these sites are considered productive due to an abundance of moisture and rich, fluvial /lacustrine soils, the rate and course of succession in the RT ecotype is dictated by the frequency, timing and severity of seasonal flooding and ice scour events.

Wildlife and Wildlife Habitat

MSF 11 sites provide only seasonal habitat for moose. Moose can forage in spring and summer on a variety of tree species, herbaceous plants, and grasses (Newbury et al. 2007), however their winter cover needs would not likely be met in Riparian Thicket sites. Moose were not detected at the site surveyed within this ecotype.

Beaver presence in Riparian Thicket habitat is closely tied to the presence of water courses. As generalist herbivores, beaver may forage seasonally on a variety of species found in Riparian Thicket sites (Fryxell and Doucett 1991). Beaver trails from the waterbody and browse within this ecotype were detected during surveys.

Primary habitat characteristics for Rusty Blackbird were identified in the Riparian Thicket ecotype surveyed. This species breeds throughout Labrador in wet habitats that provide insect and plant forage material.

A summary of wildlife habitat use and potential for the Riparian Thicket Ecotype is presented in Table 6.30.

Table 6.30 Summary of Wildlife Habitat Use and Potential for the Riparian Thicket Ecotype

Riparian Thicket Ecotype				
Species	**Habitat Potential**			**Occurrence %**
Common Name	**Primary**	**Secondary**	**Tertiary**	
Moose		•		0
Caribou			•	0
Beaver	•			100
Snowshoe hare			•	0
Spruce Grouse			•	0
Short-eared Owl			•	0
Porcupine			•	0
Lynx			•	0
Rusty Blackbird	•			0
Canada Goose			•	0

MSF 11 Ecotype: Riparian Marsh (Fen)

Map Code:	RM	**Name:**	Riparian Marsh (Fen)	**Ecotype:**	11
Total Area (km^2):	0.6			**Percentage of Study Area:**	0.2

General Site Description

The Riparian Marsh (Fen) (RM) ecotype is generally associated with lakes, ponds, rivers and streams; and at the edges of wetlands subject to periodic flooding through oscillations in the water levels associated with these waterbodies. Since the majority of lakes and ponds in the Study Area are relatively shallow a well-developed riparian marsh ecotype is generally not present. It is however patchily distributed along the shoreline area of relatively large floodplains. At these sites the substrates are derived solely from fluvial or lacustrine deposits, either in areas where sediments have been deposited on bends in the river, at confluences of the river and its tributaries, or in areas where the wave action of fresh-water lakes and ponds has resulted in the accumulation of sediments along the margins of these landforms. The RM ecotype, with its dominant emergent vegetation occurs just above the aquatic zone, occupying positions that are inundated for most of the growing season but draw down in late summer or early autumn in most years. The ecotype is an early successional sere of plant community development, maintained at an early stage of succession through frequent scouring by ice and flood waters (Figure 6.11). This ecotype occupies approximately 0.2 percent (0.6 km^2) of the Study Area (Table 6.31).

Areas with marked water fluctuations during the growing season experience periodic aerobic conditions, which limit organic matter accumulation, thus promoting the development of soils that support this riparian marsh vegetation. Plant community diversity is summarized in Table 6.32. Moist, fine-textured mineral soils, with high organic matter (humic) content, are occupied by water horsetail (*Equisetum fluviatile*) and Canada reedgrass (*Calamagrostis canadensis*), with *Drepanocladus revolvens* and star campylium moss forming an almost continuous ground cover. Although moss cover associated the MSF 17 ecotype is often high, at some sites it is almost entirely absent, possibly the result of prolonged periods of inundation. Areas characterized by organic substrates, usually in the form of a floating organic mat held together by live plant roots and rhizomes, were usually comprised largely of broad and thin-leaved graminoids, including bottle sedge (*Carex rostrata*), slender sedge (*Carex lasiocarpa subsp. americana*), three-fruited sedge (*Carex trisperma*) and mud sedge (*Carex limosa*). Other characteristic plant associations, adapted to low nutrient levels and periodic inundation, included bog buck-bean (*Menyanthes trifoliata*), marsh cinquefoil (*Comarum palustre*) and three-leaf false Solomon's-seal (*Maianthemum trifolium*). Open water habitats adjacent to this ecotype typically supported submergent and floating aquatic macrophytes including four-leaf mare's-tail (*Hippuris tetraphylla*); flat leaf bladderwort (*Utricularia intermedia*) and greater bladderwort (*Utricularia macrorhiza*). The mean species richness was 12.3 for vascular plant species and 2.0 for non-vascular plant species.

Figure 6.11 Edatopic Grid for Riparian Marsh (Fen) Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→				
	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
7					
8				100%	

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

***Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class**

Photo 41 Riparian Marsh (Fen) Ecotype – Aerial View

Photo 42 Riparian Marsh (Fen) Ecotype – Ground View

Photo 43 Riparian Marsh (Fen) Ecotype – Typical Vegetation

Photo 44 Riparian Marsh (Fen) Ecotype – Typical Soil Profile

Table 6.31 Summary of Ecological Condition for Riparian Marsh (Fen) Ecotype

Riparian Marsh (Fen) Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Riparian Marsh (Fen) Ecotype (RM)
General Location:	Restricted to the margins of lakes, ponds, rivers, streams; and at the edges of wetlands where drainage is imperfect to poor
Inventory Numbers	G42, G49, G54, V10, V24
Number of Sample Plots (n):	n=5
Site Characteristics	
Surface Expression:	Level
Topographic Position:	Level (slopes <2%); depression
Slope:	<2%
Aspect:	Variable
Soil Nutrient Regime:	Medium (C) to rich (D) nutrient status
Soil Moisture Regime:	Subhydric (7) to Hydric (8)
Successional Status:	Young edaphic climax
Structural Stage:	Herb (H)
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	5-30
Humus Form:	Fibrimors, Mesimors
Surface (Topsoil) Texture:	N/A
Average Topsoil Thickness (cm) :	N/A
Seepage:	N/A
Drainage:	Imperfect to Very Poor
Depth to Water Table:	0-10 cm
Depth to Mottles / Gleying:	N/A
Effective Texture	N/A
Effective Rooting Depth (cm)	20 to 50 cm
Coarse Fragment Percent and Type:	N/A
Depth to Bedrock:	>100 cm
Parent Material:	Fluvial, Lacustrine, Morainal (till)
Soil Classification (CSSC):	Fluvial / Lacustrine: Orthic Regosols, Gleyed Regosols, and Gleyed Humic Regosols Morainal (till): Gleysols, Gleyed Podzols

Riparian Marsh (Fen) Ecotype	
Vegetation	
Overstory Descriptor:	N/A
Understory Descriptor:	N/A
Dominant Shrub Species (% cover):	*Myrica gale*
Dominant Herb / Forb Species (% cover):	*Equisetum fluviatile*
Dominant Graminoid Species (% cover):	*Carex rostrata*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Drepanocladus revolvens*
Dominant Aquatic / Wetland Species (% cover):	*Menyanthes trifoliata*
Plant Indicator Species:	*Equisetum fluviatile*
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular	12.3/2.0
Species At Risk / Species of Conservation Concern:	

Plant Community Diversity

Table 6.32 Plant Community Diversity for Riparian Marsh (Fen) Ecotype

Riparian Marsh (Fen) Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Shrub Layer							
Chamaedaphne calyculata	leatherleaf	low shrub	20	20	3	6.67	0.33
Myrica gale	sweet gale	low shrub	5	10	3	5.00	0.67
Salix spp.	a willow	low shrub	1	1	3	0.33	0.33
Kalmia polifolia	bog laurel	low shrub	0.5	0.5	3	0.17	0.33
Vaccinium uliginosum	bog bilberry	dwarf shrub	0.5	0.5	3	0.17	0.33
Gaultheria hispidula	creeping snowberry	dwarf shrub	0.5	0.5	3	0.17	0.33
Vaccinium oxycoccos	small cranberry	dwarf shrub	0.5	0.5	3	0.17	0.33
Herb Layer							
Equisetum fluviatile	water horsetail	forb	0.5	50	3	16.83	0.67
Menyanthes trifoliata	bog buck-bean	forb	0.5	2	3	0.83	0.67
Comarum palustre	marsh cinquefoil	forb	1	1	3	0.33	0.33

Riparian Marsh (Fen) Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Maianthemum trifolium	three-leaf false Solomon's-seal	forb	1	1	3	0.33	0.33
Hippuris tetraphylla	four-leaf mare's-tail	forb	0.5	0.5	3	0.17	0.33
Carex rostrata	bottle sedge	graminoid	10	60	3	36.67	1.00
Carex lasiocarpa subsp. americana	slender sedge	graminoid	20	20	3	6.67	0.33
Carex limosa	mud sedge	graminoid	5	5	3	3.33	0.67
Carex trisperma	three-fruited sedge	graminoid	10	10	3	3.33	0.33
Calamagrostis canadensis	Canada reedgrass	graminoid	3	3	3	1.00	0.33
Carex canescens	silvery sedge	graminoid	0.5	1	3	0.50	0.67
Carex exilis	coast sedge	graminoid	0.5	0.5	3	0.17	0.33
Juncus brevicaudatus	narrow-panicled rush	graminoid	0.5	0.5	3	0.17	0.33
Moss / Lichen Layer							
Drepanocladus revolvens	limprichita moss	moss	30	30	3	20.00	0.67
Campylium stellatum	star campylium moss	moss	20	20	3	6.67	0.33
Drepanocladus spp.	a drepanocladus moss	moss	10	10	3	3.33	0.33
Sphagnum spp.	sphagnum moss	moss	10	10	3	3.33	0.33
Cladonia spp.	cladonia lichen	lichen	0.5	0.5	3	0.17	0.33
Aquatics							
Utricularia intermedia	flat leaf bladderwort	aquatic	1	1	3	0.33	0.33
Potamogeton alpinus	northern pondweed	aquatic	1	1	3	0.33	0.33
Utricularia macrorhiza	greater bladderwort	aquatic	0.5	0.5	3	0.17	0.33

** Detailed and ground inspection field sampling sites only.*

Soils associated with this ecotype vary from fibrous peat to silts with high humic content depending on parent material type and site conditions. When fluvial or lacustrine deposits are the dominant parent material, Orthic Regosols, Gleyed Regosols, and Gleyed Humic Regosols are the main soil types. When the dominant parent material is glacial till or glaciofluvial, Gleysols or Gleyed Podzols may be found. Mineral soil textures vary from fine silts and silt loams to coarse sands depending on parent material type and/or deposition event. Drainage is generally imperfect to poor, but can be moderately well on sites further away from associated floodplain. Potential rooting depth is usually less than 0.3 m, but can be deeper in moderately well-drained sites. Humus forms are dominated by Mulls. Moder humus forms are also possible on sites with intermittent flooding. The ecotype is generally nutrient-medium to rich, with a subhydric to hydric soil moisture regime (Figure 6.11). Site productivity is typically medium-rich.

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as “Special Concern” in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Bog willow (*Salix pedicellaris*) and lesser panicled sedge (*Carex diandra*), two vascular plant species identified during field surveys of the MSF11 ecotype, are considered “Species of Conservation Concern”. Bog willow (*Salix pedicellaris*) is considered “Sensitive” by NLDEC indicating it is potentially susceptible to human activities or natural events. It has been assigned a ranking of “S2S4” by the ACCDC indicating that the species is considered rare to fairly common throughout the province and of long term concern.

Purple oatgrass (*Schizachne purpurascens*) is listed as status “Undetermined” by NLDEC but has similarly been assigned rankings of “S2S4” by the ACCDC.

Disturbance and Succession Ecology

The dominant natural disturbance associated with MSF 11 sites are seasonal and yearly water level fluctuations. Seasonally, water levels tend to be highest during the winter and spring and lowest in late summer and early fall. Fluctuating water levels facilitate seed germination by drawing down water levels and thus allowing direct sunlight to penetrate the exposed shoreline sediments and trigger germination. Beaver dams in nearby streams can also cause major changes to soils and vegetation.

Wildlife and Wildlife Habitat

Although no signs of moose or Canada Goose were found during field surveys, the habitat potential for both of these species is rated as secondary. Open and aquatic areas characteristic of marsh / fen sites can provide nutrient rich forage for moose (Peek 1997), and the Canada Goose can use marsh sites for both foraging and nesting.

Beaver presence in the RM ecotype is closely tied to the presence of water courses. As generalist herbivores, beaver may forage seasonally on a variety of species commonly occurring in these sites (Fryxell and Doucett 1991). An active beaver lodge was observed on a waterbody directly adjacent the RM ecotype during field surveys.

A summary of wildlife habitat use and potential for the Riparian Marsh (Fen) Ecotype is presented in Table 6.33.

Table 6.33 Summary of Wildlife Habitat Use and Potential for the Riparian Marsh (Fen) Ecotype

Riparian Marsh (Fen) Ecotype				
Species	**Habitat Potential**			**Occurrence %**
Common Name	**Primary**	**Secondary**	**Tertiary**	
Moose		•		25
Caribou			•	0
Beaver	•			25
Snowshoe hare			•	0
Spruce Grouse			•	0
Short-eared Owl			•	0
Porcupine			•	0
Lynx			•	0
Rusty Blackbird			•	0
Canada Goose		•		0

6.2.4.4 Wetland Ecosystem Units

With respect to the Project and of consequence to wetland ecosystem units described below, it should be noted that there is an overlap between the Project Study Area and the municipal boundaries for the towns of Labrador City and Wabush. Through an agreement with the Province, the towns of Labrador City and Wabush have commited to the conservation and protection of wetands within specified Stewardship Zones encompassed by each repective municipality.

With the assistance of the Eastern Habitat Joint Venture (EHJV), a Habitat Conservation Plan has been developed by both municipalities that is intended to guide and govern activities with the potential to negatively effect wetlands and waterfowl within areas designated for conservation. Within each Stewardship Zonethere are a number of specific Management Units that represent “significant” wetlands that have been deemed of importance to waterfowl during nesting, brood-rearing, feeding and / or staging. Management Units occurring within the

municipal boundaries of Labrador Citythat overlap the Study Area include Little Wabush Lake, Wabush Narrows, Walsh River, Pike Lake North, and Pike Lake South. Similarly, Management Units for the Town of Wabush include Jean Lake Rapids, Elephant Head, Angel Lake and Waldorf River Steady. Wetlands descriptions as outlined below are considered appropriate representations of the wetlands and associated upland areas that are encompassed by these Management Units as well as the larger Stewardship Zones.

MSF 12 Ecotype: Patterned Shrub Fen

Map Code:	PF	**Name:**	Patterned Shrub Fen	**Ecotype:**	12
Total Area (km^2):	3.1			**Percentage of Study Area:**	0.8

General Site Description

Fens are minerotrophic peat lands with fluctuating water levels (Warner and Rubec 1997). Surface water movement is common within fens and may be observed in the form of channels or pools. Vegetation is strongly influenced by water depth and chemistry and may be dominated by bryophytes, graminoids, shrubs, and/or trees.

In the Study Area and regionally, shrub fens can be differentiated into two similar, yet distinct types: patterned fens and non-patterned fens. Patterned fens and non-patterned fens are floristically almost identical, but it is the patterning, an interesting morphological character, that separates the two. Patterned fens such as the Atlantic Ribbed Fen occur throughout Labrador. They occupy very gradual slopes and are characterized by series of distinctive elongated, vegetated peat ridges (strings) that project about 10 to 30 cm above the water table, alternating between narrow hollows or shallow pools (flarks). Morphologically, strings and flarks are oriented perpendicular to the topographic slope of the wetland and at right angles to the direction of groundwater movement through the fen. It is this “ribbed” pattern that defines the patterned fen ecotype. Within the Study Area, ribbing typically occupied only a portion of the wetland area; with other parts of the wetland supporting a diversity of ericaceous shrubs or forested bog vegetation. Patterned fens are easily detected on aerial photography but are almost impossible to differentiate from patterned bogs, such as string bogs, without close inspection of the plant associations. Non-patterned fens lack these repeating patterns of narrow hollows / pools and strips of vegetation.

The Patterned Shrub Fen (PF) ecotype occurs primarily on gentle slopes, level sites, and in poorly-drained peat-filled depressions (basins), on substrates classed as organic (either as well-decomposed organic material or as floating mats of organic material held together by live plant roots and rhizomes), overlying bedrock and morainal (till) deposits. Organic substrates are typically deep enough to restrict plant roots from contact with available nutrients, but the low subsurface permeability of these deposits facilitates contact with stagnant groundwater that is sufficiently mineral-rich to maintain a circumneutral (>5.5) pH allowing greater productivity than similar bog ecotypes. As a consequence, these sites have hydric (wet) moisture regimes and poor to moderate nutrient status (Figure 6.12). This ecotype occupies approximately 0.8 percent (3.1 km^2) of the Study Area (Table 6.34).

Figure 6.12 Edatopic Grid for Patterned Shrub Fen Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
		A	B	C	D	E
	0					
	1					
	2					
	3					
	4					
	5					
	6					
	7					
	8		50%	50%		

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

***Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class**

Photo 45 Patterned Shrub Fen Ecotype – Aerial View

Photo 46 Patterned Shrub Fen Ecotype – Ground View

Photo 47 Patterned Shrub Fen Ecotype – Typical Vegetation

Photo 48 Patterned Shrub Fen Ecotype – Typical Soil Profile

Table 6.34 Summary of Ecological Condition for Patterned Shrub Fen Ecotype

Patterned Shrub Fen Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Patterned Shrub Fen Ecotype (PF)
General Location:	Patterned fens have a heterogeneous surface with open, wet flarks, and drier shrubby to wooded strings and margins, typically occupying only a small portion of larger wetland complexes
Inventory Numbers:	D38B, G38, G40
Number of Sample Plots (n):	n=3
Site Characteristics	
Surface Expression:	Depression
Topographic Position:	Gentle slopes, level sites, depression
Slope:	<2%
Aspect:	Variable
Soil Nutrient Regime:	Typically classed as having poor (B) to medium (C) nutrient status.
Soil Moisture Regime:	Hygric (6) to hydric (8)
Successional Status:	Mid sere (Wetland)
Structural Stage:	Shrub / herb (SH)
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	>100 cm
Humus Form:	Fibrimors, Mesimors and Hemimor
Surface (Topsoil) Texture:	N/A
Average Topsoil Thickness (cm) :	N/A
Seepage:	N/A
Drainage:	Poor to very poor
Depth to Water Table:	At surface
Depth to Mottles / Gleying:	N/A
Effective Texture	N/A
Effective Rooting Depth (cm)	0 to 50 cm
Coarse Fragment Percent and Type:	N/A
Depth to Bedrock:	>100 cm
Parent Material:	Organic, Morainal (Till)
Soil Classification (CSSC):	Terric and Typic Fibrisols, Terric and Typic Mesisols
Vegetation	
Overstory Descriptor:	N/A
Understory Descriptor:	N/A

Patterned Shrub Fen Ecotype	
Dominant Shrub Species (% cover):	*Myrica gale, Dasiphora fruticosa,*
Dominant Herb / Forb Species (% cover):	*Solidago uliginosa*
Dominant Graminoid Species (% cover):	*Trichophorum cespitosum, Carex exilis*
Dominant Mosses, Liverwort, Lichen (% cover):	*Campylium stellatum, Sphagnum spp*
Dominant Aquatic / Wetland Species (% cover):	*Menyanthes trifoliata*
Plant Indicator Species:	*Dasiphora fruticosa, Andromeda polifolia, Betula michauxii*
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular):	30.0/5.0
Species At Risk / Species of Conservation Concern:	*Tofieldia glutinosa*

Plant Community Diversity

Table 6.35 Plant Community Diversity for Patterned Shrub Fen Ecotype

Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Larix laricina	larch	tree	0.5	0.5	2	0.25	0.50
Shrub Layer							
Dasiphora fruticosa	shrubby cinquefoil	low shrub	0.5	10	2	5.25	1.00
Larix laricina	larch	low shrub	0.5	1	2	0.75	1.00
Picea mariana	black spruce	low shrub	1	1	2	0.50	0.50
Betula michauxii	Newfoundland dwarf birch	low shrub	1	1	2	0.50	0.50
Vaccinium uliginosum	bog bilberry	low shrub	0.5	0.5	2	0.25	0.50
Rhododendron groenlandicum	common Labrador tea	low shrub	0.5	0.5	2	0.25	0.50
Juniperus communis	ground juniper	low shrub	0.5	0.5	2	0.25	0.50
Kalmia polifolia	bog laurel	dwarf shrub	0.5	0.5	2	0.50	1.00
Andromeda polifolia	bog rosemary	dwarf shrub	0.5	0.5	2	0.50	1.00
Chamaedaphne calyculata	leatherleaf	dwarf shrub	1	1	2	0.50	0.50

Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Lonicera villosa	mountain fly honeysuckle	dwarf shrub	0.5	0.5	2	0.25	0.50
Vaccinium oxycoccos	small cranberry	dwarf shrub	0.5	0.5	2	0.25	0.50
Herb Layer							
Menyanthes trifoliata	bog buck-bean	forb	1	5	2	3.00	1.00
Sanguisorba canadensis	Canada burnet	forb	1	5	2	3.00	1.00
Solidago uliginosa	bog goldenrod	forb	1	1	2	1.00	1.00
Sarracenia purpurea	northern pitcher-plant	forb	1	1	2	0.50	0.50
Viola spp.	a violet	forb	0.5	0.5	2	0.25	0.50
Selaginella selaginoides	low spike-moss	forb	0.5	0.5	2	0.25	0.50
Eurybia radula	rough-leaved aster	forb	0.5	0.5	2	0.25	0.50
Tofieldia pusilla	scotch false-asphodel	forb	0.5	0.5	2	0.25	0.50
Carex exilis	coast sedge	graminoid	20	20	2	20.00	1.00
Trichophorum cespitosum	deergrass	graminoid	15	15	2	15.00	1.00
Carex limosa	mud sedge	graminoid	7	10	2	8.50	1.00
Carex rostrata	bottle sedge	graminoid	0.5	7	2	3.75	1.00
Carex oligosperma	few-seeded sedge	graminoid	3	3	2	1.50	0.50
Trichophorum alpinum	alpine cotton-grass	graminoid	2	2	2	1.00	0.50
Carex stipata var. stipata	stalk-grain sedge	graminoid	1	1	2	0.50	0.50
Eriophorum viridicarinatum	green keeled cottongrass	graminoid	0.5	0.5	2	0.25	0.50
Moss / Lichen Layer							
Campylium stellatum	star campylium moss	moss	15	60	2	37.50	1.00
Sphagnum spp.	sphagnum moss	moss	10	35	2	22.50	1.00
Drepanocladus revolvens	limprichita moss	moss	30	30	2	15.00	0.50
Pleurozium schreberi	Schreber's moss	moss	0.5	0.5	2	0.25	0.50

Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Cladonia spp.	cladonia lichen	lichen	0.5	0.5	2	0.50	1.00
Cladina rangiferina	grey reindeer moss	lichen	0.5	0.5	2	0.25	0.50
Aquatics							
Utricularia intermedia	flatleaf bladderwort	aquatic	0.5	0.5	2	0.25	0.50

** Detailed and ground inspection field sampling sites only.*

Vegetation is composed primarily of fen species adapted to water logged and nutrient poor-medium conditions. Plant species associated with these sites varies, with alternating strings and flarks differing in species composition and structure. Strings are comprised of slightly raised ridges of peat and are dominated by brown mosses, sedges, forbs, and small shrubs. Plant community diversity is summarized in Table 6.35. Graminoids provide the majority of herbaceous cover and include coastal sedge (*Carex exilis*), bottle sedge, three-seeded sedge and green keeled cotton-grass (*Eriophorum viridicarinatum*). On sites characterized by floating organic mats overlying mineral-rich groundwater, deergrass (*Trichophorum cespitosum*) was the dominant graminoid. Herbaceous cover was limited and comprised primarily of the following species: Canada burnet, rough-leaved aster (*Eurybia radula*), bog goldenrod (*Solidago uliginosa*), three-leaf false Solomon's-seal (*Maianthemum trifolium*), pitcher-plant (*Sarracenia purpurea*), and round-leaved sundew (*Drosera rotundifolia*). Shrub species associated with these microsites include, shrubby cinquefoil, bog rosemary, bog laurel (*Kalmia polifolia*), leather-leaf, and Newfoundland dwarf birch (*Betula michauxii*). Other shrubs (e.g., sweet gale) were abundant along the edges of these habitats where the ecotype graded into drier, adjacent community types. The moss layer is prominent and dominated by brown mosses (*Campylium stellatum* and *Drepanocladus revolvens*). Stunted trees including black spruce and tamarack are scattered on the strings. They often occupying micro-hummocks of sphagnum moss and generally cover less than 10% of the string surface. Flarks, or the level areas, hollows, or pools between raised strings were dominated by sphagnum mosses, sedges, and rushes including the following species: *Sphagnum angustifolium*, *S*. *fuscum*, and *S*. *magellanicum*, mud sedge (*Carex limosa*), livid sedge (*C*. *livida*), water sedge (*C*. *aquatilis*), *coast sedge* (*C*. *exilis*)], green-keeled cotton-grass (*Eriophorum viridicarinatum*), spoon-leaf sundew (*Drosera intermedia*), bog buckbean (*Menyanthes trifoliata*), and flat-leaved bladderwort (*Utricularia intermedia*). Other characteristic species of patterned fen include *Carex vaginata, C. gynocrates, C. leptalea and C. buxbaumii*, low spike-moss (*Selaginella selaginoides*), marsh cinquefoil (*Comarum palustris*), narrow-leaved cotton-grass (*Eriophorum angustifolium*), common bog arrow-grass (*Triglochin palustris*), and common butterwort (*Pinguicula vulgaris*).

Organic soils associated with this ecotype are mainly Mesisols, dominated by organic layers in a moderate stage of decomposition (Om horizons). Organic soils may grade into mineral Gleysols at the edges of these wetlands. Drainage is usually poor to very poor, but is imperfect on transitional sites. Potential rooting depth is usually shallow due to high water levels. Humus

forms are dominated by Fibrimors and Mesimors on wet sites, and by Hemimors and humimors on imperfectly drained sites. The water table is usually at or near the surface, particularly in hollows / pools between peat ridges. This ecotype is generally nutrient-poor to -medium, with a hygric to hydric soil moisture regime. Site productivity is typically poor.

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as "Special Concern" in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Sticky false-asphodel (*Tofieldia glutinosa*) identified during field surveys of the MSF12 ecotype, are considered "Species of Conservation Concern". Sticky false-asphodel is listed as status "Undetermined" by NLDEC but has similarly been assigned rankings of "S1S3" by the ACCDC indicating that the species is considered rare to uncommon in Labrador and is of long term concern.

Disturbance and Succession Ecology

These sites are relatively stable. Fire frequency is low, and fire severity is low owing to their position in moist areas of low relief. As a result the dominant natural disturbance associated with Patterned Fen (PF) ecotypes are seasonal and yearly water level fluctuations. The quality and quantity of which is crucial to the maintenance of the fen. Seasonally, water levels tend to be highest during the winter and spring and lowest in late summer and early fall.

Depending on type of disturbance (e.g., flooding or fire), the PF ecotypes could re-establish, provided the regenerative capacity of the shrub layer was maintained. If the shrub layer were lost or otherwise compromised, these sites may succeed to more closely resemble the Graminoid Fen (GF) ecotype. Alternatively, over time fens may also paludify resulting in a separation of the rooting zone from nutrient enriched groundwater resulting in the development of a bog or bog-like conditions. In the absence of disturbance theses ecotypes will likely remain in their current condition.

Wildlife and Wildlife Habitat

Wildlife and wildlife habitat observations taken from the Patterned Fen (PF) and Non-Patterned Fen (SF) ecotypes have been compiled under the Non-Patterned Fen (SF) ecotype description. This approach was deemed appropriate in light of the marginal differences between these two separate, yet similar ecotypes as it relates to the wildlife use and the provision of wildlife habitat.

MSF 13 Ecotype: Non-Patterned Shrub Fen

Map Code:	SF	**Name:**	Non-Patterned Shrub Fen	**Ecotype:**	13
Total Area (km^2):	9.3			**Percentage of Study Area:**	2.3

General Site Description

Non-Patterned Shrub Fen (SF) ecotypes typically occur on flat areas or poorly-drained, peat-filled depressions (basins), on neutral to moderately alkaline substrates classed as organic (either as well-decomposed organic material or as floating mats of organic material held together by live plant roots and rhizomes), overlying bedrock and morainal (till) deposits (Figure 6.13). The overall topography is flat to gently undulating with microtopography characterized by hummocks and hollows. Of the wetlands observed throughout the Study area this ecotype tends to be more common, often occurring in association with other adjacent wetland types as part of larger wetland complexes. It occupies approximately 2.3 percent (9.3 km^2) of the Study Area (Table 6.36).

Non-Patterned Shrub Fens are characterized by a unique and diverse flora with a rich herbaceous layer dominated by graminoids, and a patchy to continuous moss carpet, with brown mosses more prevalent than sphagnum mosses. Plant community diversity is summarized in Table 6.37. Although the diversity of species may be relatively high, particularly within the herbaceous layer, cover values are generally low. While most plant species of this ecotype are adapted to growing in areas of high water tables and circumneutral conditions, plant associations growing on low, scattered, sphagnum hummocks typically resemble poor bog habitats, with a continuous carpet of sphagnum mosses, low ericaceous shrubs, and widely scattered or clumped, stunted tamarack and black spruce trees. The shrub layer is usually less than one meter high with shrubby cinquefoil, sweet gale, and Newfoundland dwarf birch often being the most prevalent. Common shrub species occupying slightly elevated sphagnum hummocks include: bog rosemary (*Andromeda polifolia*), leatherleaf, Labrador tea, bog laurel (*Kalmia polifolia*), and small cranberry (*Vaccinium oxycoccos*). Notable species in the moderately well-developed herb layer include common butterwort (*Pinguicula vulgaris*), bird's-eye primrose (*Primula mistassinica*), hooded ladies'-tresses (*Spiranthes romanzoffiana*), slender bog arrowgrass (*Triglochin palustris*) and Labrador Indian-Paintbrush (*Castilleja septentrionalis*). Canada burnet was the most common forb on all sites. Deergrass was the dominant graminoid. Other common, often co-dominant, graminoids in these non-patterned fens include coastal sedge, alpine cotton-grass (*Trichophorum alpinum*), mud sedge, and sheathed sedge (*Carex vaginata*). Where each of these species is dominant it indicates a unique plant association. Mosses with the greatest cover include *Campylium stellatum*, various species of *Sphagnum*, *Tomentypnum nitens* and *Drepanocladus* spp. Additionally, the high water table associated with these sites can provide the proper conditions for submergent plants, including cow lily (Nuphar variegata), flat-leaved bladderwort (*Utricularia intermedia*) and horned bladderwort (*Utricularia cornuta*).

Figure 6.13 Edatopic Grid for Non-Patterned Shrub Fen Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→					
		A	B	C	D	E
	0					
	1					
	2					
	3					
	4					
	5					
	6					
	7		6%	72%	6%	
	8		6%	10%		

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

***Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class**

Photo 49 Non-Patterned Shrub Fen Ecotype – Aerial View

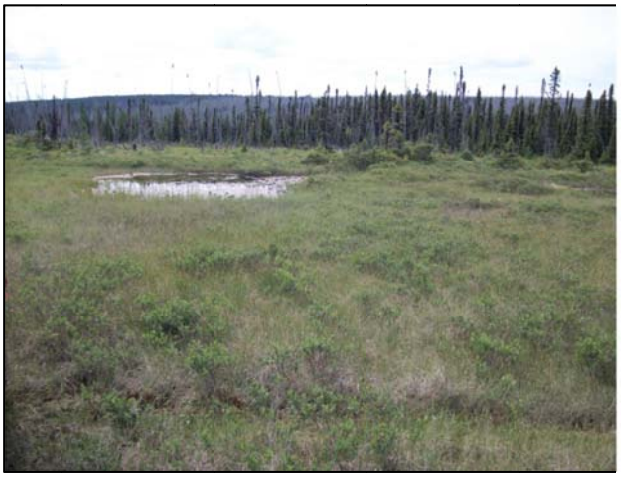


Photo 50 Non-Patterned Shrub Fen Ecotype – Ground View

Photo 51 Non-Patterned Shrub Fen Ecotype – Typical Vegetation

Photo 52 Non-Patterned Shrub Fen Ecotype – Typical Soil Profile

Table 6.36 Summary of Ecological Condition for Non-Patterned Shrub Fen Ecotype

Non-Patterned Shrub Fen Ecotype	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Non-Patterned Shrub Fen Ecotype (SF)
General Location:	Non-patterned fens are distributed across the Study Area and are the most common type of wetland found.
Inventory Numbers:	D10, D13, D15, D23, D30 G4, G14, G16, G33, G34, G35, G43, G44, G45, G47, G48, G50, G53, V6, V12, V18, V19, V22, V23, V40, V70
Number of Sample Plots (n):	n=26
Site Characteristics	
Surface Expression:	Depression
Topographic Position:	Flat level sites, depression
Slope:	<2%
Aspect:	Variable
Soil Nutrient Regime:	Typically classed as having poor (B) to medium (C) nutrient status.
Soil Moisture Regime:	Hygric (6) to Hydric (8)
Successional Status:	Mid sere (wetland)
Structural Stage:	Shrub / herb (SH)
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	>100 cm
Humus Form:	Fibrimors, Mesimors and Humimor
Surface (Topsoil) Texture:	N/A
Average Topsoil Thickness (cm) :	N/A
Seepage:	N/A
Drainage:	Poor to very poor
Depth to Water Table:	At surface
Depth to Mottles / Gleying:	N/A
Effective Texture	N/A
Effective Rooting Depth (cm)	0 to 50 cm
Coarse Fragment Percent and Type:	N/A
Depth to Bedrock:	>100 cm
Pit Depth (cm)	100+ cm
Parent Material:	Organic, Morainal (Till)
Soil Classification (CSSC):	Terric and Typic Fibrisols, Terric and Typic Mesisols, Orthic and Fera Gleysols, Gleyed Podzols

Non-Patterned Shrub Fen Ecotype	
Vegetation	
Overstory Descriptor:	N/A
Understory Descriptor:	N/A
Dominant Shrub Species (% cover):	*Myrica gale, Dasiphora fruticosa,*
Dominant Herb / Forb Species (% cover):	*Sanguisorba canadensis*
Dominant Graminoid Species (% cover):	*Trichophorum cespitosum, Trichophorum alpinum, Carex exilis*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Campylium stellatum, Sphagnum spp., Drepanocladus revolvens, Tomenthypnum nitens*
Dominant Aquatic / Wetland Species (% cover):	*Utricularia intermedia, Nuphar variegata*
Plant Indicator Species:	*Dasiphora fruticosa, Andromeda polifolia, Betula michauxii*
Plant Species Richness (Avg. Vascular / Avg. Non-Vascular):	31.7/5.8
Species At Risk / Species of Conservation Concern:	*Tofieldia glutinosa, Cirsium muticum, Veratrum viride var. viride* (along wetland margins); *Primula mistassinica, Platanthera aquilonis, Juncus bufonius, Scirpus microcarpus,* and *Eriophorum scheuchzeri* (scattered throughout); and *Potamogeton richardsonii* (in flarks / pools)

Plant Community Diversity

Table 6.37 Plant Community Diversity for Non-Patterned Shrub Fen Ecotype

Non-Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Tree Layer							
Larix laricina	larch	tree	1	10	19	1.11	0.37
Picea mariana	black spruce	tree	0.5	5	19	0.97	0.37
Shrub Layer							
Larix laricina	larch	tall shrub	0.5	7	19	1.68	0.63
Picea mariana	black spruce	tall shrub	0.5	10	19	1.61	0.68
Salix pedicellaris	bog willow	tall shrub	1	1	19	0.05	0.05
Myrica gale	sweet gale	low shrub	2.55	25	19	12.37	0.74
Larix laricina	larch	low shrub	0.5	15	19	2.65	0.79
Dasiphora fruticosa	shrubby cinquefoil	low shrub	1.2	23	19	2.14	0.26
Picea mariana	black spruce	low shrub	0.5	5	19	1.03	0.74
Kalmia polifolia	bog laurel	low shrub	15	15	19	0.79	0.05

Non-Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Rhododendron groenlandicum	common Labrador tea	low shrub	0.5	2.65	19	0.51	0.42
Betula michauxii	Newfoundland dwarf birch	low shrub	1	7	19	0.42	0.11
Salix spp.	a willow	low shrub	6.8	6.8	19	0.36	0.05
Salix pedicellaris	bog willow	low shrub	0.5	5	19	0.32	0.16
Chamaedaphne calyculata	leatherleaf	low shrub	0.5	2	19	0.26	0.21
Lonicera villosa	mountain fly honeysuckle	low shrub	3	3	19	0.16	0.05
Vaccinium uliginosum	bog bilberry	low shrub	0.5	1	19	0.08	0.11
Salix pellita	satiny willow	low shrub	1	1	19	0.05	0.05
Dasiphora fruticosa	shrubby cinquefoil	dwarf shrub	0.5	15	19	3.27	0.58
Andromeda polifolia	bog rosemary	dwarf shrub	0.5	4	19	1.06	0.84
Kalmia polifolia	bog laurel	dwarf shrub	0.5	1	19	0.35	0.42
Empetrum nigrum	black crowberry	dwarf shrub	0.5	0.7	19	0.22	0.42
Gaultheria hispidula	creeping snowberry	dwarf shrub	0.5	1	19	0.21	0.32
Vaccinium oxycoccos	small cranberry	dwarf shrub	0.5	0.5	19	0.16	0.32
Lonicera villosa	mountain fly honeysuckle	dwarf shrub	0.5	1	19	0.11	0.16
Linnaea borealis subsp. longiflora	twinflower	dwarf shrub	0.5	0.5	19	0.08	0.16
Myrica gale	sweet gale	dwarf shrub	0.5	0.5	19	0.05	0.11
Salix vestita	rock willow	dwarf shrub	0.8	0.8	19	0.04	0.05
Vaccinium uliginosum	bog bilberry	dwarf shrub	0.5	0.5	19	0.03	0.05
Salix pedicellaris	bog willow	dwarf shrub	0.5	0.5	19	0.03	0.05
Chamaedaphne calyculata	leatherleaf	dwarf shrub	0.5	0.5	19	0.03	0.05

Non-Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Vaccinium angustifolium	lowbush blueberry	dwarf shrub	0.5	0.5	19	0.03	0.05
Herb Layer							
Sanguisorba canadensis	Canada burnet	forb	1	20	19	5.18	0.68
Maianthemum trifolium	three-leaf false Solomon's-seal	forb	0.5	20	19	1.53	0.37
Eurybia radula	rough-leaved aster	forb	0.5	15	19	1.29	0.53
Solidago uliginosa	bog goldenrod	forb	0.5	2	19	1.08	0.79
Menyanthes trifoliata	bog buck-bean	forb	0.5	12.3	19	1.05	0.42
Rubus arcticus	northern blackberry	forb	0.5	2	19	0.43	0.68
Viola spp.	a violet	forb	0.5	1	19	0.37	0.58
Veratrum viride var. viride	green false hellebore	forb	6.6	6.6	19	0.35	0.05
Primula mistassinica	bird's-eye primrose	forb	0.5	3	19	0.34	0.21
Tofieldia glutinosa	sticky false-asphodel	forb	0.5	1	19	0.34	0.47
Tofieldia pusilla	scotch false-asphodel	forb	0.5	1	19	0.29	0.47
Coptis trifolia	goldthread	forb	0.5	0.6	19	0.27	0.53
Equisetum fluviatile	water horsetail	forb	5	5	19	0.26	0.05
Selaginella selaginoides	low spike-moss	forb	0.5	0.5	19	0.16	0.32
Pinguicula vulgaris	common butterwort	forb	0.5	1	19	0.13	0.16
Spiranthes romanzoffiana	hooded ladies'-tresses	forb	0.5	0.5	19	0.13	0.26
Platanthera dilatata var. dilatata	leafy white orchis	forb	0.5	1	19	0.13	0.21
Drosera rotundifolia	round leaved sundew	forb	0.5	1	19	0.13	0.16
Comarum palustre	marsh cinquefoil	forb	0.5	1.7	19	0.12	0.11
Mitella nuda	bishop's-cap	forb	0.5	0.5	19	0.11	0.21

Non-Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Rubus chamaemorus	cloudberry	forb	2	2	19	0.11	0.05
Triglochin palustris	slender bog arrowgrass	forb	0.5	1	19	0.11	0.16
Geum rivale	purple avens	forb	0.5	1	19	0.08	0.11
Drosera intermedia	spoon-leaved sundew	forb	0.5	1	19	0.08	0.11
Clintonia borealis	Clinton lily	forb	1.3	1.3	19	0.07	0.05
Lycopodium annotinum	bristly clubmoss	forb	0.5	0.5	19	0.05	0.11
Castilleja septentrionalis	Labrador indian paintbrush	forb	0.5	0.5	19	0.05	0.11
Geocaulon lividum	northern comandra	forb	1	1	19	0.05	0.05
Drosera rotundifolia	round leaved sundew	forb	0.5	0.5	19	0.05	0.11
Equisetum hyemale subsp. affine	scouring-rush	forb	0.95	0.95	19	0.05	0.05
Equisetum arvense	field horsetail	forb	0.6	0.6	19	0.03	0.05
Drosera intermedia	spoon-leaved sundew	forb	0.55	0.55	19	0.03	0.05
Cornus canadensis	dwarf dogwood	forb	0.5	0.5	19	0.03	0.05
Ranunculus lapponicus	Lapland buttercup	forb	0.5	0.5	19	0.03	0.05
Epilobium palustre	marsh willowherb	forb	0.5	0.5	19	0.03	0.05
Sarracenia purpurea	northern pitcher-plant	forb	0.5	0.5	19	0.03	0.05
Selaginella selaginoides	low spike-moss	forb	0.5	0.5	19	0.13	0.26
Trientalis borealis	starflower	forb	0.5	0.5	19	0.03	0.05
Cirsium muticum	swamp thistle	forb	0.5	0.5	19	0.03	0.05
Petasites frigidus var. palmatus	sweet coltsfoot	forb	0.5	0.5	19	0.03	0.05

Non-Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Equisetum variegatum subsp. variegatum	variegated horsetail	forb	0.5	0.5	19	0.03	0.05
Graminoid Layer							
Trichophorum cespitosum	deergrass	graminoid	4.2	30	19	18.43	0.89
Carex exilis	coast sedge	graminoid	3	40	19	10.63	0.79
Trichophorum alpinum	alpine cotton-grass	graminoid	0.5	15	19	4.22	0.95
Carex livida	livid edge	graminoid	1	20	19	2.53	0.37
Carex rostrata	bottle sedge	graminoid	0.5	16.6	19	2.22	0.21
Carex aquatilis	water sedge	graminoid	0.5	25	19	1.68	0.26
Carex lasiocarpa subsp. americana	slender sedge	graminoid	5	19	19	1.26	0.11
Carex limosa	mud sedge	graminoid	0.5	5	19	1.26	0.47
Carex vaginata	sheathed sedge	graminoid	11.4	11.4	19	0.60	0.05
Carex leptalea	bristly-stalk sedge	graminoid	1	4.6	19	0.29	0.11
Carex gynocrates	northern bog sedge	graminoid	1	3.2	19	0.22	0.11
Eriophorum viridicarinatum	green keeled cottongrass	graminoid	0.5	2	19	0.21	0.21
Danthonia intermedia	vasey oatgrass	graminoid	1	3	19	0.21	0.11
Eriophorum russeolum	russet cotton-grass	graminoid	0.5	1	19	0.16	0.26
Calamagrostis stricta	slim-stem small reedgrass	graminoid	2	2	19	0.11	0.05
Carex trisperma	three-fruited sedge	graminoid	2	2	19	0.11	0.05
Calamagrostis canadensis	Canada reedgrass	graminoid	0.5	1	19	0.08	0.11
Carex diandra	lesser panicled sedge	graminoid	0.5	1	19	0.08	0.11
Eriophorum angustifolium subsp. angustifolium	narrow-leaved cottongrass	graminoid	0.5	1	19	0.08	0.11

Non-Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Carex magellanica subsp. irrigua	boreal bog sedge	graminoid	1	1	19	0.05	0.05
Deschampsia flexuosa	crinkled hairgrass	graminoid	0.5	0.5	19	0.05	0.11
Carex pauciflora	few-flowered sedge	graminoid	1	1	19	0.05	0.05
Carex scirpoidea	bulrush sedge	graminoid	0.6	0.6	19	0.03	0.05
Carex capillaris	hair-like sedge	graminoid	0.5	0.5	19	0.03	0.05
Carex echinata subsp. echinata	little prickly sedge	graminoid	0.5	0.5	19	0.03	0.05
Eriophorum scheuchzeri	Scheuchzer cotton-grass	graminoid	0.5	0.5	19	0.03	0.05
Carex canescens	silvery sedge	graminoid	0.5	0.5	19	0.03	0.05
Elymus trachycaulus	slender wheatgrass	graminoid	0.5	0.5	19	0.03	0.05
Juncus stygius var. americanus	woods rush	graminoid	0.5	0.5	19	0.03	0.05
Moss / Lichen Layer							
Campylium stellatum	star campylium moss	moss	4.5	80	19	40.47	0.84
Sphagnum spp.	sphagnum moss	moss	1.5	50	19	18.09	0.95
Drepanocladus revolvens	limprichita moss	moss	4	60	19	14.18	0.58
Tomenthypnum nitens	tomenthypnum moss	moss	2	30	19	5.27	0.32
Moss spp. (black / yellow) - C8	unknown moss	moss	93.5	93.5	19	4.92	0.05
Pleurozium schreberi	Schreiber's moss	moss	0.5	5.6	19	0.58	0.42
Aulacomnium palustre	ribbed bog moss	moss	2	5	19	0.53	0.16
Moss spp.	unknown moss	moss	2.9	2.9	19	0.15	0.05
Polytrichum spp.	a haircap moss	moss	0.5	0.5	19	0.05	0.11
Dicranum spp.	a broom moss	moss	0.5	0.5	19	0.03	0.05
Liverwort spp.	a liverwort	moss	0.5	0.5	19	0.03	0.05

Non-Patterned Shrub Fen Ecotype							
Latin Name	**Common Name**	**Strata**	**Minimum Cover (%)**	**Maximum Cover (%)**	**Number of Sites***	**Average Cover (%)**	**Constancy (%)**
Mnium spp.	a mnium moss	moss	0.5	0.5	19	0.03	0.05
Cladina mitis	lesser green reindeer moss	lichen	0.5	7.6	19	0.58	0.42
Cladonia spp.	cladonia lichen	lichen	0.5	1	19	0.29	0.53
Cladina rangiferina	grey reindeer moss	lichen	0.5	2	19	0.24	0.32
Cladina stellaris	star-tipped reindeer lichen	lichen	0.5	1.3	19	0.09	0.11
Cetraria islandica	Iceland moss	lichen	0.5	0.5	19	0.05	0.11
Cladina arbuscula	reindeer lichen	lichen	0.5	0.5	19	0.03	0.05
Cladina spp.	reindeer lichen	lichen	0.5	0.5	19	0.03	0.05
Aquatics							
Nuphar variegata	yellow cowlily	aquatic	0.5	0.5	19	0.05	0.11
Utricularia intermedia	flatleaf bladderwort	aquatic	0.5	0.5	19	0.11	0.21
Utricularia cornuta	horned bladderwort	aquatic	0.5	0.5	19	0.03	0.05

** Detailed and ground inspection field sampling sites only.*

Organic soils associated with this ecotype are mainly Mesisols, dominated by organic layers in a moderate stage of decomposition (Om horizons). Organic soils may grade into mineral Gleysols at the edges of these wetlands. Drainage is usually poor to very poor, but is imperfect on transitional sites. Potential rooting depth is usually shallow due to high water levels. Humus forms are dominated by Fibrimors and Mesimors on wet sites, and by Hemimors on imperfectly drained sites. The water table is usually at or near the surface, particularly in hollows / pools between peat ridges. The ecotype is generally nutrient-poor to -medium, with a hygric to hydric soil moisture regime (Figure 6.13). Site productivity is typically poor.

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as “Special Concern” in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Highly ranked occurrences (SH, S1, S2 or combinations thereof) of eight sensitive plant species, sticky false-asphodel (*Tofieldia glutinosa*) S1S3, status Undetermined; redhead grass (*Potamogeton richardsonii*), S1S3, status Undetermined; bird's-eye primrose (*Primula mistassinica*) S2; Sensitive; leafy northern green orchis (*Platanthera aquilonis*) S2S3, May Be At Risk; bog willow (*Salix pedicellaris*) S2S4, Sensitive; toad rush (*Juncus bufonius*) S2S4, status Undetermined; small-fruit bulrush (*Scirpus microcarpus*) S2S4, status Undetermined; Scheuchzer's cotton-grass (*Eriophorum scheuchzeri*) S2S4, status Undetermined; and swamp thistle (*Cirsium muticum*) S2S4, status Undetermined were observed within habitats contained within the Non-Patterned Shrub Fen ecotype.

Disturbance and Succession Ecology

These sites are relatively stable. Fire frequency is low, and fire severity is low owing to their position in moist areas of low relief. As a result the dominant natural disturbance associated with MSF 13 sites are seasonal and yearly water level fluctuations. The quality and quantity of which is crucial to the maintenance of the fen. Seasonally, water levels tend to be highest during the winter and spring and lowest in late summer and early fall.

Repeated disturbances (e.g., flooding or fire), though uncommon, could maintain these ecotypes in this early successional state, provided the regenerative capacity of the shrub layer was maintained. In the absence of disturbance, over time paludification may convert these fens to bogs. Sphagnum patches and associated bog vegetation in the fens may be early signs of paludification.

Wildlife and Wildlife Habitat

Open and aquatic areas characteristic of MSF 13 sites provide nutrient rich forage for moose (Peek 1997). However, use of these sites may be seasonal as they do not offer shelter from winter weather (Thompson and Stewart 1997). Moose use of the SF ecotype was detected in 13 percent of sites surveyed.

Snowshoe hare are known to inhabit spruce swamps in which water levels are low, although it has been noted that this species prefers conifer forests, choosing cover over food availability as a major factor in habitat selection. MSF 13 sites offer summer forage of grasses and shoots and winter forage of buds, twigs, and spruce needles (Carreker 1985). Snowshoe hare evidence was found in 20 percent of the sites surveyed. Lynx may use these sites as an area in which to prey upon snowshoe hare, but due to lack of cover, these sites are poor lynx habitat. No evidence of lynx was detected during these surveys.

Rusty Blackbird breeds throughout Labrador in wet habitats that provide insect and plant forage material. During field surveys Rusty Blackbird was detected within habitat characterized by the SF ecotype at a single site. This species is listed both federally as of *special concern* (COSEWIC 2006) and provincially as *vulnerable* (NLESA 2007).

Canada Goose use Shrub Fen sites for both foraging and nesting although evidence of this species (scat) was not detected in this ecotype. Islands created in the waterways of fens are recognized as valuable nesting sites for this species (JWEL 2003).

A summary of wildlife habitat use and potential for the Non-Patterned Shrub Fen Ecotype is presented in Table 6.38.

Table 6.38 Summary of Wildlife Habitat Use and Potential for Non-Patterned Shrub Fen Ecotype

Non-Patterned Shrub Fen Ecotype					
Species	**Habitat Potential**			**Occurrence %**	**Comments**
Common Name	**Primary**	**Secondary**	**Tertiary**		
Moose		•		13	
Caribou		•		0	
Beaver			•	0	
Snowshoe hare			•	13	
Spruce Grouse		•		38	
Short-eared Owl			•	0	
Porcupine			•	0	
Lynx			•	0	
Rusty Blackbird		•		13	
Canada Goose		•		0	Fens important for breeding

MSF 14 Ecotype: Graminoid Fen

Map Code:	GF	**Name:**	Graminoid Fen	**Ecotype:**	14
Total Area (km^2):	See Non-Patterned Fen			**Percentage of Study Area:**	

General Site Description

For ecosystem mapping purposes, the Graminoid Fen (GF) ecotype is considered a subcomponent of the MSF 12 and MSF 13 ecotypes.

Graminoid Fen ecotypes are weakly minerotrophic (mineral-rich) wetlands in which the substrate is predominantly comprised of graminoid (e.g., sedge) peat in various stages of decomposition. Within the Study Area, graminoid-dominated fens occur as collapse scars within the larger wetland mosaic, as small isolated basins, and on flat surfaces that slope gently in the direction of surface and groundwater flow. Similar to the MSF 12 and MSF 13 ecotypes, these sites are generally confined to actively forming, deep organic soils or floating organic mats, in settings typically low in nutrients, but where concentrations of mineral rich groundwater are high

enough to promote the establishment of graminoid-dominated communities. Though the GF ecotype may appear uncommon across the Study Area (as indicated by low sample size numbers) it is more a function of their existence as small pockets nested within other, larger wetland complexes (Table 6.39).

Vegetation characteristic of graminoid fens are adapted to full sunlight, sustained water levels, low nutrient levels, and high mineral levels. This environment is suited to the dominance of herbaceous species, brown mosses, and minerotrophic *Sphagnum* mosses. The dominant plant species in graminoid fens are sedges (typically with 50-60 percent cover), although grasses and rushes may be common. Low shrubs may be present, but collectively they cover less than 25 percent of sites. Sphagnum mosses are either absent or represent a minor component of the moss layer, with only the most minerotrophic species present. Other mosses, especially those requiring highly minerotrophic conditions may be common. Water sedge (*Carex aquatilis*) was the dominant graminoid. Other common, often co-dominant, graminoids include coastal sedge (*C. exilis*), bottle sedge (*C. rostrata*), slender sedge (*Carex lasiocarpa*), mud sedge (*C. limosa*) and cotton-grasses *Trichophorum cespitosum*, *T. alpinum* and tall cotton-grass (*Eriophorum angustifolium* subsp. *angustifolium*). Characteristic herbs include Canada burnet (*Sanguisorba canadensis*), three-leaf false Solomon's-seal (*Maianthemum trifolium*), buckbean (*Menyanthes trifoliata*), bog goldenrod (*Solidago uliginosa*) and hooded ladies'-tresses (*Spiranthes romanzoffiana*). Other less common, often inconspicuous herbs found in rich graminoid fens include round-leaved sundew (*Drosera rotundifolia*), bird's-eye primrose (*Primula mistassinica*), Lapland buttercup (*Ranunculus lapponicus*), leafy white orchis (*Platanthera dilatata* var. *dilatata*), sticky false-asphodel (*Tofieldia glutinosa*). Characteristic shrubs, where present, include sweet-gale (*Myrica gale*), shrubby cinquefoil (*Dasiphora fruticosa*), bog willow (*Salix pedicellaris*), and mountain flyhoneysuckle (*Lonicera villosa*). Characteristic non-vascular species include the mosses *Campylium stellatum* and *Drepanocladus revolvens*, and an unidentified liverwort.

Organic soils associated with this ecotype are mainly Mesisols, dominated by organic layers in a moderate stage of decomposition (Om horizons). Organic soils may grade into mineral Gleysols at the edges of these wetlands. Drainage is usually poor to very poor, but is imperfect on transitional sites. Potential rooting depth is usually shallow due to high water levels. Humus forms are dominated by Fibrimors and Mesimors on wet sites, and by Hemimors on imperfectly drained sites. The water table is usually at or near the surface, particularly in hollows / pools between peat ridges. The ecotype is generally nutrient-poor, with a hygric to hydric soil moisture regime (Figure 6.14). Site productivity is typically poor.

Figure 6.14 Edatopic Grid for Graminoid Fen Ecotype

Soil Moisture Regime ←Wet Dry→	Soil Nutrient Regime ←Poor Rich→				
	A	B	C	D	E
0					
1					
2					
3					
4					
5					
6					
8		100%			

0 – 10%
11 – 20%
21 – 30%
31 – 40%
41 – 50%
51 – 60%
61 – 70%
71 – 80%
81 – 90%
91 – 100%

***Percentage denotes proportion of sample plots in a particular soil moisture / soil nutrient regime class**

Photo 53 Graminoid Fen Ecotype – Aerial View

Photo 54 Graminoid Fen Ecotype – Ground View

Photo 55 Graminoid Ecotype – Typical Vegetation

Photo 56 Graminoid Ecotype – Typical Soil Profile

Table 6.39 Summary of Ecological Condition for Graminoid Fen Ecotype

Graminoid Fen Ecotype*	
Site Information	
Ecoregion:	Mid Subarctic Forest-Michikamau (MSF)
Ecotype:	Graminoid Fen Ecotype (GF)
General Location:	Narrowly distributed, typically occupying small portions of larger wetland complexes
Inventory Numbers:	D15, G44, G45
Number of Sample Plots (n):	n=3
Site Characteristics	
Surface Expression:	Depression
Topographic Position:	Flat level sites, depression
Slope:	<2%
Aspect:	Variable
Soil Nutrient Regime:	Typically classed as having poor (B) to medium (C) nutrient status.
Soil Moisture Regime:	Subydric (7) to Hydric (8)
Successional Status:	Early sere (wetlands)
Structural Stage:	Graminoid (GR)
Soil Characteristics	
Organic Thickness (cm) / LFH Thickness (cm):	>100 cm
Humus Form:	Fibrimors, Mesimors and Humimor
Surface (Topsoil) Texture:	N/A
Average Topsoil Thickness (cm) :	N/A
Seepage:	N/A
Drainage:	Poor to very poor
Depth to Water Table:	At surface
Depth to Mottles / Gleying:	N/A
Effective Texture	N/A
Effective Rooting Depth (cm)	0 to 50 cm
Coarse Fragment Percent and Type:	N/A
Depth to Bedrock:	>100 cm
Pit Depth (cm)	100+ cm
Parent Material:	Organic, Morainal (Till)
Soil Classification (CSSC):	Terric and Typic Fibrisols, Terric and Typic Mesisols

Graminoid Fen Ecotype*	
Vegetation	
Overstory Descriptor:	N/A
Understory Descriptor:	N/A
Dominant Shrub Species (% cover):	*Myrica gale, Dasiphora fruticosa,*
Dominant Herb / Forb Species (% cover):	*Sanguisorba canadensis*
Dominant Graminoid Species (% cover):	*Carex exilis, C. aquatilis, Trichophorum cespitosum,*
Dominant Mosses, Liverwort, Lichen Species (% cover):	*Campylium stellatum, Drepanocladus revolvens, Sphagnum spp.*
Dominant Aquatic / Wetland Species (% cover):	*Utricularia intermedia*
Plant Indicator Species:	*Dasiphora fruticosa, Andromeda polifolia, Betula michauxii*
Plant Species Richness:	-
Species At Risk / Species of Conservation Concern:	*Tofieldia glutinosa, Ranunculus lapponicus, Primula mistassinica, Platanthera dilatata var. dilatata, Salix pedicellaris*

**GF ecotypes have been aggregated with MSF13 for ecosystem mapping purposes*

Plant Community Diversity

For ecosystem mapping purposes the GF ecotype has been aggregated with MSF10.

Rarity

All species of vascular plant encountered during the surveys were identified and their population status in Newfoundland and Labrador were determined through a review of the species rankings provided by NLDEC (NLDEC 2010), ACCDC (ACCDC 2010), COSEWIC (2010), and those listed under *SARA* and the *Newfoundland and Labrador Endangered Species Act*.

No rare elements under the protection of *SARA* or the *Endangered Species Act* (i.e., listed as “Special Concern” in Schedule 1 of *SARA*; listed in Schedule 2 or 3 of *SARA*); or ranked as SH, S1, or S2 by the ACCDC have been identified from this ecotype.

Highly ranked occurrences (SH, S1, S2 or combinations thereof) of four plant species, Lapland buttercup (*Ranunculus lapponicus*) SH, May Be At Risk; sticky false-asphodel (*Tofieldia glutinosa*) S1S3, status Undetermined; bird's-eye primrose (*Primula mistassinica*) S2, Sensitive; and bog willow (*Salix pedicellaris*) S2S4, Sensitive; were observed within habitats contained within the Graminoid Fen ecotype.

Disturbance and Succession Ecology

These sites are relatively stable. The dominant natural disturbance associated with MSF 14 sites are seasonal and yearly water level fluctuations. The quality and quantity of which is crucial to the maintenance of the fen. Seasonally, water levels tend to be highest during the winter and spring and lowest in late summer and early fall.

Repeated disturbances (e.g., flooding or fire), though uncommon, could maintain these ecotypes in this early successional state. In the absence of disturbance, over time this ecotype will eventually develop into bogs as the surface of the wetland rises above the level of nutrient enriched groundwater.

Wildlife and Wildlife Habitat

Open and aquatic areas characteristic of MSF 14 sites provide nutrient rich forage for moose (Peek 1997). However, use of these sites may be seasonal as they do not offer shelter from winter elements (Thompson and Stewart 1997). Moose sign was detected in 50 percent of the GF ecotypes surveyed.

Caribou have a pattern of lowland habitat use, in combination with varying use of lichen-rich stands of black spruce. Recent work in north-central Alberta has shown that even in areas where small peatlands are interspersed in an upland matrix, caribou select treed bogs and fens (Morton and Wynes 1997). There were no caribou detected in this ecotype during these surveys.

Beaver utilization in graminoid fen habitat is closely tied to the presence of water courses. As generalist herbivores, beaver may forage seasonally on a variety of species found in Graminoid Fen sites (Fryxell and Doucett 1991). Both old and recent browse within this ecotype were detected on 50 percent of the surveys.

Open areas within this ecotype may meet hunting requirements for some species of owl although no evidence of owls was detected during these surveys. Short-eared owls recognized by COSEWIC as a Species of *Special Concern* and provincially as *vulnerable*, use open areas for hunting small mammals and sometimes small birds (Schmelzer 2005).

The Rusty Blackbird breeds throughout Labrador in wet habitats that provide insect and plant forage material. Graminoid Fen habitat was rated as secondary for this species.

Canada Goose breeds on hummocky islands in Graminoid Fens. Forage (aquatic vegetation, grasses, roots, etc.) is also available in fen habitats (Mowbray et al. 2002). There was no evidence of this species found in this ecotype.

A summary of wildlife habitat use and potential for the Graminoid Fen Ecotype is presented in Table 6.40.

Table 6.40 Summary of Wildlife Habitat Use and Potential for Graminoid Fen Ecotype

Graminoid Fen Ecotype					
Species	**Habitat Potential**			**Occurrence %**	**Comments**
Common Name	**Primary**	**Secondary**	**Tertiary**		
Moose	•			50	
Caribou			•	0	
Beaver		•		50	One fen was 'poor' and identified as tertiary habitat; the other was rated as 'primary'
Snowshoe hare			•	0	
Spruce Grouse			•	0	
Short-eared Owl	•			0	This species requires a minimum size (~ 20ha) open habitat for hunting
Porcupine			•	0	
Lynx			•	0	
Rusty Blackbird		•		0	Presence of stream in one of these fens ranked this fen as 'primary' habitat while the other fen was ranked as tertiary
Canada Goose		•		0	fens important for breeding

** Observations of passerines were collected from sample locations G44 and G45 Only*

6.2.4.5 Sparsely Vegetated, Non-Vegetated and Anthropogenically Altered / Disturbed Ecosystem Units

MSF 15 Ecotype: Open Water

The Open Water Ecotype includes lakes, ponds and rivers across the Study Area. Lakes are defined as naturally occurring static bodies of water, greater than 2 m deep in some portion. The boundary for the lake is the natural high water mark. A pond is a small body of water greater than 2 m deep, but not large enough to be classified as a lake (e.g., less than 50 ha). Rivers include any watercourse formed when water flows between continuous, definable banks. The flow may be intermittent or perennial. An area that has an ephemeral flow and no channel with definable banks is not considered a river. This ecotype occupies approximately 14 percent (54.5 km^2) of the Study Area.

MSF 16 Ecotype: Shallow Open Water with Vegetation

A wetland composed of semi-permanent shallow open water areas and lacking extensive emergent plant cover. The water is less than 2 m deep. If vegetated (i.e., peat ridges (strings) and hollows (flarks) oriented parallel to the slope of the landform and perpendicular to the flow of groundwater), these units will be incorporated into ecotypes for interpretation), typically patterned fens. This ecotype occupies approximately 5.0 percent (1.3 km^2) of the Study Area.

MSF 17 Ecotype: Exposed Earth / Anthropogenic

Any area of exposed soil that is not included in any of the other definitions. It includes areas of recent disturbance, such as slumping, mass wasting, flooding, and human-made disturbances (e.g., access roads used for exploration drilling, borrow pits) where vegetation cover is less than 5 percent or absent entirely. This ecotype occupies approximately 6 percent (22.4 km^2) of the Study Area.

7.0 SUMMARY

7.1 Plant Species Distribution and Abundance

A total of 243 plant species were found in the Study Area. Of these, 246 were vascular plants, 13 were mosses and liverworts and 12 were lichens. The most prevalent tree species were black spruce and tamarack, with small amounts of paper birch, heart-leaved paper birch, balsam fir, white spruce, and jack pine (plantation). For a complete list of the flora identified in the Study Area, refer to Appendix B.

Biodiversity analysis, measured by species richness, found considerable differences between the plant community types in the Study Area. The highest species richness (vascular plants) was recorded in the transitional or ecotonal communities of ecotypes Tamarack / Black Spruce-Feathermoss (Water Track) and Black Spruce / Tamarack-Sphagnum Woodland (45.3 and 43.8, respectively). Species richness was lowest in Riparian Thicket (10.0) and Riparian Marsh (Fen) (12.3) which are maintained at an early stage of succession through frequent scouring by ice and flood waters.

7.2 Summary of Ecosystem Units (Ecotypes) within the Study Area

A total of 14 vegetated and 3 sparsely or non-vegetated ecotypes were identified within the Study Area, described from 114 sample plots, and based on the ecosystem classification system adapted for use with this and other similar projects completed throughout Labrador. Two of the vegetated ecotypes, Black Spruce-Labrador Tea-Feathermoss and Black Spruce-Lichen, also had corresponding burned subtypes (i.e., Hardwood Burn / Regeneration, Mixedwood Burn / Regeneration and Softwood Burn / Regeneration) which were large enough to be mapped seperately, resulting in a total of 14 vegetated map units. The 3 sparsely or non-vegetated ecotypes included open water (i.e., lake, pond, river), shallow open water with vegetation, and exposed earth / anthropogenic (Table 7.1). Non-ELC areas, those of Cloud and Shadow, account for approximately 2 percent of the mapped ELC areas. The accompanying completed ecosystem mapping shows the distribution of each ecotype within the Study Area (Appendix A).

The Study Area covers a total area of 396 km^2 (Table 7.1) of which 54 percent is in upland areas and 24 percent is in lowland areas (ecotypes BS, TF, PF, SF, RM, RT). Existing disturbances, including access roads and trails, clearings, exploration drill sites, and recreational properties, cover approximately 6 percent of the Study Area. Water (lakes, ponds, rivers) covers less than 15 percent of the Study Area.

Wetland ecotypes, predominantly Non-Patterned Shrub Fen (SF) are the dominant lowland areas, comprising 9.3 km^2 (2.3 percent) of the Study Area. Though classified as shrubby, small black spruce and tamarack are well represented in much of the SF ecotype, and over time these sites will likely transition into Black Spruce / Tamarack-Sphagnum Woodland communities. Upland areas are mainly the Black Spruce-Labrador Tea-Feathermoss (BF) ecotype (Table 7.1), dominated by black spruce and ericaceous shrubs.

Fens comprised 3.1 percent of the Study Area. Patterned Shrub Fens (PF) occupy 0.8 percent of the Study Area (3.1 km^2). Non-Patterned Shrub Fens (SF) occupy 2.3 percent (9.3 km^2) of the Study Area, of which Graminoid Fens (GF) are a minor component.

Ecotypes of restricted distribution (<1 percent of the Study Area) were those of Alpine Heath ecotypes in upland areas and Riparian Thicket, Riparian Marsh, and Patterned Fen ecotypes in the lowlands.

Approximately 2 percent of the Study Area (9.5 km^2) could not be mapped because of non-existent or poor satellite coverage, cloud cover and/or shadows. This area is generally distributed throughout the Study Area and is identified on the ecosystem map (Appendix A).

Table 7.1 Summary of Ecosystem Units (Ecotypes) within the Study Area

Ecosystem	Ecotype / Subtype	Area (km^2)	Percentage of Study Area (%)
Alpine Ecosystem	Alpine Heath (AH)	1.0	0.2
Forested Ecosystem	Hardwood Forest (HW)	5.4	1.4
Forested Ecosystem	Hardwood Burn / Regeneration (HB)	34.1	8.6
Forested Ecosystem	Mixedwood Forest (MW)	17.5	4.4
Forested Ecosystem	Mixedwood Burn / Regeneration (MB)	5.3	1.3
Forested Ecosystem	Black Spruce-Labrador Tea-Feathermoss (BF)	91.5	23.1
Forested Ecosystem	Black Spruce-Lichen (BL)	19.7	5.0
Forested Ecosystem	Softwood Burn / Regeneration (SB)	37.5	9.5
Forested Wetland Ecosystem	Black Spruce / Tamarack-Sphagnum Woodland (BS)	49.6	12.5
Forested Riparian Ecosystem	Tamarack / Black Spruce-Feathermoss (Water Track) (TF)	30.1	7.6
Non-Forested Wetland Ecosystem	Patterned Shrub Fen (PF)	3.1	0.8
Non-Forested Wetland Ecosystem	Non-Patterned Shrub Fen (*incl. Graminoid Fen) (SF)	9.3	2.3
Non-Forested Riparian Ecosystem	Riparian Thicket (RT)	0.3	0.1
Non-Forested Riparian Ecosystem	Riparian Marsh / Fen (RM)	0.6	0.2
Aquatic Ecosystem	Shallow Open Water with Vegetation	5.0	1.3
Aquatic Ecosystem	Open Water (incl. Lake / Pond / River)	54.5	13.7
Anthropogenic	Exposed Earth / Anthropogenic	22.4	5.7
	Cloud	7.8	2.0
	Shadow	1.7	0.4
Totals (Rounded)		396	100.0

7.3 Wildlife and Wildlife Habitat

There were seven species of mammals (moose, black bear, wolf, snowshoe hare, red squirrel, beaver, and muskrat) identified in the Study Area during the ELC field surveys in 2011. There were twenty-eight avian species identified during the ELC field surveys. In addition, evidence of the presence of small mammal species (i.e., voles, shrews and mice species) was also noted although it was not possible to attribute these to individual species.

In addition to some waterfowl, shorebird and forest songbird species, individuals or sign of Ptarmigan, Spruce Grouse, Ruffed Grouse, Osprey, American Kestrel and Wilson's Snipe were also detected. Additional information on waterfowl and forest songbirds may be found in separate baseline reports and companion studies currently under preparation (Stassinu 2012a; 2012b). American toad (*Bufo americanus*) was the only amphibian identified during field surveys.

Occurrences of moose and/or moose sign were detected from nine separate ecotypes (Hardwood Forest, Mixedwood Forest, Black Spruce-Lichen, Black Spruce / Tamarack-Sphagnum Woodland, Softwood Burn / Regeneration, Hardwood Burn / Regeneration, Riparian Marsh / Fen, Non-Patterned Shrub Fen and Graminoid Fen) in the Study Area. These ecotypes are generally regularly frequented by moose as they provide a variety of seasonal forage opportunities. Fen ecotypes, including Patterned Shrub Fen, Non-Patterned Shrub Fen and Graminoid Fen, provide spring and summer forage in the form of aquatic plants (e.g., cowlily) that are typically associated with shallow water pools that comprise a portion of these ecotypes. Regenerating trees and shrubs in the Softwood Burn / Regeneration and Hardwood Burn / Regeneration ecotypes provide forage (browse) at various times of year. Mature forested ecotypes (i.e., Black Spruce-Labrador Tea-Feathermoss, Black Spruce-Lichen, Black Spruce / Tamarack-Sphagnum Woodland) may provide both forage and cover for this species.

Neither caribou nor caribou sign was detected within the Study Area during the 2011 field surveys. Six ecotypes (Alpine Heath, Black Spruce-Labrador Tea-Feathermoss, Black Spruce / Tamarack-Sphagnum Woodland, Tamarack / Black Spruce-Feathermoss (Water Track), Non-Patterned Shrub Fen and Graminoid Fen) were rated as primary or secondary habitat for this species based on available forage and cover opportunities present within these ecotypes.

A single beaver, an active lodge and a dam were observed within a small pond directly south of the proposed Rose Pit. In addition, beaver sign was noted at a number of locations primarily in association with three ecotypes in the Study Area. These include the Riparian Thicket, Riparian Marsh / Fen and Graminoid Fen ecotypes. Signs of beaver presence were noted on trees (new and old browse) in and around the Graminoid Fen ecotype, in association with the Riparian Thicket ecotype where trail networks were observed in herb and forb growth, as well as at an active lodge within the Riparian Marsh / Fen ecotype

Snowshoe hare sign, including scat and browse, was found at eight ecotypes (Hardwood Forest, Mixedwood Forest, Black Spruce-Labrador Tea-Feathermoss, Black Spruce-Lichen, Softwood Burn / Regeneration, Black Spruce / Tamarack-Sphagnum Woodland, Tamarack / Black Spruce-Feathermoss (Water Track) and Non-Patterned Shrub Fen). Vegetation in these ecotypes provide cover and forage for this species throughout the year.

Spruce Grouse sign and/or individuals were identified within eight ecotypes during the 2011 field surveys, including Mixedwood Forest, Black Spruce-Labrador Tea-Feathermoss, Black Spruce-Lichen, Softwood Burn / Regeneration, Hardwood Burn / Regeneration, Black Spruce / Tamarack-Sphagnum Woodland, Tamarack / Black Spruce-Feathermoss (Water Track) and Non-Patterned Shrub Fen. Spruce Grouse females, along with juvenile spruce grouse were observed within the Softwood Burn / Regeneration and Non-Patterned Shrub Fen ecotypes.

Short-eared Owl was not detected within the Study Area during field surveys.

Porcupine was not detected within the Study Area during field surveys. Primary and secondary habitat was identified in eight ecotypes, including Hardwood Forest, Mixedwood Forest, Black Spruce-Labrador Tea-Feathermoss, Black Spruce-Lichen, Softwood Burn / Regeneration, Hardwood Burn / Regeneration, Black Spruce / Tamarack-Sphagnum Woodland and Tamarack / Black Spruce-Feathermoss (Water Track).

Lynx was not detected within the Study Area during field surveys. Primary and secondary habitat was identified in eight ecotypes largely based on snowshoe hare prey availability and the presence of suitable cover.

Surveys conducted during the 2011 field season resulted in the detection of a single Rusty Blackbird. The primary habitat characteristics for this species exist throughout the Study Area. This species breeds throughout Labrador in wet habitats that provide insect and plant forage material. Habitat for this species was identified in the PF and SF ecotypes (n=6), GF ecotype (n=1), and RT ecotype (n=1). Other ecotypes within the boreal forest with habitat characteristics such as slow-moving streams may also be identified as potential Rusty Blackbird habitat (e.g.,SB (n=1)).

Although Canada Goose was not observed during the ELC surveys, this species was observed throughout the Study Area during the waterfowl surveys (Stantec 2012a). The importance of fen habitats for breeding Canada Geese has been recognized (Mowbray et al. 2002). Canada Geese often make use of small islands within wetlands in Labrador for nesting (Minaskuat 2007). As such, habitat for this species was identified in the PF and SF ecotypes (n=5), in addition to that of the GF ecotype (n=1).

Incidental wildlife species, wildlife sign (tracks, trails, browsing, scat, etc) and critical habitat features noted within ecotypes surveyed throughout the Study Area are outlined in Table 7.2.

Table 7.2 Incidental Wildlife Observations

Ecotype / Subtype	moose	black bear	wolf	beaver	snowshoe hare	muskrat	red squirrel	small mammal (voles, shrews)	American toad	Osprey	American Kestrel	Common Raven	Herring Gull	Spruce Grouse	Ruffed Grouse	Ptarmigan	Slate-coloured Junco	American Robin	Gray Jay	Cedar Waxwing	Greater Yellow-legs	Hermit Thrush	White-throated Sparrow	Common Loon	Common Merganser	Downey Woodpecker	Pine Siskin	Lincon's Sparrow	Northern Flicker	Fox Sparrow	Rusty Blackbird	Spotted Sandpiper	Swainson's Thrush	Tree Swallow	Vesper Sparrow	Wetland Sparrow	Wilson's Snipe	Winter Wren	Yellow-shafted Flicker	Yellow-bellied Flycatcher
Alpine Heath		r	sc		br							v				sc	v																							
Hardwood Forest	br	r			br/sc	v/c		h/t															v																	
Mixedwood Forest	sc				sc		v							v					v			v																	
Hardwood Burn / Regeneration	sc	sc	sc		br			h/t			v			v					v			v	v	v		v												v	
Black Spruce-Labrador Tea-Feathermoss				sc			v	h/t											v				v				v			v									v
Softwood Burn / Regeneration	v		sc		sc		v	h/t		v		v	v	v-f/j			v		v				v							v									v
Black Spruce-Lichen	t	t	sc		v		v	h/t		v				v	v		v	v				v	v				v			v									
Black Spruce / Tamarack-Sphagnum Woodland	sc				v			h/t						v			v		v				v	v	v		v						v						
Riparian Thicket				t					v	v										v								v			v		v	v				v	
Riparian Marsh / Fen	t			l			v	v		v								v					v	v															
Non-Patterned Shrub Fen (*incl. Graminoid Fen)	v-br			br	v	v	v	h/t		v				v-f/j			v	v	v	v	v	v	v	v				v	v		v		v	v		v	v	v	v	

br-browse; h/t - holes and trails; r – rub; sc – scat; t – trail; v - visual, v-f/j - visual female with juveniles

8.0 ACCURACY ASSESSMENT

As part of the QA/QC review of vegetation mapping for the Project ELC an accuracy assessment was performed, comparing a number of ground-truthed sampling locations with that of the mapped vegetation types.

Accuracy assessment quantifies data quality so that map users may evaluate the utility of a thematic map for their intended applications. The thematic accuracy of the Project ELC was assessed by comparing the vegetation type (ecotype / subtype) shown on the map to that identified on the ground for a representative sample of evaluation points. When polygons representing vegetation types are mapped and labeled with the correct community types, then the map has “high” thematic accuracy.

The accuracy assessment for the Project ELC was completed using 100 reference points. A total of 64 reference points were *in-situ* field samples collected in the field as a result of ground trothing (points accurate to +/- 10 using Garmin GPSmap 76CSx technology), while the remaining 36 were identified from an independent assessment (desktop) of existing aerial imagery. The number of reference points by ecotype / subtype is identified in Table 8.1.

Table 8.1 Distribution of Reference Points in ELC classes.

Ecotype / Subtype	Code	Number of Reference Points
Alpine Heath	AH	0
Hardwood Forest	HW	6
Mixedwood Forest	MW	1
Burn / Regeneration (Sofwood / Hardwood / Mixedwood)	BU	14
Black Spruce-Labrador Tea-Feathermoss	BF	9
Black Spruce-Lichen	BL	6
Black Spruce / Tamarack-Sphagnum Woodland / Tamarack / Black Spruce-Feathermoss (Water Track)	BS/TF	20
Patterned Shrub Fen / Non-Patterned Shrub Fen (*incl. Graminoid Fen)	PF/SF	21
Riparian Thicket	RT	1
Riparian Marsh / Fen	RM	9
Shallow Open Water with Vegetation	SHW	5
Open Water (incl. Lake / Pond / River)	OW	7
Exposed Earth / Anthropogenic	EE	8
Cloud	Cloud	0
Shadow	Shadow	0
Totals		100

Most common form of expressing classification accuracy is the error matrix (confusion matrix or contingency table). Error matrices compare, on a class-by-class basis, the relationship between known reference data (ground truth) and the corresponding results of the habitat classification procedure.

An initial error assessment revealed that there was a high amount of confusion between Black Spruce/ Tamarack Sphagnum Woodland and Black Spruce/ Tamarack Treed Fen ecotypes, as well as Pattered Shrub Fen and Non-Pattered Shrub Fen ecotypes. This confusions is attributed to the classes having similar spectral signatures on the satellite imagery, thus it is not expected that the two classes would be seperable. As a result for this observation, the classes were merged into one for the purposes of the error assessment.

Resuts of the ELC accuracy assessment are expressed by way of an error matrix in Table 8.2. Overall or Total Accuracy is typically computed by dividing the total number of correctly classified pixels (i.e., the sum of the elements along the major diagonal) by the total number of reference pixels. When completed for the Project ELC, the Overall Accuracy for the habitat classification is 71%. Ultimately, this means that 100 reference points evaluated 71 were classified correctly through the classification procedure, and thus, if a pixel is selected at random, there is a 71% chance that that pixel is classified correctly.

Table 8.2 Error Matrix for Map Comparison or Accuracy Assessment

Ecotype / Subtype	Number of Reference Points													
	AH	**HW**	**MW**	**BU**	**BF**	**BL**	**BS/TF**	**PF/SF**	**RT**	**RM**	**SHW**	**OW**	**EE**	**Totals**
AH	0													**0**
HW		1	1			4								**6**
MW			1											**1**
BU				4		2		1						**7**
BF					8	1								**9**
BL						6								**6**
BS/TF				1			19							**20**
PF/SF			1		3			12			2	1	2	**21**
RT							1		0					**1**
RM		1			4	2				1		1		**9**
SHW											5			**5**
OW												7		**7**
EE						1							7	**8**
Totals	**0**	**2**	**3**	**5**	**15**	**16**	**20**	**13**	**0**	**1**	**7**	**9**	**9**	**100**

The accuracy of each class was also calculated by means of a class accuracy known as User's Accuracy. Users Accuracy was computed by dividing the number of correctlly classified pixels in each category by the total number of pixels that were classified in that category (the row total). Users Accuracy represents the probability that a pixel classified into a given category actually represents that category on the ground. For example, if we look at the Burn/Regeneration ecotype, with a User Accuracy of 80%, this means if a user selects a pixel classified as Burn/Regeneration on the ELC, there is an 80% chance that that same pixel is classified as such on the earth's surface. The Users Accuracy for each of the ELC classes is expressed in Table 8.3 below.

Table 8.3 Users Accuracy

Ecotype / Subtype	Code	Accuracy
Alpine Heath	AH	n/a
Hardwood Forest	HW	50.0
Mixedwood Forest	MW	33.3
Burn / Regeneration (Sofwood / Hardwood / Mixedwood)	BU	80.0
Black Spruce-Labrador Tea-Feathermoss	BF	53.3
Black Spruce-Lichen	BL	37.5
Black Spruce / Tamarack-Sphagnum Woodland / Tamarack / Black Spruce-Feathermoss (Water Track)	BS/TF	95.0
Patterned Shrub Fen / Non-Patterned Shrub Fen (*incl. Graminoid Fen)	PF/SF	92.3
Riparian Thicket	RT	n/a
Riparian Marsh / Fen	RM	100.0
Shallow Open Water with Vegetation	SHW	71.4
Open Water (incl. Lake / Pond / River)	OW	77.8
Exposed Earth / Anthropogenic	EE	77.8
Cloud	Cloud	n/a
Shadow	Shadow	n/a

9.0 ELC REPORT AND MAP USE

ELC units described in this report are representative of ecological conditions within the Study Area; however, variability is the norm within ecosystems and no classification can be expected to capture all this variation. In addition, the ELC map produced for this Project reflects dominant current conditions within each polygon which are subject to change over time. In particular, burned ecotypes will change considerably as they move through successional stages. Also, mapped polygons will almost always contain inclusions of ecotypes too small to be reflected in the supervised classification and represented in polygon labels. Therefore, this ELC report and map should be used as a guide to ecotypes within the Study Area. Users should verify conditions on the ground before proceeding with any ELC-associated site-specific activity.

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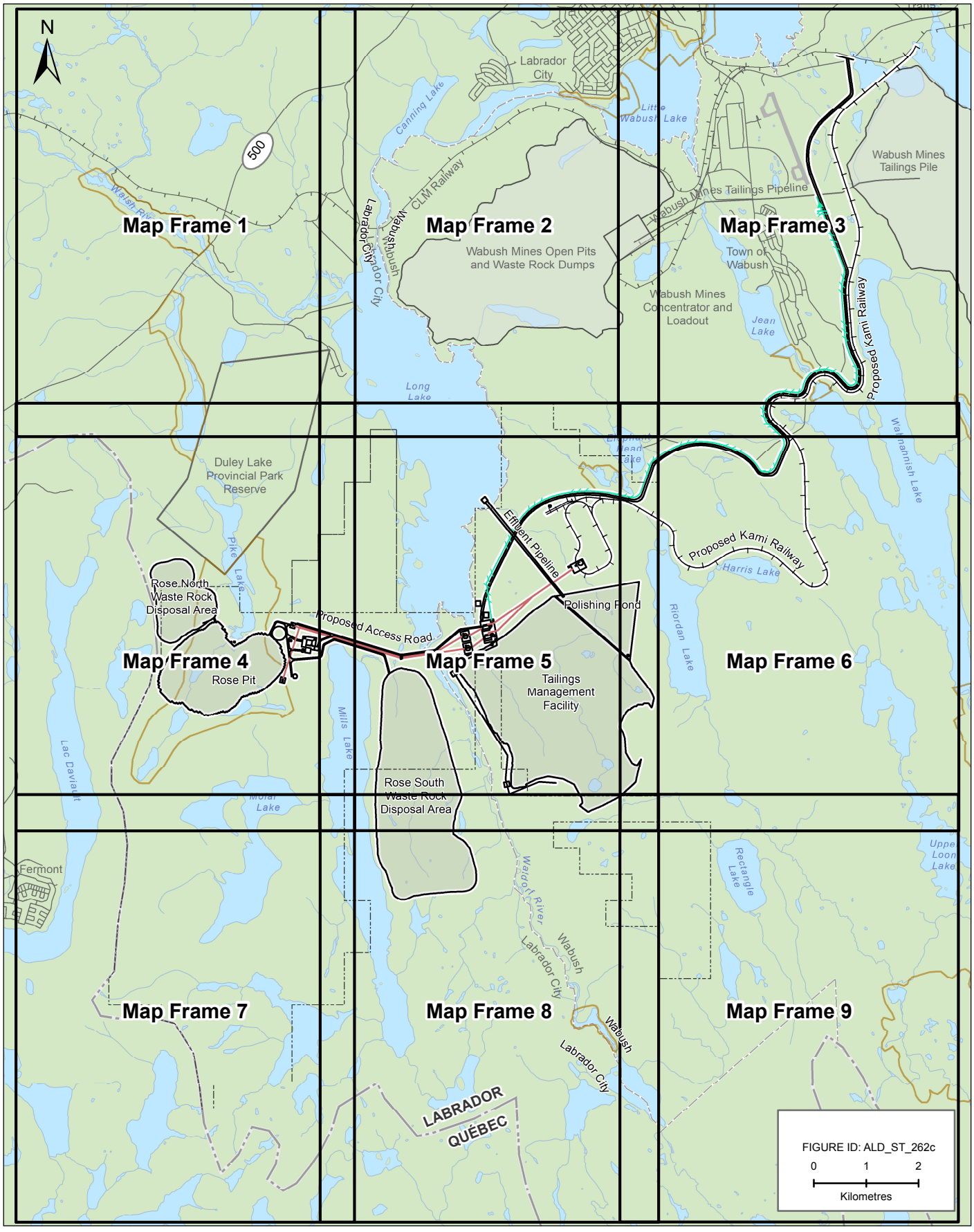
APPENDIX A

Ecosystem Mapping of the Study Area


N
Map Frame 1
Map Frame 2
Map Frame 3
Map Frame 4
Map Frame 5
Map Frame 6
Map Frame 7
Map Frame 8
Map Frame 9
500
Labrador City
Canning Lake
Little Wabush Lake
CLM Railway
Wabush
Labrador City
Wabush Mines Open Pits and Waste Rock Dumps
Wabush Mines Tailings Pile
Wabush Mines Tailings Pipeline
Town of Wabush
Wabush Mines Concentrator and Loadout
Jean Lake
Proposed Kami Railway
Long Lake
Duley Lake Provincial Park Reserve
Pike Lake
Effluent Pipeline
Proposed Kami Railway
Harris Lake
Rose North Waste Rock Disposal Area
Proposed Access Road
Polishing Pond
Rose Pit
Tailings Management Facility
Riordan Lake
Mills Lake
Lac Daviau
Rose South Waste Rock Disposal Area
Fermont
Rectangle Lake
Upper Loon Lake
Wardlaw River
Labrador City
Wabush
LABRADOR
QUÉBEC
FIGURE ID: ALD_ST_262c
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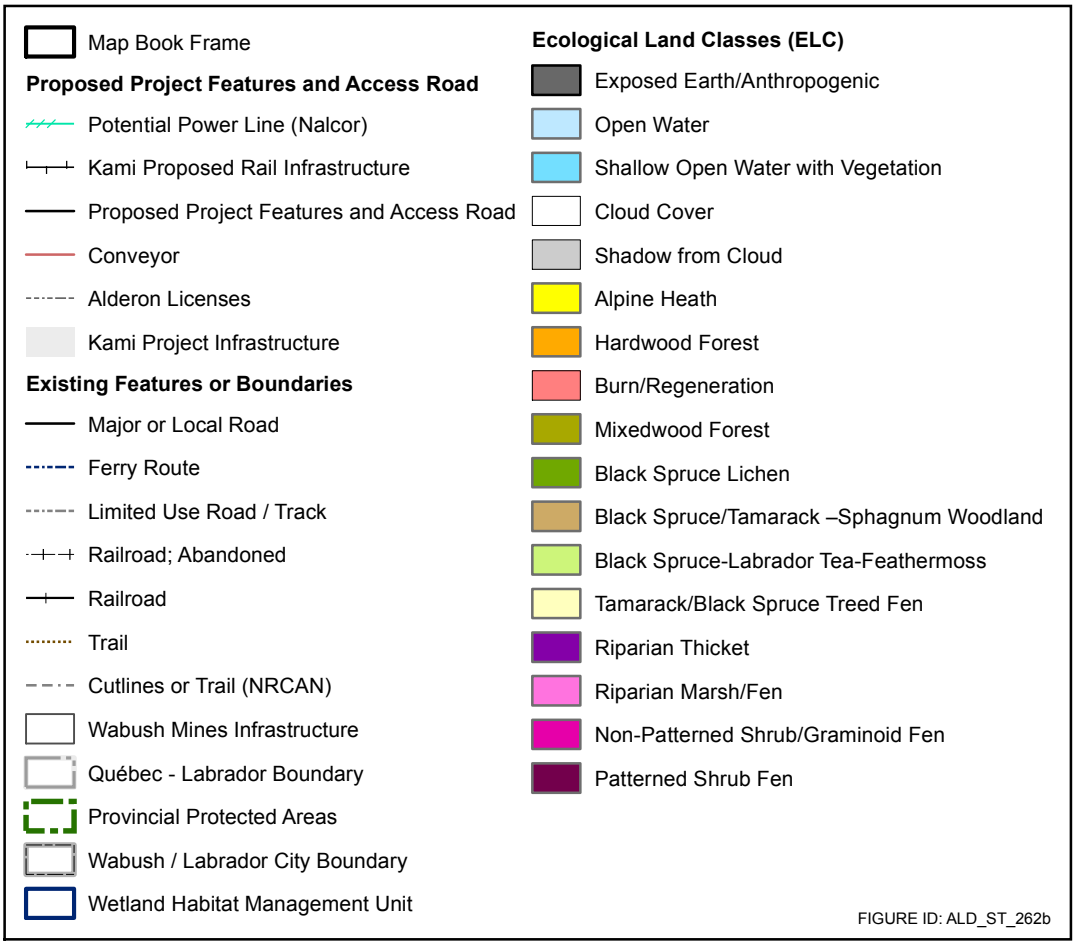
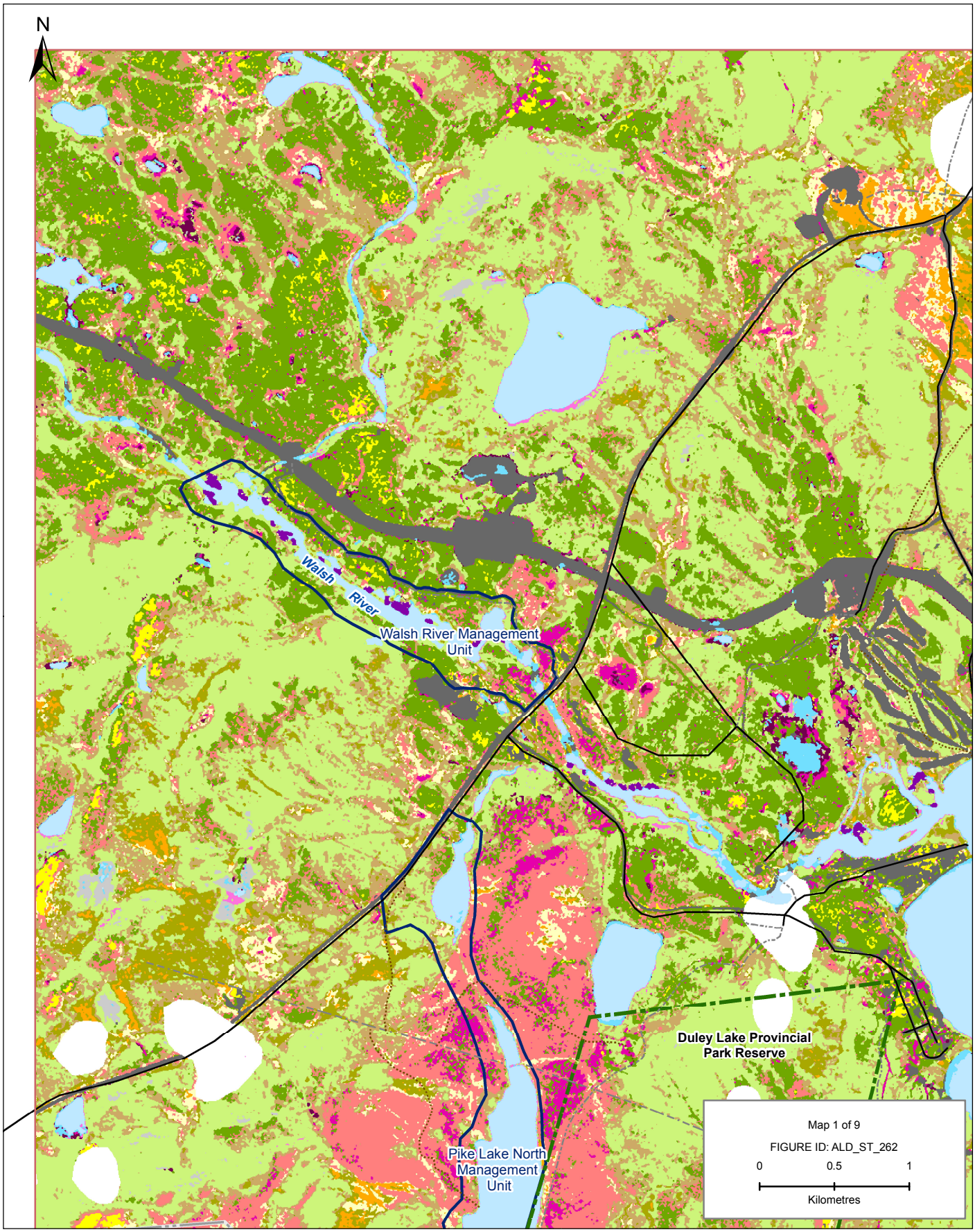
Kilometres


Map Book Frame
Proposed Project Features and Access Road
Potential Power Line (Nalcor)
Kami Proposed Rail Infrastructure
Proposed Project Features and Access Road
Conveyor
Alderon Licenses
Kami Project Infrastructure
Existing Features or Boundaries
Major or Local Road
Ferry Route
Limited Use Road / Track
Railroad; Abandoned
Railroad
Trail
Cutlines or Trail (NRCAN)
Wabush Mines Infrastructure
Québec - Labrador Boundary
Provincial Protected Areas
Wabush / Labrador City Boundary
Wetland Habitat Management Unit
Ecological Land Classes (ELC)
Exposed Earth/Anthropogenic
Open Water
Shallow Open Water with Vegetation
Cloud Cover
Shadow from Cloud
Alpine Heath
Hardwood Forest
Burn/Regeneration
Mixedwood Forest
Black Spruce Lichen
Black Spruce/Tamarack –Sphagnum Woodland
Black Spruce-Labrador Tea-Feathermoss
Tamarack/Black Spruce Treed Fen
Riparian Thicket
Riparian Marsh/Fen
Non-Patterned Shrub/Graminoid Fen
Patterned Shrub Fen
FIGURE ID: ALD_ST_262b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Walsh River
Walsh River Management Unit
Duley Lake Provincial Park Reserve
Pike Lake North Management Unit
Map 1 of 9
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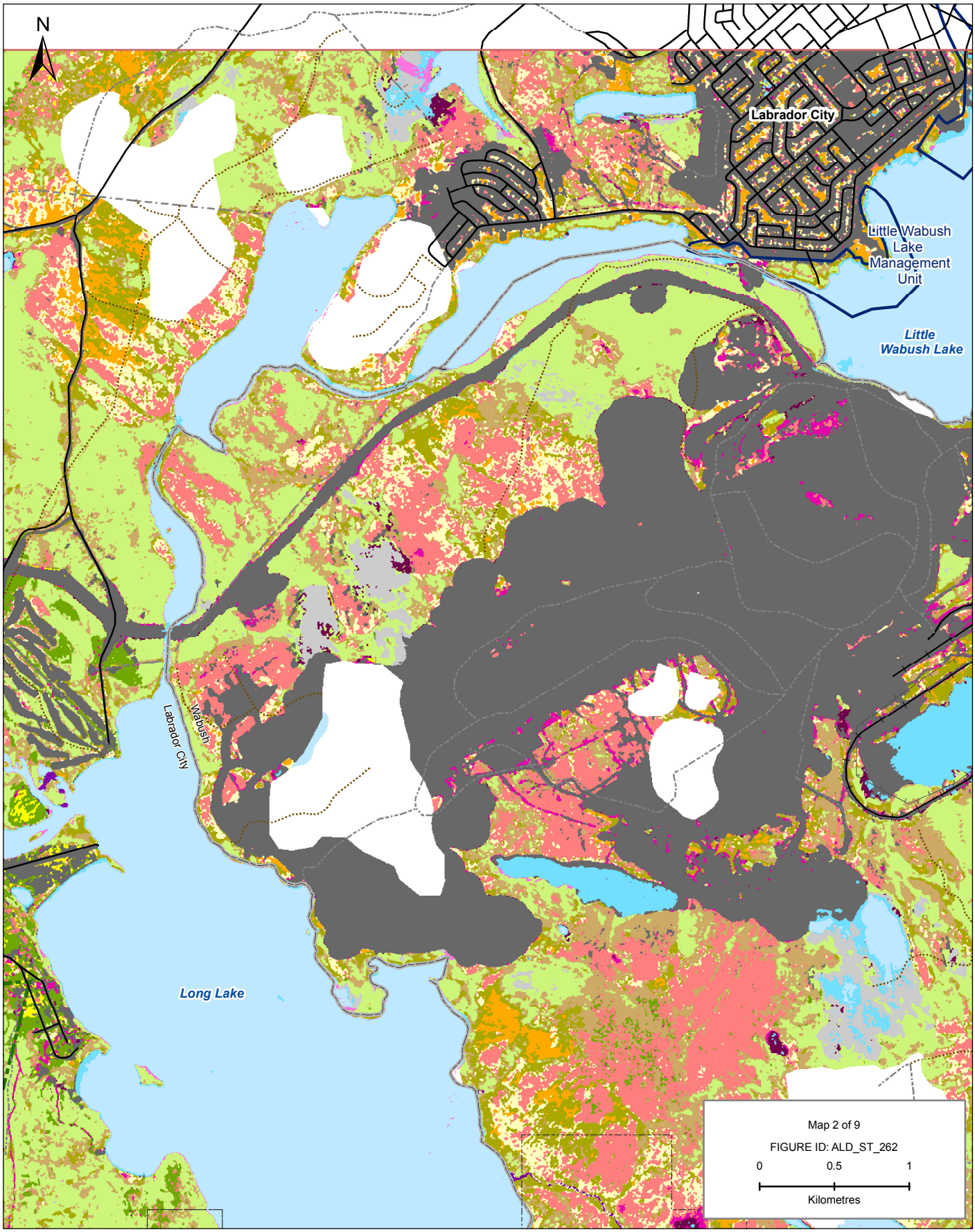
1
Kilometres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Labrador City
Little Wabush Lake Management Unit
Little Wabush Lake
Labrador City
Wabush
Long Lake
Map 2 of 9
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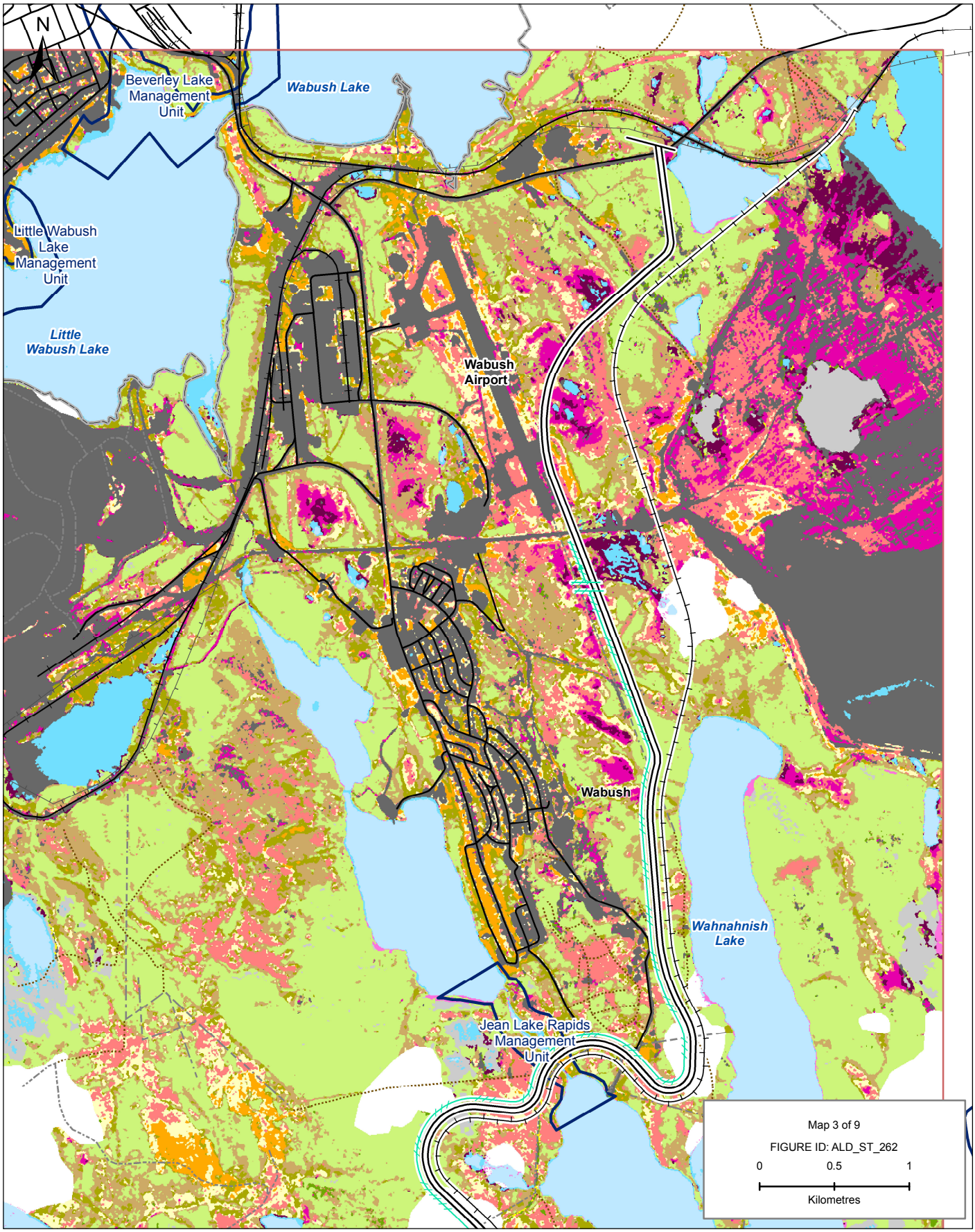
1
Kilometres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Beverley Lake Management Unit
Wabush Lake
Little Wabush Lake Management Unit
Little Wabush Lake
Wabush Airport
Wabush
Wahnahnish Lake
Jean Lake Rapids Management Unit
Map 3 of 9
FIGURE ID: ALD_ST_262
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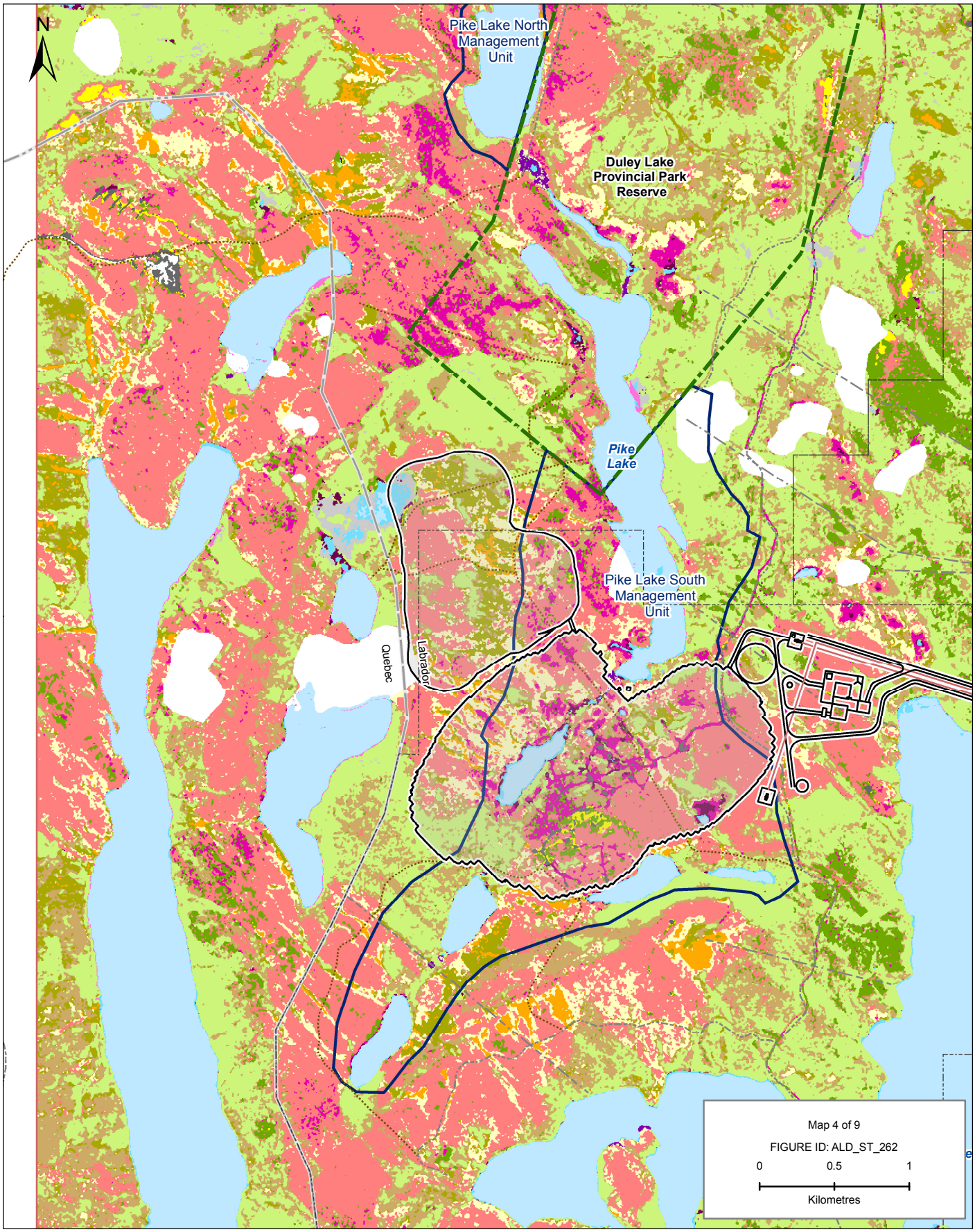
0.5
1
Kilometres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Pike Lake North Management Unit
Duley Lake Provincial Park Reserve
Pike Lake
Pike Lake South Management Unit
Quebec
Labrador
Map 4 of 9
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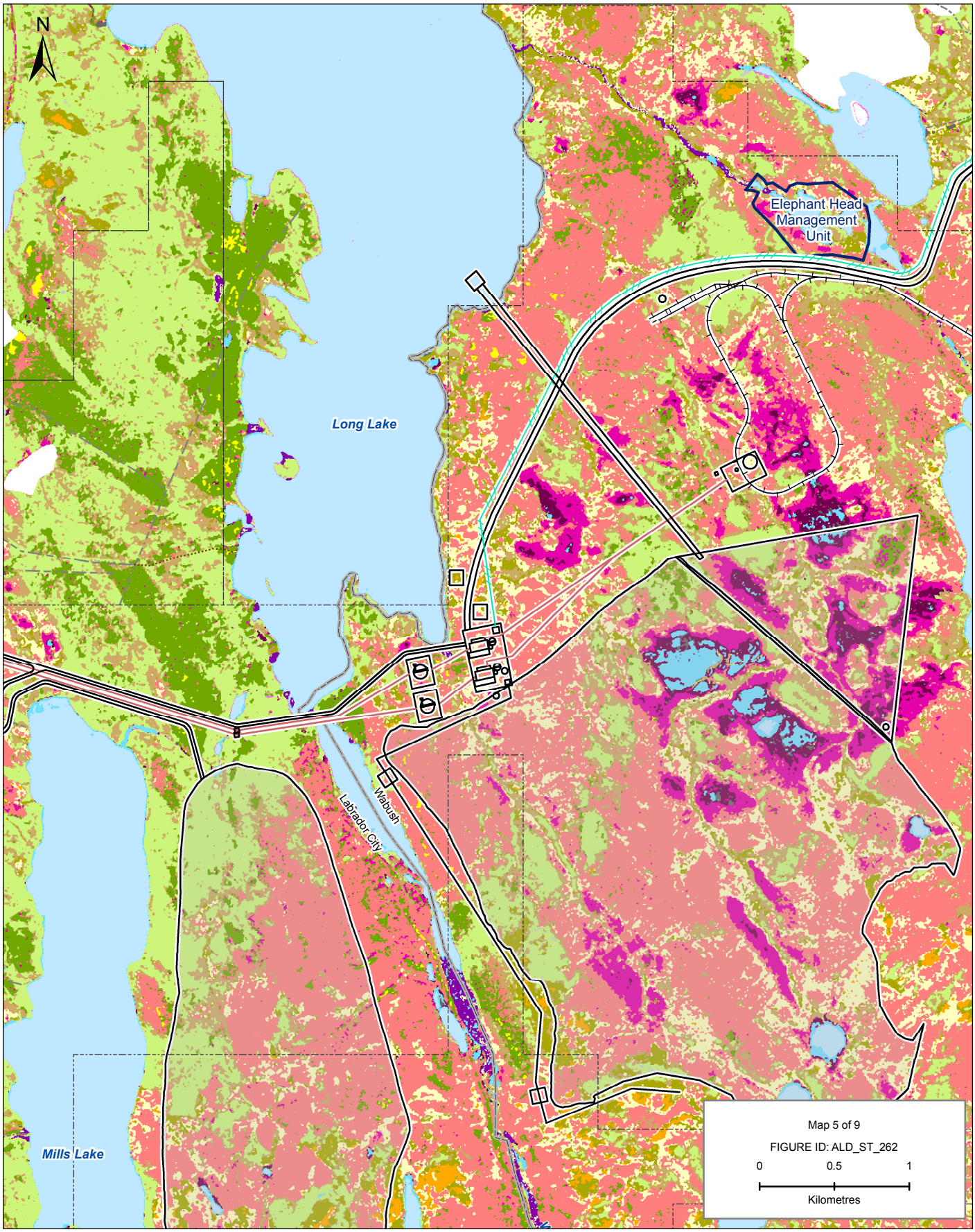
Kilometres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Elephant Head
Management
Unit
Long Lake
Labrador City
Wabush
Mills Lake
Map 5 of 9
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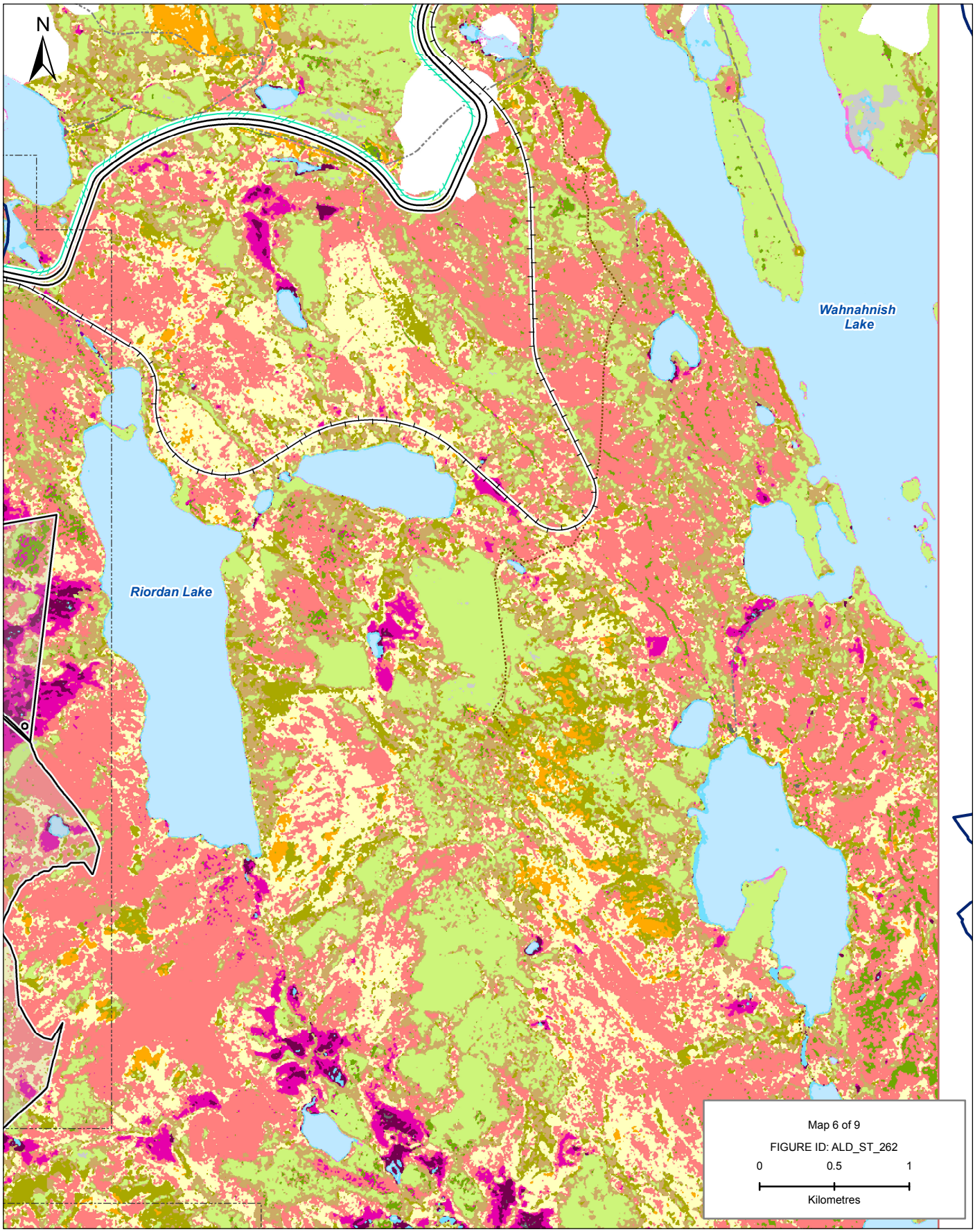
0.5
1
Kilometres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Wahnahnish Lake
Riordan Lake
Map 6 of 9
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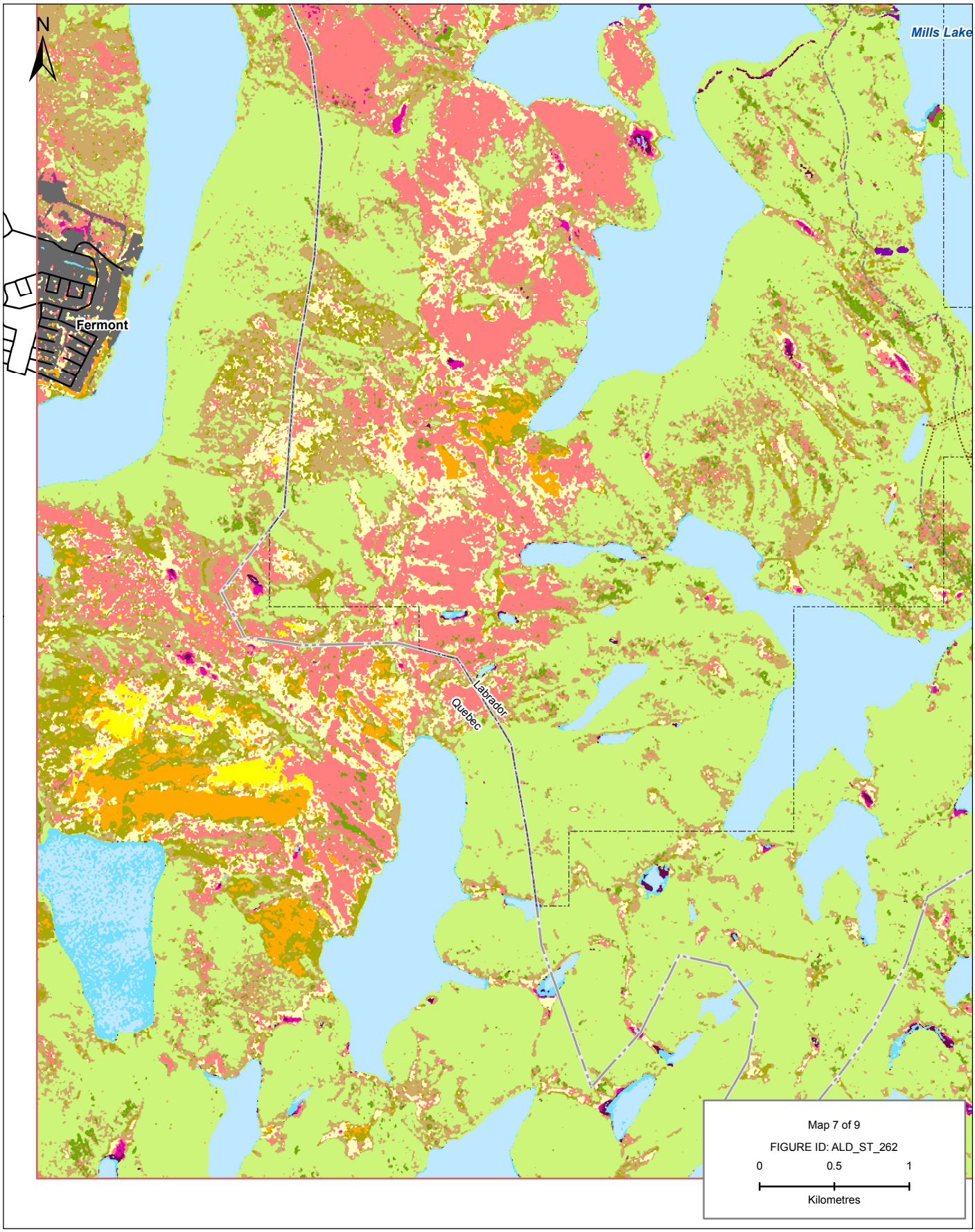
Kilometres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Mills Lake
Fermont
Labrador
Quebec
Map 7 of 9
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0.5
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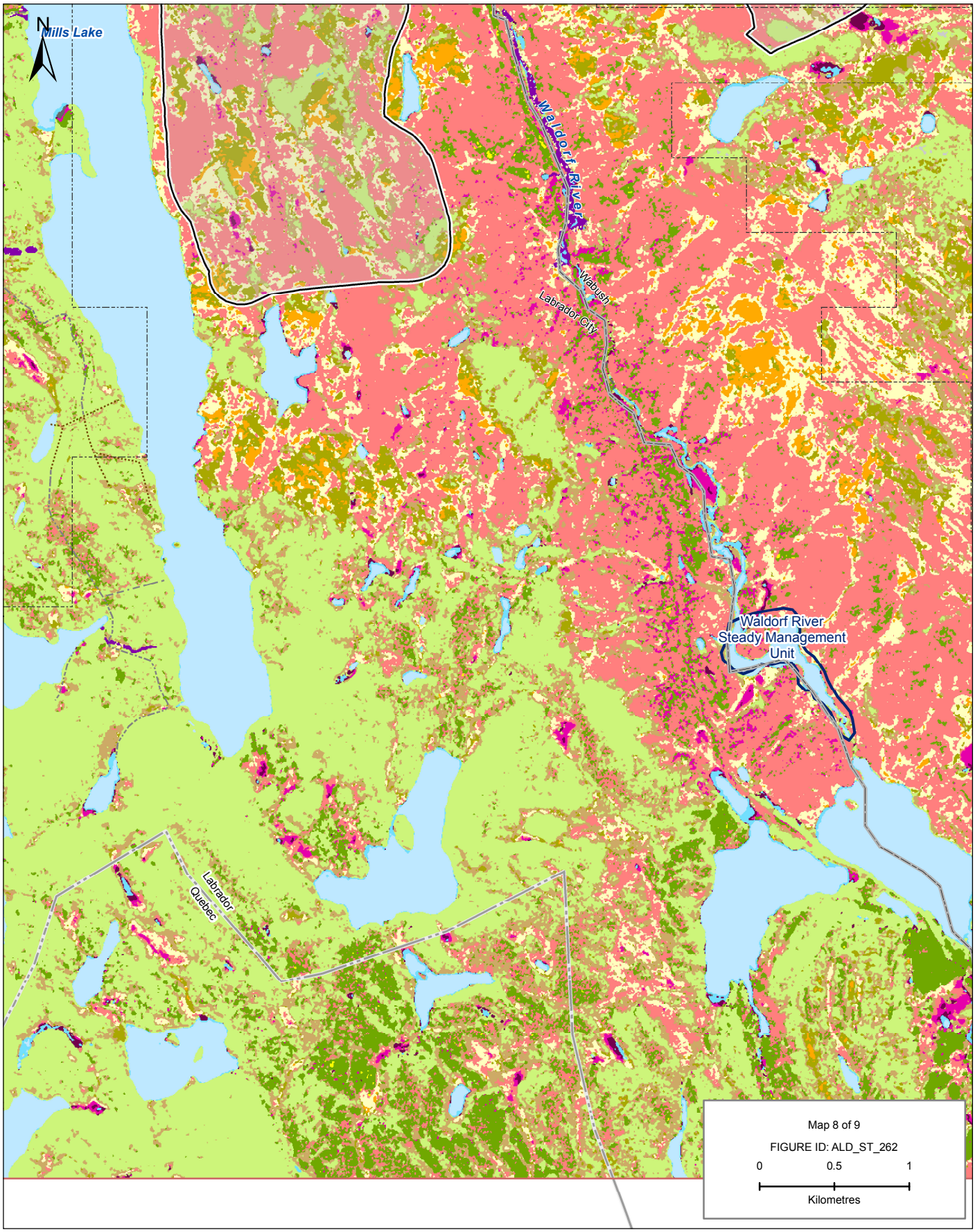
Kilometres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Mills Lake
Waldorf River
Wabush
Labrador City
Waldorf River
Steady Management
Unit
Labrador
Quebec
Map 8 of 9
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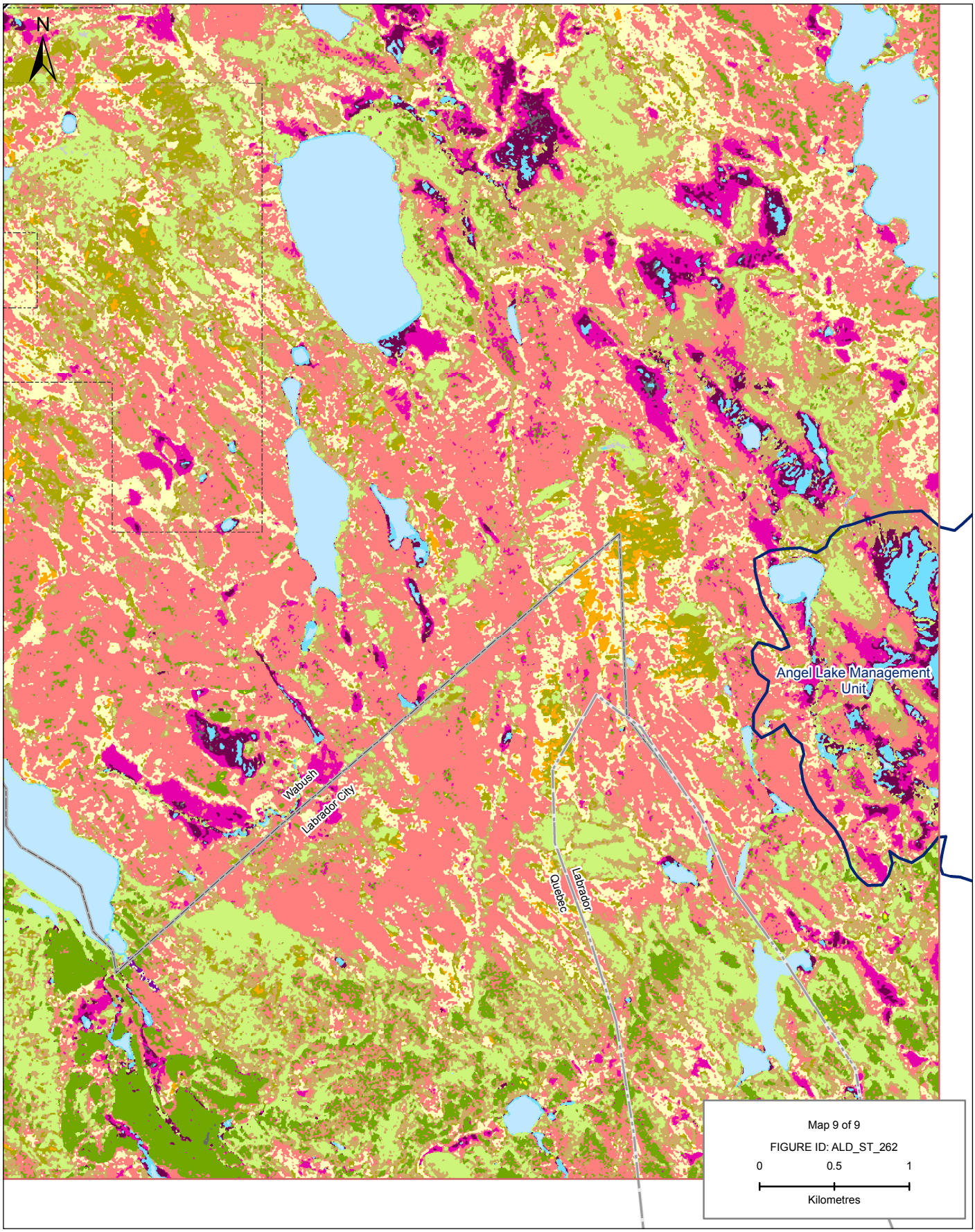
1
Kilometres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Angel Lake Management Unit
Wabush
Labrador City
Quebec
Labrador
Map 9 of 9
FIGURE ID: ALD_ST_262
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Kilometres

APPENDIX B

Scientific and Common Names of Observed Plant Species

Table B1. Scientific and Common Names of Vascular and Non-vascular Plant Species Observed Within the Kami Study Area

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
ELCode	Scientific Name	ssp./var	Common Name	Vascular / Non-vascular	G-Rank	N-Rank	S-Rank	General Status	Affinity (Meades et al, 2000; Meades 2010)	Wetland	Wetland Indicator	Forest / Open	pH	halophyte	seep	aquatic	floodplain	marsh	shore	swamp	peatland	Habitat
PMPOA040H0	*Agrostis gigantea*		Black Bentgrass	Vascular	G4G5	NNR		-	Eurasian		fac											
PMPOA04120	*Agrostis scabra*		Rough Bentgrass	Vascular	G5	NNR	S3S5	4 - Secure	Boreal NA		fac											
PGPIN01020	*Abies balsamea*		Balsam Fir	Vascular	G5	NNR	S5	4 - Secure	Boreal NA		fac											
PDAST03030	*Achillea millefolium*	var. *millefolium*	Northern Yarrow	Vascular	G5T5?	NNR	S3S4	4 - Secure	Eurasian		facu-											
PDRAN02020	*Actaea rubra*	ssp. *rubra*	Red Baneberry	Vascular	G5T5	NNR	S3S4	4 - Secure	Boreal NA		fac											
PDBET01083	*Alnus viridis*	ssp. *crispa*	Green Alder	Vascular	G5T5	NNR	S5	4 - Secure	Boreal eNA, eAsia		facu											
PDROS05030	*Amelanchier bartramiana*		Bartram Shadbush	Vascular	G5	NNR	S3S5	4 - Secure	Boreal eNA		fac											
PDAST0F010	*Anaphalis margaritacea*		Pearly Everlasting	Vascular	G5	NNR	S4S5	4 - Secure	Boreal NA, eAsia		upl											
PDERI02010	*Andromeda polifolia*	var. *glaucophylla*	Bog Rosemary	Vascular	G5	NNR	S4S5	4 - Secure	Boreal eNA	w	obl	o	a1						x			peatland
PDRAN040J0	*Anemone parviflora*	var. *parviflora*	Small-Flower Anemone	Vascular	G5T5	NNR	S3S4	4 - Secure	Arctic-alpine NA, eAsia		upl											cliff
PDERI04020	*Arctostaphylos alpina*		Alpine Bearberry	Vascular	G5	NNR	S5	4 - Secure	Arctic-alpine circumpolar		upl											
PPDRY02021	*Athyrium filix-femina*	var. *angustum*	Lady Fern	Vascular	G5T5	N5	S4S5	4 - Secure	nTemp.-Boreal eNA		fac											
PDBET02040	*Betula glandulosa*		Glandular Dwarf Birch	Vascular	G5	NNR	S5	4 - Secure	Subarctic-Boreal NA	w	obl	o	ia						x			peatland
PDBET02110	*Betula michauxii*		Michaux's Dwarf Birch	Vascular	G3G4	NNR	S5	4 - Secure	Boreal eNA	w	obl	o	ia						x			peatland
PDBET02070	*Betula minor*		Dwarf White Birch	Vascular	G4Q	NNR	S4S5	4 - Secure	Boreal eNA		fac											
PDBET020C0	*Betula papyrifera*	var. *papyrifera*	Heart-Leaved Paper Birch	Vascular	G5T5	NNR	S5	4 - Secure	Boreal NA		facu											
PDBET020C0	*Betula papyrifera*	var. *cordifolia*	Heart-Leaved Paper Birch	Vascular	G5T5	NNR	S5	4 - Secure	Boreal eNA		facu											
PDBET020H0	*Betula pumila*	var. *glandulifera*	Dwarf Birch	Vascular	G5T5	NNR	S5	4 - Secure		w	obl	of	c						f			fen
PMPOA17050	*Calamagrostis canadensis*		Blue-Joint Reedgrass	Vascular	G5	NNR	S5	-	Circumboreal	w	facw	of	i				mf	x		x	x	marsh; swamp; shore; floodplain
PMPOA17170	*Calamagrostis stricta*		Slim-Stem Small-Reedgrass	Vascular	G5	NNR	S3S5	4 - Secure		w	obl	o	c1	b					f			saltmarsh (upper); fen
PMCYP030V0	*Carex aquatilis*	var. *aquatilis*	Water Sedge	Vascular	G5T5	NNR	S3S5	4 - Secure	Circumboreal	w	obl	o	ic			e		x	f			marsh; fen; aquatic emergent
PMCYP03190	*Carex atratiformis*		Black Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Circumboreal		fac											shores; cliff
PMCYP032B0	*Carex buxbaumii* Wahlenb.		Buxbaum's Sedge	Vascular	G5	N5	S3	3 - Sensitive	Circumboreal (disj.)	w	obl	o	c		shore			x				shore seep

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
ELCode	Scientific Name	ssp./var	Common Name	Vascular / Non-vascular	G-Rank	N-Rank	S-Rank	General Status	Affinity (Meades et al, 2000; Meades 2010)	Wetland	Wetland Indicator	Forest / Open	pH	halophyte	seep	aquatic	floodplain	marsh	shore	swamp	peatland	Habitat
PMCYP031R1	*Carex bigelowii* Torr. ex Schwein.	subsp. *bigelowii*	Bigelow's Sedge	Vascular	G5TNR	NNR	S3S5	4 - Secure	Arctic amphi-Atlantic													
PMCYP03280	*Carex brunnescens*		Brownish Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Subarctic, circumboreal (subsp. sphaerostachya: Boreal eNA)		fac											
PMCYP032F0	*Carex canescens*		Hoary Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Circumboreal sHemisphere	w	obl	of	i			e		x		x	x	marsh; swamp; shore; aquatic emergent
PMCYP032G0	*Carex capillaris*		Hair-Like Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Arctic-alpine circumpolar		fac											
PMCYP032M0	*Carex castanea* Wahlenb.		Chestnut-Colored Sedge	Vascular	G5	N5	S1S2	2 - May be at risk	Boreal eNA	w	facw	of	c					x	x			shore; swamp
PMCYP033L0	*Carex deflexa* Hornem.		Short-Stemmed Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Boreal (subarctic) alpine NA		facu											
PMCYP033R0	*Carex diandra* Schrank		Lesser Panicled Sedge	Vascular	G5	NNR	S2S4	5 - Undetermined	Circumboreal	w	obl	o	c			e		x	f			marsh; fen; aquatic emergent
PMCYP033U0	*Carex disperma*		Softleaf Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Circumboreal	w	facw	f	c2								x	swamp
PMCYP03431	*Carex echinata*	ssp. *echinata*	Little Prickly Sedge	Vascular	G5T5	NNR	S3S5	4 - Secure	Boreal NA: subsp. echinata (species: circumpolar)	w	obl	of	a1					x	x	x	x	shore; swamp; marsh; peatland
PMCYP034F0	*Carex exilis*		Coast Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Boreal eNA	w	obl	o	a1						x			peatland
PMCYP034T0	*Carex flava*		Yellow Sedge	Vascular	G5	NNR	SNA	5 - Undetermined	nTemp. NA (disj.), wEurasia	w	obl	o	c1					x		x		shore; marsh
PMCYP03080	*Carex foenea* Willd. ex Elliot		Dry-Spike Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Temp.-Boreal NA		upl											
PMCYP035K0	*Carex gynocrates*		Northern Bog Sedge	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA, eAsia	w	obl	fo	c						f			fen
PMCYP036K0	*Carex interior* L.H.Bailey		Inland Sedge	Vascular	G5	NNR	S2S4	5 - Undetermined	Boreal NA	w	obl	of	c		shore				f	x	x	shore seep; fen; swamp
PMCYP03720	*Carex lasiocarpa*	subsp. *americana*	Slender Sedge	Vascular	G5	N5	SNR	5 - Undetermined	Boreal NA	w	obl	o	i			e		x		x	f	shore; fen; marsh; aquatic emergent
PMCYP037E0	*Carex leptalea*	ssp. *leptalea*	Bristly-Stalk Sedge	Vascular	G5T5	NNR	S3S5	4 - Secure	Boreal eNA	w	facw +	fo	c2		forest / shore					x	x	swamp; shore; seep
PMCYP037K0	*Carex limosa*		Mud Sedge	Vascular	G5	NNR	S5	4 - Secure	Circumboreal	w	obl	o	a1						x			peatland

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
ELCode	Scientific Name	ssp./var	Common Name	Vascular / Non-vascular	G-Rank	N-Rank	S-Rank	General Status	Affinity (Meades et al, 2000; Meades 2010)	Wetland	Wetland Indicator	Forest / Open	pH	halophyte	seep	aquatic	floodplain	marsh	shore	swamp	peatland	Habitat
PMCYP037L0	*Carex livida*		Livid Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Circumboreal (disj.)	w	obl	o	c						f			fen
PMCYP03G31	*Carex magellanica*	subsp. *irrigua*	Boreal Bog Sedge	Vascular	G5T5	N5	S4S5	4 - Secure	Circumboreal, bipolar (SA)	w	obl	fo	i						x		x	peatland; swamp
PMCYP039Q0	*Carex oligosperma*	var. *oligosperma*	Few-Seeded Sedge	Vascular	G5?T5?	NNR	S5	4 - Secure	Boreal NA	w	obl	o	a						x			peatland
PMCYP03A50	*Carex pauciflora*		Few-Flowered Sedge	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal	w	obl	o	a						x			peatland
PMCYP03BP0	*Carex rostrata*		Beaked Sedge	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal	w	obl	o	i						x			peatland
PMCYP03C80	*Carex scirpoidea*		Bulrush Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Arctic-alpine NA		upl											cliff
PMCYP03DL0	*Carex tenuiflora*		Sparse-Flowered Sedge	Vascular	G5	NNR	S3S5	4 - Secure	Circumboreal	w	obl	fo	c						f			fen
PMCYP03E00	*Carex trisperma*		Three-Seed Sedge	Vascular	G5	NNR	S4S5	4 - Secure	Boreal NA	w	obl	fo	i						x		x	swamp; peatland
PMCYP03E90	*Carex vaginata*		Sheathed Sedge	Vascular	G5	N5	S3S5	4 - Secure	Arctic circumpolar	w												
PMCYP03EE0	*Carex vesicaria*		Inflated Sedge	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal, N to cLab. (Cartwright).	w	obl	of	i					x		x	x	shore; marsh; swamp
PDSCR0D2Z0	*Castilleja septentrionalis*		Labrador Indian-Paintbrush	Vascular	G5	NNR	S4	4 - Secure	Boreal eNA		upl											
PDCAR060F0	*Cerastium fontanum* Baumg. subsp. vulgare (Hartm.) Greuter & Burdet		Common Mouse-Ear Chickweed	Vascular	GNR	NNA	SNA															
PDERI08010	*Chamaedaphne calyculata*		Leatherleaf	Vascular	G5	NNR	S5	4 - Secure	Circumboreal	w	obl	of	a1						x	x		peatland; shore
PDONA06020	*Chamerion angustifolium*		Fireweed	Vascular	G5	NNR	S5	4 - Secure	Circumboreal		fac											
PMPOA1H020	*Cinna latifolia*		Slender Wood Reedgrass	Vascular	G5	NNR	S3S5	4 - Secure	Circumboreal		fac											
PDONA04010	*Circaea alpina*		Small Enchanter's Nightshade	Vascular	G5	NNR	S4S5	-	Circumpolar		fac											
PDAST2E1U0	*Cirsium muticum*		Swamp Thistle	Vascular	G5	NNR	S2S4	5 - Undetermined	Temp. eNA	w	obl	fo	c2				m				x	swamp; floodplain
PMLIL0H020	*Clintonia borealis*		Clinton Lily	Vascular	G5	NNR	S5	4 - Secure	Boreal NA, N to cLab. (Mealy Mts.).		fac											
PDROS24010	*Comarum palustre*		Marsh Cinquefoil	Vascular	G5	NNR	S3S5	4 - Secure	Circumboreal	w	obl	o	c2					x	f			marsh; fen
PDRAN0L1G0	*Coptidium lapponicum* (L.) Gand.		Lapland Buttercup		G5	NNR	S2S3	3 - Sensitive														

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
ELCode	Scientific Name	ssp./var	Common Name	Vascular / Non-vascular	G-Rank	N-Rank	S-Rank	General Status	Affinity (Meades et al, 2000; Meades 2010)	Wetland	Wetland Indicator	Forest / Open	pH	halophyte	seep	aquatic	floodplain	marsh	shore	swamp	peatland	Habitat
PDRAN0A040	*Coptis trifolia*		Goldthread	Vascular	G5	NNR	S5	4 - Secure	Circumboreal		fac											
PDCOR01040	*Cornus canadensis*		Dwarf Dogwood	Vascular	G5	NNR	S5	4 - Secure	Boreal NA & eAsia		fac											
PDCOR010C0	*Cornus sericea*	ssp. *sericea*	Red-Osier Dogwood	Vascular	G5T5	NNR	S5	-	Boreal NA	w	facw	of	c1				mf	x		x	x	shore; marsh; swamp; floodplain
PMPOA20040	*Danthonia intermedia* Vasey		Vasey Oatgrass	Vascular	G5	NNR	SNR	5 - Undetermined														
PMPOA200A0	*Danthonia spicata*		Poverty Oat-Grass	Vascular	G5	NNR	SNR	5 - Undetermined	Temp.-Boreal NA		facu											
PDROS2C010	*Dasiphora fruticosa*	ssp. *floribunda*	Shrubby Cinquefoil	Vascular	G5	NNR	S3S4	-	Circumboreal (disj.)	w	facw	o	c					x	f	x		fen; marsh; shore
PMPOA22090	*Deschampsia flexuosa*	var. *flexuosa*	Crinkled Hairgrass	Vascular	G5T5?	NNR	S4S5	4 - Secure			upl											
PDDIA01010	*Diapensia lapponica*	var. *lapponica*	Lapland Diapensia	Vascular	G5T3T5	NNR	S4S5	4 - Secure	Arctic-alpine amphi-Atlantic		upl											cliff
PPLYC01090	*Diphasiastrum complanatum*		Trailing Clubmoss	Vascular	G5	NNR	S5	4 - Secure	Circumboreal		facu											
PPLYC01100	*Diphasiastrum sitchense*		Alaskan Clubmoss	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA, eAsia		facu											
PDDRO02050	*Drosera intermedia*		Spoon-Leaved Sundew	Vascular	G5	NNR	S4S5	4 - Secure	Boreal amphi-Atlantic	w	obl	o	i		shore				x	x		peatland; shore seep
PDDRO02070	*Drosera rotundifolia*	var. *rotundifolia*	Roundleaf Sundew	Vascular	G5T5	NNR	S5	-	Circumboreal	w	facw+	of	a						x	x	x	peatland; swamp; shore; disturbance
PPDRY0A030	*Dryopteris campyloptera*		Mountain Wood-Fern	Vascular	G5	NNR	S4	4 - Secure	Boreal eNA		fac											
PPDRY0A040	*Dryopteris carthusiana*		Spinulose Shield Fern	Vascular	G5	NNR	S4	4 - Secure	Circumboreal		fac											
PMPOA2H0Q0	*Elymus trachycaulus*	ssp. trachycaulus	Slender Wheatgrass	Vascular	G5T5	NNR	S3S5	4 - Secure			fac											
PDEMP03020	*Empetrum nigrum*		Black Crowberry	Vascular	G5	NNR	S5	4 - Secure	Arctic-alpine circumpolar		fac											peatland; headland
PDERI0D010	*Epigaea repens*		Trailing Arbutus	Vascular	G5	NNR	S2S3	3 - Sensitive	Temp. NA		facu											
PDONA06040	*Epilobium ciliatum*	ssp. *glandulosum*	Fringed Willowherb	Vascular	G5T5	NNR	S5	4 - Secure	Boreal NA, eAsia		fac											
PDONA06040	*Epilobium ciliatum*		Hairy Willow-Herb	Vascular	G5	NNR	S5	4 - Secure			fac											
PPEQU01010	*Equisetum arvense*		Field Horsetail	Vascular	G5	NNR	S5	4 - Secure	Circumboreal		fac											
PPEQU01020	*Equisetum fluviatile*		Water Horsetail	Vascular	G5	NNR	S3S4	4 - Secure	Circumboreal	w	obl	of	i			e		x		x	x	aquatic emergent; swamp; shore; marsh
PPEQU01031	*Equisetum hyemale*	var. *affine*	Rough Horsetail	Vascular	G5	NNR	SNA	excl -	Temp. NA		fac		c									
PPEQU01090	*Equisetum sylvaticum*		Woodland Horsetail	Vascular	G5	NNR	S5	4 - Secure	Circumboreal		fac											

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
ELCode	Scientific Name	ssp./var	Common Name	Vascular / Non-vascular	G-Rank	N-Rank	S-Rank	General Status	Affinity (Meades et al, 2000; Meades 2010)	Wetland	Wetland Indicator	Forest / Open	pH	halophyte	seep	aquatic	floodplain	marsh	shore	swamp	peatland	Habitat
PPEQU010B2	*Equisetum* variegatum Schleich. ex F.Weber & D.Mohr	var. *variegatum*	Variegated Horsetail	Vascular	G5T5	NNR	S3	3 - Sensitive	Circumboreal	w	facw	o	c		shore					x		shore seep; disturbance
PMCYP0A037	*Eriophorum angustifolium subsp. angustifolium*		No Common Name In Tracker	Vascular	G5	NNR	S4S5	4 - Secure	Arctic circumpolar	w	obl	o	a						x			peatland
PMCYP0A090	*Eriophorum chamissonis*		Chamissonis's Cotton-Grass	Vascular	G5	NNR	S3S5	4 - Secure	Boreal NA	w	obl	o	a						x			peatland
PMCYP0A050	*Eriophorum callitrix* Cham.		Sheathed Cotton-Grass	Vascular	G5	NNR	S2S4	5 - Undetermined	w	obl	o	a							peatland		x	w
PMCYP0A0E0	*Eriophorum viridicarinatum*		Green Keeled Cottongrass	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA	w	obl	fo	c						f		x	swamp; fen
PDSCR0P0U0	*Euphrasia nemorosa*		Common Eyebright	Vascular	G5	NNR	SNR	5 - Undetermined	Temp. amphi-Atlantic		upl											
PDASTEB0J0	*Eurybia radula*		Rough-Leaved Aster	Vascular	G5	NNR	S4S5	4 - Secure	Boreal eNA	w	obl	efo	i							x	x	shore; swamp
PMPOA2V0Q0	*Festuca rubra*		Red Fescue	Vascular	G5	NNR	S4S5	4 - Secure			fac											
PDROS0R040	*Fragaria virginiana*		Virginia Strawberry	Vascular	G5	NNR	S3S5	5 - Undetermined	Temp.-Boreal NA		fac											
PDRUB0N160	*Galium labradoricum*		Bog Bedstraw	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA	w	obl	of	c								f	fen
PDRUB0N270	*Galium triflorum*		Sweet-Scent Bedstraw	Vascular	G5	NNR	S3S4	4 - Secure	Circumboreal (disj.)		facu											
PDERI0F010	*Gaultheria hispidula*		Creeping Snowberry	Vascular	G5	NNR	S5	4 - Secure	Boreal NA, thr. Nfld., N to cLab. (Rigolet).		fac											
PDSAN04010	*Geocaulon lividum*		Northern Comandra	Vascular	G5	NNR	S5	4 - Secure	Boreal NA		fac											
PDROS0S0D0	*Geum rivale*		Purple Avens	Vascular	G5	NNR	S3S4	5 - Undetermined	Boreal amphi-Atlantic	w	obl	fo	c2		forest				f	x	x	swamp; seep; shore; fen
PMPOA2Y0K0	*Glyceria striata*		Fowl Manna-Grass	Vascular	G5	NNR	S3S5	4 - Secure	Temp.-Boreal NA	w	facw	efo	ic					x		x	x	swamp; shore; marsh
PPDRY0D030	*Gymnocarpium dryopteris*		Northern Oak Fern	Vascular	G5	NNR	S5	4 - Secure	Circumboreal (disj. in Eurasia)		fac											
PDFAB1Z010	*Hedysarum alpinum*		Apline Sweet-Vetch	Vascular	G5	NNR	S2	2 - May be at risk	Arctic-alpine		upl											
PDAST4W0B0	*Hieracium caespitosum*		Meadow Hawkweed	Vascular	GNR	NNR	SNA	7 - Exotic/Alien	European		facu											
PDHPR01030	*Hippuris vulgaris*		Common Mare's-Tail	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal	w	obl	o	c2			e						aquatic emergent
PMPOA35040	*Hierochloe odorata*		Holy Grass	Vascular	G4G5	NNR	S3S5	4 - Secure														

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
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PPLYC02070	*Huperzia selago*		Fir Clubmoss	Vascular	G5	N5			Arctic-alpine circumpolar	w	facw	of	i					?	?		?	shore; peatland; swamp
PMJUN01080	Juncus arcticus	var. balticus	Arctic Rush	Vascular	G5	NNR	S4	4 - Secure		w	facw	o	c2	b				x				saltmarsh (upper); shore
PMJUN010G0	*Juncus brevicaudatus*		Narrow-Panicled Rush	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA (disj.)	w	obl	o	i					x		x		shore; marsh; disturbance
PMJUN010J0	*Juncus bufonius*	var. *bufonius*	Toad Rush	Vascular	G5T5	NNR	S2S4	5 - Undetermined	Circumboreal	w	facw	o	ic							x		shore; disturbance
PMJUN01150	*Juncus filiformis*		Thread Rush	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal	w	obl	o	a1							x		shore
PMJUN012P0	*Juncus stygius var. americanus*		Woods-Rush	Vascular	G5	NNR	S2S4	5 - Undetermined		w	obl	efo[?]	a						x		x	swamp; peatland
PGCUP05030	*Juniperus communis*		Ground Juniper	Vascular	G5	NNR	S4S5	4 - Secure			fac											peatland
PDERI0K060	*Kalmia polifolia*		Pale Laurel	Vascular	G5	NNR	S5	4 - Secure	Boreal NA	w	obl	of	a1						x			peatland
PGPIN02020	*Larix laricina*		American Larch	Vascular	G5	NNR	S5	4 - Secure	Boreal NA		fac											
PDCPR02010	*Linnaea borealis*		Twinflower	Vascular	G5	NNR	S5	-			fac											
PMORC1N061	*Listera cordata var. cordata*	var. *cordata*	Heartleaf Twayblade	Vascular	G5T5	NNR	S3S5	4 - Secure	Circumboreal	w	facw	f	i						x		x	swamp; peatland
PDCPR030U0	*Lonicera villosa*	var. *tonsa*	Mountain Fly-Honeysuckle	Vascular	G5TNR	NNR	S5	4 - Secure		w	facw	efo	ic					x	x		x	swamp; peatland; marsh
PMJUN020G0	*Luzula parviflora*		Small-Flowered Wood-Rush	Vascular	G5	NNR	S4S5	4 - Secure	Arctic-alpine circumpolar		fac											
PPLYC01030	*Lycopodium annotinum*		Stiff Clubmoss	Vascular	G5	NNR	S5	4 - Secure	Circumboreal		fac											
PPLYC01080	*Lycopodium clavatum*		Running Pine	Vascular	G5	NNR	SNR	5 - Undetermined	Circumboreal (disj.), also sHemisphere		fac											
PPLYC010B0	*Lycopodium dendroideum*		Treelike Clubmoss	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA, eAsia		fac											
PMLIL1D050	*Maianthemum trifolium*		Three-Leaf Solomon's-Plume	Vascular	G5	NNR	S5	4 - Secure	Boreal NA, eAsia	w	obl	efo	i						x		x	peatland; swamp
PDAST69080	*Matricaria discoidea*		Pineapple-Weed Chamomile	Vascular	G5	NNR	SNA	7 - Exotic/Alien	Eurasian		facu											
PDMNY02010	*Menyanthes trifoliata*		Bog Buckbean	Vascular	G5	NNR	S5	4 - Secure	Circumboreal	w	obl	of	c1			e			f		x	aquatic emergent; swamp; fen
PDCAR0G0E0	*Minuartia groenlandica*		Mountain Sandwort	Vascular	G5	NNR	S3S4	4 - Secure	Boreal eNA		upl											
PDSAX0N050	*Mitella nuda*		Naked Bishop's-Cap	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA, Asia	w	facw	f	c2								x	swamp
PDPYR02010	*Moneses uniflora*		One-Flower Wintergreen	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal		fac											

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
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PMPOA480U0	*Muhlenbergia glomerata* (Willd.) Trin.		Marsh Muhly	Vascular	G5	N5			Boreal NA	w	obl	of	i									New record for Labrador
PDMCC02040	*Myrica gale*		Sweet Bayberry	Vascular	G5	NNR	S5	4 - Secure	Circumboreal (disj.)	w	obl	of	i					x	x	x	x	shore; peatland; swamp; marsh
PDNYM04018	*Nuphar variegata*	ssp. *variegata*	Yellow Cowlily	Vascular	G5T5	NNR		excl -	Boreal NA	w	obl	o	i			s						aquatic submergent
PDPYR03010	*Orthilia secunda*		One-Side Wintergreen	Vascular	G5	NNR	S5	4 - Secure	Circumboreal		fac											
PDAST8H0C0	*Packera aurea*		Golden Groundsel	Vascular	G5	NNR	S2S4	5 - Undetermined	Boreal eNA	w	facw	fo	c1								x	swamp
PDSAX0P070	*Parnassia kotzebuei*		Kotzebue's Grass-of-Parnassus	Vascular	G5	N5	S3S4	3 - Sensitive														
PDSAX0P0C0	*Parnassia palustris*	var. *parviflora*	Marsh Grass-Of-Parnassus	Vascular	G5	NNR	S3S5	-	Boreal NA	w	facw	o	c					x		x		shore; marsh; disturbance
PDPGN0L0D0	*Persicaria bistorta*		No Common Name In Tracker	Vascular	G5	NNR		-														
PDAST71013	*Petasites frigidus var. palmatus*	var. *palmatus*	Sweet Coltsfoot	Vascular	G5T5	NNR	S4S5	4 - Secure	Boreal NA & eAsia	w	facw	f	c2		forest						x	swamp; seep
PPTHE02010	*Phegopteris connectilis*		Northern Beech Fern	Vascular	G5	NNR	S5	4 - Secure	Circumboreal		fac											
PMPOA4U050	*Phleum pratense*		Meadow Timothy	Vascular	GNR	NNR	SNA	7 - Exotic/Alien	European		facu											
PGPIN03040	*Picea glauca*		White Spruce	Vascular	G5	NNR	S5	4 - Secure	Boreal NA		fac											
PGPIN03050	*Picea mariana*		Black Spruce	Vascular	G5	NNR	S5	4 - Secure	Boreal NA	w	facw	fo	a1						x		x	peatland; swamp
PDLNT01090	*Pinguicula vulgaris*		Common Butterwort	Vascular	G5	NNR	S4	4 - Secure	Circumboreal (disj.)	w	obl	o	c		shore					x		shore seep
PGPIN04050	*Pinus banksiana*		Jack Pine	Vascular	G5	NNR	S1	2 - May be at risk	Boreal eNA		facu											occurring in plantation
PMPOA4J030	*Piptatherum canadense* (Poir.) Dorn		Canada Mountain-Ricegrass	Vascular	G5	NNR	SU	5 - Undetermined	Boreal NA		facu											dryish peatland
PMORC1Y150	*Platanthera aquilonis*		Leafy Northern Green Orchis	Vascular	G5	NNR	S2S3	2 - May be at risk	Boreal NA, eAsia	w	facw	efo	c1		shore				f	x	x	shore; shore seep; swamp; fen
PMORC1Y072	*Platanthera dilatata*	var. *dilatata*	Leafy White Orchis	Vascular	G5T5	NNR	S4S5	4 - Secure	Boreal NA, eAsia	w	facw +	efo	c2						f	x	x	shore; swamp; fen
PMORC1Y0J0	*Platanthera obtusata*		Small Northern Bog-Orchid	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA, nEurasia (disj.)	w	facw +	f	i						x		x	largely restricted to forested peatlands
PMPOA4Z060	*Poa annua*		Annual Bluegrass	Vascular	GNR	NNR	SNA	7 - Exotic/Alien	Temp.-Boreal NA, Eurasia		facu											

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
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PDSAL01030	*Populus balsamifera*	ssp. *balsamifera*	Balsam Poplar	Vascular	G5T5	NNR	S3	-	Boreal NA	w	facw	fo	c1				f			x	x	floodplain; swamp; shore
PMPOT03010	*Potamogeton alpinus* Balbis		Northern Pondweed	Vascular	G5	N5	S2S4	5 - Undetermined	Circumboreal	w	obl	o	c			s						aquatic submergent
PMPOT030V0	*Potamogeton praelongus* Wulfén		White-Stem Pondweed	Vascular	G5	NNR	SNR	5 - Undetermined	Circumboreal	w	obl	o	c			s						aquatic submergent
PDPRI080D0	*Primula mistassinica*		Bird's-Eye Primrose	Vascular	G5	NNR	S2	3 - Sensitive	Boreal NA	w	facw +	o	c							x		shore
PDPYR04020	*Pyrola asarifolia*		Pink Wintergreen	Vascular	G5	NNR	S2S4	-		w	facw	f	c				f				x	floodplain; swamp
PDPYR04060	*Pyrola minor*		Lesser Wintergreen	Vascular	G5	NNR	S4	4 - Secure	Circumboreal		fac											
PDSCR1M050	*Rhinanthus minor*		Little Yellow-Rattle	Vascular	G5	NNR	SNR	5 - Undetermined			upl											
PDERI0M020	*Rhododendron groenlandicum*		Common Labrador Tea	Vascular	G5	NNR	S5	-	Boreal NA	w	facw +	of	i						x		x	peatland; swamp
PDGRO020J0	*Ribes glandulosum*		Skunk Currant	Vascular	G5	NNR	S5	4 - Secure	Boreal NA		fac											
PDGRO020T0	*Ribes lacustre*		Bristly Black Currant	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA, eAsia	w	facw	f	c2								x	swamp
PDROS1K0L0	*Rubus arcticus*		Northern Blackberry	Vascular	G5	NNR	S3S5	-	Boreal NA													
PDROS1K1G0	*Rubus chamaemorus*		Cloudberry	Vascular	G5	NNR	S5	4 - Secure	Arctic circumpolar	w	obl	o	a						x			peatland
PDROS1K350	*Rubus idaeus*	ssp. *strigosus*	American Red Raspberry	Vascular	G5T5	NNR	S4S5	-	Boreal NA, Asia		fac											
PDROS1K690	*Rubus pubescens*	var. *pubescens*	Dwarf Raspberry	Vascular	G5T5	NNR	S4S5	4 - Secure	Boreal NA		fac											
PDSAL02060	*Salix arctophila*		Arctic Willow	Vascular	G5	NNR	S4S5	4 - Secure														
PDSAL02070	*Salix argyrocarpa* Andersson		Northern Willow	Vascular	G4	N4N5	S4S5	4 - Secure	Boreal-subarctic eNA		upl											
PDSAL020V0	*Salix discolor* Muhl.		Pussy Willow	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA		fac											
PDSAL021E0	*Salix humilis* Marshall		Prairie Willow	Vascular	G5	NNR	S3S5	-	Boreal eNA		facu											
PDSAL02240	*Salix pedicellaris*		Bog Willow	Vascular	G5	NNR	S2S4	3 - Sensitive	Boreal NA	w	obl	o	c					x	f			fen; marsh
PDSAL02260	*Salix pellita* (Andersson) Bebb		Satiny Willow	Vascular	G5	NNR	S3S4	4 - Secure	Boreal eNA	w	facw	o	i							x		shore
PDSAL022B0	*Salix planifolia* Pursh		Tea-Leaved Willow	Vascular	G5	NNR	S5	4 - Secure	Boreal eNA													
PDSAL02310	*Salix uva-ursi* Pursh		Bearberry Willow	Vascular	G5	NNR	S4S5	5 - Secure	Arctic eNA		upl											
PDSAL02320	*Salix vestita*		Rock Willow	Vascular	G5	NNR	S3S4	4 - Secure	Arctic-alpine NA		upl											cliff
PDROS1L020	*Sanguisorba canadensis*		Canada Burnet	Vascular	G5	NNR	S3S5	4 - Secure	Boreal NA (disj.)	w	facw	o	c							x		shore

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
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PDSAR02070	*Sarracenia purpurea*		a Northern Pitcher-Plant	Vascular	G5	NNR	S4	-	Boreal eNA	w	obl	of	a1						x			peatland
PMPOA5C010	*Schizachne purpurascens* (Torr.) Swallen		Purple Oat	Vascular	G5	NNR	S2S4	5 - Undetermined	Boreal NA, eAsia		fac											floodplain
PMCYP0Q100	*Scirpus microcarpus*		Small-Fruit Bulrush	Vascular	G5	NNR	S2S4	5 - Undetermined	Boreal NA, eAsia	w	obl	of	i					x		x	x	shore; marsh; swamp
PPSEL01110	*Selaginella selaginoides*		Low Spike-Moss	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal (disj.), nwAfrica	w	obl	o	c						f			fens (rich)
PDAST8P0Z0	*Solidago macrophylla*		Large-Leaf Goldenrod	Vascular	G5	NNR	S5	4 - Secure	Boreal eNA		facu											
PDAST8P3I0	*Solidago multiradiata*	var. *multiradiata*	Alpine Goldenrod	Vascular	G5T5?	NNR	S3S4	4 - Secure	Arctic-alpine NA		upl											
PDAST8P230	*Solidago uliginosa*		Bog Goldenrod	Vascular	G4G5	NNR	S5	4 - Secure	Boreal NA	w	obl	efo	i					x	x		x	peatland; marsh; swamp
PDROS1P040	*Sorbus decora*		Northern Mountain-Ash	Vascular	G4G5	NNR	S3S5	4 - Secure	Boreal eNA		fac											
PMORC2B0V0	*Spiranthes romanzoffiana*		Hooded Ladies'-Tresses	Vascular	G5	NNR	S3S4	4 - Secure	Boreal NA	w	obl	o	i							x		shore
PDCAR0X170	*Stellaria borealis*		Northern Stitchwort	Vascular	G5	NNR	S4S5	-	Circumboreal (disj)	w	obl	f	ic								x	swamp
PMLIL1X010	*Streptopus amplexifolius*		Clasping Twisted-Stalk	Vascular	G5	NNR	S5	4 - Secure	Circumboreal (disj)	w	facw	fo	c1							x	x	swamp; shore
PMPOT03091	*Stuckenia filiformis* (Pers.) Börner subsp. alpina (Blytt) R.R.Haynes	subsp. *alpinaus*	Northern Slender Pondweed	Vascular	G5	NNR	S2S4	5 - Undetermined	Circumboreal	w	obl	o	c			s						aquatic submergent
PDASTE8210	*Symphyotrichum puniceum*	var. *puniceum*	Swamp Aster	Vascular	G5T5	NNR	S4	-	Boreal NA	w	facw	efo	ic					x		x	x	swamp; marsh; shore
PDASTE8210	*Symphyotrichum puniceum*		Swamp Aster	Vascular	G5	NNR	S4	-		w	facw	efo	ic					x		x	x	swamp; marsh; shore
PDAST930Y1	*Taraxacum ceratophorum*		Common Dandelion	Vascular	G5T5	N5	S3	3 - Sensitive	Arctic-alpine NA													
PDAST930Y0	*Taraxacum officinale*	ssp. *officinale*	Common Dandelion	Vascular	G5T5	NNR	SNA	7 - Exotic/Alien	European		fac-											
PDRAN0M0H0	*Thalictrum pubescens*		Tall Meadow-Rue	Vascular	G5	NNR	S4S5	4 - Secure	Boreal eNA	w	facw	efo	i				mf	x		x	x	marsh; swamp; shore; floodplain
PPTHE050X0	*Thelypteris noveboracensis*		New York Fern	Vascular	G5	NNR		-	Temp. eNA		fac											
PMLIL1Y035	*Tofieldia glutinosa*		Sticky False-Asphodel	Vascular	G4G5	NNR	S1S3	5 - Undetermined	Boreal NA	w	obl	o	c						f			fen

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
ELCode	Scientific Name	ssp./var	Common Name	Vascular / Non-vascular	G-Rank	N-Rank	S-Rank	General Status	Affinity (Meades et al, 2000; Meades 2010)	Wetland	Wetland Indicator	Forest / Open	pH	halophyte	seep	aquatic	floodplain	marsh	shore	swamp	peatland	Habitat
PMLIL1Y040	*Tofieldia pusilla*		Scotch False-Asphodel	Vascular	G5	N5	S4S5	4 - Secure	Arctic-alpine circumpolar													
PMCYP0A010	*Trichophorum alpinum*		Alpine Cotton-Grass	Vascular	G5	NNR	S3S5	4 - Secure	Circumboreal (disj.)	w	obl	o	c		shore				f	x		fen; shore seep
PMERI010B0	*Trichophorum cespitosum*		Seven-Angled Pipewort	Vascular	G5	NNR	S5	4 - Secure	Boreal eNA	w	obl	o	a			s						aquatic submergent; aquatic emergent
PDPRI0A010	*Trientalis borealis*	ssp. *borealis*	Northern Starflower	Vascular	G5T5	NNR	S5	4 - Secure	Boreal NA		fac											
PDFAB400B0	*Trifolium aureum*		Yellow Clover	Vascular	GNR	NNR	SNA	7 - Exotic/Alien	Eurasian		facu											
PDFAB401Z0	*Trifolium pratense*		Red Clover	Vascular	GNR	NNR	SNA	7 - Exotic/Alien	Eurasian		facu											
PDFAB40220	*Trifolium repens*		White Clover	Vascular	GNR	NNR	SNA	7 - Exotic/Alien	Eurasian		facu											
PMJCG02040	*Triglochin palustris*		Slender Bog Arrow-Grass	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal and sSA	w	obl	o		x								
PMPOA690C0	*Trisetum spicatum* (L.) K.Richt.		Narrow False Oats		G5	NNR	S3S5	4 - Secure	Arctic-alpine circumpolar		upl											
PDLNT02030	*Utricularia cornuta*		Horned Bladderwort	Vascular	G5	NNR	S4	4 - Secure	Temp.-Boreal eNA	w	obl	o	i		shore	se			x	x		peatland; aquatic submergent; shore seep
PDLNT020A0	*Utricularia intermedia*		Flatleaf Bladderwort	Vascular	G5	NNR	S4S5	4 - Secure	Circumboreal	w	obl	o	i			s						aquatic submergent
PDLNT020C0	*Utricularia macrorhiza*		Greater Bladder-Wort	Vascular	G5	NNR	S4S5	4 - Secure	Boreal NA	w	obl	o	i			s						aquatic submergent
PDERI18020	*Vaccinium angustifolium*		Late Lowbush Blueberry	Vascular	G5	NNR	S5	4 - Secure	Boreal eNA		fac											
PDERI18060	*Vaccinium caespitosum*		Dwarf Blueberry	Vascular	G5	NNR	S4S5	-			fac											rivershore
PDERI180R0	*Vaccinium oxycoccos*		Small Cranberry	Vascular	G5	NNR	S5	4 - Secure	Circumboreal	w	obl	of	a1						x			peatland
PDERI18110	*Vaccinium uliginosum*		Alpine Blueberry	Vascular	G5	NNR	S5	4 - Secure	Circumpolar		upl											
PDERI18120	*Vaccinium vitis-idaea*		Mountain Cranberry	Vascular	G5	NNR	S5	-			fac											
PDVAL03061	*Valeriana dioica* (S.Watson) F.G.Mey.	subsp. *sylvatica*	Wood Valerian	Vascular	G5T4T5	N4N5	S1	-	Boreal NA													
PMPOA6M010	*Vahlodea atropurpurea*		Mountain Hairgrass		G5	NNR	S2S4	5 - Undetermined			upl											
PMLIL25071	*Veratrum viride* var. *viride*		No Common Name In Tracker	Vascular	G5TNR	NNR	S1	2 - May be at risk	Temp. eNA		upl											
PDCPR07070	*Viburnum edule*		Squashberry	Vascular	G5	NNR	S5	4 - Secure	Boreal NA		fac											
PDVIO040X0	*Viola labradorica*		Labrador Violet	Vascular	G5	NNR	S4S5	4 - Secure	nTemp.-Boreal eNA		fac											
NLTEST7870	*Alectoria ochroleuca*		witches hair lichen	Non-Vascular																		
NLTEST7090	*Cladina arbuscula*		reindeer lichen	Non-Vascular																		

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
ELCode	Scientific Name	ssp./var	Common Name	Vascular / Non-vascular	G-Rank	N-Rank	S-Rank	General Status	Affinity (Meades et al, 2000; Meades 2010)	Wetland	Wetland Indicator	Forest / Open	pH	halophyte	seep	aquatic	floodplain	marsh	shore	swamp	peatland	Habitat
NLTEST7130	*Cladina mitis*		lesser green reindeer moss	Non-Vascular																		
NLTEST7160	*Cladina rangiferina*		grey reindeer moss	Non-Vascular																		
NLTEST7180	*Cladina stellaris*		star-tipped reindeer lichen	Non-Vascular																		
NLTEST5910	*Cladonia amaurocraea*		quill lichen	Non-Vascular																		
NLTEST6020	*Cladonia botrytes*		wooden soldiers	Non-Vascular																		
NLT0008502	*Cladonia gracilis*		smooth cladonia																			
	Cladonia rei		wand lichen	Non-Vascular																		
NLLEC1U010	*Peltigera aphthosa*		freckle pelt	Non-Vascular																		
NLTES10770	*Stereocaulon paschale*			Non-Vascular																		
	Aulacomnium palustre		ribbed bog moss	Non-Vascular																		
	Campylium stellatum		star campylium moss	Non-Vascular																		
	Climacium dendroides		tree moss	Non-Vascular																		
	Dicranum spp.		a broom moss	Non-Vascular																		
	Drepanocladus revolvens		limprichita moss	Non-Vascular																		
	Hylocomium splendens		Stair-Step Moss	Non-Vascular																		
	Liverwort spp.		a liverwort	Non-Vascular																		
	Mnium spp.		a Mnium moss	Non-Vascular																		
	Moss spp.		unknown moss	Non-Vascular																		
	Pleurozium schreberi		Schreber's moss	Non-Vascular																		
	Polytrichum spp.		a haircap moss	Non-Vascular																		

Plant Species					Status Ranking				Habitat			Habitat Characteristics										
ELCode	Scientific Name	ssp./var	Common Name	Vascular / Non-vascular	G-Rank	N-Rank	S-Rank	General Status	Affinity (Meades et al, 2000; Meades 2010)	Wetland	Wetland Indicator	Forest / Open	pH	halophyte	seep	aquatic	floodplain	marsh	shore	swamp	peatland	Habitat
	Ptillium crista-castrensis		knight's plume moss	Non-Vascular																		
	Sphagnum spp.		sphagnum moss	Non-Vascular																		
	Stereocaulon paschale		Easter lichen	Non-Vascular																		
	Tomenthypnum nitens		tomenthypnum moss	Non-Vascular																		

APPENDIX C

Structural Stages

Structural Stages

Structural stage is an important descriptor of vegetation communities. Structural stage describes the successional age of a community, e.g., young forest versus mature forest. Standard structural stage definitions were used to describe the dominant stand appearance or successional stage for mapped ecosystem types at the time of assessment. This parameter emphasizes structural habitat characteristics and it can be used to help describe the seral variation within mapped ecosystem types in the Study Area. Structural stage classes, as defined, represent modifications of the British Columbia's Terrestrial Ecosystem Mapping (TEM) system as outlined by the Resource Inventory Committee (RIC 1998).

Table C1. Structural Stage Class and Structural Stage Modifiers

Structural Stage		
Code	**Structural Stage/ Modifiers**	**Description**
1	Sparse/Bryoid	Initial stages of primary and secondary succession; bryophytes and lichens often dominant; time since disturbance may be prolonged where there is little or no soil development (bedrock, boulder fields, etc.).
1a	Sparse	Less than 10% vegetation cover.
1b	Bryoid	Bryophyte and lichen-dominated community (>50% of total vegetative cover).
2	Herb	Early successional stage or herb communities maintained by environmental conditions or disturbance; dominated by herbs; some invading or residual shrubs and trees may be present; many non-wooded communities are perpetually maintained in this stage.
2a	Forb-dominated	Includes non-graminoid herbs and ferns.
2b	Graminoid dominated	Includes grasses, sedges, reeds, and rushes.
3	Shrub/Herb (forested)	Early successional stage or shrub communities maintained by environmental conditions or disturbance; dominated by shrubby vegetation; seedlings and advance regeneration may be abundant.
3a	Low Shrub (< 2 m tall)	Dominated by shrubby vegetation < 2 m tall; seedlings and advance regeneration may be abundant; may be perpetuated indefinitely by environmental conditions or disturbance.
3b	Tall Shrub (2 – 10 m tall)	Dominated by shrubs or trees that are 2-10 m tall; often the near-climax structural stage for woodlands in the Study Area.
4	Young Forest (> 10 m tall, usually greater than 15 years old)	Trees > 10 m tall; typically densely stocked, have overtopped shrub and herb layers; self-thinning and vertical structure not yet evident in the canopy.
5	Maturing Forest (generally 60-140 years)	Trees > 10 m tall; trees established after the last disturbances have matured; understories become well developed as the canopy opens up; time since disturbance generally 0-140 years.
6	Overmature Forest (140-200 yrs)	Trees > 10 m tall; old, structurally complex stands comprised mainly of shade-tolerant and regenerating tree species, although older seral and long-lived trees from a disturbance such as fire may still dominate the upper canopy; snags and coarse woody debris in all stages of decomposition and patchy understories typical; time since disturbance generally > 140 years. *(This stage was not mapped in the Study Area but is included here for completeness.)*
7	Climax Forest (>200 yrs)	*(This stage was not mapped in the Study Area but is included here for completeness.)*

APPENDIX D

Soil Nutrient Regime Classes and Relationship to Site Properties

Table D1 Soil Nutrient Regime (SNR) Classes

	Oligotrophic	Submesotrophic	Mesotrophic	Permesotrophic	Eutrophic
	Very Poor (A)	Poor (B)	Medium (C)	Rich (D)	Very Rich (E)
Available nutrients	very low	low	moderate	abundant	very abundant
Humus form	**mor**				
			moder		
					mull
A horizon	**Ae horizon present**				
			A horizon absent		
					Ah horizon present
Organic matter content	**low (light coloured)**				
		medium (intermediate in colour)			
				high (dark coloured)	
Growth Rate	**slow**				
			moderate		
				rapid	
Soil depth	**extremely superficial**				
		very superficial to deep			
Soil texture	**coarse texture**				
			medium to fine texture		
% Coarse fragment	**high**				
			moderate to low		
Parent material mineralogy	**low base (low Ca content)**				
		medium base (medium Ca content)			
				strong base (high Ca content)	
Soil pH	**extremely-moderately acidic**				
		moderately acidic-neutral			
				slightly acidic-mildly alkaline	
Water pH (wetlands)	**<4-5**	**4.5-5.5**	**5.5-6.5**	**6.5-7.4**	**7.4+**
Seepage			**temporary**	**→→→→**	**permanent**

APPENDIX E

Soil Moisture Regime Classes and Relationship to Site Properties

Table E1 Soil Nutrient Regime (SNR) Classes

Moisture Regime	Description	Primary Water Source	Idealized Slope Position	Surface Organic Thickness (cm)	Common Soil Texture	Water Table Depth (cm)	Soil Drainage Class	Common Ecotypes
Very xeric (0)	Water is removed extremely rapidly in relation to supply; soil remains moist for a negligible amount of time following precipitation.	Precipitation	Crest-Upper Slope	<3	Very coarse (gravel to coarse sand); shallow soils	>100	Very rapid	
Xeric (1)	Water is removed from the soil very rapidly in relation to supply; soil remains moist for brief period s following precipitation.	Precipitation	Crest-Upper Slope	<3	Coarse (sand)	>100	Very rapid to rapid	AH, BL
Subxeric (2)	Water is removed from the soil rapidly in relation to supply; the soil remains wet for short periods of time following precipitations. Linked to a rapid drainage, depending on the amount of precipitation.	Precipitation	Upper Slope-Mid Slope Variable	<3	Coarse to moderately coarse (loamy sand-sandy loam)	>100	Rapid	AH, BL
Submesic (3)	Water is removed from the soil rapidly in relation to supply; water is available for moderately short periods following precipitation.	Precipitation	Upper Slope-Mid Slope Variable	3-5	Moderately coarse (sandy loam)	>100	Rapid to well	BL, BF
Mesic (4)	Water is removed from the soil rather slowly in relation to supply; soil may remain moist for a significant, but sometimes for short period of the year. Available soil moisture reflects climatic input.	Precipitation in moderate to fine-textured soil and limited seepage in coarse-textured soils	Mid Slope-Lower Slope Variable	6-9	Medium (L) to fine (SCL); few coarse fragments	>100	Well to moderately well	BL, BF, HF, MF
Subhygric (5)	Water is removed slowly enough in relation to supply to keep the soil wet for a significant part of the growing season; some temporary	Precipitation and seepage	Lower Slope Variable	10-40	Variable	<100	Imperfect	BF, HF, MF, RT, BS, TF

Moisture Regime	Description	Primary Water Source	Idealized Slope Position	Surface Organic Thickness (cm)	Common Soil Texture	Water Table Depth (cm)	Soil Drainage Class	Common Ecotypes
	seepage and possibly mottling below 20 cm.							
Hygric (6)	Water is removed slowly enough in relation to supply to keep the soil wet for most of the growing season; permanent seepage and mottling (hygric aerated); gleyed colors common (hygric reduced).	Permanent seepage; water table fluctuates often <100 cm	Toe Slope-Depression-Level Variable	10-40	Variable	30-100	Poor	BS, RT, TF
Subhydric (7)	Water is removed sc slowly that the water table remains at or n the soil surface for n of the year; gleyed mineral or organic s permanent seepage 30 cm below surface	Seepage or permanent water table <30 cm	Depression-Level Variable	>40	Variable; predominantly organics	0-30	Very poor	BS, RT, RM, TF, PF, SF
Hydric (8)	Water is removed so slowly that the water table remains at or above the soil surface all year; gleyed mineral or organic soils	Permanent surface water table	Depression-Level Variable	>40	Variable; predominantly organics	0	Very poor	RM, PF, SF, GF