WUSKWATIM GENERATION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Manitoba Hydro
and
Nisichawayasihk Cree Nation

April 2003

Volume 6
Terrestrial Environment

Nisichawayasihk Cree Nation

Manitoba Hydro

Available in accessible formats upon request.

PREFACE

Volume 6 (Terrestrial Environment) is one of a series of supporting technical volumes for Manitoba Hydro's and Nisichawayasihk Cree Nation's (NCN) application for environmental licensing of the Wuskwatim Generation Project (the Project) which is entitled Wuskwatim Generation Project Environmental Impact Statement, Volume 1 (April 2003).

The Wuskwatim Generation Project EIS is comprised of the following:

- Volume 1 – Wuskwatim Generation Project – Environmental Impact Statement
- Volume 2 – Public Consultation and Involvement
- Volume 3 – Project Description and Evaluation of Alternatives
- Volume 4 – Physical Environment
- Volume 5 – Aquatic Environment
- Volume 6 – Terrestrial Environment
- Volume 7 – Resource Use
- Volume 8 – Socio-Economic Environment
- Volume 9 – Heritage Resources
- Volume 10 – Cumulative Effects Assessment (Framework Approach)

Volume 6 has been prepared by independent discipline specialists who are members of the environmental study team retained to assist in the environmental assessment of the proposed project and provides a Terrestrial Environment Impact Assessment prepared in accordance with Final Guidelines issued by provincial and federal regulators for the Project. The supporting volumes have contributed to the preparation of the summary Environmental Impact Statement (Volume 1) and also provide additional technical and professional supporting information to assist in the technical review of the EIS. The supporting documents have been reviewed by Manitoba Hydro and NCN and are technically consistent with the EIS. They have not been edited for consistency in format, style, or wording with either the Summary EIS (Volume 1) or other supporting volumes.

The following is a list of the components of this volume and the firms responsible for completing these components:

Terrestrial Habitat and Vegetation	Ecostem Ltd. and Calyx Consultants
Insects	Wildlife Resource Consulting Services MB Ltd.
Amphibians and Reptiles	Tetr*ES* Consultants Inc.
Birds	Tetr*ES* Consultants Inc.
Mammals	Wildlife Resource Consulting Services MB Ltd.

TABLE OF CONTENTS (GENERAL)

1.0 INTRODUCTION

This volume describes the existing terrestrial environment and assesses the anticipated impacts of the construction and operation of the Project on the components of the terrestrial environment:

- terrestrial habitat and vegetation (Section 5.0);
- insects (Section 6.0);
- amphibians and reptiles (Section 7.0);
- birds (Section 8); and
- mammals (Section 9.0).

General information on the assessment approach (based on Valued Ecosystem Components or VECs) is provided in Section 2. Sections 3 and 4 provide an overview of the study area and major impacts of project construction and operation considered in the assessment. Detailed information for each discipline is provided in the specific section, including background information and the rationale for selection of VECs, study area, methods, description of the existing environment, impact assessment and mitigation, residual effects, cumulative effects, and environmental follow-up and monitoring.

2.0 ASSESSMENT APPROACH AND VALUED ECOSYSTEM COMPONENTS

The assessment considers the effects of the construction and operation of the Project. It does not consider the decommissioning of the facility, as the design life of the plant is 100 years, which is too far into the future to provide meaningful assessment of likely decommissioning plans or their effects (Volume 1, Section 2).

Project effects during construction and operation are predicted by comparing (a) what is expected to happen with the Project, and (b) what would be expected without the Project. The assessment approach recognizes that Wuskwatim Lake and adjoining waters, as well as the entire Churchill River Diversion (CRD) route, is a disrupted environment, as a result of both the initial diversion of water from the Churchill River in the 1970s and on-going regulation, as approved under *The Water Power Act*. For the purpose of assessing the effects of the proposed Project, this regulated environment is considered the baseline.

Although a broad range of environmental components are considered in the environmental impact assessment, the determination of whether or not impacts are "significant" focuses on specific environmental components (Valued Ecosystem Components or VECs) selected for their direct importance and interest to stakeholders (e.g., important species used by NCN such as moose) and/or as indicators of environmental effects to a broader assemblage of animals. Potential impacts to VECs were evaluated on the basis of the following criteria:

- nature of the effect (positive, neutral, or negative);
- magnitude of the effect (size of effect – see below);
- duration of the effect (how long the effect would last – see below);
- frequency of the effect (how often and when the effect would occur);
- spatial boundaries or geographical extent of the effect (would the effect occur in a small or a large area – see below)
- reversibility of the effect/ resilience of the VEC (could the VEC readily recover from the impact); and
- ecological context (is the VEC particularly sensitive to disturbance).

With respect to the assessment of significance for impacts to VECs, the three key assessment components were:

- *duration*: short-term (effects that last no more than one generation span of the species affected or five years for other Valued Ecosystem Components (VECs) such as water quality); long-term (more than one generation of the species affected or greater than five years for other VECs).
- *magnitude*: small (impact does not have a measurable effect on the VEC population under consideration); moderate (effect could be measured with a well designed monitoring program); and large (impact would be large enough to be readily noticed without a monitoring program).
- *geographic extent*: site (impact confined to a small area and not transportable to other areas); local (the area physically impacted by the GS including areas affected by changes in water levels and flows); and regional (the area impacted could extend well beyond the area physically impacted by the Project e.g., effects on migratory species).

A matrix that generally illustrates the differences between insignificant and significant impacts based on duration, magnitude, and geographic extent is provided in Figure 2-1; it should be noted while this matrix guides the assessment of significance, the assessment also considers other components such as "frequency" (does the effect occur more than once), "confidence" (how confident are we in the degree of impact), and VEC-specific characteristics such as "resilience" and "ecological context". For example, if the VEC in question is known to be highly resilient (i.e., adaptable and recovers well from disturbance), effects that would otherwise be considered significant could be classed as insignificant, despite the magnitude and/or duration of the impact. Conversely, impacts that might not generally be considered significant (e.g., ones that affect a small proportion of the population for a short period) might be significant for a highly vulnerable VEC where the loss of even a few individuals may affect the long-term status of the population.

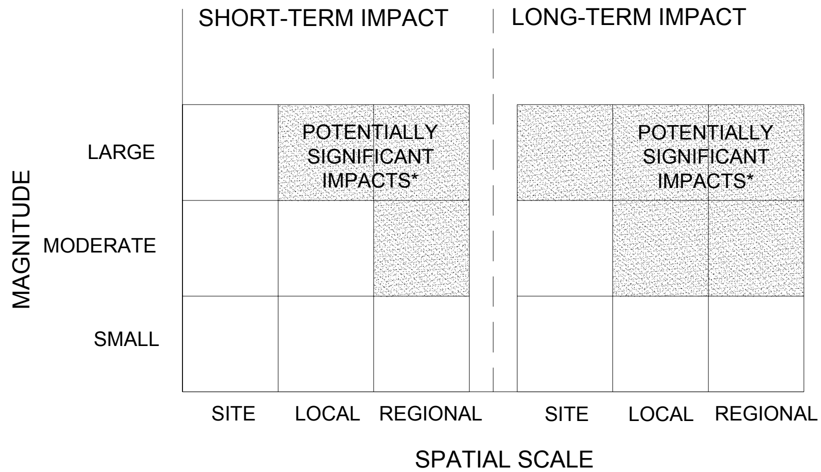

Figure 2-1. Matrix illustrating the definition of "significant" effects to VECs (*In addition to the above, effects are assessed in terms of their "frequency of occurrence", "confidence in the assessment", "resilience", and "ecological content".)

3.0 STUDY AREA

The study area varied among terrestrial environment disciplines based on habitat and life activity requirements (e.g., migration ranges, reproductive areas) of the VECs and the extent of Project effects. Most studies focused on directly affected areas (i.e., buffer zones along the affected water, around the generating station and construction site, borrow areas, and access road). Changes in these directly affected areas were placed in the context of effects within a larger areas (region); information on these is provided in each of the specific sections.

4.0 LINKAGES TO CONSTRUCTION AND OPERATION OF THE PROJECT

This section provides an overview of the major impacts from the construction and operation of the Project based on information presented in volumes 3 (Project Description) and 4 (Physical Environment) that were considered in the assessment of effects to the terrestrial environment. More detailed information specific to each of the disciplines is provided in sections 5 to 9.

4.1 CONSTRUCTION-RELATED IMPACTS

Effects to the terrestrial environment related to impacts such as clearing, sensory disturbances by construction activity (including activity by machinery and blasting), and vehicle collisions with animals were based on information presented in Volume 3. Habitat loss (due to both permanent and non-permanent works) and degradation (in areas adjacent to directly impacted sites) was assessed on the basis of GIS information provided by Manitoba Hydro (this assessment also applied to the operating period); in certain instances there are differences in the aerial extent of impacts described in this volume and volumes 3 and 4 due to differences in the map bases and definition of impacted areas.

The presence of a large workforce, as well as the access road to Wuskwatim Lake, is expected to increase disturbance due to human activity in the area. Increases in resource harvesting as a result of the workforce and increased access will depend on measures that will be outlined in Access Management Plan and measures to be undertaken by Manitoba Conservation who are responsible for the management of wildlife in the Province.

Changes to the water regime and flooding caused by the Project are considered under operation although initial impacts begin during construction.

4.2 OPERATION-RELATED IMPACTS

The primary impacts during the operating phase are linked to changes in the water regime (including related changes in processes such as erosion, the presence of the generating station and access road (permanent footprints), and the provision of road access.

Water Regime

In assessing the potential effects of the post-Project water regime on the riparian environment, two different stream-flow records for the Burntwood River at Wuskwatim Lake were used: a record based on flows that occurred since 1977 (post-CRD flows) and a long-term simulated record (86 years). The average flow for the long-term record is wetter than the post-CRD flow record, and both records have similar minimum and maximum values (Volume 4). The "existing environment" was based on the post-CRD record, while the "post-Project environment" was based on the long-term simulated record. Therefore, the predicted differences between the two conditions reflects the combined effects of the Project and the differences in the water records; for the purposes of this assessment, no attempt was made to differentiate between the relative contribution of these two sources of change.

Water levels in the immediate forebay, between Wuskwatim and Taskinigup Falls, will be raised approximately 7 m, flooding about 37 ha of terrestrial area. The Project will generally stabilize the water level near the upper end of the existing range on Wuskwatim Lake and adjoining water bodies (e.g., Wuskwatim Brook, Sesep Lake) in the reach extending from the base of Early Morning Rapids to the GS (present-day Taskinigup Falls). Post-Project, the median lake level will increase by approximately 0.3 m, and the zone of fluctuating water levels will be reduced.

During periods of low flow, conditions could arise when water levels in the reservoir would be drawn to below 233.75 m (Volume 3). Drawdown to below 233.75 is expected to occur 2.5% of the time. These low flows generally occur during the open water, and usually for several years in succession. During these times, several cycles of gradual drawdown and reponding could occur within a single season, though drawdown to the minimum reservoir level of 233 m ASL is expected to occur rarely.

Downstream of the GS, operation of the station will superimpose water level fluctuations within the day on the month-to-month and interannual changes that occur under current conditions. The largest fluctuations within the day occur in the tailrace (median 0.4 m to a maximum of 1.5 m) and decrease down river until, by Opegano Lake, the median is 0.1 m with a maximum of 0.4 m (as discussed in Volumes 3 and 4, under extremely unusual conditions, these changes could be greater). These water level changes within the day will considerably increase the frequency of water level fluctuation within the zone that is currently periodically dewatered.

Ice Conditions

Ice conditions are not expected to change significantly, though ice cover may form between Wuskwatim Falls and Taskinigup Falls.

Erosion

Assessment of habitat loss for the terrestrial environment was based on the average estimated post-Project erosion rates plus a 50% variability buffer (Volume 4, Section 6). This approach was adopted as there was considerable variation in the rates of erosion among shore types with the same classification; using above average rates reduced the possibility of under estimating losses of unusual habitat types that could be situated at points experiencing above average erosion.

The Project is expected to increase erosion in the area between Early Morning Rapids and Taskinigup Falls, particularly during the first five years of operation, which will result in a small loss of terrestrial habitat. Erosion is not expected to increase downstream of the generating station except for areas in the immediate vicinity of the generating station.

Debris

The increased erosion upstream of the generating station, will create additional debris, the majority of which is expected to be trapped within existing debris fields.

Increased Access

Manitoba Hydro and NCN, in consultation with the Nelson House Resource Management Board, will develop a plan to manage access into the Project Area. The report of a committee examining this issue is provided in Volume 3. This assessment assumed that there would be increased human usage of the area (in particular by NCN), but that access would be managed to mitigate adverse effects of over-harvesting on resource species.

WUSKWATIM GENERATION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

TERRESTRIAL HABITAT

VOLUME 6, SECTION 5

April 2003

Prepared by:

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and

Calyx Consulting

Table Of Contents

5.0 TERRESTRIAL HABITAT

5.1 OVERVIEW

Habitat provides the food, shelter and other important life history requirements that VECs and other animals need to survive and produce offspring. Habitat also provides resources such as firewood, berries and medicinal plants for local people and ecological services such as clean air and water for all people and animals.

The terrestrial habitat effects assessment considered Project effects on two major habitat types: mainland and semi-aquatic (Figure 5.1-1). Mainland habitat includes mainland wetlands (i.e., wetlands [e.g., bogs, fens] that are not hydrologically connected to rivers or riverine lakes) and uplands. Semi-aquatic habitat includes shore zone (i.e., upper sub-littoral to supra-littoral zones), lake peatland and mineral island habitat. Section 5.1.1 describes the major habitat types. Section 5.1.3 then provides an overview of some of the key linkages needed to understand and predict effects on habitat and its components (e.g. vegetation, soils, permafrost).

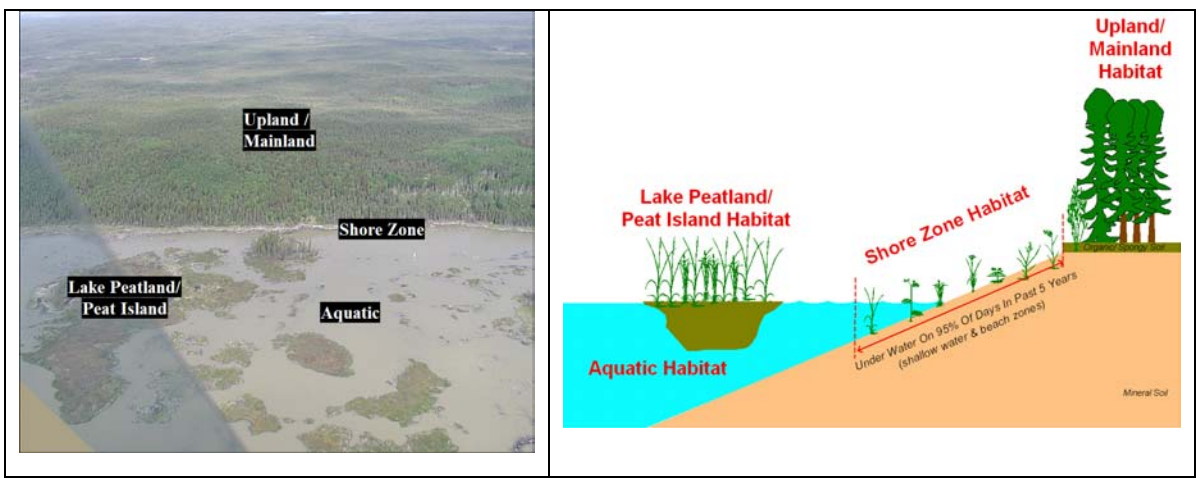


Figure 5.1-1. Major habitat types. Note: In the major habitat types, mainland/ upland includes wetlands outside of rivers and riverine lakes.

The overall goal that guided the habitat effects assessment approach is found or implicit in a number of recent provincial and federal policy documents on the ecosystem-based approach to sustainable land use: maintain ecosystem health while providing benefits to our selves, our children and other future generations (after CCFM 1992). Healthy ecosystems are important because they provide many benefits (e.g., clean air, clean water, renewable resources, recreation, jobs) and satisfy spiritual and aesthetic values. Section 5.1.4 describes how the ecosystem-based approach to land management was incorporated into the habitat effects assessment.

It is not feasible to study and predict effects on all of the ecosystem patterns and processes that have produced and maintain healthy ecosystems. The habitat effects assessment focused on habitat, habitat and plant VECs and selected indicators of ecosystem health (Section 5.1.5).

Following the guidance provided in federal environmental impact assessment documents (c.f., FEARO 1996, 2001; Milko 1998a, 1998b), as well as provincial and federal policy documents on ecologically sustainable land management (c.f., CCFM 1992, 1995), the terrestrial habitat effects assessment proceeded in a bottom-up, sequential, hierarchical fashion as follows.

(1) Identify the **Project impact areas**. These are the areas that contain the Project feature footprints. **Project features** include structures (e.g., generating station, access road), activities (e.g., vehicle traffic) and associated alterations (e.g., vegetation clearing, soil compaction on access trails). These are the areas where potential Project effects on the vegetation and soils components of habitat are highest. Effects on other ecosystem components also occur in the Project impact areas. Section 5.2.1 provides an overview of the Project impact areas that are described in Section 5.4.

(2) Identify the **Project effects areas**. These are the areas where the Project features may affect habitat, VECs and/ or ecosystem health indicators. Project effects are generally highest in the Project impact areas. Overall Project effects, especially on habitat, generally decline with distance from the Project impact areas. Therefore, the habitat effects assessment uses two zones of influence for Project effects outside of the Project impact areas:

A) Fine Habitat ZOI- This is the zone of influence that includes the area where habitat composition changes due to the indirect effects of the Project features in the impact areas. Other effects also occur in the Fine Habitat ZOI due to the indirect effects of habitat composition change or other effects of the Project features.

B) Landscape ZOI- This is the zone of influence surrounding the Fine Habitat ZOI that includes the area where habitat composition does not change but other potential Project effects still occur (e.g., altered habitat quality for species with large home ranges, fragmentation).

Project effects areas are identified and described in Section 5.4.

(3) Identify **Project effects comparison areas**. These are the larger areas surrounding the Project effects areas and are used to assess the ecological significance of any effects identified in step (2). Project effects comparison areas are identified in Section 5.2.1 and described in Section 5.3.1.

(4) Describe the existing environment using the Project effects comparison areas as the effects assessment study areas.

(5) Identify potentially significant effects in the Project effects areas (Section 5.4).

(6) Determine which potentially significant effects will be mitigated and specify mitigation measures.

To the extent possible, given existing information and scientific understanding, the Project effects and Project effects comparison areas identified in steps (2) and (3) should be ecosystem units in a hierarchical ecosystem framework rather than political or rule-of-thumb boundaries. The hierarchical ecosystem framework used in the habitat effects assessment considered linkages within and between scales of space, time and biological organization, as well as appropriate indicators of ecosystem health (Section 5.1.4).

The habitat effects assessment overview (Section 5.1) is followed by a description of the methods used in the assessment (Section 5.2). A description of the existing environment (Section 5.3) then provides the foundation for the effects assessment contained in Section 5.4. Residual effects after mitigation measures are summarized in Section 5.5 and then followed by an assessment of cumulative effects on VECs (Section 5.6). A description of follow-up and monitoring programs concludes the terrestrial habitat effects assessment (Section 5.7).

5.1.1 Ecosystem Based Approach

An ecosystem-based approach was used to describe the terrestrial ecosystem and its components, to predict the effects of the proposed Project and to assess the ecological significance of those effects. The following are the four main components of an ecosystem-based approach to effects assessment.

- All things (physical, biological and spiritual) are interconnected within and between scales of space, time and biological organization. Direct impacts can cause indirect effects.
- Both short and long-term effects must be considered. It may take many years for some indirect effects to show up.
- Meaningful consultation shapes the Project design and the assessment of Project effects:
    - People who value the local environment can identify issues of concern; and
    - People who know the local environment can provide important ecological information.
- The overall goal of ecosystem-based land management/ use is to maintain ecosystem health while providing benefits to our selves, our children and other future generations.

A number of sources provide the foundation for the components of an ecosystem-based approach to land management and effects assessment. Some aboriginal Elders teach us that everything is connected to everything else and that we should consider how our actions affect the seventh generation that comes after us. The principles of ecosystem-based management have been adopted by many provincial and federal governments in Canada and worldwide (CCFM 1992; Everett et al. 1993; FEMAT 1993; KPMG 1995). Some of the government policies and agreements that are relevant to Manitoba include COSDI, the Canadian Criteria and Indicators of Sustainable Forest Management (CCFM 1992), Manitoba's Forest Plan (KPMG 1995), Manitoba's Land And Water Strategy, The Convention on Biological Diversity and Manitoba's Principles of Sustainable Development. Manitoba Hydro also recognizes the importance of the ecosystem-based approach in at least three of its Sustainable Development Policy Principles (Volume 3 Appendix 1.0):

- "To the extent practical, plan, design, build, operate, maintain and decommission Corporate facilities in a manner that protects essential ecological processes and biological diversity."
- "Recognize its responsibility as a caretaker of the economy and the environment for the benefit of present and future generations of Manitobans."
- Recognize that there are no political and jurisdictional boundaries to our environment, and that there is ecological interdependence among provinces and nations.

If the overall goal of ecosystem-based land management is that development and other activities should be carried out in a way that maintains ecosystem health, then we need to know what ecosystem health is. Ecosystem health is maintained when native biological diversity, ecosystem condition and productivity, soil and water quantity and quality and contributions to global ecological cycles are maintained within their ranges of natural variability (CCFM 1995). Ehnes and Sidders (1999) translate the four components of ecosystem health into everyday language. "Conserving biodiversity means keeping all the living pieces, that is, the genes, plants, animals and communities, in the amounts and the types of places that they are found naturally. . . . Maintaining forest ecosystem condition and productivity means managing our activities so that the forest can recover from the stresses that we put on it. In other words, we have to live off the interest and not use up the capital. . . . Conserving soil and water resources means keeping soil and water quantity and quality near natural levels. . . . Maintaining contributions to global ecological cycles means making sure that the combined results of all the activities in an area do not affect the global life support system."

5.1.2 Major Habitat Types

Habitat is the place where a plant or animal lives. Soils, hydrology, permafrost, vegetation, vegetation age and disturbance regime are the key habitat attributes that collectively influence the presence and abundance of terrestrial plants and animals at any site. Disturbances are mostly natural forces such as wildfires and water level fluctuations. Disturbances combine with soils, groundwater and topography to produce the patchwork of habitat types that are seen looking down from a small plane. A habitat type is an area with a particular combination of soils (including soil organisms), hydrology, permafrost, vegetation, vegetation age and disturbance regime. Different species of plants and animals are found in different habitat types. Some animals use several different habitat types.

Aquatic, semi-aquatic and mainland habitat are the major habitat types found in the region (Figure 5.1-1; Table 5.1-1). Semi- aquatic habitat includes shore zone (i.e., littoral and riparian zones), lake peatland and mineral island habitat. Mainland habitat is separated from semi-aquatic habitat by the 10-year flood line (Table 5.1-1). Each major habitat type is affected by a different type of disturbance regime and has very different surface and ground water conditions. Water fluctuations are the dominant disturbance in semi-aquatic habitat, while large wildfires are the dominant disturbance in mainland habitat. Terrestrial habitat includes mainland/ upland and semi-aquatic habitat.

The terrestrial habitat effects assessment considers Project effects on the mainland/ upland[1], shore zone, lake peatland and mineral island habitat types. A much finer subdivision of the major habitat types as well as an examination of the components of habitat is required to develop an understanding of the habitat relationships of most species of plants and animals and to complete an assessment of effects on habitat. These are described below (Section 5.2.4).

Table 5.1-1. Definitions of major habitat types used in the habitat effects assessment. See Figure 5.1-1 for general locations.

Habitat Type	Description
Aquatic	Water bodies and waterways in the Project area.
Semi-Aquatic	
Shore zone	Band along aquatic shoreline that is affected by fluctuating water levels. The bottom of the band is at the elevation that was under water more than 95% of the growing season days over the past 5 years. The top of the band is at the highest elevation under water for at least 20 days during the growing season over the past 10 years.
Lake peatlands/ Peat islands	Those portions of peatlands that are in aquatic habitat. A peatland is thick spongy soil made up of dead sedges, grasses, Sphagnum mosses, etc. building up over time (see Figure 5.1-2).
Mineral islands	Mineral or bedrock islands (organic layer on top of the mineral soil < 20 cm thick) in lakes or rivers.
Mainland/ Upland	All areas that are on the mainland side of the shore zone (includes wetlands outside of rivers or lakes with open water).

[1] Mainland habitat was referred to as upland at the start of environmental impact statement work to clearly distinguish the Shore Zone from the adjacent habitat that had not been affected by the CRD water fluctuations. Upland is not the correct term for this area because adjacent habitat includes peatlands that have not yet been altered by the CRD. Also, once the analysis expanded from the Affected Aquatic Area to other mainland areas such as the access road, it became apparent that mainland would be a more appropriate term. However, by this time the term "upland" was already well entrenched in the terrestrial environmental impact statement. Therefore, Section 5 now uses the term mainland/ upland to refer to all mainland habitat outside of the Affected Aquatic Area. Although "upland" is still included in the mainland/ upland term to maintain consistency with other documents, it is emphasized that mainland/ upland habitat always includes wetlands as well as uplands.

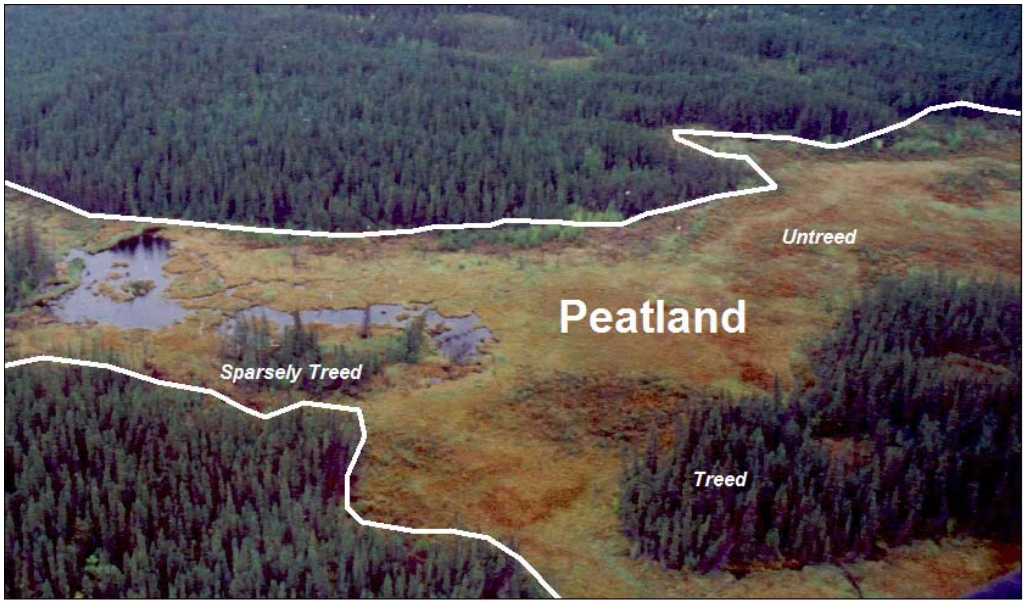
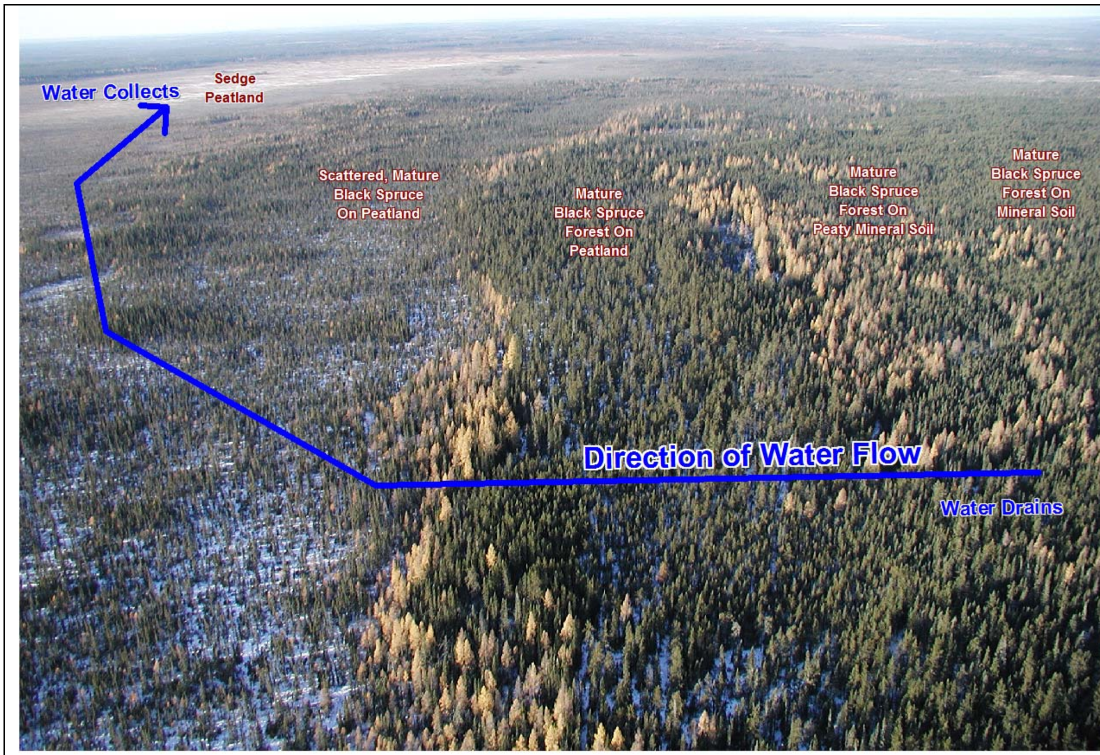


Figure 5.1-2. Example of a peatland showing treed, sparsely treed and untreed types.

5.1.3 Ecological Linkages Between And Within The Major Habitat Types

The way that habitats are arranged together is important to plants and animals. Many animal species need to use more than one habitat type to survive and/ or produce offspring over their lifetime. Beaver is a good example of a species that requires two very different habitat types to survive: aspen forest (or equivalent) and shallow water. It is important to use collections of adjacent habitats as well as habitat patches when developing an understanding of how mammals and birds use habitat and for predicting potential project impacts on those species.

Adjacent habitats often occur in a predictable sequence of types due to the strong linkages between vegetation, soils, hydrology, permafrost and disturbance regimes. The most common condition that creates a sequence of different habitat types is a hill slope (i.e., a toposequence). In the area between Thompson and The Pas, a common toposequence (starting from the top of the hill and then moving down), is black spruce forest on mineral soil, black spruce forest on peaty mineral soil, black spruce forest on bog, scattered black spruce trees on bog and, finally, sedge fen (Figure 5.1-3 (A)). In other areas where the terrain consists of shallow mineral soil mixed with exposed bedrock, the toposequence is often sparsely treed jack pine on outcrop, upland jack pine and/ or black spruce forest, black spruce forest on peatland and sparsely treed peatland (Figure 5.1-3 (B)).



(A) Common toposequence on deep mineral soil deposits.

(B) Common toposequence on the Canadian Shield or areas with exposed bedrock.

Figure 5.1-3. Sequence of habitat types going from top to bottom of hill (toposequence). Illustrates vegetation changes produced by surface and ground water flowing down hill and collecting at bottom. The water table is closer to the surface as one moves down the hill.

The habitat sequences shown in Figure 5.1-3 are common in the central Canadian boreal forest because topography can create vast differences in the amount of water available for plant growth due to the way that water flows and collects. The habitats at the top of the hill in Figure 5.1-3 B are open and dry because there is not enough water and soil for dense tree growth. In contrast, the sedge fen in the lowest area has no trees because there is too much water - the trees drown before they become tall.

Some animals use several adjacent habitat sequences as well as adjacent habitats to meet their survival and reproduction needs. A landscape is an area that has the same type of habitat sequence occurring repeatedly throughout and usually covers 2,000 to 20,000 ha (Diaz and Apostol 1992; Forman 1995)[2].

5.1.4 Effects Assessment Approach

5.1.4.1 Spatial Scales Included In The Effects Assessment

The toposequence example illustrates how ecological processes/ flows that are hidden to the eye produce the patterns that are important to plants and animals. There are many ecological processes and flows important for effects assessment that occur over multiple spatial scales. A key question then is: do ecological patterns and processes resolve at distinct spatial scales and how are those scales identified and incorporated into a habitat effects assessment?

There is a theoretical basis for determining which spatial scales are required to understand how Project impacts may affect key ecosystem components and habitat relationships. The theory comes from several sources including causal, hierarchy and levels of biological organization theory (c.f., Rowe 1961; Saris and Stronkhorst 1984; Allen et al. 1987 for seminal works). At the core of this theory is the recognition that ecological and evolutionary processes are linked across scales of space, time and biological organization. The upshot is that "break" points or transition zones for scales of time and biological organization tend to correspond with a set of spatial scales. This set of spatial scales is very useful for understanding and predicting how a Project may affect ecosystem health.

In this approach, the ecological patterns and flows found at the site, habitat or landscape scale can only be understood by also incorporating scales that are one above and one below the scale of interest (Allen et al. 1987; King 1993). The scale above the one of interest provides the context that limits possibilities, while the scale below provides the

[2] Formal definition of a landscape is a "heterogeneous land area composed of a cluster of interacting ecosystems that is repeated in similar form throughout." (Forman and Godron 1986).

mechanisms that have produced the patterns that can be seen. For example, when trying to understand ecological relationships at the habitat scale, the landscape scale provides the context and the site scale provides the mechanics (Figure 5.1-4). A Project impact that alters the landscape will affect species that meet their life needs at the habitat scale even though their habitat relationships have not changed. For example, a landscape alteration that increases the number of wide ranging mouse predators in surrounding habitats can reduce mouse populations in unaffected habitats. At a larger scale, impacts on climate will change the distributions and/ or abundance of some plant species. At a smaller scale, if we want to understand why an individual is found in a particular habitat, then we need to determine how each of the individual's life requisites are met by each habitat attribute. This requires studies at the next smaller spatial scale.

A hierarchy of nested ecosystems emerges from ecological theory (Figure 5.1-4). An ecosystem is a functional unit consisting of all living organisms (plants, animals, microbes) in a given area, and all non-living physical and chemical factors of their environment, linked together through matter (e.g., nutrients, genes, water) and energy flow. An ecosystem can be any size (e.g., a log, pond, forest) but always includes all of the components that interact with each other at the spatial scale of interest.

Thus far the site, habitat and landscape scales levels of a more detailed ecosystem hierarchy (Figure 5.1-4) have been identified. A site ecosystem includes an area of about 100 m^2. Adjacent site ecosystems combine to form fine habitat ecosystems, adjacent fine habitat ecosystems combine to form broad habitat/ landscape element ecosystems (e.g., adjacent white spruce, balsam fir and upland black spruce combine into upland conifer) and adjacent broad habitat/ landscape element ecosystems combine to form landscape ecosystems[3]. As Figure 5.1-4 illustrates, other ecosystem levels also occur at spatial scales larger than the landscape and smaller than the site.

[3] It is acknowledged that the terms "fine habitat" and "broad habitat" are awkward. These seemed to the best compromise amongst a number of possibilities. The fine habitat scale is equivalent to what a forester would call a "stand". This term was used so as to avoid the connotation that the effects assessment only considered forests. Other possible terms for fine and broad habitat (i.e., landscape element) were deemed too technical to be accessible to a relatively broad audience.

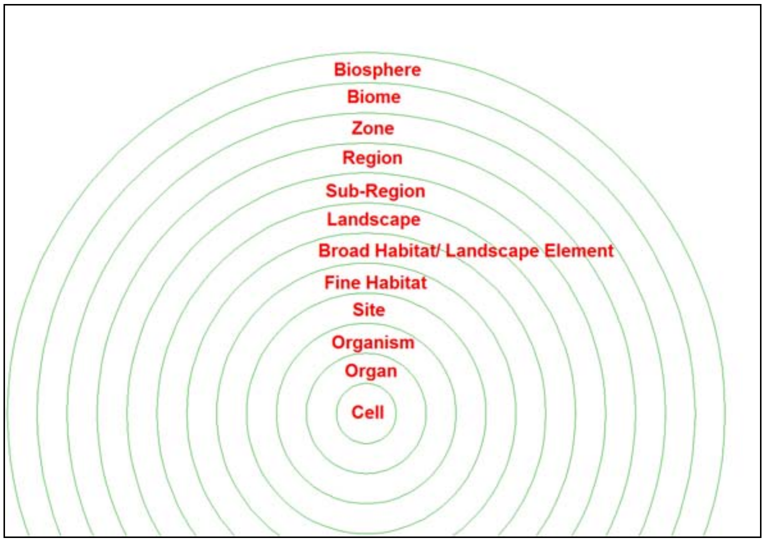


Figure 5.1-4. Hierarchy of nested ecosystem scales.

This leads to two very important questions for an environmental impact assessment of effects on terrestrial habitat, plants and animals. What range of spatial scales need to be included in an effects assessment? How are each of the needed spatial scales identified for practical purposes?

The spatial hierarchy used in the effects assessment should have enough detail and flexibility to meet the needs of the various specialists completing the assessment. The level of detail required is determined by three considerations.

(1) Scales needed to describe and understand habitat relationships (i.e., linkages between life requisites and habitat attributes) of the plants and animals included in the effects assessment.
(2) Scope of Project impacts.
(3) Scales required to understand and predict how the effects of Project impacts may alter key components of ecosystem health and the habitat relationships of selected plants and animals.

Identification of the appropriate spatial scales for understanding plant and animal habitat relationships focuses on individuals rather than populations or species. The evolutionary and ecological processes that have produced and maintain the current distributions and abundances of regional plants and animals have operated on individuals and not on populations or species. Individuals of different species satisfy their needs at different spatial scales. For example, a mouse is linked to the site whereas a moose is linked to the landscape (R. Berger pers. comm.). Most of the plants and animals receiving special attention in the terrestrial effects assessment use spatial scales that range from the site to the landscape.

Scope of Project impacts refers to the size, duration and degree of immediate, direct habitat change and organism mortality. There is a distinction here between Project impacts and Project effects (Hegmann et al. 1999). Impacts describe how the Project features directly alter ecosystems (i.e., the causes). Effects describe how impacts directly and indirectly alter ecosystem components and ecosystem health. Scope of Project impacts ultimately determines the scope of Project effects and the spatial scales required to understand and predict Project effects.

The final consideration then is the scales required to understand and predict how the effects of Project impacts may alter key components of ecosystem health and the habitat relationships of selected plants and animals. This consideration expands the spatial scales needed for terrestrial effects assessment to include the range of scales that span from the organism ecosystem to the sub-region ecosystem (Figure 5.1-4). At this stage, the focus expands from individuals and local sub-populations to regional populations.

The area needed to capture Project effects on terrestrial ecosystems will vary by species and ecosystem component. For example, construction noise has effects in adjacent areas for some animals but not for plants. In this way, a particular Project feature that is confined to a small area can have effects on some species in the surrounding landscape.

Project effects on habitat are generally highest in the Project impact areas because this is where vegetation is cleared, and in some areas, the surface organic layer is stripped and stockpiled. Indirect Project effects on habitat (e.g., soil warming, permafrost melting) generally decline with distance from the Project impact areas. On this basis, the effects assessment uses two zones of influence based on habitat effects:

A) Fine Habitat ZOI- This is the zone that surrounds the Project impact areas and includes the area where habitat composition changes due to the indirect effects of the Project features in the impact areas. Other effects also occur in the Fine Habitat ZOI due to the indirect effects of habitat composition change or other effects of the Project features.
B) Landscape ZOI- This is the zone that surrounds the Fine Habitat ZOI and includes the area where habitat composition does not change but other potential Project effects still occur (e.g., altered habitat quality for species with large home ranges, fragmentation).

Once the Project effects on a species have been identified, the ecological significance of those effects must be assessed. This can only be accomplished by comparing the magnitude of those effects to conditions in the surrounding sub-region or region. The size of the comparison sub-region will vary by ecosystem component based on the spatial scope of Project effects on that species. For example, different comparison areas are required for muskrat and caribou. The Project may only affect a few caribou but those caribou are part of a population that uses the surrounding region. The region is the appropriate scale to assess whether ecosystem health is maintained during the construction and operation of the Project (Miller and Ehnes 2000). The **Project effects comparison areas** are the larger areas surrounding the Project effects areas that are used to assess the ecological significance of any potential Project effects.

Ecosystems at scales that include the organism, site, habitat, landscape, sub-region and region (Figure 5.1-4) were included in the terrestrial effects assessment. The same theory used to identify which spatial scales should be included (causal, hierarchy and levels of biological organization theory {c.f., Rowe 1961; Saris and Stronkhorst 1984; Allen et al. 1987}) was used to determine the spatial extent of each level of the ecosystem hierarchy. Miller and Ehnes (2000) provide an overview of how this theory is used for this purpose. Section 5.2.1 presents the spatial scales/ study areas included in the effects assessment.

5.1.4.2 Application Of The Ecosystem Based Approach

Section 5.1.1 identifies the overall goal for the development and operation of large projects as: maintain ecosystem health while providing benefits to ourselves, our children and other future generations. Following extensive consultation, the Canadian Council of Forest Ministers adopted a criteria and indicators framework for monitoring ecosystem health (CCFM 1995). The criteria in this framework are the four components of ecosystem health. Each criterion/ component of ecosystem health is further divided into sub-components (Table 5.1-2). For example, the sub-components of biological diversity are genes, species and ecosystems. The CCFM framework is sufficiently general and comprehensive to integrate well with other provincial and federal environmental policies and guidance documents such as:

- A guide on biodiversity and environmental assessment (FEARO 1996);
- Reference guide: Addressing cumulative environmental effects (FEARO 2001);
- Cumulative Effects Assessment Practitioners Guide (Hegmann et al. 1999);
- Cumulative Effects Assessments In The Inuvialuit Settlement Region: A Guide For Proponents (KAVIK-AXYS 2002);

- Wetlands environmental assessment guideline (Milko 1998);
- Federal policy on wetland conservation (Canada 1991);
- Manitoba Sustainable Development Strategy; and
- Manitoba Water Policies (Manitoba 1990).

The CCFM framework of sub-dividing ecosystem health into components and sub-components was used to identify indicators of Project effects on habitat and the processes that produce and maintain habitat. This occurred in three stages. First, issues of concern and potential Project effects on terrestrial habitat and plants were identified for each sub-component of ecosystem health using relevant literature with special emphasis placed on "A guide on biodiversity and environmental assessment" (FEARO 1996) and "Reference guide: Addressing cumulative environmental effects" (FEARO 2001). Second, a generic measurable indicator of the status of each effect was identified for use in the effects assessment. As it is not feasible to investigate and assess every component of the terrestrial ecosystem, specific examples of the generic indicators were ultimately used to focus the effects assessment. Some of these specific indicators are the valued ecosystem components (VECs) used in the effects assessment. Section 5.1.5 describes how VECs were used to focus the effects assessment. Third, criteria for assessing the magnitude of Project effects on each indicator were developed.

Table 5.1-2 identifies issues of ecological concern for terrestrial habitat by sub-component of ecosystem health, the type of Project effect that would be considered negative and measurable indicators for the effect. Criteria for assessing the magnitude of an effect are described in Section 5.1.4.3.4.

Table 5.1-2. Main issues of concern for terrestrial habitat, how the issue could be affected by the Project and measures/ indicators of effects by components and sub-component of ecosystem health.

		Potential Effect (type of change that is considered to be negative is shown in italics)	Measure/ Indicator
Biodiversity	Ecosystem	Ecosystem diversity *- increase or decrease*	Amount and location of all habitat types
		Priority Habitat Loss Areas with high biological diversity *- area loss*.	Amount and location of shore zone habitat altered or lost. Amount and location of riparian habitat altered or lost. Amount and location of mixedwood forest altered or lost.
		Critical habitat for plants *- area loss*.	Amount and location of critical habitat types
		Rare or uncommon habitats *- area loss*.	Amount and location of white spruce and balsam fir forest altered or lost
		Relic ecosystems (e,g. old forests, original grasslands) *- area loss*.	Amount and location of relic habitat types
		Fragile ecosystems *- area loss*	Amount and location of dry jack pine forest altered or lost. Amount and location of wetlands altered or lost.
		Fragmentation & Connectivity *- increase & decrease, respectively*	Road density (km of roads per km^2)
	Species	Rare species *- loss or reduction in abundance*	White spruce, balsam fir abundance and distribution
		Endangered/threatened species *- loss or reduction in abundance*	Abundance and distribution where feasible; otherwise, amount and location of high quality habitat altered or lost.
		Invasive/ exotic species *- increase in abundance and/ or distribution*	Qualitative analysis based on Project features and current distributions
		Populations at outer limits of their range *- population loss or reduction in abundance*	Abundance and distribution where feasible; otherwise, amount and location of high quality habitat altered or lost.
		Species with low reproductive capacity *- population loss or reduction in abundance*	White spruce and balsam fir abundance and distribution
		Species highly sensitive to disturbance (e.g., rare orchids) *- population loss or reduction in abundance*	Abundance and distribution where feasible; otherwise, amount and location of high quality habitat altered or lost
	Genetic	Genetic interchange *- inhibited*	Fragmentation measures (see above)

		Potential Effect (type of change that is considered to be negative is shown in italics)	Measure/ Indicator
Ecosystem Condition & Productivity	Incidence of disturbance & stress	Fire regime - *change in frequency, intensity or severity*	Change in frequency, intensity and severity.
		Plant & berry harvesting - *increase*	Amount harvested
		Air pollution - *increase*	Qualitative analysis
	Ecosystem resilience	Wetland function - *net loss*	Amount and location of wetland altered or lost by type & location
		Large, long-lived species - *loss or reduction in abundance*	White spruce distribution
		Landscape flows - *alteration*	Fragmentation
	Extant biomass	Primary productivity - *reduction or increase*	Habitat type composition
Soil Resources	Quantity	Productive soil -*loss*	Area loss or change by land type[1]
	Quality	Site type - *conversion*	Area of permafrost melted Area converted to a different site type
		Ground and surface water flow - *change*	Area with altered flows
		Alteration of soil properties - *chemical or physical change*	Area compacted
Contributions To Global Ecological Cycles	Carbon Budget	Vegetation biomass - *reduction*	Change in habitat composition by type
		Soil carbon - *loss*	Change in habitat composition by type Change in peatland area Change in permafrost area
	Forest land conversion	Forest lost - *net reduction*	Area converted from forest to other vegetation types
	Hydrological Cycles	Surface area of water - *increase or decrease*	Surface area of water (aquatic volume)

[1] Land type refers to similar broad combinations of soils, ground water, surface water and permafrost.

5.1.4.3 Assessment Criteria

Potential changes in the indicators of Project effects were evaluated based on the following criteria.

- Nature.
- Duration.
- Frequency.
- Geographic extent.
- Magnitude.

These criteria were described in Volume 6 Section 2. Variations specific to the habitat effects assessment are described below.

5.1.4.3.1 Nature

Table 5.1-2 specifies the nature of a potential effect that is considered positive, neutral or negative by VEC and indicator.

5.1.4.3.2 Duration

The duration of the potential effects of an impact was assessed based on the three prediction periods used in the habitat effects assessment:

- Short-term: Effect persists less than 5 years;
- Medium-term: Effect persists 6 to 25 years;
- Long-term: Effect persists 26 to 100 years.

5.1.4.3.3 Geographic Extent

Project impacts and potential effects will occur over different geographic areas for the various indicators of ecosystem health. The geographic extent of a Project effect was assessed as being confined within one of the spatial scales in the following hierarchy.

Site: One or more of the Project feature footprints (i.e., a Project impact area).

Landscape: Landscape ecosystem that contains Project impact areas. A landscape is an area large enough to capture Project effects on habitat (e.g., permafrost melting due to clearing) that do not extend further than 1 km from one or more sites. Effects include those on the individual organisms or sub-populations directly affected (i.e., the individuals but not the regional populations affected) and on the rates or frequencies of ecological processes (e.g., changes in soil moisture regime in adjacent habitat due to alteration of groundwater flows by road or new water regime). The landscape extent includes the Fine Habitat ZOI and Landscape ZOI (Section 5.1.4.1). A 1 km buffer around the Project impact areas was used to capture all landscape scale habitat effects.

Sub-Region: Area surrounding the landscapes. The sub-region is an area large enough to capture Project effects that extend more than 1 km from the Project footprints but affect an area less than approximately 300,000 ha in size. Sub-Region size was selected to be large enough to serve as a comparison area for effects confined to the landscape scale. For organisms, Sub-Region size should be large enough to capture the populations of most species where effects on individuals are confined to the landscape area. For ecological patterns or processes, Sub-Region size should be large enough to capture a relatively stable shifting mosaic for most pattern or process indicators whose effects are confined to the landscape area. A stable shifting mosaic defines an area large enough to be used to establish a range of natural variability. On this basis, the Sub-Region is also used as a comparison area (see Section 5.1.3) for indicators or species with effects confined to the Landscape ZOI.

Region: Area surrounding the Sub-Region. The Region is an area large enough to capture Project effects that extend over an area larger than the Sub-Region. Also serves as a comparison area for species or indicators with effects at the Sub-Region scale. Region should be large enough (1) to capture the populations of species with individuals affected at the Sub-Region scale, and (2) to capture a relatively stable shifting mosaic for ecological pattern or process indicators with effects at the Sub-Region scale (e.g., wildfire disturbance regime).

Each geographic extent above the Project impact area is referred to as a **study area**. Study areas are described in Section 5.2.1.

5.1.4.3.4 Magnitude

The magnitude of a potential negative effect from a Project impact differs for each indicator of ecosystem health. Regulatory thresholds for changes to population size, habitat area or ecological function do not exist except for wetlands that are subject to a federal trigger (Federal Policy on Wetland Conservation). For the remaining sub-components of ecosystem health, the goal is to maintain each indicator (Table 5.1-2) within the range of natural variability found in the comparison sub-region/ region ("natural" means before the effects of any existing human developments and activities other than traditional land use occurred).

Establishing data-based ranges of natural variability for each sub-component of ecosystem health could not be justified for this environmental impact statement given the anticipated nature and geographic extent of potential effects. For most indicators of ecosystem health, effect magnitude was assessed using rules-of-thumb. For indicators where established thresholds do not exist, some past environmental impact assessments have used a change of more than 10% as the threshold separating a moderate from a high magnitude effect (KAVIK-AXYS 2002). A 10% threshold for high magnitude was generally adopted for the habitat indicators (Table 5.1-3). A 5% high magnitude threshold was used for rare species or priority habitat types since they are more sensitive to small changes from benchmark states. For example, a number of botanists have indicated that collecting more than 5% of the individuals of the population of a rare species would affect the viability of that population (Wagner 1995 cited in AXYS 2001).

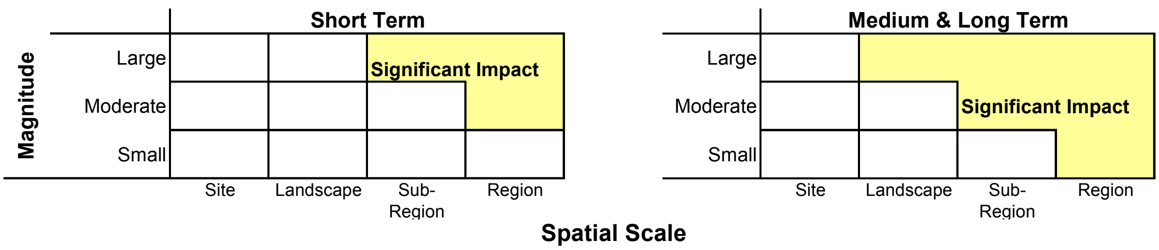
Table 5.1-3. Criteria for assessing impact magnitude by for each sub-component of ecosystem health. See Table 5.1-2 for a description of the issues associated with each component.

	Sub-Component	Magnitude	Range For Project-related Change In Measure
Biodiversity	Ecosystem	Small	Alteration or loss of habitat type is less than 1% of total area in Sub-Region.
		Moderate	Alteration or loss of common habitat type is between 1% and 10% of total area in Sub-Region;
			Alteration or loss of a priority habitat type is between 1 and 5% of total area in Sub-Region.
		Large	Alteration or loss of a common habitat type is greater than 10% of total area in Sub-Region.
			Alteration or loss of a priority habitat type is greater than 5% of total area in Sub-Region.
	Plant species	Small	Predicted reduction in abundance is less than 1%.
		Moderate	For rare plants, predicted reduction in abundance is between 1 and 5%.
			For other plants, predicted reduction in abundance is between 1 and 10%.
		Large	Population viability is threatened. For rare plants, predicted reduction in abundance is greater than 5%.
			For other plants, predicted reduction in abundance is greater than 10%.
	Genetic	Small	Fragmentation measure changes less than 1% for Sub-Region.
		Moderate	Fragmentation measure changes between 1% and 10% for Sub-Region.
		Large	Fragmentation measure changes more than 10% for Sub-Region.
Ecosystem Condition & Productivity	Incidence of disturbance & stress	Small	Qualitative assessment since it is very difficult to predict how the wildfire regime could change.
		Moderate	Qualitative assessment
		Large	Qualitative assessment
	Ecosystem resilience	Small	Alteration or loss is less than 1% of total area in Sub-Region.
		Moderate	Alteration or loss is between 1% and 10% of total area in Sub-Region.
		Large	Alteration or loss is greater than 10% of total area in Sub-Region.
	Extant biomass	Small	Alteration or loss is less than 1% of total area in Sub-Region.
		Moderate	Alteration or loss is between 1% and 10% of total area in Sub-Region.
		Large	Alteration or loss is greater than 10% of total area in Sub-Region.
Soil Resources	Quantity	Small	Alteration or loss is less than 1% of total area in Sub-Region.
		Moderate	Alteration or loss is between 1% and 5% of total area in Sub-Region.
		Large	Alteration or loss is greater than 5% of total area in Sub-Region.
	Quality	Small	Alteration or loss is less than 1% of total area in Sub-Region.
		Moderate	Alteration or loss is between 1% and 10% of total area in Sub-Region.
		Large	Alteration or loss is greater than 10% of total area in Sub-Region.
Contributions To Global Ecological	Carbon Budget, Forest Land Conversion, Hydrological Cycles	Small	Alteration or loss is less than 1% of total area in Sub-Region.
		Moderate	Alteration or loss is between 1% and 5% of total area in Sub-Region.
		Large	Alteration or loss is greater than 5% of total area in Sub-Region.

5.1.4.4 Determination Of Effect Significance

A preliminary determination of the ecological significance of a Project effect was made based on the extent, magnitude and duration of using Table 5.1-4. The final determination was based on the ecological context, reversibility and scientific uncertainty of the effect. In this approach, some non-significant effects could become significant and vice versa. For example, a potential small, Sub-Regional, long-term effect could be considered significant if it relates to a species in decline across the Province.

Table 5.1-4. Criteria used to determine whether or not a predicted Project effect is ecologically significant.



5.1.5 VEC Selection

As it is not feasible to investigate and assess every one of the potential indicators of ecosystem health identified in Table 5.1-2, the effects assessment focuses on those species or indicators having high ecological importance and/ or high importance to NCN and/or thought to provide good representation for one or more sub-component of ecosystem health. These are the valued ecosystem components (VEC) and they are the focus of this effects assessment. The VECs receiving special attention in the terrestrial habitat assessment are dry jack pine forest, balsam fir, dry ground cranberry, velvet-leaf blueberry, bog cranberry, sweet flag (rat root) and wild mint (Table 5.1-5). Given that habitat is the foundation for all terrestrial VECs, several additional indicators of ecosystem health were included in the habitat assessment: land type distribution and abundance, habitat type distribution and abundance, sensitive species (i.e., endangered, threatened or rare plants) distributions and abundances and road density (km of roads/ km^2 of Sub-Region). Collectively, these VECs and indicators provide representation for the areas where Table 5.1-2 indicates that there may be potential Project effects on ecosystem health. For some indicators, representation is provided in the way that ecosystem linkages are expected to change a particular habitat or land type.

Table 5.1-5. Valued ecosystem components (VECs), other indicators of ecosystem health, measurable forms of indicators used in the terrestrial habitat assessment and ecosystem health issues represented.

VECs & Indicators (Cree and scientific names in brackets)	**Measurable Indicator** (see Section 5.1.4 for rationale)	**Issues Represented**
Dry jack pine forest (Oskahtik, Dry *Pinus banksiana* forest)	Amount and location of dry jack pine forest altered or lost.	Uncommon habitat type sensitive to fire regime.
Balsam fir (Napakasiht, *Abies balsamea*)	Amount and location of white spruce forest altered or lost. Amount and location of moderate and high quality white spruce habitat altered or lost.	Rare species and rare habitat, species with low reproductive capacity, species at outer limit of range, large long-lived species.
Dry ground cranberry (Wesakemina[1], *Vaccinium vitis-idaea*)	Amount and location of moderate and high quality habitat altered or lost.	Upland forest and peatland habitat; berry harvesting
Velvet-leaf blueberry (Ethinimina, *Vaccinium myrtilloides*)	Amount and location of moderate and high quality habitat altered or lost.	Open upland habitat and berry harvesting
Bog cranberry (Wesakemina[1], *Oxycoccus microcarpus*)	Amount and location of moderate and high quality habitat altered or lost.	Peatland habitat; berry harvesting
Sweet flag/ rat root (Wikhees, *Acorus americanus*)	Amount and location of moderate and high quality habitat altered or lost.	Shore zone habitat; harvesting.
Wild mint (Wikaskwah, *Mentha arvensis*)	Amount and location of moderate and high quality habitat altered or lost.	Shore zone habitat; harvesting.
Habitat type distribution	Amount and location of mainland, shore zone, lake peatland and mineral island habitat altered or lost by type.	Ecosystem diversity, high biodiversity habitat (e.g., mixedwood forest), rare and fragile habitat, rare tree species, wetland function, riparian conversion, air pollution increase, primary productivity, forest loss and vegetation biomass carbon.
Sensitive species (i.e., endangered, threatened or rare species)	Abundance and distribution where feasible; otherwise, amount and location of high quality habitat altered or lost.	
Land type[2] distribution	Amount and location altered or lost by type.	Wetland function, productive soil, site type conversion, ground and surface water flow, soil carbon.
Road density	Change in road length in Sub-Region area (km/ km^2).	Fragmentation, connectivity, genetic interchange, landscape flows

[1] Cree language does not differentiate between dry-ground cranberry and bog cranberry. [2] Land type refers to similar broad combinations of soil type, ground water, surface water and permafrost.

5.2 METHODS

5.2.1 Project Impact Areas

The Project impact areas used in the habitat effects assessment are shown in Figure 5.2-1. The Project impact areas contain the footprints of the Project features considered in the effects assessment.

5.2.2 Study Areas

Study areas for the terrestrial habitat (i.e., vegetation, soils and other interconnected environmental factors) assessment were selected to correspond to the various Project impact areas, Project effects areas and Project effects areas comparison areas following the rationale described in Section 5.1.4.

The mainland/ upland Project impact areas (Table 5.1-1) formed by the temporary or "permanent"[4] footprints created by the access road, borrow pits, borrow pit access roads and generating station are defined as the **Mainland/ Upland Project Areas** (Figure 5.2-2). Each project footprint is a separate Mainland/ Upland Project Area because the scope of related effects differs. The Generating Station Project Areas include the temporary construction areas and areas disturbed by noise, etc. during construction.

Different landscape areas were identified to capture the Landscape ZOI effects (Section 5.1.4.3.3) in Mainland/ Upland habitat. Landscape effects from the Access Road and Borrow Pit Project Areas were captured by the **1 km Upland Buffer** which is a 1 km buffer surrounding these Mainland/ Upland Project Areas (Figure 5.2-2; Table 5.2-1). A 1 km buffer was thought to be large enough to capture either all or a substantial portion of the home ranges of most of the directly affected individual mammals and birds (R. Berger pers. comm.).

[4] A "permanent" change is a habitat change that is present for the entire 100 year maximum prediction period used in the environmental impact statement.

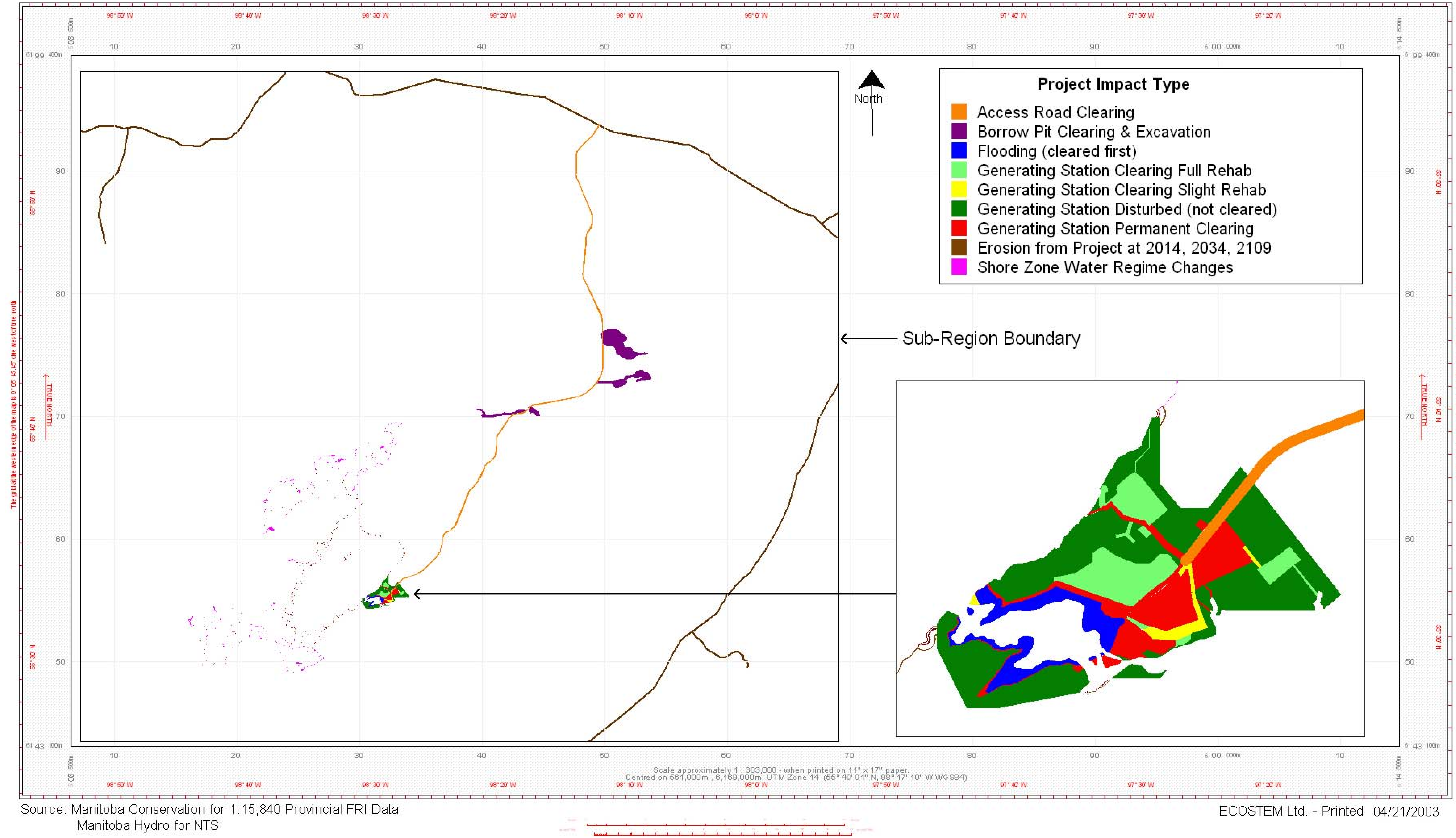


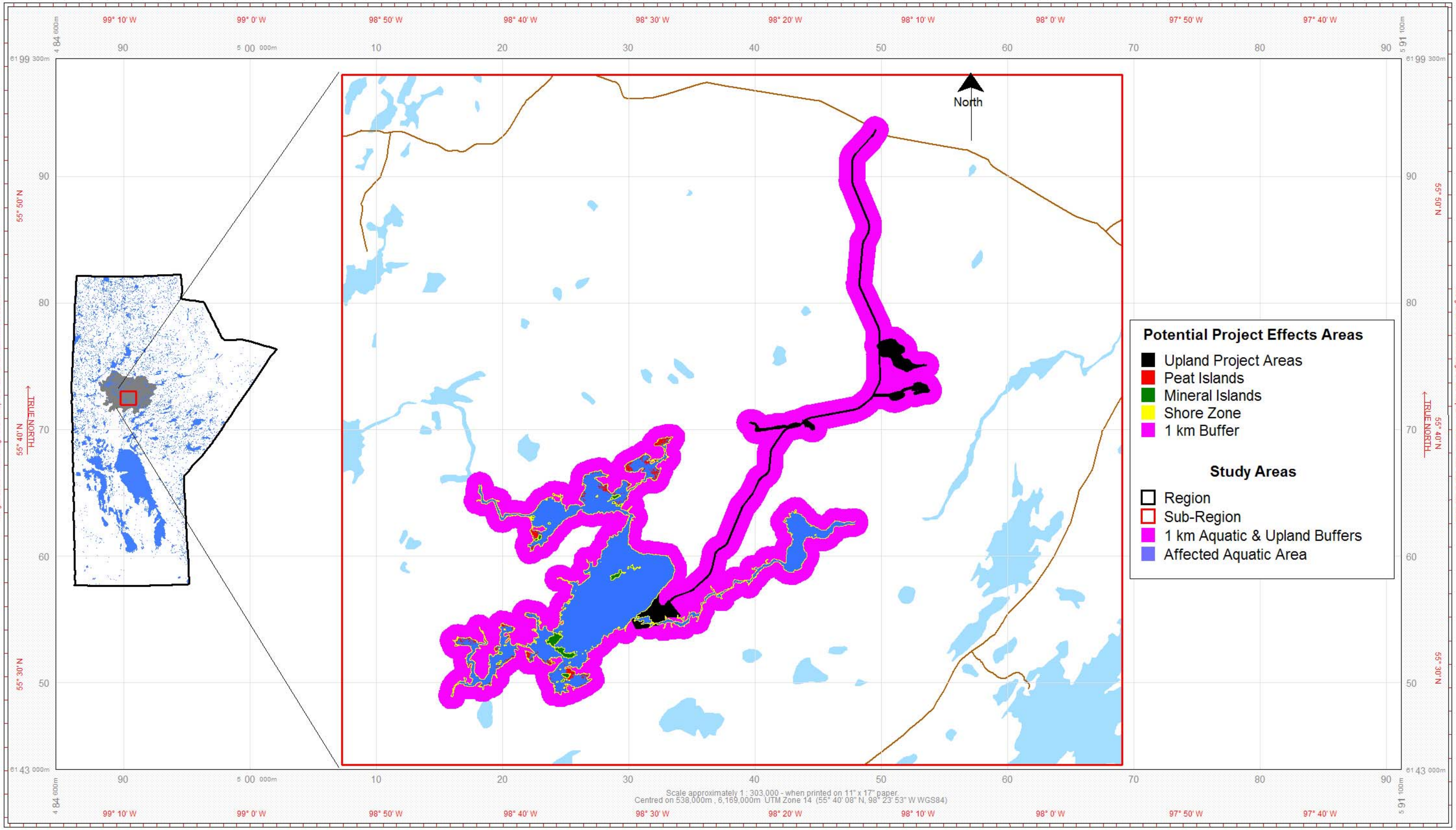
Figure 5.2-1. Areas cleared or physically altered during construction and/ or operation.

Note: Shore Zone water regime change and incremental project erosion impact areas appear spotty because the areas affected are small.

The ecological significance of Access Road and Borrow Pit Project Areas effects on VECs and other indicators of ecosystem health was assessed by comparing expected changes in the Project Areas to conditions in the 1 km Upland Buffer, the **Sub-Region** and the **Region** study areas (Section 5.1.3). The Sub-Region was thought to be large enough to capture the populations of most species that had affected individuals with home ranges confined to portions of the 1 km Upland Buffer. The Region was selected to be large enough to capture a relatively stable shifting mosaic of forest habitat types under the historic wildfire regime (ECOSTEM unpubl. results). The analysis was based on a combination of data sources including Soil Landscapes of Canada, Watersheds of Canada, National Topographic Survey and the FRI.

Table 5.2-1. Impact, effects and comparison study areas.
See Table 5.1-1 for definitions of major habitat types and Section 5.1.4 for the rationale for study areas used for effects and comparisons.

Impact Area	Effects Or Comparison Study Areas
Mainland/ Upland Project Areas Includes generating station area, access road, borrow pits and borrow pit access road Project impact areas.	1 km Upland Buffer for access road and borrow pits; 1 km Aquatic Buffer for generating station and erosion. Sub-Region; Region.
Affected Aquatic Area Aquatic habitat areas affected by the proposed water regime. See aquatic section for description.	See Aquatic volume.
Shore Zone Shore habitat found along the Affected Aquatic Area shoreline.	Current conditions in Affected Aquatic Area; Unregulated lakes nearby.
Mineral Islands	Current conditions in Affected Aquatic Area; Unregulated lakes nearby.
Peat Islands	Current conditions in Affected Aquatic Area; Historic conditions in Affected Aquatic Area; Unregulated lakes nearby.



Sources: Manitoba Conservation- 1:15,840 FRI
Manitoba Hydro- NTS data

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Figure 5.2-2. Terrestrial habitat impact, effects and comparison study areas. The impact areas are the Upland Project Areas and the Affected Aquatic Area. The potential effects areas are the 1 km Upland Buffer, 1 km Aquatic Buffer, Shore Zone, Mineral Islands and Peat Islands. Comparison areas are the 1 km Upland Buffer, 1 km Aquatic Buffer, Sub-Region and Region. Region is grey area in province key map.

Mainland/ Upland landscape effects from the Generating Station Project Area, Project-related erosion and water regime changes were captured by the **1 km Aquatic Buffer** which is a 1 km buffer surrounding the **Affected Aquatic Area** (Figure 5.2-2). The **Affected Aquatic Area** is those portions of the Burntwood River and connected lakes that are expected to undergo Project-related changes in water regime (i.e., the frequency distribution, seasonality or duration of water levels). The primary use of the 1 km Aquatic Buffer is to serve as one of the comparison areas used to assess the ecological significance of Project effects from the Generating Station Project Area and incremental erosion. Incremental erosion is erosion above what would occur without the Project. The **Sub-Region** and **Region** were the other comparison areas for Project effects (Section 5.1.4.3.3).

The Affected Aquatic Area is the study area for semi-aquatic habitat, that is, mineral island, lake peatland habitat and shore zone habitat (Table 5.1-1) that will be affected by the Project. **Mineral Islands** are simply those mineral islands located in the Affected Aquatic Area. The ecological significance of predicted changes to Mineral Islands was assessed by comparison with current conditions, the 1 km Aquatic Buffer and the Sub-Region.

Lake peatlands in the Affected Aquatic Area have been separated from the shoreline, reduced in area and fragmented by CRD. Today most lake peatlands are island remnants that are separated from the mainland edge by several metres at least (Figure 5.1-1). For this reason, the lake peatlands in the Affected Aquatic Area are called **Peat Islands.** Predicted changes to Peat Islands were compared to current conditions, historic conditions and to unregulated lakes nearby.

The band of shore habitat (Table 5.1-1; Figure 5.1-1) found along the Affected Aquatic Area shoreline is the **Shore Zone** study area (Figure 5.2-2). This is the terrestrial habitat that can experience daily fluctuations in surface water levels. A description of the rationale used to choose the upper and lower elevation limits of the Shore Zone band is provided in Section 5.2.4.1.2. The ecological significance of predicted Project effects on Shore Zone habitat was assessed by comparing predicted changes to current conditions and to conditions in nearby unregulated lakes.

5.2.3 Information Sources Other Than EIS Studies

5.2.3.1 Traditional Knowledge

There is a wealth of traditional knowledge and a history of the use of plants among the Nisichawayasihk Cree Nation (NCN). NCN's traditional knowledge comes from their larger experience gained in traditional use areas and their Resource Management Area. The Sub-Region is contained within these larger areas.

Some of the NCN members' traditional knowledge was passed on to the terrestrial specialists through interviews with Elders and Resource Users by NCN Community Consultants in Nelson House (Traditional Knowledge Pilot Project Interview Results), the 2000-2001 Resource Harvest Calendar and informal conversations at community open houses and with NCN field assistants. Traditional knowledge from NCN members in Nelson House is also included in Aboriginal Plant Use in Canada's Northwest Boreal Forest (Marles et al. 2000). N. Tays, a co-author of that book and a resident of Nelson House, also gathered traditional knowledge about plants as a field team member in 2000 and 2001.

5.2.3.2 Other Studies

There has been limited prior scientific research on terrestrial habitat or plants in the Region, Sub-Region and 1 km Aquatic Buffer. No prior scientific research has been conducted in the 1 km Upland Buffer or the terrestrial habitat of the Affected Aquatic Area. Studies that have sample sites in the Sub-Region include:

- Boreal Ecosystem-Atmosphere Study (BOREAS);
- Boreal Forest Transect Study (Price and Apps 1995);
- Acid Rain National Early Warning System (ARNEWS);
- International Biological Program (IBP) Survey;
- Manitoba Conservation forest health monitoring and growth and yield plots;
- Tolko Industries Ltd. forest plots;
- Bio-physical land inventory of the Churchill-Nelson Rivers study area (Beke et al. 1973); and
- INCO.

The relevance of results from the above studies to the habitat effects assessment is limited due to the nature of the data collected, location of sample plots, sample intensity, spatial scale of the results and/ or availability of results. Results from some of the studies assisted with the interpretation of ecological relationships between habitat components (i.e., soils, hydrology, permafrost, vegetation and disturbance).

The Manitoba Conservation Data Centre (CDC) has amalgamated verifiable records of vascular plant specimens from many reliable sources. CDC data were used for the rare plant component of the habitat effects assessment.

The biophysical land inventory completed by Beke et al. (1973) includes portions of the Region and Sub-Region. This inventory includes descriptions of typical surface deposits, soils, vegetation and associations between surface deposits, soils, topography and vegetation. This document provided valuable information during the design of the sampling program and in the interpretation of results.

Volume 7 Appendix 5-3 provides descriptions of the remaining studies listed above.

5.2.4 EIS Studies

5.2.4.1 Existing Environment

This section describes the methods and studies used in the habitat and plants effects assessment.

Different approaches were used to map and sample the mainland/ upland and the Affected Aquatic Area (i.e., shore zone, lake peatland/ peat island, mineral island) habitat types due to the differences in available map information and the nature of Project impacts and potential effects.

5.2.4.1.1 Mainland/ Upland Habitat

Background

A hierarchical approach was used to map mainland/ upland ecosystem units using the rationale described in Section 5.1.4. The hierarchy is Region, Sub-Region, landscape, broad habitat type (i.e., landscape element), fine habitat type, site and organism ecosystem (Section 5.1.3). To the extent feasible given available information, ecological units at each scale of the hierarchy were mapped as combinations of similar soils, surface water, ground water, vegetation, vegetation age and disturbance regime. Map categories reflected a level of detail appropriate for the spatial scale. Combinations of similar soils, surface water and ground water are the land type component of the ecosystem/ habitat. Land type provides the substrate, nutrients and water for most terrestrial vascular plants and is, therefore, the foundation for understanding existing relationships between vegetation, soils and disturbance and for predicting potential Project effects.

Fine habitat was the most detailed scale for which maps were developed. The fine habitat scale represented the best balance between sufficient detail for all of the terrestrial specialists and reasonable effort given the anticipated nature and magnitude of Project effects. Generalizations for the site and organism ecosystem scales were developed from field data, literature reviews and expert opinion. Maps for the broad habitat, landscape, Sub-Region and Region scales were created by combining similar fine habitat polygons into larger polygons representing more general categories.

Land Type

Fine Habitat To Region Scale Maps

Surface materials and soils maps are the foundation for developing maps for the land type component of habitat. Existing surface material information consisted of a 1:250,000 digital map completed (Velduis unpubl. data) for a portion of the Sub-Region (Figure 5.2-3). This map provided sufficient detail for mapping land types at a level of detail appropriate for a spatial scale between the Sub-Region and Region. A GIS was used to group polygons into twenty types based on texture, relief and depth to bedrock classes based on primary and secondary surface material type.

More detailed surface materials and soils maps were available for portions of the Sub-Region. J D Mollard and Associates (Mollard unpubl. data) and Manitoba Hydro (Bukowsky 2002) provided 1:20,000 maps for a portion of the 1 km Upland Buffer (completed for the purpose of locating the access roads and borrow pits). Surface material complex types were mapped for the 1 km Aquatic Buffer by ECOSTEM based on 1:20,000 aerial photography flown in 1985, field sampling and aerial surveys (preliminary polygons provided Resource Analysis Surveys based on photo-interpretation). Ground-truthing of these data was concentrated within 200 m of the shoreline since this is where most water-related impacts were expected to occur based on soil sampling (see below).

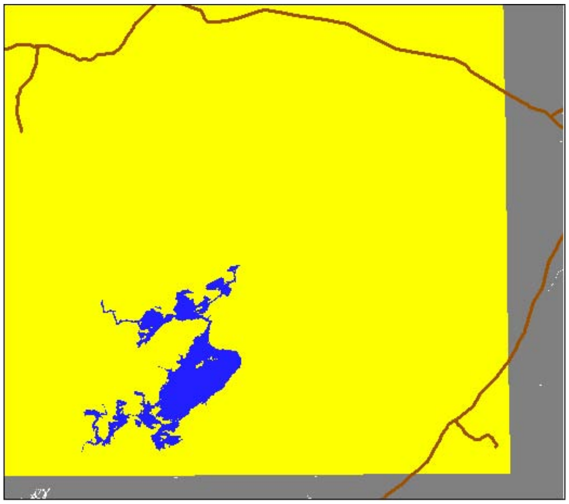


Figure 5.2-3. Portion of Sub-Region covered by 1:250,000 surface material map (Veldhuis unpubl. data) Sub-Region in grey; surface materials area in yellow.

Given the limited coverage of existing detailed surface material mapping, the land type component of habitat was mapped using the digital Manitoba Forest Resource Inventory (FRI). The FRI available for the Region was completed by Manitoba Conservation Forestry Branch using 1:15,840 aerial stereo-photos. Even though the FRI provides limited land type information, it was selected as the database used to map all habitat type components since it is the only source of existing land cover and vegetation information available at the fine habitat level of detail for all of the spatial scales used in the habitat effects assessment. The reliability of the FRI was assessed where it was used as a surrogate for a component of habitat.

The reliability of the FRI to provide a meaningful land type mapping was assessed by comparing FRI cover types with the field validated mapping of surface material complex types in the 1 km Aquatic Buffer (ECOSTEM unpubl. data and results). Surface material complex type is a grouping of surface material types that commonly occur together as mosaics at a scale of 1:20,000 (e.g., peat plateau bog and horizontal collapse fen) or toposequences (lacustrine clay blanket, veneer bog, peat plateau bog). A surface material complex type in the 1 km Aquatic Buffer map is roughly equivalent to the land type component at the landscape spatial scale and is therefore at a much coarser spatial scale than the fine habitat types of the FRI.

There was a good correspondence between FRI land cover type and surface material complex type in the 1 km Aquatic Buffer (ECOSTEM unpubl. data and results). These results suggested that the main difficulties with using the current FRI to map land types are that the FRI information is too coarse to map wetland types and mineral versus organic soil at the fine habitat scale. Ideally, the land type component of a fine habitat type map would include modal soil type (mineral versus organic), soil texture, depth to bedrock, depth to water table, permafrost presence, moisture regime and drainage regime. In the FRI database, there is only a basic separation of mineral from organic soils; peatlands are not even subdivided into bogs and fens. These broad soil classes were inferred using various combinations of FRI variables. For example, patches with black spruce forest growing on site class 3 were mapped as peatland.

Overall, the comparison conducted for the 1 km Aquatic Buffer suggested that the FRI provides an adequate mapping of broad but not fine land types. The level of effort required to complete a more detailed field mapping or photo-interpretation of fine land types was not deemed reasonable given the anticipated scope of Project effects. Consequently, broad habitat was the finest possible scale land type mapping feasible for all spatial scales/ study areas.

The FRI was used to create broad land type (Table 5.2-2) maps for all of the study areas. The combinations of FRI variables used to identify the locations of broad land type classes are provided in Table 5.2-2. Most peatland with black spruce forest growing on it is expected to be bog, while most peatland with tamarack forest is expected to be fen. This added step was not taken in the land type mapping due to the lack of widely distributed sample plots outside of the 1 km buffers. More detailed mapping was only completed for the 1 km Aquatic Buffer and portions of the 1 km Upland Buffer.

Other information was used to supplement the information provided by the FRI-based land type maps. In addition to those sources already mentioned above, regional surface materials and soils descriptions were summarized from the Soil Landscapes of Canada data (ECOSTEM unpubl. data and results). Topographical information for the Sub-Region and 1 km Upland and Aquatic Buffers was derived from 1:50,000 National Topographic Survey (NTS) datasets provided by Manitoba Hydro. Smith et al. (1998) provided general descriptions of bio-physical conditions.

Table 5.2-2. Broad land types as derived from FRI cover type.

Broad Land Type	FRI Cover Types Included
Exposed bedrock	Bare or sparsely treed bedrock
Dry mineral soil	Forest with jack pine or birch as primary species on site class 2[1]
	Forest with black spruce as primary species on site class 3
	Forest with aspen as primary species on site classes 2 or 3
Mineral soil	All forest types not included in dry mineral, peaty mineral or peatland land types
Peaty mineral soil	Forest with black spruce and/ or tamarack comprising more than 70% of the overstorey on site class 1
Peatland	Forest with black spruce and/ or tamarack as primary species on site class 2
	Sparsely treed muskeg
Frozen peatland	Taiga (Northern transition forest)
Wet bog	Muskeg and string bogs
Wetland	Wet soils with tall shrubs
Fen with patches of water	Beaver floods
Fluctuating water	Mud/ salt flats
Shallow water	Marsh
Islands	Small islands (less than 2 ha)
Lake	Lakes
River	Rivers
Agriculture	Hayland, clearing, abandoned cultivated land, moist prairie and wet meadow
Human	Protection forest, recreation, human features (e.g., towns, roads), gravel pits, dugouts
Other	Precipitous slopes/ fragile sites

[1] The precise description of site class varies by tree species. Site class 1 represents the best growing conditions for the species, site class 2 the second best and site class 3 the worst.

Site Scale Field Sampling

Information for the site and organism ecosystem scales was provided by field data collected in 2000 and 2001. Sampling in 2000 consisted of a soils and vegetation pilot study. The soils component of the pilot study included samples located along transects and at spot locations selected during boat or aerial surveys. In 2000, transects were located to represent broad combinations of FRI vegetation type and the preliminary surface material complex mapping (Resource Analysis Surveys 2000). Soils were sampled in 1 m soil pits, 30 cm deep spade holes (i.e. pencil pits) and auger holes. This fieldwork revealed that mainland peatlands along the shoreline were much less abundant than expected based on photo-interpretation.

Findings from the soil and vegetation pilot study conducted in 2000 were used to develop an integrated soils and vegetation sampling design for 2001. In 2001, sample transects were located in those portions of the 1 km Aquatic Buffer that were likely to be affected by the proposed water regime (Figure 5.2-6). At most sample locations, two replicate transects were randomly located along the shoreline within the same habitat patch. Sample transects passed through the Shore Zone and into the first 150 m of the mainland (may be upland or peatland). Sample plots were placed at strategic locations along each transect. Two mainland plots were located along each transect at the upper edge of the Shore Zone ("mainland edge" plot) and at a random distance between 50 and 150 m from the mainland edge ("mainland interior" plot). Most soil pits in 2001 were dug on the mainland side of the mainland edge. In this field study, site scale soils data for the Mainland/ Upland Project Areas were only collected at the mainland edge in the Generating Station Project Area. Others collected soil data in the Access Road Project Area.

Over the two sample years, 58 soil pits were dug along 46 transects in 35 different general locations in the 1 km Aquatic Buffer plots (Figure 5.2-4). Soils information collected included ecosite type, depth of LFH layer, depth of surface organic layer, depth to bedrock, humus form, depth to prominent mottling, depth to gleying, depth to water table, drainage regime, moisture regime, mode of surface deposition, rooting depth and soil profile description. In the soil profile description, information included for each horizon was horizon name, thickness, texture percent stoniness, structure (grade, class, kind) and color (not for all horizons). The overall soil patterns portrayed by the soil pits were validated with numerous pencil pits and auger holes along these transects and at other locations identified during boat and aerial surveys.

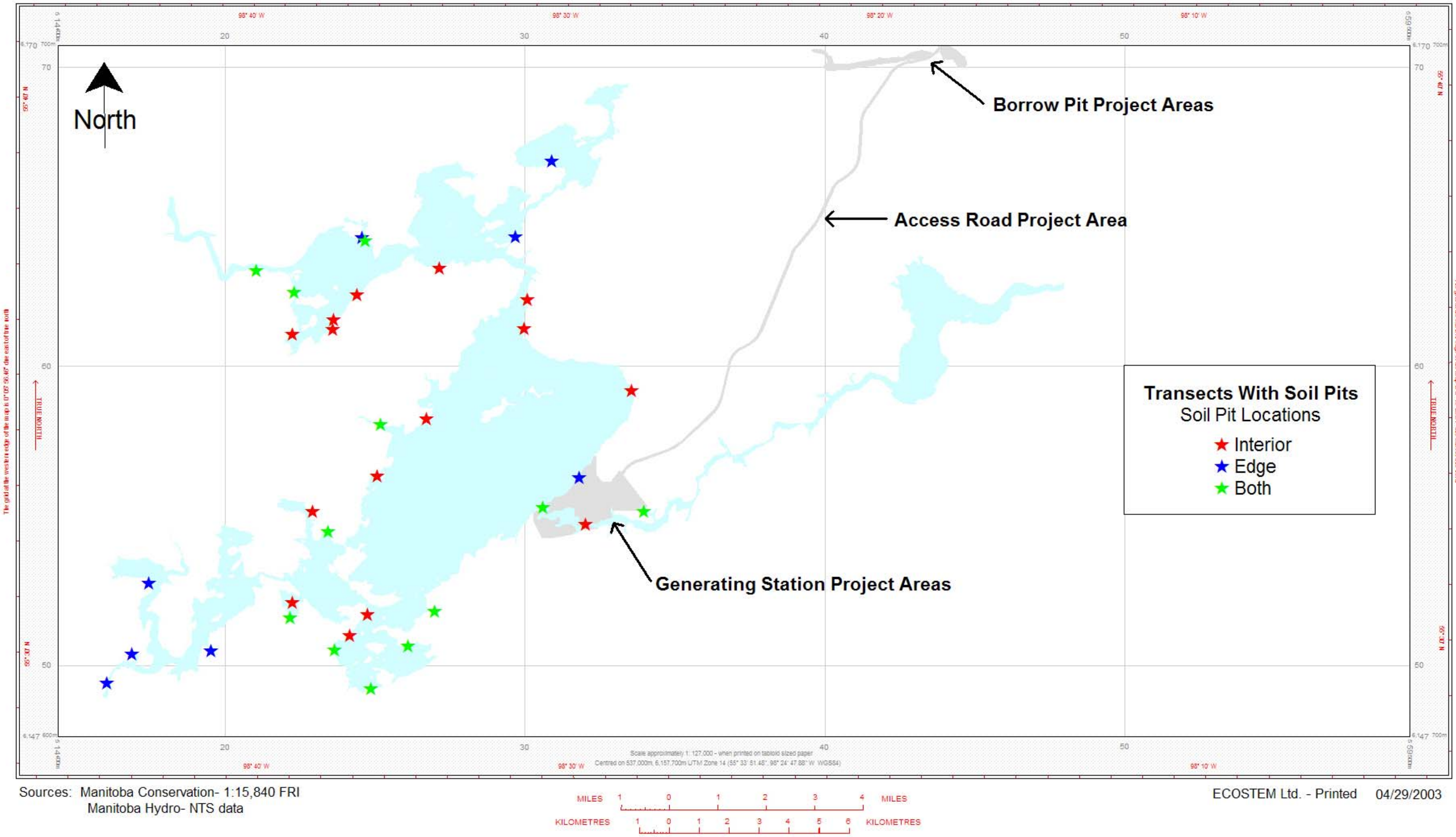


Figure 5.2-4. General locations of soil pits in 2000 and 2001. "Interior" indicates that the pit was at least 50 m from the Shore Zone; "Edge" indicates that the pit was within 5 m of the Shore Zone; "Both" indicates that pits were dug at both locations.

Vegetation

Fine Habitat To Region Scale Maps

The vegetation component of habitat was mapped from the FRI for all spatial scales/ study areas above the site. The FRI is an excellent database for mapping fine forest types, fine open vegetation types growing on dry sites and broad non-forested wetland vegetation types. The main disadvantage with using the FRI for mapping the vegetation component of habitat is that the photography is somewhat out of date (flown between 1985, 1989 and 1991, depending on area). To address this concern, the attributes of the forested land cover types located in the 1 km Buffers were updated during the summers of 2000 and 2001 (Plus4 Consulting unpubl. data). These field updates revealed that most changes to the FRI involved a slight aging of the forest and/ or the typical changes in forest cover type that result from succession (e.g., jack pine dominated to jack pine and black spruce mixture; J. Dyck pers. comm.). These were considered minor drawbacks given the high potential for the FRI to provide detailed information at all of the spatial scales used in the terrestrial effects assessment.

Appendix 5.10 lists the 14 broad and 86 fine vegetation types used in the habitat mapping. The broad vegetation types were used for most descriptions, while the fine vegetation types were primarily used to identify uncommon or rare types and in the development of habitat models for the VECs.

Site Scale Field Sampling

Detail for the site and organism ecosystem scales was provided by field data collected in vegetation plots. As noted above, a pilot study was conducted in 2000. The vegetation component of the pilot study consisted of a reconnaissance survey in the Upland Project Areas and the Shore Zone. Percent cover was estimated in 177 quadrats (1 x 1 m) spaced at 20 m intervals along the 32 transects established in 2000 (see Appendix 0 for locations and number of vegetation samples). The Project botanist also walked through areas that had high potential for rare plants or unusual vegetation types.

In 2001, the vegetation component of the integrated sampling design included two 6 x 15 m plots located in the mainland edge and interior (see previous sub-section). Plots were placed with the long side parallel to the shoreline. Presence/ absence data were collected in fifteen 0.5 x 1 m quadrats centered on the grid points formed by evenly subdividing the 6 x 15 m plot. Trees and snags were counted in the entire plot by species and diameter class. To be counted as a tree, a tree species stem had to be at least 1.3 m tall. A snag was a dead tree that was leaning less than 45 ° from vertical. Tree and snag diameter classes were 0-5 cm, 5-15 cm, 15-25 cm and > 25cm. A soil pit was located in the Mainland Edge Zone beside the Mainland Edge plot at a subset of the water depth transects sampled in 2001. Pencil pits and auger holes were dug at numerous other plots and locations in the Shore Zone. Plots occurring in forest vegetation were classified into a Manitoba Forest Ecosystem Classification Vegetation Types (FEC V-Types). A total of 63 edge and interior plots were sampled in the 1 km Aquatic Buffer and on treed Peat Island (Figure 5.2-6; see Appendix 0 for locations and number of vegetation samples). Walk-through surveys were also conducted to confirm that the sampled mainland plots were representative and to locate rare plants and vegetation types. Section 5.2.4.1.3 further describes rare plant survey methods.

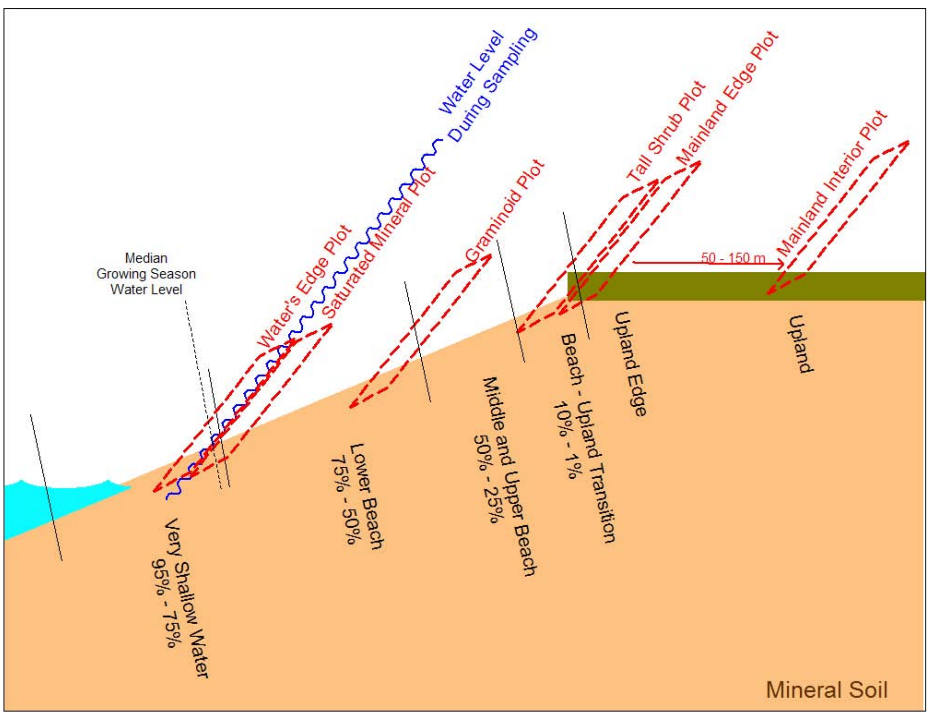


Figure 5.2-5. Locations of vegetation sample plots along the mainland and water depth transects.

NCN members recording snag data.

All plants growing inside the quadrat in this interior forest plot are identified and recorded.

Vegetation in the Access Road and Borrow Pit Upland Project Areas was sampled with walk-throughs. Walk-throughs were the only form of sampling in these Project Areas because the final routing was not determined until after the growing season was over.

A combination of descriptive statistics, ANOVA, ordination and clustering techniques were used to analyze the vegetation data (ECOSTEM unpubl. data and results). Results from these analyses were used to characterize: (1) mainland edge and interior plots by site type; and (2) forest vegetation composition for the most common Manitoba Forest Ecosystem Classification system vegetation types (FEC V-Types). Most of the results focus on forest habitat since this was where most of the mainland plots occurred. Results from the FEC V-Type characterizations were used to develop descriptions for the most common broad habitat types.

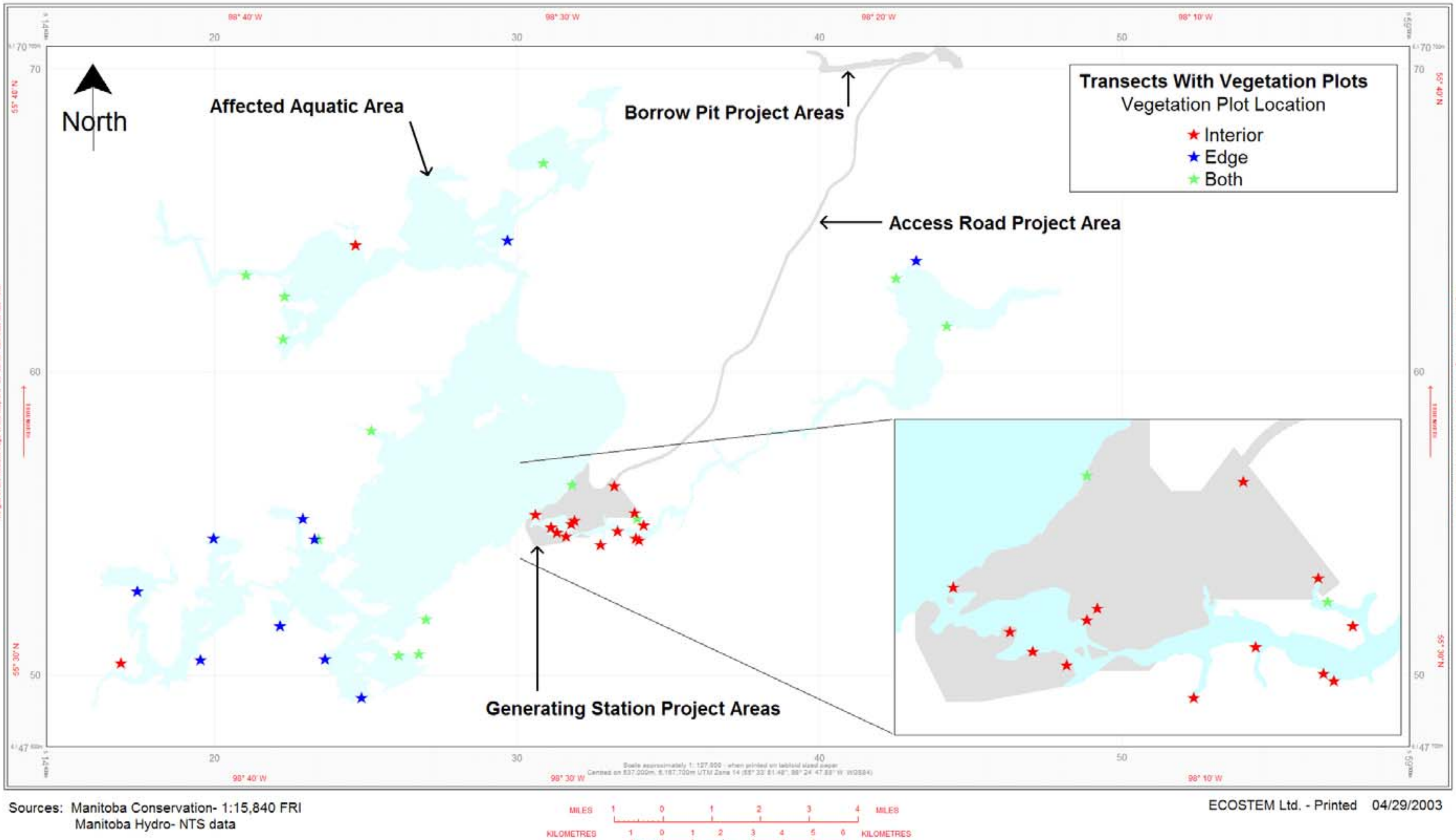


Figure 5.2-6. General locations of 2001 vegetation transects. See Figure 5.2-4 for transects with soil samples.

Disturbance Regimes

Fine Habitat To Region Scale Maps

Upland habitat has been produced primarily by two different wildfire disturbance regimes (Ehnes 2000; ECOSTEM unpubl. data and results for Region) and modified to a minor degree by other types of disturbances including various human activities. There are no detailed fire history studies for the Sub-Region. Research from elsewhere in the Manitoba boreal forest suggests that some wetlands found in the upland habitat area probably only experience large wildfires infrequently depending on the wetland type and size (Ehnes 2000). Available fire history information (Figure 5.2-7), satellite imagery and the FRI indicate that most upland habitat is exposed to frequent, large wildfires (ECOSTEM unpubl. data and results). Unfortunately, there is not enough fire history information available to classify wetlands into different types based on different wildfire regimes. Therefore, a single wildfire disturbance regime was used for all mainland/ upland habitat.

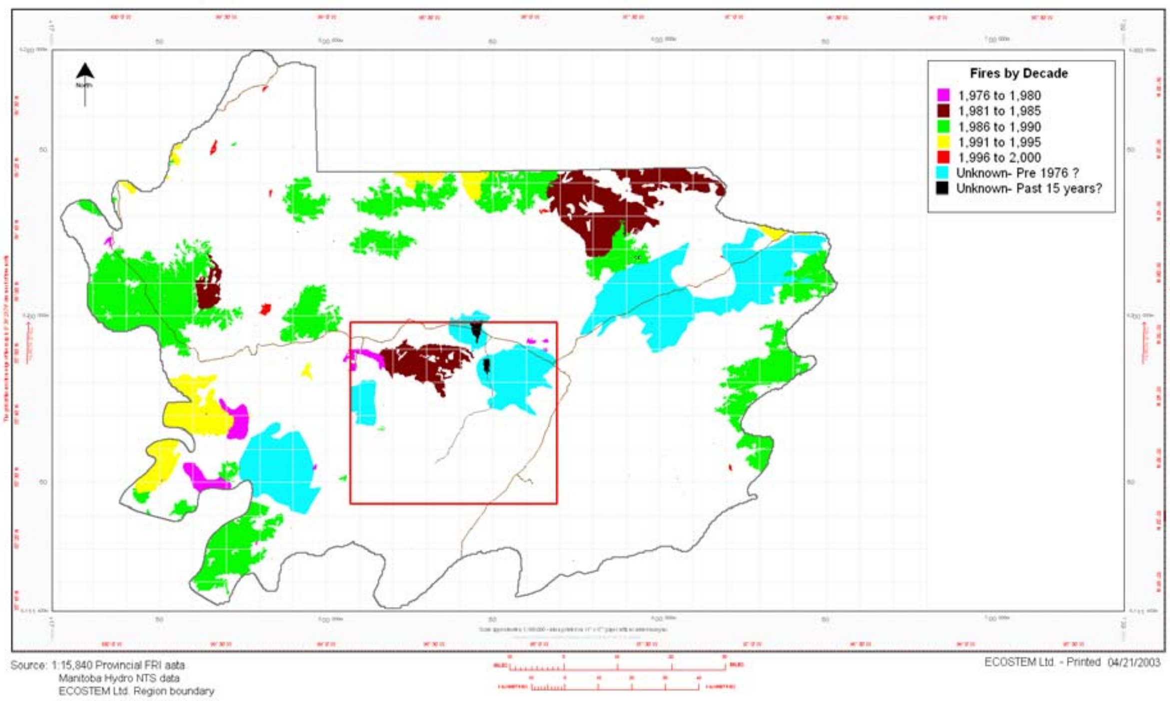


Figure 5.2-7. Recent fire history in Region.

Age

Fine Habitat To Region Scale Maps

Age classes in the habitat classification (Table 5.2-3) were derived from FRI cutting class. Although age is now incorporated into new forest inventories, only a small percentage of forest stands in the FRI available for the Region or Sub-Region have had an age update. Cutting class, which is actually a measure of forest stand height, is the only age indicator in the FRI.

The reliability of FRI cutting class as an indicator of forest age was assessed by comparing the Region's cutting class map with fire history information, satellite imagery and field information. This comparison indicated that the FRI was a fairly reliable indicator of recently disturbed and young forest (ECOSTEM unpubl. data and results). The information required to assess the reliability of the remaining cutting classes as indicators of age class in the Region was not available. Nevertheless, there are some data that provide broad relationships. Manitoba Conservation Forestry Branch has published age class ranges for cutting class (Appendix Table 5.10-2). Also, field experience in eastern Manitoba suggests that cutting class is a fairly reliable indicator of age class with two exceptions: peatlands and old upland forest. Stand height can be a poor indicator of age on peatlands where nutrient availability retards tree growth. This exception is somewhat addressed in the Forestry Branch age/ cutting class table by providing age class ranges by site class for black spruce and tamarack (Appendix Table 5.10-2). In eastern Manitoba (i.e., FML # 1), a comparison of the area in "overmature" forest with fire history maps and field experience suggested that the "overmature" cutting class was generally a good indicator of the locations of old upland forest for this area (Ehnes 2001). Since vegetation age receives the lowest emphasis in the habitat effects assessment, the degree of reliability provided by FRI cutting class was considered adequate.

Table 5.2-3. Age classes used in the habitat classification.

FRI Cutting Class	Cutting Class Description	Age Class
0	Recent disturbance (Forest land not restocked after disturbance)	Recently disturbed
1	Average height of the stand < 3 m	New
2	Average height of the stand >= 3 m and <= 10 m	Young
3	Average height of the stand > 10 m and DBH > 9 cm	Immature
4	Mature stands	Mature
5	"Overmature" stands	Old

See Appendix 5.9.2 for age ranges in each cutting class by species.

Integration Of Habitat Components

A mainland/ upland habitat classification was created for Sub-Region by combining the vegetation type, land type and age class classifications derived from the FRI. This approach ultimately led to the use of fourteen land types, 37 broad habitat types and 113 fine habitat types for use in the habitat assessment (see Appendix 5.10 for broad and fine habitat types). Most study and project area descriptions use the broad habitat types. The fine habitat types were used to identify rare and uncommon types and as the basis of habitat modeling for the VECs. Very general descriptions of "land cover" for the various spatial scales/ study areas were provided by aggregating broad habitat types into more general classes.

5.2.4.1.2 Semi-Aquatic Habitat (i.e., Shore Zone, Peat Island and Mineral Island Habitat)

Background

At the site scale, special attention was focused on the Shore Zone and Peat Island habitats (Figure 5.2-2) since they meet critical needs for some species (e.g., muskrat, shore birds, waterfowl) and they are the terrestrial habitats that would be most affected by the proposed changes in water levels and fluctuations. An understanding of the relationships between vegetation and environmental factors in these habitats provides the foundation for developing habitat-use relationships for VECs and for predicting potential Project effects on soils, vegetation and VECs.

Water fluctuations are the dominant disturbance in the Shore Zone and Peat Island habitats. Water fluctuations as measured by the timing, length, seasonality and predictability of water elevations collectively define the water regime of a particular water body. In the Affected Aquatic Area (Figure 5.2-2), current and post-Project water regimes differ above the proposed generating station, in the Burntwood River downstream of the generating station and in Opegano Lake (water regimes are described below). The Affected Aquatic Area was subdivided into three major geographic zones that coincided with the three different water regimes. These geographic zones were used in the description of Shore Zone, Mineral Island and Peat Island habitat.

Water regime, light regime, erosion, sediment deposition, depth to bottom freezing, ice pressure, bottom slope, bottom shape and soil type are the most important influences on the locations and abundances of different wetland plant species (Hellsten 2000; Keddy 2000). These factors along with vegetation collectively define habitat for individual plants and animals.

Influences on vegetation can be grouped into three types of factors: lake, shore and site (Hellsten 2000). Placing major influences into these three groups provides a basis for developing an understanding of cross-scale linkages between organisms and ecological processes. Lake factors are those influences on vegetation that are similar throughout the entire lake. Water and light[5] regimes are the most important lake factors affecting all types of semi-aquatic habitat. Water regime indirectly creates two other important influences on vegetation: depth to bottom freezing and ice pressure on the bottom. Shore factors are influences that change in different parts of the lake and create different limitations on which species can occur and how abundant they are. Shore factors include broad classifications of wave action, bank erosion, turbidity, bottom slope, bottom shape and type of surface materials. Shore factors are the land type, ground water and disturbance regime components of broad habitat (Section 5.1.4). Site factors are the site scale versions of shore factors and are used to describe fine habitat. Site factors combine with adjacent mainland conditions and chance events to determine which species and vegetation types actually occur at a particular location.

The following sections describe:

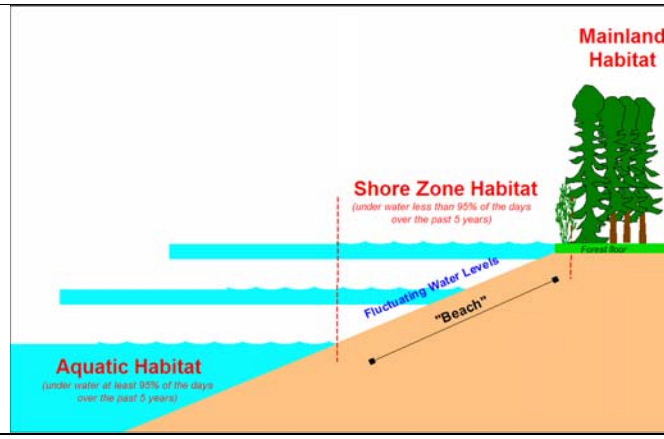
- the main ways that these environmental factors are interrelated and influence vegetation composition in the Shore Zone;
- how the water duration zone conceptual approach was used to understand ecological relationships; and,
- how the water duration zone conceptual approach was used to predict how the Project may affect Shore Zone Habitat along the mainland/ upland and Mineral Island shorelines.

<u>Water Regime</u>

Water regime is the most important influence on where different plant species are found within the Shore Zone (Hellsten 2000; Keddy 2000). At any given place along the shoreline, day to day water fluctuations create a band of habitat where the amount of lake bottom that is exposed or the amount of mainland habitat that is flooded constantly changes (i.e., the Shore Zone; Figure 5.2-8).

[5] Light regime in this context refers to underwater. Underwater light has little influence on the species included in the terrestrial component of the assessment so its consideration is left to the aquatic section of the environmental impact statement.

Figure 5.2-8. Band of habitat created by day to day and year to year fluctuations in water levels/ depths.



At any given place on the shoreline, Shore Zone plants arrange themselves into bands of different species primarily based on different tolerances to the duration of flooding (Hellsten 2000; Keddy 2000). Species that can only survive under water for a short period grow in the higher portion of the Shore Zone because it is rarely under water (e.g. tall shrubs). Species that cannot survive out of the water for very long grow on the lower elevations of the Shore Zone (e.g. pondweed). A common water depth species sequence in the Affected Aquatic Area Shore Zone (upland to shallow water) is black spruce, willow, Canada bluejoint grass, tall manna grass, woolgrass, water sedge, northern manna grass, mint, beggar's ticks and burreed (Figure 5.2-9).

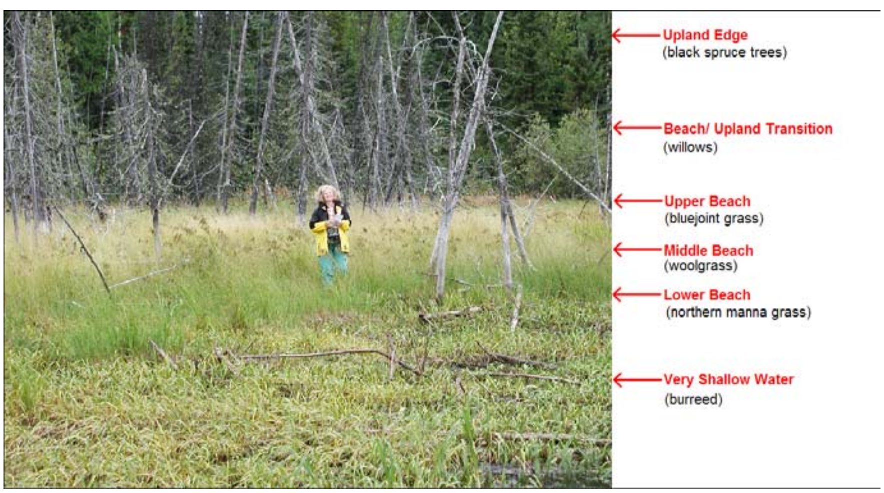


Figure 5.2-9. Vegetation bands in Shore Zone showing some common species and the associated water duration zones. Water level is unusually low in this photo. Very Shallow Water zone is usually under water.

Plant species distributions along the water depth gradient are best understood when related to growing season water depths over the past few years rather than water depth on the day of sampling (Rorslett 1984; Mark and Johnson 1985; Wilcox and Meeker 1991;

Hellsten 2000). Species distributions are related to growing season water depths (i.e., standardized water depths) using a lake's "inundation curve" (Hellsten 2000). An inundation curve is the result of plotting the percentage of days that water elevations were at a particular standardized water depth. A standardized water depth is the water elevation on a given day minus the 3–5 year median growing season water elevation. Figure 5.2-11 shows the inundation curve for Wuskwatim Lake between January 1, 1997 to December 31, 2001 (water level data provided by Manitoba Hydro).

One way to understand the inundation curve is to think of yourself standing at the waterline in the Shore Zone on May 15, 2001 when the water was at 233.40 m ASL. All of you except for the bottom of your feet would be out of the water. Now imagine that you had been standing in that spot every day from January 1, 1997 to December 31, 2001. On 10% of those days you would have been standing in water that was at least 71 cm deep. On 50% of those days you would have been standing in water that was at least 44 cm deep. Your feet were out of the water on 25% of those days and the water surface was at least 30 cm below your feet on 10% of those days. If you now imagine that you are a plant, the water duration zones indicate how long a plant must cope with various water depths over its life span. Only a small percentage of plants can survive at Shore Zone elevations that are under water more than 75% of the time.

Research elsewhere indicates that Shore Zone plant species distributions are best understood by dividing the inundation curve into sections called water duration zones (Hellsten 2000). Everyday language works well enough to name the water duration zones even though there are technical names for them (i.e., lower sub-littoral, upper sub-littoral, lower eu-littoral, middle eu-littoral, upper eu-littoral, supra-littoral). The water duration zones going from lowest to highest elevation are Shallow Water/ Aquatic, Very Shallow Water, Lower Beach, Middle Beach, Upper Beach, Beach/ Mainland Edge Transition and Mainland Edge (Figure 5.2-11; Figure 5.2-9). Table 5.2-4 summarizes water duration zones and associated standardized water depths, Wuskwatim Lake elevation ranges and characteristic types of species.

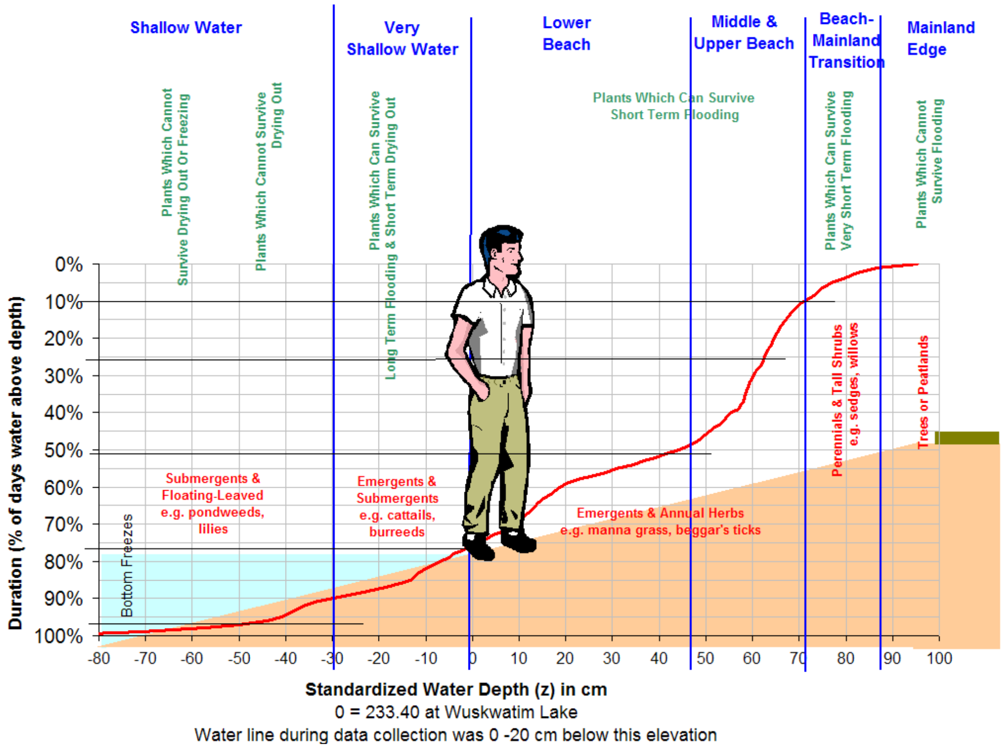


Figure 5.2-10. Water duration zones identified by distributions of different groups of plants.

The red line is the lake's inundation curve, an inverted cumulative frequency distribution of standardized water depths. The inundation curve is from Wuskwatim Lake. Median growing season water level occurs where z = 0. The lake's inundation curve shows the percentage of days over the past X years that each standardized water depth occurred. The water duration zones are identified using the methodology of Hellsten (2000).

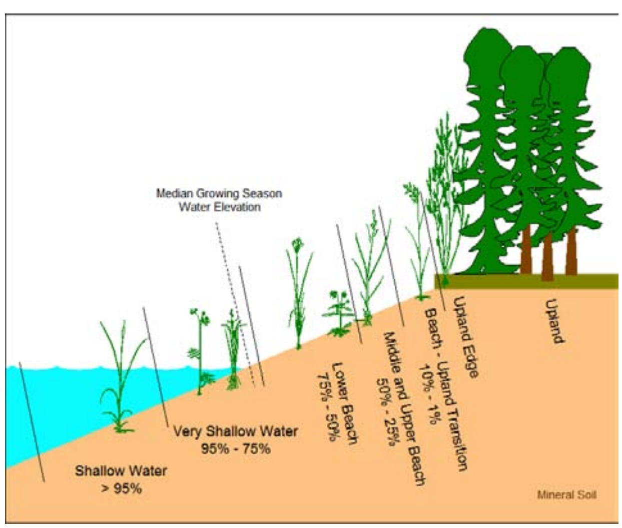


Figure 5.2-11. Water duration zones and types of plants found in them.

See Table 5.2-4 for definitions of zones and Figure 5.2-9 for an example shoreline stretch.

The width of the beach (i.e. the exposed organic or mineral substrate that is the lake bottom on some days) varies with water levels. The beach is at its widest when water levels are at their lowest elevation. Also, on any given day, the beach width is different at various places along the shoreline because the slope and shape of the lake bottom varies. A low slope area will have a much wider beach than a high slope area.

Shore Zone Of Mainland/ Upland and Mineral Island Habitat

Fine Habitat To Affected Aquatic Area Scale Maps

Shore Zone environmental factors and vegetation (i.e., the components of habitat) were mapped in several steps. First, a common shoreline was adopted for use in all of the aquatic and terrestrial environment analyses. An existing shoreline was available from the erosion analysis (J. D. Mollard and Associates unpubl. data), but portions of this shoreline were not suited for the terrestrial and aquatic effects assessments. The erosion analysis classified portions of the sheltered bays as non-eroding areas and, therefore, often uses the open water edge of Peat Island aggregations as the shoreline in these areas. The habitat shoreline in the sheltered bays follows the approximate edge of CRD effects on lake peatlands (Figure 5.2-2; see Volume 5 for description of methods used to create "standardized shoreline"). This was necessary to capture the Shore Zone habitat that occurs in these areas (Figure 5.1-1).

Preliminary Shore Zone environmental factor maps were created by adapting the shore material type, shore slope and bank height map data produced for the erosion modeling (Volume 4). The Mollard mapping had to be modified for the habitat analysis because some shore type and bank slope categories that are important for shore vegetation were not included in the Mollard maps because they are not important for erosion modeling.

The preliminary mapping of Shore Zone environmental factors was validated using a combination of aerial and boat surveys conducted in 2001 and 2002. Ground-truthing consisted of pencil pits and auger holes at numerous locations. The final mapping of shore factors was the basis for the Shore Zone land, ground water and disturbance types (i.e., environment types) for the Shore Zone habitat map.

Table 5.2-4. Water duration zones, associated water conditions and types of species found in each zone.

Water Duration Zone	Water Conditions	Elevation Range At Wuskwatim Lake (m ASL)	Typical Species
Shallow Water	Under water at least 95% of the time*.	< 232.99	Covered in aquatic section
Very Shallow Water	Under water more than 75% but less than 95% of the time. Bottom freezing occurs in most or all of this zone.	232.99 – 233.41	Plants which cannot tolerate desiccation but which can tolerate bottom freezing and ice pressure. Hydrophytes ("real" aquatic plants according to some authors)
Lower Beach	Under water more than 50% but less than 75% of the time	233.41 – 233.84	Plants which can tolerate alternating periods of inundation and desiccation during a season between years where the condition may persist for more than about 45 days. Tall emergents. Most are monocots. These species also expand their distribution into the higher portion of the Very Shallow Water when water levels drop for a prolonged period.
Middle & Upper Beach	Under water more than 10% but less than 50% of the time	233.84– 234.10	Plants which can tolerate alternating periods of inundation and desiccation during a season between years where the condition may persist for more than about 30 days. Tall to short emergents. Most are graminoids and ruderal herbs.
Beach/ Upland Transition	Under water more than 1% but less than 10% of the time	234.10 – 234.26	Plants which grow poorly in wet soil but can survive periodic short-term flooding. Graminoids, ruderal herbs, shrubs.
Mainland Edge- Mineral Soil	Under water less than 1% of the time & surface organic layer < 20 cm deep	> 234.26	Plants which will die if their roots are under water for extended periods during the growing season. Most woody plants, many herbs.
Mainland Edge- Peatland	Under water less than 1% of the time & surface organic layer >= 20 cm deep		Fen or bog plants. Substrate edge may be a floating or expandable mat which moves up and down with moderate water level fluctuations thereby protecting plant roots from submergence. Most woody plants, ericaceous plants, many herbs.

* All durations are based on a time period of several years at least.

Various aspects of Shore Zone vegetation were also mapped during the aerial and boat surveys. These features included beach vegetation type, presence of cattail (*Typha latifolia*) stands in the Very Shallow Water Zone (Table 5.2-4) and width of dead tree fringe at the forest edge. Dead trees at the mainland edge identify the areas most likely to experience tree die-off when water elevations are high.

Site Scale Field Sampling

Site scale information on Shore Zone vegetation was obtained from integrated soil and vegetation transects established in 2001. As described in Section 5.2.4.1.1, transects were located in areas that were likely to be affected by the proposed water regime (Figure 5.2-6). The Shore Zone portion of these transects sampled a water depth gradient. Transects were sited perpendicular to the shoreline starting in the Very Shallow Water water duration zone extending through the Beach zones onto the Mainland Edge and then into the mainland interior.

Plots were placed at strategic locations along the water depth transects. Plots could not be placed in specific water duration zones during sampling because historical water level data did not become available until after the field work was completed. Plots were located at the following conditions along the water depth transects: in the water at the water's edge, on the saturated mineral or organic soil immediately above the water's edge, in the dense grass and sedge band, in the tall shrub band and on the mainland edge (Figure 5.2-5). Not all conditions were present at every transect.

Each plot along the transect was 6 x 15 m with the long side parallel to the water's edge. Presence/ absence data were collected in fifteen 0.5 x 1 m quadrats centered on the grid points formed by an even subdivision of the 6 x 15 m plot. Trees and snags within the plot were counted by species and diameter class. To be counted as a tree, a tree species stem had to be at least 1.3 m tall. A snag was a dead tree that was leaning less than 45 ° from vertical. Tree and snag diameter classes were 0-5 cm, 5-15 cm, 15-25 cm and > 25cm. A soil pit was located in the Mainland Edge Zone beside the Mainland Edge plot at a subset of the water depth transects sampled in 2001. Pencil pits and auger holes were dug at numerous other plots and locations in the Shore Zone.

Table 5.2-5. Plot types and their locations along the water depth gradient. See **Figure 5.2-5** also.

Plot Type	Location	Potential Water Duration Zones
Water's Edge	In the water at the water's edge.	Very Shallow Water
Saturated Mineral	On the saturated mineral or organic soil immediately above the water's edge.	Lower Beach
Graminoid	In the dense graminoid band.	Middle to Upper Beach
Tall Shrub	In the tall shrub band.	Upper Beach or Beach/ Mainland Edge Transition
Mainland Edge	On the mainland edge. Can be either forest or peatland.	Mainland Edge
Mainland Interior	Random distance between 50 and 150 m from Mainland Edge	None

Once the historical water level data became available it was clear that some of the plot locations on the water depth transects coincided with particular water duration zones (Figure 5.2-5). The water line during field sampling was between 233.2 and 233.4 m ASL, which is from 0 to 20 cm below the median growing season water level of 233.40 m ASL (Figure 5.2-10). The Water's Edge, Saturated Mineral and Mainland Edge plots were in the Very Shallow Water, Lower Beach and Mainland Edge water duration zones, respectively (Table 5.2-5).

Species distributions were assessed based on the percentage of plots in which a species occurred. Species abundance was measured as the mean number of quadrats per plot that a species occurred in. Species distributions and abundances were identified and related to the water duration zones and shore factors using descriptive statistics, cross-tabulations, TWINSPAN and detrended correspondence analysis. ANOVA was used to test for the statistical significance of differences in means. The SPSS and PC-ORD software packages were used to complete the data analyses.

Data analysis identified the most common sequences of vegetation bands and associated environmental conditions. Shore Zone broad habitat types were created by combining the Shore Zone environment types with the most common sequences of vegetation bands.

Mammal and bird specialists desired an estimate of the change in beach vegetation area by vegetation type. This requires a measure of beach width as well as shoreline length. The actual width of the beach at any given water level varies considerably around the lake depending on the local slope and shape of the lake bottom as well as the water level.

Precise estimates of zone widths require field measurements of beach slope and shape. The horizontal width of each duration zone was estimated using shoreline length and slope. Beach slopes were not measured in the field. Beach slope was visually estimated into broad classes during the mapping of shore material types (Table 5.3-7). These observations suggested that beach slopes in the protected bays where most of the vegetated beaches are found range between 2% and 12% with a median above the midpoint. The horizontal width of each duration zone was estimated assuming that on average slopes are 8% and flat. Note that this should be interpreted as a qualitative estimate of beach width, which provides an order-of-magnitude estimate of the relative impact of the proposed water regime on Shore Zone area. Changing the average slope affects the absolute zone widths but not the relative change in pre- versus post- project beach width.

Peat Islands

Peat Island locations, boundaries and dominant vegetation cover in 2001 were mapped using a combination of 1998 digital orthophotos (1:60,000 scale), aerial surveys conducted in September 2001 and June 2002, photos from the 2001 aerial survey and field notes from boat surveys. Peat Island boundaries were initially digitized from the 1998 orthophotos and then modified as required based on field information. Changes in island location or presence between 1998 and 2001 were identified as an attribute in the spatial database. Only major changes were recorded due to the large number of small islands.

Peat Island soils were sampled with auger holes and soil pits. Numerous Peat Islands were augered to determine minimum peat depth and whether they were floating or anchored. Soil pits were dug and profiles described on three treed peat islands.

Peat Island vegetation was sampled in vegetation plots on three treed peat islands, foot reconnaissance and boat reconnaissance.

5.2.4.1.3 Habitat and Plant VECs

VEC distribution and abundance was described using a combination of the fine habitat to Region scale GIS map data and site scale field data. Univariate and multivariate statistics were used to develop habitat relationships for each VEC using these data. The ways that terrestrial habitat and plant VECs have been incorporated into the effects assessment are summarized in Table 5.1-2 and Table 5.1-5.

Simple habitat models were developed for the VECs. More complex models were not feasible given the amount of field data. Models for VECs where a census was available (e.g., dry jack pine forest) were based on relationships between vegetation and environmental factors such as land type, topography and disturbance regime.

5.2.4.1.4 Sensitive Plants

Species are sensitive to human developments and activities for a number of reasons. Following the guidance provided by the federal guide to biodiversity assessment (FEARO 1996), the terrestrial habitat effects assessment specifically addresses species that are endangered, threatened, provincially rare or uncommon, regionally rare or uncommon, near a range limit in the province or have low reproductive potential. This group of species is referred to as "sensitive plants". The ways that sensitive plants have been incorporated into the effects assessment are summarized in Table 5.1-2 and Table 5.1-5.

Endangered or threatened species were those included in the federal and provincial lists. Plant species with populations that are in danger of extinction or extirpation are provided protection federally through the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) or provincially through the Endangered Species Act. In the provincial and federal legislation, species are classified as endangered or threatened, depending on the likelihood that they will be lost if no action is taken to conserve the species.

Using federal or provincial endangered and threatened lists to determine which are the rare plant species can be misleading. These lists are limited for plants because little is known about the distribution of most plant species outside of the densely settled areas. The Manitoba Conservation Data Centre (CDC) is starting to fill this gap by ranking the "rarity" of Manitoba plant species based on known occurrences. Species are ranked (e.g., S1, G5) based on their rarity (scale from 1 to 5 where 1 is very rare, 5 is widespread and abundant; definitions of the letter and numerical ranks are found in the Appendices) within the provincial (S), national (N) and global (G) ranges/ spatial scales. These ranks are adjusted as new distribution and abundance information becomes available.

Prior to field studies, literature reviews confirmed that no species of vascular plant listed as endangered or threatened or ranked as provincially or globally very rare or rare was previously recorded in the Region. A list was prepared of the provincially very rare and rare species (ranked as S1 and S2 by the CDC) that might occur in the Region and the habitats where they have been found. Field botanists familiarized themselves with these species prior to fieldwork. Other field personnel were briefed on the appearance of species that would be easy to identify and encouraged to make note and report the locations of the plants. NCN members were asked if they had seen some of these plants in the course of work or travel in their Resource Management Area. Any sightings of sensitive plants were recorded during all field activities.

Searches for provincially very rare, rare and uncommon plants (S ranks 1-3) were conducted as part of the 2000 vegetation pilot study and during extensive reconnaissance on foot, by air and by boat around the shoreline buffer of Wuskwatim Lake, Wuskwatim Brook and Cranberry Lakes. Potential locations and records of rare plants within the Sub-region were used as a guide to direct searches and general reconnaissance both in the affected areas and more widely in the Sub-region (Section 6.2.3.2). Sampling on transects was repeated at different times during the growing season to maximize the likelihood that all vascular plants would be observed and could be identified to species. Locations of encountered S2 and S3 species were recorded and specimens were taken only if population numbers were sufficient.

The searches for the provincially very rare, rare and uncommon species continued in 2001 with additional sites selected from analysis of regional and project site-specific data to identify rare and uncommon habitats. Because the water levels in the spring and summer of 2001 were lower than in 2000, additional vegetation sampling plots were sited in the various water duration zones. This facilitated the expansion of rare plant (S ranks 1-3) searches into the Shallow Water Zones (Section 5.2.3.1.2.3). Locations of S1, S2 and S3 species were recorded.

Regionally rare and uncommon species are also of special concern for biodiversity assessment. Distribution and abundance information adequate to assess the regional rarity of species was only available for tree species. A tree species was classified as rare or uncommon in the Region or Sub-Region if its mapped overstorey coverage was less than 0.06% and 2.1% of land area, respectively. The same criteria were used to identify regionally rare and uncommon fine habitat types, whether or not they were forest types.

5.2.4.2 Effects Assessment

The terrestrial habitat effects assessment proceeded in a bottom-up, sequential, hierarchical fashion as follows (Section 5.1).

(1) Identify and describe the **Project impact areas**.

Identify and describe the **Project effects areas**: fine habitat ZOI and landscape zone of influence (i.e., 1 km buffers)

(2) Identify and describe **Project effects comparison areas**.

(3) Describe the existing environment using the Project effects comparison areas as the effects assessment study areas.

(4) Identify potentially significant effects in the Project effects areas.

(5) Determine which potentially significant effects will be mitigated and specify mitigation measures.

(6) Describe residual Project effects.

(7) Assess cumulative effects.

(8) Specify appropriate follow-up and monitoring.

The habitat effects assessment is presented differently for mainland/ upland and semi-aquatic (i.e., Shore Zone, Peat Islands, Mineral Islands) habitat due to the very different nature of Project impacts in the two major habitat types.

Three effects prediction periods are used for most effects in the assessment: 5 years (2009 - 2014), 6 - 25 years (2015 - 2034) and 26 - 100 years (2035 - 2109) post-Project.

5.2.4.2.1 Mainland/ Upland Habitat

The mainland/ upland habitat effects assessment occurs in a sequence of steps. First, Project features[6] and the mainland habitat that they impact are identified. The footprints that contain the Project features become the Mainland/ Upland Project (i.e., impact) Areas. Second, habitat effects in the Mainland/ Upland Project Areas are described. Third, the indirect effects of Project features on habitat composition in areas adjacent to the Mainland/ Upland Project Areas are considered. Finally, fragmentation is considered as a landscape scale indirect effect of the access road and associated Project features.

Some of the cleared areas shown in tables are slightly different than stated in the Project description (Volume 3). Depending on the situation, some of the sources of the differences were:

- different base maps were used (e.g., FRI versus NTS);
- area and distance calculations were spherical rather than Cartesian (increases area by 1% - 3%); and/ or
- different issues required different assumptions about how some impacts would be incorporated into the assessment. These situations are explicitly described in relevant sub-sections.

The habitat effects assessment takes a conservative approach and treats all of the habitat within the Project impact area and Fine Habitat ZOI as if it is lost during construction. Potential effects magnitude was assessed using the criteria provided in Section 5.1.4.3.

5.2.4.2.2 Shore Zone, Peat Island and Mineral Habitat

The semi-aquatic habitat effects assessment also occurred in a sequence of steps. First, all of the Shore Zone, Peat Island and Mineral Island habitat was treated as Project impact area since all of these areas are affected by water regime changes. Second, predicted Project induced changes to environmental factors are described. Third, expected effects on semi-aquatic habitat are described. Fourth, a consideration of indirect effects on the adjacent mainland edge habitat is provided. Specific indirect effects include changes to soil moisture regime, permafrost melting, tree mortality, distribution of emergent cattails and habitat loss from erosion.

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[6] Project features include structures (e.g., generating station), activities (e.g., construction vehicle travel) and associated alterations (e.g., vegetation clearing, soil compaction on access trails).

With regard to erosion, there are differences in the reported areas of erosion in the habitat assessment and the erosion assessment in Volume 4. The differences arise from a combination of factors which include the different starting shorelines, different base maps and a different approach to calculating areas losses. There is a large difference in total area eroded primarily due to the different baseline shorelines. However, the two approaches yield small differences in estimated Project-related erosion because these calculations are relatively unaffected by the locations of the baseline shoreline.

An estimate of peatland disintegration rates was required to predict the future area of Peat Islands. Four case study areas were identified based on important influences on peatland disappearance. Case study areas were selected to represent differences in factors that influence the rate of peatland disintegration. Peat Islands/ lake peatlands in the four case study areas were mapped from aerial photography flown in 1972 (pre-CRD baseline), 1978 and 1985. Aerial photography flown in 1981 was also available for one of the case study areas.

5.2.4.2.3 Habitat VECs, Plant VECs and Road Density

The simple habitat models developed for the VECs were used to create a habitat quality map for each VEC. Each map was split into zones (Project impact areas, fine habitat ZOI, landscape band, Sub-Region) and area affected was calculated by habitat quality class (i.e. high, moderate, poor, very poor). Sub-Region was used as the comparison area for assessing the significance of expected Project effects. The potential significance of Project effects on VECs was assessed using the criteria provided in Section 5.1.4.3.

5.3 EXISTING ENVIRONMENT

5.3.1 Mainland/ Upland Habitat

5.3.1.1 Region

The Region provides the ecological context and constraints for the Sub-Region and other study areas nested within it. The Region is 24,790 km^2 (2,345,924 ha) in area, spanning an east to west distance of approximately 230 km and a north to south distance of approximately 170 km (Figure 5.2-2). Volume 4 provides a general description of Region climate, surface materials, geology and soils.

5.3.1.1.1 Disturbances

Disturbances have interacted with soils, topography and hydrology to produce the current patchwork of vegetation, habitat and landscape element and landscape types. Wildfire and insect and disease outbreaks are the major disturbances that are controlled primarily at the Region spatial scale.

Wildfire

Large wildfires are the dominant type of natural disturbance in the central Canadian boreal forest (Payette 1992). Other disturbances such as windthrow or insect and disease infestations can also affect large areas but wildfire causes complete vegetation mortality over a much larger area.

Large wildfires have played a critical role in producing the vegetation mosaic that are seen looking down from a plane. Large wildfires also have a key role in determining the distribution and abundance of animals. The plants and animals found in the Manitoba boreal forest have coped with frequent large fires for thousands of years. Large wildfires maintain the ecological health of the Region ecosystem by affecting many ecological patterns and processes including ones that cannot be seen (e.g., soil nutrient availability).

Available fire history information for the Region (Section 5.2.4.1.1) suggests that most of the recent large fires in the Region were outside the Sub-Region (Figure 5.2-7). Large, recent fires that have been mapped occurred in 1981 and 1980 and affected 21,820 and 2,420 ha, respectively (not all of the area inside the fire boundary burned). Satellite imagery, field observations and FRI cutting class suggest that several recent large fires in the Sub-Region are missing from the digital fire history. Some of these fires may have occurred before 1976. These include three fires that were about 31,000, 10,000 and 9,000 ha in area (light blue in Figure 5.2-7). Two smaller, more recent fires (about 1,400 and 700 ha) occurred in the area of the proposed access road.

Insects and Disease Outbreaks

Insects and diseases play important roles in the life cycles of forest ecosystems and produce change at all stages of the forest life cycle from thinning high-density young stands to tree mortality and decomposition in old stands. Insects and disease are a constant presence in all vegetation types and ages. Insect or disease outbreaks can influence forest composition and age at spatial scales as large as the Sub-Region. Associated tree mortality can considerably raise the flammability of the forest and potentially increase the size and severity of large fires. Appendix 5.11.1 describes the forest insects and diseases that undergo outbreaks in the Sub-Region.

5.3.1.1.2 Land Cover and Land Type Composition

Approximately 90% of the Region is terrestrial habitat. Region land type composition is dominated by a mixture of peatland, mineral soil and peaty mineral soil (Figure 5.3-1). Peatlands are found throughout the Region but are more abundant in the south-central and northeastern portions of the Region.

Region land cover is dominated by a mixture of conifer forest and sparsely treed peatlands (Figure 5.3-2). Black spruce accounts for most of the trees in the conifer forest and sparsely treed peatlands. Jack pine is the second-most abundant tree species. As expected, the distribution of land cover reflects the land types.

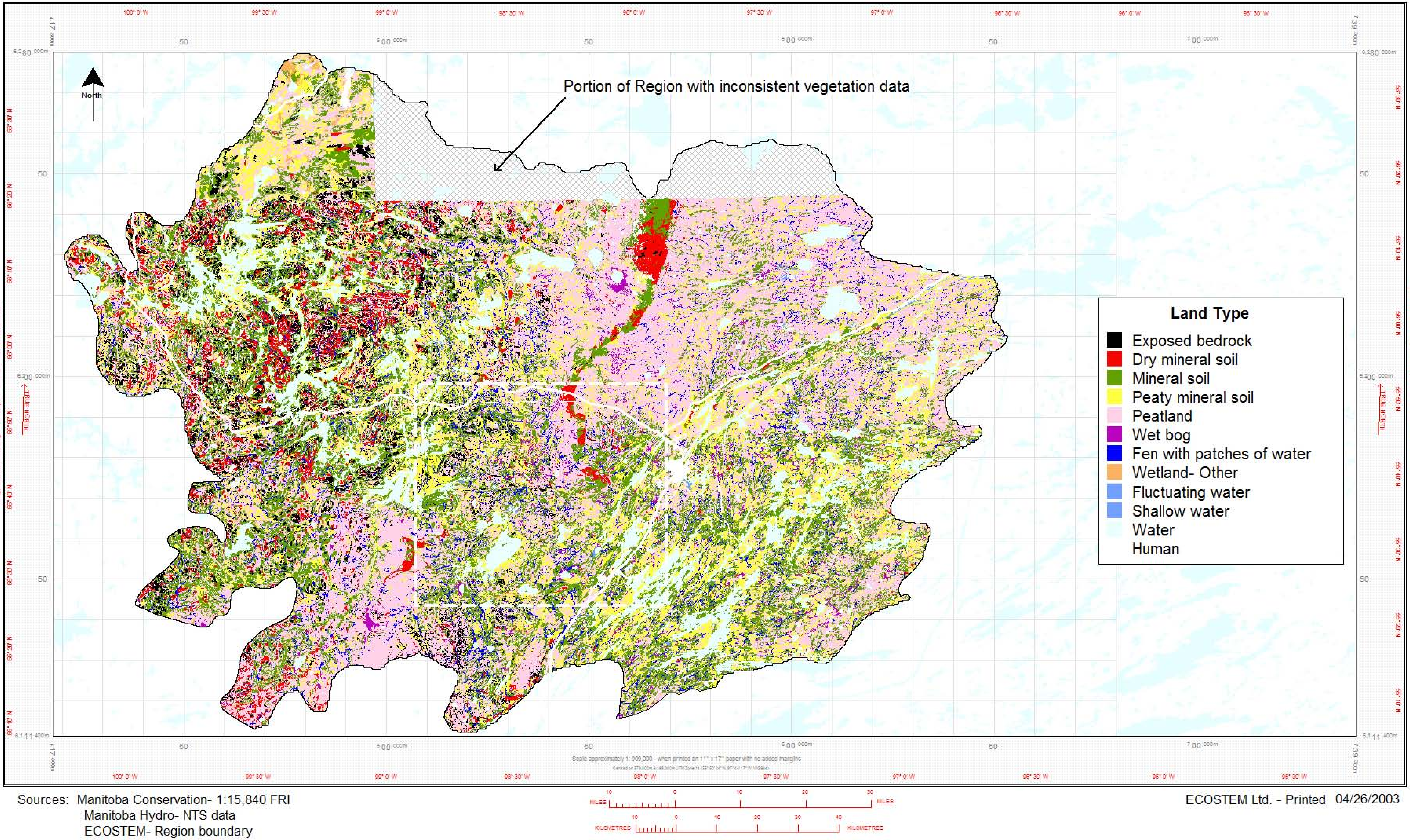

Figure 5.3-1. Region land type. Sub-Region boundary shown as white dashed line.

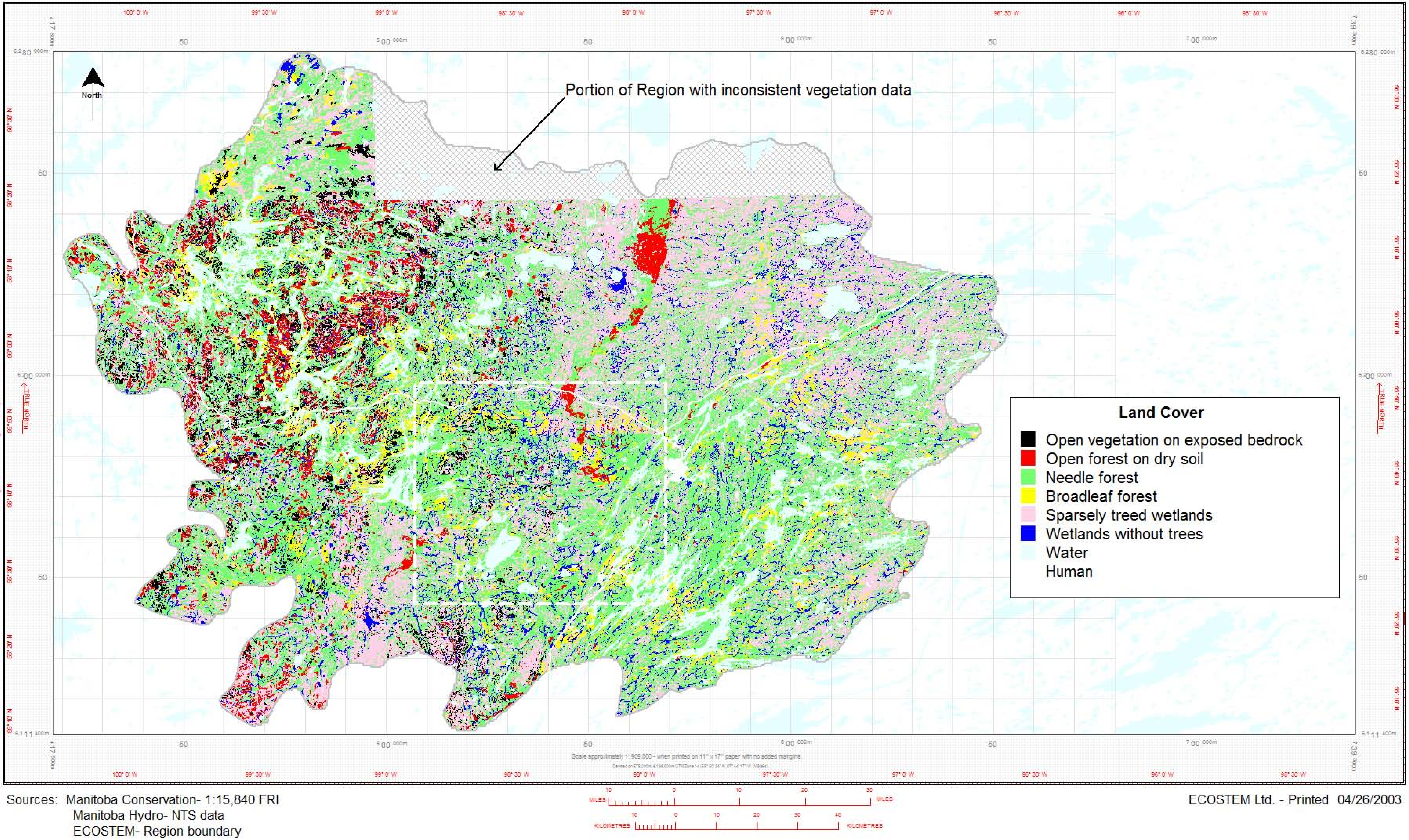

Figure 5.3-2. Region land cover. Sub-Region boundary shown as white dashed line.

5.3.1.2 Sub-Region

The Sub-Region is 3,356 km^2 (335,625 ha) in area, spanning an east to west distance of approximately 62 km and a north to south distance of approximately 55 km (Figure 5.2-2). Water covers about 10% of the Sub-Region leaving 301,724 ha of terrestrial habitat not including Peat Islands in the Affected Aquatic Area.

5.3.1.2.1 Climate, Topography and Surface Materials

The Sub-Region lies within a warm, humid portion of the High Boreal Ecoclimatic Region in Manitoba (Smith et al. 1998). Soil climate in the Sub-Region is cold, sub-humid to humid and Cryoboreal. Terrain drops across the Sub-Region from about 300 m ASL in the northwest to about to 190 m ASL in the southeast (Source: 1:50,000 NTS data). Calcareous, clayey[7] glaciolacustrine sediments are the most widespread and abundant surface materials in the portion of the Sub-Region with surface material information (Figure 5.3-3). Bog and fen are the next most abundant primary surface material categories. A very large bog and fen complex is found in the northeast quadrant of the Sub-Region. A flat-topped ridge of wave-washed, glacio-fluvial material runs in a north-south direction adjacent to and east of the large bog and fen complex (see sand areas in Figure 5.3-3). North of Highway 391 this ridge is peaked and known locally as Eagle Hill. A second ridge runs in an east-west direction about 3 km southeast of the first one. The access road and the largest borrow areas are located on these two ridges. A third glacio-fluvial ridge known as Partridge Crop Hill creeps into the southwestern quadrant of the Sub-Region. Bedrock outcrops occur throughout the Sub-Region but are uncommon. Widespread to continuous permafrost is found throughout the Sub-Region.

Bedrock outcrops occur throughout the Sub-Region but are uncommon. Bedrock in these areas generally has a thin cover of clayey glaciolacustrine sediments and some shallow till deposits. Areas with bog, fen, silty and sandy dominated surface material types are uncommon in the Sub-Region.

Soils are predominantly complexes of grey luvisols developed in calcareous clayey surface materials and patches of very poorly drained deep and shallow mesisolic organic soils derived from sedge and woody peat (Smith et al. 1998). Permanently frozen peatlands are found throughout the area primarily as peat plateau and palsa bogs, and,

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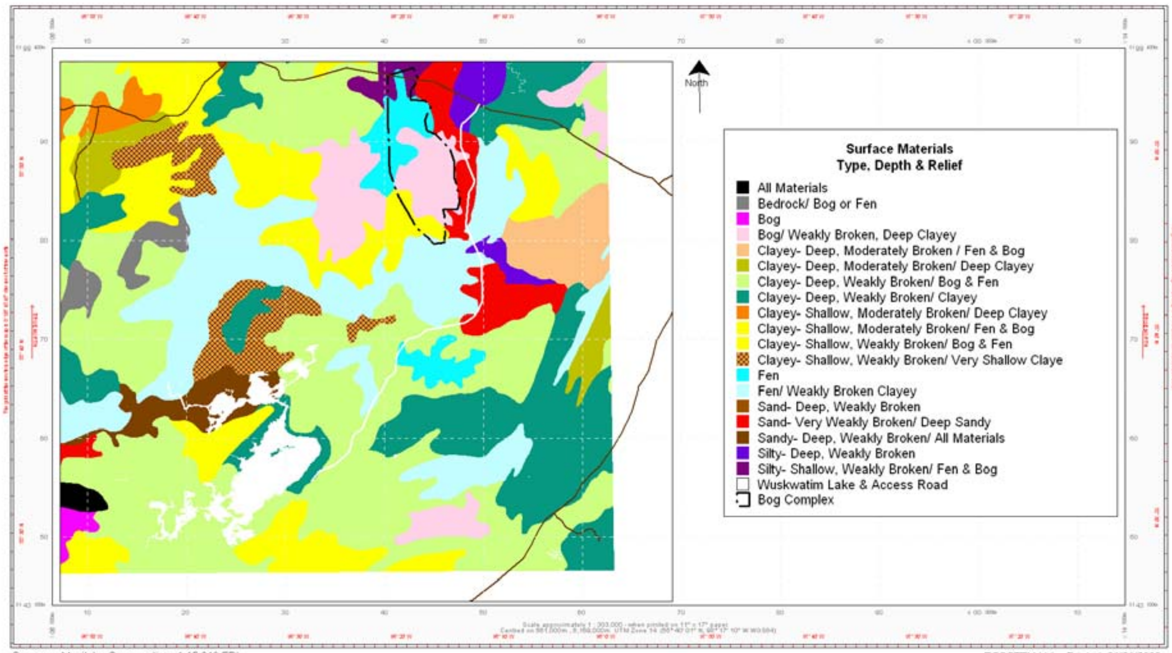
[7] Clays interspersed with silt, loam and/ or sand.

secondarily as veneer bogs. Humic gleysols generally occur in the transition zone between luvisols and organic soils. Local pockets of well to excessively drained dystric brunisols have developed on deep glaciofluvial deposits (e.g., the ridges described above) or on shallow, sandy textured, stony veneers of water-worked glacial till.



Sources: Manitoba Conservation- 1:15,840 FRI
Manitoba Hydro- NTS data

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Figure 5.3-3. Distribution of primary and secondary surface materials in the Sub-Region.

Notes: Primary surface material covers at least 50% of the polygon; primary + secondary materials cover at least 85% of polygon. Weakly broken = area has long gentle slopes or very short steep slopes. Differences in elevation generally less than 23 m. Moderately broken = area has long moderate slopes or short steep slopes. Differences in elevation generally less than 61 m. Note that these surface material data are only available for 83% of the Sub-Region. Source: H. Veldhuis. 1:250,000 unpubl. data for NTS sheet 63O.

5.3.1.2.2 Disturbances

Human features are the only type of large disturbances that are primarily controlled at the Sub-Region scale.

Human Features

Most of the existing human features are concentrated along the northern and eastern edges of the Sub-Region. Nelson House and Thompson are located in the northwest and northeast corners of the Sub-Region. Highway 391 runs along the northern edge and connects Nelson House to Thompson. Highway 6 runs along the eastern edge of the Sub-Region and connects Thompson to southern Manitoba. There is a transmission line south of Highway 391. Various developments including mine sites, parks and residential developments are scattered along Highway 6. Many human activities are associated with these features. Timber harvesting is described in Volume 7 Section 5. Permanent human features account for 2,624 ha of Sub-Region area.

Land Type Composition

Land type composition in the Sub-Region is dominated by a mixture of peatland, mineral soil and peaty mineral soil with each covering 39%, 27% and 19% of Sub-Region land area, respectively (Figure 5.3-4). Exposed bedrock, dry mineral soil and fen with patches of water are uncommon; the remaining land types are very uncommon or rare. Although peatlands are found throughout the Sub-Region, they are more abundant in the southwest and the northeast corners of the Sub-Region (Figure 5.3-6).

Dry mineral soil has developed on two types of surface deposits: deep, coarse textured material or shallow mineral soil of all textures over bedrock. Most of the dry mineral soils are concentrated in four areas of deep, coarse textured materials: three ridges along the proposed access road and one along the western edge of the Sub-Region. The four ridges were formed by post-glacial rivers and consist of sandy and gravelly material. This type of surface deposit is rare in the Sub-Region, Region and Province (Figure 5.3-5).

Sub-Region land type composition is similar to the Region except that mineral soil and peaty mineral soil are more abundant, while peatland and dry mineral soil are less abundant (Figure 5.3-4).

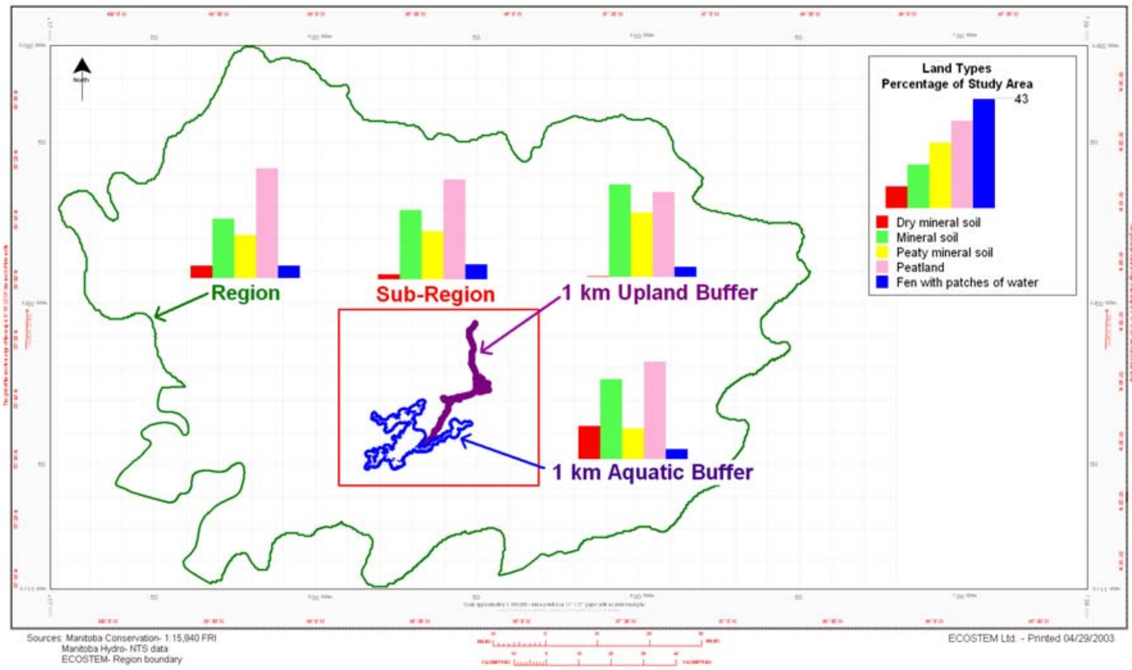
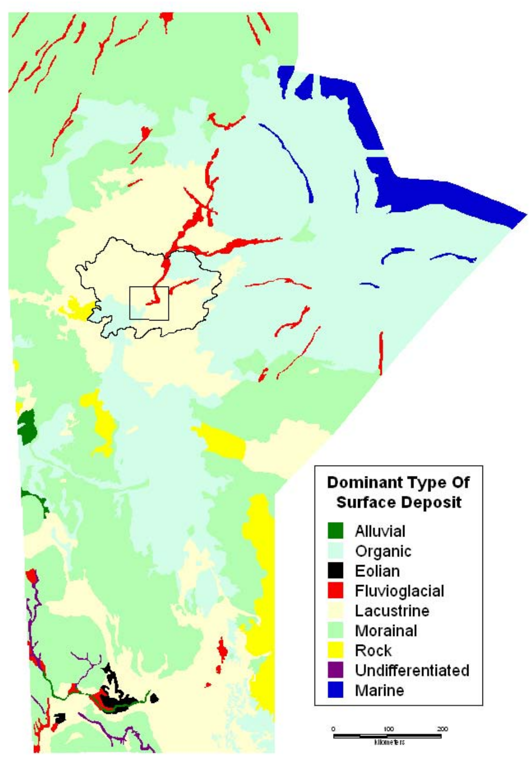


Figure 5.3-4. Comparison of land type composition in the habitat study areas.

Notes: Bars show percentage of land area in the study area. Types covering less than 5% of area in all of the study areas are not shown (i.e., exposed bedrock, wet bog, wetland, fluctuating water, frozen peat, human).

Figure 5.3-5. Dominant mode of parent material deposition in Manitoba.

Source: Soil Landscapes of Canada. Region and Sub-Region boundaries outlined in black.



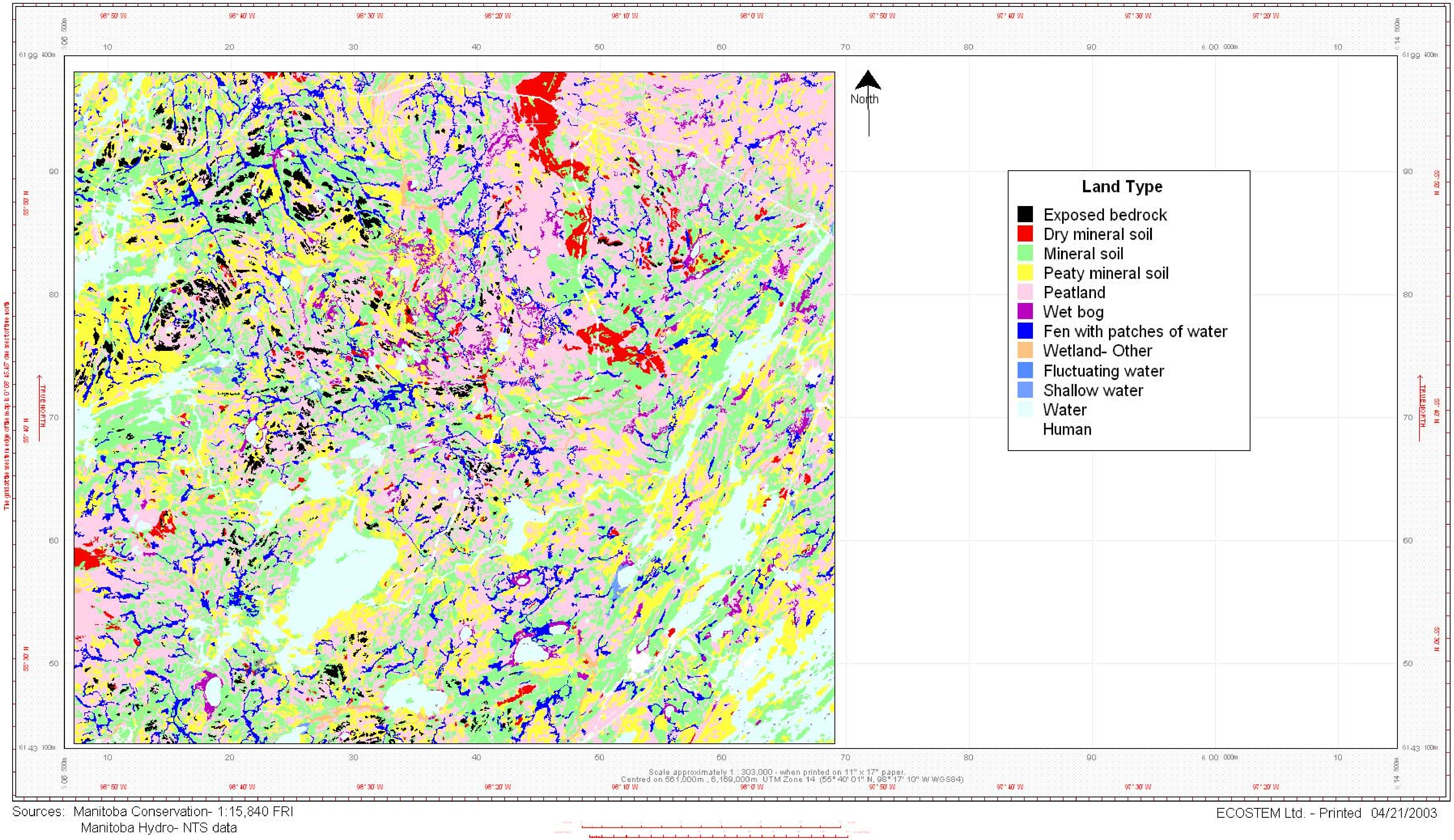


Figure 5.3-6. Land type composition in the Sub-Region. Proposed access road is dashed white line.

5.3.1.2.3 Land Cover Composition

Sub-Region land cover is dominated by a mixture of conifer forest and very open vegetation on peatlands (each cover 48% and 29% of Sub-Region terrestrial area, respectively; Figure 5.3-7). Most of the very open vegetation on exposed bedrock is in the northwest portion of the Sub-Region (Figure 5.3-8). As expected, open forest on dry mineral soil is concentrated in the same four areas as the dry mineral soil land type. Broadleaf forest also has a concentrated distribution. Very open vegetation on wetlands other than peatlands is typically found around the margins of the smaller lakes and in the low-lying areas that connect lakes and rivers.

Sub-Region and Region land cover are similar except that the Sub-Region has more conifer forest and less very open vegetation on peatlands or dry mineral soil (Figure 5.3-7).

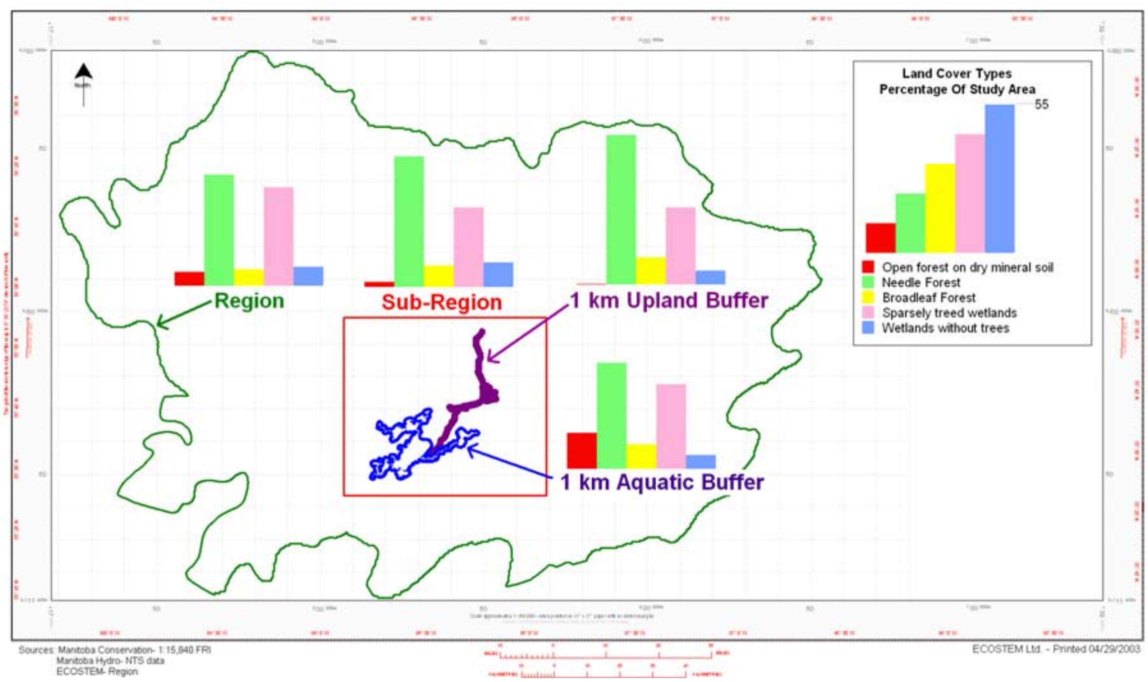


Figure 5.3-7. Comparison of land cover composition in the habitat study areas.

Bars show percentage of land area in the study area. The columns in each bar chart do not add to 100% because land types that had a maximum coverage less than 10% are not shown.

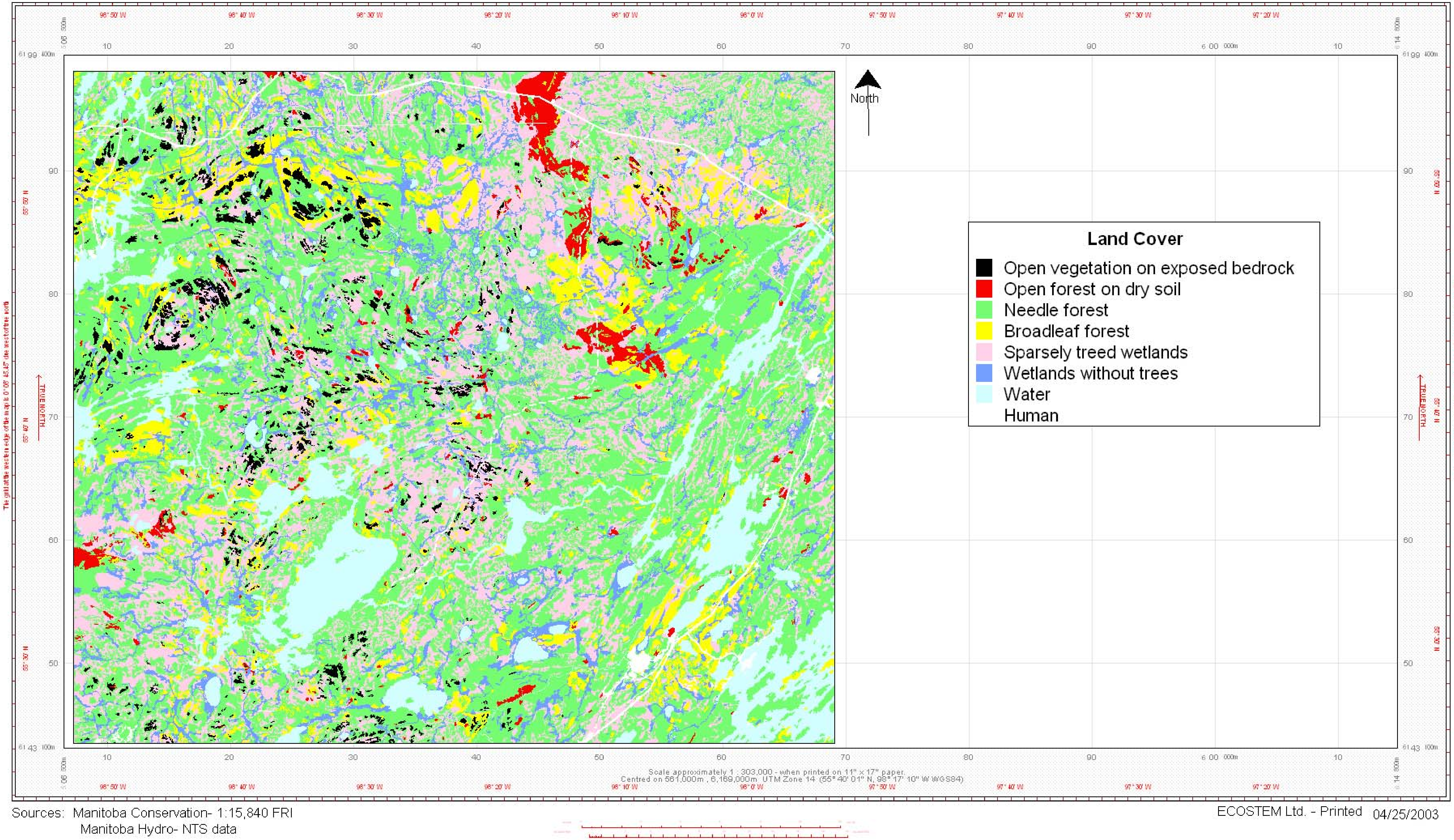


Figure 5.3-8. Land cover composition in the Sub-Region. Proposed access road is dashed white line.

5.3.1.2.4 Broad Habitat/ Landscape Element Composition

Land cover was sub-divided into 37 broad habitat types (22 types when there is no separation of forest age classes) based on field surveys and analysis of the fine habitat to Region scale habitat maps (Appendix 5.10).

Sparsely treed wetland is the most abundant broad habitat type in the Sub-Region (29% of terrestrial habitat area; Figure 5.3-9; Figure 5.3-10), followed by black spruce forest on peaty mineral soil (15%). Most of the rest of the Sub-Region is covered by a balanced mixture of black spruce forest on peatland, other conifer forest on mineral soil, jack pine forest on mineral soil and low shrub, graminoid and/ or emergent wetlands (each cover about 10%). The most uncommon (i.e., cover <= 2% of the Sub-Region) broad habitat types are open forest on dry mineral soil, hardwood forest on mineral soil, tall shrub wetland, other conifer mixedwood forest on mineral soil and black spruce & other mixedwood forest on peatland. Figure 5.3-11 shows habitat in selected locations.

Sub-Region and Region broad habitat composition are similar except that the Sub-Region has less sparsely treed wetland and a slightly higher abundance of several other types (Figure 5.3-9).

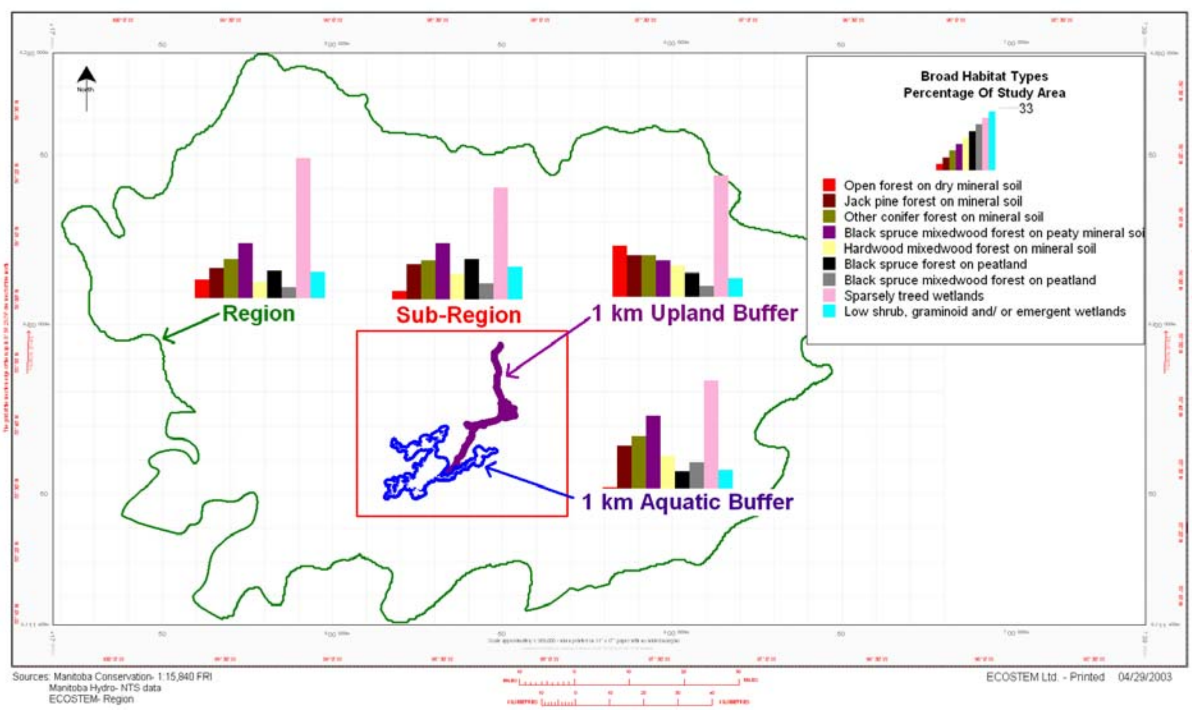
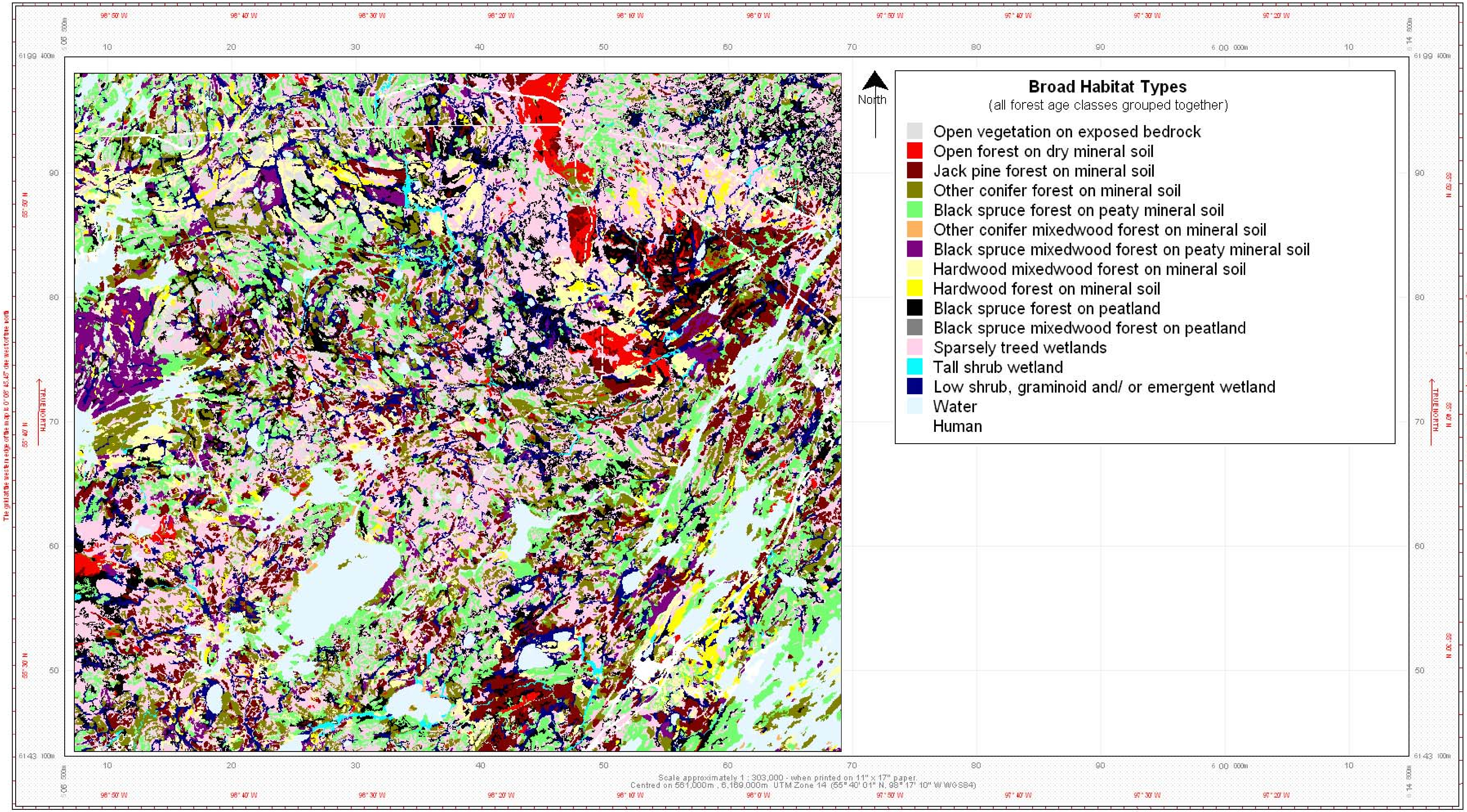


Figure 5.3-9. Comparison of broad habitat composition in the various study areas.

Bars show percentage of land area in the study area. The columns in each bar chart do not add to 100% because land types that had a maximum coverage less than 10% are not shown.



Source: Manitoba Conservation for 1:15,840 Provincial FRI Data
Manitoba Hydro for NTS Features

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Figure 5.3-10. Broad habitat/ landscape element composition in the Sub-Region. All age classes for the forest types were grouped together to simplify the map. Proposed access road shown as white dashed line.

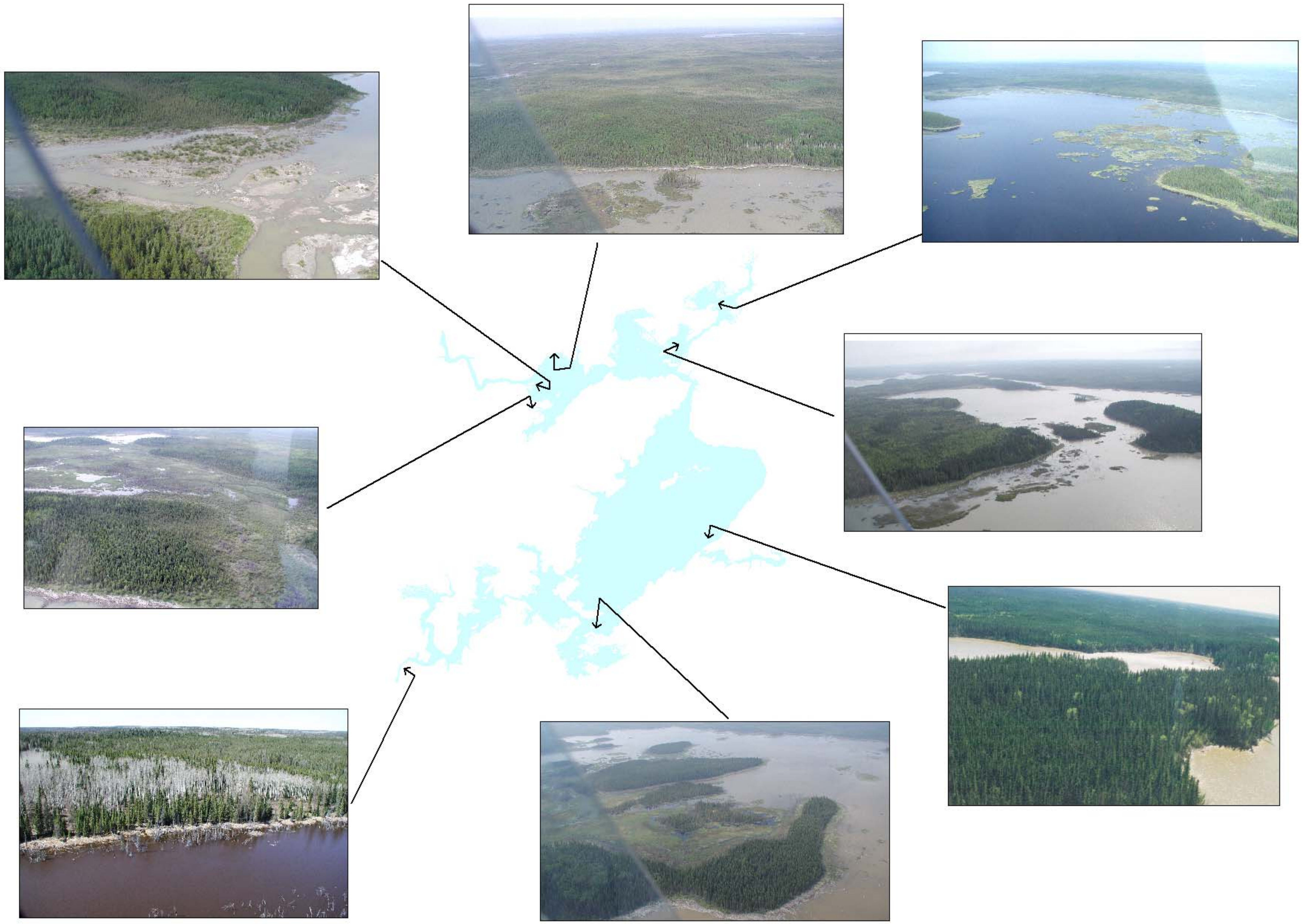


Figure 5.3-11. Photos of the 1 km Aquatic Buffer. Last leg of line before arrow shows direction of photo. Photos not representative of the entire stretch of the Buffer.

5.3.1.2.5 Broad Habitat Types- Distribution In Sub-Region, Species Composition and Site Conditions

Summary descriptions of the most common broad habitat types were prepared based on information from sample plots, field surveys, the FRI and other sources relevant to the Sub-Region (see Section 5.2.1). Descriptions of forest types are for mature forest. Detailed results are provided in Appendix 5.11.2.

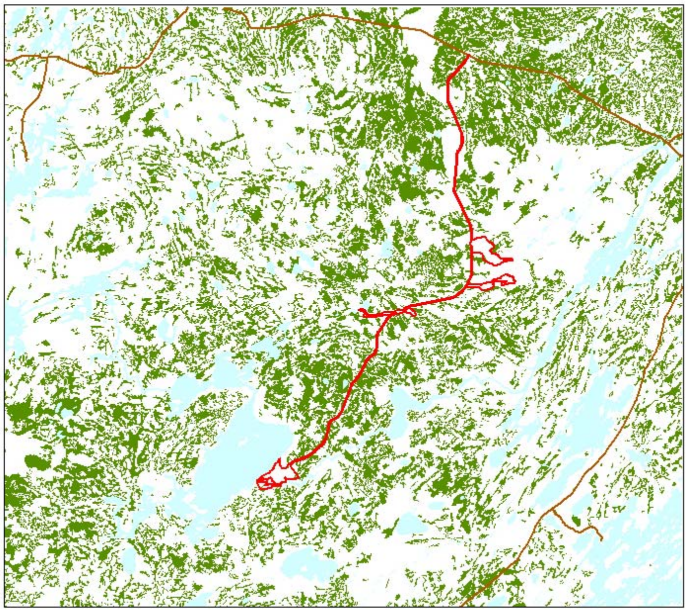
The broad habitat type descriptions list the most common vegetation and site conditions in mature forest. Age class differences are ignored to simplify the descriptions. Species composition changes with age but these changes are not as dramatic as the differences between soil/ land types (Ehnes 1998). Other than the characteristic species, the broad habitat types can include considerable variability in species composition from one location to another.

The distribution map included in each broad habitat description shows the overall distribution pattern for the broad habitat type. Small habitat patches for some types (e.g., black spruce forest on peatland) are not visible at the small scale used for these maps. The small map scale also hides important spatial associations between habitat types such as those that occur along a toposequence (Figure 5.1-3). These types of relationships are brought forward in the fine habitat type description that follows below. The broad habitat type descriptions also list the most common vegetation and site conditions.

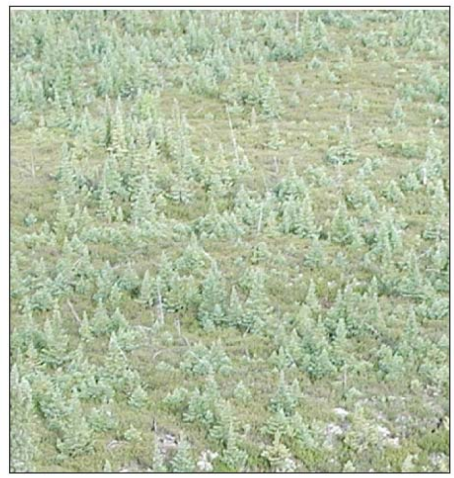
All of the broad habitat types that cover at least 5% of the Sub-Region are widespread. Nevertheless, some types have concentrated or patchy distributions of the large patches visible at the small map scale used in the habitat descriptions.

Sparsely Treed Peatland

Sparsely treed peatland (Figure 5.3-12) is the most abundant broad habitat type in the Sub-Region and Region. Sparsely treed peatland is most abundant in a band that runs from the southwest to the northeast in the Sub-Region. This broad habitat type is located in low-lying areas and has a level surface. Soils are organic. Most of the area in this habitat type is bog but fens also occur. Tree growth is poor due to cold and wet soil conditions. It is a very open habitat.



Sub-Region Distribution
Project impact areas outlined in red.



Aerial View

Characteristic Vegetation Composition

Scattered stunted black spruce trees.
Sparse tall shrub layer.
Sparse to dense low shrub layer with Labrador tea, bog cranberry, dry ground cranberry and leatherleaf.
Sphagnum rmoss ground cover.

Characteristic Site Conditions

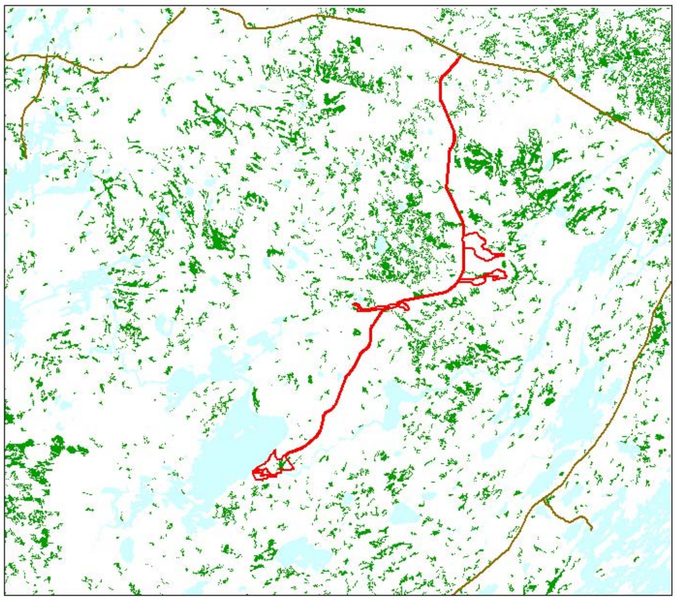
20 - 100 cm+ organic soil primarily derived from Sphagnum mosses.
Water table within 20 cm of surface.
Sporadic permafrost.

Ground View

Figure 5.3-12. Sparsely treed peatland broad habitat type.

Black Spruce Forest On Peatland

Black spruce forest on peatland distribution appears patchy (Figure 5.3-13). Many distribution voids are simply due to the small map scale. This type often occurs (1) in the elevational transition between sparsely treed peatland and black spruce forest on peaty mineral soil, or (2) as mounds (i.e., peat plateau bog) scattered in a sparsely treed peatland. The peatland mounds are formed by permafrost and Sphagnum moss growth. Peat plateau bogs are rare along the Affected Aquatic Area shoreline due to the effects of the CRD (Section 5.3.3.4). This habitat type is highly variable. Tree canopy closure ranges from open to closed which influences understorey species composition.



Sub-Region Distribution
Project impact areas outlined in red.

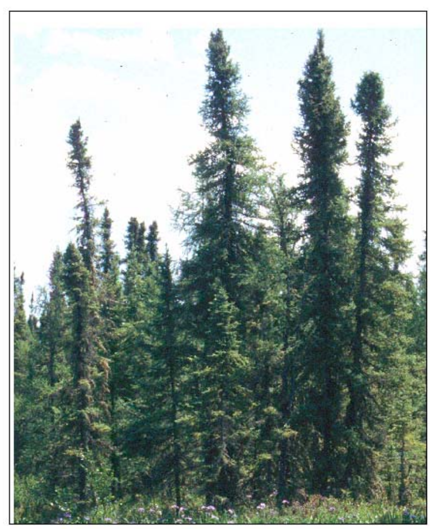
Aerial View

Characteristic Vegetation Composition

Open to closed black spruce overstorey;
scattered tamarack in some patches.
Sparse tall shrub layer.
Sparse to dense low shrub layer with Labrador tea, bog cranberry, dry ground cranberry and leatherleaf.
Sphagnum moss ground cover.

Characteristic Site Conditions

20 - 100 cm+ organic soil primarily derived from Sphagnum mosses.
Water table deeper than 20 cm.
Permafrost common.



Ground View

Figure 5.3-13. Black spruce forest on peatland broad habitat type.

Black Spruce Forest On Peaty Mineral Soil

The distribution of black spruce forest on peaty mineral soil is not as patchy as it appears on the distribution map (Figure 5.3-14). It is the most common black spruce forest type along the Affected Aquatic Area shoreline. Black spruce forest on peaty mineral soil usually has a relatively dense tree canopy, a sparse understorey and a feathermoss ground cover. Some of the map polygons in this habitat type could have peatland or mineral rather than peaty mineral soils due to the limited information available to map the land type component of habitat (Section 5.2.4.1.1). Land type in most map polygons touching the shoreline of the Affected Aquatic Area should be accurate due to ground-truthing.

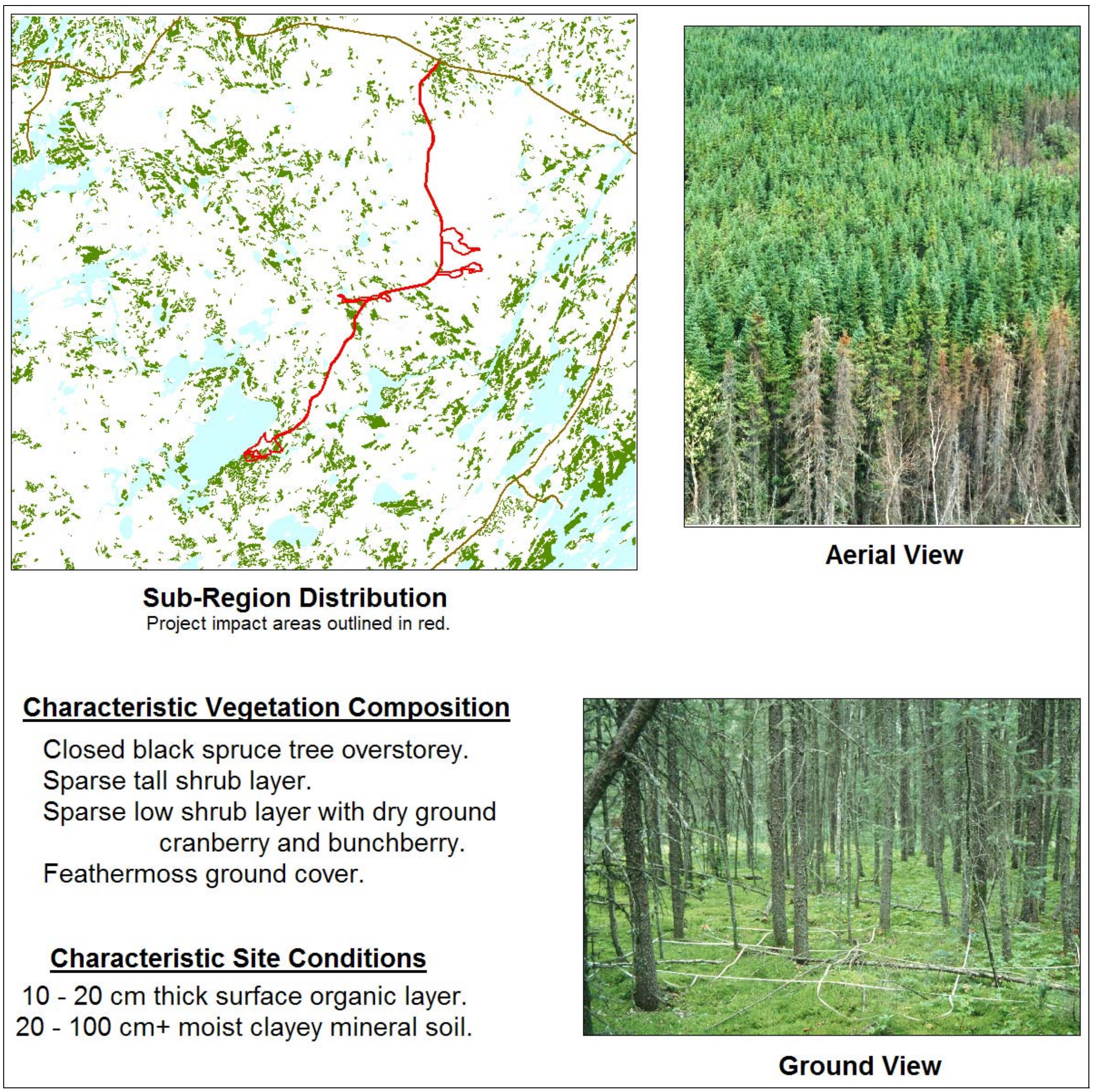


Figure 5.3-14. Black spruce forest on peaty mineral soil broad habitat type.

Other Conifer Forest On Mineral Soil

Other conifer forest on mineral soil is a variable broad habitat type (Figure 5.3-15). Black spruce/ jack pine forest on mineral soil is the most abundant fine habitat type within this broad type, however, two rare fine habitat types (i.e., white spruce and balsam fir forest) are also included. Other conifer forest on mineral soil is distinguished from black spruce forest on peaty mineral soil by a thinner surface organic layer, a drier soil moisture regime and related differences in vegetation composition.

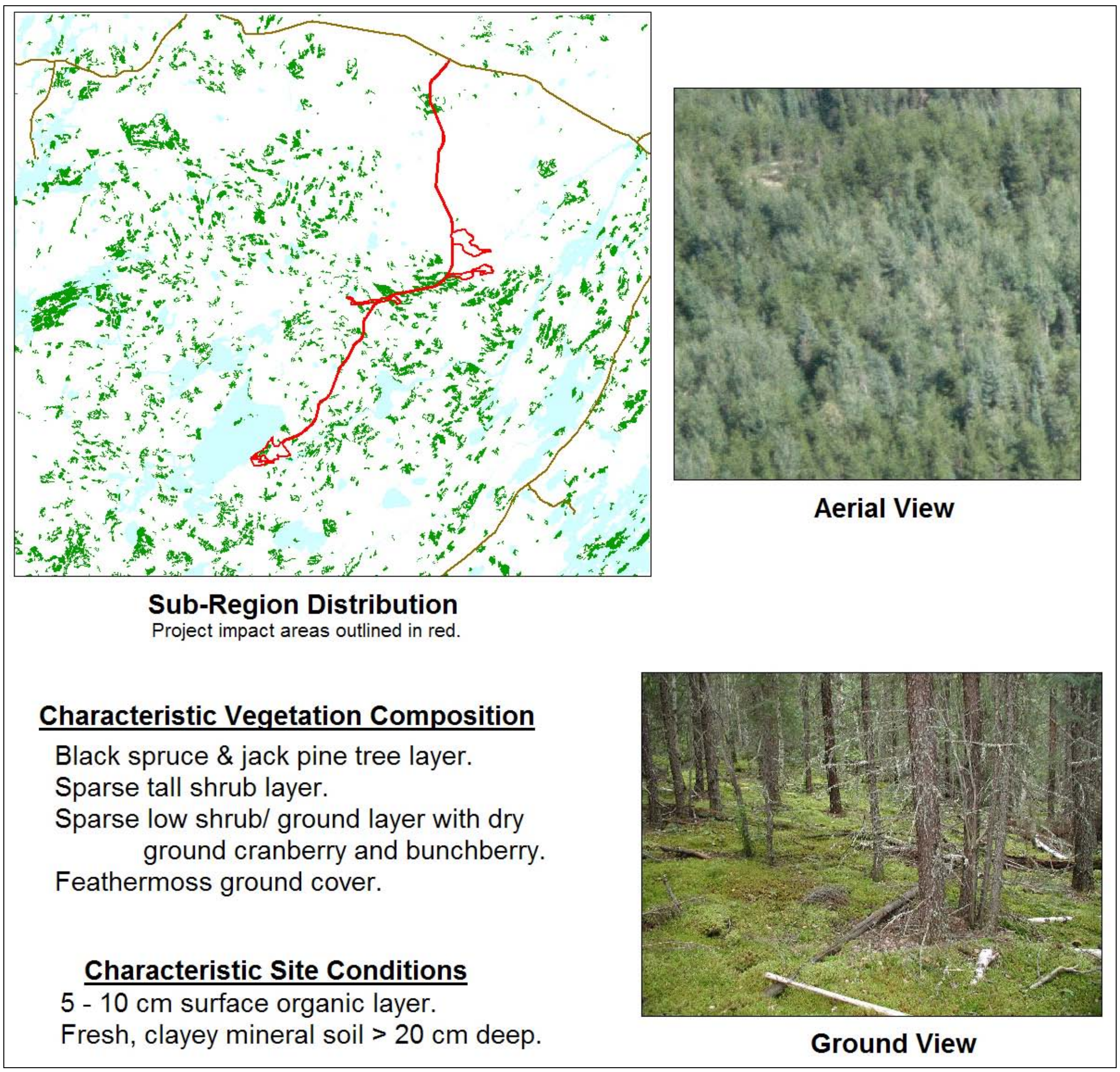
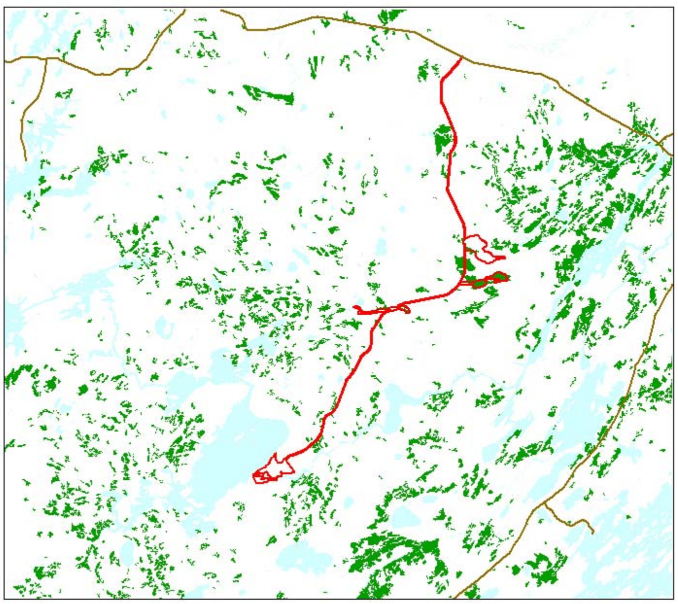


Figure 5.3-15. Other conifer forest on mineral soil broad habitat type.

Jack Pine Forest On Mineral Soil

The distribution of large patches of jack pine forest on mineral soil is patchy (Figure 5.3-16). Soil conditions are quite variable. Jack pine forest can develop on clayey soil, sandy loams, loams or sandy soil with ground water within 1 m of the surface. Understorey species composition is also variable reflecting the variability in soil conditions.



Sub-Region Distribution
Project impact areas outlined in red.

Aerial View

Characteristic Vegetation Composition

Jack pine tree layer.
Very sparse tall shrub layer.
Sparse low shrub/ ground layer with dry ground cranberry & bunchberry.
Feathermoss, haircap moss & scattered reindeer lichen ground cover.

Characteristic Site Conditions

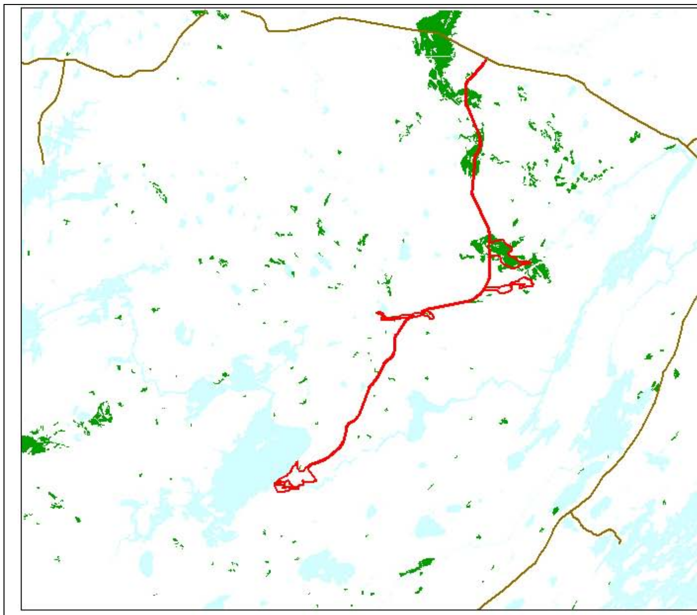
1 - 10 cm surface organic layer.
Dry to fresh mineral soil > 20 cm deep.
Soils texture variable.

Ground View

Figure 5.3-16. Jack pine forest on mineral soil broad habitat type.

Open Forest On Dry Mineral Soil

Most open forest on dry mineral soil is concentrated in three areas (Figure 5.3-17). As already noted, these concentrations are located on glacio-fluvial deposits. Open forest on dry mineral soil is quite different from the other non-broadleaf forest types even though it is dominated by jack pine. This broad habitat type is very open and has a ground cover dominated by reindeer lichens.



Sub-Region Distribution
Project impact areas outlined in red.

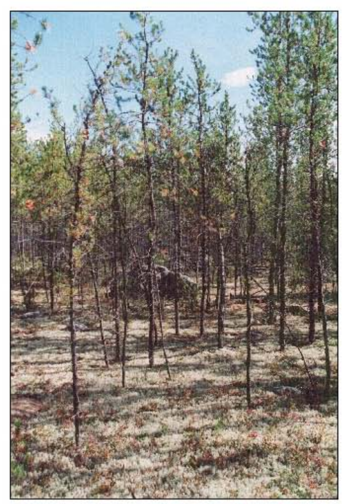
Aerial View

Characteristic Vegetation Composition

Very open jack pine tree layer.
Very sparse tall shrub layer.
Very sparse low shrub/ ground layer with blueberry & bunchberry.
Reindeer lichen, haircap moss & feathermoss ground cover.

Characteristic Site Conditions

Thin surface organic layer.
Sandy or gravelly mineral soil > 20 cm deep.

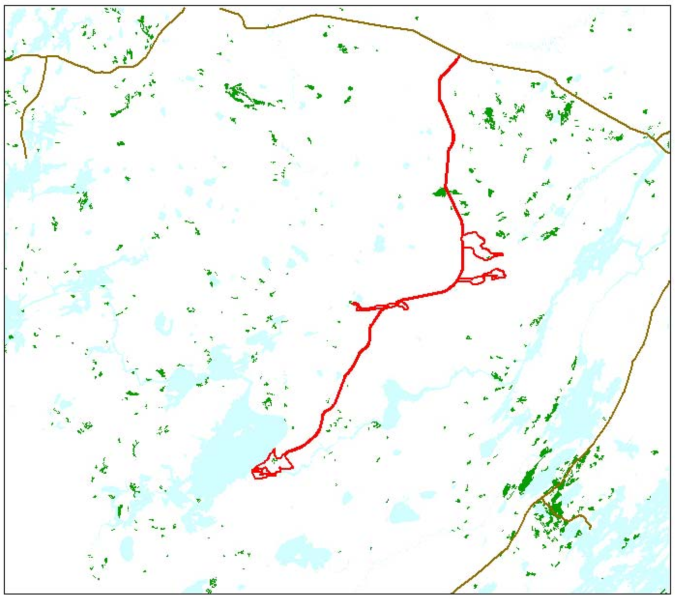


Ground View

Figure 5.3-17. Open forest on dry mineral soil broad habitat type.

Hardwood Forest On Mineral Soil

Hardwood forest on mineral soil covers a small percentage of the Sub-Region (Figure 5.3-18). Most of this is forest is dominated by aspen but there are a few patches of white birch or balsam poplar. Hardwood forest on mineral soil is the forest type with the densest and richest understorey.



Sub-Region Distribution
Project impact areas outlined in red.

Aerial View
In spring before leaf-out

Characteristic Vegetation Composition

Aspen tree layer.
Rich tall shrub layer with green alder & rose.
Rich low shrub/ ground layer with low bush cranberry, biship's cap & bunchberry.
Broadleaf litter ground cover.

Characteristic Site Conditions

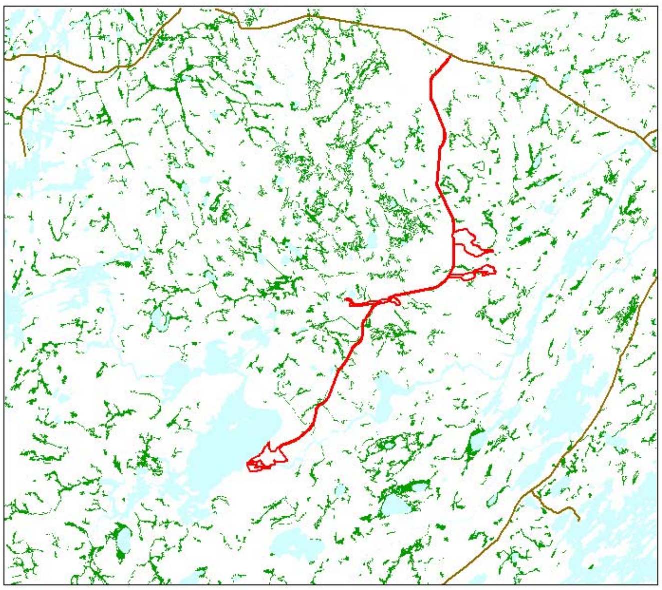
Thin surface organic layer.
Fresh to moist clayey mineral soil > 20 cm deep.

Ground View

Figure 5.3-18. Hardwood forest on mineral soil broad habitat type.

Low Shrub, Graminoid and/ or Emergent Wetland

Low shrub, graminoid and/ or emergent wetland has a net-like distribution (Figure 5.3-19) since large patches of this broad habitat type are usually found along the margins of streams, rivers and lakes where water energy from wave action or current is low. Although vegetation and site conditions in this habitat type can be quite variable, most of the Sub-Region area is graminoid fen.



Sub-Region Distribution
Project impact areas outlined in red.

Aerial View

Characteristic Vegetation Composition

No trees
No tall shrubs..
Very sparse low shrub layer.
Sedge & brown moss ground cover.

Characteristic Site Conditions

Surface organic layer 10 - 100+ cm.
Water table < 20 cm from surface.
Often floating as it covers a waterbody.

Ground View

Figure 5.3-19. Low shrub, graminoid and/ or emergent wetland broad habitat type.

5.3.1.2.6 Fine Habitat Composition

Fine habitat types provide the more detailed view (Section 5.1.4.2) as well as the foundation for VEC habitat modeling. Fine habitat types help identify sensitive habitat types and species that occur in the study areas.

The rarest (i.e., cover < 0.06% of the study land area) fine habitat types in the Sub-Region and Region are as follows.

- Forest where the most abundant tree species in the canopy is:
  - balsam fir;
  - white spruce;
  - tamarack;
  - balsam poplar;
  - aspen and white birch combination;
  - white birch; and
  - white birch mixedwood.
- Willow/ alder wetland.
- Alder wetland.
- Ericaceous low shrub/ Sphagnum bog.

There may be other wetland types that are also rare but these are not apparent in available map information. Field surveys indicated that the tall shrub wetland and ericaceous low shrub/ Sphagnum bog habitat types are not as rare as they appear to be in the maps because they typically occur in patches that are too small to map at the fine habitat scale (i.e., 1:15,840). Balsam poplar, white birch and tamarack forest types were not considered further in the effects assessment since they are not located within the Project effects areas (i.e., within the 1 km Buffers; Figure 5.2-2).

White spruce or balsam fir forest are rare habitat types that are generally found along the shoreline of the Burntwood River system and occur in areas to be affected by the Project. These species are examined under the consideration of VECs (Section 5.3.2.1). Most of the open forest on dry mineral soil broad habitat type (previous section) is the jack pine forest on dry mineral soil fine habitat type. This fine habitat type is uncommon in the Sub-Region (i.e. covers < 2.1% of Sub-Region land area) and occurs in the 1 km Upland Buffer. Jack pine forest on dry mineral soil is also a VEC (Section 5.3.2.2).

5.3.1.2.7 Plant Species Distributions and Abundances

A total of 225 species of vascular plants were recorded during field investigations conducted in 2000, 2001 and 2002 (see Appendix 5.11 Table 5.11-3 for a species list). Of this total, 169 species typically occur in mainland/ upland habitat, 27 in aquatic habitat and 29 in both types of habitat. Five mosses and lichens were recorded to the species level in plots. There were 28 additional taxa identified only to genus because they could not be identified to species in a vegetative or seedling state. They may or may not represent additional species.

Tree Species

Black spruce is the dominant tree species in the Region (Appendix 5.11 Table 5.11-4) and Sub-Region. Jack pine and aspen are the next most common canopy tree species in forests, occurring as the primary species in about 13% and 6%, respectively, of the Sub-Region. Jack pine and aspen occur on 50% and 41% of forest land in the Region (Appendix 5.11 Table 5.11-4). White spruce, tamarack and birch are uncommon species. Each occur on less than 3.5% of forest land in the Region. Balsam fir is the most uncommon species in the Region.

Understorey Species

Sub-Region understorey plant composition information for the mainland/ upland habitat types was collected in the habitat transect sample plots. Therefore, the following generalizations about species composition are most reliable for the 1 km Aquatic Buffer rather than the Sub-Region because they are not based on a representative sample. Sample plots were concentrated in those areas where Project effects were expected (i.e., around the proposed Generating Station; within 200 m of the Affected Aquatic Area shoreline).

All 53 of the mainland edge and interior sample plots occurred in forest habitat even though the transects and the mainland interior plot on each transect were randomly located. Most plots were either in the black spruce forest on peaty mineral soil or the black spruce forest on peatland habitat type. These results were consistent with the habitat composition of the 1 km Aquatic Buffer (Section 5.3.1.3.4).

Black spruce was the most common and abundant tree species in the mainland sample plots. Black spruce was found in 50 of the 53 plots (ECOSTEM unpubl. results based on

Calyx Consulting unpubl. data), in all vegetation types and with a mean density of 2,396 stems/ ha. Aspen was the second most common species, occurring in 20 plots across most vegetation types. All other species were found in less than 6 plots. Balsam fir and paper birch were the most uncommon species, only occurring in two plots.

Moss spp., stair-step moss (*Hylocomium splendens*), black spruce (*Picea mariana*), bunchberry (*Cornus canadensis*) and dry-ground cranberry (*Vaccinium vitis-idaea*) were the most common understorey species (in descending order), occurring in at least 80% of the mainland plots (ECOSTEM unpubl. results based on Calyx Consulting unpubl. data). Dry-ground cranberry (*Vaccinium vitis-idaea*) and bunchberry (*Cornus canadensis*) were the most abundant species with mean frequencies of 8.2 and 7.4, respectively (maximum possible is 15).

Most species were just as common in mainland edge as in mainland interior plots (i.e., forest edge versus interior). Exceptions included common horsetail (*Equisetum arvense*), northern bedstraw (*Galium boreale*), Labrador tea (*Ledum groenlandicum*), wild strawberry (*Fragaria virginiana*) and small scouring-rush (*Equisetum scirpoides*) which were substantially more common in the forest edge than in the forest interior. In contrast, dewberry (*Rubus pubescens*) and one-sided wintergreen (*Pyrola secunda*) were somewhat less common in the forest edge. Dry-ground cranberry (*Vaccinium vitis-idaea*) was more abundant in the forest edge than in the interior.

Species composition was also examined by Manitoba FEC V-Type. Results from this analysis are incorporated into the broad habitat type descriptions (Section 5.3.1.2.5).

5.3.1.2.8 Forest Age

Forest habitat comprises 47% of Sub-Region land area. The species composition and age of forests are continually changing in a cycle maintained by large wildfires. A typical large wildfire causes complete aboveground vegetation mortality in a burn patch thereby returning the age of the plant community to zero. Clearly this also causes a sudden, drastic change in species composition. Boreal vegetation is well adapted to frequent large wildfires. Burned patches undergo a successional sequence of vegetation types which often eventually return to a type that is similar to the pre-fire type (see Ehnes 1998 for results from eastern Manitoba and a review of the relevant literature). Age class differences in vegetation structure and composition are important factors in animal habitat selection (R. Berger pers. comm.).

As expected, the age class distribution of Sub-Region forests largely reflects fire history (compare Figure 5.3-20 with Figure 5.2-7; recall that the limitations of using FRI cutting class as an indicator of age class described in Section 5.2.4.1.1). Most forest is in intermediate age classes. Old and recently disturbed forest are the most uncommon classes. Old forest occurs in concentrations (1) near Highway 6, (2) on islands in Paint Lake, along the shoreline and near Wuskwatim Lake, (3) near the junction of Highway 391 and the Nelson House access road, and (4) in the southeast corner near Partridge Crop Hill (Figure 5.3-21).

The age class distribution of Region and Sub-Region forests are different (Figure 5.3-20). Recently disturbed forest is much less abundant (covers 6 rather than 16% of area) in the Sub-Region, while all other age classes are slightly more abundant. Most of the old forest in the Sub-Region is located in the Paint Lake area and around Wuskwatim Lake (Figure 5.3-21). Most of the recently disturbed forest was produced by a single large fire.

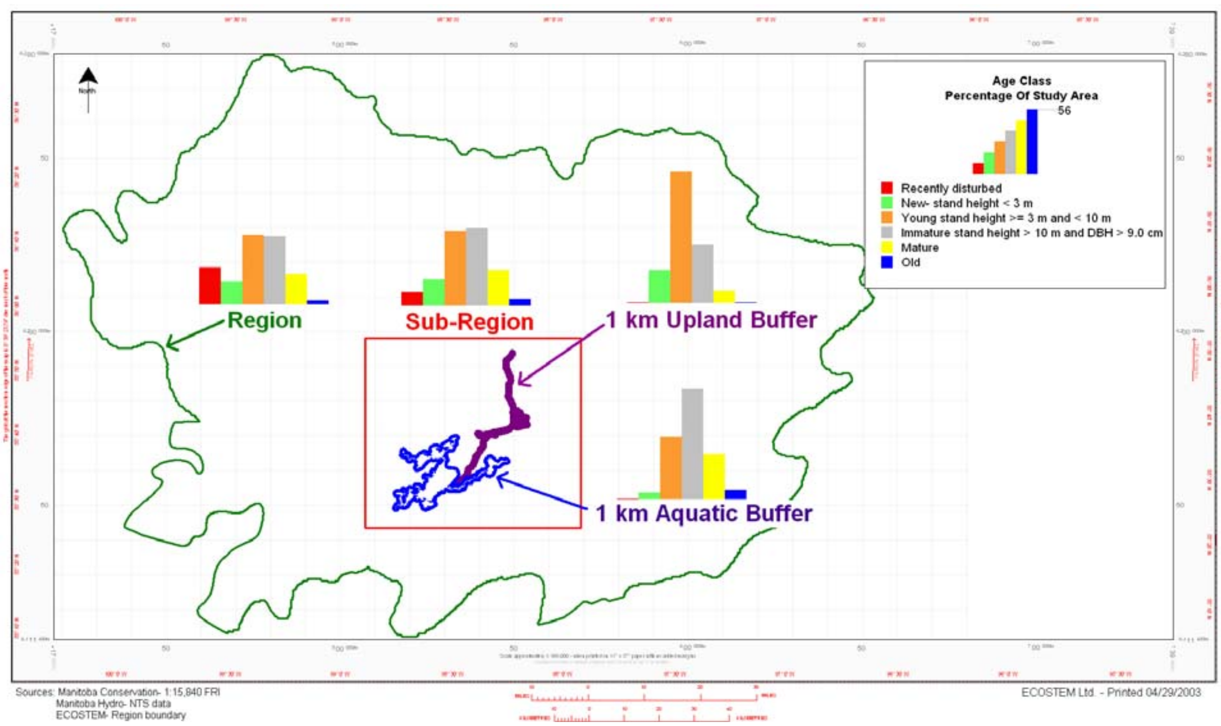
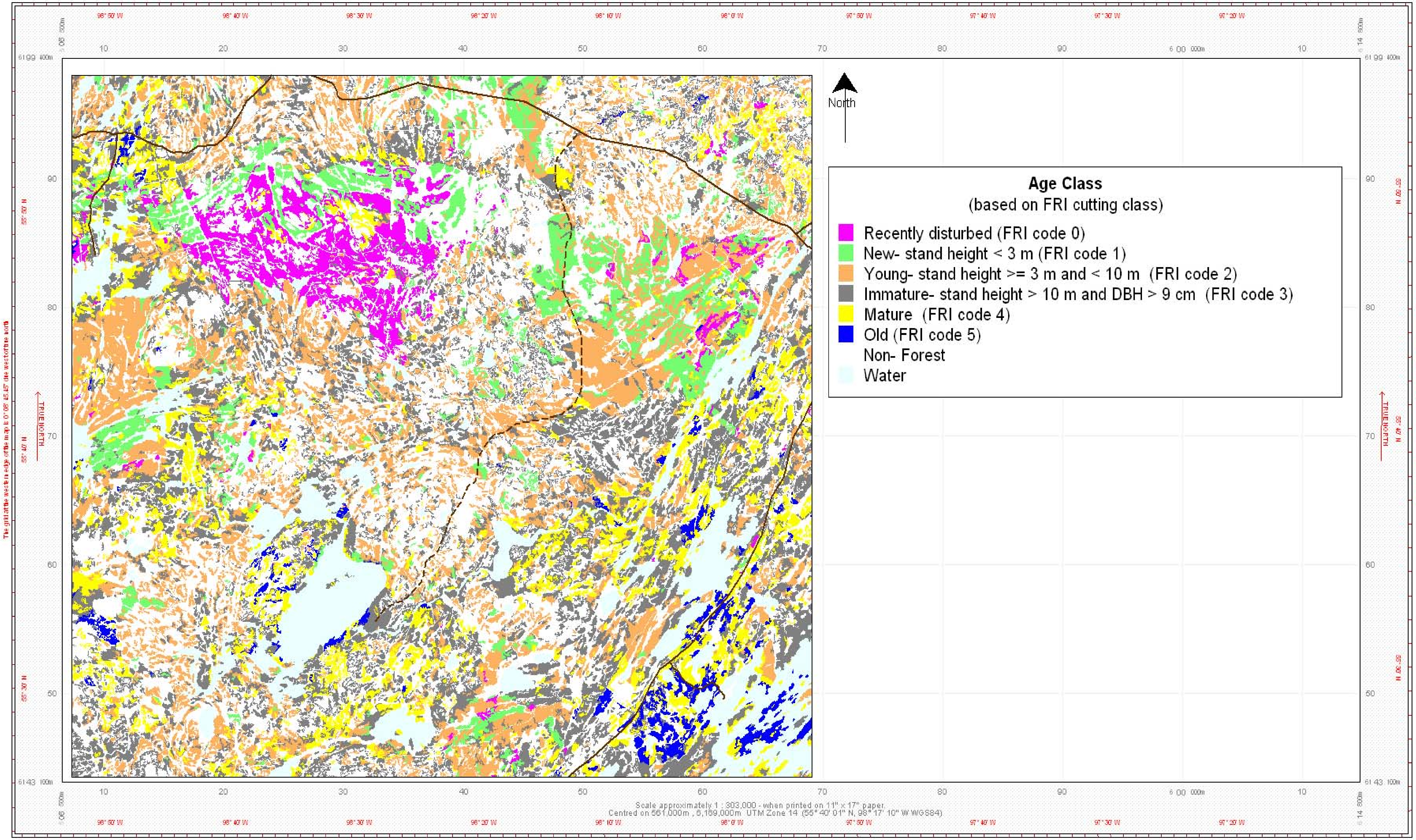


Figure 5.3-20. Age class structure of forest habitat in study areas.

Notes: 1 km Upland Buffer in purple; 1 km Aquatic Buffer in blue.



Source: Manitoba Conservation for 1:15,840 Provincial FRI Data
Manitoba Hydro for NTS Features

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Figure 5.3-21. Forest age in the Sub-Region.

5.3.1.2.9 Associations between Vegetation and Surface Materials, Climate and Disturbance

Black spruce forest on mineral soil tends[8] to occur in areas with either deep clayey materials, deep clayey materials interspersed with bog and fen, or fen interspersed with weakly broken clayey materials (Appendix 5.11 Table 5.11-2). Black spruce forest on peatland tends to occur on fen interspersed with weakly broken clayey materials and tends to be less prevalent on deep, weakly broken clayey materials interspersed with bog and fen. The distribution of sparsely treed black spruce peatland is similar to the overall distribution of the surface material types. In contrast, sparsely treed tamarack peatlands are concentrated on bog and fen interspersed with clayey materials.

Jack pine dominated forest and jack pine forest on dry sites tend to be found on sandy material in the Sub-Region. The balance of the jack pine forest on dry sites is distributed throughout most of the remaining surface material types probably on localized shallow soils over bedrock. Jack pine mixedwood forest is concentrated on mixtures of clay and bog/ fen.

White spruce and balsam fir forest are too uncommon to relate to the available surface materials information. These forest types are generally found on islands in lakes or along the shore of lakes and rivers on the Burntwood River system (Section 5.3.2.1). This association may be because these locations have a lower probability of burning. White spruce and balsam fir are fire intolerant species. Research in southeastern Manitoba has shown that white spruce and balsam fir generally do not reappear in a burn patch until at least 30 years after fire (Ehnes 1998).

Aspen forest tends to occur in areas with deep, weakly broken clayey materials interspersed with fen and bog. Within these areas, aspen forest is not found in the fens and bogs but replaces black spruce forest on mineral soil in the toposequence shown in Figure 5.1-3.

The surface material polygons used to derive the results in Table 5.11-2 are large and mask the high variability in soil types that produces a rich mosaic of broad habitat types. For example, the black spruce forest on mineral soil, black spruce forest on peatland and sparsely treed black spruce bog or fen land cover types often occur as a toposequence

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[8] A type "tends" to something if its representation is substantially disproportionate in relative terms e.g., percentage of area accounted for by vegetation type is greater than percentage of area accounted for by surface material type. Note that these results suggest patterns but not definitive relationships because they involve a cross-scale comparison (i.e., vegetation at fine habitat scale and land type at the landscape scale).

throughout the boreal forest (Figure 5.1-3). In an area with undulating clayey glaciolacustrine deposits, black spruce forest is often found from the crest to the lower slope positions, while open black spruce occurs in the peat-filled basins between the clay hummocks or in the low areas leading into creeks or lakes (Figure 5.3-22). The transition from forest growing on mineral to organic soils occurs in the lower and toe slope positions. In this toposequence, the spruce trees become less dense as the water table gets closer to the surface.

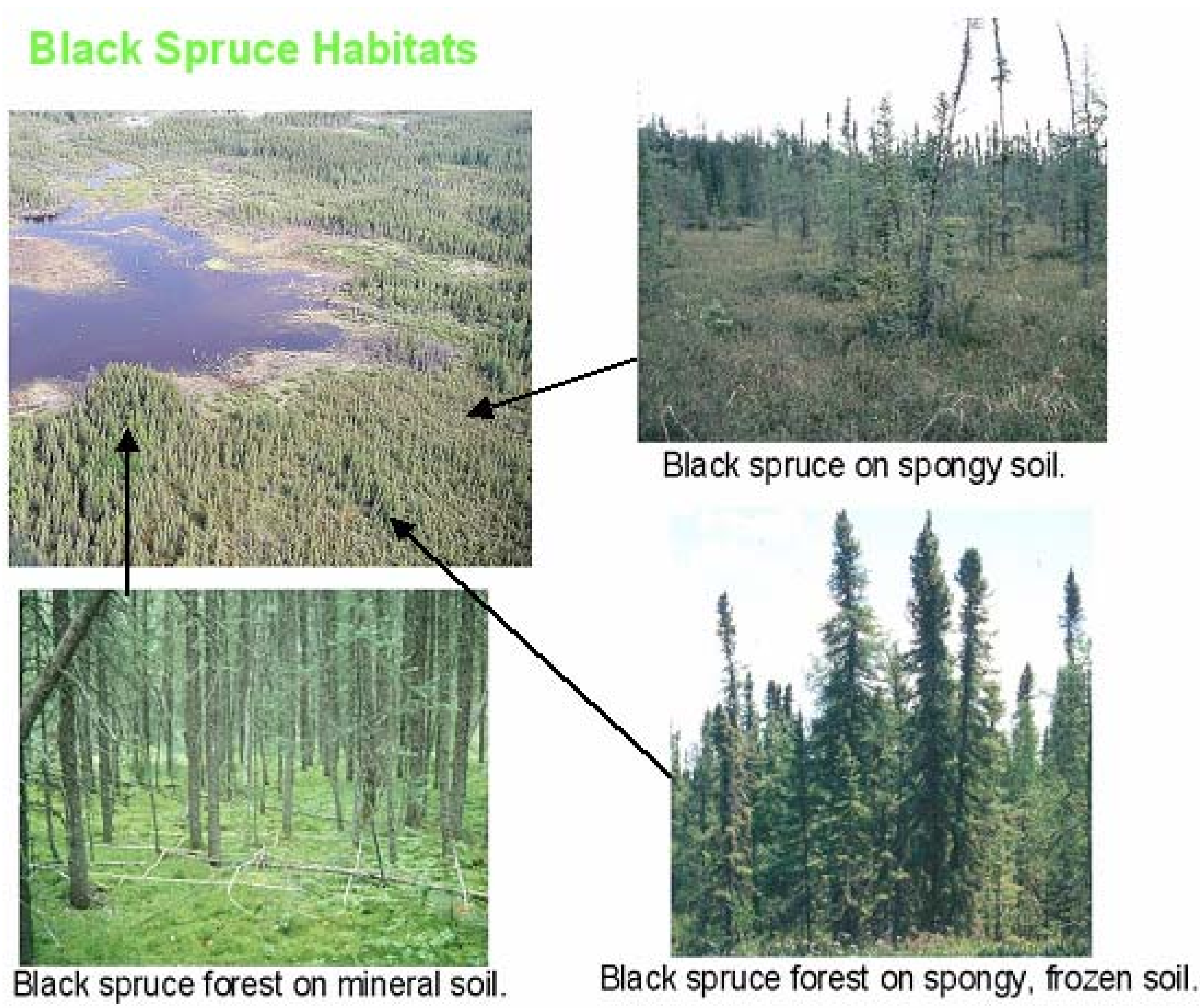


Figure 5.3-22. Sequence of black spruce forest on mineral soil, black spruce forest on peat soil and very open black spruce with low shrubs and sedges on spongy soil/ peatland.

See Section 5.3.1.2.5 for descriptions of the habitat types.

5.3.1.3 1 km Aquatic Buffer

The 18,920 ha 1 km Aquatic Buffer is comprised of 64% forest, 33% wetland and 3% other types including water.

5.3.1.3.1 Surface Materials and Topography

Surface materials in the 1 km Aquatic Buffer are primarily a mosaic of clayey deposits interspersed with bogs (Figure 5.3-23). Clayey deposits with veneer bog patches and occasional peat plateaus is the most abundant surface material complex type in the 1 km Aquatic Buffer (Figure 5.3-24). Varved lacustrine materials (i.e., alternating layers of silty and clayey materials) are common in the clayey patches found throughout the 1 km Aquatic Buffer. Most of the mineral soils in sample pits had textures that ranged from silty clay to heavy clay. Mineral surface materials tend to be shallower along the upstream reach of the Burntwood River and along the northeastern shore of Wuskwatim Lake. Exposed bedrock outcrops are uncommon in the 1 km Aquatic Buffer and concentrated in the south bay of Cranberry Lakes.

Peat plateau bogs were not found on the mainland side of the Affected Aquatic Area shoreline presumably due to the past effects of CRD. Higher water levels have apparently melted all of the permafrost in the Mainland Edge of the Shore Zone, leading to the collapse of peat plateaus and the formation of horizontal fens and marshes. Figure 5.3-25 shows an example of a collapsing peat plateau bog in the Affected Aquatic Area that has been separated from the mainland and is slowly disappearing.

Horizontal fens with patches of open water, bog and/ or marsh are scattered throughout the 1 km Aquatic Buffer along the margins of small lakes inside the Buffer or where creeks enter the lakes or Burntwood River. The horizontal fens with patches of open water, bog and/ or marsh surface material complex type generally coincides with the "low shrub, graminoid and/ or emergent wetland" broad habitat type. The water table in these fens and bogs is usually within 20 cm of the surface. In this land type, a bog is a successional stage that follows fen formation in localized areas where Sphagnum mosses are able to establish and flourish.

A direct comparison of surface materials in the 1 km Aquatic Buffer and the Sub-Region cannot be made because the mapping methodologies are too different. Some general observations can be made based on the available information. The area in peatlands and sandy deposits is much lower in the 1 km Aquatic Buffer compared to the Sub-Region.

Peatlands are probably less abundant in the protected bays due to the effects of CRD and in the main body of Wuskwatim Lake due to high wave energy. The 1:250,000 Sub-Region surface materials map indicates that most of the Cranberry Lakes area is surrounded by patches of sand interspersed with other materials (ECOSTEM unpubl. results). Sandy materials may be more common than shown in the 1 km Aquatic Buffer because ground-truthing of the surface material complex map was concentrated near the shoreline.

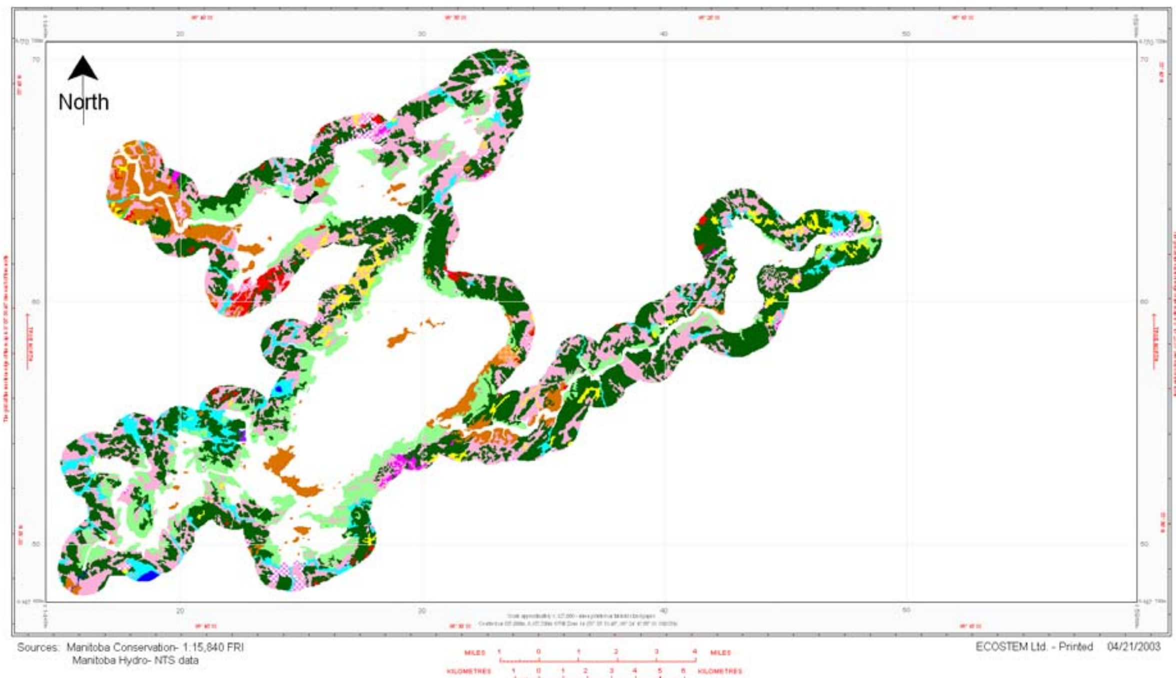


Figure 5.3-23. Surface material complex types in the 1 km Aquatic Buffer and on Mineral Islands.

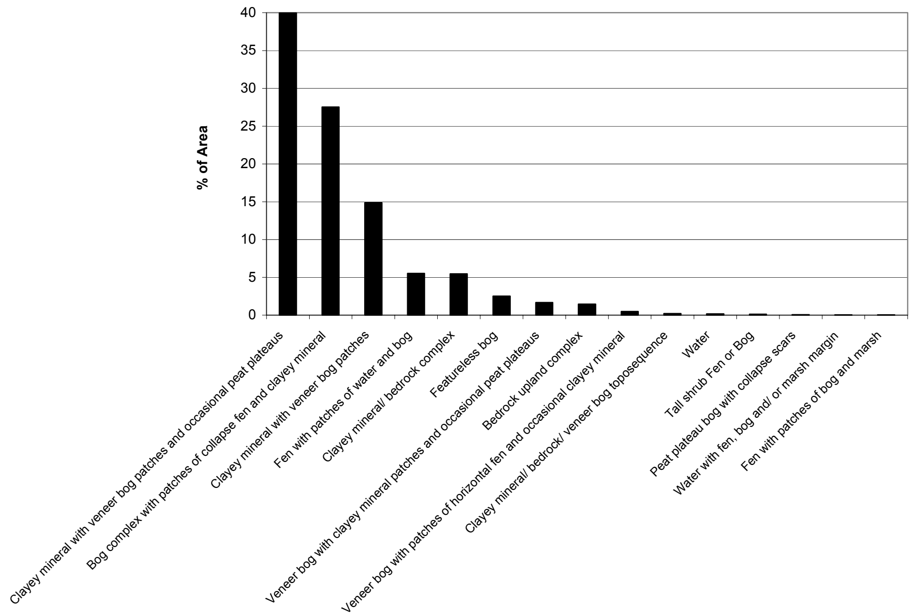


Figure 5.3-24. Surface material complex types in 1 km Aquatic Buffer as a percentage of total land area.

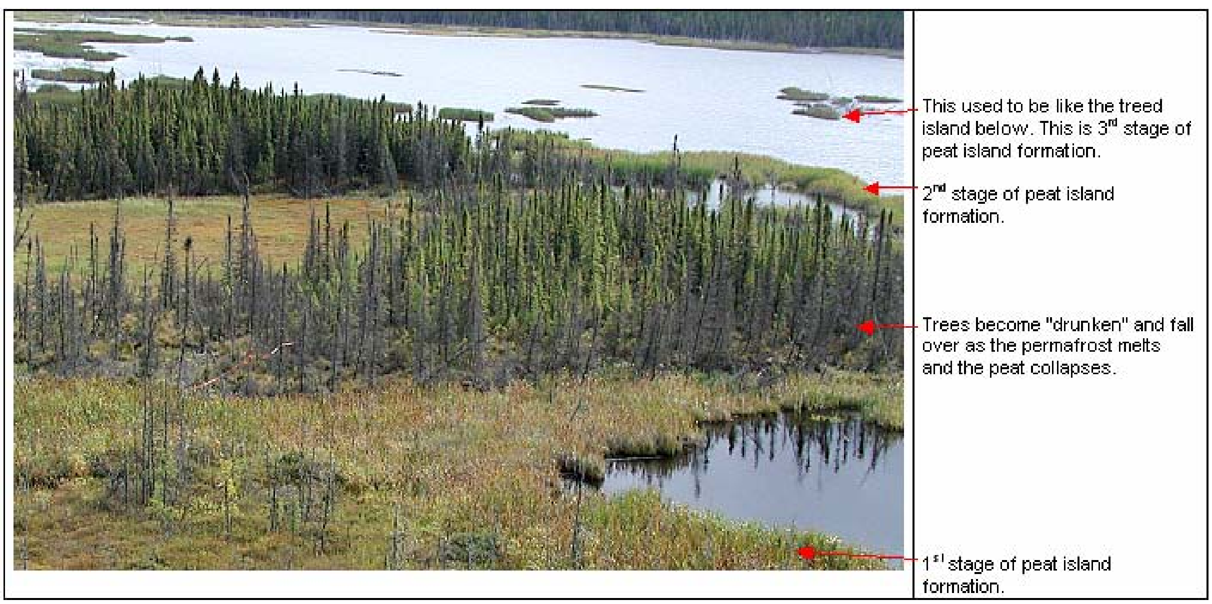


Figure 5.3-25. Peat plateau bog collapsing after higher water levels melt permafrost.

The 1 km Aquatic Buffer was sub-divided into seven geographic zones based on broad differences in surface materials and vegetation (Table 5.11-6; Figure 5.3-26). Surface materials downstream of the proposed dam are substantially different from the rest of the 1 km Aquatic Buffer. Clayey deposits with patches of veneer bog and occasional peat plateaus are more abundant along the Burntwood River and Opegano Lake (59% and 48% of the areas, respectively) compared to a median of 37% for all of the zones (Table 5.11-6). The higher prevalence of peat plateau bogs in this area is associated with lower relief (Figure 5.3-27). Downstream of the generating station, there are large flat areas that slope gently to the shoreline. In contrast, much of the buffer along Wuskwatim Lake has high slopes along the shoreline. Water drains off rapidly in these areas, which limits the percentage of area in saturated soils where deep peat and peat plateau bogs can develop. Gently sloping, low relief along Opegano Lake is also associated with the highest percentage of featureless bog. It is not known to what extent the higher prevalence of bogs is also related to how much the water regime was changed by the CRD.

Cranberry Lakes has the best representation of the various surface material complex types (Figure 5.3-26). Cranberry Lakes is distinguished from the other geographic zones in the 1 km Aquatic Buffer by shallower surface materials. It is the only zone where sandy surface materials were found. High, clayey, eroding banks occur along the north shore of the Burntwood River above the first Cranberry Lake.

The Sesep Lake geographic zone is distinguished from the other zones by the highest percentage of area in bog complex with patches of fen and clay deposits. As with the Opegano Lake zone, large peatland complexes are found in areas with low relief.

Wuskwatim Main and Wuskwatim South Bay have substantially more clayey deposits with veneer bog patches than the other geographic zones. Wuskwatim South Bay is distinguished from the other zones by a combination of high abundance of clayey deposits with veneer bog patches and low abundance of bog complex with patches of collapse fen and clayey deposits. Wuskwatim Brook has the second best representation of the various surface material complex types and the highest percentage of area in fen with patches of water and bog. Relatively low relief and low overall slope also characterize this zone.

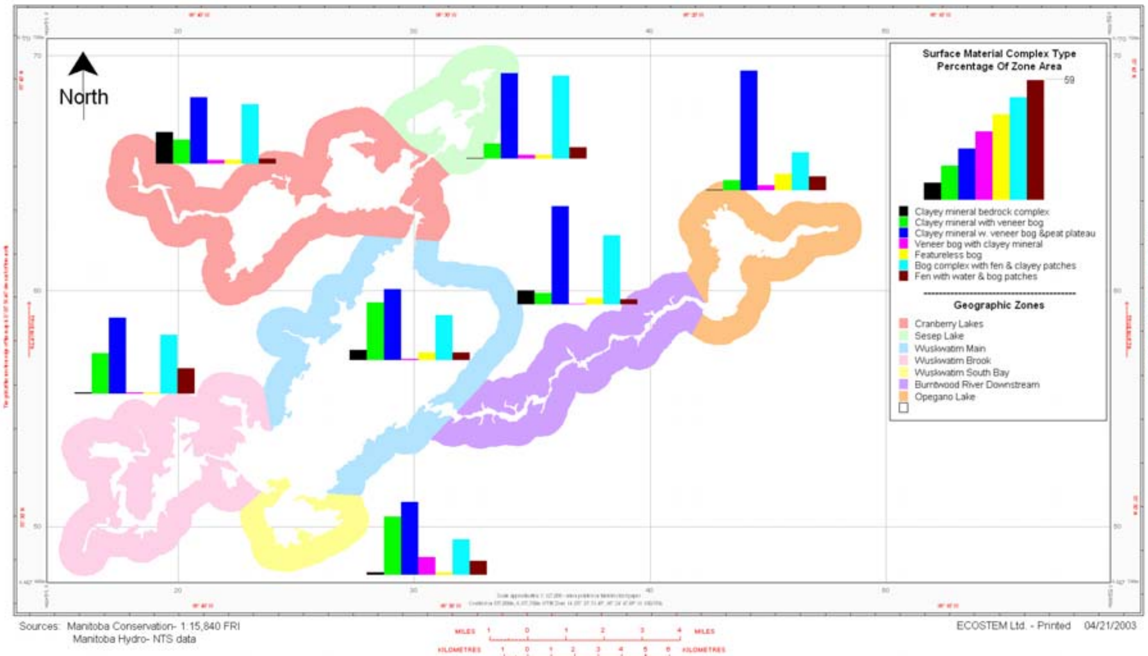


Figure 5.3-26. Surface material complex type as a percentage of total area in the geographic zone.

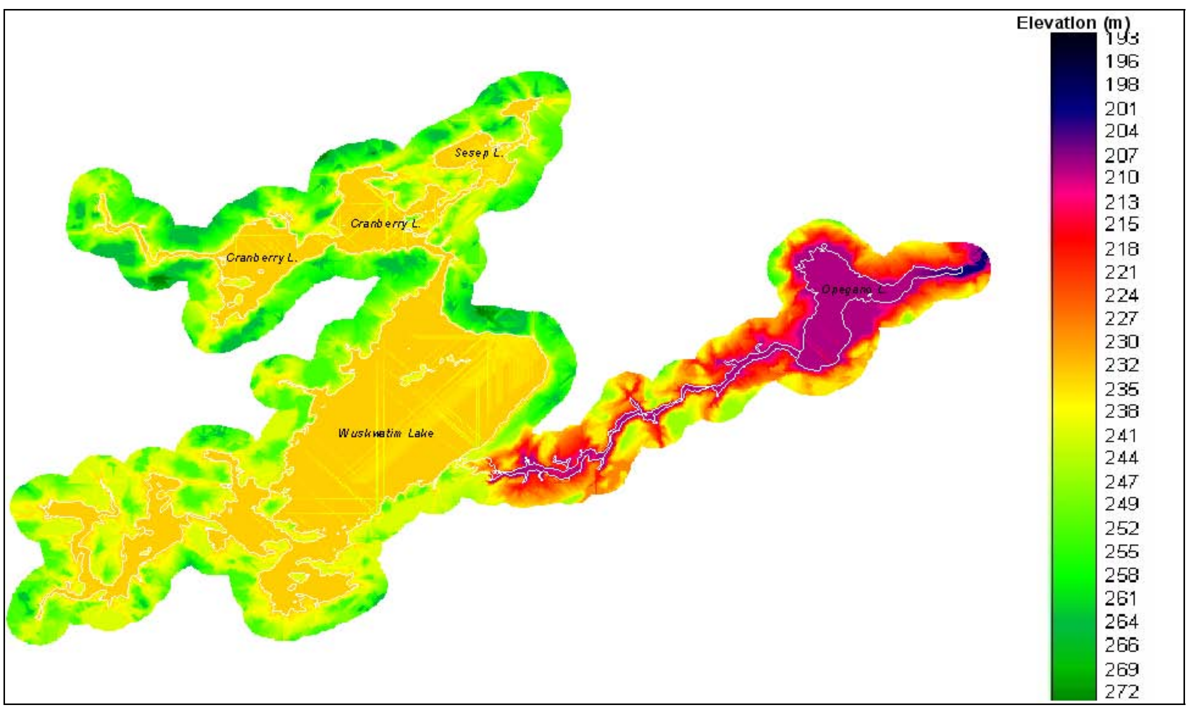


Figure 5.3-27. Elevations in the 1 km Aquatic Buffer.

Source: Interpolated from 1:50,000 NTS data provided by Manitoba Hydro. White line is existing shoreline in Affected Aquatic Area.

5.3.1.3.2 Land Type

The 1 km Aquatic Buffer is dominated by a mixture of mineral soil, peatlands and peaty mineral soil (Figure 5.3-28). This is the same overall pattern portrayed by the surface materials map.

Land type composition in the 1 km Aquatic Buffer is broadly similar to the Region, Sub-Region and 1 km Upland Buffer (Figure 5.3-4). Peatlands and dry mineral soils are much less abundant in the 1 km Aquatic Buffer than elsewhere in the Sub-Region, while mineral and peaty mineral soils are somewhat more abundant. Peat plateau bogs are virtually absent next to the Affected Aquatic Area shoreline due to the long-term effects of the CRD.

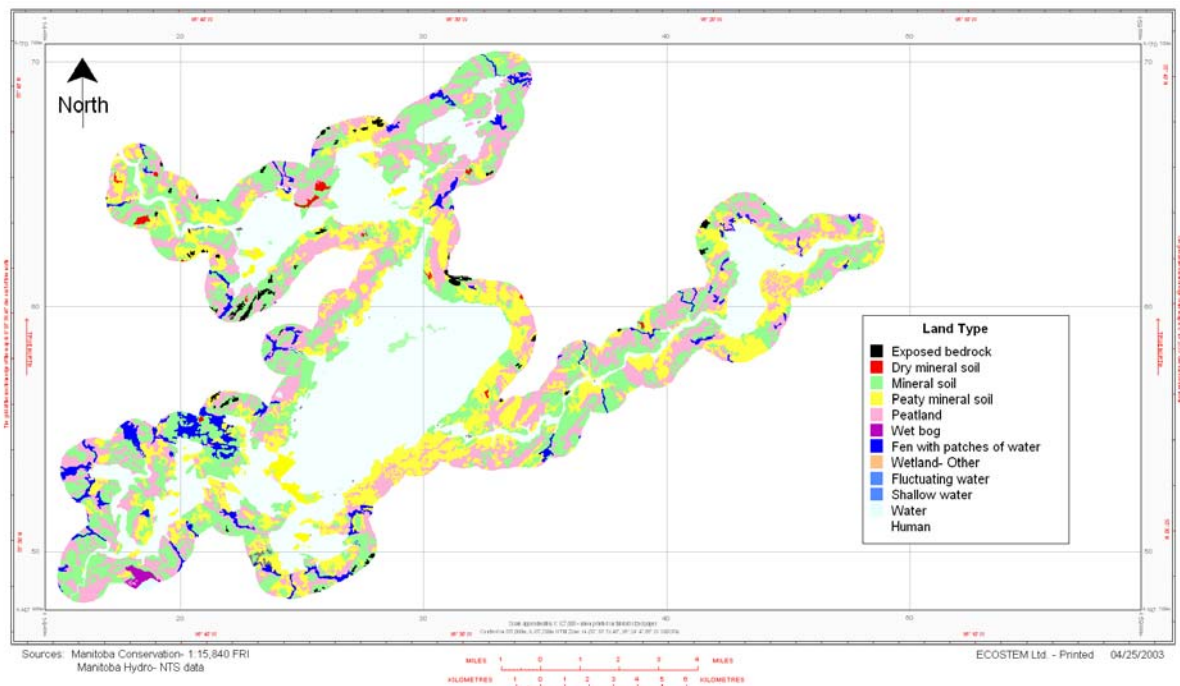


Figure 5.3-28. Land type in 1 km Aquatic Buffer.

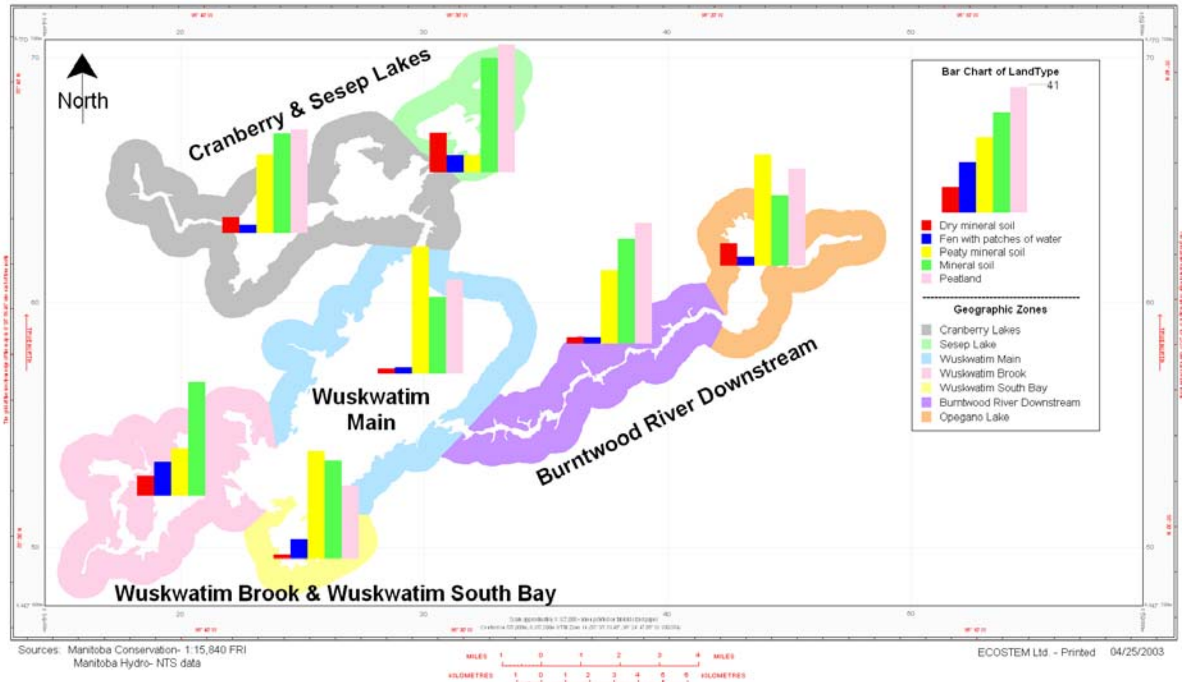


Figure 5.3-29. Land type in the geographic zones of 1 km Aquatic Buffer.

5.3.1.3.3 Land Cover

Land cover in the 1 km Aquatic Buffer (Figure 5.11-1) is broadly similar to the Region and Sub-Region (Figure 5.3-7). Very open vegetation on wetlands or on exposed bedrock cover a lower percentage of area than in the Region or Sub-Region, while conifer forest and hardwood forest cover a higher percentage of area. The 1 ha of human land cover is the former location of the community. Land cover, broad habitat, fine habitat and forest age class composition all vary by geographic zone in the 1 km Aquatic Buffer (Figure 5.3-26). Geographic zone differences, which generally reflect land type composition and topography, are described in Appendix 5.11.3.

5.3.1.3.4 Broad and Fine Habitats

Broad habitat composition in the 1 km Aquatic Buffer is similar to the Sub-Region with a few exceptions (Figure 5.3-9). The 1 km Aquatic Buffer has slightly more black spruce forest on peaty mineral soil and other conifer forest on mineral soil and slightly less black spruce forest on peatland and graminoid wetland (see Section 5.3.1.2.5 for habitat descriptions). The 1 km Aquatic Buffer contains 54% of Sub-Region balsam fir and white spruce forest. The concentrated distribution of white spruce forest and scattered balsam fir saplings and trees along the shoreline probably reflects land type composition differences between the buffer and the Sub-Region combined with the sheltering effect of Wuskwatim Lake against fires.

Broad habitat composition in Sesep Lake zone is quite different from the rest of the 1 km Aquatic Buffer zone (Appendix 5.11.3). Black spruce forest on peaty mineral soil is much less abundant than in the other geographic zones of the 1 km Aquatic Buffer and black spruce forest on peatland coverage is low. These are offset by the highest percentages of area in open black spruce on peat, hardwood forest (includes hardwood dominated mixedwoods) and jack pine forest (includes pine dominated mixedwoods).

5.3.1.3.5 Forest Age

The age class distribution of forests in the 1 km Aquatic Buffer is somewhat different from the Sub-Region and quite different from the Region (Figure 5.3-20). Forests in the 1 km Aquatic Buffer are older than elsewhere, there is no recently disturbed forest and the percentage of area in new and young forests is lower. This may be due to the sheltering effect of Wuskwatim Lake against large fires. Most of the old forest is in the Wuskwatim Main geographic zone (Figure 5.3-30; Appendix 5.11.3).

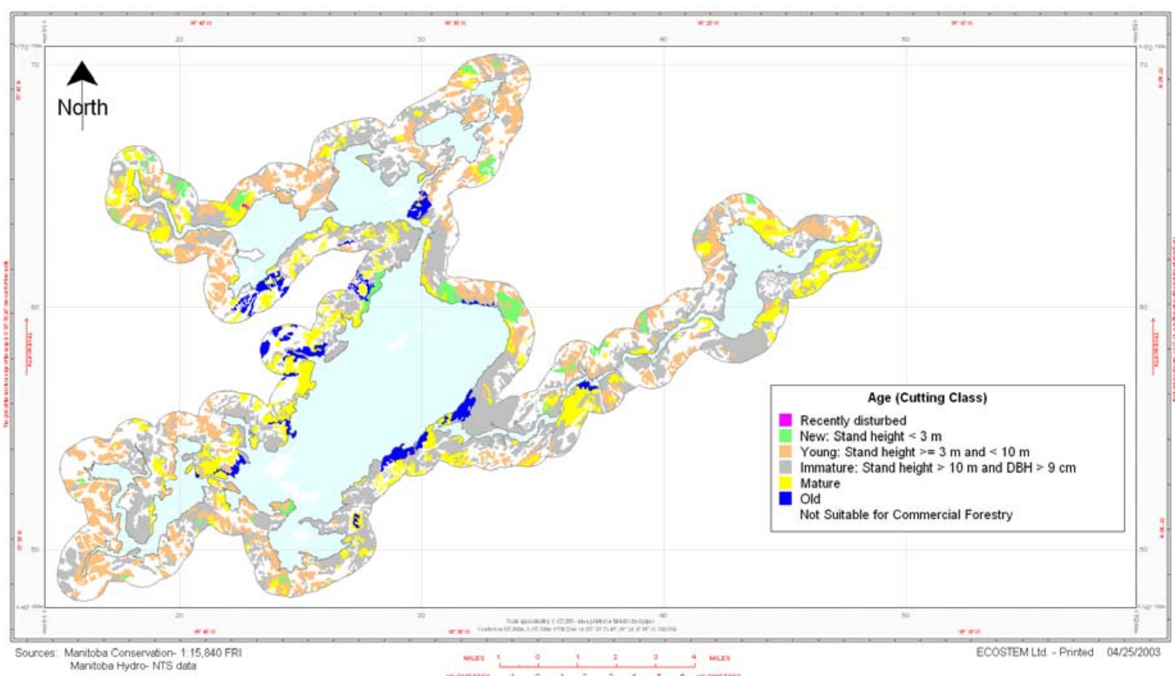


Figure 5.3-30. Forest age in 1 km Aquatic Buffer.

5.3.1.4 1 km Upland Buffer

The 13,030 ha 1 km Upland Buffer is comprised of 62% forest, 37% wetland and 1% other types, including water. Most of the northern half of the 1 km Upland Buffer is located on a glacio-fluvial ridge (Figure 5.3-31).

Figure 5.3-31. Example area along northern half of 1 km Upland Buffer showing clearing for access road alignment.

5.3.1.4.1 Topography, Surface Materials and Soils

Surface materials in the northern half of the 1 km Upland Buffer are dominated by sandy materials and by a mixture of deep, weakly broken clayey materials with patches of bog and fen in the southern half (Figure 5.3-32; ECOSTEM unpubl. results). Fen with patches of weakly broken clayey materials is scattered along the 1 km Upland Buffer. The 1 km Upland Buffer comprises 5% of the Sub-Region area but includes 51% of the Sub-Region's sand dominated surface material types.

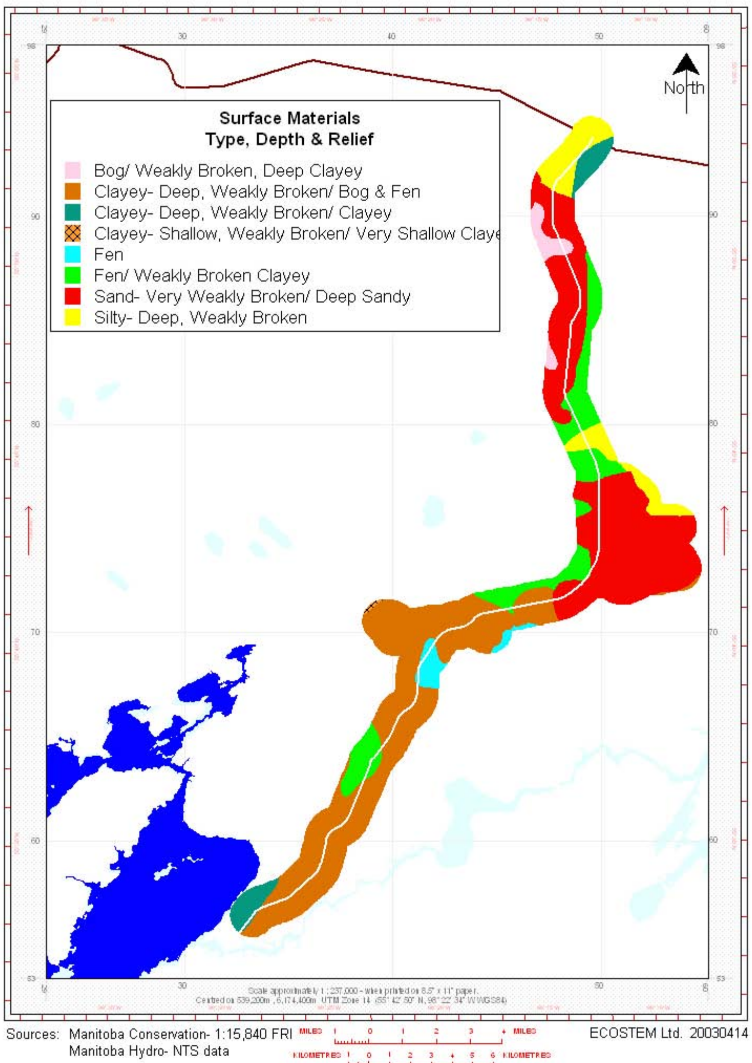


Figure 5.3-32. Surface materials in the 1 km Upland Buffer.

5.3.1.4.2 Land Type

The land type map (Figure 5.3-33) is not directly comparable with the surface material complex map due to differences in map resolution and classifications. The overall patterns portrayed by the two sources are consistent with each other.

Land type composition in the 1 km Upland Buffer (Figure 5.3-33) is substantially different from the other study areas (i.e., Region , Sub-Region, 1 km Aquatic Buffer). Compared with Sub-Region percentage cover, the 1 km Upland Buffer has 5.5 times more dry mineral soil and slightly more mineral soil which is mostly offset by substantially less peaty mineral soil (Figure 5.3-4).

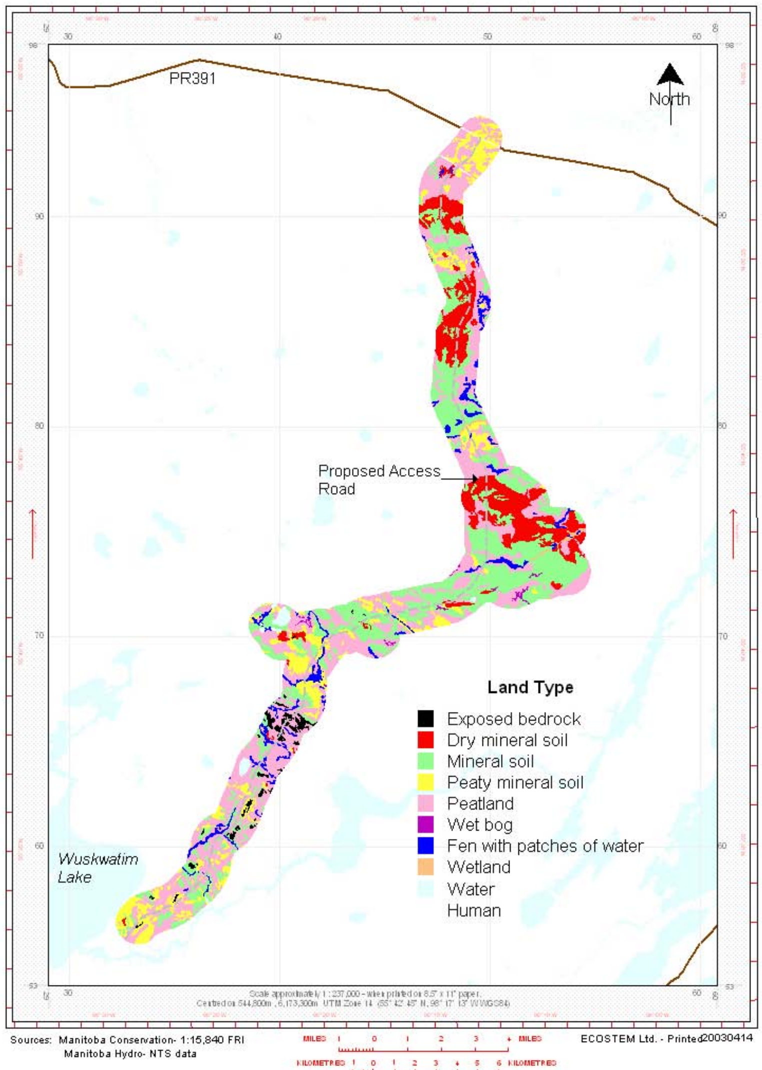


Figure 5.3-33. Land type in the 1 km Upland Buffer.

5.3.1.4.3 Land Cover

As a reflection of land type, land cover in the 1 km Upland Buffer is substantially different from the other study areas. Conifer forest covers 29% less area than in the Sub-Region, while open forest covers 550% more area (Figure 5.3-7). Open forest on dry mineral soil is concentrated in the northern half of the 1 km Upland Buffer.

5.3.1.4.4 Broad and Fine Habitat

Habitat composition in the 1 km Upland Buffer (Figure 5.3-34) closely reflects land type composition. Vegetation in the 1 km Upland Buffer is primarily a mixture of very open black spruce ericaceous (30%), open jack pine forest (15%), black spruce forest (15%) and black spruce/ jack pine forest (11%). The jack pine forest is concentrated on the sandy surface materials. Habitat in the 1 km Upland Buffer is similar to the Region and Sub-Region except that jack pine forest on dry sites is much more abundant (Figure 5.3-9). Thirty percent of Sub-Region jack pine forest on dry sites is in the 1 km Upland Buffer.

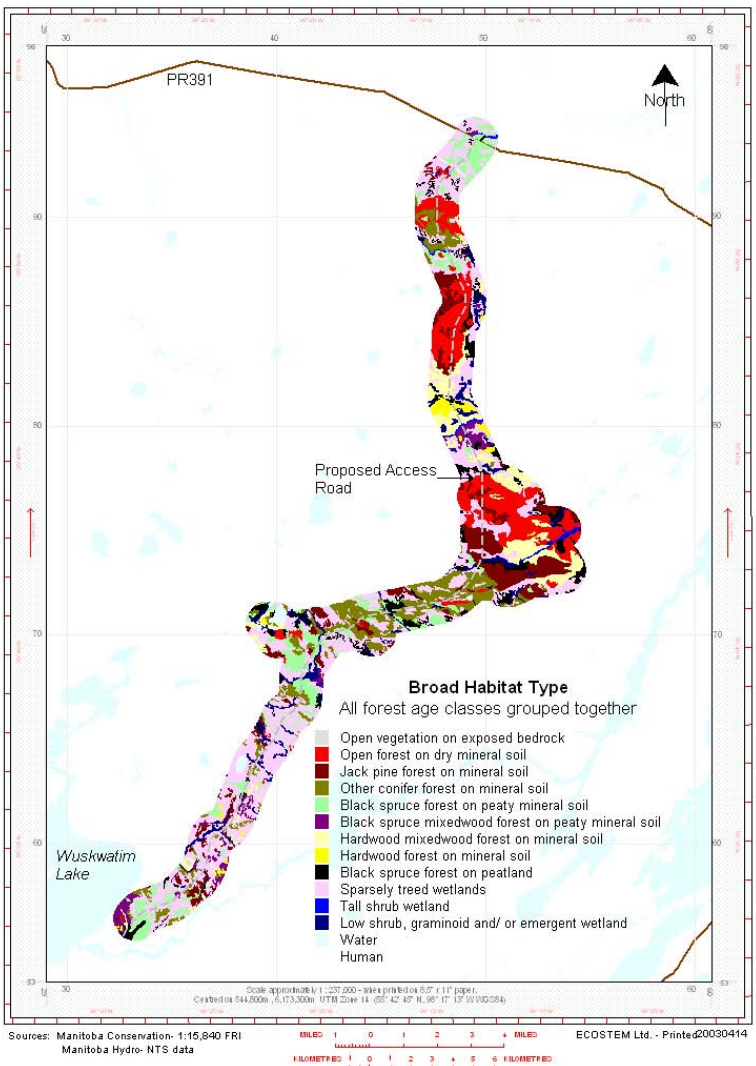


Figure 5.3-34. Broad habitat composition of the 1 km Upland Buffer.

5.3.1.4.5 Forest Age

Compared with the other study areas, the 1 km Upland Buffer has the highest percentage of area in young forest and the lowest percentages of area in immature, mature and old forest (Figure 5.3-21). Young forest is most abundant on sandy surface materials (compare Figure 5.3-35 with Figure 5.3-32).

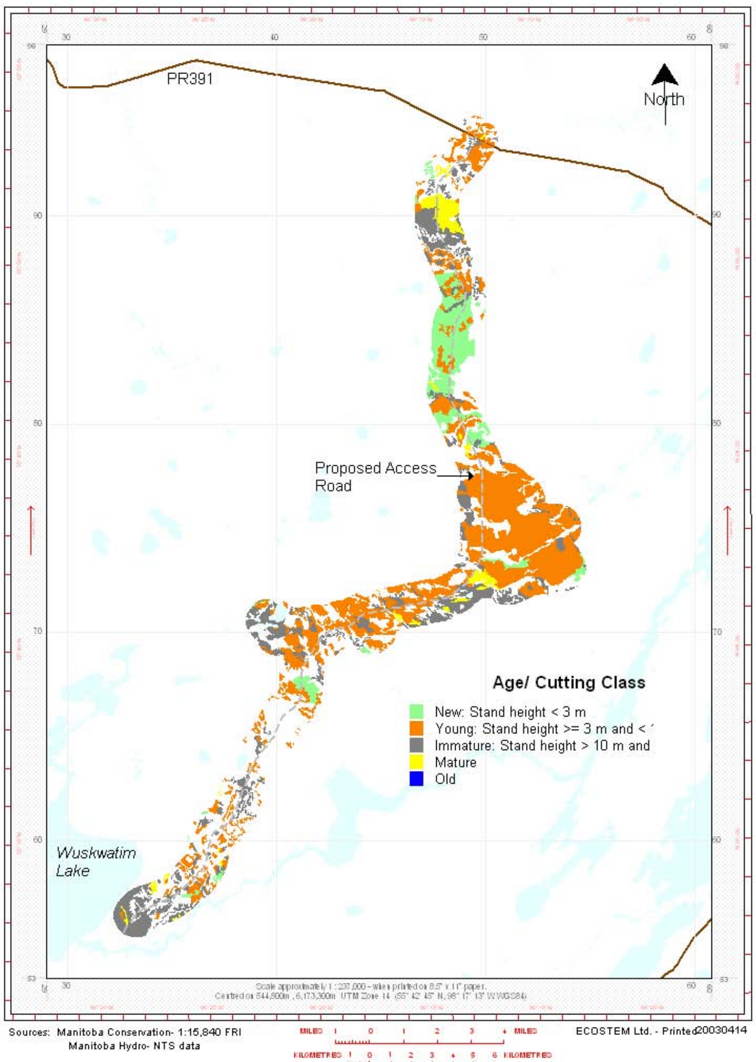


Figure 5.3-35. Age/ cutting class in the 1 km Upland Buffer.

5.3.2 Mainland/ Upland VECs and Road Density

5.3.2.1 Balsam Fir (Napakasiht/ **Abies balsamea** *(L.) Mill.)/ White Spruce (Wapiskimnahtik/* **Picea glauca** *(Moench) Voss)*

Balsam fir is an evergreen, coniferous tree found throughout the central and eastern boreal forest. The tree usually has a conical shape, flat needles arranged in a flattened spray and smooth bark dotted with blisters filled with an aromatic, sticky resin. Balsam fir often grows in mixed stands with white spruce and/ or aspen.

Balsam fir is able to grow in shade. Saplings can form a fairly dense understory under the forest canopy. A mature forest patch may contain abundant balsam fir in the understorey but none or few individuals in the overstorey. Balsam fir is slow to return after fire, has a shallow root system that it susceptible to wind throw, is susceptible to several damaging fungi and is the preferred food of spruce budworm. The naturally limited overstorey distribution of balsam fir and the limited information on understorey distribution presents a challenge for mapping the distribution of this VEC.

White spruce is an evergreen, coniferous tree common throughout the central and eastern boreal forest in moist woods. In optimal growing conditions, the tree usually has the shape of a cylinder with a conical top. Its needles are four-sided and the bark is rough. Its shade tolerance is lower than balsam fir but higher than black spruce. White spruce often grows in mixed stands with balsam fir and/ or aspen. It has higher nutrient requirements than other boreal conifers.

White spruce is a hardier tree species with a more widespread distribution than balsam fir. These characteristics make this species more amenable to distribution mapping using aerial photography. White spruce was used as a surrogate for balsam fir since the two species often grow together. They are both fire intolerant and grow best under similar environmental conditions.

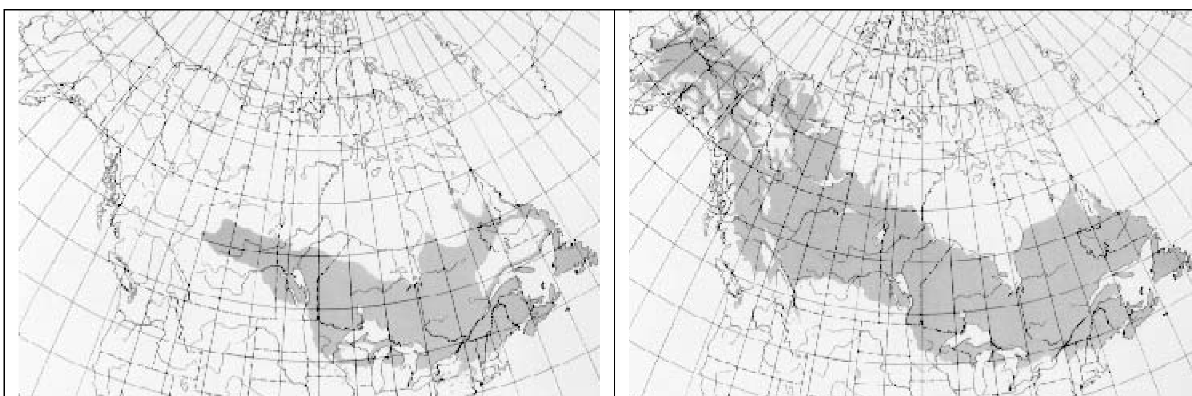
Overview Of Distribution And Ecology

The Sub-Region is nestled within the northern and southern limits of balsam fir's range in Manitoba (Figure 5.3-36 A). White spruce is more widely distributed than balsam fir in Manitoba. Balsam fir can grow on a wide range of mineral and organic soils, while white spruce is generally limited to mineral soils (Burns and Honkala 1990; Bell 1991). White spruce has higher fertility requirements than other conifers (Burns and Honkala 1990; Bell 1991). Despite their broad ranges of soil tolerance, the northern distributions of both species are often limited to river valleys, lakeshores and south-facing slopes (Burns and

Honkala 1990; Smith et al. 1998). In the Region, most balsam fir and white spruce forest occurs within approximately 300 m of large lakes and rivers.

The various types of white spruce or balsam fir forest account for less than 0.14% of the Region land area. White spruce and balsam fir trees occur on a slightly more widespread basis as a minor component of some forest patches. Still, less than 3.3% of Region and 1.8% of Sub-Region land area contains any amount of white spruce. Less than 0.03% of Region and Sub-Region land area contains balsam fir. In contrast, 78% of forest area contains black spruce and 50% contains jack pine. The limited distribution of white spruce is reflected in the vegetation types. White spruce in the Sub-Region is concentrated within 300 m of the Affected Aquatic Area shoreline (Figure 5.4-4).

Wildfire is probably the main factor limiting the distribution of balsam fir and white spruce in the Region. Unlike jack pine or black spruce, balsam fir and white spruce cannot regenerate quickly after a fire. Their cones are not serotinous and they do not sprout from roots or root collars. Studies in southeastern Manitoba found that at least 30 years are required for these species to reestablish in a burn patch if there is no seed source in the adjacent unburnt forest (Ehnes 1998, 2000). Large lakes or rivers provide some protection against fire and increase the probability that balsam fir and white spruce will have time to reestablish in the area.



(A) Balsam fir

(B) White spruce

Figure 5.3-36. Native range of (A) balsam fir and (B) white spruce (Source: Burns and Honkala 1990).

Habitat Associations- White Spruce

White spruce habitat associations are described before balsam fir because white spruce is used as a surrogate for balsam fir.

The known locations of white spruce in the Sub-Region are:

- white spruce forest primarily occurs within 300 m of large lakes and rivers and on islands in large lakes in the Sub-Region (Figure 5.3-37) and the Region;
- white spruce overstorey trees outside of white spruce forest types were found in the same locations as white spruce forest (Figure 5.3-37); and
- field studies found trees in the north Generating Station Project Area and at three stream crossings along the proposed access road (Table 5.3-1, Figure 5.3-37).

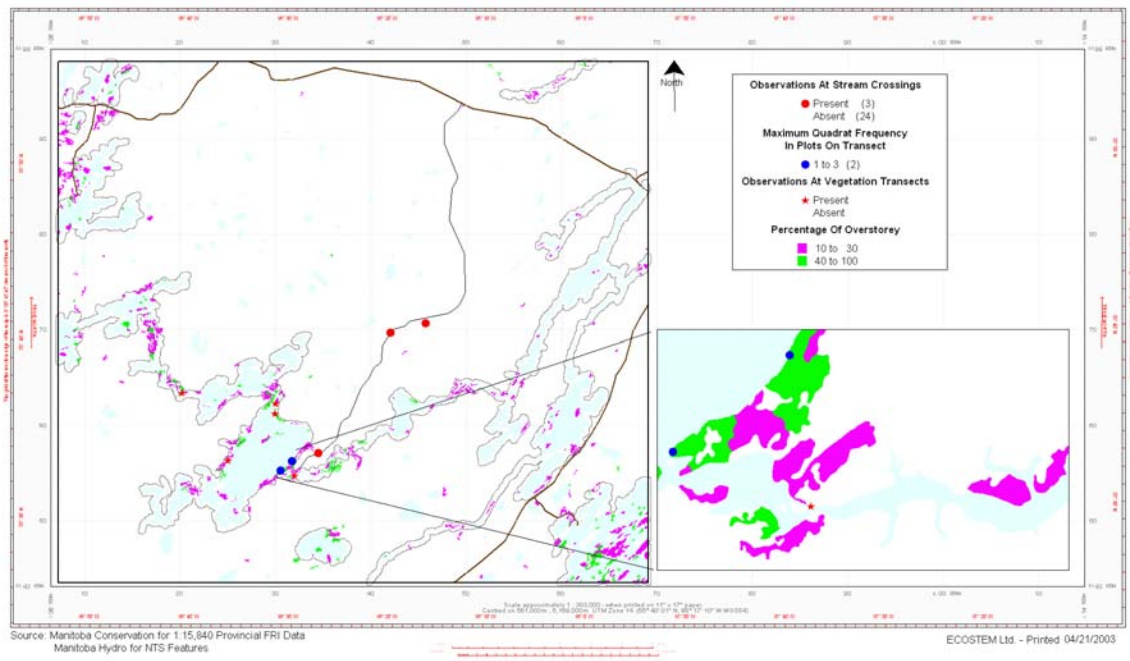


Figure 5.3-37. Known locations of white spruce in the Sub-Region.
Light grey line is 300 m buffer around large lakes and rivers.

In the Sub-Region, all but one of the 147 habitat patches and over 99% of the area that had at least 40% white spruce in the tree canopy occurred on mineral soil (Table 5.3-2). The remaining habitat with 10 – 30% white spruce in the overstorey was evenly split between mineral and peaty mineral soil. The field plots with white spruce occurred in mineral soil habitat patches (Table 5.3-1). Stream areas also provide good protection against wildfires where they pass through ravines. Stream crossing surveys found white spruce in three habitat patches with land types other than mineral. The habitat patch land type probably does not accurately reflect the soil type in these locations because (1) the pedestrian surveys actually traversed across the boundary of adjacent habitat patches, and (2) riparian strips are not mapped at the fine habitat scale if they are too narrow.

Table 5.3-1. Balsam fir and white spruce field observations and associated fine habitat type.

Sample Location	Balsam Fir Plot[1]	Balsam Fir FRI[2]	White Spruce Plot	White Spruce FRI	Habitat Type[3]
BWR 01	8		1	70	White spruce/ Conifer > 70% forest on Mineral soil
GS 01				30	Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil
GS 11				10	Black spruce > 70% forest on peaty mineral soil
GS 12				10	Black spruce > 70% forest on peaty mineral soil
GS 21				70	White spruce mixedwood forest on Mineral soil
SSP 01				20	Black spruce > 70% forest on Mineral or peaty soil
WSM 01	10		1	40	Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil
WSM 15				20	Black spruce/ White spruce mixedwood forest on peaty mineral soil
Access Road D			1	0	Black spruce > 70% forest on peaty mineral soil
Access Road E			1	0	Graminoid fen with patches of water
Access Road N	1		1	0	Black spruce sparsely treed peatland

[1] Abundances for plots is number of quadrats; abundances for Access Road locations are presence/ absence.
[2] Percentage of stand basal area in surrounding FRI polygon.

Table 5.3-2. Number of habitat patches containing white spruce by percentage of white spruce and land type.

WS	Peaty mineral soil	Mineral soil	Peatland	Grand Total
10	66	60	2	128
20	61	94		155
30	10	93		103
40		76		76
50		18		18
60	1	24		25
70		20		20
80		3		3
90		2		2
100		4		4
Grand Total	138	394	2	534

Available information indicated that habitat quality for white spruce habitat in the Sub-Region was:

- High for (1) mineral soil within 300 m of large lakes and rivers and (2) large mineral soil islands in large lakes;
- Moderate for (1) peaty mineral soil within 300 m of large lakes and rivers and (2) large peaty mineral soil islands in large lakes;
- Very poor for all other conditions.

Figure 5.3-38 shows white spruce habitat quality in the Sub-Region. The simple model classified 20% of the 300 m aquatic buffer as high quality habitat and 16% as moderate quality habitat. All of the remaining habitat was considered to be very poor for white spruce.

Figure 5.3-38 is a map of potential locations that could support white spruce based on a simple model. Some poor or very poor patches may actually have white spruce, while many high quality locations have no white spruce. White spruce was either absent or present with an overstorey composition of less than 5% (i.e., white spruce percent cover < 10%) in 93% of the 300 m buffer. Low white spruce abundance and deviations between habitat quality and actual white spruce occurrence were expected because factors other than habitat are important influences on white spruce distribution (e.g., site specific conditions, fire history, logging history).

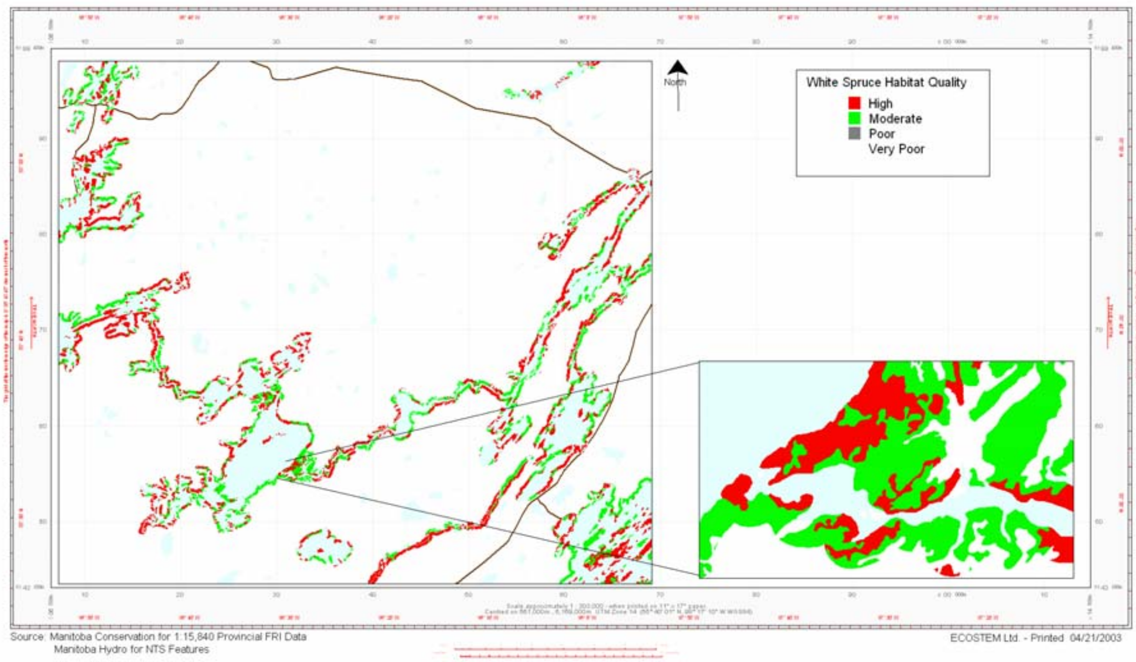


Figure 5.3-38. White spruce habitat quality in the Sub-Region.

Model accuracy in the 300 m large lake and island buffer was assessed by comparing observed white spruce tree abundance with predicted habitat quality. The simple model classified 68% of the 300 m large lake buffer as very poor quality habitat. Only 16% of the area with less than 10% white spruce was classified as high quality habitat (Table 5.3-3). Once the actual percentage of white spruce increased to 10%, the amount of habitat predicted to be very poor declined to zero. Virtually all of the habitat with at least 40% white spruce in it was classified as high quality habitat.

Just because there is a good correspondence between observed and predicted values does not mean that the simple model can reliably predict where white spruce will occur. If that were the case then white spruce would be found in all of the red and green areas in Figure 5.3-38. As already noted, the distribution of white spruce is more limited than that of high quality habitat because distribution is controlled by more than soil type and distance from water. For example, one large wildfire that burns to the water's edge will wipe out many kilometres of white spruce in the 300 m buffer.

Keeping in mind that the model essentially predicts the locations where white spruce is most likely and least likely to be found, the model performed reasonably well at predicting white spruce habitat quality. The simple model performed very well at predicting very poor quality habitat. All of the habitat patches classified as very poor white spruce habitat had 0% - 5% white spruce in the patch (Table 5.3-4). White spruce occurrence increased from 0 in very poor quality habitat to 11% in moderate habitat and then to 25% in high quality habitat. This is the desired trend in model accuracy for a species that is sparsely distributed.

Table 5.3-3. White spruce habitat quality model accuracy based on a comparison of actual locations (from FRI) with predicted habitat quality in the 300 m large lake aquatic buffer. Values are percentage of area in each habitat quality by overstorey cover category.

Percentage Of Overstorey Trees In The Habitat Patch That Are White Spruce	Percentage of Area By Habitat Quality			300 m Buffer Area (ha)
	High	Moderate	Very Poor	
0%	16	16	68	53,340
10%	38	62		999
20%	65	35		1,096
30%	93	7		801
40%	100			682
50%	100			96
60%	95	5		124
70%	100			130
80%	100			8
90%	100			10
100%	100			5
Total Area (ha)	11,607	9,421	36,263	57,292

Table 5.3-4. White spruce habitat quality model accuracy based on a comparison of predicted habitat quality with actual locations (from FRI) in the 300 m large lake aquatic buffer.

Trees In The Habitat Patch That Are White Spruce	High	Moderate	Very Poor	
0%	75	89	100	53,340
10% – 100%	25	11	0	999
All	11,607	9,421	36,263	57,292

Habitat Associations- Balsam Fir

The known locations of balsam fir in the Sub-Region are:

- balsam fir forest was found on one island in Wuskwatim Lake (Figure 5.3-39);
- balsam fir overstorey trees outside of balsam fir forest were found either on two islands in a large lake (Paint Lake) or at the water's edge along the Burntwood River (Figure 5.3-39); and
- field studies found seedlings, saplings and/ or widely scattered trees only in the north Generating Station Project Area and at one stream crossing along the Access Road (Figure 5.3-39). All field observations were on the mineral soil land type.

There were only six habitat patches containing balsam fir in the overstorey: one was classified as a forest type that contains balsam fir, four contained 10% balsam fir and one contained 20% balsam fir. Only limited understorey information is available for balsam fir and white spruce. It is possible that the understorey distributions of these species are more widespread than indicated by the FRI.

The two habitat sample plots with balsam fir (Table 5.3-2) were in the generating station area. Both plots were in a habitat patch that contained white spruce on mineral soil.

Based on the literature and field information, understorey balsam fir is expected to occur in similar locations as overstorey white spruce. Therefore, balsam fir habitat quality ratings for the Sub-Region were the same as for white spruce. That is, high quality balsam fir habitat was (1) mineral soil within 300 m of large lakes and rivers and (2) large mineral soil islands in large lakes. Moderate quality habitat was (1) peaty mineral soil within 300 m of large lakes and rivers and (2) large peaty mineral soil islands in large lakes. All other conditions were classed as very poor balsam fir habitat. Balsam fir habitat model performance was not assessed because balsam fir occurrence was too low for a meaningful evaluation.

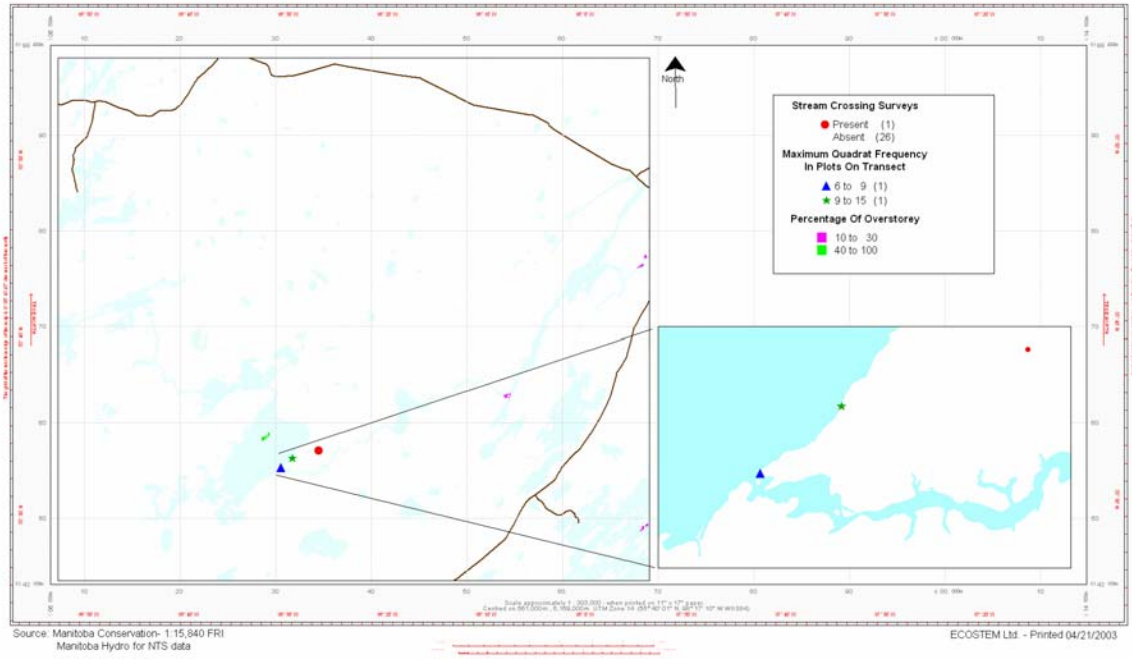


Figure 5.3-39. Known locations of balsam fir in the Sub-Region.

5.3.2.2 Jack Pine (Oskahtik/ **Pinus banksiana** *Lamb. Forest on Dry Sites)*

Jack pine (*Pinus banksiana* Lamb.) is an evergreen, coniferous tree common throughout the boreal forest on a wide range of site conditions. It is considered to be a pioneer species because it is shade intolerant and regenerates well after fire.

<u>Overview Of Distribution And Ecology</u>

The Region falls well within the native range of jack pine in Manitoba (Figure 5.3-40). Jack pine can grow on a wide range of mineral and organic soils (Burns and Honkala 1990; Bell 1991). It even appears in recently burned black spruce bogs where it often persists for up to twenty years (Ehnes 1998).

Wildfire and shade intolerance are probably the main factor maintaining the distribution of jack pine in the Region. A change in the fire regime that reduces the average time between large fires would probably reduce the distribution and abundance of jack pine. Shade intolerance would prevent jack pine from establishing in the immature to old forest that would cover a higher percentage of the Region under a longer fire rotation.

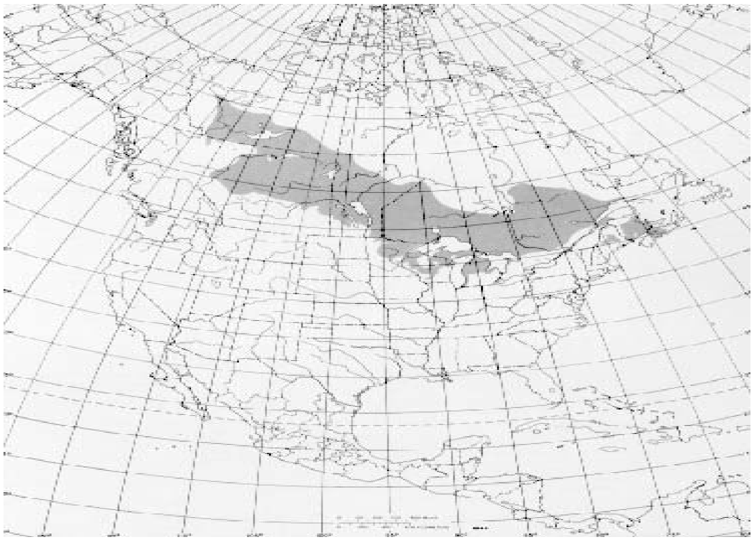


Figure 5.3-40. Native range of jack pine (Source: Burns and Honkala 1990).

Habitat Associations

Virtually all of the open forest on dry mineral soil (Figure 5.3-17) is the jack pine forest on dry sites fine habitat type. Therefore, the distribution and typical characteristics of this VEC were already described in Figure 5.3-17. A habitat model was not developed for the dry jack pine forest VEC because the reliability of the census of its current distribution (i.e., FRI based mapping) cannot be improved upon with available information.

5.3.2.3 Dry Ground Cranberry (Wesakemina/ **Vaccinium vitis-idaea** *L.)*

Dry ground cranberry is a dwarf perennial shrub. Its creeping evergreen stems and branches bear edible red berries which remain on the plant in winter. Seeds are spread through bird and mammal droppings.

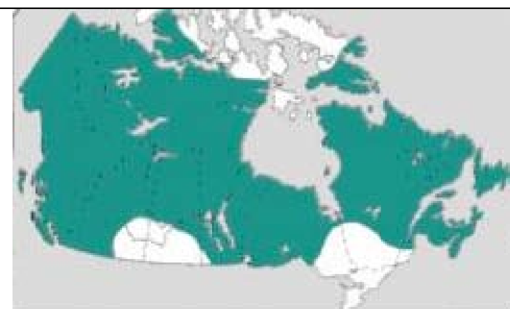
Dry ground cranberry is widespread throughout the boreal forest (Hall and Shay 1981; Johnson et al. 1995; Ringius and Sims 1997), Manitoba (Scoggan 1957) and in the Sub-Region (Figure 5.3-41). It is found on a wide range of habitats from open, very dry uplands to black spruce bogs (Hall and Shay 1981; Ehnes 1998). Ringius and Sims (1997) describe dry ground cranberry as a shade intolerant species that indicates nutrient poor soils. It had a high association with open bogs and jack pine forest in their data.

Dry ground cranberry abundance is thought to be more dependent on moisture than nutrient availability since its nutrient requirements are relatively low (Hall and Shay 1981). Abundance is generally highest in bogs and moist sites. In southeastern Manitoba, its abundance increased from very dry to wet sites, as represented by the transition from bedrock outcrops to peatlands (Ehnes 1998).

Dry ground cranberry occurred on all of the peatland sample plots whether or not they had forest cover. It was the most abundant (measured as frequency in plot quadrats) and one of the five most widespread understorey species in the mainland sample plots (Section 5.2.4.1.1). On the uplands, dry ground cranberry was more common in black spruce than mixedwood forests. Over all the plots, dry ground cranberry distribution was most highly correlated with black spruce (*Picea mariana*) and Labrador tea (*Ledum groenlandicum*; r = 0.74 and 0.71, respectively, P<0.001).

High quality dry ground cranberry habitat in the Sub-Region was essentially sparsely treed wetlands and immature to mature black spruce forest on mineral or peaty mineral soil. Specific details for the dry ground cranberry quality habitat classification are shown in Table 5.3-5.

High quality dry ground cranberry habitat is widespread and abundant in the Sub-Region (Figure 5.3-42). Forty-two percent of Sub-Region habitat is high quality and 13% is moderate quality (Table 5.3-6).



Dry ground cranberry photo and range in Canada *(Source: Ringius and Sims 1997)*

Table 5.3-5. Habitat quality ratings for dry ground cranberry, bog cranberry and velvet-leaf blueberry. H = High, M = Moderate, P = Poor, VP = Very Poor.

Broad Habitat Type	Dry Ground Cranberry	Bog Cranberry	Velvet-Leaf Blueberry
Open vegetation on Exposed bedrock	P	VP	H
Open forest on Dry mineral soil- Immature	P	VP	H
Open forest on Dry mineral soil- Mature	P	VP	H
Open forest on Dry mineral soil- Young	P	VP	H
Jack pine forest on Mineral soil- Immature	M	VP	M to H*****
Jack pine forest on Mineral soil- Mature	M	VP	M to H*****
Jack pine forest on Mineral soil- Young	P	VP	M to H*****
Other conifer forest on Mineral soil- Immature	M	VP	M to H*****
Other conifer forest on Mineral soil- Mature	M	VP	M to H*****
Other conifer forest on Mineral soil- Young	P	VP	M to H*****
Black spruce forest on Peaty mineral soil- Immature	H	P to M***	M to H*****
Black spruce forest on Peaty mineral soil- Mature	H	P to M***	M to H*****
Black spruce forest on Peaty mineral soil- Young	P	P to M***	M to H*****
Other conifer mixedwood forest on Mineral soil- Immature	M	VP	M to H*****
Other conifer mixedwood forest on Mineral soil- Mature	M	VP	M to H*****
Other conifer mixedwood forest on Mineral soil- Young	P	VP	M to H*****
Black spruce & other mixedwood forest on Peaty mineral soil- Immature	H	VP	M to H*****
Black spruce & other mixedwood forest on Peaty mineral soil- Mature	H	VP	M to H*****
Black spruce & other mixedwood forest on Peaty mineral soil- Young	P	VP	M to H*****
Hardwood mixedwood forest on Mineral soil- Immature	P	VP	P to M *****
Hardwood mixedwood forest on Mineral soil- Mature	P	VP	P to M *****
Hardwood mixedwood forest on Mineral soil- Young	P	VP	P to M *****
Hardwood forest on Mineral soil- Immature	VP	VP	P
Hardwood forest on Mineral soil- Mature	VP	VP	P
Hardwood forest on Mineral soil- Young	VP	VP	P
Black spruce forest on Peatland- Immature	H	M to H**	VP
Black spruce forest on Peatland- Mature	H	M to H**	VP
Black spruce forest on Peatland- Young	M	M to H**	VP
Black spruce forest on Peatland- Immature	H	M	P
Black spruce & other mixedwood forest on Peatland- Young	H	M	P
Sparsely treed wetland	H	H	VP
Tall shrub on wetland	M	M	VP
Low shrub, graminoid and/ or emergent wetland	VP or H*	M or H****	VP
Small islands (< 2 ha)	M	VP	M
Water	VP	VP	VP
Human	VP	VP	VP
Human- Linear	VP	VP	VP

* Very poor in graminoid fen; high in Sphagnum bog. ** Moderate in closed forest and high in open. *** Poor in closed forest and moderate in open. **** Moderate in graminoid fen; high in Sphagnum bog. ***** High in open forest. ****** Moderate in open forest.

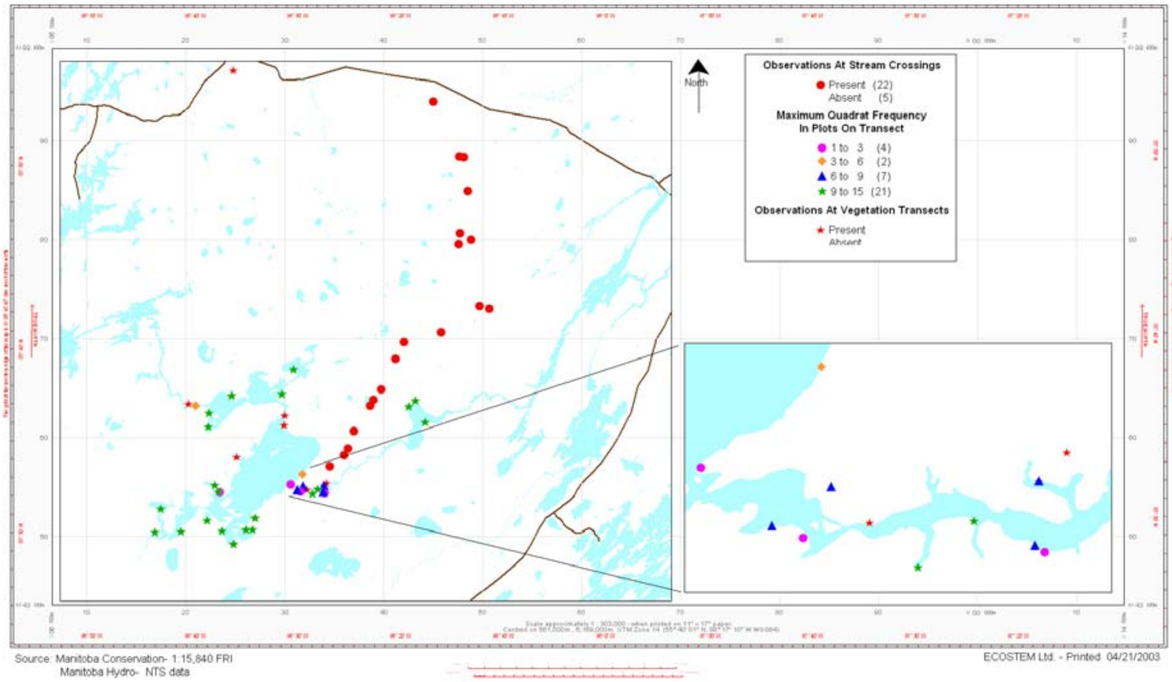


Figure 5.3-41. Known locations of dry ground cranberry in the Sub-Region.

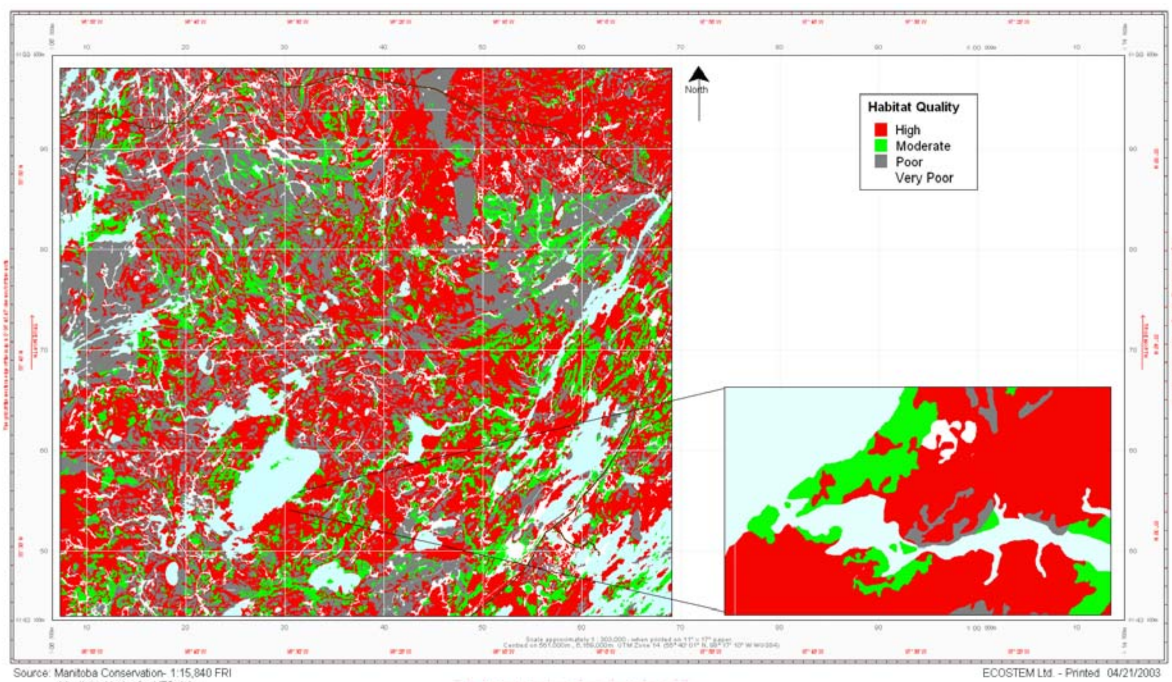


Figure 5.3-42. Dry ground cranberry habitat quality in the Sub-Region.

Table 5.3-6. Sub-Region habitat quality for dry ground cranberry, bog cranberry and velvet-leaf blueberry.

Habitat Quality	Dry Ground Cranberry		Bog Cranberry		Velvet-Leaf Blueberry	
	Area (ha)	% of Area	Area (ha)	% of Area	Area (ha)	% of Area
High	140,166	42%	92,576	28%	24,510	7%
Moderate	44,543	13%	32,700	10%	105,486	31%
Poor	89,654	27%	64,245	19%	23,810	7%
Very Poor	61,262	18%	146,103	44%	181,819	54%
All	335,625	100%	335,625	100%	335,625	100%

5.3.2.4 Bog Cranberry (Wesakemina/ **Oxycoccus microcarpus** *Turcz. {***Vaccinium oxycoccus***})*

Bog cranberry is a tiny, trailing, evergreen shrub. Its slender branches trail along the ground rooting at the nodes. It produces large edible red berries, which ripen late in the year often persisting under the snow.

Bog cranberry is widespread throughout the boreal forest (Johnson et al. 1995), Manitoba (Scoggan 1957) and in the Sub-Region. Ringius and Sims (1997) describe it as a shade intolerant species characteristic of wet, nutrient poor, organic soils. This is consistent with other literature (Scoggan 1959; Johnson et al. 1995; Ehnes 1998). Bog cranberry is occasionally found in moist coniferous feathermoss forest. NCN members indicated that cranberries were harvested in the Cranberry Lakes area prior to the CRD. The area was named for the abundance of berries that grew there.

Dry ground cranberry range in Canada *(Source: Ringius and Sims 1997)*

Field sampling included the most common forest types along the water's edge in the Affected Aquatic Area. Of these forest types, bog cranberry was most widespread in black spruce Sphagnum/ feathermoss forest (found in 5 of 6 plots). The only high species correlation in the plot data was with Sphagnum spp. ($r = 0.92$, $P<0.001$).

An open plant community with a Sphagnum ground cover appears to be the most reliable predictor of high bog cranberry abundance. High quality bog cranberry habitat was essentially open bogs, sparsely treed bogs or open black spruce forest on peatlands. Specific details on the ratings of other habitat types are shown in Table 5.3-5.

High quality bog cranberry habitat is widespread and abundant in the Sub-Region (Figure 5.3-44). High quality habitat covers 28% of the Sub-Region (Table 5.3-6).

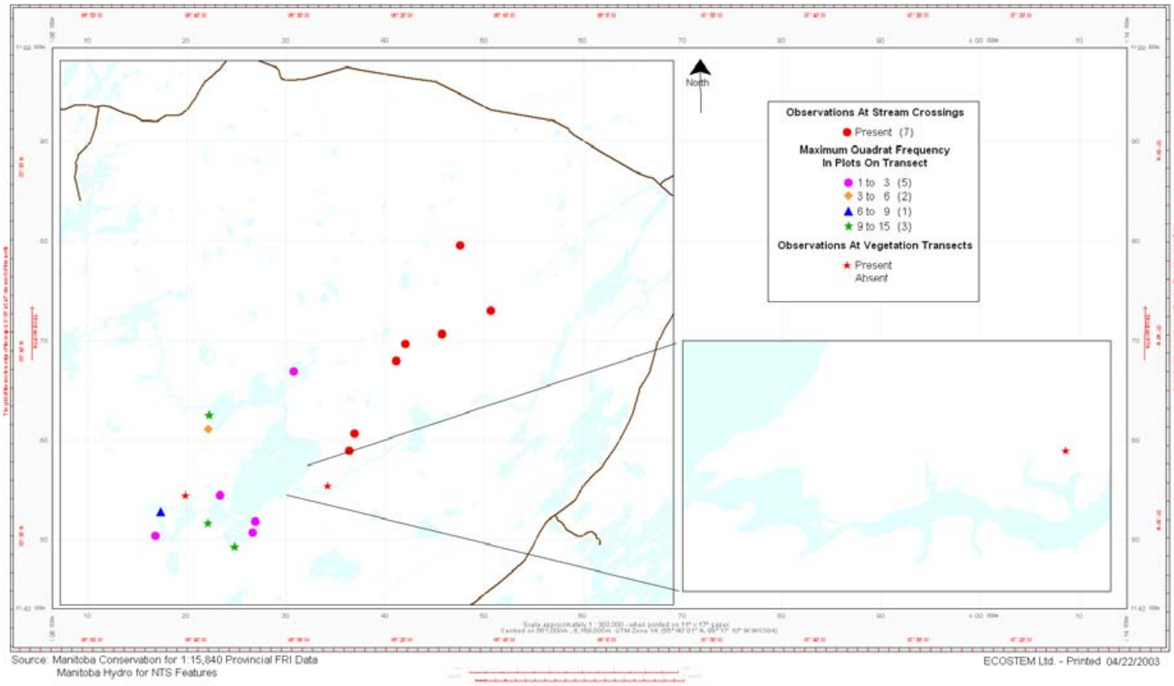


Figure 5.3-43. Known locations of bog cranberry in the Sub-Region.

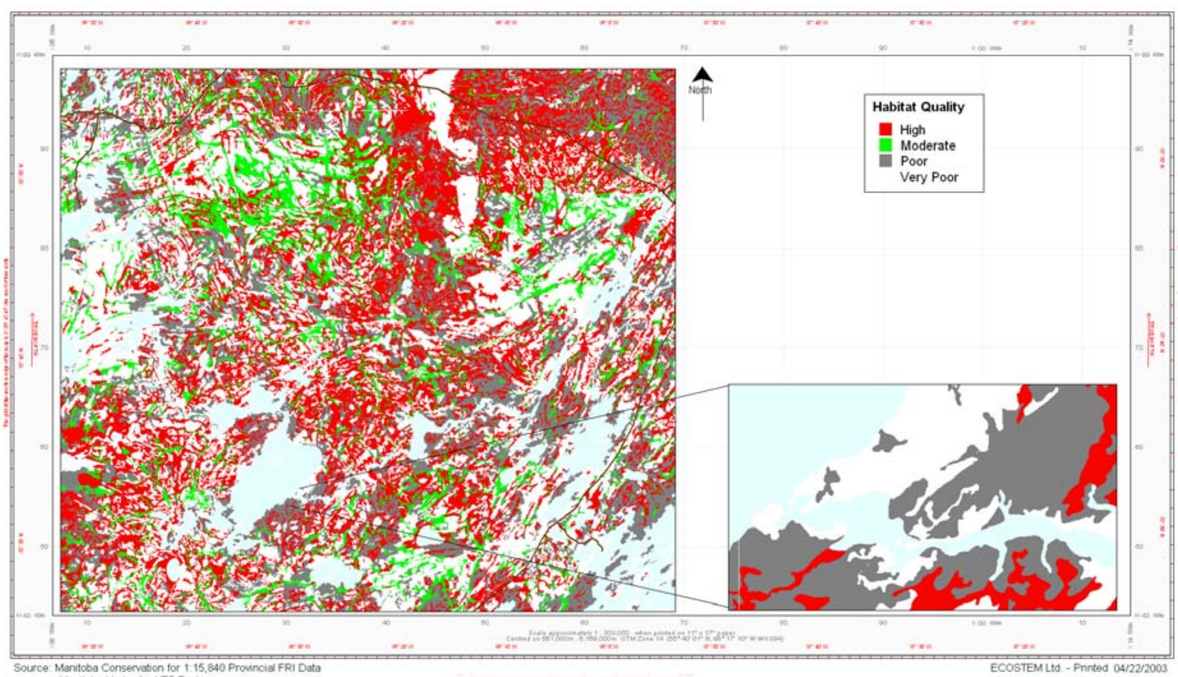


Figure 5.3-44. Bog cranberry habitat quality in the Sub-Region.

5.3.2.5 *Velvet-Leaf Blueberry (Ethinimina/* **Vaccinium myrtilloides** *Michx.)*

Velvet-leaf blueberry is a low, branching perennial shrub. From 10 – 40 cm tall it produces clusters of dark blue, sweet edible berries. Tiny hairs on the leaves and stems give the plant a “velvety” appearance.

Velvet-leaf blueberry is widespread throughout the boreal forest (Johnson et al. 1995), Manitoba (Scoggan 1957) and the Sub-Region but is not as common as dry ground cranberry. It is found in open vegetation (Johnson 1995) on a wide range of site types (Ehnes 1998). In southeastern Manitoba, velvet-leaf blueberry was common on outcrops, shallow mineral soils (depth to bedrock < 100 cm) and peatlands; peak cover occurred in open vegetation on shallow mineral soils (Ehnes 1998).

Velvet-leaf blueberry was found in 11 of the 68 field plots located outside of the Shore Zone (ECOSTEM unpubl. results based on Calyx Consulting unpubl. data). Plots with blueberry occurred in a wide range of FEC V-Types, but black spruce mixedwood/ shrub and herb rich (V17) was the most frequent type. All but one plot was on mineral soil. The only high species correlations were with bunchberry (*Maianthemum canadense*) and aspen (*Populus tremuloides*; $r = 0.77$ and 0.60, respectively, $P<0.001$).

High quality velvet-leaf blueberry habitat in the Sub-Region was essentially open vegetation on the various mineral soil land types. Specific details of the velvet-leaf blueberry quality habitat ratings are shown in Table 5.3-5.

High quality blueberry habitat only covers 7% of the Sub-Region, but moderate quality habitat accounts for a further 31% (Table 5.3-6). High quality habitat is concentrated in the jack pine forest on dry sites and mineral soil in the recent large wildfires (Figure 5.3-46). Moderate quality habitat is widespread throughout the Sub-Region.

Velvet- leaf blueberry

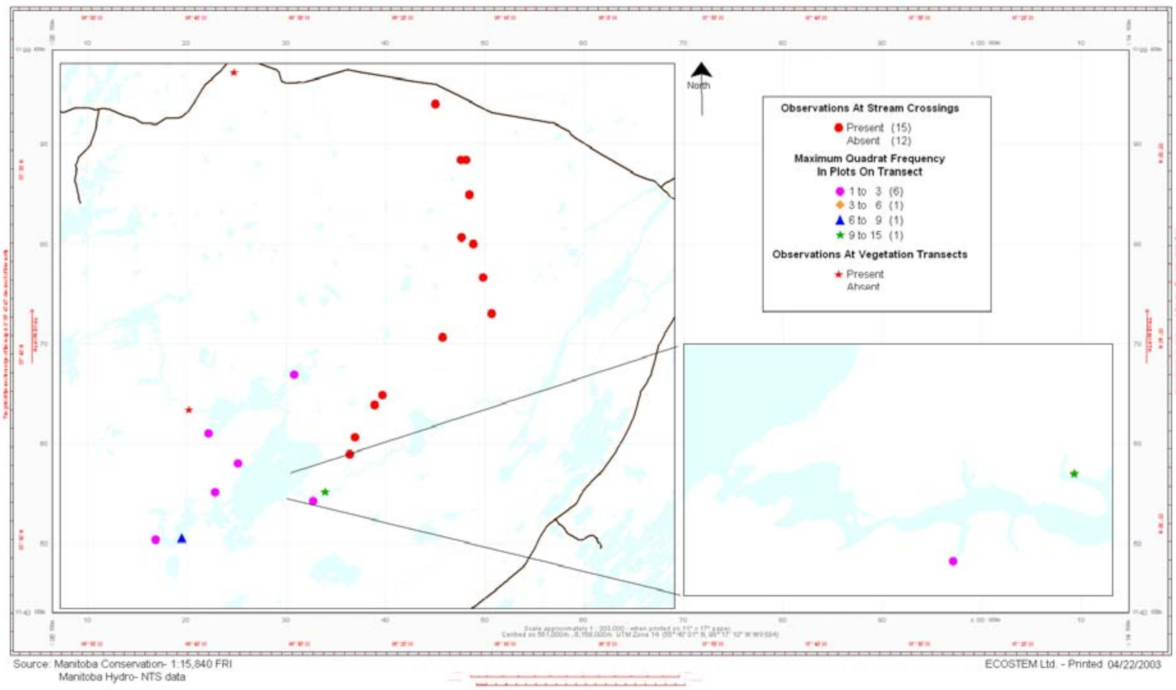


Figure 5.3-45. Known locations of velvet-leaf blueberry in the Sub-Region.

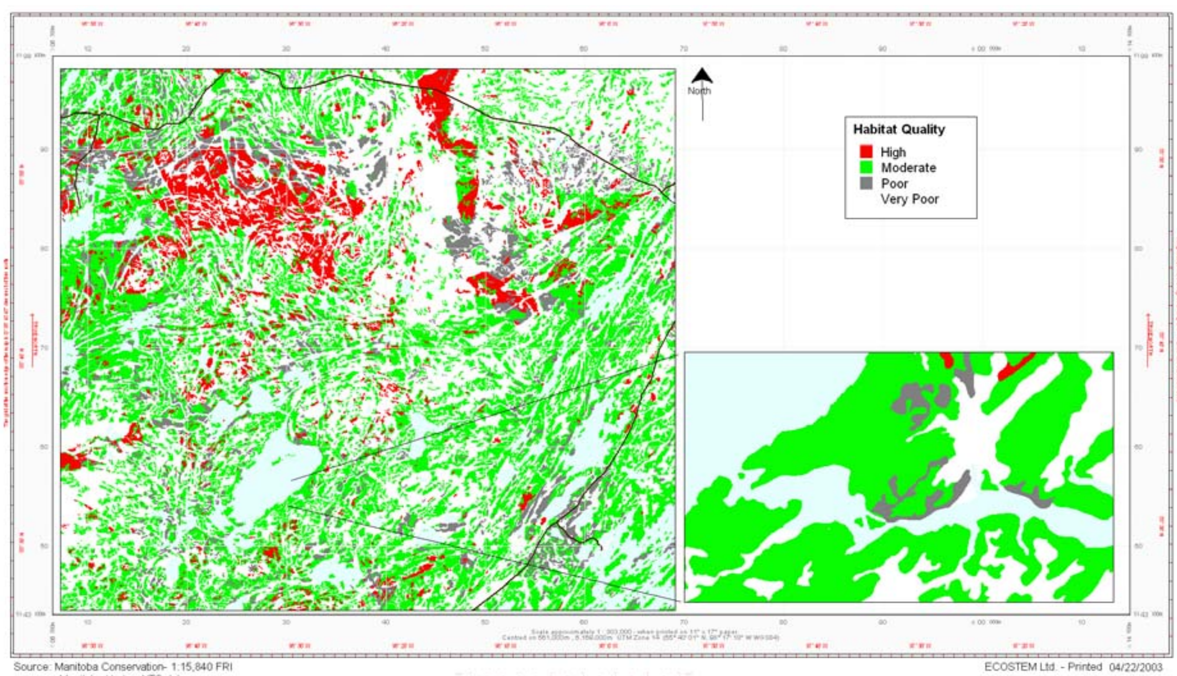


Figure 5.3-46. Velvet-leaf blueberry habitat quality in the Sub-Region.

5.3.2.6 Road Density (km of road/ km^2 of Sub-Region)

Linear features such as the access road have a number of effects on ecosystem functions and landscape flows. Linear features are called corridors in landscape ecology. New corridors affect ecosystem function because their introduction converts habitat into other types, fragments habitat and acts as a conduit, barrier, source and/ or sink for species (Forman 1995). Corridors create edge, which reduces habitat for interior species. Corridors that act as barriers reduce connectivity, which affects genetic interchange. Corridors serve as a conduit when they increase predation or the expansion of invasive plant species, among other things. A road functions as a sink when crossing animals are killed by vehicles. These are only a few examples that illustrate the ecological functions of corridors.

Road density (length of roads in the study area expressed as km/ km^2) can be a good indicator of the extent of fragmentation effects on plant and animal populations from human activities (Forman 1995). Increased road density improves access, which can then lead to increased harvesting, habitat disturbance and fire frequency. Sub-Region road density is currently 0.040 km/km^2.

5.3.3 Semi-Aquatic Habitat

Semi-aquatic habitat includes Shore Zone, Peat Island and Mineral Island habitat (Section 5.1.1) occurring within and around the Affected Aquatic Area (Figure 5.3-47). The Affected Aquatic Area covers 10,258 ha and includes 337 km of shoreline. Of this total, 285 km is along the mainland and 52 km is along mineral islands. Most of the mineral island shoreline is in Cranberry Lakes, Wuskwatim Lake and Wuskwatim Brook. The upstream shoreline length is 273 km. The habitat shoreline is 11 km longer than the shoreline used for the erosion analysis (Volume 4 Section 6) for the reasons described in Section 5.2.4.1.2.

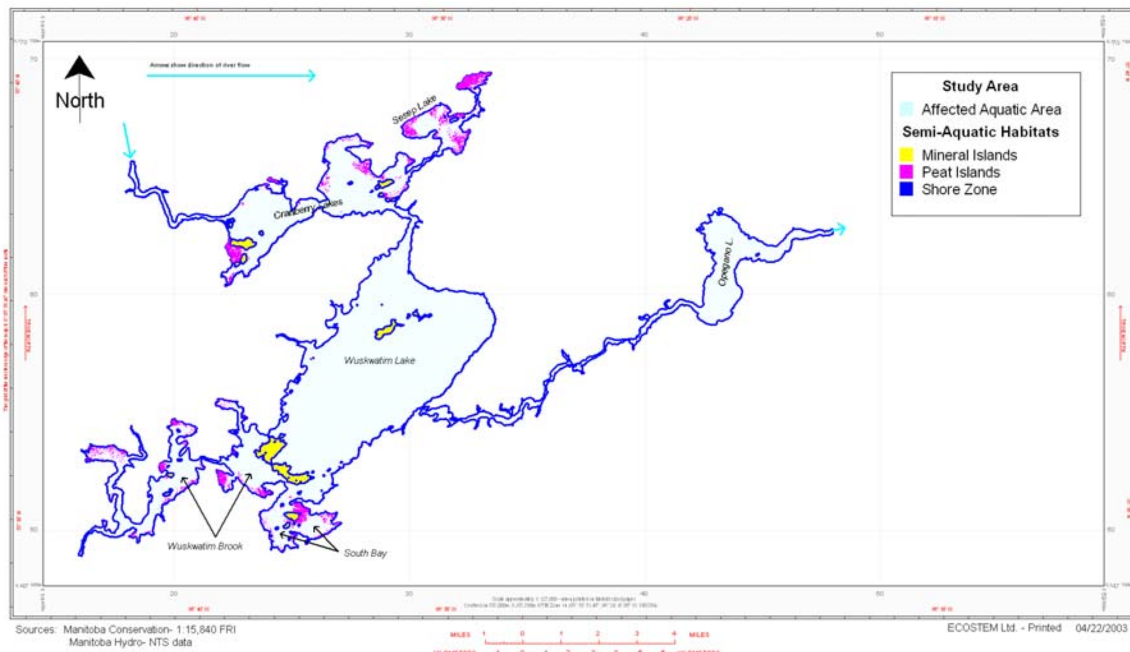
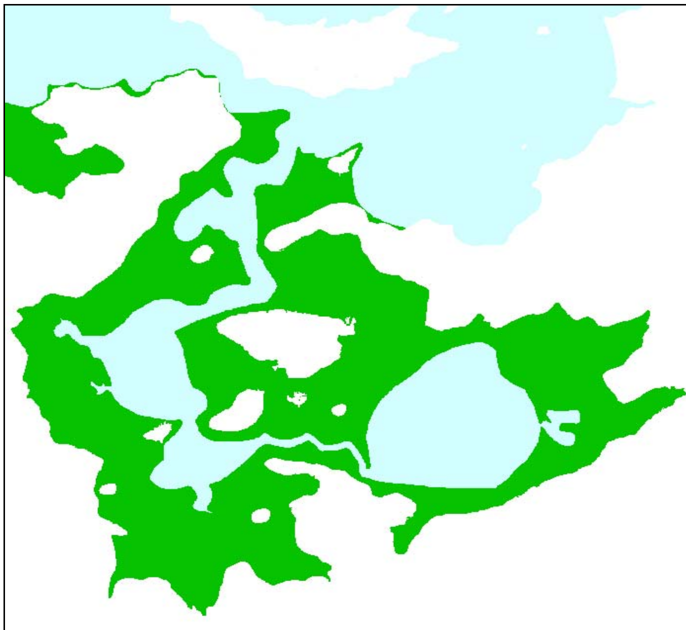


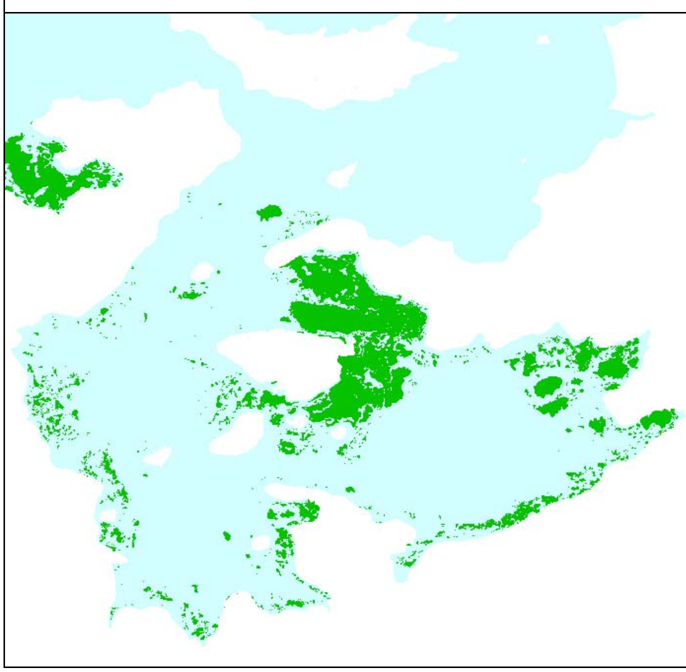
Figure 5.3-47. Semi-aquatic habitat in the Affected Aquatic Area.

The current distribution of different semi-aquatic habitat types is a relatively recent development. Historical aerial photography indicates that, prior to the initiation of CRD in 1977, extensive lake peatlands extended from the Mainland Edge (Table 5.2-4) well out into the water in the sheltered bays (Figure 5.3-48). Historical aerial photography also suggests that marshes were virtually absent in the sheltered bays because the lake edge of the peatlands extended to a water depth that was too great for most emergent plants. The Affected Aquatic Area stood out during an aerial survey of nearby unregulated lakes. In nearby unregulated lakes, shore bogs and fens generally extend from the Mainland Edge into the shallow water and marshes are uncommon. This comparison should be used with some caution as there may be other reasons for the difference. Although the nearby comparison lakes are unregulated, they generally differ from pre-CRD conditions in the Affected Aquatic Area in two respects. The comparison lakes do not have a major river flowing through them and the percentage of shoreline in exposed bedrock or shallow mineral soils is higher.



(A) Pre- CRD

- Peatlands extend well out into the lake (green areas).
- No beach vegetation.
- Probably was little emergent vegetation because water was too deep.



(B) Current Conditions

- Most of the lake peatlands have disappeared.
- A Shore Zone appeared where mainland peatlands extended into the lake.
- Emergent and beach vegetation established along shoreline.
- Species present are those typical of marshes with a high degree of water level fluctuation.

Figure 5.3-48. Change in peatland distribution in the low gradient areas before CRD and in 2001 in an example sheltered bay (Wuskwatim South Bay in Figure 5.3-47). Green areas are lake peatlands.

5.3.3.1 Water Regimes

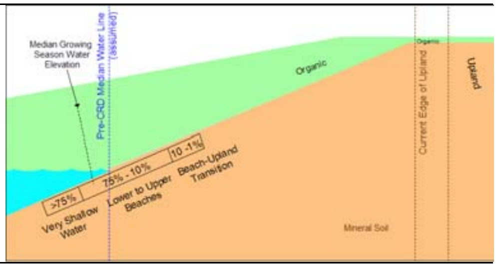
The water duration zone approach was used to understand and predict the effects of the historic and proposed water regimes on shoreline vegetation. Two different historic water regimes have produced the current Shore Zone vegetation and soils. These are the unregulated (pre-CRD) and the CRD regulated water regimes. Figure 5.3-49 summarizes the assumed pre-CRD, the measured upstream post-CRD and the predicted upstream Project water regimes in terms of water levels, timing of fluctuations and water duration zones (i.e., percentage of days under water). The three water regimes are quite different. Understanding how they differ helps us to interpret and use field data appropriately for the description of the existing environment and the prediction of project impacts. A summary of some of the expected habitat differences associated with the three water regimes is also provided in Figure 5.3-49.

Water Regime Status/ Change | **Effects On Habitat**

Unregulated (Pre- CRD)

Water levels usually highest in spring and lowest in fall and winter.

State of nature.



Current Conditions (Post- CRD)

Water level changes:

- median level raised approximately 3 m;
- more variable than under natural conditions;
- mostly highest in fall and winter; lowest in spring.

Shoreline environmental changes include:

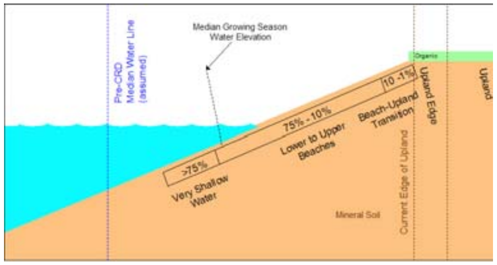
- increased substrate instability, turbidity, bottom freezing, ice pressure and ice scouring in late winter;
- horizontal width of the Beach water duration zones increased;
- horizontal width of the Very Shallow Water zone increased.

Initial effects of CRD:

- emergents and peatlands under water;
- forest edge pushed back.

Current conditions:

- Species common in the Lower to Upper Beach water duration zones are:
  (1) Tolerant of widely fluctuating water levels.
  (2) Rapid colonizers.
- Cattail establishment on the lake bottom has been limited.



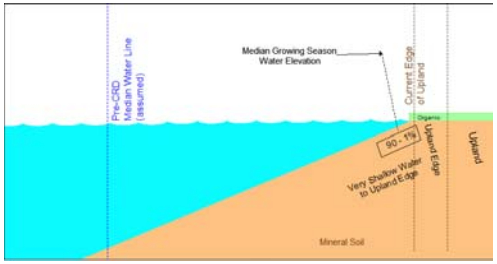
Predicted (Post- Project)

- Water levels would be relatively stable near the top end of the current range.

Environmental changes include:

- reductions in substrate instability, turbidity, bottom freezing, ice pressure and ice scouring in late winter;
- beach and beach/ mainland edge transition zone substantially narrower in most areas;
- horizontal width of Very Shallow Water zone decreased;
- part of the current Very Shallow Water zone becomes "aquatic" habitat (i.e. part of the Shallow Water zone).

See Section 5.4.2.2.

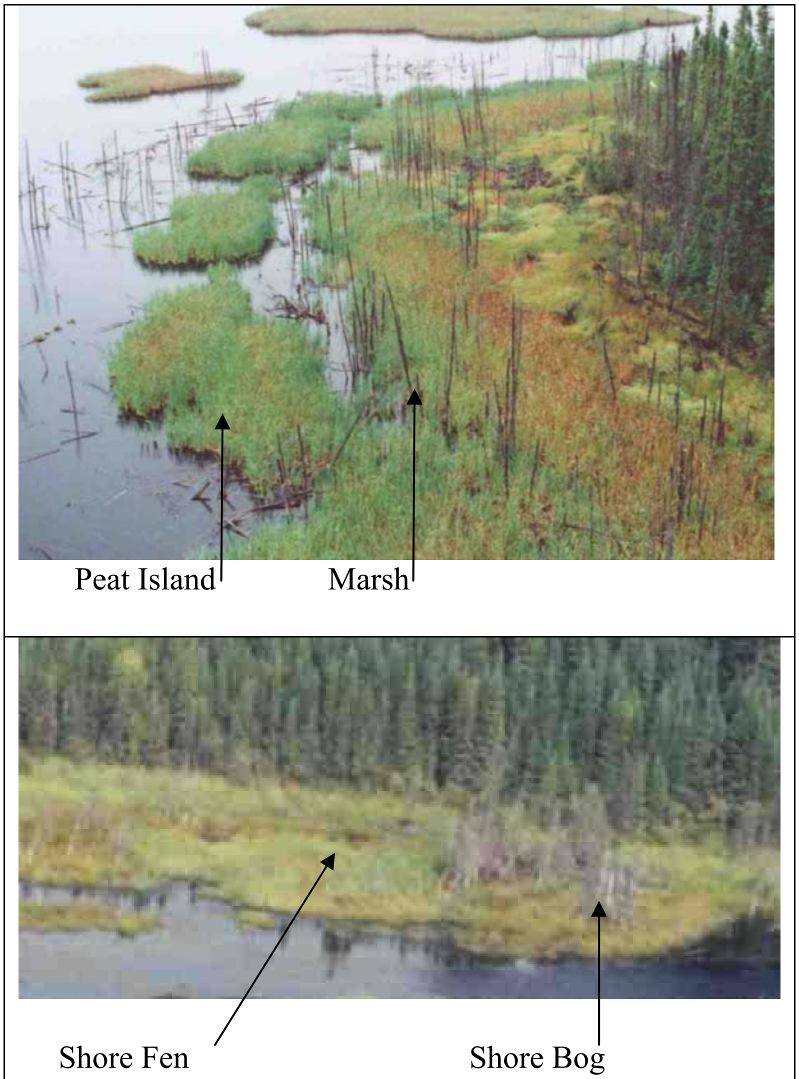


Slope exaggerated in all three schematics

Figure 5.3-49. Water regimes during pre-CRD, post-CRD and the proposed Project and effects on vegetation in low slope areas.

5.3.3.2 Wetland Distribution

Most marshes and other types of wetlands other than Peat Islands in the Affected Aquatic Area are currently confined to the sheltered bays outside of Wuskwatim Lake. Wetlands are a mixture of lacustrine bay marshes, shore bog, shore fen (Figure 5.3-50; Warner and Rubec 1997) and Peat Islands.



Profiles of shore bog & shore fen are similar. Main difference is that the surface of the bog is further from the water level so that plants must rely on precipitation for nutrients. Water level differences result in different types of characteristic surface vegetation.

Figure 5.3-50. Wetland types in the sheltered bays.

5.3.3.3 Shore Zone

5.3.3.3.1 Shore Environment Conditions

Shore Zone habitat is the combination of vegetation and environmental conditions. Shore Zone vegetation is strongly influenced by water regime, wave energy, water current, bottom freezing and soil type (Section 5.2.4.1.2). Shore Zone habitat distribution and composition was mapped as combinations of Shore Zone environment and vegetation types.

Shore Zone environment types were mapped as 18 combinations of shore material type, bank height and water energy (Table 5.3-7;) based on field observations and analysis of field data.

Table 5.3-7. Shore material types used in the Shore Zone habitat mapping.

Shore Material Type	Description
BR	Bedrock
BRh	High bedrock (top of bedrock elevation at shoreline > 234.5 m)
BRm	Moderately high bedrock (top of bedrock elevation at shoreline ~234 - 234.5 m)
BRl	Low bedrock (top of bedrock elevation at shoreline > 233.5 m)
BClg	Low slope clayey deposits over hidden bedrock
LC	Clay and silt banks
LC/ BRh	Clay and silt on bedrock with high mineral/ bedrock interface (contact > 234 m)
LC/ BRm	Clay and silt on bedrock with moderately high mineral/ bedrock interface (contact ~233.5 - 234.3 m)
LC/ BRm-l	Clay and silt on bedrock with moderately high to low mineral/ bedrock interface
LC/ BRl	Clay and silt on bedrock with low mineral/ bedrock interface (contact ~233.5 m)
LChg	Clayey beach with slope > 100%
LCmg	Clayey beach with slope ~10% - 100%
LClg	Clayey beach with slope < ~10%
O	Organic material on clayey beach with slope < ~10%
O + LClg	Mixture of O and LClg within shoreline stretch.
PT	Upland peatland extends to the middle beach at least. No beach vegetation present.
FL	Floodplain
Sand	Sandy bank

The shore material categories were the same as those developed by J. D. Mollard and Associates (JDMA) for the erosion modeling except for five categories that were either new or modified. The JDMA fen (FN) and bog (BG) categories were reclassified as either peatland (PT) or organic (O). Peatland shore material identifies locations where a mainland peatland covers at least all of the Lower to Upper Beach zones. Organic shore material identifies beach with a sedimentary organic and/ or thin remnant peat layer over mineral soil. Sloped shoreline (LClg) was subdivided into low, medium and high slopes, <~10%, ~10 – 100% and >100%, respectively (LClg, LCmg and LChg categories in Table 5.3-7). Bank heights were assessed relative to the new shore type classification (Table 5.3-8). Figure 5.3-51 illustrates some of the common shore material types.

Table 5.3-8. Bank height categories used in the Shore Zone habitat mapping.

Category	Description
None	No bank (applies only to clayey beach, organic beach or peatland)
Low	< ~1m above 233.6 m ASL
Low & Medium	Mixture of low and high in shoreline stretch
Medium	~1-3 m above 233.6 m ASL
High	>~ 3 m above 233.6 m ASL

<u>Shore Materials and Bank Height</u>

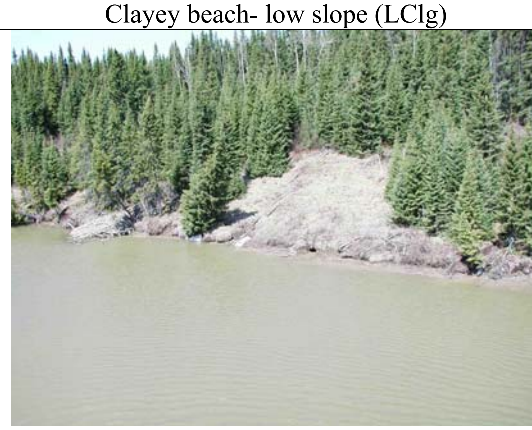
Low slope clayey beach (Figure 5.3-51) is the most common type of shore material comprising 30% of the Affected Aquatic Area shoreline (Table 5.11-9; Figure 5.3-52). Lacustrine clayey material over low bedrock, banked lacustrine clayey material and peatland (i.e., shore bog or shore fen) each make up about 14% of the shoreline. Organic beach, mixtures of low slope clayey and organic beach, clayey deposits over medium elevation bedrock and medium slope clayey beach are the only other shore material types that comprise at least 2% of the potentially affected shoreline. Clayey banks with or without exposed underlying bedrock are generally confined to the Burntwood River, the south shore of Cranberry and Wuskwatim Main (Figure 5.3-53). Peatland shoreline is generally found along the upper reaches of creek mouths or behind aquatic peatlands where water level fluctuations and/ or water energy are relatively low (e.g., upstream of Sesep Lake).

Organic or clayey "beaches" (0) appear in the low gradient areas upstream of Wuskwatim Falls when water levels fall below about 234.0. These are located in the Lower to Upper Beach and Beach/ Upland Transition water duration zones in the Shore Zone (Table 5.2-4). As water levels fluctuate, the width of the organic or clayey "beaches" changes based on the local slope and the shape of the lake bottom in the water fluctuation zone.

Organic beach at low water (O)

Clayey beach- low slope (LClg)

Clayey beach- medium slope (LCmg)



Clayey beach- high slope (LChg)

Banked clayey deposits (LC)

Clayey deposits over low bedrock (LC/BRl)

Figure 5.3-51. Shore material types.

Notes: See Table 5.3-7 for shore material type codes and descriptions. All photos were taken when water levels were at the 90th percentile for Wuskwatim Lake thereby exposing all of the water duration zones except for the Shallow Water zone.

Shore materials in the Cranberry Lakes geographic zone are most similar to the overall average (Figure 5.3-52). However, shore materials in the other geographic zones vary considerably from each other. For example, low slope clayey beach makes up 68% of shoreline in the Wuskwatim South Bay zone but only 2% in Opegano Lake and 4% in Wuskwatim Main (Table 5.11-9). Sesep Lake shore material is more than 90% peatland, low slope clayey beach, organic beach and mixtures of low slope clayey and organic beaches. Sesep Lake has no bedrock or clayey deposits over bedrock in the Shore Zone. Wuskwatim Brook and Wuskwatim South Bay are similar to Sesep Lake in that they are dominated by low slope clayey beach and organic beach. Wuskwatim Brook has more than double the percentage of shoreline in low slope clayey beach than Sesep Lake and lacks organic beach. Wuskwatim South Bay has the highest percentage of low slope clayey beach of all the zones. In Wuskwatim South Bay, organic shoreline types are evenly distributed between organic beach and peatland. Wuskwatim Main has the rockiest shoreline - bedrock or clayey deposits over bedrock make up 69% of the shoreline. Clayey banks account for most of the remaining shoreline. The shoreline along the Burntwood River Downstream mostly consists of medium slope clayey beach, banked clayey deposits, clayey deposits over low bedrock and clayey deposits over medium bedrock. The Opegano Lake shoreline is dominated by clayey banks, medium slope clayey beach, peatland and clayey deposits over low bedrock.

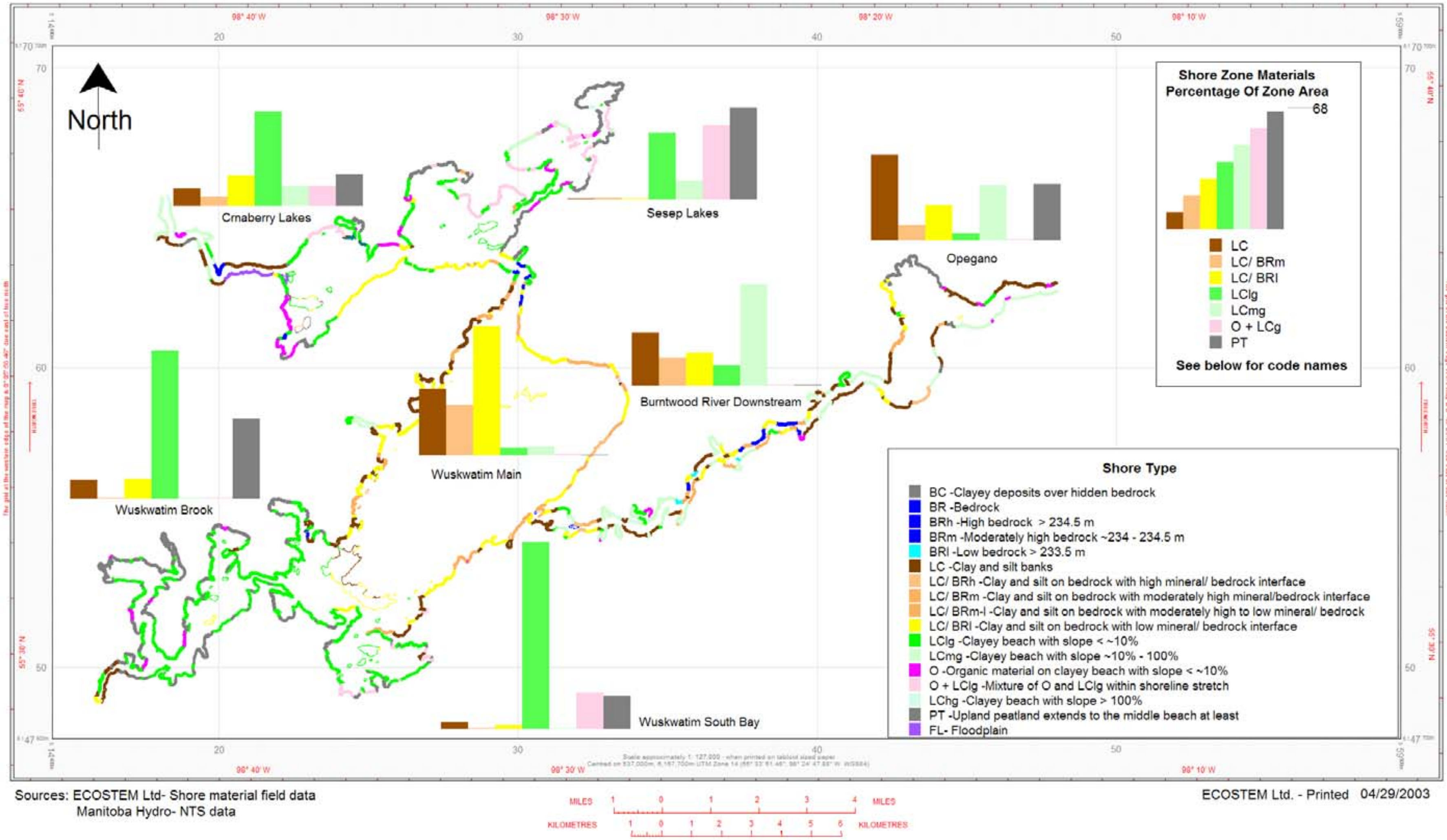


Figure 5.3-52. Shore Zone materials in the Affected Aquatic Area.

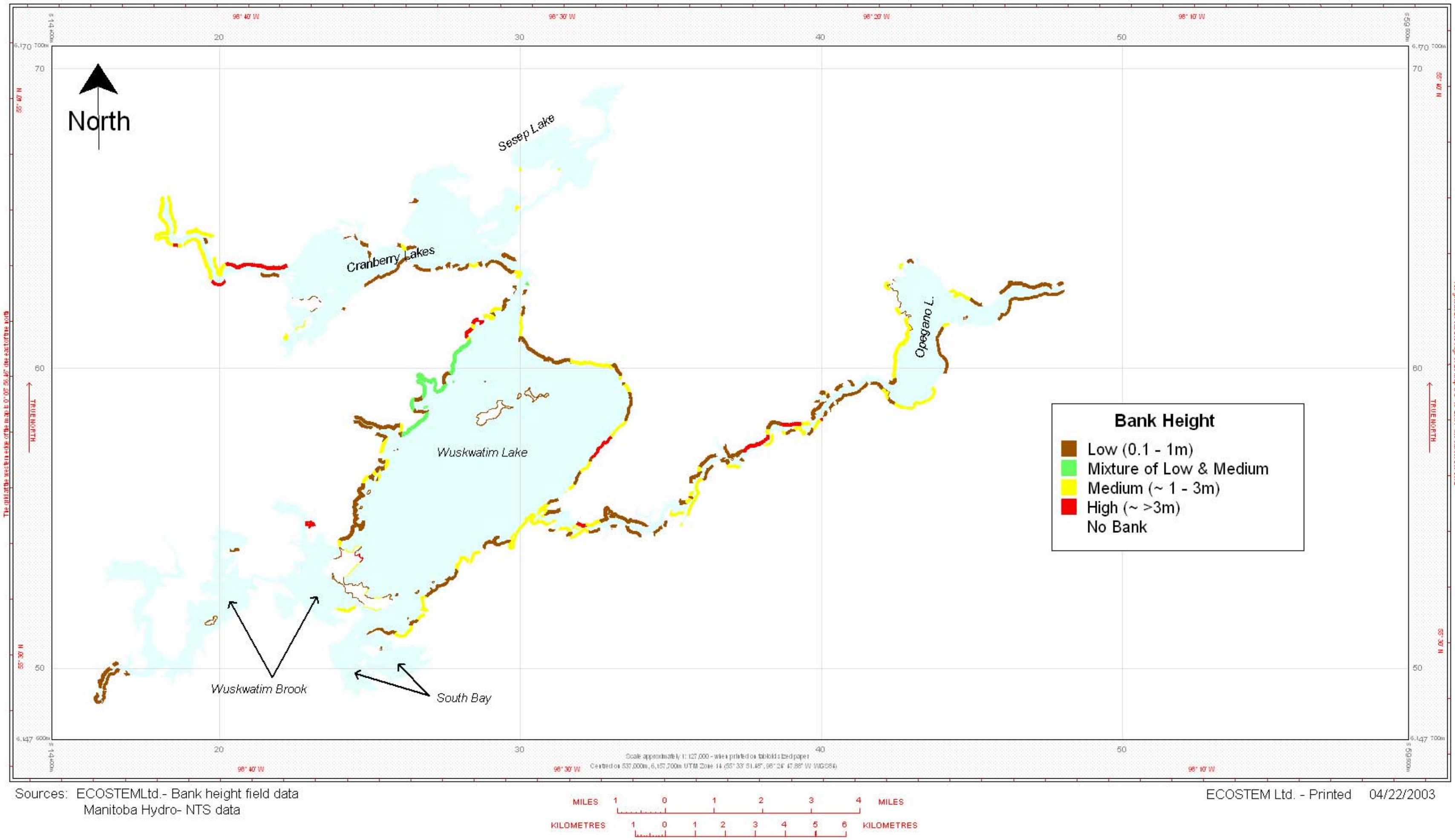


Figure 5.3-53. Shore Zone bank height in Affected Aquatic Area.

Water Energy

Five water energy classes representing three wave and two current energy levels were mapped: low wave, moderate wave, high wave, moderate current and high current. Preliminary water energies were assigned to sections of the habitat shoreline by transferring wave energies from the J. D. Mollard and Associates erosion maps (Volume 4 Sections 6 and 7). The two new water current categories occurred along the Burntwood River either upstream of Cranberry Lake or downstream of Wuskwatim Falls (J. D. Mollard and Associates classified these stretches of shoreline as low wave energy). In the water energy map, stretches of Burntwood River shoreline that were not in bays were classified as exposed to high current unless they were in locations that usually have slower current such as the inside of river bends, eddies behind points and the edges of some floodplains.

As expected, there is a distinct geographic distribution of water energy effects on the Shore Zone (Figure 5.3-54). For the most part, high and moderate wave energy shoreline is found on Wuskwatim Lake, high current shoreline occurs along the Burntwood River and low water energy shoreline occurs elsewhere.

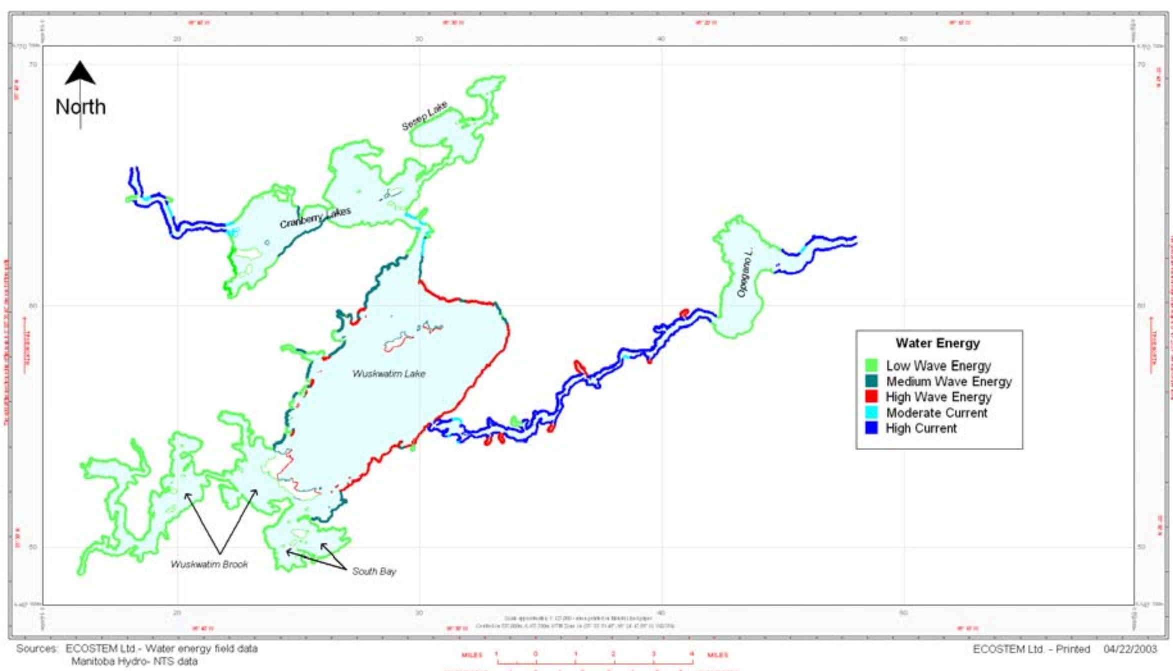


Figure 5.3-54. Shore Zone water energy in Affected Aquatic Area.

Low slope clayey beach and organic beach shorelines tend to occur in the same areas ostensibly due to the interactions between adjacent mainland topography, erosion and the historical distribution of aquatic peatlands. For example, low slope clayey beach and peatland shorelines in the Wuskwatim Main geographic zone are confined to the few long, narrow bays. All of the high and most of the medium wave energy shoreline is in Wuskwatim Main (Figure 5.3-54). In contrast, most of the shoreline in the Sesep Lake, Wuskwatim South Bay, Cranberry Lakes and Wuskwatim Brook zones are organic beach or low slope clayey beach. Most of that shoreline was covered by peatlands prior to CRD (Figure 5.3-55).

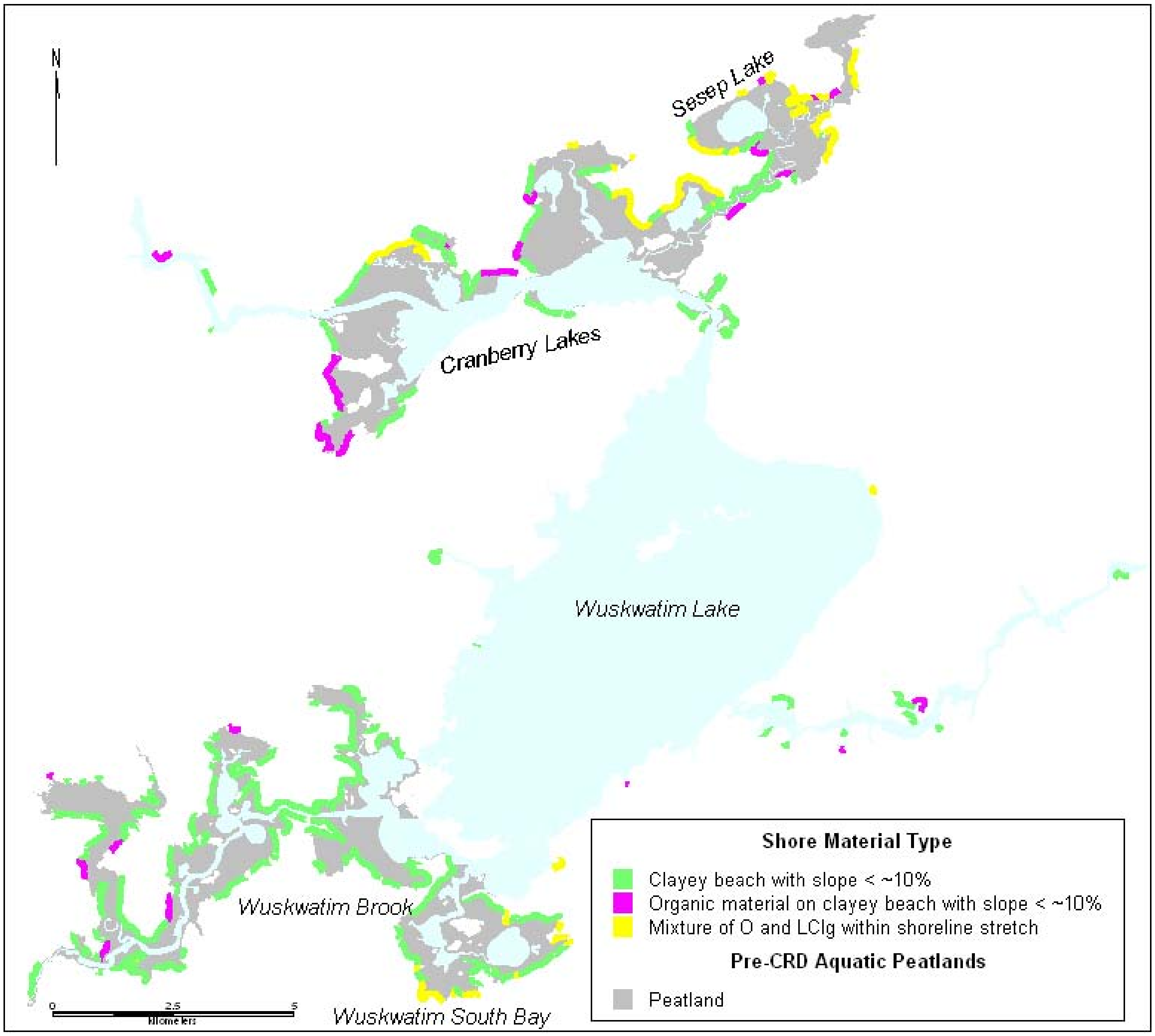


Figure 5.3-55. Locations of pre-CRD aquatic peatlands compared with low slope clayey beach and organic beach shore material types.

5.3.3.3.2 Vegetation

Shoreline Distribution

About 38% of the shoreline had beach vegetation during the aerial surveys conducted in early September 2001 (Figure 5.3-56). Most vegetation in the Shore Zone was found on organic or low slope clayey beaches. Floodplains in the Burntwood River Upstream support some vegetation under the current water regime because water levels are generally relatively low during the summer.

The absence of shoreline vegetation on many of the mineral shore material types is probably due to the combined effects of high water energy and an unstable bottom. Figure 5.3-56 and Figure 5.3-57 show that there is rarely enough organic or clayey beach vegetation to map where shorelines are actively eroding or only partially stabilized. Vegetation is entirely absent along most clayey banked stretches of shoreline (Figure 5.3-58). Peatlands also prevent or limit the establishment of beach vegetation because a thick layer of peat extends well away from the mainland edge so that a beach does not appear unless water levels are very low.

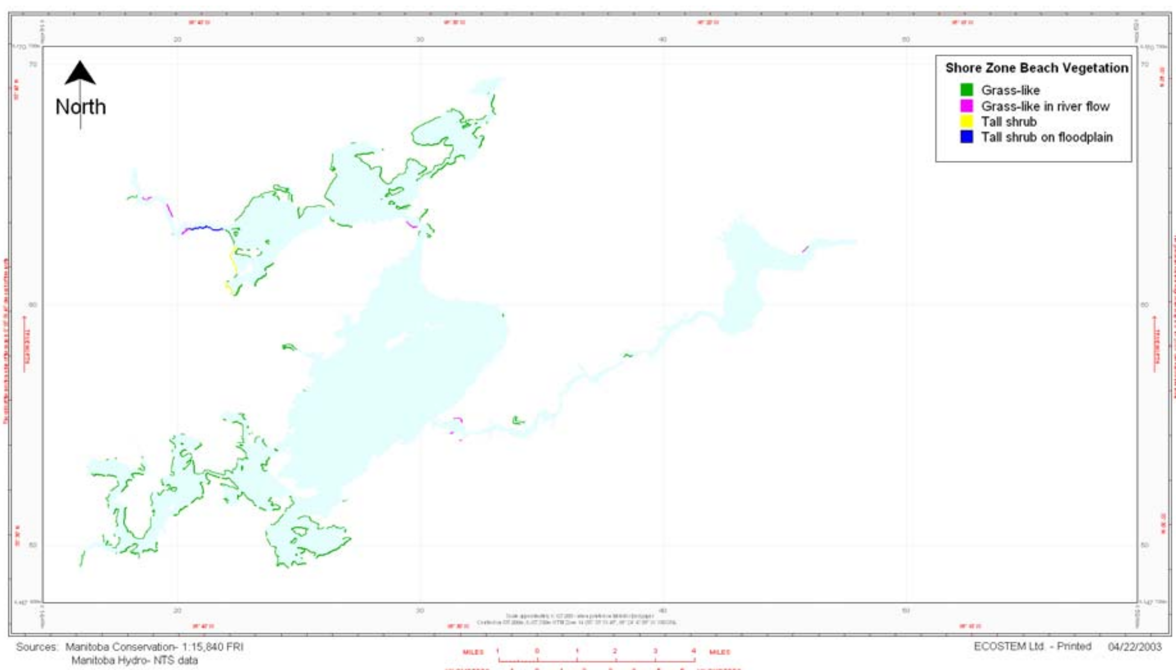


Figure 5.3-56. Distribution of Shore Zone vegetation types.

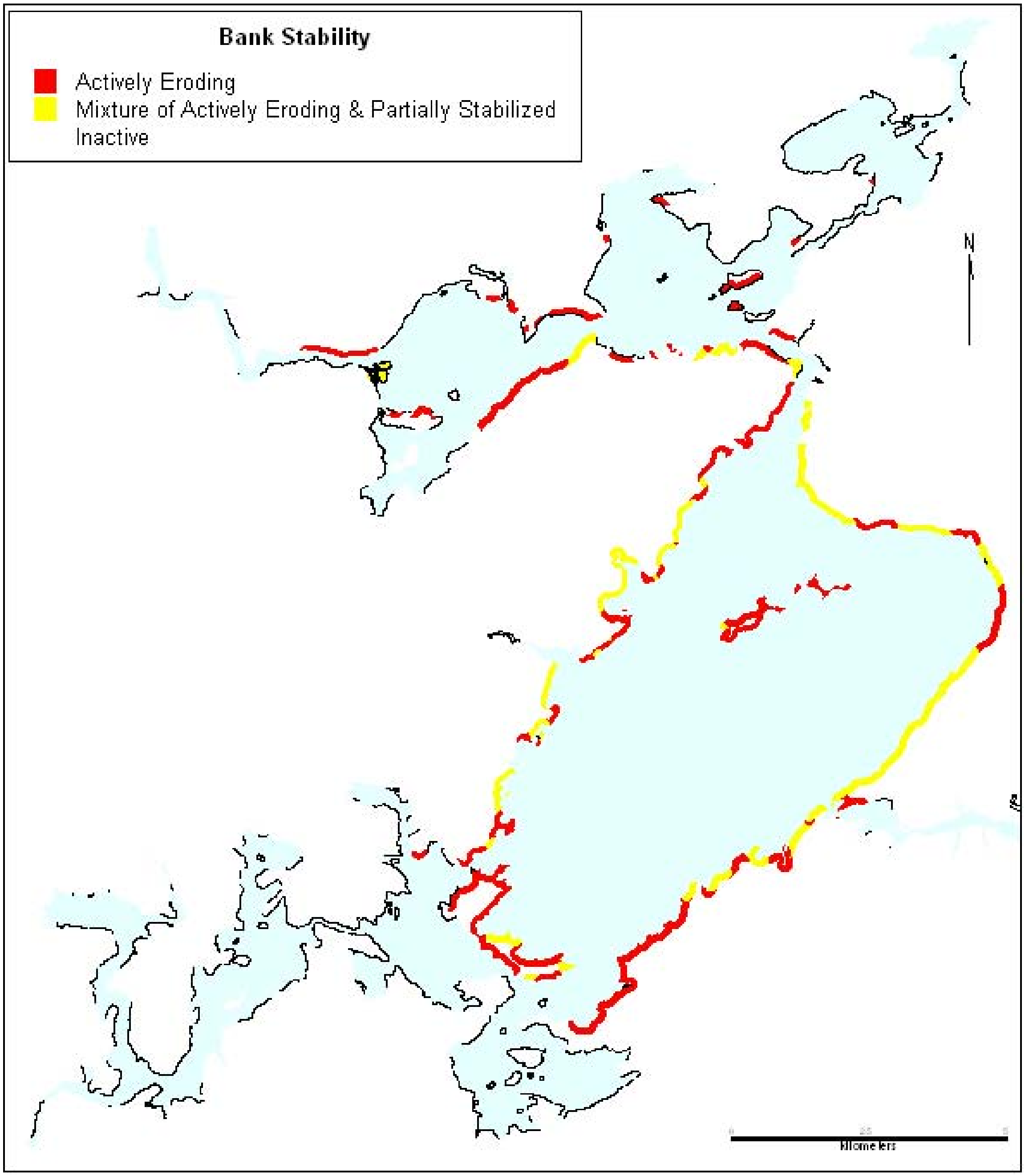


Figure 5.3-57. Locations of upstream water fluctuation zone vegetation compared with bank stability.

Figure 5.3-58. Clayey banked shoreline along west shore of Wuskwatim Lake at low water (90th percentile). Note the absence of vegetation in the beach or shallow water zones.

Organic or clayey "beach" vegetation occurs along most of the shoreline in the Cranberry Lakes, Sesep Lake, Wuskwatim Brook and Wuskwatim South Bay geographic zones (Table 5.3-9). There is little vegetation on the shoreline in the Wuskwatim Lake, Burntwood River Downstream and Opegano Lake geographic zones.

About 94% of the organic and clayey beach vegetation is a grass-like plant community dominated by sedges, grasses and herbs that can establish quickly on newly exposed organic or mineral beach. Tall shrub communities, which comprise the rest of the beach vegetation, are confined to two bays in the Cranberry Lake zone, one Muskesou River stretch upstream of Sesep Lake and the floodplain along the south side of the Burntwood River upstream (Figure 5.3-56). The two small tall shrub communities in the Cranberry Lakes are likely the result of a recently disintegrated peatland shoreline and are not expected to persist.

Table 5.3-9. Percentage of Affected Aquatic Area shoreline covered by different vegetation types (% of shoreline with beach vegetation) by geographic zone.

Geographic Zone / Vegetation Type	Cranberry Lakes & Burntwood River Upstream	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Wuskwatim South Bay	Burntwood River Downstream	Opegano Lake	All Areas
Grass-like & pioneer herbs	85	99	72	100	100	96	40	94
Grass-like in river current	5	0	28	0	0	4	60	3
Tall shrub	7	1	0	0	0	0	0	2
Tall shrub on floodplain	4	0	0	0	0	0	0	1
None- Clay bank								
None- Bedrock								
None- Peatland								
None- High wave energy	0							
Total length of all types (km)	44	17	3	48	16	2	0	129

Vegetation Composition Changes in the Water Duration Zones

Each of the different Shore Zone vegetation types mapped during aerial surveys (Figure 5.3-56) actually consist of a sequence of species bands occurring in the different water duration zones (see Section 5.2.4.1.2 for description of water duration zones). Multivariate data analysis was used to relate the information from the water depth transect sample plots to the water duration zones. From these data, a "core" sequence of vegetation types through the water duration zones was described (Figure 5.3-59). By core is meant those species that were found in each of the water duration zones at most sample locations and field observations around the shoreline.

The species composition of the vegetation sequences varies based on where the sample transect is located in the Affected Aquatic Area. Differences in bottom characteristics and water energy promote some species and inhibit others (Hellsten 2000; Keddy 2000). These differences in environmental factors cause local differences in the species composition of water depth vegetation sequences. Certain animals select which portions of the Shore Zone to use based on the sequence of vegetation bands found in the water duration zones.

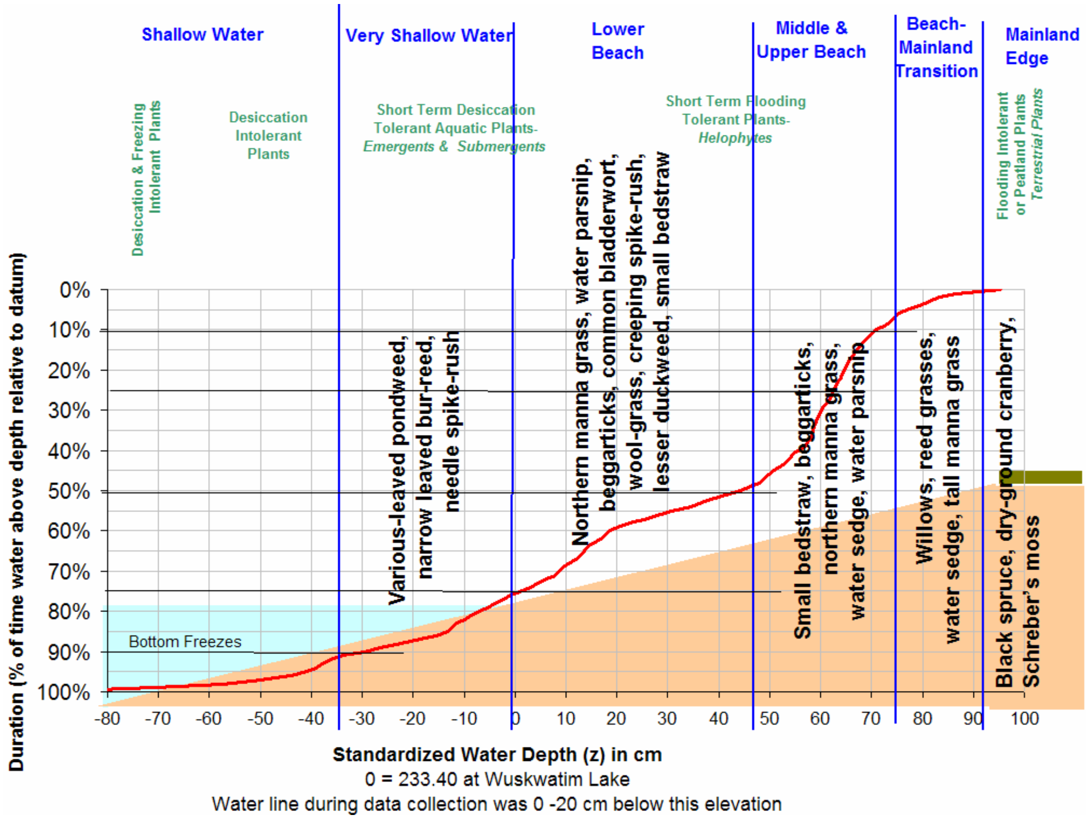


Figure 5.3-59. Core water duration zone vegetation sequence (i.e., species found at most locations along the shoreline where there is enough vegetation to map in an aerial survey).

Shore Zone Habitat Composition

Shore Zone habitat types (Table 5.3-10) were created by grouping similar vegetation sequences with the broad Shore Zone environment types that they occurred on. Each Shore Zone habitat type is described as a sequence of vegetation bands extending from the Very Shallow Water to the Mainland Edge water duration zones on the particular broad environment type.

Table 5.3-10. Shore Zone habitat types and associated vegetation sequence and Shore Zone environment types.

See Appendix 5.11.4 for further details.

Shore Zone Habitat Type	Shore Zone Habitat Type Code	Shoreline Vegetation Sequences Included
No Vegetation Sequence- Substrate or Water Energy Unsuitable	1	No Vegetation- Bedrock Substrate
"		No Vegetation- Actively Eroding
"		No Vegetation- Slope Too High
"		No Vegetation- Wave Energy Too High
"		No Vegetation- Substrate & Current Unsuitable
No Vegetation Sequence- Peat to Water's Edge	2	Peatland with no beach vegetation
Moderate Water Energy Sparse Vegetation	3	Few Species- Wave Energy Moderate
"		Clay Substrate Species Tolerant of Current
"		Veg Sporadic- Substrate & Current Stress
"		Clay & Organic Substrate Species Tolerant of Current
Floodplain Vegetation	4	Tall shrub on floodplain
"		Terrestrial Floodplain Veg Only- Current Unsuitable
Clayey Vegetation	5	Clay Substrate Species
"		Mixture of Clay & Organic Substrate Species
High Slope Sparse Vegetation	7	Little Vegetation- Slope High
Organic Vegetation	8	Organic Substrate Species
Tall Shrub On Peat Vegetation	9	Tall shrub on peat

The Shore Zone habitat types (Table 5.3-10) that have vegetation are: Clayey Vegetation, Organic Vegetation, Moderate Water Energy Sparse Vegetation, Floodplain Vegetation, Thin Substrate Sparse Vegetation, High Slope Sparse Vegetation and Tall Shrub On Peat Vegetation. Table 5.3-11 shows have the vegetation sequence component of Shore Zone habitat differs from the core sequence illustrated in Figure 5.3-59 based on broad environmental conditions.

Table 5.3-11. Shore Zone habitat types: composition of vegetation bands in water duration zones (i.e., vegetation sequences) on clayey, organic and fast current/ floodplain bottom types.

Water Duration Zone *	**Core Vegetation Sequence** (Species found along most shoreline where beach vegetation occurs)	**Species More Common and/ or Abundant In Shore Zone Habitat Type Relative to the Core Vegetation Sequence** (i.e., each vegetation sequence includes the species from the widespread sequence plus species modifications listed)		
		Clayey Vegetation	**Organic Vegetation**	**Moderate Water Energy Sparse Vegetation or Floodplain Vegetation**
Very Shallow Water	various-leaved pondweed (*Potamogeton gramineus*), narrow leaved bur-reed (*Sparganium angustifolium*) / Needle spike-rush (*Eleocharis acicularis*)	common mare's-tail (*Hippuris vulgaris*)	various-leaved pondweed (*Potamogeton gramineus*), narrow leaved bur-reed (*Sparganium angustifolium*), needle spike-rush (*Eleocharis acicularis*), sweet flag (*Acorus americanus*)	water horsetail (*Equisetum fluviatile*)
Lower beach	northern manna grass (*Glyceria borealis*), water parsnip (*Sium suave*), beggarticks (*Bidens cenua*), common bladderwort (*Utricularia vulgaris*), wool-grass (*Scirpus cyperinus*), creeping spike-rush (*Eleocharis palustris*), lesser duckweed (*Lemna minor*), small bedstraw (*Galium trifidum*) These species also occur in the upper portion of the Very Shallow Water.	common cattail (*Typha latifolia*)	wool-grass (*Scirpus cyperinus*), creeping spike-rush (*Eleocharis palustris*)	common cattail (*Typha latifolia*) in sites formed by eddies at high water
Middle beach	small bedstraw (*Galium trifidum*), beggarticks (*Bidens* spp.), northern manna grass (*Glyceria borealis*), water sedge (*Carex aquatilis*), water parsnip (*Sium suave*)	marsh cinquefoil (*Potentilla palustris*), beggarticks (*Bidens* spp.)	small bedstraw (*Galium trifidum*)	
Beach/ Mainland Transition	willows (*Salix* spp.), reed grasses (*Calamagrostis* spp.), water sedge (*Carex aquatilis*) / tall manna grass (*Glyceria grandis*)	water sedge (*Carex aquatilis*), sedges (*Carex* spp.), northern bedstraw (*Galium boreale*)		willows (*Salix* spp.)

Water Duration Zone *	**Core Vegetation Sequence** (Species found along most shoreline where beach vegetation occurs)	**Species More Common and/ or Abundant In Shore Zone Habitat Type Relative to the Core Vegetation Sequence** (i.e., each vegetation sequence includes the species from the widespread sequence plus species modifications listed)		
Mainland Edge	black spruce (*Picea mariana*), dry-ground cranberry (*Vaccinium vitis-idaea*), Schreber's moss (*Pleurozium schreberi*)	prickly rose (*Rosa acicularis*), twin flower (*Linnaea borealis*), bunchberry (*Cornus canadensis*), stair-step moss (*Hylocomium splendens*)	willows (*Salix* spp.), Labrador tea (*Ledum groenlandicum*), Small bog cranberry (*Oxycoccus microcarpos*), alpine bearberry (*Arctostaphylos alpina*), small scouring-rush (*Equisetum scirpoides*), Sheathed sedge (*Carex vaginata*), *Sphagnum* spp.	
Examples				 

* Shallow water covered in aquatic section.

Shore Zone habitat occurs on 39% of the Affected Aquatic Area shoreline (Table 5.3-12; Figure 5.3-60). Clayey Vegetation is the most common habitat type, covering 79% of the shoreline. The remaining shoreline with habitat is distributed into the remaining Shore Zone habitat types. All of the Floodplain Vegetation (2% of shoreline) occurs in the Burntwood River upstream and its inlet into Cranberry Lake. Organic Vegetation is evenly distributed between the Sesep Lake and Wuskwatim Brook geographic zones. Moderate Water Energy Vegetation occurs in the Wuskwatim Main, Burntwood River Downstream and Opegano Lake zones.

Table 5.3-12. Distribution of vegetation sequence types (percentage of total length) on potentially affected shoreline by geographic zone.

Vegetation Sequence Type	Cranberry Lakes & Burntwood River Upstream	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Wuskwatim South Bay	Burntwood River Downstream	Opegano Lake	Shore Length In All Areas (km)
No Vegetation- Substrate or Water Energy Unsuitable	32	2	95	15	7	96	95	48
No Vegetation- Peat to Water's Edge	11	33	0	29	12	0	3	13
Moderate Water Energy Sparse Vegetation	9	0	2	0	0	1	2	3
Floodplain Vegetation	7	0	0	0	0	0	0	2
Clayey Vegetation	33	51	1	54	81	2	0	30
High Slope Sparse Vegetation	2	7	1	0	0	1	0	1
Organic Vegetation	3	7	0	2	0	0	0	2
Tall Shrub On Peat Vegetation	4	0	0	0	0	0	0	1
Total Length (km)	78	26	62	85	20	42	24	337

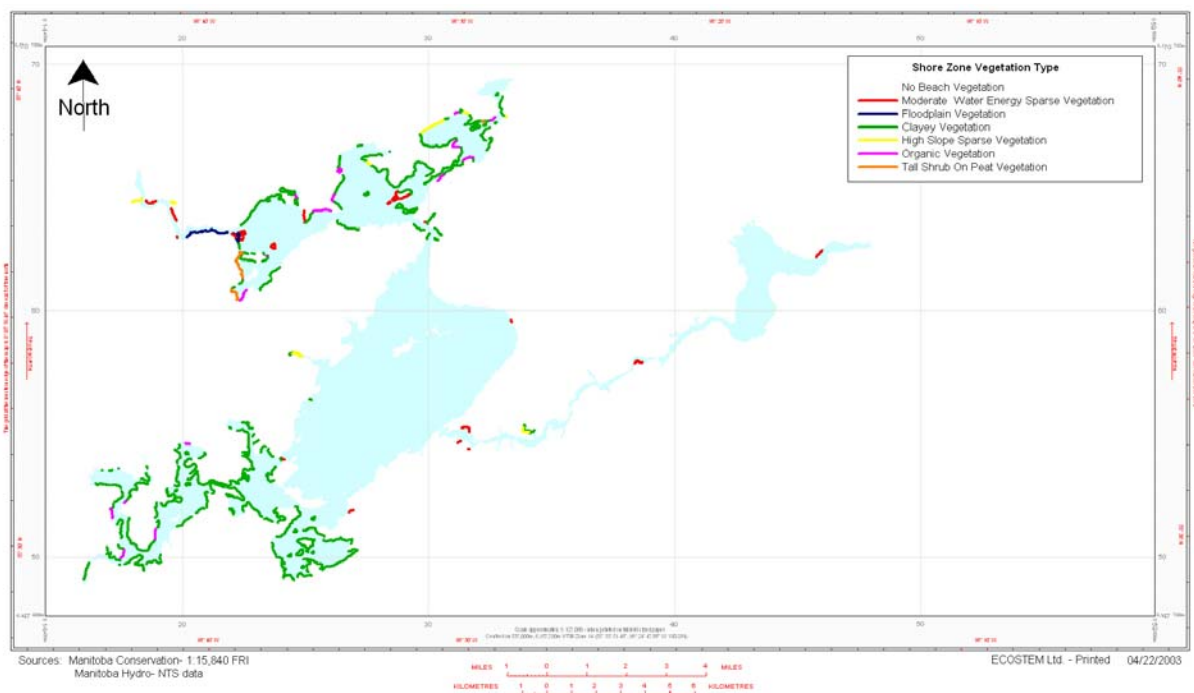


Figure 5.3-60. Locations of Shore Zone habitat types.

See Table 5.3-11 for description of vegetation sequence type (i.e., sequence of vegetation types found along a transect through the water duration zones).

The horizontal width and area covered by each Shore Zone habitat type was estimated using the combined estimated width of the Very Shallow Water, Beach and Beach/ Mainland Edge Transition zones. Based on the Shore Zone slope assumption (Section 5.2.4.1.2), the estimated average widths of the duration zones range from a low of 104 cm in the Upper Beach to a high of 544 cm in the Lower Beach (Table 5.3-13). There is an estimated 139.5 ha of Shore Zone habitat along the Affected Aquatic Area shoreline. Note that these should be interpreted as order-of-magnitude estimates of Shore Zone width and area. The percentage distribution of these habitats by geographic zone is provided in Table 5.3-14.

Table 5.3-13. Estimated depth ranges and band widths of water duration zones under current conditions assuming an 8% flat slope.

Zone	Width of Duration Zone (cm)
Very Shallow Water	525
Lower Beach	544
Middle Beach	228
Upper Beach	104
Beach/ Upland Transition	199
All Zones	1,601

Table 5.3-14. Total estimated area (ha) of Shore Zone habitat types on Affected Aquatic Area shoreline by geographic zone.*

Vegetation Sequence Type	Cranberry Lakes & Burntwood River Upstream	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Wuskwatim South Bay	Burntwood River Downstream	Opegano Lake	All Areas
Moderate Water Energy Sparse Vegetation Sequence	7.2		1.3			0.5	0.4	9.5
Floodplain Vegetation Sequence	5.5							5.5
Clayey Vegetation Sequence	27.7	14.2	0.6	49.2	17.1	0.8		109.6
High Slope Sparse Vegetation Sequence	1.3	1.9	1.0			0.6		4.8
Organic Vegetation Sequence	2.7	2.1		2.0				6.8
Tall Shrub On Peat Vegetation Sequence	3.1	0.1						3.3
All Types	47.6	18.3	2.9	51.3	17.1	1.9	0.4	139.5

* See Section 5.2.4.1.2 for explanation of method used to estimate areas.

5.3.3.3.3 Distribution of Emergent Cattails (*Typha latifolia*)

Although cattails (*Typha latifolia*) are generally abundant in the low slope areas, cattails occur primarily on the Peat Islands (see 5.3.7 for further details). Emergent cattail stands large enough to be mapped (i.e., occur as a continuous band or in patches along at least a 50 m stretch) occur along only 1.6% of the mainland shoreline and are absent along the mineral island shoreline (Table 5.3-15). Over half of the mapped emergent cattail stands are in the Wuskwatim South Bay geographic zone, while there are none in Wuskwatim Brook, Burntwood River Downstream and Opegano Lake zones (Figure 5.3-61).

Table 5.3-15. Distribution of emergent cattails (percentage of total length) along the Affected Aquatic Area shoreline by geographic zone.

Emergent Cattails[1]	Cranberry Lakes & Burntwood River Upstream	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Wuskwatim South Bay	Burntwood River Downstream	Opegano Lake	All Areas
Absent	99	96	100	99	86	100	100	98
Present	1	4		1	14			2
Total Length (km)	78	26	62	85	20	42	24	337

[1] Edge of patch within 2m of shoreline in August, 2001. [2] Mainland only.

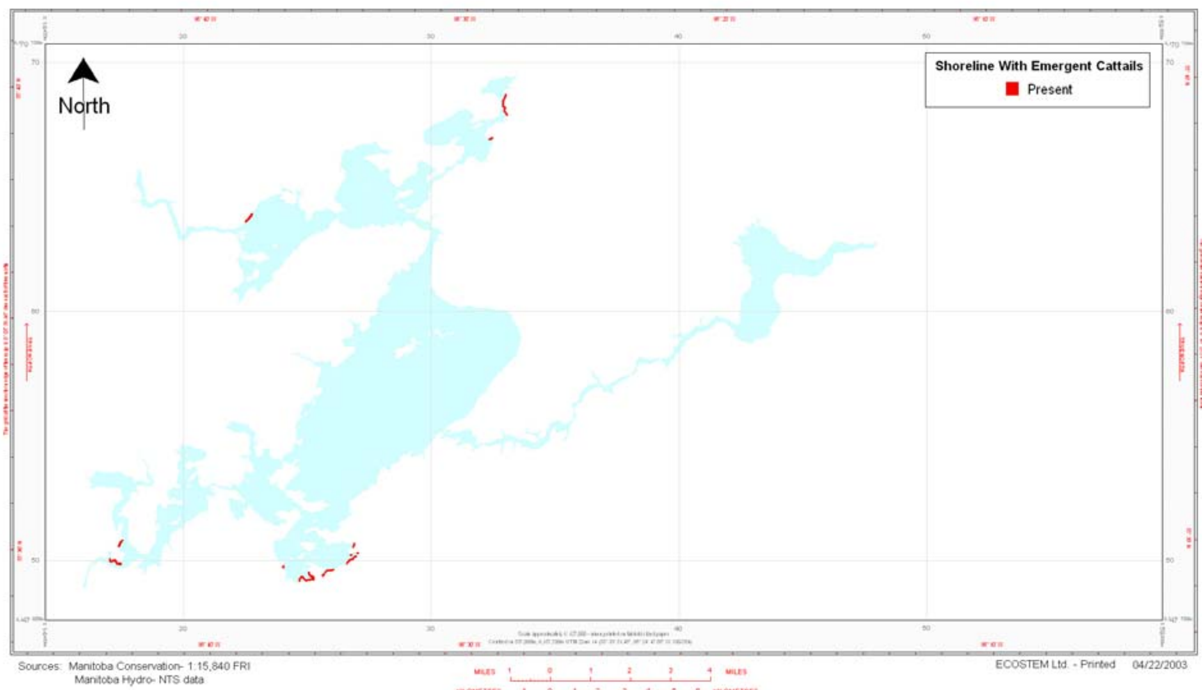


Figure 5.3-61. Locations of emergent cattails (*Typha latifolia*) within 2m of shoreline in August, 2001.

5.3.3.3.4 Conversion of Forested to Aquatic Habitat

Black spruce, the most widespread and abundant species in the forest edge, has a shallow root system with most roots occurring within the top 20 cm of the soil profile (Burns and Honkala 1990). The presence of dead black spruce trees in the forest edge is a good indicator that vegetation has been affected by saturated soil. Soil saturation occurs when elevated lake water levels either raise ground water levels in mainland soils or gradually increase soil moisture regime.

Black spruce mortality observed in the low gradient portions of the Affected Aquatic Area (Figure 5.3-62) could be from either the delayed long-term effects of CRD or recent high water levels. In August 2001, needles were absent but fine branches were present on dead trees in the forest fringe. This condition is indicative of a dead tree decay stage that only persists for about the first year indicating that the trees probably died during the previous growing season, that is, during 2000. This suggested that recent water levels are more important than medium term fluctuations in tree mortality since the water was low during the 2001 growing season, high in the 2000 growing season and low in the 1999 growing season (water level source: Manitoba Hydro unpubl. data).

A dead tree fringe (i.e., dead trees in the forest edge) occurs along 15% of the shoreline (Table 5.11-10). With a few minor exceptions, dead trees in the forest edge are confined to shoreline that is organic, peatland or low to medium slope clay (Table 5.11-11; Figure 5.3-63)[9]. The one stretch of shoreline that has a dead tree fringe that is four trees wide occurs upstream of Sesep Lake in a disintegrating peatland located between two islands and the mainland.

Although peatland and low slope clayey beach both occur in low slope areas, peatland shoreline has a lower percentage of dead trees than low slope clayey beach (25 versus 61% of shoreline with dead trees; Table 5.11-11). Potential explanations for lower tree mortality on peatland are: (1) the root system of black spruce trees on peat are better developed to cope with high water table; and/ or (2) the peat floats or expands to some degree at high water levels so that tree roots are not submerged.

[9] The dead tree fringe shown for banked lacustrine clay shoreline in Table 5.11-11 occurs near the outlet of Wuskwatim Brook where inadequate data were available to disaggregate the LC dominated shoreline into LC and LCmg.

Figure 5.3-62. Dead tree fringe along stretch of shoreline in the Wuskwatim Brook geographic zone.

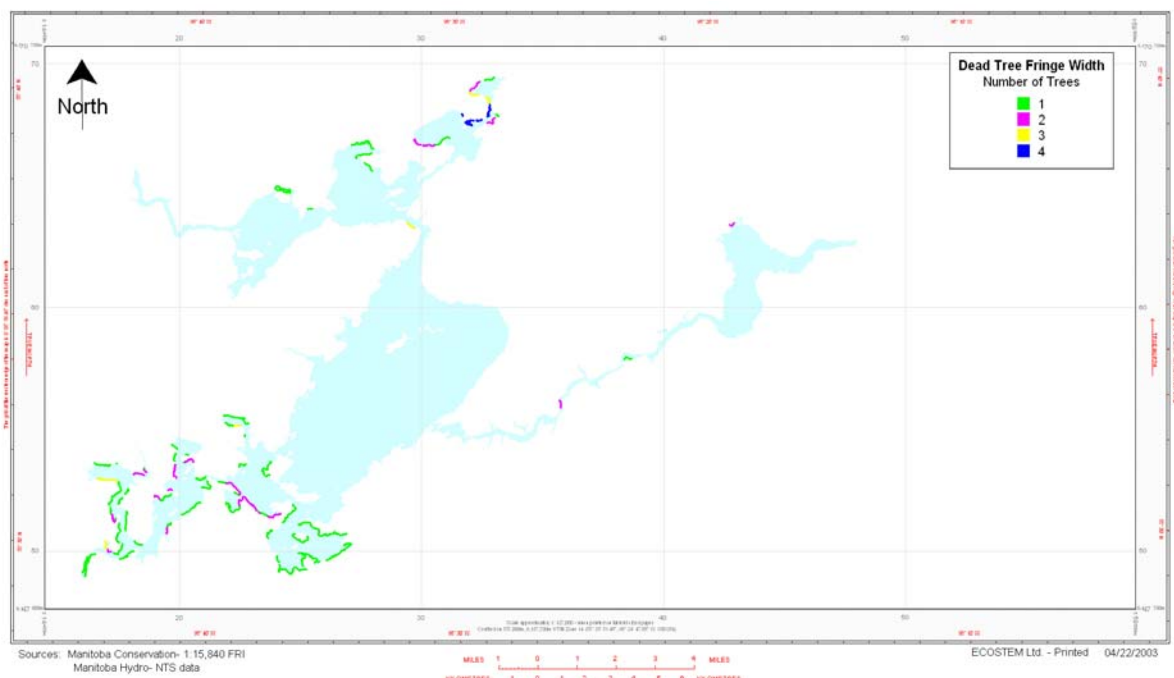


Figure 5.3-63. Location and width of dead tree fringe in forest edge in August, 2001.

5.3.3.4 Peat Islands

Lake peatlands in the proposed Affected Aquatic Area have already undergone substantial disintegration due to the operation of the Churchill River Diversion (CRD) since 1977. Prior to CRD, the surface of the water in the protected bays was partially or completely covered by lake peatlands (Figure 5.3-55). Historical aerial photography indicates that approximately 84% of pre-CRD lake peatlands have disappeared. What remains consists of many small fragments and a few large peatland remnants referred to as Peat Islands (Figure 5.3-64). Historical peatland disintegration is described in more detail in the effects assessment section (Section 5.4.2.2.2.4).

Peat Islands are either floating or grounded on the lake bottom. Virtually all Peat Islands are separated from the Mainland Edge by a band of beach and/ or water (Figure 5.3-64). The width of the separation band varies with fluctuating water levels.

In 2001, there were 8,714 distinct Peat Islands that had a combined area of 411 ha and a perimeter of 524 km (Table 5.3-16). There were no Peat Islands in the Wuskwatim Main, Burntwood River Downstream or Opegano Lake geographic zones (Figure 5.3-65). Most of the Peat Islands were small. Seventy-five percent were less than 86 m^2 and 98% were less than 0.2 ha in area. The largest Peat Island was 35 ha.

Figure 5.3-64. Peat islands in Wuskwatim Brook area.

Table 5.3-16. Distribution of Peat Islands in 2001 by geographic zone.

Geographic Zone	Number	Area (ha)	Area (%)
Cranberry Lakes & Burntwood River Upstream	2,572	108	26
Sesep Lake	2,029	133	32
Wuskwatim Brook	2,848	109	27
Wuskwatim South Bay	1,265	61	15
All Areas	8,714	411	100

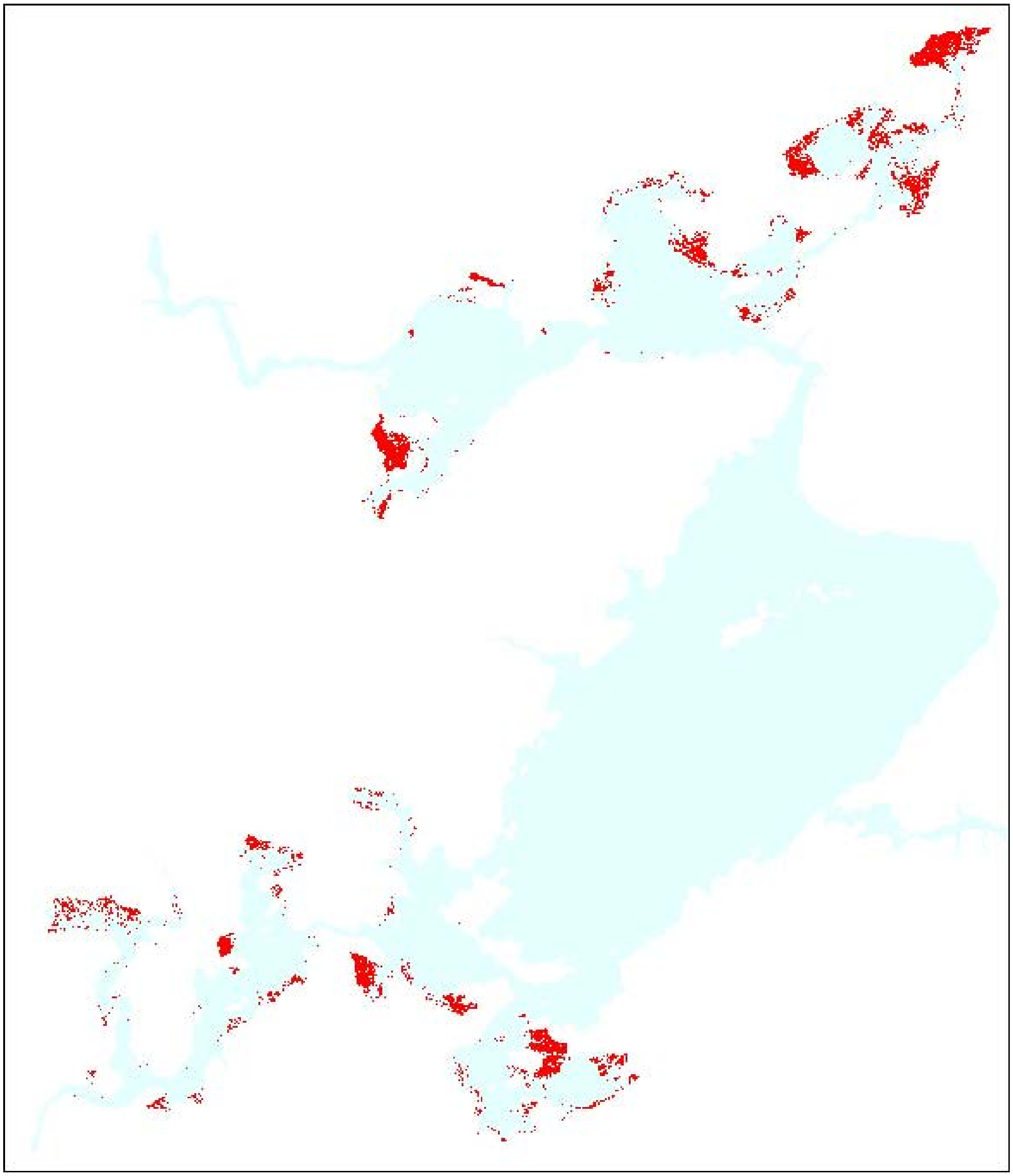


Figure 5.3-65. Locations of Peat Islands in Affected Aquatic Area. Peat Islands are in red.

Surface vegetation on the Peat Islands was mapped into dominant types (Table 5.3-17). A mapped polygon may contain up to 25% cover of types other than dominant type.

Table 5.3-17. Peat island surface vegetation types. The type is determined by the species which make up the majority of the surface cover.

Category	Type	Comments
4	Sedge	
5	Ericaceous	Ericaceous plants & Sphagnum mosses
7	Treed	Relic peat plateau bogs
8	Bare peat	
9	Submerged peat	
10	Cattails with or without submerged fringe	The periphery of many peat islands is sunken below the water level. This sunken fringe is often colonized by cattails (*Typha latifolia*).
11	Tall shrub	
14	Sedge with cattail fringe	
15	Ericaceous with cattail fringe	
17	Ericaceous and cattail mosaic	Polygon consists of patches of both cover types.
19	Ericaceous with small treed patches	
22	Tall shrub & sedge mosaic	Polygon consists of patches of both cover types.
24	Unknown	

Cattail (*Typha latifolia)* and sedge (*Carex* spp.) were the most abundant types of dominant vegetation cover on Peat Islands (Table 5.3-18). Although sedge islands accounted for a smaller percentage of Peat Islands area than cattail, sedge island area would probably be higher than cattail if the sedge portions of sedge with cattail fringe, ericaceous and sedge mosaic and tall shrub and sedge mosaic were mapped separately.

Ericaceous plant communities were the third most abundant type of cover on Peat Islands. Ericaceous plant communities generally had the same low shrub vegetation that is typically found in bogs. This is not surprising since ericaceous Peat Islands are thought to be remnant bogs that have not converted to the cattail or sedge cover types.

Treed Peat Islands account for about 16% of Peat Island area. Vegetation on these islands is typically a black spruce dominated tree layer over a typical bog understorey and a Sphagnum ground cover. Frost was encountered in all of the soil samples from these islands. Treed Peat Islands appear to be remnant pre-CRD black spruce peat plateau bogs.

The balance of cover on Peat Islands (6.8% of area) consisted of ericaceous with small treed patches, bare peat, submerged peat and unknown cover types.

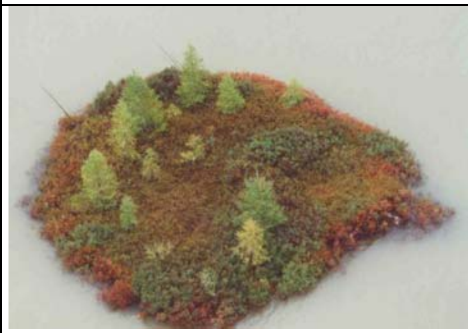
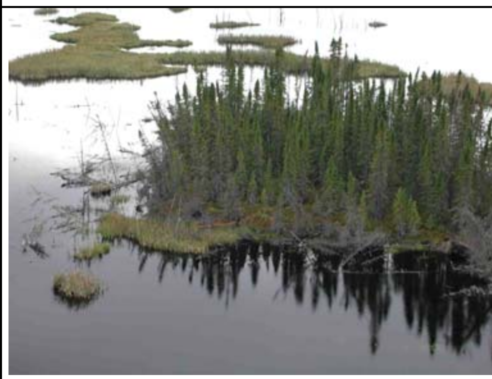
Table 5.3-18. Peat Island cover in Affected Aquatic Area by type.

Cover	%	Area
Cattail	23	94.1
Sedge with cattail fringe	8	34.2
Sedge	17	71.1
Ericaceous and sedge mosaic	8	34.9
Ericaceous	14	58.0
Ericaceous with cattail fringe	7	27.2
Ericaceous with small treed patches	0	0.4
Tall shrub & sedge mosaic	1	3.3
Tall shrub	1	2.3
Treed island	16	65.2
Bare peat	0	1.0
Submerged peat	0	0.0
Unknown	5	19.6
All types	100	411.4

[1] See Table 5.3-19 for a description of types.

Table 5.3-19. Peat Island cover types.

Cover Type	Photo Example
Cattail	
Sedge	
Ericaceous and sedge mosaic	

Ericaceous	
Ericaceous with cattail fringe	
Ericaceous with small treed patches	
Treed island	
Bare peat	
Submerged peat	

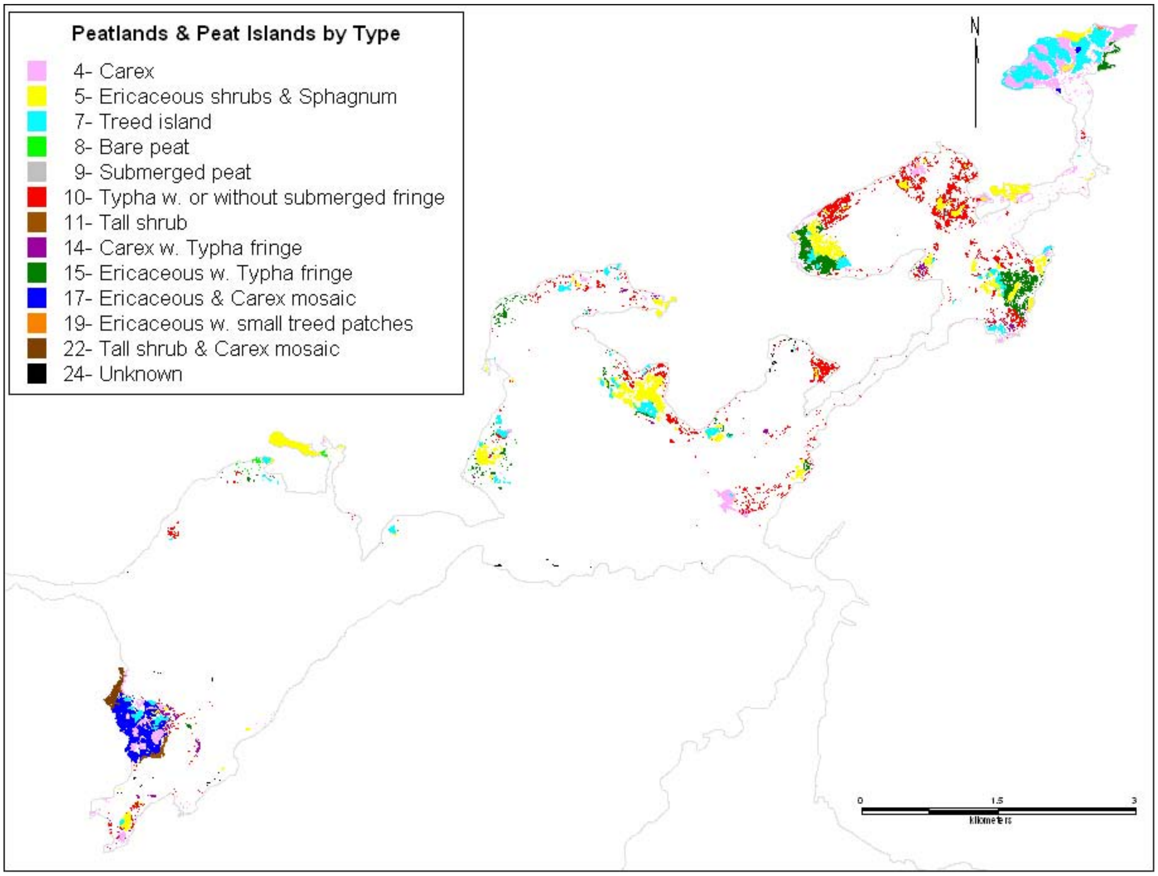


Figure 5.3-66. Peat islands by type in the Cranberry and Sesep Lakes geographic zones.

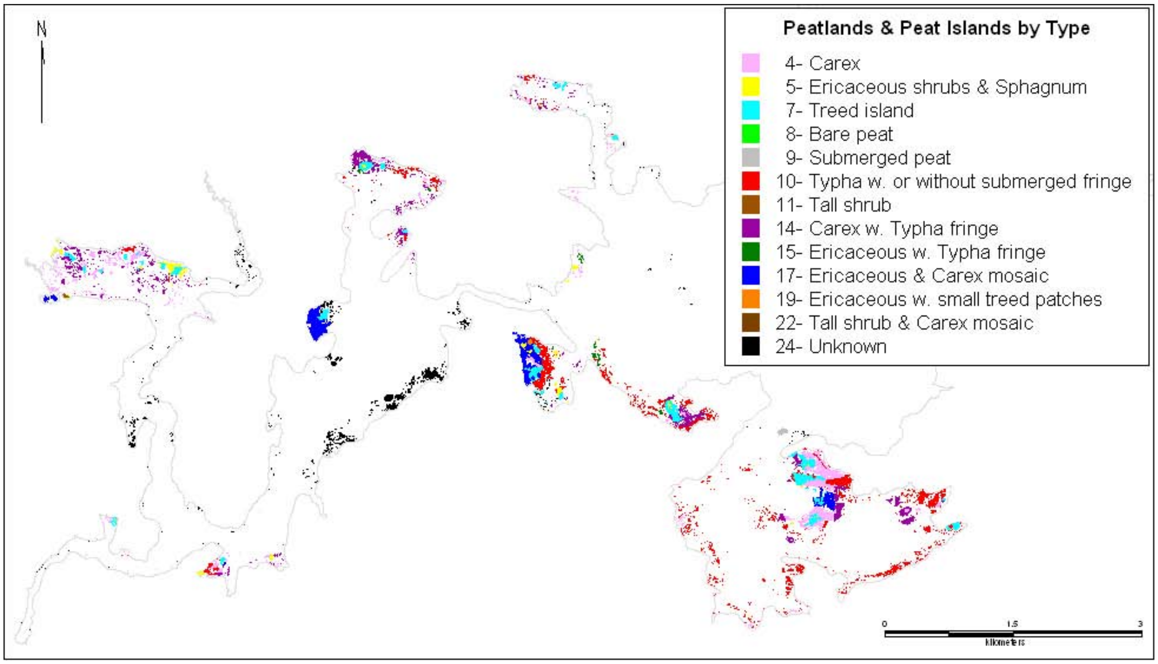


Figure 5.3-67. Peat islands by type in the Wuskwatim Brook and Southeast Bay geographic zones.

The composition of Peat Island cover in 2001 (Figure 5.3-66; Figure 5.3-67) differed substantially by geographic zone (Table 5.11-12) and by bay (Table 5.11-13). Some bays were dominated by a single cover type. For example, Muskesou River outlet area Peat Islands were mostly Treed, Sesep Lake and Wuskwatim South Bay were mostly Cattail, Bay 2 in Cranberry Lakes was mostly Ericaceous and Sedge mosaic and Bay 25 in Wuskwatim Brook was mostly Sedge and Sedge with Cattail fringe.

5.3.3.5 Mineral Islands

The Affected Aquatic Area has 119 Mineral Islands with a combined area of 314 ha (Table 5.3-20). All of the large islands are in Wuskwatim Main (Figure 5.11-1). Mineral Island Shore Zone surface materials are predominantly sloped clayey deposits or clayey deposits over low bedrock. Various types of black spruce forest account for 90% of land cover. One of the islands in Wuskwatim Lake supports the only balsam fir forest (25 ha) in the Sub-Region and 30% of Regional balsam fir forest.

Table 5.3-20. Distribution of broad habitat types (percentage of area) on Mineral Islands.

Broad Cover Type	%
White spruce > 70% forest	4
White spruce/ conifer > 70% forest	1
Black spruce > 70% forest	46
Black spruce/ jack pine > 70% forest	3
Spruce/ Fir > 70% forest	2
Balsam fir/ spruce > 70% forest	8
White spruce conifer mixedwood forest	1
Black spruce mixedwood forest	18
Black spruce/ jack pine mixedwood forest	2
Black spruce forest on peatland	2
Black spruce mixedwood forest on peatland	2
Aspen/ conifer mixedwood forest	1
Aspen > 70% forest	3
Sparsely treed black spruce peatland	1
Small Islands	6
Total Area (ha)	314

5.3.4 Semi-Aquatic VECs

5.3.4.1 Wild Mint (Wikaskwah/ Mentha arvensis *L.)*

Wild mint is a perennial herb growing about 10 – 50 cm tall. It has square stems, leaves opposite each other and tiny flowers in clusters around the stem. The stems and leaves are strongly aromatic because they contain the essential oil menthol.

Wild mint is widespread in the boreal forest (Johnson et al. 1995), in the southern two-thirds of Manitoba (Scoggan 1957) and in the Sub-Region. Wild mint is typically found on nutrient rich, very moist substrates (Jeglum 1971, 1973). Wild mint was widespread in the Shore Zone of the Affected Aquatic Area. Abundance was highest on exposed mineral soil in the Lower to Upper Beach water duration zones of the low gradient areas (Figure 5.3-68).

Wild mint photo and range in Manitoba, Alberta and the northern U.S. (Source: Tom Reaume unpubl. manu.)

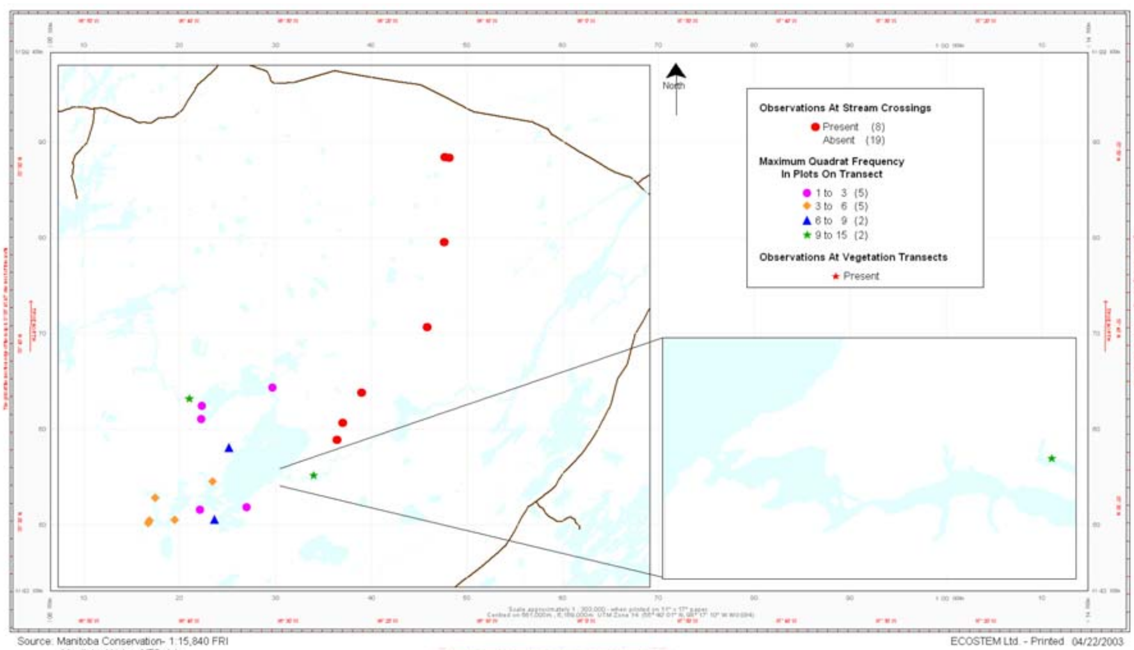


Figure 5.3-68. Distribution and abundance of wild mint at the Shore Zone and mainland plots in the 1 km Aquatic Buffer.

Wild mint habitat quality was classified based on Shore Zone shore material type and Peat Island cover type as described in Table 5.3-21. Low gradient clayey material in the Shore Zone was the only habitat to be considered as high quality.

High quality mint habitat occurred on 29% of the Affected Aquatic Area shoreline (Table 5.11-14) and was concentrated in the southern parts of the upstream Affected Aquatic Area (Figure 5.3-68). Most of the remaining high quality habitat was located in the Cranberry Lakes area. Moderate quality habitat covered 15% of the shoreline and was concentrated along the Burntwood River and in the Cranberry Lakes area. Very poor quality habitat accounted for 52% of the shoreline.

Table 5.3-21. Wild mint habitat quality in Affected Aquatic Area.

Habitat Quality	Environmental Conditions
High	• Low gradient clayey material in the Shore Zone.
Moderate	• Mixture of low gradient mineral and organic material in the Shore Zone; • Floodplain material in the Shore Zone; • Medium gradient clayey material in the Shore Zone.
Poor	• Low gradient organic material in the Shore Zone; • High gradient clayey material in the Shore Zone.
Very Poor	• All other Shore Zone shore material types; • All Peat Island types.

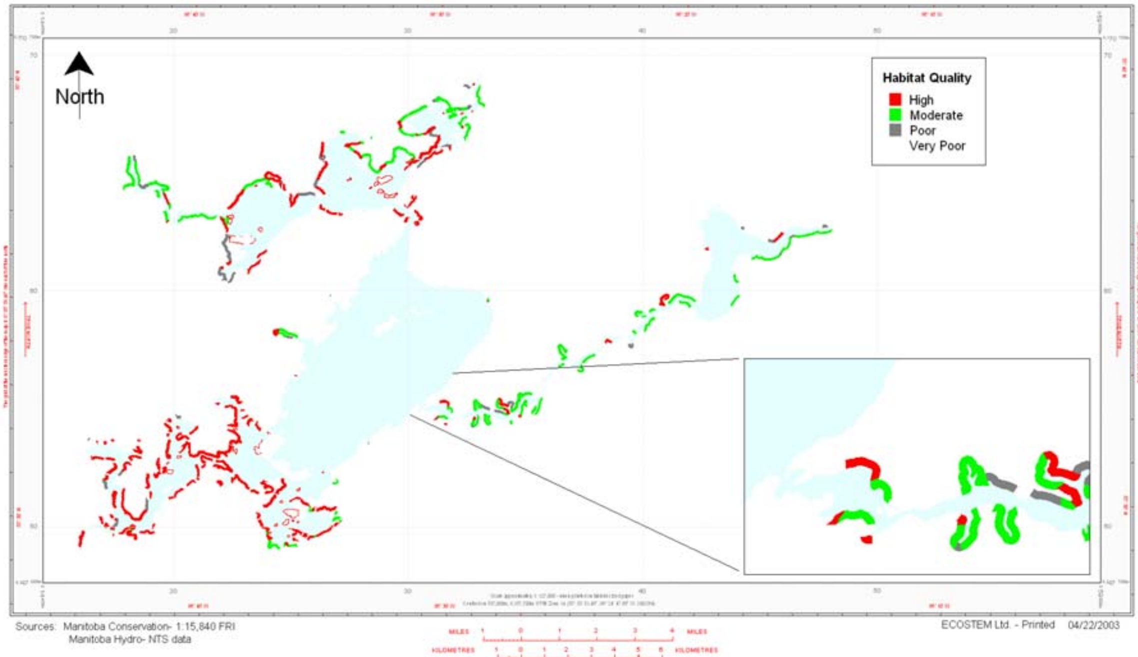


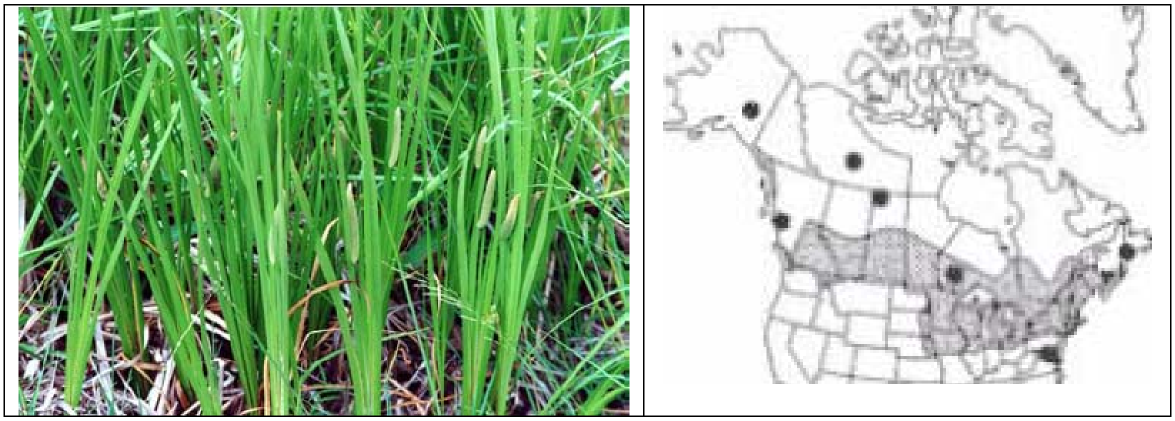
Figure 5.3-69. Wild mint habitat quality on Peat Islands and the Shore Zone in the Affected Aquatic Area.

5.3.4.2 Sweet Flag/ Rat Root (Wikhees/ Acorus americanus *(Raf.) Raf. (*A. calamus *L.))*

Sweet flag is a tall perennial plant usually found growing in water. It has long narrow sword shaped leaves that can be over 1 m long. The bright green leaves often hide the brownish flowers that are crowded onto a spike. The plant forms clumps spreading by thick rhizomes.

Sweet flag is widespread in the boreal forest (Johnson et al. 1995), in the southern three-quarters of Manitoba (Scoggan 1957) and in the Sub-Region. Sweet flag is typically found in sheltered marshes with a peat bottom, but also occurs in marshes with a mineral bottom or on saturated mineral soil in the lower beach zone. NCN members indicated that sweet flag was abundant in the Sesep Lake area prior to CRD.

Sweet flag was widespread but sparse in the Affected Aquatic Area (Figure 5.3-70). In the field plots, Sweet flag was found on organic substrate in the Very Shallow Water and Lower Beach zones (Figure 5.3-68). This indicates that sweet flag is a shallow water species that tolerates water fluctuations, since the Lower Beach zone was under water during the growing season prior to sampling. Field observations indicated that sweet flag also occurred in the protected bays on peat where the water table was at or very near the surface. It was not observed on the Peat Islands.



Sweet flag photo and range in Canada (Source: Flora of North America)

Sweet flag habitat quality was classified based on Shore Zone shore material type and Peat Island cover type as described in Table 5.3-22. Only 2% and 4% of the Affected Aquatic Area shoreline was classified as high or moderate quality sweet flag habitat (Table 5.11-15). Over 75% of the shoreline was very poor quality habitat. All of the habitat classified as poor to high quality for sweet flag occurred upstream in the Wuskwatim Brook, Sesep Lake and Cranberry Lake areas (Figure 5.3-71).

Table 5.3-22. Sweet flag habitat quality in Affected Aquatic Area.

Habitat Quality	Environmental Conditions
High	• Low gradient organic material in the Shore Zone of protected bays; • In protected bays on peat where the water table is at or very near the surface.
Moderate	• Mixture of low gradient mineral and organic material in the Shore Zone.
Poor	• Low gradient clayey material in the Shore Zone of protected bays.
Very Poor	• All other shore material types; • All Peat Island types.

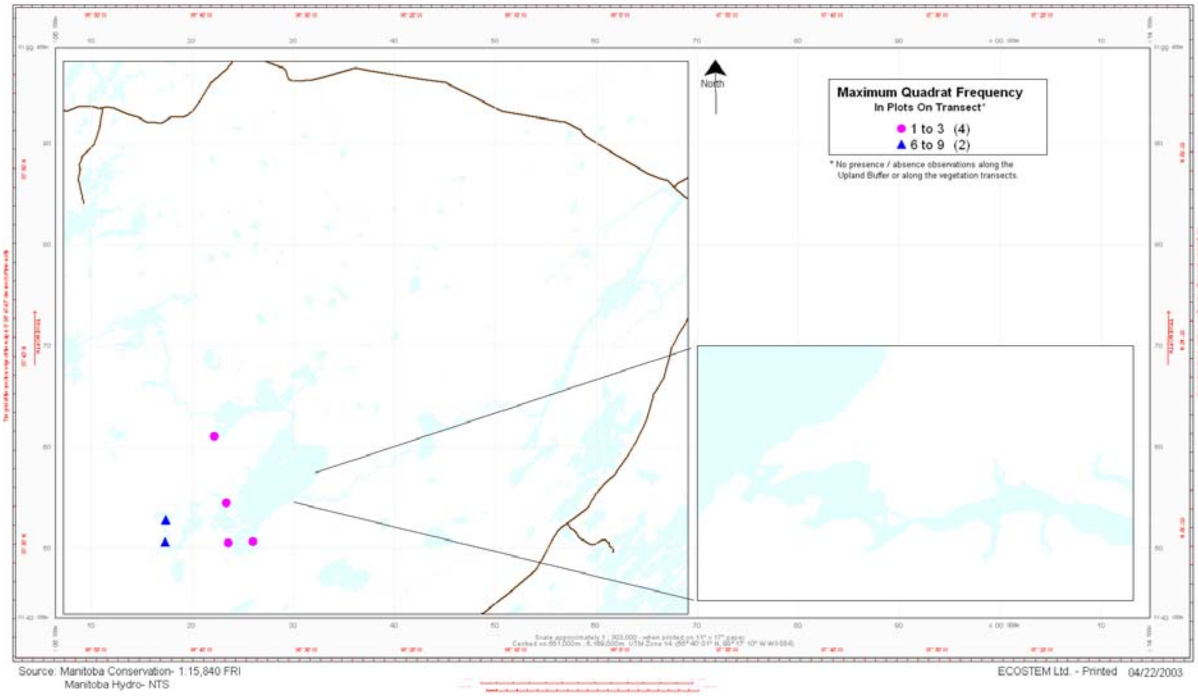


Figure 5.3-70. Distribution and abundance of sweet flag at the Shore Zone and mainland plots in the 1 km Aquatic Buffer.

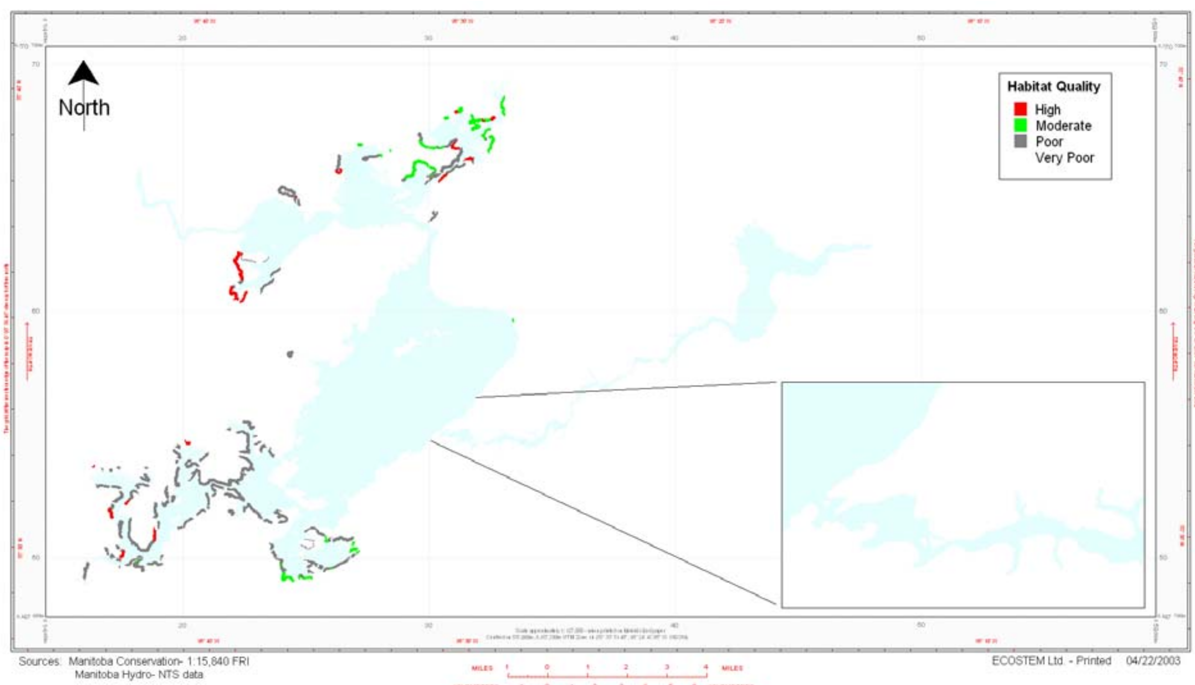


Figure 5.3-71. Sweet flag habitat quality on Peat Islands and the Shore Zone in the Affected Aquatic Area.

5.3.4.3 Bog Cranberry (Wesakemina/ **Oxycoccus microcarpus** *Turcz. (***Vaccinium oxycoccus***))*

NCN members indicated that cranberries were harvested in the Cranberry Lakes area prior to CRD. The area was named for the abundance of berries that grew there. What constituted high quality bog cranberry habitat in the Affected Aquatic Area was essentially the same as described for the mainland habitat (Section 5.3.2.4). High quality bog cranberry habitat was open bogs, sparsely treed bogs or open black spruce forest on peatlands. This type of habitat occurs on the Peat Islands and on the peatland Shore Zone material type where there is no bank (Table 5.3-23).

Upstream, high quality bog cranberry habitat is widespread in the sheltered low slope areas (Figure 5.3-72). Downstream, moderate to high quality bog cranberry habitat is limited to the northern end of Opegano Lake. About 15% of the Shore Zone has habitat suitable for bog cranberry (Table 5.3-23). About 37% of Peat Island area is high quality habitat.

Table 5.3-23. Shore Zone and Peat Island habitat quality for bog cranberry.

Figures are percentage of shoreline length in Affected Aquatic Area and percentage of area for Peat Islands.

Habitat Type	Habitat Quality		
	High	Moderate	Very Poor
Shore Zone			
Peatland with low bank	15		
All other types			85
Peat Islands			
Submerged peat			0
Bare peat			0
Sedge			17
Sedge with cattail fringe			8
Cattail with or without submerged fringe			23
Tall shrub & sedge mosaic		1	
Ericaceous and cattail mosaic		8	
Ericaceous with cattail fringe	7		
Ericaceous shrubs & Sphagnum mosses	14		
Ericaceous with small treed patches	0		
Tall shrub		1	
Treed	16		
Unknown			5
All Peat Island types	37	10	54
Peat Island areas (ha)	151	41	221

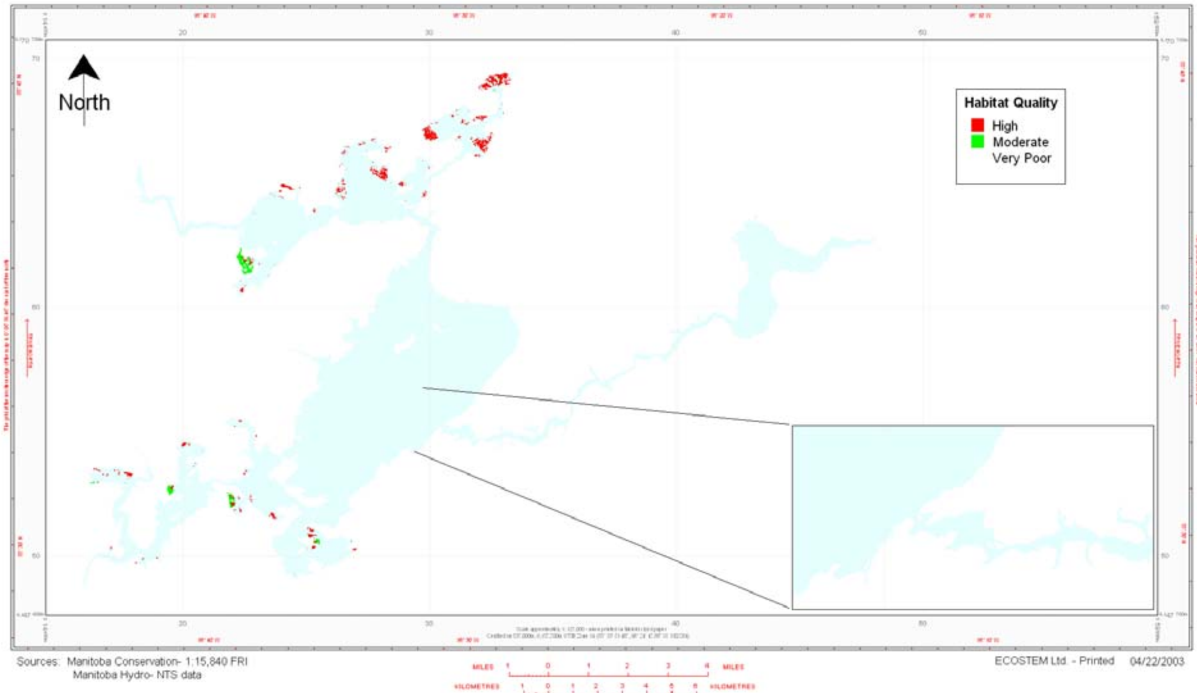


Figure 5.3-72. Bog cranberry habitat quality on Peat Islands and the Shore Zone in the Affected Aquatic Area.

5.3.5 Sensitive Species

5.3.5.1 Endangered, Threatened or Provincially Very Rare Plants

Prior to field studies, literature reviews confirmed that no vascular plant listed as endangered or threatened or ranked as globally very rare, globally rare or provincially very rare was previously recorded in the Sub-Region (D. Falk pers. comm.; see Appendix 2 Table 5.11-16 for CDC ranking system and Table 5.11-17 for a list of the provincially very rare and rare species that might occur in the Sub-Region and the habitats where they have been found outside of the Region). None of these species were found during field investigations.

5.3.5.2 Provincially Rare Plants

Six provincially rare to uncommon plant species (ranked S2, S2S3, S3, S3?) were found in the Sub-Region (Table 5.3-24).

Table 5.3-24. Rare and uncommon plants (Manitoba Conservation Data Centre) found in the Sub-Region.
See Appendix Table 5.11-16 for definitions of ranks.

Rank	Species Name	Common Names
S2	*Vaccinium caespitosum* Michx.	Dwarf bilberry, dwarf blueberry
S2	*Torreyochloa pallida* (Torr.) Church	Pale manna grass
S2	*Nymphaea tetragona* Georgi	Pygmy water-lily
S2S3	*Thalictrum sparsiflorum* Turcz.	Few-flowered meadow rue
S3?	*Bidens beckii* Torr. ex Spreng.	Water marigold
S3	*Astragalus americanus* (Hook.) Jones	American milk-vetch

Plant names are from Scoggan 1979. A list of vascular plants found in the study is provided in Appendix Table 5.11-3.

***Vaccinium caespitosum*/ Dwarf bilberry, dwarf blueberry – S2**

Dwarf blueberry is a matted, small shrub often with inconspicuous flowers or fruit, that grows close to the ground and can easily be overlooked. It grows in the boreal forest from Manitoba to Alaska in coniferous (especially pine) forest, on slopes, shores and tundra. Dwarf blueberry has not been collected or recorded in many locations in Manitoba, hence its designation by CDC. In the opinion of Dr. Karen Johnson (Curator of Botany {retired}, Manitoba Museum), dwarf blueberry is more widespread than the few records indicate (pers. comm.). Field observations from the Sub-Region support Dr. Johnson's assessment.

***Nymphaea tetragona*/ Pygmy water-lily – S2**

In its vegetative state, pygmy water-lily resembles the small yellow water-lily. In August, pygmy water-lily displays white flowers that only open late in the day in full sunshine. It grows in quiet waters, ponds and deep ditches. Pygmy water-lily seems to have a restricted recorded range in a small belt in the western boreal region. It has been found at Minago Lake, north of Lake Winnipeg. Pygmy water-lily was observed in only one location in a roadside pond adjacent to PR 391.

***Torreyochloa pallida*/ Pale manna grass- S2**
There are few recorded occurrences of pale manna grass in Manitoba, so little is known about its provincial habitat and range. Pale manna grass has been found in the Whiteshell and at one location on the shoreline of Birchtree Lake.

5.3.5.3 Provincially Uncommon Plants (S3)

***Thalictrum sparsiflorum*/ Few-flowered meadow rue – S2S3**
Few-flowered meadow rue occurs in moist meadows, thickets and woods in the boreal forest from Manitoba west to the Yukon and Alaska. Few-flowered meadow rue was found in one only location during field investigations several hundred metres from the shoreline of Wuskwatim Lake in a beaver-flooded alder thicket. This is the first recorded observation in the Sub-region. Few-flowered meadow rue may be more common than its ranking suggests as it is listed as scattered across the boreal forest in Johnson (1995).

***Bidens beckii*/ Water marigold - (S3?)**
Water marigold is an aquatic plant found in ponds, slow streams and quiet bays. At Wuskwatim, populations of these plants were observed in the Sesep area and also in a bay at the south end of the lake (K.Kroeker pers. comm.). The Wuskwatim Lake observation is at the northern edge of its Manitoba range.

***Astragalus americanus*/ American milk-vetch – (S3)**
American milk vetch is found on streambanks, shores and moist open woods in Canada from B.C. to the Gaspe. In Manitoba, it is at the northern edge of its range in the study area. It was found on streambanks on the proposed road access route.

5.3.5.4 Regionally Rare To Uncommon Plants

Based on available information, the only regionally rare species are balsam fir and white spruce. Information on these species is provided in Section 5.2.4.1.3.

5.3.5.5 Species Near Their Documented Range Limits

Information on ranges of plants in the Region is somewhat sketchy. To a large extent this is likely due to the lack of field collections and botanical surveys. The most common northern locations cited in Scoggan 1979 are Gillam, Churchill and The Pas. A synthesis of herbaria records (MMMN) and literature surveys (Flora of N.A., Flora of Canada, Plants of the Aspen Parkland and Western Boreal Forest, Carex in Saskatchewan) indicates the following about range limits of species found in the Region:

- most species occur in a much wider range than the Region and many are found throughout most of Manitoba; and
- no plants have a range restricted to the region.

Plants approaching the southern limit of their documented range in the Region include:

- *Abies balsamea* – overstorey balsam fir (see Section 5.3.2.1)
- *Arctostaphylos alpina* – Alpine bearberry
- *Juncus castaneus* – chestnut rush
- *Solidago multiradiata* – alpine goldenrod

Solidago multiradiata **Ait. – Alpine Goldenrod**

Alpine goldenrod is found in meadows, rocky places and at high elevations from south central Saskatchewan through north and central Manitoba and along the coasts of Hudson Bay to the east in Canada. In Manitoba, it has been found south to Cross Lake.

Arctostaphylos alpina **(L.) Spreng. – Alpine bearberry**

Alpine bearberry is a dwarf shrub that is found in the northern regions of the northern hemisphere. In Canada, it occurs in wet mossy forests, muskeg and tundra north to the arctic coast. In Manitoba, it is found in the northern third of the province south to The Pas. During field surveys alpine bearberry was recorded in 19 shoreline study plots ranging across the whole study area and in two locations along the road access route.

Juncus castaneus **Sm. – Chestnut rush**

Chestnut rush is a plant of wet shores, river flats, fens, marshes and tundra across Canada. In Manitoba, it has been found around the Hudson Bay shoreline and southward along the Nelson and Hayes Rivers. Chestnut rush was found in an inland peatland east of the road access route.

Plants beyond or approaching the northern limits of their documented range:

- *Abies balsamea* – overstorey balsam fir (see Section 5.3.2.1)
- *Arceuthobium pusillum* – dwarf mistletoe (on *Picea*)
- *Aster ciliolatus* – Lindley's aster
- *Bromus ciliatus* – fringed brome
- *Diervilla lonicera* – bush-honeysuckle
- *Galium triflorum* – sweet-scented bedstraw
- *Halenia deflexa* – spurred gentian
- *Melampyrum lineare* – cow-wheat
- *Polygala paucifolia* – gaywings
- *Sarracenia purpurea* –pitcher-plant

Arceuthobium pusillum Peck. – Dwarf mistletoe

Dwarf mistletoe is a plant parasitic on spruce trees (*Picea* spp.). It is found in Canada from eastern Saskatchewan to the Atlantic Provinces. In Manitoba, it has been collected as far north as The Pas. Dwarf mistletoe was observed on a black spruce tree at one location in the Wuskwatim Brook area.

Bromus ciliatus L. – Fringed brome

Fringed brome is a grass occurring in open woods and meadows in the boreal forest north and west to Great Bear Lake and Alaska. In Manitoba, it occurs in the southern half of the province, the northernmost collection being at Herb Lake. Fringed brome was found in one location in the Wuskwatim Brook area and in one location during field surveys of the proposed Mile 17 access road.

Diervilla lonicera P. Mill – Bush honeysuckle

Bush honeysuckle is found in dry woods, rocky areas and clearings in Canada from east-central Saskatchewan to the Atlantic region. It occurs in southern Manitoba north to Cross Lake. Bush honeysuckle was recorded in two locations along the road access route and in a dry coniferous forest within the Sub-Region but outside the Aquatic and Upland Buffer Zones.

Halenia deflexa (Sm.) Griseb. – Spurred gentian

Found in moist woods and thickets in the southern boreal forest, spurred gentian's range in Canada is from BC across the country to the Atlantic. Its range in Manitoba is in the southern half of the province up to Cross Lake. Spurred gentian was recorded in a dry coniferous forest within the Sub-Region but outside the Aquatic and Upland Buffer Zones.

***Melampyrum lineare* Desr. – Cow-wheat**

Cow-wheat is found across Canada from BC to the Atlantic. It grows in mossy coniferous forests, heaths and barrens and dry, sandy jack pine woods. In Manitoba it is documented as occurring from the US border north to Wekusko Lake. Cow-wheat was found in a dry coniferous forest within the Sub-Region but outside the Aquatic and Upland Buffer Zones.

***Polygala paucifolia* Willd. – Gaywings**

A plant of the southern boreal forest, it is found sporadically in moist coniferous woodlands. It ranges from northeast Alberta and Saskatchewan east to the Atlantic Provinces. In Manitoba it occurs north to Oxford House. Gaywings was found in a mixed coniferous forest on the west side of Wuskwatim Lake and in one location on the road access route.

***Sarracenia purpurea* L. – Pitcher plant**

Pitcher plants occur in bogs and fens from northeastern BC to the Atlantic. In Manitoba it has been recorded in bogs and fens from Shoal Lake north to Bear Lake, which is just north of Oxford House. In the Sub-Region pitcher plants were found in several inland fens and bogs

5.4 EFFECTS AND MITIGATION

The terrestrial habitat effects assessment approach is described in Sections 5.1 and 5.2.4.2. In brief, the effects assessment proceeded in a bottom-up, sequential, hierarchical fashion as follows:

(1) identify the Project impact areas.
(2) identify the Project effects areas: fine habitat ZOI and landscape zone of influence (i.e., 1 km buffers)
(3) identify Project effects comparison areas.
(4) describe the existing environment using the Project effects comparison areas as the study areas.
(5) identify potentially significant effects in the Project effects areas.
(6) determine which potentially significant effects will be mitigated and specify mitigation measures.
(7) describe residual Project effects.
(8) assess cumulative effects.
(9) specify appropriate follow-up and monitoring.

Project impact areas were introduced in Section 5.2.1 to set the stage for study area selection based on the Project effects comparison areas. The existing environment in the four study areas, the Region, Sub-Region, 1 km Aquatic Buffer and 1 km Upland Buffer, was then described. This section describes the Project impact areas in detail and then conducts the terrestrial habitat and VEC effects assessment. This section also describes the mitigation measures that will be used to eliminate the significance of any expected negative effects.

5.4.1 Mainland/ Upland Habitat

5.4.1.1 Project Impact Areas

Mainland/ upland habitat areas that contain Project impacts (i.e., contain the footprints of Project features) are called the Upland Project Areas. Upland Project Areas created during construction (Figure 5.4-1) include:

- access road right-of-way (48.2 km long by 100 m wide).
- granular borrow pits.
- access roads to the granular borrow pits (200 m wide).
- clearing of the flooded area between the Wuskwatim Lake outlet and the dam (includes all of one island and part of two others).

- three islands in the Burntwood River at the generating station site.
- generating station structures south of the river.
- generating station structures and construction camp north of the river.

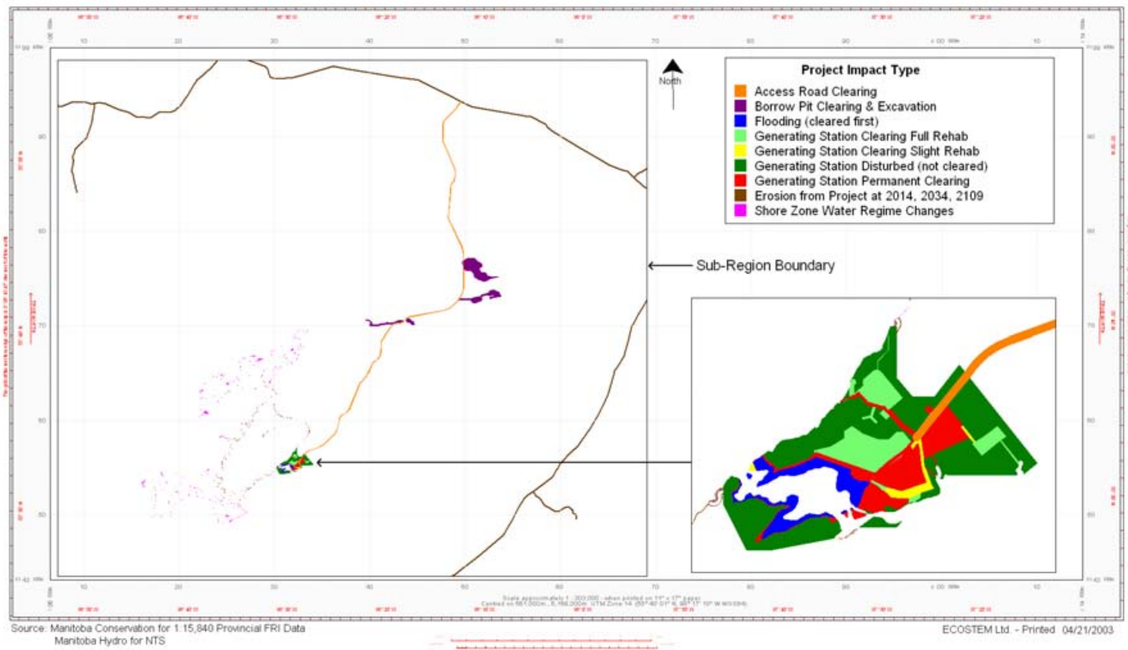


Figure 5.4-1. Areas that would be cleared or physically altered during construction and/ or operation.

Note: Shore Zone and incremental project erosion impact areas appear spotty because the areas affected are small. See Figure 5.2-1 for a larger version of this map.

Several assumptions were made to estimate the amounts and types of mainland/ upland habitat that would be directly affected during construction.

The Borrow Pit Project Areas include all of the potential granular borrow pits along with a 200 m wide access road to pits that do not cross the access road (Figure 5.4-1). The habitat effects assessment conservatively assumed that the entire area of the Borrow Pit Project Areas will be cleared during construction. Although nine granular borrow pit areas are identified, it is likely that only J4, J6 and part of G will actually be used (Volume 3). In fact, preliminary engineering investigations suggest that as little as 5.6% of the 654 ha of potential area may be sufficient (Volume 3). The actual locations and amounts of granular borrow pit clearing will be determined during construction. Assuming that all of the Borrow Pit Project Areas would be cleared during construction creates a contingency area of 617 ha (i.e., 95.4% of potential area) to allow for pockets of poor quality material, shallower than expected deposits and other contingencies.

For the access road and associated features (e.g., ditches, emissions from vehicle traffic), it was assumed that all of the 100 m access road right-of-way (RoW) would be cleared during construction. This is the Access Road Project Area (Figure 5.4-1). Actual clearing in this area (i.e., the RoW) will generally be 80 m depending on road curvature and terrain, but could be as wide as 100 m. Clearing along most of the access road length is expected to be 80 m (Volume 3, Section 4). Assuming that the entire RoW would be cleared during construction, there would be an excess uncleared area in the RoW that could be as high as 96 ha in the unlikely event that the cleared band was 80 m along the entire length of the access road (Table 5.4-1). If only 20% of the road length is cleared to a 100 m width, then the excess area in the Access Road Project Area would be 77 ha.

Table 5.4-1. Cleared and intact areas within the 100 m Access Road RoW under different assumptions about clearing.

Scenario	Cleared Width (m)	Percentage of Road Length Cleared At Width	Length (km)	Assumed Actual Cleared Road Area		Residual Area (ha)
				Sub-Total (ha)	Total (ha)	
A	100	100%	48.2	482	482	0
B	80	100%	48.2	386	289	96
C	80	90%	43.4	347		
	100	10%	4.8	48	308	87
D	80	80%	38.6	309		
	100	20%	9.6	96	328	77

The excess area between assumed and expected clearing in the Access Road Project Area captures some of the indirect effects of access road features and provides a partial allowance for roadbed borrow pit clearing that occurs outside of the RoW. Roadbed material will come from the excavated ditches and from roadbed borrow pits located 100 to 150 m from the access road. Clearing for roadbed borrow material is estimated to affect a maximum of 2.5 and 5.0 ha of area per km along the north and south halves of the access road, respectively (Volume 3, Section 4). More area is affected along the southern half because a higher percentage of the RoW length passes through soils that are unsuitable for a roadbed. It is estimated that up to 208 ha may be required for roadbed borrow pits. The actual locations and amounts of roadbed borrow pit clearing will be determined during construction.

Due to the uncertainties related to the locations of the roadbed borrow pits, it was assumed that the contingency area in the Borrow Pit Project Areas and the excess area in the Access Road Project Area (100 m band less a typical actual clearing width of 80 m for the road and ditches) would be adequate to capture the roadbed borrow pit impact areas. This was considered reasonable because:

- the Borrow Pit Project Areas include up to 617 ha of unaffected area and the Access Road Project area includes up to 96 ha of excess area;
- only some portions of the south half of the Access Road require up to 5 ha/ km of clearing. Area shortages in portions of the south half of the Access Road Project Area should be at least partially offset by unused areas elsewhere along the road. Any shortages that are not offset should be small (i.e., < 55 ha; Table 5.4-1) and affect habitat types that are very common in the Sub-Region. Clearing in environmentally sensitive areas will be minimized or avoided as specified in the Environmental Protection Plan that will be developed for the Project;
- although the roadbed borrow pits will be located outside the 100 m access road band, most should be in the same habitat patches included in the Access Road Project Area;
- given the nature of materials required for roadbed, the types of habitat in the 617 ha of contingency area in the Borrow Pit Project Areas should be similar to that in the roadbed borrow pit areas.

These assumptions generate different apparent amounts of total roadbed and granular borrow pit clearing than shown in the Project description (Volume 3, Section 4). The Project description shows Borrow Pit Project Area clearing of ~5.6% of 654 ha plus roadbed borrow pit clearing of 208 ha. The habitat effects assessment shows the entire 654 ha of granular borrow pits as being cleared, with this total including a portion of the 208 ha of roadbed borrow pit clearing (the rest is captured in the Access Road Project Area).

Based on these assumptions, construction features will directly affect up to 1,605 ha of mainland/ upland habitat in the Generating Station, Access Road and Borrow Pit Project Areas (Table 5.4-2). The Generating Station Project Areas include 182 ha of clearing and 226 ha of disturbance. Of the total Generating Station Project Area clearing, 112 ha is permanent (includes flooded area) and 70 ha will be partially to fully rehabilitated. Effects in the disturbed area include physical disturbance from people living and working in the area during construction (e.g., foot trails, accidental clearing) and indirect effects of clearing (see below).

Table 5.4-2. Area and perimeter of Upland Project Areas directly affected by the Project during construction.

See Figure 5.4-1 for locations of Project Areas.

Upland Project Area	Area (ha)	
	Sub-Total	Total
Access Road		**482**
Borrow Pits		**716**
Borrow Pit G	392	
Borrow Pit H Access Road	45	
Borrow Pit H-E	90	
Borrow Pit H-W	64	
Borrow Pit J Access Road	34	
Borrow Pit J-1	7	
Borrow Pit J-2	10	
Borrow Pit J-3	7	
Borrow Pit J-4	6	
Borrow Pit J-5	22	
Borrow Pit J-6	38	
Generating Station		**407**
Clearing for flooding	38	
Clearing with full rehabilitation	60	
Clearing with partial rehabilitation	10	
Permanent Clearing	74	
Disturbed but not cleared	226	
All Areas		**1,605**

5.4.1.2 Types of Habitat Effects Considered

Direct effects of the Project in the Mainland/ Upland Project Areas include habitat loss related to vegetation clearing, surface organic layer removal and soil excavation and potential habitat conversion from disturbance, accidental events and/ or soil compaction, etc..

A number of indirect effects are expected to arise from the direct effects of the Project in the Mainland/ Upland Project Areas. Some of these indirect effects lead to further indirect effects. For example, clearing trees in a black spruce peat plateau bog often leads to higher soil temperature, permafrost melting, collapse of the peat plateau and, finally, formation of collapse scar fen and/ or open water habitat. Surface soil conditions change from fresh to very wet and cause a dramatic change in vegetation from black spruce forest on bog to sedge fen. In this example, the direct effect is clearing, the initial indirect effect is soil warming, the secondary indirect effect is permafrost melting, the tertiary indirect effect is peat plateau collapse and the final effect is conversion to sedge fen.

The indirect Project effects considered in the habitat assessment are listed in Table 5.4-3.

Table 5.4-3. Indirect effects of Project features that were considered in the habitat assessment.

(1) Changes to soil moisture and fertility caused by ditching and road construction (e.g., peatland drains and water table drops);
(2) Soil heating and permafrost melting in peatlands caused by clearing;
(3) Tree blowdown caused by clearing;
(4) Edge effects on plant species caused by clearing;
(5) Habitat disturbance or conversion caused by accidental spills or disturbance;
(6) Habitat conversion caused by airborne deposition from road dust and fuel combustion generated by vehicles and construction equipment;
(7) Crowding out of native plants by alien invasive species introduced by vehicle traffic and construction equipment;
(8) Changes in habitat composition due to higher fire frequency and/ or severity from better access; and
(9) Habitat fragmentation from access road.

Given the nature of direct and indirect effects, the effects assessment treats all of the habitat within the Mainland/ Upland Project Areas as if it is lost during construction.

As indicated by the collapsing peat plateau bog example, the same indirect effects that occur inside the Mainland/ Upland Project Areas may also occur in adjacent areas. The nature and spatial extent of habitat effects will vary from none to conversion from one habitat type to another type that has very different composition and structure (e.g., from forest to a non-forest type). The nature and extent of indirect habitat effects are a function of the existing habitat type, topographic position and hydrology. A precise assessment of the aerial extent of indirect habitat effects (other than invasive plants and wildfire) would require a set of decision rules that would be applied to each fine habitat patch in a GIS. The decision rules would establish the type of effect and zone of influence based on fine habitat type, topographic position and hydrology. This was not pursued because the level of effort required to achieve greater precision was not justified given the magnitude of potential effects. Instead, it was assumed that the maximum extent of most indirect effects large enough to result in habitat conversion would be less than 150 m from the cleared areas. The exceptions were effects from invasive species, wildfire and landscape effects such as fragmentation.

Most indirect habitat effects from the Mainland/ Upland Project Areas were generally captured with a 150 m buffer around the Project areas. This 150 m band is referred to as the fine habitat zone of influence (Fine Habitat ZOI). The habitat effects assessment takes a conservative approach and treats all of the habitat within a Fine Habitat ZOI as if it is lost during construction. Landscape level effects on habitat were considered individually for invasive species, fire and fragmentation.

5.4.1.3 Construction

5.4.1.3.1 Generating Station

<u>Effects in the Project Impact Areas</u>

The habitat effects assessment takes a conservative approach and treats all of the habitat within the Generating Station Project Areas as if it is lost during construction.

A mosaic of peaty mineral soil, mineral soil and peatlands dominates the Generating Station Project Areas (Figure 5.4-2). Peaty mineral soil is dominant on the south side of the Burntwood River. The three islands in the flooding area are exposed bedrock with patches of thin mineral soils. None of the affected land types are rare or uncommon.

Land cover in the Generating Station Project Areas is dominated by conifer forest (88%) with small patches of hardwood forest and very open vegetation on bedrock or wetland. Broad habitat composition in the Generating Station Project Areas is primarily a mixture of immature black spruce & other moist forest on peaty mineral soil (32% of land area), mature other conifer forest on mineral soil (19%; Figure 5.4-3; Appendix 5.12 Table 5.12-2), immature black spruce & other conifer mixedwood forest on peaty mineral soil (17%) and immature black spruce & other conifer forest on peatland (12%). Except for those containing white spruce, none of the affected broad habitat types are rare, uncommon or thought to play a key role in landscape flows. Vegetation is predominantly a mixture of different types of black spruce forest (84% of total area). Most of the remaining vegetation is white spruce or aspen forest. White spruce and balsam fir forest are rare in the Region and Sub-Region (Section 5.3.2.1). The Generating Station Project Areas contain 6% of Sub-Region white spruce forest and 1% of white spruce mixedwood forest (Figure 5.4-4). Some of the remaining white spruce forest in the 1 km Aquatic Buffer will be lost to erosion (see Section 5.4.2.2.1.6). Approximately one-third of the white spruce is in the cleared areas; the rest is in the disturbed area. The Generating Station Project Areas contain 63 of the Sub-Region's 5,068 ha of old forest (Figure 5.4-5).

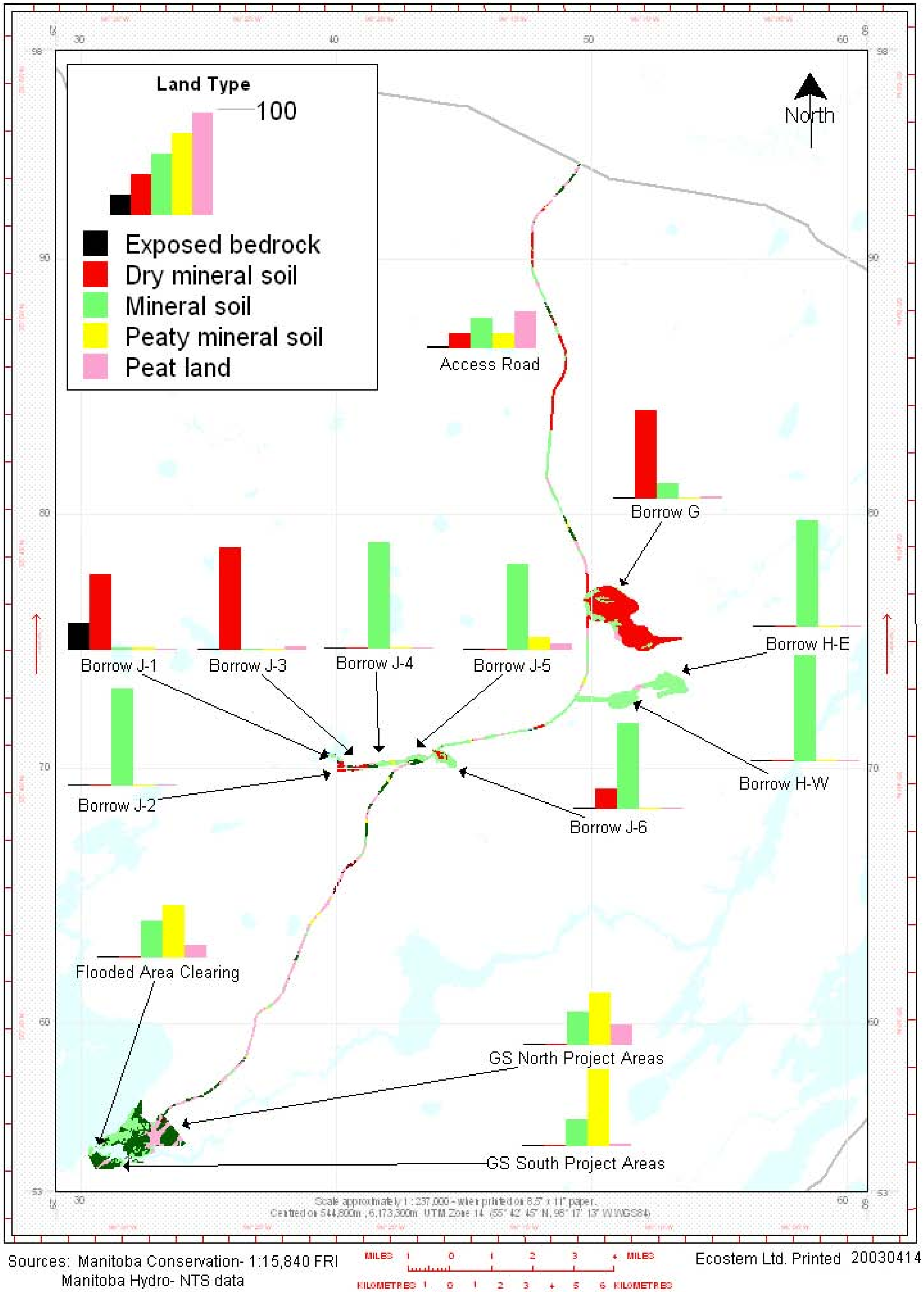


Figure 5.4-2. Land type composition in the Mainland/ Upland Project Areas.

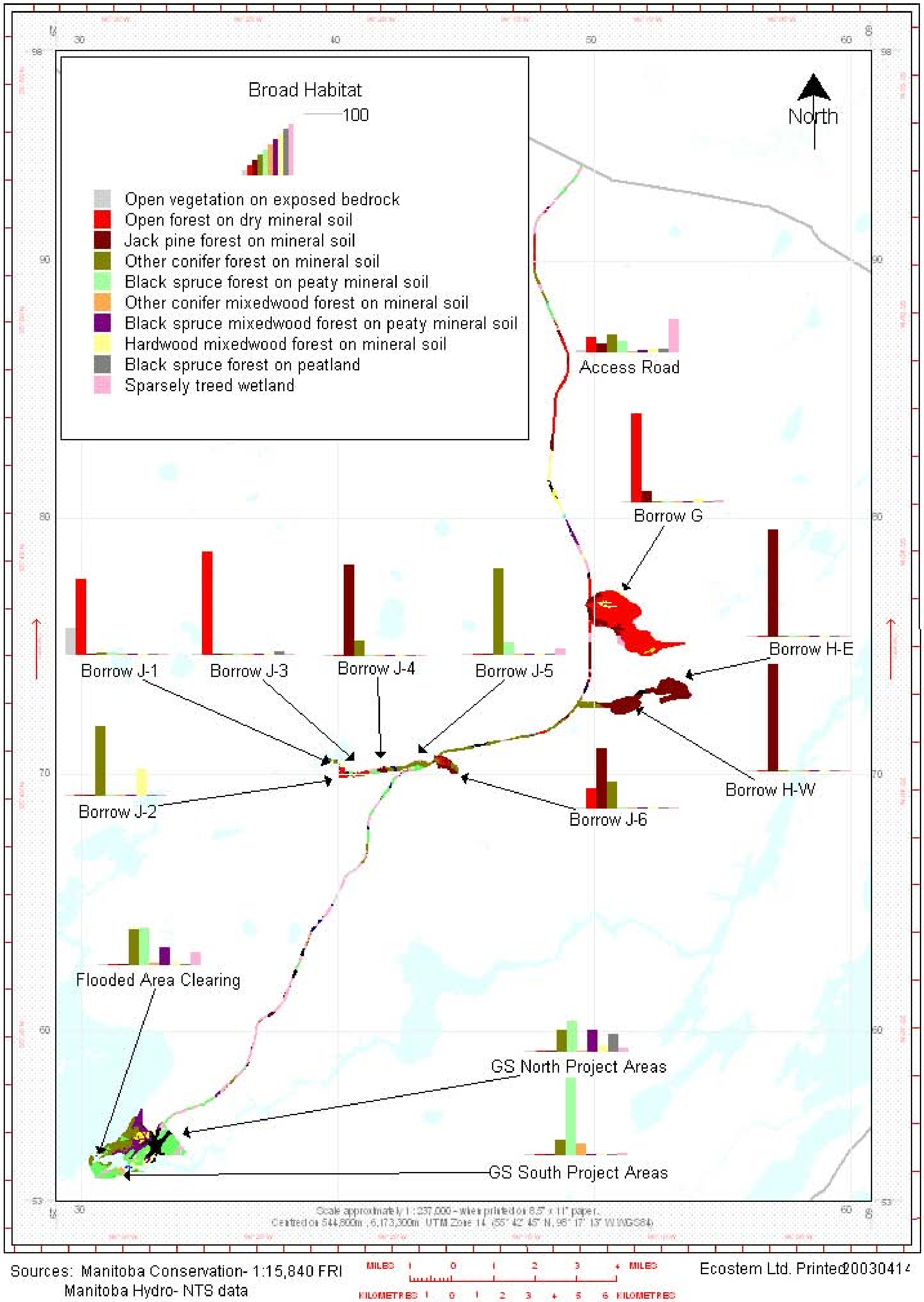


Figure 5.4-3. Broad habitat composition in the Mainland/ Upland Project Areas.

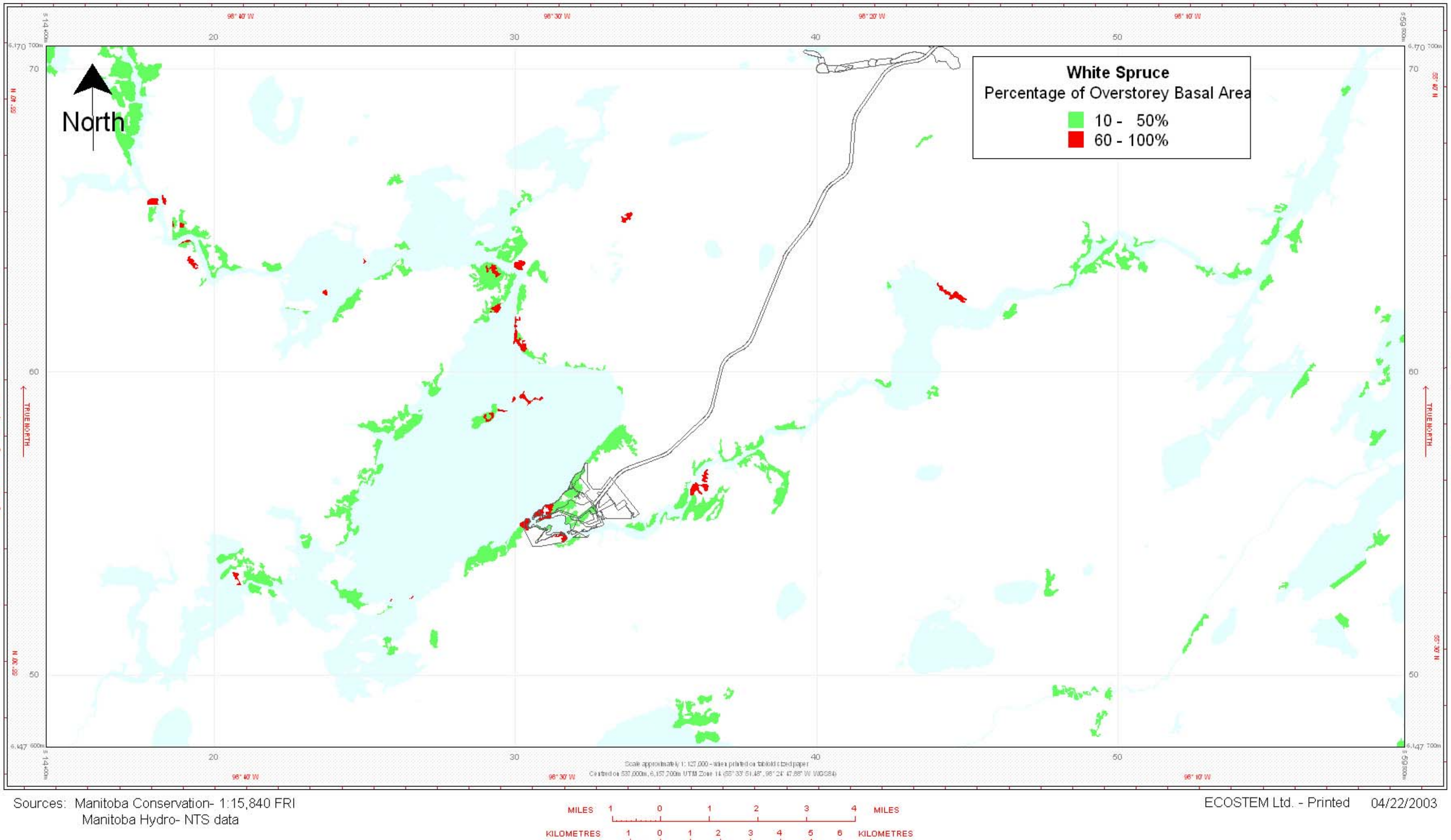


Figure 5.4-4. Locations of white spruce in forest near the Generating Station Project Area.

Note: Mainland/ Upland Project Areas outlined in black.

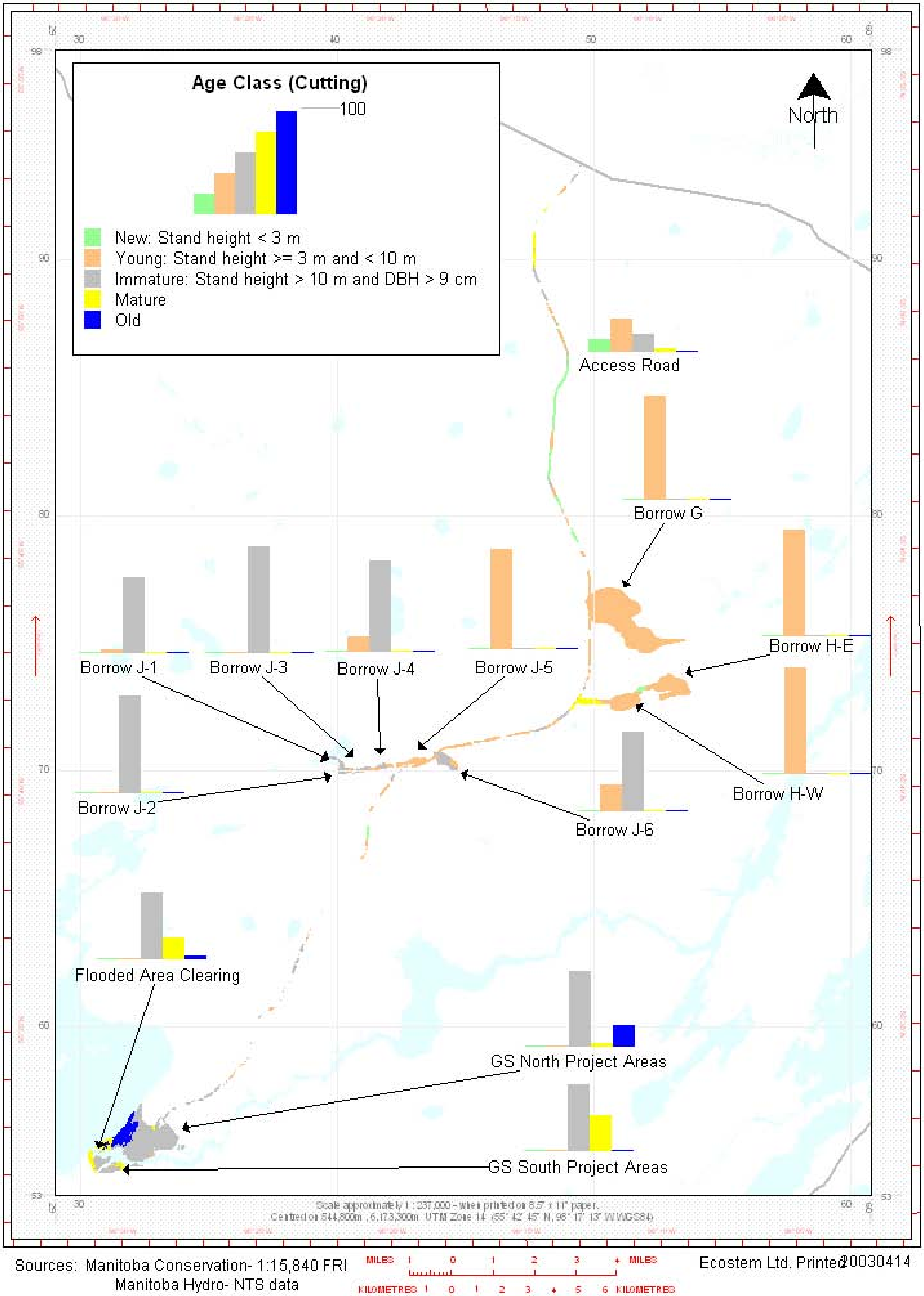


Figure 5.4-5. Age class composition in the Mainland/ Upland Project Areas.

Effects in the Fine Habitat Zone Of Influence

The Generating Station Disturbed Area envelope (Figure 5.4-1) is large enough to capture indirect construction effects (Table 5.4-3) other than invasive species, wildfire and fragmentation. Introductions of alien invasive species and changes to the fire regime are discussed in the Access Road Project Areas section since the potential for habitat change from these sources is higher along the Access Road than around the Generating Station. A significantly increased risk of fire outbreak in the Generating Station Project Areas is not expected given Project fire control precautions. Fire control precautions will include roving fire patrols during construction and maintaining fire suppression equipment in the generating station work area during construction and operation (Volume 3).

5.4.1.3.2 Access Road and Potential Borrow Pits

Effects in the Project Impact Areas

Special measures will be taken during road construction to reduce indirect effects on permafrost in a portion of the Access Road Project Area. In a continuous 2.5 kilometre stretch along the southern half of the access road, the roadbed will be constructed using granular fill material placed directly on top of the unstripped peat (Volume 3 Section 4). In addition, a 20 cm layer of thermal insulation will be placed beneath the embankment in the ice rich zones to mitigate the potential for subsidence in these areas.

The habitat effects assessment takes a conservative approach and treats all of the habitat in the Access Road and Borrow Pit Project Areas as if it is lost during construction.

The Access Road and Borrow Pit Project Areas are located on a ridge of fluvioglacial material. This is an uncommon dominant deposit type in the Province and Region (Figure 5.3-5). Land type in the Access Road Project Area is a mixture of peatland (36% of area), mineral soil (30%), dry mineral soil (15%) and peaty mineral soil (14%; Figure 5.4-2; Appendix 5.12 Table 5.12-4). Dry mineral soils are concentrated along the northern half of the access road (Figure 5.4-2).

Land cover in the Access Road Project Area is predominantly a mixture of conifer forest (44% of land area), very open vegetation on peatlands (31%) and open forest on dry mineral soil (15%; Appendix 5.12 Table 5.12-5). Broad habitat is primarily a mixture of black spruce sparsely treed wetlands (Figure 5.4-3), other conifer forest on mineral soil, open forest on dry mineral soil, black spruce forest on peaty mineral soil and jack pine forest on mineral soil. Other conifer forest on mineral is mostly black spruce/ jack pine >

70%, while the open forest is mostly jack pine > 70% on dry mineral soil. Jack pine forest on dry mineral soil is uncommon in the Sub-Region.

The Access Road does not capture a highly disproportionate percentage of any broad habitat type. That is, the Access Road includes 0.14% of the Sub-Region land area but only one fine habitat type comprises as much as 1% of Sub-Region area (i.e., jack pine forest on dry mineral soil; Appendix 3 Table 5.12-6 and Table 5.12-7).

Land type composition in the Borrow Pit Project Areas varies by pit but either dry mineral or mineral soil is dominant (Table 5.12-4). The Access Road and Borrow Pit Project Areas include 7% of Sub-Region dry mineral soil (Appendix 5.12 Table 5.12-4). The 1 km Upland Buffer around the access road and borrow pits includes 26% of Sub-Region dry mineral soil.

Land cover and habitat composition in the Borrow Pit Project Areas closely reflects land type composition. Land cover in the borrow pits is dominated by open forest on dry mineral soil and/ or conifer forest. Habitat composition varies by pit but generally reflects the dominance of dry mineral soils. Jack pine forest on dry mineral soil is the dominant habitat type in Borrow pits G, J-2 and J-3 (Figure 5.4-3). Jack pine forest on dry mineral soil is the dominant habitat type in Borrow pits H-W and H-E. Borrow pits J-1, J-4, J-5 and J6 are dominated by jack pine/ black spruce forest on mineral soil (amount of black spruce varies greatly). Borrow Pit G captures a highly disproportionate percentage of the Sub-Region's open forest on dry mineral soil (8%).

There is very little mature and no old habitat in the Borrow Pit or Access Road Project Areas (Figure 5.4-5).

Effects in the Fine Habitat Zone of Influence

Effects Other than from Invasive Plants, Fire and Fragmentation

The access road project features have a number indirect effects on adjacent areas (Table 5.4-3). Assuming a 150 m zone of influence from the centerline of the access road (i.e., extent of potential indirect effects), the access road Project features may indirectly affect an additional 1,456 ha (0.4% of the Sub-Region land area) of terrestrial habitat adjacent to the Access Road Project Area (i.e., 300 m Fine Habitat ZOI band minus 100 m access road band for 48 km). The habitat effects assessment assumes that all of this habitat is lost during construction. A Fine Habitat ZOI band was not placed around the Borrow Pit Project Areas because indirect effects were expected to be small there. These Project Areas have no ditching and only a small percentage of the borrow pits will actually be cleared. The contingency area in these areas (Section 5.4.1.1) should be more than adequate to capture any indirect effects in these areas.

Approximately 70% of the access road Fine Habitat ZOI contains surface material deposits (Table 5.4-4) that are common and widely distributed in the Sub-Region. The exceptions are the glacio-fluvial deposit types.

Table 5.4-4. Distribution of surface deposit types in the Access Road Project Area fine habitat ZOI (i.e., 300 m band centered on access road; ZOI area does not include the Access Road Project Area)**.**

Surface Deposit Type	Area (ha)	Percent of Area
Peat plateau bog	130	9
Veneer bog	253	17
Horizontal fen	105	7
Collapse scar fen	30	2
Stream fen	33	2
Glacio-fluvial apron	308	21
Glacio-fluvial hummocky	4	0
Glacio-fluvial ridge	147	10
Lacustrine blanket	398	27
Hummocky bedrock	47	3
Total	1,456	100

Broad habitat composition in the access road Fine Habitat ZOI is similar to the Access Road Project Area. Approximately 75% of this Fine Habitat ZOI contains broad habitat types that are common and widely distributed in the Sub-Region (Table 5.4-5). Sub-Regionally uncommon, narrowly distributed broad habitat types found in the ZOI include open vegetation on exposed bedrock and open forest on dry mineral soil. Ditching and clearing are not expected to have a measurable indirect effect on the uncommon habitat types. These habitat types are open, have vegetation that is already coping with dry soils and have microclimatic conditions that are already unsuitable for interior plant species.

Table 5.4-5. Distribution of broad habitat types in the Access Road Project Area zone of habitat influence (i.e., 300 m band centered on access road; ZOI area does not include the Access Road Project Area)**.**

Broad Habitat Type	Area (ha)	Percent of Area
Open vegetation on exposed bedrock	30	2.1
Open forest on dry mineral soil	217	14.9
Jack pine forest on mineral soil	129	8.9
Other conifer forest on mineral soil	229	15.7
Black spruce & other moist forest on peaty mineral soil	177	12.2
Black spruce & other mixedwood forest on peaty mineral soil	44	3.0
Hardwood mixedwood forest on mineral soil	67	4.6
Hardwood forest on mineral soil	11	0.8
Black spruce & other forest on peatland	68	4.7
Sparsely treed wetland	430	29.5
Tall shrub wetland	5	0.4
Low shrub, graminoid and/ or emergent wetland	46	3.1
Water	1	0.1
Human	2	0.2
All Types	1,456	100.0

Invasive Plant Species

Invasive plant species may be introduced during construction and operation by vehicles using the Access Road and by construction equipment. Some of the invasive plants listed by White et al. (1993) occur in the Sub-Region, while others not there yet have the potential to colonize. A list of invasive plants with the potential to occur in the Sub-Region was developed based on observations in the Sub-Region, observations by the Project botanist at other locations in the Region and from herbaria distribution records.

In general, the Project is not expected to significantly increase the risk of invasive species becoming a problem. Invasive species are not new to the province (or region in some cases) and have not become a problem in the Region as yet. If invasive plants become a problem, it seems more likely that this will occur from sources other than Project vehicle traffic and construction equipment. On the other hand, invasive species may become a problem if the Project introduces large numbers of individuals through other Project features such as the seeding of ditches along the access road or creating a large area with ideal conditions for the colonization of a particular invasive species (e.g., accidental fire). Comments specific to selected invasive species are provided below.

Invasive plants already in the Region include:

- Reed canary grass (*Phalaris arundinacea*);
- Sweet clovers (*Melilotus* spp.).

Reed canary grass is one of the plants that "appear to constitute the most significant threat to wetland natural areas" (White et al. 1993). It was found at one stream crossing along the Access Road. The Project is not expected to significantly increase the risk of canary grass spread since it was introduced into central Manitoba more than 50 years ago and past development in the Region has not encouraged significant spread.

The sweet clovers are considered to have a moderate potential to threaten native habitats in Canada (White et al. 1993). Sweet clovers are found in disturbed, open sites such as road shoulders and in borrow areas (Johnson et al. 1995). These plants do not appear to be a problem in natural habitats in the Region (J. Krindle field observations; Tolko staff, pers. comm.). They are not expected to become a problem on dry sites in borrow areas along the northern half of the Access Road if they are not included in any mixtures used to seed the ditches.

Invasive plants may be introduced from outside of the Region. White et al. (2003) consider the following species to be the principal alien invasive problem species in Canada:

- Glossy buckthorn/ black buckthorn (*Rhamnus frangula*);
- Flowering-rush (*Butomus umbellatus*);
- Common buckthorn (*Rhamnus cathartica*);
- Garlic mustard/ hedge garlic (*Allaria petiolata*);
- Leafy spurge/ wolf's milk/ Faitours grass (*Euphorbia esula*);
- European frog-bit (*Hydrocharis morsus-ranae*); and
- Purple loosestrife/ swamp loosestrife (*Lythrum salicaria*).

Glossy buckthorn, common buckthorn and flowering rush have been found in southern Manitoba (herbaria records). They are not considered a significant concern because their range in Manitoba for many years has been restricted to the southern quarter of the province.

Purple loosestrife is a highly invasive species that has been extending its range northward in the province. The northern-most recorded observation of purple loosestrife is The Pas, which is 240 km south of the Sub-Region (C. Lindgren pers, comm. 2003). Efforts elsewhere to control purple loosestrife have met with little success because it is so effective at expanding its range. It is such a highly invasive species that it should ultimately spread throughout any region where growing conditions are favorable. Construction and operation of the Project are not expected to significantly increase the risk of purple loosestrife or leafy spurge invasion because purple loosestrife is most often spread in wetlands and marshes by waterfowl independent of disturbance or development. Leafy spurge is most likely to spread in the lighter soils of agricultural and prairie grasslands, which are not found in either of the 1 km buffers.

Fire Regime

Wildfire has played the largest role in producing the current distribution of upland habitat types in the Sub-Region. Paradoxically, some habitat types that are maintained by wildfire can be quite sensitive to changes in the frequency or severity of large fires. Open jack pine forest on dry sites is the most important example along the access road. Most of the soil water and nutrients in the sandy to gravelly soils in this habitat type are held in the surface organic layer. This surface organic layer can be completely removed when a wildfire is unusually severe or when two wildfires occur within a few years of each other. This converts open forest on dry soil to a reindeer lichen, haircap moss and sparse grass community on very dry soil. Research indicates a change in fire frequency can also influence the distribution and abundance of other habitat types that are less sensitive to an extreme fire event (Bergeron and Dansereau 1993).

Access can change fire frequency and/ or severity in an area. Humans are a major cause of fire ignitions. Fire ignition data for Manitoba indicate that humans started 59% of the forest fires that occurred in the 30 years from 1970 to 1999 (http://www.gov.mb.ca/natres/fire/Fire-Historical/firestatistic.html). Human starts were from a variety of sources, some of which included vehicle traffic, construction and recreation.

More traffic and people may lead to more large and/ or more severe fires. Increases in fire frequency and/ or severity could change the Sub-Region's habitat composition over a long period of time. Some of the potential changes include:

- higher percentage of young habitat and lower percentage of mature and old habitat.

- increase in the abundance of post-fire pioneer species (e.g., Bicknell's geranium, fireweed, haircap mosses) and a reduction in the abundance of mature to old vegetation species (e.g., reindeer lichens, balsam fir, white spruce).
- conversion of forest to shrubland or grassland. This is a special concern in the jack pine forest on dry sites along the northern half of the access road.

There is no reliable way to predict how much fire frequency or severity could increase due to better access. It only takes one fire to remove surface soil organic matter over a large area and have a substantial effect on a regionally rare or uncommon habitat type. Restricting access at Highway 391 during construction and operation, roving fire patrols in the generating station area and along the access road during construction and maintaining fire suppression equipment in the generating station work area during construction and operation should reduce the risk of a large fire.

Predictions of Project effects on the fire regime are further complicated by interactions with climate change. The current consensus is that climate change will shrink the boreal forest in Manitoba (Manitoba Climate Change Task Force 2001). Drier climate and increased fire frequency and severity could move the southern border of the boreal forest northward by somewhere between 100 and 700 km (Scott and Suffling 2000). Any Project effects on fire regime and, thereby, habitat would be completely overwhelmed if changing climate causes such drastic changes in habitat composition.

5.4.1.4 Operation

Project impacts will be greatly reduced during operation. The number of people present and level of activity will decline dramatically. All of the areas not required for permanent Project features will be rehabilitated after construction is complete. In general, the organic material removed and stock piled during construction will be spread in the temporarily cleared and stripped areas to assist re-vegetation (Volume 3).

5.4.1.4.1 Generating Station

Effects in the Project Impact Areas

Post-construction rehabilitation in the Generating Station Project Areas is expected to reduce clearing from 144 ha to 74 ha (Figure 5.4-1; Table 5.4-6). Most of the cleared area was immature black spruce forest and a small amount of mature white spruce forest prior to clearing. Recovery of the black spruce forest habitat in temporarily cleared areas is expected to take at least 50 years because the topsoil will be stripped and there will be substantial disturbance to soils. White spruce forest is not expected to recur without regeneration efforts. This is addressed in Section 5.4.4.1.1.

Table 5.4-6. Types of direct physical changes in the Generating Station Project Areas during construction.

Project Impact Area	Construction	Operation	Restored
Generating Station Project Areas			
Flooding (clearing during construction)	38	38	0
Clearing	144	74 [4]	70
Physical Disturbance	approx. 226	approx. 168 [1]	58
Access Road			
Direct Effects	482 [2]	approx. 365	117
Indirect Effects[1]	approx. 974 [2]	approx. 362	612
Fires	unknown	unknown	
Borrow Pits			
Pits	636 [2]	approx. 20 [3]	616
Access Roads To Pits	80		80
Approximate Total[5]	2,600	1,000	1600
Percentage of Sub-Region land area	0.8%	0.3%	

[1] Represents a buffer around the cleared areas to capture the maximum expected extent of physical effects such as permafrost collapse, altered groundwater flows. etc.. [2] Includes allowance for up to 207 ha of roadbed borrow pit clearing. [3] Allowance for gravel stockpiles. [4] Degree of rehabilitation in the 70 ha of temporary clearing varies. [5] The totals are approximate and represent the maximum predicted area.

Effects in the Fine Habitat Zone of Influence

Direct Project effects on habitat in the Physical Disturbance Area are expected to be negligible during operation. Indirect effects in the generating station Fine Habitat ZOI (i.e., the peripheral band in the Generating Station Disturbed Area; Figure 5.4-6) should be greatly reduced because a number of impacts that were creating indirect effects during construction will be greatly reduced in magnitude during operation. Impacts that should become greatly reduced in magnitude during operation include:

- accidental spills or disturbance;

- airborne deposition from road dust and fuel combustion generated by vehicles and construction equipment;
- alien invasive species introduction by vehicle traffic and construction equipment; and
- increased fire frequency and/ or severity due to better access.

It is expected that habitat effects from accidental spills, accidental disturbance and airborne deposition will become unnoticeable during operation.

Up to 168 ha of the 226 ha Physical Disturbance Area may remain converted to a different habitat type during operation (Table 5.4-6). Indirect effects on peatlands in the Fine Habitat ZOI will not be substantially reduced because the changes to permafrost and depth to water table are permanent (i.e., will continue through the 100 year projection period). This affects up to 25 ha of habitat (Table 5.4-7). The degree to which edge effects on habitat composition are reduced during construction is directly related to how completely and quickly temporarily cleared areas return to their pre-Project habitat composition. Based on the expectations for forest regeneration described in the previous sub-section, reductions in Fine Habitat ZOI effects are expected to be minimal during the 100 year effects prediction period. If that is the case, then up to 168 ha of mainland habitat may remain slightly to highly altered during the effects prediction period. The potential long-term effect is of special concern for 48 ha of forest containing white spruce and balsam fir (29% of the Fine Habitat ZOI band; Table 5.4-7; Figure 5.4-6), a rare habitat type with a limited distribution in the Sub-Region and Region. Balsam fir and white spruce mitigation measures are discussed in Section 5.4.4.1.1.

Table 5.4-7. Fine habitat composition in generating station clearing permanent zone of habitat influence.

Fine Habitat Type	Area (ha)	Percent of Area
Black spruce/ Balsam fir/ White spruce > 70% forest on mineral soil- Immature	2	1
Black spruce/ Balsam fir/ White spruce > 70% forest on mineral soil- Old	26	16
White spruce/ Conifer > 70% forest on mineral soil- Mature	10	6
Black spruce > 70% forest on peaty mineral soil- Immature	52	31
Black spruce > 70% forest on peaty mineral soil- Mature	4	2
Black spruce > 70% forest on peaty mineral soil- Old	4	2
White spruce mixedwood forest on mineral soil- Mature	5	3
Black spruce mixedwood forest on peaty mineral soil- Immature	22	13
Black spruce/ White spruce mixedwood forest on peaty mineral soil- Immature	5	3
Aspen/ Conifer mixedwood forest on Mineral soil- Immature	3	2
Aspen/ Conifer mixedwood forest on Mineral soil- Mature	1	1
Aspen > 70% forest on Mineral soil- Immature	8	5
Black spruce > 70% forest on Peatland- Immature	14	8
Black spruce > 70% forest on Peatland- Young	2	1
Black spruce/ Tamarack > 70% forest on Peatland- Immature	1	1
Black spruce sparsely treed peatland	8	5
All Types	168	100

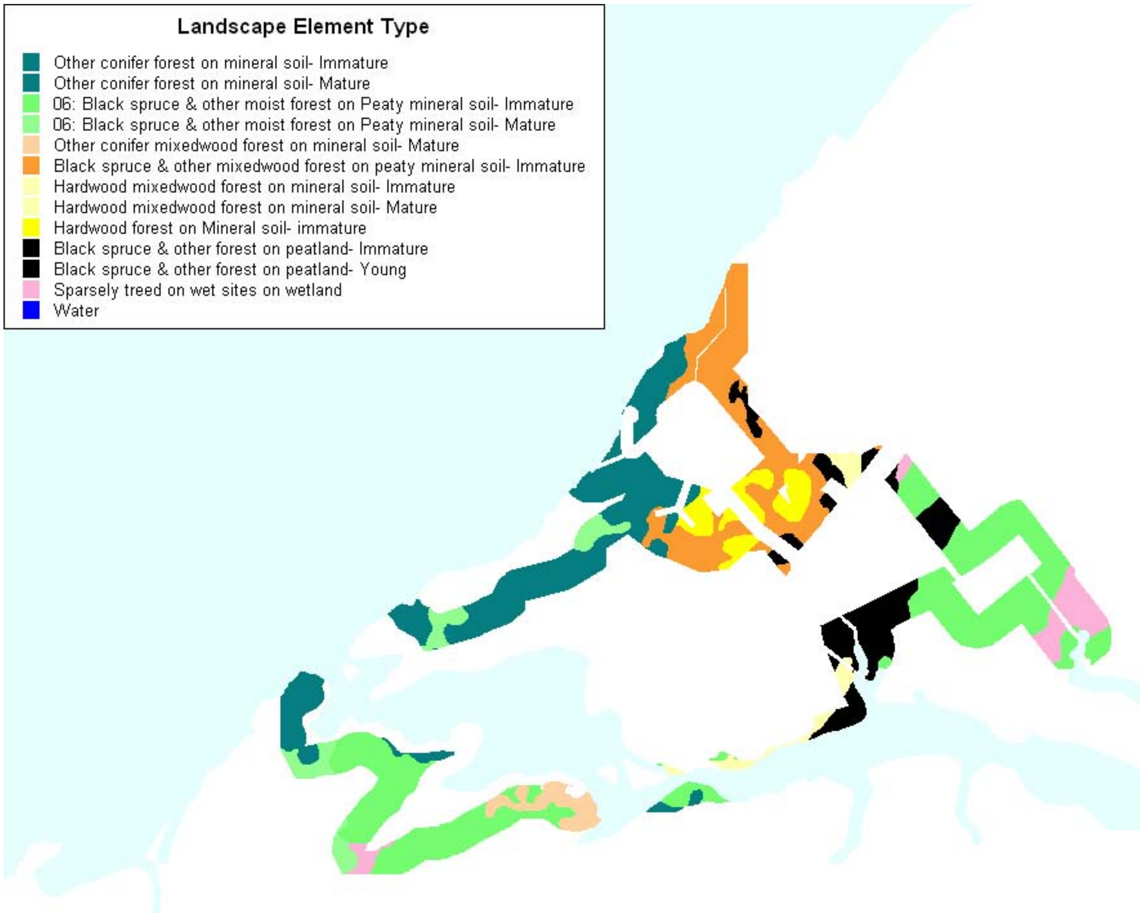


Figure 5.4-6. Broad habitat composition in permanent generating station clearing zone of habitat influence (Fine Habitat ZOI).
Fine Habitat ZOI area is 168 ha.

5.4.1.4.2 Access Road and Potential Borrow Pits

Effects in the Project Impact Areas

Regeneration of temporarily cleared areas in the Access Road and Borrow Pit Project Areas may restore up to 813 ha of habitat (Table 5.4-6). As much as 600 ha of these areas may not have experienced any disturbance during construction if borrow pit clearing requirements meet current projections (Volume 3). Spreading stock-piled organic material on temporarily cleared areas will assist revegetation. Because the jack pine forest on dry sites is an uncommon habitat type, potential effects on this habitat type will be mitigated as described in Section 5.4.4.1.2. In the ditches along the access road, the combination of seeding and natural vegetation regrowth should produce vegetated habitat. To calculate the area of potential revegetation, it was assumed that less than 75 m of the 100 m access road right-of-way would remain cleared, on average, during operation. Based on this assumption, it is expected that 25% of the Access Road Project Area (i.e., 117 ha) will undergo revegetation and recover to habitat (Table 5.4-6).

Effects in the Fine Habitat Zone of Influence

The combination of access restrictions, elimination of construction equipment and greatly reduced traffic volumes along the Access Road will substantially reduce indirect Project effects related to:

- accidental spills or disturbance;
- airborne deposition from road dust and fuel combustion generated by vehicles and construction equipment;
- alien invasive species introduced by vehicle traffic and construction equipment; and
- increased fire frequency and/ or severity due to better access.

Indirect effects on peatlands in the access road zone of influence will not be substantially reduced because the changes to permafrost and depth to water table are permanent (i.e., will continue through the 100 year projection period). This affects up to 68 ha (Table 5.4-5).

The area of habitat recovery to the original habitat type was estimated by assuming that the access road permanent Fine Habitat ZOI would decline from 150 m to 75 m. That is, the permanent access road Fine Habitat ZOI is expected to be a 25 m wide band on both sides of the access road RoW. On this basis it is expected that the total area of indirect habitat effects along the access road will decline by 612 ha from 974 ha to 362 ha (Table 5.4-6). All of the access road permanent Fine Habitat ZOI is expected to contain habitat types that are found in the Sub-Region.

5.4.2 Semi-Aquatic Habitat

5.4.2.1 Construction

5.4.2.1.1 Changes to Water Regime

Upstream and downstream water regimes will remain unchanged during construction. Short-term effects on water levels during construction of coffer dams are not expected to create water level fluctuations that would be considered abnormal in the current water regime. Therefore, construction effects on Shore Zone, Peat Island or Mineral Island habitat are not expected. Given the Project design and other measures that will be in the EnvPP, effluent discharge and accidental events are not expected to have noticeable effects on semi-aquatic habitat during construction or operation.

5.4.2.1.2 Habitat Effects

No construction effects on Shore Zone habitat are expected since the current water regime will be maintained. Clearing for the area to be flooded for the generating station area is the only Upland Project feature expected to affect Shore Zone habitat. This area has already been included in the flooding area (Table 5.4-2; Figure 5.4-1).

No construction effects on Peat Islands are expected since the current water regime will be maintained and there are no Upland Project features in the vicinity of any Peat Island.

The three Mineral Islands near the generating station were included in the Mainland/ Upland habitat effects assessment (Section 5.4.1.3.1). No construction effects on the remaining Mineral Islands are expected provided that recreational and other use during construction is light and that the two large islands in the north of part of Wuskwatim Lake are not used. One of these large islands supports the only balsam fir forest in the Sub-Region.

5.4.2.2 Operation

5.4.2.2.1 Upstream

5.4.2.2.1.1 Changes to Water Regime

The proposed Project would narrow the range of water level fluctuations and maintain the new range at a higher median elevation. Manitoba Hydro has identified five zones of operation within the proposed operating range (Table 5.4-8). Zones 1 and 2 would be the normal operating range of water fluctuations for the Project. Exceptions to the normal range will occur under several types of unusual conditions captured in Zones 3 to 5. Over the long-term, abnormal operation is expected to occur on 2.5% of the days. Operation in Zone 5 is expected to occur 1 year out of 20, on average. All five zones are well within the historic frequency distribution of water levels.

Table 5.4-8. Forebay water regime operating zones and percentage of days forebay is expected to be in the zone.

Zone	Water Elevation Range (m ASL)	Percentage of Days[1]	Cumulative Percentage of Days	Drawdown & Re-Ponding Period
1	233.87 to 234.00	85.0	85.0	daily
2	233.75 to 233.87	12.5	97.5	1 – 4 days
3	233.5 to 233.75	1.2	98.7	4 – 7 days
4	233.25 to 233.5	1.0	99.7	7 – 10 days
5	233.00 to 233.25	0.3	100.0	4 – 7 weeks

[1] Percentages for Zones 3 to 5 estimated from Figure 5.2-5 in Volume 3 Section 5.

The assessment of Project effects on semi-aquatic habitat (i.e., Shore Zone, Peat Island and Mineral Island habitat) was completed prior to the final adjustments to the proposed upstream water regime operating ranges. The semi-aquatic habitat effects assessment assumed that the proposed generating station would be operated so that the forebay is between 233.9 m and 234.1 m ASL on 99% of the days and that typical day-to-day water level fluctuations would be less than 10 cm (not including wind and waves). Under the final proposed water regime, the forebay will remain between 233.75 m and 234.0 m ASL on 97.5% of the days (Table 5.4-8). Therefore, the water regime used in the habitat effects assessment has a normal range of water fluctuations that is 5 cm narrower with a maximum that is 10 cm higher than the final proposed water regime.

The final adjustments to the proposed water regime do not change any of the habitat effects predictions. However, introduction of the Zone 3 and 4 abnormal operating ranges increases the uncertainty of some predictions because the drawdown and re-ponding is expected to occur during the open water season over four to seven days for up to five years in a row. Zone 5 operation does not affect the certainty of predictions because a similar scenario occurs under natural conditions during droughts. It is assumed that semi-aquatic habitat is adapted to cope with the type of situation created by Zone 5 operation.

The pre- and post- Project upstream water depth duration curves and zones used in the habitat effects assessment are shown in Figure 5.2-10 and Figure 5.4-7, respectively. Water regime related changes to environmental conditions in the Shore Zone include:

- median growing season water elevation will rise by 60 cm from 233.40 to 234.00;
- the 99th percentile of water elevations will be 16 cm lower;
- the range of Shore Zone water depths will decline (see below for details);
- the width of the water depth duration zones will decline (see below for details);
- there will be no seasonality to water depths (Figure 5.4-7); and
- wave mixed zone width, the standardized depth to bottom freezing and the ice pressure zone are all expected to decline.

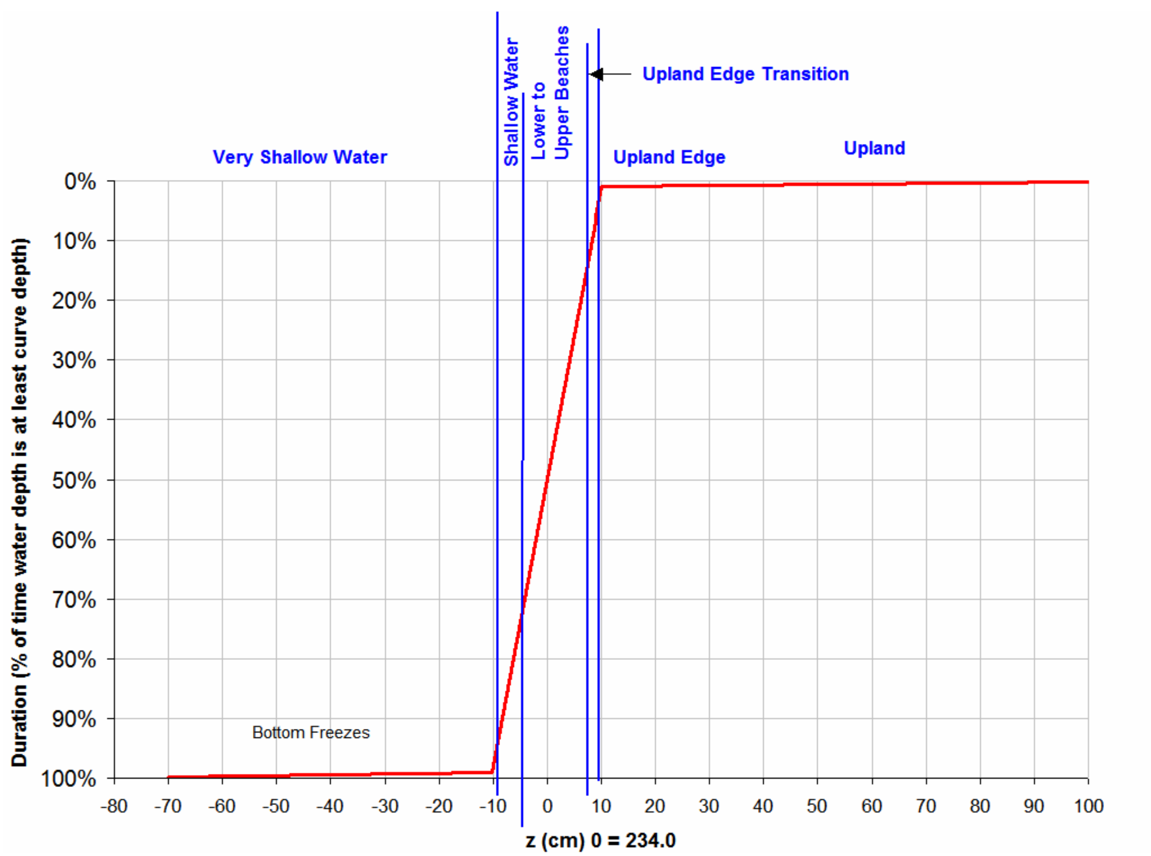


Figure 5.4-7. Projected post- project water depth duration zones.

5.4.2.2.1.2 Shore Zone

Shoreline Environmental Conditions

Water regime changes are expected to lead to three other substantial changes in Shore Zone environmental conditions.

First, more stable water levels at a higher median growing season elevation will reduce the width of the Lower to Upper Beach zones (Table 5.4-9) and eliminate exposed mineral soil with a fresh moisture regime (compare Figure 5.4-8 with Figure 5.4-9). Mineral and organic soil in the narrower post-Project beach are expected to have a wet or saturated moisture regime. Changes to Shore Zone size are discussed below.

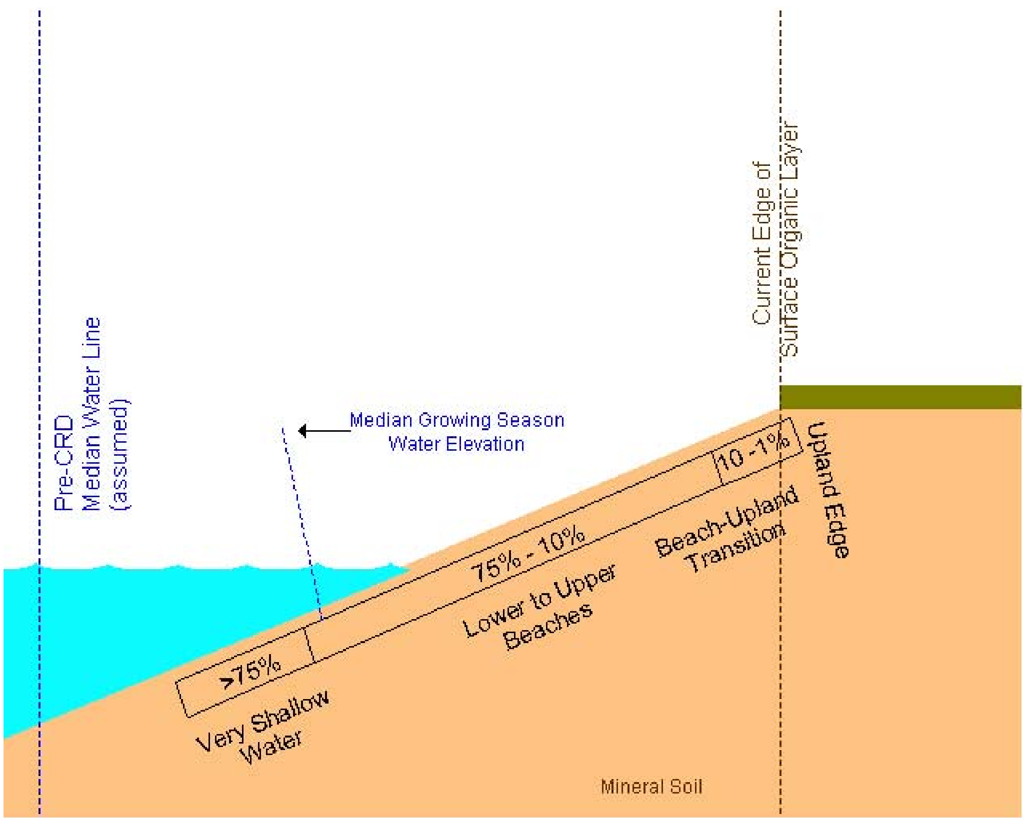


Figure 5.4-8. Schematic representation of water duration zones and surface organic layer under current conditions.

Second, stable water levels are expected to facilitate the gradual lakeward expansion of the surface organic layer in the Mainland Edge and further reduce the average width of the Beach zones. Under current conditions, the eroded edge of the surface organic material (Figure 5.4-10) in the Beach/ Mainland Edge Transition zone of the low gradient areas occurs at an elevation of about 234.1 (this is approximately at the 90th percentile of water elevations or 10th percentile of water depths; Figure 5.2-10). Under current conditions, the Beach/ Mainland Edge Transition zone extends to an elevation of 234.2 m ASL. Under the proposed water regime used in the effects assessment, the Beach/ Mainland Edge Transition zone would stop at 234.1 (234.0 in the final water regime) and only include a 2 cm range of water depths on less than 1% of the days (Figure 5.4-9 A). A more stable water regime will reduce wave disturbance of the eroded edge and allow tree and shrub roots to colonize closer to and more densely in the eroded edge, which will lead to stronger binding of the surface organic layer. The expected ultimate outcome is a reduction in mechanical breakdown of the eroded edge. Over the short to medium term (5 – 25 years), the combined direct and indirect effects of the proposed water regime is expected to convert the organic or clayey beach to thick organic soil. The extent and length of time required for this conversion will vary by location depending on slope, substrate and Mainland Edge habitat type. Conversion of the organic or clayey beach to a thick surface organic layer in the narrow Beach/ Mainland Edge Transition zone is expected to occur within 5 to 10 years depending on local conditions. Since the conversion time frame is closer to the 5 rather than the 25 year time period, the predictions assume that all of the organic or clayey beach in the Beach/ Mainland Edge Transition zone would convert to a thick surface organic layer by the end of the 5 year projection period.

Third, over an even longer period of time, it is expected that shoreline peatland will form in the low slope areas of the sheltered bays and then expand out on to the surface water of the lake. All of the organic and clayey beach material is expected to disappear in these areas over the medium to very long-term (25 – 100+ years; Figure 5.4-9 C and D). This would restore these areas towards the condition that existed prior to the CRD when the surface of all of the Shore Zone in the low gradient areas was covered by peatlands (Figure 5.3-55). The rate of shoreline peatland formation and expansion will vary around the Affected Aquatic Area depending on a number of factors including exposure to wave energy.

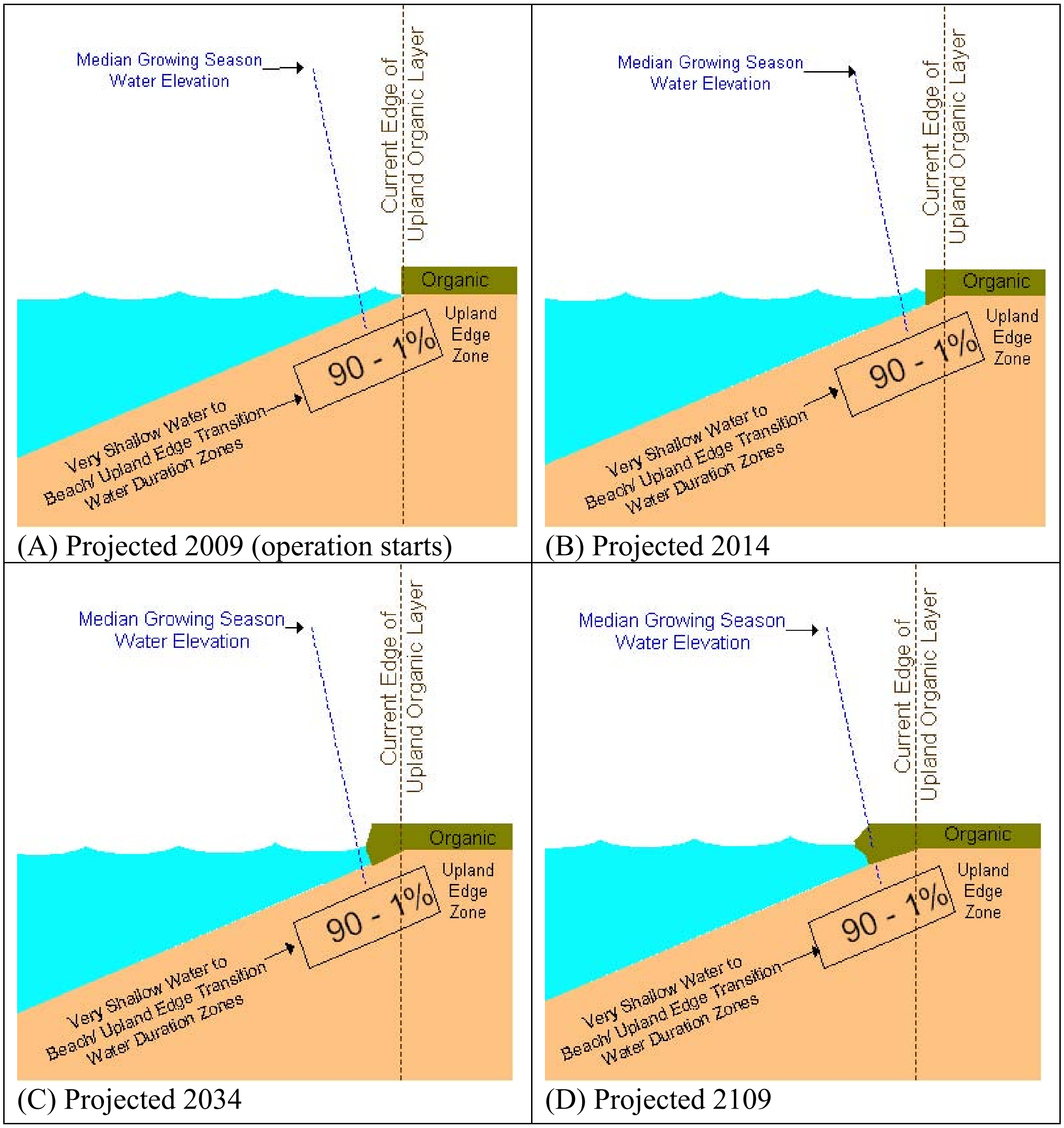


Figure 5.4-9. Schematic representation of projected water duration zones and surface organic layer expansion at 2009, 2014, 2034 and 2109.

Figure 5.4-10. Eroded surface organic layer edge located in Beach/ Mainland Edge Transition zones.

Shore Zone Size

Projections for the Shore Zone in the low gradient areas of the forebay indicate that the range of water depth fluctuation will decline from 128 to 19 cm (Table 5.4-9; also compare Figure 5.2-10 with Figure 5.4-7). Average Shore Zone width in the low slope areas will be reduced by an estimated 85% from approximately 1,601 to 243 cm. It is estimated that Shore Zone area will be reduced from approximately 140 ha to 23 ha. This should be interpreted as a qualitative/ order-of-magnitude estimate of beach width which provides an estimate of the relative impact of the proposed water regime. The estimated area loss is approximate because several assumptions were made in deriving both the pre- and post-project areas (see Section 5.2.4.1.2). The key assumption in the calculation is the average slope of the beach. Changing the average slope affects the absolute widths of the zones but not the relative pre- versus post- project change in beach width.

Table 5.4-9. Estimated depth ranges and band widths of water duration zones under current conditions and post-project (assumes 8%, flat substrate slope).

Zone	Depth Range (cm)		Band Width (cm)	
	Current Conditions	Post- Project	Current Conditions	Post- Project
Very Shallow Water	42	4	525	52
Lower Beach	43	5	544	65
Middle Beach	18	5	228	65
Upper Beach	8	3	104	39
Beach/ Upland Transition	16	2	199	23
All Zones	128	19	1,601	243

Relatively wide organic and clayey beaches will only appear during the rare 1 m drawdowns that occur when the generating station is operating in Zone 5 (Table 5.4-8). The expected drawdown duration is too short for new beach vegetation to develop.

Ongoing erosion will increase habitat shoreline length (note the distinction between the "habitat shoreline" and the "erosion shoreline"; see Section 5.2.4.1.2) whether or not the project is built. Under both scenarios, increases in habitat shoreline length will cease once non-erodible shore materials are encountered. Erosion and related shoreline length increase is not predicted to occur in the low slope areas.

Habitat shoreline length will also increase by about 100 m due to the 38 ha of new flooding in the area immediately upstream of the dam on the Burntwood River (Figure 5.4-1). In the newly flooded area, habitat shoreline length is expected to increase by 605 m on the mainland but this will be mostly offset by a decrease of about 500 m on the islands that will become inundated, removed or incorporated into Project structures. New mainland shoreline includes some shore types that support vegetation, while mineral island shoreline losses are all for shore types that do not support Shore Zone vegetation (e.g., bedrock).

In some situations, peat collapse due to groundwater induced permafrost melting can increase shoreline length. Field reconnaissance indicated that there is permafrost in the peatlands in the 1 km buffer. However, no permafrost was found within 10 m of the mainland edge. Therefore, any collapse scars created by the new water regime are expected to occur back from the shoreline and should not contribute additional debris or submerged peat to the Shore Zone.

Vegetation Changes

The reduction in the widths of the Very Shallow Water, Lower to Upper Beach and Beach/ Mainland Edge Transition zones and the gradual conversion of organic and clayey shore material to thick organic or peatland material is expected to change the vegetation found in the different water duration zones (i.e., the vegetation sequences). Environmental conditions will become unfavorable for plants intolerant of wet or saturated soil. The nature of changes vegetation sequence composition varies for the 5, 25 and 100 year projection periods (Figure 5.4-9 A to D) by shore material type.

Immediate Changes

Shoreline stretches currently undergoing active erosion do not have a Shore Zone vegetation sequence extending from the Very Shallow Water through to the Beach/ Mainland Edge Transition zone (Figure 5.3-58). This does not mean that there is no aquatic vegetation in these stretches or that scattered plants cannot be found on the beach, the toe of the eroding banks or in the crevices of rocks along the shore. The absence of a mapped vegetation sequence indicates that conditions are too harsh for the development of enough vegetation to map in an aerial survey (vegetation in the Shallow Water zone of these and other areas is dealt with in the Aquatic Environment volume). Areas currently undergoing erosion are not expected to develop a Shore Zone vegetation sequence until erosion ceases. Erosion is projected to continue in these areas during all of the 100 year projection period.

In the non-eroding areas, the extent of shoreline with a vegetation sequence is expected to remain unchanged over the short-term with one exception. The Sparse Vegetation-Moderate Water Energy sequence is expected to disappear because the bottom will be under deeper water and exposed to current most of the time. This sequence may reappear over the long-term if deposition recreates floodplains or shelves in these locations.

Several years may be required for a Clayey or Organic vegetation sequence to establish in the short stretch of new shoreline in the newly flooded area that is not dyked.

Based on the estimated reductions in water duration zone widths derived from the water duration zone approach (Figure 5.4-9), the proposed water regime will initially reduce the area of the various vegetation sequences by approximately 115 ha (Table 5.4-10; Figure 5.4-9 A). As previously noted, this is an approximation because several assumptions were made in deriving both the pre- and post-project areas. The largest area reduction occurs in the Clayey vegetation sequence which accounts for most of the pre-project beach vegetation.

Table 5.4-10. Immediate post- project changes in the area (ha) of the vegetation sequence types.

Shore Vegetation Sequence Type	Pre-Project	Post-Project 2009	Difference
Moderate Water Energy Sparse Vegetation	10		-10
Floodplain Vegetation	6	1	-5
Clayey Vegetation	110	20	-90
High Slope Sparse Vegetation	5	1	-4
Organic Vegetation	7	1	-6
Tall Shrub On Peat Vegetation	3	0	-3
All Types*	140	23	-116

* Totals may differ from sum of categories due to rounding.

Predictions- Five Year Period (2009 – 2014)

The geographic distribution of Very Shallow Water and Beach zone vegetation is not expected to change during the first five years of project operations. However, the area covered by the vegetation sequences and the species composition of the vegetation sequences is expected to change (Figure 5.4-9 B). Species intolerant of prolonged root submergence will decline, while those promoted by stable water levels will increase. In the Beach/ Mainland Edge Transition zone, vegetation composition is expected to shift towards what is now found in the Mainland Edge zone. Some of the species which suffer declines in the Upper Beach should experience increases in the Beach/ Mainland Edge Transition.

There may be some short-term tall shrub mortality along the shoreline stretches with the Tall Shrub on Peatland vegetation sequence (Figure 5.3-60). The degree of tall shrub mortality will be determined by the extent to which the peat mat floats or expands and thereby protects shrub roots from long-term inundation. This is expected to occur to a very limited degree if at all since the current tall shrub band in the Mainland Edge occurs at an elevation that is expected to be above the normal operating range.

Vegetation in the Beach/ Mainland Edge Transition Zone is expected to convert to a composition similar to that in the current Mainland Edge as the organic or clayey beach develops a thick surface organic layer or into a peatland (Figure 5.4-9 B to D). Which Mainland Edge vegetation type develops will vary according to the pre-Project vegetation sequence type and to the habitat type in the Mainland Edge. Most of these Mainland Edge habitat types are either black spruce feathermoss forest on mineral soil, tall shrub on organic soil, open bog or open fen. In general, it is expected that vegetation in the Beach/ Mainland Edge Transition zone will become characterized by:

- a shrub layer containing black spruce (*Picea mariana*) seedlings and saplings and one or more of willow (*Salix* spp.), prickly rose (*Rosa acicularis*) and Labrador tea (*Ledum groenlandicum*);
- an understorey of dry-ground cranberry (*Vaccinium vitis-idaea*), bunchberry (*Cornus canadensis*), twin flower (*Linnaea borealis*), fireweed (*Epilobium angustifolium*), northern bastard toadflax (*Geocaulon lividum*), water sedge (*Carex aquatilis*) and reed grass (*Calamagrostis* spp.); and
- a ground cover of Schreber's moss (*Pleurozium schreberi*), Sphagnum mosses and other moss species.

Species whose distribution and abundance is likely to increase in the Beach/ Mainland Edge Transition zone include marsh reed grass (*Calamagrostis canadensis*), water sedge (*Carex aquatilis*), bluegrass (*Poa* spp.), rough cinquefoil (*Potentilla norvegica*) and marsh cinquefoil (*Potentilla palustris*). In stretches where there is exposed mineral soil, nodding beggarticks (*Bidens cernua*) and wild mint (*Mentha arvensis*) are also expected to increase.

In the Middle and Upper Beaches, stable water levels and wetter soils are expected to substantially reduce the distributions and abundances of nodding beggarticks (*Bidens cernua*), marsh reed grass (*Calamagrostis canadensis*), water sedge (*Carex aquatilis*), wild mint (*Mentha arvensis*), bluegrass (*Poa* spp.), and/ or rough cinquefoil (*Potentilla norvegica*). None of these species can tolerate prolonged root submergence. Species whose distribution and abundance is likely to increase include beaked sedge (*Carex rostrata*), northern manna grass (*Glyceria borealis*), creeping spike-rush (*Eleocharis palustris*), water horsetail (*Equisetum fluviatile*), water smartweed (*Polygonum amphibium*) and/ or water parsnip (*Sium suave*). All are able to grow in shallow water and are thought to be tolerant of bottom freezing and ice pressure. Which species actually increase will be determined by local conditions.

Species composition changes in the post-project Very Shallow Water zone are expected to be similar to those in the Lower Beach. Stable water levels are expected to eliminate nodding beggarticks (*Bidens cernua*), marsh reed grass (*Calamagrostis canadensis*), water sedge (*Carex aquatilis*), wild mint (*Mentha arvensis*), bluegrass (*Poa* spp.) and/ or rough cinquefoil (*Potentilla norvegica*) but increase the distributions and abundances of northern manna grass (*Glyceria borealis*), beaked sedge (*Carex rostrata*), creeping spike-rush (*Eleocharis palustris*), water horsetail (*Equisetum fluviatile*), woolgrass (*Scirpus cyperinus*), water smartweed (*Polygonum amphibium*) and/ or water parsnip (*Sium suave*).

Predictions For 25 and 100 Year Periods (2015 – 2034 and 2035 - 2109)

The horizontal lakeward expansion of the surface organic layer is expected to continue through the 25 and 100 year projection periods (Figure 5.4-9 C, D). However, some time after the first several years there will be a shift in the nature of the horizontal expansion. Terrestrialization should take over from organic layer thickening by feathermoss growth and vascular plant litter accumulation.

Terrestrialization is the well known process whereby the surface of a lake or pond is gradually infilled by peatlands (c.f. Jeglum 1973, National Wetlands Working Group 1997). A sedge fen begins to form at the water's edge as the roots and litter of emergent plants (e.g., slender sedge {*Carex lasiocarpa*}, beaked sedge {*Carex rostrata*}) raise the organic layer above the water surface. Other species tolerant of saturated soils soon colonize the surface of the newly formed peat (e.g., leatherleaf (*Chamaedaphne calyculata*), sweet gale (*Myrica gale*), marsh cinquefoil (*Potentilla palustris*)) and supplement the litter produced by sedges. As the peat grows vertically it increases the distance between the substrate surface and the water. This facilitates the colonization by species tolerant of wet but not completely inundated rooting conditions (e.g., Sphagnum mosses, water sedge (*Carex aquatilis*), marsh reed grass (*Calamagrostis* spp.), bog willow (*Salix pedicellaris*). If Sphagnum mosses are able to flourish and dominate ground cover, the peat can eventually thicken to the point where most plant roots are no longer in contact with the nutrient enriched lake water. At this stage, plants obtain most of their nutrients from precipitation and a bog has developed. Meanwhile, the edge of the bog is still a fen which continues to grow horizontally further into the lake.

The formation and horizontal expansion of shoreline peatlands is expected to gradually eliminate emergent vegetation including common cattail (*Typha latifolia*) in the Beach, Very Shallow Water and Shallow Water zones of the low gradient areas (Figure 5.4-9 D).

In other words, all of the shoreline vegetation sequences present in 2014 (Table 5.4-10) will eventually disappear. Some emergent species that are not part of the group that forms the initial fen should be able to colonize the wet peatland fringe. Common cattail (*Typha latifolia*) is among these species. Currently cattail it is quite abundant on the fringes of the Peat Islands in the sheltered bays of the future forebay.

Distribution of Emergent Cattails

The distribution of emergent cattail is not expected to be substantially affected by the Project. In southern Manitoba, common cattail is often abundant in the shore zone of lakes and ponds. Although common cattail (*Typha latifolia*) is quite abundant on the Peat Islands, to date it has not become an abundant emergent in the Shore Zone. It is not known what currently limits common cattail distribution and abundance in the Shore Zone of the Affected Aquatic Area. Some possibilities include the seasonality of water levels, extent of bottom freezing and/ or ice scouring during winter drawdowns. Based on available information, water regime changes are not expected to substantially affect emergent cattail abundance. However, it must be noted that it is possible that cattail abundance could increase in the upstream Shore Zone. The distribution of cattails on Peat Islands is discussed in Section 5.4.2.2.2.4.

Conversion of Forested to Aquatic Habitat

The possibility that water regime changes could increase tree mortality in the Mainland Edge zone through effects on permafrost or increased soil moisture was considered. Tree mortality due to peat plateau collapse is not expected to occur in the Mainland Edge because permafrost was not found within 10 m of the current shoreline. Further tree mortality due to soil saturation is not expected to occur since the 99th percentile of proposed water elevations (1st percentile of post-project water depths) will be more than 10 cm below the 99th percentile of the current water regime.

5.4.2.2.1.3 Peat Islands

Historical Changes in Peat Islands

Lake peatlands totalling 2,517 ha in areas covered most of the surface waters in the low gradient areas prior to the CRD (Table 5.4-11). The CRD appears to have resulted in the breakup and/ or disappearance of 2,106 ha of lake peatlands thereby creating 411 ha of Peat Islands (Figure 5.4-12). Peatlands have disappeared either because they: (1) were submerged by the approximately 3 m increase in water levels (Figure 5.3-49); (2) fragments broke off and were carried downstream of Wuskwatim Lake; or (3) disintegrated over time. Some of the Peat Islands are mobile because they are not anchored to the lake bottom.

Table 5.4-11. Post-CRD lake peatland losses by peatland geographic zone.
See Figure 5.4-13 for location of zones.

Peat Bay	Original Area (ha)	2001 Area (ha)	Percentage of Area Lost
Cranberry Lake 1 North	186	10	95
Cranberry Lake 1 South	285	41	85
Cranberry Lake 2	518	56	89
Sesep Lake 1	256	83	68
Sesep Lake 2	87	50	42
Wuskwatim Brook North	566	59	90
Wuskwatim Brook South	311	51	84
Wuskwatim South Bay	308	61	80
Total	2,517	411	84

As a percentage of original area, lake peatland losses were highest in the north part of the Cranberry Lake 1 and Wuskwatim Brook 2 North Peat Island geographic zones (Table 5.4-11; Figure 5.4-12; Figure 5.4-13). Sesep Lake 1 and 2 had the lowest percentage of lake peatland area lost possibly due in part to the fact that these peat zones were the most sheltered and had the highest lake bottom elevations. Compared with the other Peat Island zones, Sesep Lake 1 and 2 have a higher bottom elevation and were therefore affected by water fluctuations a much lower percentage of the time. Cranberry Lake 1 zone has the highest water energy exposure (Figure 5.3-54) and the highest percentage of peatland area loss. The Wuskwatim South Bay Peat Island zone, which has no current, had the lowest relative loss of lake peatlands.

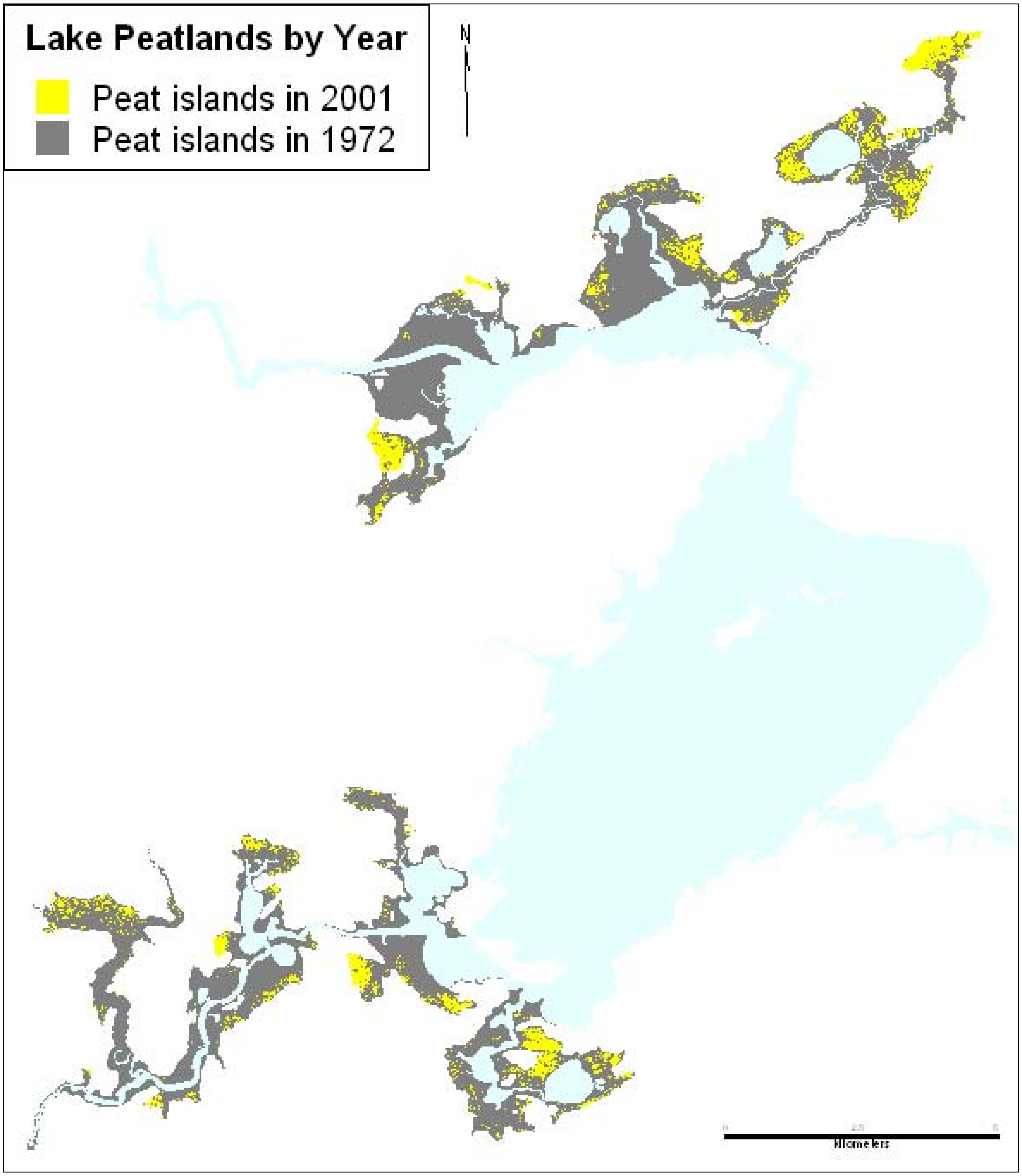


Figure 5.4-11. Lake peatlands in 1972 (pre-CRD) and Peat Islands in 2001.

1972 = Areas in black and yellow; 2001 = yellow. It is assumed that there was no disintegration between 1972 and the initiation of CRD in 1977.

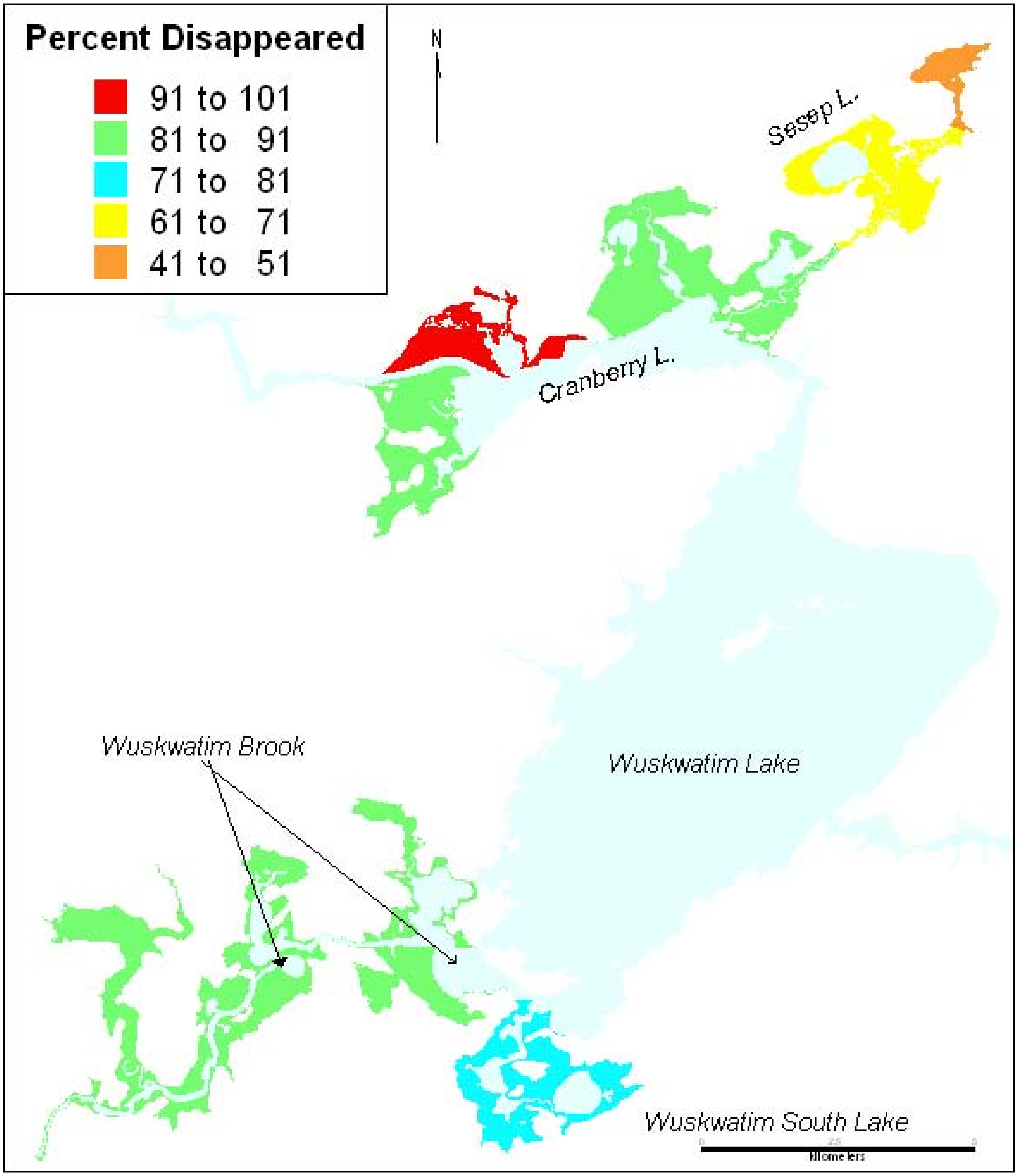


Figure 5.4-12. Percentage of pre-CRD lake peatlands that disappeared by 2001 by Peat Island zone.

See Figure 5.4-13 for Peat Island geographic zones.

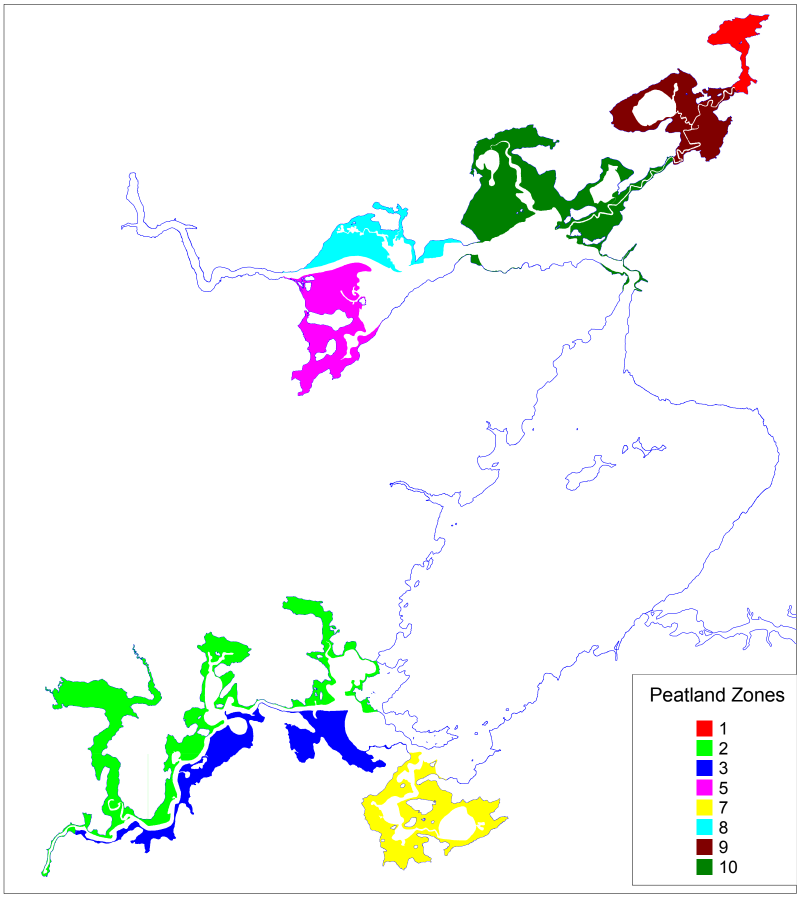


Figure 5.4-13. Peat Islands geographic zones in the upstream portion of the Affected Aquatic Area.

An estimate of peatland disintegration rates was required to predict the future area of Peat Islands. Sesep Lake 1, Cranberry Lake 1 North, Cranberry Lake 1 South and Wuskwatim South Bay were selected as case study areas because they represented large variations in apparently important influences on peatland disappearance (i.e., bottom elevation, exposure to water energy as current and waves (Figure 5.3-54).

Lake peatlands disintegrated very rapidly after CRD (Figure 5.4-14). It appears that an average of 52% of lake peatlands in the case study areas were lost in the first year. First year losses ranged from 23% in Sesep to 85% in Cranberry North. Disintegration rates for all study areas dropped dramatically by 1985 and leveled off between 1998 and 2001. Although aerial surveys suggested that only 1.6 ha of Peat Islands disappeared between 1998 and 2001, this should be viewed as the minimum 1998 – 2001 area (small islands lost during this period were not mapped due to the small area involved). Actual area loss during these three years could be as high as 20 ha which would reduce the area of Peat Islands in 2001 to 391 ha.

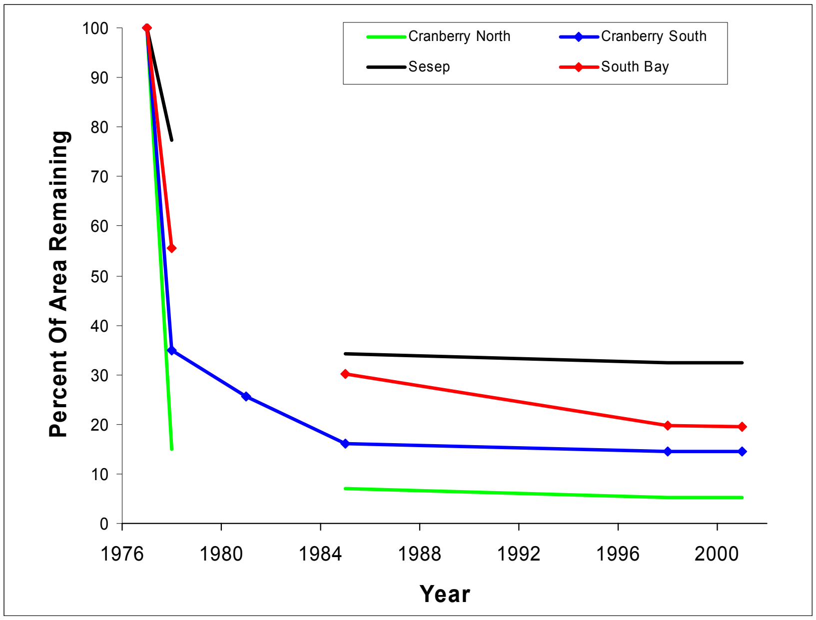


Figure 5.4-14. Peatland disintegration in four case study areas. 1976 area based on 1972 aerial photography and assumes there was no disintegration between 1972 and 1976.

It appears that the rate of Peat Island disintegration is currently approaching zero in all of the case study areas (Figure 5.4-14). The estimated 1998 – 2001 rates of disintegration in the case study areas averaged 0.2% with a range of 0 to 0.5%. The actual rates of disintegration could be higher for this period if the area lost was substantially higher than mapped during aerial surveys. Even if the total area loss between 1998 and 2001 was at the high end of the estimated range, the rate of loss would still be lower than the 1.4% observed between 1985 and 1998.

Total Peat Island area is expected to decline until the Project begins operation provided that the current water regime is maintained and there are no catastrophic events (e.g., a 1 in 100 year flood or an extended drawdown due to drought; both events would be just as detrimental but for different reasons). A range for estimated area lost was calculated using the estimate rate for 1998 – 2001 (Table 5.4-12) as the low end of the range and the 1985 – 1998 rate for the high end. Based on this range of rates, total Peat Island area is projected to decline to somewhere between 368 and 396 ha by 2009. The upper limit is within the estimated area range for 2001.

Once operation begins, the peatland area near the proposed dam will become connected to the forebay due to flooding. It is estimated that up to 3 ha of this peatland could be converted to Peat Islands as permafrost melts and peat plateau bogs disintegrate.

Table 5.4-12. Annualized rate of lake peatland loss for various available time periods.

Year	Cranberry North	Cranberry South	Sesep	Wuskwatim South Bay	All C.S. Areas
1977 - 1978	-85.0	-65.1	-22.8	-44.5	-52.1
1978 - 1985	-7.7	-7.7	-8.0	-6.5	-7.4
1985 - 1998	-1.9	-0.7	-0.4	-2.6	-1.4
1998 - 2001	0.0	0.0	0.0	-0.5	-0.2

Impact Predictions: 5, 25 and 100 Year Periods (2014, 2034 and 2109)

Peat Island area is expected to stabilize shortly after the Project begins operation. Water level fluctuations and exposure to water energy are the most important factors which limit lake peatland formation and ostensibly contribute to its disintegration. Stabilized water levels are expected to stop Peat Island disintegration on a net basis. That is, some Peat Islands are expected to disintegrate or sink however this area loss should be offset by horizontal growth of the remaining islands.

Shoreline bogs and fens in the areas protected from wave energy are expected to start expanding horizontally from the Mainland Edge into the lake sometime after about five years. Eventually this horizontal expansion should eliminate most, if not all, emergent vegetation (Figure 5.4-15). This horizontal expansion is expected to be accelerated in areas with Peat Islands that are immobile at the stabilized water levels because shore peatlands will merge with Peat Islands.

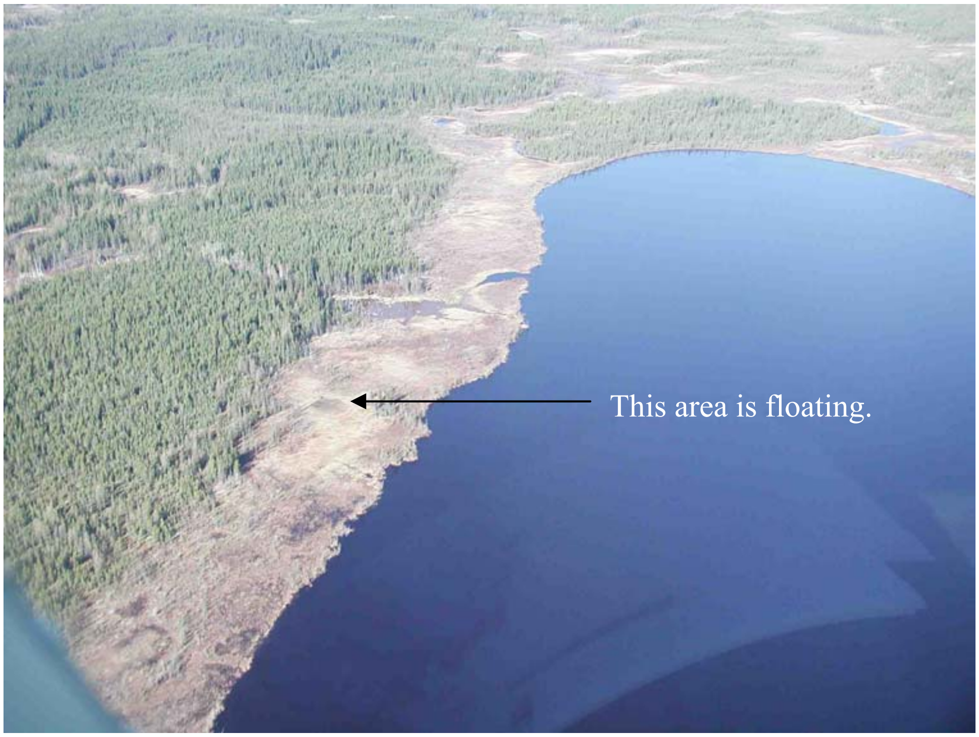


Figure 5.4-15. Emergent vegetation in a nearby lake has been eliminated by expanding shoreline peatland.

5.4.2.2.1.4 Mineral Islands

Stable water levels will submerge 18 ha of mineral islands that are exposed under low water levels. These islands are bare to sparsely vegetated. All other operational impacts to mineral islands are the result of erosion and are included in the following section.

5.4.2.2.1.5 Qualifications on Semi-Aquatic Habitat Predictions

The semi-aquatic habitat predictions were based on a number of assumptions and a limited understanding of the factors currently controlling habitat composition. For example, it is not known what extent ice pressure, bottom freezing, nutrient availability in lake water and recent changes in climate influence the current distribution and composition of Shore Zone and Peat Island vegetation. A considerable amount of field research would be required to substantially increase scientific understanding of these linkages. Such research is beyond the scope of this Project. The predicted changes in semi-aquatic habitat are those considered most likely given available information.

5.4.2.2.1.6 Erosion

Total Erosion

In estimating habitat loss from erosion, the habitat effects assessment estimates use the 1998 shoreline as the baseline to standardize differences between the erosion modelling and habitat effects assessment shorelines (Section 5.2.4.1.2). A portion of this total is not actual erosion but an adjustment factor that creates a common shoreline for the Mollard (Volume 4 Sections 6 and 7) and terrestrial habitat erosion predictions. This has no effect on the estimate of Project-related incremental erosion.

Total mainland and mineral island habitat that could be lost to erosion from 1998 to 2109 is 578 ha under current conditions and 606 ha if the project is built (Table 5.4-13; assumes erosion rates are historical averages plus 50%).

Table 5.4-13. Predicted Project-related incremental erosion at 2014, 2034 and 2109 and total erosion from 1998 to 2109 post-Project (includes mineral islands).

Period	Area (ha)
1998 to 2109 Current Conditions	578
2009 - 2014 Project-related	27
2015 - 2034 Project-related	45
2035 - 2109 Project-related	28
Total	606

Erosion is largely confined to the Wuskwatim Main geographic zone and portions of the south shore of Cranberry Lakes (Figure 5.4-16).

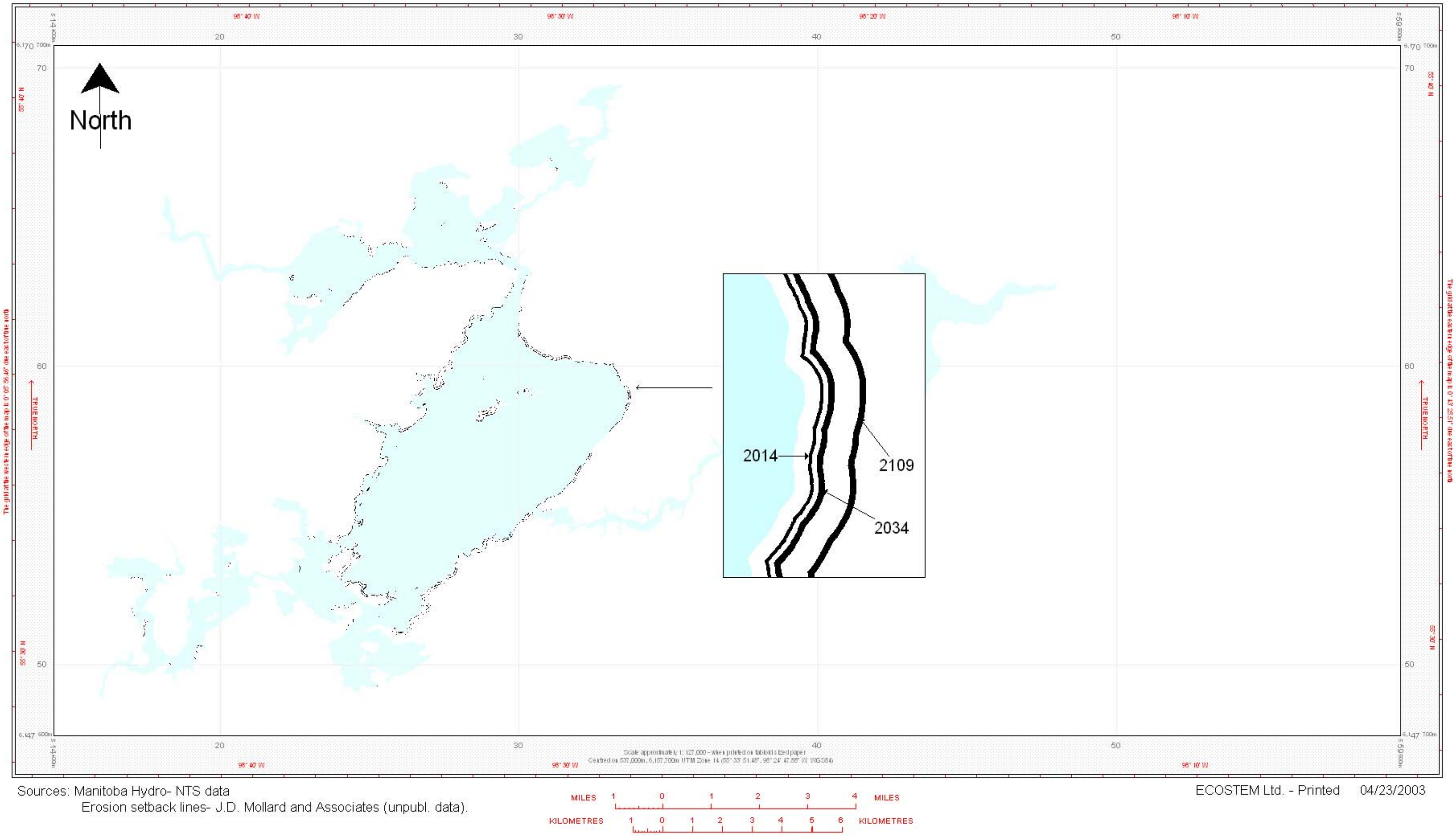


Figure 5.4-16. Predicted incremental Project erosion for the 2014, 2034 and 2109 projection periods. Black bands show the amount of erosion that may occur with the Project when measured in each of the years. Predictions assume that erosion rates are historical average plus 50%.

Most of the total eroded area over the 100 year projection period is mineral and peaty mineral soil (Table 5.10 29). Peatland accounts for 8% of the eroded area. Eroded land cover is predominantly conifer forest but includes 12% hardwood forest, 6% very open vegetation on peatlands, 1% very open vegetation on other wetlands and 1% small islands. Black spruce dominant and black spruce mixedwood forest are the most abundant vegetation type covering 37% and 12% of the eroded area, respectively (Table 5.10 30). White spruce, white spruce mixedwood and balsam fir forest account for 7%, 8% and 4% of the eroded area (Table 5.12-10).

Erosion will eliminate 11%, 10% and 97% of Sub-Region white spruce, white spruce mixedwood and balsam fir forest over the 100 year projection period (comparable figures for the Region are 2%, 4% and 48%). The 25 ha of balsam fir forest is located on the large island in the north of Wuskwatim Main. White spruce and balsam fir forests are the only rare vegetation types that will be affected by erosion.

Incremental Project Erosion

The portions of total erosion that are attributable to the Project are 27, 45 and 28 ha when measured at 2014, 2034 and 2109, respectively (Table 5.4-13). Note that the Project-related erosion at 2014 or 2034 would be eroded under current conditions even if the Project does not proceed. Project-related erosion losses at any snapshot in time are temporary.

With only a few exceptions, the percentage distribution of Project-related erosion by land type, land cover, broad habitat and vegetation type is similar to total erosion for the 100 projection period (Table 5.12-8, Table 5.12-9, Table 5.12-10). Exceptions by classification type are as follows:

- Land type- A substantially higher percentage of peatland is incrementally eroded during the 2035 to 2109 period. Higher peatland erosion is offset by lower mineral and peaty mineral soil erosion.

- Land cover type- A substantially lower percentage of hardwood forest is incrementally eroded during the 2035 to 2109 period. Lower hardwood forest erosion is offset by higher conifer forest and very open vegetation on peatland erosion.

- Vegetation type- A substantially higher percentage of black spruce forest is incrementally eroded during the 2035 to 2109 period. Higher black spruce forest erosion is offset by lower balsam fir, black spruce mixedwood white spruce mixedwood and hardwood forest erosion.

5.4.2.2.2 Downstream

5.4.2.2.2.1 Changes to Water Regimes

Raw downstream historical water level data were only available for Opegano Lake for the last five years (October 29, 1997 to October, 2002). Raw water level data are required to construct the current water regime water duration zones required to understand the existing distribution of Shore Zone vegetation.

Because the post-CRD water regime is not reflective of long-term cycles, Manitoba Hydro uses a long-term simulated record to predict future flows. The average flow for the long-term record is wetter than the post-CRD flow record, and both records have similar minimum and maximum values (Volume 1 Section 6.3.2). Two different stream-flow records for the Burntwood River at Wuskwatim Lake were used: a record based on flows that occurred since 1997 (post-CRD flows) and a long-term simulated record (86 years). "The 'existing environment' was based on the post-CRD record, while the "post-Project environment" was based on the long-term simulated record. Therefore, the predicted differences between the two conditions reflect the combined effects of the Project and the differences in the water records. For the purposes of this assessment, no attempt was made to differentiate between the relative contribution of these two sources of change" (Volume 1 Section 6.3.2). The following two paragraphs, which have been largely reiterated from Volume 1 Section 6.3.2, describe downstream predictions based on the long-term record.

Operation of the generating station would involve cycling between the 3 units, each of which would generally be operated at the discharge for maximum efficiency or "best gate" (Volume 1 Section 6.3.2). The variation in the number of units operating during various periods within the day will superimpose within the day water level changes onto the month to month changes that presently occur. The magnitude of these fluctuations varies with inflow and location along the river. The largest fluctuations within the day occur in the tailrace (median 0.4 m to a maximum of 1.5 m) and decrease down river until, by Opegano Lake, the median is 0.1 m with a maximum of 0.4 m (under extremely unusual conditions, these changes could be greater). These water level changes within the day will considerably increase the frequency of water level fluctuation within the Shore Zone: daily changes are minimal under existing conditions and for example, Opegano

Lake, will experience daily changes greater than 0.1 m about 60% of the time post-Project.

Minimum downstream water levels will decrease, as the discharge of 1 unit (328 m3/s) is lower than the post-CRD minimum of 440m3/s and the 5th percentile flow (600 m3/s). These minimum water levels will occur when inflow is less than approximately 660 m3/s (7th percentile flow), and operation will consist of cycling between 1 and 2 units within the day, resulting in several hours of minimum water levels each day.

Raw water level data were used to develop water depth duration curves for Opegano Lake. These data indicated that the median water level during that period was 208.46 m ASL and the median growing season water level was 208.14 m (Figure 5.4-17). Day to day water level variations on 75% of the days were under 2 cm for the entire five year period and the growing season portion of it. Day to day variations ranged from 0 to 45 cm for the entire five year period and 0 to 8 cm for the growing season. Year to year median water levels over 90% of the years varied by 104 cm and 75 cm during the winter and open water periods, respectively. On Wuskwatim Lake, the comparable variations were 98 and 95 cm.

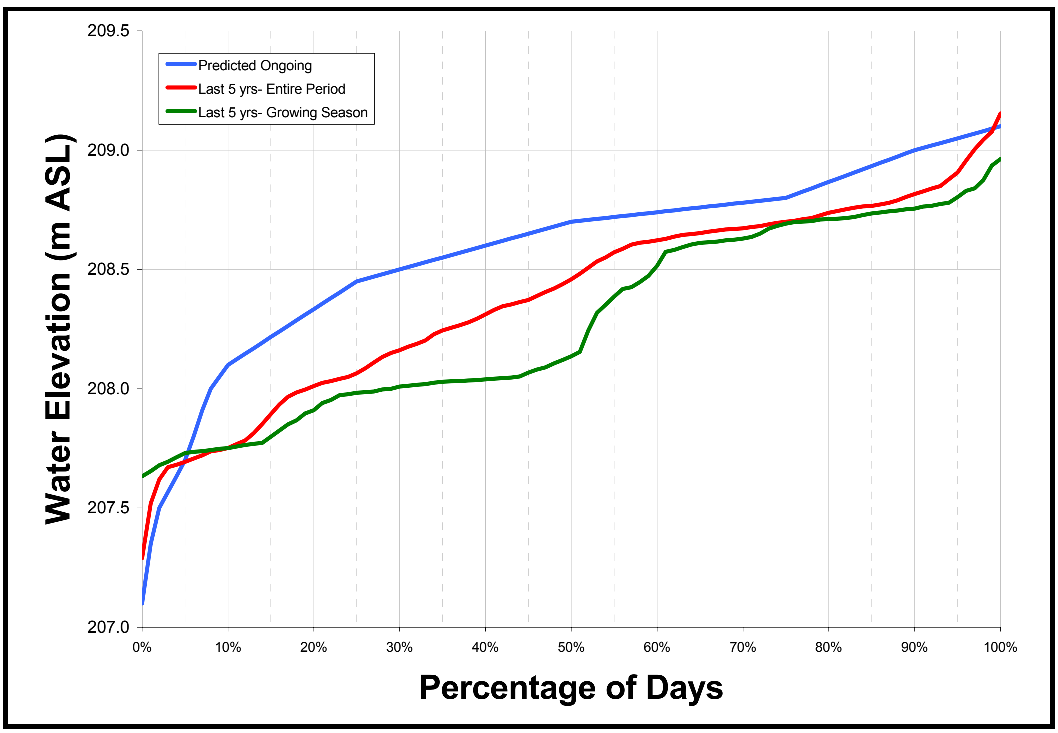


Figure 5.4-17. Current and projected daily water level variations and water duration curves for Opegano Lake.

Notes: Location of "Predicted Ongoing" duration curve approximated from Volume 3 Figure 5.2-10. "Last 5 yrs." based on water level data provided by Manitoba Hydro.

The median water level on Opegano Lake is expected to increase by approximately 24 cm to 208.70 m ASL with an inter-decile range from 208.10 m to 209.00 m (Figure 5.4-17). Growing season water levels will be below year-round levels on 80% of the days. Comparing predicted water levels with levels observed over the past five years suggests that post-Project median growing season water levels may increase by up to 56 cm (Figure 5.4-17).

To provide some added indication of historic downstream water levels and daily, monthly and seasonal variations and how they may change, it was assumed that the overall five and 24 year historical pattern observed on Wuskwatim Lake was reflected downstream on the Burntwood River and Opegano Lake. A comparison of the last five years and the post-CRD historical water data for Wuskwatim Lake indicated that the long-term water duration curve was 6 to 14 cm lower than the five year curve, depending on which percentile was examined. On that basis, the increase in post-Project Opegano Lake water levels may be greater than shown in Figure 5.4-17. On the other hand, this may simply be an artefact of comparing results from actual versus simulated water data.

Higher water levels on Opegano Lake will be accompanied by higher daily water level fluctuations. Daily water level fluctuations on 75% of the days are expected to increase from a maximum of approximately 2 cm to 28 cm. Staging may result in stretches of days where fluctuations are very low followed by stretches of consecutive days where fluctuations are very high.

In the tailrace area, the predicted median water level is 212.2 m with an inter-decile range from about 211.1 m to 212.5 m. Daily tailrace variations on 75% of the days are expected to be up to 92 cm and 106 cm on an ongoing basis and during the growing season. This implies a 20 to 40 cm increase in median water levels and an increase in daily variations of up to 104 cm during the growing season.

5.4.2.2.2.2 Shore Zone

Higher water levels and higher daily variations in water levels will affect peatlands that are currently on the mainland side of the shoreline but still hydrologically connected to the Affected Aquatic Area. Currently there are 1,583 ha of mainland peatlands with an edge that is connected to the downstream Affected Aquatic Area.

It is difficult to predict how far inland these peatlands could be affected because there are no data on the topography of the mineral and/ or bedrock substrate underlying the peat. Surface topography and bank conditions suggested that up to 57 ha, or 3.8%, of the connected peatlands could be affected by the altered water regime (Table 5.4-14). These peatlands occur in the creek mouths and at the north end of Opegano Lake (Figure 5.4-18).

Table 5.4-14. Downstream peatlands potentially affected by changes to water regime.

Habitat Type	Burntwood River	Opegano Lake	All Areas
Black spruce > 70% forest on peatland	3	4	7
Black spruce sparsely treed peatland	14	8	28
Graminoid fen with patches of water	10	19	29
All Types	27	30	57

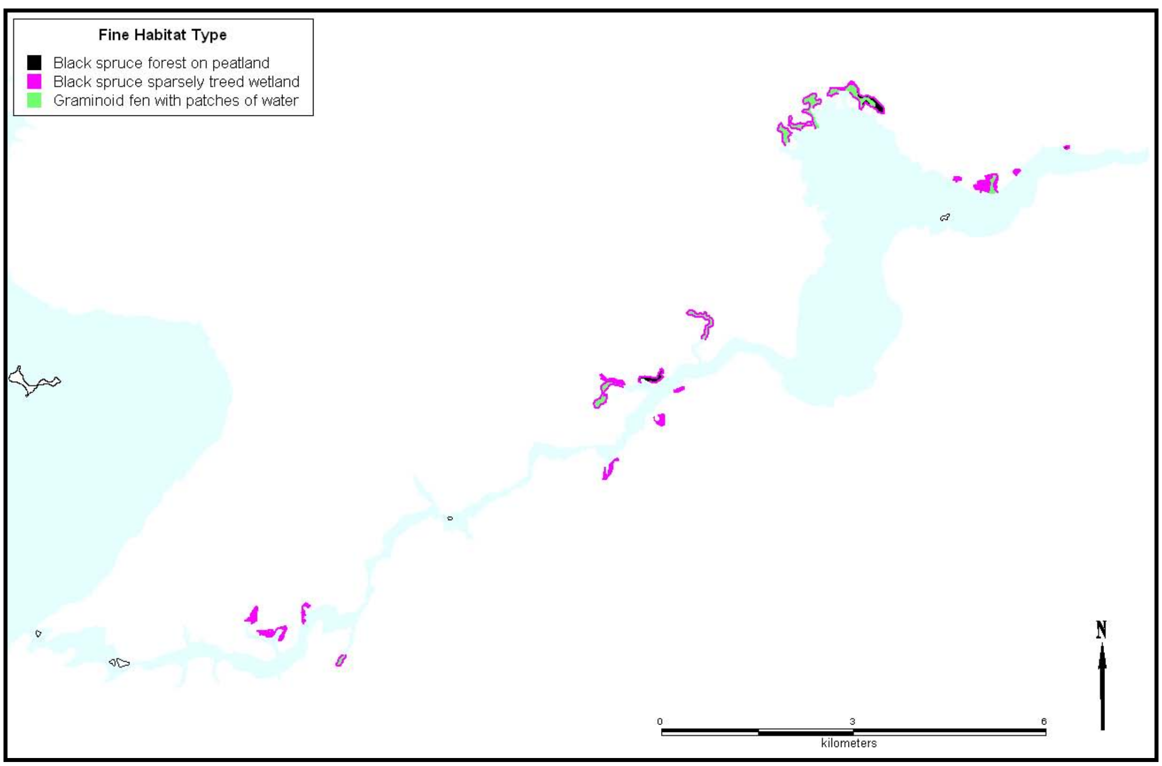


Figure 5.4-18. Mainland peatlands potentially affected by downstream water regime changes.

If the new water regime affects downstream peatlands in the same way that CRD affected upstream peatlands, then effects should occur in three stages.

(1) Most of the peatlands will break away from their connections to the adjacent mainland areas. This will leave fragmented organic material on the underlying clay and/ or bedrock.
(2) In some locations this residual organic material should decompose and expose mineral soil over time.
(3) After several years of exposure to water fluctuations, the shoreline should become a mixture of organic beach, low to high slope clayey beach and mainland peatland extending into the water.

Total downstream shoreline length and Shore Zone area will be increased by mainland peatland effects. If the areal extent of disturbed peatlands is as shown in Figure 5.4-18, then downstream shoreline length could increase by up to 16% (11.2 km). Shore Zone area would also increase since it is a direct function of shoreline length and beach slope. If half of the shoreline length increase is in low gradient areas then the total Shore Zone area suitable for beach vegetation could increase by 8 to 10 ha.

5.4.2.2.2.3 Shoreline Vegetation

Currently, Shore Zone vegetation sequences are absent along most of the downstream shoreline (Figure 5.3-56) due to unsuitable shore material type, high slopes and highly fluctuating water levels. Vegetation sequences are not expected to develop in any of these areas due to the increase in the degree of fluctuations. There may even be a small loss of existing Shore Zone vegetation but this is expected to be minimal due to the limited amount currently present.

Water depth vegetation sequences will develop in the low gradient portions of the newly created shoreline where mainland peatlands become Peat Islands. Vegetation in these areas is expected to be mostly a mixture of the clayey and organic vegetation sequences currently found in the upstream areas (Table 5.3-12). The tall shrub on peat and "No Vegetation- Peat to Water's Edge" vegetation sequences should account for the remaining shoreline vegetation.

5.4.2.2.2.4 Peat Islands

Water regime changes will break down some of the disturbed peatlands into Peat Islands. Breakdown of the peatlands in the north end of Opegano Lake and in the creeks that occur in low slope terrain is expected to occur in three stages.

(1) Peatlands undergo slight fragmentation and become Peat Islands. In this stage, the distribution between Peat Islands and water is expected to be similar to the current condition of Peat Islands in the northern bay of the Sesep Lakes geographic zone (Figure 5.3-66);
(2) Peat Island disintegration exposes water in about 50% of the bay (analogous to largest bay in the Sesep Lakes zone); and
(3) Most to all of the Peat Islands have disappeared.

Only some of the disturbed mainland peatlands are expected to proceed through all three stages. The maximum expected loss assuming that all peatlands disintegrate is 57 ha. This is not expected to significantly affect wetland function in the 1 km Aquatic Buffer or the Sub-Region. The peatland types affected are common and it is predicted that a maximum of 3.6% of their edges would be affected.

Certainty in the peatland disintegration predictions is moderate. Some breakdown is expected to occur but it is difficult to predict the aerial extent of disintegration due to the lack of data on underlying mineral surface topography.

5.4.2.2.2.5 Mineral Islands

There is only one mineral island in the downstream stretch of the river. The Project is not expected to affect this island because its shore is lacustrine clay over bedrock which is a non-erodible shore material type.

5.4.2.2.2.6 Erosion

Substantial Project-related incremental erosion of downstream mainland habitat is not expected to occur (Volume 4, Section 7). Therefore, the Project was not expected to significantly affect mainland habitat in the downstream portion of the Affected Aquatic Area.

5.4.3 Summary Of Construction and Operation Effects on Habitat

All of the areas expected to undergo physical changes as a direct result of the construction and operation of the Project are shown in Figure 5.4-1. During construction, up to 2,600 ha of habitat may be directly and indirectly affected by Project features in the Mainland/ Upland Project Areas and by water regime changes in the Affected Aquatic Area (Table 5.4-15). The habitat effects assessment takes a conservative approach and assumes that all of these areas are "lost" habitat during construction. A substantial proportion of these areas contains habitat which is undisturbed during construction (e.g., potential borrow pit areas).

The amount of terrestrial habitat that could be potentially affected is expected to decline to approximately 1,200 ha during operation. Approximately 660 ha of this total is either permanently lost to Project features or is converted to aquatic habitat.

Table 5.4-15. Estimated areas (ha) of direct and indirect physical change during Project construction and operation. An "approx." in front of an area indicates that it is an estimate of the maximum predicted area.

Impact	Construction	Operation
Access Road		
Direct Effects	482 [2]	approx. 365
Indirect Effects[1]	approx. 974 [2]	approx. 362
Fires	unknown	unknown
Borrow Pits		
Pits	636 [2]	approx. 20 [3]
Access Roads To Pits	80	
Generating Station Project Areas		
Flooding (cleared first)	38	38
Clearing	144	74 [4]
Physical Disturbance	approx. 226	0
Indirect Effects[1]	0	approx. 160
Project-related Added Erosion (assumes erosion rates equal historical average + 50%)		
2014	0	approx. 27
2034	0	approx. 45
2109	0	approx. 28
Permanently Submerged		
Shore Zone Beach	0	approx. 116
Mineral Islands	0	18
Peat Islands		
Upstream	0	increase
Downstream	0	decrease
Combined	0	net increase
Accidental Events Other Than Fire	negligible	negligible
Approximate Total [6]	2,600	1,200 [5]
Percentage of Sub-Region land area	0.8%	0.4%

[1] Represents a buffer around the cleared areas to capture the maximum expected extent of physical effects such as permafrost collapse, altered groundwater flows. etc.. During construction, indirect effects of generating station features are included in "Physical Disturbance". [2] Includes allowance for up to 207 ha of roadbed borrow pit clearing. [3] Allowance for gravel stockpiles. [4] Degree of rehabilitation in the 70 ha of temporary clearing varies. [5] Total only includes incremental erosion for the projection period with the largest increment (2034) since these areas would be lost under current conditions. [6] The totals are approximate and represent the maximum predicted area.

5.4.3.1 Mainland/ Upland Habitat

Potential construction and operational effects on mainland/ upland habitat composition are expected to be negative, extend into the 1 km buffers, be small in magnitude and continue for at least 26 years.

All direct and indirect construction effects on mainland/ upland habitat except from accidental forest fires are expected to be limited to less than 2,600 ha or 0.8% of the Sub-Region land area. Construction is not expected to substantially alter the habitat composition of the Sub-Region given the mitigation measures that will be included in the Project (see below). Removal of structures and termination of activities not required for operation is expected to reduce Project effects substantially. Project-related erosion is the only mainland/ upland habitat impact added during operation. Project erosion is predicted to affect a maximum of 0.01% of Sub-Region land area and therefore will not substantially affect any upland/mainland habitat type after implementation of the mitigation measures described below.

Direct and indirect habitat effects from construction and operation will gradually decrease to the extent that complete vegetation recovery occurs in the temporarily cleared borrow pit, access road and generating station areas (Figure 7.5-6) and to the extent that bog vegetation becomes more abundant on lake peatlands in the forebay. If natural regeneration is successful in returning all temporarily cleared areas back to their pre-Project habitat types, then the extent of Project effects could be reduced to less than 0.4% of Sub-Region land area. Indirect Project effects could be higher if construction or operation introduces highly invasive plants or increases fire frequency and/ or severity but this is not expected given the mitigation measures described below.

Vegetation recovery will be assisted in cleared areas by grading the terrain and spreading stockpiled organic material. The grass mixture used to seed ditches will only contain native and/ or non-invasive introduced grasses (i.e., will not contain sweet clover {*Melilotus offincianilis*} or other herbs). The risk of Project-related fire starts will be reduced by restricting access at Highway 391 during construction and operation, roving fire patrols in the generating station area and along the access road during construction, and maintaining fire suppression equipment in the generating station work area during construction and operation. These measures should reduce the risk of a large fire.

5.4.3.2 Semi-Aquatic Habitat

Construction is not expected to have a noticeable effect on Shore Zone, Peat Island and Mineral Island habitat (Figure 7.5-1), VECs or related indicators. Operation is expected to affect areas upstream and downstream of the generating station in opposite ways.

Upstream, the more stable water regime is expected to stop the on-going disintegration of the Peat Islands created by CRD flooding. The types of plants growing on the Peat Islands should start to change after approximately five years of operation. Cattails should gradually become less abundant, while sedges, ericaceous shrubs (e.g., leatherleaf, Labrador tea), willows and Sphagnum mosses should become more abundant on Peat Islands. After the initial five years of operation, peatlands should start to form along the shorelines of the protected bays that are peripheral to the main body of Wuskwatim Lake. Over time, shoreline peatlands are expected to gradually expand into the lake and merge with the existing Peat Islands. In the process, plants growing on the exposed shore would be eliminated and emergent plants (e.g., cattails) forced into deeper water. The expansion of shoreline peatlands and the elimination of most of the area of emergent plants, if it occurs as expected, could eventually restore these bays to a condition similar to that which existed prior to CRD. These are considered to be positive ecological effects because they partially restore native ecosystem and species diversity. Federal and provincial policies advocate the maintenance and restoration of native biodiversity (c.f., CCFM 1995).

Upstream, more stable water levels are not expected to noticeably change the percentage of shoreline with beach vegetation. Stabilization at the upper end of the range of water elevations will substantially narrow the band of saturated soil and reduce beach habitat with saturated soil by up to 85%. The combination of stable water levels and less beach with saturated soil is expected to reduce the abundance of the species that are now the most widespread and abundant on the beach in the shore zone (i.e., Beggar’s ticks, Canada bluejoint, water sedge, wild mint, meadow grass, and rough cinquefoil). Species which grow better where water levels are stable (i.e., beaked sedge, manna grass, marsh spikerush, water horsetail, water smartweed, and water parsnip) should increase in distribution and abundance, but only for a few decades due to localized expansion of shoreline peatlands into the lake. Upstream water regime changes are not expected to substantially affect the groundwater level in uplands or the permafrost in peatlands next to the shoreline.

Downstream effects of the new water regime are expected to be the reverse of those upstream. Currently there are no Peat Islands in downstream reaches. Higher water level fluctuations, especially if water levels are generally higher, could break up as much as 57 ha of mainland peatlands into Peat Islands. Downstream shoreline length and Shore Zone beach area will be increased to the extent that peatlands become separated from the adjacent mainland/ upland areas. The shoreline plant species which are disadvantaged by stable water regimes on upstream shorelines should become more widespread and abundant on the newly created downstream shoreline with the fluctuating water levels.

5.4.3.2.1 Peat Island Habitat and Shore Zone Habitat

Potential construction and operational effects on Peat Island and Shore Zone habitat are expected to be positive, extend throughout the Affected Aquatic Area, be moderate in magnitude and continue for at least 26 years.

The opposite upstream and downstream effects of water regime changes are expected to have a net positive effect on Peat Island and Shore Zone habitat, including vegetation composition. The net effect is positive because there is more area affected upstream. Certainty regarding these potential effects is moderate because these predictions are especially sensitive to the uncertainties related to climate change and because the predictions rely on an added assumption about the depth to underlying mineral soil in the downstream peatlands that may be affected by water regime changes.

5.4.3.2.2 Mineral Island Habitat

Potential construction and operational effects on Mineral Island habitat are expected to be negative, extend throughout the Affected Aquatic Area, be moderate in magnitude and continue for at least 26 years.

The Project will permanently submerge 18 ha of low, very sparsely vegetated to bare mineral islands and incrementally erode up to 3.4% (10 ha) of the remaining mineral islands. This incremental mineral island erosion would eventually occur even if the Project does not proceed.

5.4.4 VECs And Road Density

The following sections summarize how Project features are expected to affect VECs and road density (an indicator of fragmentation effects). There is a high degree of certainty for many of the expected effects for several reasons. Firstly, the conclusions are based on the results of site-specific investigations and habitat maps that cover all of the study areas (i.e., a census). Secondly, the percentage of the habitat area affected is small for most types. Thirdly, most of the affected VECs are common within the Sub-Region and only a small percentage of their high quality habitat is affected. All certainties that are reported as being low or moderate rather than high are reduced due to the:

- lack of detailed information for understorey species, rare plant species and vegetation succession in the Region and Sub-Region; and
- unknown response of soils, plants and habitat to long-term changes in water regimes, water nutrient status, climate and the fire regime.

Sources of additional uncertainty are described, where applicable.

The geographic extent of each Project effect was assessed in one of four categories: site scale for effects confined to one or more Project footprints, landscape scale for effects contained within the 1 km Buffers (Figure 5.2-2), Sub-Region scale for effects contained within the Sub-Region and Region scale for all other effects. In all cases, the significance of an effect (i.e., small, moderate or large) was assessed using the Sub-Region as the comparison area.

5.4.4.1 Mainland/ Upland Habitat

5.4.4.1.1 Balsam Fir (Napakasiht) and White Spruce (Wapiskimnahtik)

Potential construction and operational effects on balsam fir and white spruce are expected to be negative but insignificant (landscape scale, small in magnitude with mitigation and continue for at least 26 years) .

Balsam fir and white spruce cannot regenerate quickly after a fire. As a result, these are rare species in the Sub-Region and Region (Section 5.3.2.1). Most of the regional balsam fir and white spruce forest occurs within 300 m of large lakes or rivers which provide some protection against fire. Balsam fir seedlings, saplings and widely scattered trees were found in the generating station footprint and at two access road stream crossings. Mineral soil within 300 m of large lakes and rivers and mineral islands in large lakes was classified as high quality balsam fir and white spruce habitat.

Construction and operation will affect approximately 80 ha of balsam fir and white spruce forest types. Construction will affect 65 ha or 5% of Sub-Region forest with at least 40% balsam fir and/or white spruce forest in the overstorey and many of the known locations of understorey balsam fir. In the Generating Station Project Areas, clearing and disturbance will affect 2% and 4% of the white spruce forest, respectively (Table 5.4-16). Balsam fir forest is not affected during construction but understorey balsam fir is. Understorey balsam fir and white spruce seedlings, saplings and widely scattered trees will also be affected in the Generating Station Project Areas and at some crossings along the Access Road. Depending on the year, operation will incrementally erode 1 to 3 ha of the largest balsam fir stand in the Sub-Region and other shoreline forests containing understorey balsam fir. Erosion during operation also affects 10 to 15 ha of white spruce forest. Construction will affect 1% and 4% of high quality balsam fir/white spruce habitat in the Sub-Region and the 1 km Aquatic Buffer, respectively (Table 5.4-17). Certainty regarding the potential effects is moderate.

Project effects on balsam fir and white spruce will be mitigated by two measures. First, access road and borrow pit clearing and disturbance will avoid existing concentrations of balsam fir and white spruce to the extent feasible. Prior to clearing, the Project's terrestrial ecologist will clearly mark existing concentrations of balsam fir and white spruce that should be avoided to the extent feasible. Second, protection and regeneration measures will be undertaken to ensure that there is no long-term net loss of balsam fir/white spruce forest. This will be achieved by prohibiting, to the extent feasible, any activities in those portions of the generating station disturbance area (Figure 5.4-1) that contain white spruce and balsam fir concentrations and by regeneration efforts in appropriate locations in the 1 km Aquatic Buffer. Restricting activities in the generating station disturbance area could maintain up to 39 ha of white spruce forest. Regeneration efforts (i.e., seeding, planting and/or transplanting balsam fir and white spruce) will be undertaken to the extent required to achieve no net loss of 120 ha of these habitat types. This is overcompensating for the 80 ha that is expected to be affected and provides additional mitigation to ensure "no net loss". Regeneration will occur in appropriate locations in the 1 km Aquatic Buffer area and will be monitored to ensure that the 120 ha "no net loss" target is met. A field study on the current understorey distribution and environmental associations of balsam fir and white spruce will be undertaken to determine the best locations for regeneration efforts. The Project's terrestrial ecologist will locate the regeneration areas and perform inspections to ensure that the 120 ha "no net loss" target is met. Inspections will occur immediately after planting, at three years and again at seven years. An added potential mitigative measure is to prohibit use of the two large islands in the north of part of Wuskwatim Lake. Even though these islands are expected to disappear over time due to ongoing erosion, they have the potential to provide a seed source for the mainland and potentially critical habitat in the meantime.

Certainty regarding the potential effects is moderate because the high degree of certainty provided by the map of overstorey trees in the Sub-Region is offset by a lack of information on the understorey distribution of balsam fir and white spruce.

Table 5.4-16. Percentage of Sub-Region balsam fir and white spruce forest in the Upland Project Areas.

Vegetation Type	Flooding (cleared first)	Generating Station Permanent Clearing	Generating Station Clearing Slight Rehab	Generating Station Disturbed (not cleared)
Balsam fir/ Spruce > 70% forest				
White spruce > 70% forest	2	0	0	4
White spruce mixedwood forest	0	0		1
All types	1	0	0	2
Area of all types (ha)	8	2	1	20

Table 5.4-17. Balsam fir and white spruce habitat affected in the Upland Project Areas (percentage of Sub-Region habitat) by habitat quality.

Quality	Percentage of Sub-Region Habitat							300m Buffer	Area (ha)
	Access Road	Flooding (cleared first)	Generating Station Clearing Full Rehab	Generating Station Clearing Slight Rehab	Generating Station Disturbed (not cleared)	Generating Station Permanent Clearing	All Areas		
High	0	0	0	0	1	0	1	4	11,715
Moderate	0	0	0	0	1	0	2	8	9,689
Very Poor	0	0	0	0	1	0	1	4	7,461
All	0	0	0	0	1	0	1	5	28,866
Area (ha)	16	38	60	10	214	73	28,866	7,581	

5.4.4.1.2 Dry Jack Pine Forest (Oskahtik)

Potential construction and operational effects on dry jack pine forest are expected to be negative but insignificant (landscape to sub-regional scale, small in magnitude with mitigation and continue for at least 26 years) .

Dry jack pine forest is a habitat type that is maintained by wildfire but can be quite sensitive to changes in the frequency or severity of large fires. Most of the soil nutrients and water in this habitat type are held in the thin layer of organic material over the mineral soil. Two fires within a short time interval or an usually severe fire can burn off all of this organic material leading to the long-term conversion of an open forest stand to a reindeer lichen, haircap moss and sparse grass community. A Project-related increase in fire frequency and/ or severity could convert a substantial percentage of Sub-Region dry jack pine forest to non-forested vegetation types.

A large proportion of the Sub-Region's dry jack pine forest is located along the Access Road. Up to 648 ha of dry jack pine forest will be directly and indirectly affected by the Upland Project Areas (Table 5.4-18). This amounts to 10% of Sub-Region dry jack pine forest. Depending on the extent of borrow pit development, the Project may affect up to 9% or 575 ha of the dry jack pine forest in the Sub-Region. An additional 17% of Sub-Region dry jack pine forest is located along the access road RoW. Increased access increases the risk that more fires will start because people are a major cause of fires. A Project-related increase in fire frequency and/or severity could create a long-term reduction in the amount of dry jack pine forest in the Sub-Region. There is no reliable way to predict how much the Project will increase the risk of a large fire or of an increased number of small fires. Only one large fire is sufficient to remove soil organic matter and convert a large area to a different habitat type. Also, the complicating effect of climate change is of special concern for this VEC. Therefore, certainty regarding potential Project effects is low.

Project effects on dry jack pine forest will be mitigated by two measures. First, the risk of Project-related fire starts will be reduced by restricting access at Highway 391 during construction and operation, roving fire patrols in the generating station area and along the access road during construction and maintaining fire suppression equipment in the generating station work area during construction and operation. These measures should reduce the risk of a large fire. Second, regeneration measures will be undertaken to ensure that the long-term net loss of dry jack pine forest does not exceed 70 ha (1% of Sub-Region dry jack pine forest). If borrow pit development occurs as expected, then up to 300 of the 575 ha of affected dry jack pine forest could remain undisturbed. The remainder of affected dry jack pine forest is in the access road and the areas that may be indirectly affected by clearing, ditching and other effects besides changes to fire frequency and/or severity. Regeneration efforts will be undertaken to the extent required to reduce the long-term loss of dry jack pine forest to 70 ha. Jack pine will be seeded and/ or planted in the affected areas. A terrestrial ecologist will recommend regeneration methods, inspect the regeneration areas immediately after planting, at three years and again at seven years and, based on inspections, recommend whether further regeneration efforts are required to reduce the net loss to 70 ha.

Table 5.4-18. Dry jack pine forest in Project Areas, Access Road zone of influence, 1 km Upland Buffer and Sub-Region.

	Access Road Clearing	**Borrow Pit Clearing**	Indirect Effects Other Than Fire	1 km Upland Buffer	Sub-Region Area (ha)
Percentage of Sub-Region	1	6	3	26	100
Area (ha)	73	358	217	1,678	6,477

5.4.4.1.3 Dry Ground Cranberry (Wesakemina)

Potential construction and operational effects on dry ground cranberry are expected to be negative and insignificant (landscape scale, small in magnitude and continue for 6 – 25 years).

Dry ground cranberry is widespread throughout the boreal forest and in the Sub-Region. Sparsely treed wetlands and immature to mature black spruce forest on mineral or peaty mineral soil were classified as high quality dry ground cranberry habitat in the Sub-Region. High quality dry ground cranberry habitat is widespread and abundant in the Sub-Region.

Project construction will remove or physically disturb 0.7% of Sub-Region high and moderate quality dry ground cranberry habitat (Table 5.4-19). Indirect Project effects (i.e., effects related to soil, groundwater and microclimate changes adjacent to cleared areas) may reduce the quality of a further 384 and 66 ha (0.3% and 0.1%) of Sub-Region high and moderate quality habitat, respectively. Project effects will be partially offset during operation to the extent that: (1) disturbed areas regenerate back to typical habitat types; and (2) bog vegetation becomes more abundant on lake peatlands in the Affected Aquatic Area.

Project effects on dry ground cranberry will be mitigated by spreading stockpiled organic material in cleared areas to assist vegetation recovery.

Table 5.4-19. Dry ground cranberry in Project Areas and Sub-Region (percentages of Sub-Region area excepted as noted).

			Habitat Quality		
Location	High	Moderate	Poor	Very Poor	All
Project Areas- Direct Effects	**0.3**	**0.4**	**1.0**	**0.1**	**0.5**
Access Road Clearing	0.1	0.1	0.3	0.1	0.2
Borrow Pit Clearing & Excavation	0.0	0.1	0.7	0.0	0.2
Flooding (cleared first)	0.0	0.0	0.0		0.0
GS Clearing- Full Rehab	0.0	0.0	0.0	0.0	0.0
GS Clearing- Slight Rehab	0.0	0.0	0.0		0.0
GS- Permanent Clearing	0.1	0.1	0.0	0.0	0.1
GS Disturbed (not cleared)	0.0	0.0	0.0	0.0	0.0
Project Areas- Indirect Effects	**0.3**	**0.1**	**0.5**	**0.2**	**0.3**
Project Effects land area (ha)	874	254	1,372	78	2,577
Sub-Region land area (ha)	140,166	44,543	89,654	27,361	301,724

5.4.4.1.4 Velvet-Leaf Blueberry (Ethinimina)

Potential construction and operational effects on velvet-leaf blueberry are expected to be negative and insignificant (extend into the 1 km Buffers, small in magnitude and continue for 6-25 years).

Velvet-leaf blueberry is widespread in the Sub-Region but is not as common as dry ground cranberry. Open vegetation on the various mineral soil land types was classified as high quality velvet-leaf blueberry habitat. High quality blueberry habitat, which covers 7% of the Sub-Region, is concentrated in the jack pine forest that is regenerating in the recent large wildfire areas. Moderate quality habitat is widespread and accounts for a further 31% of Sub-Region area.

Project construction will clear or physically disturb between 1.2% and 2.6% (1,246 ha) of moderate to high quality velvet-leaf blueberry habitat in the Sub-Region (Table 5.4-20). The range of moderate to high quality habitat loss assumes that somewhere between 10% and 100% of the potential borrow pit areas will be cleared. Indirect Project effects may reduce the quality of an added 0.7% of high quality habitat and 0.4% of moderate quality habitat. A Project-related increase in fire frequency and/or severity would affect high quality habitat. Project-related erosion will not significantly affect high quality blueberry habitat. Project effects will be partially offset during operation to the extent that disturbed areas undergo natural regeneration. Direct and indirect Project effects range from small to moderate depending on the extent of borrow pit clearing and changes to fire frequency and/or severity. Certainty regarding the potential effects is moderate.

Project effects on velvet-leaf blueberry will be mitigated by spreading stockpiled organic material in cleared areas to assist vegetation recovery. The risk of Project-related fire starts will be reduced by restricting access at Highway 391 during construction and operation, roving fire patrols in the generating station area and along the access road during construction and maintaining fire suppression equipment in the generating station work area during construction and operation.

Table 5.4-20. Velvet-leaf blueberry in Project Areas and Sub-Region (percentages of Sub-Region area excepted as noted).

			Habitat Quality		
Location	High	Moderate	Poor	Very Poor	All
Project Areas- Direct Effects	1.8	0.8	0.3	0.2	0.5
Access Road Clearing	0.3	0.2	0.1	0.1	0.2
Borrow Pit Clearing & Excavation	1.5	0.3	0.1	0.0	0.2
Flooding (cleared first)		0.0	0.0	0.0	0.0
GS Clearing- Full Rehab		0.1	0.0	0.0	0.0
GS Clearing- Slight Rehab		0.0	0.0	0.0	0.0
GS Clearing- Permanent	0.0	0.2	0.1	0.0	0.1
GS Disturbed (not cleared)		0.0	0.0	0.0	0.0
Project Areas- Indirect Effects	0.7	0.4	0.2	0.2	0.3
Project Effects area (ha)	609	1,195	129	645	2,577
Sub-Region area (ha)	24,510	105,486	23,810	147,918	301,724

5.4.4.2 Semi-Aquatic Habitat

5.4.4.2.1 Wild Mint (Wikaskwah)

Potential construction and operational effects on wild mint are expected to be positive and significant (local, moderate and long-term {26-100 years}).

Wild mint is widespread in the boreal forest and along the Affected Aquatic Area shoreline. Low gradient clayey beach was classified as high quality wild mint habitat. High quality mint habitat occurred on 29% of the Affected Aquatic Area shoreline and was concentrated in the southern parts of the upstream Affected Aquatic Area. The proposed water regime is expected to reduce the amount of high quality mint habitat which should reduce its abundance. Reducing mint abundance is considered a positive effect because it helps to restore mint towards pre-CRD levels. Federal and provincial policies advocate the maintenance and restoration of native biodiversity. Certainty regarding the potential significance of effects is moderate.

5.4.4.2.2 Sweet Flag/ Rat Root (Wikhees)

Potential construction and operational effects on sweet flag are expected to be positive and significant (extend throughout the Affected Aquatic Area, moderate magnitude and continue for at least 26 years).

Sweet flag is widespread in the boreal forest and in the Sub-Region. NCN members indicated that sweet flag was abundant in the Sesep Lake area prior to CRD. Habitat was classified as high quality for sweet flag habitat if it was in the protected bays and was either low slope organic shoreline or peat with a very high water table. Only 2% and 4% of the Affected Aquatic Area shoreline was classified as high and moderate quality sweet flag habitat.

Stable water levels and the increase in peatland area should substantially increase the amount of moderate and high quality sweet flag habitat. Certainty in the predicted effects is moderate.

5.4.4.2.3 Bog Cranberry (Wesakemina)

Potential construction and operational effects on bog cranberry are expected to be neutral and insignificant (extend into the 1 km Buffers and throughout the Affected Aquatic Area, nil magnitude on a net basis and continue for 6-25 years).

Bog cranberry is widespread throughout the boreal forest and in the Sub-Region. High quality bog cranberry habitat consists of open bogs, sparsely treed bogs or open black spruce forest on peatlands on the mainland, mineral islands and boggy Peat Islands. High quality bog cranberry habitat is widespread and abundant in the Sub-Region (28% of mainland and 37% of Peat Island area).

Project construction will remove or physically disturb 202 ha (0.5%) of mainland high and moderate quality bog cranberry habitat and indirectly affect a further 0.3% of high quality mainland habitat (Table 5.4-21). Indirect Project effects may reduce the quality of up to 283 ha (0.3%) of Sub-Region high quality habitat and 43 ha (0.1%) of moderate quality habitat. Operation will increase the amount of high quality habitat to the extent that disturbed areas undergo natural regeneration and as bog vegetation becomes more abundant on lake peatlands including Peat Islands.

Table 5.4-21. Bog cranberry in Project Areas and Sub-Region (percentages of Sub-Region area excepted as noted).

	Habitat Quality				
Location	High	Moderate	Poor	Very Poor	All
Project Areas- Direct Effects	0.2	0.1	0.5	1.0	0.5
Access Road Clearing	0.2	0.1	0.1	0.2	0.2
Borrow Pit Clearing & Excavation	0.0	0.0	0.0	0.6	0.2
Flooding (cleared first)	0.0		0.0	0.0	0.0
GS Clearing- Full Rehab	0.0		0.0	0.0	0.0
GS Clearing- Slight Rehab			0.0	0.0	0.0
GS Clearing- Permanent	0.0		0.2	0.1	0.1
GS Disturbed (not cleared)	0.0		0.1	0.0	0.0
Project Areas- Indirect Effects	0.3	0.1	0.2	0.4	0.3
Project Effects area (ha)	462	65	449	1,602	2,577
Sub-Region area (ha)	92,576	32,700	64,245	112,202	301,724

5.4.4.3 Sensitive Species

Potential construction and operational effects on sensitive plants are not expected to be significant.

No plants listed as endangered, threatened or provincially very rare were found or known to occur in the Sub-Region. Noticeable effects on provincially rare plants are not expected either because field information suggests the species are more common than their CDC listing or because the species were not observed in the areas that may be affected by the Project. Based on available information, balsam fir and white spruce are the only species that are regionally rare. Certainty regarding potential effects is moderate due to the limited amount of historical plant inventory work in the Sub-Region.

Potential effects on sensitive plants will be mitigated by three measures. First, the risk of increased harvesting or disturbance of sensitive plants will be reduced by restricting access at Highway 391. Second, endangered and threatened plant surveys will be conducted along the access road prior to construction. Locations of such plants will be clearly marked. Clearing and disturbance will be minimized in marked areas to the extent feasible. Third, the grass mixture used to seed ditches will only contain native and/ or non-invasive introduced grasses (i.e., will not contain sweet clover {*Melilotus officianilis*} or other herbs).

Details on effects on sensitive plants are described below. Habitat information and Sub-Region distribution information were provided in Section 5.3.5.

5.4.4.3.1 Endangered, Threatened or Provincially Very Rare Species

No effects on endangered, threatened or provincially very rare plant species are expected since none are known to occur in the Sub-Region.

5.4.4.3.2 Provincially Rare Plants

Vaccinium caespitosum **- Dwarf bilberry – S2**

Populations in the cleared portions of the Mainland/ Upland Project Areas will be eliminated in clearing and construction activities. It is likely that the effects on this species will be insignificant. Some experts believe that dwarf blueberry is more widespread in Manitoba than the few records indicate (K. Johnson pers. comm.) and this opinion is confirmed by field observations in the Region. Suitable habitat is common.

***Torreyochloa pallida*/ Pale manna grass S2**

Project effects on pale manna grass are not expected as the one recorded location is on the shoreline of Birchtree Lake. The downstream water regime will be managed so that there is no noticeable effect on water fluctuations at Birchtree Lake (Volume 3).

***Nymphaea tetragona*/ Pygmy or small white water-lily – S2**

Project effects on pygmy water lily are not expected as the only recorded population is not near any area that will be affected by the proposed Project.

5.4.4.3.3 Provincially Uncommon Plants

***Thalictrum sparsiflorum* - Few-flowered meadow rue – S2S3**

Project effects on few-flowered meadow rue are not expected as the only recorded population is not in any area that will be affected by the proposed Project.

***Bidens beckii* - Water marigold - (S3?)**

It is uncertain what effects, if any, the proposed water regime may have on water marigolds. It's current CDC ranking (S3?) suggests that it may be more common than the CDC database records support. Water marigolds were not uncommon in the Affected Aquatic Area.

***Astragalus americanus* – American milk-vetch – (S3)**

Project effects on American milk vetch are expected to be insignificant as buffer zones around stream crossings will be maintained during construction.

5.4.4.3.4 Species Near Their Documented Provincial Range Limits

Other than balsam fir and white spruce, Project effects on species near their documented provincial range limits are not expected to be significant either because field information suggests the species are more common than their herbarium records suggest, because the species were not observed in the areas that may be affected by the Project and/ or because only a small area of potential habitat is affected.

5.4.4.4 Road Density

Project-related changes in road density are expected to have effects that are negative, landscape scale, small in magnitude, and continue for at least 26 years.

Although the Project would increase Sub-Region road density by 40% from 0.040 km/km^2 to 0.058 km/km^2, this is still expected to be below the level needed to affect sensitive plants and animal populations. Grizzly bears are considered one of the North American species most sensitive to roads. Road effects on grizzly bears are not expected to occur at road densities below 0.16 km/km^2 (AXYS 2001).

Two general mitigative measures will reduce some of the effects of increased road density. The risk of Project-related fire starts will be reduced by restricting access at Highway 391 during construction and operation, roving fire patrols in the generating station area and along the access road during construction and maintaining fire suppression equipment in the generating station work area during construction and operation. Increased disturbance and resource harvesting will be mitigated by restricting access at Highway 391.

5.5 RESIDUAL EFFECTS

Residual effects on terrestrial habitat, habitat and plant VECs and selected effects indicators are summarized in Table 7.10-1. Effects on habitat are described followed by variations or emphases that are relevant for each VEC.

Residual effects on the six VECs are expected to be significant only for wild mint and sweet flag where they are positive. The frequency and/or severity of Project induced forest fires will need to be mitigated (see tables below) to maintain an insignificant negative residual effect on dry jack pine forest.

Table 5.5-1. Residual Project effects on terrestrial habitat, VECs and selected ecosystem components during construction and operation.

INDICATOR	PROJECT IMPACTS (source of effects)	DESCRIPTION OF EFFECTS	MITIGATION MEASURES	RESIDUAL EFFECTS
Mainland/ Upland Habitat & VECs				
Habitat	**CONSTRUCTION**			
	Clearing and construction of access roads, borrow areas, generating station area; accidental disturbance by people or equipment; accidental spills; changes to soil moisture and fertility due to ditching & drainage; soil warming and permafrost melting in peatlands due to adjacent clearing; tree blowdown adjacent to cleared areas; edge effects on plants adjacent to cleared areas; deposition of airborne road dust and emissions from vehicles and construction equipment; effluent discharge and waste disposal from the construction camp and activities.	Small[1] loss of vegetation cover; small conversion of habitat types.	Measures identified in the Project Description, and measures that will be identified in the EnvPP and the Access Management Plan such as access restrictions, minimizing clearing, spreading stock-piled organic material to encourage vegetation re-growth.	Negative, small, 1 km Buffer scale, longer than 25 years
	Introduction of invasive species on incoming people, vehicles and equipment.	Small conversion of habitat types.	Measures identified in the Project Description, and measures that will be identified in the EnvPP and the Access Management Plan such as access restrictions, minimizing clearing, spreading stock-piled organic material to encourage vegetation re-growth. The grass mixture used to seed ditches will only contain native and/ or non-invasive introduced grasses (i.e., will not contain sweet clover {*Melilotus offincianilis*} or other herbs)	Negative, small to large, Sub-Region scale, longer than 25 years
	Change in forest fire frequency and/or severity due to better access to, and more people in, the area;	Small to moderate conversion of habitat types depending on change in fire frequency and/ or severity.	Measures identified in the Project Description and measures that will be identified in the EnvPP and Access Road Management Plan such as access restriction at Highway 391 and maintaining fire suppression equipment at GS site.	Negative, small to large, Sub-Region scale, longer than 25 years
	OPERATION			
	Access road and permanent generating station structures; access-related disturbance; Wuskwatim Lake water levels stabilized within narrow range below historic highs; Opegano water levels slightly higher and more variable below median flows; small flooded area; incremental upstream erosion, downstream peatland breakdown and accidental events.	Small loss of vegetation cover; small conversion of habitat types.	Measures identified in the Project Description, and measures that will be identified in the EnvPP and the Access Management Plan such as access restriction at Highway 391, spreading stock-piled organic material to encourage vegetation re-growth.	Negative, small, 1 km Buffer scale, longer than 25 years

INDICATOR	PROJECT IMPACTS (source of effects)	DESCRIPTION OF EFFECTS	MITIGATION MEASURES	RESIDUAL EFFECTS
	Introduction of invasive species on incoming people, vehicles and equipment.	Small conversion of habitat types.	Measures identified in the Project Description and that will be identified in the EnvPP such as access road management, minimizing clearing, spreading stock-piled organic material to encourage vegetation re-growth. The grass mixture used to seed ditches will only contain native and/ or non-invasive introduced grasses.	Negative, small, 1 km Buffer scale, longer than 25 years
	Change in forest fire frequency and/or severity due to better access to, and more people in, the area;	Small to moderate conversion of habitat types depending on change in fire frequency and/ or severity.	Measures identified in the Project Description and that will be identified in the EnvPP such as access road management and maintaining fire suppression equipment nearby.	Negative, small, Sub-Region scale, longer than 25 years if no changes in fire frequency or severity.
Balsam Fir & White Spruce	**CONSTRUCTION**			
	These species are especially sensitive to clearing losses and changes in fire frequency.	Large loss of known populations and of high quality habitat.	Clearly mark existing concentrations of balsam fir and white spruce along the access road as sensitive sites prior to construction. To extent feasible, avoid clearing or disturbing these sites. Undertake protection and regeneration measures to ensure that there is no long-term net loss of 120 ha[2] of affected balsam fir/ white spruce forest by: (1) protecting concentrations of balsam fir and white spruce in the generating station site "disturbance" area to the extent feasible; and (2) seeding, planting and/or transplanting balsam fir and white spruce to the extent required in appropriate locations in the Aquatic Buffer area.	Negative and insignificant (small, 1 km Buffer scale, longer than 25 years) if no change in fire frequency and/ or severity.
	OPERATION			
	These species are especially sensitive to erosion losses and changes in fire frequency.	Small loss of known populations and high quality habitat; habitat loss is temporary.	Regenerate so that there is no net loss of balsam fir and white spruce forest (see above).	Negative and insignificant (small, 1 km Buffer scale, less than 5 years) if no change in fire frequency and/ or severity.

INDICATOR	PROJECT IMPACTS (source of effects)	DESCRIPTION OF EFFECTS	MITIGATION MEASURES	RESIDUAL EFFECTS
Dry Jack Pine Forest	**CONSTRUCTION**			
	This habitat type is especially sensitive to changes in forest fire frequency and/or severity.	Moderate to large loss of dry jack pine forest depending on change in fire frequency and/ or severity.	Restrictions on use of access road; Maintain fire suppression equipment at GS site; Undertake regeneration measures to ensure that the maximum long-term net loss of dry jack pine forest is less than 70 ha by seeding and/or planting.	Negative and insignificant (small, Sub-Region scale, longer than 25 years) if no change in fire frequency and/ or severity.
	OPERATION			
	This habitat type is especially sensitive to changes in forest fire frequency and/or severity.	Moderate to large loss of dry jack pine forest depending on change in fire frequency and/ or severity.	Restrictions on use of access road.	Negative and insignificant (small, Sub-Region scale, longer than 25 years) if no change in fire frequency and/ or severity.
Dry Ground Cranberry	**CONSTRUCTION**			
	Same as for all mainland habitat.	Same as for all mainland habitat.	Same as for all mainland habitat.	Negative and insignificant (small, 1 km Buffer & Affected Aquatic Area scale, 6 - 25 years)
	OPERATION			
	Same as for all mainland habitat.	Same as for all mainland habitat.	Same as for all mainland habitat.	Negative and insignificant (small, 1 km Buffer scale, 6 - 25 years)
Velvet-Leaf Blueberry	**CONSTRUCTION**			
	This species is somewhat sensitive to increased fire frequency on dry sites	Same as for all mainland habitat.	Same as for all mainland habitat.	Negative and insignificant (small, 1 km Buffer scale, 6 - 25 years)
	OPERATION			
	This species is somewhat sensitive to increased fire frequency on dry sites	Same as for all mainland habitat.	Same as for all mainland habitat.	Negative and insignificant (small, 1 km Buffer scale, 6 - 25 years)

INDICATOR	PROJECT IMPACTS (source of effects)	DESCRIPTION OF EFFECTS	MITIGATION MEASURES	RESIDUAL EFFECTS
Bog Cranberry	**CONSTRUCTION**			
	Same as for mainland habitat.	Same as for all mainland habitat.	Same as for all mainland habitat.	Negative and insignificant (small, 1 km Buffer scale, 6 - 25 years)
	OPERATION			
	Net increase in area of lake peatlands due to water regime changes.	Increase in amount of high quality habitat.	Same as for all mainland habitat.	Positive and insignificant (small, 1 km Buffer scale, longer than 25 years)
Road Density	**CONSTRUCTION**			
	Clearing, construction and use of access roads.	Same as for all mainland habitat.	Same as for all mainland habitat.	Negative, small, 1 km Buffer scale, longer than 25 years
	OPERATION			
	Maintenance and use of access roads.	Habitat fragmentation, habitat conversion from increased disturbance, increased harvesting.	Same as for all mainland habitat.	Negative, small, 1 km Buffer scale, longer than 25 years

INDICATOR	PROJECT IMPACTS (source of effects)	DESCRIPTION OF EFFECTS	MITIGATION MEASURES	RESIDUAL EFFECTS
Semi-Aquatic Habitat (shore zone, peat islands and mineral islands) & VECs				
Habitat	**CONSTRUCTION**			
	Clearing and construction of generating station area structures; accidental events such as spills or fire; accidental disturbance by people or equipment; effluent discharge	Very small loss or conversion of habitat	Measures that will be identified in the EnvPP, such as materials handling and storage.	None
	Introduction of invasive species on incoming people, vehicles and equipment.	Very small loss or conversion of habitat	None	Negative, small, site scale, 6 - 25 years
	OPERATION			
	Wuskwatim water levels stabilized within narrow range below historical highs; Opegano water levels slightly higher and more variable below median flows; small flooded area; incremental upstream erosion, downstream peatland breakdown and accidental events.	Upstream: long-term increase in area of lake and shore peatlands; long-term habitat conversion. Downstream: small decrease in mainland peatlands; small increase in shore zone area.	Measures that will be identified in the EnvPP, such as materials handling and storage.	Positive, 1 km Buffer & Affected Aquatic Area scale, moderate and at least 26 years
	Introduction of invasive species on incoming people, vehicles and equipment.	Very small loss or conversion of habitat	None	Negative, small, site scale, 6 - 25 years
Wild Mint	**CONSTRUCTION**			
	Same as for semi-aquatic habitat	None	Same as for semi-aquatic habitat	None
	OPERATION			
	Same as for semi-aquatic habitat	Reduction in amount of high quality habitat.	Same as for semi-aquatic habitat	Positive and significant (1 km Buffer scale & Affected Aquatic Area, moderate and at least 26 years)
Sweet Flag	**CONSTRUCTION**			
	Same as for semi-aquatic habitat	None	Same as for semi-aquatic habitat	None
	OPERATION			
	Same as for semi-aquatic habitat	Increase in amount of high quality habitat.	Same as for semi-aquatic habitat	Positive and significant (1 km Buffer & Affected Aquatic Area scale, moderate and at least 26 years)

INDICATOR	PROJECT IMPACTS (source of effects)	DESCRIPTION OF EFFECTS	MITIGATION MEASURES	RESIDUAL EFFECTS
Sensitive Plants				
	CONSTRUCTION			
	Same as for all mainland and semi-aquatic habitat.	No endangered, threatened or very rare plants known to occur in Sub-Region.	Measures identified in the Project Description and measures that will be identified in the EnvPP such as access road management, minimizing clearing, spreading stock-piled organic material to encourage vegetation re-growth. The grass mixture used to seed ditches will only contain native and/ or non-invasive introduced grasses.	None measurable
	OPERATION			
	Same as for all mainland and semi-aquatic habitat.	No endangered, threatened or very rare plants known to occur in Sub-Region. Dwarf blueberry (*Vaccinium caespitosum*), small white water-lily (*Nymphaea tetragona*) and *Torreyochloa pallida* (pale manna grass) were the only rare plants found in the Sub-Region. Dwarf blueberry is probably more common than its current ranking indicates. The other species were distant from all of the areas directly affected by the Project.	Measures that will be identified in the EnvPP, such as materials handling and storage.	None measurable

[1] For area based measures: Small = < 1% of area; Moderate = 1 - 10% of area; Large = > 10% of area except for rare types where the threshold is 5% rather than 10%. [2] Note that this overcompensates for the area of expected effects by 40 ha.

5.6 CUMULATIVE EFFECTS

5.6.1 Cumulative Effects on Habitat

The cumulative effects assessment for terrestrial habitat and plant VECs considered those "projects", or portions thereof, that were in the Sub-Region. Effects outside of the Sub-Region were not expected to compound Project effects given the distance from the Sub-Region boundary to the affected habitat (Figure 5.4-1). Potential "projects" or activities included in the cumulative effects assessment for habitat and plant VECs were:

- Wuskwatim Transmission Project;
- ongoing CRD losses with respect to balsam fir and white spruce;
- increased number of cabins;
- TLE from NCN;
- designation of Partridge Crop Hill Area of Special Interest as a protected area;
- forestry activities; and
- climate change.

Other potential projects or activities were not considered either because they were too uncertain (e.g., new mines, ongoing habitat conversion due to accumulation of airborne deposition from the INCO smelter) or were not expected to have a noticeable independent effect on VECs (e.g., trails).

The overall approach taken in the cumulative effects assessment was to estimate the maximum potential effect on terrestrial habitat and VECs if all of the proposed projects were to proceed. This involved many assumptions about what the "project" impacts could be, the likelihood that the "project" would proceed and the scientific understanding about how terrestrial habitat and plants might respond to assumed impacts. The reliability of information regarding the spatial extent and geographic location of the assessed projects varied greatly from very high if the Wuskwatim Generation Project proceeds (i.e., Wuskwatim Transmission Project) to very low.

The assessment of cumulative effects on terrestrial habitat and VECs was limited to the fifty year period extending from 2009 to 2059 due to the high uncertainty about how climate change could affect habitat (see below). Two scenarios were considered: one with and the other without the designation of the Partridge Crop Hill Area of Special Interest (ASI) as a protected area.

The direct long-term effects of the proposed Wuskwatim Transmission Project consist of a band of modified vegetation in the RoW, construction access roads and construction borrow pits. The Sub-Region portion of the transmission line RoW is approximately 445 ha (Figure 5.6-1). Direct and indirect habitat effects are assessed in the EIS for the Wuskwatim Transmission Project. The transmission line RoW is the only impact from that project considered in the cumulative effects assessment.

Because balsam fir and white spruce are rare overstorey species in the region, ongoing CRD erosion losses were included in the assessment of cumulative effects on balsam fir and white spruce to ensure that those losses were taken into account. CRD continues to affect these species and high quality habitat in the area. The total area of high quality habitat loss is relatively small for other VECs. CRD erosion will eventually cease once the shoreline reaches non-erodible materials or when banks stabilize.

Future cabin development is expected to occur along the Sub-Region portion of the Burntwood River (Volume 7). Currently it is estimated that approximately ten cabins might be built along the waterways, however, this number is highly uncertain. For the cumulative effects assessment it was assumed that as many as twenty cabins could be built, that the primary effect of a cabin is the equivalent of about 1 ha of clearing (includes an allowance for firewood cutting), on average, and that no new roads would be built to access cabins.

With regard to TLE, plans may be developed for an increase in human usage of Wuskwatim Lake (Volume 1 Section 6.12-2). The development of associated infrastructure (e.g., cabins) would likely occur. Effects from this source would be similar to future cabin development. The effect of TLE on habitat is not expected to be noticeable unless it involves clearing or disturbing existing balsam fir and white spruce forest or a substantial proportion of their high quality habitat.

Designation of the Partridge Crop Hill ASI as a protected area (Figure 5.6-1) could have a large positive effect on Sub-Region habitat and VECs. Approximately 30,000 ha of the Partridge Crop Hill ASI overlaps the Sub-Region. Current indications are that this ASI will likely be designated a protected area (Section 8.5.4- Commercial Forestry). The effects would be positive to the extent that the scope of other projects would be reduced rather than become more concentrated in the remainder of the Sub-Region.

Forestry effects were assessed based on the expected maximum possible effect. This consisted of two components: the maximum area that could be harvested in fifty years and the potential habitat effects on harvested areas in terms of habitat loss or conversion. The maximum area that could be harvested over 50 years is equal to the area of forest in Forest Resource Inventory cutting classes 3 to 5. Habitat loss or conversion occurs when areas in roads and cut-blocks do not regenerate back to a habitat type that is typical for the site type. Tolko Industries Ltd. holds the license to harvest softwood timber in the Sub-Region under FMLA #2. Hardwood rights are currently unallocated. Based on current plans, it is anticipated that virtually all harvesting will target coniferous species.

Coniferous forest with trees that will be large enough to cut over the 50 year CEA period covers about 78,000 ha of the Sub-Region (some of this area would not actually be cut because it occurs as small, localized concentrations that are distant from any likely road development). There has been no research in the Sub-Region to assess how well vegetation and soils recover after timber harvesting (F. Donald pers. comm.). Research from the eastern Manitoba boreal forest found that post-logging vegetation recovery was substantially different from post-fire recovery on comparable sites up to 37 years after disturbance (Ehnes 1998). Over the long term, there was conversion to other forest types that were more open, had lower jack pine and black spruce abundance, higher aspen, balsam fir and tamarack abundance and higher abundance of understorey species that are characteristic of higher light and lower nutrient availability. Conversion from forest to non-forest was unusual and typically occurred where roads passed through peatlands. It is not known to what extent the eastern Manitoba results represent post-logging recovery in the Sub-Region. For the cumulative effects assessment, it was assumed that the maximum effects on potential area available for harvest would be a 2% conversion to a non-forest habitat type (much of this area would be in roads through peatlands) and a 10% conversion to a substantially different forest type (usually from conifer to hardwood or hardwood dominated mixedwood).

The maximum anticipated effect of forestry activities is less than 10,000 ha or 3% of the Sub-Region. Removal of the Partridge Crop Hill ASI from the area available for harvest would only reduce the maximum potential effect of forestry activities slightly since about half of the ASI contains habitat types that are not suitable for commercial forestry.

Climate change may have the largest effect on habitat and VECs over the long term. Climate change is occurring but we cannot predict how much climate related ecological factors (e.g. temperature, precipitation, the frequency of extreme events, fire frequency) will change in the Sub-Region. Although it is not known if precipitation will increase or decrease, there appears to be a current consensus that air temperature and fire frequency will increase. Higher air temperatures will raise soil temperatures and reduce the percentage of the Sub-Region that contains permafrost. Increased fire frequency will shift habitat toward types that contain species more tolerant of frequent fires and to younger age classes. The ultimate anticipated effect of climate change is a shrinking of the boreal forest in Manitoba.

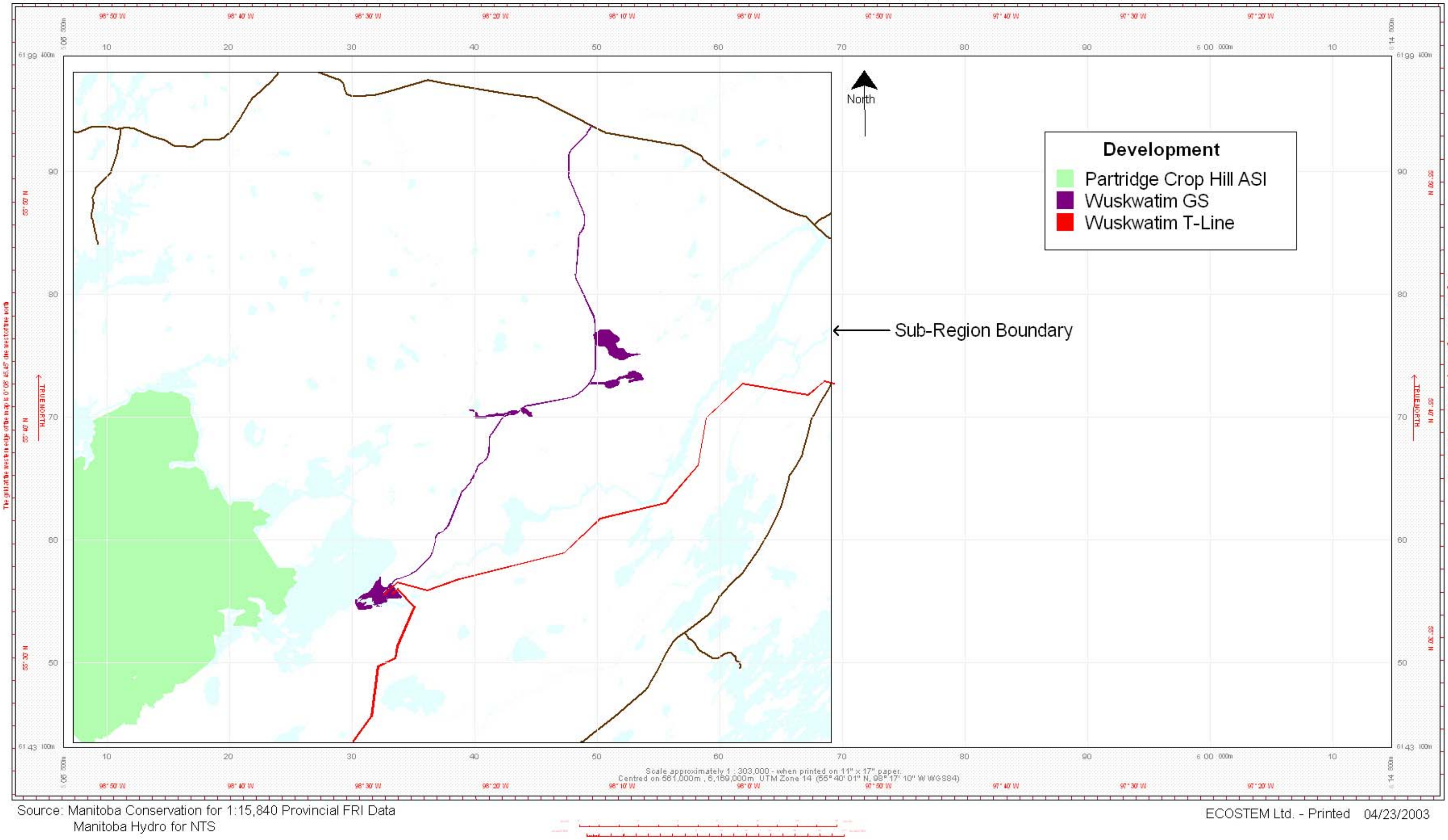


Figure 5.6-1. Potential "projects" in the Sub-Region.

5.6.2 Cumulative Effects on VECs

The anticipated independent effects of each of the potential "projects" and the maximum anticipated cumulative effects of all projects on terrestrial habitat and plant VECs was considered under two different scenarios based on whether or not the Partridge Crop Hill ASI becomes a protected area (Figure 5.6-1). When assessing the maximum anticipated cumulative effects, the potential effects of each of the considered "projects" were weighted based on their degree of spatial overlap and the certainty of the assessment. For example, a positive effect occurs if the Partridge Crop Hill ASI is protected, however, this does not completely offset the effects of other "projects" because the affected VEC populations are widely separated. The degree of certainty in the assessment of potential effects varied greatly. Certainty was influenced by how much is currently known about "project" impacts, the likelihood that the "project" will proceed and the scientific understanding about how terrestrial habitat and plants might respond to the project's impacts. Another critical factor in the CEA is whether or not each of the future "projects" undertakes mitigation to remove significant negative residual effects. Table 5.6-1 summarizes the maximum anticipated independent effects of each of the potential "projects" and the maximum anticipated cumulative effects of all projects on terrestrial habitat and plant VECs if there is no mitigation by proposed "projects".

Habitat provides the context for the VECs. Cumulative effects on habitat may increase from small to moderate or large in magnitude largely due to the potential direct and indirect effects of climate change (e.g., fire frequency increases). Certainty regarding this particular effect is low due to the highly uncertain effects of climate change.

Effects on balsam fir may increase from small to moderate or large due to cabin development, TLE and future CRD erosion (Table 5.6-1). Effects on dry jack pine forest may increase from small to large depending on the extent to which other "projects" increase fire frequency and/ or severity. As described below, these effects can be reduced to insignificant levels with mitigation. Designating the Partridge Crop Hill ASI as a protected area could partially offset the increase in effects on dry jack pine forest and could reduce the magnitude of Project effects on dry ground cranberry and velvet-leaf blueberry from small to nil.

Table 5.6-1. Maximum anticipated independent effects of potential "projects" in the Sub-Region and maximum anticipated cumulative effects if all "projects" proceed with or without a protected area.

Note: Assumes no mitigation by potential projects. All negative independent effects except those from climate change can be reduced to insignificant with mitigation. See Table 5.6-2 for a summary of cumulative effects after mitigation. See end of table for explanation of abbreviations.

	Development/ Activity	Description Of Potential Effect No Mitigation	Assessment Of Potential Effect No Mitigation	Certainty	Summary Of Effect Without Mitigation		
					Independent	Cumulative- No Protected Areas	Cumulative- Partridge Crop Protected
Habitat							
	Wuskwatim Generation Project *	Small loss of vegetation cover; Small conversion of habitat types.	Negative, small, landscape scale, longer than 25 years.	H	-		
	Wuskwatim Transmission Line	Direct conversion of 0.1% of Sub-Region habitat.	Negative, landscape scale, small and longer than 25 years	H	-		
	New cabins and TLE	Very small loss and conversion of habitat.	None measurable.	H	~0		
	Partridge Crop Hill ASI	Protection of 10% Sub-Region from intensive development/ activities.	Positive, Sub-Region scale, small and longer than 25 years	I	+		
	Timber harvesting	Small to moderate conversion of forest habitat to non-forest and other forest types.	Negative, Sub-Region scale, small to moderate and longer than 25 years	I	- / - -		
	Climate change temperature increase.	Small to moderate shift in species composition.	Negative, Sub-Region scale, small to large and longer than 25 years	L	- / - -		
	Climate change fire frequency increase.	Moderate to large conversion of forest habitat to non-forest and other forest types and younger age classes..	Negative, Sub-Region scale, moderate to large and longer than 25 years	L	- - / - - -		
	Cumulative effects no mitigation**					- - / - - -	- - / - - -

Development/ Activity	Description Of Potential Effect No Mitigation	Assessment Of Potential Effect No Mitigation	Certainty	Summary Of Effect Without Mitigation		
Balsam Fir						
Wuskwatim Generating Station *	Large loss of known populations and of high quality habitat.	Negative, small, landscape scale, longer than 25 years.	H	-		
Wuskwatim Transmission Line	No direct loss of balsam fir forest; 2 ha loss of white spruce forest.	Negative, site scale, small and longer than 25 years	H	-		
New cabins and TLE	Small to large loss of known populations depending on where cabins are located. Small loss of high quality habitat.	Negative, site scale, small to large and longer than 25 years.	H	- / - - -		
Partridge Crop Hill ASI	None	None	H	~0		
Timber harvesting	Balsam fir not a target species.	Very small to none	H	~0		
Climate change.	Small to large increase in species distribution and abundance due to temperature increase more than offset by reductions due to increase in fire frequency and/ or severity..	Negative, Sub-Region scale, small to large and longer than 25 years.	L	?		
Future CRD erosion	Moderate to large loss of known populations of balsam fir and white spruce (up to 99 ha or 11% of forest with at least 40% of species in canopy).	Negative, moderate to large, landscape scale, longer than 25 years.	H	- - / - - -		
Cumulative effects no mitigation**					- - / - - -	- - / - - -
Dry Jack Pine Forest						
Wuskwatim Generating Station *	Moderate loss of dry jack pine forest. Moderate to large loss if fire frequency and/ or severity increases.	Negative, small if no change in fire regime, Sub-Region scale, longer than 25 years.	L	-		
Wuskwatim Transmission Line	Direct loss of 3 ha of dry jack pine forest.	Negative, site scale, very small and longer than 25 years	H	~0		
New cabins and TLE	Very small to small loss of dry jack pine forest.	None to very small.	L	~0		
Partridge Crop Hill ASI	Protection of about 800 ha of dry jack pine forest and 3,000 ha of jack pine forest on mineral soil.	Positive, Sub-Region scale, large and longer than 25 years.	I	+ + +		
Timber harvesting	No long term loss. Conversion of up to 1,000 ha. New roads and trails increase fire risk.	Negative, landscape scale, small to moderate and longer than 25 years.	I	-		
Climate change.	Small increase to large decrease in distribution and abundance depending on changes to fire regime.	Positive and small to negative and large, Sub-Region scale and longer than 25 years.	L	+ / - - -		
Cumulative effects no mitigation**					~0 / - - -	+ / - -

	Development/ Activity	Description Of Potential Effect No Mitigation	Assessment Of Potential Effect No Mitigation	Certainty	Summary Of Effect Without Mitigation		
Dry Ground Cranberry							
	Wuskwatim Generating Station *	Permanent clearing and increased fire frequency remove small amount of high quality habitat but increase in lake peatlands increases high quality habitat.	Negative to neutral and insignificant: small, landscape scale, longer than 25 years.	H	-		
	Wuskwatim Transmission Line	Clearing of treed peatlands and conversion of forest to open habitat types increases high quality habitat.	Positive, landscape scale, small and longer than 25 years	H	+		
	New cabins and TLE	Very small to small loss of high quality habitat.	None to very small.	H	~0		
	Partridge Crop Hill ASI	Protection of over 10,000 ha of high quality habitat.	Positive, Sub-Region scale, moderate and longer than 25 years.	I	+ + +		
	Timber harvesting	Small increase in distribution and abundance due to some conversion to more open peatland habitat.	Positive, landscape scale, small and longer than 25 years.	H	+		
	Climate change.	Small to large decrease or increase in distribution and abundance depending on changes to fire regime.	Negative or positive, Sub-Region scale, small to large and longer than 25 years.	L	?		
	Cumulative effects no mitigation**					-	0
Velvet-Leaf Blueberry							
	Wuskwatim Generating Station *	Permanent clearing and increased fire frequency remove high quality habitat but habitat conversion increases high quality habitat.	Negative and insignificant: small, landscape scale, 6 - 25 years.	H	-		
	Wuskwatim Transmission Line	Conversion of forest to open habitat types increases high quality habitat.	Positive, landscape scale, small and longer than 25 years	H	+		
	New cabins and TLE	Very small to small loss of high quality habitat.	None to very small.	H	~0		
	Partridge Crop Hill ASI	Protection of over 1,200 ha of high quality habitat.	Positive, Sub-Region scale, small and longer than 25 years.	I	+ + +		
	Timber harvesting	Small increase in distribution and abundance due to conversion to more open upland habitat.	Positive, landscape scale, small and longer than 25 years.	I	+		
	Climate change.	Small to large decrease or increase in distribution and abundance depending on changes to fire regime.	Negative or positive, Sub-Region scale, small to large and longer than 25 years.	L	?		
	Cumulative effects no mitigation**					-	0

	Development/ Activity	Description Of Potential Effect No Mitigation	Assessment Of Potential Effect No Mitigation	Certainty	Summary Of Effect Without Mitigation		
Bog Cranberry							
	Wuskwatim Generating Station *	Permanent clearing remove high quality habitat but habitat conversion and new lake peatlands increase high quality habitat.	Neutral, small, landscape scale, longer than 25 years.	H	-		
	Wuskwatim Transmission Line	Conversion of peatland forest to open habitat types increases high quality habitat.	Positive, landscape scale, small and longer than 25 years	H	+		
	New cabins and TLE	Very small to small loss of high quality habitat.	None to very small.	H	~0		
	Partridge Crop Hill ASI	Protection of over 10,000 ha of high quality habitat.	Positive, Sub-Region scale, moderate and longer than 25 years.	I	+ + +		
	Timber harvesting	Small increase in distribution and abundance due to habitat conversion.	Positive, landscape scale, small and longer than 25 years.	I	+		
	Climate change.	Small to large decrease or increase in distribution and abundance depending on changes to fire regime.	Negative or positive, Sub-Region scale, small to large and longer than 25 years.	L	?		
	Cumulative effects no mitigation**					-	-
Wild Mint							
	Wuskwatim Generating Station *	Reduction in amount of high quality habitat.	Positive and significant (landscape scale, moderate and at least 26 years)	H	-		
	Wuskwatim Transmission Line	None	None	H	~0		
	New cabins and TLE	None to very small.	None to very small.	H	~0		
	Partridge Crop Hill ASI	None	None	I	~0		
	Timber harvesting	None	None	H	~0		
	Climate change.	Unknown	Unknown	L	?		
	Cumulative effects no mitigation**					-	-

	Development/ Activity	Description Of Potential Effect No Mitigation	Assessment Of Potential Effect No Mitigation	Certainty	Summary Of Effect Without Mitigation		
Sweet Flag							
	Wuskwatim Generating Station *	Increase in amount of high quality habitat.	Positive and significant (landscape scale, moderate and at least 26 years)	H	+		
	Wuskwatim Transmission Line	None	None	H	~0		
	New cabins and TLE	None to very small.	None to very small.	H	~0		
	Partridge Crop Hill ASI	None	None	I	~0		
	Timber harvesting	None	None	H	~0		
	Climate change.	Unknown	Unknown	L	?		
	Cumulative effects no mitigation**					+	+

* Residual Project effects only. ** All negative cumulative effects can be reduced to insignificant with mitigation.

Magnitude for area based measures: Small = < 1% of area; Intermediate = 1 - 10% of area; Large = > 10% of area for all measures except for rare habitats and plants where large threshold is 5%. Certainty of assessment of potential effects: L=low; I=intermediate; H=high. Summary of effect: - = negative, small and insignificant; -- = negative, moderate and significant; --- = negative, large and significant; same conventions hold for positive effects.

The potential benefits of mitigation were also considered. Table 5.6-2 summarizes the maximum anticipated cumulative effects on terrestrial habitat and plant VECs if all of the potential projects proceed with and without mitigation. Two different scenarios are shown based on whether or not the Partridge Crop Hill ASI becomes a protected area. When assessing the maximum anticipated cumulative effects, the potential effects of each of the considered projects were weighted based on their degree of spatial overlap and the certainty of the assessment. For example, a positive effect occurs if the Partridge Crop Hill ASI is protected, however, this does not completely offset the effects of other projects because the affected VEC populations are widely separated.

Assessment of cumulative effects on VECs suggests that other projects may increase effects on balsam fir and dry jack pine forest and that effects will remain insignificant only if the other projects undertake appropriate mitigation.

In the case of balsam fir, a small and insignificant effect can only be achieved if mitigation is undertaken by all projects. Otherwise, a moderate to large effect is expected for balsam fir, primarily due to the ongoing effects of CRD. Cumulative effects on dry jack pine forest may not be reduced if other "projects" undertake mitigation because the potential increase in effects magnitude is primarily due to the potentially large effects of climate change. Certainty regarding this particular effect is low due to the highly uncertain effects of climate change.

Table 5.6-2. Maximum anticipated cumulative effects if all of the potential projects in the Sub-Region proceed with or without mitigation by potential projects and with or without designation of the Partridge Crop Hill ASI as a protected area*.

VEC	Mitigation By Projects Other Than Wuskwatim GS?[1]			
	No		Yes	
	No Protected Areas	ASI Protected[2]	No Protected Areas	ASI Protected[2]
Balsam Fir	- - / - - -	- - / - - -	-	-
Dry Jack Pine Forest	~0 / - - -	+ / - -	~0 / - - -	+ / - -
Dry Ground Cranberry	-	0	n/a	n/a
Velvet-Leaf Blueberry	-	0	n/a	n/a
Bog Cranberry	-	-	n/a	n/a
Wild Mint	-	-	n/a	n/a
Sweet Flag	+	+	n/a	n/a

* Summary of effect: - = negative, small and insignificant; -- = negative, moderate and significant; --- = negative, large and significant; same conventions hold for positive effects.
[1] The Wuskwatim Generation Project does not have a significant, negative residual effect on any VEC.
[2] Partridge Crop Hill ASI. n/a = mitigation not applicable since cumulative effect is not significant.

5.7 FOLLOW-UP AND MONITORING

Residual Project effects are expected to be either: (1) positive (i.e., semi-aquatic habitat and related VECs); or (2) negative but insignificant if there is no substantial increase in fire frequency and/ or severity. Expected effects were based on major assumptions regarding mitigation measures, changes in fire regime, water regimes, and climate change. Therefore, monitoring will focus on:

- mitigation measures intended to eliminate or reduce effects on VECs from significant to insignificant; and
- the major assumptions (e.g., fire regime parameters).

5.7.1 Balsam Fir/ White Spruce and Jack Pine Regeneration

Balsam fir/ white spruce and jack pine regeneration areas will be monitored to ensure that regeneration targets are met. A terrestrial ecologist will inspect the regeneration areas immediately after planting, at three years and again at seven years. A report will be submitted after each inspection that includes:

- maps of areas of the areas where regeneration is successful and unsuccessful; and
- recommendations as to amounts and locations of any further balsam fir/ white spruce or jack pine regeneration efforts required to achieve the regeneration targets.

5.7.2 Major Assumptions

The major assumptions used to develop the habitat and VEC effects predictions were:

- the upstream and downstream water regimes that affect semi-aquatic habitat composition will be as described in Volume 6 Section 5.3.3;
- fire frequency and/ or severity will not change; and
- climate change will have a minor effect on habitat composition over the next fifty years.

Habitat and/or VEC monitoring would only be required if it becomes apparent that there are substantial deviations from the water regime and fire regime assumptions. Therefore, the monitoring program for the first two major assumptions will consist of actual and contingent components.

The water regime will be monitored and a report will be provided every five years (starting in year three of operation) for the first 25 years of operation. A fire regime report will be provided annually during construction and annually for the first 10 years of operation and every five years following that period for 15 years. Each report will include an analysis of relevant data, a comparison with assumptions included in this EIS, an assessment of how any changes alter the effects of the assessment, and a recommendation on whether or not contingent monitoring is required. The upstream and downstream water regime review will be based on an analysis of water elevation data provided by Manitoba Hydro. The fire frequency and/or severity review will be based on an analysis of: (1) fire history reports obtained from Manitoba Conservation and Manitoba Hydro personnel; and (2) a field inspection of any large fires that occur in or near the 1 km Aquatic Buffer or the 1 km Upland Buffer.

If one of the annual review reports determines that further monitoring is required, then a separate contingent monitoring report will be submitted. Recommendations for contingent monitoring will be based on an assessment of the nature of the deviation and its potential effects on terrestrial habitat and VECs.

No assessment of the ultimate accuracy of the climate change assumption will be made because the effects of climate change are global and beyond the control of the Project. If climate change effects are as pronounced as predicted by some modeling scenarios, then major habitat change would overwhelm any potential Project effect, could not be mitigated and would occur even if the Project did not proceed. Manitoba Hydro is closely monitoring this and actively participating in research.

5.8 CITATIONS

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5.9 GLOSSARY

List of Acronyms

ANOVA – Analysis of variance

ASI - Area of Special Interest

ASL - Above Sea Level

CCFM - Canadian Council of Forest Ministers

CDC - Manitoba Conservation Data Centre

COSEWIC - Committee on the Status of Endangered Wildlife in Canada

CRD - Churchill River Diversion

EIS - Environmental Impact Statement

EnvPP - Environmental Protection Plan

FEARO - Federal Environmental Assessment Review Office

FML - Forest Management License

FMU - Forest Management Unit

GHG - greenhouse gas

GIS - Geographic Information System

ha - hectares

km - kilometres

m - metres

MESA - *Manitoba Endangered Species Act*

RMA - Resource Management Area

RoW - Right-of-Way

RTL - Registered Trapline

TLE - Treaty Land Entitlement

TWINSPAN – Two way indicator species analysis

VEC - Valued Ecosystem Component

ZOI – zone of influence of Project impacts, that is, area of direct and indirect Project effects on the organisms or process of interest

Definition of Terms

1 km Aquatic Buffer - a 1 km band around the Affected Aquatic Area that encompasses all anticipated mainland habitats to be directly disturbed by the generating station structures and Project related erosion.

1 km Upland Buffer - a 1 km band around the access road and borrow pits that encompasses all anticipated mainland habitats to be directly disturbed by these Project features.

Above Sea Level (ASL) - elevations are referenced to Geodetic Survey of Canada, Canadian Geodetic Vertical Datum 1928, 1971 Local Adjustment.

Affected Aquatic Area - encompasses all the aquatic, Shore Zone, Peat Island and Mineral Island habitat in the affected waterway from Early Morning Rapids to the Opegano Lake outlet.

borrow areas - or borrow 'sites' or 'pits'; areas were materials (e.g., gravel, sand, silt, clay) are excavated for use.

borrow pit - the hole left by the removal of material (usually sand or gravel) for construction purposes.

Churchill River Diversion (CRD) - involved constructing a control structure at the outlet of Southern Indian Lake to divert a large portion of the Churchill River down the Rat/Burntwood rivers into the lower Nelson River at Split Lake to enhance power production at the Kettle, Long Spruce and Limestone operating stations.

conifer - any of the cone-bearing trees in the order Pinales, including the pine, fir and spruce; having simple, needle-like leaves.

cumulative effects - the combined effects of several projects on the environment. Cumulative effects have to be considered as part of the environmental assessment process.

cumulative impact - the impact on the environment which results from the effects of a project when combined with those of other past, existing and imminent projects and activities.

cutting class - a classification within the Manitoba Forest Resource Inventory that is a representation of size, vigor, state of development, and maturity of forest stands for harvesting purposes.

ecosystem - a functional unit consisting of all living organisms (plants, animals, microbes) in a given area, and all non-living physical and chemical factors of their environment, linked together through matter (e.g., nutrients, genes, water) and energy flow. An ecosystem can be any size (e.g., a log, pond, forest) but always includes all of the components that interact with each other at the spatial scale of interest.

ecosystem health - condition where native biodiversity, ecosystem condition and productivity, soil and water quality and quantity and contributions to global ecological cycles are maintained within their ranges of natural variability.

Environmental Impact Assessment (EIA) - an assessment of the effect that a project will have on the environment, undertaken as part of a review under the *Environment Act* (Manitoba) or the *Canadian Environmental Assessment Act.*

Environmental Impact Statement (EIS) - a document setting out the results of an environmental impact assessment (see EIA), including adverse (and sometimes positive) effects of a proposed development. The document is filed as part of an application for environmental approvals under the *Environment Act* (Manitoba) or the *Canadian Environmental Assessment Act.*

Environmental Protection Plan (EnvPP) - a 'user-friendly' guide for the contractor that includes: information such as a brief project description; updated construction schedule; summary identifying environmental sensitivities and mitigative actions; listing of all federal, provincial or municipal approvals, licenses, or permits that are required for the project; a description of general corporate practices and specific mitigating actions for the various construction activities; emergency response plans, training and information; and environmental/engineering monitoring plans and reporting protocols.

erosion – 1) the wearing away of the earth's surface by the action of water, wind, current, etc.; and, 2) in reference to fish – the wearing away of tissues, typically used in reference to fins.

Fine Habitat ZOI - this is the zone of Project influence that includes the area where habitat composition changes due to the indirect effects of the Project features in the impact areas. Other effects also occur in the Fine Habitat ZOI due to the indirect effects of habitat composition change or other effects of the Project features.

footprint - the surface area occupied by a structure or activity.

Forest Resource Inventory - a classification system and inventory derived from aerial photo interpretation of the province's forest resources. It is the base information that is used to calculate growth and yield and the annual allowable cut.

generating station - a complex of structures used in the production of electricity. A hydroelectric generating station would include the powerhouse, spillway, dam(s) and transitions structures.

Geographic Information System (GIS) - a computerized information system which uses geo-referenced spatial and tabular databases to capture, store, update, manipulate, analyze and display information.

gleying – gray colour change in a soil horizon which indicates that the soil is continuously or periodically saturated by water.

ha (hectares) - a metric unit of square measure equal to 10,000 square metres or 2.471 acres.

habitat type - an area (i.e., a patch) that has similar soils, hydrology, vegetation, vegetation age and disturbance regime (e.g., water fluctuations, large fires).

humus – the soil organic matter that remains after most of the plant and animal residues have decomposed.

land type - an area (i.e., a patch) that has similar soils, surface water and ground water.

Landscape ZOI - this is the zone of Project influence surrounding the Fine Habitat ZOI that includes the area where habitat composition does not change but other potential Project effects still occur (e.g., altered habitat quality for species with large home ranges, fragmentation).

mainland/ upland habitat- all non-aquatic habitat that is on the mainland side of the shore zone (includes wetlands).

Mineral Island habitat - mineral or bedrock islands in lakes or rivers (organic layer on top of the mineral soil is less than 20 cm thick).

Peat Island habitat - lake peatland fragments that are in the Affected Aquatic Area. A peatland is thick spongy soil that is the result of dead sedges, grasses, Sphagnum mosses, etc. building up over time. Lake peatlands in the Affected Aquatic Area are called Peat Islands because pre-CRD lake peatlands have broken down into islands.

peatland - a type of ecosystem in which organic matter is produced faster than it is decomposed, resulting in the accumulation of at least 40 cm of partially decomposed vegetative material called peat.

permafrost - permanently frozen ground.

Project areas –areas that contain the footprints of Project features. Also referred to as Project impact areas.

Project effects areas - the areas where the Project features may directly and indirectly affect habitat, VECs and/ or ecosystem health indicators. Consist of three nested areas: Project impact areas; Fine Habitat ZOI; and Landscape ZOI.

Project effects comparison areas - the larger areas surrounding the Project effects areas that are used to assess the ecological significance of any effects identified in the terrestrial habitat effects assessment (i.e., Sub-Region or Region).

Project features - include Project structures (e.g., generating station, access road), activities (e.g., vehicle traffic) and associated alterations (e.g., vegetation clearing, soil compaction on access trails).

Project impact areas –areas that contain the footprints of Project features. Also referred to as Project Areas.

reach - term used to describe sections of a river.

Region - an ecological region encompassing the southern three-quarters of the NCN Resource Management Area and all of the proposed development site. Used as a comparison study area for assessing the ecological significance of some Project effects.

serotinous – cones which can remain on the tree for several years without opening unless stimulated by high heat.

Shore Zone habitat - band along the Affected Aquatic Area shoreline that is affected by fluctuating water levels. The bottom of the band is at the elevation that was under water more than 95% of the growing season days over the past 5 years. The top of the band is at the highest elevation under water for at least 20 days during the growing season over the past 10 years

Sub-Region - a block of approximately 340,000 ha centered on the proposed development site. Used as a comparison study area for assessing the ecological significance of some Project effects.

5.10 APPENDIX 1 - METHODS BACKGROUND TABLES

Table 5.10-1. Broad and fine habitat types used in the terrestrial habitat assessment.

Broad Habitat	Fine Habitat
Open vegetation on Exposed bedrock	Barren on Exposed bedrock Black spruce sparsely treed on Exposed bedrock Hardwood sparsely treed on Exposed bedrock Jack pine sparsely treed on Exposed bedrock
Open forest on Dry mineral soil	Aspen > 70% forest on Dry mineral soil- Immature Aspen > 70% forest on Dry mineral soil- Young Aspen/ Conifer mixedwood forest on Dry mineral soil- Immature Aspen/ Conifer mixedwood forest on Dry mineral soil- Young Aspen/ Jack pine mixedwood forest on Dry mineral soil- Young Aspen/ White birch > 70% forest on Dry mineral soil- Immature Balsam fir mixedwood forest on Dry mineral soil- Immature Balsam fir/ Spruce > 70% forest on Dry mineral soil- Immature Black spruce > 70% forest on Dry mineral soil- Immature Black spruce > 70% forest on Dry mineral soil- Mature Black spruce > 70% forest on Dry mineral soil- New Black spruce > 70% forest on Dry mineral soil- Recently disturbed Black spruce > 70% forest on Dry mineral soil- Young Black spruce mixedwood forest on Dry mineral soil- Immature Black spruce mixedwood forest on Dry mineral soil- New Black spruce mixedwood forest on Dry mineral soil- Recently disturbed Black spruce mixedwood forest on Dry mineral soil- Young Black spruce/ Balsam fir/ White spruce > 70% forest on Dry mineral soil- Immature Black spruce/ Balsam fir/ White spruce > 70% forest on Dry mineral soil- New Black spruce/ Balsam fir/ White spruce > 70% forest on Dry mineral soil- Recently disturbed Black spruce/ Balsam fir/ White spruce > 70% forest on Dry mineral soil- Young Black spruce/ Jack pine > 70% forest on Dry mineral soil- Immature Black spruce/ Jack pine > 70% forest on Dry mineral soil- Mature Black spruce/ Jack pine > 70% forest on Dry mineral soil- New Black spruce/ Jack pine > 70% forest on Dry mineral soil- Recently disturbed Black spruce/ Jack pine > 70% forest on Dry mineral soil- Young Black spruce/ Jack pine mixedwood forest on Dry mineral soil- Immature Black spruce/ Jack pine mixedwood forest on Dry mineral soil- Mature Black spruce/ Jack pine mixedwood forest on Dry mineral soil- Recently disturbed Black spruce/ Jack pine mixedwood forest on Dry mineral soil- Young Black spruce/ Tamarack > 70% forest on Dry mineral soil- Young Black spruce/ White spruce mixedwood forest on Dry mineral soil- Immature Black spruce/ White spruce mixedwood forest on Dry mineral soil- New Black spruce/ White spruce mixedwood forest on Dry mineral soil- Recently disturbed

Broad Habitat	Fine Habitat
	Black spruce/ White spruce mixedwood forest on Dry mineral soil- Young Jack pine > 70% forest on Dry mineral soil- Immature Jack pine > 70% forest on Dry mineral soil- Mature Jack pine > 70% forest on Dry mineral soil- New Jack pine > 70% forest on Dry mineral soil- Old Jack pine > 70% forest on Dry mineral soil- Recently disturbed Jack pine > 70% forest on Dry mineral soil- Young Jack pine mixedwood forest on Dry mineral soil- Immature Jack pine mixedwood forest on Dry mineral soil- Mature Jack pine mixedwood forest on Dry mineral soil- New Jack pine mixedwood forest on Dry mineral soil- Recently disturbed Jack pine mixedwood forest on Dry mineral soil- Young Jack pine/ Black spruce > 70% forest on Dry mineral soil- Immature Jack pine/ Black spruce > 70% forest on Dry mineral soil- Mature Jack pine/ Black spruce > 70% forest on Dry mineral soil- New Jack pine/ Black spruce > 70% forest on Dry mineral soil- Old Jack pine/ Black spruce > 70% forest on Dry mineral soil- Recently disturbed Jack pine/ Black spruce > 70% forest on Dry mineral soil- Young Jack pine/ Black spruce mixedwood forest on Dry mineral soil- Immature Jack pine/ Black spruce mixedwood forest on Dry mineral soil- Mature Jack pine/ Black spruce mixedwood forest on Dry mineral soil- New Jack pine/ Black spruce mixedwood forest on Dry mineral soil- Old Jack pine/ Black spruce mixedwood forest on Dry mineral soil- Recently disturbed Jack pine/ Black spruce mixedwood forest on Dry mineral soil- Young White spruce > 70% forest on Dry mineral soil- Immature White spruce > 70% forest on Dry mineral soil- Young White spruce mixedwood forest on Dry mineral soil- Immature White spruce mixedwood forest on Dry mineral soil- New White spruce mixedwood forest on Dry mineral soil- Young White spruce/ Conifer > 70% forest on Dry mineral soil- Immature White spruce/ Conifer > 70% forest on Dry mineral soil- Mature White spruce/ Conifer > 70% forest on Dry mineral soil- Recently disturbed White spruce/ Conifer > 70% forest on Dry mineral soil- Young White spruce/ Conifer mixedwood forest on Dry mineral soil- Immature White spruce/ Conifer mixedwood forest on Dry mineral soil- Recently disturbed White spruce/ Conifer mixedwood forest on Dry mineral soil- Young
Jack pine forest on Mineral soil	Jack pine > 70% forest on Mineral soil- Immature Jack pine > 70% forest on Mineral soil- Mature Jack pine > 70% forest on Mineral soil- New Jack pine > 70% forest on Mineral soil- Old Jack pine > 70% forest on Mineral soil- Recently disturbed Jack pine > 70% forest on Mineral soil- Young

Broad Habitat	Fine Habitat
	Jack pine mixedwood forest on Mineral soil- Immature Jack pine mixedwood forest on Mineral soil- Mature Jack pine mixedwood forest on Mineral soil- New Jack pine mixedwood forest on Mineral soil- Old Jack pine mixedwood forest on Mineral soil- Recently disturbed Jack pine mixedwood forest on Mineral soil- Young Jack pine/ Black spruce > 70% forest on Mineral soil- Immature Jack pine/ Black spruce > 70% forest on Mineral soil- Mature Jack pine/ Black spruce > 70% forest on Mineral soil- New Jack pine/ Black spruce > 70% forest on Mineral soil- Old Jack pine/ Black spruce > 70% forest on Mineral soil- Recently disturbed Jack pine/ Black spruce > 70% forest on Mineral soil- Young Jack pine/ Black spruce mixedwood forest on Mineral soil- Immature Jack pine/ Black spruce mixedwood forest on Mineral soil- Mature Jack pine/ Black spruce mixedwood forest on Mineral soil- New Jack pine/ Black spruce mixedwood forest on Mineral soil- Old Jack pine/ Black spruce mixedwood forest on Mineral soil- Recently disturbed Jack pine/ Black spruce mixedwood forest on Mineral soil- Young
Other conifer forest on Mineral soil	Balsam fir > 70% forest on Mineral soil- Immature Balsam fir/ Spruce > 70% forest on Mineral soil- Immature Balsam fir/ Spruce > 70% forest on Mineral soil- Mature Balsam fir/ Spruce > 70% forest on Mineral soil- Old Balsam fir/ Spruce > 70% forest on Mineral soil- Recently disturbed Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil- Immature Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil- Mature Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil- New Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil- Old Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil- Recently disturbed Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil- Young Black spruce/ Jack pine > 70% forest on Mineral soil- Immature Black spruce/ Jack pine > 70% forest on Mineral soil- Mature Black spruce/ Jack pine > 70% forest on Mineral soil- New Black spruce/ Jack pine > 70% forest on Mineral soil- Old Black spruce/ Jack pine > 70% forest on Mineral soil- Recently disturbed Black spruce/ Jack pine > 70% forest on Mineral soil- Young Black spruce/ Tamarack > 70% forest on Mineral soil- Immature Black spruce/ Tamarack > 70% forest on Mineral soil- Mature Black spruce/ Tamarack > 70% forest on Mineral soil- New Black spruce/ Tamarack > 70% forest on Mineral soil- Recently disturbed Black spruce/ Tamarack > 70% forest on Mineral soil- Young White spruce > 70% forest on Mineral soil- Immature

Broad Habitat	**Fine Habitat**
	White spruce > 70% forest on Mineral soil- Mature White spruce > 70% forest on Mineral soil- New White spruce > 70% forest on Mineral soil- Old White spruce > 70% forest on Mineral soil- Recently disturbed White spruce > 70% forest on Mineral soil- Young White spruce/ Conifer > 70% forest on Mineral soil- Immature White spruce/ Conifer > 70% forest on Mineral soil- Mature White spruce/ Conifer > 70% forest on Mineral soil- New White spruce/ Conifer > 70% forest on Mineral soil- Old White spruce/ Conifer > 70% forest on Mineral soil- Recently disturbed White spruce/ Conifer > 70% forest on Mineral soil- Young
Black spruce forest on Peaty mineral soil	Black spruce > 70% forest on Peaty mineral soil- Immature Black spruce > 70% forest on Peaty mineral soil- Mature Black spruce > 70% forest on Peaty mineral soil- New Black spruce > 70% forest on Peaty mineral soil- Old Black spruce > 70% forest on Peaty mineral soil- Recently disturbed Black spruce > 70% forest on Peaty mineral soil- Young Tamarack > 70% forest on Peaty mineral soil- Immature Tamarack > 70% forest on Peaty mineral soil- Young Tamarack/ Spruce > 70% forest on Peaty mineral soil- Immature Tamarack/ Spruce > 70% forest on Peaty mineral soil- Mature Tamarack/ Spruce > 70% forest on Peaty mineral soil- New Tamarack/ Spruce > 70% forest on Peaty mineral soil- Old Tamarack/ Spruce > 70% forest on Peaty mineral soil- Recently disturbed Tamarack/ Spruce > 70% forest on Peaty mineral soil- Young
Other conifer mixedwood forest on Mineral soil	Balsam fir mixedwood forest on Mineral soil- Immature Balsam fir mixedwood forest on Mineral soil- Mature Balsam fir mixedwood forest on Mineral soil- Young Balsam fir/ Spruce mixedwood forest on Mineral soil- Immature Balsam fir/ Spruce mixedwood forest on Mineral soil- Mature Balsam fir/ Spruce mixedwood forest on Mineral soil- Old Balsam fir/ Spruce mixedwood forest on Mineral soil- Young White spruce mixedwood forest on Mineral soil- Immature White spruce mixedwood forest on Mineral soil- Mature White spruce mixedwood forest on Mineral soil- New White spruce mixedwood forest on Mineral soil- Old White spruce mixedwood forest on Mineral soil- Recently disturbed White spruce mixedwood forest on Mineral soil- Young White spruce/ Conifer mixedwood forest on Mineral soil- Immature White spruce/ Conifer mixedwood forest on Mineral soil- Mature White spruce/ Conifer mixedwood forest on Mineral soil- New White spruce/ Conifer mixedwood forest on Mineral soil- Old

Broad Habitat	Fine Habitat
	White spruce/ Conifer mixedwood forest on Mineral soil- Recently disturbed White spruce/ Conifer mixedwood forest on Mineral soil- Young
Black spruce mixedwood forest on Mineral soil	Black spruce mixedwood forest on Mineral soil- Immature Black spruce mixedwood forest on Mineral soil- Mature Black spruce mixedwood forest on Mineral soil- New Black spruce mixedwood forest on Mineral soil- Old Black spruce mixedwood forest on Mineral soil- Recently disturbed Black spruce mixedwood forest on Mineral soil- Young Black spruce/ Balsam fir mixedwood forest on Mineral soil- Immature Black spruce/ Jack pine mixedwood forest on Mineral soil- Immature Black spruce/ Jack pine mixedwood forest on Mineral soil- Mature Black spruce/ Jack pine mixedwood forest on Mineral soil- New Black spruce/ Jack pine mixedwood forest on Mineral soil- Old Black spruce/ Jack pine mixedwood forest on Mineral soil- Recently disturbed Black spruce/ Jack pine mixedwood forest on Mineral soil- Young Black spruce/ Tamarack mixedwood forest on Mineral soil- Immature Black spruce/ Tamarack mixedwood forest on Mineral soil- Young Black spruce/ White spruce mixedwood forest on Mineral soil- Immature Black spruce/ White spruce mixedwood forest on Mineral soil- Mature Black spruce/ White spruce mixedwood forest on Mineral soil- New Black spruce/ White spruce mixedwood forest on Mineral soil- Old Black spruce/ White spruce mixedwood forest on Mineral soil- Recently disturbed Black spruce/ White spruce mixedwood forest on Mineral soil- Young Black spruce/ Balsam fir mixedwood forest on Mineral soil- Mature Black spruce/ Balsam fir mixedwood forest on Mineral soil- Old Black spruce/ Balsam fir mixedwood forest on Mineral soil- Young Black spruce/ Tamarack mixedwood forest on Mineral soil- Mature
Hardwood mixedwood forest on Mineral soil	Aspen/ Conifer mixedwood forest on Mineral soil- Immature Aspen/ Conifer mixedwood forest on Mineral soil- Mature Aspen/ Conifer mixedwood forest on Mineral soil- New Aspen/ Conifer mixedwood forest on Mineral soil- Old Aspen/ Conifer mixedwood forest on Mineral soil- Recently disturbed Aspen/ Conifer mixedwood forest on Mineral soil- Young Aspen/ Jack pine mixedwood forest on Mineral soil- Immature Aspen/ Jack pine mixedwood forest on Mineral soil- Mature Aspen/ Jack pine mixedwood forest on Mineral soil- New Aspen/ Jack pine mixedwood forest on Mineral soil- Old Aspen/ Jack pine mixedwood forest on Mineral soil- Recently disturbed Aspen/ Jack pine mixedwood forest on Mineral soil- Young Balsam poplar/ Conifer mixedwood forest on Mineral soil- Immature Balsam poplar/ Conifer mixedwood forest on Mineral soil- Mature Balsam poplar/ Conifer mixedwood forest on Mineral soil- New

Broad Habitat	Fine Habitat
	Balsam poplar/ Conifer mixedwood forest on Mineral soil- Old Balsam poplar/ Conifer mixedwood forest on Mineral soil- Young Hardwood/ Pine mixedwood forest on Mineral soil- Recently disturbed Hardwood/ Pine mixedwood forest on Mineral soil- Young White birch/ Jack pine mixedwood forest on Mineral soil- Mature White birch/ Jack pine mixedwood forest on Mineral soil- Old White birch/ Jack pine mixedwood forest on Mineral soil- Young White birch/ Spruce & Balsam fir mixedwood forest on Mineral soil- Immature White birch/ Spruce & Balsam fir mixedwood forest on Mineral soil- Mature White birch/ Spruce & Balsam fir mixedwood forest on Mineral soil- New White birch/ Spruce & Balsam fir mixedwood forest on Mineral soil- Old White birch/ Spruce & Balsam fir mixedwood forest on Mineral soil- Young
Hardwood forest on Mineral soil	Ash > 70% forest on Mineral soil- Immature Ash > 70% forest on Mineral soil- Mature Aspen > 70% forest on Mineral soil- Immature Aspen > 70% forest on Mineral soil- Mature Aspen > 70% forest on Mineral soil- New Aspen > 70% forest on Mineral soil- Old Aspen > 70% forest on Mineral soil- Recently disturbed Aspen > 70% forest on Mineral soil- Young Aspen/ White birch > 70% forest on Mineral soil- Immature Aspen/ White birch > 70% forest on Mineral soil- Mature Aspen/ White birch > 70% forest on Mineral soil- Recently disturbed Aspen/ White birch > 70% forest on Mineral soil- Young Balsam poplar > 70% forest on Mineral soil- Immature Balsam poplar > 70% forest on Mineral soil- Mature Balsam poplar > 70% forest on Mineral soil- New Balsam poplar > 70% forest on Mineral soil- Old Balsam poplar > 70% forest on Mineral soil- Recently disturbed Balsam poplar > 70% forest on Mineral soil- Young Elm > 70% forest on Mineral soil- Mature Maple > 70% forest on Mineral soil- Immature Maple > 70% forest on Mineral soil- Mature Maple > 70% forest on Mineral soil- Old Maple > 70% forest on Mineral soil- Recently disturbed Maple > 70% forest on Mineral soil- Young White birch > 70% forest on Mineral soil- Immature White birch > 70% forest on Mineral soil- Mature White birch > 70% forest on Mineral soil- New White birch > 70% forest on Mineral soil- Old White birch > 70% forest on Mineral soil- Young
Black spruce forest on	Black spruce > 70% forest on Peatland- Immature

Broad Habitat	**Fine Habitat**
Peatland	Black spruce > 70% forest on Peatland- Mature Black spruce > 70% forest on Peatland- New Black spruce > 70% forest on Peatland- Old Black spruce > 70% forest on Peatland- Recently disturbed Black spruce > 70% forest on Peatland- Young Black spruce/ Balsam fir/ White spruce > 70% forest on Peatland- Immature Black spruce/ Jack pine > 70% forest on Peatland- Immature Black spruce/ Jack pine > 70% forest on Peatland- New Black spruce/ Jack pine > 70% forest on Peatland- Recently disturbed Black spruce/ Jack pine > 70% forest on Peatland- Young Black spruce/ Tamarack > 70% forest on Peatland- Immature Black spruce/ Tamarack > 70% forest on Peatland- Mature Black spruce/ Tamarack > 70% forest on Peatland- New Black spruce/ Tamarack > 70% forest on Peatland- Old Black spruce/ Tamarack > 70% forest on Peatland- Recently disturbed Black spruce/ Tamarack > 70% forest on Peatland- Young Tamarack > 70% forest on Peatland- Immature Tamarack > 70% forest on Peatland- Mature Tamarack > 70% forest on Peatland- New Tamarack > 70% forest on Peatland- Recently disturbed Tamarack > 70% forest on Peatland- Young Tamarack/ Spruce > 70% forest on Peatland- Immature Tamarack/ Spruce > 70% forest on Peatland- Mature Tamarack/ Spruce > 70% forest on Peatland- New Tamarack/ Spruce > 70% forest on Peatland- Recently disturbed Tamarack/ Spruce > 70% forest on Peatland- Young
Black spruce mixedwood forest on Peatland	Black spruce mixedwood forest on Peatland- Immature Black spruce mixedwood forest on Peatland- Mature Black spruce mixedwood forest on Peatland- New Black spruce mixedwood forest on Peatland- Recently disturbed Black spruce mixedwood forest on Peatland- Young Black spruce/ Jack pine mixedwood forest on Peatland- Young Black spruce/ Tamarack mixedwood forest on Peatland- Young Black spruce/ White spruce mixedwood forest on Peatland- Immature Black spruce/ White spruce mixedwood forest on Peatland- New
Sparsely treed wetland	Black spruce sparsely treed on Peatland Eastern cedar sparsely treed on Peatland Sparsely treed on Frozen peat Sparsely treed on Peatland Tamarack sparsely treed on Peatland
Tall shrub wetland	Alder on Wetland Dwarf birch on Wetland

Broad Habitat	Fine Habitat
	Shrub on Wetland Willow on Wetland
Low shrub, graminoid and/ or emergent wetland	Barren on Frozen peat Ericaceous low shrub/ Sphagnum bog Ericaceous low shrub/ Sphagnum with graminoid bog Graminoid on Fen with patches of water Marsh in Shallow water Mud/ salt flats in Fluctuating water Sand beaches in Fluctuating water
Small islands	Small islands (less than 2 ha.)
Water	Lake River
Human	Abandoned cultivated land Airstrips Cropland - cultivated Drainage ditches Dry upland ridge prairie Dugouts/ water holes Fence lines (community pastures), fire guards Gravel pits/ mine sites Hayland - cultivated Land clearing in progress Moist prairie Pastureland - domestic animals Precipitous slopes/ fragile sites Recreational sites Roads/ railroads Shelter belts Townsites/ residential sites Transmission lines/ pipelines Wet meadow in Agriculture

Table 5.10-2. Manitoba Forestry Branch- Age ranges of cutting classes in the Wuskwatim Region (Forest Sections 6 and 8; Source: Manitoba Conservation)

Age class midpoint shown in brackets.

Working Group / Site	Habitat Type	Cutting Class				
		Stand height < 3 m	Average height of the stand >= 3 m and <= 10 m	Average height of the stand > 10 m and DBH > 9 cm	Mature stands	"Overmature" stands
Jack Pine / All	Jack pine, Jack pine on dry, Jack pine mixedwood forest	1 – 10 (5)	11 – 25 (18)	26 - 70	71 - 90	91+
Black Spruce / 1	Black spruce on mineral	1 – 15 (8)	16 – 30 (23)	31 - 70	71 - 90	91+
Black Spruce / 2 & 3	Black spruce on peat or dry	1 – 30 (15)	31 – 75 (53)	76 - 120	121 - 160	161+
White Spruce / All	White spruce	1 – 20 (11)	21 – 30 (26)	31 - 90	91 - 110	111+
Balsam Fir / All	Balsam fir	1 – 10 (5)	11 – 25 (18)	26 - 70	71 - 90	91+
Tamarack / 1	Tamarack	1 – 15 (8)	16 – 30 (23)	31 - 70	71 - 110	111+
Tamarack / 2	Black spruce on peat	1 – 25 (13)	26 – 70 (48)	71 - 120	121 - 160	161+
Hardwoods / All	Hardwood	1 – 15 (8)	16 – 30 (23)	31 - 70	71 - 90	91+

Table 5.10-3. Locations of vegetation transects sampled in 2000.

Study Area	Transect Name	Transect Number	Number of Quadrats	Number Times Sampled in 2000
Burntwood River	BWR	1	6	3
	BWR	2a	4	3
	BWR	2b	6	3
	BWR	3	3	2
	BWR	5	11	3
	BWR	6	5	3
	BWR	12	5	1
	BWR	17	7	3
	BWR	18	5	1
	BWR	19	5	2
	BWR	20	5	3
Wuskwatim Brook	WSB	1	6	3
	WSB	2a	4	1
	WSB	2b	3	1
	WSB	4	5	2
	WSB	5	5	2
	WSB	6	5	1
	WSB	7a	5	1
	WSB	8	5	1
	WSB	9	7	3
	WSB	10	5	3
	WSB	11	8	3
Wuskwatim Lake (Main body)	WSM	1	6	3
	WSM	2	5	1
	WSM	6	5	3
	WSM	8	5	3
	WSM	9	6	3
	WSM	10	5	1
	WSM	11	5	2
	WSM	12	5	2
	WSM	15	12	3
	WSM	16	9	3

Table 5.10-4. Locations of vegetation transects sampled in 2001.

Study Area	Transect Name	Transect Number	# Plots/ #Quadrats	Date Sampled in 2001
Burntwood River	BWR	18	5/75	25-Jun-01
(incl. Cranbery Lakes)	BWR	17	5/75	23-Jul-01
	BWR	18R	4/60	18-Aug-01
	BWR	15R	3/45	19-Aug-01
	BWR	20	3/45	19-Aug-01
	BWR	5	3/45	24-Aug-01
	BWR	1R	1/15	25-Aug-01
	BWR	1	1/15	28-Aug-01
Wuskwatim Brook	WSB	10R	5/75	22-Jun-01
	WSB	7A	3/45	20-Jul-01
	WSB	16	4/60	23-Jun-01
	WSB	7AR	3/45	22-Jul-01
	WSB	10	4/60	22-Jul-01
	WSB	9	3/45	24-Jul-01
	WSB	2	3/45	25-Jul-01
	WSB	2R	4/60	26-Jul-01
	WSB	4	4/60	30-Jul-01
	WSB	16R	3/45	20-Aug-01
	WSB	17	3/45	20-Aug-01
	WSB	4R	3/45	20-Aug-01
	WSB	18R	3/45	22-Aug-01
	WSB	1	4/60	22-Aug-01
	PT	1	1/22	28-Aug-01
	PT	2	1/12	28-Aug-01
	MRAT	1	1/15	20-Jul-01
	MRAT	2	1/15	20-Jul-01
	WSB	18	3/45	22-Aug-01
Opegano Lake	OPG	3	3/45	21-Aug-01
	OPG	1	2/30	26-Aug-01
	OPG	2	3/45	26-Aug-01
Sesep Lake	SSP	2	5/75	24-Jun-01
	SSP	1R	3/54	28-Aug-01
	SSP	3R	3/45	28-Aug-01
	SSP	1	3/45	19-Jul-01
	SSP	3	4/60	27-Aug-01
	PT	3	2/30	28-Aug-01
Wuskwatim Lake (Main)	WSM	1	2/30	28-Aug-01
	WSM	11	4/60	19-Jul-01
	WSM	15	3/45	24-Jul-01
	WSM	15R	3/45	25-Jul-01
Generating Staion Site	GS	11	1/15	21-Aug-01
	GS	1	1/15	25-Aug-01

Study Area	Transect Name	Transect Number	# Plots/ #Quadrats	Date Sampled in 2001
	GS	12	1/15	21-Aug-01
	GS	21	1/15	21-Aug-01
	GS	19	1/15	23-Aug-01
	GS	15	1/15	23-Aug-01
	GS	RK	1/15	23-Aug-01
	GS	24	1/15	21-Aug-01

5.11 APPENDIX 2 - EXISTING ENVIRONMENT: DETAILED RESULTS AND TABLES

5.11.1 Forest Insect and Disease Outbreaks in the Region

The original text for this appendix was provided by Plus4 Consulting.

5.11.1.1 Insects

Jack Pine Budworm

Jack pine budworm is the major influencing insect of Manitoba's jack pine forests (Manitoba Conservation 1996). The most recent infestation in the Thompson area occurred during 1984 and 1985 causing extensive top kill and whole tree mortality. Moderate and severe defoliation were mapped in the Thompson vicinity extending southeast to Cotton Lake and southwest to Setting Lake. Another band extended generally northwest to approximately Lynn Lake (Moody et al, 1984). The population crash coincided with population reductions across the province in 1996 (Manitoba Conservation, 1986, 1991, 1996).

Source: Hiratsuka et al, 1995

Spruce Budworm

Although spruce budworm is an important cause of widespread defoliation, growth reduction and mortality of white spruce and balsam fir in many areas of the province, this species has not been a major influence in the Region (Manitoba Conservation, 1986, 1991, 1996, 2002). This is likely due to the low concentration of the primary host species within the area, although river and lakeshore stands of white spruce are susceptible.

Source: Manitoba Conservation

Forest Tent Caterpillar

The most recent forest tent caterpillar outbreak within the Region occurred south-west of Thompson in the late 1980's (Grandmaison, 1988). The infestation was documented as straddling sections of PTH#6 between Thompson and Setting Lake and extending south to approximately Cross Lake. Trembling aspen is quite tolerant to repeated defoliation, although annual growth rates are affected and such stresses cause trees to become susceptible to attacks from other insects and diseases.

Other Insects

There are numerous other insects at work in forested environments that do not normally appear in epidemic proportions. Instead they affect individual branches, trees or localized areas. The more common of these species affecting the major boreal forest tree species include the white pine *(Pissodes strobi)* and Warren root collar weevils *(Hylobius warreni)* affecting particularly white and black spruce. The larvae of the white pine weevil feed in the terminals of many conifer often killing three years of growth in one season (Manitoba Natural Resources, 1996). Root collar weevil larvae feed at the base of the tree bole causing growth loss in mature trees and mortality in young trees. The Warren root collar weevil also feeds on jack pine with similar effects as in the spruces. Young jack pine trees are also susceptible to terminal weevils that attack the leader growth, setting tree growth back two to three years (Hiratsuka, 1995).

Trembling aspen are particularly susceptible to the poplar borer *(Saperda calcarata)*. Open grown trees and those on edges of stands are preferred. The poplar borer is not a serious problem in heavily forested area (Hiratsuka, 1995). Although sometimes riddled with tunnels, trees are usually not killed by the poplar borer however, stems are weakened and susceptible to wind breakage. Tunnel openings act as infection areas for various rot fungi further weakening and possibly killing the tree.

5.11.1.2 Diseases

The term “disease”, as it applies to trees and other plants is difficult to define because it covers a wide range of biological phenomena. A workable definition states that “ disease is any prolonged disturbance to the normal functioning of a plant that results in a permanent and frequently injurious abnormality” (Baranyay et al, 1979). Diseases therefore, result in some form of permanent damage that causes some level of malfunctioning in plants.

Effects on plants vary greatly with disease type, stage of infection and development, and the number of pathogens affecting a plant at any one time. Diseases are responsible for wide ranging effects on plants that include foliage discoloration, foliage drop, deformities, plant weakening, mortality, decomposition, soil formation and maintenance (Baranyay et al, 1979). The decomposition of plant material is part of the nutrient cycle in forested ecosystems and, similar to insects, diseases are an integral ecological force that influences forest stand structure and vegetative species composition. The rate of decomposition of dead woody material by decay-causing fungi in forest stands affects their susceptibility to fire.

Disease agents are classified as either infectious or non-infectious depending on their ability to multiply and spread. Non-infectious agents and diseases are often not recognized or underestimated regarding their ecological importance due to their temporary nature. However, they often serve as pre-conditioners to infectious agents which tend to have a more persistent nature (Baranyay et al, 1979).

Non-infectious Agents

Non-infectious agents are part of the non-living environment and represent factors that are unfavorable to the normal functioning of plants. Common non-infectious agents include cold, heat, hail, snow & ice, lightning, fire, smoke, nutrient imbalance, water deficiency, water excess, wind and animals. Each of the above factors affect plant species and communities differently. The effects of multiple non-infectious agents may be imposed on plant communities locally and/or regionally. In addition, severity, duration and recurrence may vary widely.

Infectious Agents

Infectious diseases are contagious and involve a causal relationship with pathogens that colonize living or non-living plant tissue. Such pathogens are known as parasites and saprophytes respectively. Infectious agents are grouped according to their similarities as viruses, bacteria, fungi and higher plants. Most known infectious plant diseases are caused by fungi. Fungi are plants that lack chlorophyll and must therefore live either as saprophytes or parasites drawing on the resources of other organisms for survival *(Baranyay et al, 1979)*. Fungi are most commonly known for being causal agents of wood stain and wood decay.

There are few parasitic higher plants in the boreal forest although some are influential in forest pathology. The most common and well-known within the study area is the dwarf mistletoe, a true seed plant which has a limited amount of chlorophyll, therefore being not totally dependent on the host. It does however, cause growth loss and eventual mortality to part or the entire host tree.

Infectious diseases can be classified according to portions of the host plant affected; i.e., foliage, fruit, bark, wood, root, stem. Table 5.11-1 provides an overview of the common infectious diseases of forest plants found in the Region.

Table 5.11-1. Common infectious diseases of forest plants within the Wuskwatim Generating Station Region.

Disease	Causal Agent(s)	Host(s)	Remarks
Foliage specific			
Pine needle rust	*Elytroderma deformans* (Darker)	Jack pine (Pinus banksiana)	Continuous attacks reduce the amount of current year foliage
Spruce needle rust	*Chrysomyxa ledicola* (Peck) Lagerh. *Chrysomyxa ledi* (Alb. & Schw.) de Bary *Chrysomyxa empetri* (Pers.) Schroet	White spruce (Picea glauca), black spruce (Picea mariana), Labrador tea (Ledum groenlandicum) White spruce, black spruce, crowberry (Empetrum nigrum)	Dominant rusts of the boreal forest; defoliation but usually not serious; Repeated infection can cause considerable defoliation & growth reduction
Poplar ink spot	*Ciborinia whetzelii* (Seaver)	Trembling aspen (Populus tremuloides)	Pre-mature defoliation but not detrimental to hosts survival
Poplar leaf spot	*Marssonina tremuloidis* (Ell. & Ev.) Kleb	Trembling aspen	Attacks leaves & shoots; not detrimental to hosts survival
Fruit specific			
Spruce cone rust	*Chrysomyxa pirolata* (Wint.)	White spruce, black spruce, wintergreen (Pyrola spp. & Moneses spp.)	Reduces seed production & may influence species regeneration
Bark specific			
Cytospora canker	*Valsa sordida* (Nit.) *Cytospora chrysosperma* (Pers.)	Balsam poplar (Populus balsamifera), trembling aspen	Will spread to the sapwood; kills branches in 1 year and severely infected trees in 2 to 3 years; not significant in natural forests
Hypoxylon canker	*Hypoxylon pruinatum* (Klotzch) Cke.	Trembling aspen	May girdle & kill pole-sized trees in 3 to 4 years
Comandra blister rust	*Cronartium comandrae* (Peck.)	Jack pine, bastard toad flax (Comandra pallida) & Geocaulon lividum	Generally affects young stands & may be beneficial in stand thinning
Western gall rust	*Peridermium harknessii* (J.P. Moore) *Cronartium coleosporiodes* (D.&H.) Arth.	Jack pine, Indian paintbrush, owl clover, cow wheat	Occurs in pockets of high incidence; serious in local areas
Wood specific – root & butt decays			

Disease	Causal Agent(s)	Host(s)	Remarks
Shoestring root rot	*Armillaria mellea* (Vahl ex FR.) Quel.	Jack pine, white spruce, black spruce, trembling aspen, etc.	Widespread, may cause extensive mortality in regeneration, otherwise moderate losses through decay
Brown cubical butt rot	*Coniophora puteana* (Schum. Ex Fr.) Karst	White spruce	Widespread and significant in mature & over-mature stands
Red rot & butt rot of conifers	*Polyporus tomentosus* (Fr.)	White spruce	Widespread but variable between stands
Yellow stringy butt rot of conifers	*Flammula alnicola* (Fr.) Kummer	White spruce	Sporadically in mature & over-mature stands
Brown mottled root rot	*Pholiota adipose* (Fr.) *Pholiota spectabilis* (Fr.) Quel.	Trembling aspen, balsam poplar	Occasional high losses in over-mature trees
Wood specific – stem decays			
Red ring rot	*Fomes pini* (Thore ex Pers.) Lloyd.	Jack pine, white spruce, balsam fir (Abies balsamea)	Gradual decay of wood
Red heart rot	*Stereum sanguinolentum* (Alb. & Schw.)	White spruce, black spruce	Widespread; wood degradation & decay
White trunk rot	*Fomes igniarius* (L. ex Fr.) Kickx	Trembling aspen, balsam poplar, white birch (Betula papyrifera)	Widespread; wood degradation & decay
Brown mottled stem rot	*Pholiota destruens* (Brond.) Quel.	Trembling aspen, balsam poplar	Widespread; wood degradation & decay
Yellow stringy rot	*Radulum casearium* (Morgan) Lloyd *Peniophora polygonia* (Pers ex Fr.) Bourd. & Galz.	Trembling aspen	Widespread; wood degradation & decay
Wood specific – dead wood decays			
Brown cubical rot	*Fomes pinicola* (Swartz ex Fr.) Cke.	White spruce, black spruce, jack pine, trembling aspen, white birch, etc.	Widespread; an important decayer of dead woody material
Brown cubical pocket rot	*Lenzites saepiaria* (Wulf. Ex Fr.) Fr. *Trametes odorata* (Wulf. Ex Fr.) Fr. *Fomes subroseus* (Weit) Overh.	All conifers, trembling aspen, balsam poplar Jack pine, white spruce All conifers	World wide; an important decayer of dead woody material Widespread; an important decayer of dead woody material Widespread; an important decayer of dead coniferous woody

Disease	Causal Agent(s)	Host(s)	Remarks
			material
Yellow spongy rot	*Ganoderma applanatum* (Pers ex Wallr.) Pat	Mainly hardwoods	Widespread; an important decayer of dead hardwoods
Pitted saprot	*Polyporus abietinus* (Dicks. Ex Fr.)	All conifers	Widespread; an important decayer of dead coniferous woody material; also affects live sapwood
White mottled rot	*Fomes fomentarius* (L. ex Fr.) Kickx	White birch	Widespread; an important decayer of dead trees
Diseases affecting more than one tissue			
Dwarf mistletoe	*Arceuthobium americanum* (nutt. Ex engelm. *Arceuthobium pusillus* (nutt. Ex engelm.	Jack pine, occasionally white spruce	Usually associated with dry, sandy sites; will cause considerable stand thinning through mortality; conspicuous symptom is the witches broom; reduces tree growth, causes branch & eventual tree mortality; also provides opportunity for other infectious agents to attack
Yellow witch's broom	*Melampsorella caryophyllacearum* (Schroet.) *Chrysomyxa arctostaphyli* (Diet.)	Balsam fir, chickweed (Stellaria spp. & Cerastium spp.) White spruce, black spruce, bearberry (Arctostaphylos uva-ursi)	Appears on isolated tress or small pockets Appears on isolated tress or small pockets

5.11.2 Existing Environment- Detailed Results

Table 5.11-2. Sub-Region vegetation distribution across dominant and secondary surface material types (percentage of area).

Cover Type	Total Area (ha)	All Materials	Bedrock/ Bog or Fen	Bog	Bog/ Weakly Broken, Deep Clayey	Fen	Fen/ Weakly Broken Clayey	Clayey- Deep, Moderately Broken / Fen & Bog	Clayey- Deep, Moderately Broken/ Deep Clayey	Clayey- Deep, Weakly Broken/ Bog & Fen	Clayey- Deep, Weakly Broken/ Clayey	Clayey- Shallow, Moderately Broken/ Deep Clayey	Clayey- Shallow, Moderately Broken/ Fen & Bog	Clayey- Shallow, Weakly Broken/ Bog & Fen	Clayey- Shallow, Weakly Broken/ Very Shallow Claye	Sand- Deep, Weakly Broken	Sand- Very Weakly Broken/ Deep Sandy	Sandy- Deep, Weakly Broken/ All Materials	Silty- Deep, Weakly Broken	Silty- Shallow, Weakly Broken/ Fen & Bog
Jack pine > 70% forest	3,168				4	1	9	18	0	24	5		2	7	2		23	1	1	4
Jack pine 40 - 70%/ Black spruce forest	11,416	0	0	0	2	1	14	5	4	40	15	0	4	10	2		1	2	1	0
White spruce > 70% forest	22						35			2	49							14		
White spruce 40 - 70%/ Conifer forest	296				3		8		2	46	32		3	4				2		
Black spruce > 70% forest on mineral soil	34,976	0	1	0	4	1	13	2	3	32	20	2	9	5	3	0	0	2	1	0
Black spruce 40 - 70%/ Jack pine forest	23,844	0	1	0	4	1	15	1	3	38	13	2	5	8	4		2	2	0	0
Black spruce 40 - 70%/ White spruce or Fir forest	967		2		7	1	2	1	3	47	29	5		2				1		
Black spruce/ Tamarack > 70% forest	42						73				27									
Black spruce > 70% forest on peatland	25,695	1	1	1	9	3	20	5	1	25	11	1	5	8	3	0	2	1	2	1
Jack pine > 70% on dry site	5,254	1	1	0	4	3	6	1		6	2		1	10	2	1	57	3	2	1
Balsam fir 40 - 70%/ Spruce forest	25										100									
Tamarack > 70% forest	5						66							34						
Tamarack 40 - 70%/ Spruce forest	164		3				76			8	2			10	2					
Jack pine mixedwood forest	3,240				1	1	6	19	1	39	13		1	10	1		4	1	3	0
Jack pine/ Black spruce mixedwood forest	4,377				3	1	8	9	1	38	15	0	4	8	6		5	2	0	2
Jack pine mixedwood on dry forest	834					1	8	9		9	1	1	0	14			37	18	0	2
White spruce mixedwood forest	42						9			71	13	1		6						
White spruce conifer mixedwood forest	342						4		4	36	37		5	15				1		
Black spruce mixedwood forest	5,196		2		2	2	16	6	1	21	14	1	14	3	8		5	2	2	2
Black spruce/ Jack pine mixedwood forest	6,086		11		0	0	6	0	1	56	12	1	5	2	2			4		0
Black spruce mixedwood forest	325						5			23	39	2	11	9	1			10		
Spruce mixedwood forest on peat	339				5	9	21			38	3	1	7	15	1					
Aspen/ Pine mixedwood forest	7,223		1		7	1	5	4	1	36	9	0	8	7	4		13	3	0	0
Aspen/ Spruce and/ or fir mixedwood forest	10,594		1		4	3	9	3	8	30	9	1	16	3	5		2	2	2	1
Hardwood/ Pine mixedwood forest	8						100													
Birch/ Spruce, fir mixedwood forest	146		1		4	31	38			20				5	0					
Balsam poplar mixedwood forest	98		6		16	3	0	3		62			10							
Aspen > 70% forest	4,858		2		1	1	6	5	1	37	22	1	10	4	2		2	3	2	1
White birch > 70% forest	209				4		3			5	85			1	1			1		
Balsam poplar > 70% forest	9									100										
Black spruce sparsely treed peatland	72,415	1	1	1	6	4	15	1	1	36	12	1	4	8	4	0	2	2	3	1
Tamarack sparsely treed wetland	3,797			0	28	8	34	0	0	19	4		1	2	0		3			1
Jack pine sparsely treed rock	7,547		14	0	1	0	9	0	1	15	4	5	20	11	19	0	0	2	0	
Total Area for All Cover Types (ha)	278,238	1,084	3,830	1,093	15,954	7,490	5,704	88,764	39,900	2,862	17,404	18,999	10,020	6,507	38,986	58	8,944	4,972	3,824	1,842
Surface material type as % of total area	100	0	1	0	6	2	14	3	2	32	14	1	6	7	4	0	3	2	1	1

Table 5.11-3. Plants recorded in the Wuskwatim Sub-Region during field surveys conducted in 2000, 2001 and 2002. Nomenclature for vascular plants follows Scoggan (1979) except for three species where Scoggan name is in {}.

Scientific Name	Common Name	CDC Rank
Abies balsamea (L.) Mill.	Balsam Fir	S5
Achillea millefolium L. *var. borealis* (Bong.) Farw.	Common Yarrow	S5
Acorus americanus (Raf.) Raf. {*A. calamus* L.}	Sweetflag	S5
Actaea rubra (Ait.) Willd.	Red Baneberry	S5
Agrimonia striata Michx.	Agrimony	S4
Agropyron trachycaulum (Link) Malte	Slender Wheat-grass	S?
Agrostis hyemalis (Walt.) BSP.	Tickle Grass	S5
Agrostis sp.	Bent Grass	
Agrostis stolonifera L.	Red Top	SE
Alnus crispa (Ait.) Pursh	Green Alder	S5
Alnus rugosa (Du Roi) Spreng.	Speckled Alder	S5
Alopecurus aequalis Sobol.	Short-awned Foxtail	S5
Amelanchier alnifolia Nutt.	Saskatoon	S5
Andromeda glaucophylla Link	Bog Rosemary	S4
Anemone canadensis L.	Canada Anemone	S5
Anemone multifida Poir.	Cut-leaved Anemone	S5
Antennaria neglecta Greene	Field Pussy-toes	S5
Aquilegia brevistyla Hook.	Small-flowered Columbine	S4
Aralia nudicaulis L.	Wild Sarsaparilla	S5
Arctostaphylos alpina (L.) Spreng. *ssp. rubra*	Alpine Bearberry	S5
Arctostaphylos uva-ursi (L.) Spreng.	Bearberry	S5
Arenaria lateriflora L	Blunt-leaved Sandwort	S5
Aster borealis (T.&G.) Provencher	Marsh or Rush Aster	S5
Aster ciliolatus Lindl.	Lindley's Aster	S5
Aster puniceus L.	Purple-stemmed Aster	S5
Astragalus americanus (Hook.) James	American Milkvetch	S3
Beckmannia syzigachne (Steud.) Fern.	Slough Grass	S5
Betula papyrifera Marsh.	Paper Birch	S5
Betula pumila L. *var. glandulifera* Regel	Swamp Birch	S5
Bidens beckii Torr. ex Spreng.	Water Marigold	S3?
Bidens cernua L.	Smooth Beggar-ticks	S5
Botrychium lunaria (L.) Sw.	Moonwort	S4
Botrychium virginianum (L.) Sw.	Rattlesnake Fern	S5
Bromus ciliatus L.	Fringed Brome	S5
Calamagrostis canadensis (Michx.) Nutt.	Reed Grass	S5
Calamagrostis inexpansa Gray	Northern Reed Grass	S5
Calamagrostis sp.	Reed Grass	
Calla palustris L.	Wild Calla	S5
Callitriche verna L.	Vernal Water-starwort	S5
Caltha natans Pall.	Floating Marsh Marigold	S3S4
Caltha palustris L.	Marsh Marigold	S5

Scientific Name	Common Name	CDC Rank
Calypso bulbosa (L.) Oakes	Fairy or Venus-slipper	S4
Campanula aparinoides Pursh	Marsh Bellflower	S5
Cardamine pratensis L.	Cuckcoo Flower	S4S5
Carex aenea Fern.	Silvery-flowered Sedge	S5
Carex aquatilis Wahl.	Water Sedge	S5
Carex atherodes Spreng.	Awned Sedge	S5
Carex bebbii (Bailey) Fern.	Bebb's Sedge	S5
Carex canescens L.	Silvery Sedge	S5
Carex deflexa Hornem.	Bent Sedge	S5
Carex disperma Dewey	Two-seeded Sedge	S5
Carex gynocrates Wormskj.	Northern Bog Sedge	S5
Carex interior Bailey	Inland Sedge	S4?
Carex lacustris Willd.	Lakeshore Sedge	S5
Carex paupercula Michx.	Bog Sedge	S5
Carex retrorsa Schwein.	Turned Sedge	S5
Carex rostrata Stokes	Beaked Sedge	S4
Carex sartwellii Dew.	Sartwell's Sedge	S4
Carex siccata Dewey	Hay Sedge	S5
Carex sp.	Sedge	
Carex vaginata Tausch.	Sheathed Sedge	S5
Carum carvi L.	Caraway	SE
Chamaedaphne calyculata (L.) Moench	Leatherleaf	S5
Cicuta bulbifera L.	Water Hemlock	S5
Circaea alpina L.	Small Enchanter's Nightshade	S5
Cladina mitis (Sandst.) Hustich	Yellow Reindeer Lichen	S?
Cladina rangiferina (L.) Nyl.	True Reindeer Lichen	S?
Cladina sp.	Lichen	S?
Cladina stellaris (Opiz.) Brodo	Cauliflower Lichen	S?
Corallorhiza trifida Chat.	Early Coralroot	S?
Cornus canadensis L.	Bunchberry	S5
Cornus stolonifera Michx.	Red-osier Dogwood	S5
Corydalis aurea Willd.	Golden Corydalis	S5
Corydalis sempervirens (L.) Pers.	Pink Corydalis	S4S5
Cryptogramma crispa (L.) R.Br.	Parsley Fern	S4
Diervilla lonicera Mill.	Bush Honeysuckle	S5
Drosera rotundifolia L.	Round-leaved Sundew	S5
Elaeagnus commutata Bernh.	Wolf Willow	S4
Eleocharis acicularis (L.) R.& S.	Needle Spike-rush	S5
Eleocharis palustris (L.) R.& S.	Creeping Spike-rush	S5
Elymus innovatus Beal	Hairy Wild Rye	S5
Epilobium angustifolium L.	Fireweed	S5
Epilobium glandulosum Lehm.	Willowherb	S5
Equisetum arvense L.	Common Horsetail	S5
Equisetum fluviatile L.	Swamp Horsetail	S5

Scientific Name	Common Name	CDC Rank
Equisetum palustre L.	Marsh Horsetail	S4
Equisetum pratense Ehrh.	Meadow Horsetail	S4S5
Equisetum scirpoides Michx.	Dwarf Scouring-rush	S5
Equisetum sylvaticum L.	Woodland Horsetail	S5
Erigeron hyssopifolius Michx.	Fleabane	S4
Eriophorum brachyantherum Trautv.	Closed-sheathed Cotton-grass	S5
Fragaria vesca L.	Woodland Strawberry	S4S5
Fragaria virginiana Dcne.	Smooth Wild Strawberry	S5
Galium boreale L.	Northern Bedstraw	S5
Galium trifidum L.	Bedstraw	S5
Galium triforum Michx.	Sweet-scented Bedstraw	S5
Geocaulon lividum (Richards.) Fern.	Northern Comandra	S5
Geranium bicknellii Britt.	Bicknell's Geranium	S5
Geum aleppicum Jacq.	Yellow Avens	S5
Glaux maritima L.	Sea-milkwort	S4S5
Glyceria borealis (Nash) Batchelder	Northern Manna Grass	S5
Glyceria grandis Wats.	Tall Manna Grass	S5
Goodyera repens (L.) R. Br. *var. ophiodes* Fern.	Lesser Rattlesnake Plantain	S5
Halenia deflexa (Sm.) Griseb.	Spurred Gentian	S5
Heracleum lanatum Michx.	Cow Parsnip	S5
Hierochloe odorata (L.) Beauv.	Sweet Grass	S5
Hippuris vulgaris L.	Mare's-tail	S5
Hylocomium splendens (Hedw.) B.S.G.	Stair-step Moss	S?
Juncus balticus Willd.	Baltic Rush	S5
Juncus castaneus Sm	Chestnut Rush	S3?
Juncus bufonius L.	Toad Rush	S5
Juniperus communis L.	Low Juniper	S5
Juniperus horizontalis Moench.	Ground Juniper	S5
Kalmia polifolia Wang.	Pale Bog-laurel	S5
Larix laricina (Du Roi) Koch	Tamarack	S5
Lathyrus ochroleucus Hook.	Cream-coloured Vetchling	S4S5
Lathyrus palustris L.	Marsh Vetchling	S5
Lathyrus sp.		
Lathyrus venosus Muhl. *var. intonsus* Butt. & St. John	Wild Peavine	S5
Ledum groenlandicum Oeder.	Labrador Tea	S5
Lemna minor L.	Duckweed	S5
Limosella aquatica L.	Mudwort	S4S5
Linnaea borealis L.	Twinflower	S5
Listera cordata (L.) R. Br.	Heart-leaved Twayblade	S4?
Lonicera dioica L.	Twining Honeysuckle	S5
Lonicera involucrata (Richards) Banks	Black Twinberry	S4
Lonicera oblongifolia (Goldie) Hook.	Swamp Fly-honeysuckle	S4
Lonicera villosa (Michx.) R.& S.	Mountain Fly Honeysuckle	S4
Lycopodium annotinum L.	Stiff Clubmoss	S5

Scientific Name	Common Name	CDC Rank
Lycopodium clavatum L.	Running Pine	S4
Lycopus uniflorus Michx.	Northern Bugle-weed	S5
Lysimachia thyrsiflora L.	Tufted Loosestrife	S5
Maianthemum canadense Desf.	Wild Lily-of -the -valley	S5
Melampyrum lineare Desr.	Cow-wheat	S5
Melilotus alba Desr.	White Sweet Clover	S?
Melilotus officinale (L.) Pallas	Yellow Sweet Clover	SE
Mentha arvensis L.	Common Mint	S5
Menyanthes trifoliata L.	Bogbean	S5
Mertensia paniculata (Ait.) Don	Tall Lungwort	S5
Mitella nuda L.	Bishop's Cap	S5
Moneses uniflora (L.) Gray	One-flowered Wintergreen	S5
Monotropa uniflora L.	Indian-pipe	S4
Moss		
Myrica gale L.	Sweet Gale	S5
Myriophyllum spicatum L.	Spiked Water-milfoil	S5
Nuphar variegatum Engelm.	Yellow Pond Lily	S5
Nymphaea tetragona Georgi	Pygmy Water-lily	S2
Orchis rotundifolia Banks	Small Round-leaved Orchis	S5
Oryzopsis asperifolia Michx.	Mountain Rice Grass	S5
Oryzopsis pungens (Torr.) Hitchc.	Northern Rice Grass	S5
Oxycoccus microcarpus Turcz.	Small Bog Cranberry	S5
Parnassia palustris L.	Northern Grass-of-Parnassus	S5
Peltigera sp.	Pelt Lichen	
Petasites palmatus (Ait.) Gray	Palmate-leaved Coltsfoot	S5
Petasites sagittatus (Pursh) Gray	Arrow-leaved Coltsfoot	S4
Petasites vitifolius Greene	Vine-leaved Coltsfoot	HYB
Phacelia franklinii (R. Br.) Gray	Franklin's Scorpionweed	S5
Phalaris arundinacea L.	Canary Reed-grass	S5
Picea glauca (Moench.) Voss	White Spruce	S5
Picea mariana (Mill.) BSP	Black Spruce	S5
Pinus banksiana Lamb.	Jack Pine	S5
Plantago major L.	Common Plantain	SE
Platanthera obtusata Lindley {*Habenaria obtusata* (Pursh) Richards}	Blunt Leaf Orchid	S5
Pleurozium schreberi (Brid.) Mitt.	Feather Moss	S?
Poa nemoralis L.	Wood Bluegrass	S5
Poa palustris L.	Fowl Bluegrass	S5
Poa sp.	Bluegrass	
Polygala paucifolia Willd.	Fringed Milkwort	S4
Polygonum amphibium L. var. stipulaceum (Coleman) Fern.	Water Smartweed	S5
Polygonum sp.	Smartweed	
Populus balsamifera L.	Balsam Poplar, Black Poplar	S5
Populus tremuloides Michx.	Trembling Aspen, White Poplar	S5

Scientific Name	Common Name	CDC Rank
Potamogeton gramineus L.	Various-leaved Pondweed	S5
Potamogeton natans L.	Pondweed	S5
Potamogeton pectinatus L.	Sago Pondweed	S5
Potamogeton praelongus Wulfen.	White-stemmed Pondweed	S5
Potamogeton richardsonii (A Benn.) Rydb. {*Potamogeton perfoliatus* L.}	Richardson's Pondweed	S5
Potamogeton vaginatus Turcz.	Sheathed Pondweed	S5
Potamogeton zosteriformis Schum.	Eelgrass Pondweed	S5
Potentilla anserina L.	Silverweed	S5
Potentilla norvegica L.	Rough Cinquefoil	SU
Potentilla palustris (L.) Scop.	Marsh Cinquefoil	S5
Potentilla sp.	Cinquefoil	
Potentilla tridentata Ait.	Three-toothed Cinquefoil	S5
Prunus pensylvanica L.f.	Pin Cherry	S5
Prunus virginiana L.	Chokecherry	S5
Ptilium crista-castrensis	Moss	S?
Pyrola asarifolia Michx.	Common Pink Wintergreen	S5
Pyrola secunda L.	One-sided Wintergreen	S5
Pyrola sp.	Wintergreen	
Pyrola virens Schweigg.	Green-flowered Wintergreen	S5
Ranunculus aquatilis L.	White Water Crowfoot	S5
Ranunculus cymbalaria Pursh.	Seaside Crowfoot	S5
Ranunculus gmelinii DC.	Small Yellow Water Buttercup	S5
Ranunculus lapponicus L.	Lapland Buttercup	S4S5
Ranunculus sp.	Buttercup	
Rhamnus alnifolia L'Her.	Alder-leaved Buckthorn	S5
Rhinanthus crista-galli L.	Common Yellow Rattle	S4
Ribes americanum Mill.	Wild Black Current	S5
Ribes glandulosum Grauer	Skunk Currant	S5
Ribes hudsonianum Richards.	Northern Wild Black Currant	S5
Ribes lacustre (Pers.) Poir.	Bristly Black Currant	S4
Ribes oxyacanthoides L.	Bristly Wild Gooseberry	S5
Ribes sp.	Currant	
Ribes triste Pall.	Wild Red Currant	S5
Rorippa islandica (Oeder) Borbas	Marsh Yellow Cress	S5
Rosa acicularis Lindl.	Prickly Rose	S5
Rubus acaulis Michx.	Stemless Raspberry	S5
Rubus chamaemorus L.	Cloudberry	S5
Rubus idaeus L.	Raspberry	S5
Rubus pubescens Raf.	Dewberry	S5
Rumex crispus L.	Curled Dock	SE
Rumex maritimus L.	Golden Dock	S5
Rumex sp.	Dock	
Sagittaria cuneata Sheldon	Arum-leaved Arrowhead	S5

Scientific Name	Common Name	CDC Rank
Sagittaria sp.	Arrowhead	
Salix bebbiana Sarg.	Bebb's Willow	S5
Salix candida Flugge.	Hoary Willow	S5
Salix myrtillifolia Anderss.	Myrtlle-leaved Willow	S5
Salix sp.	Willow	
Sarracenia purpurea L.	Pitcher Plant	S5
Schizachne purpurascens (Torr.) Swallen	Purple Oat Grass	S5
Scirpus cyperinus (L.) Kunth	Wool-grass	S5
Scirpus sp.	Bulrush	
Scutellaria epilobiifolia Hamilton	Common Skullcap	S5
Shepherdia canadensis (L.) Nutt.	Soapberry	S5
Sisyrinchium montanum Greene	Blue-eyed Grass	S5
Sium suave Walt.	Water Parsnip	S5
Smilacina trifolia (L.) Desf.	Three-leaved Solomon's Seal	S5
Solidago hispida Muhl.	Hairy Goldenrod	S5
Solidago multiradiata Ait.	Alpine Goldenrod	S5
Sonchus arvensis L.	Perenial Sowthistle	S5
Sparganium angustifolium Michx.	Narrow-leaved Bur-reed	S5
Sparganium sp.	Bur-reed	
Sphagnum spp.	Peat mosses	
Spiranthes romanzoffiana Cham.	Hooded Ladies'-tresses	S5
Stachys palustris var. pilosa (Nutt.) Fern.	Woundwort	S5
Stellaria longifolia Muhl.	Long-leaved Stitchwort	S5
Stellaria longipes Goldie	Long-stalked Stitchwort	S5
Stellaria sp.	Stitchwort	
Symphoricarpos albus (L.) Blake	Snowberry	S5
Taraxacum officinale Weber	Common Dandelion	S5
Thalictrum sparsiflorum Turcz.	Few-flowered Meadow Rue	S2S3
Torreyochloa pallida (Torr.) Church	Pale Manna Grass	S2
Typha latifolia L.	Common Cattail	S5
Urtica dioica L.	Stinging Nettle	S5
Utricularia vulgaris L.	Greater Bladderwort	S5
Vaccinium caespitosum Michx.	Dwarf Bilberry	S2
Vaccinium myrtilloides Michx.	Velvet-leaf Blueberry	S5
Vaccinium uliginosum L.	Bog Blueberry	S5
Vaccinium vitis-idaea L.	Dry-ground Cranberry	S5
Viburnum edule (Michx.) Raf.	Low-bush Cranberry	S5
Vicia americana Muhl.	American Vetch	S5
Viola adunca Sm.	Early Blue Violet	S5
Viola nephrophylla Greene	Bog Violet	S5
Viola renifolia Gray	Kidney-shaped Violet	S4S5
Viola sp.	Violet	
Woodsia ilvensis (L.) R. Br.	Rusty Woodsia	S5

Table 5.11-4. Total forest area in which various tree species occur by percentage of overstorey basal area.

Percentage of basal area	Black spruce	Jack pine	White spruce	Balsam fir	Tamarack	Aspen	Birch
10	44,705	92,676	12,362	578	16,030	139,615	14,629
20	72,294	117,087	11,188	236	11,331	100,616	7,045
30	81,540	103,261	6,191	177	5,159	60,655	2,773
40	64,925	58,652	2,871	96	1,225	34,162	2,077
50	27,888	25,880	821	25	190	10,368	444
60	73,644	55,213	1,113	27	279	34,855	717
70	112,723	44,770	418	25	250	35,030	1,412
80	116,040	28,590	68		58	15,967	495
90	93,517	7,867	18		7	6,458	165
100	151,430	8,143	12		10	3,776	358
Total area (ha)	838,705	542,138	35,064	1,165	34,541	441,503	30,115

Table 5.11-5. Number of plots and distribution of tree species in those plots by fine habitat type.

	All	Fine Habitat Type			
Species		Black Spruce Peaty Mineral	Black Spruce Peatland	Black Spruce Mixedwood	White Spruce Mixedwood
Black spruce (*Picea mariana*)	50	20	6	23	1
Jack pine (*Pinus banksiana*)	5	1	0	4	0
White spruce (*Picea glauca*)	4	0	0	1	3
Balsam fir (*Abies balsamea*)	2	0	0	0	2
Trembling aspen (*Populus tremuloides*)	20	7	0	10	3
Paper birch (*Betula papyrifera*)	2	0	0	2	0
Balsam poplar (*Populus balsamifera*)	4	3	0	1	0
Total number of plots (N)	53	20	6	23	4

5.11.3 Existing Environment- Habitat Composition Of The 1 km Aquatic Buffer.

Table 5.11-6. Surface material complex composition (percentage of land area) in the geographic zones of the 1 km Aquatic Buffer.

Type	1 km Buffer	Median of Zones	Cranberry Lakes	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Wuskwatim South Bay	River Downstream	Opegano Lake
Bedrock upland complex	1	0.7	4.4	0.2	1.1	0.4	1.2	0.2	0.7
Fluviolacustrine sand	0		0.4						
Clayey / bedrock complex	6	1.1	15.1	0.3	4.9	0.8	1.1	6.8	0.1
Clayey / bedrock/ veneer bog toposequence	0				1.4				
Clayey with veneer bog patches	15	11.8	11.8	7.5	27.5	19.8	28.3	5.8	5.1
Clayey with veneer bog interspersion and occasional peat plateaus	40	36.6	32.2	42.0	34.0	36.6	35.4	48.2	58.6
Veneer bog with clayey patches and occasional peat plateaus	2	2.0	2.1	2.0	0.8	0.8	8.7	0.1	2.2
Featureless bog	3	1.8	1.6	1.8	3.6	0.3	1.0	2.8	7.8
Bog complex with patches of collapse fen and clayey	27	28.3	29.1	40.8	21.4	28.3	17.2	33.7	18.5
Veneer bog with patches of horizontal fen and occasional clayey	0	0.2	0.5	0.2	1.7	0.1		0.1	0.3
Peat plateau bog with collapse scars	0				0.0	0.2			
Tall shrub fen or bog	0		0.4			0.1	0.1		
Fen with patches of bog and marsh	0	0.0	0.1		0.0	0.1	0.0		0.0
Fen with patches of water and bog	6	5.3	2.4	5.3	3.5	12.2	7.1	2.2	6.6
Water with fen, bog and/ or marsh margin	0					0.2			
Water	0	0.0			0.2	0.7	0.1	0.0	
Area of all types (ha)	18,994	2,462	4,421	1,520	3,074	3,884	1,020	2,918	2,155

Table 5.11-7. Land type composition of 1 km Aquatic Buffer geographic zones (percentage of land area).

Land Type	Cranberry Lakes	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Southeast Bay	River Down-stream	Opegano Lake	All Areas
Agriculture	0							0
Dry mineral soil	5	12	2	6	1	2	7	5
Exposed bedrock	2	0	1	0	1	0	1	1
Fen with patches of water	2	5	2	11	6	2	3	4
Peaty mineral soil	25	5	40	15	34	24	35	25
Mineral soil	32	36	25	37	31	33	23	31
Mineral soil or exposed bedrock					2	0		0
Peatland	33	41	30	29	23	39	31	33
Wet bog				1				0
Wetland	0			0	0			0
Area of all types (ha)	4,399	1,514	3,057	3,841	1,012	2,907	2,147	18,878

Land cover composition varies by geographic zone in the 1 km Aquatic Buffer (Table 5.11-8). Sesep Lake geographic zone has substantially different land cover composition compared with the other geographic zones (Table 5.11-8). Conifer forest cover is much lower, while the cover of other types are higher.

Broad habitat composition varies in the different geographic zones of the 1 km Aquatic Buffer (Figure 5.3-11). Broad habitat composition in Sesep Lake zone is quite different from the rest of the 1 km Aquatic Buffer zone (Figure 5.11-3); there is a strong contrast between upland and lowland land cover types. Black spruce forest on peaty mineral soil is much less abundant than in the other zones. Black spruce forest on peaty mineral soil covers 7% of the Sesep Lake buffer compared with a median of 34% for the rest of the geographic zones in the buffer. Sesep Lake has the second lowest percentage of area in black spruce forest on peatlands. Relatively low black spruce forest on mineral soil coverage is offset by the highest percentages of area in open black spruce on peat, hardwood forest (includes hardwood dominated mixedwoods) and jack pine forest (includes pine dominated mixedwoods). This is also reflected in the fine habitat types within the generalized cover types. For example, jack pine dominated forest (jack pine > 70% of basal area) and aspen/ jack pine mixedwood forest are much more prevalent around Sesep Lake than in the other zones (4.5% and 12.3% compared with second highest at 1.2% and 7.2%).

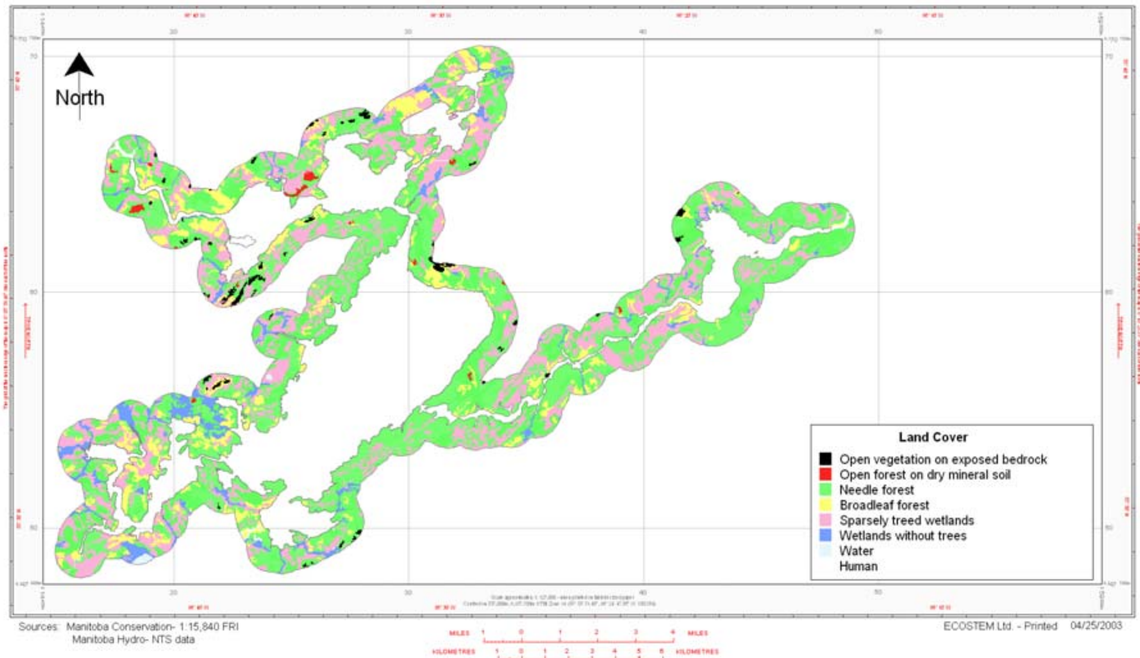

Figure 5.11-1. Land cover in 1 km aquatic buffer.

Table 5.11-8. Land cover by geographic zone in the 1 km Aquatic Buffer.

Land Cover	Median	Cranberry Lakes	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Wuskwatim South Bay	River Down-stream	Opegano Lake
Open vegetation on exposed bedrock	1	2	0	1	0	1	0	1
Open forest on dry mineral soil	5	5	12	2	6	1	2	7
Conifer forest	54	48	26	66	39	62	54	64
Hardwood forest	10	13	18	6	14	10	8	3
Very open vegetation on peatlands	28	29	39	23	28	18	34	22
Very open vegetation on other wetlands	3	3	5	2	12	9	2	3
Human		0						
Total area (ha)	2,907	4,404	1,514	3,057	3,841	1,015	2,907	2,147

Cranberry Lakes generalized land cover is most similar to the mean and median of the zones. Cranberry Lakes also has the highest heterogeneity of surface materials. Of the fine habitat types, only jack pine sparsely treed rock, jack pine > 70% on dry sites and willow wetland are substantially more prevalent around Cranberry Lakes than in the other zones. Each of these areas account for less than 2.3% of the zone. The area in willow wetland was concentrated in low lying areas south of or leading away from the Burntwood River. Jack pine on outcrop or dry sites is scattered throughout the zone. The only white spruce forest in the Aquatic Buffer occur in this zone. Two of the three patches occur along the Burntwood River.

Wuskwatim Main has the highest percentage of area in other conifer mixedwood forest in general and black spruce mixedwood forest in particular (15.6% and 10.5% of area, respectively; Figure 5.11-3). The white spruce conifer mixedwood (white spruce most abundant but <51%, other conifers making up difference to 70% conifer) is along the western shore of the lake. All of the white spruce mixedwood (white spruce 51 – 70%) is near the proposed dam straddling this and the Burntwood River buffer zones. Hardwood (including hardwood mixedwood forest) and pine mixedwood forest cover are low along Wuskwatim Main. Open black spruce cover is the median value even though virtually all peatland along the shoreline has disappeared. This is due to large peatland complexes located behind the hill running along the lakeshore.

The highest percentages of area in muskeg/ beaver flood and lowest percentages of black spruce on peatland distinguish Wuskwatim Brook from the other zones. Beaver flood cover is highest in this zone (10.5% compared with second highest 6.2%). This reflects differences in surface materials described in the previous section. Combined area of these two land cover types in the entire buffer is only 9%.

Wuskwatim Brook Southeast Bay and Opegano Lake jointly have the highest percentage of area in black spruce forest on mineral soil, the most abundant land cover type in the buffer as a whole. High black spruce forest on mineral soil coverage is partially offset by the lowest area coverages of open black spruce on peatland and pine mixedwood forest. Black spruce/ jack pine mixedwood does not occur in the Wuskwatim South Bay. Mainland marsh cover is highest in this zone but only accounts for 0.3% of the area.

Burntwood River land cover is relatively indistinct from the overall buffer. It has the second highest percentage of area in open black spruce on peat and the second lowest area in other conifer mixedwood. White spruce mixedwood is most prevalent along the Burntwood River.

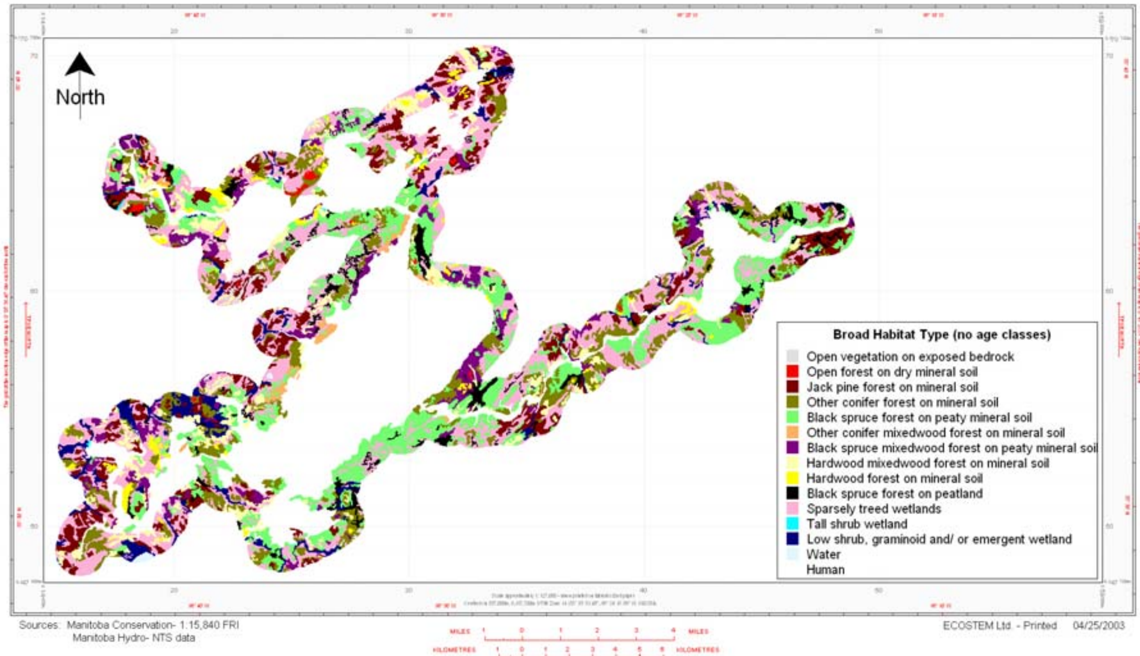

Figure 5.11-2. Broad habitat in 1 km Aquatic Buffer.

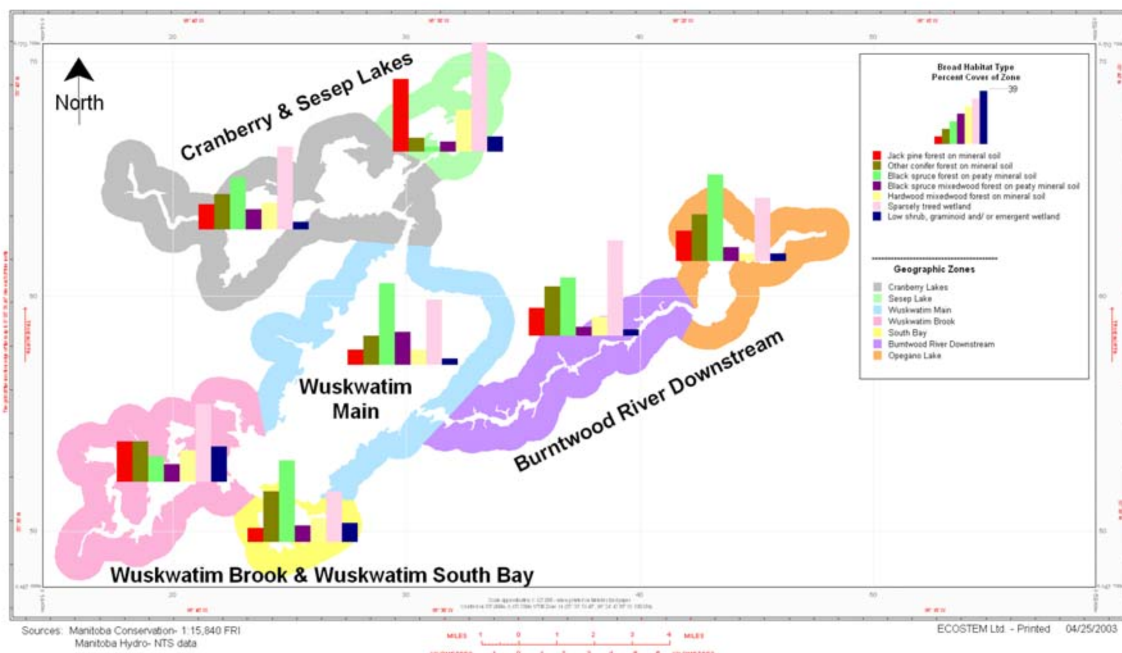

Figure 5.11-3. Broad habitat type as a percentage of total buffer zone area.

As already noted, Opegano Lake along with Wuskwatim Brook Southeast Bay have the highest percentage of area in black spruce forest on mineral soil. Black spruce dominant differs more than black spruce/ jack pine cover from the buffer medians and means. Opegano Lake has the lowest percentage of area in hardwood forest cover. Open tamarack wetland covers 3.8% of the area which is more than double that in Wuskwatim Main, the zone with the second highest cover.

Most of the old forest is in the Wuskwatim Main geographic zone (Figure 5.3-30).

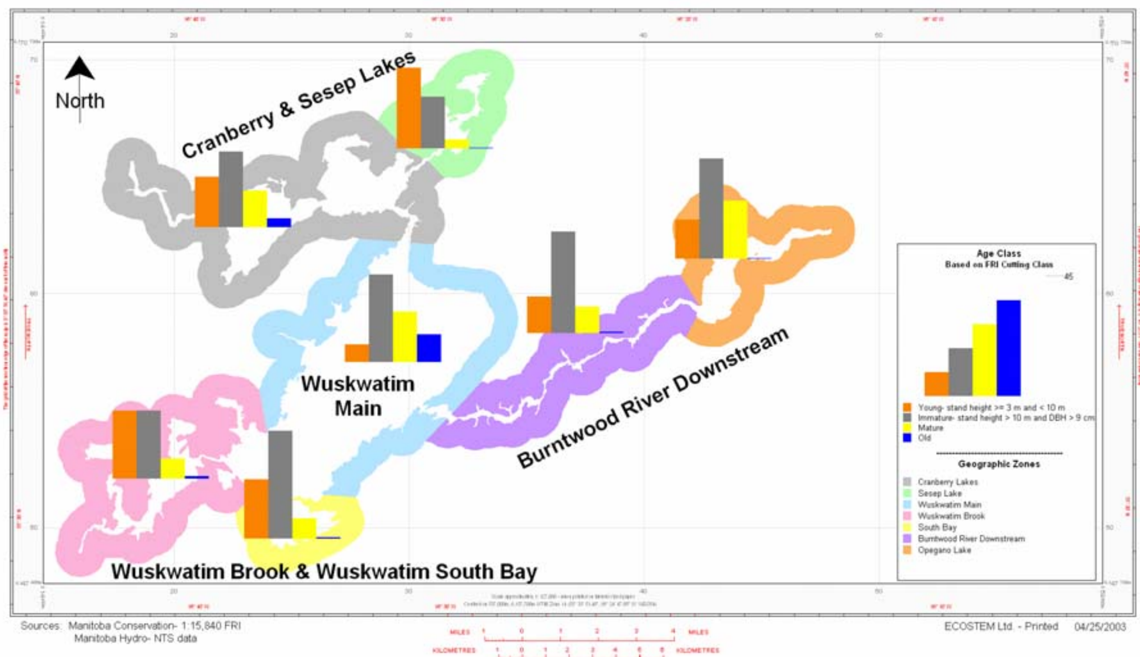

Figure 5.11-4. Age class distribution in 1 km Aquatic Buffer as a percentage of total forest area.

5.11.4 Existing Environment- Vegetation Composition In Different Shore Zone Elevation Bands And Water Duration Zones

5.11.5

Table 5.11-9. Percentage distribution of shore material types (percentage of total length) on Affected Aquatic Area shoreline by geographic zone.

Shore Material Type	Cranberry Lakes & Burntwood River Upstream	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Wuskwatim South Bay	Burntwood River Downstream	Opegano Lake	All Zones
Bedrock	1	0	0	0	0	0	0	0
Bedrock- surface high above water	1	0	1	0	0	4	0	1
Bedrock- surface moderately high above water	1	0	0	0	0	3	0	1
Bedrock- surface low above water	0	0	0	0	0	2	0	0
Clay over hidden bedrock	1	0	0	0	0	0	0	0
Clayey banked	7	0	24	7	2	19	31	12
Clayey deposit over bedrock- clay/ rock interface high above water	0	0	2	0	0	2	4	1
Clayey deposit over bedrock- clay/ rock interface moderately high above water	3	0	18	0	0	10	6	6
Clayey deposit over bedrock- clay/ rock interface moderately high to near water	0	0	2	0	4	0	0	1
Clayey deposit over bedrock- clay/ rock interface near water	11	0	46	7	1	12	13	15
Clay beach- slope > 100%	0	1	1	0	0	2	0	0
Clay beach- slope 12 - 100%	7	7	3	0	0	37	20	9
Clay beach- slope < 12%	34	24	3	54	68	7	2	29
Organic beach	8	8	0	2	0	2	4	3
Mixture of organic & clayey low slope beach	7	27	0	0	13	0	0	5
Peatland	11	33	0	29	12	0	20	15
Floodplain	7	0	0	0	0	0	0	2
Sandy bank	1	0	0	0	0	0	0	0
Total Shoreline Length (km)	78	26	62	85	20	42	24	337

Table 5.11-10. Distribution of dead trees in the forest edge (percentage of total length) on the Affected Aquatic Area shoreline by geographic zone.

Width of Dead Tree Fringe (number of trees)	Cranberry Lakes & Burntwood River Upstream	Sesep Lake	Wuskwatim Main	Wuskwatim Brook	Wuskwatim South Bay	Burntwood River Downstream	Opegano Lake	All Areas
0	94	75	100	67	44	98	99	85
1	6	5	0	23	56	1	0	11
2	0	8	0	8	0	1	1	3
3	1	4	0	2	0	0	0	1
4	0	8	0	0	0	0	0	1
Total Length (km)	78	26	62	85	20	42	24	337

Table 5.11-11. Width of dead tree fringe in forest edge by shore material type. Values in columns are percentage of shoreline with a dead tree fringe of the particular width.

Shore Material	Width (number of dead trees)					Total Length with Dead Trees (km)
	All Widths	1	2	3	4	
Bedrock						
High bedrock (top of bedrock elevation at shoreline > 234.5 m)						
Moderately high bedrock (top of bedrock elevation at shoreline ~234 - 234.5 m)			3			
Low bedrock (top of bedrock elevation at shoreline > 233.5 m)	1					0
Clayey deposits over hidden bedrock						
Clay and silt on bedrock with high mineral/ bedrock interface (contact > 234 m)						1
Clay and silt on bedrock with moderately high mineral/ bedrock interface (contact ~233.5 - 234.3 m)						
Clay and silt on bedrock with moderately high to low mineral/ bedrock interface						
Clay and silt on bedrock with low mineral/ bedrock interface (contact ~233.5 m)						
Clay and silt banks	2	3	0	0	0	
Clayey beach with slope > 100%	0	0	0	0	0	31
Clayey beach with slope ~10% - 100%	0	0	0	0	0	0
Clayey beach with slope < ~10%	61	66	51	64	0	1
Organic material on clayey beach with slope < ~10%	2	3	0	0	0	5
Mixture of O and LClg within shoreline stretch	0	7	10	0	71	0
Upland peatland extends to the middle beach at least. No beach vegetation present.	25	21	35	36	29	13
Floodplain	0	0	0	0	0	
Sand	0	0	0	0	0	
Total Length All Types With Dead Trees (km)	52	37	9	3	2	52

Table 5.11-12. Peat Island cover in Affected Aquatic Area by geographic zone (percentage of total area).

Cover*	Cranberry Lakes	Sesep Lake	Wuskwatim Brook	Wuskwatim South Bay	All Areas	Total Area (ha)
Cattail (*Typha latifolia*)	18.9	21.8	17.2	42.5	22.9	94
Sedge (*Carex* spp.) with Cattail fringe	2.9	1.0	20.0	12.8	8.3	34
Sedge (*Carex* spp.)	11.3	20.9	14.2	25.7	17.3	71
Ericaceous	25.1	18.6	5.4	0.6	14.1	58
Ericaceous and Sedge mosaic	16.4	0.4	12.6	4.7	8.5	35
Ericaceous with Cattail fringe	5.4	14.7	1.7	0.0	6.6	27
Ericaceous with Small Treed Patches	0.0	0.1	0.2	0.0	0.1	0
Tall Shrub	1.9	0.0	0.2	0.0	0.6	2
Tall Shrub & Sedge mosaic	3.1	0.0	0.0	0.0	0.8	3
Treed Island	12.8	22.5	12.1	13.6	15.9	65
Bare peat	0.9	0.0	0.0	0.0	0.2	1
Submerged peat	0.0	0.0	0.0	0.0	0.0	0
Unknown	1.4	0.0	16.4	0.1	4.8	20
Total area of all types (ha)	108	133	110	61	411	411

* See Table 5.3-19 for a description of cover types. See Figure 25 for location of bays.

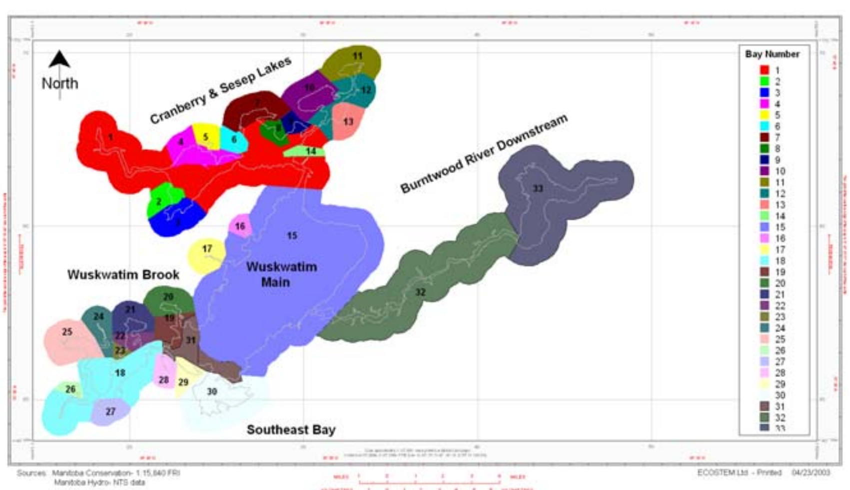

Figure 5.11-5. Peat Island bay numbers.

Table 5.11-13. Peat Island cover* (percentage of total bay area) in Affected Aquatic Area by "bay".

Bay	Cattail (*Typha latifolia*)	Sedge (*Carex* spp.) with Cattail fringe	Sedge (*Carex* spp.)	Ericaceous and Sedge mosaic	Ericaceous	Ericaceous with Cattail fringe	Ericaceous with Small Treed Patches	Tall Shrub & Sedge mosaic	Tall Shrub	Treed Island	Bare peat	Submerged peat	Unknown	Area of All Cover types (ha)
1	56	0	10	0	11	0	0	0	0	0	0	0	23	2
2	3	3	17	51	1	1	0	10	6	9	0	0	0	35
3	26	15	21	0	28	0	0	0	0	4	0	0	6	7
4	28	1	1	0	7	12	0	0	0	37	14	0	0	4
5	0	0	1	0	94	0	0	0	0	0	6	0	0	6
6	7	1	4	0	42	20	0	0	0	25	1	0	0	8
7	31	5	7	0	22	16	0	0	0	19	0	0	0	9
8	21	2	0	0	50	6	0	0	0	21	0	0	0	24
9	79	0	0	0	7	0	0	0	0	2	0	0	13	5
10	46	0	7	0	23	17	0	0	0	6	0	0	0	47
11	0	0	41	1	6	4	0	0	0	48	0	0	0	48
12	16	5	31	0	45	0	0	0	0	3	0	0	0	11
13	21	3	5	0	22	35	0	0	0	14	0	0	0	27
14	37	0	43	0	14	5	0	0	0	1	0	0	0	9
18	0	0	2	0	0	0	0	0	0	0	0	0	97	14
19	1	1	49	0	15	13	0	0	0	12	0	0	8	3
20	20	40	13	0	3	0	0	0	0	21	0	0	2	4
21	21	49	11	0	1	3	0	0	0	13	0	0	1	12
22	18	58	12	0	4	0	0	0	0	9	0	0	0	2
23	0	0	0	74	0	0	0	0	0	13	0	0	13	8
24	0	0	0	0	0	0	0	0	0	0	0	0	100	1
25	4	34	34	3	11	0	0	0	1	12	0	0	0	24
26	0	0	46	0	4	0	0	0	0	50	0	0	0	1
27	21	19	38	2	13	0	0	0	0	7	0	0	0	5
28	32	2	4	33	7	0	1	0	0	15	0	0	4	21
29	44	26	3	0	3	7	0	0	0	16	0	0	0	15
30	43	13	26	5	1	0	0	0	0	14	0	0	0	61
31	0	0	15	0	0	0	0	0	0	0	0	0	85	0
All	23	8	17	8	14	7	0	1	1	16	0	0	5	411
Area in All Bays (ha)	94	34	71	35	58	27	0	3	2	65	1	0	20	411

[1] See Table 5.3-19 for a description of cover types. See Figure 5.11-5 for location of bays.

Table 5.11-14. Wild mint habitat quality in Shore Zone and Peat Island habitat. Values are percentage of shoreline length in Affected Aquatic Area and percentage of area for Peat Islands.

Habitat Type	Habitat Quality				Length (m)/ Area (ha)
	High	Moderate	Poor	Very Poor	
Shore Zone					
High bedrock (top of bedrock elevation at shoreline > 234.5 m)				0.9	2885
Moderately high bedrock (top of bedrock elevation at shoreline ~234 - 234.5 m)				0.7	2,260
Bedrock				0.4	1,443
Low bedrock (top of bedrock elevation at shoreline > 233.5 m)				0.3	893
Clayey deposits over hidden bedrock				0.3	875
Clay and silt on bedrock with high mineral/ bedrock interface (contact > 234 m)				0.9	3,047
Clay and silt on bedrock with moderately high mineral/ bedrock interface (contact ~233.5 - 234.3 m)				5.7	19,220
Clay and silt on bedrock with moderately high to low mineral/ bedrock interface				0.7	2,412
Clay and silt on bedrock with low mineral/ bedrock interface (contact ~233.5 m)				15.3	51,784
Clay and silt banks				12.3	41,417
Floodplain		1.5			5,125
Sandy				0.2	813
Clayey beach with slope > 100%			0.5		1,645
Clayey beach with slope ~10% - 100%		8.8			29,708
Clayey beach with slope < ~10%	28.8				97,346
Mixture of O and LClg within shoreline stretch		4.6			15,517
Organic material on clayey beach with slope < ~10%			3.5		11,671
Upland peatland extends to the middle beach at least. No beach vegetation present.				14.7	49,569
All Shore Zone Types	28.8	14.9	3.9	52.3	337,630
Shore Zone Length (km)	97	50	13	177	
Peat Islands				100	

Table 5.11-15. Sweet flag habitat quality in Shore Zone and Peat Island habitat. Figures are percentage of shoreline length in Affected Aquatic Area and percentage of area for Peat Islands.

Habitat Type	High	Moderate	Poor	Very Poor	Length (m)/ Area for All Qualities
Shore Zone					
High bedrock (top of bedrock elevation at shoreline > 234.5 m)				0.9	2,885
Moderately high bedrock (top of bedrock elevation at shoreline ~234 - 234.5 m)				0.7	2,260
Bedrock				0.4	1,443
Low bedrock (top of bedrock elevation at shoreline > 233.5 m)				0.3	893
Clayey deposits over hidden bedrock				0.3	875
Clay and silt on bedrock with high mineral/ bedrock interface (contact > 234 m)				0.9	3,047
Clay and silt on bedrock with moderately high mineral/ bedrock interface (contact ~233.5 - 234.3 m)				5.7	19,220
Clay and silt on bedrock with moderately high to low mineral/ bedrock interface				0.7	2,412
Clay and silt on bedrock with low mineral/ bedrock interface (contact ~233.5 m)				15.3	51,784
Clay and silt banks				12.3	41,417
Floodplain				1.5	5,125
Sandy				0.2	813
Clayey beach with slope > 100%				0.5	1,645
Clayey beach with slope ~10% - 100%				8.8	29,708
Clayey beach with slope < ~10%			18.4	10.4	97,346
Mixture of O and LClg within shoreline stretch		3.6		1.0	15,517
Organic material on clayey beach with slope < ~10%	2.4			1.0	11,671
Upland peatland extends to the middle beach at least. No beach vegetation present.				14.7	49,569
All Shore Zone Types	2.4	3.6	18.4	75.6	337,630
Shore Zone Length (km)	8	12	62	255	338
Peat Islands				100	

Table 5.11-16. Manitoba Conservation Data Centre species ranks: rarity codes and descriptions.

The Manitoba Conservation Data Centre ranks species based on their rarity within several geographic ranges. Rankings are based on verified observations of the species.

:Rarity	Description
1	Very rare throughout its range/country/subnation or in the province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation.
2	Rare throughout its range or in the province (6 to 20 occurrences). May be vulnerable to extirpation.
3	Uncommon throughout its range or in the province (21 to 100 occurrences).
4	Widespread, abundant, and apparently secure throughout its range or in the province, with many occurrences, but the element is of long- term concern (> 100 occurrences).
5	Demonstrably widespread, abundant, and secure throughout its range or in the province, and essentially irradicable under present conditions.

Ranges considered are global (G), national (N), provincial/ state (S). Example rankings: S1, G3

Table 5.11-17. Provincially very rare and rare plants with potential to occur in the Sub-Region.

Scientific Name	Common Name	Habitat	Confirmed Location Outside The Region	MB CDC S Rank
Arenaria macrophylla Hook. *(Moehringia macrophylla)*	large-leaved sandwort	sandy, rocky shores, wooded slopes	South Indian L.	S1 S2
Arethusa bulbosa L.	swamp-pink	sphagnum bogs peat meadows	Wekusko Lake	S2
Astragalus bodinii Sheldon	milk-vetch	cobble beaches, grassy areas	Cross L. Pipestone L.	S1
Drosera linearis Goldie	slender-leaved sundew	calcareous fens	Easterville,God's R.	S2
Glyceria pulchella (Nash) Schum.	graceful manna grass	wet soil, shallow water	Norway House	S2
Lycopodium tristachyum Pursh	ground cedar	dry woods, clearings	Norway House, Cross L.	S2
Nymphaea odorata Ait.	fragrant water-lily	quiet water	Minago R.	S2
Nymphaea tetragona Georgi	small water-lily	ponds	Minago R.	S2
Salix arbusculoides Anderss.	shrubby willow	stream banks, open forest, muskeg	Flin Flon,Nelson R.	S2 S3
Selaginella selaginoides (L.) Link.	northern spike-moss	damp shores, mossy banks	The Pas, Gillam	S2
Vaccinium caespitosum Michx.	dwarf blueberry	open woods and clearings		S2
Viola selkirkii Pursh	long-spurred violet	wet woods	The Pas	S1
Woodsia alpina (Bolton) S.F. Gray	northern woodsia	calcareous outcrops	Norway House, Island L.	S1
Woodsia glabella R. Br.	smooth woodsia	calcareous outcrops	Flin Flon	S2
Woodsia oregana Eat.	large woodsia	schist cliffs	FlinFlon	S1

5.12 APPENDIX 3 - PROJECT EFFECTS: DETAILED RESULTS AND TABLES

Table 5.12-1. Land type composition in the Generating Station Project Areas and comparison areas; Generating Station Project Areas as a percentage of comparison areas.*

Land Type	GS Project Areas (%)	**GS Clearing (ha)**				**GS Disturbed (ha)**	Perccentage of Area			Percentage of Comparison Area	
		Operational Flooding	Permanent	Full Rehab	Slight Rehab		Region	Sub-Region	1 km Aquatic Buffer	GS Project Areas as % of Sub-Region	GS Project Areas as % of Aquatic Buffer
Exposed bedrock	1					2	4	2	1	0	1
Dry mineral soil							4	2	0		
Mineral soil	29	13	17	22	4	66	21	25	36	0	2
Peaty mineral soil	53	20	33	37	4	120	15	17	25	0	4
Peatland	17	4	23	1	2	37	39	35	32	0	1
Wet bog							1	2	0		
Fen with patches of water							4	6	4		
Wetland- Other							1	1	0		
Fluctuating water							0	0			
Shallow water							0	0	0		
Lake							11	9	0		
River	0	0					1	1	0		
Agriculture							0	0	0		
Human							0	1			
Total Area (ha)	407	38	74	60	10	226	2,345,924	335,625	18,920		
Total Land Area (ha)	407	38	74	60	10	226	2,085,865	301,724	18,885		

* Percentage values in columns 1 and 7 – 10 are based on total area including water.

Table 5.12-2. Broad habitat composition in the Generating Station Project Areas and as a percentage of comparison areas.

		GS Clearing (ha)					Perccentage of Area			Percentage of Comparison Area	
Broad Habitat Type	**GS Project Areas (%)**	Operational Flooding	Generating Station Permanent Clearing	Generating Station Clearing Full Rehab	Generating Station Clearing Slight Rehab	**GS Disturbed- not cleared** (ha)	Region	Sub-Region	1 km Aquatic Buffer	GS Structure as % of Sub-Region	GS Structure as % of Aquatic Buffer
Open vegetation on Exposed bedrock	1						4	3	1	0	1
Other conifer forest on Mineral soil- Immature	2	5	0			3	3	3	4	0	1
Other conifer forest on Mineral soil- Mature	19	8	5	19	1	45	2	2	3	1	12
Other conifer forest on Mineral soil- Young							6	4	6		
Black spruce forest on Peaty mineral soil- Immature	32	13	28	11	3	75	5	6	12	1	6
Black spruce forest on Peaty mineral soil- Mature	4	1	1			15	2	2	3	0	3
Black spruce forest on Peaty mineral soil- Young							7	6	3		
Other conifer mixedwood forest on Mineral soil- Immature							0	0	0		
Other conifer mixedwood forest on Mineral soil- Mature	2	0	1			6	0	0	1	2	7
Black spruce mixedwood forest on Peaty mineral soil- Immature	17	6	4	26	1	30	1	1	3	3	14
Black spruce mixedwood forest on Peaty mineral soil- Mature							1	1	1		
Black spruce mixedwood forest on Peaty mineral soil- Young							2	3	3		
Hardwood mixedwood forest on Mineral soil- Immature	4	0	8	1	3	3	1	1	4	0	2
Hardwood mixedwood forest on Mineral soil- Mature	0		0			2	1	1	2	0	0
Hardwood mixedwood forest on Mineral soil- Young							2	4	2		
Hardwood forest on Mineral soil- Immature	3		2	2		9	1	0	1	1	5
Hardwood forest on Mineral soil- Mature							0	1	1		
Hardwood forest on Mineral soil- Young							1	1	0		
Black spruce forest on Peatland- Immature	12		22	1	2	23	3	4	3	0	10
Black spruce forest on Peatland- Mature							1	1	1		
Black spruce forest on Peatland- Young	1				0	2	3	4	1	0	1
Sparsely treed wetland	4	4	0	0		12	36	29	28	0	0
Small islands (< 2 ha)	1	1	2				0	0	0	1	12
Total area (ha)	407	38	74	60	10	226	2,345,924	335,625	18,920		
Total land area (ha)	407	38	74	60	10	226	2,085,865	301,724	18,885		

Note: Percentage totals for some columns do not sum to 100% because table only includes those habitat types that occur in the Generating Station Project Areas as well as types similar to those present (e.g., successional stages).

Table 5.12-3. Fine habitat composition in the Generating Station Project Areas and as a percentage of comparison areas.

		GS Clearing (ha)					Perccentage of Area			Percentage of Comparison Area	
Fine Habitat Type	**GS Project Areas (%)**	Operational Flooding	Permanent Clearing	Full Rehab	Slight Rehab	**GS Disturbed- not cleared (ha)**	Region (%)	Sub-Region (%)	1 km Aquatic Buffer (%)	GS Project Areas as % of Sub-Region	GS Project Areas as % of Aquatic Buffer
Jack pine sparsely treed on Exposed bedrock	1					2	4	3	1	0	1
Black spruce > 70% forest on Mineral or peaty soil- Immature	32	13	28	11	3	75	5	6	12	1	6
Black spruce > 70% forest on Mineral or peaty soil- Mature	2	0	0			8	2	2	2	0	2
Black spruce > 70% forest on Mineral or peaty soil- New							1	1	1		
Black spruce > 70% forest on Mineral or peaty soil- Old	2	1	1			7	0	0	1	1	5
Black spruce > 70% forest on Mineral or peaty soil- Young							5	4	2		
Black spruce mixedwood forest on Mineral or peaty soil- Immature	15	6	4	23	1	25	0	1	1	4	25
Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil- Immature	2	5	0			2	0	0	1	2	5
Black spruce/ Balsam fir/ White spruce > 70% forest on Mineral soil- Old	13	1	4	19		31	0	0	0	8	79
Black spruce/ Jack pine > 70% forest on Mineral soil- Immature	0					1	2	3	3	0	0
Black spruce/ White spruce mixedwood forest on Mineral or peaty soil- Immature	2			3		5	0	0	0	6	10
White spruce mixedwood forest on Mineral soil- Mature	2	0	1			6	0	0	0	22	74
White spruce/ Conifer > 70% forest on Mineral soil- Mature	6	7	1		1	15	0	0	1	8	14
Aspen > 70% forest on Mineral soil- Young							0	0	0		
Aspen > 70% forest on Mineral soil- Immature	3		2	2		9	1	0	1	1	5
Aspen/ Conifer mixedwood forest on Mineral soil- Immature	4	0	8	1	3	3	1	1	2	1	4
Aspen/ Conifer mixedwood forest on Mineral soil- Mature	0		0			2	1	1	2	0	0
Black spruce > 70% forest on Peatland- Immature	12		22	1	2	22	3	4	3	0	10
Black spruce > 70% forest on Peatland- New							1	1	0		
Black spruce > 70% forest on Peatland- Young	1				0	2	1	2	1	0	2
Black spruce/ Tamarack > 70% forest on Peatland- Immature	0					1	0	0	0	0	5
Black spruce sparsely treed Peatland	4	4	0	0		12	33	27	27	0	0
Small islands (less than 2 ha.) on Mineral soil or exposed bedrock	1	1	2				0	0	0	1	12

Note: Percentage totals for some columns do not sum to 100% because table only includes those habitat types that occur in the Generating Station Project Areas as well as types similar to those present (e.g., successional stages).

Table 5.12-4. Land type in the Access Road and Borrow Pit Areas and as a percentage of comparison areas.

	Perccentage of Project Area												Perccentage of Area			Percentage of Sub-Region					Percentage of Upland Buffer			
Land Type	Access Road	Borrow Pit G	Bo rrow Pit H Access	Borrow Pit H-E	Borro w P it H-W	Borrow Pit J Access	Borrow Pit J-1	Borrow Pit J-2	Borrow Pit J-3	Borrow Pit J-4	Borrow Pit J-5	Borrow Pit J-6	Region	Sub-Region	1 km Upland Buffer	1 km Upland Buffer	Access Road	Borrow G	Borrow J	Borrow H	Access Road	Borrow G	Borrow J	Borrow H
Exposed bedrock	2					0			25				4	2	1	2	0		0		4		1	
Dry mineral soil	15	84				24		96	71			18	4	2	13	26	1	5	0		4	20	2	
Mineral soil	30	14	84	100	100	33	93		1	100	80	82	21	25	30	5	0	0	0	0	4	1	2	5
Peaty mineral soil	14					23			2		13	0	15	17	12	3	0		0		4		1	
Peatland	36	3	16		0	11		4			7		39	35	37	4	0	0	0	0	4	0	0	0
Wet bog	0												1	2	0	1	0				1			
Wetland	0												1	1	1	3	0				2			
Fen with patches of water	3	0				8							4	6	4	3	0	0	0		2	0	0	
Lake	0					2	7						11	9	1	0	0		0		0		1	
River													1	1	0	0								
Human	0												0	1	0	1	0				3			
All types																					4	3	1	2
Total Land Area (ha)	482	392	45	90	64	34	7	10	7	6	22	38	2,085,865	301,724	12,917									

Table 5.12-5. Land cover composition in the Access Road and Borrow Pit Project Areas and as a percentage of comparison areas.

	Perccentage of Project Area												Perccentage of Area			Percentage of Sub-Region					Percentage of Upland Buffer			
Land Cover	Access Road	Borrow Pit G	Borrow Pit H Access	Borrow Pit H-E	Borrow Pit H-W	Borrow Pit J Access	Borrow Pit J-1	Borrow Pit J-2	Borrow Pit J-3	Borrow Pit J-4	Borrow Pit J-5	Borrow Pit J-6	Region	Sub-Region	1 km Upland Buffer	1 km Upland Buffer	Access Road	Borrow G	Borrow J	Borrow H	Access Road	Borrow G	Borrow J	Borrow H
Very open vegetation on Exposed bedrock	2					0			25				4	2	1	2	0		0		4		1	
Open forest on Dry mineral soil	15	84				24		96	71			18	4	2	13	26	1	5	0		4	20	2	
Forest- Conifer	44	9	97	100	100	56	64	4	3	100	93	82	37	43	39	4	0	0	0	0	4	1	2	4
Forest- Hardwood	5	4	3	0		4	28						5	7	9	5	0	0	0	0	2	1	0	0
Very open vegetation on peatlands	31	3	0		0	6					7		32	26	31	5	0	0	0	0	4	0	0	0
Very open vegetation on other wetlands	3	0				8							6	8	5	2	0	0	0		2	0	0	
Human	0												0	1	0	1	0				3			
Water	0					2	7						11	10	1	0	0		0		0		1	
Total Land Area (ha)	482	392	45	90	64	34	7	10	7	6	22	38	2,084,747	301,558	12,917									

Table 5.12-6. Broad habitat types in the Access Road and Borrow Pit Project Areas (percentage of land area) and as a percentage of comparison areas.

	Perccentage of Project Area												Perccentage of Area			Percentage of Sub-Region					Percentage of Upland Buffer			
Broad Habitat Type	Access Road	Borrow Pit G	Borrow Pit H Access	Borrow Pit H-E	Borrow Pit H-W	Borrow Pit J Access	Borrow Pit J-1	Borrow Pit J-2	Borrow Pit J-3	Borrow Pit J-4	Borrow Pit J-5	Borrow Pit J-6	Region	Sub-Region	1 km Upland Buffer	1 km Upland Buffer	Access Road	Borrow G	Borrow J	Borrow H	Access Road	Borrow G	Borrow J	Borrow H
Open vegetation on Exposed bedrock	2					0			25				4	3	1	2	0		0		4		1	
Open forest on Dry mineral soil- Immature	2					24		96	71			18	1	0	2	18	1		2		5		13	
Open forest on Dry mineral soil- Mature	3												0	0	2	27	2				6			
Open forest on Dry mineral soil- Young	10	84											3	1	9	28	1	8			4	27		
Jack pine forest on Mineral soil- Immature	1					8				85		56	1	2	1	2	0		1		5		27	
Jack pine forest on Mineral soil- Mature													1	2	0	0								
Jack pine forest on Mineral soil- Young	8	9	45	100	100	0							5	5	10	8	0	0	0	1	3	3	0	14
Other conifer forest on Mineral soil- Immature	3					0	69						3	3	4	4	0		0		4		1	
Other conifer forest on Mineral soil- Mature	1		36										2	2	1	1	0			0	7			20
Other conifer forest on Mineral soil- Young	11					22			1	15	80	25	6	4	7	6	0		0		6		4	
Black spruce forest on Peaty mineral soil- Immature	5												5	6	3	2	0				5			
Black spruce forest on Peaty mineral soil- Mature	0												2	2	0	1	0				1			
Black spruce forest on Peaty mineral soil- Young	6					23			2		13	0	7	6	5	4	0		0		4		2	
Black spruce mixedwood forest on Peaty mineral soil- Immature	1												1	1	1	7	0				3			
Black spruce mixedwood forest on Peaty mineral soil- Mature													1	1	0	0								
Black spruce mixedwood forest on Peaty mineral soil- Young	2					1							2	3	1	2	0		0		6		0	
Hardwood mixedwood forest on Mineral soil- Immature	0					4	28						1	1	1	3	0		0		0		3	
Hardwood mixedwood forest on Mineral soil- Mature	0												1	1	0	0	0				4			
Hardwood mixedwood forest on Mineral soil- Young	5	3	3	0									2	4	7	8	0	0		0	2	1		0
Hardwood forest on Mineral soil- Immature							3						1	0	0	2			0				1	
Hardwood forest on Mineral soil- Young	1	1											1	1	1	7	0	0			2	2		
Black spruce forest on Peatland- Immature	4					4		4					3	4	3	3	0		0		4		0	
Black spruce forest on Peatland- Young	1		16										3	4	3	3	0			0	1			2
Sparsely treed wetland	31	3	0		0	7					7		36	29	31	5	0	0	0	0	4	0	0	0
Tall shrub wetland	0												1	1	1	3	0				2			
Low shrub, graminoid and/ or emergent wetland	3	0				8							6	8	5	2	0	0	0		2	0	0	
Human- Linear	0												0	0	0	2	0				3			

Note: Percentage totals for some columns do not sum to 100% because table only includes those habitat types that occur in the Generating Station Project Areas as well as types similar to those present (e.g., successional stages).

Table 5.12-7. Fine Habitat type in the Access Road and Borrow Pit Project Areas and as a percentage of comparison areas.

	Perccentage of Project Area												Perccentage of Area			Percentage of Sub-Region					Percentage of Upland Buffer			
Fine Habitat Type	Access Road	Borrow Pit G	Borrow Pit H Access	Borrow Pit H-E	Borrow Pit H-W	Borrow Pit J Access	Borrow Pit J-1	Borrow Pit J-2	Borrow Pit J-3	Borrow Pit J-4	Borrow Pit J-5	Borrow Pit J-6	Region	Sub-Region	1 km Upland Buffer	1 km Upland Buffer	Access Road	Borrow G	Borrow J	Borrow H	Access Road	Borrow G	Borrow J	Borrow H
Jack pine sparsely treed on Exposed bedrock	2					0			25				4	3	1	2	0		0		4		1	
Jack pine > 70% forest on Dry mineral soil- Immature	2											18	0	0	1	29	2		1		6		4	
Jack pine/ Black spruce > 70% forest on Dry mineral soil- Immature	1					7		96					0	0	0	11	1		2		5		23	
Jack pine > 70% forest on Dry mineral soil- Mature	0												0	0	0	9	1				6			
Jack pine/ Black spruce > 70% forest on Dry mineral soil- Mature	2												0	0	2	53	3				6			
Jack pine > 70% forest on Dry mineral soil- New	6												0	0	3	32	3				8			
Jack pine > 70% forest on Dry mineral soil- Young	3	84											0	1	6	45	1	18			2	41		
Jack pine/ Black spruce > 70% forest on Mineral soil- Immature	1					7				85		56	1	1	1	2	0		1		7		37	
Jack pine > 70% forest on Mineral soil- New	1												1	0	1	26	1				2			
Jack pine > 70% forest on Mineral soil- Young	3	9	31	100	87	0							0	1	4	19	1	1	0	6	3	8	0	33
Jack pine/ Black spruce > 70% forest on Mineral soil- Young	1												2	2	2	5	0				2			
Jack pine mixedwood forest on Dry mineral soil- Young	1												0	0	0	11	1				7			
Jack pine mixedwood forest on Mineral soil- Young	1												0	1	1	6	0				5			
Jack pine/ Black spruce mixedwood forest on Mineral soil- Young	2		14		13								0	1	2	11	0			1	4			6
Black spruce/ Jack pine > 70% forest on Mineral soil- Immature	3					0	64						2	3	3	4	0		0		4		1	
Black spruce/ Jack pine > 70% forest on Mineral soil- Mature	1		36										1	2	1	2	0			0	7			20
Black spruce/ Jack pine > 70% forest on Mineral soil- Young	11					21			1	15	80	25	3	3	7	9	1		0		6		4	
Black spruce > 70% forest on Peatland- Immature	4					4		4					3	4	3	3	0		0		5		0	
Black spruce/ Tamarack > 70% forest on Peatland- Immature	0												0	0	0	5	0				2			
Black spruce > 70% forest on Peatland- New			16										1	1	1	3				0				5
Black spruce > 70% forest on Peatland- Young	1												1	2	1	3	0				3			
Black spruce > 70% forest on Peaty mineral soil- Immature	5												5	6	3	2	0				5			
Black spruce > 70% forest on Peaty mineral soil- Mature	0												2	2	0	1	0				1			
Black spruce > 70% forest on Peaty mineral soil- New	1												1	1	1	6	0				6			
Black spruce > 70% forest on Peaty mineral soil- Young	5					22			2		13	0	5	4	5	5	0		0		4		2	
Black spruce mixedwood forest on Peaty mineral soil- Immature	1												0	1	1	9	0				3			
Black spruce mixedwood forest on Peaty mineral soil- New	1												0	0	0	6	1				9			
Black spruce mixedwood forest on Peaty mineral soil- Young	1					1							1	0	1	6	0		0		6		0	
Aspen/ Conifer mixedwood forest on Mineral soil- Immature	0												1	1	0	2	0				1			
Aspen/ Jack pine mixedwood forest on Mineral soil- Immature						4	26						0	1	1	4			0				4	

	Perccentage of Project Area												Perccentage of Area			Percentage of Sub-Region					Percentage of Upland Buffer			
Fine Habitat Type	Access Road	Borrow Pit G	Borrow Pit H Access	Borrow Pit H-E	Borrow Pit H-W	Borrow Pit J Access	Borrow Pit J-1	Borrow Pit J-2	Borrow Pit J-3	Borrow Pit J-4	Borrow Pit J-5	Borrow Pit J-6	Region	Sub-Region	1 km Upland Buffer	1 km Upland Buffer	Access Road	Borrow G	Borrow J	Borrow H	Access Road	Borrow G	Borrow J	Borrow H
Aspen/ Conifer mixedwood forest on Mineral soil- Mature	0												1	1	0	0	0				4			
Aspen/ Conifer mixedwood forest on Mineral soil- New	1												0	1	1	2	0				5			
Aspen/ Jack pine mixedwood forest on Mineral soil- New	3												0	1	1	12	1				7			
Aspen/ Conifer mixedwood forest on Mineral soil- Young	1	1											1	1	2	10	0	0			2	2		
Aspen/ Jack pine mixedwood forest on Mineral soil- Young		2	3	0									0	1	3	12		0		0		2		0
Aspen > 70% forest on Mineral soil- Immature							3						1	0	0	2			0				1	
Aspen > 70% forest on Mineral soil- Young	1	1											0	0	1	10	0	0			3	3		
Black spruce sparsely treed on Peatland	31	3	0		0	6					1		33	27	30	5	0	0	0	0	4	0	0	0
Tamarack sparsely treed on Peatland	0					1					6		1	1	2	6	0		0		0		1	
Willow on Wetland	0												1	1	1	3	0				2			
Graminoid on Fen with patches of water	3	0				8							5	6	4	3	0	0	0		2	0	0	
Ericaceous low shrub/ Sphagnum on Wet bog	0												1	2	0	1	0				1			
Lake	0					2	7						12	10	1	0	0		0		0		1	
Roads/ railroads	0												0	0	0	1	0				1			
Transmission lines/ pipelines	0												0	0	0	2	0				5			

Table 5.12-8. Land type composition (percentage of area) of predicted total erosion and incremental Project erosion (includes mineral islands).

Land Type	2014	2034	2109	1998 – 2109
Dry mineral soil	0	0	0	0
Mineral soil	53	48	38	43
Peaty mineral soil	45	49	52	47
Peatland	1	2	9	8
Wetland	0	0	0	0
Fen with patches of water	1	0	0	1
Agriculture	0	0	0	0
Area (ha)	27	45	28	606

Table 5.12-9. Broad habitat type composition (percentage of area) of predicted total erosion and incremental Project erosion (includes mineral islands).

Broad Habitat Type	2014	2034	2109	1998 - 2109
Open forest on Dry mineral soil- Immature	0	0	0	0
Open forest on Dry mineral soil- Mature				0
Open forest on Dry mineral soil- Young	0	0	0	1
Jack pine forest on Mineral soil- Immature	0	0	0	0
Jack pine forest on Mineral soil- Mature	0	0	1	0
Jack pine forest on Mineral soil- Young	0	1	1	1
Other conifer forest on Mineral soil- Immature	8	7	5	8
Other conifer forest on Mineral soil- Mature	11	12	10	8
Other conifer forest on Mineral soil- Young	2	2	5	4
Black spruce & other moist forest on Peaty mineral soil- Immature	13	16	21	17
Black spruce & other moist forest on Peaty mineral soil- Mature	19	19	16	16
Black spruce & other moist forest on Peaty mineral soil- Young	1	1	1	1
Other conifer mixedwood forest on Mineral soil- Immature	6	5	3	4
Other conifer mixedwood forest on Mineral soil- Mature	7	5	4	3
Black spruce & other mixedwood forest on Peaty mineral soil- Immature	5	5	3	4
Black spruce & other mixedwood forest on Peaty mineral soil- Mature	3	2	3	2
Black spruce & other mixedwood forest on Peaty mineral soil- Young	5	7	8	7
Hardwood mixedwood forest on Mineral soil- Immature	4	3	1	3
Hardwood mixedwood forest on Mineral soil- Mature	7	6	3	4
Hardwood mixedwood forest on Mineral soil- Young	2	3	4	2
Hardwood forest on Mineral soil- Immature	1	1	1	1
Hardwood forest on Mineral soil- Mature	1	1		1
Hardwood forest on Mineral soil- Young				0
Black spruce & other forest on Peatland- Immature	1	1	2	2
Black spruce & other forest on Peatland- Mature			2	0
Black spruce & other forest on Peatland- Young	0	0	0	0
Sparsely treed on wet sites on wetland	1	1	6	6
Tall shrub on wetland	0	0	0	0
High water table wetland on wetland	1	0	0	1
Small islands (< 2 ha)	4	1		1
Human	0	0	0	0
Area (ha)	27	45	28	606

Table 5.12-10. Fine habitat type composition (percentage of area) of predicted total erosion and incremental Project erosion (includes mineral islands).

Fine Habitat Type	2014	2034	2109	1998 -2109
Jack pine/ Black spruce > 70 forest on Dry mineral soil- Young	0	0	0	0
Jack pine > 70 forest on Mineral soil- Immature				0
Jack pine > 70 forest on Mineral soil- Young				0
Jack pine/ Black spruce > 70 forest on Mineral soil- Immature	0	0	0	0
Jack pine/ Black spruce > 70 forest on Mineral soil- Mature	0	0	0	0
Jack pine/ Black spruce > 70 forest on Mineral soil- Old	0	0	1	0
Jack pine/ Black spruce > 70 forest on Mineral soil- Young	0	1	1	1
Jack pine/ Black spruce mixedwood forest on Dry mineral soil- Immature	0	0	0	0
Jack pine/ Black spruce mixedwood forest on Dry mineral soil- Old				0
Jack pine/ Black spruce mixedwood forest on Dry mineral soil- Young				0
Jack pine/ Red pine mixedwood forest on Dry mineral soil- Immature				0
Balsam fir/ Spruce > 70 forest on Mineral soil- Immature	3	4	2	4
Black spruce/ Balsam fir/ White spruce > 70 forest on Mineral soil- Immature	1	1	1	1
Black spruce/ Balsam fir/ White spruce > 70 forest on Mineral soil- Mature	1	1	1	1
Black spruce/ Balsam fir/ White spruce > 70 forest on Mineral soil- Old	2	3	3	1
Black spruce/ Balsam fir/ White spruce > 70 forest on Mineral soil- Young				0
Black spruce/ Jack pine > 70 forest on Mineral soil- Immature	1	1	2	1
Black spruce/ Jack pine > 70 forest on Mineral soil- Mature	0	0	1	1
Black spruce/ Jack pine > 70 forest on Mineral soil- Old				0
Black spruce/ Jack pine > 70 forest on Mineral soil- Young	2	2	5	4
White spruce > 70 forest on Mineral soil- Immature	3	1	0	2
White spruce > 70 forest on Mineral soil- Mature	0	0		0
White spruce/ Conifer > 70 forest on Mineral soil- Mature	5	6	4	4
White spruce/ Conifer > 70 forest on Mineral soil- Old	2	2	1	1
Black spruce > 70 forest on Peaty mineral soil- Immature	13	16	21	17
Black spruce > 70 forest on Peaty mineral soil- Mature	8	9	9	8
Black spruce > 70 forest on Peaty mineral soil- New	0	0	0	0
Black spruce > 70 forest on Peaty mineral soil- Old	11	10	7	8
Black spruce > 70 forest on Peaty mineral soil- Young	0	0	1	1
White spruce mixedwood forest on Mineral soil- Mature				0
White spruce/ Conifer mixedwood forest on Mineral soil- Immature	6	5	3	4
White spruce/ Conifer mixedwood forest on Mineral soil- Mature	7	5	4	3
Black spruce mixedwood forest on Peaty mineral soil- Immature	2	2	2	2
Black spruce mixedwood forest on Peaty mineral soil- Mature				0

Fine Habitat Type	2014	2034	2109	1998 -2109
Black spruce mixedwood forest on Peaty mineral soil- New	3	4	4	5
Black spruce mixedwood forest on Peaty mineral soil- Young	3	2	3	2
Black spruce/ Jack pine mixedwood forest on Peaty mineral soil- Immature				0
Black spruce/ Jack pine mixedwood forest on Peaty mineral soil- Mature				0
Black spruce/ Jack pine mixedwood forest on Peaty mineral soil- Young			0	0
Black spruce/ White spruce mixedwood forest on Peaty mineral soil- Immature	3	2	1	2
Black spruce/ White spruce mixedwood forest on Peaty mineral soil- Old	3	2	3	2
Aspen/ Conifer mixedwood forest on Mineral soil- Immature	4	3	1	3
Aspen/ Conifer mixedwood forest on Mineral soil- Mature	5	5	2	4
Aspen/ Conifer mixedwood forest on Mineral soil- New	2	3	3	2
Aspen/ Conifer mixedwood forest on Mineral soil- Old	1	2	1	1
Aspen/ Conifer mixedwood forest on Mineral soil- Young	0	0	0	1
Aspen/ Jack pine mixedwood forest on Mineral soil- Immature	0	0	0	0
Aspen/ Jack pine mixedwood forest on Mineral soil- Young				0
Aspen > 70 forest on Mineral soil- Immature	1	1	1	1
Aspen > 70 forest on Mineral soil- Mature	1	1		1
Aspen > 70 forest on Mineral soil- Old				0
Aspen > 70 forest on Mineral soil- Young				0
Black spruce > 70 forest Peatland- Immature	1	1	2	2
Black spruce > 70 forest Peatland- Mature			1	0
Black spruce > 70 forest Peatland- Old			1	0
Black spruce > 70 forest Peatland- Young	0	0	0	0
Black spruce/ Tamarack > 70 forest Peatland- Immature				0
Black spruce sparsely treed Peatland	1	1	6	6
Willow wetland	0	0	0	0
Graminoid fen with patches of water	1	0	0	1
Marsh				
Small islands (less than 2 ha.)	4	1		1
Moist prairie on Agriculture	0	0	0	0
Area (ha)	27	45	28	606

SECTION 6: INSECTS AND OTHER INVERTEBRATES

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VOLUME 6 SECTION 6

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6.0 INSECTS

6.1 INTRODUCTION

Invertebrates, as discussed in this document, are defined as those living organisms that do not have a spinal column. Biologists have described over one million animals on our planet, and of those, 97% represent a vast range of invertebrate types (Barth and Broshears 1982). Invertebrates include many groups of organisms from single-celled animals (i.e., those that we can not see without a microscope), to worms, slugs, clams, spiders, crayfish and insects (Appendix 6.1-1.).

Invertebrates are components of ecosystems surrounding the proposed Project Area. Although NCN members indicated that all animals (including invertebrates) are considered important (Volume 6 Section 2), for the purposes of decision-making related to the Project it was necessary to distinguish those species that are of specific interest to resource users. Insects were selected for assessing the significance of any Project-related effects on the invertebrates because they are important indicators of ecosystem health, function, and stability.

Insects (**Nunicos** in Cree) are invertebrates and organisms of the class **Insecta**. They include a large variety of organisms such as bees, beetles, dragonflies, grasshoppers, and butterflies. Insects are important because they are involved with the **microflora** in decomposition, and with **flora** in pollination. They are also an important part of the food web, and are eaten by a variety of fish, amphibians, reptiles, mammals, and birds.

An evaluation of insects was conducted to increase the understanding of the existing community structure that will allow for more accurate predictions of potential impacts of the proposed Project on fish, bird, and mammal populations. Groups associated with lower terrestrial trophic levels such as plants are being considered with the terrestrial portion of the assessment (Volume 6 Section 5). Groups associated with lower aquatic trophic levels such as bacteria, algae (large filamentous algae and microscopic phytoplankton), large rooted plants (aquatic macrophytes), and invertebrates (zooplankton and benthic invertebrates), are being considered in the aquatic portion of the assessment (Volume 5 Section 7).

6.2 APPROACH AND METHODS

Very few comprehensive studies of insects have been carried out for the north-central boreal zone of Manitoba and elsewhere in the boreal forest, especially regarding the terrestrial phase of insect life cycles for many species. It is expected however, that the limited number of studies available are adequate to describe the insect fauna represented in the Project Area (Volume 3).

6.2.1 Study Area

Five superimposed Study Areas, including Region, Sub-Region, Affected Aquatic Area, Aquatic Buffer, and Upland Buffer (Volume 6 Section 5) define the insect Study Areas.

6.2.2 VECs

Although insects are not identified as Valued Ecosystem Components, they are used to describe ecosystem components and linkages because insects are important indicators of ecosystem health, function, and stability.

6.2.3 Traditional Knowledge

NCN and Manitoba Hydro have recognized the importance of integrating Traditional Knowledge in the EIS. Although TK for insects was not obtained specifically, aquatic insect knowledge was obtained from numerous sources, including commercial fishers, subsistence fishers, Elders, and field assistants (Volume 2 and Volume 5 Section 7). This is important because the **insect larva** and other stages of some aquatic insects transform into **terrestrial and riparian insects**. In the initial workshops held during February 2000, and in subsequent discussions, NCN identified several concerns. In terms of direct use by NCN, certain species of aquatic and terrestrial plants that comprise insect habitat are considered in Volumes 5 and 6. With respect to the impact assessment, NCN stressed the need for a 'holistic' approach that considers all parts of the environment including the small organisms and plants on which fish and wildlife depend.

6.2.4 Scientific Studies

A limited number of studies are available for some areas of the boreal zone of Canada, but most of these are limited both regionally and in scope to only a single or limited number of species. As there are very few studies or surveys that can be referenced when assessing the expected insect fauna of this region, the following summary is based primarily on Danks and Foottit (1989), a paper which discusses insects relative to the entire boreal zone of Canada, unless otherwise noted. Other invertebrate studies in the study area that include the aquatic portion of many insect species life-cycles, especially as they relate to fish ecology, may be found in Volume 5.

6.2.5 EIS Studies

Terrestrial insects in the Project Area were not investigated during field studies. Other information relating to insects, invertebrates, and lower trophic levels of the aquatic environment are found in Volume 5 Section 7. This volume contains information on some terrestrial insect larvae and other stages that require aquatic habitat early in their life cycles (e.g., Chironomidae (midges) and Ephemeroptera (mayflies)).

6.3 EXISTING ENVIRONMENT

6.3.1 Overview of the Insect Communities

In terms of both biomass and diversity, invertebrates are the largest animal group, of which insects are a large part. They influence the ecology of vertebrate animals, including humans, to a considerable degree (Coffin and Pfannmuller 1988). Approximately 22,000 insect species are estimated to occur within the boreal zone, and many of these species likely occur within the Region. Core populations of these species are located farther south, and extend northward into the boreal zone to varying degrees. Information on most aspects of the composition and biology of the boreal insect fauna is incomplete. Data on boreal species have been collected chiefly in southern transitional ecosystems adjacent to boreal zones, rather than in truly boreal systems.

Based on the diversity of habitat (Section 6.3.3), it is expected that many of Manitoba's northern boreal forest insect species will occur in the Sub-Region. Habitat for insect species in the Upland and Aquatic Buffers is not expected to differ substantially from habitat found in the Sub-Region. The distribution of invertebrates in the boreal forest environment however, can be highly variable among habitat types, and abundance can vary even among similar habitat types. Uncommon insect species will likely be a function of less common habitat types such as particular trees (mature white spruce, *Picea glauca*, balsam fir, *Abies balsamea*), on other rare plants, landscape types that may contain uncommon features or combinations of features such as soil and topography (e.g., glacial outwash plain), or other uncommon habitat features such as woody debris or factors related to uncommon water features such as springs or seeps (Volumes 4, 5 and 6). Critical, limiting or unique insect habitats are not expected in the Region; but data are not available to be certain they are not present in either the Upland or Aquatic Buffers.

6.3.2 Rare Insect Species

There is concern about adding insects to Endangered Species lists in Canada (Summary of the meeting of the Scientific Committee for the Biological Survey of Canada, Terrestrial Arthropods, April 2000). The likelihood of misclassifying a species as endangered is relatively high because knowledge is limited and some species of insects come and go in cycles. A description of the regulatory process for the Project and the relevant provincial and federal legislation are summarized in Volume 1.

The Manitoba Endangered Species Act (MESA), the Species At Risk Act (SARA) and the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) do not assess the species status of terrestrial insects other than butterflies (Lepidoptera). The most recent listing includes no Threatened or Endangered butterflies expected to occur within the Region.

Most species of Lepidoptera are not sufficiently studied or monitored to determine whether or not they are endangered or threatened. Conversely, some insect species that have only been collected once or twice in an area may well turn out to be quite common in the right habitat. Nonetheless, listing species that are rare or have limited ranges provides a means to obtain protection for their habitats, such as springs.

A few butterfly species in the Region may be relatively rare (i.e., seldom occurring or found) because they have limited distributions, have a certain affinity to particular boreal habitats that may be rare, or have not been well enough collected or regularly monitored to determine how common or rare these species actually are (Klassen et al. 1989). The nearest major collecting sites in the Region include Nelson House and Thompson. Potentially rare or uncommon species found in these areas are listed in Table 6.3-1.

Table 6.3-1. Possible rare butterfly species found in the Region (Klassen et al. 1989).

Common Name	Scientific Name	Remarks
Columbine Dusky Wing	*Erynnis lucilius*	Rarely been found in Manitoba
Western Pine Elfin	*Callophrys eryphon*	Few records; primary habitat includes pine forest edges and openings, occasionally in forest meadows and bogs
Yukon Blue	*Vacciniina optilete*	Scarce in Manitoba, although common in Alaska and Yukon
Chryxus Arctic	*Oeneis chryxus*	Extremely localized, small widely scattered colonies; habitat includes open pine forests

6.3.3 Habitats of Boreal Forest Insects

Insect habitats in the Project Area range from relatively small and site-specific to extensive and abundant. For example, insect habitats in the boreal zone include the canopies of coniferous and deciduous trees, understory plants, organic litter, dead wood, and soil. In addition, many insects of the boreal zone (or their larvae) live in variety of aquatic habitats or rely on aquatic habitats for a portion of their life cycle. Although most insect species found in the boreal zone are generalists, some are specialized and require just one plant species (such as the pitcher-plant mosquito, *Wyeomyia smithii* (Coquillett) or the pitcher-plant midge *Metriocnemus knabi* (Coquillett)). Most of these species also occur in similar habitats further south.

Major groupings of terrestrial insect habitats that occur in the Project Area are listed in Volume 6 Section 5. The soils and plants that characterize terrestrial habitats also determine the insect associations found in those habitats. There are literally hundreds of potential terrestrial and riparian insect habitat types if measured at the smallest scale (e.g., one tree snag may provide habitat, or food, cover, and space for thousands of individuals and possibly hundreds of species). Mapping boreal forest insect habitat at this scale is not practical. Because boreal forest insect habitats are poorly understood even at considerably larger scales, insect habitats were illustrated by initially dividing it into two broad categories: forest insect habitat and wetland insect habitat (Figure 6.3-1). These broad groups were refined (Appendix 6.3-1) by recompiling 17 broad habitat types, one fine habitat type and peat islands (Volume 6 Section 5) into nine general terrestrial insect habitats (Figure 6.3-2). These two scales can be used to assess Project-related habitat impacts.

Riparian insect habitats consist of lakeshore margins, creeks, rivers, beaver floods, swamps, peatlands (including peat islands and fens) and other lowlands and upland boreal forests that are linked hydrologically to lakes and watercourses, and the structures of plants, debris, and soil present in these sites. With a few exceptions, the Upland and Aquatic Buffers both contain similar types of soils, landforms, topography, drainage, water levels, and shore sediments in the Sub-Region. Any combination of these factors, including the proximity to water, can influence the quality of insect habitats. Habitats and aquatic insects are outlined in Volume 5 Sections 6 and 7.

Emergent grasses, sedges interspersed with low shrubs, young trees, and herbs often dominate shore and riverine habitats (Volume 6 Section 5). Submergent vegetation close to shore is also a riparian feature that provides important aquatic habitat (Volume 5 Section 6). Other riparian habitats include tall shrub peatlands, springs, pond margins, and other wetlands.

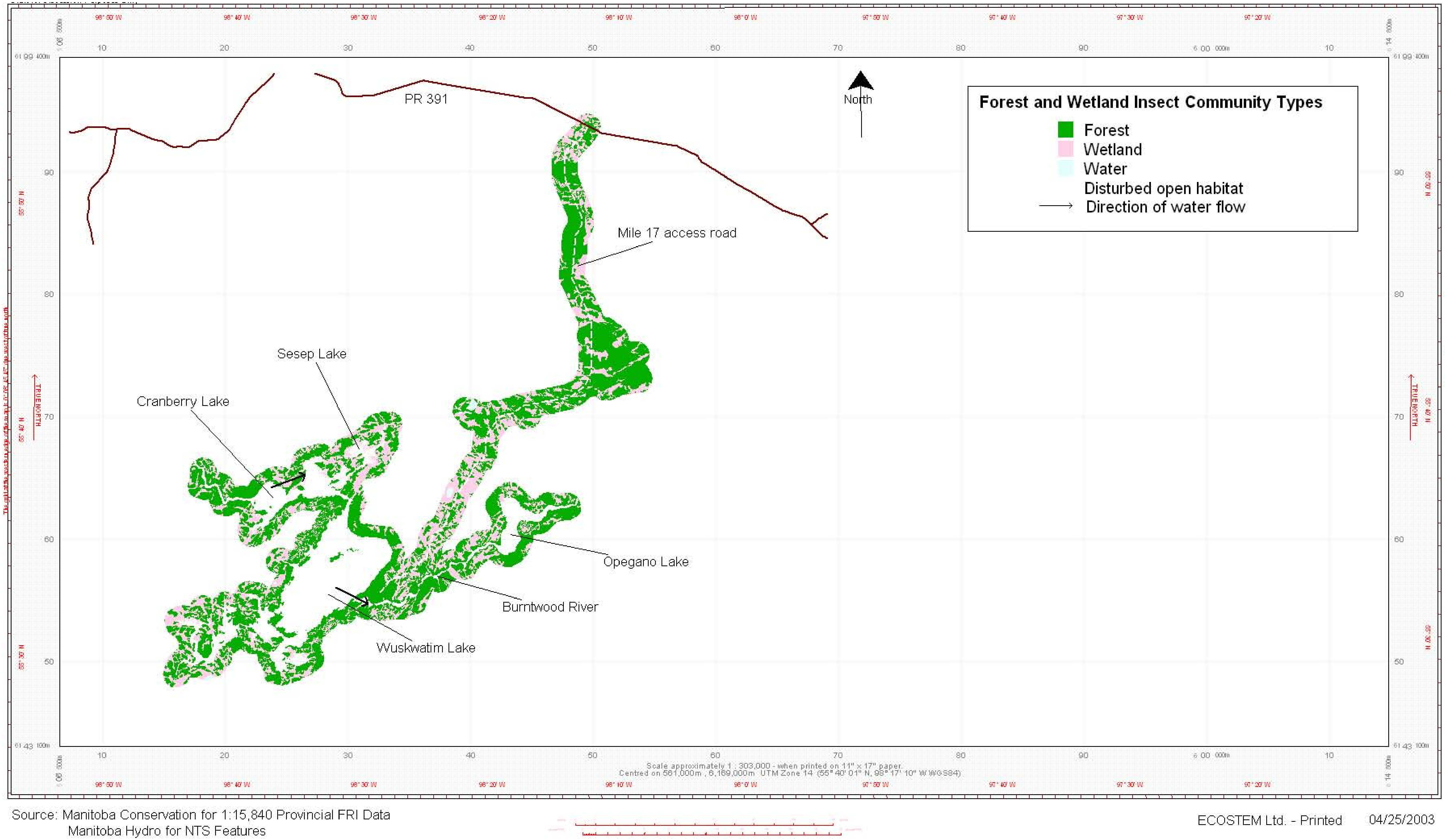

Figure 6.3-1. Forest and wetland insect habitat divisions located in the Upland and Aquatic Buffers.

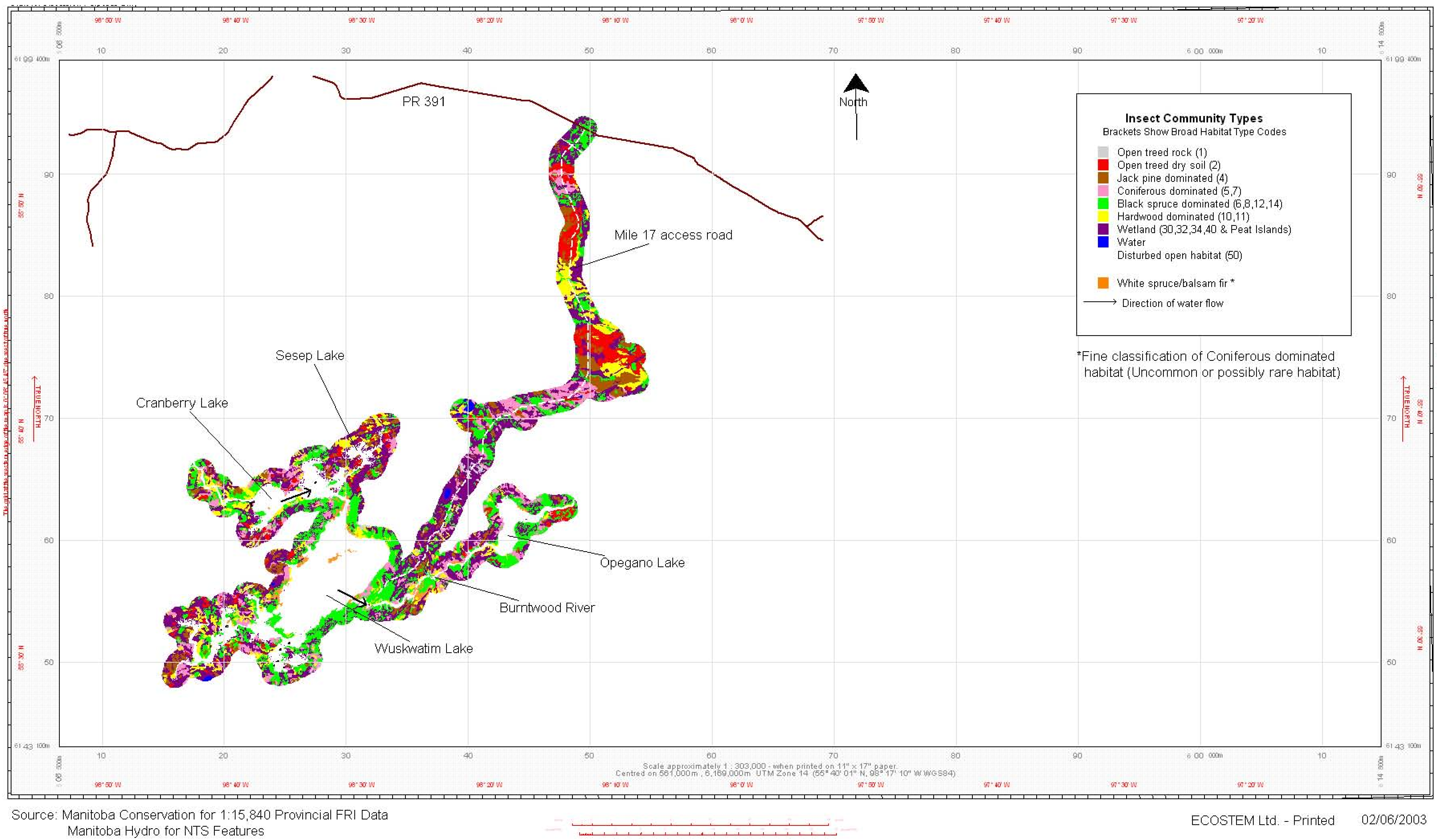

Figure 6.3-2. Terrestrial and riparian insect habitat in the Upland and Aquatic Buffers based on nine habitat types.

At the highest insect habitat division, forest insect habitats are likely dominated by insect orders such as Lepidoptera, Coleoptera, Hymenoptera, Diptera, and Hemiptera. In contrast, Diptera and Coleoptera likely dominate wetland habitats. Danks and Rosenberg (1987) provide a summary table of insects found in bogs, fens and marshes (Appendix 6.3-2.) that may be typical of wetland insect habitat in the Upland and Aquatic Buffers.

Sparsely treed peatland (i.e., wetland insect habitat) and black spruce on peatlands (i.e., black spruce dominated insect habitat) dominate the Upland and Aquatic Buffers (Figure 6.3-2). The soils, plants and moisture regimes that are found in these habitats characterize the forest and wetland habitat groups by total area. Insect species and possibly groups of insects should change as either dominant tree species or soils change. For example, hardwood forest (e.g., aspen, balsam poplar, white birch) and deciduous shrubs will contain specialized mites, a large group of acarids that cause the formation of bladderlike galls on many hardwood trees (Ives and Wong 1988). As described by cut class, forest types having a higher proportion of intermediate and mature forest stands should have a higher abundance of insects such as sawflies and wood-boring beetles (Volume 6 Section 5), as compared to unproductive forest. Insects found in vertical structure (e.g., tree trunks), and in particular, black spruce, should be common in the Upland and Aquatic Buffers.

Uncommon or possibly rare insect habitats include white spruce/balsam fir (at the fine habitat scale) and open treed dry soil. Although these habitats will contain mostly typical boreal insects that are located in the canopies or vertical wood structures, there is a small possibility that these two habitat types contain a few species that are habitat specialists; in particular, insects that are found only in white spruce or balsam fir, insects that are found in sandy soils, or a relatively rare butterfly species such as *Chryxus Arctic*, that could be extremely localized in small, widely scattered colonies, and utilize open pine forest. Although limited in distribution and extent, both these habitat types occur in the Upland and Aquatic Buffers.

6.3.4 Overview of the Ecological Roles of Boreal Insects

Some families or genera of insects are characteristically boreal because they live in habitats that are particularly abundant in that zone. Species that feed as larvae on trees are best known in this respect. They include diprionid sawflies, many of which are host specific on conifers, and beetles such as scolytids that attack weak or dying trees. Lepidoptera (moths, butterflies, skippers) and their larvae are especially well-represented in forests.

Numerous species belonging to these groups are considered forest pests (Volume 6 Section 5) that play a significant role in overall forest health (Ives and Wong 1988). They may damage forests to the extent that their functions are limited for wildlife habitat or commercial use. The biodiversity of forests also may be altered as a result of the impacts of such damage (Hall 1994).

Other species of the forest are most conspicuous in their adult stages. Mosquitoes such as *Aedes punctor* and *A. communis* inhabit the northern woods but do not venture into extensive open areas. Conversely, groups such as aculeate Hymenoptera (bees, wasps, ants) are more-or-less confined to open disturbed areas, but can also be present in forest.

On shrubs and herbs, especially in clearings, some Hemiptera (true bugs) are better represented than they are on forest trees. Together with deciduous trees, such plants also harbour diverse leaf miners (such as agromyzid and anthomyiid Diptera), gall makers (tenthredinid sawflies, etc.), and other **phytophages**, as well as their predators and parasites.

Dead wood and habitats under bark are colonized in particular by many species, including beetles (Coleoptera). Soil and litter layers contain large numbers of mites and the larvae of many species of Diptera (flies). All of these groups play an important role in forest decomposition and nutrient recycling.

Fresh waters such as large boreal lakes tend to contain many species of most major aquatic groups, but they tend to have relatively low productivity. Many of these tend to be widely distributed generalist species. Vernal ponds, filled by snowmelt, are the main larval habitats for the common northern mosquitoes of the genus *Aedes*. Winter frozen **aestival** ponds, which contain water all summer, support many hundreds of species.

Northern **lotic** habitats produce large populations of blackflies and large rivers contain many other species of different groups. Midges, for example, were the most common taxa in the majority of Reach 3 (Burntwood River below Taskginigup Falls) habitats (Volume 5 Section 7). Numerous studies have been conducted on streams, where species of midges, stoneflies, mayflies, and caddisflies are especially characteristic. Stream or river outlets from lakes, which combine water flow with an abundance of nutrients, support especially high populations of various insect species.

The fauna of wetlands is only partly known, but fens do support a relatively rich fauna of midges and other species. Some of the insects that occur in peatlands, especially in bogs, are characteristic of boreal regions including several species of more habitat-specific dragonflies, water beetles, and midges. Wetland insects provide food resources for breeding or migrating birds. Insects are also involved with the microflora in decomposition. Numerous wetland arthropods prey on or parasitize others. Aquatic and terrestrial zones interchange insects, including aerial adults of midges, and other insects that emerge into terrestrial habitats from the water. Interchanges between aquatic and terrestrial zones are augmented by fluctuations in water level, which cause the terrestrial and aquatic zones to overlap.

The most common interaction between vertebrates and invertebrates is the use of invertebrates as food by vertebrates (Murkin and Batt 1987). Waterfowl, fish, and many other wetland vertebrates including small mammals such as shrews and bats, in all or part of their life cycles, regularly feed on insects and other invertebrates. Some insects are vectors of disease and parasites to vertebrates and plants (Volume 6 Section 5).

A number of vertebrate species will use aquatic insects and other invertebrates as a food source. For example, waterfowl will consume large quantities of insects and other invertebrates in the breeding season, in order to meet increased protein demands resulting from gonadal development and egg laying. Juvenile waterfowl will also consume invertebrates to meet the protein demands required for growth and feather development. Consequently, insect and other invertebrate densities may be an important factor in waterfowl habitat selection in the spring breeding season (Murkin and Batt 1987). Many other birds will also utilize insects as an important food source (Volume 6 Section 8).

Insects and other invertebrates are also an important food source to other species, such as fish (Volume 5), amphibians and reptiles (Volume 6 Section 7), and mammals (Volume 6 Section 9). Generally, fish prefer macroinvertebrates to large zooplankton. Frogs that occur in bogs feed on terrestrial insects associated with the bog vegetation or on emerging aquatic insects. Shrews (*Sorex* spp.) are important mammalian predators of insects that live in marshes or peatlands; most other mammalian predators occur in surrounding upland regions.

As a result of the trophic interactions between vertebrates and insects (including other invertebrates), the latter serve as intermediate hosts or vectors for vertebrate parasites and diseases. Various trematodes, nematodes, and cestodes affect waterfowl through intermediate aquatic invertebrate hosts (Murkin and Batt 1987).

6.3.5 Summary of Ecological Relationships for Some Insect Groups Found in Peatlands and Marshes

Many insect species are found in peatlands or possibly lake, pond, or marsh-type environments within the Sub-Region. The following is a summary of the ecological relationships for some insect groups that are typically found in these types of environments.

Water mites [many orders]

- May occasionally form a significant part of the diet for fish and turtles (Smith 1987).
  (numerous species found in Manitoba; Smith 1987)

Mayflies and Caddisflies [Ephemeroptera and Trichoptera]

- Important food source for fish and birds.
  (numerous species found in Manitoba; Flannagan and Macdonald 1987)

Dragonflies [Odonata]

- Important biological control agents against mosquitoes and black flies.
- Dragonfly larvae play an important role in the diet of fishes (Hilton 1987) and birds.
- Three of the 46 odonate genera that occur in Canada (*Gomphaeschna*, *Williamsonia*, and *Nannothemis*) exclusively inhabit bogs and 14 of 196 species usually are restricted to this habitat. However, some of these species may also occur in fens and occasionally in *Carex* marshes.
  (numerous species found in Manitoba; Hilton 1987)

Water bugs [Hemiptera]

- Aquatic and semi-aquatic Hemiptera are important predators that can influence community structure, and can be used in biological control. All are predaceous, and are important predators of mosquito larvae. They are also an important source of food for vertebrates (Scudder 1987).
  (numerous species found in Manitoba; Scudder 1987)

Water beetles [Coleoptera]

- Water beetles occur principally in shallow water, usually close to the water's edge. For this reason, they are particularly susceptible to even minor fluctuations in water level. Larvae less tolerant of environmental extremes than are adults (Larson 1987).

  (numerous species found in Manitoba; Larson 1987)

Biting flies [Diptera]

- Biting flies include Culicidae (mosquitoes), Tabanidae (horse flies and deer flies), and Ceratopogonidae (no-see-ums) as well as Simuliidae (black flies).
- Immature stages are aquatic or semi-aquatic (black fly larvae breed exclusively in running water).
- Northern regions are characterized by high densities of biting flies; adults may serve as vectors of numerous pathogens including viruses, sporozoans, and filarial worms (Lewis 1987).

  (numerous species found in Manitoba; refer to Lewis 1987 for a summary of the Culicidae, Tabanidae, and Ceratopogonidae)

Non-biting flies [Diptera]

- These include the midges, likely the most diverse and abundant group of insects present in Canadian peatlands and marshes. They serve to release nutrients from bottom sediments into overlying waters, and facilitate oxygen uptake by sediments. The burrowing activity of many chironomid larvae into fallen macrophyte litter tends to increase the rate of microbial decomposition of these materials. They are also an important link in aquatic food chains from primary producers to higher-level invertebrate and vertebrate consumers such as birds (Wrubleski 1987).
- Vulnerable to changing water levels: drought or flooding of wetland habitats can greatly reduce populations.

  (numerous species found in Manitoba; Wrubleski 1987)

6.4 IMPACT ASSESSMENT AND MITIGATION

This section outlines predicted impacts on boreal insects resulting from specific Project activities during construction and operation of the Project. Negative impacts could result from habitat loss, habitat alteration, and accidents associated with the Project; however, mitigation measures described in this document (which are focused on habitats) may reduce or avoid such impacts, allowing most of them to remain small. In assessing how insects will respond to specific impacts, this section will focus on the loss or change of habitat in the plant community (Volume 6 Section 5).

6.4.1 Summary of Effects

The potential effects of Project construction and operation on insects should be small, site-specific to local, and not significant. This is due in large part to expectedly large insect populations with generally high reproductive capabilities, and the apparent lack of any critical habitat in the areas to be affected by the Project. Measurable effects on insect populations should not extend beyond the Upland Project Areas and immediate shorelines. Insect habitats of the Upland Project Areas are substantially similar to insect habitats found in both the Upland and Aquatic Buffers, in the Sub-Region and Region.

Small, negative, long-term, and site-specific to local effects to insects are expected as a result of removal and alteration of forest insect habitat along the access road right-of-way, in borrow areas, and at the proposed generating station site. Changes in permanently wetted habitats on shorelines, and incremental erosion on shorelines will also affect localized populations (Volume 6 Section 5). The resultant minor negative impacts will include:

- decreases in forest insect abundance;
- changes in the distribution or movements of a few species (e.g., moths) associated with attraction/repulsion due to noise (and possibly light sources) at construction sites, the generating station, effluent and waste disposal; and the access road; and
- mortality and potential habitat changes associated with accidental events such as fire or chemical spills.

Small, positive, long-term, and site-specific to local impacts to insects and insect habitat are expected with the:

- revegetation of some habitat in the Project Areas;
- long-term increase of peatland insect habitat around Wuskwatim Lake;

- increase of aquatic habitats including permanently wetted habitats around the lake, the sewage lagoon, drainage ditches, and possibly standing water in borrow areas; and
- increase in open canopy, low grass/forb/shrub and aquatic insect abundance.

Measures that will be identified in the Environmental Protection Plan, such as minimizing clearing, encouraging re-growth of natural vegetation, and material handling and storage procedures will reduce effects to terrestrial and riparian insects.

6.4.2 Construction

This section focuses on expected impacts and mitigation actions that will occur during the construction phase. The study area selected to describe impacts on the terrestrial insect habitats includes the Upland Project Areas (Volume 6 Section 5). Because the majority of impacts are not expected to extend beyond the Upland Project Areas, the Upland and Aquatic Buffers were selected for comparison.

In the six-year construction period, insects may experience, to differing degrees, the following types of impacts:

- terrestrial insect habitat effects including the loss or gain of habitats by removal or alteration at the Generating Station footprint, access road and borrow areas;
- sensory disturbance effects from light and noise; and
- accidental events such as chemical spills or fire.

It is important to note that while insects that are present in the Upland Project Areas can be expected to experience these impacts, the focus of concern is on population level effects. Although there is no specific insect mitigation measures prescribed, the application of other habitat-based mitigation measures (e.g., Volume 6 Section 5) should indirectly minimize insect population–level effects.

6.4.2.1 Effects on Insects during Construction

This section discusses expected Project-related construction effects on insects. An impact hypothesis for construction effect linkages to insects is presented in Appendix 6.4-1

Project construction-related activities should have a small, site-specific to local, long-term, and therefore insignificant negative effect on insect populations in the Upland and Aquatic Buffers.

Habitat Effects

Habitat effects such as the loss of forest stems and canopy or the increase of open spaces, grasses and disturbance tolerant plants will continue throughout Project construction, and possibly cause changes in a few species of insects by affecting insect distribution, navigation, reproduction, and by possibly affecting insect abundance. **These effects are considered small to moderate, site-specific to local, and long-term, and should have insignificant negative effects on insect populations during construction.**

As indicated in Volume 6, Section 5, construction will physically change many hectares of upland habitat (excluding flooded habitat and erosion), and subsequently impact the insects found in the soil, vegetation, and water. Although nine borrow pit areas are identified, it is likely that only a few will actually be used (Volume 3), therefore minimizing insect habitat loss. The largest Upland Project Areas are the Access Road, Borrow Pit G, and the Generating Station North.

Based on the small home ranges of many insects, and the extremely large population size of insect species generally found in the boreal forest, impacts to terrestrial insects are not expected to be measurable beyond the Upland Project Areas. Most insect habitats are common, and comprised of insects that prefer areas dominated by either black spruce forest or wetlands. Other relatively common broad habitat types in the Upland Buffer (and extending into the Sub-Region) that should have typical boreal forest insects include: jack pine dominated, coniferous dominated, hardwood dominated, and open treed rock habitats.

Uncommon or possibly rare insect habitat that will be affected most by the Project in the Upland Buffer is open forest on dry mineral soils. Many insect species that are located in this habitat type are likely common (e.g., insects that prefer jack pine trees), abundant, and typical of many other boreal forest habitats. However, without field verification, there is a possibility that this habitat type may contain a few species that are habitat specialists; in particular, insects that are found in sandy soils, or a butterfly species such as *Chryxus Arctic*, that can be extremely localized in small, widely scattered colonies, and utilizes open pine forest.

Habitat losses or habitat changes from this Project are considered small, site-specific and long-term, and are not expected to result in significant negative impacts to insect populations in the Upland and Aquatic Buffers during construction. Although there may be uncommon or rare insect species that may specialize in uncommon habitat features such as jack pine on dry mineral soils (Volume 6 Section 5), Project effects should be no more than moderate, site-specific, and long-term. It is still anticipated that insignificant negative impacts will occur even for uncommon insect species. Habitat reclamation of borrow areas, sites around the Generating Station, and the planting of tree species such as white spruce are expected to mitigate and reduce the small loss of uncommon or possibly rare insect habitat.

Specific pathways of change and anticipated habitat effects include the following.

- Removal of boreal forest plant communities for the access road, borrow areas, and the footprint of the Generating Station. The small loss of boreal forest plants will decrease the cover, food and space available for some insects. Loss of forest habitat may change the site-specific movements and distribution of a few insect species. There may be a small decrease in insect abundance of those species that use forest canopy, vertical structure, and forest floor litter.
- Removal of uncommon plants in the area will reduce the food, cover and space available for certain insect species. Abundance may decrease for forest insects that are located in the canopy, or that use vertical woody structure of specialized habitats including white spruce, balsam fir or jack pine on dry soil.
- The removal and redistribution of litter, surface organics and soil, and grubbing in the access road and Generating Station, will modify the habitat of some insect species. The distribution of insects that are predominantly found in the litter, surface organics, roots and soil will be changed wherever soil and surface materials are stored. A small decrease in insect abundance at these sites may occur.
- Plants that recolonize disturbed sites, or those plants that are seeded (e.g., ditches) will create food, cover and space for some insect species. Insect abundance may increase for those species that use plants growing on disturbed sites (e.g., insects that use forbs such as *Epilobium* spp., *Rumex* spp.). There will be an increase in insect abundance and species that use edges, open canopy forests, grassland and wet meadow habitats. Insects that use downed and woody debris (i.e., debris left on the sites such as tree branches) may increase.
- The lagoon, standing water (ponding) and ditches will increase aquatic and riparian insect habitat. Changes to cover, food and space at these sites will increase insect abundance for those species that require water or aquatic and emergent plants. There may be some changes to insect movements and distributions will occur at these sites. For organisms found in peatland and marsh habitats, the survival of these organisms depends on a number of interrelated

factors, one of which is a change in the water regime. Fluctuations in water level may change the relative suitability for aquatic, riparian and terrestrial arthropod species, as well as their predators (Danks and Rosenberg 1987).

- Small changes in exposure and microclimates will affect some insects. Those that use exposed soil, sand, gravel, and waste rock piles should increase. There may be an increase of insects that tolerate warmer microclimates in summer and exposure to colder microclimates in winter.
- Road and roadside maintenance will periodically alter insect habitat. When the cover, food and space for some species change, insects that use low vertical structure, openings, and grasses should increase. Insects that do not tolerate salt, dust, exhaust fumes or vehicle emissions will decrease. Insect species that tolerate salt, dust, exhaust fumes or other emissions from vehicles will remain stable or increase.
- Changes in wildlife habitat (including amphibians, birds and mammals) may lead to some small change in insect distribution. Changes in parasitic insect distributions may result from changes in wildlife distributions.

Sensory Disturbances and Other Effects

Sensory disturbance effects such as noise and vibration from vehicles, machinery and people, or from light sources, will continue throughout Project construction, and possibly cause changes in a few species of insects by affecting their distribution, navigation, reproduction, and by causing some insect mortality. **These effects are considered small, site-specific to local, long-term, and therefore, should have insignificant negative effects on insect populations during construction.**

Pathways of change and anticipated effects include the following:

- Noise and vibration from vehicles, machinery, people and blasting in the Upland Project Areas may interfere with insect navigation or possibly interfere with reproduction, especially for insects that occupy rock or soil. Some interference with movements or reproduction may reduce insect abundance for certain species.
- Light (e.g., security lights, street lights) will attract certain insect species (e.g., moths) to the Generating Station site at night. By attracting insects, artificial lights interfere with movements, navigation and therefore, may cause changes in the distribution of some species. Artificial lights may also reduce feeding opportunities or may interfere with reproduction, and essentially reduce the

effectiveness of natural habitat in the vicinity of light sources. The few insect species that congregate around artificial light sources may be more susceptible to predation (e.g., bats), and subsequently result in decreased abundance

Accidental Events

Accidental events such as chemical spills or fire may occur during Project construction. The risk of these types of events is considered small. If these events occur, they may result in some habitat change and insect mortality. Accidental fire would have potentially the largest effect on insects and insect habitat. **Effects from accidental events may range from small to large, site-specific to local, and short-term to long-term. Excluding a large-scale accidental fire, accidental events should have insignificant negative effects on insect populations during construction.**

Pathways of change and anticipated effects include the following:

- Hazardous waste (e.g., oil) that is accidentally spilled on plants or soil, may be consumed or come into contact with some insect species. Chemicals may cause mortality to insects that are in contact with these plants, or those that live in the soil, and this may lead to a small decrease in site-specific insect abundance.
- Accidental fires may cause insect mortality and affect insect habitat by changing soil and litter properties, and decrease the vertical structure (i.e., tree trunks and canopy) of the community. Habitat change would decrease the abundance of insects that use forest canopy, vertical structure and forest floor litter, but would increase insect abundance and species that use low vertical structure, openings, grasses, plants that recolonize the site and dead wood. As the plant community grows back into forest over the long-term, forest insects will likely return into these sites.

6.4.3 Operation

This section focuses on expected impacts and mitigation actions that will occur during the operation phase. Operation activities are detailed in Volume 3. Over the duration of the Project, insects may experience events that are similar to construction impacts, but with possible changes in magnitude, duration and scale: Potential impacts include:

- terrestrial insect habitat effects including the loss or gain of habitats by flooding and water level stabilization;

- sensory disturbance effects from light and noise; and
- accidental events such as chemical spills or fires.

It is important to note that while insects that are present in Upland and Aquatic Buffers can be expected to experience these impacts, the focus of concern is on population level effects. Although there is no specific insect mitigation measures prescribed, the application of other habitat-based mitigation measures (e.g., Volume 6 Section 5) should indirectly minimize insect population–level effects.

6.4.3.1 Effects on Insects during Operation

This section discusses expected Project-related operation effects on insect species. An impact hypothesis for operational effects on insects is presented in Appendix 6.4-2.

Project operation-related activities should have a small, site-specific to local, long-term, and therefore insignificant negative effect on insect populations in the Upland and Aquatic Buffers.

Habitat Effects

Habitat effects such as flooding and changes to permanently wetted areas along shorelines will continue throughout Project operation and possibly cause changes in a few species of insects by affecting insect distribution, navigation, reproduction, and by possibly affecting insect abundance. **These effects are considered small, site-specific to local and long-term, and therefore should have insignificant effects on insect populations during operation.**

Major waterways, including insect habitat in the Aquatic Buffer are a regulated system: most of the system is no longer changing rapidly as a result of the CRD, though peatlands (islands) may be continuing to slowly break down (Volume 6 Section 5). Insect populations (particularly riparian species) currently reflect the regulated system, though it is unclear whether insect populations are still changing as a result of CRD. The terrestrial forest insects outside the influence of CRD likely remain unchanged.

Immediate and long-term impacts to terrestrial and semi-aquatic insects are not expected to extend much beyond the shorelines and flooded areas in the Aquatic Buffer. When insect communities are described at a broad habitat scale, insect habitat comparisons can be made between terrestrial shoreline habitat, peat islands, and other insect habitats located in the Aquatic Buffer. Most insect habitats such as black spruce dominated forest and wetland habitat are common. Other relatively common broad habitat types in the

Aquatic Buffer (and extending into the Sub-Region) that likely have typical boreal forest insects include: jack pine dominated; coniferous dominated; hardwood dominated; and open treed rock habitats.

There may be uncommon or possibly rare insect species present wherever vegetation types are rare. A vegetation type is considered rare if it covers less than or equal to 0.05% of the study area under consideration (Volume 6 Section 5). The rarest land cover types in the Sub-Region, as described by tree species in the canopy are balsam fir, white spruce, tamarack, balsam poplar, aspen and white birch combination, willow/alder, alder, white birch mixedwood, ericaceous shrub/ sphagnum and barren. From the rare vegetation types list, insects that specialize on balsam fir and white spruce trees may be affected most from habitat losses. These losses will be minimized by mitigation measures described in Volume 6 Section 5.

Flooding and the creation of permanently wetted habitats from lake stabilization at around 234 m ASL along shorelines, will likely cause some terrestrial vegetation decays and nutrient release that may provide richer aquatic habitats. Some species, such as mayfly larvae and dytiscid beetles will take advantage of these sites. Pools of standing water may also be created, which will be utilized by mosquito larvae and other larvae. Use of temporary habitats may reduce predation for some species.

The interchange between aquatic and terrestrial zone insects may be affected by a reduction of water level fluctuations above the dam, and an increase of daily water level fluctuations below the dam. For example, blackflies may select less exposed microsites during rapid flows and scouring of the substrate in spring. Mayflies may move from more rapid to slower waters, particularly for emergence. Rapid water flows may also delay spring hatching or development, depress populations, or delay full colonization for other species, such as for sand-dwelling chironomids.

The inclusion of some dying or dead vegetation may increase habitat for some insect species while reducing or changing habitat for others. The standing crop of invertebrates varies considerably among different species of submerged aquatic macrophytes (Murkin and Batt 1987). The surface area of submerged vegetation is an important factor positively related to invertebrate biomass.

Habitat losses or habitat changes from this Project are considered small, site-specific and long-term, and are not expected to result in significant negative impacts to insect populations in the Aquatic Buffers during operation. Although uncommon or rare insect species that may specialize in rare habitat features in the Sub-Region (such as white spruce or balsam fir) may continue to decline in abundance (Volume 6 Section 5), Project effects are still considered small, site-specific and long-term. It is anticipated that insignificant negative impacts will occur for uncommon or possibly rare insect species. Habitat reclamation of borrow areas, sites around the Generating Station including the redistribution of topsoil over disturbed sites, the seeding of plants, and planting tree species such as white spruce is expected to mitigate and reduce the small loss of insect habitat (Volume 6 Section 5).

Specific pathways of change and anticipated habitat effects include the following:

- A small area of boreal forest habitat will be removed. Cover, food and space for insects that use forest canopy, vertical structure, and forest floor litter will be removed, and result in a decrease in the abundance of these species.
- Flooding will create aquatic and riparian insect habitat. Cover, food and space will increase for insects that require water, aquatic and emergent plants, and possibly result in increased abundance of certain riparian insect species.
- Permanently wetted habitats will result from water stabilization of Wuskwatim Lake at about 234 m ASL. Permanently wetted habitat may change the riparian shoreline width at some locations, and change some plant populations and soil conditions along the shorelines. Shoreline terrestrial habitat loss will occur in the short-term as cover, food and space for certain terrestrial insect species decreases. Some aquatic insect habitat may also decrease (e.g., insects that utilize cattails), while other species (e.g., insects that utilize sedges, aquatic plants) increases. There will be a resulting change to the abundance and diversity of the shoreline insect community.
- Long-term changes, including the loss of marshlands and peat island habitats, will decrease riparian insect habitat. Concurrently, formation of shoreline peatlands as a result of stable water conditions will change the abundance and diversity of the insect community; and possibly increase the abundance of insects that require peatland habitat, low vertical structure, water, openings, sedges, and permanently wetted, organic soils.
- Long-term incremental erosion (small loss of terrestrial habitat over 100 years) will cause changes to terrestrial insect habitats. Cover, food and space may be reduced for those insects located in soil, litter, forest canopy, and vertical structure near shorelines. Some insect species that require snags and logs will increase as some trees die along the shorelines as a result of erosion.

- Reclamation, including the redistribution of soil and surface organics, and the natural re-vegetation in borrow pits and Generating Station sites will increase terrestrial insect habitat. Short-term and long-term changes in cover, food and space may result in a small increase in the abundance of insects that use disturbed site vegetation (use forbs such as *Epilobium* spp., *Rumex* spp), low vertical structure such as shrublands, grasses, wet meadows and eventually trees and open canopy forest.
- Road and roadside maintenance will periodically alter insect habitat. When the cover, food and space for some insect species change, insects that use low vertical structure, openings, and grasses should increase. Insects that do not tolerate salt, dust, exhaust fumes or vehicle emissions will decrease. Insect species that tolerate salt, dust, exhaust fumes or other emissions from vehicles will remain stable or increase.
- Changes in wildlife habitat (including amphibians, birds and mammals) may lead to some change in wildlife distribution. Changes in parasitic insect distributions may result from changes in wildlife distributions.

Sensory Disturbances and Other Effects

Sensory disturbances and other effects are considered small, site-specific to local, and long-term, and therefore, should have insignificant negative effects on insect populations during operations.

As described in Section 6.4.2.1., sensory disturbance effects such as noise and vibration from vehicles, machinery and people, and from light sources, will continue throughout the operation of the Project, and possibly affect a few species of insects, and may affect insect distribution, navigation, reproduction, and mortality. Pathways of change should be similar to the construction period. Sensory disturbance effects are smaller during operation (e.g., lower traffic volumes) than in the construction period.

Accidental Events

Possible effects from accidental events may range from small to large, site-specific to local, and short-term to long-term. Excluding a large-scale accidental fire, accidental events should have insignificant negative effects on insect populations during operations.

As described in Section 6.4.2.1., accidental events such as chemical spills or fire will continue throughout the operation of the Project. The risk of these types of events is considered to be small. If these events do occur, they would result in some habitat change and insect mortality. Pathways of change would be similar to the construction period. Accidental fire would have the largest effect on insects and insect habitats.

6.5 RESIDUAL EFFECTS

Effects to insects as a result of Project construction and operation should be insignificant due to large insect populations with generally high reproductive capabilities, the apparent lack of any critical habitat in the areas to be affected by the Project, and the application of mitigation measures that generally minimize environmental disturbances (Table 6.5-1). **Small, negative to neutral residual effects are expected** with possible changes to:

- terrestrial insect abundance from the conversion of forested habitats to open habitats in the upland Project Areas;
- riparian insect abundance from the changes to permanently wetted shorelines (at about 234 m ASL), the small flooded area, and incremental erosion;
- movements and reproduction from sensory disturbances such as noise or possibly light; and
- mortality associated with accidental events (i.e., spills or fire).

6.6 CUMULATIVE EFFECTS

The impact of cumulative effects to insects was assessed relative to existing developments and reasonably foreseeable future land or water-based developments (Volume 10). This Project is not considered to have cumulative impacts on insects with existing developments in the area or on any future developments.

6.7 ENVIRONMENTAL FOLLOW-UP AND MONITORING

A monitoring program is not anticipated for terrestrial insects, although aquatic insects and other invertebrates will be monitored if the Project proceeds (Volume 5 Section 7).

Table 6.5-1. Summary of impacts, description of effect, mitigation, and residual effects to insects.

SPECIES	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
Terrestrial Insects	**CONSTRUCTION**			
	Clearing and construction of access roads, borrow areas, generating station area; sensory disturbances from noise and light; possible accidental events from spills or fire.	Habitat changes to cover, food and space; changes to movements; decrease in reproduction; possible mortality.	Measures identified in the Project Description or EnvPP, such as minimizing clearing, and encouraging re-growth of vegetation, will indirectly reduce effects to terrestrial insects.	Negative and insignificant (long-term, small, site-specific to local)
	OPERATION			
	Wuskwatim Lake water level will be stabilized at about 234 ASL; small flooded area; incremental erosion; road maintenance; sensory disturbances from noise and light; possible accidental events from spills or fire.	Habitat changes to cover, food and space; changes to movements; changes to reproduction; possible mortality.	Measures identified in the Project Description or EnvPP, such as not using petroleum products to control dust on roads, will indirectly reduce effects to terrestrial insects.	Negative and insignificant (long-term, small, site-specific to local)
Riparian Insects[a]	**CONSTRUCTION**			
	Clearing and construction of access roads, borrow areas, generating station area; sensory disturbances from noise and light; possible accidental events from spills or fire.	Habitat changes to cover, food and space; changes to movements; increase in reproduction; possible mortality.	Measures that will be identified in the EnvPP, such as materials handling and storage, will indirectly reduce effects to insects.	Negative and insignificant (long-term, small, site-specific to local)
	OPERATION			
	Wuskwatim Lake water level will be stabilized at about 234 ASL; small flooded area; incremental erosion; incremental debris; road maintenance; sensory disturbances from noise and light; possible accidental events from spills or fire.	Habitat changes to cover, food and space; changes to movements; changes to reproduction; possible mortality.	Measures that will be identified in the EnvPP, such as materials handling and storage, will indirectly reduce effects to riparian insects.	Negative and insignificant (long-term, small, site-specific to local)
Rare Insects	**CONSTRUCTION**			
	Clearing and construction of access roads, borrow areas, generating station area; sensory disturbances from noise and light; possible accidental events from spills or fire.	Habitat changes to cover, food and space; changes to movements; changes in reproduction; possible mortality.	Measures identified in the Project Description or EnvPP, such as minimizing clearing, and encouraging re-growth of vegetation, will indirectly reduce effects to rare insects.	Negative and insignificant (long-term, small, site-specific to local)
	OPERATION			
	Wuskwatim Lake water level will be stabilized at about 234 ASL; small flooded area; incremental erosion; road maintenance; sensory disturbances from noise and light; possible accidental events from spills or fire.	Habitat changes to cover, food and space; changes to movements; changes to reproduction; possible mortality.	Measures identified in the Project Description or EnvPP, such as not using petroleum products to control dust on roads, will indirectly reduce effects to rare insects.	Negative and insignificant (long-term, small, site-specific to local)

[a] - See Volume 5 Section 7 for aquatic insects

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6.9 GLOSSARY

aestival - of or relative to summer.

flora - plant life such as grass or trees especially characteristic of a region.

Insecta - any of a particular class of arthropods (such as bugs or bees) with a well-defined head, thorax, and abdomen, only three pairs of legs, and typically one or two pairs of wings.

invertebrates - animals without a spinal column.

insect larva - the immature, wingless, and often vermiform feeding form that hatches from the egg of many insects, alters chiefly in size while passing though several molts, and is finally transformed into a pupa or chrysalis from which the adult emerges.

lotic - pertaining to moving water.

microflora - minute plants; those invisible to the naked eye.

phytophages - organisms that eat live plants.

Nunicos - Cree name for insects.

riparian insect - association of insects that prefer to occupy habitats adjacent to water-dominated ecosystems.

terrestrial insect - association of insects that prefer to occupy upland habitats in forest-based ecosystems.

6.10 APPENDICES

Appendix 6.1-1. List of invertebrate groups.

Major Group	Remarks
Protozoans	Acellular and single-celled animals, of which some are serious parasites of man
Sponges	Organisms with no organs or well defined tissues; mainly salt water species with only a few species found in fresh water; probably not located in the Project area
Colenterates	Organisms having features more complex than sponges such as organization of cells into functional tissues; exclusively aquatic and, with few exceptions, are limited to salt water
Acoelomates	Small animals shaped like a worm; often parasitic such as flatworms
Pseudocoelomates	Small animals shaped like a worm that live in aquatic or parasitic habitats such as nematodes
Annelids	More advanced worms such as the earthworm and leeches
Mollusks	Many of these animals have shells such as snails; others without shells such as slugs
Chelicerates	Large variety of animals including spiders, scorpions, ticks and mites
Crustaceans	Mainly aquatic animals including crayfish
Myriapods	Many-legged and secretive animals like centipedes and millipedes
Insects	Wide range of animals such as bees, grasshoppers, dragonflies, beetles, and butterflies; many types crawl on the ground while some fly; larval stages are common in lakes and ponds
Lophophorates	These animals often resemble plants; mainly aquatic organisms that have a crown of tentacles surrounding the mouth
Echinoderms	Mainly salt water animals like starfish
Deuterostomes	Very small, specialized invertebrates maily found in salt water such as acorn worms; probably not located in the study area

Appendix 6.3-1. Broad insect habitat characterization.

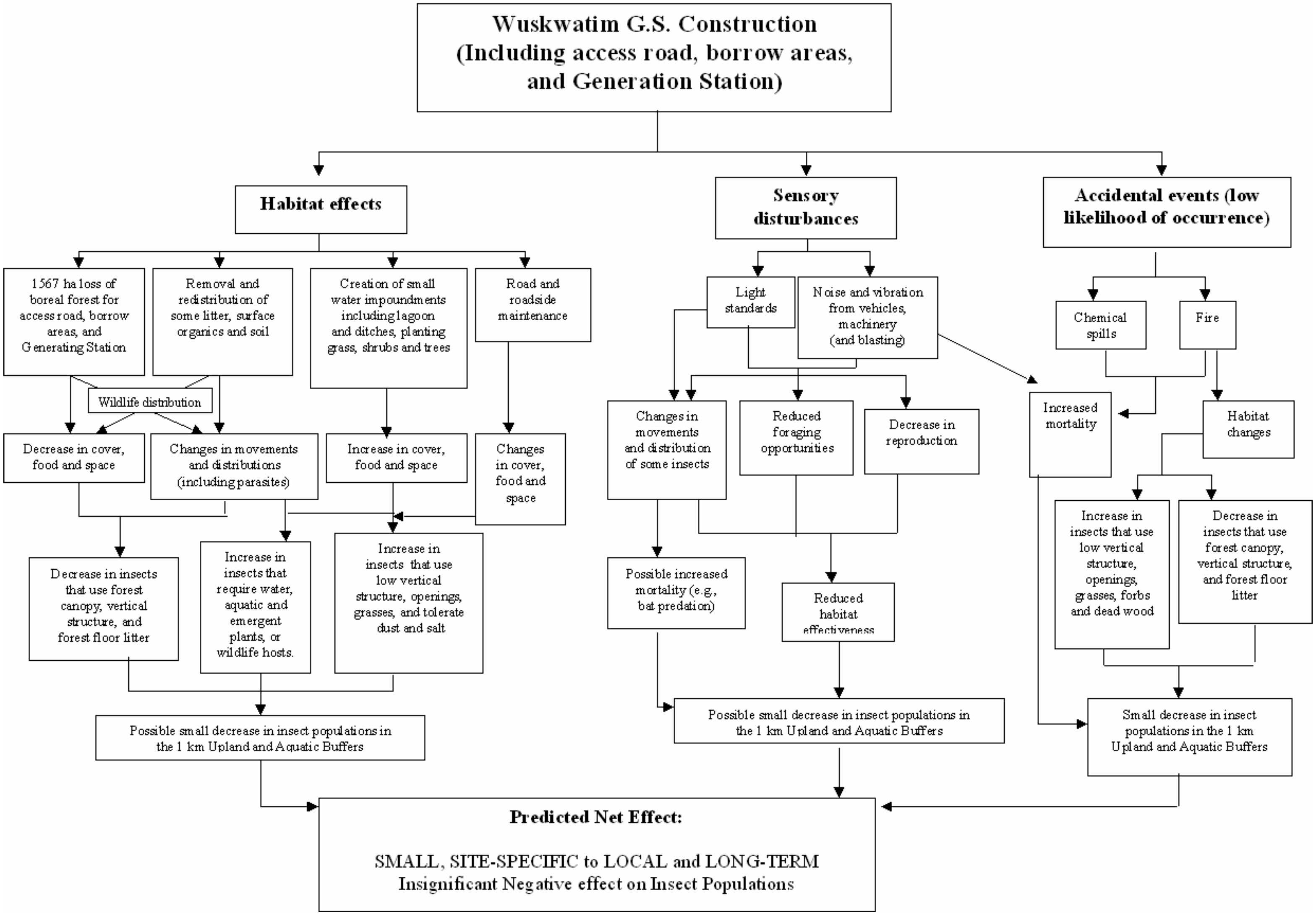
Broad and Fine Habitat Types*	Broad Insect Habitat	Insect Habitat Types	Habitat Type Grouping
Open vegetation on exposed bedrock	Forest	Open treed rock	1
Open forest on dry mineral soil- 3 age classes	Forest	Open treed dry soil	2
Jack pine forest on mineral soil- 3 age classes	Forest	Jack pine dominated	3
Other conifer forest on Mineral soil- 3 age classes	Forest	Coniferous dominated	4
Black spruce forest on Peaty mineral soil-3 age classes	Forest	Black spruce dominated	5
Black spruce dominated conifer mixedwood forest on Peaty mineral soil- 3 age classes	Forest	Black spruce dominated	5
Other conifer mixedwood forest on Mineral soil- 3 age classes	Forest	Coniferous dominated	4
Hardwood mixedwood forest on Mineral soil- 3 age classes	Forest	Hardwood dominated	6
Hardwood forest on Mineral soil- 3 age classes	Forest	Hardwood dominated	6
Black spruce forest on Peatland- 3 age classes	Forest	Black spruce dominated	5
Black spruce mixedwood forest on Peatland- 3 age classes	Forest	Black spruce dominated	5
Sparsely treed wetland	Wetland	Wetland	7
Tall shrub wetland	Wetland	Wetland	7
Low shrub, graminoid and/ or emergent wetland	Wetland	Wetland	7
Small islands (< 2 ha)	Wetland	Wetland	7
Human	Forest	Disturbed open	8
Human- Linear	Forest	Disturbed open	8
Peat islands	Wetland	Wetland	7
White spruce/balsam fir	Forest	White spruce/Balsam fir	9

* Volume 6 Section 5

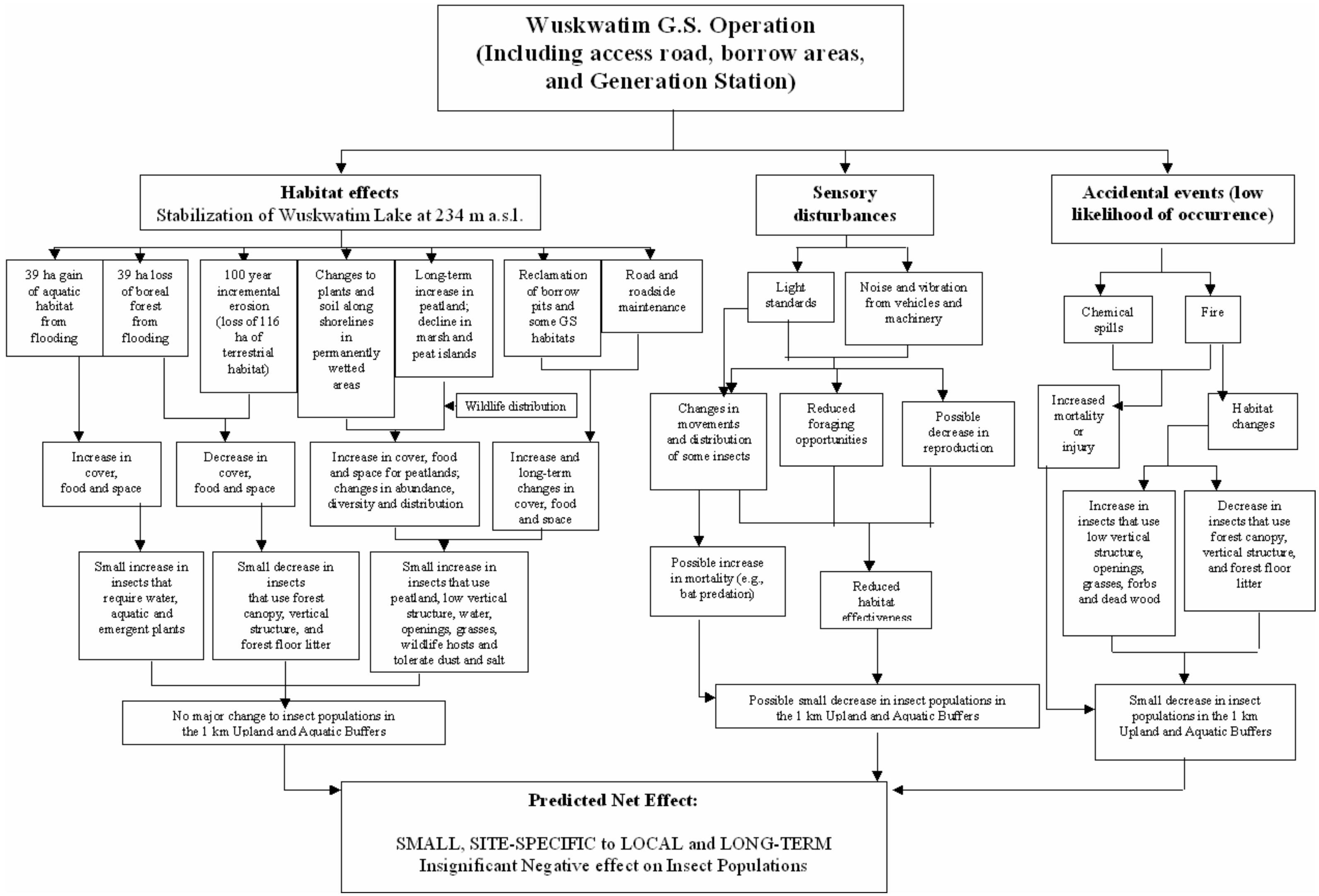
Appendix 6.3-2. Number and percentage of species in aquatic groups reported from Canada (Danks and Foottit 1989) with additions, and with provisional estimates for families in which only some of the species are aquatic, and numbers so far reported (papers in this volume) from bogs, fens, and marshes, and those numbers of insect habitat specialists "restricted to" bogs and marshes (data for fens are limited).

	Number (percentage) of aquatic species reported					
					Restricted to	
	Canadian total (approx.)	Bogs	Fens	Marshes	Bogs	Marshes
Hydracarina	500	30(6)	17(3)	41(8)	0	0
Ephemeroptera	301	1(0.3)	0	4(10	0	0
Odonata	195	63(32)	22(11)	72(37)	14(7)	0
Plecoptera	250	0	0	0	-	-
Hemiptera	138	33(24)	32(22)	61(44)	0	0
Coleoptera	579	107 + (18)*		296 + (51)	20?(37)*	0
Diptera						
Culicidae	74	10(14)	11(15)	33(45)	1(1)	1(1)
-breeding++		10	11	16		
Tabanidae	132	38(29)	11(8)	22(17)	3(2)	0
-breeding++		32	11	16		
Ceratopogonidae	180	6(3)	0	6(3)	?	?
-breeding++		3	0	4		
Chironomidae	480	30(6)	38(8)	53(11)	1(0.2)	0
Other families	1170	?	?	?	?	?
Trichoptera	546	9(2)	0	36(7)	0	1(0.2)
Other orders	90	?	?	?	?	?
Total Insecta	**4135**					
Total for insect groups with data	**2875**	**327(11)**	**131 + (5 +)**	**624(22)**	**(0.9)**	**(0.07)**

*includes bogs and fens
++figure shows the number of species consistently breeding in the habitats shown.
excluding other families of Diptera and other orders, for which detailed data from bogs, fens and marshes are not available.



Appendix 6.4-1. Impact hypothesis for insect populations during construction.



Appendix 6.4-2. Impact hypothesis for insect populations during operation.

SECTION 7: AMPHIBIANS AND REPTILES

Prepared by: Tetr*ES* Consultants Inc.

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7.0 AMPHIBIANS AND REPTILES

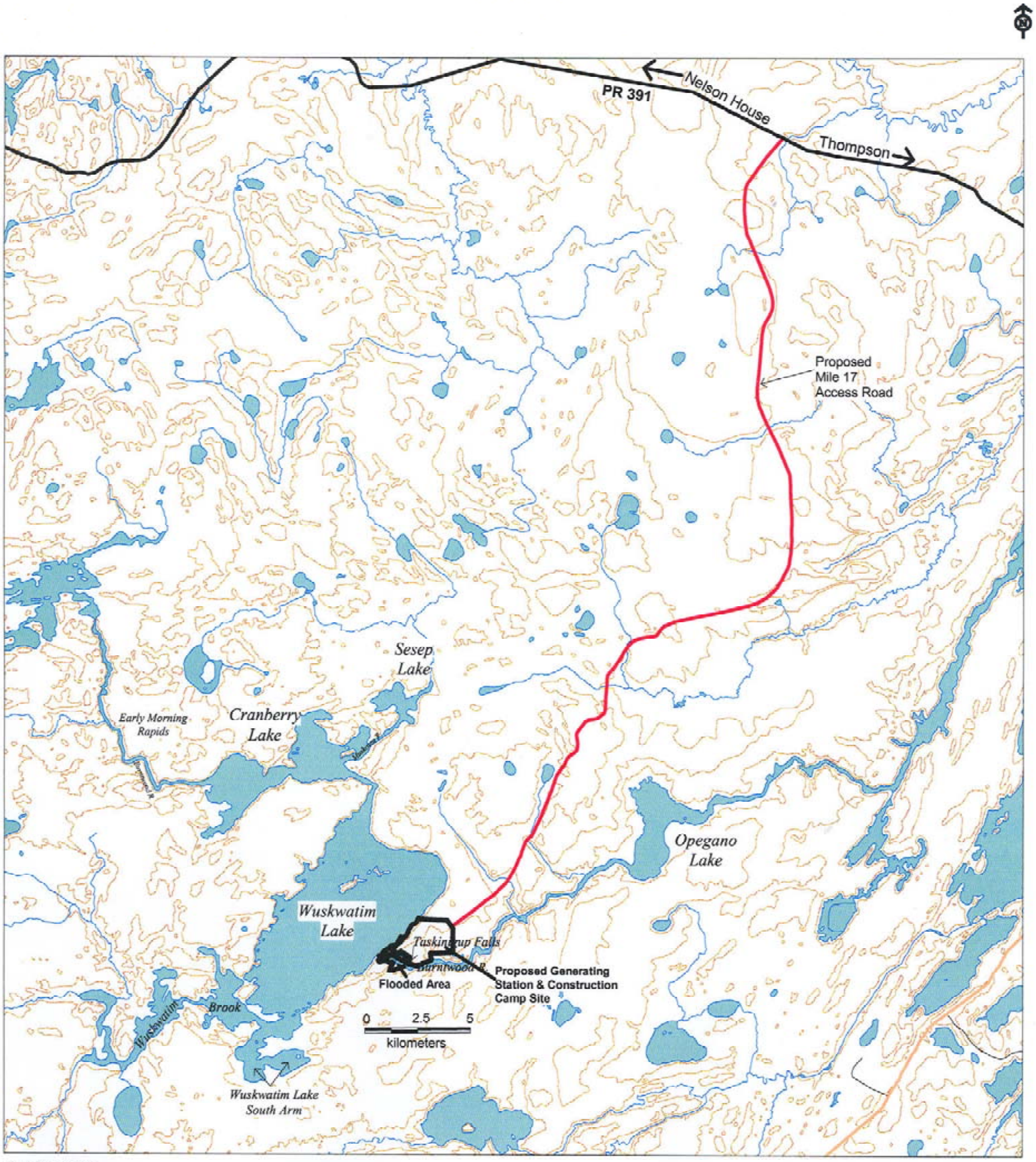
7.1 INTRODUCTION

The Wuskwatim Generating Station study area is located in the **Boreal Shield Ecozone** of northern Manitoba (Figure 7.1-1). The study area is within the documented range of three **amphibian species**: the leopard frog (*Rana pipiens*), the wood frog (*Rana sylvatica*) and the boreal chorus frogs (*Pseudacris triseriata*; Preston 1982). Wood frogs and boreal chorus frogs are common throughout most of Manitoba, and are not listed by The Committee on **Endangered** Wildlife in Canada (**COSEWIC** 2002) or (**MESA**) as being rare or endangered. Leopard frog **populations** in Manitoba are classified by COSEWIC (2002) as being of **Special Concern** due to population declines throughout most of western Canada.

Frogs and their populations are suitable environmental indicators of **habitat** change and **ecosystem** imbalance (e.g., Wyman 1990; Blaustein and Wake 1990, 1995; Gartshore *et al.* 1995). A general pattern of decline in frog populations has been observed world-wide over the past 30 years. Possible causes of this decline include, but are not limited to: pollution, acidity, harvesting, parasites, disease, traffic mortality on roads, habitat alterations/fragmentation, drought, global climate change, ultra-violet radiation, physiological sensitivity and natural population fluctuations (e.g., Wyman 1990; Bishop 1992; Koonz 1992; Wassersug 1992; CARENET 2002). Frog eggs are particularly sensitive to freezing, excess UV radiation, pollution and acidity. Mercury, for example, is a toxin that affects frogs' reproductive organs and eggs (Preston *pers. comm.* 1996).

Several aspects of the **life history** and biology of frogs and other amphibians make them particularly sensitive to environmental change. Amphibians inhabit aquatic and **terrestrial** habitats, have highly permeable skin and sensitive eggs that can rapidly absorb toxic substances, change from primarily herbivorous tadpoles to carnivorous adults and are generally restricted to small home ranges (CARENET 2002). Natural environmental variables that influence frog distribution, abundance and reproduction include: the number of frost free days, ambient temperature, mean annual precipitation, composition and structure of plant communities, and potential evapotranspiration rate (Preston 1982).

There are no reptile species whose documented ranges extend as far north as the Wuskwatim study area. However, range limits can be poorly defined and variable so some reptile species that occur south of the study area, such as the red-sided garter snake (*Thamnophis sirtalis parietalis*), western painted turtle (*Chrysemys pictabelli*) and snapping turtle (*Chelydra serpentina serpentina*) may occur in the study area.



wusk_frogs_stdy.wor

Study Area for Amphibians and Reptiles

Figure 7.1-1

None of the **reptiles** that have any potential to occur in the study area are listed under COSEWIC or MESA as being endangered, **threatened** or of conservation concern in Manitoba. Manitoba populations of snakes and turtles and the environmental factors influencing their survival and productivity are not clearly understood. Among the major factors that threaten reptile populations in Canada are: habitat destruction, traffic mortality, predators, contamination, and the pet trade (CARENET 2002). Snakes have economic value; prior to 1983, 23,000 to 69,000 snakes were harvested annually in Manitoba (Koonz 1983).

7.1.1 Study Area

The presence of frogs was recorded primarily during terrestrial breeding-bird **transects** in the Wuskwatim Lake and Opegano Lake areas (Section 7.2.2). The study area for amphibians and reptiles is illustrated in Figure 7.1-1.

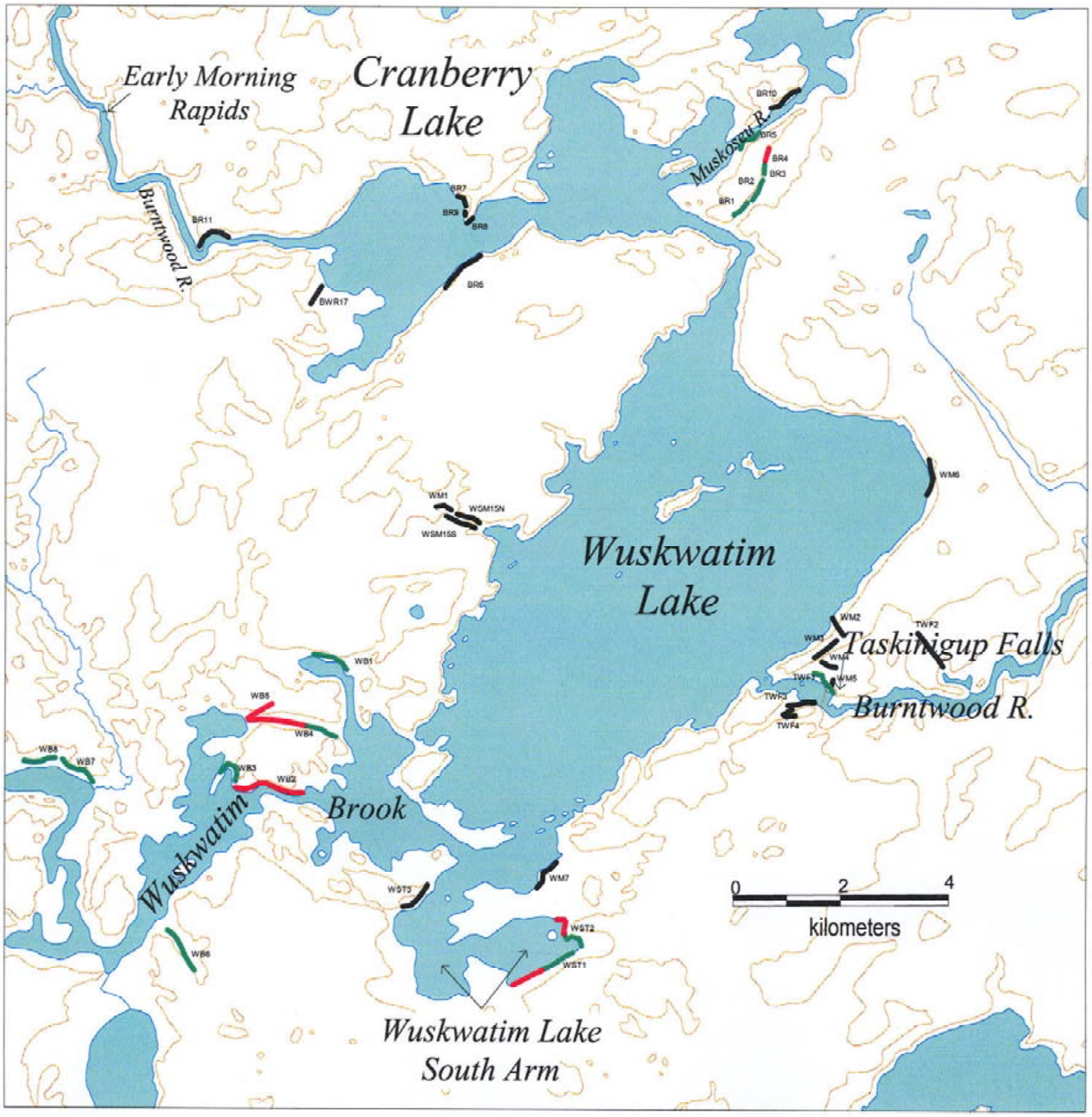
7.2 METHODS

7.2.1 Traditional Knowledge

Amphibians and reptiles are not currently harvested by **NCN** members. Information regarding amphibians and reptiles in the study area was obtained from local resource users was gained through independent conversations with Tetr*ES* personnel while boating in the area or at meetings (e.g., open houses). Resource harvest surveys did not question local resource users regarding amphibians and reptiles. Additionally, the resource harvest calendars did not reveal information or insight regarding amphibians and reptiles.

7.2.2 EIS Studies

The presence and relative abundance of frogs was recorded in the Wuskwatim study area in the spring (May/June) of 2000 and 2001 during terrestrial breeding surveys (Section 8.2.3.3 and Tetr*ES* 2003a,b). Amphibian surveys were conducted along transects during an approximate three-week period in: late May and early-June in the vicinity of Wuskwatim Lake in 2000; in both the Wuskwatim and Opegano Lake areas in 2001; and along the proposed Mile 17 Access Road and borrow areas on July 2 and 3, 2002 (Figures 7.2-1 to 7.2-3). Sampling occurred at 93 survey stops along 16 transects in 2000, at 173 stops along 34 transects in 2001, and at 66 stops along 13 transects in 2002 (Table 7.2-1). While surveying the access road and borrow area sites in 2002, observers also watched and listened for frogs (i.e., **reconnaissance** over 15 to 30 minute periods) at four streams that may be potentially crossed by the access road.



Survey transects from 2000 & 2001

Survey transects from 2000 only

Survey transects from 2001 only

Note: Transect names are beside each survey line. Transect habitat descriptions are provided in TetrES (2003 a,b).

Amphibian and Terrestrial Breeding Bird Transects Surveyed During Spring 2000 and 2001 in the Wuskwatim Lake Area

Figure 7.2-1

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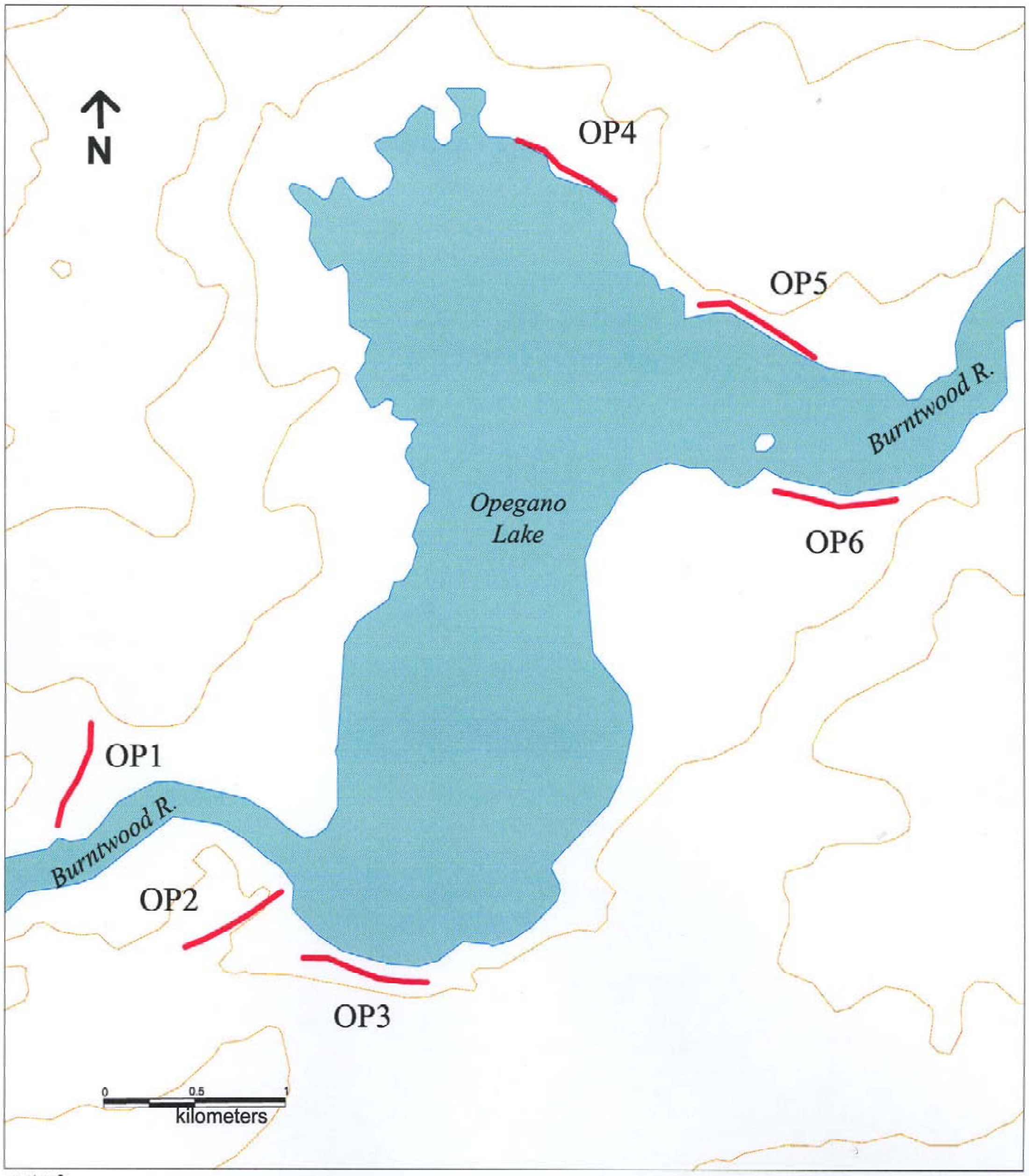

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Transect habitat descriptions are provided in TetrES 2003 a,b.

Amphibian and Terrestrial Breeding Bird Transects Surveyed During Spring 2001 in the Opegano Lake Area

Figure 7.2-2

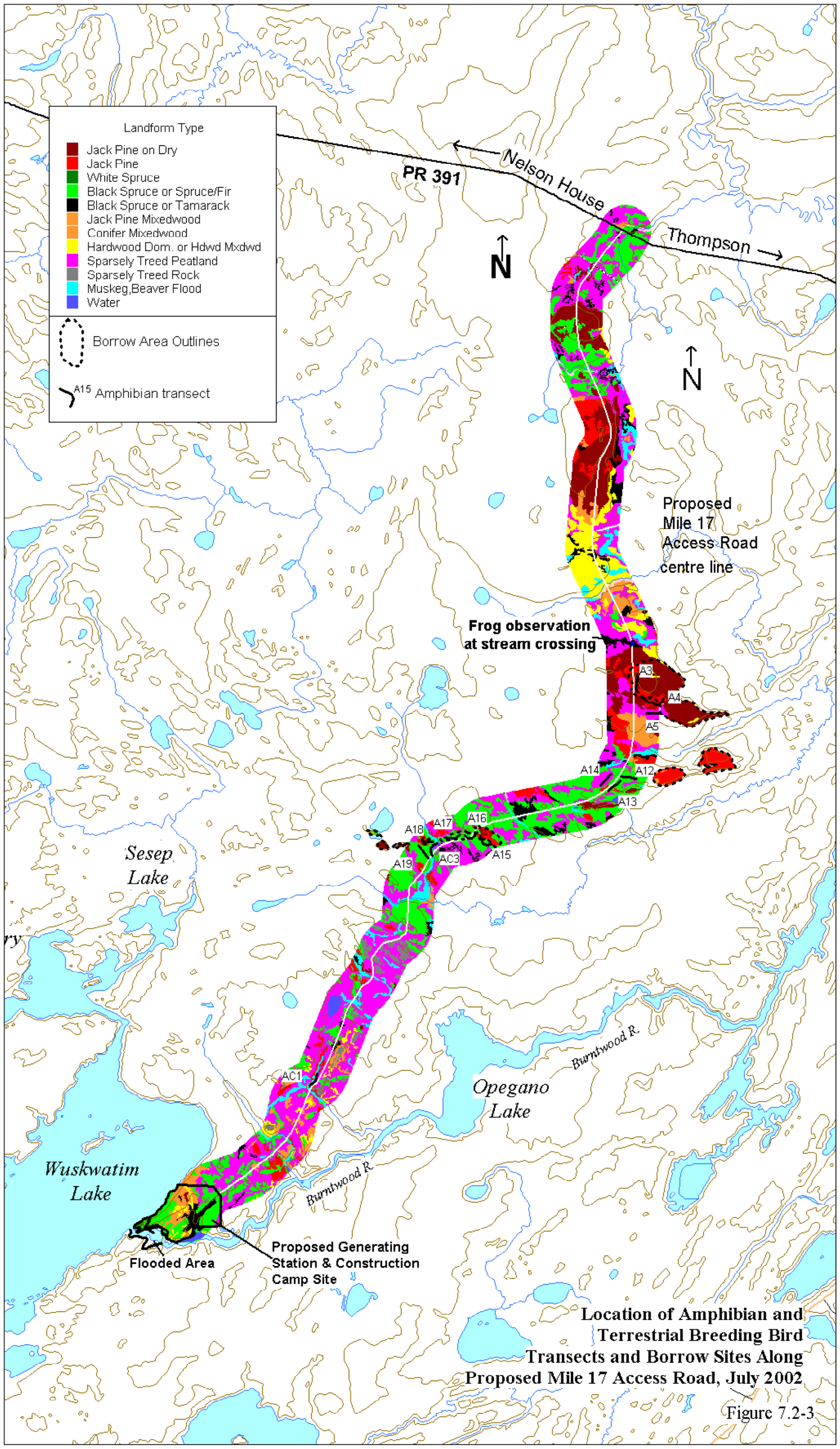

Landform Type
Jack Pine on Dry
Jack Pine
White Spruce
Black Spruce or Spruce/Fir
Black Spruce or Tamarack
Jack Pine Mixedwood
Conifer Mixedwood
Hardwood Dom. or Hdwd Mxdwd
Sparsely Treed Peatland
Sparsely Treed Rock
Muskeg,Beaver Flood
Water
Borrow Area Outlines
A15 Amphibian transect
PR 391
Nelson House
Thompson
N
N
Proposed
Mile 17
Access Road
centre line
Frog observation
at stream crossing
A3
A4
A5
A14
A12
A13
A16
A17
A18
A19
AC3
A15
AC1
Sesep
Lake
Opegano
Lake
Burntwood R.
Burntwood R.
Wuskwatim
Lake
Flooded Area
Proposed Generating
Station & Construction
Camp Site
Location of Amphibian and
Terrestrial Breeding Bird
Transects and Borrow Sites Along
Proposed Mile 17 Access Road, July 2002
Figure 7.2-3
acord_amphib_ms01

TABLE 7.2-1

HABITAT GROUPS SURVEYED DURING AMPHIBIAN AND TERRESTRIAL BREEDING BIRD SURVEYS IN THE WUSKWATIM STUDY AREA[a] IN 2000, 2001 AND 2002

Habitat Group	2000		2001		2002*	
	Number of Survey Stops	Percentage of Total Survey Stops[b]	Number of Survey Stops	Percentage of Total Survey Stops[b]	Number of Survey Stops	Percentage of Total Survey Stops[b]
Black Spruce Forest [b]	53	58%	71	41%	28	42%
Coniferous Forest (Spruce Dominant) [c]	15	16%	37	21%	13	20%
Coniferous Forest (Black Spruce & Jack Pine Dominant) [d]	-	-	-	-	4	6%
Conifer-Dominant Mixedwood (Spruce Dominant) [e]	10	11%	15	9%	1	2%
Conifer-Dominant Mixedwood (Spruce & Jack Pine Dominant) [f]	3	3%	13	8%	7	11%
White Spruce Forest [g]	4	4%	10	6%	-	-
Trembling Aspen Forest [h]	-	-	8	5%	1	2%
Trembling Aspen Dominant Mixedwood [i]	4	4%	8	5%	1	2%
Coniferous Forest (Black Spruce / Tamarack Mix) [j]	4	4%	5	3%	2	3%
Jack Pine Forest [k]	-	-	3	2%	9	14%
White Birch Forest [l]	-	-	3	2%	-	-
Totals	93	100%	173	100%	66	100%

* Along proposed access road route and borrow areas only during July 2 and 3, 2002
a = Includes the Wuskwatim Lake area in 2000 (June 4 - 11), and the Wuskwatim Lake and Opegano Lake areas in 2001 (May 29 - June 13)
b = Black Spruce 71 - 100%
c = Softwoods (71 - 100%) with Black Spruce < 71%, White Spruce < 71%, Jack Pine less than 20%
d = Black Spruce, 40-70%, with 2nd major spp. Jack Pine
e = Spruce 51% to 70%, second major
species: hardwoods
f = Jack Pine at least 20% (no more than 70%), and Spruce plus Jack Pine at least 65%, second major species:
g = White Spruce 71 - 100%
h = Trembling Aspen 71 - 100%
i = Trembling Aspen 50 - 70%, second major species: softwoods
j = Softwoods (71 - 100%) with 25 - 50% Tamarack, second major species: Black Spruce
k = Jack Pine 71 - 100%
l = White Birch 71 - 100%
Note that 53 stops (58%) in 2000, 39 stops (23%) in 2001 and 15 stops (23% plus additional reconnaissance) in 2002 included surveying birds and frogs in adjacent bog, fen or marsh habitat

Terrestrial amphibian/breeding bird transects were primarily located within and adjacent to areas that will likely be affected by the **Project**, and provided representative samples within the various habitat groups that characterize the Wuskwatim study area (Figures 7.2-1 to 7.2-3).

The primary limitation with this procedure was that sampling occurred during the cooler hours of the day (i.e., early morning hours) in early June, when frog calling was not likely at its peak.

A standard coding system was used to indicate frog presence and relative abundance on the basis of the number of frogs heard during the 5-minute observation period at each survey stop:

- 1 = individuals can be counted, no overlapping calls;
- 2 = individual calls are distinguishable but overlapping; and
- 3 = full chorus, calls continuous and overlapping (number cannot be estimated with precision).

Additional information that was recorded during frog surveys included:

- location (transect name and UTM co-ordinates);
- time;
- weather information (temperature, wind direction and speed, cloud cover and precipitation); and
- habitat description.

Similar information regarding frogs was also collected during boat-based surveys conducted in the Wuskwatim area in 2000 and 2001 (Table 7.2-2). Of the 1,479 **km** reach that was surveyed in the study area during the spring and summer months of 2000 and 2001 (i.e., months when frogs are likely to be observed), 989 km was along the Burntwood River between Early Morning Rapids and Opegano Lake and the remaining 490 km was in the Notigi and Wapisu Lake areas. The survey results provide qualitative information on frogs in the areas sampled.

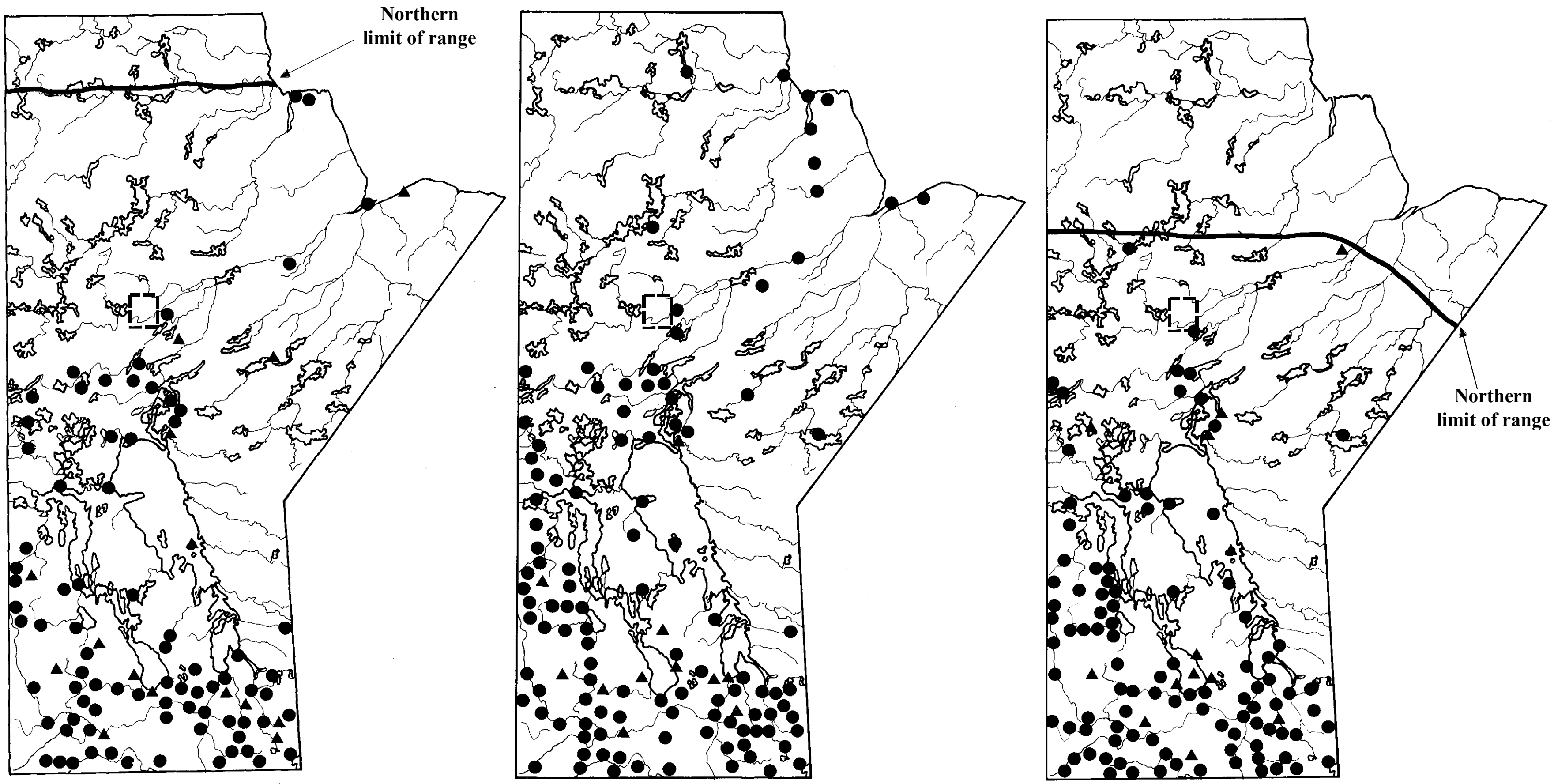
7.3 EXISTING ENVIRONMENT

Most amphibian and reptile species in Manitoba are generally restricted to more southerly distributions within the province. The three species of amphibians whose known northern ranges extend to the Wuskwatim study area include the boreal chorus frog, wood frog and northern leopard frog (Figure 7.3-1; Preston 1982). These three species

TABLE 7.2-2

BOAT-BASED SURVEYS IN 2000 AND 2001

Location	JUNE (SPRING) 2000				MAY/JUNE (SPRING) 2001			
	Number of Surveys Completed	Total Shoreline Kms Surveyed	Total Area Surveyed (Km^2)	Survey Dates	Number of Surveys Completed	Total Shoreline Kms Surveyed	Total Area Surveyed (Km^2)	Survey Dates
Wuskwatim Brook	1	60	10.2	June 3	3	177	30.5	May 30, June 1, June 7
Wuskwatim Lake South Arm	1	15.5	5	June 3	3	47	15.0	May 29, June 4, June 6
Wuskwatim Main Lake	1	38	28	June 2	2	79	52	May 31, June 3
Cranberry Lake	1	32	14.4	June 6	3	114	43.2	May 28, June 2, June 5
Muskoseu River & Sesep Lake					2	26	4.1	June 2, June 5
Burntwood R. West to Early Morning Rapids	1	6.25	1.1	June 6	2	13	2.2	June 2, June 5
Opegano Lake	-	-	-	-	3	78	19.4	June 10 , 11, 12
Burntwood R. at Opegano Lake	-	-	-	-	3	(Included in Opegano Lk total)	6.7	June 10 , 11, 12
Wapisu Lake	1	156	-	June 12 - 14 to complete	1 (partial)	57	-	June 14
Notigi Lake	1	82	-	June 14 - 16 to complete part of lake	-	-	-	-
	JULY / AUGUST (SUMMER) 2000				JULY / AUGUST (SUMMER) 2001			
Wuskwatim Brook	2	120	20.4	July 30, Aug. 1	Sufficient information obtained on locations of waterbird brood-rearing habitat in summer 2000			
Wuskwatim Lake South Arm	2	31	10	July 30 & 31				
Wuskwatim Main Lake	2	76	56	July 29 & 31				
Cranberry Lake	2	64	28.8	July 29 & 31				
Burntwood R. West to Early Morning Rapids	2	12.5	2.2	July 29 & 31				
Wapisu Lake	1	156	-	July 26 - 27 to complete				
Notigi Lake	1	39	-	July 28, partial lake				
	SEPTEMBER (FALL) 2000				SEPTEMBER (FALL) 2001			
Wuskwatim Brook	4	240	40.8	Sept. 21 - 24	1	60	10.2	Sept. 19
Wuskwatim Lake South Arm	4	62	20	Sept. 21 - 24	3	47	15.0	Sept. 17, 18, 19
Wuskwatim Main Lake	-	-	-	-	1	38	28.0	Sept. 17
Cranberry Lake	-	-	-	-	1	32	14.4	Sept. 18
Muskoseu River & Sesep Lake	-	-	-	-	1	16	2.0	Sept. 18
Burntwood R. West to Early Morning Rapids	-	-	-	-	1	6	1.1	Sept. 18
Wapisu Lake	1	187	-	Sept. 25 & 26, most of lake	-	-	-	-
Notigi Lake	1	42	-	Sept. 27, partial lake	-	-	-	-



BOREAL CHORUS FROG **WOOD FROG** **LEOPARD FROG**

LEGEND
● - Specimens located in collections of the Manitoba Museum of Man and Nature, the National Museum of Natural Sciences, the Royal Ontario Museum or the University of Manitoba
▲ - Literature records of sight or auditory records
⌜⌟ - Wuskwatim GS Study Area

Source: Preston 1982

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Distribution of Wood Frogs, Boreal Chorus Frogs and Leopard Frogs in Manitoba
Figure 7.3-1

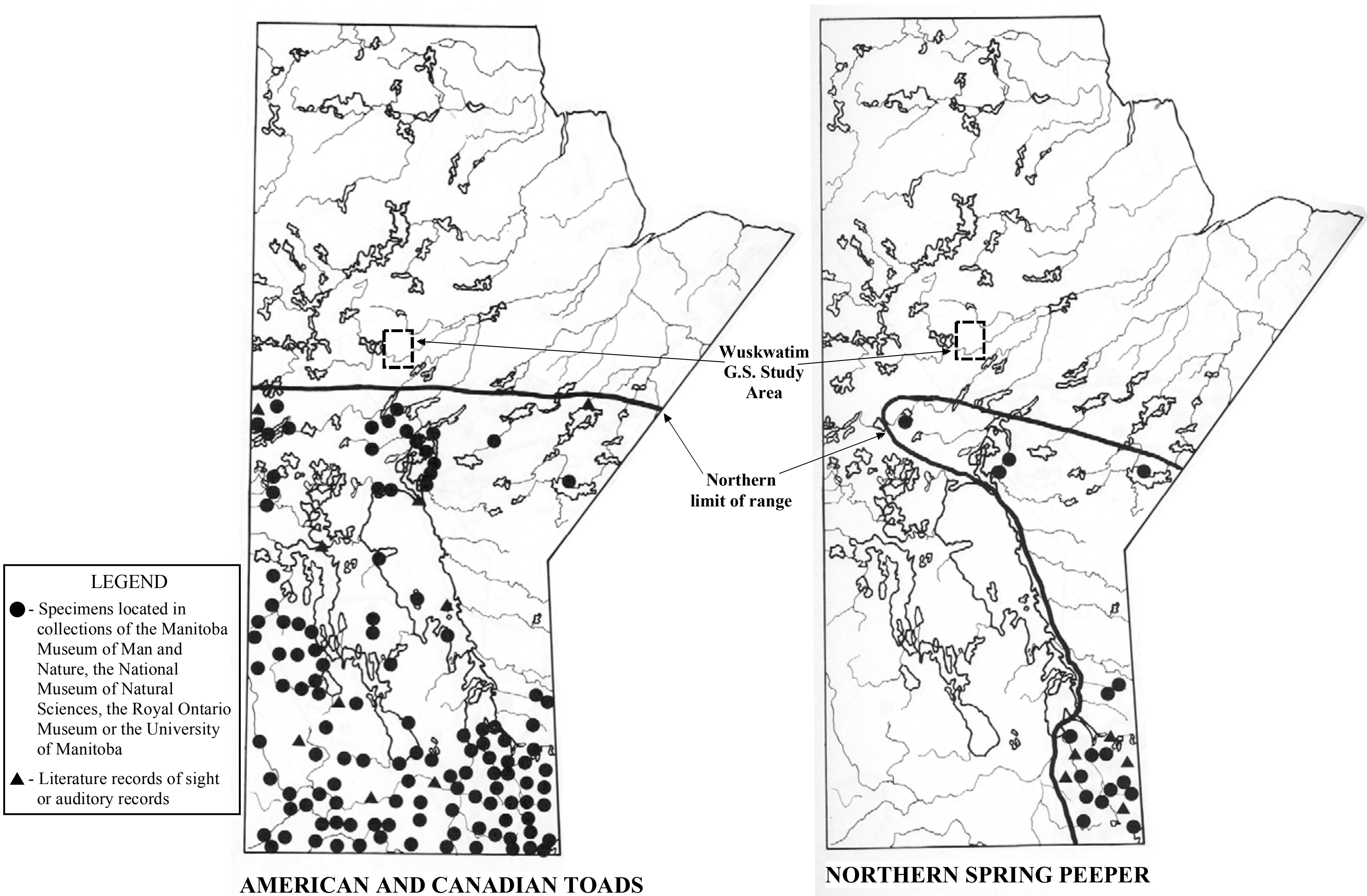
are the most abundant and widespread of the 15 amphibian species known to be native to Manitoba (Koonz 1992).

Of the three frog species with documented ranges occurring within the study area, the northern leopard frog is near the northern limit of its range (Figure 7.3-1). The boreal chorus frog's range extends further north to the latitude of the Seal River (within Hudson Bay Lowland north of Churchill) and the wood frog can be found north into Nunavut (Preston 1982). Amphibian species that may potentially occur within the study area, but their documented ranges are to the south include the American and Canadian toads, and the northern spring peeper (Figure 7.3-2; Preston 1982).

Boreal chorus frogs and wood frogs are early breeders that deposit their eggs beneath the water surface in the spring, where they remain attached to plant stems or on pond bottoms until they hatch 4 to 24 days later, depending on temperature (Legier 1952). The results of field studies in the Wuskwatim study area suggest that boreal chorus and wood frogs were breeding in late May to mid-June. Along the coasts of Hudson Bay and James Bay in northern Ontario, wood frogs breed in mid-May and tadpoles transform by late July (Schueler 1973). In northwestern Alberta, wood frogs and boreal chorus frogs spawn prior to mid-June, but can to spawn in July further north (Roberts and Levin 1979). Wood frogs tend to lay eggs in large communal egg masses in ephemeral ponds (Forester and Lykens 1988). Eggs are typically laid at an intermediate depth (30 - 40 cm) in years of normal precipitation, but in dry years are laid in shallow water (< 18 cm). Transformation from larval to adult form takes approximately 50 to 70 days for boreal chorus frogs and 45 to 85 days for wood frogs (Legier 1952; Preston 1982). Tadpoles require a pond that supports sufficient supplies of algae and phytoplankton and that does not dry up until after the tadpoles have undergone metamorphosis into adults.

After metamorphosis, wood frogs and boreal chorus frogs become terrestrial, and disperse far from water into moist woods, often taking refuge under leaf litter, logs and rocks where they also overwinter (Roberts and Levin 1979; Preston 1982).

The northern leopard frog typically breeds in April or early May in southern Manitoba (Preston 1982). In August, leopard frogs return to lakes, deep ponds, rivers and creeks to overwinter. The northern leopard frog has economic value. Prior to the population decline in the mid-1970s, up to 50,000 kg of frogs per year were shipped from Manitoba to U.S. biological supply houses for use in biology classrooms (Koonz 1992). Massive die-offs of Manitoba's northern leopard frogs were first observed in 1975, and resulted in the lack of export of frogs between 1976 and 1983. By 1991, northern leopard frogs had generally reoccupied their traditional range but had not approached their prior densities (Koonz 1992).



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Source: Preston 1982

Distribution of American and Canadian Toads and Northern Spring Peeper in Manitoba
Figure 7.3-2

Although leopard frogs can still be abundant at a few sites where they occur, their dramatic population declines in western Canada and elsewhere led to them being listed as Special Concern in Canada by COSEWIC in April 1998 (CARENET 2002; COSEWIC 2002).

The study area is north of the documented distribution of reptiles, including red-sided garter snakes (Figure 7.3-3). Red-sided garter snakes occur throughout southern Manitoba, but most known winter denning areas are mainly associated with limestone bedrock outcrops from the Interlake northwestward to Flin Flon (Koonz 1983). Dens occur where snakes can get below the frost line in sink holes, springs, rock piles, caves, or animal burrows. Red-sided garter snakes typically emerge from hibernation in the spring (April/May), after which they may travel up to 18 km to their summer range before returning to the den site in the fall (typically September; Gregory and Stewart 1975; Gregory 1977). Preferred summer habitats are associated with ponds in forested areas.

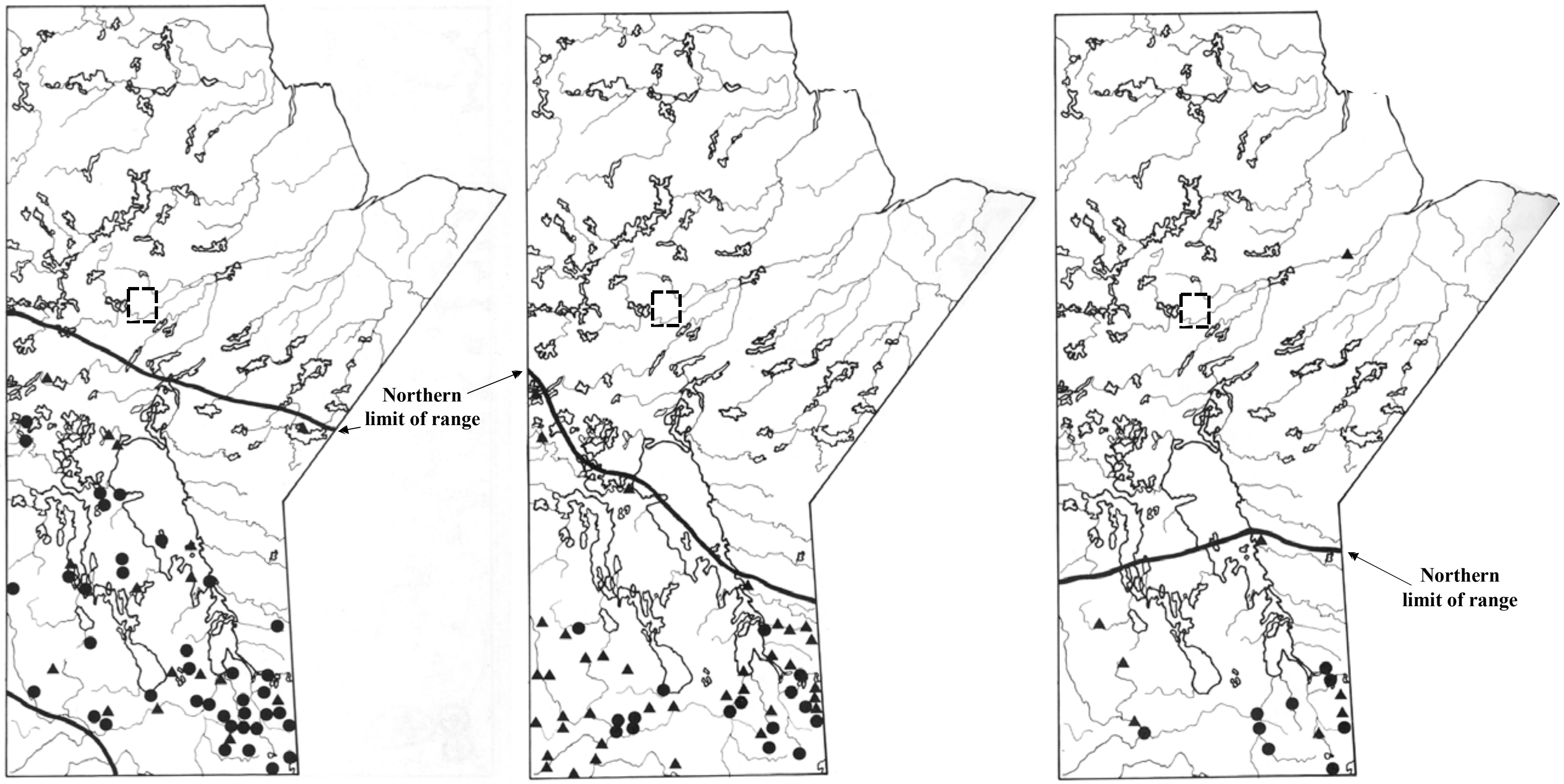
Other reptile species that may occur in low numbers in the study area are the common snapping turtle and western painted turtle. While the typical range of these species is well south of the Wuskwatim study area, there are sighting records of the snapping turtle along the Nelson River near Gillam (Preston 1982).

7.3.1 Wuskwatim and Opegano Lakes and Environs

Locations of frog observations (either sound or visual) within the Wuskwatim and Opegano Lakes area are illustrated in Figure 7.3-4 and listed in Section 7.8.1 (Table 7.8-1). The most commonly observed amphibian species in 2000 and 2001 was the boreal chorus frog, with one wood frog being observed. Other amphibian or reptile species were not detected during either terrestrial breeding-bird surveys or boat-based surveys.

The **shoreline** of the main body of Wuskwatim Lake, characterized by clay-silt and bedrock shorelines, has generally poor frog habitat. Although there are areas surveyed in the Wuskwatim and Opegano Lake area that have suitable frog habitat (marshy bays, wet low-lying shoreline, inland creeks and ponds), the number of frog observations was relatively low in all areas surveyed.

Although amphibians do not appear to be numerous in the study area overall, there are a few small areas of concentrated numbers in the Wuskwatim Brook and Cranberry Lake areas. More amphibians were observed within back bay and marshy habitat in those areas than on the Wuskwatim main lake or the south arm of Wuskwatim Lake (Section 7.8.1, Table 7.8-1).



RED-SIDED GARTER SNAKE **WESTERN PAINTED TURTLE** **COMMON SNAPPING TURTLE**

LEGEND

● - Specimens located in collections of the Manitoba Museum of Man and Nature, the National Museum of Natural Sciences, the Royal Ontario Museum or the University of Manitoba

▲ - Literature records of sight or auditory records

[ ] - Wuskwatim GS Study Area

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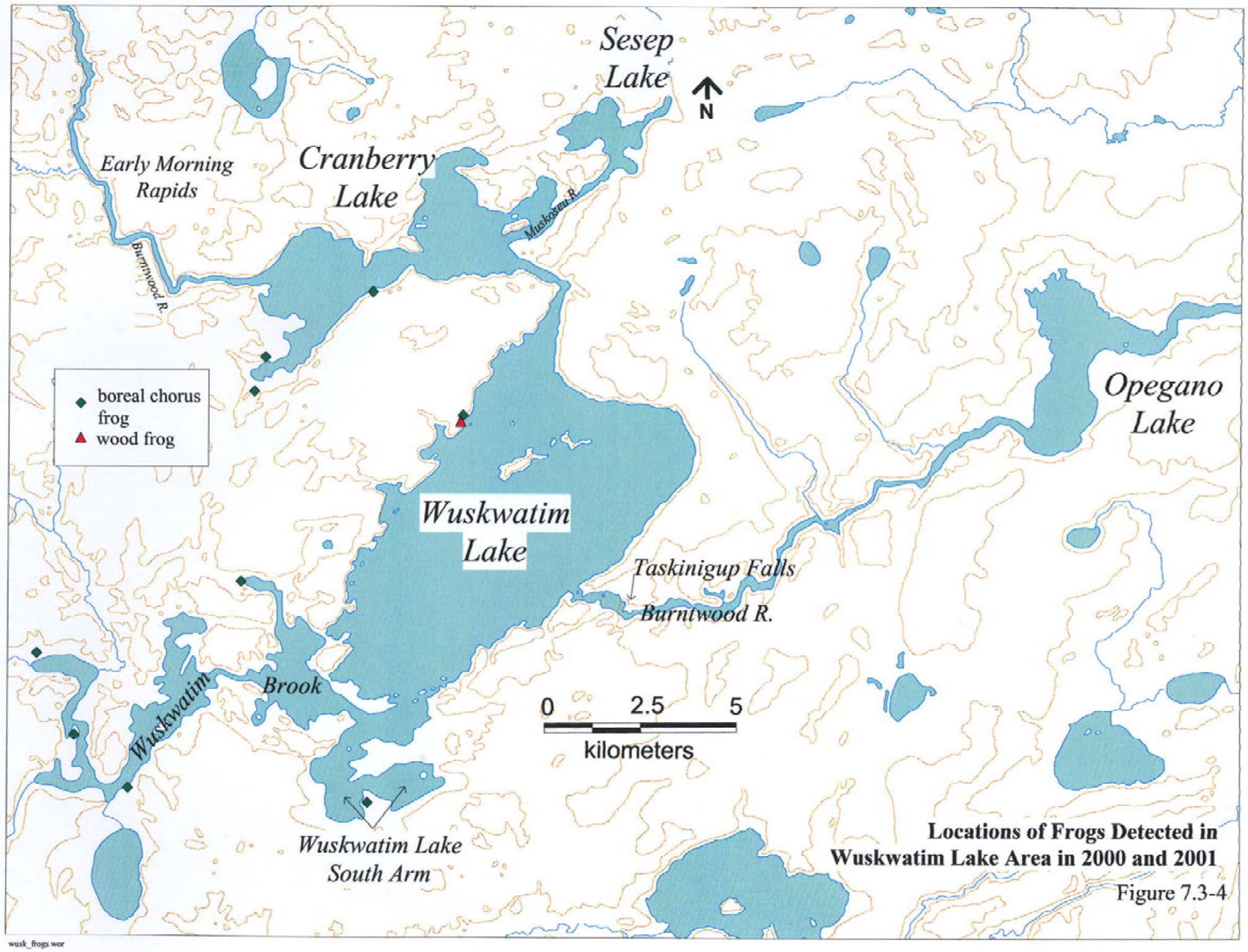
Source: Preston 1982

Distribution of Common Snapping Turtle, Western Painted Turtle and Red-Sided Garter Snake in Manitoba

Figure 7.3-3



Locations of Frogs Detected in Wuskwatim Lake Area in 2000 and 2001

Figure 7.3-4

The number of frogs recorded in the Wuskwatim study area is low as compared to other boreal study sites. In a study of amphibians in the boreal ecozone of northeastern Alberta, Roberts and Levin (1979) determined that the estimated maximum population densities were 196 wood frogs/**ha** and 23 boreal chorus frogs/ha. Roberts and Levin (1979) found that most frogs were found within 50 **m** of waterbodies in moist, low-lying habitats vegetated by sedges, grasses, horsetails, willows and poplar; average estimated densities in these areas were 28.3 wood frogs and 4.5 boreal chorus frogs/ha. They found lower densities in upland **mixed woods** and no frogs were found in dry, sandy habitats supporting jack pine forests; average estimated densities in upland mixed wood habitats were 10.8 wood frogs/ha and 0.7 boreal chorus frogs/ha.

The low numbers of frogs observed in the Wuskwatim study area is likely only partially attributable to the study methods used. Most land-based surveys occurred between sunrise and 1000h, when the temperatures were low and frog calling may have been less than at other times of the diurnal cycle, particularly the evening period. However, Roberts and Levin (1979) demonstrated that boreal chorus and wood frogs are active during cool mornings and afternoons during the breeding season and that the numbers observed during those different times of day were not substantially different.

Boat-based surveys in the Wuskwatim study area were conducted throughout the day, including the warmer periods of the diurnal cycle. As with sampling that occurred along breeding bird transects, the results suggested that very few frogs were within or adjacent to the Wuskwatim and Cranberry Lakes areas. Boat-based surveys were limited to surveying frog presence in the littoral zone and were not suited to surveying amphibians that may have been in waters further inland.

Boreal chorus frogs are typically the first amphibian species to call in the spring (Preston 1992), which may partly explain why they were the most commonly heard species in the mornings in the early spring. Boreal chorus and wood frogs typically occur in shallow waterbodies inland from major rivers and lakes where water flow and aquatic predators are minimal, as was observed in the Lower Churchill River area (Tetr*ES* 1997). Wood frogs prefer small ponds surrounded by shrubby thickets and forest (Preston 1982). This habitat is limited within the area that might be potentially affected by the Project.

The relatively low frog densities suggest that suitable frog habitat is limited in the study area. The reason(s) for this apparent lack of productive frog habitat is unclear. Some of the characteristics of the study area that may be partly responsible include:

- the general absence of meadow marshes and shallow ponds;

- high sediment load in waterways and **riparian** habitats that have been flooded by the Churchill River Diversion; and
- the presence of small ponds, **bogs** and fens that may have water-quality conditions such as high acidity levels that are unsuitable for the survival of frog eggs and larvae.

No reptiles were observed in the Wuskwatim study area during terrestrial and boat-based bird surveys in 2000 and 2001 (Tetr*ES* 2003a,b). Likewise, local resource users (Ron Spence and Harry Spence *pers. comm.* 2002) indicated that they have not seen snakes or turtles in the Nelson House RMA, including the Wuskwatim study area. If any reptiles occur in the study area, they likely would be present in very low numbers.

7.3.2 Access Road and Borrow Areas

No frogs were observed during amphibian/**breeding bird survey** transects located along the access road or in borrow areas. These surveys occurred primarily within upland habitats for potential borrow areas and within a mix of upland and lowland habitat for access road sites. Frogs were observed at only one of the four creeks investigated during reconnaissance (Section 7.8.1, Table 7.8-2); four wood frogs were observed at the site shown in Figure 7.2-3. Although no frogs were observed within or near other waterbodies investigated, some of those waterbodies appeared to provide suitable habitat for both boreal chorus and wood frogs.

The timing of sampling in early July is within the normal courtship period for both frog species (Preston 1982). The general lack of amphibians within the potential borrow area and access road sites may largely be due to the apparent low quality of the habitat. The lack of wood frogs and boreal chorus frogs observed in upland habitat in northeastern Alberta was similarly attributed to the presence of unsuitable, dry habitat (Roberts and Levin 1979). Hot weather conditions during the week prior to sampling that occurred along the access road and borrow areas in 2002 (maximum daily temperatures ranged from 24ºC to 35ºC) may also have contributed to the low numbers of amphibians observed.

7.4 IMPACT ASSESSMENT AND MITIGATION

This section provides an evaluation of the potential effects of the Project on amphibians and reptiles in accordance with the Wuskwatim Generating Station Guidelines. The following criteria, as described in the Guidelines and in Sections 2.3 and 2.4, were used to define, evaluate and compare the potential effects of the Project on amphibians and reptiles:

- nature of effect - either "positive" or "adverse" **environmental effects**;
- magnitude of the effect – small, moderate or large;
- **temporal** boundaries and duration of the effect – short-term or long-term;
- frequency of the effect – may be a constant or recurring effect;
- reversibility of the effect – the degree to which effects can be removed from the ecosystem either by **mitigation** or as a result of natural ecosystem function;
- spatial boundaries – site-specific, local or regional; and
- ecological context – the individual species or groups demonstrating an effect within the context of the Project's relationship to the evolving and changing ecosystem.

7.4.1 Overview of Impacts to Amphibians and Reptiles

Two of the three amphibian species whose documented ranges include the Wuskwatim Generating Station study area were observed in low numbers (wood frog and boreal chorus frogs), while the third species (leopard frog) was not observed during field studies in 2000 and 2001.

The main potential Project-related effects on amphibians are associated with:

- clearing of habitat along access roads, borrow areas and at the generating station site;
- clearing and flooding of the **forebay** area between Wuskwatim and Taskinigup Falls;
- fragmentation-related effects of the road and other Wuskwatim Generating Station site infrastructure on frog breeding and **overwintering** habitat; and
- mortality associated with vehicles that travel along the road during the construction and operational periods.

The total amount of land to be cleared for the Project, including the access road and borrow areas, is estimated to be 1,380 ha if 100% of the potentially available borrow areas are required and would be cleared (or 707 ha if only 6% are required; Volume 3). After Project construction, 497 ha would be required for the long-term operation and maintenance of the Project (including the access road), 60 ha would be fully **rehabilitated** and 10 ha would be partly rehabilitated (Volume 3). Some suitable amphibian habitat occurs within the areas potentially affected by construction and operation of the Project, but the majority of potentially affected habitat in the study area is of low quality for amphibians. **Potential effects of generating station construction**

and operation on amphibian populations are expected to be site-specific, negligible, long-term and not significant.

No reptile species has a documented range that extends as far north as the Wuskwatim Generating Station study area. No reptiles were observed during field studies conducted in this study area in 2000 and 2001. Additionally, local resource users indicated that they had not seen reptiles in the study area. **Due largely to the apparent lack of reptiles within or near the areas potentially affected, Project construction and operation are expected to have no impact on reptiles.**

7.4.2 Construction and Demobilization

7.4.2.1 Access Road

The effects of access road development on amphibian populations are expected to be site-specific, small, long-term and not significant.

The proposed access road (or "Mile 17 Road") will be about 48-km long, have a 100 m right-of-way, and cover an area of 479 ha in total (Volume 3). Considering that the amount of clearing will vary between 60 m to 100 m, depending largely on sight lines, the total area cleared will likely be somewhat less than 479 ha.

The majority of the access road route is located on dry, upland area which generally will provides little suitable habitat for frogs. Stream crossings do provide some suitable frog habitat. During field studies in 2002, frogs were observed at only one stream-crossing site (Section 7.8.1, Table 7.8-2). The small, long-term loss of amphibian habitat from access road construction may be partially off-set by slight improvements in habitat where increased **ponding** occurs near roads.

Development of the roadbed will result in a long-term removal of some summer **foraging** and overwintering habitat. The removal of forest **cover** often lowers the abundance and **diversity** of amphibians by changing the habitat and microclimate by altering air and soil temperatures, humidity, light intensity, and windspeed, which cause ponds to dry up (McLeod and Gates 1998; Ross *et al*. 2000). Tree clearing (and grubbing) also removes or degrades amphibian habitat associated with leaf litter or coarse woody debris and shrubs.

As a result of clearing and road construction, a few unidentified breeding ponds may be removed, and the quality of streams as amphibian breeding areas and movement corridors may be degraded. These activities may also increase in-stream fine sediments, thereby lowering habitat quality and densities of amphibians in waterways near road construction sites (Welsh and Olliver 1998).

Considering the low habitat quality and low observed amphibian numbers in the Wuskwatim study area, the effects of access road construction are anticipated to be small and local. These effects can be reduced through minimizing the amount of clearing, by clearing in the winter to the extent feasible, by retaining buffers of shrubs and trees near streams and other waterbodies and, where necessary, using silt fences (Volume 3 and the EnvPP). Retaining some slash piles and coarse woody debris (i.e., snags and logs) on the forest floor would benefit amphibians (Ross *et al*. 2000). Retention or plantings of **buffer zones** would provide cover and spawning habitat for frogs (McLeod and Gates 1998; Seburn and Seburn 2000). Placement of slash away from streams and the development of culverts at these crossings will help to maintain corridors between wetlands and year-round frog habitat.

Traffic associated with the construction and use of the Mile 17 access road may cause mortality to a small number of amphibians. Studies have shown that traffic can have a negative effect on frog populations and that these effects increase with increasing traffic volumes (Fahrig *et al*. 1995; Carr and Fahrig 2001). Frogs are especially susceptible to traffic-related mortality where roads are situated such that frogs disperse across the roadway to suitable foraging, breeding, and overwintering sites. In a four-year study of wildlife mortality along a 3.6-km section of the Long Point Causeway (Lake Erie, Ontario), Ashley and Robinson (1996) found that amphibians (mostly leopard frogs) accounted for 92% of the 32,000 road kills, followed by birds (4%), reptiles (3%) and mammals (1%). Estimates of the survival rate of toads crossing roads with 24 to 40 cars/hr ranged from 0 to 50% (Fahrig *et al*. 1995; Carr and Fahrig 2001). Heine (in Vos and Chardon 1998) predicted virtually all amphibians that cross roads experiencing traffic ratios of more than 26 cars/hr would be killed. However, traffic volume during the construction phase of the Wuskwatim Project (160 vehicles/day or 6.7 vehicles/hr) is low enough to have only a small effect on local amphibian populations (Volume 3).

Road rights-of-way will also fragment the habitat and may create a "barrier" that could result in a reduced amount of frog movement between habitats, particularly for roads with high traffic volumes (Gibbs 1998; Yanes *et al*. 1995). This negative impact can be reduced where natural streams and well-designed culverts provide amphibians with movement corridors.

Pollution from vehicle emissions and from road runoff that contains toxic chemicals, petroleum, salts and sediment can also have an adverse effect on amphibian populations

(Carr and Fahrig 2001). Increases in the acidity of breeding ponds decreases egg mass densities, reducing hatching success and increasing overall mortality of wood frog and American toad embryos (Gascon and Planas 1986; Freda and McDonald 1993). The potential for similar effects to occur as a result of the Wuskwatim Generating Station Project such as oil spills and pollution associated with vehicle usage along the access road is small, site-specific and related primarily to contingency events.

7.4.2.2 Borrow Areas

The effects of borrow area utilization on amphibian populations are expected to be small, local, long-term and not significant.

In addition to the 654 ha area associated with potential granular borrow areas illustrated in Figure 7.2-3, a 26-ha area south of Taskinigup Falls has been identified as a potential source of impervious borrow material (Volume 3). Some sites within the 680-ha area may be excavated, resulting in the removal of a very limited amount of low-quality frog habitat .

Borrow areas are generally well-drained upland granular deposits that provide little or no suitable amphibian habitat. Therefore, the removal of forest cover, understory vegetation and soil layers during excavation activities is expected to remove very little potential amphibian habitat and would result in a small local negative effect to amphibians.

The potential effects on amphibians would be minimized through clearing vegetation in the winter, when snow can act as an insular and protective cover that minimizes the amount of ground compaction by equipment (Section 7.4.2.1), and by increasing the surface area of the excavated site only as required (Volume 3 and the EnvPP). Potential impacts on frogs would also be minimized by excavating at sites away from streams and ponds. Regardless of mitigation measures taken during clearing and excavation, equipment used in the development of borrow areas may crush and thereby cause the mortality of some frogs.

As outlined in the EnvPP, borrow sites that are **decommissioned** would be re-sloped and re-vegetated through spreading stockpiled organic material that contains woody, vegetative material. Pools of water may occur where depressions or pits in the ground remain on impermeable **substrates** (e.g., bedrock or clay). As a result, marginal frog habitat may develop at a few of these sites, particularly at large and shallow depressions that develop aquatic vegetation.

7.4.2.3 Construction Camp and Associated Facilities

The effects of construction camp development on amphibian populations are expected to be site-specific, small, long-term and not significant.

Most of the clearing for the construction camp and associated facilities will likely occur prior to May 2004 (Volume 3). The area to be cleared is an upland spruce-dominated forest that was not observed to support frog populations. The area that will be affected by clearing and construction of the construction camp is predominantly low-quality frog habitat.

7.4.2.4 Forebay Clearing

The effects of forebay clearing on amphibian populations are expected to be small, local, long-term and not significant.

Approximately 39 ha of forest would be cleared in the forebay area between Taskinigup and Wuskwatim falls (Volume 3). Clearing would remove a small amount of low-quality amphibian habitat that was not observed to support amphibians during field studies in 2001. Due in large part to the poor quality amphibian habitat in the area, the effect on amphibians would be minimal. The effects would be further minimized by clearing in the winter when protective snow cover is present and boreal chorus and wood frogs are overwintering under logs, rocks and other substrates (Section 7.4.2.1). While some overwintering amphibians may be crushed by clearing equipment, some may also escape damage by being under hard substrates (e.g., rocks and tree stumps) that are not over-turned by clearing activities.

The reach between Wuskwatim and Taskinigup Falls has very high flows in the Burntwood River. This high flow regime makes the area generally unsuitable as frog habitat.

7.4.2.5 Generating Station

The effects of generating station development on amphibian populations are expected to be site-specific, small, long-term and not significant.

The **footprint** area of the generating station, included flooded area, would be about 184 **hectares** (Volume 3), in an area of low quality frog habitat. River conditions near the generating station are not suitable for amphibian breeding or foraging and were not found to support amphibians. Any suitable amphibian habitat that would be lost is primarily inland from the riverbanks and riparian habitat. Therefore, activities such as clearing and blasting are expected to have little effect on amphibians in the area.

7.4.2.6 Contingency Events

The potential for spillage or leaks of petroleum products (e.g., gasoline, diesel and heating oil) is associated with all phases of construction (e.g., the road, development of the generating station site, etc.). Such unanticipated events have the potential to contaminate waterbodies and soils in areas where amphibians forage, breed, travel and overwinter.

While the effect of such contingency events on amphibians would generally be very small and site-specific if they occur on terrestrial habitat, these effects have the potential to be larger if spills and leaks of hazardous materials enters a waterbody that supports breeding frog populations.

The effects on frogs from contingency events such as petroleum spillage and leaks are expected to be small, site-specific and not significant. This is due in large part to the very low populations of frogs and the lack of any sensitive frog habitat that can be identified as occurring in the areas to be affected by construction activities. The magnitude of the potential effects is also expected to be minimized through implementation of measures outlined in the EnvPP, e.g., proper containment of fuels and storage away from waterbodies and other potentially sensitive sites.

7.4.3 Operation

7.4.3.1 Generating Station

The effects of generating station operation on amphibian populations are expected to be small, local, long-term and not significant.

The operation-related activities and structures that have some potential to affect amphibians in the study area are:

- flooding of about 37 ha between Wuskwatim and Taskinigup Falls;
- long-term inundation of shoreline reaches of Wuskwatim and Cranberry lakes as a result of maintaining forebay levels at 234 m **ASL**;
- increased **erosion**; and
- increased frog mortality resulting from the long-term use of the access road.

The area between Taskinigup and Wuskwatim falls that will be flooded currently provides marginal frog habitat. Therefore, flooding of land in this area is expected to have a small effect on local frog populations. The most suitable amphibian habitat in the study area occurs in the southwest bay of Cranberry Lake and the south bays of Wuskwatim Lake (Figure 7.3-4). By stabilizing the level of Wuskwatim Lake at or near the upper limit of its current operating range (234 m ASL), generating station operations may result in the loss of some frog habitat along the shorelines of these bay areas and in other shoreline reaches along Wuskwatim Lake. Most of the habitat along the shoreline of the main part of Wuskwatim Lake is of marginal quality for amphibians.

There is potential for the increased and stabilized water levels in Wuskwatim Lake to affect local **groundwater** levels further inland. If these effects result in increased wetland areas inland from the lake, this may create new frog habitat, partly offsetting habitat lost along the shores of the main lake. Considering the presently low populations of amphibians throughout the Wuskwatim study area, such a slight improvement in habitat quality might result in a slight increase in the number of amphibian in the area.

7.4.3.2 Access Road

The effects of access road operation on amphibian populations are expected to be site-specific, small, long-term and not significant.

Amphibian habitat along the access road is largely low quality or non-existent, except in low-lying areas and in the immediate vicinity of stream crossings (Section 7.4.2.1). Operational effects on frog habitat may result from road dust and vehicle emissions. Vehicle-related mortality of a relatively small numbers of frogs due to traffic during Project operation is expected to occur over the long term (over the 100 years of expected operations). Due to the largely reduced annual frequency of road traffic expected during the period of Project operation as compared to construction (Volume 3), annual frog mortality along the access road during the operational phase is expected to be minimal.

7.5 RESIDUAL IMPACTS

Residual impacts are the positive and negative effects of the proposed Project that persist after the implementation of mitigation measures. The assessment of environmental impacts and mitigation measures is outlined in Section 7.4. The negative residual impacts to amphibian populations are expected to mostly be associated with:

- the loss and degradation (such as through fragmentation) of some low quality habitat along the access road and at the generating station site;
- clearing and flooding of the forebay;
- mortality associated with the long-term use of the access road (i.e., vehicle-amphibian collisions); and

- the increased rates of erosion, which are expected in the first 5 years of operation and to be followed by a gradual return to pre-Project conditions over 20 years, that would likely cause a reduction in the amount of suitable amphibian habitat.

As discussed previously, some minor positive effects on amphibians are possible if ponding occurs alongside the access road and if water stabilization on Wuskwatim Lake results in increased wetland areas inland due to higher groundwater levels.

Residual impacts to amphibian populations as a result of generating station development are not expected to be significant.

7.6 CUMULATIVE IMPACTS

Cumulative effects to amphibians were assessed relative to the expected effects to amphibian habitat regarding past, present and reasonably foreseeable future projects and activities within ecodistricts defined in Section 7.8.2. The cumulative effects to amphibians are primarily associated with: habitat loss, **habitat fragmentation** and access roads, particularly associated with the forestry industry.

To assess cumulative effects to amphibians, an ecosystem-based approach utilizing a federally/provincially established ecodistrict classification system was used (Section 7.8.2). Effects to amphibian habitat within those ecodistricts potentially affected by the Project were assessed. Approximately 0.04% of the area within the relevant ecodistricts is expected to be affected by the Project, with an additional 2.3% potentially affected by other developments including forestry activities.

Due to the uncertainty associated with the future location of potential forestry activities (i.e. land disturbance from timber harvesting) and associated roads, sufficient information is not available to fully assess the potential **cumulative impacts** to amphibians resulting from those forestry activities.

No significant adverse cumulative effects to amphibians are expected as a result of the Project in combination with other projects or activities. Therefore, the residual effects of the Project to amphibians are not considered to be significant.

7.7 MONITORING AND FOLLOW UP

There will be an extensive environmental **monitoring** program during construction and operation activities for the Wuskwatim Generating Station Project. This program is outlined in Volume 1 (Section 10). Apart from activities outlined in the overall monitoring program (Volume 1, Section 10), no monitoring activities specifically related to amphibian populations are proposed. Within the potentially affected reaches of the Burntwood River system, amphibian populations are low and are not concentrated in areas that would likely be affected by the Project; this would make it difficult to monitor and detect changes in amphibian populations.

Any notable effects on amphibians or reptiles observed during the process of construction-related monitoring should be reported to the Environmental Inspector for determination of the need for amphibian monitoring or mitigation, e.g., installing drift fencing leading to culverts and/or additional road signage. For example, unanticipated high mortality of frogs crossing at a few sites along the Mile 17 Road in the early summer may require that mitigative steps be implemented at that time and/or in anticipation of a repeat in crossings of the access road in late summer as frogs return to overwintering sites.

7.8 APPENDICES

The following sub-sections contain additional relevant information referred to in previous amphibian-related sections of the **EIS** (Section 7).

7.8.1 Frog Observations

Table 7.8-1 identifies the locations where amphibians were observed during breeding bird surveys (2 of 332 survey stops), boat-based surveys (of the 2,209 km surveyed in total, 1,479 km was surveyed in May, June or July during the frog breeding season) and reconnaissance in 2000 and 2001. Table 7.8-2 provides the observations of frogs and their habitats along four creeks examined on July 2, 2002.

TABLE 7.8-1

NUMBER AND LOCATION OF AMPHIBIAN OBSERVATIONS IN THE WUSWATIM STUDY AREA, 2000 AND 2001

Survey	Date	Time	Location	Species	Code*	Number
Boat-based Survey Shore Stop	02/06/2000		Wuskwatim Lake, Main	boreal chorus frog	3	>5
Boat-based Survey Shore Stop	02/06/2000		Wuskwatim Lake, Main	wood frog	1	2
Boat-based Survey	03/06/2000		Wuskwatim Brook	boreal chorus frog	?	?
Boat-based Survey	08/06/2000	12:40	Wuskwatim Brook	boreal chorus frog	3	>?
Boat-based Survey	08/06/2000		Wuskwatim Brook	boreal chorus frog	3	>20
Boat-based Survey	09/06/2000		Cranberry Lake South Bay	boreal chorus frog	2	5
Wuskwatim Boat-based Surveys	5/29/2001	17:00	Wuskwatim Lake, S-Arm	boreal chorus frog	3	
Wuskwatim Breeding Bird Survey	01/06/2001	6:01	Wuskwatim Brook	boreal chorus frog	?	
Wuskwatim Breeding Bird Survey	09/06/2001	9:50	Cranberry Lake	boreal chorus frog	3	
Boat-based Survey	09/06/2000		Cranberry Lake Creek to South (approx. location)	boreal chorus frog	3	>10

*1=individuals can be counted, no overlapping calls; 2=individual calls are distinguishable but overlapping; 3=full chorus, calls continuous and overlapping (number cannot be estimated with precision)

Refer to Figure 8-2 for locations of frogs detected in the Wuskwatim area

TABLE 7.8-2

DESCRIPTION OF RECONNAISSANCE SITES FOR FROGS SAMPLED ALONG MILE 17 ACCESS ROAD ON JULY 2, 2002

Location	Coordinates	Date	Time	Frogs	No.	Notes	Habitat
AC2	549828 6177854	July 2, 2002	11:05 (start) 11:18 (end)	wood frogs	3	at least 1 seen that wasn't calling	
AC4 - Creek along the southern portion of road	E541203 N6167985	July 2, 2002	08.43(start) 09.12(end)	None	0		creek in 40-50m wide floodplain; sedges and willows with some standing dead; forest is class 3 with 75% cover. BS85, TL10, JP5; some young TL and BS along the forest margins
AC5	552175 6192922	July 2, 2002	~11:30 ~11:45	None			willow/sedge along creek; water is moving through a culvert; BS (100%) on either side of the creek
AC6	549326 6193891	July 2, 2002		None		creek cross access road about 700m to the south;	larger creek than AC5 - 3m wide; sedge edges; forst on south side of road is Black Spruce (95%) - Tamarack (5%)/willow-young spruce margin (Pict. #13); creek on south side of road is Black Spruce (85%) - Tamarack (10%) - Trembling Aspen (5%), with creek wider (4-5m) and some occassionally flooded Black Spruce

7.8.2 Cumulative Effects Assessment Approach and Analysis

7.8.2.1 Approach

The approach used to assess the cumulative effects of the Project on amphibians was also used for birds (Section 8.6). The Cumulative Effects Assessment (CEA) regarding amphibians and birds has incorporated the Guidelines to the degree feasible with respect to "*the cumulative effects assessment shall look at all effects that are likely to result form the project when they are anticipated to occur in combination with other projects or activities that have been, or will be carried out*".

In general, the CEA for amphibians and birds assumed an ecosystem approach as stated by the Guidelines that "*the scope of the environmental assessment shall include examination of…the biological environment, including terrestrial and aquatic ecosystems…*" (Section 2.3.2 of the Guidelines). The CEA for amphibians and birds involved the following steps:

- identification of projects and activities in the general region that have occurred, are currently occurring or may occur;
- identification of the ecodistricts which are potentially affected by the Project and related activities (ref. Section 1.3);
- scoping of the regional projects and activities to exclude those which occur outside of the potentially affected ecodistricts;
- scoping of effects to remove those in which there is excessive uncertainty with respect to effects identification;
- assessment of the project and activities on the overall cumulative human-related effects within potentially affected ecodistricts, and
- evaluation and perspective on the relative significance of the identified effects.

7.8.2.2 Projects and Activities Potentially in the Region

The past and current projects and activities that were considered in the CEA due to their potential temporal or spatial overlap with amphibian and bird habitats or populations potentially affected by the Project are listed in Volume 10.

7.8.2.3 Spatial Area of the Assessment

Guidance as provided by Section 48.1 of the *Canadian Environmental Assessment Act* Inclusion List Regulations was used to scope the spatial extent of the assessment:

- "*Physical activities…that are intended to threaten the continued existence of a biological population in an ecodistrict, either directly or through the alteration of its habitat*".

The CEA of amphibian and bird-related effects restricted its assessment to the ecodistricts directly affected by the Wuskwatim Generation Project. This includes the following ecodistricts which are illustrated in Figures 7.8-1 and 7.8-2:

- #350 – Waskaiowaka Lake;
- #356 – Three Point Lake; and
- #363 – Sipiwesk Lake.

A small part of the access road (approximately 0.5 km) is also located in Ecodistrict #361, but due to the very limited extent of the road into this ecodistrict (approximately 0.0001% of the area of Ecodistrict #361), it was excluded from further assessment.

7.8.2.4 Projects and Activities Included in the Amphibian and Bird CEA

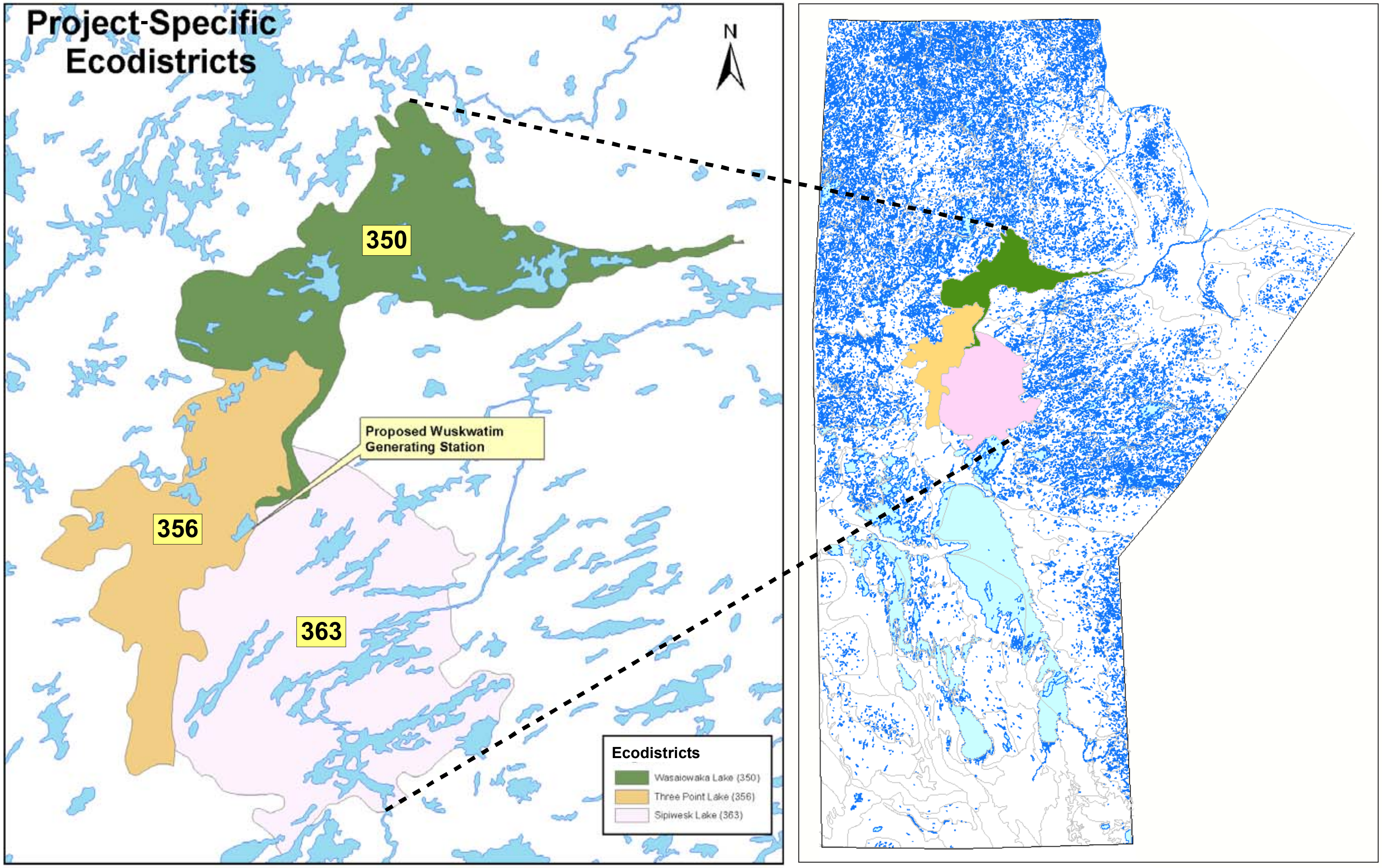
Given the spatial area assessed for the amphibian and bird CEA (Section 7.8.2.3), the list of projects considered in the CEA (Volume 10) was adjusted to include only those within the ecodistricts primarily affected. Figures 7.7-1 and 7.8-2 illustrate this area.

Within these ecodistricts, the following projects and activities may have cumulative effects on amphibians and birds:

- Wuskwatim Generation Station;
- Wuskwatim Access Road;
- Wuskwatim Transmission Line;
- forestry;
- existing roads and trails;
- existing transmission lines; and
- existing communities, mines, cabins, etc.

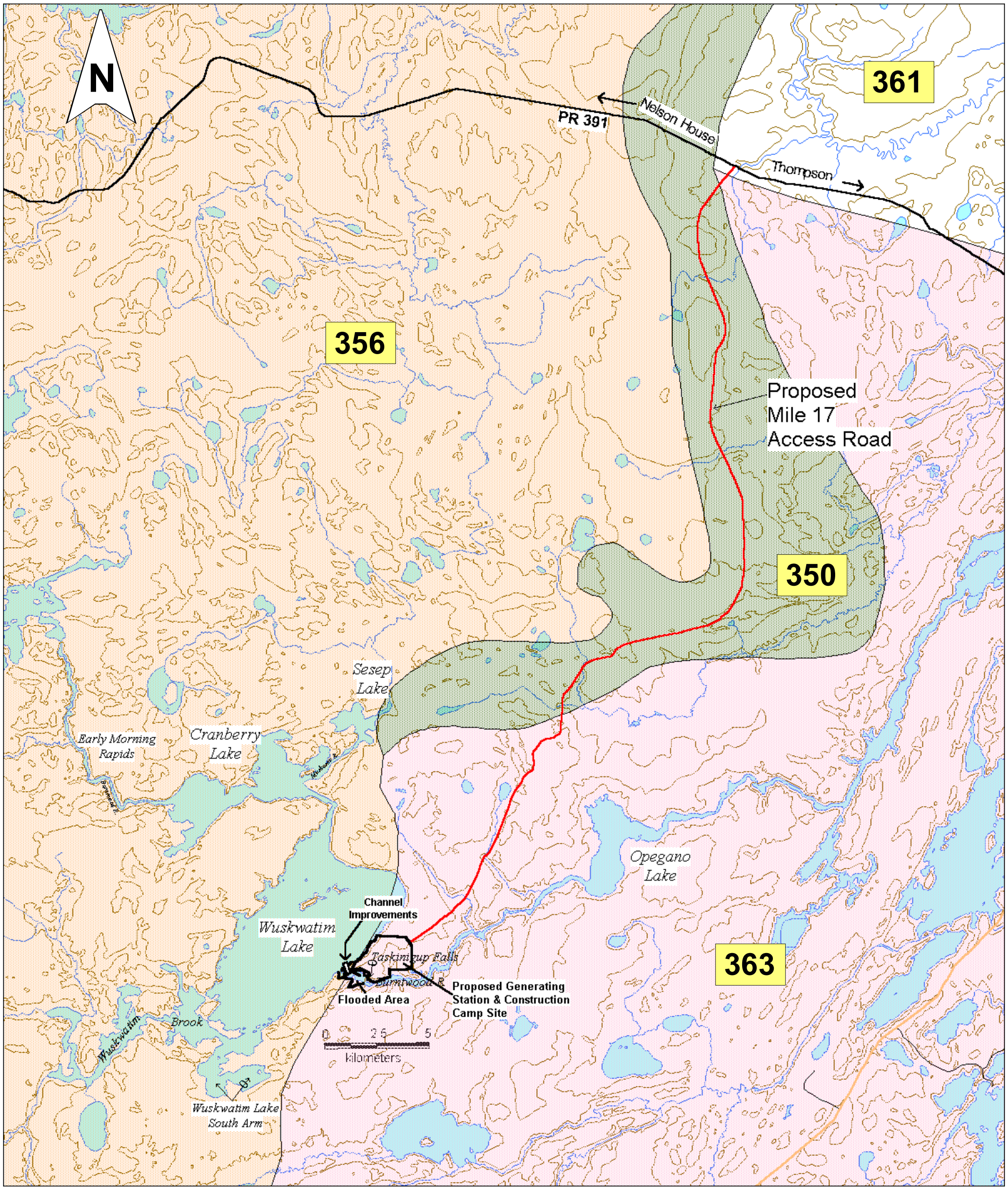
7.8.2.5 Effects on Amphibian and Bird Habitat

The identified effects on habitat as a result of the Wuskwatim Generation Station were summarized from (Volume 5). Identified effects on habitat as a result of the Wuskwatim Transmission Lines were summarized from "Wuskwatim Transmission Line Wildlife Supporting Document" (Tetr*ES* 2003c).



Proposed Wuskwatim Generating Station Ecodistrict Overview

Figure 7.8-1



363 - Ecodistrict Identification Number

Ecodistricts within the Wuskwatim Generating Station Study Area
Figure 7.8-2

Wusk GS Study Area v2.dsf

Forestry effects had been previously identified as about 3% of a project-related sub-region (Volume 1, Section 7.11.1), which overlaps with the ecodistricts indicated in Section 7.8.2.3. This level of forestry influence (3% of the area over a period of 50 years) was therefore assumed for all of the ecodistricts assessed as the predicted degree of habitat disruption. Wildfires can reset landscape features modified by forestry back to a nearly natural state. After allowing for this effect, residual wildlife habitat potentially disturbed by forestry is reduced from 3% to 1.9% of the area over 50 years (Tetr*ES* 2003c). Therefore, forestry is projected to have a residual effect on about 1.9% of wildlife habitat within each potentially affected ecodistrict over 50 years.

There is uncertainty regarding the future development of roads, trails and other linear corridors (e.g., seismic and mining exploration cutlines) within each potentially affected ecodistrict. The assessment relied upon an evaluation based on the existing historical magnitude of disturbance related to road/railway corridors using the provincial Forest Resource Inventory (FRI) dataset for each ecodistricts. A similar methodology was used to describe cabin/community development and other human developments in the area.

Issues related to climate change were not explored due to the substantive uncertainty with respect to the potential impacts on amphibians and birds.

The cumulative effects to amphibians and birds are anticipated to be associated with the following:

- potential habitat loss associated with permanent structures (generating station, roads, etc.), impoundment, access road bed, etc.;
- potentially disrupted habitat relating to vegetative clearing, right-of-way clearing, and roadway traffic; and
- potential effective habitat loss due to reduced wildlife use of available but disturbed areas adjacent to the above effects.

It is anticipated that the affected areas of habitat disruption (as opposed to loss) could include up to an approximate 400 m radius of the directly affected area for birds due to habitat fragmentation and creation of a habitat "edge-effect" (Tetr*ES* 2003c). For amphibians, habitat disruption effects may extend up to 800 m from a road (1,400 m for leopard frogs (Forman 2000; Carr and Fahrig 2001), but the extent of amphibian habitat disruption away from other disturbed areas (e.g., generating station) is unknown.

Table 7.8-3 summarizes the potential cumulative effects within each ecodistrict. The total degree of cumulative habitat loss, disruption and reduced use within the affected

Table 7.8-3 Cumulative Effects Assessment Summary for Amphibians and Birds

Ecodistrict	Total Area (km^2)	Landscape Feature	Potential Effect (km^2)			Percent of Ecodistrict			
			Direct Habitat Loss[1]	Habitat Disruption[2]	Altered Habitat Utilization[3]	Direct Habitat Loss[1]	Habitat Disruption[2]	Altered Habitat Utilization[3]	
350	10,110	Wuskwatim Generation Station							
		Wuskwatim Access Road (31.9 km)	3.2		25.5	0.03		0.25	
		Wuskwatim Transmission Line							
		Forestry (50 year window)[4]		192.1	614.7		1.90	6.08	
		Existing Roads and Trails[5]	0.2		3.2	0.002		0.03	
		Existing Transmission Lines[6]		0.3	4.0		0.003	0.04	
		Existing Communities, Mines, Cabins	0.2			0.002			
		Wuskwatim Generation Project	3.2		25.5	0.03		0.25	
		Forestry and Wuskwatim Transmission Line		192.1			1.90	6.08	
		Other Existing Features	0.4	0.3	7.2	0.004	0.003	0.07	
356	7,930	Wuskwatim Generation Station							
		Wuskwatim Access Road (0 km)							
		Wuskwatim Transmission Line		3.8	28.0		0.05	0.35	
		Forestry (50 year window)[4]		150.7	482.2		1.90	6.08	
		Existing Roads and Trails[5]	4.3		68.8	0.05		0.87	
		Existing Transmission Lines[6]		3.2	42.7		0.04	0.54	
		Existing Communities, Mines, Cabins	5.3			0.07			
		Wuskwatim Generation Project							
		Forestry and Wuskwatim Transmission Line		154.5	510.2		1.95	6.43	
		Other Existing Features	9.6	3.2	111.5	0.12	0.04	1.41	
363	15,724	Wuskwatim Generation Station	0.1	3.0		0.001	0.02		
		Wuskwatim Access Road (14.4 km)	1.4	7.2	11.6	0.01	0.05	0.07	
		Wuskwatim Transmission Line	0.2	8.5	79.6	0.001	0.05	0.51	
		Forestry (50 year window)[4]		298.8	956.2		1.90	6.08	
		Existing Roads and Trails[5]	29.6		473.6	0.19		3.01	
		Existing Transmission Lines[6]		27.8	370.7		0.18	2.36	
		Existing Communities, Mines, Cabins	63.7			0.41			
		Wuskwatim Generation Project	1.5	10.2	11.6	0.01	0.06	0.07	
		Forestry and Wuskwatim Transmission Line	0.2	307.3	1035.8	0.001	1.95	6.59	
		Other Existing Features	93.3	27.8	844.3	0.59	0.18	5.37	
TOTAL	33,764	Wuskwatim Generation Project	4.7	10.2	37.1	0.01	0.03	0.11	
		Forestry and Wuskwatim Transmission Line	0.2	653.9	1546.0	0.00	1.94	4.58	
		Other Existing Features	103.3	31.3	962.9	0.31	0.09	2.85	**TOTAL**
		Total Cumulative Effect in the Ecodistricts (% of area)				**0.32**	**2.06**	**7.54**	**9.92**
		Effect in the Ecodistricts without the Project (% of area)				**0.31**	**2.03**	**7.43**	**9.77**
		Effect in the Ecodistricts caused only by the Project (% of area)				**0.01**	**0.03**	**0.11**	**0.15**

Notes:

CEA based on 50-year projected cumulative disruption (ref. Volume 6, Section 5).

1) "Direct Habitat Loss" involves a loss of wildlife habitat due to massive disruption caused by roadbed or building construction.

2) "Habitat Disruption" involves an alteration of wildlife habitat due to right-of-way development or forestry cutblocks.

3) "Altered Habitat Utilization" involves changes in how wildlife use wildlife habitat adjacent to areas of habitat loss or Disruption. The 400 m allowance obtained from literature values discussed in Appendix D of the Wuskwatim Transmission Line, Wildlife Technical Supporting Document" TetrES 2003.

4) Forestry cutblocks assumed to be an average of 0.1 km2 in area with an edge of 0.4 km long.

5) Road and Trail rights-of-way assumed to be 50 metres in width.

6) Transmission line rights-of-way assumed to be 60 metres in width.

ecodistricts is anticipated to increase from a projected 50-year baseline of 9.8% of the area without the Project, to 9.9% of the area with the Project. Therefore, the Project is anticipated to increase human disruption in the area by 0.1%, which is not a substantive change.

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7.10 GLOSSARY

ASL above sea level

Amphibian cold-blooded animal of the Class Amphibian that typically lives on land but breeds in water (e.g., frogs, toads, salamanders).

bog wetland ecosystem characterized by an accumulation of peat, acid conditions and a plant community dominated by sphagnum moss

Boreal Shield Ecozone as classified by Environment Canada; an ecological land classification consisting predominantly of boreal forest on soils overlying Precambrian shield rock. This ecozone stretches across more than 1.8 million square kilometers from Newfoundland west to Alberta.

breeding bird survey standardized surveys conducted during the breeding season for a given area whereby observers record the number of birds seen or heard along a travel route

buffer zone **1)** an area that protects or reduces impacts to a natural resource from human activity; **2)** a strip of land along roads, trails or waterways that is generally maintained to enhance aesthetic values or ecosystem integrity

COSEWIC Committee on the Status of Endangered Wildlife in Canada

cover **1)** Vegetation such as trees or undergrowth that provides shelter for wildlife; **2)** also the surface area of a stratum of vegetation as based on the vertical projection on the ground of all above-ground parts of the plant; **3)** also the material in or over-hanging the wetland area of a lake or stream which provides fish with protection from predators or adverse flow conditions, e.g., boulders, deep pools, logs, vegetation

cumulative impact the impact on the environment which results from the effects of a project when combined with those of other past, existing and imminent projects and activities

decommissioned to remove infrastructure or equipment from active service

density the number of individuals in relation to the space in which they occur

diversity related to the number of different species or different features in a given location

ecosystem a functional unit consisting of all living organisms (plants, animals, microbes, etc.) in a give area, and all non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be any size (e.g., a log, pond, forest) but always functions as a whole unit.

EIS Environmental Impact Statement. a document setting out the results of an environmental impact assessment (see EIA), including adverse (and sometimes positive) effects of a proposed development. The document is filed as part of an application for environmental approvals under the *Environment Act* (Manitoba) or the *Canadian Environmental Assessment Act.*

environmental effect is defined by CEAA, in respect of a project meaning:
(a) any change that the project may cause in the environment, including any effect of such change on health and socio-economic conditions, on physical and cultural heritage, on the current use of lands and resources for traditional purposes by aboriginal persons, or by any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and
(b) any change to the project that may be caused by the environment, whether any such change occurs within or outside Canada

erosion the wearing away of the earth's surface by the action of water, wind, current, etc.

footprint	the surface area occupied by a structure or activity
foraging	the act of locating, capturing and eating prey
forebay	the portion of a reservoir immediately upstream of a hydroelectric facility
groundwater	the portion of sub-surface water that is below the water table, in the zone of saturation
ha	hectares
habitat	the place where a plant or animal lives; often related to a function such as breeding, feeding, etc.
habitat fragmentation	the division of habitat into isolated "islands" which can considerably impair the ability of a population to use the area because of its small size and discontinuity
hectare	a metric unit of square measure equal to 10,000 square metres or 2.471 acres
impact	a positive or negative effect of a disturbance on the environment or a component of the environment
km	kilometres
life history	the timeline of an organism's life; including development, maturation and reproduction
m	metres
MESA	*Manitoba Endangered Species Act*
mitigation	actions taken during the planning, design, construction and operation of works to reduce or avoid potential adverse effects
mixed woods	forests lacking a clearly dominant (>75% composition) tree species

monitoring	any on-going process or program for measuring the actual effects of constructing or operating a development
NCN	Nisichawayasihk Cree Nation
overwintering	remaining through the winter months
ponding	formation of a reservoir due to the damming of a river or creek; retention of water to replenish an existing reservoir
population	a group of interbreeding organisms of the same species that occupy a particular area or space
Project	the Wuskwatim Generating Station Project
reconnaissance	a preliminary survey or inspection
rehabilitate	to carry on or cause a process of rehabilitation
rehabilitation	restoring to a more normal state; when referring to land, restoring the area to promote re-vegetation.
riparian	along the banks of rivers and streams
shorelines	the narrow strip of land in immediate contact with the sea, lake or river
species	a group of inter-breeding organisms that can produce fertile offspring
substrate	the surface or material on which an organism lives or to which it is attached
temporal	pertaining to time
terrestrial	living on or in the ground, or related to the ground

threatened species as defined by COSEWIC, a species likely to become endangered if limiting factors are not reversed

transect a long, continuous sample area

SECTION 8: BIRDS

Prepared by: Tetr*ES* Consultants Inc.

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8.0 BIRDS

8.1 INTRODUCTION

Birds have an important role in **ecosystem** function within the **NCN** Resource Area, with some birds (e.g., ducks, geese and grouse) being harvested for domestic use. In Manitoba, birds and their **habitat** currently receive protection under the provincial *Wildlife Act* and ***Endangered Species*** *Act* and under the federal *Migratory Birds Convention Act*. The federal *Species At Risk Act* (**SARA**), which is yet to be enacted, would afford additional legislative protection to **threatened** and endangered bird species that may occur in the study area. A list of bird species that occur within the bird study area is provided in Appendix 8.8.1.

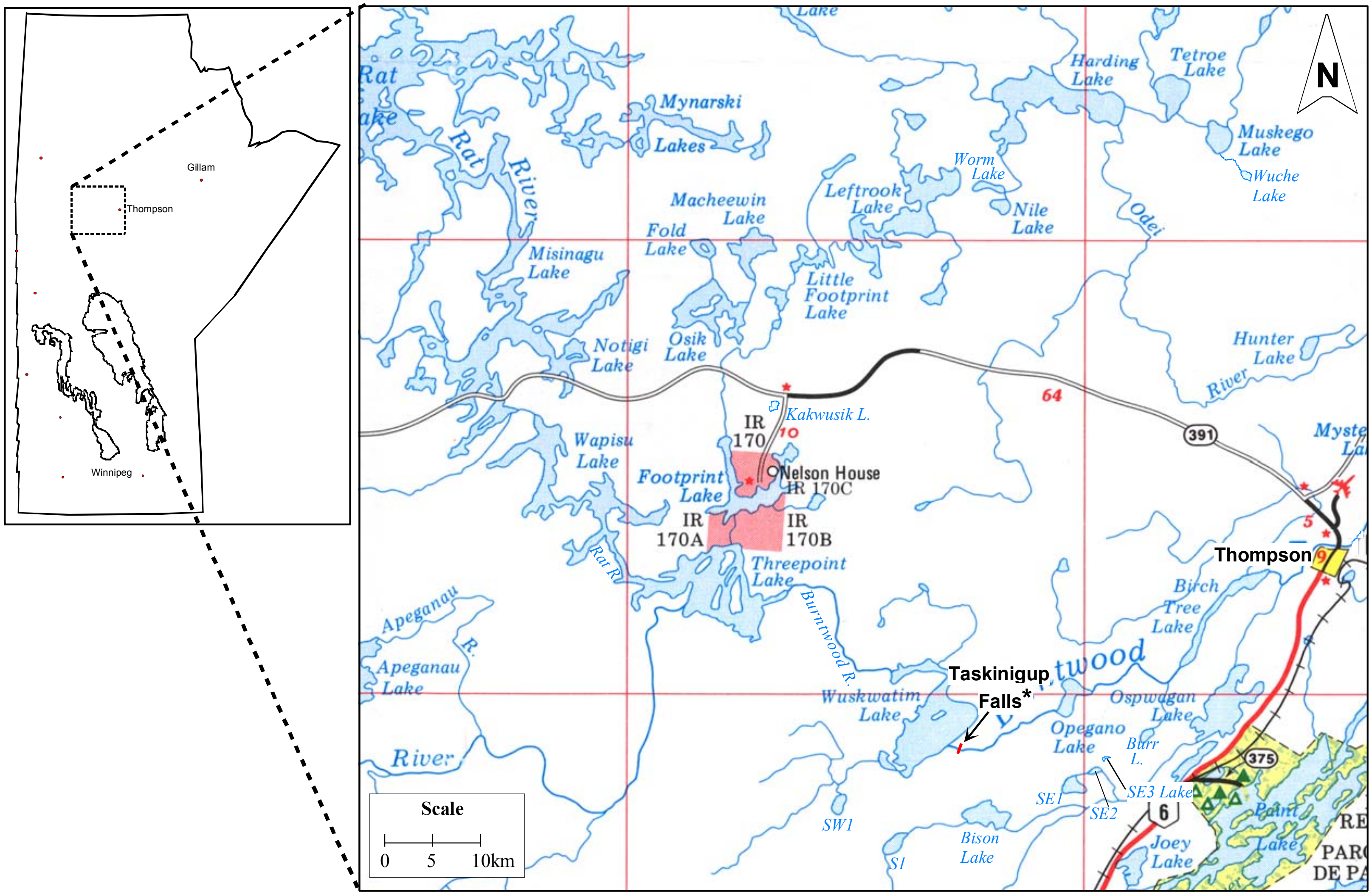
8.2 METHODS

8.2.1 Bird Study Area

The area within which bird studies were conducted in 2000 and 2001 is illustrated in Figure 8.2-1. Within this bird study area (Figure 8.2-1), bird **populations** and distribution were studied along waterbodies of the Rat-Burntwood River system, including Wuskwatim Lake, and along waterbodies adjacent to the Rat-Burntwood River system for regional comparison purposes. A physical description of the **terrestrial** habitat in the region is provided in Section 5.0.

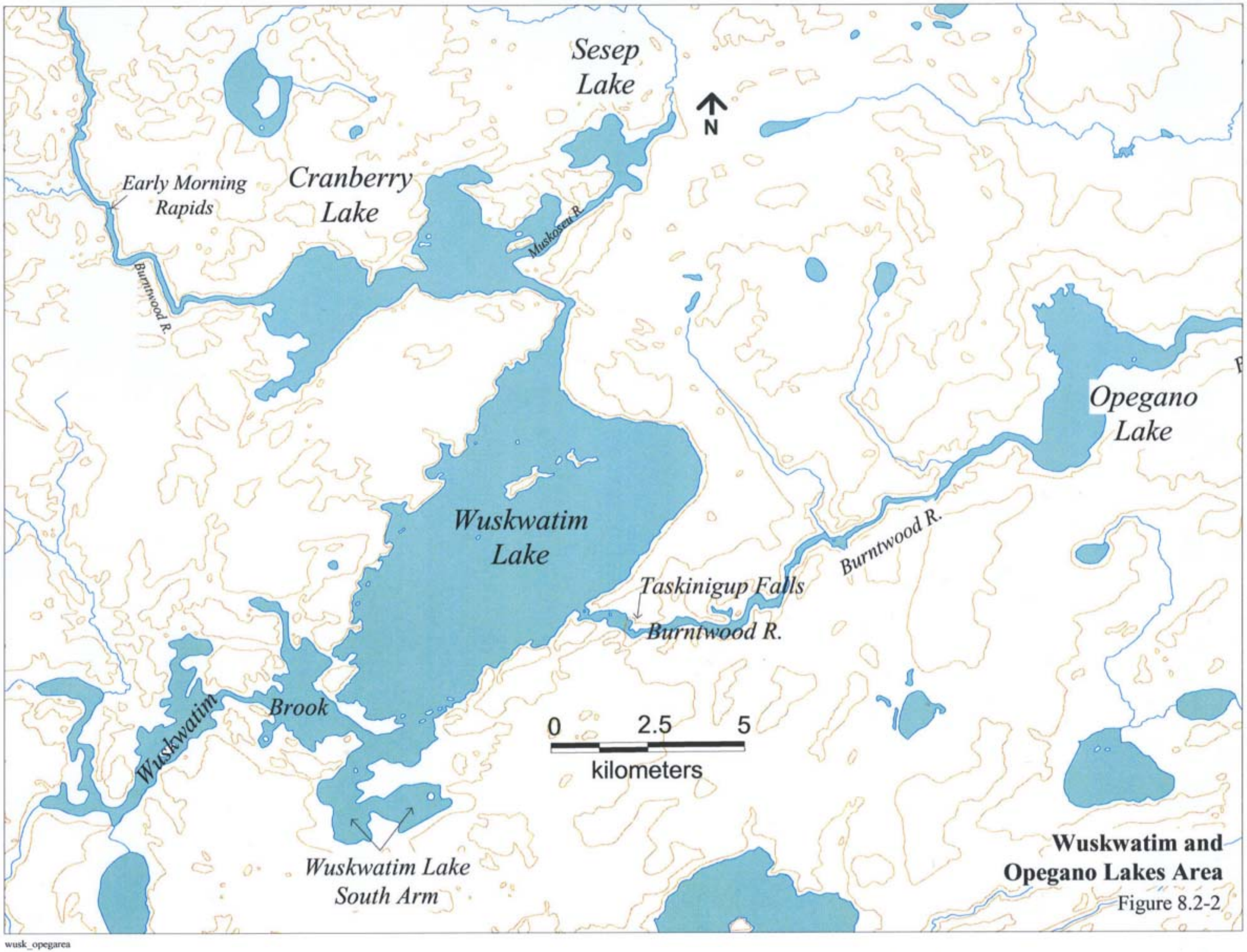
Bird surveys within the bird study area were primarily focused in the Wuskwatim Lake and Opegano Lake areas, which are the areas that would be most affected by the construction and operation of a generating station at Taskinigup Falls. Specifically, this area of focussed studies included: the Burntwood River between Cranberry Lake and Early Morning Rapids, Cranberry Lake, Sesep Lake, the main Wuskwatim Lake, the south arm of Wuskwatim Lake, the Wuskwatim Brook area, the Burntwood River between Wuskwatim Lake and Opegano Lake, and Opegano Lake (Figure 8.2-2). Throughout Section 8, the 'Wuskwatim Lake area" refers specifically to all waterbodies listed above except the Burntwood River between Wuskwatim Lake and Opegano Lake.

Other waterbodies along the Rat-Burntwood River system (i.e., 'on-system' areas) were also surveyed and compared to waterbodies adjacent to, but outside, the Rat-Burntwood River system (i.e., 'off-system' areas) to compare the densities and distribution of breeding and migrating birds in these areas. This approach provides an indication of the overall magnitude of bird use of the areas that would be affected by the **Project** compared to areas that would not be affected by the Project. Additionally, birds were



* - **Proposed Wuskwatim Generating Station Site**

Bird Study Area
Figure 8.2-1



Wuskwatim and Opegano Lakes Area

Figure 8.2-2

also surveyed within representative habitat types along the proposed access road route to predict bird abundance and distribution in similar habitats along the length of the proposed generating station access road routes.

8.2.2 Traditional Knowledge

Traditional Knowledge (**TK**) of the local NCN people has been blended with results of scientific studies to assist in judging the significance of project effects on bird populations in the study area. Traditional Knowledge of birds in the Nelson House RMA, including the bird study area, was obtained from the following sources:

- interviews with NCN resource harvesters;
- Harvest Calendar survey (Aug. to Nov. 2001 and Jan. to March 2002);
- comments from NCN representatives at project meetings and workshops;
- Country Foods Distribution records; and
- conversations with NCN people, including those assisting with scientific studies.

Much of the bird-related TK obtained from NCN people was related to the harvesting of birds in the Nelson House RMA. The effects of the Project on resource use in the study area is assessed in Volume 7. Additional available TK that relates to historical and recent bird abundance and distribution within the Nelson House RMA (including the bird study area) is provided in Section 8.3 and has been considered, in addition to results of scientific studies, in the assessment of **impacts** to birds (Sections 8.4 to 8.6). It must be noted that TK information was not available for all types of birds within the bird study area. Only TK information from the above sources has been used in this **EIS**. However, much more TK exists than the EMT was able to acquire. For practical reasons, not all TK could be obtained from all NCN people for all types of birds.

8.2.3 Previous Scientific Studies

Other than bird studies conducted in the study area in 2000 and 2001 as part of this EIS, additional limited information regarding long-term bird population trends for the boreal region of Manitoba, that includes the study area, was obtained from the Canadian Wildlife Service (CWS) and the U.S. Fish and Wildlife Service. Other information regarding bird presence in the study area was obtained from discussions with local resource users and Natural Resource Officers (Manitoba Conservation).

8.2.4 EIS Studies

Studies of bird populations, distribution and habitat use were conducted within the bird study area (Figure 8.2-1) during the spring, summer and fall of 2000 and 2002. Methods used for conducting bird surveys were consistent with standard procedures and included using the **Point Count Method** for conducting breeding bird inventories (Ralph *et al*. 1993; Walsh 1993).

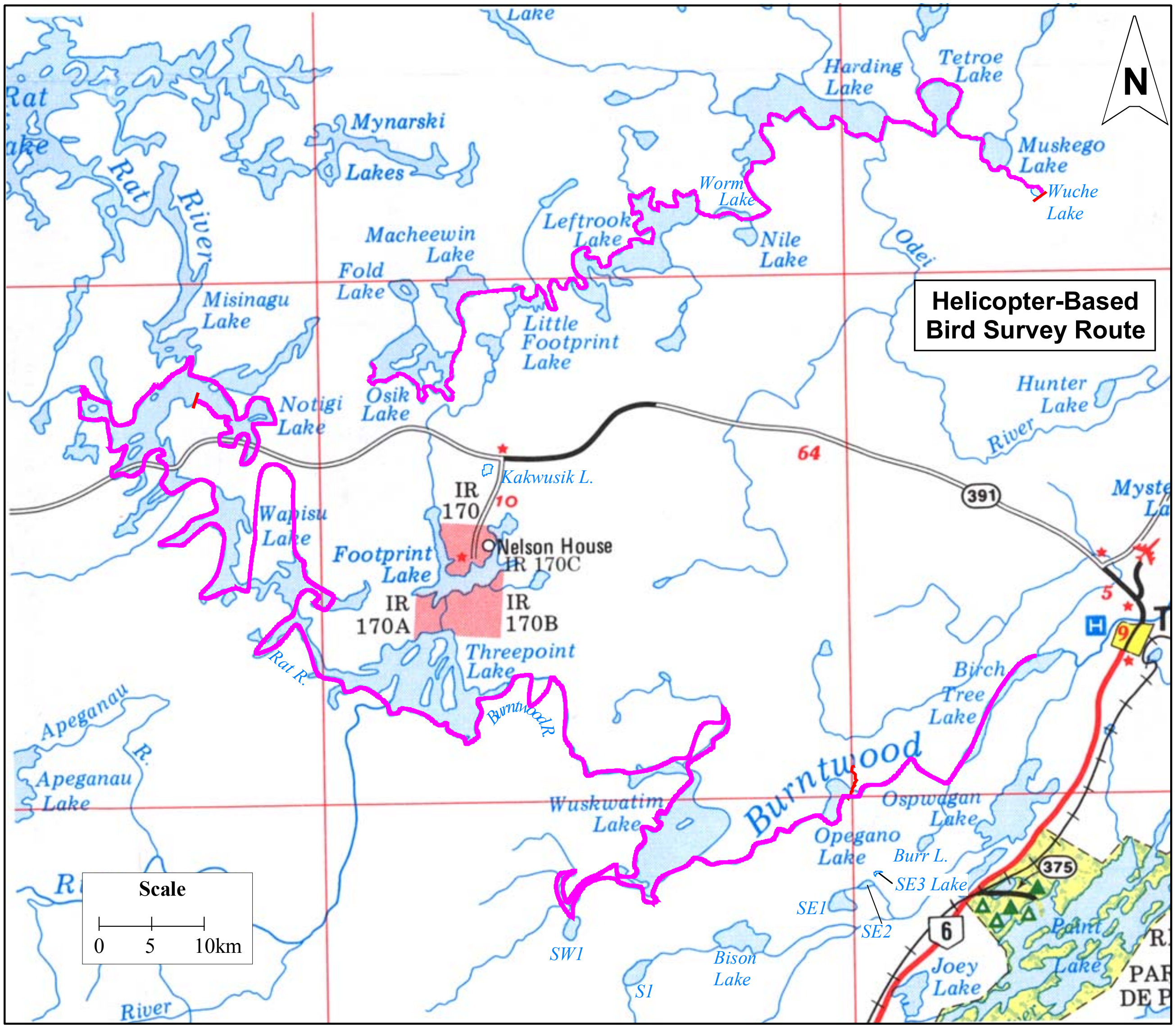
To obtain data on bird abundance, distribution, **diversity** and habitat use within the bird study area, three survey methods were used: helicopter-based surveys (to compare bird presence along the Rat-Burntwood River system to areas adjacent to the system); boat-based surveys (to compared bird presence in different areas of the Wuskwatim and Opegano Lake areas); and terrestrial breeding bird **transects** (to compare bird presence in different areas of the Wuskwatim and Opegano Lake areas and within representative forested and non-forested habitat types).

Sections 8.2.4.1 to 8.2.4.3 provide an overview of bird survey methods and rational for sampling locations and timing. Details of bird survey methods are provided in Appendix 8.8.2.

8.2.4.1 Helicopter Surveys

Aerial surveys were conducted by helicopter along the Rat-Burntwood River system from the north-end of Birch Tree Lake near Thompson, through the Opegano and Wuskwatim Lake area, then northwest to Notigi Lake (Figure 8.2-3). Helicopter surveys were also conducted along other waterbodies adjacent to, and outside the Rat-Burntwood River system; particularly along the larger lake system north of Provincial Road 391 from Wuche Lake southwest to Osik Lake and south to the Footprint Lake area at Nelson House (Figure 8.2-3).

By surveying waterbodies in these areas, comparisons were made regarding the abundance and distribution of birds using the Rat-Burntwood River system, which has been affected by the **CRD**, to waterbodies adjacent to the Rat-Burntwood River system that have not been affected by the CRD. By surveying these "on-system" and "off-system" areas, information was obtained regarding the importance of the Rat-Burntwood River system to breeding and migrating **waterbirds** compared to adjacent, unaffected waterbodies. Helicopter surveys conducted over the Wuskwatim and Opegano Lake areas were also used in conjunction with boat survey data for those areas to more fully describe bird abundance and use of the areas that will be potentially affected by the proposed Project.



Helicopter-Based Bird Survey Route
Figure 8.2-3

These aerial surveys were designed to assess populations of larger birds such as **waterfowl**. Therefore, helicopter-based surveys underestimated numbers of small birds such as **passerines** (i.e., songbirds) and, to a lesser extent, **shorebirds**. Surveys were conducted once during the spring and fall **migrations** and once during the summer waterfowl **brood**-rearing season in 2000 and 2001 to determine the abundance and distribution of waterbirds and other wildlife visible from the helicopter.

Two biologists, one on either side of the helicopter, recorded birds observed within an approximate 200 **m** distance from the helicopter. A third study team member navigated and informed the biologists of their location along the survey route. The helicopter flew at a consistent height (30-40 metres) and speed (~80 km/hr) to facilitate estimates of bird **density** along the survey routes. The locations and timing of helicopter surveys conducted in 2000 and 2001 are provided in Table 8.2-1. Additional details regarding helicopter survey methods and areas surveyed are provided in Appendix 8.8.2.

8.2.4.2 Boat-based Surveys

To obtain data on the approximate abundance, diversity and habitat use of waterbirds, including waterfowl, bird surveys were conducted by boat during daylight hours along the **shorelines** of the Wuskwatim Lake area in 2000 and the Wuskwatim Lake and Opegano Lake areas in 2001 (Figures 8.2-4 and 8.2-5). Boat-based surveys were conducted during the spring and fall in 2000 and 2001 to obtain data on the use of the study area by spring nesting birds and spring and fall migrating birds. Boat-based surveys were also conducted in the summer of 2000 to identify key areas for waterbird brood rearing.

At each boat survey stop illustrated in Figures 8.2-4 and 8.2-5, birds observed within an approximate 1 km^2 area were recorded. The number and location of boat-based bird surveys conducted in 2000 and 2001 are provided in Section 7.2, Table 7.2-2.

8.2.4.3 Terrestrial Breeding Bird Surveys

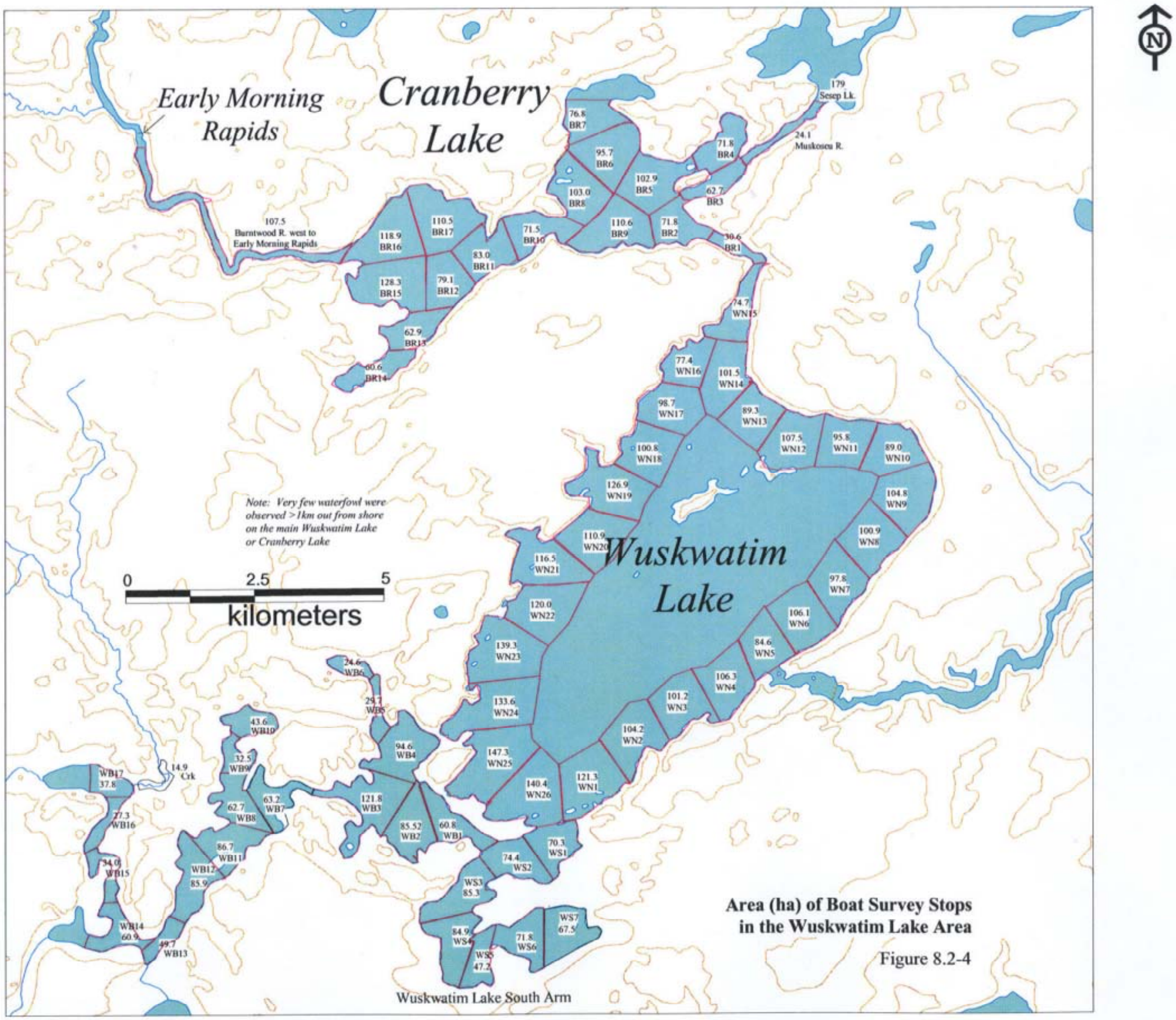
Terrestrial **breeding bird surveys** were conducted during an approximate three-week period from late May to mid-June in the vicinity of Wuskwatim Lake in 2000 and in the Wuskwatim Lake and Opegano Lake areas in 2001. Surveys were conducted at 93 survey stops located along 16 pre-selected line transect sites in 2000 and at 173 stops along 34 transects in 2001. The majority of transect stops surveyed in 2000 were surveyed again in 2001. Breeding bird surveys occurred during the periods of peak morning singing activity, typically between sunrise and 1000h.

TABLE 8.2-1

HELICOPTER-BASED WATERBIRD SURVEYS, 2000 & 2001

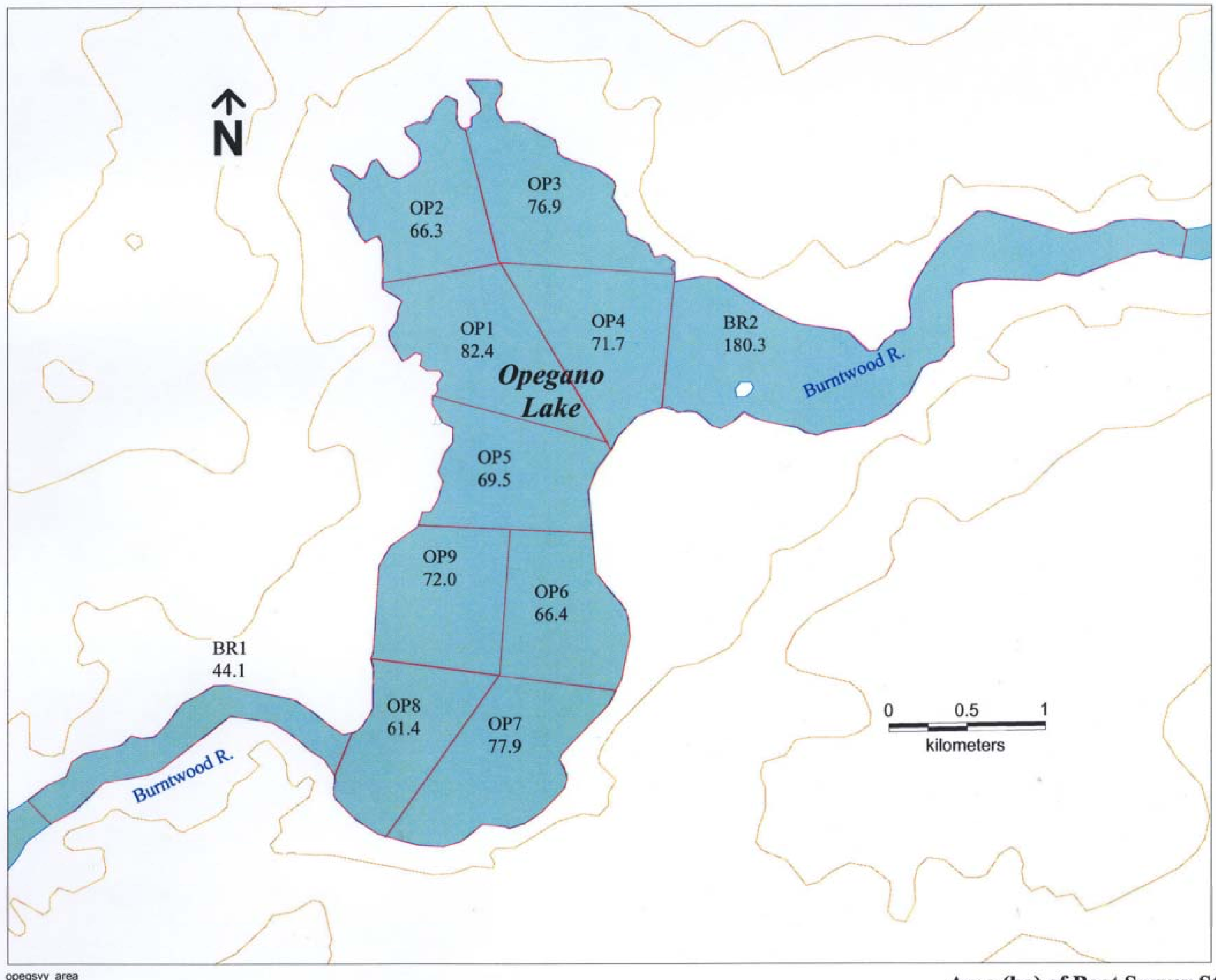
Location	2000/2001 Variations	2001 New Areas	2000 Shoreline Area Surveyed (km^2) Spring May 30 - June 1	2000 Summer July 24 - 25	2000 Fall Sept. 19 - 20	2001 Shoreline Area Surveyed (km^2) Spring May 17 - 18	2001 Summer July 10 - 11	2001 Fall Sept. 15 - 16
RAT-BURNTWOOD RIVER SYSTEM (I.e. "On-System Waterbodies")								
Birchtree Lake			7.8	6.4	6.4	No Data	7.7	8.4
Burntwood R - Birchtree to Opegano Lake			4.2	4.2	4.2	approx. 4.4	4.4	4.4
Opegano Lake	Opegano Lake - N & W side		2.8					
	Opegano Lake - S side			2.0				
	Opegano Lake - Circled (almost)				5.2	approx. 5.0	5.0	5.0
Burntwood R - Opegano to Wuskwatim Lake			5.6	5.6	5.6	approx. 6.6	6.5	6.7
Wuskwatim (Main) Lake	Wuskwatim Lake - N half of E side		4.4					
	Wuskwatim Lake - S half of E side			2.0	2.0	approx. 2.2	2.1	2.4
	Wuskwatim Lake - W side to Cranberry Lake			4.4	5.6	approx. 6.0	6.0	5.6
Wuskwatim Lake - South Arm				1.8	1.8	approx. 5.0	5.0	5.0
Wuskwatim Brook				2.8	6.8	approx. 16.0	16.8	15.1
Cranberry Lake	Cranberry Lake (partial)		2.8	2.8	2.8			
	Cranberry Lake - E side + N side					approx. 8.4	8.7	8.1
		Sesep Lake				approx. 4.3	4.3	4.2
Burntwood R - Cranberry to Early Morning Rapids			3.2	3.2	3.2	2.2	1.8	2.1
Burntwood R - Early Morning Rapids to Threepoint Lake			6.8	6.8	6.8	10.9	10.9	11.2
Threepoint Lake	Threepoint Lake - S half		8.2	8.6	8.2	8.9	10.0	
	Threepoint Lake (partial)							10.6
Rat River - Threepoint to Wapisu Lake			2.9	2.9	2.9	2.5	2.5	approx. 2.5
Wapisu Lake			36.4	27.2	10.0	39.6	42.1	
	Wapisu Lake (fall 2001) **2 sections**							40.5
		Creek S of Notigi Control Structure				5.6	4.3	4.8
Notigi Lake			25.2	25.2	26.0	35.5	40.5	36.3
OUTSIDE THE RAT-BURNTWOOD RIVER SYSTEM (I.e. "Off-System Waterbodies")								
Wuche Lake - Circled			1.4	0.8	0.8	1.5	1.3	0.7
Creek from Wuche to Muskego Lake			1.6			1.9	1.4	1.3
Muskego Lake	Muskego Lake - Circled		3.6	1.6	1.6		4.5	1.2
	Muskego Lake - S shore					1.8		
Creek from Muskego to Tetroe Lake			1.6	1.6		1.5	1.4	1.8
Tetroe Lake - Circled			4.8	4.8	4.8	5.5	5.0	5.1
Wapawukaw R. to Harding Lake			2.4	2.4	2.4	2.3	2.8	2.7
Harding Lake - S shore			8.6	8.6	8.6	8.8	9.1	8.3
Munichoos Creek to Worm Lake			2.6	2.6	2.6	2.6	2.7	2.7
Worm Lake			1.4	1.4	1.4	2.4	2.2	2.2
Leftrook Lake - N & W sides			13.6	10.6	10.6	17.2	17.0	16.8
		Cut across from Leftrook to Little Footprint L				1.2		
		Little Footprint R to Little Footprint L					2.0	2.8
Little Footprint Lake	Little Footprint Lake - mid section			2.8	2.8			
	Little Footprint Lake - N side					2.5	4.2	5.4
Mancheewin Lake	Macheewin Lake - mid section			1.8	1.8			
	Macheewin Lake - S side					3.6	3.2	3.5
		Osik Lake - E,S & W sides				7.9	9.0	8.3

Refer to Figure 8.2-1 for waterbody locations within the bird study area



Area (ha) of Boat Survey Stops in the Wuskwatim Lake Area

Figure 8.2-4



Area (ha) of Boat Survey Stops in the Opegano Lake Area
Figure 8.2-5

Terrestrial breeding bird surveys were also conducted at 66 stops along 13 transects within representative habitats along, and adjacent to, the proposed Mile 17 access road route. These surveys were conducted on July 2 and 3, 2002 between 0525 h and 1020 h.

The locations of breeding bird transects were pre-selected using topographical mapping, aerial photographs and general **reconnaissance** in association with helicopter and boat-based surveys conducted in spring 2000 and 2001. Breeding bird transects were located in a variety of habitats that could be potentially affected by the proposed Project (Section 7.2, Table 7.2-1 and Figures 7.2-1 to 7.2-3). Descriptions of the habitat at each transect stop were recorded during surveys to allow the correlation of bird survey results with specific habitat types. Additional details regarding terrestrial breeding bird survey methods are provided in Appendix 8.8.2.

8.2.4.4 Habitat-based Analysis (Access Road)

Bird populations and habitats along the proposed Mile 17 access road were assessed using Habitat Suitability Index (HSI) **models** and the results of ground-based field surveys conducted during spring 2002.

Analysis of HSI models provided an interpretation of Forest Resource Inventory (FRI) data for the proposed generating station access road route right-of-way (ROW) and two 1000 metre buffer strips on either side of the proposed road route centerline with respect to the remaining Nelson House RMA. Results from these studies were used to determine the relative impact the road and adjacent borrow sites will have on birds within the various forested and non-forested habitats along, and adjacent to, this route. HSI modelling was used to predict the approximate abundance of ideal bird habitat for available HSI model species along and adjacent to the Mile 17 access road compared to the remaining Nelson House RMA. This comparison provides a general indication of the potential magnitude of bird habitat alterations associated with the clearing and operation of the proposed access road. At present, there are 12 provincially-accepted indicator bird species for which HSI models currently exist and that are used in the assessment, including:

- Pileated Woodpecker;
- Ruffed Grouse;
- Great Gray Owl;
- Hairy Woodpecker;
- Common Yellowthroat;
- Yellow Warbler;
- Magnolia Warbler;

- Barred Owl;
- Red-breasted Nuthatch;
- Black and White Warbler; and
- Ruby-crowned Kinglet.

Details regarding the method used for the habitat-based analysis for the access road and borrow area using HIS models are provided in Appendix 8.8.2.

8.2.4.5 VEC Species

As discussed in Section 2.2, a number of Valued Ecosystem Component species (i.e., “VECs”) were selected to assist in the assessment of environmental impacts resulting from the construction and operation of the proposed generating station. Bird VECs have been selected primarily as ‘indicators’ of the health of their primary breeding habitats. For example, should the abundance of marsh habitat decrease following project construction and operation, it follows that the presence and abundance of birds dependant on marsh habitat would also decrease in the Wuskwatim Lake area. Using this VEC or ‘indicator species’ method, the health and suitability of a variety of different habitats for breeding birds can be monitored. The following criteria were used to select bird VEC species that:

- use the habitat(s) that will likely be most changed by the Project (i.e., marsh, **bog**/fen habitat, standing dead trees/other woody debris, erodible shoreline habitat), with emphasis on the most critical habitats and most sensitive life stages of the species (i.e., nesting, brood rearing and associated habitats);
- are present in sufficiently abundant numbers within the primarily affected area so their populations can be accurately monitored from year to year;
- are representative of the major groups of birds present in the potentially affected area; and
- are of particular importance to the local people (e.g., as a hunted species or spiritually important species).

The bird VEC species selected, and the rationale for their selection, are described below.

The Canada Goose was selected as a VEC species for the following reasons:

- it is an important sport/subsistence hunted species;
- commonly nests on floating/anchored bog/marsh habitat, on island habitat (including on top of muskrat houses) and on shoreline habitat;
- it is the only goose species nesting in the study area; and

- it is an important prey item for various economically-valuable furbearers such as the red fox.

The Mallard was selected as a VEC species for the following reasons:

- it is an important sport/subsistence hunted species;
- it is the most abundant waterfowl species in the Wuskwatim Lake area;
- it is a representative 'dabbler' duck species; and
- it is an upland-nesting species that uses marsh habitat for brood-rearing and **foraging**.

The Bufflehead and Common Goldeneye are grouped together to represent a VEC due to their very similar behaviour and habitat requirements. This species group was selected as a VEC for the following reasons:

- they nest in tree cavities, especially in standing dead trees in the Wuskwatim Lake area;
- they are both hunted for sport/substance harvest;
- they are representative of 'diver' duck species; and
- they are abundant in the Wuskwatim Lake area.

The Common Loon was selected as a VEC species for the following reasons:

- it nests along shorelines, especially islands, at or near water level (nests vulnerable to water level fluctuations);
- it is a representative fish-eating waterbird;
- it is present in sufficient numbers for **monitoring** in the Wuskwatim Lake area; and
- it has spiritual significance to the local people.

The Bald Eagle was selected as a VEC species for the following reasons:

- it is a spiritually-significant species to the local species;
- it nests in trees along the shoreline;
- it is a common**-raptor** species in the Wuskwatim Lake area; and
- it is a representative raptor species.

The Red-winged Blackbird was selected as a VEC species for the following reasons:

- it nests almost exclusively in marsh habitat;

- it is very abundant in marsh habitat within the Wuskwatim Lake and Opegano Lake areas; and
- it is a representative Neotropical migrant passerine species.

The Palm Warbler was selected as a VEC species for the following reasons:

- it is closely associated with bog/fen habitat;
- of the passerine species associated with bog/fen habitat, it has been recorded in relatively high numbers in the Wuskwatim Lake and Opegano Lake area; and
- it is a representative Neotropical migrant passerine species.

The Belted Kingfisher was chosen as a VEC species for the following reasons:

- it nests in clay/silt banks;
- it is a representative fish-eating bird species; and
- it is present in sufficient numbers for monitoring within the Wuskwatim Lake area.

The Common Snipe was chosen as a VEC species for the following reasons:

- it forages and nests in association with marsh, fen and bog habitat;
- it is a common shorebird in the Wuskwatim Lake area; and
- it is a representative shorebird species.

8.3 EXISTING ENVIRONMENT

8.3.1 Overview of Bird Community

The Wuskwatim bird study area occurs within the **Boreal Shield Ecozone**, as defined by Environment Canada (Wiken 1986), which is characterized by mostly spruce-dominated forests interspersed with lakes, rivers, streams and other abundant wetlands such as bogs and marshes. Approximately 184 bird species breed or potentially breed within the Wuskwatim study area (Appendix 8.8.1), with an additional 34 species migrating through the area to breed further north. Twenty-eight species occur within the study area year-round. Some of the most common birds found within the major habitat types in the Wuskwatim bird study area are listed in Table 8.3-1. No nationally, regionally or locally important migratory bird habitat occurs within the bird study area as indicated by Environment Canada and the Canadian Wildlife Service (Poston *et al*. 1990).

No threatened or endangered bird species, as listed by **COSEWIC** (Committee on the Status of Wildlife in Canada) or **MESA** (*Manitoba Endangered Species Act*) were

Table 8.3-1

Most common birds observed in key habitat types in the Wuskwatim Study area*

Conifer-dominant Forest
• Ruby-crowned Kinglet
• Yellow-rumped Warbler
• Chipping Sparrow
• Common Snipe
• Dark-eyed Junco
• Swainson's Thrush
• Magnolia Warbler

Deciduous-dominant Forest
• Red-eyed Vireo
• Ovenbird
• Alder Flycatcher
• Swainson's Thrush
• Ruby-crowned Kinglet
• Magnolia Warbler

Marshes
• Red-winged Blackbird
• Common Grackle
• Mallard
• Bufflehead
• Common Goldeneye
• Canada Goose
• Ring-necked Duck
• Green-winged Teal
• American Wigeon

Fens & Bogs
• Common Snipe
• Northern Waterthrush
• Alder Flycatcher
• Palm Warbler
• Sandhill Crane
• Olive-sided Flycatcher

* Common birds observed during surveys conducted in 2000 and 2001 primarily near shoreline areas. Refer to TetrES 2003a,b for densities of birds observed in various habitat types in 2000 and 2001.

Refer to Section 8.8, Appendix 8.8.1 for a list of bird species that potentially breed in the Wuskwatim study area.

observed within the bird study area during field studies conducted in 2000 and 2001. The Peregrine Falcon, which is listed in Manitoba as "threatened" by COSEWIC and "endangered" by MESA, may migrate through the study area. The Peregrine Falcon is the only **threatened species** potentially found within the Wuskwatim bird study area. There is the remote possibility that three other endangered species may potentially be found within the study area: the Eskimo Curlew, Whooping Crane and Piping Plover. The breeding range of the first two species is outside the bird study area. However, there is the remote possibility that these two species may migrate through the bird study area. The Piping Plover is unlikely to nest within the bird study area due to the lack of suitable extensive sand/gravel beach nesting habitat. It is unknown if the Piping Plover may migrate through the bird study area.

Two bird species listed as "**Special Concern**" in Manitoba by COSEWIC potentially occur within the Wuskwatim bird study area: the Short-eared Owl and the Yellow Rail. Both species may be found in marsh or bog habitat, with the Short-eared Owl requiring more extensive open areas for foraging and nesting (Godfrey 1986). Refer to Appendix 8.8.1 for a complete list of birds that occur, or potentially occur, within the Wuskwatim bird study area.

For the purpose of discussion, birds that occur within the bird study area have been categorized into four major groups: 1) waterbirds (including geese; ducks; swans; loons; grebes; bitterns; herons; pelicans; cormorants; gulls and terns); 2) raptors (including: eagles; hawks; falcons; osprey and owls); 3) passerines (songbirds); and 4) other birds such as shorebirds, cranes and rails, upland game birds (grouse and ptarmigan), woodpeckers, kingfishers and nighthawks.

8.3.2 Historic Perspective

The bird study area environment, as it exists under the current water regime, is considered the 'baseline existing environment' for the assessment of this project's potential impacts. Refer to Volume 4 for a description of the Wuskwatim lake water regime involving the two baseline bird study years of 2000 and 2001.

NCN representatives indicated that some bird populations and their distributions within the Nelson House RMA have changed from the pre-CRD condition. They attribute these changes to the altered water regime along the Rat-Burntwood River System resulting from the CRD (NCN Community Consultants 2002). Some NCN people have also indicated that some bird species that were present prior to the CRD, but were reduced in number or were not observed after the CRD (e.g., Willow Ptarmigan, owls, some songbird species), are now beginning to be observed in the Nelson House RMA again (Sections 8.3.5 to 8.3.7). Therefore, some bird species populations, under "existing conditions", may be in a state of flux as some bird habitats that were altered as a result of the CRD begin to become established elsewhere within the Nelson House RMA.

8.3.3 Global and Regional Perspective

Bird populations are influenced by many environmental factors present at the breeding and non-breeding grounds as well as during migration. Declines have been documented for many bird species populations, particularly for many neotropical migrant bird species (birds that winter in the neotropics: Mexico, the Caribbean, Central and South America) and several waterfowl species (Canadian Wildlife Service Waterfowl Committee 2001; Downes *et al*. 2002; Wilkins and Otto 2002).

Examples of factors that may contribute to global and regional declines in bird species populations include:

- habitat loss and fragmentation (e.g., Diamond 1986; Robbins *et al*. 1989; Askins *et al*. 1990; Kirk *et al*. 1997);
- increased nest predation (e.g., Böhning-Gaese *et al*. 1993) and cowbird parasitism in the case of songbirds (e.g., Brittingham and Temple 1983);
- severe weather and climate change (e.g., Nott *et al*. 2002);
- hunting pressure (e.g., Sargent and Raveling 1992); and
- environmental toxicants/pollution (e.g., Tucker 2000).

Many factors, including those listed above, may contribute to population declines in any particular bird species. However, determining the relative importance of these factors, depending on the species, is a subject of ongoing debate in the scientific community.

8.3.4 Waterbirds

For the purpose of discussion, 'waterbirds' include: waterfowl (geese, ducks and swans), gulls, terns, loons, grebes, bitterns, herons, pelicans and cormorants.

8.3.4.1 Traditional Knowledge of Waterbirds

Traditional Knowledge of waterbirds has been obtained from participating NCN members (Section 8.2.2) and is provided in Table 8.3-2. This TK regarding waterbirds has been considered along with results of scientific studies (Sections 8.3.4.2 to 8.4.2.7) in the assessment of expected impacts of the proposed Project to waterfowl (Section 8.4).

TABLE 8.3-2

TRADITIONAL KNOWLEDGE - WATERBIRDS [a]

Species / Type of Bird	Comment / Information Provided	Location	Source
Waterfowl			
Black Scoter	Large flocks of migrating Black Scoter stop over on the main lake, usually during October.	Wuskwatim Lake	Ron Dysart, Sept. 22, 2000
Canada Geese*	Wuskwatim Lake is a well-used staging area for migrating Canada Geese* compared to other lakes in the general area. They typically stay overnight, and continue migration the next day.	Wuskwatim Lake	Ron Dysart, June 3, 2000
Canada Geese* and Snow Geese	Large numbers of geese were on the main lake in the morning of Sept. 20th, 2000, and they left later on in the day.	Wuskwatim Lake	Ron Dysart, Sept. 22, 2000
Dabbling Ducks (including Mallards*)	Dabbling ducks avoid areas with standing and floating dead timber in water (goldeneye, Bufflehead and Wood Ducks are exceptions).	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Ducks	Duck numbers have been low in the area for a long time - since the first flooding. Very few Northern Pintails, Wood Ducks, Green-winged Teal nowadays. More Lesser Scaup and Greater Scaup.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Ducks (including Mallards*, Common Goldeneye* and Bufflehead* among others)	Duck hunting activity was concentrated in the NCN resource use area immediately surrounding Nelson House (35%) and north of PR 391 (35%) . 14% of duck hunting occurred in the Wuskwatim study area.	NCN resource use area	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Ducks (including Mallards*, Common Goldeneye* and Bufflehead* among others)	NCN people hunt ducks in spring.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Ducks (including Mallards*, Common Goldeneye* and Bufflehead* among others)	In the past, duck numbers were plentiful everywhere; now they are few and far between. The whole system is affected and flight patterns have changed. Ducks used to be a daily source of food; now they are a delicacy in spring.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Geese (inlcuding Canada Geese*)	Hunted	"Sixes Camp" (Mile 10 north from Thompson)	NCN Members: comments from the TK Pilot Project Interview, April 2002
Geese (inlcuding Canada Geese*)	Hunted during spring.	Notigi Lake	NCN Member: comment from the TK Pilot Project Interview, April 2002
Geese (inlcuding Canada Geese*)	Most geese were harvested in the NCN resource use area immediately surrounding Nelson House (65%), with 26% harvested from the area north of PR 391 and less than 1% harvested from the Wuskwatim study area.	NCN resource use area	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Lesser Scaup, Commom Goldeneye* and Bufflehead*	Most commonly hunted in fall.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Mallards and Lesser Scaup ("black duck")	Most commonly hunted waterfowl species.	NCN resource use area	NCN Future Devleopment Office Study

Table 8.3-2 (cont'd)

Species / Type of Bird	Comment / Information Provided	Location	Source
Mergansers	Hunters get mergansers, but don't eat them.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Scoter, Ducks and Geese	Used to be many scoter on the lake I nthe late fall. In spring, many geese and ducks are in certain bays during mid-May, just after ice break-up.	Notigi Lake	Harry Spence, Sept. 27, 2000
Tundra Swans	Many swans are on Sesep Lake in May. They stop over there in fall, but not in as large flocks.	Sesep Lake	Ron Dysart, Sept. 22, 2000
Waterfowl	Noticed that where waterlevels are stabilized, there are more nesting waterfowl.	NCN resource use area	Sam Dysart, April 10, 2002, EIS Review Meeting - Terrestrial Environment, Winnipeg
Waterfowl	Water is open early in the spring at the inlet of the Burntwood River at Footprint Lake. Waterfowl congregate there in the spring.	Burntwood River at Footprint Lake	NCN Member: comment from the Harvest Calendar Survey (2001/2002)
Waterfowl	Three of 10 trappers interviewed hunt ducks and geese in the area.	Area of Interest [b]	NCN Members: comments from the Resource Harvester Interviews, Jan. 28, 2002
Waterfowl	Abundant waterfowl before CRD noted by three NCN members.	Wuskwatim Lake	NCN Members: comments from the TK Pilot Project Interview, April 2002
Waterfowl	Waterfowl hunted in the Wuskwatim Lake area before CRD noted by four NCN members.	Wuskwatim Lake	NCN Members: comments from the TK Pilot Project Interview, April 2002
Waterfowl	Described as being commonly hunted in the following areas before CRD (see next column).	Wuskwatim Lake area, Footprint L., Wapisu L., Notigi L. and Opegano L.	NCN Members: comments from the TK Pilot Project Interview, April 2002
Waterfowl	All waterfowl species were hunted or are still hunted in the following areas (see next column):	Wuskwatim L. area, river system from Nelson House to Wuskwatim L., all along Burntwood river system, Notigi to Rat L., Squirrel L., Gauer L., Harding L., Baldock L., Wapisu L., Mynarksi L., Leftook L., Fold L., Little Footprint L., South Indian L., Misinagu L., "Mile 20"	NCN Members: comments from the TK Pilot Project Interview, April 2002

Table 8.3-2 (cont'd)

Species / Type of Bird	Comment / Information Provided	Location	Source
Waterfowl	Hunted in the Snow Lake area.	Snow Lake	NCN Member: comment from the TK Pilot Project Interview, April 2002
Waterfowl	Still lots around, especially in the fall.	Wuskwatim Lake area	NCN Member: comment from the TK Pilot Project Interview, April 2002
Waterfowl	39% of hunting activity occurred in Zone 1.	Area immediately surrounding Nelson House (ref. Resource Use section of EIS)	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Waterfowl	37% of hunting activity occurred in Zone 3.	NCN resource use area north of PR 391	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Waterfowl	9% of hunting activity occurred in Zone 2.	Wuskwatim study area and area anticipated to be affected by the Project (includes Wuskwatim Lake)	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Waterfowl	There are no areas in Zone 2 that people fly into to specifically hunt waterfowl.	Wuskwatim study area and area anticipated to be affected by the Project (includes Wuskwatim Lake)	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Waterfowl	Waterfowl hunting was primarliy concentrated during spring (14% and 58% of waterfowl harvest was obtained in April and May 2002, respectively. 12% occurred in October.	NCN resource use area	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Waterfowl	Waterfowl contributed 4% to the total number of meat meals consumed by NCN members and consisted of slightly more geese than ducks.	NCN resource use area	NCN Members: Country Foods Program records, 1994 - 2001
Waterfowl	People used to collect waterfowl eggs in spring, but not anymore.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Gulls and Terns			
Gulls	Some NCN resource users harvest gull eggs in the spring.	Area of Interest [b]	NCN Members: comments from the Resource Harvester Interviews, Jan. 28, 2002
Gulls	Gulls are harvested.	Small lake south of the Area of Interest [b]	NCN Members: comments from the Resource Harvester Interviews, Jan. 28, 2002
Gulls	In 2002, a floating island came up against the shore of the gull nesting island on Wuskwatim Lake. Gulls were seen fighting over the breeding area which included the peat island up against the rocky island.	Wuskwatim Lake (main)	Sam Dysart, Oct 24, 2002, EIS Review Meeting - Terrestrial Environment, Winnipeg
Bonaparte's Gull	Few Bonaparte's Gulls are seen nowadays.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Terns	Arctic [*Common?*] terns that eat fish don't come anymore.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000

Table 8.3-2 (cont'd)

Species / Type of Bird	Comment / Information Provided	Location	Source
Loons, Pelicans and Cormorants			
Common Loon*	A loon was caught and drowned in a commercial fishing net. Fishers say "a few" are caught in nets each year in the Wuskwatim Lake area.	Wuskwatim Lake area	NCN Commercial Fishers: Ron Dysart's Camp, Spring 2001
Pelicans and cormorants	10 people reported seeing more pelicans and cormorants in the area.	Area of Interest [b]	NCN Members: comments from the Resource Harvester Interviews, Jan. 28, 2002
Bitterns and Herons			
Bitterns	Decline in bittern population due to loss of the natural shoreline.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Great Blue Herons	Great Blue Herons live in the area, but not in large numbers; there's a colony near the Dancing Circle.	NCN resource use area (and Wuskwatim Lake area)	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000

* = VEC species

[a] Where "waterbirds" = waterfowl (geese, ducks and swans), gulls, terns, loons, greebes, bitterns, herons, pelicans and cormorants

[b] "Area of Interest" as described to NCN resource users during the Resource Harvester Interviews: Kinosaskaw Lake downstream through Wuskwatim Lake to Birch Tree Lake north to PR 391 and a corridor south of the Rat / Burntwood River

Note that the above information does not represent all TK of the NCN people regarding waterbirds

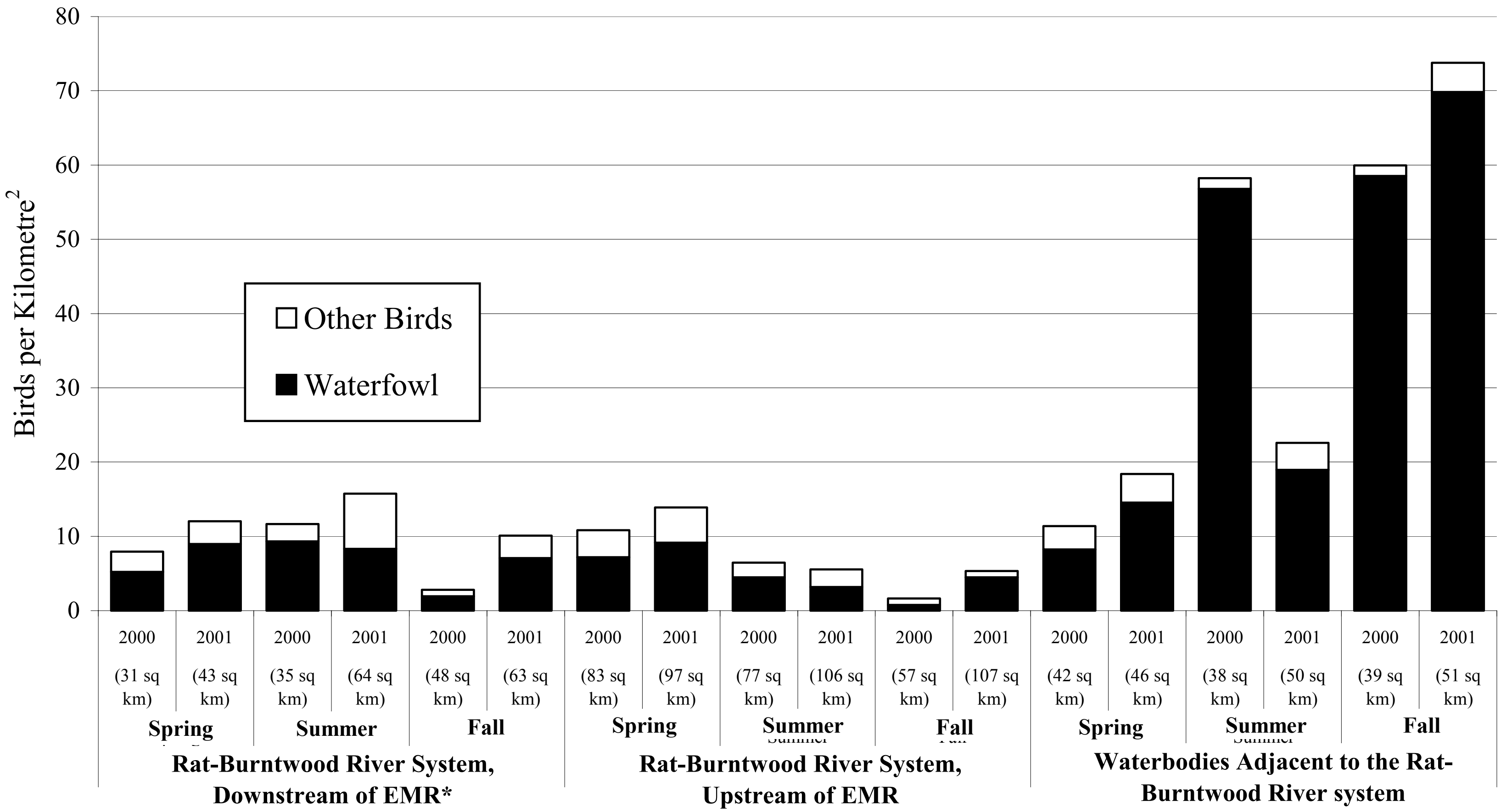
8.3.4.2 On-system vs. Off-system

The following describes the relative abundance and distribution of waterbirds along the Rat-Burntwood River system from Birch Tree Lake to Early Morning Rapids and upstream to Notigi Lake (i.e., "on-system", including Wuskwatim Lake) and along the series of waterbodies adjacent to, but off the Rat-Burntwood River system (i.e., "off-system") for regional comparison purposes.

Results of helicopter surveys conducted within the bird study area in 2000 and 2001 indicated that there was notable annual and seasonal variation in the numbers of waterbirds observed in the bird study area (Tetr*ES* 2003a,b). The majority of birds observed during each year were waterbirds (93% of 6,777 birds in 2000 and 88% of 9,158 birds in 2001; Tetr*ES* 2003a,b). Of the waterbirds observed in 2000 and 2001 during helicopter surveys, 94% and 90%, respectively, were waterfowl. During spring, summer and fall surveys in 2000 and 2001, the highest densities of waterfowl were observed along waterbodies adjacent to the Rat-Burntwood River system (Figures 8.3-1 to 8.3-7). Since the majority of waterbirds observed along the Rat-Burntwood River system and along adjacent off-system waterbodies were waterfowl, this section will focus on waterfowl, with more details regarding other waterbirds provided in Sections 8.3.4.3 to 8.3.4.7.

During spring surveys, when waterfowl are migrating and many species are initiating nesting, waterfowl densities along the Rat-Burntwood River system were slightly lower but comparable to waterfowl densities along waterbodies adjacent to the Rat-Burntwood River system (Figure 8.3-1).

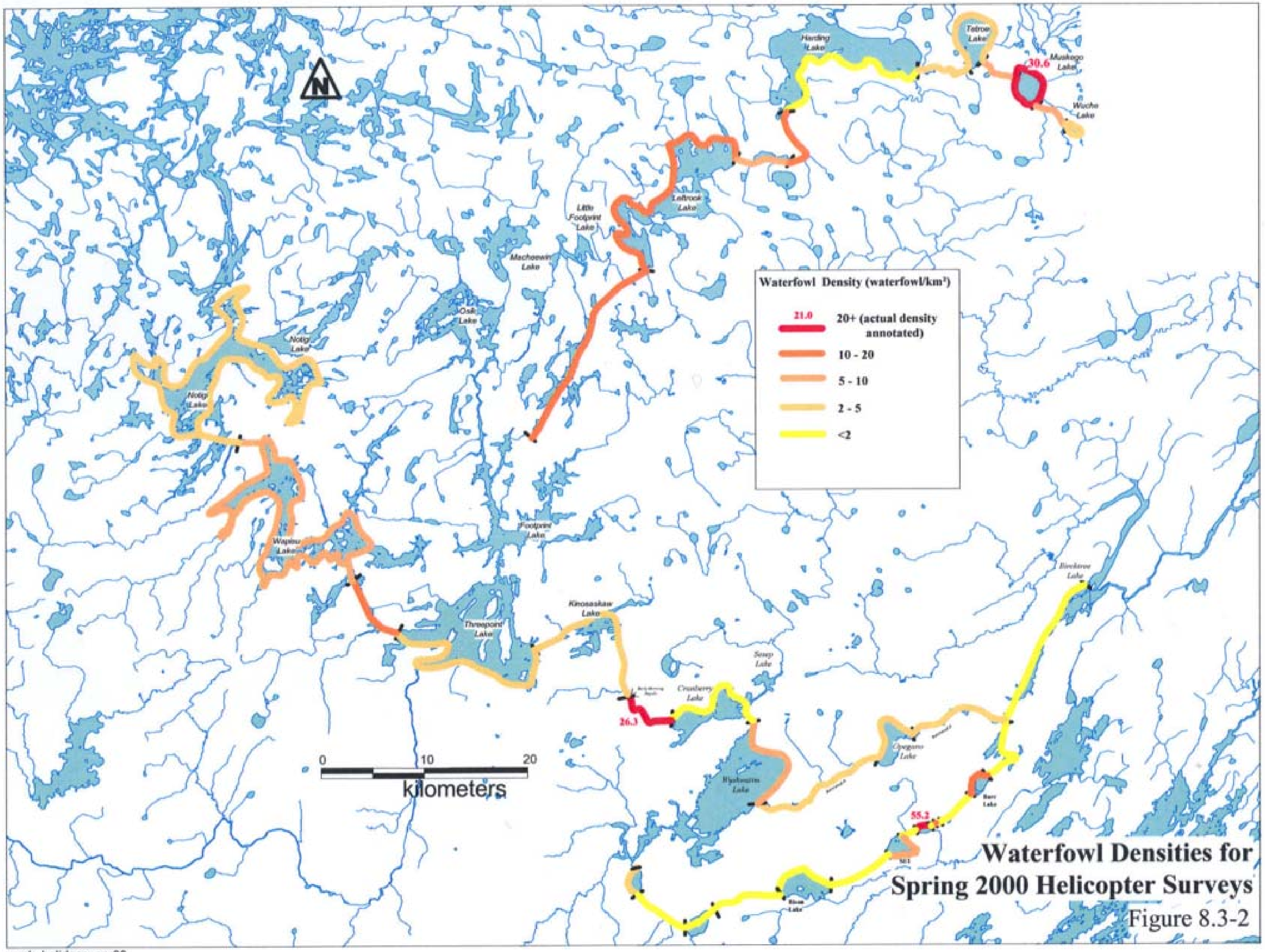
During summer surveys in 2000 and 2001, 9.5-fold and 3.7-fold higher densities of waterfowl were observed on off-system waterbodies, respectively, compared to waterbodies along the Rat-Burntwood River system (Figure 8.3-1). Although many female waterfowl are brooding their young during the mid- to late-July period when helicopter surveys were conducted, most waterfowl observed during summer helicopter surveys were post-breeding males and females without broods. Although much lower densities of waterfowl were observed along the Rat-Burntwood River system compared to off-system waterbodies during summer helicopter surveys in 2000 and 2001, a higher density of broods per square kilometre surveyed was observed along the Rat-Burntwood River system in 2000 (0.10 broods/km^2) and 2001 (0.63 broods/km^2) compared to off-system waterbodies in 2000 (0.08 broods/km^2) and 2001 (0.20 broods/km^2; Tetr*ES* 2003a,b). This suggests that the adjacent off-system waterbodies are more important to



Note: Waterfowl includes: ducks, geese and swans
Downstream of EMR* = Birch Tree Lake to Early Morning Rapids (EMR)
Upstream of EMR = Early Morning Rapids to Notigi Lake
*Includes waterbodies potentially affected by the proposed Wuskwatim Generating Station
Refer to Tetr*ES* 2003 a,b for additional survey results
P:\0221-Hydro\29-Wusk-Notig-Gull\11-31 Wusk-Notigi GS\Fieldwork 2001\Helicopter\2000-2001 comparison\Stretch summary.xls

Comparative Abundance of Birds Observed During Helicopter Surveys of the Bird Study Area in 2000 and 2001

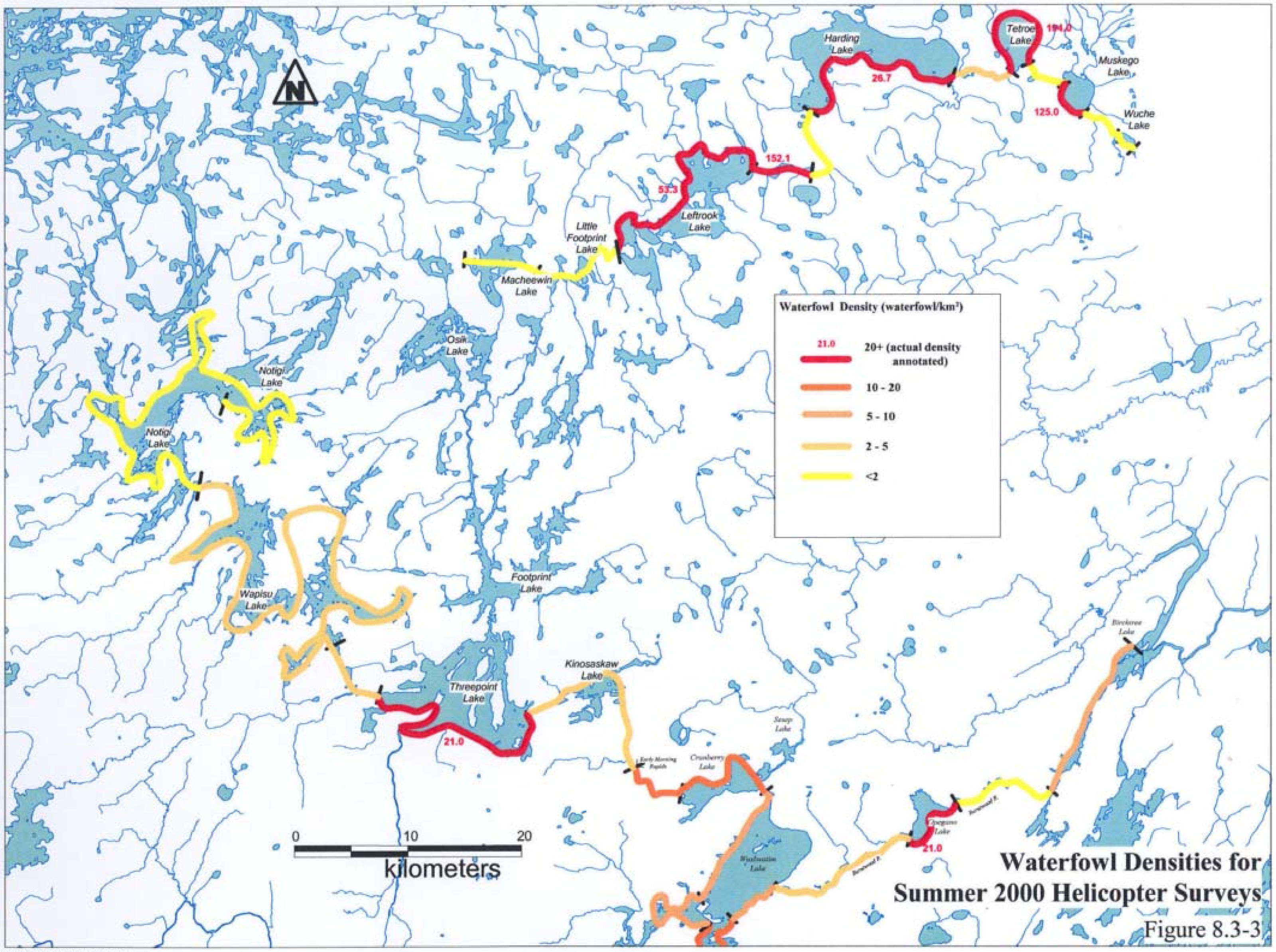
Figure 8.3-1



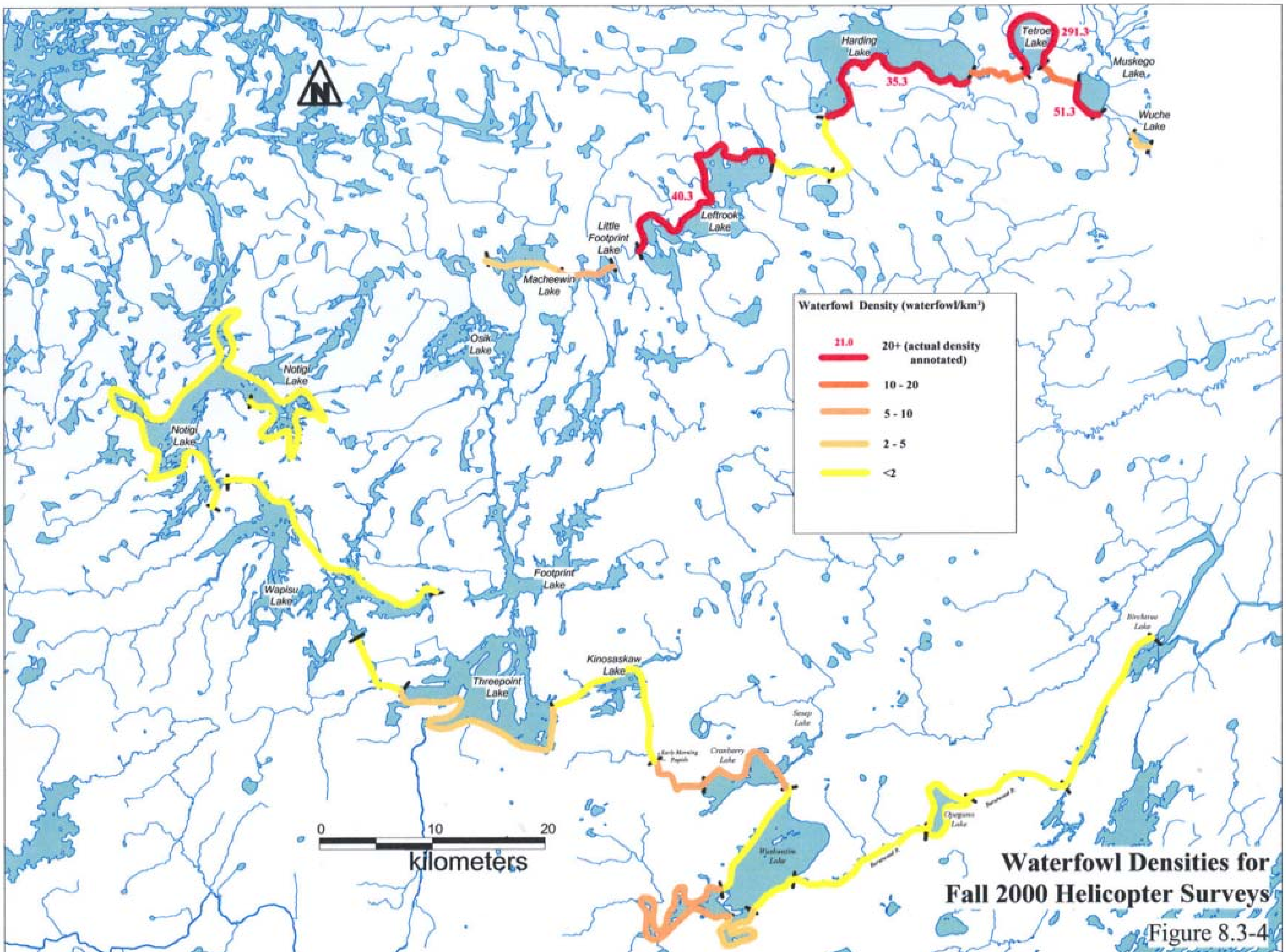
Waterfowl Densities for Spring 2000 Helicopter Surveys

Figure 8.3-2

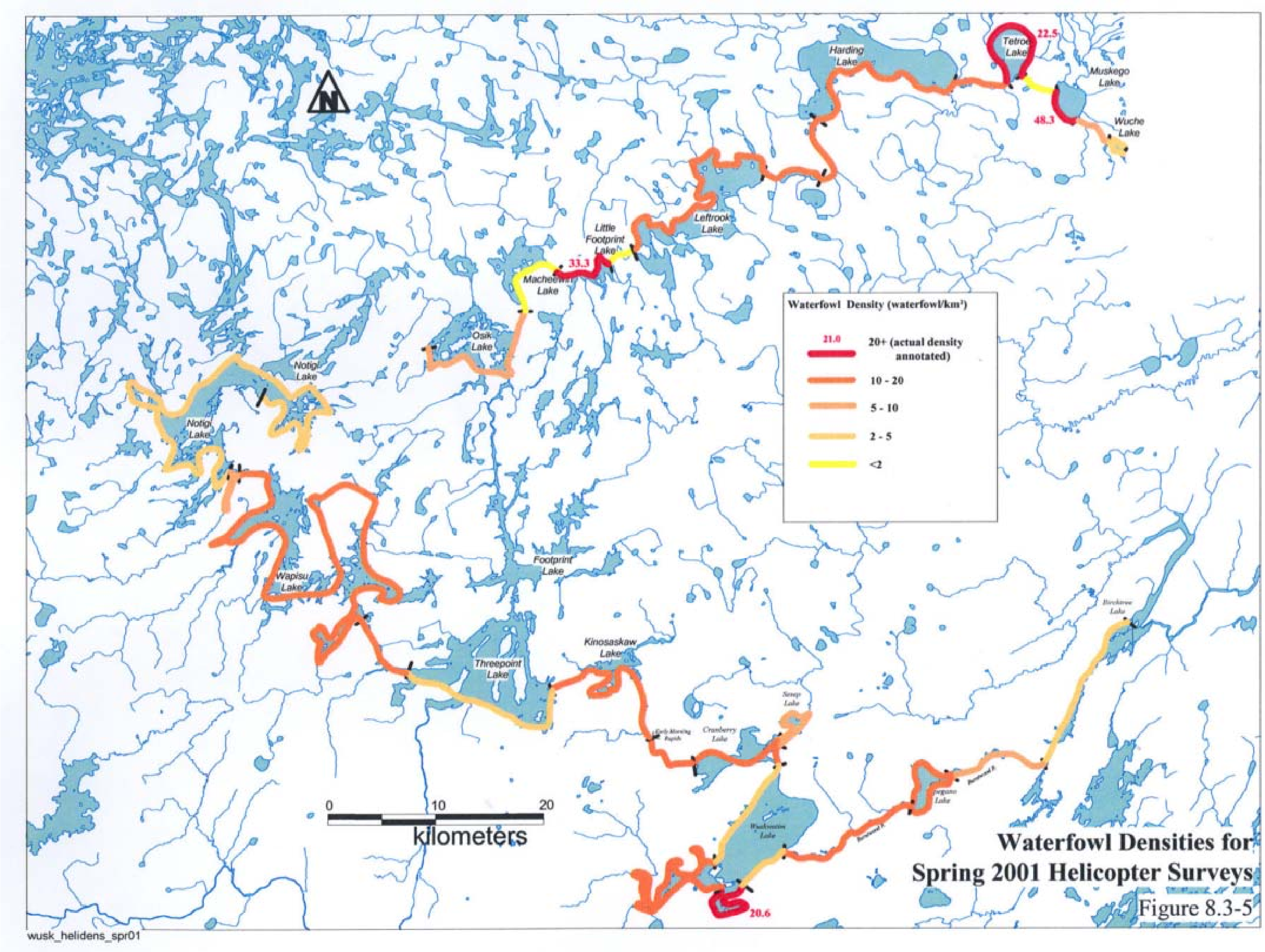
wusk_helidens_spr00



wusk_helidens_sum00

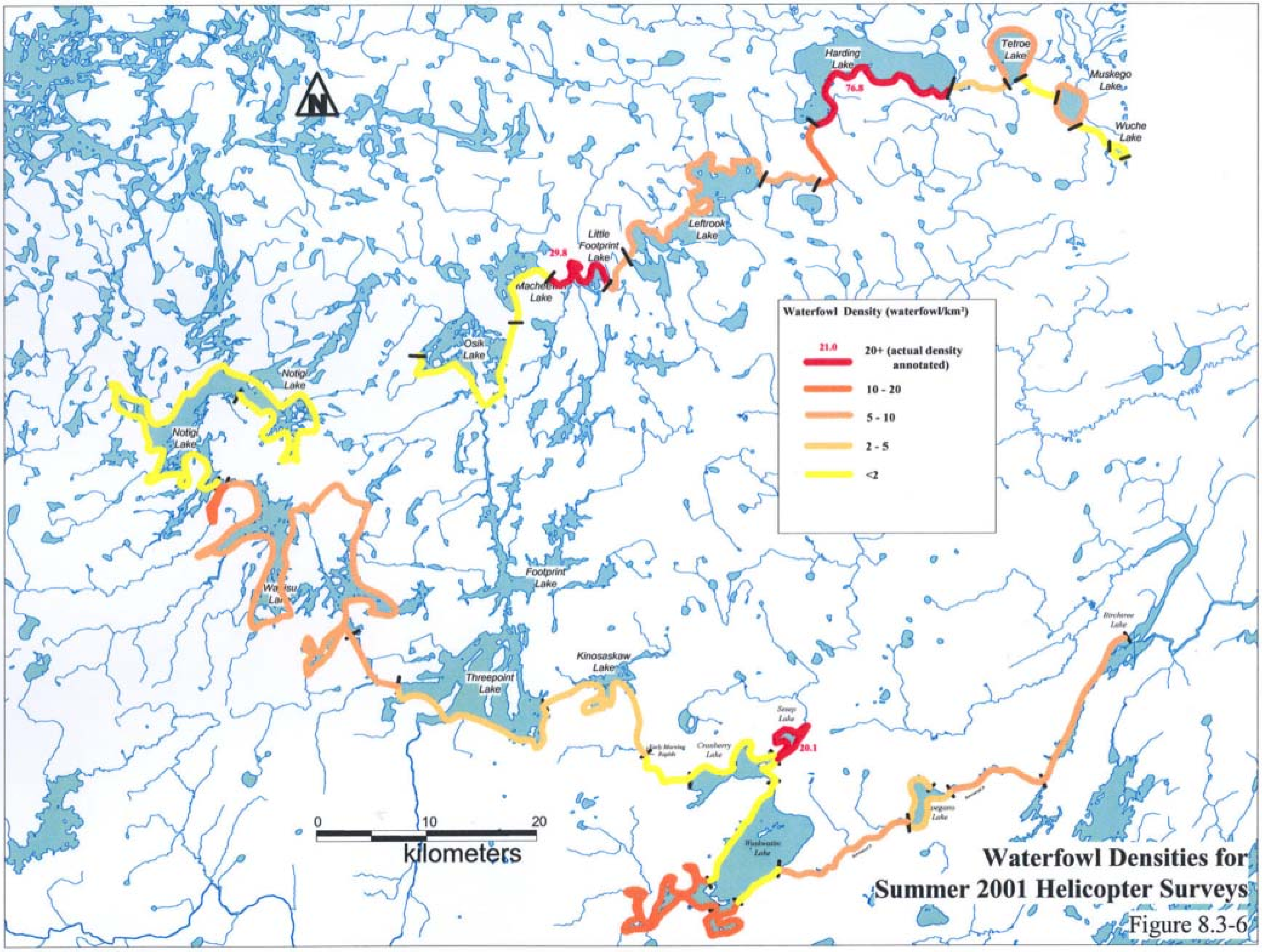


wusk_helidens_fal00

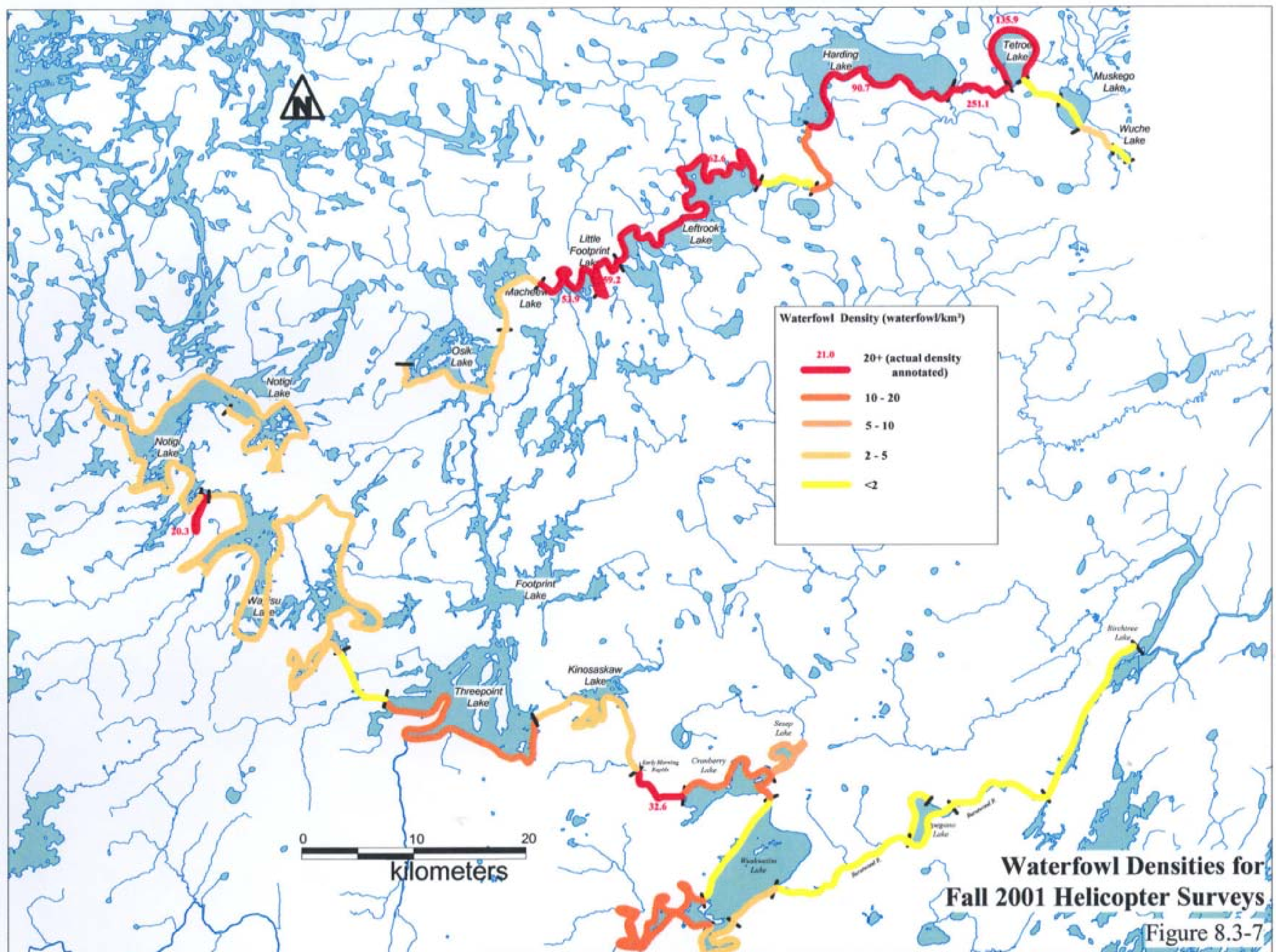


Waterfowl Densities for Spring 2001 Helicopter Surveys

Figure 8.3-5



wusk_helidens_sum01



Waterfowl Densities for Fall 2001 Helicopter Surveys

Figure 8.3-7

migrating and pre-migrating **loafing** and foraging waterfowl, whereas the Rat-Burntwood River system may be more important for nesting and brood-rearing waterfowl.

Similar densities of waterfowl broods were observed during summer helicopter surveys along the Rat-Burntwood River reach that will be affected by the proposed project (i.e., Birch Tree Lake to Early Morning Rapids; 0.52 ± 0.24 broods/km^2 in 2000 and 2001) and along the unaffected reach (i.e., Early Morning Rapids upstream to Notigi Lake; 0.30 ± 0.04 broods/km^2 in 2000 and 2001; Tetr*ES* 2003a,b).

Approximately 2.8-fold lower densities of broods were observed during summer 2000 helicopter surveys compared to 2001 along the entire surveyed reach of the Rat-Burntwood River system. A 50-cm increase in water levels from late May through to late June 2000, as indicated by gauge station data at Wuskwatim Lake (Volume 4), may have flooded some waterfowl nests along the Rat-Burntwood River system thereby possibly reducing the number of broods observed in 2000 compared to 2001.

During fall surveys, when most waterfowl are beginning migration, waterfowl densities were 45-fold and 13-fold higher along adjacent off-system waterbodies in 2000 and 2001, respectively, compared to waterfowl densities along the Rat-Burntwood River system. These fall survey results emphasize the importance of the adjacent off-system waterbodies for migrating waterfowl compared to the Rat-Burntwood River system.

Waterbird VEC Species

VEC species that have been chosen to represent waterbirds include the: Canada Goose, Mallard, Bufflehead and Common Goldeneye (together) and Common Loon. Rationale for the selection of these birds as VECs, is provided in Section 8.2.4.5. A brief description of the general biology of these species is provided below.

Canada Goose

The Canada Goose is the earliest nesting waterfowl species in the Wuskwatim study area, typically initiating nesting in May before the ice and snow has completely melted in the area (Bellrose 1976; Raveling 1978). This species nests in the vicinity of water near lakes, ponds, larger streams and marshes and often forages on sedges, grasses and on berry-bearing plants (especially *Vaccinium* spp. and *Empetrum* spp.; Prevett *et al*. 1985; Godfrey 1986). Canada Geese usually nest on the ground near water, especially on islands or other raised areas with a good view of the waterbody, such as on muskrat and beaver houses (Cooper 1978; Godfrey 1986). Individual female geese occasionally use the same nest site in consecutive breeding seasons and most often use the same type of nest site near previous nest sites (Geis 1956; Cooper 1978). Re-nesting attempts by Canada Geese that have deserted or lost their nests early in the nesting season does occasionally occur. However, re-nesting appears to be less frequent in more northern latitudes (Belrose 1976). During the brood-rearing period, sedge shorelines and sedge marshes become important habitat for Canada Geese (Raveling 1977).

Mallard

Mallards are considered an ‘upland-nesting’ duck species, meaning that they are primarily a ground-nesting species that frequently nests away from water (Bellrose 1976; Godfrey 1986). However, Mallards nest in the widest variety of habitats of any duck species and will also nest in marsh habitat over water (Bellrose 1976). Mallards are one of the earliest-nesting duck species in the Wuskwatim Lake area, with most Mallards likely arriving during April and most initiating clutches during May (Townsend 1966; Bellrose 1976). Mallard hens brood their young primarily within marsh habitat and prefer deep marshes in larger lakes and ponds with the most stable water levels (Bellrose 1976). In cases where the first nesting attempt fails, previous studies have estimated that up to 50% of females that lose nests may re-nest (Bellrose 1976). Mallards are considered a ‘**dabbling duck**’ species, meaning they usually feed by tipping their bodies head-downwards into the water. The diet of Mallards is highly variable and often consists of the seeds of various aquatic plants such as pondweed, sedges and grasses (Bellrose 1976). The diet of Mallards varies with life **stage** and can consist of a high content of animal matter; primarily aquatic insects and amphipods (Bartonek 1972; Bellrose 1976; Godfrey 1986).

Bufflehead and Common Goldeneye

Bufflehead and Common Goldeneye are ‘diver’ duck species, meaning that they primarily forage by diving underwater in search of food. Both species nest primarily in tree cavities, including larger woodpecker holes near water (Bellrose 1976; Godfrey 1986). Buffleheads, especially, commonly nest in old Northern Flicker nest holes (Bellrose 1976). The height of nest holes can vary from 0.75 metres to 18 metres above the ground (Bellrose 1976; Godfrey 1986). Nest cavities used in the Wuskwatim Lake area in 2000 and 2001 were 0.5 metres or higher above water level in standing dead trees (Tetr*ES* 2003a). Many other cavity-nesting birds compete with Buffleheads and Common Goldeneye for suitable nest holes. For this reason, it is doubtful that hens which have nests destroyed during **incubation** would have sufficient opportunity to re-nest although little information is available regarding re-nesting by these species in northern boreal areas (Bellrose 1976). Brood rearing of young Buffleheads and Common Goldeneye occurs further away from emergent vegetation **cover** and more often in open water of ponds and lakes compared to most other duck species (Bellrose 1976). Both species feed mostly on animal matter such as aquatic insects, crustaceans and molluscs. However, some plant material is also eaten such as pondweed and seeds of aquatic plants (Bellrose 1976).

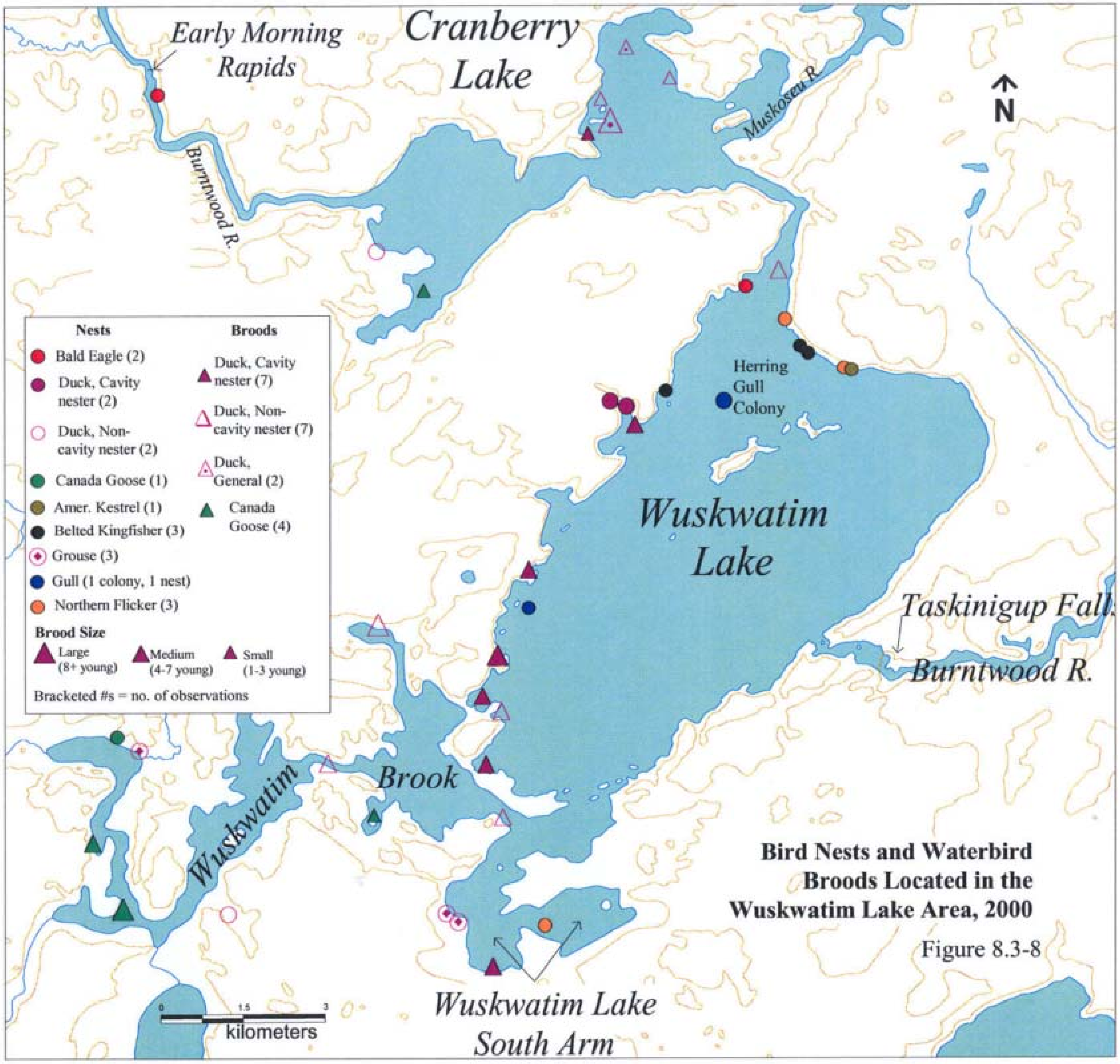
Common Loon

Boreal forest lakes are the breeding habitat for most Common Loons in North America (Yonge 1981). The spring arrival of loons to the breeding area coincides closely with ice break-up on lakes (Yonge 1981). This species nests along shorelines (especially islands) and occasionally on muskrat houses, as do Canada Geese. Nests consist of decaying vegetation, are often mostly surrounded by water (such as on an island) and are constructed on a firm **substrate** usually with very little emergent vegetation cover near the nest (Yonge 1981).

Common Loon nests are often placed such that the rim of the nest is in contact with water (Yonge 1981). For this reason, loon nests are vulnerable to wave action and will often nest in areas that provide some shelter, such as in bays (Yonge 1981). A study of loons on a northern boreal lake near The Pas, Manitoba indicated that egg-laying commenced during the third week of May with peak laying in most nests occurring at the end of May and beginning of June when two eggs are normally laid (Yonge 1981). Common Loons will often re-nest (typically no more than once) when both eggs in the nest are lost due to predation or other factors (Yonge 1981). Hatching intervals between the first and second egg range from 6 to 42 hours with both chicks abandoning the nest within six hours of the second chick hatching (Yonge 1981). The diet of Common Loons consists almost exclusively of fish, particularly of younger size (age) classes (Yonge 1981; Barr 1996).

8.3.4.3 Wuskwatim Lake Area

This section describes the general population distributions and habitat use of the major bird groups for the Wuskwatim Lake area which includes: the Wuskwatim Brook area, the south arm of Wuskwatim Lake, the main Wuskwatim Lake, Cranberry Lake, the Muskoseu River and Sesep Lake area and the Burntwood River reach between Cranberry Lake and Early Morning Rapids (Figure 8.3-8). The locations of waterbird (and other bird) nests and broods located within the Wuskwatim Lake area during field studies in 2000 and 2001 are illustrated in Figures 8.3-8 and 8.3-9.



Bird Nests and Waterbird Broods Located in the Wuskwatim Lake Area, 2000

Figure 8.3-8

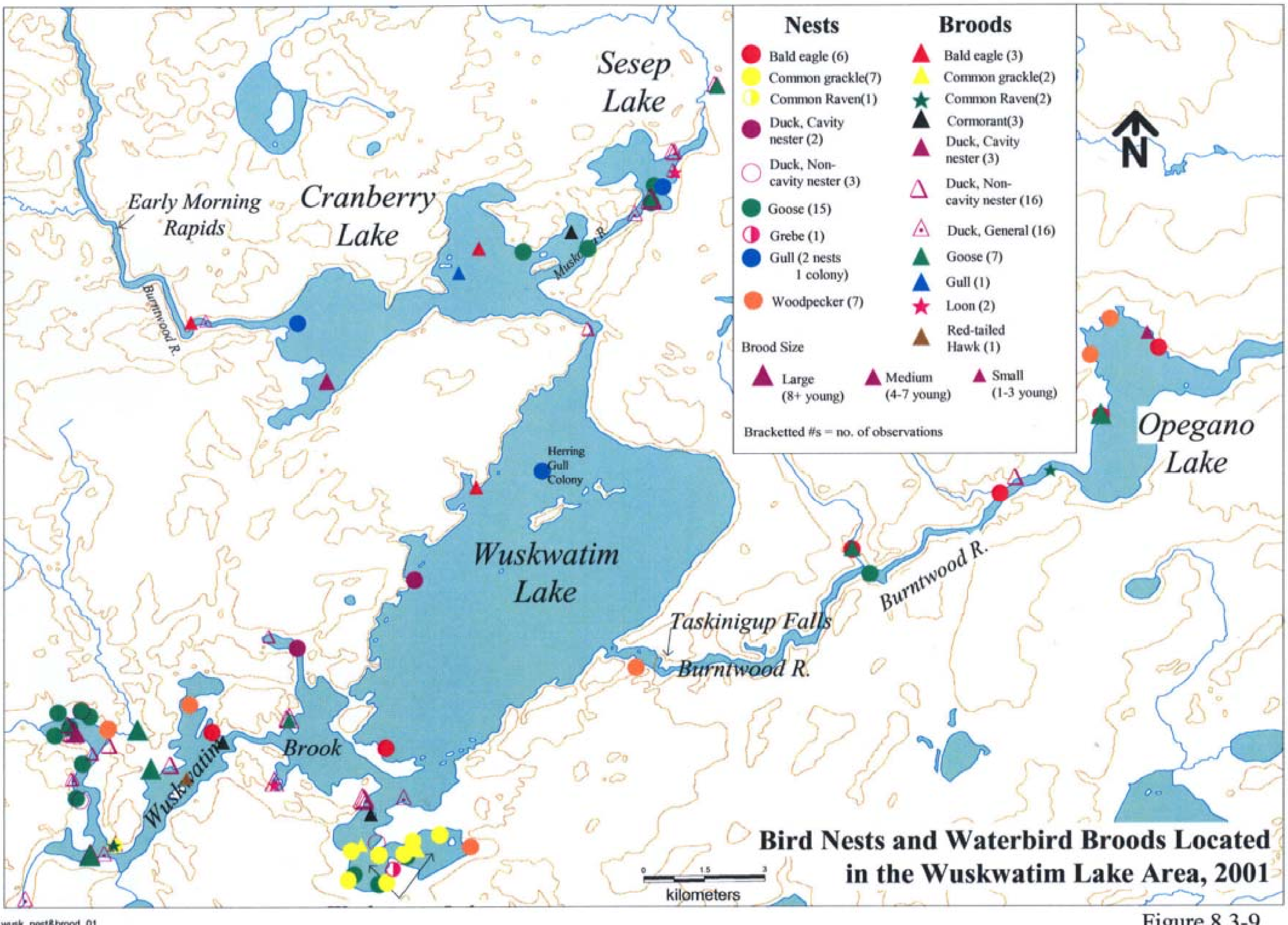

Nests
Bald eagle (6)
Common grackle(7)
Common Raven(1)
Duck, Cavity nester (2)
Duck, Non-cavity nester (3)
Goose (15)
Grebe (1)
Gull (2 nests 1 colony)
Woodpecker (7)
Broods
Bald eagle (3)
Common grackle(2)
Common Raven(2)
Cormorant(3)
Duck, Cavity nester (3)
Duck, Non-cavity nester (16)
Duck, General (16)
Goose (7)
Gull (1)
Loon (2)
Red-tailed Hawk (1)
Brood Size
Large (8+ young)
Medium (4-7 young)
Small (1-3 young)
Bracketted #s = no. of observations
Sesep Lake
Cranberry Lake
Early Morning Rapids
Burntwood R.
Wuskwatim Lake
Herring Gull Colony
Taskinigup Falls
Burntwood R.
Opegano Lake
Wuskwatim
Brook
N
0 1.5 3
kilometers
Bird Nests and Waterbird Broods Located in the Wuskwatim Lake Area, 2001
wusk_nest&brood_01

Figure 8.3-9

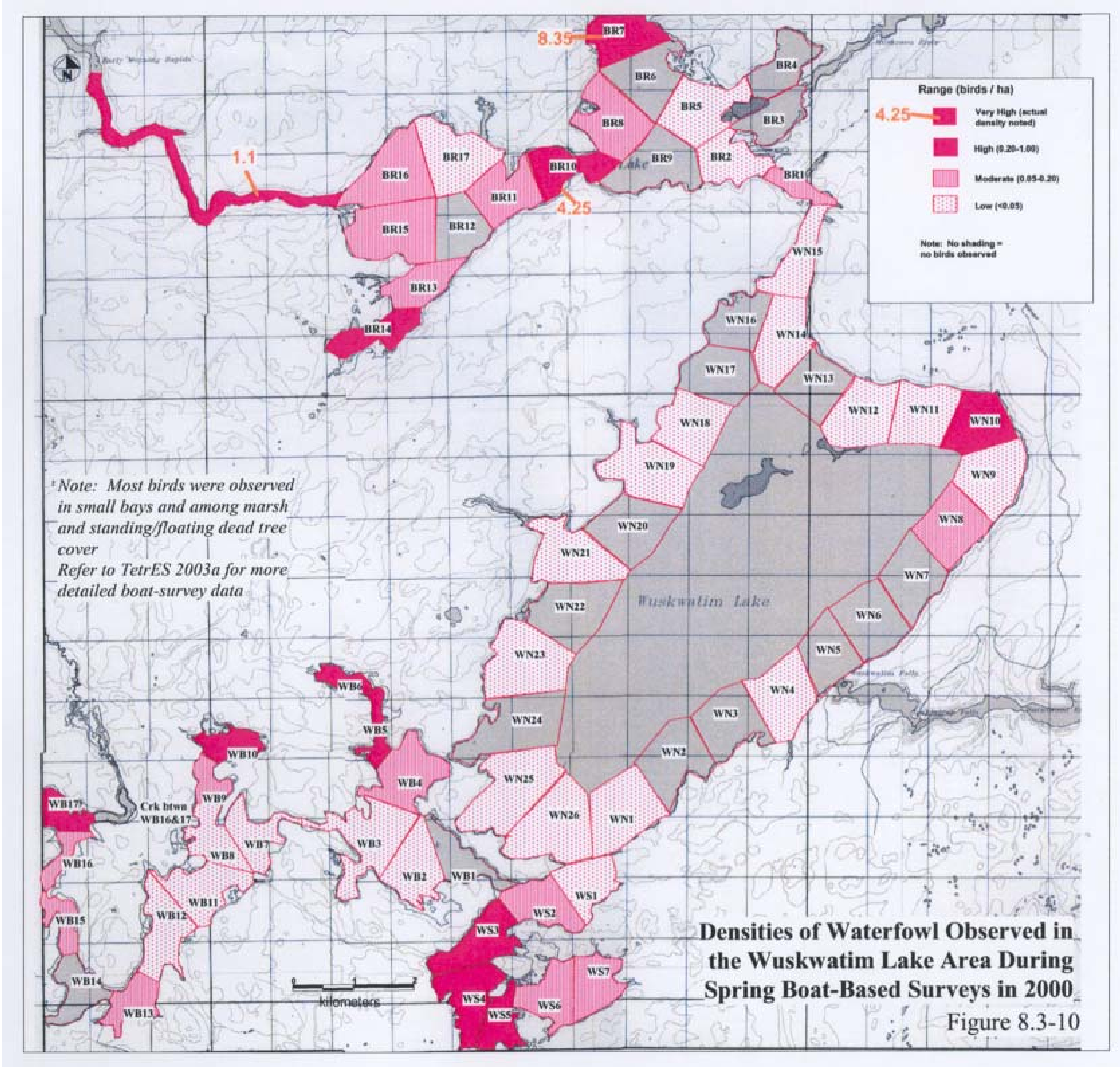
Waterfowl

Abundance and Distribution

Boat and helicopter-based surveys of the Wuskwatim Lake area during 2000 and 2001 suggest that there is considerable annual and seasonal variability regarding where the highest densities of waterfowl occur (Tetr*ES* 2003a,b). Figures 8.3-10 to 8.3-14 illustrate the average seasonal densities of waterfowl observed in the Wuskwatim Lake area during boat-based surveys conducted in 2000 and 2001. During spring boat-based surveys in 2000, the most northern area surveyed (i.e., the Burntwood River from Cranberry Lake to Early Morning Rapids and the Cranberry Lake area) had the highest densities of waterfowl. During spring boat-based surveys in 2001, the opposite trend occurred with high waterfowl densities in the most southern areas surveyed (i.e., the south arm of Wuskwatim Lake and the Wuskwatim Brook area). However, the highest spring densities of waterfowl recorded during boat-based surveys in both survey years were observed in 2001 in the Muskoseu River and Sesep Lake area, an area with abundant marsh habitat for **staging**, breeding and foraging waterfowl.

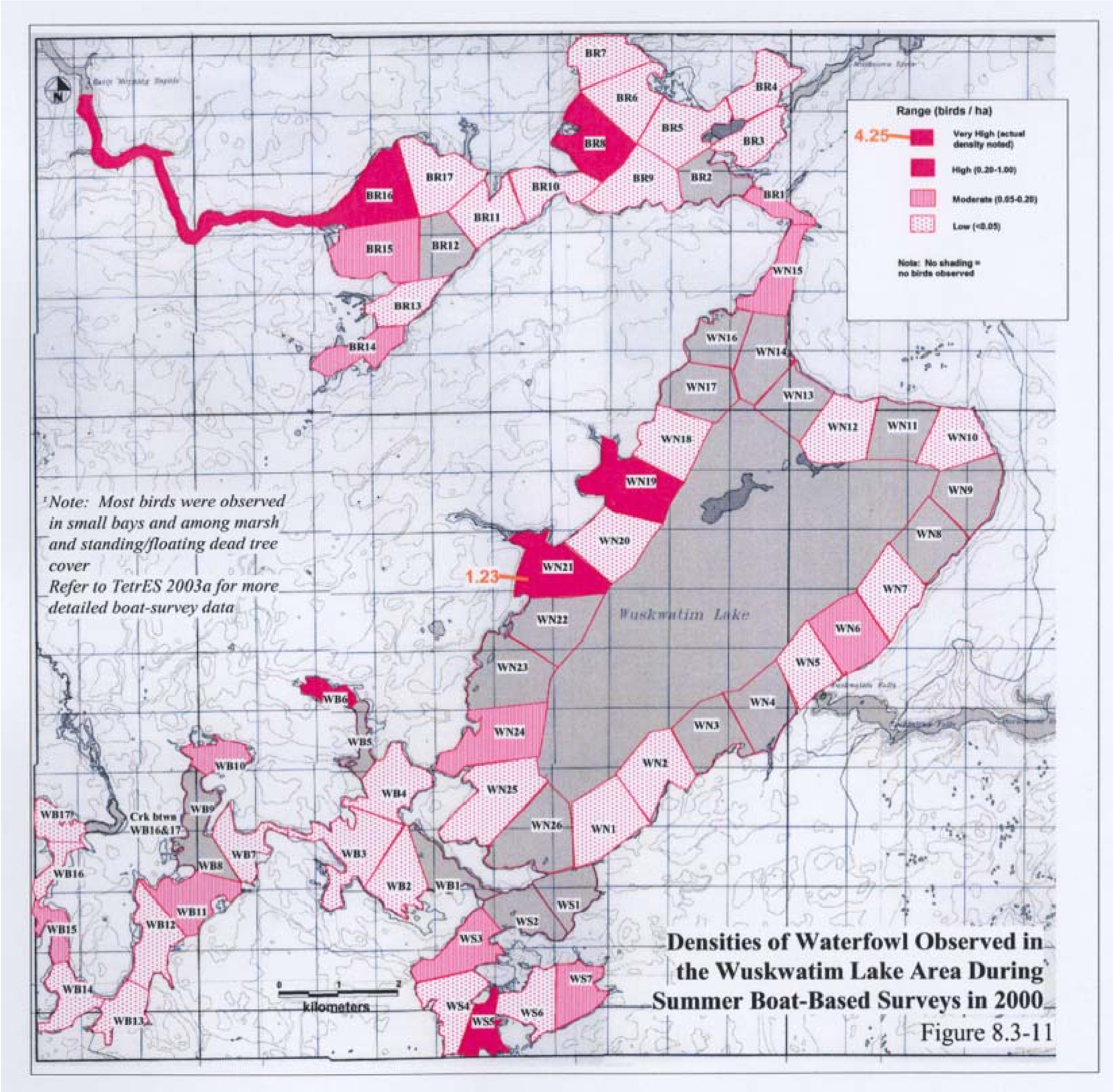
Helicopter surveys during spring 2001 also indicate that the highest densities of waterfowl were located in the south arm of Wuskwatim Lake (Figure 8.3-5; Tetr*ES* 2003b). Spring helicopter surveys in both 2000 and 2001 indicated that high densities of waterfowl were also observed along the Burntwood River section between Cranberry Lake and Early Morning Rapids and at Opegano Lake (Figures 8.3-2 and 8.3-5; TetrES 2003a,b). Very low densities of waterfowl were observed during spring helicopter surveys over Cranberry Lake in 2000 (Figure 8.3-2). However, the third-highest density of waterfowl in the Wuskwatim Lake area was observed during the spring helicopter survey in 2001. Additional data from subsequent survey years will be required to discern the most important areas for waterfowl in the Wuskwatim Lake area during spring.

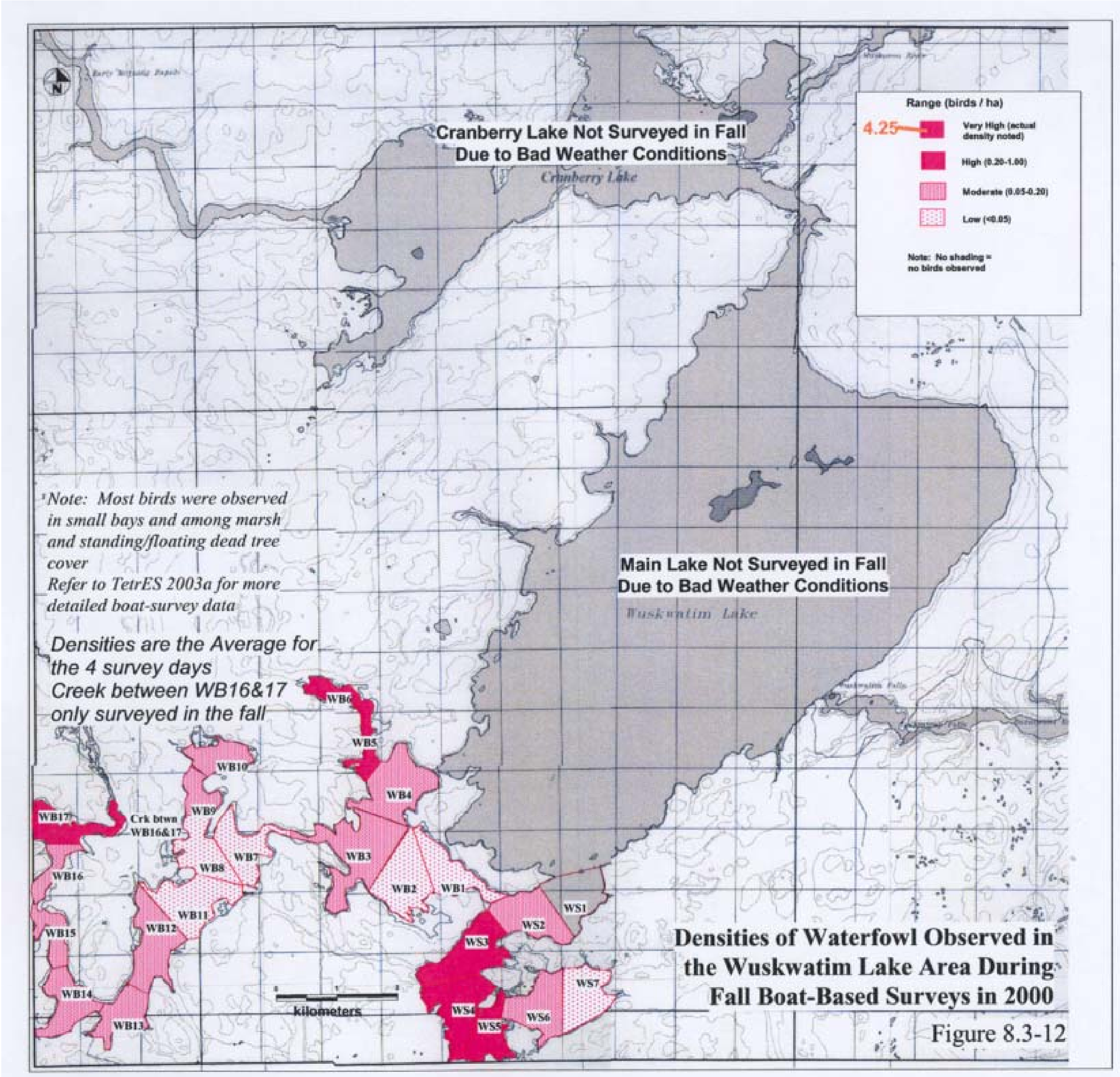
The abundance and distribution of waterfowl in the Wuskwatim Lake area during summer 2000 and 2001 surveys was highly variable (Tetr*ES* 2003a,b). However, the south arm of Wuskwatim Lake appeared to consistently have very high densities of waterfowl during summer helicopter surveys in both years. Summer boat-based surveys in the Wuskwatim Lake area in 2000 also indicated that the highest waterfowl densities occurred at the south arm of Wuskwatim Lake suggesting that this area is likely particularly important habitat for pre-migratory and brood-rearing waterfowl (Tetr*ES* 2003a). The abundance of marsh habitat in that area provides ideal nesting and brood-



Densities of Waterfowl Observed in the Wuskwatim Lake Area During Spring Boat-Based Surveys in 2000

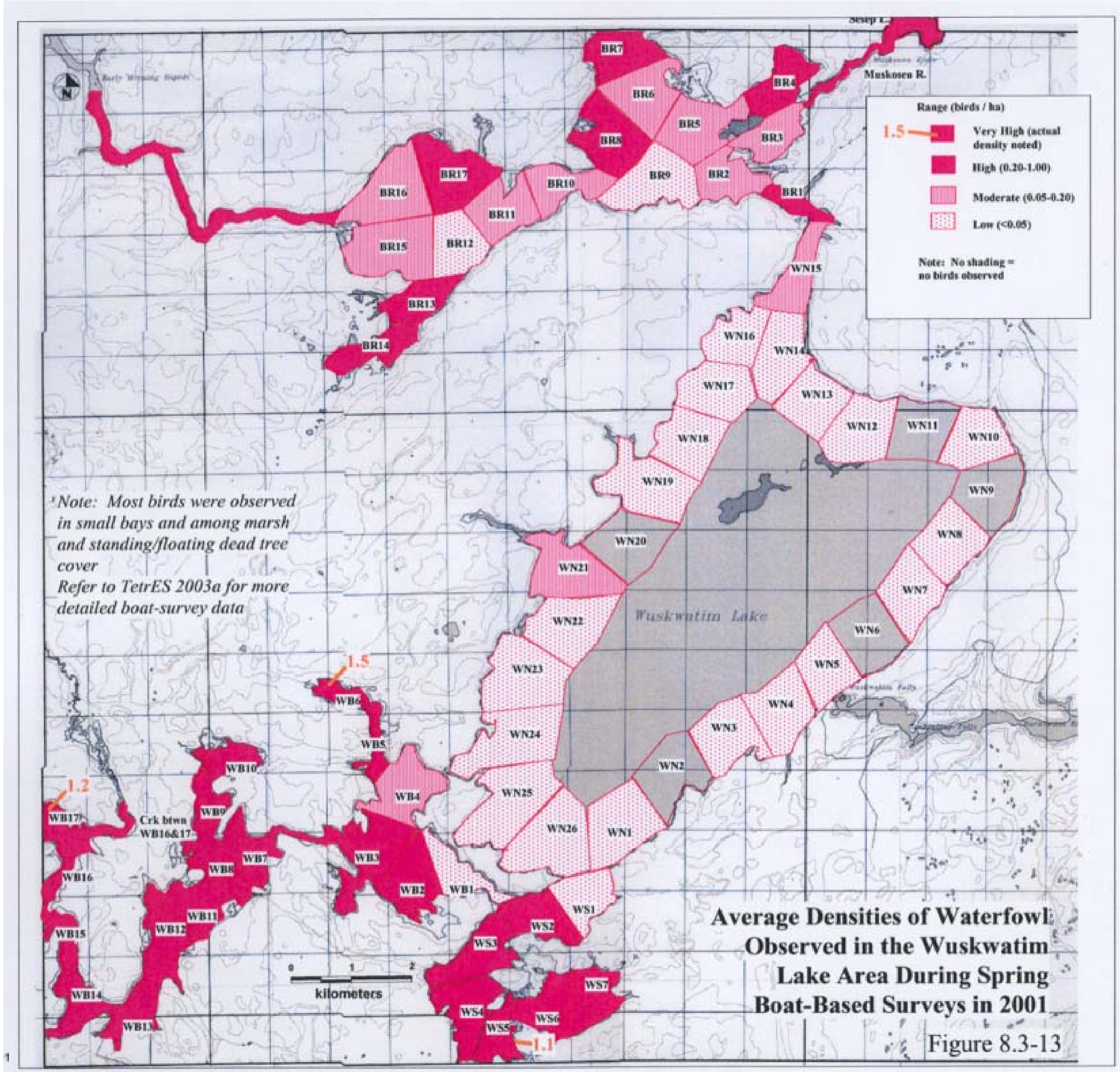
Figure 8.3-10


Range (birds / ha)
4.25
Very High (actual density noted)
High (0.20-1.00)
Moderate (0.05-0.20)
Low (<0.05)
Note: No shading = no birds observed
Note: Most birds were observed in small bays and among marsh and standing/floating dead tree cover
Refer to TetrES 2003a for more detailed boat-survey data
1.23
Wuskwatim Lake
kilometers
Densities of Waterfowl Observed in the Wuskwatim Lake Area During Summer Boat-Based Surveys in 2000
Figure 8.3-11



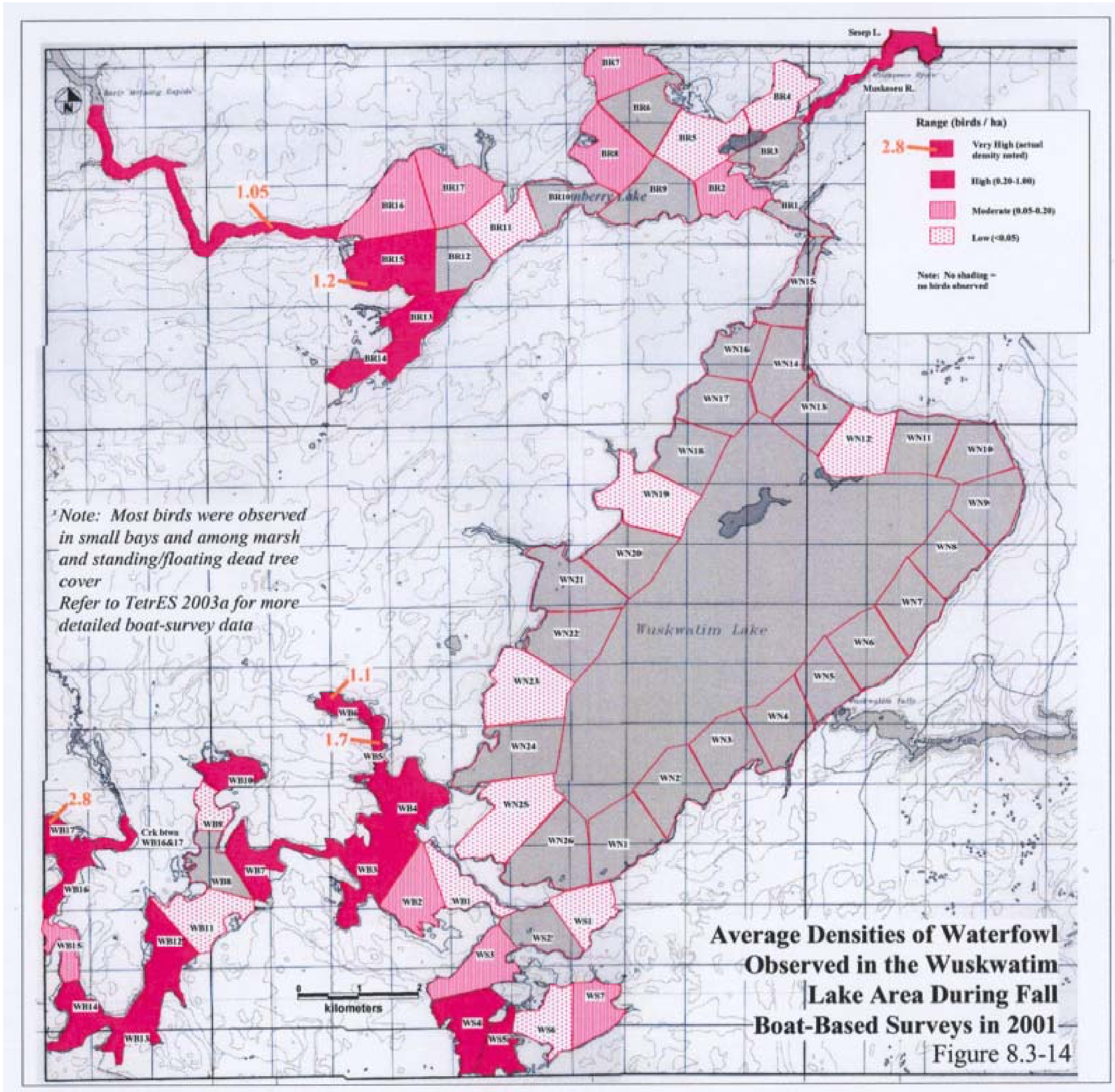
Densities of Waterfowl Observed in the Wuskwatim Lake Area During Fall Boat-Based Surveys in 2000

Figure 8.3-12



Average Densities of Waterfowl Observed in the Wuskwatim Lake Area During Spring Boat-Based Surveys in 2001

Figure 8.3-13



Average Densities of Waterfowl Observed in the Wuskwatim Lake Area During Fall Boat-Based Surveys in 2001

Figure 8.3-14

rearing habitat for many duck species and provides good cover for staging waterfowl. Results of helicopter surveys during summer 2000 and 2001 suggest that Sesep Lake and the Wuskwatim Brook area are also important areas for waterfowl during the summer.

Fall boat-based surveys in the Wuskwatim Lake area in 2001 indicated that the most important areas for waterfowl, in terms of highest densities recorded, occurred in the Burntwood River area between Cranberry Lake and Early Morning Rapids and in the Wuskwatim Brook area. Only the Wuskwatim Brook area and south arm of Wuskwatim Lake could be surveyed by boat during fall 2000 due to poor weather conditions. At that time, slightly higher densities of waterfowl were observed at the south arm of Wuskwatim Lake compared to the Wuskwatim Brook area (Tetr*ES* 2003a). Helicopter-based surveys in the Wuskwatim Lake area in 2000 and 2001 indicated that the most important areas for waterfowl were the Wuskwatim Brook area, Cranberry Lake and the Burntwood River between Cranberry Lake and Early Morning Rapids (Tetr*ES* 2003a,b).

Habitat Use

Throughout the Wuskwatim Lake area during 2000 and 2001 baseline surveys, the majority of waterfowl observed were usually located in sheltered bay areas, particularly among marsh habitat and also among standing dead trees and other floating and anchored deadwood debris when available (Tetr*ES* 2003a,b). Marsh habitat, either with or without the presence of standing dead trees or other wood debris, was particularly important for waterfowl in the south arm of Wuskwatim Lake and the Wuskwatim Brook area during spring and fall. Marsh habitat in the Cranberry Lake and Sesep Lake areas appears to be used more by waterfowl during spring rather than fall. Marsh habitat was essentially absent from the main Wuskwatim Lake during 2000 and 2001, which is likely a factor influencing the relatively low densities of waterfowl in the main Wuskwatim Lake area during spring when shelter is required for nesting waterfowl.

In addition to marsh habitat, standing dead trees and downed woody debris (floating and beached debris) along shorelines and in bays were often used as shelter by waterfowl in some areas during 2000 and 2001, particularly at Cranberry Lake, Wuskwatim Brook, Sesep Lake and the south arm of Wuskwatim Lake. On the main Wuskwatim Lake, woody debris along shorelines was often used during fall by the relatively few waterfowl located in that area.

Waterfowl VEC Species

During spring and summer surveys in 2000 and 2001, the areas with the highest densities of Canada Geese within the Wuskwatim Lake area included: the Burntwood River area between Cranberry Lake and Early Morning Rapids, the Sesep Lake area, the south arm of Wuskwatim Lake and the Wuskwatim Brook area (Tetr*ES* 2003a,b). All of these areas provide good foraging and brood-rearing habitat for Canada Geese. A limited amount of potential Canada Goose nesting habitat occurs along the section of the Burntwood River between Cranberry Lake and Early Morning Rapids. The best Canada Goose nesting habitat occurs in areas with the most abundant floating marsh/island habitat which includes: the west end of the Wuskwatim Brook area, the northeast area of Cranberry Lake, the Sesep Lake area and the south arm of Wuskwatim Lake (TetrES 2003a,b). The highest number of Canada Goose nests observed during bird surveys of the Wuskwatim Lake area in 2000 and 2001 were located at the west end of the Wuskwatim Brook area (Figures 8.3-8 and 8.3-9). During fall migration in September 2000 and 2001, the highest densities of Canada Geese were typically observed along the Burntwood River between Cranberry Lake and Early Morning Rapids, on Cranberry Lake and in the Wuskwatim Brook area (Tetr*ES* 2003a,b).

During spring and summer surveys in 2000 and 2001, the areas with the highest densities of Mallards within the Wuskwatim Lake area included: the south arm of Wuskwatim Lake, the Sesep Lake area, along the Burntwood River between Cranberry Lake and Early Morning Rapids and the Wuskwatim Brook area (Tetr*ES* 2003a,b). The Burntwood River area appeared to be mostly used by post-breeding male Mallards, whereas the other high mallard-density areas contained abundant marsh habitat suitable as cover and brood-rearing habitat. Important areas for brooding Mallards included the Wuskwatim Brook area and Sesep Lake. During fall migration in September 2001, the highest densities of Mallards were observed along the Burntwood River between Cranberry Lake and Early Morning Rapids, on Cranberry Lake and in the Wuskwatim Brook area. Due to poor weather during September 2000 boat-based surveys, the entire Wuskwatim Lake area could not be surveyed. Only one Mallard was observed during the helicopter survey in the Wuskwatim Lake area in 2000.

During spring surveys in 2000 and 2001, when Bufflehead and Common Goldeneye are nesting, the areas with the highest densities of Bufflehead and Common Goldeneye within the Wuskwatim Lake area included: the Burntwood River between Cranberry Lake and Early Morning Rapids, the south arm of Wuskwatim Lake, Cranberry Lake, the Wuskwatim Brook area and the Sesep Lake area. Habitat containing numerous standing dead trees with suitable nesting cavities occurred in all of the above areas, with the exception of the Burntwood River reach. During summer surveys, when female Bufflehead and Common Goldeneye are brooding their young, the areas with the highest densities of these two species included: the Sesep Lake area, the Burntwood River between Cranberry Lake and Early Morning Rapids, Cranberry Lake, Wuskwatim Brook and the south arm of Wuskwatim Lake. Bufflehead and Common Goldeneye broods were most commonly observed on the main Wuskwatim Lake (Tetr*ES* 2003a). However, broods of either species have also been observed on Cranberry Lake, Sesep Lake and the Wuskwatim Brook area (Tetr*ES* 2003b). Due to the relatively small number of Bufflehead and Common Goldeneye broods observed in 2000 and 2001, additional surveys in subsequent years would be required to determine which areas are the most important brood-rearing areas for these two species. These two duck species are less dependent on marsh cover when brooding their young and are usually seen in open water near shoreline areas (Belrose 1976).

Other Waterbirds

Gulls and Terns

Approximately 13 to 15 pairs of Herring Gulls were observed nesting on small island habitat on the west side of the main Wuskwatim Lake in 2000 and 2001. No other Herring Gull or Ring-billed Gull nests were observed in the Wuskwatim or Opegano Lake areas. In the Wuskwatim and Opegano Lake areas, the highest density of gulls and terns observed was during spring 2001 in the Sesep Lake area where similar densities of Herring Gulls, Ring-billed Gulls, Black Terns and Bonaparte’s Gulls were observed (Tetr*ES* 2003b). Common Terns were uncommon in the Wuskwatim Lake area. Gulls and terns were present in the second-highest densities (although 4.5-fold lower than at Sesep Lake) during spring in the Wuskwatim Brook area where Herring Gulls, Bonaparte’s Gulls, Ring-billed Gulls and a few Black Terns were observed. The abundance of marsh habitat in the Sesep Lake and Wuskwatim Brook areas appeared to be important foraging habitat for all species of gulls and terns observed. Of the gulls and terns observed, only the Black Tern is known to nest primarily in marsh habitat, although Herring Gulls may also use floating bog islands for nesting. Bonaparte’s Gulls nest primarily in spruce trees (Godfrey 1986).

Densities of gulls and terns observed in the Wuskwatim Lake area during fall surveys in mid-September were very low (Tetr*ES* 2003a,b), suggesting that the majority of gulls and terns had migrated from the area by that time.

Pelicans and Cormorants

Very few pelicans and cormorants were observed in the Wuskwatim Lake area during surveys conducted in 2000 and 2001 (Tetr*ES* 2003a,b). Very limited suitable nesting habitat for these species occurs in the Wuskwatim Lake area. The few pelicans and cormorants observed were likely migrating birds, non-breeding individuals, or birds that were breeding in more suitable habitat in the region and were only occasionally foraging and roosting in the Wuskwatim Lake area.

Loons, Grebes, Bitterns and Herons

The highest densities of loons, grebes, bitterns and herons consistently occurred in the Sesep Lake area, the south arm of Wuskwatim Lake and the Wuskwatim Brook area during all seasons surveyed in 2000 and 2001 (Tetr*ES* 2003a,b). Grebes, bitterns and herons either require or prefer some amount of marsh habitat for cover, foraging and/or nesting. These three areas have the highest abundance of marsh habitat in the Wuskwatim Lake area and are the most sheltered from wind and wave action compared to the open-water areas of the main Wuskwatim Lake and Cranberry Lake (Section 5). Loons do not require marsh habitat. However, they prefer sheltered bays and inlets for nesting (Yonge 1981).

VEC Species – Common Loon

During spring surveys in 2000 and 2001, when Common Loons were nesting, the highest densities of loons were observed in the Wuskwatim Brook area, the south arm of Wuskwatim Lake and at Sesep Lake. These areas offer sheltered shoreline habitat (including some floating bog island habitat) on which to nest.

During summer surveys, when loons are rearing their young, the majority of Common Loons were observed in the Wuskwatim Brook area, the south arm of Wuskwatim Lake and at Sesep Lake. These areas likely offer good foraging habitat for this piscivorous (i.e., fish-eating) species. Loons continued to be observed in the highest densities in these three areas during September surveys (Tetr*ES* 2003a,b).

8.3.4.4 Wuskwatim to Taskinigup Falls

For the purpose of discussion, this section of the study area includes the approximately 1.7 **km** reach of the Burntwood River between Wuskwatim Falls and Taskinigup Falls, and the approximate "**Footprint**" area of the proposed generating station and associated construction camp, buildings and other works located on the north side of this Burntwood

River section (Volume 3). This section of the river is not entirely navigable by boat. Therefore, bird survey data below are derived from helicopter-based surveys and terrestrial breeding bird surveys of this area.

Waterfowl

Very little suitable waterfowl habitat and very few waterfowl were observed in this relatively short section of the Burntwood River between Wuskwatim and Taskinigup Falls in 2000 and 2001. This is likely due to the overall high water velocity, strong currents and very limited amount of cover and appropriate nesting habitat for waterfowl in this area. During spring terrestrial breeding bird surveys along the north and south shores of this section of the Burntwood River, a few waterfowl were observed loafing in the water near shore on the north side of the river during 2000 (n = 3 waterfowl) and 2001 (n = 4 waterfowl). Only four waterfowl were observed along a terrestrial breeding bird transect surveyed in spring 2001 on the south side of the river adjacent to a bay area having some standing dead trees, other woody debris and emergent vegetation.

Downstream areas of the Burntwood River and other key areas of the Wuskwatim and Opegano Lake areas offer higher quality and more abundant waterfowl habitat.

Other Waterbirds

The only other waterbirds observed along the Burntwood River between Wuskwatim and Taskinigup Falls during bird surveys were two Herring Gulls loafing on the water near a bay on the south side of the river during a terrestrial survey in spring 2001. This area does not provide an abundance of suitable nesting, brood-rearing or foraging habitat for waterbirds primarily due to the relatively small area and the high water velocity and currents that occur along this reach of the Burntwood River.

8.3.4.5 Taskinigup Falls to Opegano Lake

This section of the Burntwood River (Figure 8.2-3) was surveyed by helicopter during the spring, summer and fall of 2000 and 2001. The following information on bird use of this area was primarily derived from those surveys.

Waterfowl

The majority of the approximate 15-kilometre reach of this section of the Burntwood River between Taskinigup Falls and Opegano Lake consists of forested, relatively steep banks with occasional bay areas. Bay areas along this reach provide the most suitable waterfowl habitat for nesting, foraging and brood-rearing. Helicopter surveys in 2000 and 2001 during the summer brood-rearing period indicated that a moderate number of waterfowl (average of 3.5 ± 1.1 geese/km^2 and 2.2 ± 1.3 ducks/km^2, respectively) occurred along this river reach. This reach of the Burntwood River appears to be particularly good foraging habitat for mergansers since mergansers were often one of the most common waterfowl observed along this reach (Tetr*ES* 2003a,b).

This reach of the river appears to be used more by spring migrating ducks with 1.8-fold to 3.3-fold more ducks observed along this reach during spring surveys in 2000 and 2001, respectively, than during summer surveys. No waterfowl were observed along this reach during the fall helicopter survey in 2000 and only three ducks were observed in fall 2001 along this reach. However, this reach may be used by fall migrating waterfowl as much as during spring since the migration of waterfowl during the fall through this region may occur over a longer time period than during spring migration (Bellrose 1976). Therefore, "peaks" in migrating waterfowl movements along this section of the river may not be as detectable on any one day during fall.

Waterfowl VEC Species

All of the geese observed along the Taskinigup Falls to Opegano Lake reach of the Burntwood River were Canada Geese. The highest densities of Canada Geese were observed during the summer helicopter survey along this reach. Although Canada Geese are known to nest along riverbanks, they prefer island habitat for nesting when available. Few islands suitable for nesting Canada Geese occur along this reach of the Burntwood River. However, more abundant nesting habitat, including suitable islands, occurs in the nearby Cranberry and Sesep Lake areas. It is therefore likely that this reach of the Burntwood River supports some pairs of nesting Canada Geese. However, other areas of the Wuskwatim Lake area are likely more important for nesting geese.

Although no Mallards were observed along the Taskinigup Falls to Opegano Lake reach of the Burntwood River during helicopter surveys in 2000, Mallards were one of the most abundant duck species observed along this reach during the spring and summer surveys in 2001 (Tetr*ES* 2003a,b). Mallards are known to nest along **riparian** areas, however they require marsh cover for brood rearing. Some limited amount of emergent vegetation occurs in the few bays and inlets along this reach of the river. However, these small areas may not be suitable for brood-rearing Mallards. Hen Mallards often lead their broods overland to nearby suitable marshlands. Some wetlands of suitable brood-rearing quality may occur within a kilometre, or less, to the south of this reach of the Burntwood River. Therefore, this reach may support a limited number of nesting Mallards.

Buffleheads and Common Goldeneye were not observed along the Taskinigup Falls to Opegano Lake reach of the Burntwood River during helicopter surveys in 2000. Eight Common Goldeneye and five Buffleheads were observed during spring 2001, and two Buffleheads were observed during the summer survey. Some Common Goldeneye and Bufflehead may nest in tree cavities on the upland shore areas of this reach of the river. However, more abundant nesting habitat (e.g., old woodpecker holes in dense areas of standing dead trees) occurs in key areas throughout the Wuskwatim Lake area. Comparatively few standing dead trees suitable as cavity nesting habitat occur along this reach of the river between Taskinigup Falls and Opegano Lake.

Other Waterbirds

During spring helicopter surveys in 2000 and 2001 along the Burntwood River between Taskinigup Falls and Opegano Lake, the majority of waterbirds other than waterfowl that were observed were gulls (Tetr*ES* 2003a,b). This reach of the river provides suitable foraging habitat for gulls, and may provide some limited nesting habitat on the few small islands that occur along this reach. Up to 30 gulls were typically observed foraging during spring at a rapids area approximately 3 km upstream along the Burntwood River at Opegano Lake in 2001 during boat-based surveys. However, no nesting gulls were observed in the area (Tetr*ES* 2003a,b).

Pelicans have been observed along this reach of the Burntwood River during the summer of 2000 (3 pelicans) and 2001 (flock of 22 pelicans). Since no breeding colonies of pelicans have been observed in the Wuskwatim Lake or Opegano Lake areas, it is likely that they were either non-breeding pelicans or were breeding pelicans making foraging trips to this reach of the river. This reach of the river does not provide important nesting habitat for pelicans, but may have some value as foraging habitat during spring and fall.

The only other waterbirds observed along this reach of the Burntwood River during 2000 and 2001 helicopter surveys were three Red-necked Grebes observed in spring 2001. Some grebes may nest in the few bay areas along the length of this river reach where sufficient amounts of marsh/emergent vegetation occur. However, much more abundant grebe nesting habitat occurs at the nearby Sesep Lake, south arm of Wuskwatim Lake and Wuskwatim Brook areas.

VEC Species – Common Loon

No Common Loons were observed along this reach of the Burntwood River during helicopter surveys in 2000 nor 2001. Although loons will forage for fish in rivers, most have been observed foraging on lakes in the Wuskwatim study area suggesting that lakes are their preferred foraging habitat.

8.3.4.6 Opegano Lake

Bird survey information for Opegano Lake is from helicopter-based surveys in spring, summer and fall of 2000 and 2001 and from boat and terrestrial breeding bird transect surveys conducted in 2001.

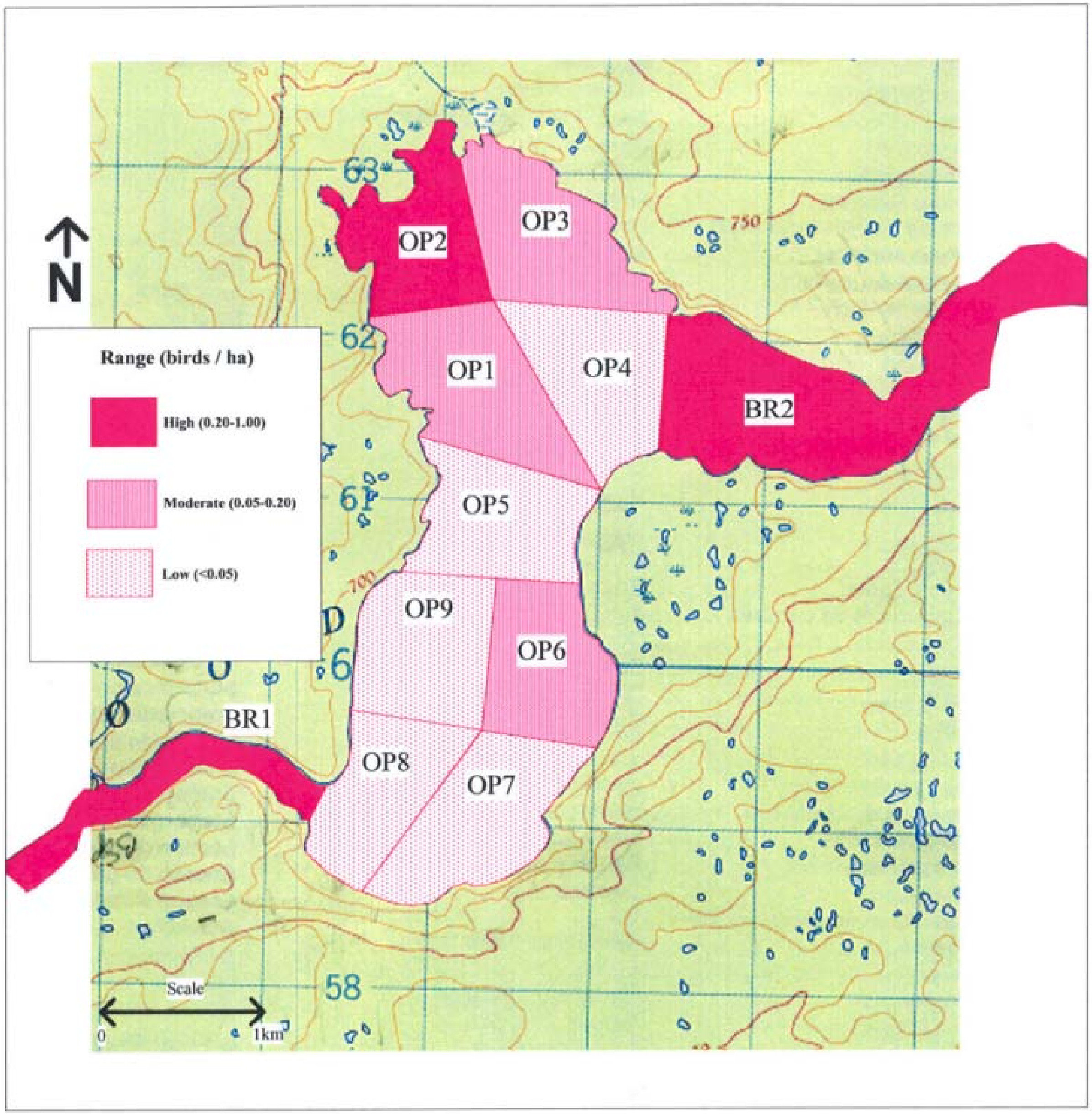
Waterfowl

The majority of the shoreline length of Opegano Lake is relatively regular, meaning there are few inlets, bays and peninsulas compared with many other waterbodies along the Rat-Burntwood River system. Additionally, only a small amount of marsh habitat occurs at this lake. For these reasons, Opegano Lake is not a particularly important area for nesting waterfowl in the Wuskwatim study area. During boat-based surveys in spring 2001, the highest densities of waterfowl were observed at the northwest end of the lake where the marsh habitat occurs and along the two sections of the Burntwood River at the southwest and northeast ends of the lake (Figure 8.3-15).

During spring surveys at Opegano Lake in 2000 and 2001, almost all waterfowl observed on Opegano Lake were ducks. Similar numbers of ducks were observed on Opegano Lake during summer surveys compared to spring surveys, with relatively few geese observed during summer surveys. This suggests that Opegano Lake may be more important to breeding ducks than geese. Half of the ducks observed were located in bay habitat which highlights the importance of bay habitat to ducks given that there is relatively little bay habitat at Opegano Lake. This lake does not appear to be an important waterbody for migrating waterfowl during the fall since only one duck was observed during the September 2000 helicopter survey and no waterfowl observed during the September 2001 survey.

Waterfowl VEC Species

Opegano Lake does not appear to be an important area for nesting Canada Geese. No geese were observed during helicopter surveys in 2001. The 50 geese observed during boat-based surveys in 2001 were all observed flying over the lake. Only one small forested island occurs on this lake, which may support one pair of nesting Canada Geese. A brood of 10 Canada Geese were observed on this lake during the summer helicopter survey in 2001 suggesting at least two pairs of Canada Geese likely nested along or



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Average Densities of Waterfowl Observed in the Opegano Lake Area During Spring Boat-based Surveys in 2001

Figure 8.3-15

adjacent to Opegano Lake (Tetr*ES* 2003b). Canada Geese typically lay 4 to 6 eggs and will often brood their young together in larger groups (Godfrey 1986).

Mallards were the most common duck species observed at Opegano Lake during spring 2001 boat-based surveys. However, they were not the most common duck species observed during helicopter surveys in 2000 and 2001. A small number of mallards may nest at Opegano Lake, making use of the limited amount of marsh present at the north end of the lake for brood rearing.

Buffleheads and Common Goldeneye were the most abundant ducks observed during spring and summer helicopter surveys in 2001 and second-most common of the ducks observed during boat-based surveys in 2001. Only two Buffleheads were observed during helicopter surveys in 2000. The relatively low numbers of standing dead trees that occur at Opegano Lake at the north end are mostly too narrow in circumference to contain abundant suitable cavities for nesting Buffleheads and Common Goldeneye. Only one brood of Common Goldeneye/Buffleheads were observed in that area near the standing dead trees during a helicopter survey in July 2001 (Tetr*ES* 2003b).

Other Waterbirds

Opegano Lake does not contain suitable nesting habitat for gulls or terns. However, some nesting habitat may occur on a few small islands along the Burntwood River near Opegano Lake. No terns were observed at Opegano Lake. Of the gulls that were observed, the majority (up to 30 gulls) were seen foraging at the rapids area along the Burntwood River, approximately 3 km upstream of Opegano Lake (Section 8.3.4.4). The majority of gulls observed at Opegano Lake were flying over the water or along the shoreline (Tetr*ES* 2003b).

The only other waterbirds observed at Opegano Lake were Common Loons.

VEC Species – Common Loon

During helicopter surveys in spring and summer of 2000 and 2001, at least one Common Loon was observed on Opegano Lake (Tetr*ES* 2003a,b). This lake likely supports at least one pair of nesting Common Loons. Primarily due to the size and shape of this lake, and the presence of only one suitable nest island, it is unlikely that more than two pairs of Common Loons would nest at this lake (Yonge 1981).

8.3.4.7 Access Road and Borrow Areas

Bird survey information for the proposed access road and borrow areas is from terrestrial breeding bird surveys and reconnaissance conducted during July 2 and 3, 2002, within representative habitats (Section 7.2, Figure 7.2-3).

Waterfowl and Other Waterbirds

The majority of habitat that occurs within a 2 km wide band along the proposed access road centerline is forested (94%; Section 5) and is not considered optimal habitat for waterfowl. The proposed borrow site areas are almost entirely forested (>99%; Section 5). Therefore very little potential waterfowl habitat occurs within the proposed borrow areas.

Less than 6% of the habitat that occurs within the 2 km wide band along the proposed access road centerline, and less than 1% of the habitat that occurs within proposed borrow areas consists of potential waterbird habitat (i.e., open water, marsh, muskeg, beaver flood, or tall shrub wetland; Section 5). Some Canada Geese may forage in the open, sparsely-treed habitats that occur within 36% of the 2 km wide band along the access road centerline and 2.1% of the proposed borrow area habitats (Section 5).

8.3.5 Raptors

For the purpose of discussion, raptors include: eagles, hawks, falcons, owls and osprey.

8.3.5.1 Traditional Knowledge of Raptors

Traditional Knowledge of raptors has been obtained from participating NCN members (Section 8.2.2) and is provided in Table 8.3-3. This TK regarding raptors has been considered along with results of scientific studies (Sections 8.3.5.2 to 8.3.5.7) in the assessment of expected impacts of the proposed project to raptors (Section 8.4).

8.3.5.2 On-system vs. Off-system

Abundance and Distribution

The abundance and distribution of raptors throughout the study area during spring, summer and fall surveys in 2000 and 2001 were highly variable (Figure 8.3-16). Of all the raptors observed during spring, summer and fall helicopter surveys within the study area in 2000 and 2001 (n = 265 raptors), the majority (89%) were Bald Eagles. Other raptor species observed during helicopter surveys included: Golden Eagles, Osprey, Red-tailed Hawks, Northern Harriers, American Kestrels, Cooper's Hawks, Merlin and a Northern Goshawk.

TABLE 8.3-3

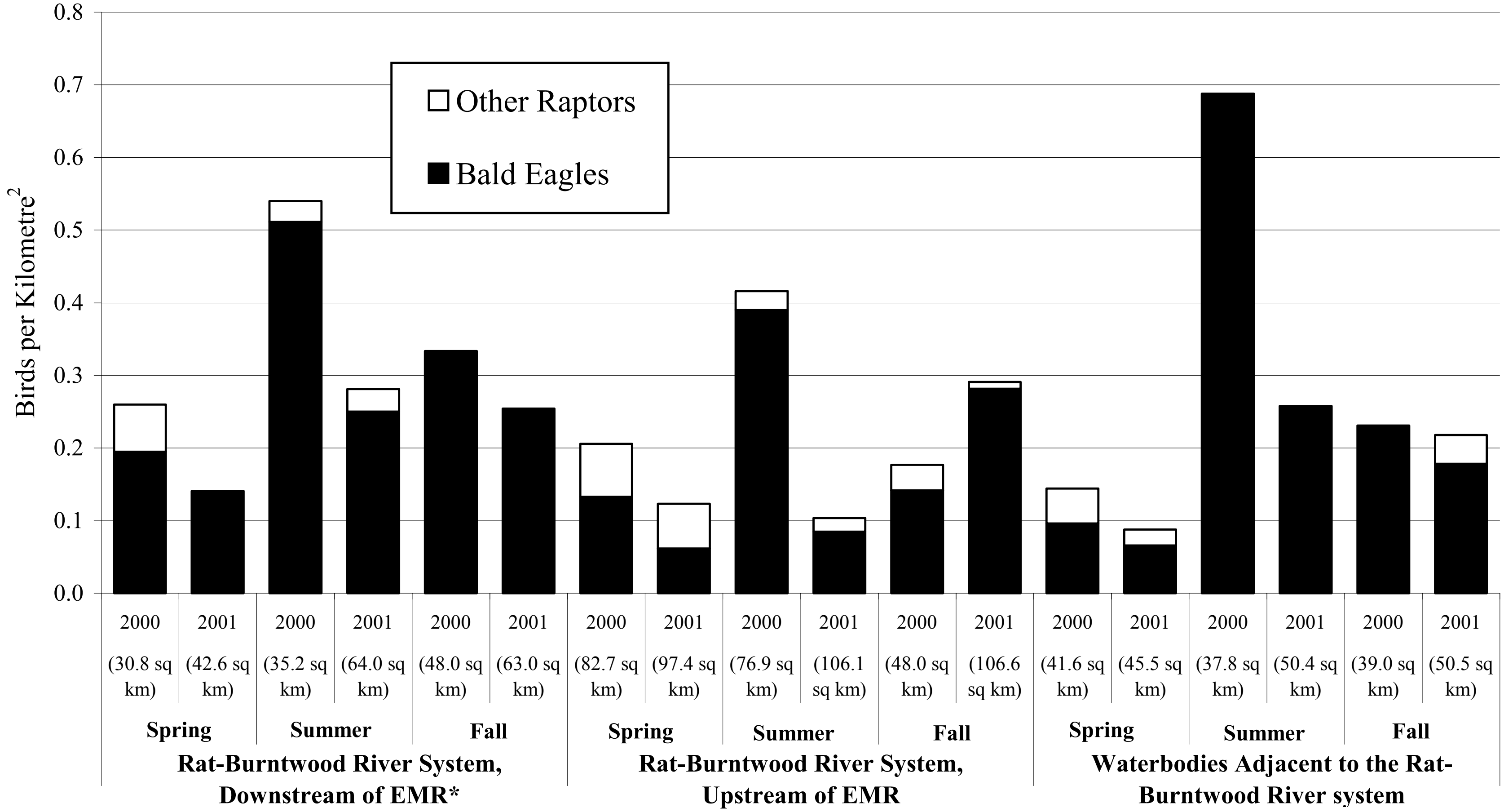
TRADITIONAL KNOWLEDGE - RAPTORS [a]

Species / Type of Bird	Comment / Information Provided	Location	Source
Bald Eagle*	Regarding Bald Eagle nest at Notigi Lake (uncertain if it was being used in mid-June): nest was active earlier this spring.	Notigi Lake	Harry Spence, June 16, 2000
Bald Eagle*	There are few Bald Eagles.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Eagles (including Bald Eagles*)	Eagles follow commercial fishing areas (where fish guts are left). They often nest close to these places.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Eagles (including Bald Eagles*)	There are as many as 13 eagle nests on islands in Fifteen Mile Lake.	Fifteen Mile Lake	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Eagles (including Bald Eagles*)	Some eagles are seen in Wapisu Lake during the day, but not in the evening. No nests have been spotted there.	Wapisu Lake	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Golden Eagle	Golden Eagles have nested in the Cranberry Lake area.	Cranberry Lake	Ron Spence, April 10, 2002, EIS Review Meeting - Terrestrial Environment, Winnipeg
Owls	Owls not around since CRD; now they are slowly coming back.	NCN resource use area	Ron Spence, April 10, 2002, EIS Review Meeting - Terrestrial Environment, Winnipeg
Owls	Hasn't heard/seen owls in the Wuskwatim Lake area.	Wuskwatim Lake	Keith Spence, June 2001
Owls and Red-tailed Hawks	People see a loss of owls and Red-tailed Hawks.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000

* = VEC species

[a] Where "raptors" = Eagles, hawks, falcons, owls and osprey

Note that the above information does not represent all TK of the NCN people regarding raptors



Note:
Raptors = eagles, hawks, falcons, owls and osprey
Downstream of EMR* = Birch Tree Lake to Early Morning Rapids (EMR)
Upstream of EMR = Early Morning Rapids to Notigi Lake
*Includes waterbodies potentially affected by the proposed Wuskwatim Generating Station
Refer to TetrES 2003 a,b for additional survey results
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Densities of Raptors Observed During Helicopter Surveys of the Bird Study Area in 2000-2001
Figure 8.3-16

The highest densities of raptors were observed during summer helicopter surveys in 2000 with raptor densities at adjacent off-system waterbodies being 1.5-fold higher than along the Rat-Burntwood River system (Figure 8.3-16). The density of raptors was also 1.5-fold higher along adjacent off-system waterbodies compared to the Rat-Burntwood system during summer 2001 surveys. During the summer when helicopter surveys were conducted (i.e., mid- to late July), most hatch-year raptors would either be in the nest or recently **fledged** but near the original nest site at that time. Most raptor observations during summer surveys were of breeding age adult or sub-adult (non-breeding) Bald Eagles.

Bald Eagle nests were not as readily observed during the helicopter-based surveys as compared to boat-based surveys. This is primarily due to the nature of helicopter surveys (i.e., designed primarily for waterbird observations) and that depending on the location of the nest, many Bald Eagle nests may not be easily visible by helicopter. Therefore, comparisons of Bald Eagle nest densities along the Rat-Burntwood River system to along adjacent off-system waterbodies are done using only helicopter survey results for consistency and to minimize survey method bias between survey areas. Refer to Sections 8.3.5.3 to 8.3.5.6 for observations of Bald Eagle nests in the Wuskwatim and Opegano Lake areas.

During spring helicopter surveys in 2000 and 2001, raptor densities were 1.6-fold and 1.4-fold higher, respectively, along the Rat-Burntwood River system compared to along adjacent off-system waterbodies. During fall surveys, densities of raptors along the Rat-Burntwood River system were only slightly higher than along adjacent off-system waterbodies.

Results regarding the importance to raptors of the Rat-Burntwood River area compared to adjacent off-system areas are inconclusive due to the annual variability in raptor densities observed in the study area in 2000 and 2001 (Figure 8.3-16).

Raptor VEC Species

The Bald Eagle is the VEC species chosen to represent raptors (Section 8.2.4.5). A brief description of the general biology of this species is provided below.

Bald Eagles breed throughout the forested regions of Manitoba, especially along mainland and island shorelines (Godfrey 1986; Koonz 1988; Brezener and DeSmet 2000). Nests are typically located 3 to 20 metres off the ground in **deciduous** or **coniferous** trees. When deciduous trees are selected, they are most often trembling aspen

(Gerard *et al*. 1975). Individual nests may be used for 20 or more consecutive years (Koonz 1988).

Bald Eagles are not sexually mature until 4 or 5 years of age (Godfrey 1986). They begin nesting in April, with young fledging at 10 to 12 weeks of age from mid-July to mid-August. Bald Eagles primarily consume fish during the breeding season, but are opportunistic and will prey on waterfowl, small mammal and scavenge carrion, particularly during migration (Koonz 1988).

8.3.5.3 Wuskwatim Lake Area

Raptor species observed during bird surveys in 2000 and 2001 in the Wuskwatim Lake area include: Bald Eagle, Northern Harrier, Sharp-shinned Hawk, Cooper's Hawk, Red-tailed Hawk, Rough-legged Hawk, Golden Eagle, American Kestrel, Merlin and Great Horned Owl (Tetr*ES* 2003,a,b). The majority of these species have only been observed on one to three occasions. The Bald Eagle is a common raptor species in the Wuskwatim Lake area. American Kestrel and Merlin are two other species that have been observed on more than three occasions and are fairly common in the area. The American Kestrel is a cavity-nesting species that makes use of the abundant old woodpecker holes in standing dead trees in the Wuskwatim area, particularly at the south arm of Wuskwatim Lake (Tetr*ES* 2003a,b).

<u>VEC Species – Bald Eagle</u>

Within the Wuskwatim Lake area during spring surveys in 2000 and 2001, the highest densities of Bald Eagles were observed along the Burntwood River between Cranberry Lake and Early Morning Rapids and at Cranberry Lake (Tetr*ES* 2003a,b). During summer surveys in the Wuskwatim Lake area in 2000 and 2001, the highest densities of Bald Eagles were also observed at Cranberry Lake and along the Burntwood River between Cranberry Lake and Early Morning Rapids, with high densities also occurring along the Burntwood River between Wuskwatim and Opegano Lakes.

Bald Eagles were generally more widely distributed throughout the Wuskwatim Lake area during fall surveys with the Wuskwatim Brook area having considerably higher densities of Bald Eagles during fall surveys than during spring or summer surveys. Also, in contrast to spring and summer surveys, only one Bald Eagle was observed along the Burntwood River between Cranberry Lake and Early Morning Rapids during fall surveys. This suggests that adults and fledged young may forage away from the spring nest site later in the season to take advantage of productive foraging sites in the local area before migration commences in October (Koonz 1988).

Two confirmed active or likely active Bald Eagle nests were recorded in the Wuskwatim Lake area in 2000, with one nest recorded in this area in 2001 (Tetr*ES* 2003a,b). Nests from both years were located in the top of mature trembling aspen trees within 10 metres of eroding shoreline. Previous Bald Eagle surveys conducted throughout Manitoba have also indicated that Bald Eagles most commonly nest along the shores (rather than inland) along larger rivers and lakes with nests most commonly located in mature spruce or trembling aspen (Whitfield *et al*. 1974; Gerrard *et al*. 1975; Koonz 1988).

Regarding the two Bald Eagle nests observed in 2000 in the Wuskwatim Lake area, one was at the north end of the main Wuskwatim Lake, with the second nest located along the Burntwood River adjacent to, and downstream of, Early Morning Rapids. In 2001, the only active Bald Eagle nest was located in the Wuskwatim Brook area and was likely a newly-established nest as it was quite visible by boat and was not observed during boat-based surveys in 2000.

The nest at the north end of Wuskwatim Lake that was active in 2000 was also observed in 2001. However, this nest was inactive in 2001 and the nest tree was also now very close (within 1 metre) to the actively-eroding shoreline.

It is not known if the active nest located in 2000 along the Burntwood River adjacent to Early Morning Rapids was used again in 2001 because this nest was not visible during boat-based surveys in 2001. This was due to lower water levels in 2001 not allowing the survey boat to get as close to the rapids in 2001 compared to during surveys conducted in 2000. Although the nest was visible by boat in 2000, it was not detected during helicopter surveys in 2000 nor in 2001. Of the maximum of eight Bald Eagles observed along this reach of the Burntwood River on June 5, 2001, only one was a mature adult, with the other eagles being immature birds ranging in age from 1 year to 3 years (Tetr*ES* 2003,b).

8.3.5.4 Wuskwatim to Taskinigup Falls

No raptor species were observed during bird surveys in 2000 or in 2001 along the 1.7 km reach of the Burntwood River between Wuskwatim Falls and Taskinigup Falls. Raptors were also not observed during terrestrial breeding-bird surveys in 2000 and 2001 within the proposed generating station footprint and adjacent area. It is likely that a few pairs of hawks and owls nest in the mostly mature spruce-dominant forests that occur within this relatively small area.

8.3.5.5 Taskinigup Falls to Opegano Lake

The only type of raptor observed along this reach of the Burntwood River during bird surveys in 2000 and 2001 were eagles. All were Bald Eagles, with the exception of one Golden Eagle observed during a spring helicopter survey in 2000. Although Golden Eagles usually nest on cliffs, they occasionally nest in trees along rivers and lakes. It is possible that a pair of Golden Eagles may be nesting in this area. Alternatively, this individual may have been migrating through the area, or was a non-breeding (e.g., immature) bird foraging in the area.

<u>VEC Species – Bald Eagle</u>

Between two and seven Bald Eagles have been observed during helicopter surveys conducted in 2000 and 2001 along this reach of the Burntwood River, with the exception of spring 2000, when no Bald Eagles were observed along this reach (Tetr*ES* 2003a,b). A Bald Eagle nest containing young has been observed along this reach of the river in both 2000 and 2001.

8.3.5.6 Opegano Lake

The only raptor species observed in the Opegano Lake area during bird surveys in 2000 and 2001 were Bald Eagles. It is likely that other raptors such as hawks and owls nest in this area also, but were not detected during surveys.

<u>VEC Species – Bald Eagle</u>

Two Bald Eagle nests were located at Opegano Lake in 2001; one at the north end of the lake in a trembling aspen and one on the west side of the lake in a spruce tree (Tetr*ES* 2003a,b). The same nest observed in 2001 at the north end of the lake was also observed during helicopter surveys in 2000. This number of nesting Bald Eagles on a lake the size of Opegano is quite high in relation to the density of Bald Eagles nesting in the Wuskwatim Lake area (Section 8.3.5.3). Therefore, the Opegano Lake area and adjacent reaches of the Burntwood River appear to be ideal breeding and foraging habitat for this species.

8.3.5.7 Access Road and Borrow Areas

Although no raptors, including Bald Eagles (VEC species), were observed during breeding bird surveys and reconnaissance of the proposed access road route and borrow areas, it is likely that various hawk, owl and falcon species nest and forage within habitats present in those areas. Bald Eagles and osprey are rarely observed far from large lakes and rivers. Therefore, these species would likely not occur within proposed borrow site areas and along the proposed access road route which does not traverse through or adjacent to the shoreline of large rivers and lakes.

8.3.6 Passerines (Songbirds)

8.3.6.1 Traditional Knowledge of Passerines (Songbirds)

Traditional Knowledge of passerines (songbirds) has been obtained from participating NCN members (Section 8.2.2) and is provided in Table 8.3-4. This TK regarding Passerines has been considered along with results of scientific studies (Sections 8.3.6.3 to 8.3.6.4) in the assessment of expected impacts of the proposed project to raptors (Section 8.4).

8.3.6.2 Passerine (Songbird) VEC Species

VEC species that have been chosen to represent passerines include the Red-winged Blackbird and Palm Warbler (Section 8.2.4.5). A brief description of the general biology of these species is provided below.

Red-winged Blackbird

Neotropical migrants are birds of the Western Hemisphere that migrate long distances from wintering grounds in the New World Tropics (or "Neotropics") to breeding grounds in North America. Neotropical migrant species are of particular concern in North America due to evidence of general population declines of many Neotropical Migrant species over the past several decades (Robbins *et al*. 1989). Red-winged Blackbird populations in Manitoba have shown a slight, but not statistically significant, negative trend in population abundance over the past 25 years (Downes *et al.* 2002).

The colonial-nesting Red-winged Blackbird nests primarily within thick cattail marsh habitat (Godfrey 1986; Ehrlich *et al*. 1988; Bezener and DeSmet 2000). The open-cup nest of this polygamous (one male mating with several females) species is woven among tall, rigid marsh vegetation and other adjacent vegetation such as shrubs (Ehrlich *et al.* 1988). The nest is typically located near or over water. In the Wuskwatim Lake area, nesting occurs primarily during late May and early June. The female takes 10 to 12 days to incubate 2 to 6 eggs with young fledging from the nest after 11 to 14 days (Ehrlich *et al.* 1988). Adult Red-winged Blackbirds have a variable diet consisting primarily of insects, spiders, and seeds, whereas the young are fed 100% insects (Ehrlich *et al.* 1988; Bezener and DeSmet 2000).

TABLE 8.3-4

TRADITIONAL KNOWLEDGE - PASSERINES [a] (SONGBIRDS)

Species / Type of Bird	Comment / Information Provided	Location	Source
Blackbirds (including Red-winged Blackbirds*) and American Robins	Decline in blackbird and robin populations due to loss of the natural shoreline.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Songbirds	Several species of songbirds disappeared after CRD and some species are just starting to come back.	NCN resource use area	NCN elders: comments during initial scoping meetings for the project (2000)
Sparrows	People see a loss of sparrows.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Swallows	Hunted by slingshot in the Footprint Lake area.	Footprint Lake	NCN Members: comment from the TK Pilot Project Interview, April 2002
Waxwings	People used to hunt waxwings.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000

* = VEC species

[a] Includes songbirds and other 'perching birds' such as crows and ravens (nighthawks, hummingbirds, kingfishers and woodpeckers are 'other birds'; ref. Table 8.3-6).

Note that the above information does not represent all TK of the NCN people regarding songbirds

Palm Warbler

The Palm Warbler primarily nests in association with mature sphagnum bogs with scattered black spruce or barren areas (Godfrey 1986; Ehrlich *et al.* 1988; Bezener and DeSmet 2000). The Palm Warbler builds an open-cup nest on the ground, or low off the ground, in a shrub or small spruce. Four or five eggs are incubated for 12 days. Young fledge from the nest after 12 days. The diet of the Palm Warbler consists mostly of insects which it hover-gleans from the ground and vegetation at various heights (Ehrlich *et al.* 1988; Bezener and DeSmet 2000). Insufficient data is available to determine long-term population trends for the Palm Warbler in Manitoba.

8.3.6.3 Wuskwatim Lake and Opegano Lake Areas

The majority of potentially-affected habitat in the Wuskwatim Lake and Opegano Lake areas primarily consists of spruce-dominated forest (particularly adjacent to lakes, rivers and streams), marsh and bog/fen habitat. Therefore, bird survey efforts were focussed primarily within these habitats. Table 8.3-1 lists those bird species most commonly recorded within key habitat types in the Wuskwatim Lake area.

The most common bird species within forested habitats are passerine species (Table 8.3-1). Table 8.3-5 lists those passerine species that are most common within the major forested habitat groups surveyed in the Wuskwatim Lake area. No one passerine species was found only within one specific forest-habitat type. The most common passerine species recorded in forest habitats within the Wuskwatim Lake area are also very common within boreal forest habitat throughout Manitoba (Erskine 1977; Bezener and DeSmet 2000).

Within marsh habitat, the most common bird species was the Red-winged Blackbird (Tetr*ES* 2003a,b). Where standing dead trees occurred in association with marsh habitat, Common Grackles were also frequently recorded. The majority of marsh habitat occurs at Sesep Lake, the south arm of Wuskwatim Lake and the Wuskwatim Brook area.

Within fen and bog habitat, the most common passerine species included: Northern Waterthrush, Alder Flycatcher, Palm Warbler and Olive-sided Flycatcher. Fen and bog habitat occurs throughout the Wuskwatim Lake and Opegano Lake areas (Section 5). It is the fen and bog habitat, and associated bird species, that occur adjacent to the Wuskwatim Lake area shoreline and along the access road route that would potentially be most affected by the Project.

TABLE 8.3-5

COMMON PASSERINE (SONG BIRD) SPECIES PRESENCE WITHIN FOREST HABITAT GROUPS SURVEYED DURING TERRESTRIAL BREEDING BIRD SURVEYS IN THE WUSKWATIM STUDY AREA, 2001

Habitat Group Surveyed	Most Common Passerine Bird Species Observed Within the Study Area[a]					
	Ruby-crowned Kinglet	Yellow-rumped Warbler	Chipping Sparrow	Dark-eyed Junco	Swainson's Thrush	Magnolia Warbler
Black Spruce Forest [b]	✓	✓	✓	✓	✓	
Coniferous Forest (Spruce Dominant) [c]	✓	✓	✓	✓	✓	✓
Conifer-Dominant Mixedwood (Spruce Dominant) [d]	✓	✓	✓			✓
Conifer-Dominant Mixedwood (Spruce & Jack Pine Dominant)[e]	✓	✓	✓	✓		✓
White Spruce Forest [f]	✓	✓	✓			
Trembling Aspen Dominant Mixedwood [g]	✓				✓	✓
Coniferous Forest (Black Spruce / Tamarack Mix)[h]	✓	✓		✓	✓	
Trembling Aspen Forest [i]		✓			✓	✓
Jack Pine Forest [j]	✓	✓	✓			
White Birch Forest [k]			✓		✓	

a = Species indicated as being 'common' within a habitat group occurred in densities of 0.3 birds/ha or higher. Species are listed in order of overall abundance within the Study Area.
b = Black Spruce 71 - 100%
c = Softwoods (71 - 100%) with Black Spruce < 71%, White Spruce < 71%, Jack Pine less than 20%
d = Spruce 51% to 70%, second major species: hardwoods
e = Jack Pine at least 20% (no more than 70%), and Spruce plus Jack Pine at least 65%, second major species: hardwoods
f = White Spruce 71 - 100%
g = Trembling Aspen 50 - 70%, second major species: softwoods
h = Softwoods (71 - 100%) with 25 - 50% Tamarack, second major species: Black Spruce
i = Trembling Aspen 71 - 100%
j = Jack Pine 71 - 100%
k = White Birch 71 - 100%
Refer to Tetr*ES* 2003b for densities recorded within each habitat group.

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VEC Species – Red-winged Blackbird

The Red-winged Blackbird was the most common passerine species observed during bird surveys of the Wuskwatim study area in 2000 and 2001 (Tetr*ES* 2003a,b). The most important areas for Red-winged Blackbirds were within cattail marsh habitat at Sesep Lake, the south arm of Wuskwatim Lake and in the Wuskwatim Brook area.

VEC Species – Palm Warbler

The **Palm Warbler** was regularly recorded in association with bog/fen habitat in the Wuskwatim study area (Tetr*ES* 2003a,b). Palm Warblers were most frequently recorded along terrestrial breeding bird transects in the Wuskwatim Brook area and at the south arm of Wuskwatim Lake.

8.3.6.4 Access Road and Borrow Areas

The majority of potentially affected habitat along and adjacent to the proposed access road and borrow areas consists of spruce and/or jackpine-dominated forest including sparsely-treed open areas (88% and 97%, respectively; Section 5). Passerine species most commonly observed within those habitats during early July breeding bird surveys of those areas in 2002 included: Dark-eyed Juncos, Swainson's Thrushes, Yellow-rumped Warblers, Ruby-crowned Kinglets and Hermit Thrushes (Tetr*ES* 2003b). All of these species are very common within similar habitats throughout the bird study area and similar boreal forest habitat throughout Manitoba (Erskine 1977; Bezener and DeSmet 2000). No habitats or birds considered unique or rare in the bird study area were observed (Tetr*ES* 2003b).

8.3.7 Other Birds (Shorebirds, Upland Game Birds, Cranes and Rails, etc.)

8.3.7.1 Traditional Knowledge of Other Birds

Traditional Knowledge of birds other than those types discussed in Sections 8.3.4 to 8.3.6 has been obtained from participating NCN members (Section 8.2.2) and is provided in Table 8.3-6. This TK regarding other birds has been considered along with results of scientific studies (Sections 8.3.7.3 to 8.3.7.7) in the assessment of expected impacts of the proposed project to other birds (Section 8.4).

TABLE 8.3-6

TRADITIONAL KNOWLEDGE - OTHER BIRDS [a]

Species / Type of Bird	Comment / Information Provided	Location	Source
Upland Game Birds			
Willow Ptarmigan	Willows decreased because of CRD. As a result, so did the Willow Ptarmigan, but they are slowly coming back.	NCN resource use area	Ron Spence, April 10, 2002, EIS Review Meeting - Terrestrial Environment, Winnipeg
Unknown gamebird [b]	A bird described as a ptarmigan with a large, brilliantly coloured tail and short wings was lying in tall grass near the Dancing Circle.	Wuskwatim Lake	NCN Member: comment from the Resource Harvester Interviews, Jan. 28, 2002
Ptarmigan and grouse	Three of 10 trappers interviewed hunt ptarmigan and grouse in the area.	Area of Interest [b]	NCN Members: comments from the Resource Harvester Interviews, Jan. 28, 2002
Ptarmigan and grouse	Hunted by slingshot.	Footprint Lake, "Sixes Camp" (Mile 10 north from Thompson)	NCN Members: comment from the TK Pilot Project Interview, April 2002
Grouse	36% of hunting activity occurred in Zone 1.	Area immediately surrounding Nelson House (ref. Resource Use section of EIS)	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Grouse	33% of hunting activity occurred in Zone 3.	NCN resource use area north of PR 391	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Grouse	22% of hunting activity occurred in Zone 2.	Wuskwatim study area and area anticipated to be affected by the Project (includes Wuskwatim Lake)	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)
Grouse	Most hunting attempts occurred in October (22%), November (46%) and April (13%). No grouse hunting occurred in September 2001 and May 2000.	NCN resource use area	NCN Members: results of the Harvest Calendar survey (Aug. 2001 - May 2002)

Table 8.3-6 (cont'd)

Species / Type of Bird	Comment / Information Provided	Location	Source
Ptarmigan	Ptarmigan feed on willows around shore.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Spruce Grouse	Spruce Grouse are plentiful.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Ptarmigan	Ptarmigan are present at Lynn Lake and Thompson, but not in the NCN area. However, they are slowly coming back.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Cranes			
Cranes	People haven't seen Whooping [*Sandhill?*] Cranes since CRD.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Sandhill Cranes	NCN people don't hunt Sandhill Cranes.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Other Birds			
Hummingbirds	There were many hummingbirds around before CRD, but not now.	NCN resource use area	Ron Spence, April 10, 2002, EIS Review Meeting Terrestrial Environment, Winnipeg
Shorebirds	Sandpipers and other shorebirds aren't seen anymore; there's a loss in NCN's culture when these things happen.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000
Common Nighthawks	Few Common Nighthawks are seen nowadays.	NCN resource use area	Transcription of workshop notes on natural land resources in the NCN area, Thompson, Manitoba, Feb. 29 & March 1, 2000

* = VEC species

[a] "Other birds" includes shorebirds, upland game birds, cranes, rails and all other birds that are not waterfowl, raptors or passerines (song birds)

[b] Possible species may include: Sharp-tailed Grouse or escaped Ring-necked Pheasant (often kept on game reserves)

Note that the above information does not represent all TK of the NCN people regarding other birds

8.3.7.2 Other Bird VEC Species

VEC Species – Belted Kingfisher

Belted Kingfishers are common throughout most of Manitoba from mid-April to early October (Bezener and DeSmet 2000). They are typically associated with lake and river shoreline habitat where they spend the majority of their time perched near or over the water watching for small fish which are their primary food items (Godfrey 1986; Bezener and DeSmet 2000). They will also occasionally forage on large aquatic insects, frogs, small rodents and birds (Ehrlich *et al.* 1988). Due to their foraging habits, kingfishers prefer clearer-water lakes, rivers and ponds. Belted Kingfishers typically nest in a one to two-metre long tunnel cavity, which the kingfishers excavate, near the top of a steep earth bank along river and lake shorelines. Six to eight eggs are usually laid with incubation lasting 23 to 24 days (Godfrey 1986). Kingfisher nestlings fledge when approximately 34 to 35 days old and are independent approximately 10 days after leaving the nest cavity (Ehrlich *et al*. 1988). Usually, separate nesting and foraging territories are defended (Ehrlich *et al*. 1988).

VEC Species – Common Snipe

The Common Snipe is common throughout Manitoba from mid-April to October (Bezener and DeSmet 2000). They are associated primarily with marsh, fen and bog habitat and will frequent the grassy margins of creeks, sloughs and wet meadows (Godfrey 1986; Ehrlich *et al*. 1988; Bezener and DeSmet 2000). Common Snipes nest on the ground, usually in a small clump of grass under low vegetation in young open mixedwood or deciduous woodlands and alder thickets. The nest is a depression in the ground sparsely lined with grass, moss and leaves. Four eggs are incubated for approximately 20 days (Ehrlich *et al*. 1988; Bezener and DeSmet 2000). Once hatched, the young are **precocial** (mobile, downy, follow parents, find their own food) and are able to fly after approximately 20 days (Ehrlich *et al*. 1988). Common Snipes probe soft substrates for larvae, worms and other soft invertebrates and will also eat molluscs, crustaceans, spiders, small **amphibians** and some seeds (Bezner and DeSmet 2000). Common Snipe populations in Manitoba have shown a statistically significant ($P < 0.05$) increasing trend in the past 25 years (Downes *et al*. 2002). However, within the Boreal Shield region of Canada which includes the Project study area, the Common Snipe population trend has significantly decreased between 1991 and 2000 (Downes *et al.* 2002).

8.3.7.3 Wuskwatim Lake Area

Shorebirds

Only two species of shorebirds were commonly observed in the Wuskwatim Lake area during bird surveys in 2000 and 2001: the Spotted Sandpiper and Common Snipe. Spotted Sandpipers were typically observed foraging among floating woody debris and beached woody debris along shorelines. However, these sandpipers were also observed foraging along shorelines where woody debris was not present. The importance of woody debris habitat for Spotted Sandpipers is presently uncertain. Spotted Sandpipers are known to use a wide variety of shoreline habitat for foraging and nesting (Brezener and DeSmet 2000). Common Snipe were recorded in association with bog/fen and marsh habitat during terrestrial breeding bird surveys.

Upland Game Birds

Although at least two species of upland game birds occur in the vicinity of Wuskwatim Lake (i.e., Ruffed Grouse and Spruce Grouse), only the Ruffed Grouse was recorded during bird surveys in the Wuskwatim Lake and Opegano Lake areas in 2000 and 2001 (Tetr*ES* 2003a,b). During spring terrestrial breeding bird surveys in 2000 (92 survey stops) and 2001 (170 survey stops), only 4 and 12 Ruffed Grouse were recorded, respectively. Populations of grouse are naturally highly cyclical and therefore populations can vary greatly over several consecutive years (Bezener and DeSmet 2000).

Cranes and Rails

Sandhill Cranes were recorded during bird surveys in a variety of areas in the vicinity of Wuskwatim Lake during 2000 and 2001 (Tetr*ES* 2003a,b). Although suitable nesting habitat occurs in the Wuskwatim Lake area (i.e., bogs/fens and marshes), this species was not particularly abundant in this area (26 were cranes recorded in 2000 and 28 cranes were recorded in 2001). Where cranes were recorded, they were associated within bog/fen and marsh habitat at Cranberry Lake, Wuskwatim Brook, Opegano Lake, the south arm of Wuskwatim Lake, and at Sesep Lake.

American Coots and Sora were the only rail species observed in the Wuskwatim Lake area during boat-based surveys in 2000 and 2001 (Tetr*ES* 2003a,b). American Coots are uncommon in the Wuskwatim Lake area as they are north of their usual breeding range in Manitoba (Bezener and DeSmet 2000). Coots were most commonly recorded during bird surveys in the south arm of the Wuskwatim Lake area during spring in 2000 (n = 19 coots) and 2001 (n = 1 coot). The south arm of Wuskwatim Lake has suitable habitat for coots, which prefer shallow marshes, ponds and semi-permanent open water and emergent vegetation for nesting and foraging (Godfrey 1986; Bezener and DeSmet 2000).

Very few Sora were observed during bird surveys of the Wuskwatim Lake area, with more Sora recorded during spring 2000 (n = 10 Sora) than in 2001 (n = 1 Sora; Tetr*ES* 2003a,b). All Sora were recorded in the Wuskwatim Brook area and at the south arm of Wuskwatim Lake. The Sora usually nests on floating or anchored marsh/bog vegetation which is common in these two areas.

Woodpeckers

The most common woodpecker species recorded during bird surveys of the Wuskwatim Lake area in 2000 and 2001 was the Northern Flicker (Tetr*ES* 2003a,b). Other woodpecker species recorded included: the Hairy Woodpecker, Three-toed Woodpecker, Yellow-bellied Sapsucker and Black-backed Woodpecker. Northern Flickers, although variable in their selection of nest site substrates, prefer to nest in a cavity in a standing dead tree in which the male and female excavate (Godfrey 1986; Ehrlich *et al*. 1988; Bezener and DeSmet 2000). Northern Flickers also tend to prefer more open forested habitat and riparian habitat (Godfrey 1986; Bezener and DeSmet 2000). During bird surveys in the Wuskwatim Lake area, Northern Flickers were observed where large diameter standing dead trees occurred. These areas primarily included the south arm of Wuskwatim Lake and the Wuskwatim Brook area. During 2000 and 2001, several active Northern Flicker nest cavities were observed in standing dead trees in these areas (Tetr*ES* 2003a,b).

VEC Species – Common Snipe

During terrestrial breeding-bird surveys conducted in spring 2000 and 2001 in the Wuskwatim Lake area, densities of Common Snipe were highest along transects at the south arm of Wuskwatim Lake, Cranberry Lake and in the Wuskwatim Brook area (Tetr*ES* 2003a,b). The presence of relatively high Common Snipe densities in these areas reflects the relative abundance of marsh, fen and bog habitat present in these areas within which Common Snipe breed and forage (Section 5).

VEC Species – Belted Kingfisher

Belted Kingfishers have been observed throughout the Wuskwatim Lake area with the highest densities observed during spring (2000 and 2001) and summer (2000) boat-based surveys along the Burntwood River between Cranberry Lake and Early Morning Rapids and along the shoreline of Cranberry Lake (Tetr*ES* 2003a,b). Two active nest cavities were observed within the steep banks of the north end of the main Wuskwatim Lake in 2000. Kingfisher nest holes were occasionally noticed within steep banks of the north end of the main Wuskwatim Lake and the northwest end of Cranberry Lake near the Burntwood River during 2001 surveys although nest activity status could not be confirmed.

The highest number of Belted Kingfishers observed during surveys on any given day was nine kingfishers observed at Cranberry Lake on May 28, 2001. Seven of the nine kingfishers were observed along the narrow channel and far southeast end of Cranberry Lake near the north end of the main Wuskwatim Lake. It is likely that steep bank areas of Cranberry Lake and the north end of the main Wuskwatim Lake are particularly important nesting areas for Belted Kingfishers in the Wuskwatim Lake area. Good kingfisher foraging habitat also appears to occur in these areas due to the relatively frequent sightings of this species in these areas (Tetr*ES* 2003a,b).

8.3.7.4 Wuskwatim to Taskinigup Falls

During spring terrestrial breeding-bird surveys in 2000 and 2001 in the Wuskwatim Falls to Taskinigup Falls area (including the proposed generating station footprint and adjacent area), very few birds other than passerines (songbirds) and waterbirds were observed (Tetr*ES* 2003a,b). One Ruffed Grouse was recorded along a transect through the proposed generating station footprint and adjacent works area. Two shorebirds (Spotted Sandpiper and a Solitary Sandpiper) were observed along the north and south sides of the Burntwood River, respectively. Four Northern Flickers were also observed along the river with a pair observed nesting in a standing dead tree in a bay on the south side of the river.

VEC Species – Belted Kingfisher

One Belted Kingfisher was observed along the north side of the Burntwood River and three were observed along the shore of a bay on the south side of the river (Tetr*ES* 2003b). The shoreline area between Wuskwatim Falls and Taskinigup Falls offers good foraging habitat for Belted Kingfishers and some limited nesting habitat where clay/silt shoreline banks are steep and relatively high.

VEC Species – Common Snipe

No Common Snipe were recorded in 2000 or 2001 during spring terrestrial breeding bird surveys in the area between Wuskwatim Falls and Taskinigup Falls (Tetr*ES* 2003a,b). This is likely due to the minimal availability of bog, fen or marsh habitat in this area.

8.3.7.5 Taskinigup Falls to Opegano Lake

Of the birds other than waterbirds, raptors and passerines observed along the Burntwood River between Taskinigup Falls and Opegano Lake during surveys in 2000 and 2001, all were either shorebirds or Belted Kingfishers (Tetr*ES* 2003a,b). Shorebirds, in particular, occurred in high numbers along this reach of the river during the summer survey of 2001, but not during the surveys in spring 2001 or spring and summer 2000 (Tetr*ES* 2003a,b). When water levels are relatively low along this reach of the Burntwood River, foraging habitat for shorebirds is increased as more substrate along shallow areas adjacent to the riverbanks are exposed.

VEC Species – Common Snipe

No Common Snipe were observed along this reach of the Burntwood River during surveys in 2000 nor 2001. Common Snipe likely occur inland away from this reach of the river, particularly to the south where upland areas adjacent to the river grade to low bog areas and other wetlands. This reach of the river and adjacent upland shoreline area are not ideal habitat for breeding or foraging Common Snipe.

VEC Species – Belted Kingfishers

Up to three Belted Kingfishers have been observed along the Burntwood River between Taskinigup Falls and Opegano Lake (spring helicopter survey, 2001; Tetr*ES* 2003b). The steep banks along most of this reach of the Burntwood River likely provide good potential burrow nest sites for this species. Foraging habitat along most of this reach of the Burntwood River is ideal for Belted Kingfishers.

8.3.7.6 Opegano Lake

A variety of birds other than waterbirds, raptors and passerines have been observed at Opegano Lake during bird surveys. These birds include: shorebirds, Sandhill Cranes, Belted Kingfishers, woodpeckers and a Common Nighthawk (Tetr*ES* 2003a,b). The most common shorebirds observed were Spotted Sandpipers. This species was usually observed foraging on a wide-variety of shoreline substrates around the lake including woody debris along the shore. Nine Sandhill Cranes were recorded along a terrestrial breeding-bird transect in spring 2001 at the north end of Opegano Lake where some marsh and bog areas occur providing some limited breeding and foraging habitat for this species (Tetr*ES* 2003b). Three species of woodpecker were recorded at Opegano Lake: the Northern Flicker, Three-toed Woodpecker and Black-backed Woodpecker. Two Northern Flicker nest holes were observed in standing dead trees at the north end of Opegano Lake during spring boat-based surveys in 2002 (Tetr*ES* 2003b).

VEC Species – Common Snipe

The only Common Snipe recorded in the Opegano Lake area was during spring terrestrial breeding bird surveys in 2001 (Tetr*ES* 2003b). A total of two Common Snipe were observed during a terrestrial transect at the northeast end of Opegano Lake. Habitat along this transect included some adjacent fen and bog habitat which would be good breeding and foraging habitat for the Common Snipe.

VEC Species – Belted Kingfisher

Belted Kingfisher have been observed at various shoreline locations all around Opegano Lake with a maximum of five kingfishers observed during one survey day (Tetr*ES* 2003b). Steep clay/sand banks occur in various areas around the shoreline of Opegano Lake, providing suitable nesting habit for this species. The lake and adjacent reaches of the Burntwood River to the northeast and southwest also provide good foraging habitat for the Belted Kingfisher.

8.3.7.7 Access Roads and Borrow Areas

During breeding bird surveys and reconnaissance of the proposed access road and borrow area in July 2002, the majority (94%) of 422 birds recorded were primarily forest-dwelling passerine (songbird) species. Therefore, few "other birds" were recorded during surveys of those areas. Non-passerine species were often recorded in habitats other than forest, such as Sandhill Cranes and Common Snipe which are associated with bog areas (Tetr*ES* 2003b). Two shorebird species (Greater Yellowlegs and Solitary Sandpiper) were also observed near creek shorelines. Although no upland gamebirds were recorded during bird surveys along 13 transects (66 listening stops), nor during reconnaissance of the area, it is likely that upland gamebirds do occur within suitable habitat along the proposed access road route and borrow site areas (Tetr*ES* 2003b).

8.4 IMPACT ASSESSMENT AND MITIGATION

8.4.1 Overview of Impacts to Birds

Potential construction-related effects on birds are primarily associated with: the clearing of habitat along access roads, borrow areas and at the generating station site area; clearing and staged flooding of the **forebay** area between Wuskwatim Falls and Taskinigup Falls during generating station construction; and noise associated with machinery, people and activities such as blasting. Some potential construction-related effects to birds, such as those resulting from clearing and blasting, can be minimized by restricting those activities to outside the most sensitive breeding and brood-rearing months (i.e., May to late July). **Considering implementation of these mitigative**

measures, construction-related impacts to birds are expected to be small to moderate, site-specific, short to long-term and not significant.

Note that the designation of "significant negative impacts" is primarily based on a quantifiable and substantial (i.e., large) decrease in bird populations on a site-specific, local or regional scale over the short-term (Section 4). The "significance" conclusions, as stated throughout this document, may not necessarily be shared by all NCN community members. Traditional Knowledge regarding birds has been collected (Tables 8.3-2 to 8.3-4 and 8.3-6) to assist in the determination of significant effects throughout the impact sections of this document (Sections 8.4 to 8.6).

Operation-related effects on birds are primarily associated with long-term loss of marsh and peat island habitat, land loss through **erosion**, and increased human access to the Wuskwatim Lake area (Section 5 and Volume 7).

Water level stabilization will reduce the frequency of nest flooding of those bird species that nest near water level such as loons, grebes and many waterfowl. However, water level stabilization is also expected to gradually degrade off-shore marsh areas (Section 5), which will reduce marsh nesting and cover habitat for those species that require marsh habitat for nesting, cover and/or foraging (e.g., many waterfowl, grebes, rails). Over the long term, those birds that require marsh habitat would gradually be displaced to other marsh habitat available within the local bird study area. Note that 'off-shore marsh habitat' for the purpose of bird impact evaluation, is described as peatland habitat consisting of Typha (i.e., cattails), Carex (i.e., sedge) with Typha fringe or low, shrub habitat with Typha fringe (Section 5). The long-term loss of peat island habitat will reduce the amount of optimal nesting habitat for several waterbird species including geese, loons and some ducks. Other operational effects to birds include some potential for increased bird mortality related to hunting (due to increased access to the Wuskwatim Lake area and areas adjacent to the access road) and vehicle-bird collisions along the access road.

Overall, negative effects to birds associated with Project operation are expected to be small to moderate, mostly site-specific, long-term and not significant.

8.4.2 Construction and Demobilization

8.4.2.1 Access Road

Clearing

Negative impacts to birds, associated with the clearing of the access road right-of-way (ROW) during the winter of 2004, will be moderate, long-term, site-specific and therefore not significant.

The ROW clearing for the access road will take place primarily during winter months (January through March 2004), if licence is obtained in December 2003 (Volume 3). Clearing of the ROW during winter months would minimize direct impacts to most birds because:

- only year-round resident birds (28 species) plus occasional occurrences of Ptarmigan and Snowy Owls would be present (compared to approximately 184 breeding species during non-winter months); and
- it is the non-breeding season for most birds (ravens, crows and owls begin nesting in March/April and are the earliest nesting birds in the area; Hood and Pisiak 1998).

The long-term impact to birds associated with clearing of the access road ROW is primarily associated with the removal or direct alteration of approximately 479 **hectares** of bird habitat (based on 100 m wide, 48 km long ROW). Considering that the amount of clearing will vary between 60 m and 100 m, depending largely on sight lines, the total area cleared will likely be somewhat less than 479 ha.

In addition to the habitat that will be removed to construct the road ROW, some adjacent bird habitat will also be affected due to: debris pushouts; gravel stockpiles; **habitat fragmentation**; habitat 'edge effects'; and alteration of water table and drainage adjacent to the road. Bird use of habitat adjacent to clearings (e.g., roads, forestry cutblocks, transmission lines) can be altered within an area up to approximately 400 m from the cleared area (Tetr*ES* 2003c).

The variety of habitats within a two-kilometre width area centred along the access road route is illustrated in Section 7.2, Figure 7.2-3. Table 8.4-1 lists the amount of bird habitat that will be replaced by the 'footprint' of the road in comparison to remaining un-cleared habitat within a two kilometre width area centred along the main access road

ROW. Table 8.4-1 also lists the approximate number of breeding bird pairs that will likely be displaced as a result of direct habitat removal.

As summarized in Table 8.4-1, approximately 5% of the total bird habitat area surveyed within the two-kilometre wide area centred along the main access road ROW will be directly removed (i.e., cleared or directly altered) for road construction. Therefore, the number of breeding bird pairs that will be displaced into other areas represents approximately 5% (or 2,500 ± 300 breeding bird pairs) of the estimated 49,700 ± 6,200 number of breeding bird pairs that would potentially nest within the two-kilometre wide area centred along the main access road ROW. The approximate total number of displaced breeding bird pairs along the access road route will be slightly higher than indicated above to account for the remaining 5% of habitat that occurs along the two-kilometre wide area along the road route that was not surveyed for breeding birds (Table 8.4-1). Those habitats not surveyed included scattered small patches of sparsely treed rock, water and sites currently impacted by human activities.

Using the available bird Habitat Suitability Index (HSI) models (Section 8.2.4.4), the approximate amount of prime habitat for selected modelled bird species was estimated for the two-kilometre buffer strip area centred along the access road and compared with the prime habitat available throughout the Nelson House RMA (Table 8.4-2). Proportionally, the ratio of prime habitat available for each HSI model species is similar along the access road route compared to the Nelson House RMA with the possible exception of Yellow Warbler habitat (i.e., higher proportion of shrub-willow habitat along the proposed access road route compared to what is proportionately available within the Nelson House RMA). In summary, less than one percent of the prime habitats available for the HSI modelled species within the Nelson House RMA will potentially be altered due to the access road construction. One exception is Yellow Warbler prime habitat (i.e., shrub-willow habitat) where approximately 3.6% of this habitat available in the Nelson House RMA may be potentially affected.

Table 8.4-1

ESTIMATES OF THE NUMBER OF BREEDING BIRD PAIRS IN HABITAT[a] ALONG THE PROPOSED ACCESS ROAD ROUTE

Bird Habitat Group	Number of Survey Stops			Bird Density[b]	Std. Dev. (±)	2 km Band Width Centred along Access Road			Road Footprint Area***		
	2000	2001	2002*			Habitat Area (ha)	Approximate Number of Breeding Bird Pairs	Std. Dev. (±)	Habitat Area (ha)	Approximate Number of Breeding Bird Pairs	Std. Dev. (±)
FORESTED											
Black Spruce Forest [c]	53	71	-	6.12	1.66	1,126	6,891	1,869	56	345	93
Open Black Spruce on Peat [d]	0	0	9	5.02	1.15	3,742	18,785	4,303	187	939	215
Coniferous Forest (Spruce Dominant) [e]	15	37	-	5.29	0.03	54	286	2	3	14	0
Coniferous Forest (Black Spruce & Jack Pine Dominant) [f]	0	0	4	2.68	1.41	1,166	3,125	1,644	58	156	82
Conifer-Dominant Mixedwood (Spruce & Jack Pine Dominant) [g]	3	13	-	4.76	1.26	314	1,495	396	16	75	20
Conifer-Dominant Mixedwood (Spruce Dominant) [h]	10	12	-	4.93	0.45	328	1,617	148	16	81	7
Trembling Aspen Forest [i]	0	8	-	6.00	1.76	169	1,014	297	8	51	15
Trembling Aspen Dominant Mixedwood [j]	4	8	-	5.05	1.65	500	2,525	825	25	126	41
Jack Pine Forest [k]	0	3	-	4.90	0.86	1,565	7,669	1,346	78	383	67
Sub-Totals	85	152	13	-	-	8,964	43,406	5,242	448	2,170	262
NON-FORESTED											
Fen / Bog [l]		52		12.77	6.52	496	6,334	3,234	25	317	162
TOTALS	-	-	-	-	-	**9460**	**49,740**	**6,159**	**473**	**2,487**	**308**

Estimates based on 95% of the total area of habitat types indicated as occuring in the 2 km width area along the road centre line (Section 5) and data from 250 bird survey stops from surveys conducted in 2000, 2001 and 2002 in the Wuskwatim study area.
Note that not all habitats that exist with the 2 km width area along the road centre line were surveyed. Breeding bird survey efforts currently provide approximately 95% representation of all habitat within the 2km width area along the access road route.
* Only survey data from 2002 within those habitats where no previous data were available is used. Rational: A late spring resulted in a shortened time-period where the majority of birds were singing. Therefore data collected in 2002 along the access road route under-represents actual breeding bird densites in habitats surveyed.
** Breeding birds would be displaced to alternative suitable breeding habitat in the local area due to habitat removal as a result of clearing activities for the access road right-of-way (ROW)
*** Assuming a 100m width of area along the centre line will be directly impacted and that the ratio of habitats within the100m band width are approximated by those habitats that occur within the 2 km band width centred along the access road route. This would equal approximately 5% of the habitat within the 2 km band width being potentially directly impacted by road construction.
a = information based on those forested habitat types where terrestrial breeding bird surveys were conducted in 2000 and 2001 (with information for [d] and [f] habitats collected in 2002)
b = Approximate number of breeding bird pairs / ha (not including birds recorded within offshore non-forested habitat)
c = Black Spruce 71 - 100% (FRI sub-type code 13)
d = Black Spruce 71 - 100%, mostly open crown closure, on peat/muskeg (FRI sub-type code 701)
e = Softwoods (71 - 100%) with Black Spruce < 71%, White Spruce < 71%, Jack Pine less than 20% (FRI sub-type codes 11,13)
f = Softwoods (71 - 100%) with Black Spruce > 40 - 70%, second major species: Jack Pine (FRI sub-type code 14)
g = Jack Pine at least 20% (no more than 70%), and Spruce plus Jack Pine at least 65%, second major species: hardwoods (FRI sub-types codes 44, 46, 51, 54)
h = Spruce 51% to 70%, second major species: hardwoods (FRI sub-types codes 50, 53, 58)
i = Trembling Aspen 71 - 100% (FRI sub-type code 90)
j = Trembling Aspen 50 - 70%, second major species: softwoods (FRI sub-type codes 81, 82, 83, 84)
k = Jack Pine 71 - 100% (FRI sub-type code 4)
l = includes shrubby wetlands, muskeg and beaver flood areas (FRI sub-codes 720-725, 830-839, 848). Note that the approximate density of breeding bird pairs varied depending on surrounding forested cover

TABLE 8.4-2

COMPARISON OF 'HSI MODEL*' PRIME HABITAT AREA ALONG AND ADJACENT TO THE PROPOSED ACCESS ROAD ROUTE WITHIN THE NCN RESOURCE MANAGEMENT AREA (RMA)

HSI MODEL	Approximate Prime Habitat Equivalent [a] (PHE) Area								
	Access Road Route [b] Productive [c]	Access Road Route Non-productive	**Access Road Route** (8,491 ha)	**% of PHE [a] Along Access Road Route**	NCN RMA	NCN RMA Non-productive	**NCN RMA** (2,486,948 ha)	**% of PHE [a] Within NCN RMA**	**% of PHE Area Occurring Along Access Road Route V.S. Remaining NCN RMA**
Barred Owl	409	-	**409**	4.8%	150,755	-	**150,755**	6.1%	**0.27%**
Black & White Warbler	1,560	-	**1,560**	18.4%	376,590	-	**376,590**	15.1%	**0.42%**
Common Yellowthroat	10	449	**459**	5.4%	202,582	126,449	**329,030**	13.2%	**0.14%**
Great Grey Owl, Breeding	737	-	**737**	8.7%	197,024	-	**197,024**	7.9%	**0.38%**
Great Grey Owl, Foraging	727	2,933	**3,660**	43.1%	356,043	830,779	**1,186,822**	47.7%	**0.31%**
Magnolia Warbler	2,204	1,132	**3,336**	39.3%	480,432	302,547	**782,979**	31.5%	**0.43%**
Pileated Woodpecker	72	-	**72**	0.8%	70,183	-	**70,183**	2.8%	**0.10%**
Red-breasted Nuthatch	2,218	1,094	**3,312**	39.0%	562,062	308,047	**870,109**	35.0%	**0.38%**
Ruby-crowned Kinglet	2,050	-	**2,050**	24.1%	504,417	-	**504,417**	20.3%	**0.41%**
Ruffed Grouse	1,412	-	**1,412**	16.6%	282,052	-	**282,052**	11.3%	**0.50%**
Three-toed Woodpecker	795	-	**795**	9.4%	300,468	-	**300,468**	12.1%	**0.27%**
Yellow Warbler	602	29	**630**	7.4%	6,035	11,913	**17,948**	0.7%	**3.64%**

* = Habitat Suitability Index Model (refer to Appendix 8.8.2 for details of method used in this analysis)
a = Prime Habitat Equivalent area is the amount of habitat considered 'ideal' for each HIS Model species
b = Two kilometre width area centred along the proposed access road right-of-way
c = habitat considered "productive" (i.e. forested and potentially harvestable) and "non-productive" (i.e. non-forested or not potentially merchantable) by the Manitoba

Road Construction

The negative effects of access road construction on birds are expected to be small, short-term, site-specific and therefore not significant.

After the road ROW is cleared, during the winter of 2004 (January to March), construction of the main access road is scheduled to be completed by September 2005 (Volume 3). The presence and activities of work crews and machinery will likely result in periodic, local disturbances of a relatively small number of birds that will occur, and potentially nest, adjacent to the access road.

Fuel and oil spills are a potential threat to bird habitat, particularly for ground-nesting and foraging species and for those bird species that nest and forage in or adjacent to aquatic environments such as many waterfowl species, cranes and rails. However, the threat of fuel and oil spills will be minimized due to control measures outlined in the Project Description (Volume 3) and to be described in the **Environmental Protection Plan** (EnvPP).

Traffic associated with road and project construction may result in the death or injury of a few birds as a result of bird collisions with trucks travelling to and from specific construction areas. Construction-associated traffic along the access road will vary with season and time of day (Volume 3). The responses of birds to road traffic has not been extensively studied. Therefore, local bird species' reactions to expected construction-related traffic disturbance are unknown.

8.4.2.2 Borrow Areas

Clearing

The negative effects of borrow area (including borrow area access road) clearing on birds is expected to be small to moderate, long-term to short-term (depending on which sites remain open indefinitely), site-specific and therefore not significant.

The locations and habitat description information for the proposed borrow areas are illustrated in Section 7.2, Figure 7.2-3 (also see Section 5). If all borrow areas are to be used in road and project construction, a total of approximately 716 **ha** of bird habitat would be cleared (Section 5). Table 8.4-3 lists the approximate amount of each bird habitat group that will be cleared and the approximate number of breeding bird pairs that will be displaced to adjacent, available habitat. Since approximately 99.7% of the

TABLE 8.4-3

ESTIMATES OF THE NUMBER OF BREEDING BIRD PAIRS IN HABITAT [a] WITHIN PROPOSED BORROW AREAS INCLUDING BORROW AREA ACCESS ROADS

Bird Habitat Group	Number of Survey Stops			Bird Density[b]	Std. Dev. (±)	Total Area Cleared at all Borrow & Road Sites**		
	2000	2001	2002*			Habitat Area (ha)	Approximate Number of Displaced*** Breeding Bird Pairs	Std. Dev. (±)
FORESTED								
Black Spruce Forest [c]	53	71	-	6.12	1.66	10.9	67	18
Open Black Spruce on Peat/Muskeg[d]	0	0	9	5.02	1.15	21.6	108	25
Coniferous Forest (Spruce Dominant) [e]	15	37	-	5.29	0.03	0.0	0	0
Coniferous Forest (Black Spruce & Jack Pine Dominant) [f]	0	0	4	2.68	1.41	56.8	152	80
Conifer-Dominant Mixedwood (Spruce & Jack Pine Dominant) [g]	3	13	-	4.76	1.26	25.0	119	32
Conifer-Dominant Mixedwood (Spruce Dominant) [h]	10	12	-	4.93	0.45	0.2	1	0
Trembling Aspen Forest [I]	0	8	-	6.00	1.76	3.9	23	7
Trembling Aspen Dominant Mixedwood [j]	4	8	-	5.05	1.65	17.4	88	29
Jack Pine Forest [k]	0	3	-	4.90	0.86	548.6	2,688	472
Sub-Totals	85	152	13	-	-	684.4	3,247	482
NON-FORESTED								
Fen / Bog [l]	52			12.77	6.52	2.7	34	18
TOTALS	-	-	-	-	-	**687.1**	**3,281**	**482**

Estimates based on 96% of the total area of habitat types indicated in Section 5 as occuring in the nine proposed borrow site areas and data from 250 bird survey stops from surveys conducted in 2000, 2001 and 2002 in the Wuskwatim study area.

* Only survey data from 2002 within those habitats where no previous data were available is used. Rational: A late spring resulted in a shortened time-period where the majority of birds were singing. Therefore data collected in 2002 along the access road route under-represents actual breeding bird densites in habitats surveyed.

** See Section 7.2, Figure 7.2-3 for locations of proposed borrow sites. Estimates based on the clearing of all proposed borrow sites.

*** Breeding birds would be displaced to alternative suitable breeding habitat in the local area due to habitat removal as a result of clearing activities for the borrow sites. Bird use of the borrow pit areas will increase as these sites become gradually rehabilitated.

a = information based on those forested habitat types where terrestrial breeding bird surveys were conducted in 2000 and 2001 (with information for [d] and [f] habitats collected in 2002)

b = Approximate number of breeding bird pairs / ha (not including birds recorded within offshore non-forested habitat)

c = Black Spruce 71 - 100% (FRI sub-type code 13)

d = Black Spruce 71 - 100%, mostly open crown closure, on peat/muskeg (FRI sub-type code 701)

e = Softwoods (71 - 100%) with Black Spruce < 71%, White Spruce < 71%, Jack Pine less than 20% (FRI sub-type codes 11,13)

f = Softwoods (71 - 100%) with Black Spruce > 40 - 70%, second major species: Jack Pine (FRI sub-type code 14)

g = Jack Pine at least 20% (no more than 70%), and Spruce plus Jack Pine at least 65%, second major species: hardwoods (FRI sub-types codes 44, 46, 51, 54)

h = Spruce 51% to 70%, second major species: hardwoods (FRI sub-types codes 50, 53, 58)

i = Trembling Aspen 71 - 100% (FRI sub-type code 90)

j = Trembling Aspen 50 - 70%, second major species: softwoods (FRI sub-type codes 81, 82, 83, 84)

k = Jack Pine 71 - 100% (FRI sub-type code 4)

l = includes shrubby wetlands, muskeg and beaver flood areas (FRI sub-codes 720-725, 830-839, 848). Note that the approximate density of breeding bird pairs varied depending on surrounding forested cover type.

proposed borrow site and borrow site access road areas consist of forested land, the majority of birds that will be displaced will be forest-dwelling songbirds. Relatively few waterbirds will be affected by proposed borrow site clearing activities. Borrow site clearing activities are scheduled to occur in conjunction with access road ROW clearing activities between January and March 2004 (Volume 3) and will therefore mostly minimize direct clearing-related impacts to birds since this time period is primarily outside the breeding season for most bird species (Section 8.4.2.1).

Excavation Activities

The negative effects of excavation activities on birds are expected to be small, short-term, site-specific and therefore not significant.

Noise related to excavation-related activities is expected to have a short-term and variable effect on birds in adjacent habitat. Several studies have concluded that many birds habituate quickly to very loud sounds, even exceeding 130 dB (e.g., large explosive blasts and jet aircraft engines; Bomford and O'Brien 1990; Larkin 1996). Canada Geese have been known to habituate to propane exploders within the season they are deployed (Heinrich and Craven 1990). The response of raptor species to loud sudden noise appears variable; Prairie Falcons have been observed fleeing nests with eggs in response to blasting, however Peregrine Falcons have been observed rearing young close to blasting and other construction activity (Larkin 1996). Neither of these two falcon species breed within the Wuskwatim study area. Regarding the impacts of military heavy artillery training in the vicinity of Bald Eagle nests, a study suggested that Bald Eagle nesting success was not significantly impacted (Russell et al. 1993 In: Larkin 1996). This suggests that similar noise levels that occur during construction activities will likely not affect Bald Eagles that may be in the area. Note that few, if any, Bald Eagle nests are expected to occur in the immediate vicinity of the borrow areas and access road ROW due to the lack of appropriate nesting habitat (Section 8.3.5.7).

Information is lacking on the effects of blasting and continuous loud noise specifically on passerine (i.e., songbird) species, which make up the majority of bird species within the borrow site areas. However, several studies have shown that noise levels such as those produced at excavation sites by drilling and heavy machinery (85 dB) and noise above that level up to 130 dB (e.g., explosive blasts) appear to have little effect on several wildlife species including many birds since habituation to loud noise is common (Climo 1987; Bomford and O'Brien 1990).

Decommissioning

Borrow sites that will be **decommissioned** (Volume 3) will be re-sloped and naturally re-vegetated by spreading stockpiled organic material back over the borrow sites as outlined in the EnvPP. This mitigative strategy will reduce long-term impacts to birds at these borrow site areas.

8.4.2.3 Construction Camp and Associated Facilities

The negative impacts to birds, associated with the clearing activities for the construction camp and associated facilities, will be moderate, long-term, site-specific and therefore not significant.

Clearing activities for the construction camp and associated facilities are scheduled to begin January 2004 and be completed by March 2004 (Volume 3). As indicated in Section 8.4.2.1, impacts to birds as a result of clearing occurs during winter months will be minimized due to the relatively few species present, and limited nesting activities at that time.

Table 8.4-4 summarizes the amount of bird habitat that will be cleared to accommodate the construction camp and associated facilities and lists the approximate number of breeding bird pairs that will be displaced to other available local habitats. The areas to be cleared and affected by noise, push-outs, etc. within the local generating station area total approximately 407 hectares. Impacts to birds will be minimized when clearing activities occur outside the peak bird-nesting season (i.e., May, June and July). This mitigative measure will substantially reduce impacts to birds that would result from destruction of active nests.

The area to be cleared consists mostly of conifer-dominated forest (approximately 90%; Volume 5). Bird species that are most common within that habitat type and will be displaced to other locally available habitats include mostly passerine species such as Ruby-crowned Kinglets, Chipping Sparrows, Yellow-rumped Warblers and Magnolia Warblers (Tetr*ES* 2003b). No bird species listed as endangered, threatened or of concern by COSEWIC or MESA, were observed during ground-based reconnaissance and breeding-bird surveys within the areas to be cleared for the construction camp and associated facilities in 2000 and 2001.

Buffer zones adjacent to watercourses will be a minimum of 10 metres plus 1.5-times the slope gradient in accordance with Manitoba's "Stream Crossing Guidelines For The Protection of Fish and Fish Habitat". This mitigative measure will minimize disturbance

TABLE 8.4-4
ESTIMATES OF THE APPROXIMATE NUMBER OF BREEDING BIRD PAIRS IN HABITAT* WITHIN PROPOSED GENERATING STATION, CAMP SITE & ASSOCIATED AREAS

Bird Habitat Group	Number of Survey Stops			Bird Density[b]	Std. Dev. (±)	Total Disturbed Area *			Total Footprint Area for the Permanent G.S. and Associated Facilities**		
	2000	2001	2002*			Habitat Area (ha)	Approximate Number of Breeding Bird Pairs	Std. Dev. (±)	Habitat Area (ha)	Approximate Number of Displaced*** Breeding Bird Pairs	Std. Dev. (±)
FORESTED											
Black Spruce Forest [c]	53	71	-	6.12	1.66	92.8	568	154	43.0	263	71
Open Black Spruce on Peat/Muskeg [d]	0	0	9	5.02	1.15	68.5	344	79	26.0	131	30
White Spruce Forest[e]	4	10	-	4.75	0.47	12.7	60	6	8.0	38	4
Coniferous Forest (Spruce Dominant) [f]	15	37	-	5.29	0.03	53.6	284	2	10.0	53	0
Coniferous Forest (Black Spruce & Jack Pine Dominant) [g]	0	0	4	2.68	1.41	2.4	6	3	0.0	0	0
Conifer-Dominant Mixedwood (Spruce & Jack Pine Dominant) [h]	3	13	-	4.76	1.26	0.0	0	0	0.0	0	0
Conifer-Dominant Mixedwood (Spruce Dominant) [I]	10	12	-	4.93	0.45	69.2	341	31	11.0	54	5
Trembling Aspen Forest [j]	0	8	-	6.00	1.76	12.4	74	22	2.0	12	4
Trembling Aspen Dominant Mixedwood [k]	4	8	-	5.05	1.65	18.7	94	31	8.0	40	13
Jack Pine Forest [l]	0	3	-	4.90	0.86	2.6	13	2	0.0	0	0
Sub-Totals	89	162	13	-	-	332.9	1,785	180	108.0	591	79
NON-FORESTED											
Fen / Bog [m]		52		12.77	6.52	0.0	0	0	0.0	0	0
TOTALS	**-**	**-**	**-**	**-**	**-**	**332.9**	**1,785**	**180**	**108.0**	**591**	**79**

Estimates based on 100% of the total area of habitat types indicated in Section 5 as occuring in the nine proposed G.S. site local area and data from 250 bird survey stops from surveys conducted in 2000, 2001 and 2002 in the Wuskwatim study area.
* "Disturbed Area" = total area affected by clearing, noise, push outs etc. See Section 5 for location of generating station local site area and proposed areas to be cleared. Note that some of the cleared areas will be rehabilitated and the remaining areas will constitute the permanent G.S. footprint area.
** This area excludes those sites that will be cleared during construction phase of the project, but will be allowed to regenerate after project construction is complete.
*** Breeding birds would be displaced to alternative suitable breeding habitat in the local area due to habitat removal as a result of clearing activities for the generating station site and associated infrastructure.
a = information based on those forested habitat types where terrestrial breeding bird surveys were conducted in 2000 and 2001 (with information for [d] and [g] habitats collected in 2002)
b = Approximate number of breeding bird pairs / ha (not including birds recorded within offshore non-forested habitat)
c = Black Spruce 71 - 100% (FRI sub-type code 13)
d = Black Spruce 71 - 100%, mostly open crown closure, on peat/muskeg (FRI sub-type code 701)
e = White Spruce 71 - 100% (FRI sub-code 10)
f = Softwoods (71 - 100%) with Black Spruce < 71%, White Spruce < 71%, Jack Pine less than 20% (FRI sub-type codes 11,13)
g = Softwoods (71 - 100%) with Black Spruce > 40 - 70%, second major species: Jack Pine (FRI sub-type code 14)
h = Jack Pine at least 20% (no more than 70%), and Spruce plus Jack Pine at least 65%, second major species: hardwoods (FRI sub-types codes 44, 46, 51, 54)
i = Spruce 51% to 70%, second major species: hardwoods (FRI sub-types codes 50, 53, 58)
j = Trembling Aspen 71 - 100% (FRI sub-type code 90)
k= Trembling Aspen 50 - 70%, second major species: softwoods (FRI sub-type codes 81, 82, 83, 84)
l = Jack Pine 71 - 100% (FRI sub-type code 4)
m = includes shrubby wetlands, muskeg and beaver flood areas (FRI sub-codes 720-725, 830-839, 848). Note that the approximate density of breeding bird pairs varied depending on surrounding forested cover type. Therefore this denisty must be recorded as a range of number of bird pairs likely occuring within fen/bog habitat.

to birds within that buffer zone area and in adjacent waterbodies. Also, trees containing large nests of sticks will be identified, left undisturbed and will be reported to the Natural Resources Officer (NRO) as indicated in the EnvPP. Once the generating station is constructed and operational (2009), the construction camp and associated facilities will be decommissioned and stockpiled organics will be spread over disturbed areas to promote vegetation re-growth as indicated in the EnvPP. In following years as vegetation becomes re-established, this mitigative effort will reduce long-term impacts to birds.

8.4.2.4 Forebay Clearing

The negative impacts to birds, associated with the clearing and staged flooding of the forebay area will be moderate, long-term, site-specific and therefore not significant.

Clearing of approximately 39 ha of forest area within the forebay area between Wuskwatim Falls and Taskinigup Falls will occur in two stages, during winter months of 2005 and 2007 (Volume 3). As indicated in Section 8.4.2.1, clearing of the forebay area during winter will minimize impacts to birds due to the relatively few species present, and limited nesting activities occurring at that time.

Bird habitat that will be cleared within the forebay area consists primarily of mature spruce-dominated riparian forest (96%; Section 5) and includes some bay habitat which contains a limited amount of waterbird foraging and potential nesting habitat. The forebay area that will be cleared during construction activities will be flooded as the generating station is constructed. Therefore, the forebay area terrestrial habitat to be cleared will be removed and replaced as aquatic habitat. This area to be cleared and flooded would result in the displacement of approximately 170 ± 10 pairs of breeding birds in addition to a limited number of waterbirds that may have nested in association with marsh/sedge habitat within the bay areas. Over time, some marsh habitat may become re-established in shallow zones within the flooded bay areas.

8.4.2.5 Generating Station

The main permanent generating station works that would be constructed and remain after the construction camp and associated facilities are decommissioned, include the:

- powerhouse/service bay complex;
- spillway;
- embankment dam and dike to contain the spillway;
- channel improvement at Wuskwatim Falls; and
- access road.

The footprint area of these works (excluding the access road and borrow areas; Sections 8.4.2.1 and 8.4.2.2) consist of approximately 184 hectares of primarily spruce-dominated mature forest, including approximately 39 ha of habitat (south shore generating station structure and forebay) along the southwest shores of the Burntwood River between Wuskwatim Falls and Taskinigup Falls.

Table 8.4-4 lists the areas of various bird habitats that will be disturbed (i.e., affected by clearing, noise, push-ups, etc.) for both the construction camp and permanent generating station works and the approximate number of breeding bird pairs (1,800 ± 200) that will be displaced to other available local habitats. Due to the very turbulent, high-velocity water associated with the location of the proposed spillway and powerhouse at Taskinigup Falls, the aquatic habitat and shoreline of this footprint area was seldom used as foraging habitat by waterbirds (Tetr*ES* 2003a,b).

Blasting will be required during the construction of: access roads and camp (infrastructure); the spillway and powerhouse at Taskinigup Falls; and at the channel improvement area at Wuskwatim Falls. Blasting will occur periodically at the generating station site during August to November 2005, May and November 2008, and at the channel improvement area in May to July 2008. As indicated in Section 8.4.2.2, blasting appears to have a variable, short-term effect on bird species.

8.4.2.6 Overview of Effects on Valued Ecosystem Component Species

A summary of the expected results of construction-related effects to bird VECs is presented in Table 8.4-5. Details regarding how construction-related activities affect each of the selected VEC species are provided in Appendix 8.8.3.

In summary, construction-related effects to bird VECs are expected to be small, short-term, site-specific and therefore not significant.

8.4.3 Operation

8.4.3.1 Generating Station

Permanent structures associated with the generating station site that may pose an occasional risk to some birds include the communication tower and transmission lines to/from the powerhouse and switching station. Birds have been known to collide with wires associated with those structures, occasionally resulting in injury or death (e.g., Avery *et al*. 1980; Herbert *et al*. 1995). However, these structures are not located immediately adjacent to the shoreline in areas of high bird density. Therefore, the risk to

TABLE 8.4-5

CONSTRUCTION-RELATED EFFECTS TO BIRD VECS [a]

VEC Species	Overall Impact			
	Magnitude	Time Scale	Spatial Scale	Significant Negative Impact? [b]
Canada Goose	Small	Short-term	site-specific	No
Mallard	Small	Short-term	site-specific	No
Bufflehead and Common Goldeneye	Small	Short-term	site-specific	No
Common Loon	Small	Short-term	site-specific	No
Bald Eagle	Small	Short-term	site-specific	No
Red-winged Blackbird	Small	Short-term	site-specific	No
Palm Warbler	Small	Short-term	site-specific	No
Belted Kingfisher	Small	Short-term	site-specific	No
Common Snipe	Small	Short-term	site-specific	No

a = Valued Ecosystem Component Species (Sections 2 and 8.2.4.5 for an explanation of VECs and rational for the selection of the above listed species)

b = Details regarding how construction-related activities affect each of the above listed VECs, and resulting impact conclusions, are presented in Appendix 8.8.3

Note: available relevant TK information has been considered in the above impact assessment conclusions (Tables 8.3-2,8.3-4 and 8.3-6)

For definitions of the various magnitude, time scale and spacial scale terms, refer to Section 2 birds that are especially susceptible to wire collisions, such as waterfowl, cranes and large raptors such as Bald Eagles, is minimized.

Flooded Areas

Negative impacts to birds associated with the flooding of terrestrial habitat during generating station operation will be moderate, long-term, site-specific and therefore not significant.

As indicated in Volume 3, approximately 37 hectares of land will be permanently flooded due to the increase and stabilization of forebay and Wuskwatim Lake water levels at the 234 m level. Table 8.4-6 summarizes the approximate areas of the various bird habitats that will be affected (i.e., cleared and flooded) by the operation of the Wuskwatim

Generating Station compared to the approximate amount of adjacent, alternative bird habitat within a one kilometre 'buffer zone' area back from the shorelines of the Wuskwatim Lake and Opegano Lake area.

As indicated in Table 8.4-6, a relatively small amount of bird habitat will be flooded during Project operation (37 ha) compared to the amount of adjacent available habitat remaining within the one kilometre buffer area around the Wuskwatim Lake area (18,885 ha). Flooding of the 37 ha of habitat would displace approximately 200 ± 24 breeding bird pairs into alternative habitat in the local area. This estimate of the number of breeding bird pairs that will be displaced from flooded habitat represents a very small percentage (<0.003%) of the number of breeding bird pairs estimated to be within the one kilometre buffer zone in the Wuskwatim Lake area.

As indicated in Table 8.4-6 and Section 5, the habitat that would be flooded is spruce-dominated forest. Terrestrial breeding bird surveys conducted in 2000 and 2001 indicated that Ruby-crowned Kinglets, Yellow-rumped Warblers, Chipping Sparrows and Common Snipe are the most abundant bird species in spruce-dominated forest (Tetr*ES* 2003a,b). These species are also very common in other conifer-dominant habitats throughout the study area. It is expected that no bird species population in the bird study area will be significantly affected by the flooding of approximately 37 hectares of terrestrial habitat as a result of generating station operations.

TABLE 8.4-6
ESTIMATES OF THE NUMBER OF BREEDING BIRD PAIRS IN HABITAT[a] WITHIN THE 1KM BUFFER ZONE* AND THE PROPOSED FLOODED AREAS IN THE WUSKWATIM LAKE AREA

Bird Habitat Group	Number of Survey Stops			Bird Density[b]	Std. Dev. (±)	1 km Buffer Zone*			Flooded Area[c]		
	2000	2001	2002**			Habitat Area (ha)	Approximate Number of Breeding Bird Pairs	Std. Dev. (±)	Habitat Area (ha)	Approximate Number of Breeding Bird Pairs Displaced***	Std. Dev. (±)
FORESTED											
Black Spruce Forest [d]	53	71	-	6.12	1.66	3,613	22,112	5,998	14.0	86	23
Open Black Spruce Forest on Peat/Muskeg [e]	0	0	9	5.02	1.15	6,037	30,306	6,943	4.0	20	5
Coniferous Forest (Spruce Dominant) [f]	15	37	-	5.29	0.03	511	2,703	15	6.0	32	0
Coniferous Forest (Black Spruce & Jack Pine Dominant) [g]	0	0	4	2.68	1.41	2,011	5,389	2,836	0.0	0	0
Conifer-Dominant Mixedwood (Spruce & Jack Pine Dominant) [h]	3	13	-	4.76	1.26	1,273	6,059	1,604	0.0	0	0
Conifer-Dominant Mixedwood (Spruce Dominant) [i]	10	12	-	4.93	0.45	998	4,920	449	6.0	30	3
White Spruce Forest [j]	4	10	-	4.75	0.47	5	24	2	7.0	33	3
Trembling Aspen Forest [k]	0	8	-	6.00	1.76	400	2,400	704	0.0	0	0
Trembling Aspen Dominant Mixedwood [l]	4	8	-	5.05	1.65	1,573	7,944	2,595	0.0	0	0
Jack Pine Forest [m]	0	3	-	4.90	0.86	410	2,009	353	0.0	0	0
Sub-Totals	89	162	-	-	-	16,831	83,866	10,116	37	200	24
NON-FORESTED											
Off-shore Marsh [n]	43		-	21.3	8.6	147	3,131	1,264	0.0	0	0
Fen / Bog [o]	52		-	12.77	6.52	919	11,736	5,992	0.0	0	0
Sub-Totals	-		-	-	-	1066	14,867	6,124	0	0	0
TOTALS	**-**	**-**	**-**	**-**	**-**	**17,897**	**98,733**	**11,826**	**37**	**200**	**24**

Estimates based on habitat types (and total area) indicated in Section 5 as occuring in the buffer zone (note that for forested habitat types, only those birds observed in forest habitat were included in the density calculations).
Note that not all habitats that exist with the 1km buffer zone area were surveyed. Breeding bird survey efforts provide approximately 94% representation of all habitat within the 1km buffer zone area.
* 1km width from the shoreline inland that includes both proposed flooded land and land that will not be flooded
** Only survey data from 2002 within those habitats where no previous data were available is used. Rational: A late spring resulted in a shortened time-period where the majority of birds were singing. Therefore data collected in 2002 along the access road route under-represents actual breeding bird densites in habitats surveyed.
*** Breeding birds would be displaced to alternative suitable breeding habitat in the local area due to habitat alteration as a result of the Project
a = information based on those habitat types where terrestrial breeding bird surveys were conducted in 2000 and 2001 (with information for [e] and [g] habitats collected in 2002)
b = Approximate number of breeding bird pairs / ha
c = Flooded area between Taskinigup Falls and Wuskwatim Falls
d = Black Spruce 71 - 100% (FRI sub-type code 13)
e = Black Spruce 71 - 100%, mostly open crown closure, on peat/muskeg (FRI sub-type code 701)
f = Softwoods (71 - 100%) with Black Spruce < 71%, White Spruce < 71%, Jack Pine less than 20% (FRI sub-type codes 11,13)
g = Softwoods (71 - 100%) with Black Spruce > 40 - 70%, second major species: Jack Pine (FRI sub-type code 14)
h = Jack Pine at least 20% (no more than 70%), and Spruce plus Jack Pine at least 65%, second major species: hardwoods (FRI sub-types codes 44, 46, 51, 54)
i = Spruce 51% to 70%, second major species: hardwoods (FRI sub-types codes 50, 53, 58)
j = White Spruce 71 - 100% (FRI sub-types code 10)
k = Trembling Aspen 71 - 100% (FRI sub-type code 90)
l = Trembling Aspen 50 - 70%, second major species: softwoods (FRI sub-type codes 81, 82, 83, 84)
m = Jack Pine 71 - 100% (FRI sub-type code 4)
n = density range caluclated from terrestrial breeding bird surveys that occurred adjacent to off-shore marsh habitat. "Marsh" = Section 5 vegetation catagories: 1) Typha (cattail), 2) Carex (sedges) with Typha fringe, 3) Ericaceous (low shrubs) with Typha fringe.
Note: according to an analysis of the FRI data for the 1km buffer zone, no 'terrestrial' (I.e. non-off-shore) marsh habitat occurs within the 1km buffer zone
o = includes shrubby wetlands, muskeg and beaver flood areas (FRI sub-codes 720-725, 830-839, 848). Note that the approximate density of breeding bird pairs varied depending on surrounding forested cover type. (2000 and 2001 data combined)

Standing dead trees are common in certain areas in waterbodies within the Wuskwatim study area due to the flooding of terrestrial forested habitat in the 1970's as a result of the CRD. The large-diameter standing dead trees provided ideal nesting habitat for various woodpecker species. As a result of previous woodpecker nesting activity, many of the large diameter standing dead trees provide abundant cavities for cavity-nesting species (in particular: Bufflehead, Tree Swallows, and American Kestrels). Other bird species that may nest in cavities in standing dead trees include: Common Goldeneye, Common Grackles and Northern Flickers (a woodpecker species that will occasionally use old nest holes). When water levels are increased to 234 m, some nest holes may no longer be usable (i.e., underwater) or desirable as nest holes (i.e., too close to the water surface). However, as observed during boat-based surveys in 2000 when water levels were at approximately 234 m, abundant usable nest holes were available for cavity-nesting birds (Tetr*ES* 2003a).

Altered Water Regime

The Wuskwatim Generating Station will normally be operated such that the water level on Wuskwatim Lake will be at approximately 234 m **ASL** ± 0.05 (Volume 3). For short-term emergency purposes, the water level may drop as low as 233 metres. This operating regime will result in more stable (i.e., consistent) water levels compared to the existing water regime where water levels fluctuate (rise and drop) throughout the open water season (Volume 3). Daily water level data recorded at Wuskwatim Lake by Manitoba Hydro indicates that water levels have increased by 20 centimetres or more within a one or two-week period during the peak waterbird nesting period (mid-April to mid-June) at least 12 of the 24 years since the CRD was implemented in 1977 (Appendix Section 8.8.4, Table 8.8-2). Water level increases of that magnitude during that spring time period may have resulted in the flooding of waterbird nests that were located at or near water level. Examples of birds that may build their nests at or near water level include loons, rails, cranes, grebes, and many waterfowl species.

The more stable water regime during project operation will benefit many bird species that nest at or near water level. More stable water levels will reduce the risk of nest flooding events for those species.

Stable water levels will also alter some bird habitat such as offshore anchored and floating peatlands and marshes (Section 5). Under the existing water regime, offshore anchored and floating peatlands have been gradually deteriorating, at least since the CRD (Section 5). It is expected that once the generating station is operational, resulting in a more stable water regime, the deterioration of offshore peatlands (i.e., lands not containing cattails) will cease, and should expand after approximately five years of project operation (Section 5). Therefore, the more stable water regime during Project operation will be beneficial to birds using offshore peatland habitat since the long-term disintegration of that habitat will be mitigated. Examples of birds using off-shore peatland habitat include nesting and foraging Canada Geese and open bog dwelling species such as Lincoln's Sparrows.

The more stable water regime resulting from the Project is expected to result in the gradual deterioration of off-shore marsh habitat (i.e., peatlands containing cattails; Section 5). There is expected to be an initial increase in marsh nesting bird numbers such as some waterfowl species prior to the noticeable deterioration of marsh areas due to reduced nest flooding resulting from the more stable water regime. However, as marsh areas begin to noticeably deteriorate (5 years following project operation; Section 5) this benefit will be offset by the long-term decrease in available marsh habitat. It is expected that bird species dependant on some amount of marsh habitat for foraging, nesting and/or shelter will relocate their activities to other suitable marsh habitat in the local area within or adjacent to the bird study area as marsh habitat begins to deteriorate. Examples of birds that nest and/or forage in offshore marsh habitat include waterfowl, grebes, rails, cranes, snipe, and marsh-dwelling songbird species such as Red-winged Blackbirds.

The increase and stabilization of water levels at 234 m may also result in some limited expansion of fen and bog areas in low-lying areas adjacent to shorelines of the Wuskwatim Lake area (Section 5). This will be beneficial to those bird species that nest and forage in fen and bog habitats such as Palm Warblers, Common Snipe, Lincoln's Sparrows, rails, cranes and some waterfowl.

Downstream of the proposed generating station (along the Burntwood River from Taskinigup Falls to Birch Tree Lake), water levels are expected to fluctuate during project operation. At Opegano Lake, maximum daily fluctuations may be as high as 0.45 m (Volume 3). These fluctuations are considerably more that what would typically occur upstream of the generating station in the Wuskwatim Lake area, where water levels would be relatively stabilized around 234 m ASL. Operation-related effects on birds using this downstream area would be primarily associated with: land loss thought erosion; potential creation of peat islands, increased 'Shore Zone' habitat; and increased potential for nest flooding due to variable water levels.

Peat islands and lowland shoreline habitats are considered high quality nesting habitat for many bird species including geese and some ducks. The potential for the creation of peat islands in lowland bay areas along the Burntwood River and at Opegano Lake would provide additional nesting habitat for birds that prefer to nest on island habitat such as loons, geese and some ducks. An increase in the Shore Zone habitat would result in increased foraging habitat for grazing birds such as geese that prefer to forage on young sedge and grass shoots that are common along intermittently exposed shoreline areas. The potential for nest flooding would increase in the lowland shoreline areas in the downstream reach due to potentially more frequent, higher water level changes. As a result, the extent of long-term use of those areas for nesting would likely decline. However, lowland shoreline areas are not very common in the downstream reach of the Burntwood River to Birch Tree Lake compared to the Wuskwatim Lake area. Therefore, the impacts to birds using the downstream shoreline and adjacent lowland habitats due to fluctuating water levels would be small, local, long-term and not significant.

Erosion

Under existing conditions, erodible shoreline areas, which make up approximately 30% of the entire Wuskwatim Lake area shoreline, are receding at an above normal rate due to CRD impacts (rates are variable; Volume 4). These erodible shorelines are concentrated in the main part of Wuskwatim Lake and represent 75% of that shoreline. Once the generating station project is operational, it is expected that there will be a substantial increase in shoreline erosion in the first 5 years, which will gradually reduce over the following 20 years back to current erosion rates. Over a 25-year timeframe, this equates to an approximate 50% increase in shoreline loss, over existing rates, in those areas with erodible shorelines.

During the time of increased erosion rates during project operation, some terrestrial bird habitat at erodible shorelines will be eroded at variable rates throughout each year (Volume 4). Birds most susceptible to the effects of erosion of their habitat include those species that typically nest at or near the shoreline. Examples of birds that nest at or near erodible shorelines and would be particularly vulnerable to increased erosion rate events include: the Bald Eagle, which typically nests in trees adjacent to the shoreline (Section 8.3.5); Belted Kingfishers, which typically nest in cavities excavated in clay/silt (i.e., erodible) banks (Section 8.3.7.2); and a variety of species that may nest near the shoreline (e.g., Northern Waterthrush, Spotted Sandpiper). Since erosion effects are much more pronounced along exposed shorelines on larger waterbodies such as on the main Wuskwatim Lake and at Cranberry Lake, few waterfowl will be directly affected by shoreline erosion effects as most waterfowl nest within or near sheltered bay areas.

Erosion events where large sections of shoreline slump into the water would directly impact bird species primarily during the spring when most nesting activities are occurring (mid-April to mid-June). Erosion events during the remainder of the open-water season would result in the gradual reduction in available terrestrial habitat and potential nest sites for the upcoming nesting season.

8.4.3.2 Access Road

Traffic

The estimated volume and nature of vehicle traffic along the proposed access road that would connect PR #391 to the proposed Wuskwatim Generating Station during project operation is described in Volume 3. Road traffic during the operation phase of the Project will be substantially less than during the construction phase of the Project (Section 8.4.2.1). Low traffic volumes along the access road during project operation will minimize disturbance and collision risk to birds.

Long-term Access

The installation and 24-hour monitoring of an effective access-control gate near the junction of the access road with PR #391 during project construction will limit public access to areas made accessible by the access road. Discussions between Manitoba Hydro and NCN are ongoing regarding options to control public access along the Wuskwatim access road during project operation. Limited public access to this road will minimize potential disturbance and hunting of birds in areas made accessible by the access road. Bird surveys and reconnaissance of the habitat along and adjacent to the access road and borrow areas did not reveal the presence of any unique or especially productive bird habitats that would be particularly vulnerable to human disturbance. A review of available Traditional Knowledge of the area through which the access road traverses does not indicate the presence of particularly sensitive or productive bird habitat that would be significantly harmed by limited long-term access along the road (Tables 8.2-2 to 8.2-4 and 8.2-6).

8.4.3.3 Effects on Valued Ecosystem Component Species

A summary of the expected results of operation-related effects to bird VECs is presented in Table 8.4-7. A summary of how operation-related impacts affect selected bird VECs is presented in Figures 8.4-1 to 8.4-9. Details regarding how operation-related impacts affect each VEC species are provided in Appendix 8.8.5. **In general, operation-related effects to bird VECs are expected to be small, long-term, local and therefore not significant.**

TABLE 8.4-7

OPERATION-RELATED EFFECTS TO BIRD VECS [a]

VEC Species	Overall Impact*			
	Magnitude	Time Scale	Spatial Scale	Significant Negative Impact? [b]
Canada Goose	Small	Long-term	Local	No
Mallard	Small	Long-term	Local	No
Bufflehead and Common Goldeneye	Small	Long-term	Local	No
Common Loon	Small	Long-term	Local	No [c]
Bald Eagle	No Net Effect			
Red-winged Blackbird	Small	Long-term	Local	No
Palm Warbler	Small	Long-term	Local	No [d]
Belted Kingfisher	Small	Long-term	Local	No
Common Snipe	Small	Long-term	Local	No [d]

* Several aspects of operation-related effects will affect each VEC species to varying degrees and across different time and spacial scales. However, this table represents the overall effect of project operations on each VEC population.

a = Valued Ecosystem Component Species (ref. Sections 2 and 8.2.4.5 for an explanation of VECs and rational for the selection of the above listed species)

b = Details regarding how operation-related activities affect each of the above listed VECs, and resulting impact conclusions, are explained in detail in Appendix 8.8.5

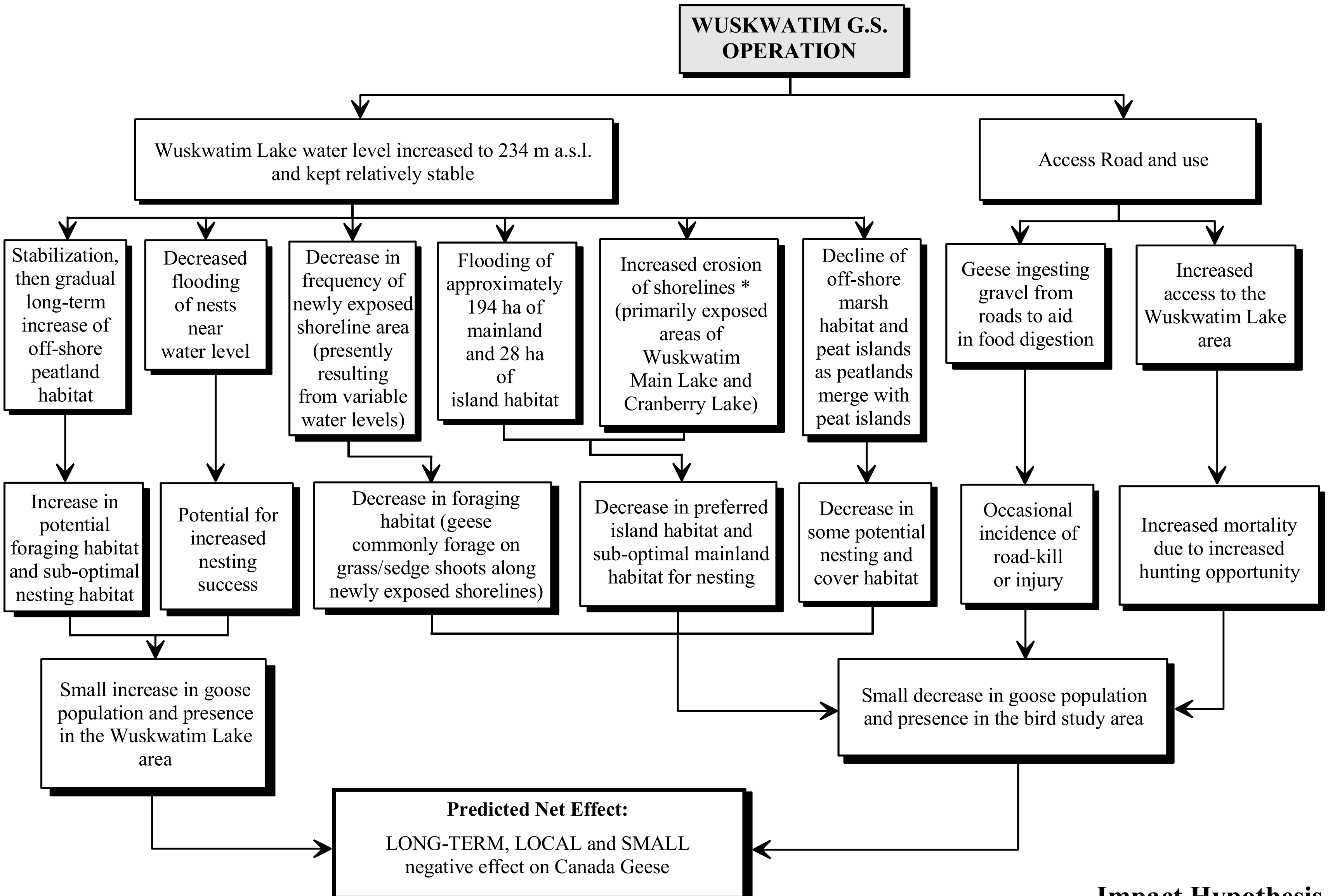
c = The positive effect of increased loon nesting success related to decreased frequency of nest flooding may be offset by increased mortality in fishing nets if commercial fishing increases as a result of improved access to the Wuskwatim Lake area

d = Overall effects to Palm Warblers and Common Snipe are expected to be positive due to the overall increase in off-shore boggy peatlands and possible increase in more open mainland bog areas as the water table rises

Refer to Figures 8.4-1 to 8.4-9 for a summary of how operation-related impacts affect the above listed VEC species

Note: available relevant TK information has been considered in the above impact assessment conclusions (ref. Tables 8.3-2 to 8.3-4 and 8.3-6)

For definitions of the various magnitude, time scale and spacial scale terms, refer to Section 2

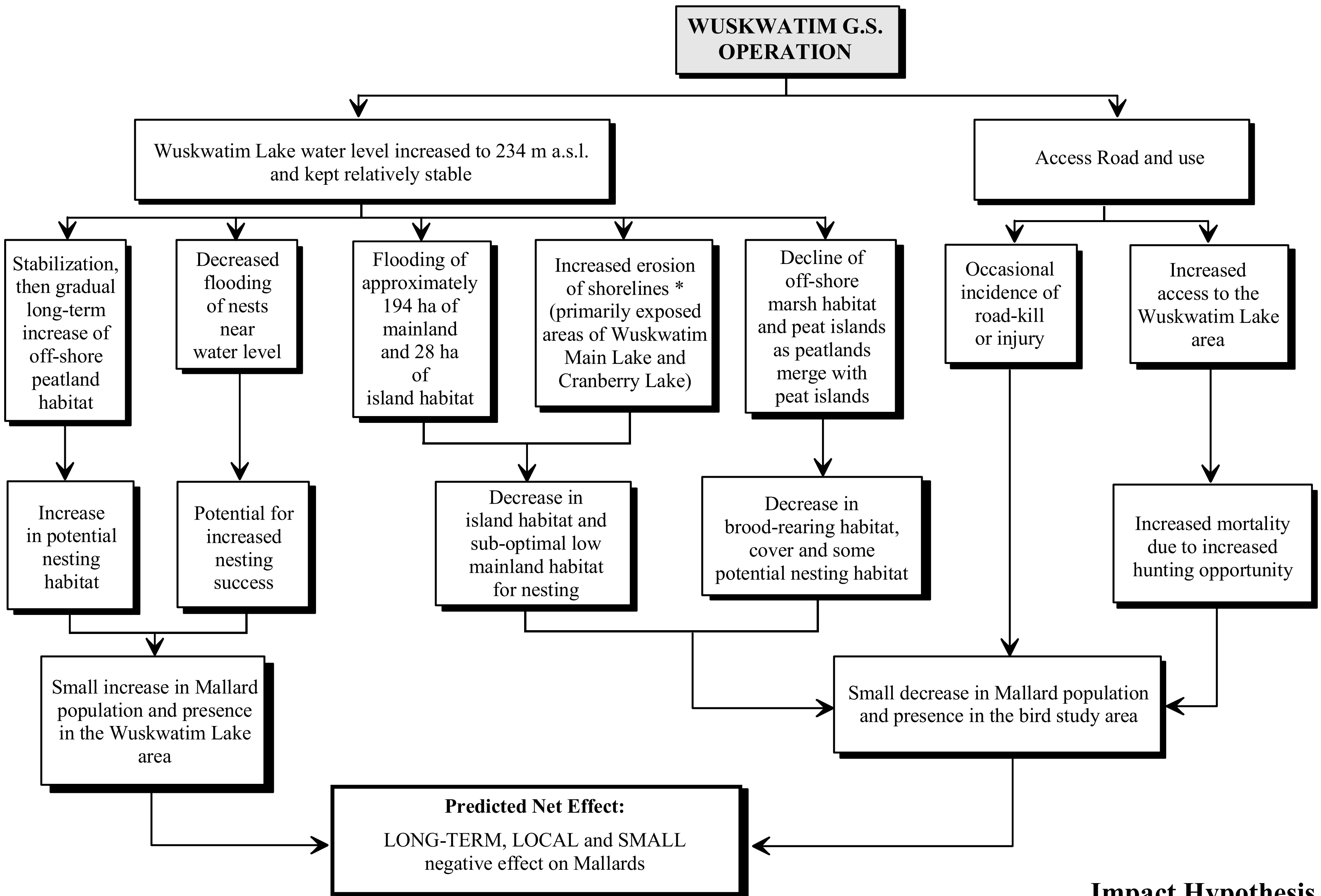


* During first 5 years; gradually reducing back to current rates over the next 20 years

Note: Bird study area is illustrated in **Figure 8.2-1**

Impact Hypothesis for the Canada Goose

Figure 8.4-1

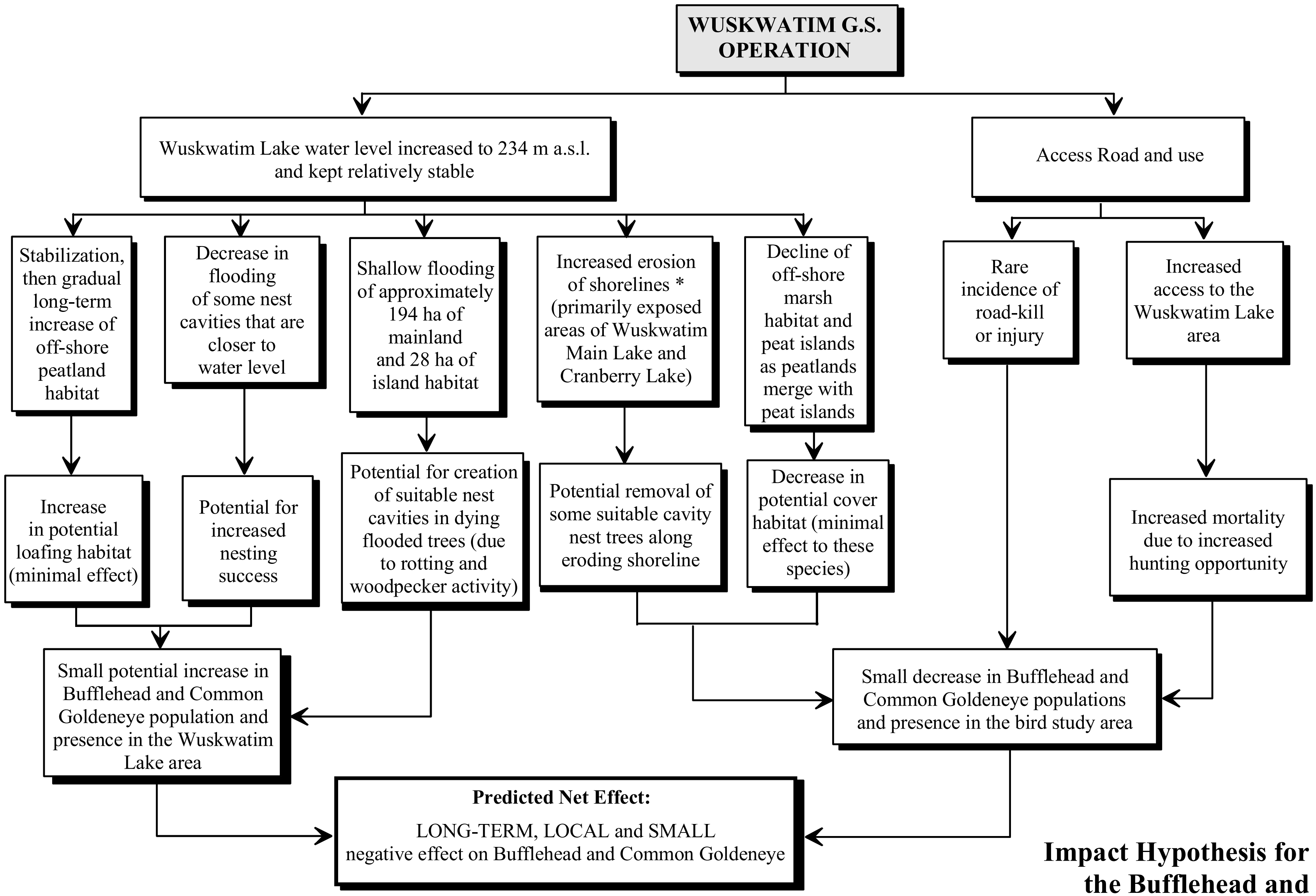


* During first 5 years; gradually reducing back to current rates over the next 20 years

Note: Bird study area is illustrated in **Figure 8.2-1**

Impact Hypothesis for the Mallard

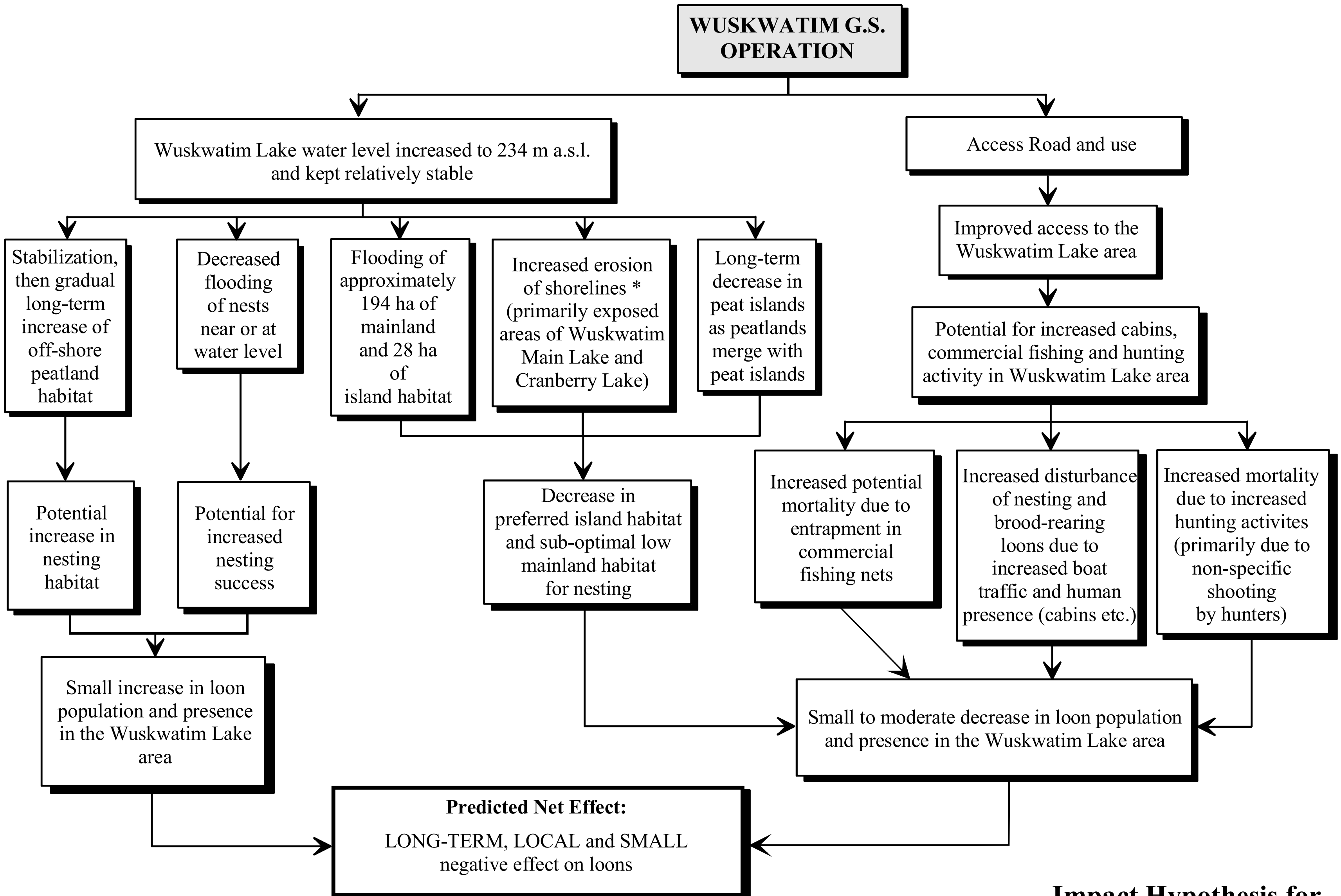
Figure 8.4-2



Impact Hypothesis for the Bufflehead and Common Goldeneye
Figure 8.4-3

* During first 5 years; gradually reducing back to current rates over the next 20 years

Note: Bird study area is illustrated in **Figure 8.2-1**

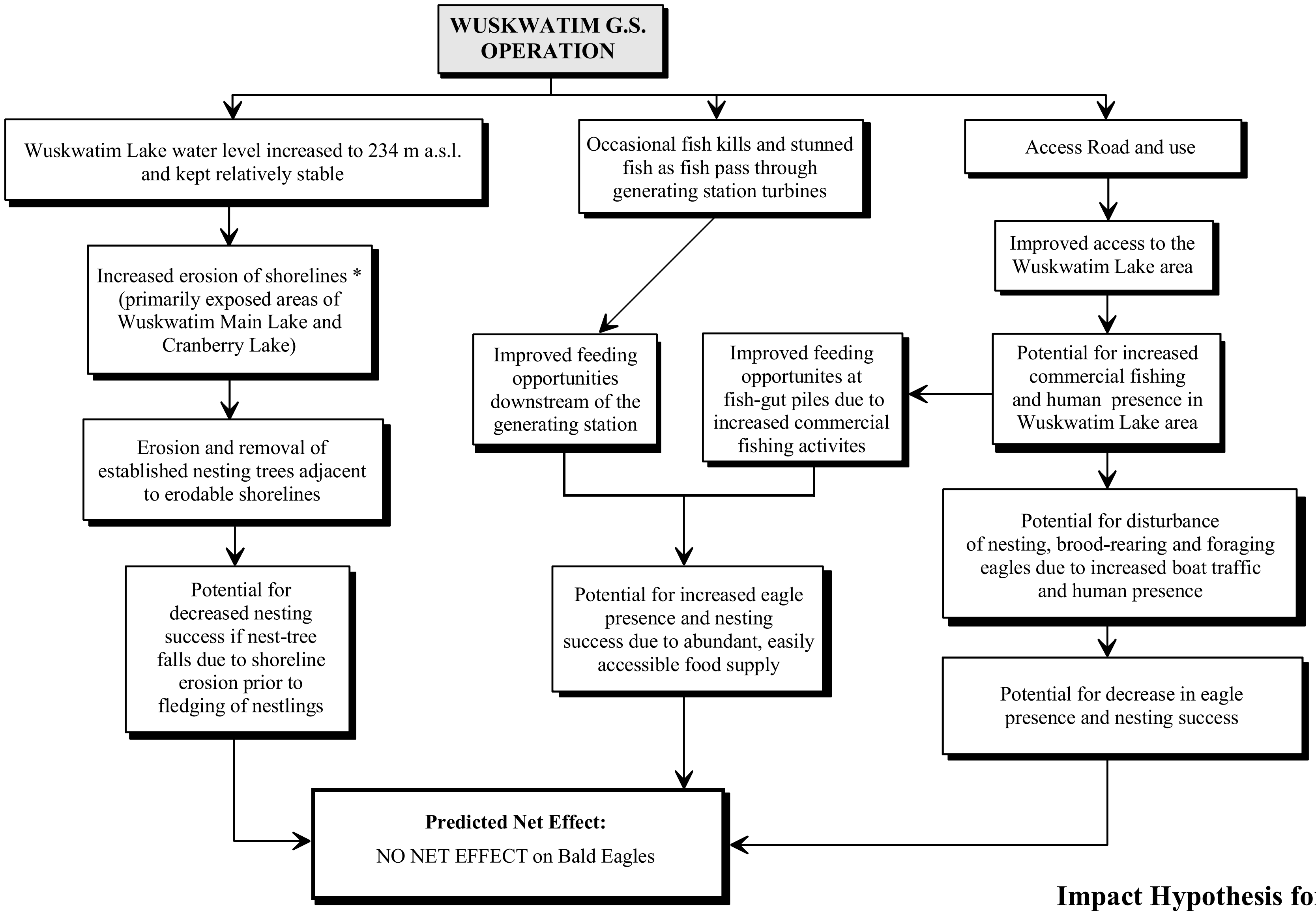


* During first 5 years; gradually reducing back to current rates over the next 20 years

Note: Bird study area (i.e. "Local" area) is illustrated in **Figure 8.2-1**

Impact Hypothesis for the Common Loon

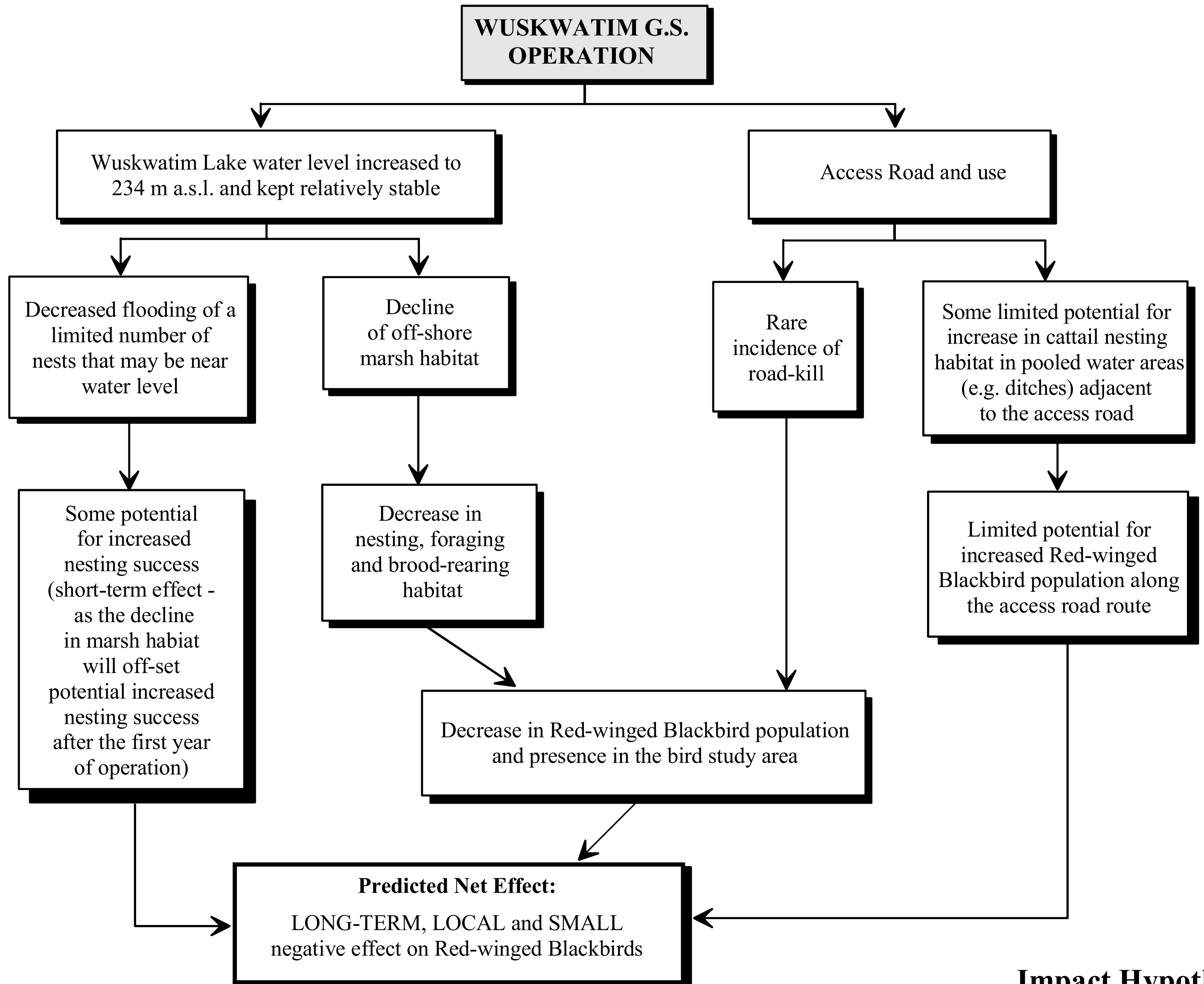
Figure 8.4-4



* During first 5 years; gradually reducing back to current rates over the next 20 years

Note: Bird study area (i.e. "Local" area) is illustrated in **Figure 8.2-1**

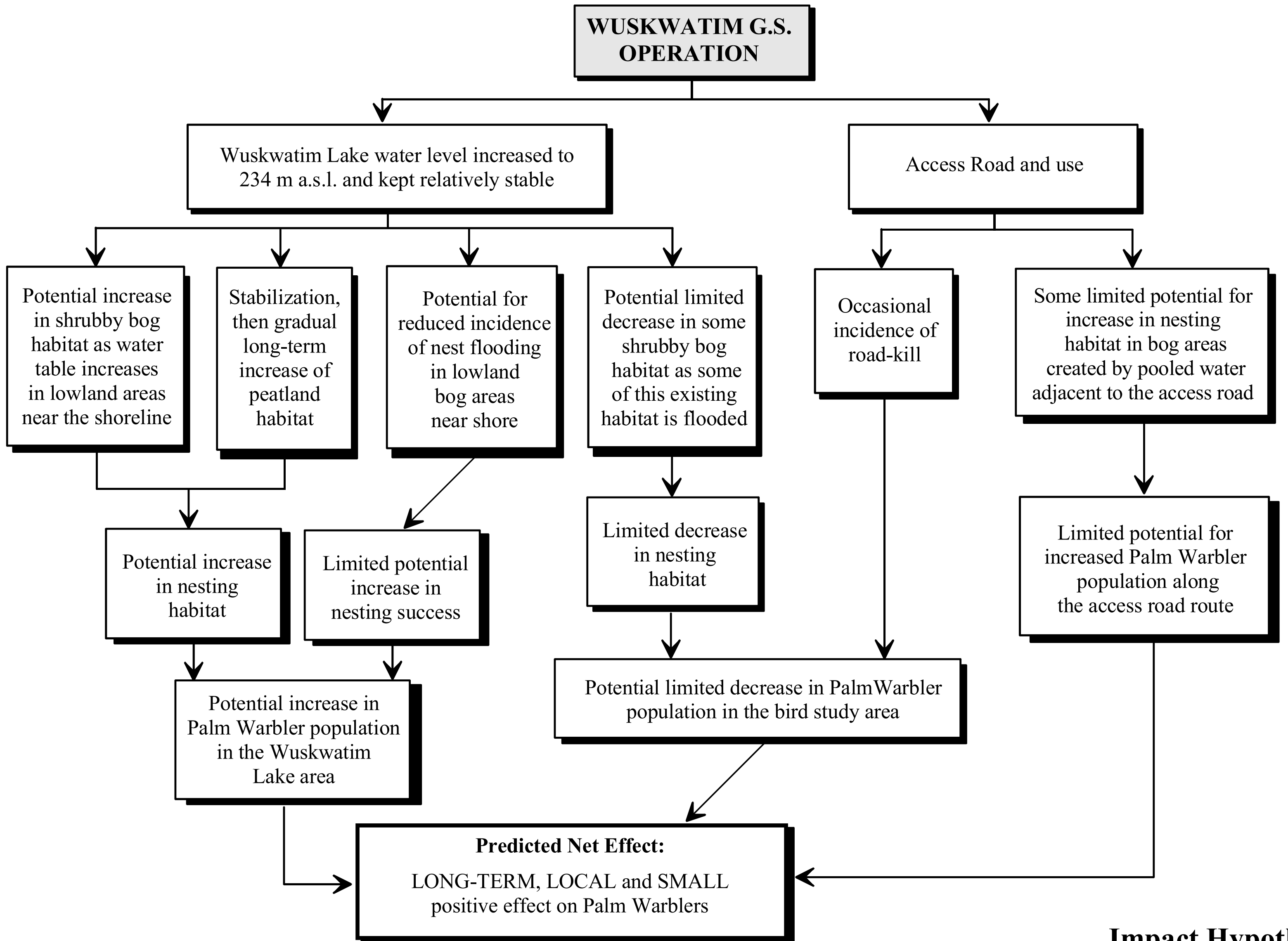
Impact Hypothesis for the Bald Eagle
Figure 8.4-5



Impact Hypothesis for the Red-winged Blackbird

Figure 8.4-6

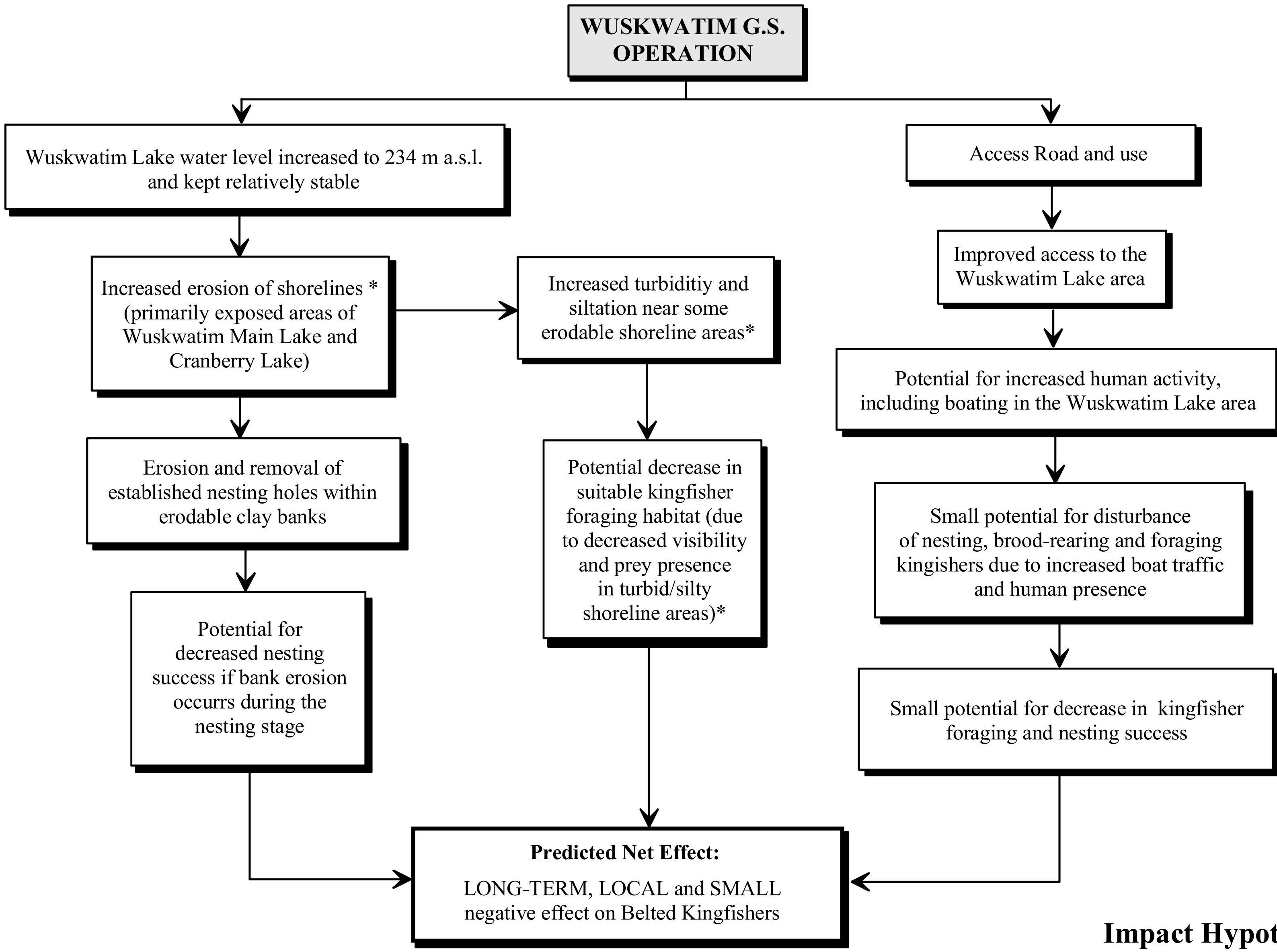
Note: Bird study area is illustrated in **Figure 8.2-1**



Note: Bird study area is illustrated in **Figure 8.2-1**

Impact Hypothesis for the Palm Warbler

Figure 8.4-7

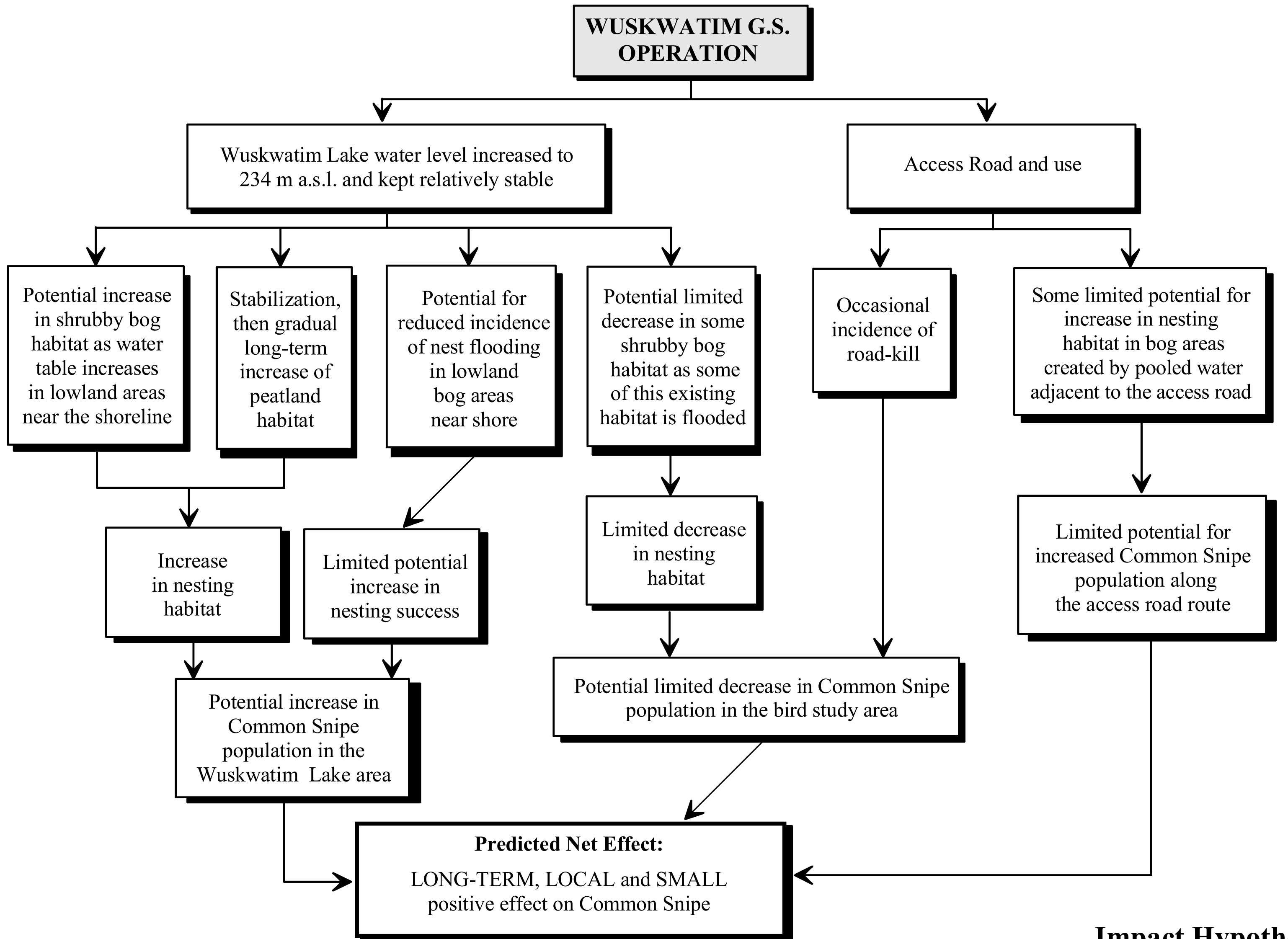


Impact Hypothesis for the Belted Kingfisher

Figure 8.4-8

* During first 5 years; gradually reducing back to current rates over the next 20 years

Note: Bird study area (i.e. "Local" area) is illustrated in **Figure 8.2-1**



Note: Bird study area is illustrated in **Figure 8.2-1**

Impact Hypothesis for the Common Snipe

Figure 8.4-9

8.5 RESIDUAL IMPACTS

Residual impacts are the positive and negative effects of the proposed Project that persist after the implementation of mitigative measures. The assessment of environmental impacts to birds and methods proposed to prevent or mitigate potential impacts are provided in Section 8.4. **As discussed below, the residual negative environmental effects of the Project to birds are expected to be not significant.**

Residual impacts to birds that will persist during project operation are primarily associated with changes in peatland and marsh habitat, continued erosion of erodible shorelines and human access (especially hunters) into the Wuskwatim Lake area. The long-term gradual increase in peatland habitat in the Wuskwatim lake area bays will eventually result in the reduction of peat islands as peatlands grow out from shore and merge with these islands (Section 5). This reduction in peat island habitat will reduce the amount of preferred island nesting habitat for waterbird species such as geese, loons and some ducks. However, it is expected that some of these types of waterbirds will continue to use the peatlands, to a lesser degree, as sub-optimal nesting habitat and as foraging habitat in the case of Canada Geese.

The gradual long-term reduction of marsh habitat in the Wuskwatim Lake area (Section 5) will result in the gradual displacement of marsh-dwelling birds, including many waterfowl species, to other suitable marsh areas in the bird study area. This gradual loss of marsh habitat is not expected to significantly impact bird populations in the bird study area as the majority of marsh-dwelling birds are expected to relocate to alternative marsh habitat in the bird study area.

The continued, long-term and temporarily increased rate of erosion of vulnerable mainland and island habitat (Volume 4) will result in the gradual loss of some terrestrial bird habitat in the Wuskwatim Lake area. Birds will be displaced from the eroded land to adjacent suitable habitat. Erosion is not expected to significantly impact bird populations.

Increased human access to the Wuskwatim Lake area via the access road and the likelihood of increased cabin development is expected to result in the long-term increase in game bird hunting and the opportunistic harvesting of other bird species. However, due to the gradual loss of marsh habitat and resulting gradual displacement of marsh-dwelling birds including many waterfowl species, hunting opportunities for waterfowl will also be reduced. Therefore increased access and development in the Wuskwatim

Lake area will result in a very minor annual loss of waterfowl from the bird study area. Traditional Knowledge information indicates that the majority of bird harvesting occurs in areas outside the Wuskwatim Lake area (Table 8.3-2). Although an access road into the Wuskwatim Lake area is expected to be associated with increases in the harvest of birds in that area (Volume 7), the increase is not expected to result in a **significant impact** on bird populations in the region.

8.6 CUMULATIVE IMPACTS

Cumulative effects to bird VECs were assessed relative to the expected effects to bird habitat regarding past, present and reasonably foreseeable future projects and activities within ecodistricts defined in Section 7.8.2. The cumulative effects to birds are primarily associated with habitat loss and habitat fragmentation, particularly associated with the forestry industry.

To assess cumulative effects to birds, an ecosystem-based approach utilizing a federally/provincially established ecodistrict classification system was used (Section 7.8.2). Effects to bird habitat within those ecodistricts potentially affected by the Project were assessed. Approximately 0.15% of the area within the relevant ecodistricts is expected to be affected by the Project, with an additional 9.8% potentially affected by other developments including forestry activities.

Forestry roads may also temporarily increase human access to areas suitable for waterfowl and other game bird hunting. However, due to the uncertainty associated with the future location of potential forestry activities and associated roads, sufficient information is not available to fully assess the potential **cumulative impacts** to birds resulting from human access via access roads.

No significant adverse cumulative effects to birds are expected as a result of the Project in combination with other projects or activities. Therefore, the residual effects of the Project to birds are not considered to be significant.

8.7 MONITORING AND FOLLOW-UP

The bird monitoring program outlined in Sections 8.7.1 to 8.7.3 is primarily intended to confirm impact statements regarding the effects of the Project on birds as described in this EIS (Sections 8.4 to 8.6), and to test whether unexpected impacts are occurring. Should unexpected impacts occur, information obtained from baseline and monitoring studies will assist in the review and development of any **mitigation** measures that may be required. Such monitoring is a responsible follow-up to project implementation and is a typical current practice for Manitoba Hydro.

8.7.1 Continued Baseline Studies

To provide context to which construction and operation monitoring studies can be compared, several years of baseline studies must be conducted. Due to the degree of natural annual variation in bird abundance and distribution patterns, several years of baseline studies are required to account for the average variation of bird abundance and distribution in the bird study area. Information from several years of surveys will be used to produce an accurate baseline that describes the existing **environment** regarding bird presence and use of the Wuskwatim study area with a level of accuracy that will allow meaningful comparisons with study results from construction and post-construction monitoring periods. Baseline studies were conducted in 2000 and 2001, and are proposed to continue, prior to the initiation of project construction. Since water levels won't be relatively stable at 234 m ASL until October 2008, baseline studies with respect to the current water regime can potentially occur up to, and including 2007 (Volume 4).

Due to the annual variability in bird populations, the ability to detect potential changes in bird populations as a result of project construction and operation increases with each additional year of survey data during baseline and monitoring years. Regarding the potential effects of project construction activities and stabilized water levels at 234 m ASL on terrestrial breeding birds, one or two additional years of baseline bird survey data is required for the ability to detect a substantial (e.g., 10%) decrease in bird populations in key terrestrial habitat types most common in the potentially affected areas (Appendix 8.8.6).

8.7.2 Monitoring During Construction

In addition to monitoring project-related impacts to birds during project operation (Section 8.7.3), the effects of project construction activities will also be monitored to test construction-related impact predictions regarding birds.

Monitoring of birds will occur during Project construction to monitor local bird population reactions to construction-related disturbances that are either least understood and less accurately predictable due to lack of relevant previous studies, or which require investigation because of the potential for substantive effects. Among the construction-related disturbances that require additional study to deduce the effects to birds include blasting and forebay water level increase. Therefore, bird surveys will be conducted in habitats near where clearing and construction activities would occur.

8.7.3 Monitoring During Operation

Three to four years of bird survey data will be required during project operation to test EIS predictions regarding bird impacts and to determine if any mitigation efforts are required due to unexpected impacts. Monitoring of bird population and distribution during generating station operation will provide data that will be compared to the three to four years of baseline study results and the several years of construction monitoring results.

After three to four years of bird monitoring studies during project operation, the monitoring program will be reviewed to assess whether additional years of monitoring are required to accurately determine if any operation effects are occurring regarding bird populations and distribution in the area affected by project operation.

8.8 APPENDICES

The following sub-sections contain additional relevant information referred to in previous bird-related sections of the EIS (Section 8). Detailed results and discussion regarding scientific bird studies conducted in the bird study area in 2000 and 2001 are provided in supplemental field study reports (Tetr*ES* 2003a,b).

8.8.1 Bird List for the Wuskwatim Generating Station Bird Study Area

A bird list for the Bird Study area is provided in Table 8.8-1.

8.8.2 EIS Study Methods

Additional details regarding bird survey methods not described in Section 8.2 are provided in Sections 8.8.2.1 to 8.8.2.5.

8.8.2.1 Helicopter Surveys

The standard operating procedures used to conduct helicopter surveys were as follows:

- wind speed was less than 25 km/hr;
- flew at approximately 80 km/hr at 30-45 m;
- the helicopter flew primarily within 200 m of waterbody shorelines such that when surveying lakes, one observer had a clear view of the shoreline while the second observer viewed the main body of the lake;
- a third person directed the pilot and tracked the progress of helicopter using a Garmin GPS (Global Positioning System) in relation to mapping and the pre-selected survey route;

  - this individual also served as a secondary observer, and informed primary observers of wildlife sightings;
  - the guide/secondary observer was available for some portions of survey in the spring and summer;
- two primary observers were positioned on opposite sides of the helicopter and recorded all wildlife within 200 m of the helicopter;
- recorded survey times at continuous intervals including the beginning and end of waterbodies and prominent landforms along the route;
- recorded number and species of birds and other wildlife notes on data sheets;
- acronyms were used for birds seen to abbreviate writing time and optimize observation time;
- unidentifiable shorebirds were categorized as small, medium, or large; and
- recorded pertinent observations regarding landform and habitat features (e.g., plant community type, woody debris) along the survey route.

Aerial surveys were designed for assessing populations of larger birds such as waterfowl, other large waterbirds (e.g., gulls) and raptors such as eagles. Therefore, aerial surveys underestimated numbers of small birds such as passerines and, to a lesser extent, shorebirds.

TABLE 8.8-1

BIRD LIST[a] FOR THE WUSKWATIM GENERATING STATION STUDY AREA

Scientific Name	Common Name	Status[b]	Observed During 2000 Fieldwork	Observed During 2001 Fieldwork
Gavia immer	Common Loon	B	✓	✓
Podilymbus podiceps	Pied-billed Grebe	B	✓	✓
Podiceps auritus	Horned Grebe	B	✓	
Podiceps grisegena	Red-necked Grebe	B	✓	✓
Aechmophorus occidentalis	Western Grebe	B,N		
Pelecanus erythrorhynchos	American White Pelican	B,N	✓	
Phalacrocorax auritus	Double-crested Cormorant	B,N	✓	✓
Botaurus lentiginosus	American Bittern	B	✓	
Nycticorax nycticorax	Black-crowned Night-Heron	B,N		
Ardea herodias	Great Blue Heron	B	✓	✓
Cygnus columbianus	Tundra Swan	M	✓	✓
Anser albifrons	Greater White-fronted Goose	M		
Anser caerulescens	Snow Goose	M	✓	
Anser rossii	Ross's Goose	M		
Branta canadensis	Canada Goose	B	✓	✓
Aix sponsa	Wood Duck	B,N		
Anas crecca	Green-winged Teal	B	✓	✓
Anas rubripes	American Black Duck	B	✓	✓
Anas platyrhynchos	Mallard	B	✓	✓
Anas acuta	Northern Pintail	B	✓	✓
Anas discors	Blue-winged Teal	B	✓	✓
Anas clypeata	Northern Shoveller	B	✓	✓
Anas strepera	Gadwall	B,N	✓	
Anas americana	American Wigeon	B	✓	✓
Aythya valisinerina	Canvasback	B,N	✓	
Aythya americana	Redhead	B,N		
Aythya collaris	Ring-necked Duck	B	✓	✓
Aythya marila	Greater Scaup	M	✓	✓
Aythya affinis	Lesser Scaup	B	✓	✓
Somateria mollissima	Common Eider	M		
Melanitta nigra	Black Scoter	M	✓	✓
Melanitta perspicillata	Surf Scoter	M		
Melanitta fusca	White-winged Scoter	B	✓	
Bucephala clangula	Common Goldeneye	B	✓	✓
Bucephala albeola	Bufflehead	B	✓	✓
Lophodytes cucullatus	Hooded Merganser	B		✓
Mergus merganser	Common Merganser	B	✓	✓
Mergus serrator	Red-breasted Merganser	B	✓	
Oxyura jamaicensis	Ruddy Duck	B,N		
Pandion haliaetus	Osprey	B	✓	✓
Haliaeetus leucocephalus	Bald Eagle	B	✓	✓
Circus cyaneus	Northern Harrier	B	✓	
Accipiter striatus	Sharp-shinned Hawk	B	✓	✓
Accipiter cooperii	Cooper's Hawk	B,N	✓	

Table 8.8-1 (cont'd)

Scientific Name	Common Name	Status[b]	Observed During 2000 Fieldwork	Observed During 2001 Fieldwork
Accipiter gentilis	Northern Goshawk	P		
Buteo platypterus	Broad-winged Hawk	B,N		
Buteo jamaicensis	Red-tailed Hawk	B	✓	✓
Buteo lagopus	Rough-legged Hawk	M	✓	
Aquila chrysaetos	Golden Eagle	B	✓	
Falco sparverius	American Kestrel	B	✓	✓
Falco columbarius	Merlin	B	✓	✓
Falco peregrinus anatum	Peregrine Falcon	M		
Falco rusticolus	Gyrfalcon	W[?]		
Perdix perdix	Gray (Hungarian) Partridge	I, B[?],N		
Dendragapus canadensis	Spruce Grouse	P	✓	
Lagopus lagopus	Willow Ptarmigan	B[?]	✓	
Bonasa umbellus	Ruffed Grouse	P	✓	✓
Tympanuchus phasianellus	Sharp-tailed Grouse	P		
Coturnicops noveboracensis	Yellow Rail	B		
Rallus limicola	Virginia Rail	B[?],N		
Porzana carolina	Sora	B	✓	✓
Fulica americana	American Coot	B	✓	✓
Grus canadensis	Sandhill Crane	B	✓	✓
Grus americana	Whooping Crane	M[?]		
Pluvialis dominica	Lesser golden-Plover	M		
Charadrius semipalmatus	Semipalmated Plover	M		
Charadrius melodus	Piping Plover	B[?],N		
Charadrius vociferus	Killdeer	B		
Tringa melanoleuca	Greater Yellowlegs	B	✓	✓
Tringa flavipes	Lesser Yellowlegs	B	✓	✓
Tringa solitaria	Solitary Sandpiper	B		✓
Actitis macularia	Spotted Sandpiper	B	✓	✓
Numenius borealis	Eskimo Curlew	M[?]		
Limosa haemastica	Hudsonian Godwit	M		
Limosa fedoa	Marbled Godwit	B[?]		
Arenaria interpres	RuddyTurnstone	M	✓	✓
Calidris conutus	Red Knot	M		
Calidris alba	Sanderling	M		
Calidris pusilla	Semipalmated Sandpiper	M		
Calidris minutilla	Least Sandpiper	M	✓	
Calidris bairdii	Baird's Sandpiper	M		
Calidris melanotos	Pectoral Sandpiper	M		
Calidris alpina	Dunlin	M[?]		
Limnodromus griseus	Short-billed Dowitcher	B[?]		
Gallinago gallinago	Common Snipe	B	✓	✓
Phalaropus tricolor	Wilson's Phalarope	B,N		
Phalaropus lobatus	Red-necked Phalarope	M	✓	
Phalaropus fulicarius	Red Phalarope	M[?]		
Larus pipixcan	Franklin's Gull	B,N		
Larus philadelphis	Bonaparte's Gull	B	✓	✓

Table 8.8-1 (cont'd)

Scientific Name	Common Name	Status[b]	Observed During 2000 Fieldwork	Observed During 2001 Fieldwork
Larus delawarensis	Ring-billed Gull	B	✓	✓
Larus argentatus	Herring Gull	B	✓	✓
Sterna caspia	Caspian Tern	B		
Sterna hirundo	CommonTern	B	✓	✓
Sterna forsteri	Forster's Tern	B[?],N		
Chlidonias niger	Black Tern	B	✓	✓
Zenaida macroura	Mourning Dove	B[?],N		
Bubo virginianus	Great Horned Owl	P	✓	
Nyctea scandiaca	Snowy Owl	M,W		
Surnia ulula	Northern Hawk-Owl	P		
Strix varia	Barred Owl	P		
Strix nebulosa	Great Gray Owl	P		
Asio otus	Long-eared Owl	B		
Asio flammeus	Short-eared Owl	B		
Aegolius funerus	Boreal Owl	P		
Aegolius acadicus	Northern saw-whet Owl	P,N		
Chordeiles minor	Common Nighthawk	B	✓	✓
Chaetura pelagica	Chimney Swift	B[?],N		
Archilochus colubris	Ruby-throated Hummingbird	B,N		
Cerlye alcyon	Belted Kingfisher	B	✓	✓
Sphyrapicus varius	Yellow-bellied Sapsucker	B	✓	✓
Picoides pubescens	Downy Woodpecker	P		
Picoides villosus	Hairy Woodpecker	P	✓	✓
Picoides tridactylus	Three-toed Woodpecker	P		
Picoides arcticus	Black-backed Woodpecker	P	✓	✓
Colaptes auratus	Northern Flicker	B	✓	✓
Dryocopus pileatus	Pileated Woodpecker	P	✓	✓(evidence)
Contopus borealis	Olive-sided Flycatcher	B	✓	✓
Empidonax flaviventris	Yellow-bellied Flycatcher	B	✓	✓
Empidonax alnorum	Alder Flycatcher	B	✓	✓
Empidonax minimus	Least Flycatcher	B	✓	✓
Sayornis phoebe	Eastern Phoebe	B		
Tyrannus tyrannus	Eastern Kingbird	B	✓	✓
Eremophila alpestris	Horned Lark	B[?],W	✓	
Tachycineta bicolor	Tree Swallow	B	✓	✓
Riparia riparia	Bank Swallow	B	✓	
Hirundo pyrrhonota	Cliff Swallow	B		
Hirundo rustica	Barn Swallow	B		
Perisoreus canadensis	Gray Jay	P	✓	✓
Cyanocitta cristata	Blue Jay	B		
Pica pica	Black-billed Magpie	P		
Corvus brachyrhynchos	American Crow	P	✓	✓
Corvus corax	Common Raven	P	✓	✓
Parus atricapillus	Black-capped Chickadee	P		
Parus hudsonicus	Boreal Chickadee	P	✓	✓
Sitta canadensis	Red-breasted Nuthatch	P	✓	✓
Sitta carolinensis	White-breasted Nuthatch	P,N		

Table 8.8-1 (cont'd)

Scientific Name	Common Name	Status[b]	Observed During 2000 Fieldwork	Observed During 2001 Fieldwork
Certhia americana	Brown Creeper	P,N		✓
Troglodytes aedon	House Wren	B[?],N		
Troglodytes troglodytes	Winter Wren	B	✓	✓
Cistothorus platensis	Sedge Wren	B		✓
Cistothorus palustrus	Marsh Wren	B[?],N	✓	✓
Regulus satrapa	Golden-crowned Kinglet	B	✓	✓
Regulus calendula	Ruby-crowned Kinglet	B	✓	✓
Sialia currucoides	Mountain Bluebird	B		
Catharus minimus	Gray-cheeked Thrush	M		
Catharus ustulatus	Swainson's Thrush	B	✓	✓
Catharus guttatus	Hermit Thrush	B	✓	✓
Turdus migratorius	American Robin	B	✓	✓
Dumetalla carolinesis	Gray Catbird	B[?],N		
Toxostoma rufum	Brown Thrasher	B[?],N		
Anthus spinoletta	Water Pipit	M	✓	✓
Bombycilla garrulus	Bohemian Waxwing	B		
Bombycilla cedrorum	Cedar Waxwing	B	✓	✓
Lanius excubitor	Northern Shrike	M		
Sturnus vulgaris	European Starling	B,I		
Vireo solitarius	Blue-headed Vireo	B		
Vireo gilvus	Warbling Vireo	B[?],N		
Vireo philadelphicus	Philadelphia Vireo	B		
Vireo olivaceus	Red-eyed Vireo	B	✓	✓
Vermivora peregrina	Tennessee Warbler	B	✓	✓
Vermivora celata	Orange-crowned Warbler	B	✓	✓
Vermivora ruficapilla	Nashville Warbler	B	✓	✓
Dendroica petechia	Yellow Warbler	B	✓	✓
Dendroica pensylvanica	Chestnut-sided Warbler	B[?],N		
Dendroica magnolia	Magnolia Warbler	B	✓	✓
Dendroica tigrina	Cape May Warbler	B	✓	✓
Dendroica coronata	Yellow-rumped Warbler	B	✓	✓
Dendroica virens	Black-throated Green Warbler	B	✓	✓
Dendroica fusca	Blackburnian Warbler	B	✓	✓
Dendroica palmarum	Palm Warbler	B	✓	✓
Dendroica castanea	Bay-breasted Warbler	B	✓	✓
Dendroica striata	Blackpoll Warbler	B	✓	✓
Mniotilta varia	Black-and-white Warbler	B		
Setophaga ruticilla	American Redstart	B		
Seiurus aurocapillus	Ovenbird	B	✓	✓
Seiurus noveboracensis	Northern Waterthrush	B	✓	✓
Oporonsis agilis	Connecticut Warbler	B		
Oporornis philadelphia	Mourning Warbler	B		
Geothlypis trichas	Common Yellowthroat	B	✓	✓
Wilsonia pusilla	Wilson's Warbler	B		
Wilsonia candensis	Canada Warbler	B		
Pheucticus ludovicianus	Rose-breasted Grosbeak	B	✓	
Spizella arborea	American Tree Sparrow	B	✓	✓

Table 8.8-1 (cont'd)

Scientific Name	Common Name	Status[b]	Observed During 2000 Fieldwork	Observed During 2001 Fieldwork
Spizella passerina	Chipping Sparrow	B	✓	✓
Spizella pallida	Clay-colored Sparrow	B?,N	✓	
Pooecetes gramineus	Vesper Sparrow	B		
Passerculus sandwichensis	Savannah Sparrow	B	✓	✓
Ammodramus leconteii	Le conte's Sparrow	B	✓	✓
Ammodramus caudacutus	Sharp-tailed Sparrow	B?,N		
Passerella iliaca	Fox Sparrow	B		
Melospiza melodia	Song Sparrow	B	✓	
Melospiza lincolnii	Lincoln's Sparrow	B	✓	✓
Melospiza georgiana	Swamp Sparrow	B		
Zonotrichia albicollis	White-throated Sparrow	B	✓	✓
Zonotrichia leucophrys	White-crowned Sparrow	B	✓	
Zonotrichia querula	Harris's Sparrow	M	✓	
Junco hyemalis	Dark-eyed Junco	B	✓	✓
Calcarius lapponicus	Lapland Longspur	M	✓	
Calcarius pictus	Smith's Longspur	M		
Plectophenax nivalis	Snow Bunting	M		
Agelaius phoeniceus	Red-Winged Blackbird	B	✓	✓
Xanthocephalus xanthocephalus	Yellow-headed Blackbird	B		✓
Euphagus carolinus	Rusty Blackbird	B	✓	✓
Euphagus cyanocephalus	Brewer's Blackbird	B	✓	
Quiscalus quiscula	Common Grackle	B	✓	✓
Molothrus ater	Brown-headed Cowbird	B		
Icterus galbula	Northern Oriole	B,N		
Pinicola enucleator	Pine Grosbeak	P	✓	
Carpodacus purpureus	Purple Finch	B		✓
Loxia curvirostra	Red Crossbill	P		
Loxia leucoptera	White-winged Crossbill	P		
Carduelis flammea	Common Redpoll	P	✓	✓
Carduelis hornemanni	Hoary Redpoll	M,W		
Carduelis pinus	Pine Siskin	B?,N		
Carduelis tristis	American Goldfinch	B,N	✓	
Coccothraustes vespertinus	Evening Grosbeak	B,N		
Passer domesticus	House Sparrow	B,I		

[a] Birds known or likely to occur within the study area
[b] Note: B = breeding, M = migrant, P = permanent resident, N = northern extent of range, W = winter range, I = introduced, ? = unknown; appropriate habitat uncertain
Source: Godfrey 1986

8.8.2.2 Boat-Based Surveys

On Wuskwatim Lake, Wuskwatim Brook and Cranberry Lake, survey stops occurred approximately every kilometre (Figure 8.2-4). On Sesep Lake, Opegano Lake and the Burntwood River from Cranberry Lake to Early Morning Rapids, the survey boat continuously traveled at a slow speed (5 to 15 km/hr) along shoreline areas (Figure 8.2-5). On the main portions of lakes (Wuskwatim, Cranberry, Sesep and Opegano), the boat was typically about 30-100 m off-shore and as much as 200 m off-shore where woody debris did not permit travel closer to shore. In back bay areas and along creeks and channels, the boat was often 10-30 m from shore. Two biologists used binoculars to scan the water and adjacent habitat for wildlife within 360° of the boat. These surveys were specifically designed to efficiently locate waterbirds. However, other types of birds as well as mammals and amphibians were recorded when observed or heard. The following information was recorded onto data sheets:

- general background information, i.e., observer names, date, survey replicate number;
- weather conditions, including percentage of cloud cover, temperature, wind speed (recorded with an anemometer and precipitation;
- location, using a Garmin GPS, and time for each survey stop or sample area; and
- wildlife information including species, number observed, habitat, activity (e.g., foraging, loafing, resting) and general observations.

To ensure that birds were neither re-counted nor under-represented during surveys, records were kept of any birds that were outside the area being sampled or that were displaced by the motorboat.

8.8.2.3 Terrestrial Breeding Bird Surveys

General habitat descriptions for each transect and detailed descriptions of each stop provided in Tetr*ES* (2002a,b). Habitat groups surveyed during terrestrial breeding bird surveys are listed in Section 7.2, Table 7.2-1.

The methods for conducting breeding bird inventories were consistent with standard procedures for conducting population surveys using the Point Count Method (Ralph *et al*.1993; Welsh 1993). Surveys were conducted between 0445h and 1100h. Each transect stop was located at approximately 150 m intervals. The UTM coordinates of each transect stop were recorded using a Garmin 12 GPS unit. Two biologists recorded all birds heard and observed within a 75 m radius at each stop. One of the two biologists recorded information on one data sheet to avoid double-counting birds at each stop. After the biologists arrived at a new stop, they waited a few minutes for birds to settle down prior to beginning the five minute sample. The number of birds and other wildlife heard or seen was recorded. Additional information collected included the number of birds heard or seen outside 75 m radius area and the number of birds flying over each stop. The number of stops per transect ranged from 1 to 10 (Tetr*ES* 2003a,b).

The length and orientation of transects were adapted to suit the terrain associated with each survey area. For example, most transects were located along low riparian or lake shore habitat with the shoreline located within a few metres of the observers. The habitat use of each bird relative to habitat edges was also recorded (e.g., water, marsh, forest interior, etc.).

The number and locations of breeding bird transects conducted were primarily restricted by boat access and weather conditions. Surveys were not conducted when rain or winds (approximately ≥20 km/hr) interfered with the intensity or audibility of bird songs, or when fog or rain interfered with visibility. Although surveys typically ended around 1000h, they ended as early as 0930h in cases where bird singing ceased (likely in response to environmental cues such as increasing temperature). Since surveys occurred in the morning hours, a few species that are more active and sing more frequently in the evening and at night were likely under-represented during counts (e.g., Common Nighthawks, Owls).

The field investigators conducting the surveys were familiar with the songs, calls, and visual identification of the species encountered. Pre-field training, including listening to bird calls and pre-field work in the Wuskwatim area, added to the integrity of species identification and resulting data.

8.8.2.4 Reconnaissance

In addition to standard bird survey techniques, general reconnaissance of key areas likely to be affected by the Project was also conducted before and after bird surveys. Additional information regarding birds and other wildlife was noted and is presented in annual field study reports (Tetr*ES* 2003a,b).

8.8.2.5 Habitat-based Analysis (Access Road)

Habitat Suitability Index (HSI) models present a set of hypotheses concerning species-habitat relationships (Kuhnke and Watkins 1999). These models are a compilation of research data, literature review and expert opinion: often the end product of modelling workshops involving a number of environmental and resource management professionals. The HSI models are designed to utilize the Manitoba Forest Resource Inventory (FRI) database, which describes the vegetative compositions of distinct forest stands throughout the province. The assigning of an HSI value to a particular stand (within a range between 0.0 - 1.0, with 1.0 representing optimum habitat) indicates only the presence of vegetation-based habitat features that are important to the life requirements of a given species. Other factors that may affect the distribution patterns of a species are not accounted for, limiting the HSI models' power in predicting actual population levels.

The species that were chosen for modelling in this analysis followed the list proposed by Kuhnke and Watkins (1999) on behalf of the Manitoba Forestry / Wildlife Management Project (MFWMP). Their objective was to assemble a list of vertebrate species from a full spectrum of habitat conditions that would effectively serve as a cross-section of all wildlife habitat use found in the boreal forest. It was recognized by the MFWMP that a selection process should include reference to both emphasis and indicator species. Emphasis species have specific commercial, recreational, cultural and aesthetic values to society. Indicator species are used in a surrogate role to represent the habitat preferences of a number of different species with similar life requirements. Only the avian species selected by Kuhnke and Watkins that currently have Manitoba-based HSI models were evaluated for this section. These species are listed below:

Emphasis Species	Indicator Species
Great Gray Owl	Common Yellowthroat
Pileated Woodpecker	Yellow Warbler
Ruffed Grouse	Magnolia Warbler
Three-toed Woodpecker	Barred Owl
	Red-breasted Nuthatch
	Black-and-white Warbler
	Ruby-crowned Kinglet

This analysis compares the habitat potential of a buffer zone extending 1 kilometre to each side of the Wuskwatim Generating Station access road against the overall habitat potential present within the NCN Resource Management Area (RMA). Prime Habitat Equivalent (PHE) values were calculated to assist in this comparison. A PHE value is derived by multiplying the area of a given forest stand (in hectares) by its modeled HSI value. These stand-level PHE values were then summed to estimate the theoretical potential for an avian species across the entire evaluated area. While this is an over-simplification of actual conditions, it is a convenient generalization enabling a comparison of habitat potentials on a landscape-level of analysis. Table 8.4-2 in Section 8.4.2.1 summarizes the calculated PHE values for productive and non-productive (where applicable) code forested areas within each of the two evaluated areas. The area-adjusted PHE figures within the shaded columns of Table 8.4-2 should be used to weigh the relative potentials of the two areas being compared.

8.8.3 Construction-related Effects on Valued Ecosystem Component Species

This section discusses expected project-related construction effects on bird species that have been selected as VECs (Section 8.2.4.5).

Project construction-related activities are expected to have a short-term, site-specific, small and therefore insignificant negative impact on bird VECs in the bird study area.

VEC Species - Canada Goose

Impact on Nesting

Limited sub-optimal goose nesting habitat occurs in the areas of proposed generating station construction activities including the construction camp and related infrastructure areas adjacent to the generating station site. No goose nests have been observed in those areas during field studies conducted in 2000 and 2001 (Tetr*ES* 2003a,b).
Preliminary examination of habitat maps of the proposed access road route and borrow areas suggest that very little habitat suitable for goose nesting occurs along, or immediately adjacent to the road route, or within or adjacent to proposed borrow areas. Ground-based surveys and helicopter over-flights during early July 2002, revealed that geese occurred in very low numbers along the proposed access road route (Tetr*ES* 2003b). No goose nests or evidence of nesting were present at that time.

Within the Wuskwatim study area, more suitable Canada Goose nesting habitat occurs at larger waterbodies, preferably with some marsh and island habitat such as at Harding Lake and the Wuskwatim Brook area (Tetr*ES* 2003a,b).

Impact on Feeding Habitat

The dominant forage of Canada Geese includes grasses and sedges (Section 8.3.4) that most commonly occur in lowland areas adjacent to fens, bogs and marshes and more upland, non- or sparsely-forested ridges. Since the majority of habitat to be cleared during construction-related activities at the generating station and construction camp site is forested (approximately 95%), a limited amount of Canada Goose foraging habitat will be affected in those areas. Some suitable Canada Geese foraging habitat occurs along non-forested and sparsely forested areas along the proposed access road route, including within the sparsely treed muskeg areas that constitute approximately 32% of the access road route. Berry-bearing plants that are also important forage for Canada Geese occur within these more open areas and will attract some geese, particularly during fall migration. Overall, the area to be cleared for the access road would not remove a locally significant amount of Canada Goose foraging habitat.

Impact on Brood-rearing Habitat

During July in the Wuskwatim study area, the majority of Canada Geese are rearing their young (Tetr*ES* 2003a,b). Habitat where geese have been observed rearing their young is similar to areas where they have been observed nesting (i.e., areas within or near larger waterbodies with marsh and island habitat and also along the Burntwood River; Tetr*ES* 2003a,b). The proposed access road route does not traverse through any areas that would be considered important or ideal Canada Goose brood-rearing habitat. Therefore, access road construction will not significantly impact Canada Goose brood-rearing habitat.

Very limited potential goose brood-rearing habitat occurs within the footprint area of the construction camp, generating station and associated facilities as over 94% of these areas consist of inland mature forests that are not suitable goose brood-rearing habitat. No goose broods have been observed in or adjacent to the high velocity turbulent water at Taskinigup Falls where the proposed spillway will be constructed (Tetr*ES* 2003a,b). However, up to four adult Canada Geese have been observed in bay habitat between Wuskwatim Falls and Taskinigup Falls during spring bird surveys (Tetr*ES* 2003b). It is possible that a few goose nests and broods may occur in this bay habitat that will be cleared and flooded during generating station construction. However, much more abundant brood-rearing habitat occurs at nearby areas such as at the south arm of Wuskwatim Lake and the Wuskwatim Brook area. Therefore, construction activities in the generation station area will not significantly impact Canada Goose brood-rearing habitat.

<u>VEC Species - Mallard</u>

Impact on Nesting

The Mallard is considered an 'upland' nesting duck species meaning that they are primarily a ground-nesting species that frequently nests away from water (Section 8.3.4). Mallards typically nest within 90 metres of water but may nest 450 metres or more away from water (Bellrose 1976). Therefore, it is likely that some mallards may nest within the areas that will be affected by the generating station construction activities that provide suitable nest cover (e.g., dense vegetation approximately 0.5 metres high; Bellrose 1976). Once the construction camp and associated facility areas are decommissioned and left to naturally re-vegetate, the resulting young, dense successional plant growth that occurs within the first few years of forest regeneration would potentially provide better Mallard nesting cover than the original forest habitat in areas that are not much further than 100 metres distance from the river or lake shoreline. However, Mallards require some amount of marsh habitat at least within one or two kilometres from the nest site as brood-rearing habitat. Very little marshy habitat will be present in the vicinity of the generating station site as a result of clearing and flooding of shoreline habitat within the forebay area of the Burntwood River within the first few years. Therefore, it is likely that very few Mallards would nest within the regenerating areas in the first few years following the decommissioning of construction camp and associated areas. However, some marsh habitat will likely become re-established over time within the shallow near-shore areas within bay habitat in the cleared and flooded area thereby improving the potential for Mallards to nest near this forebay area.

Clearing of the access road ROW will likely remove some limited amount of Mallard nesting habitat. However, most of the road ROW is not located within or adjacent to areas that would be considered ideal, high Mallard productivity habitat (i.e., wetlands with abundant 0.4 hectare or smaller ponds with marsh vegetation; Bellrose 1976). Therefore, the effect of access road construction on mallard nesting habitat will not be significant.

Impact on Feeding Habitat

Mallards have a highly variable diet that consists mostly of the seeds of emergent aquatic plants and aquatic invertebrates (Bellrose 1976). The area that will be cleared at the generating station site to accommodate the construction camp and associated facilities does not include suitable aquatic habitat for foraging Mallards. The generating station spillway will be constructed at Taskinigup Falls, where turbulent high-velocity water is not suitable aquatic habitat for foraging Mallards. The forebay area of the Burntwood River that will be cleared and flooded during project construction contains some suitable foraging habitat along quieter, weedy shoreline areas and in small bays between Wuskwatim and Taskinigup Falls. Clearing and flooding of that area will result in a degradation of Mallard foraging habitat in the first year. However, as emergent aquatic vegetation becomes re-established along the new forebay shoreline, Mallard foraging habitat will improve.

Along the access road ROW, very little Mallard foraging habitat will be removed since the majority of the road ROW passes through forested and other non-wetland areas.

Impact on Brood-rearing Habitat

During summer months, when Mallard hens are raising their broods, they require waterbodies with some amount of marsh habitat for foraging and cover (Bellrose 1976). A very limited amount of potential brood-rearing habitat will be cleared and flooded within the forebay area between Wuskwatim Falls and Taskinigup Falls. However, more abundant brood-rearing habitat occurs within the local area such as Wuskwatim Brook, the south arm of Wuskwatim Lake and Sesep Lake. Therefore, construction activities at the generating station area would not significantly impact Mallard brood-rearing habitat.

The access road ROW also will not significantly impact Mallard brood-rearing habitat since the majority of the road ROW does not traverse through Mallard nesting, foraging or brood-rearing habitat.

VEC Species - Bufflehead and Common Goldeneye

Impact on Nesting

Bufflehead and Common Goldeneye nest in cavities (e.g., old woodpecker holes) which are often located in standing dead trees that are abundant throughout the Rat-Burntwood system (Section 8.3.4). Within the generating station and construction camp area, relatively few standing dead trees, suitable for nesting Bufflehead or Common Goldeneye, occur in the footprint area for the generating station, construction camp and associated facilities. The highest density (low to moderate) of standing dead trees in the generating station and camp area occurs in quiet bays in the Burntwood River forebay area between Wuskwatim Falls and Taskinigup Falls. These trees will be removed during forebay clearing activities, thereby removing a limited number of potential nest trees for these species. However, more abundant standing dead trees suitable for Bufflehead and Common Goldeneye nesting occur nearby in the south arm of Wuskwatim Lake, the Wuskwatim Brook area, and other environs of the Wuskwatim Lake area.

Limited potential nesting habitat for Bufflehead and Common Goldeneye occurs along the proposed access road route. These two **diving duck** species prefer larger, deeper ponds and lakes for foraging and brood-rearing (Bellrose 1976). Since few waterbodies occur along the access road route that would be suitable as nesting habitat for these two diving duck species, construction of the access road route will not significantly impact local Bufflehead and Common Goldeneye populations.

Impact on Feeding Habitat

The diets of both Bufflehead and Common Goldeneye consist mostly of animal matter such as aquatic insects, snails, mussels and other aquatic invertebrates (Bellrose 1976). During migration, most waterbodies would provide suitable foraging habitat for these species. However, during nesting and brood-rearing in spring and summer, females with broods commonly forage on larger lakes and rivers. As a result of clearing and flooding of the forebay area between Wuskwatim Falls and Taskinigup Falls, some Bufflehead and Common Goldeneye foraging habitat in that limited area will be degraded. Several years after forebay clearing and flooding, the aquatic invertebrate fauna will become well-established on the newly flooded substrate thereby improving Bufflehead and Common Goldeneye foraging habitat in the forebay area between Wuskwatim Falls and the spillway.

Since the proposed access road route does not traverse through or adjacent to a large number of waterbodies, very little Bufflehead and Common Goldeneye foraging habitat will be impacted by construction of the proposed access road.

Impact on Brood-rearing Habitat

Bufflehead and Common Goldeneye raise their broods on larger ponds and lakes with less dependence on marsh for cover compared to dabbler duck species such as Mallards (Bellrose 1976). It is possible that the quiet bay areas of the forebay area on the Burntwood River between Wuskwatim Falls and Taskinigup Falls that will be cleared and flooded may be used as brood-rearing habitat by a few Bufflehead and Common Goldeneye. However, much more extensive brood-rearing habitat for these two duck species occurs on nearby Wuskwatim Lake area. Therefore the clearing and flooding of the forebay area during construction activities will not significantly impact Bufflehead and Common Goldeneye brood-rearing habitat.

Since the proposed access road route does not traverse through or adjacent to a large number of waterbodies, very little suitable Bufflehead and Common Goldeneye brood-rearing habitat will be affected by construction of the proposed access road.

VEC Species - Common Loon

Impact on Nesting

The proposed forebay area of the Burntwood River between Wuskwatim Falls and Taskinigup Falls is not ideal Common Loon nesting habitat since loons prefer to nest on large lakes (Gingras and Paszkowski 1999), especially on islands in an area sheltered from strong wave action (Section 8.3.4). However, it is possible that a pair of loons may nest in one of the quiet bays in the forebay area, although no nesting loons have been observed in that area in 2000 and 2001 (Tetr*ES* 2003a,b). The clearing and flooding of this forebay area during Project construction will therefore not affect a large amount of loon nesting habitat.

The proposed access road route does not traverse through, or adjacent to, any larger waterbodies that would be considered suitable nesting habitat for Common Loons. Therefore, access road construction activities will not significantly impact Common Loon nesting habitat.

Impact on Feeding Habitat

Although Common Loons have not been observed within the proposed forebay area between Wuskwatim Falls and Taskinigup Falls, this area potentially provides foraging habitat for loons. Due to the relatively limited amount of potential loon foraging habitat within the proposed forebay area compared to the adjacent Wuskwatim Lake area, forebay clearing and flooding activities related to the construction of the Project will not significantly impact Common Loon foraging habitat.

The proposed access road route does not traverse through, or adjacent to, any larger waterbodies that would be considered preferred foraging habitat for Common Loons. However, during migration, it is possible that some loons may forage on adjacent streams and ponds containing sufficient-sized forage fish. Considering that loons more commonly forage on large lakes with abundant suitable forage fish available (Gingras and Paszkowski 1999), access road construction will not significantly impact Common Loon foraging habitat.

Impact on Brood-rearing Habitat

Although the proposed forebay area between Wuskwatim Falls and Taskinigup Falls is not ideal Common Loon nesting habitat, it is possible that a pair of loons may nest and have young in one of the sheltered bays in the forebay area. However, more abundant and more suitable Common Loon nesting and brood-rearing habitat occurs nearby in the south arm of Wuskwatim Lake, and other sheltered areas such as Wuskwatim Brook. Therefore, clearing and flooding of the proposed forebay area during project construction will not significantly impact Common Loon brood-rearing habitat.

Since the proposed access road route does not traverse through, or adjacent to, any large waterbodies that would be considered suitable loon nesting habitat, a significant amount of brood-rearing habitat will not be affected by access road construction activities.

Bald Eagle

Impact on Nesting and Brood-Rearing Habitat

Bald Eagles typically nest and raise young 3 to 20 metres off the ground in deciduous or coniferous trees near mainland or island shorelines (Section 8.3.5). During bird surveys in 2000 and 2001, no Bald Eagle nests were observed within the area to be cleared for the generating station camp, associated facilities or in the generating station footprint area. Eagle nests were also not observed in the area to be cleared and flooded along the Burntwood River between Taskinigup Falls and Wuskwatim Falls. Although some limited potential Bald Eagle nesting habitat will be cleared in the generating station area, abundant suitable Bald Eagle nesting habitat occurs throughout the Wuskwatim Lake area. Therefore, there will be a small, site-specific negative effect associated with the removal of a very limited amount of potential Bald Eagle nesting habitat. For the cleared area, except for the permanent generating station works, this effect will be temporary as potential nest trees will grow in **rehabilitated** sites (i.e., sites cleared for project construction purposes only; Volume 3).

The access road and borrow site areas are not located within or through areas adjacent to large lakes and rivers. Therefore, very little potential Bald Eagle nesting habitat will be affected by road construction and borrow site clearing.

Impact on Feeding Habitat

Bald Eagles typically forage for fish, carrion, smaller mammals and other birds such as waterfowl adjacent to larger waterbodies such as rivers and lakes (Section 8.3.5). The majority of the area to be cleared for the construction camp, associated facilities and generating station occurs inland from the Wuskwatim Lake and Burntwood River shorelines and would not be considered good foraging habitat for Bald Eagles.

Construction and clearing activities affecting the shoreline at Taskinigup Falls and the area between Wuskwatim Falls and Taskinigup Falls will alter and temporarily disrupt a very limited amount of potential Bald Eagle foraging habitat. More abundant Bald Eagle foraging habitat occurs throughout the Wuskwatim Lake area.

The access road and borrow site areas do not occur within or through areas that are considered typical foraging habitat for Bald Eagles. Therefore, road construction and borrow site clearing activities will have a very small, limited effect on Bald Eagle foraging habitat.

VEC Species - Red-winged Blackbird

Impact on Nesting and Brood-rearing Habitat

Red-winged Blackbirds nest almost exclusively in marsh habitat, particularly in cattail marshes (Section 8.3.6.2). Marsh habitat does not occur in the mainland and shoreline areas that will be cleared to accommodate the construction camp, associated facilities and generating station. Within the area to be cleared and flooded along the Burntwood River between Taskinigup Falls and Wuskwatim Falls, some very limited amount of emergent vegetation and potential Red-winged Blackbird nesting habitat may occur within bay areas along the river between the two falls. However, no Red-winged Blackbirds were recorded during a terrestrial breeding bird survey along the shoreline of one of these bay areas during spring 2001.

No marsh habitat, suitable for breeding Red-winged Blackbirds, has been observed during field studies along the proposed access road route (Section 5; Tetr*ES* 2003b). Ditch areas created on either side of the access road during construction may provide good conditions for the growth of cattails in open low, wet areas. Red-winged Blackbirds commonly nest in ditch areas adjacent to open areas containing dense cattail growth (Short 1985). Therefore, some limited amount of marsh habitat suitable for breeding Red-winged Blackbirds may be created immediately adjacent to the road in wet ditch areas adjacent to open non- or sparsely-forested habitat.

Impact on Feeding Habitat

Adult Red-winged Blackbirds have a variable diet consisting primarily of insects, spiders, and seeds, whereas the young are fed 100% insects (Section 8.3.6.2). During nesting, Red-winged Blackbirds typically forage in the marsh area near their nesting territory due to the abundant insects associated with marsh habitat. During migration, blackbirds congregate in flocks and will feed in a wide variety of habitats (Short 1985). As with nesting habitat, access road construction may affect a limited amount of foraging habitat. However, a limited amount of foraging habitat will also be created within low, wet ditches where cattails become established.

Surveys and reconnaissance of borrow site areas in 2002 indicated that these areas occur in upland habitat containing virtually no wetland habitat potentially suitable for Red-winged Blackbirds. Therefore, it is unlikely that borrow area clearing and material extraction activities will affect Red-winged Blackbirds.

VEC Species – Palm Warbler

Impact on Nesting and Brood-rearing Habitat

The Palm Warbler primarily nests in association with mature sphagnum bogs within scattered black spruce or barren areas (Section 8.3.6.2). This type of habitat generally does not occur in the mainland areas that will be cleared to accommodate the construction camp, associated facilities and generating station. Within the area to be cleared and flooded along the Burntwood River between Taskinigup Falls and Wuskwatim Falls, some limited amount of potential Palm Warbler habitat may occur in association with forested areas that will be cleared and flooded. However, more extensive spruce bog habitat occurs throughout the Wuskwatim Lake area which is ideal Palm Warbler nesting and brood-rearing habitat.

The potential for the removal of some limited amount of spruce bog habitat used by breeding Palm Warblers for nesting and brood-rearing is higher along the proposed access road route and borrow areas. The footprint of the access road/borrow areas would require the removal of approximately 33 hectares of black spruce treed muskeg (i.e., young and immature black spruce forest on peatland; Section 5) which would contain the majority of Palm Warbler habitat along the proposed access road route compared to other habitats that also occur along the route. This amount of black spruce treed muskeg comprises approximately 5% of the black spruce treed muskeg habitat that occurs within a two kilometre buffer zone area centred along the road route (i.e., Upland Buffer; Section 5). Therefore, abundant alternative Palm Warbler nesting habitat occurs adjacent to the access road route and borrow areas.

Impacts on Foraging Habitat

The diet of Palm Warblers consists mostly of insects which it hover-gleans from the ground and vegetation at various heights (Section 8.3.6.2). During the nesting period, Palm Warblers forage within their nesting territories. Therefore, Palm Warbler foraging habitat will be affected as discussed above under "Impacts on Nesting and Brood-rearing Habitat".

VEC-Species – Belted Kingfisher

Impact on Nesting and Brood-rearing Habitat

Belted Kingfishers typically nest in a one to two-metre long tunnel cavity, which the kingfishers excavate, near the top of a steep earth bank along river and lake shorelines (Section 8.3.7.2). During terrestrial breeding bird surveys conducted in 2000 and 2001 along the Burntwood River shoreline areas that will be affected by generating station construction activities, one Belted Kingfisher was observed foraging over the water each year (Tetr*ES* 2003a,b). Although no nest hole was located, there is a relatively small amount of suitable bank area that kingfishers could potentially nest in between Wuskwatim Falls and Taskinigup Falls. However, the majority of bank substrate, suitable for nesting kingfishers in the Wuskwatim area, occurs nearby in areas such as Wuskwatim Lake and Cranberry Lake and along the Burntwood River between Cranberry Lake and Early Morning Rapids.

Although the proposed access road route crosses several small streams, the total stream bank area that will be affected by road construction is very limited. Therefore, kingfisher nesting and brood-rearing habitat will not be significantly affected by access road construction activities. The borrow site areas are not located in habitat suitable for nesting kingfishers.

Impact on Foraging Habitat

Belted kingfisher foraging territories can be within and/or outside their established nesting territory (Section 8.3.7.2). To forage, kingfishers require suitable perch sites such as over-hanging/leaning trees or standing dead trees along the shorelines of lakes or rivers. Clearing activities in the forebay area between Wuskwatim and Taskinigup Falls will affect some kingfisher foraging habitat within this approximate 1.5 km length of the Burntwood River. Once that area is flooded to the treeline during spillway construction, the forebay area will again provide suitable perch sites for foraging Belted Kingfishers.

As previously stated, the proposed access road crosses only a few small streams and all potential borrow site areas except one are not located in areas potentially suitable for foraging kingfishers. Therefore, a very limited amount of potential kingfisher foraging habitat will be affected by road construction and borrow area clearing. More suitable kingfisher foraging habitat occurs nearby in areas along the Rat-Burntwood River system.

VEC Species – Common Snipe

Impact on Nesting and Brood-rearing Habitat

Common Snipe nest on the ground in young open mixedwood or deciduous woodlands and alder thickets frequently near marsh, fen or bog habitat (Section 8.3.7.2). The majority of habitat that will be cleared to accommodate the construction camp, associated facilities and generating station does not include this type of habitat. No Common Snipe were observed in those areas during reconnaissance and terrestrial breeding bird surveys in 2000 and 2001 (Tetr*ES* 2003a,b).

Although much of the access road route traverses through dryer upland areas wherever possible, the road will be constructed through some low, moist woodland areas where some Common Snipe may nest. Borrow site areas occur in upland locations that would not be suitable Common Snipe nesting habitat. However, Common Snipe and their preferred nesting habitat are very abundant throughout the Wuskwatim study area. Therefore, Common Snipe nesting habitat will not be significantly impacted by construction of the proposed access road and clearing of the potential borrow site areas.

Impact on Foraging Habitat

Common Snipe also forage within habitats suitable for nesting. Therefore, construction activities related to the construction camp, associated facilities and generating station will not significantly impact snipe foraging habitat due to the lack of that type of habitat in those areas. As previously stated, some amount of Common Snipe nesting, and therefore foraging, habitat will be affected by access road construction. However, abundant alternative habitat occurs throughout the Wuskwatim study area.

8.8.4 Wuskwatim Lake Water Levels During Peak Waterbird Nesting Season

Table 8.8-2 provides daily changes in the water level on Wuskwatim Lake during the peak waterbird nesting period (mid-April to mid-June) for those post-CRD years where complete data for that time period are available.

Table 8.8-2

OCCURRENCES WHEN WUSKWATIM LAKE WATER LEVELS INCREASED AT LEAST 20 CENTIMETRES (0.2 metres) DURING THE PEAK WATERBIRD NESTING PERIOD (MID-APRIL TO MID-JUNE)*

Day	1978 Water Level Elevation (m)	1978 Daily Waterlevel Change (m)	1979 Water Level Elevation (m)	1979 Daily Waterlevel Change (m)	1980 Water Level Elevation (m)	1980 Daily Waterlevel Change (m)	1981 Water Level Elevation (m)	1981 Daily Waterlevel Change (m)	1982 Water Level Elevation (m)	1982 Daily Waterlevel Change (m)	1983 Water Level Elevation (m)	1983 Daily Waterlevel Change (m)	1985 Water Level Elevation (m)	1985 Daily Waterlevel Change (m)
Apr 15	233.117		233.769		233.900		233.831		233.057		233.050		233.554	
Apr 16	233.087	-0.030	233.769	0.000	233.900	0.000	233.833	0.002	233.058	0.001	233.050	0.000	233.541	-0.013
Apr 17	233.056	-0.031	233.751	-0.018	233.910	0.010	233.821	-0.012	233.064	0.006	233.053	0.003	233.544	0.003
Apr 18	233.026	-0.030	233.739	-0.012	233.910	0.000	233.818	-0.003	233.071	0.007	233.060	0.007	233.544	0.000
Apr 19	232.992	-0.034	233.739	0.000	233.920	0.010	233.810	-0.008	233.076	0.005	233.069	0.009	233.545	0.001
Apr 20	232.962	-0.030	233.730	-0.009	233.920	0.000	233.806	-0.004	233.074	-0.002	233.072	0.003	233.550	0.005
Apr 21	232.931	-0.031	233.721	-0.009	233.930	0.010	233.804	-0.002	233.077	0.003	233.080	0.008	233.564	0.014
Week 1 Total		-0.186		-0.048		0.030		-0.027		0.020		0.030		0.010
Apr 22	232.919	-0.012	233.699	-0.022	233.940	0.010	233.795	-0.009	233.080	0.003	233.095	0.015	233.582	0.018
Apr 23	232.907	-0.012	233.681	-0.018	233.950	0.010	233.787	-0.008	233.088	0.008	233.109	0.014	233.604	0.022
Apr 24	232.895	-0.012	233.681	0.000	233.960	0.010	233.777	-0.010	233.095	0.007	233.124	0.015	233.651	0.047
Apr 25	232.879	-0.016	233.669	-0.012	233.970	0.010	233.771	-0.006	233.100	0.005	233.135	0.011	233.703	0.052
Apr 26	232.867	-0.012	233.660	-0.009	233.970	0.000	233.765	-0.006	233.107	0.007	233.157	0.022	233.745	0.042
Apr 27	232.855	-0.012	233.660	0.000	233.970	0.000	233.754	-0.011	233.115	0.008	233.170	0.013	233.794	0.049
Apr 28	232.843	-0.012	233.641	-0.019	233.950	-0.020	233.748	-0.006	233.130	0.015	233.162	-0.008	233.832	0.038
Week 2 Total		-0.088		-0.080		0.020		-0.056		0.053		0.082		**0.268**
Week 1 & 2 Total		-0.274		-0.128		0.050		-0.083		0.073		0.112		**0.278**
Apr 29	232.843	0.000	233.620	-0.021	233.930	-0.020	233.741	-0.007	233.166	0.036	233.186	0.024	233.863	0.031
Apr 30	232.840	-0.003	233.611	-0.009	233.920	-0.010	233.736	-0.005	233.218	0.052	233.201	0.015	233.897	0.034
May 01	232.840	0.000	233.590	-0.021	233.900	-0.020	233.730	-0.006	233.288	0.070	233.214	0.013	233.936	0.039
May 02	232.840	0.000	233.570	-0.020	233.880	-0.020	233.736	0.006	233.363	0.075	233.224	0.010	233.960	0.024
May 03	232.840	0.000	233.560	-0.010	233.860	-0.020	233.732	-0.004	233.427	0.064	233.236	0.012	233.980	0.020
May 04	232.837	-0.003	233.550	-0.010	233.830	-0.030	233.728	-0.004	233.486	0.059	233.250	0.014	233.991	0.011
May 05	232.837	0.000	233.530	-0.020	233.800	-0.030	233.736	0.008	233.538	0.052	233.265	0.015	233.971	-0.020
Week 3 Total		-0.006		-0.111		-0.150		-0.012		**0.408**		0.103		0.139
Week 2 & 3 Total		-0.094		-0.191		-0.130		-0.068		**0.461**		0.185		**0.407**
Week 1, 2 & 3 Total		-0.280		-0.239		-0.100		-0.095		**0.481**		0.215		**0.417**
May 06	232.846	0.009	233.520	-0.010	233.780	-0.020	233.762	0.026	233.574	0.036	233.276	0.011	233.969	-0.002
May 07	232.852	0.006	233.500	-0.020	233.750	-0.030	233.806	0.044	233.594	0.020	233.285	0.009	233.959	-0.010
May 08	232.861	0.009	233.500	0.000	233.730	-0.020	233.850	0.044	233.605	0.011	233.302	0.017	233.960	0.001
May 09	232.870	0.009	233.490	-0.010	233.690	-0.040	233.891	0.041	233.612	0.007	233.323	0.021	233.948	-0.012
May 10	232.876	0.006	233.490	0.000	233.670	-0.020	233.925	0.034	233.615	0.003	233.355	0.032	233.933	-0.015
May 11	232.885	0.009	233.480	-0.010	233.640	-0.030	233.952	0.027	233.608	-0.007	233.367	0.012	233.916	-0.017
May 12	232.898	0.013	233.470	-0.010	233.620	-0.020	233.974	0.022	233.617	0.009	233.389	0.022	233.902	-0.014
Week 4 Total		0.061		-0.060		-0.180		**0.238**		0.079		0.124		-0.069
Week 3 & 4 Total		0.055		-0.171		-0.330		0.226		**0.487**		**0.227**		0.070
Week 2, 3 & 4 Total		-0.033		-0.251		-0.310		0.170		**0.540**		**0.309**		0.338
Week 1, 2, 3 & 4 Total		-0.219		-0.299		-0.280		0.143		**0.560**		**0.339**		0.348
May 13	232.907	0.009	233.460	-0.010	233.600	-0.020	233.989	0.015	233.618	0.001	233.400	0.011	233.894	-0.008
May 14	232.916	0.009	233.460	0.000	233.570	-0.030	233.991	0.002	233.595	-0.023	233.408	0.008	233.882	-0.012
May 15	232.952	0.036	233.460	0.000	233.540	-0.030	233.986	-0.005	233.574	-0.021	233.422	0.014	233.879	-0.003
May 16	232.968	0.016	233.460	0.000	233.530	-0.010	233.982	-0.004	233.559	-0.015	233.434	0.012	233.878	-0.001
May 17	232.968	0.000	233.470	0.010	233.500	-0.030	233.975	-0.007	233.545	-0.014	233.447	0.013	233.869	-0.009
May 18	232.986	0.018	233.480	0.010	233.480	-0.020	233.964	-0.011	233.532	-0.013	233.466	0.019	233.855	-0.014
May 19	233.038	0.052	233.480	0.000	233.460	-0.020	233.955	-0.009	233.517	-0.015	233.472	0.006	233.827	-0.028
Week 5 Total		0.140		0.010		-0.160		-0.019		-0.100		0.083		-0.075
Week 4 & 5 Total		**0.201**		-0.050		-0.340		0.219		-0.021		0.207		-0.144
Week 3, 4 & 5 Total		0.195		-0.161		-0.490		0.207		0.387		0.310		-0.005
Week 2, 3, 4 & 5 Total		0.107		-0.241		-0.470		0.151		0.440		**0.392**		0.263
Week 1, 2, 3, 4 & 5 Total		-0.079		-0.289		-0.440		0.124		0.460		**0.422**		0.273
May 20	233.056	0.018	233.500	0.020	233.450	-0.010	233.941	-0.014	233.505	-0.012	233.468	-0.004	233.828	0.001
May 21	233.087	0.031	233.520	0.020	233.440	-0.010	233.919	-0.022	233.495	-0.010	233.475	0.007	233.828	0.000
May 22	233.160	0.073	233.540	0.020	233.430	-0.010	233.907	-0.012	233.481	-0.014	233.480	0.005	233.823	-0.005
May 23	233.187	0.027	233.580	0.040	233.410	-0.020	233.887	-0.020	233.464	-0.017	233.489	0.009	233.828	0.005
May 24	233.218	0.031	233.570	-0.010	233.400	-0.010	233.869	-0.018	233.448	-0.016	233.487	-0.002	233.823	-0.005
May 25	233.245	0.027	233.590	0.020	233.390	-0.010	233.850	-0.019	233.428	-0.020	233.482	-0.005	233.825	0.002
May 26	233.288	0.043	233.600	0.010	233.390	0.000	233.833	-0.017	233.409	-0.019	233.476	-0.006	233.832	0.007
Week 6 Total		**0.250**		0.120		-0.070		-0.122		-0.108		0.004		0.005
Week 5 & 6 Total		**0.390**		0.130		-0.230		-0.141		-0.208		0.087		-0.070
Week 4, 5 & 6 Total		**0.451**		0.070		-0.410		0.097		-0.129		0.211		-0.139
Week 3, 4, 5 & 6 Total		0.445		-0.041		-0.560		0.085		0.279		0.314		0.000
Week 2, 3, 4, 5 & 6 Total		0.357		-0.121		-0.540		0.029		0.332		0.396		0.268
Week 1, 2, 3, 4, 5 & 6 Total		0.171		-0.169		-0.510		0.002		0.352		**0.426**		0.278
May 27	233.306	0.018	233.610	0.010	233.400	0.010	233.814	-0.019	233.378	-0.031	233.475	-0.001	233.824	-0.008
May 28	233.330	0.024	233.630	0.020	233.420	0.020	233.790	-0.024	233.367	-0.011	233.487	0.012	233.810	-0.014
May 29	233.355	0.025	233.640	0.010	233.440	0.020	233.776	-0.014	233.347	-0.020	233.494	0.007	233.825	0.015
May 30	233.385	0.030	233.650	0.010	233.450	0.010	233.766	-0.010	233.324	-0.023	233.499	0.005	233.829	0.004
May 31	233.416	0.031	233.650	0.000	233.460	0.010	233.763	-0.003	233.305	-0.019	233.499	0.000	233.800	-0.029
Jun 01	233.440	0.024	233.670	0.020	233.480	0.020	233.768	0.005	233.279	-0.026	233.493	-0.006	233.811	0.011
Jun 02	233.458	0.018	233.680	0.010	233.510	0.030	233.776	0.008	233.256	-0.023	233.484	-0.009	233.812	0.001
Week 7 Total		0.170		0.080		0.120		-0.057		-0.153		0.008		-0.020
Week 6 & 7 Total		**0.420**		**0.200**		0.050		-0.179		-0.261		0.012		-0.015
Week 5, 6 & 7 Total		**0.560**		**0.210**		-0.110		-0.198		-0.361		0.095		-0.090
Week 4, 5, 6 & 7 Total		**0.621**		0.150		-0.290		0.040		-0.282		0.219		-0.159
Week 3, 4, 5, 6 & 7 Total		0.615		0.039		-0.440		0.028		0.126		0.322		-0.020
Week 2, 3, 4, 5, 6 & 7 Total		0.527		-0.041		-0.420		-0.028		0.179		0.404		0.248
Week 1, 2, 3, 4, 5, 6 & 7 Total		0.341		-0.089		-0.390		-0.055		0.199		**0.434**		0.258

Day	1994 Water Level Elevation (m)	1994 Daily Waterlevel Change (m)	1995 Water Level Elevation (m)	1995 Daily Waterlevel Change (m)	1996 Water Level Elevation (m)	1996 Daily Waterlevel Change (m)	1997 Water Level Elevation (m)	1997 Daily Waterlevel Change (m)	1998 Water Level Elevation (m)	1998 Daily Waterlevel Change (m)	1999 Water Level Elevation (m)	1999 Daily Waterlevel Change (m)	2000 Water Level Elevation (m)	2000 Daily Waterlevel Change (m)	2001 Water Level Elevation (m)	2001 Daily Waterlevel Change (m)
Apr 15	232.670		233.071		233.586		233.901		234.056		232.714		233.523		233.688	
Apr 16	232.664	-0.006	233.082	0.011	233.582	-0.004	233.877	-0.024	234.063	0.007	232.701	-0.013	233.495	-0.028	233.670	-0.018
Apr 17	232.659	-0.005	233.096	0.014	233.582	0.000	233.850	-0.027	234.068	0.005	232.690	-0.011	233.458	-0.037	233.655	-0.015
Apr 18	232.665	0.006	233.109	0.013	233.572	-0.010	233.825	-0.025	234.076	0.008	232.679	-0.011	233.428	-0.030	233.636	-0.019
Apr 19	232.671	0.006	233.132	0.023	233.558	-0.014	233.805	-0.020	234.081	0.005	232.672	-0.007	233.400	-0.028	233.615	-0.021
Apr 20	232.672	0.001	233.152	0.020	233.546	-0.012	233.780	-0.025	234.083	0.002	232.667	-0.005	233.380	-0.020	233.595	-0.020
Apr 21	232.682	0.010	233.160	0.008	233.534	-0.012	233.757	-0.023	234.092	0.009	232.662	-0.005	233.372	-0.008	233.563	-0.032
Week 1 Total		0.012		0.089		-0.052		-0.144		0.036		-0.052		-0.151		-0.125
Apr 22	232.691	0.009	233.181	0.021	233.516	-0.018	233.735	-0.022	234.095	0.003	232.657	-0.005	233.364	-0.008	233.528	-0.035
Apr 23	232.697	0.006	233.187	0.006	233.501	-0.015	233.719	-0.016	234.095	0.000	232.655	-0.002	233.352	-0.012	233.493	-0.035
Apr 24	232.692	-0.005	233.200	0.013	233.483	-0.018	233.703	-0.016	234.090	-0.005	232.656	0.001	233.347	-0.005	233.459	-0.034
Apr 25	232.695	0.003	233.201	0.001	233.460	-0.023	233.683	-0.020	234.087	-0.003	232.655	-0.001	233.356	0.009	233.427	-0.032
Apr 26	232.698	0.003	233.204	0.003	233.429	-0.031	233.666	-0.017	234.088	0.001	232.651	-0.004	233.371	0.015	233.398	-0.029
Apr 27	232.697	-0.001	233.216	0.012	233.393	-0.036	233.639	-0.027	234.094	0.006	232.647	-0.004	233.374	0.003	233.365	-0.033
Apr 28	232.702	0.005	233.214	-0.002	233.358	-0.035	233.622	-0.017	234.101	0.007	232.650	0.003	233.378	0.004	233.343	-0.022
Week 2 Total		0.020		0.054		-0.176		-0.135		0.009		-0.012		0.006		-0.220
Week 1 & 2 Total		0.032		0.143		-0.228		-0.279		0.045		-0.064		-0.145		-0.345
Apr 29	232.707	0.005	233.225	0.011	233.324	-0.034	233.594	-0.028	234.106	0.005	232.651	0.001	233.384	0.006	233.342	-0.001
Apr 30	232.712	0.005	233.228	0.003	233.291	-0.033	233.569	-0.025	234.108	0.002	232.653	0.002	233.404	0.020	233.365	0.023
May 01	232.717	0.005	233.232	0.004	233.261	-0.030	233.547	-0.022	234.105	-0.003	232.656	0.003	233.425	0.021	233.387	0.022
May 02	232.713	-0.004	233.238	0.006	233.231	-0.030	233.526	-0.021	234.107	0.002	232.654	-0.002	233.444	0.019	233.412	0.025
May 03	232.720	0.007	233.241	0.003	233.206	-0.025	233.508	-0.018	234.101	-0.006	232.656	0.002	233.461	0.017	233.428	0.016
May 04	232.724	0.004	233.244	0.003	233.185	-0.021	233.494	-0.014	234.122	0.021	232.661	0.005	233.474	0.013	233.441	0.013
May 05	232.731	0.007	233.261	0.017	233.166	-0.019	233.484	-0.010	234.135	0.013	232.668	0.007	233.487	0.013	233.447	0.006
Week 3 Total		0.029		0.047		-0.192		-0.138		0.034		0.018		0.109		0.104
Week 2 & 3 Total		0.049		0.101		-0.368		-0.273		0.043		0.006		0.115		-0.116
Week 1, 2 & 3 Total		0.061		0.190		-0.420		-0.417		0.079		-0.046		-0.036		-0.241
May 06	232.740	0.009	233.270	0.009	233.157	-0.009	233.475	-0.009	234.143	0.008	232.684	0.016	233.495	0.008	233.457	0.010
May 07	232.758	0.018	233.279	0.009	233.147	-0.010	233.467	-0.008	234.146	0.003	232.690	0.006	233.498	0.003	233.474	0.017
May 08	232.812	0.054	233.278	-0.001	233.135	-0.012	233.457	-0.010	234.148	0.002	232.707	0.017	233.504	0.006	233.488	0.014
May 09	233.088	0.276	233.283	0.005	233.128	-0.007	233.448	-0.009	234.149	0.001	232.726	0.019	233.529	0.025	233.488	0.000
May 10	233.096	0.008	233.277	-0.006	233.120	-0.008	233.447	-0.001	234.146	-0.003	232.749	0.023	233.532	0.003	233.482	-0.006
May 11	233.113	0.017	233.277	0.000	233.117	-0.003	233.446	-0.001	234.158	0.012	232.761	0.012	233.533	0.001	233.470	-0.012
May 12	233.134	0.021	233.287	0.010	233.118	0.001	233.441	-0.005	234.168	0.010	232.791	0.030	233.531	-0.002	233.454	-0.016
Week 4 Total		**0.403**		0.026		-0.048		-0.043		0.033		0.123		0.044		0.007
Week 3 & 4 Total		**0.432**		0.073		-0.240		-0.181		0.067		0.141		0.153		0.111
Week 2, 3 & 4 Total		**0.452**		0.127		-0.416		-0.316		0.076		0.129		0.159		-0.109
Week 1, 2, 3 & 4 Total		**0.464**		**0.216**		-0.468		-0.460		0.112		0.077		0.008		-0.234
May 13	233.165	0.031	233.296	0.009	233.121	0.003	233.432	-0.009	234.174	0.006	232.824	0.033	233.529	-0.002	233.429	-0.025
May 14	233.182	0.017	233.297	0.001	233.126	0.005	233.428	-0.004	234.176	0.002	232.849	0.025	233.530	0.001	233.414	-0.015
May 15	233.185	0.003	233.301	0.004	233.131	0.005	233.417	-0.011	234.174	-0.002	232.883	0.034	233.531	0.001	233.401	-0.013
May 16	233.197	0.012	233.313	0.012	233.138	0.007	233.405	-0.012	234.170	-0.004	232.922	0.039	233.540	0.009	233.419	0.018
May 17	233.220	0.023	233.325	0.012	233.144	0.006	233.394	-0.011	234.167	-0.003	232.955	0.033	233.549	0.009	233.440	0.021
May 18	233.242	0.022	233.310	-0.015	233.171	0.027	233.382	-0.012	234.164	-0.003	232.982	0.027	233.560	0.011	233.461	0.021
May 19	233.248	0.006	233.311	0.001	233.225	0.054	233.372	-0.010	234.156	-0.008	233.006	0.024	233.574	0.014	233.476	0.015
Week 5 Total		0.114		0.024		0.107		-0.069		-0.012		**0.215**		0.043		0.022
Week 4 & 5 Total		**0.517**		0.050		0.059		-0.112		0.021		**0.338**		0.087		0.029
Week 3, 4 & 5 Total		**0.546**		0.097		-0.133		-0.250		0.055		**0.356**		0.196		0.133
Week 2, 3, 4 & 5 Total		**0.566**		0.151		-0.309		-0.385		0.064		0.344		0.202		-0.087
Week 1, 2, 3, 4 & 5 Total		**0.578**		**0.240**		-0.361		-0.529		0.100		0.292		0.051		-0.212
May 20	233.248	0.000	233.314	0.003	233.285	0.060	233.360	-0.012	234.154	-0.002	233.030	0.024	233.589	0.015	233.486	0.010
May 21	233.247	-0.001	233.313	-0.001	233.343	0.058	233.348	-0.012	234.150	-0.004	233.058	0.028	233.608	0.019	233.520	0.034
May 22	233.241	-0.006	233.317	0.004	233.387	0.044	233.335	-0.013	234.148	-0.002	233.082	0.024	233.630	0.022	233.549	0.029
May 23	233.233	-0.008	233.319	0.002	233.426	0.039	233.327	-0.008	234.141	-0.007	233.104	0.022	233.645	0.015	233.566	0.017
May 24	233.226	-0.007	233.316	-0.003	233.457	0.031	233.320	-0.007	234.142	0.001	233.130	0.026	233.662	0.017	233.573	0.007
May 25	233.218	-0.008	233.318	0.002	233.477	0.020	233.312	-0.008	234.136	-0.006	233.153	0.023	233.677	0.015	233.570	-0.003
May 26	233.208	-0.010	233.318	0.000	233.489	0.012	233.306	-0.006	234.133	-0.003	233.170	0.017	233.692	0.015	233.561	-0.009
Week 6 Total		-0.040		0.007		**0.264**		-0.066		-0.023		0.164		0.118		0.085
Week 5 & 6 Total		0.074		0.031		**0.371**		-0.135		-0.035		**0.379**		0.161		0.107
Week 4, 5 & 6 Total		0.477		0.057		0.323		-0.178		-0.002		**0.502**		**0.205**		0.114
Week 3, 4, 5 & 6 Total		0.506		0.104		0.131		-0.316		0.032		**0.520**		**0.314**		0.218
Week 2, 3, 4, 5 & 6 Total		0.526		0.158		-0.045		-0.451		0.041		0.508		**0.320**		-0.002
Week 1, 2, 3, 4, 5 & 6 Total		0.538		**0.247**		-0.097		-0.595		0.077		0.456		0.169		-0.127
May 27	233.197	-0.011	233.326	0.008	233.491	0.002	233.299	-0.007	234.130	-0.003	233.187	0.017	233.700	0.008	233.543	-0.018
May 28	233.176	-0.021	233.328	0.002	233.488	-0.003	233.291	-0.008	234.124	-0.006	233.205	0.018	233.732	0.032	233.525	-0.018
May 29	233.166	-0.010	233.305	-0.023	233.479	-0.009	233.286	-0.005	234.121	-0.003	233.220	0.015	233.788	0.056	233.504	-0.021
May 30	233.148	-0.018	233.315	0.010	233.467	-0.012	233.282	-0.004	234.118	-0.003	233.233	0.013	233.847	0.059	233.480	-0.024
May 31	233.141	-0.007	233.313	-0.002	233.461	-0.006	233.277	-0.005	234.116	-0.002	233.241	0.008	233.901	0.054	233.459	-0.021
Jun 01	233.129	-0.012	233.312	-0.001	233.452	-0.009	233.271	-0.006	234.109	-0.007	233.247	0.006	233.939	0.038	233.435	-0.024
Jun 02	233.113	-0.016	233.311	-0.001	233.448	-0.004	233.272	0.001	234.104	-0.005	233.256	0.009	233.971	0.032	233.413	-0.022
Week 7 Total		-0.095		-0.007		-0.041		-0.034		-0.029		0.086		**0.279**		-0.148
Week 6 & 7 Total		-0.135		0.000		0.223		-0.100		-0.052		0.250		**0.397**		-0.063
Week 5, 6 & 7 Total		-0.021		0.024		0.330		-0.169		-0.064		0.465		**0.440**		-0.041
Week 4, 5, 6 & 7 Total		0.382		0.050		0.282		-0.212		-0.031		**0.588**		**0.484**		-0.034
Week 3, 4, 5, 6 & 7 Total		0.411		0.097		0.090		-0.350		0.003		**0.606**		**0.593**		0.070
Week 2, 3, 4, 5, 6 & 7 Total		0.431		0.151		-0.086		-0.485		0.012		0.594		**0.599**		-0.150
Week 1, 2, 3, 4, 5, 6 & 7 Total		0.443		0.240		-0.138		-0.629		0.048		0.542		0.448		-0.275

Table 8.8-2 (cont'd)

Day	1978 Water Level Elevation (m)	1978 Daily Waterlevel Change (m)	1979 Water Level Elevation (m)	1979 Daily Waterlevel Change (m)	1980 Water Level Elevation (m)	1980 Daily Waterlevel Change (m)	1981 Water Level Elevation (m)	1981 Daily Waterlevel Change (m)	1982 Water Level Elevation (m)	1982 Daily Waterlevel Change (m)	1983 Water Level Elevation (m)	1983 Daily Waterlevel Change (m)	1985 Water Level Elevation (m)	1985 Daily Waterlevel Change (m)
Jun 03	233.498	0.040	233.680	0.000	233.530	0.020	233.778	0.002	233.243	-0.013	233.473	-0.011	233.824	0.012
Jun 04	233.519	0.021	233.680	0.000	233.550	0.020	233.783	0.005	233.220	-0.023	233.479	0.006	233.856	0.032
Jun 05	233.538	0.019	233.680	0.000	233.570	0.020	233.790	0.007	233.203	-0.017	233.483	0.004	233.872	0.016
Jun 06	233.559	0.021	233.670	-0.010	233.580	0.010	233.789	-0.001	233.186	-0.017	233.492	0.009	233.879	0.007
Jun 07	233.577	0.018	233.680	0.010	233.600	0.020	233.795	0.006	233.164	-0.022	233.498	0.006	233.894	0.015
Jun 08	233.587	0.010	233.680	0.000	233.620	0.020	233.809	0.014	233.147	-0.017	233.508	0.010	233.900	0.006
Jun 09	233.611	0.024	233.690	0.010	233.630	0.010	233.821	0.012	233.135	-0.012	233.521	0.013	233.960	0.060
Week 8 Total		0.153		0.010		0.120		0.045		-0.121		0.037		0.148
Week 7 & 8 Total		0.323		0.090		0.240		-0.012		-0.274		0.045		0.128
Week 6, 7 & 8 Total		0.573		0.210		0.170		-0.134		-0.382		0.049		0.133
Week 5, 6, 7 & 8 Total		0.713		**0.220**		0.010		-0.153		-0.482		0.132		0.058
Week 4, 5, 6, 7 & 8 Total		**0.774**		0.160		-0.170		0.085		-0.403		0.256		-0.011
Week 3, 4, 5, 6, 7 & 8 Total		0.768		0.049		-0.320		0.073		0.005		0.359		0.128
Week 2, 3, 4, 5, 6, 7 & 8 Total		0.680		-0.031		-0.300		0.017		0.058		0.441		0.396
Week 1, 2, 3, 4, 5, 6, 7 & 8 Total		0.494		-0.079		-0.270		-0.010		0.078		**0.471**		0.406
Jun 10	233.629	0.018	233.690	0.000	233.640	0.010	233.837	0.016	233.128	-0.007	233.530	0.009	233.996	0.036
Jun 11	233.650	0.021	233.680	-0.010	233.650	0.010	233.847	0.010	233.106	-0.022	233.543	0.013	234.037	0.041
Jun 12	233.669	0.019	233.680	0.000	233.660	0.010	233.865	0.018	233.091	-0.015	233.551	0.008	234.054	0.017
Jun 13	233.681	0.012	233.680	0.000	233.670	0.010	233.878	0.013	233.072	-0.019	233.561	0.010	234.081	0.027
Jun 14	233.690	0.009	233.680	0.000	233.680	0.010	233.889	0.011	233.049	-0.023	233.568	0.007	234.085	0.004
Jun 15	233.699	0.009	233.680	0.000	233.690	0.010	233.899	0.010	233.036	-0.013	233.577	0.009	234.081	-0.004
Jun 16	233.711	0.012	233.680	0.000	233.710	0.020	233.911	0.012	233.008	-0.028	233.594	0.017	234.079	-0.002
Week 9 Total		0.100		-0.010		0.080		0.090		-0.127		0.073		0.119
Week 8 & 9 Total		0.253		0.000		**0.200**		0.135		-0.248		0.110		0.267
Week 7, 8 & 9 Total		0.423		0.080		**0.320**		0.078		-0.401		0.118		0.247
Week 6, 7, 8 & 9 Total		0.673		0.200		0.250		-0.044		-0.509		0.122		0.252
Week 5, 6, 7, 8 & 9 Total		**0.813**		0.210		0.090		-0.063		-0.609		0.205		0.177
Week 4, 5, 6, 7, 8 & 9 Total		**0.874**		0.150		-0.090		0.175		-0.530		0.329		0.108
Week 3, 4, 5, 6, 7, 8 & 9 Total		**0.868**		0.039		-0.240		0.163		-0.122		0.432		0.247
Week 2, 3, 4, 5, 6, 7, 8 & 9 Total		0.780		-0.041		-0.220		0.107		-0.069		0.514		0.515
Week 1, 2, 3, 4, 5, 6, 7, 8 & 9 Total		0.594		-0.089		-0.190		0.080		-0.049		0.544		0.525
> 20cm Rise in Water Level During the 9 Week Period		✓		✓		✓		✓		✓		✓		✓

Day	1994 Water Level Elevation (m)	1994 Daily Waterlevel Change (m)	1995 Water Level Elevation (m)	1995 Daily Waterlevel Change (m)	1996 Water Level Elevation (m)	1996 Daily Waterlevel Change (m)	1997 Water Level Elevation (m)	1997 Daily Waterlevel Change (m)	1998 Water Level Elevation (m)	1998 Daily Waterlevel Change (m)	1999 Water Level Elevation (m)	1999 Daily Waterlevel Change (m)	2000 Water Level Elevation (m)	2000 Daily Waterlevel Change (m)	2001 Water Level Elevation (m)	2001 Daily Waterlevel Change (m)
Jun 03	233.104	-0.009	233.302	-0.009	233.444	-0.004	233.274	0.002	234.106	0.002	233.261	0.005	233.996	0.025	233.388	-0.025
Jun 04	233.089	-0.015	233.284	-0.018	233.434	-0.010	233.279	0.005	234.101	-0.005	233.272	0.011	234.014	0.018	233.364	-0.024
Jun 05	233.074	-0.015	233.288	0.004	233.427	-0.007	233.277	-0.002	234.097	-0.004	233.280	0.008	234.031	0.017	233.340	-0.024
Jun 06	233.051	-0.023	233.301	0.013	233.422	-0.005	233.278	0.001	234.091	-0.006	233.286	0.006	234.038	0.007	233.317	-0.023
Jun 07	233.027	-0.024	233.300	-0.001	233.415	-0.007	233.266	-0.012	234.086	-0.005	233.286	0.000	234.046	0.008	233.298	-0.019
Jun 08	233.017	-0.010	233.314	0.014	233.407	-0.008	233.267	0.001	234.081	-0.005	233.287	0.001	234.059	0.013	233.287	-0.011
Jun 09	233.014	-0.003	233.317	0.003	233.397	-0.010	233.267	0.000	234.076	-0.005	233.307	0.020	234.070	0.011	233.288	0.001
Week 8 Total		-0.099		0.006		-0.051		-0.005		-0.028		0.051		0.099		-0.125
Week 7 & 8 Total		-0.194		-0.001		-0.092		-0.039		-0.057		0.137		0.378		-0.273
Week 6, 7 & 8 Total		-0.234		0.006		0.172		-0.105		-0.080		0.301		0.496		-0.188
Week 5, 6, 7 & 8 Total		-0.120		0.030		0.279		-0.174		-0.092		0.516		0.539		-0.166
Week 4, 5, 6, 7 & 8 Total		0.283		0.056		0.231		-0.217		-0.059		0.639		0.583		-0.159
Week 3, 4, 5, 6, 7 & 8 Total		0.312		0.103		0.039		-0.355		-0.025		**0.657**		**0.692**		-0.055
Week 2, 3, 4, 5, 6, 7 & 8 Total		0.332		0.157		-0.137		-0.490		-0.016		0.645		**0.698**		-0.275
Week 1, 2, 3, 4, 5, 6, 7 & 8 Total		0.344		0.246		-0.189		-0.634		0.020		0.593		0.547		-0.400
Jun 10	233.009	-0.005	233.325	0.008	233.379	-0.018	233.269	0.002	234.073	-0.003	233.312	0.005	234.068	-0.002	233.273	-0.015
Jun 11	233.003	-0.006	233.322	-0.003	233.365	-0.014	233.270	0.001	234.073	0.000	233.317	0.005	234.077	0.009	233.271	-0.002
Jun 12	233.006	0.003	233.323	0.001	233.354	-0.011	233.272	0.002	234.068	-0.005	233.318	0.001	234.086	0.009	233.272	0.001
Jun 13	233.005	-0.001	233.312	-0.011	233.341	-0.013	233.267	-0.005	234.067	-0.001	233.328	0.010	234.100	0.014	233.267	-0.005
Jun 14	233.011	0.006	233.304	-0.008	233.327	-0.014	233.259	-0.008	234.065	-0.002	233.322	-0.006	234.109	0.009	233.265	-0.002
Jun 15	233.043	0.032	233.305	0.001	233.312	-0.015	233.249	-0.010	234.077	0.012	233.316	-0.006	234.119	0.010	233.267	0.002
Jun 16	233.070	0.027	233.313	0.008	233.296	-0.016	233.243	-0.006	234.079	0.002	233.310	-0.006	234.128	0.009	233.286	0.019
Week 9 Total		0.056		-0.004		-0.101		-0.024		0.003		0.003		0.058		-0.002
Week 8 & 9 Total		-0.043		0.002		-0.152		-0.029		-0.025		0.054		0.157		-0.127
Week 7, 8 & 9 Total		-0.138		-0.005		-0.193		-0.063		-0.054		0.140		0.436		-0.275
Week 6, 7, 8 & 9 Total		-0.178		0.002		0.071		-0.129		-0.077		0.304		0.554		-0.190
Week 5, 6, 7, 8 & 9 Total		-0.064		0.026		0.178		-0.198		-0.089		0.519		0.597		-0.168
Week 4, 5, 6, 7, 8 & 9 Total		0.339		0.052		0.130		-0.241		-0.056		0.642		0.641		-0.161
Week 3, 4, 5, 6, 7, 8 & 9 Total		0.368		0.099		-0.062		-0.379		-0.022		0.660		**0.750**		-0.057
Week 2, 3, 4, 5, 6, 7, 8 & 9 Total		0.388		0.153		-0.238		-0.514		-0.013		0.648		**0.756**		-0.277
Week 1, 2, 3, 4, 5, 6, 7, 8 & 9 Total		0.400		0.242		-0.290		-0.658		0.023		0.596		0.605		-0.402
> 20cm Rise in Water Level During the 9 Week Period		✓		✓		✓						✓		✓		

*From years where complete data is available during the peak waterbird nesting period (April 15 to June 16)

Note that partial data available for 1987 and 1991 (i.e. incomplete data for the mid-April to mid-June time period) also indicates that: the water level increased 28 cm between May 24 and June 4, 1987; and water level increased 22 cm between May 7 and May partial

Data from Manitoba Hydro

Shaded cells = trends in increasing waterlevels above 20cm

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8.8.5 Operation-related Effects on Valued Ecosystem Component Species

The following summarizes project-related operation effects on bird species that have been selected as VECs (Section 8.2.4.5).

8.8.5.1 Canada Goose

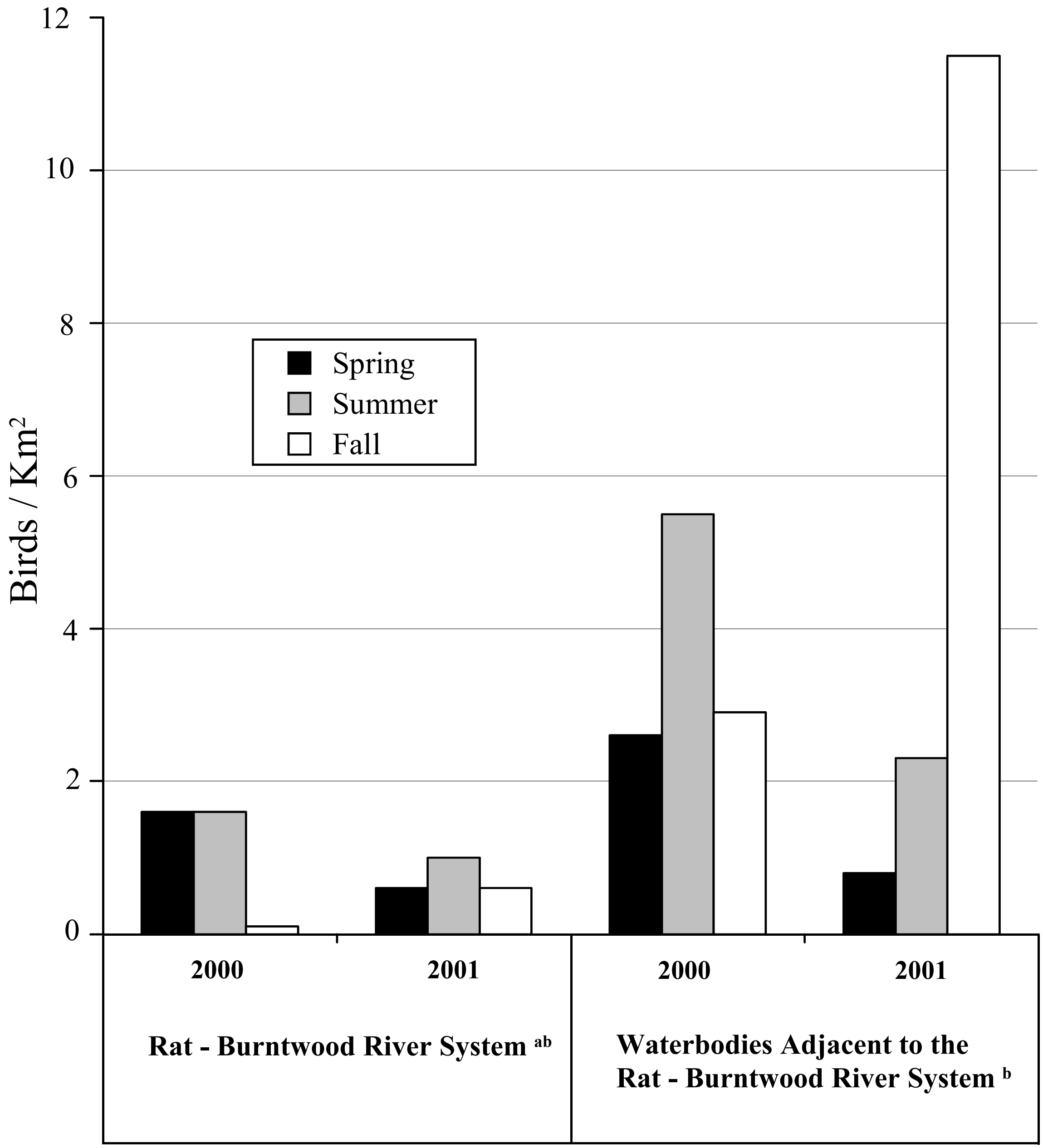
Field studies were conducted to assess waterbird use of the bird study area (Figure 8.2-1), including the Wuskwatim Lake area, during the spring, summer and fall of 2000 and 2001 (Tetr*ES* 2003a,b). In the Wuskwatim Lake area, Canada Geese have been observed foraging, nesting, brood-rearing and staging during migration (Tetr*ES* 2003a,b).

Local resource users have indicated that Wuskwatim Lake is used as a nightly 'stop-over' waterbody for migrating Canada Geese (Table 8.3-2). Although Canada Geese are present during spring, summer and fall in the Wuskwatim Lake area, higher densities of Canada Geese have been observed along waterbodies adjacent to the Rat-Burntwood river system during helicopter surveys in 2000 and 2001 (Figures 8.8-1 to 8.8-7). Traditional Knowledge information regarding birds in the study area documented as results of the Harvest Calendar Survey and interviews with NCN resource harvesters (Volume 7), also indicated that waterbodies closer to Nelson House were primary locations for Canada Goose harvesting rather than the Wuskwatim lake area (Table 8.3-2). It is expected that increased access into the Wuskwatim lake area via the access road will likely increase Canada Goose mortality in the area due to expected increased hunting activities in the area. This information, in combination with relevant previous research pertaining to Canada Goose habitat use (see below), have allowed the formation of the following hypothesis: **The project operation will result in an insignificant, long-term, local and small negative effect on Canada Geese** (Figure 8.4-1).

<u>Life Requirements Potentially Affected by the Project</u>

<u>Nesting Habitat</u>

Initially, the water level increase and stabilization will likely have a positive effect on Canada Geese due to the reduced probability of nest flooding from variable water levels. During field studies in 2000 and 2001, Canada Goose nests were most often observed on low, peat islands or other island substrate (Tetr*ES* 2003a,b). Other studies support the preference of islands for nesting in riparian habitats (Childress 1971a,b; Gibson and Buss 1972; Raveling 1977; O'Neil 1988; Bruggink *et al*. 1994; Tetr*ES* 1997). Mainland shore



Note: Refer to Tetr*ES* 2003 a,b for area surveyed in each season in 2000 and 2001

[a] River sections and associated lakes from Birch Tree Lake to Notigi Lake

[b] Ref. Figures 8.8-2 to 8.8-7

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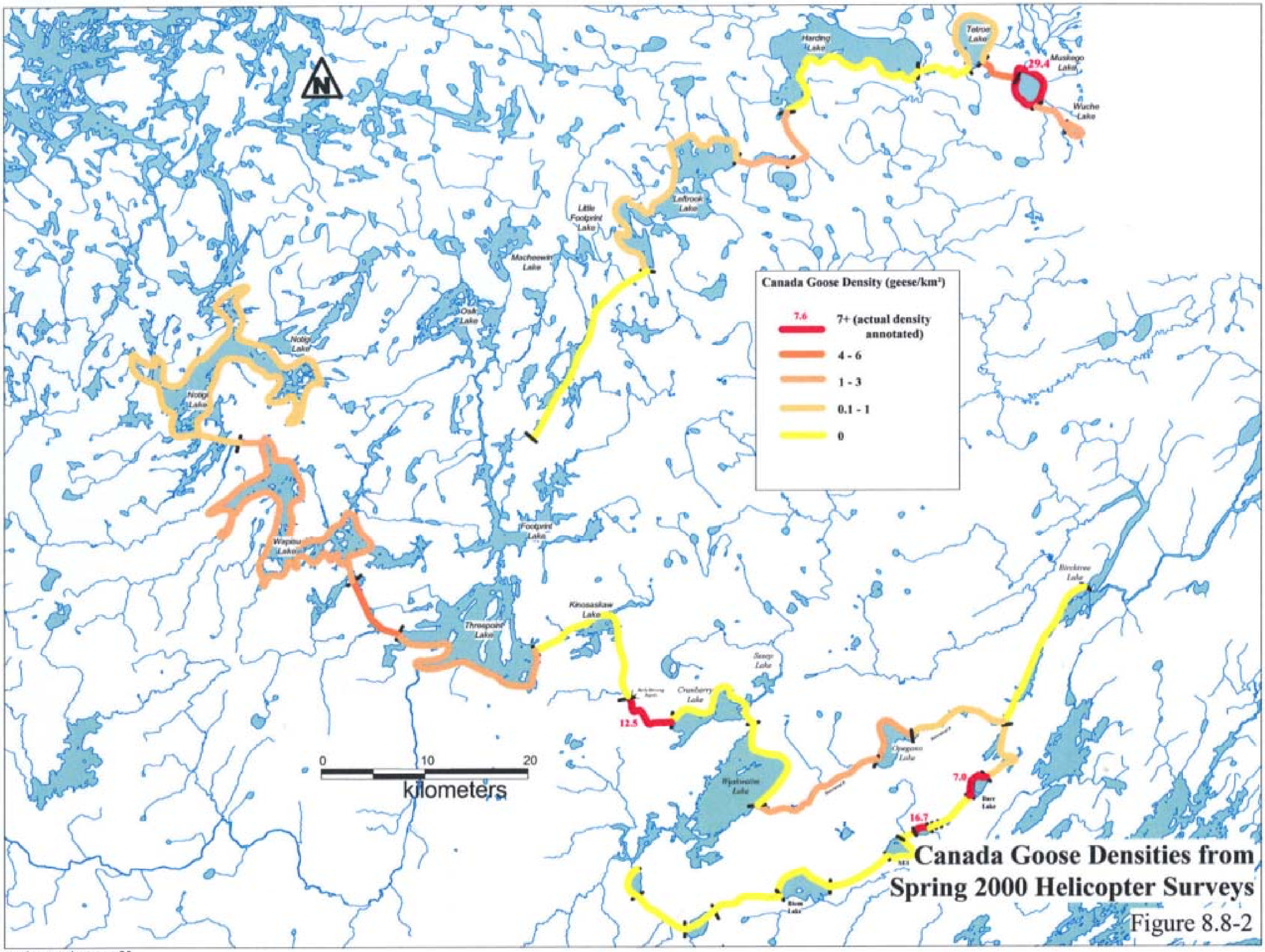
Densities of Canada Geese Along, and Adjacent to, the Rat-Burntwood River System During Helicopter Surveys in 2000 and 2001

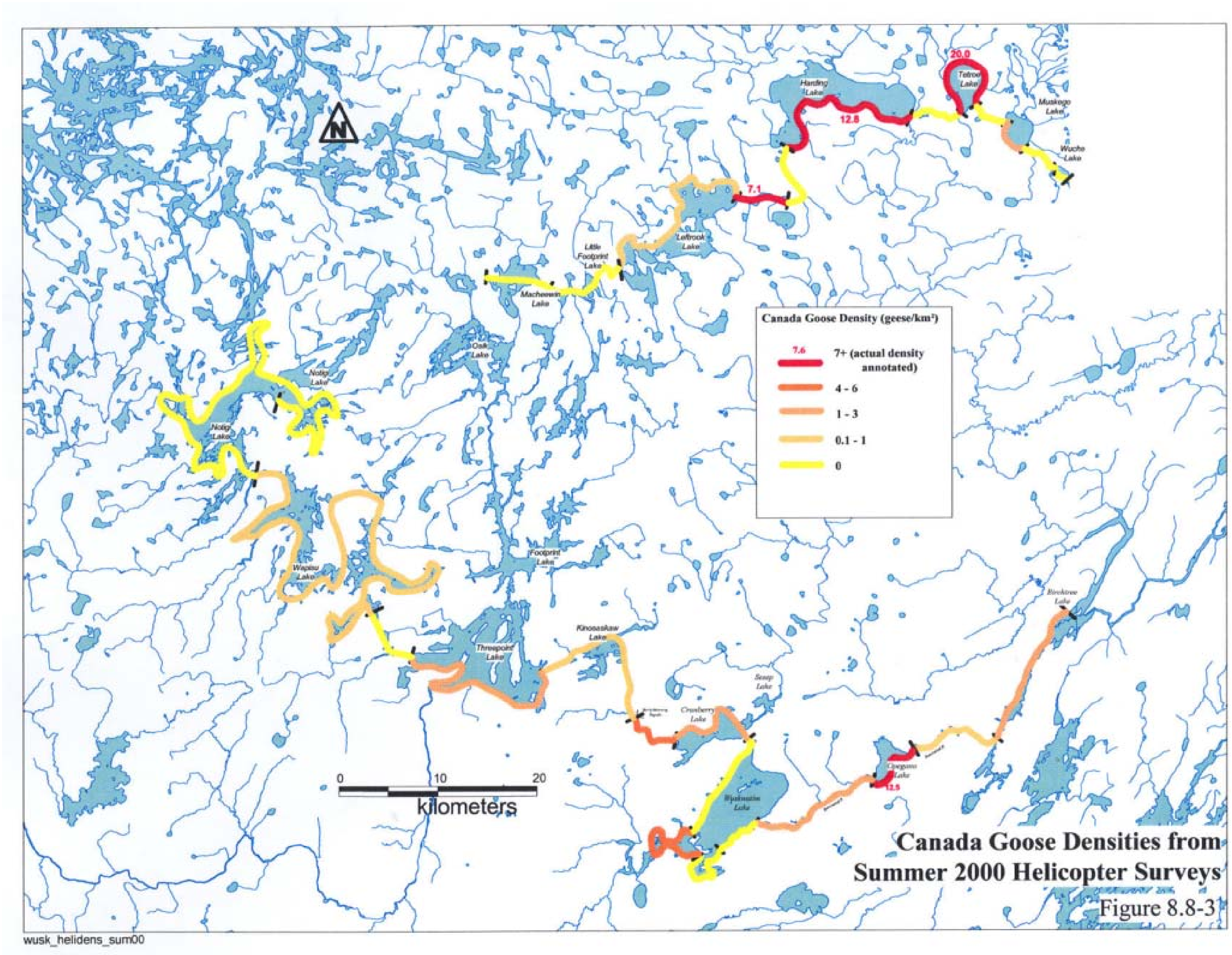
Figure 8.8-1



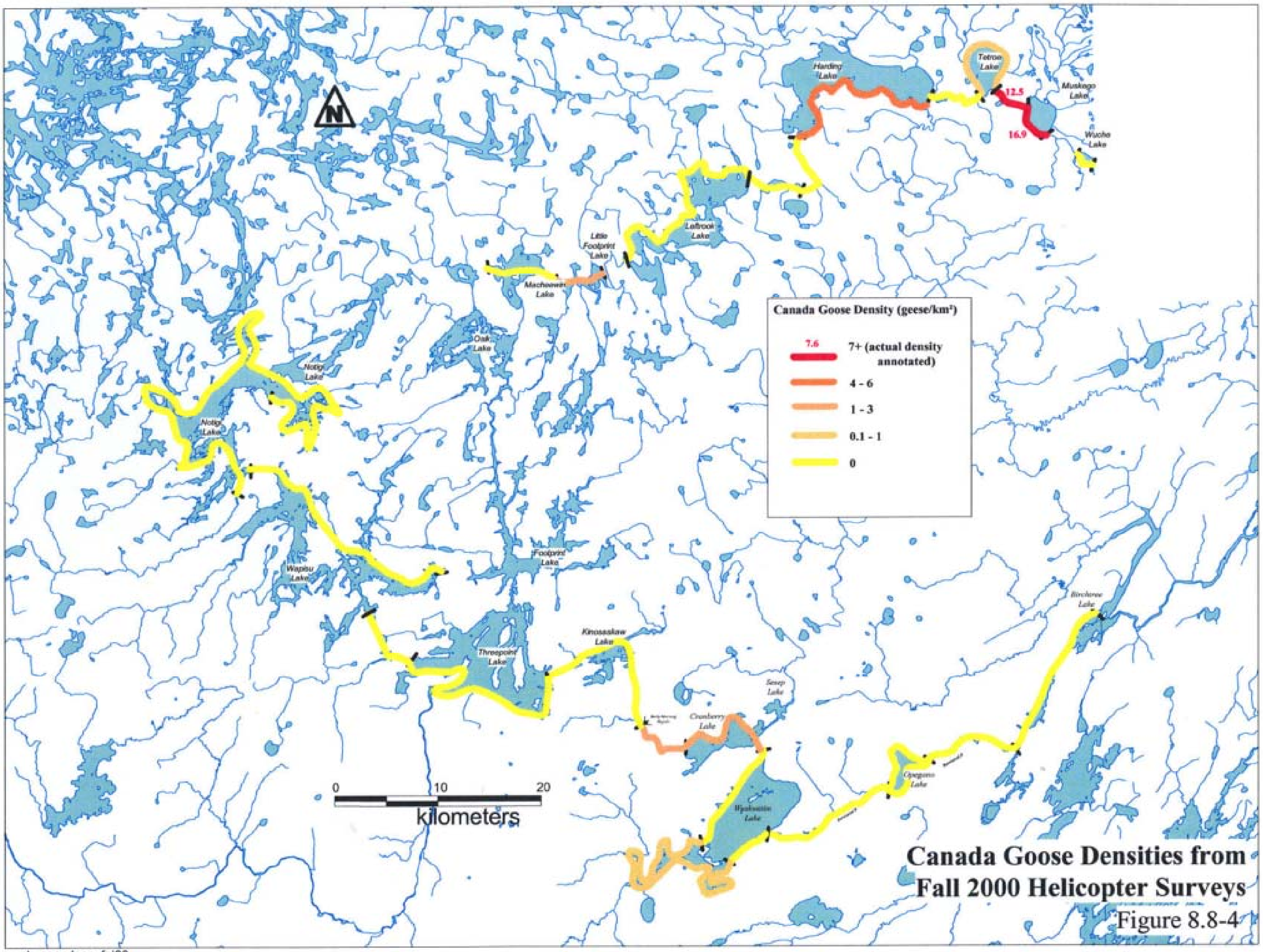
Canada Goose Densities from Spring 2000 Helicopter Surveys

Figure 8.8-2

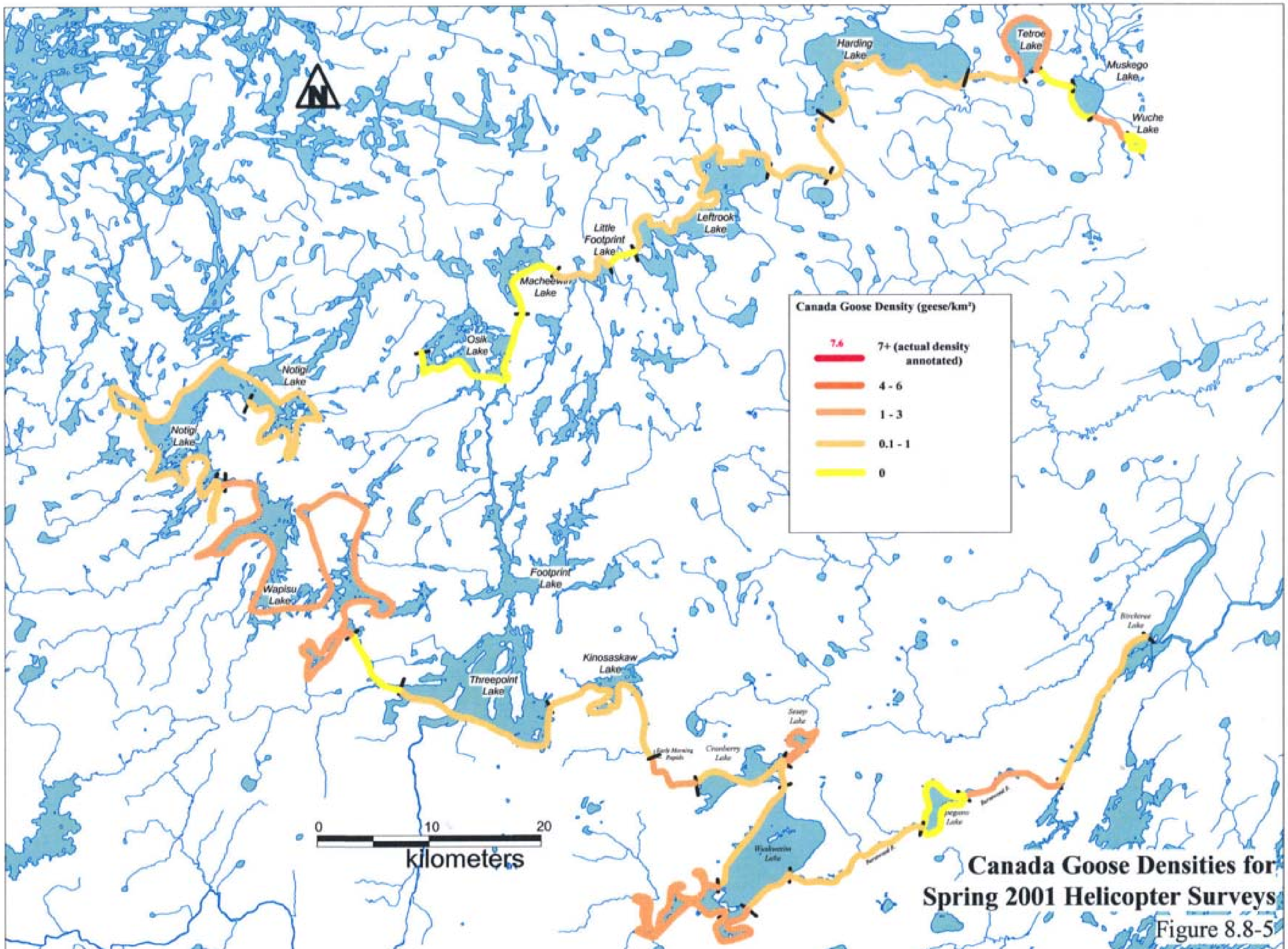
wusk_goosdens_spr00



Canada Goose Densities from Summer 2000 Helicopter Surveys
Figure 8.8-3

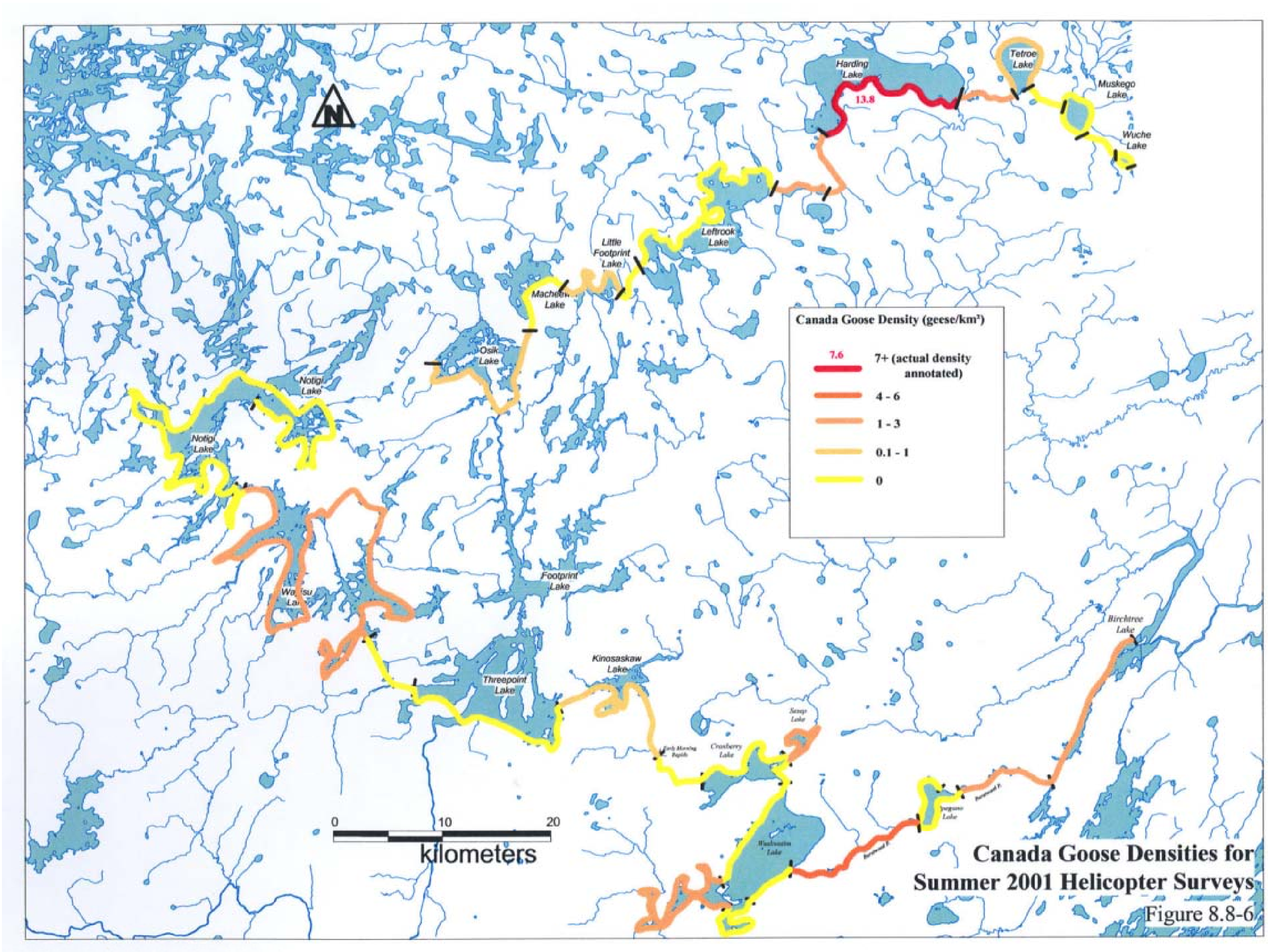


wusk_goosdens_fal00

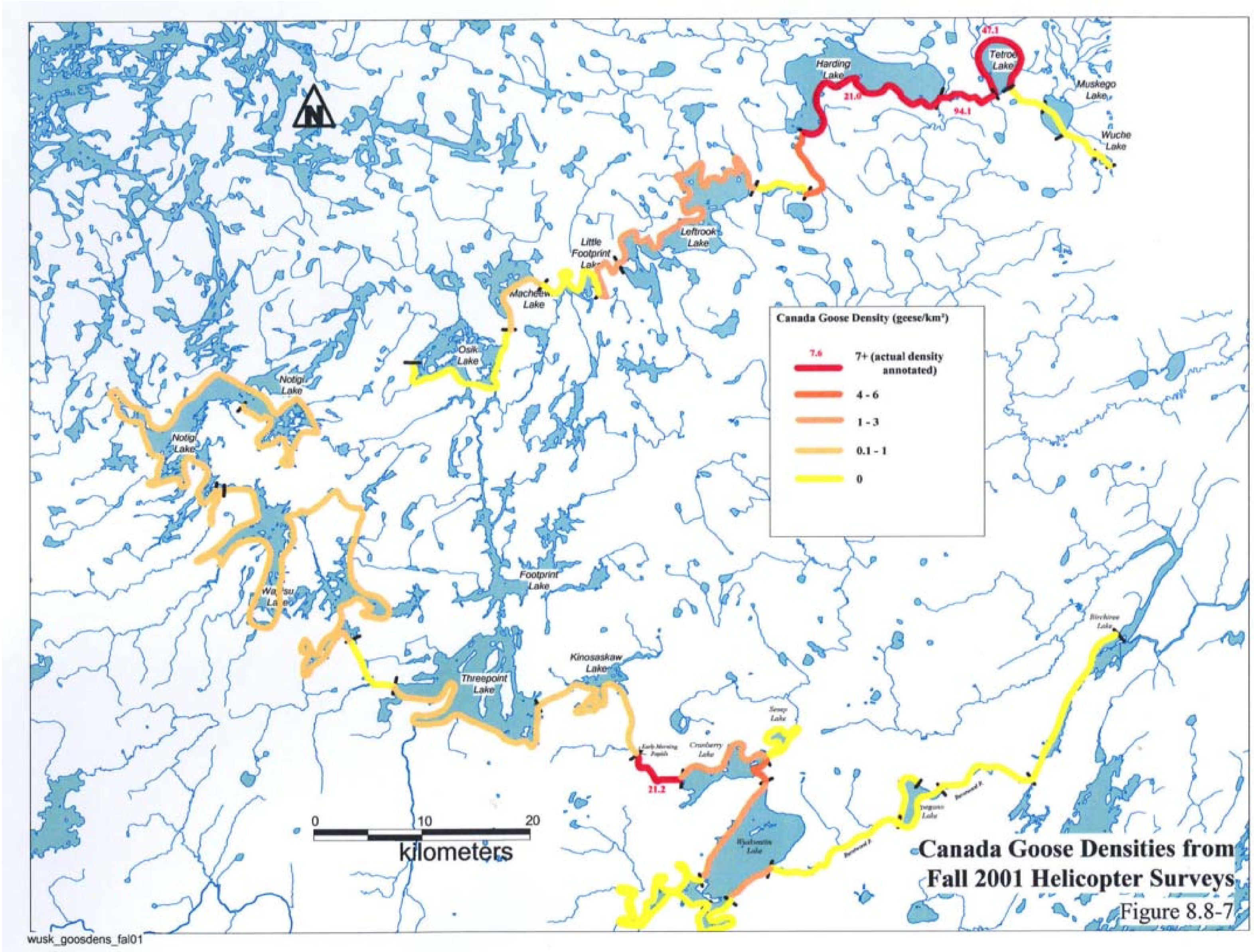


Canada Goose Densities for Spring 2001 Helicopter Surveys
Figure 8.8-5

wusk_goosdens_spr01



Canada Goose Densities for Summer 2001 Helicopter Surveys
Figure 8.8-6



Canada Goose Densities from Fall 2001 Helicopter Surveys
Figure 8.8-7

habitat is selected less often by nesting geese. However, this habitat is also important as alternative or sub-optimal nesting habitat (Boothroyd 1985; Bruggink *et al*. 1994).

Since the majority of Canada Goose nests in the bird study area were observed during helicopter surveys in 2000 and 2001, nest heights above water level could not be determined. However, goose nests observed during boat-based surveys were typically located on low peat islands that were less than 0.5 metres above water level (Tetr*ES* 2003a,b), making those nests vulnerable to increases in water level during the nesting season. For example, some goose nests located 0.4 metres or lower above water level in the Wuskwatim Lake area between mid-April and mid-June (peak waterfowl nesting season) may have been flooded during at least 6 of the past 25 years since the CRD (Appendix 8.8.4, Table 8.8-2). A study of nesting Canada Geese at Marshy Point, Manitoba indicated that the height of nests above water at the time of nest discovery varied from 5 mm to 5.5 m (n = 542 nests); the mean being 0.4 m for ground nests (Cooper 1978).

Increased erosion rates within the first five years of project operation will result in increased shoreline erosion and will reduce the amount of clay/silt-based island habitat for loafing, foraging and nesting geese. Additionally, peat island habitat is expected to stabilize, then decrease over the long term during project operation which will reduce optimal nesting habitat for Canada Geese (Section 5). Existing peat island habitat in the Wuskwatim Lake area typically supports low vegetation, providing ideal habitat for nesting Canada Geese which prefer a clear view of the waterbody and surrounding area (Childress 1971a,b; Boothroyd 1985; O'Neil 1988). As peatlands expand from shore in sheltered bay areas and merge with peat islands over time, the resulting peatlands may be used by some geese as sub-optimal nesting habitat.

Feeding Habitat

During field studies in 2000 and 2001, adult Canada Geese were observed loafing, and likely feeding, among grasses and sedges along shoreline habitat (Tetr*ES* 2003a,b). Canada Geese were most often observed near the Burntwood River at Cranberry Lake, along the Burntwood River west to Early Morning Rapids, in marshy bays in Wuskwatim Brook and along the low west shoreline of Sesep Lake. Canada Geese are known to occur in high concentrations at major creek and river mouths, suggesting a preference for food that occurs there such as *Eleocharis* (Briscoe 1974). Canada Geese are known to commonly forage on sedge and grass shoots growing along newly exposed shorelines (e.g., Brooks 1985; Prevett *et al*. 1985). Once water levels are increased to 234 m ASL and stabilized, the amount of newly exposed shoreline area resulting from decreasing water levels will be reduced. Therefore, some goose foraging habitat will also be reduced once water levels are increased and stabilized during project operation.

There may also be a slight increase in Canada Goose foraging habitat due to the expected increase in peatland habitat (Section 5). Since some peatland areas support goose forage such as sedges and grasses (Section 5), these peatlands would likely be used by foraging Canada Geese.

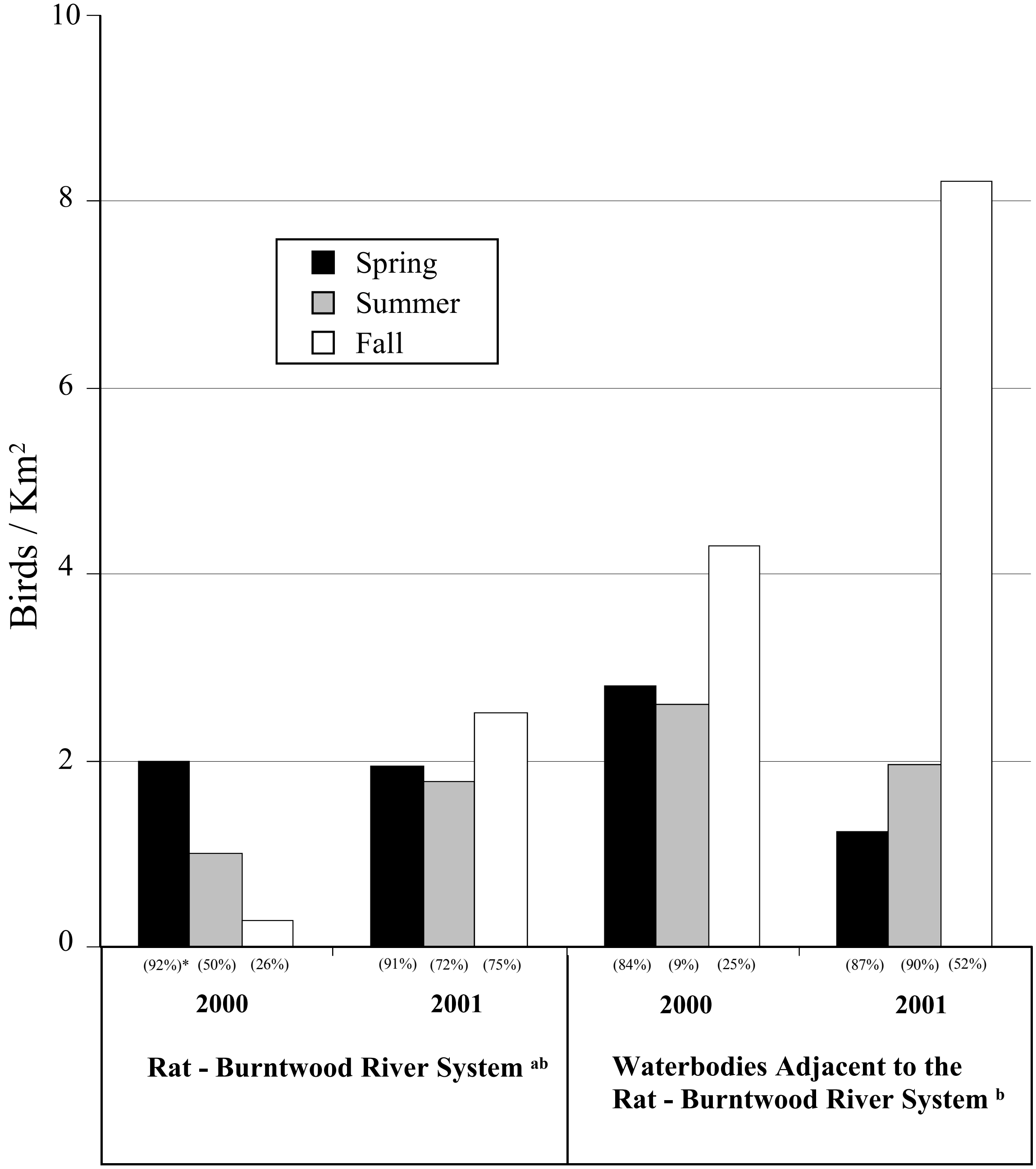
<u>Brood-rearing Habitat</u>

During field studies in 2000 and 2001 in the Wuskwatim Lake area, Canada Goose broods were most often observed in protected bay and creek areas with abundant marshy and emergent vegetation for cover, particularly in the Wuskwatim Brook area (Figures 8.3-8 and 8.3-9). Areas of emergent vegetation are known to be important for brood-rearing Canada Geese (Kadlec 1963). With the predicted gradual decrease in marshy habitat due to stabilized water levels during project operation (Section 5), the amount of potential Canada Goose brood-rearing habitat will decrease over time.

8.8.5.2 Mallard

Mallards were one of the most common waterfowl species observed in the bird study area during the spring, summer and fall of 2000 and 2001 (Tetr*ES* 2003a,b). Although the pattern of Mallard distribution in the bird study area was variable during 2000 and 2001 surveys, these data suggest that higher densities of Mallards may generally occur along waterbodies adjacent to the Rat-Burntwood River system rather than along the Rat-Burntwood River system during fall (Figure 8.8-8).

Within the Wuskwatim Lake area, Mallards were most commonly observed in sheltered bay areas (particularly those with some amount of marsh cover and often with some woody debris) such as in the Wuskwatim Brook, the south arm of Wuskwatim Lake, Sesep Lake and bay areas of Cranberry Lake (Figures 8.8-9 to 8.8-14; Tetr*ES* 2003a,b). Mallards were also observed along waterbodies adjacent to the Rat-Burntwood River system during the spring, summer and fall of 2000 and 2001, particularly at Leftrook,



Note: Refer to Tetr*ES* 2003 a,b for area surveyed in each season in 2000 and 2001
* Percentage of ducks identified to species
[a] River sections and associated lakes from Birch Tree Lake to Notigi Lake
[b] Ref. Figures 8.8-9 to 8.8-14

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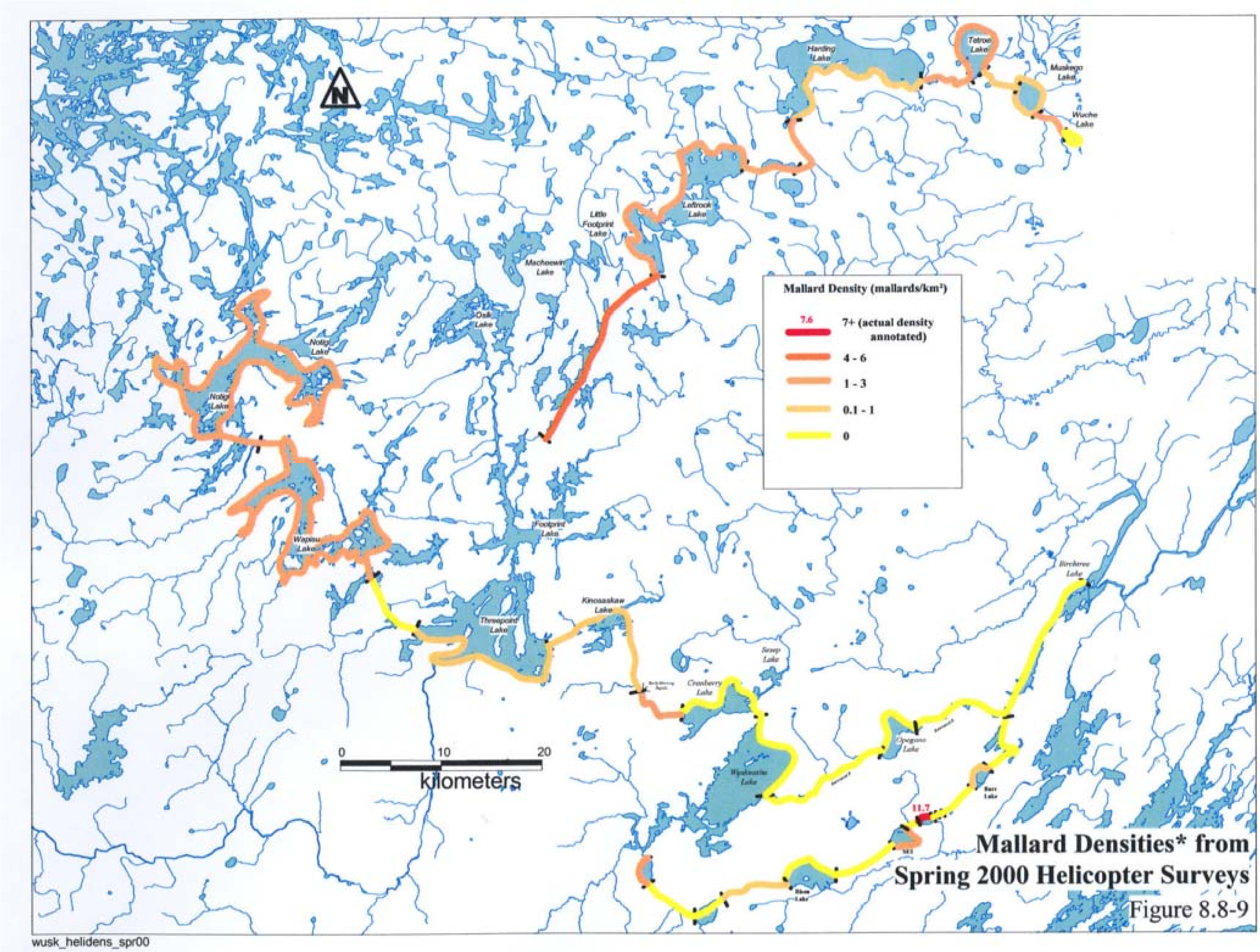
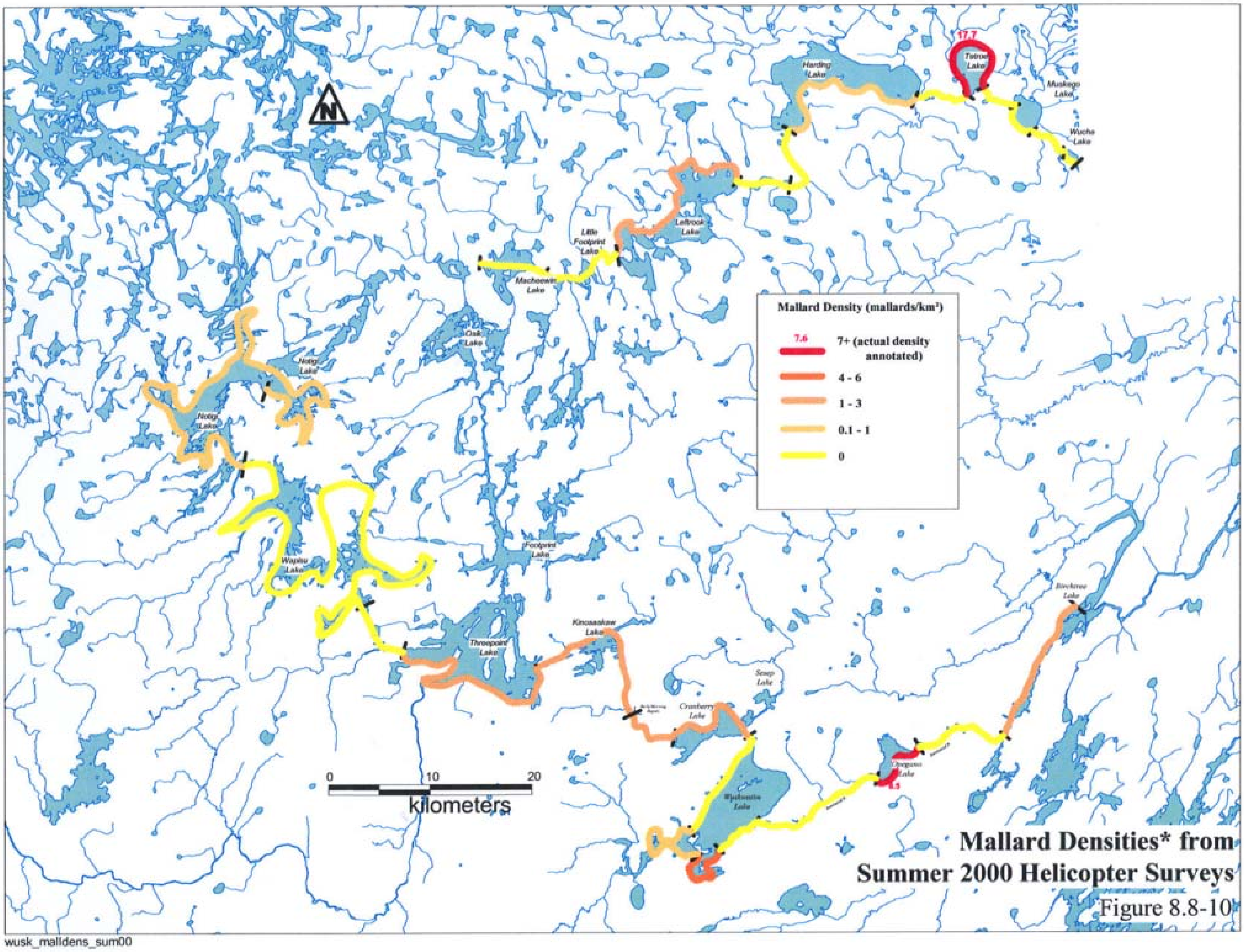
Densities of Mallards Along, and Adjacent to, the Rat-Burntwood River System During Helicopter Surveys in 2000 and 2001

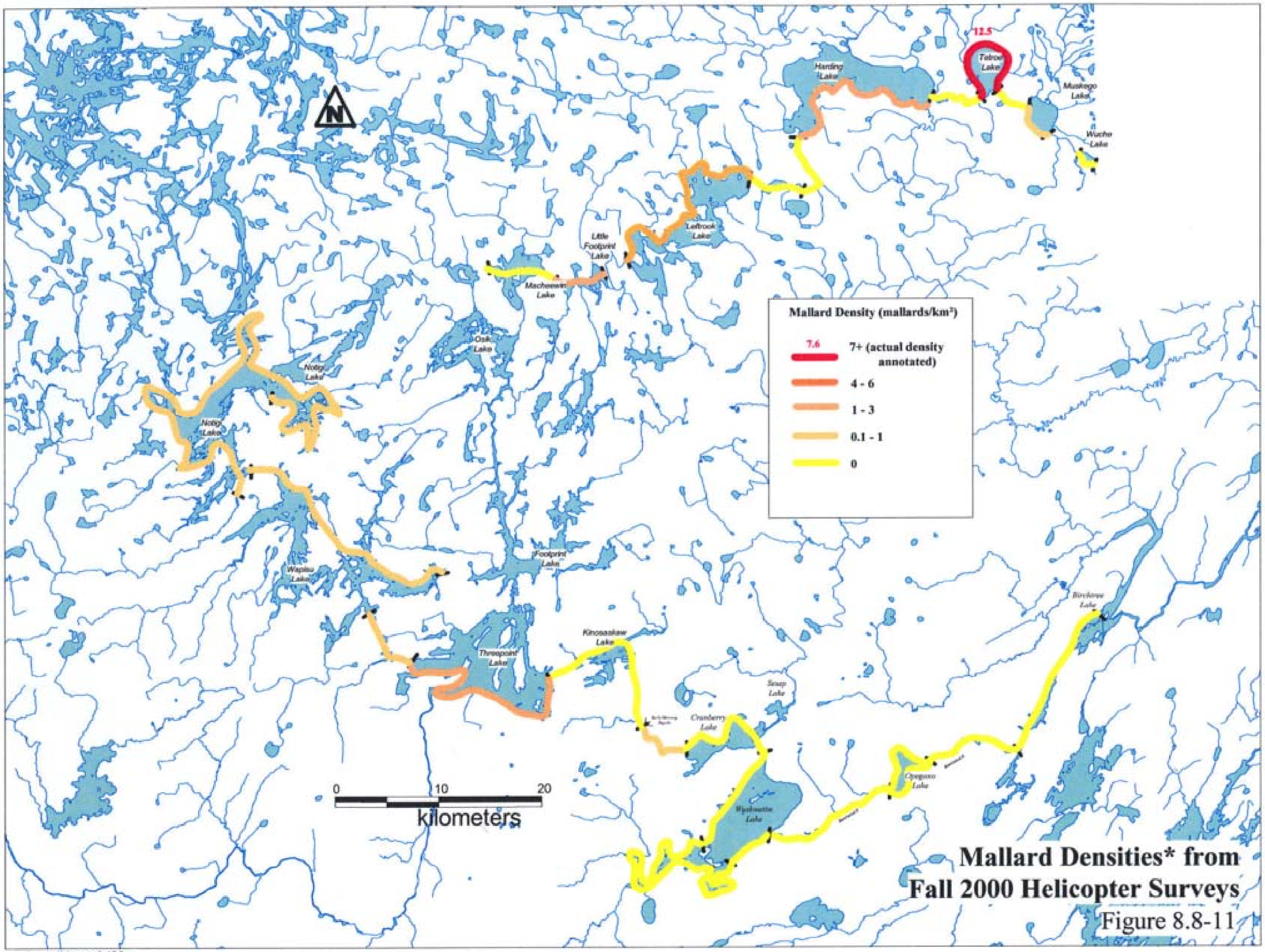
Figure 8.8-8



*- data from those ducks identified to species (88% of 913 ducks observed)



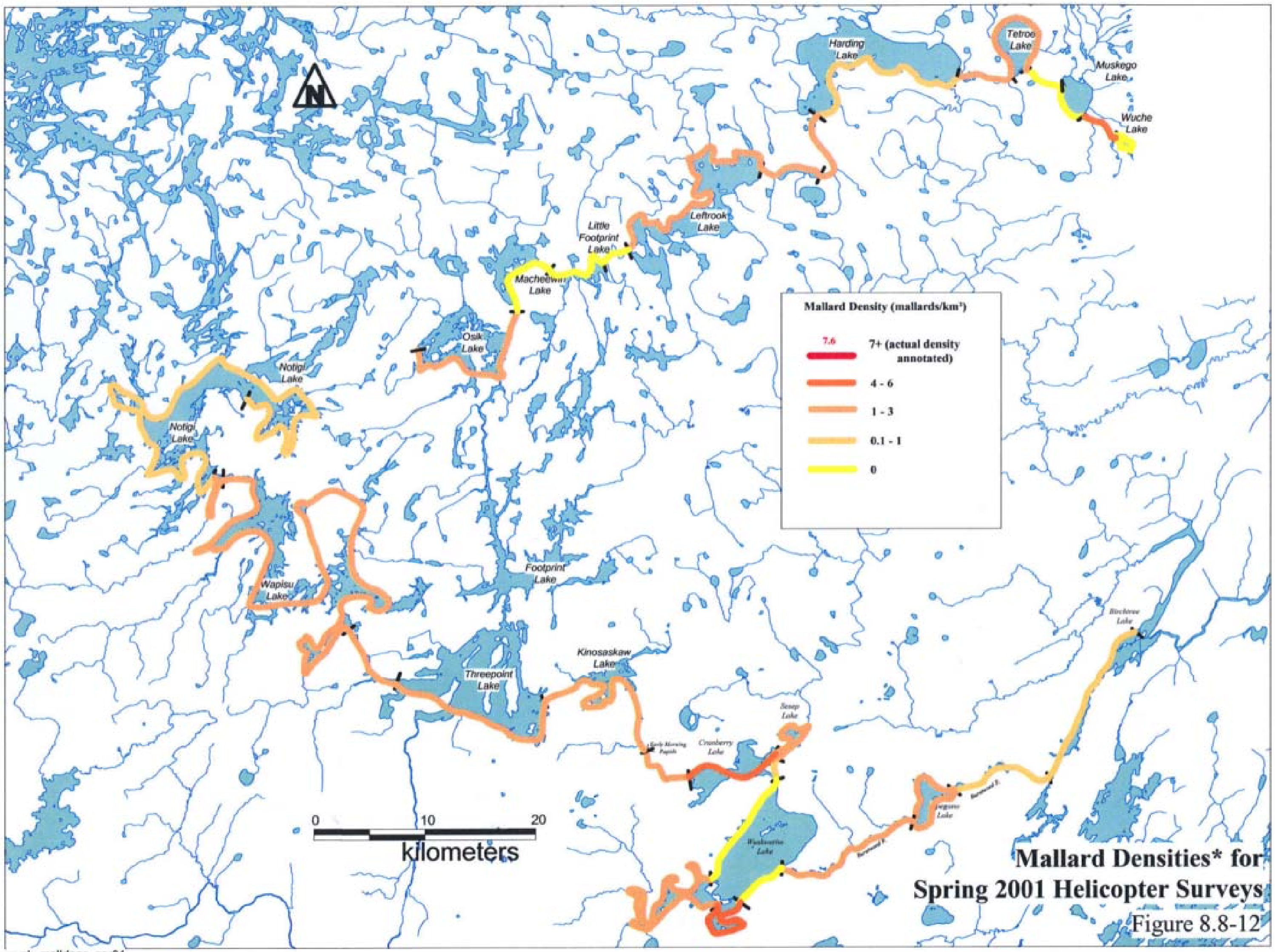
* - data from those ducks identified to species (11% of 2417 ducks observed)



Mallard Densities* from Fall 2000 Helicopter Surveys
Figure 8.8-11

wusk_malldens_fal00

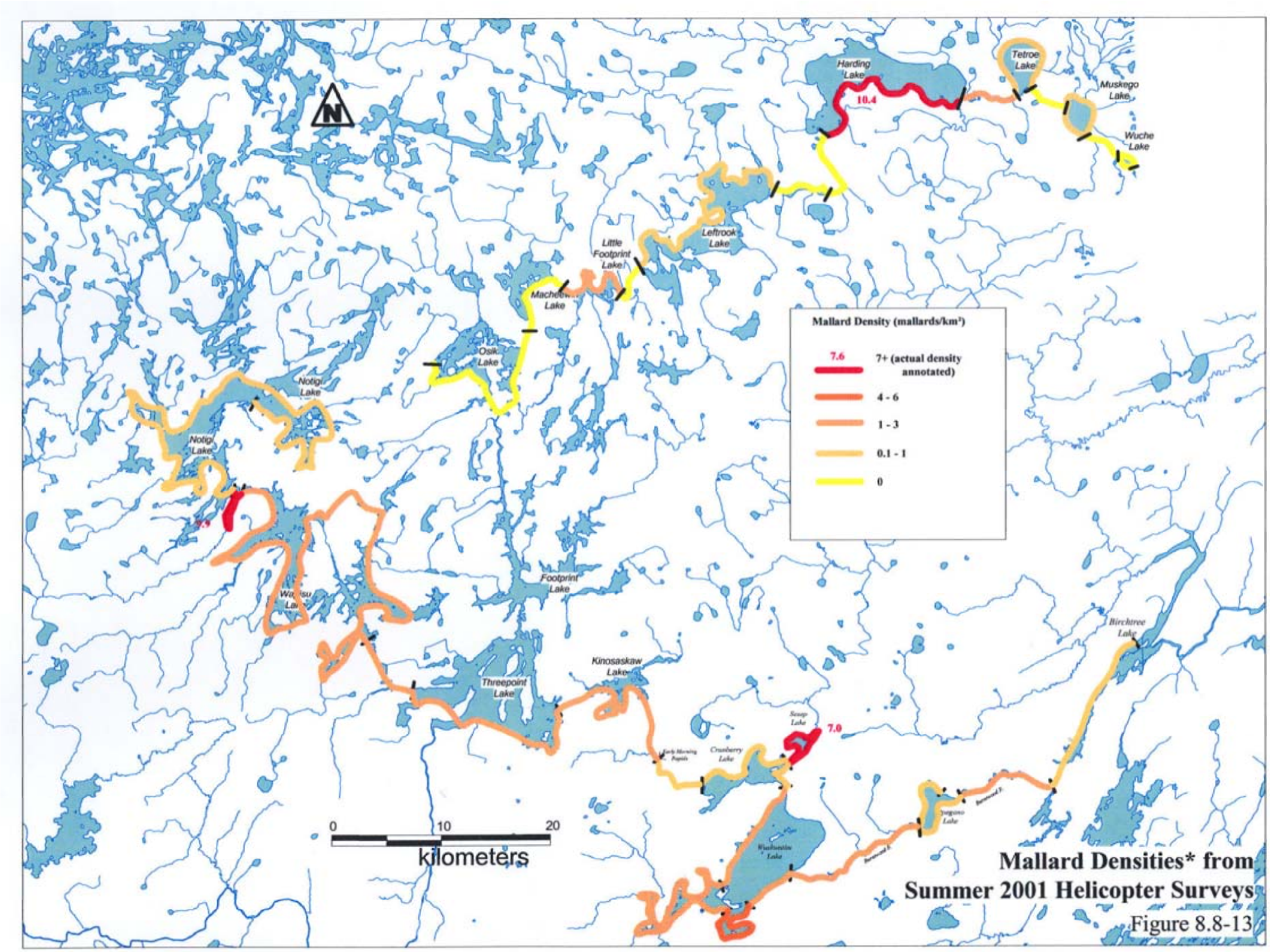
** - data from those ducks identified to species (25% of 2156 ducks observed)*



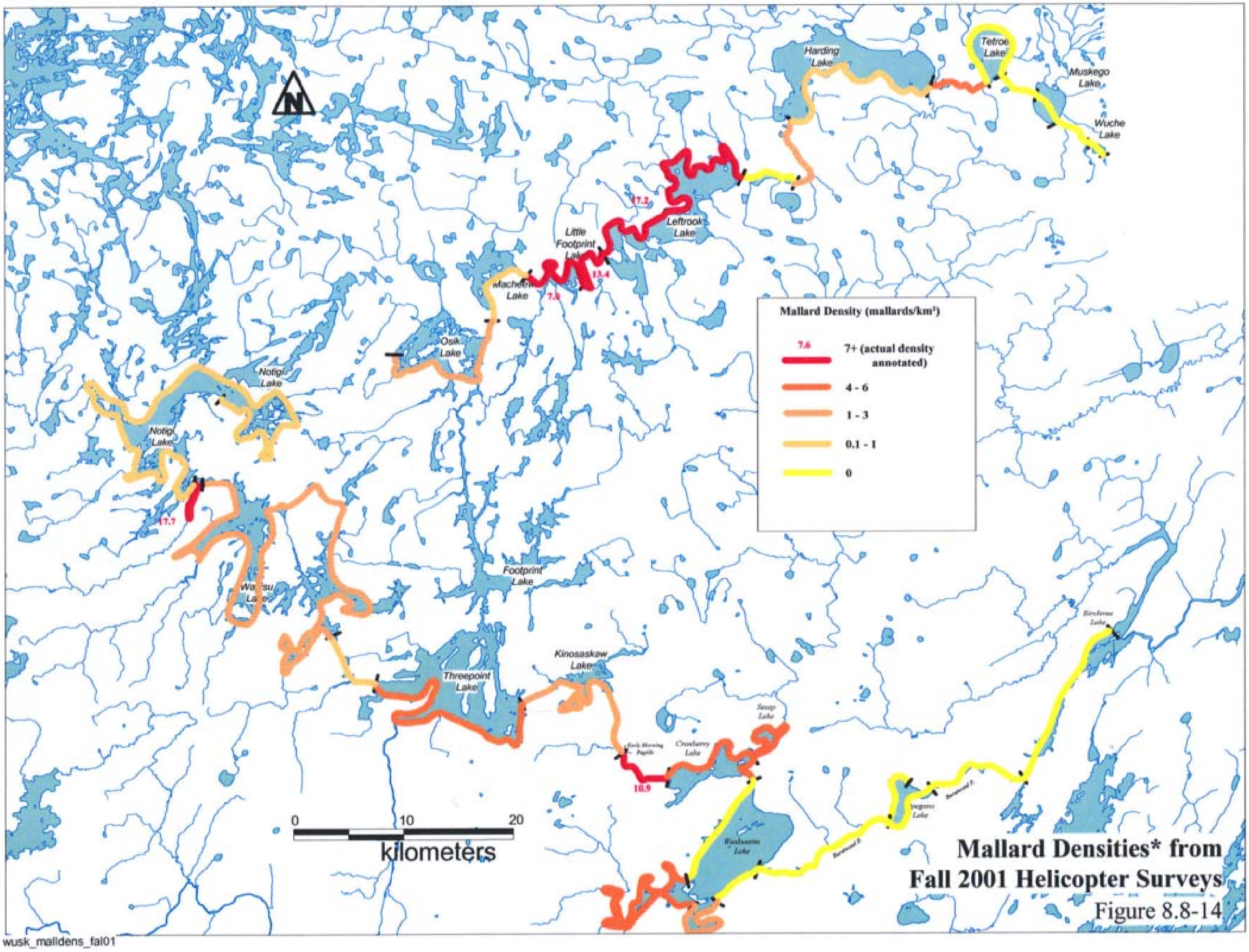
Mallard Densities* for Spring 2001 Helicopter Surveys
Figure 8.8-12

wusk_malldens_spr01

** - data from those ducks identified to species (90% of 2055 ducks observed)*



Mallard Densities* from Summer 2001 Helicopter Surveys
Figure 8.8-13



Mallard Densities* from Fall 2001 Helicopter Surveys

Figure 8.8-14

* data from those ducks identified to species (57% of 3754 ducks)

Little Footprint, Harding and Tetroe Lakes and adjacent streams (Figures 8.8-9 to 8.8-14).

Documented Traditional Knowledge information regarding birds in the study area (Volume 7) indicated that waterbodies closer to Nelson House are primary locations for waterfowl harvesting (including Mallard) rather than the Wuskwatim Lake area (Table 8.3-2). It is expected that increased access into the Wuskwatim Lake area via the access road will likely increase Mallard mortality in the area due to increased hunting activities in the area. This information, in combination with relevant previous research pertaining to Mallard habitat use (see below) have allowed the formation of the following hypothesis: **The Project operation will result in an insignificant, long-term, local and small negative effect on Mallards** (Figure 8.4-2).

Life Requirements Potentially Affected by the Project

Nesting Habitat

Initially, the water level increase and stabilization will have a small positive effect on Mallards due to the reduced probability of nest flooding for those few nests that may be located in low-lying areas vulnerable to variable water levels. Mallard nest site selection is highly variable and nests are often not located in low areas that would be vulnerable to flooding from typical water level fluctuations (Bellrose 1976). During field studies in 2000 and 2001, two confirmed Mallard nests that were discovered during bird surveys and general reconnaissance were both located on islands greater than one metre above water level (Tetr*ES* 2003a,b). Island habitat would be considered optimal habitat for nesting Mallards due to the reduced probability of nest depredation by terrestrial mammals such as foxes. The long-term reduction of peat islands will result in decreased optimal nesting habitat for Mallards.

Feeding Habitat

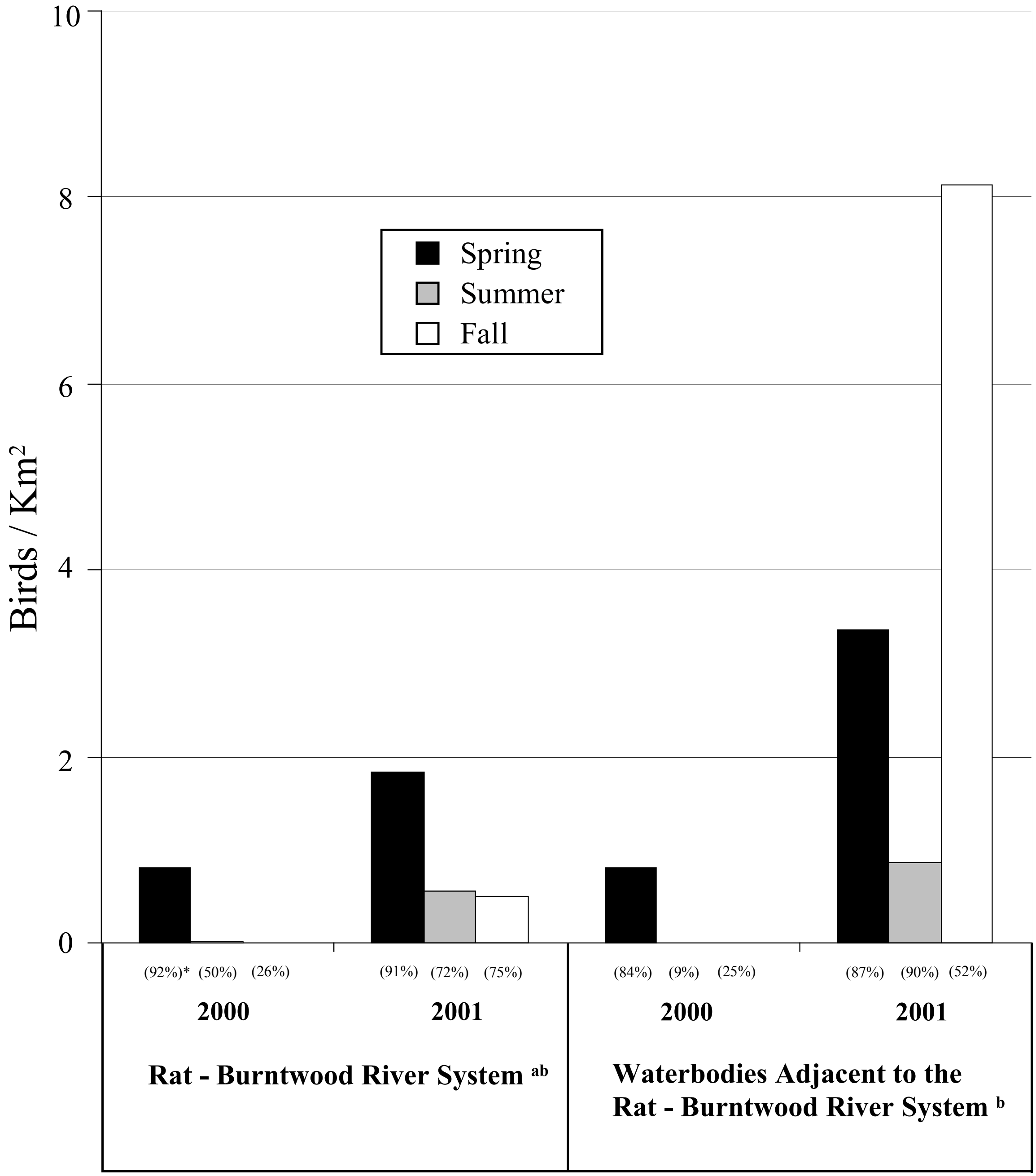
The Mallard is a 'dabbling' duck that feeds primarily in shallow waters in ponds and bays of larger lakes (Bellrose 1976). Mallards have a highly diverse diet that consists largely of invertebrates and plant material that are found in high concentrations in marshland and shallow-water habitats. The diverse nature of the adult Mallard diet suggests that food availability is typically not a factor limiting adult Mallard survival on the breeding grounds. However, a recent study suggests that some boreal wetlands are devoid of Mallard broods because they do not offer enough food (i.e., the habitat characteristics do not promote the production of sufficient quantities of food for ducklings; Nummi *et al*. 2000). Therefore, in the Wuskwatim lake area, locations with high food production potential (such as marsh areas present at Sesep Lake, the south arm of Wuskwatim Lake, Wuskwatim Brook and bay areas of Cranberry Lake) are likely very important foraging habitats for Mallard broods. Mallard broods observed during field studies in 2000 and 2001 in the Wuskwatim Lake area were primarily located in those areas (90% of 19 broods observed; Tetr*ES* 2003a,b). Therefore, the predicted reduction of marsh habitat during project operation (Section 5) is expected to reduce the availability of some foraging habitat for adult Mallards, and especially for Mallard broods.

<u>Brood-rearing Habitat</u>

As indicated above, during field studies in 2000 and 2001, Mallard broods were primarily located in close association with marsh habitat. Emergent vegetation such as sedges, whitetop, bulrush and cattail (characteristic of marshlands) provide important cover and foraging habitat for Mallard broods (e.g., Bellrose 1976; Talent *et al*. 1982; Sayler and Willms 1997). The predicted reduction of marsh habitat during project operation (Section 5) is expected to reduce the availability of brood-rearing habitat for Mallards.

8.8.5.3 Bufflehead and Common Goldeneye

Bufflehead and Common Goldeneye are two species of cavity-nesting 'diving' ducks that have been commonly observed throughout the bird study area during bird surveys conducted in 2000 and 2001 (Tetr*ES* 2003a,b). Considerably more of these two species were observed during helicopter surveys in 2001 compared to 2000 in spring, summer and fall (Figure 8.8-15). Data from 2001 suggest that densities of these species may be higher along waterbodies adjacent to the Rat-Burntwood River system rather than along the Rat-Burntwood River system, particularly during spring and fall (Figures 8.8-15 to 8.8-21).



Note: Refer to Tetr*ES* 2003 a,b for area surveyed in each season in 2000 and 2001
* Percentage of ducks identified to species
[a] River sections and associated lakes from Birch Tree Lake to Notigi Lake
[b] Ref. Figures 8.8-16 to 8.8-21

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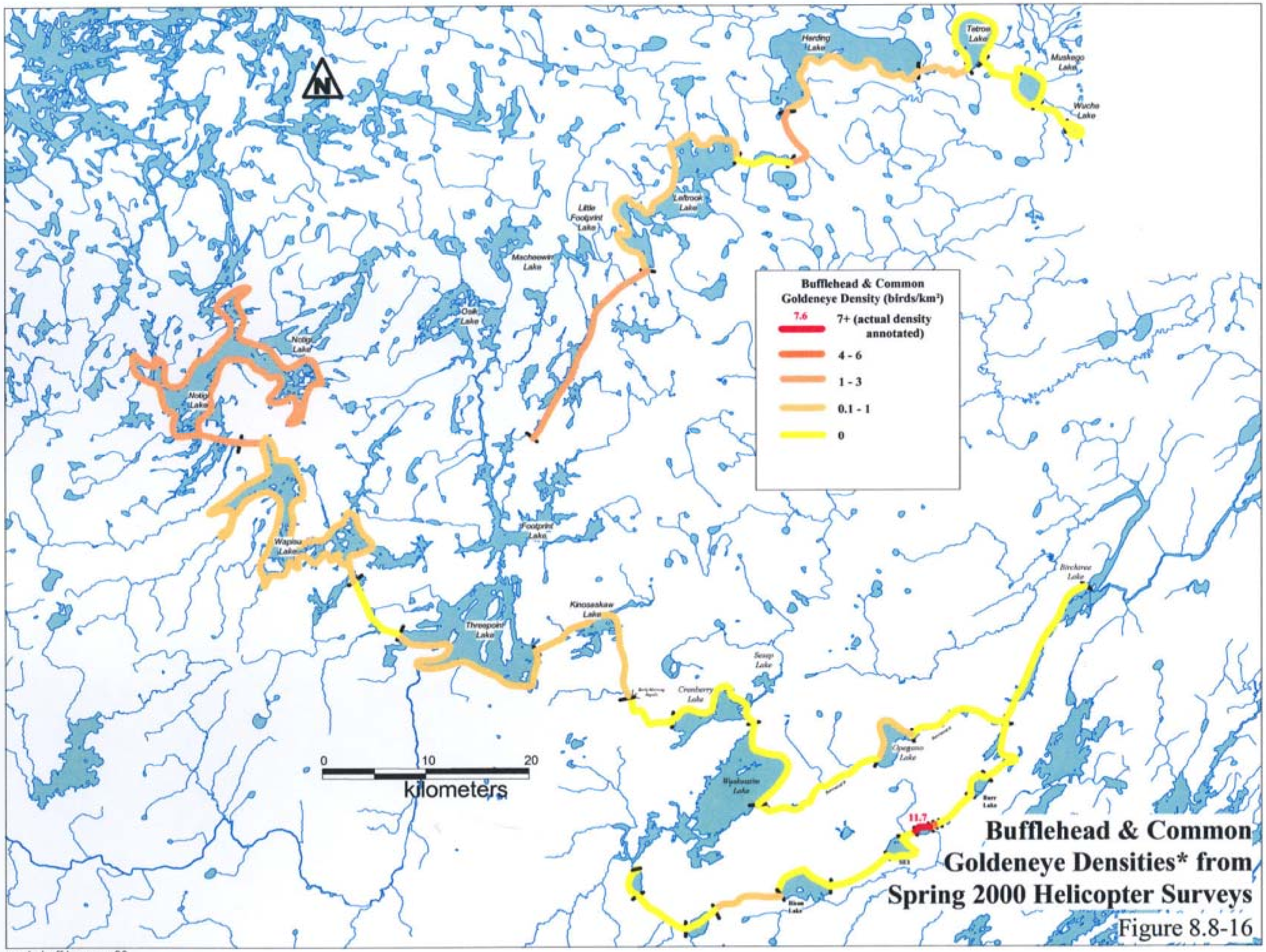
Densities of Buffleheads and Common Goldeneye Along, and Adjacent to, the Rat-Burntwood River System During Helicopter Surveys in 2000 and 2001

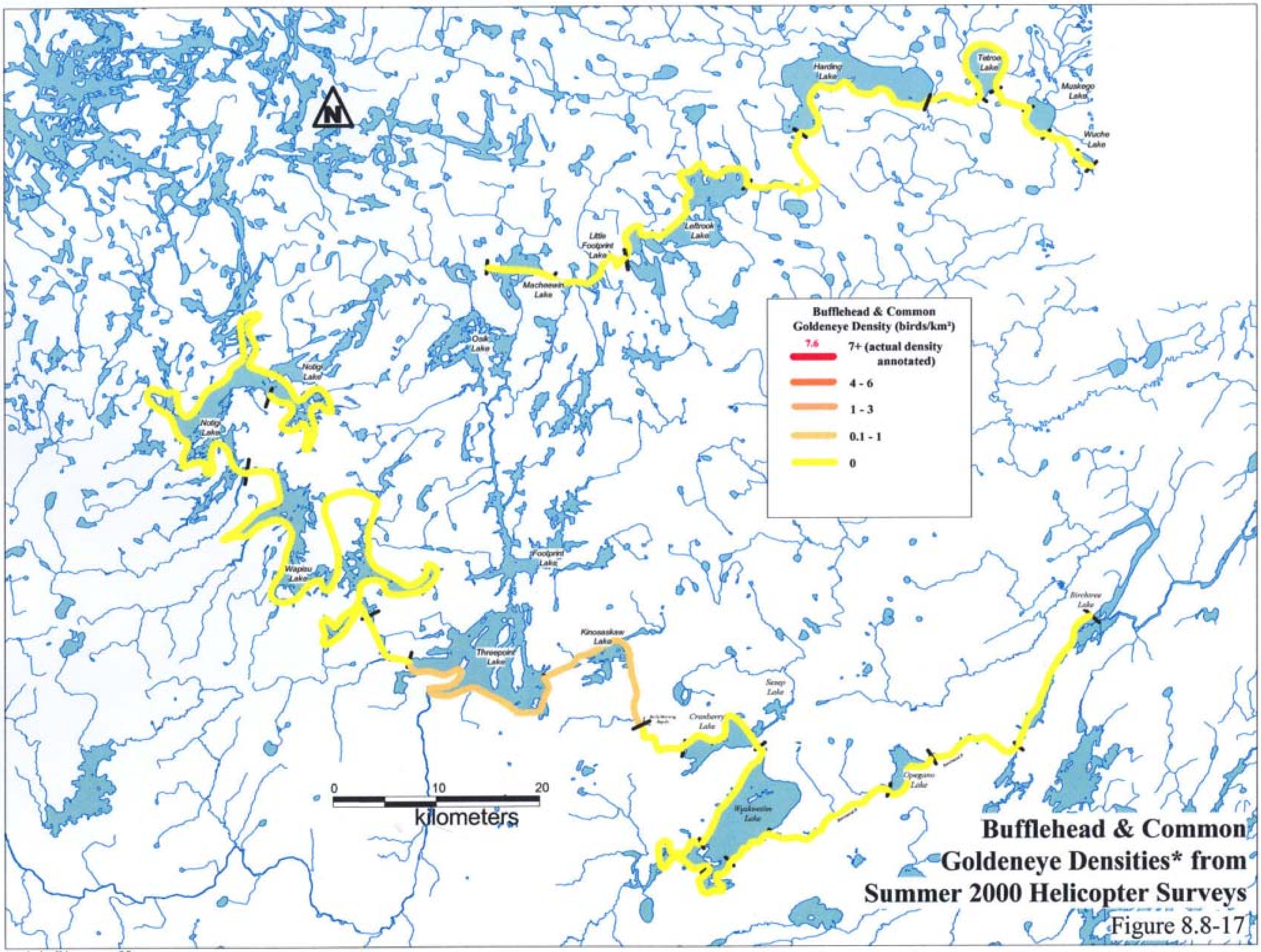
Figure 8.8-15



Bufflehead & Common Goldeneye Densities* from Spring 2000 Helicopter Surveys
Figure 8.8-16

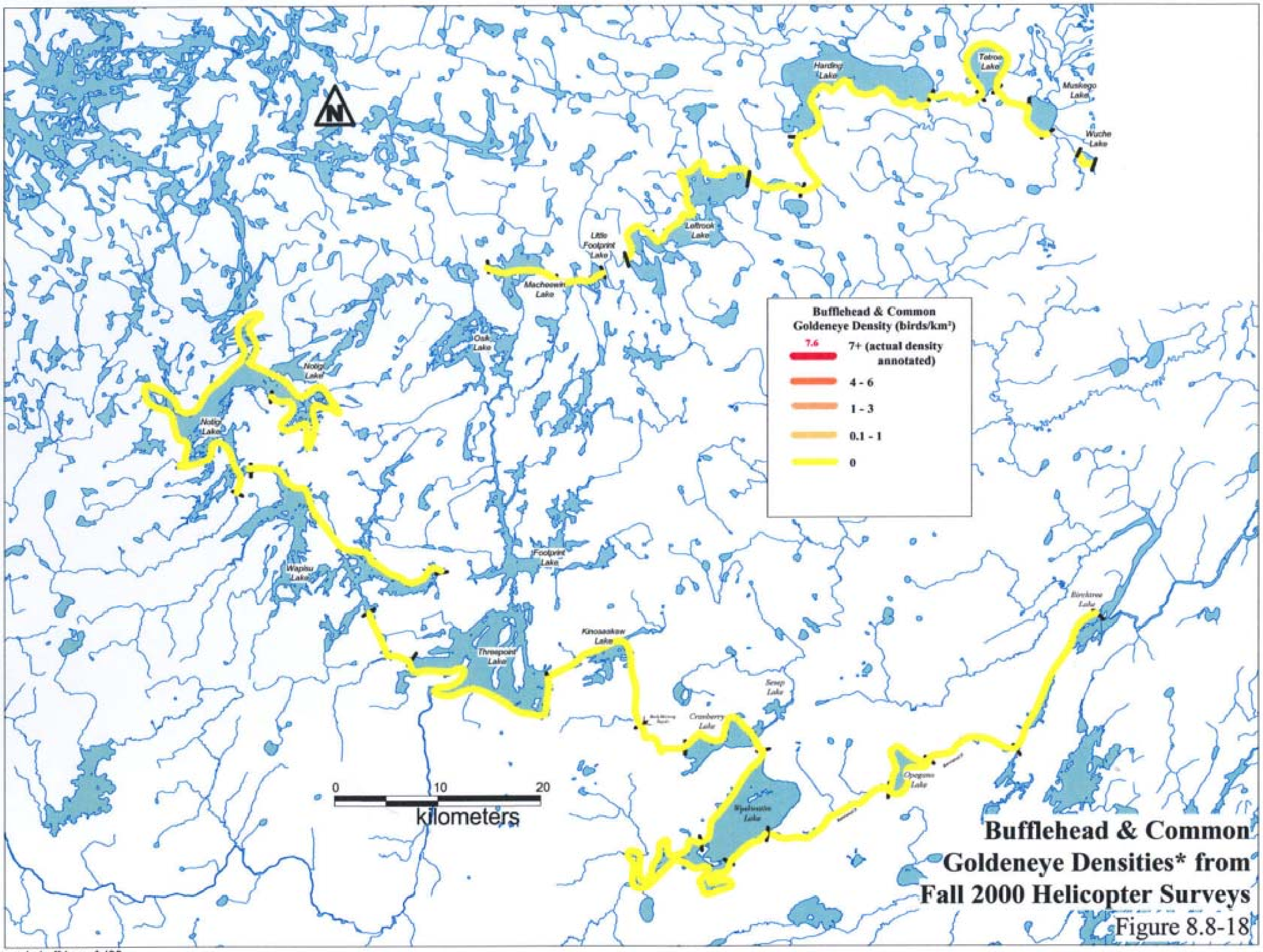
wusk_buffdens_spr00

** - data from those ducks identified to species (88% of 913 ducks observed)*



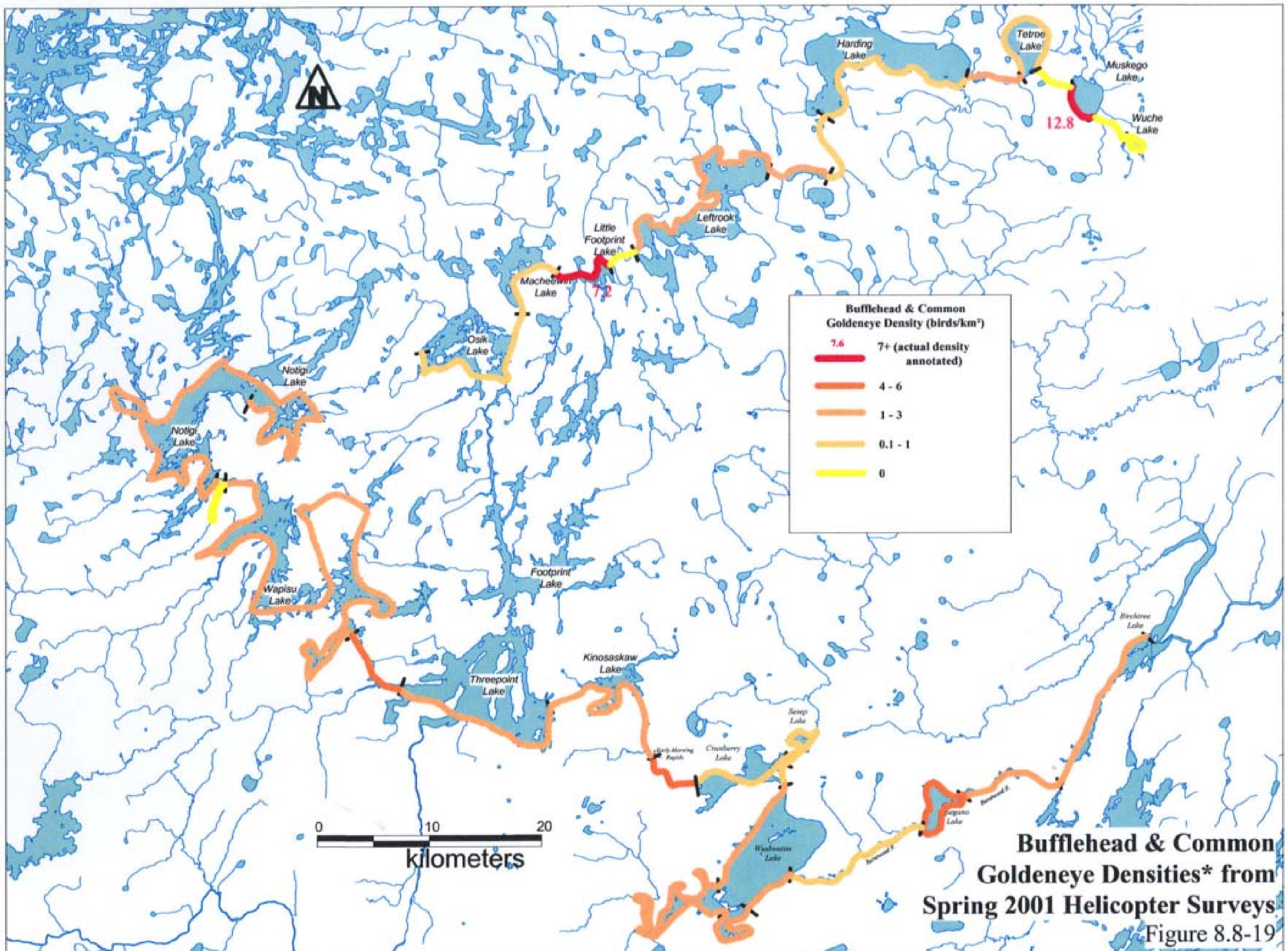
wusk_buffdens_sum00

** - data from those ducks identified to species (11% of 2417 ducks observed)*



wusk_buffdens_fal00

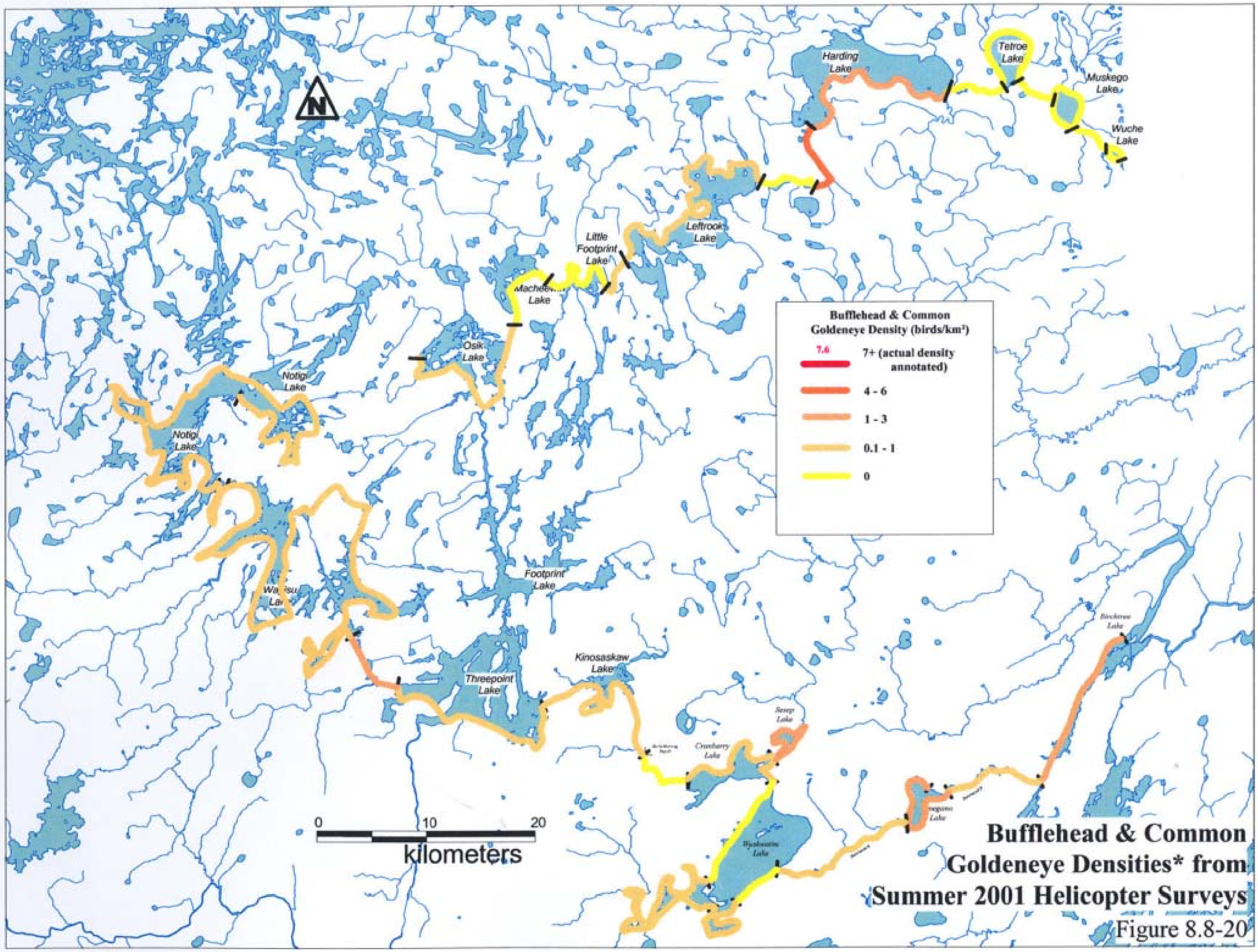
** - data from those ducks identified to species (25% of 2156 ducks observed)*



Bufflehead & Common Goldeneye Densities* from Spring 2001 Helicopter Surveys
Figure 8.8-19

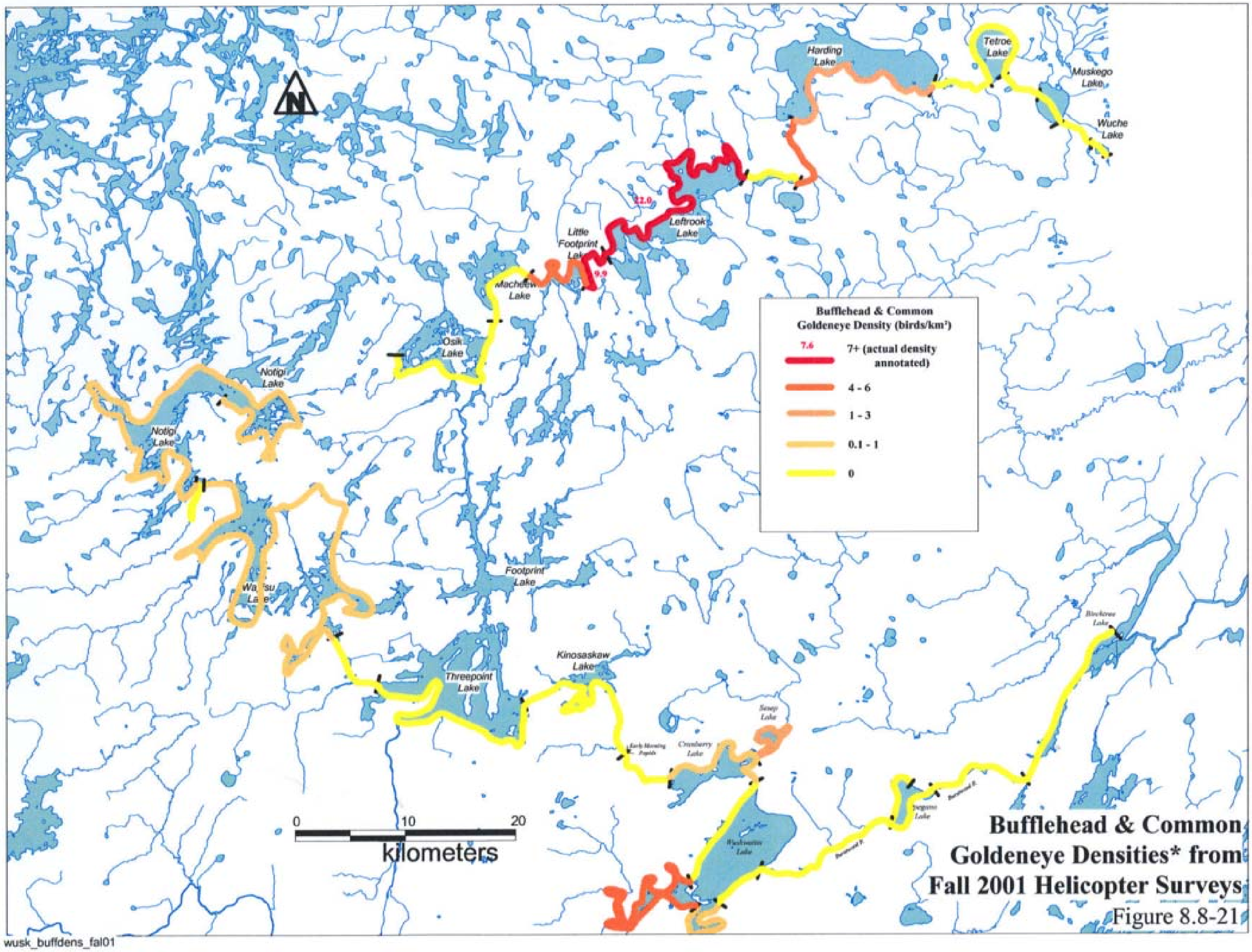
wusk_buffdens_spr01

** - data from those ducks identified to species (90% of 2055 ducks observed)*



Bufflehead & Common Goldeneye Densities* from Summer 2001 Helicopter Surveys
Figure 8.8-20

** - data from those ducks identified to species (82% of 1752 ducks observed)*



** data from those ducks identified to species (57% of 3754 ducks)*

Traditional Knowledge of birds in the study area, results of the Harvest Calendar Survey and interviews with NCN resource harvesters (Volume 7) indicated that waterbodies closer to Nelson House are primary locations for waterfowl harvesting (including Bufflehead and Common Goldeneye) rather than the Wuskwatim Lake area (Table 8.3-2). It is expected that increased access into the Wuskwatim Lake area via the access road will likely increase the mortality of these two duck species due to expected increased hunting activities in the area. This information, in combination with relevant previous research regarding habitat use by these two species (see below) have allowed for the formation of the following hypothesis: **The Project operation will result in an insignificant, long-term, local and small negative effect on Bufflehead and Common Goldeneye** (Figure 8.4-3).

Life Requirements Potentially Affected by the Project

Nesting Habitat

Water level increase and stabilization around 234 m ASL will initially have a minimal effect on Bufflehead and Common Goldeneye nesting habitat since nest holes observed during surveys in spring 2000 (when water levels were at, or near, 234 m ASL) were at least 0.5 metres above water level (Tetr*ES* 2003a). However, some nest holes not observed may have been flooded or become too close to the water level to be suitable as nest sites. Previous research indicates that these species typically select nesting cavities that are higher than 0.5 metres above water level, with most being between 0.75 and 18 metres above water level (Erskine 1972; Bellrose 1976; Godfrey 1986; Eadie *et al*. 1995). The increased water level and resulting increased soil saturation in some treed shoreline and island areas may result in a small increase in the potential for the creation of suitable nest cavities in dying flooded trees due to rotting and woodpecker activity. This potential increase in tree nest cavities is expected to be offset by the gradual loss of suitable nest trees due to increased and continued erosion of land areas supporting suitable nest trees.

Feeding Habitat

The diets of Bufflehead and Common Goldeneye are comprised primarily of aquatic invertebrates (mostly aquatic insects) in addition to some vegetation such as pondweed and seeds (Erskine 1972; Bellrose 1976; Gauthier 1993; Eadie *et al*. 1995). Both species dive while foraging for invertebrates, with most foraging activities occurring in shallow areas (usually <4 m deep) along shorelines where the highest concentrations of aquatic invertebrate occur (Erskine 1972; Jones and Drobney 1986; Eadie *et al*. 1995). The availability of abundant invertebrate prey has been shown to be a factor influencing foraging habitat selection (Eadie *et al*. 1995; Erskine 1972). These species have been known to often avoid habitats where competitor fish are present (Eadie *et al*. 1995; Erskine 1972).

Since no major changes in fish or aquatic invertebrate populations are expected as a result of the Project (Volume 5, Sections 7 and 8), substantial changes in Bufflehead and Common Goldeneye prey availability are also not expected. Although the increased water level will provide more shallow aquatic foraging habitat, stabilized water levels will result in increased peatland expansion into sheltered aquatic habitats (Volume 6, Section 5). Therefore, there is expected to be no measurable net change in available foraging habitat for these two species.

<u>Brood-rearing Habitat</u>

These two species do not depend on marsh and other areas of emergent vegetation for brood-rearing activities, foraging or cover compared to most dabbling duck species (Erskine 1972; Bellrose 1986; Gauthier 1993; Eadie *et al*. 1995). Therefore, the reduction of marsh habitat as a result of the Project is not expected to affect the amount of suitable brood-rearing habitat available for these species. Both species lead their broods into open water habitat shortly (< 48 hrs) after hatching (Erskine 1972; Eadie *et al*. 1995).

At night or during inclement weather, females often brood their young on shore in grassy shoreline vegetation, or on platforms (e.g., peat islands; floating logs or other woody debris near shore; Erskine 1972; Gauthier 1993; Eadie *et al*. 1995). Therefore, the presence of woody debris in the Wuskwatim Lake area is likely of some benefit to female Bufflehead and Common Goldeneye brooding young (<2 weeks old) ducklings. Since the amount of woody debris (Volume 4) and other potential brooding cover types are not expected to be substantially reduced as a result of project operation, there is expected to be no net change in the amount of available brood-rearing cover habitat.

8.8.5.4 Common Loon

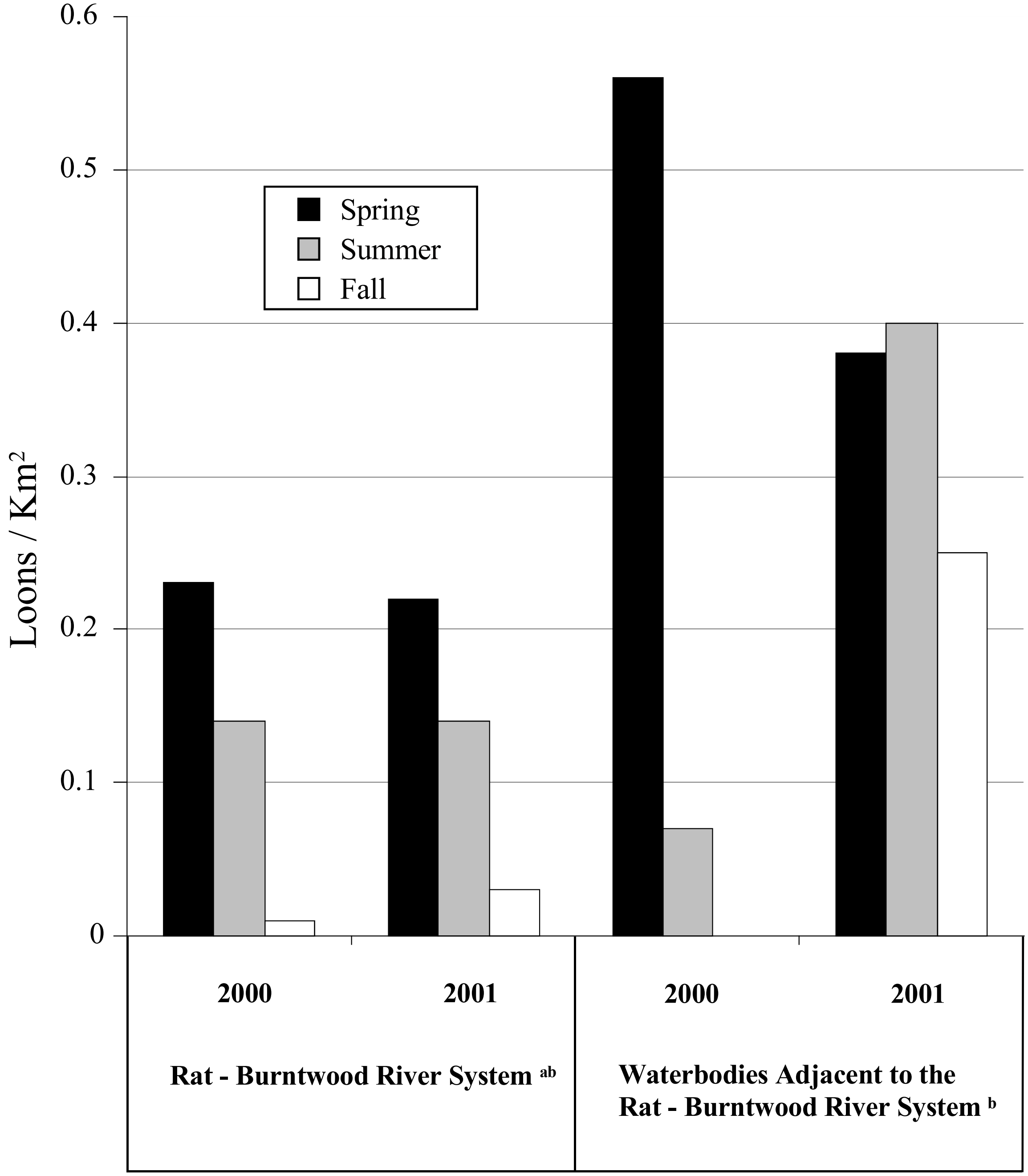
During spring helicopter surveys in 2000 and 2001, higher densities of loons were observed on waterbodies adjacent to the Rat-Burntwood River system compared to waterbodies along the Rat-Burntwood River system. Densities of loons recorded during summer and fall helicopter surveys on and off the Rat-Burntwood River System were variable (Figures 8.8-22 to 8.8-28).

Available Traditional Knowledge regarding loons in the bird study area is lacking. However, at least one loon was inadvertently caught and drowned in an NCN **commercial fishing** net in the Wuskwatim Lake area during spring 2001 (Table 8.3-2). Commercial fishers indicated that ‘a few’ loons are caught each year in commercial fishing nets.

Commercial fishing opportunities will be facilitated by the presence of the access road (Volume 7, Section 3). It is expected that continued or increased commercial fishing in the Wuskwatim Lake area will result in the continued annual loss of a few loons. Several studies have documented loon mortality resulting from commercial fishing activities (e.g., Bartonek 1965; Vermeer 1973; Barr 1981; McIntyre and Barr 1997). This information, combined with relevant previous research regarding habitat use by the Common Loon (see below) has allowed for the formation of the following hypothesis: **The Project operation is expected to have an insignificant, long-term, local and small negative effect on Common Loons** (Figure 8.4-4).

<u>Nesting Habitat</u>

Common Loons nest at or near the water surface, preferably on island shorelines of boreal lakes (Yonge 1981; McIntyre and Barr 1997; Gingras and Paszkowski 1999). Increased and continued erosion of islands and expected long-term loss of peat islands as a result of project operation will reduce the amount of optimal nesting habitat for Common Loons in the Wuskwatim Lake area. However, more stable water levels during project operation will be very beneficial to nesting loons since loon nests are susceptible to flooding due to variable water levels. The potential for increased boat traffic and human presence in the area due to increased access to Wuskwatim lake may pose a disturbance risk to some nesting loons.



Note: Refer to Tetr*ES* 2003 a,b for area surveyed in each season in 2000 and 2001
* Percentage of ducks identified to species
[a] River sections and associated lakes from Birch Tree Lake to Notigi Lake
[b] Ref. Figures 8.8-23 to 8.8-28

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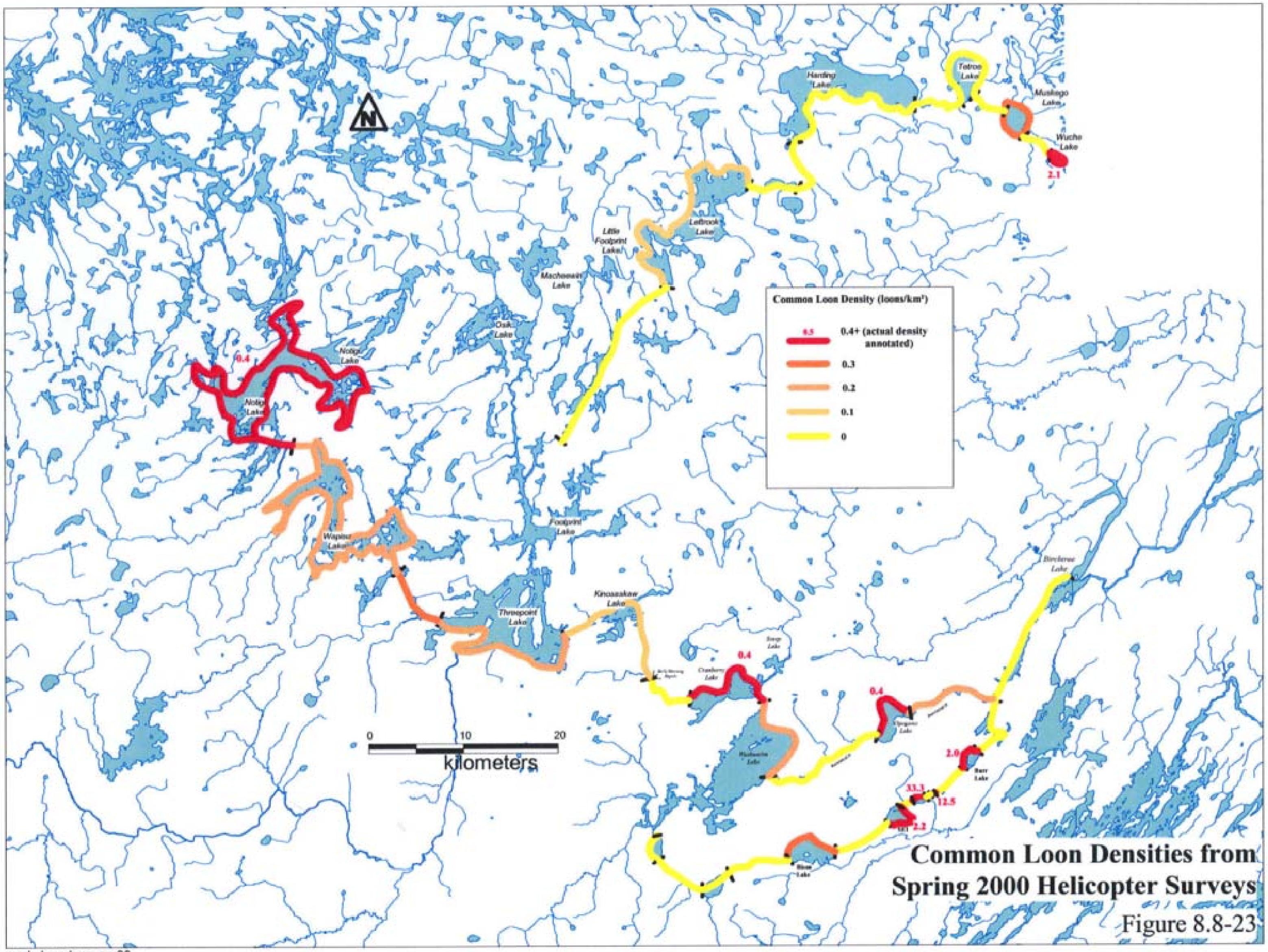
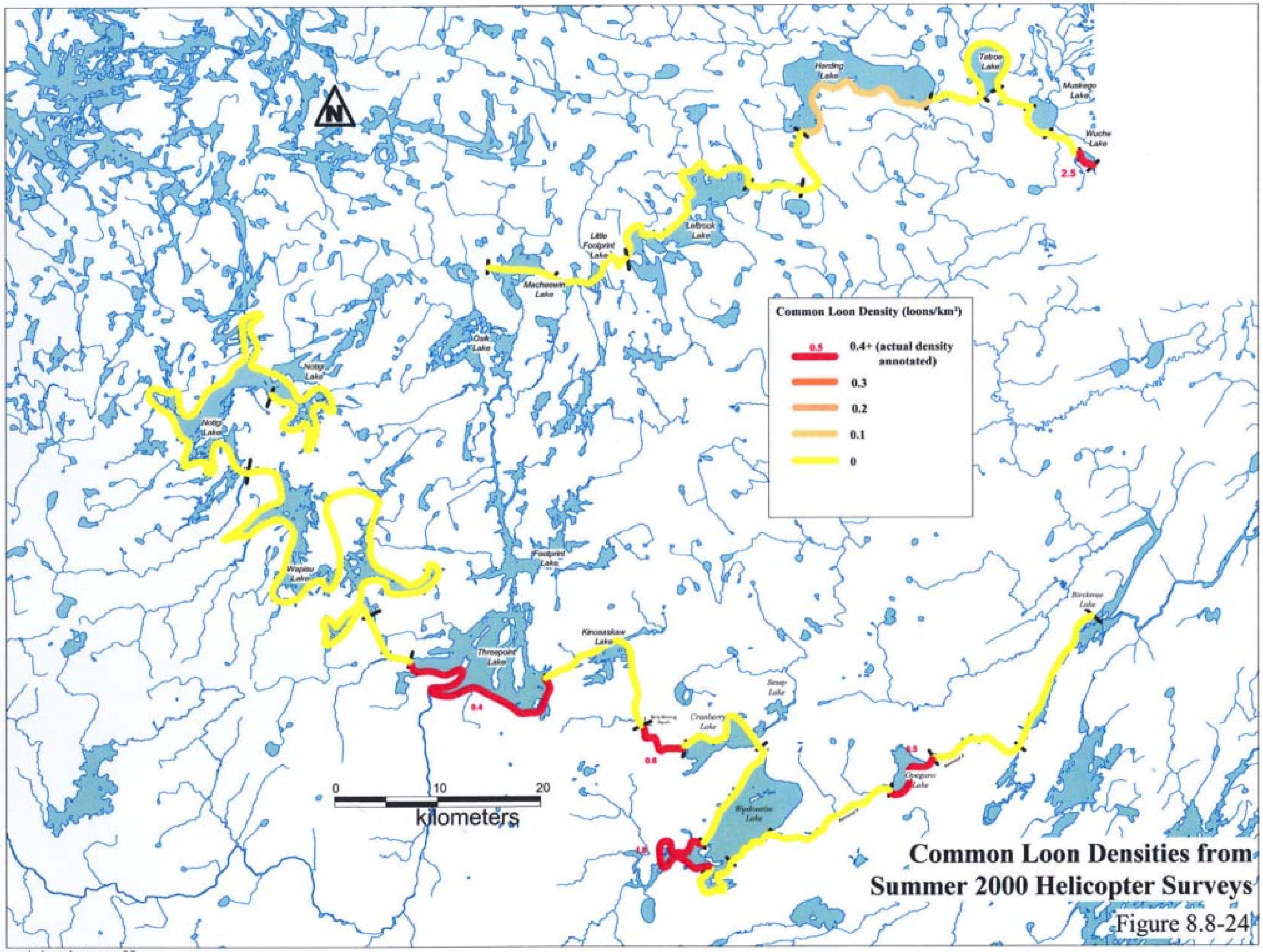
Densities of Common Loons Along, and Adjacent to, the Rat-Burntwood River System During Helicopter Surveys in 2000 and 2001

Figure 8.8-22

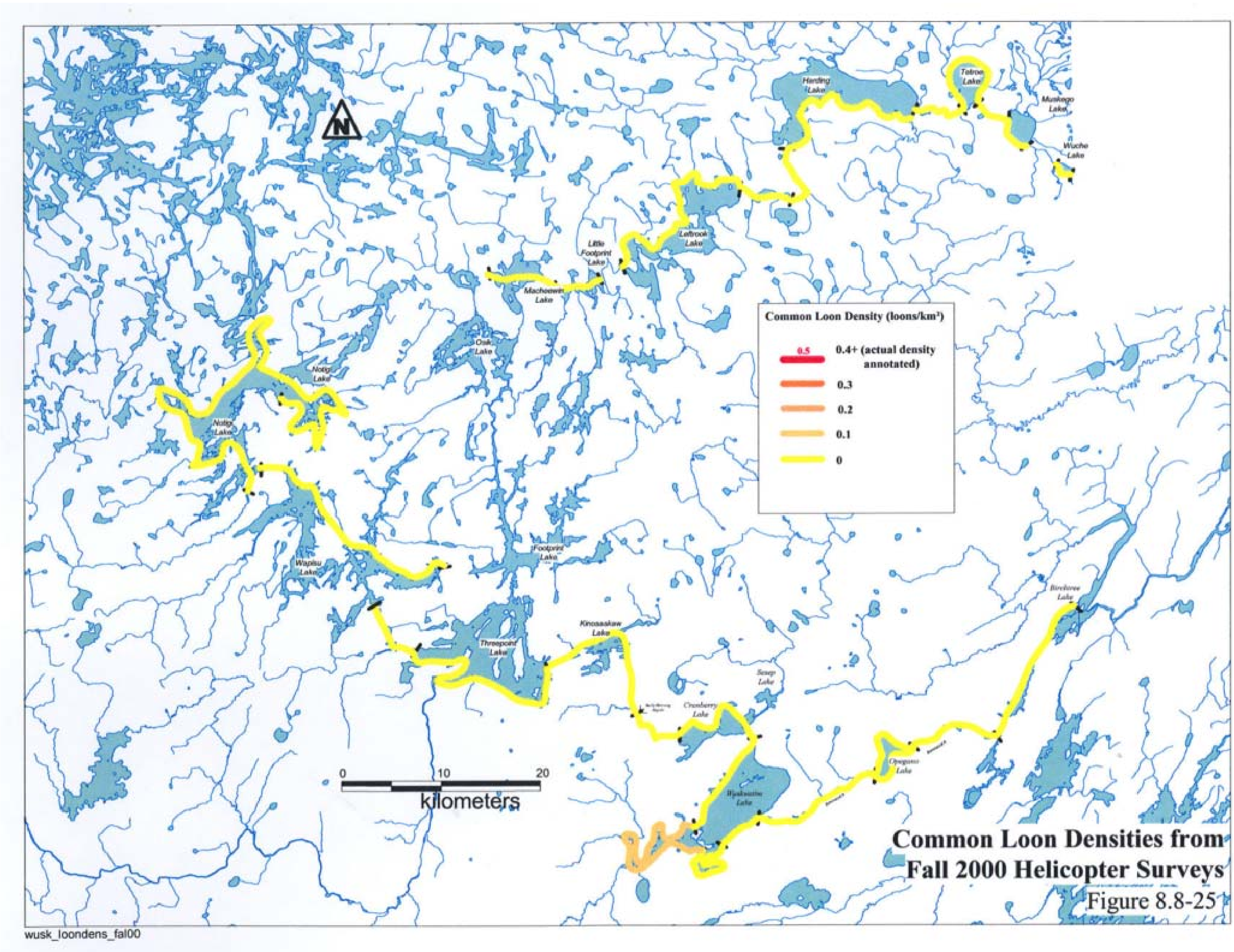


Common Loon Densities from Spring 2000 Helicopter Surveys
Figure 8.8-23

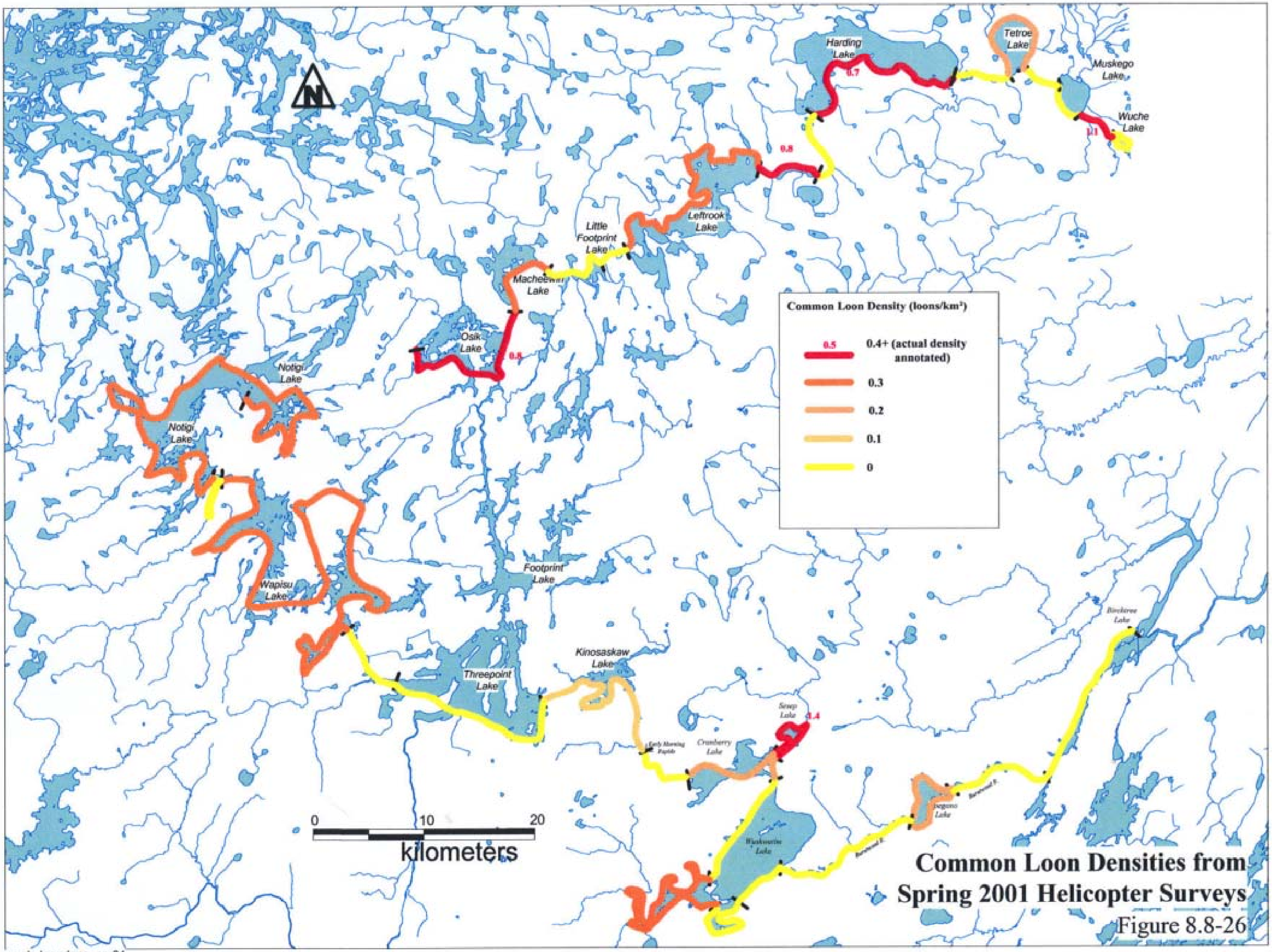
wusk_loondens_spr00



wusk_loondens_sum00

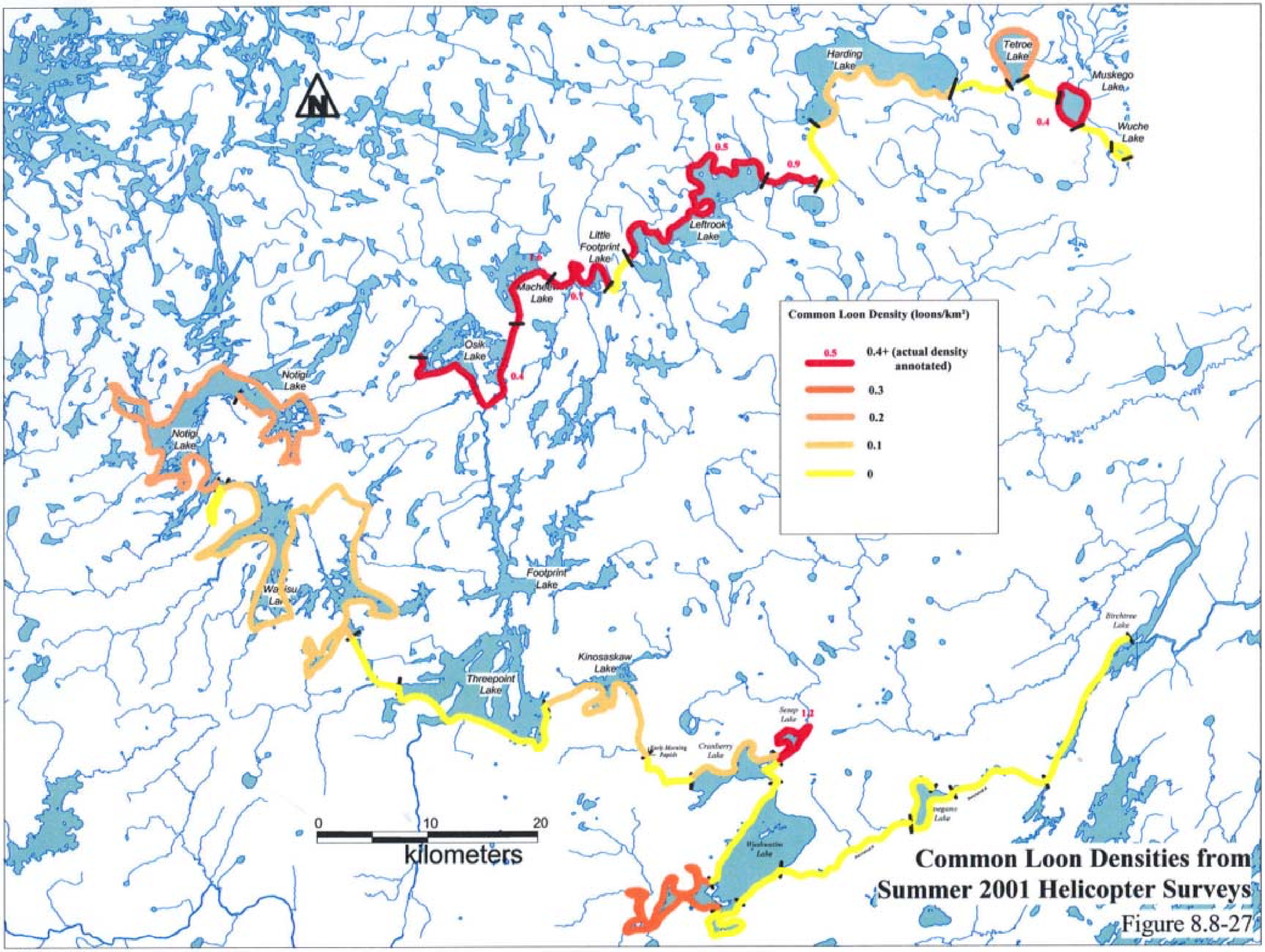


Common Loon Densities from Fall 2000 Helicopter Surveys
Figure 8.8-25



Common Loon Densities from Spring 2001 Helicopter Surveys
Figure 8.8-26

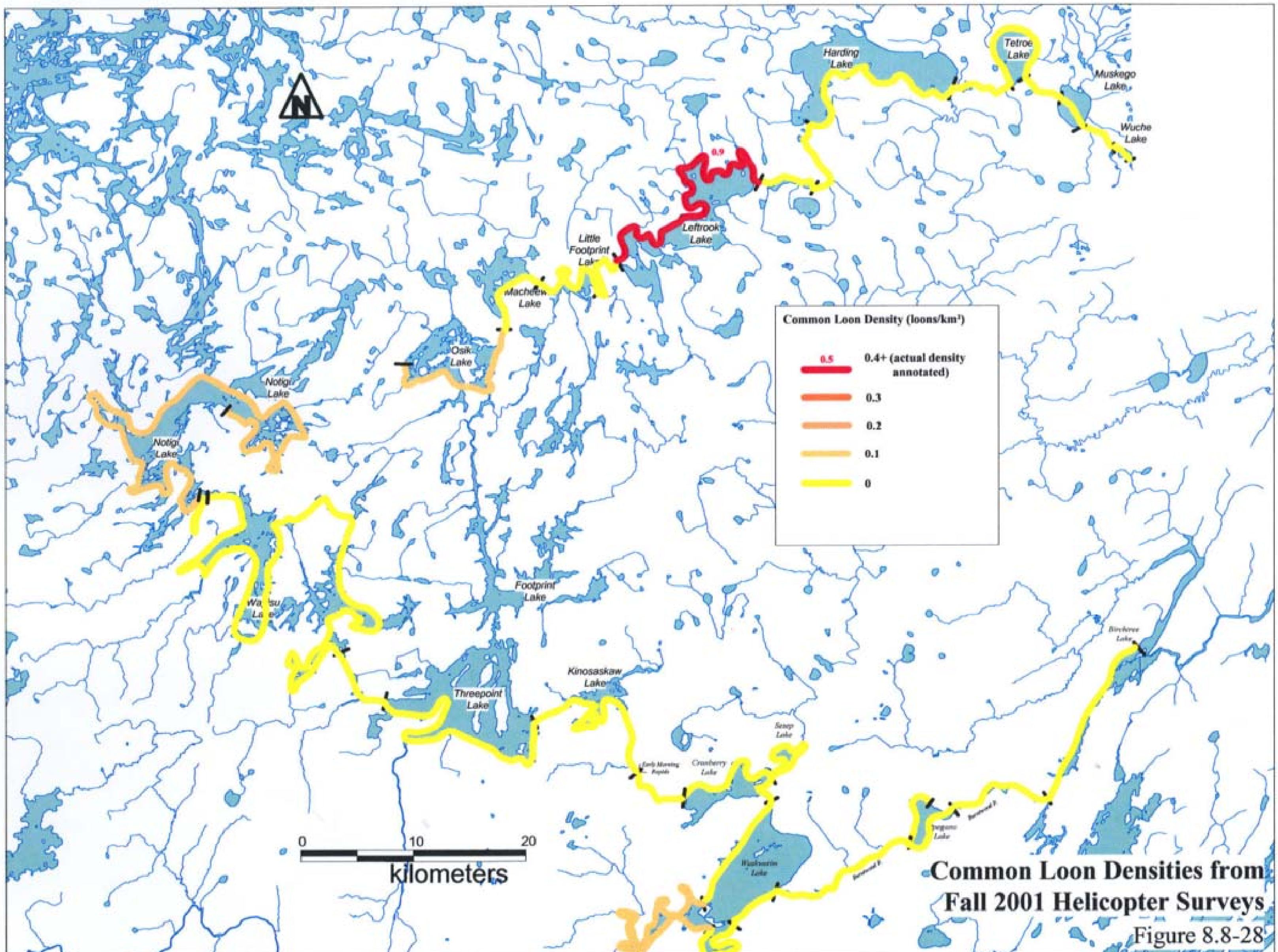
wusk_loondens_spr01



Common Loon Densities from Summer 2001 Helicopter Surveys

Figure 8.8-27

wusk_loondens_sum01



Common Loon Densities from Fall 2001 Helicopter Surveys
Figure 8.8-28

wusk_loondens_fal01

Feeding Habitat

Common Loons feed primarily on fish, but are opportunistic and will feed on other aquatic vertebrates, some invertebrates and some vegetation (Barr 1996; McIntyre and Barr 1997). The breeding success of Common Loons has been shown to be correlated with lake area and prey abundance, especially the availability of fish (e.g., Gingras and Paszkowski 1999). Breeding Common Loons occasionally forage for themselves off their nesting lake, but do not import fish to feed chicks (Gingras and Paszkowski 1999). Foraging activity often occurs over shoals, around islands, and in marsh areas with abundant small fish (Gingras and Paszkowski 1999).

Project operation is not expected to substantially alter populations of fish or other aquatic prey species (Volume 5, Sections 7 and 8). However, increased erosion and suspended sediment in certain areas (Volume 4) may limit suitable foraging areas slightly more than current conditions since loons require good underwater visibility within the upper five metres of the water column for efficient foraging (Barr 1996; McIntyre and Barr 1997). Studies of loons in Southern Ontario indicated that no lake with Secchi disk readings <1.5 m, and which could be considered to be a turbid lake with poor underwater visibility, was occupied by breeding loons (Barr 1996).

Brood-rearing Habitat

Common Loons require lakes with sufficient fish populations and some sheltered habitat such as bays to successfully raise their young (McIntyre and Barr 1997; Gingras and Paszkowski 1999). Increased human activities and presence in the Wuskwatim Lake area as a result of increased access may result in some disturbance of loons with young. Brood-rearing loons typically react to disturbances by separating from their young; in which case, the young become vulnerable to exposure and predation and will reduce their food intake as a result of disturbance (Yonge 1981; Barr 1996).

8.8.5.5 Bald Eagle

Results of helicopter surveys in 2000 and 2001 suggest that Bald Eagle densities during spring and fall appear similar along the Rat-Burntwood River system compared to adjacent waterbodies (Figure 8.8-29). More variable densities of Bald Eagles were observed on and off the Rat-Burntwood River system during summer surveys (Figures 8.8-29 to 8.8-35 and Tetr*ES* 2003a,b).

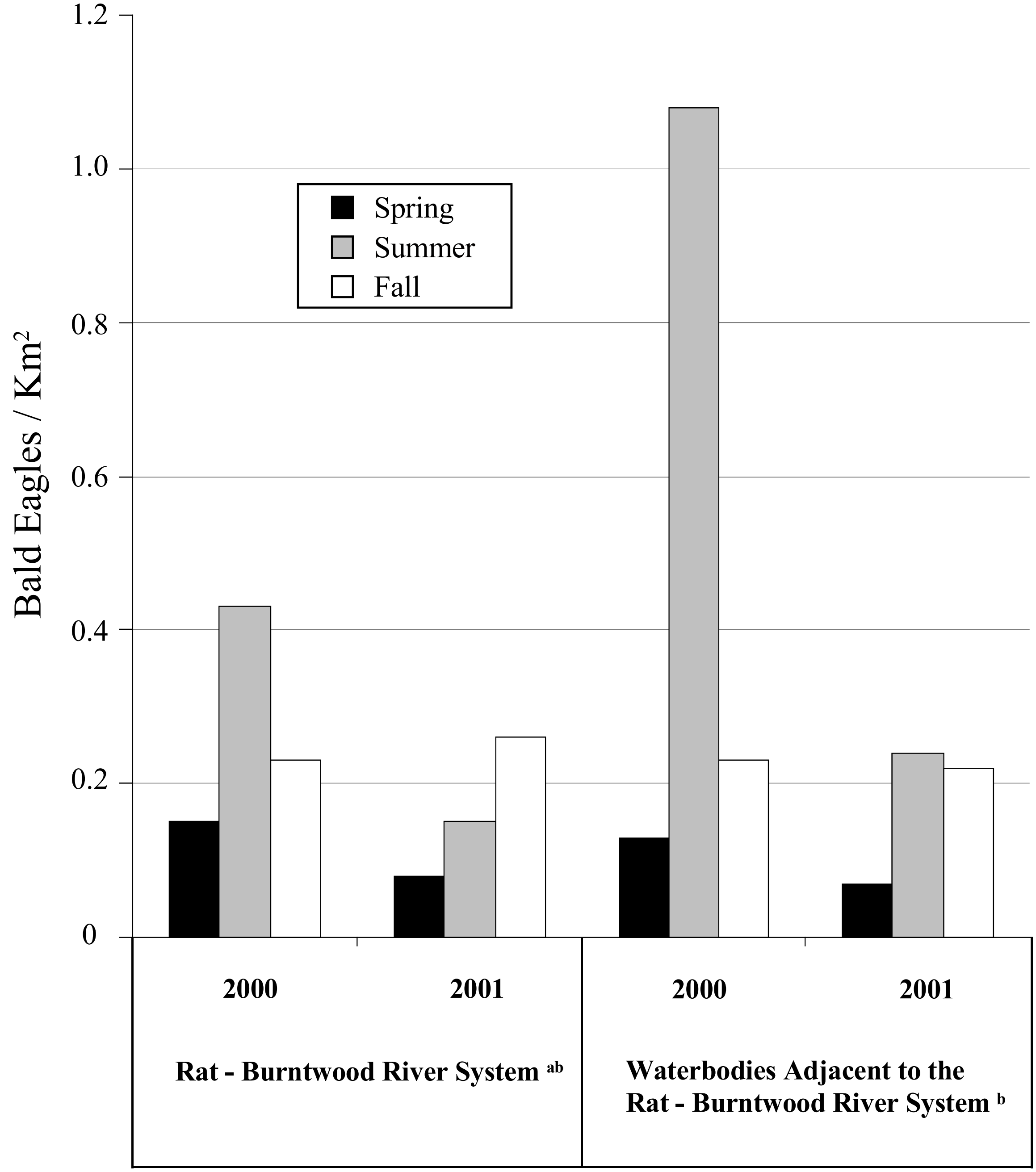
Available Traditional Knowledge regarding Bald Eagles in the bird study area indicates that eagles are concentrated in areas where commercial fishing occurs and that they often nest near fish gut disposal areas (Table 8.3-3). Since the access road is expected to make commercial fishing ventures more viable in the Wuskwatim Lake area (Volume 7), Bald Eagles will benefit from the expected increased seasonal availability of fish gut piles from continued commercial fishing activities in the Wuskwatim Lake area. Additionally, some fish will likely be affected (stunned or killed) by passing through the generating station turbines (Volume 5), which will also improve foraging opportunities for Bald Eagles in the area downstream of the generating station.

Alternatively, increased human presence and boat traffic in the Wuskwatim Lake area is expected to increase the potential for disturbance of nesting, brood-rearing and foraging Bald Eagles. Increased and continued erosion in the Wuskwatim Lake area (Volume 4) will result in decreased nesting success if nest-trees fall due to shoreline erosion prior to fledging of nestlings. During field studies in 2000 and 2001 in the Bird Study area, Bald Eagle nests were typically located within 10 metres of erodible shoreline (Tetr*ES* 2003a,b).

The above information combined with relevant previous research regarding habitat use by the Bald Eagle (see below) has allowed for the formation of the following hypothesis: **The Project operation is expected to have no net effect on Bald Eagles**.

Nesting Habitat

Bald Eagles nest in deciduous and coniferous trees, usually near the shoreline of larger lakes and rivers (Whitfield *et al*. 1974; Koonz 1988). Nests are typically placed from 3 to 20 metres off the ground (Koonze 1998; Beuhler 2000). Nests observed in the bird study area during 2000 and 2001 were typically within 10 metres of the shoreline (Tetr*ES* 2003a,b). Another study in Central Manitoba and Saskatchewan found that 68% of 219 nests observed were within 46 metres of a river or lake shoreline (Whitfield *et al*. 1974).

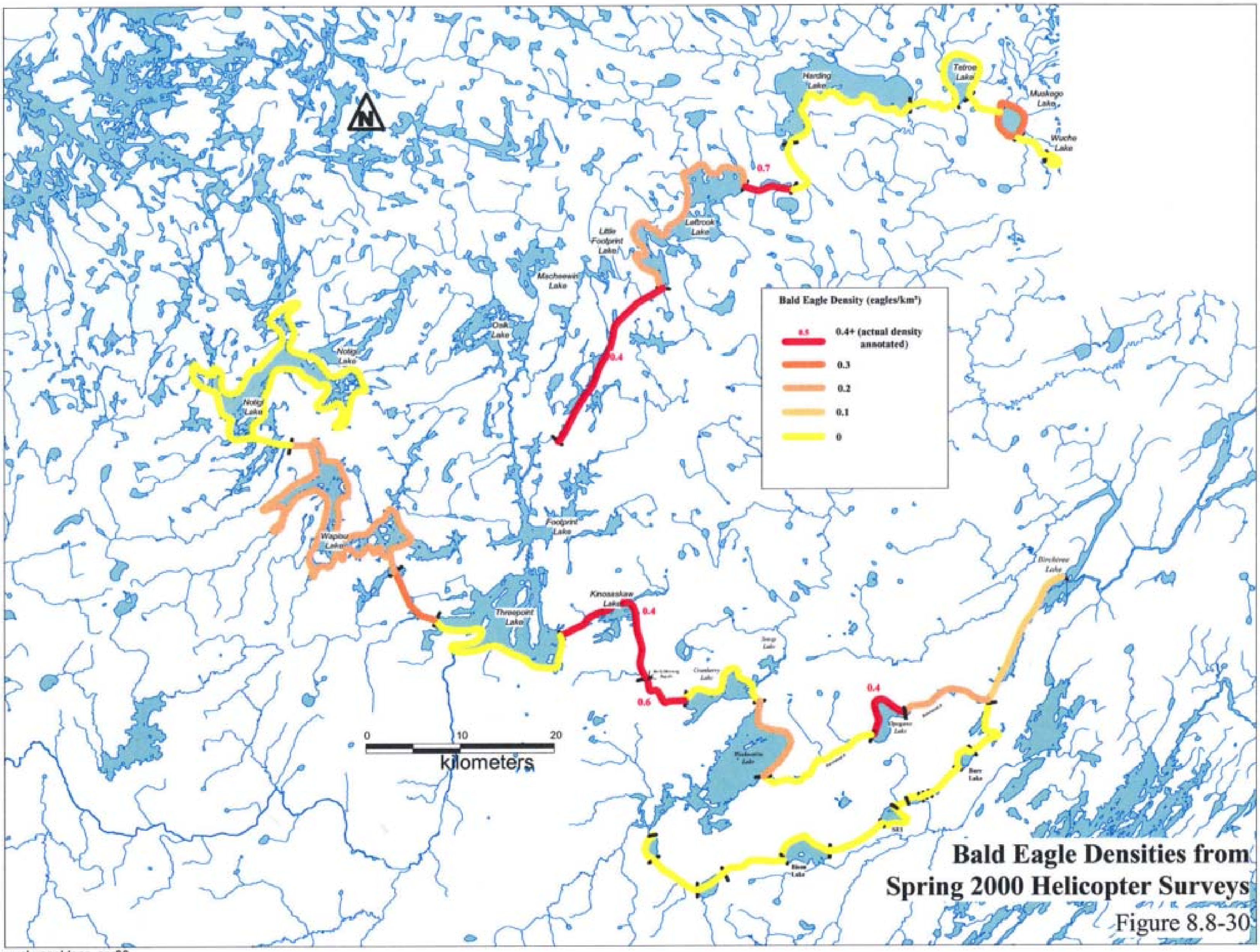


Note: Refer to Tetr*ES* 2003 a,b for area surveyed in each season in 2000 and 2001
* Percentage of ducks identified to species
[a] River sections and associated lakes from Birch Tree Lake to Notigi Lake
[b] Ref. Figures 8.8-30 to 8.8-35

01_files\29_wusgl\baea summary 2000 & 2001.dsf

Densities of Bald Eagles Along, and Adjacent to, the Rat-Burntwood River System During Helicopter Surveys in 2000 and 2001

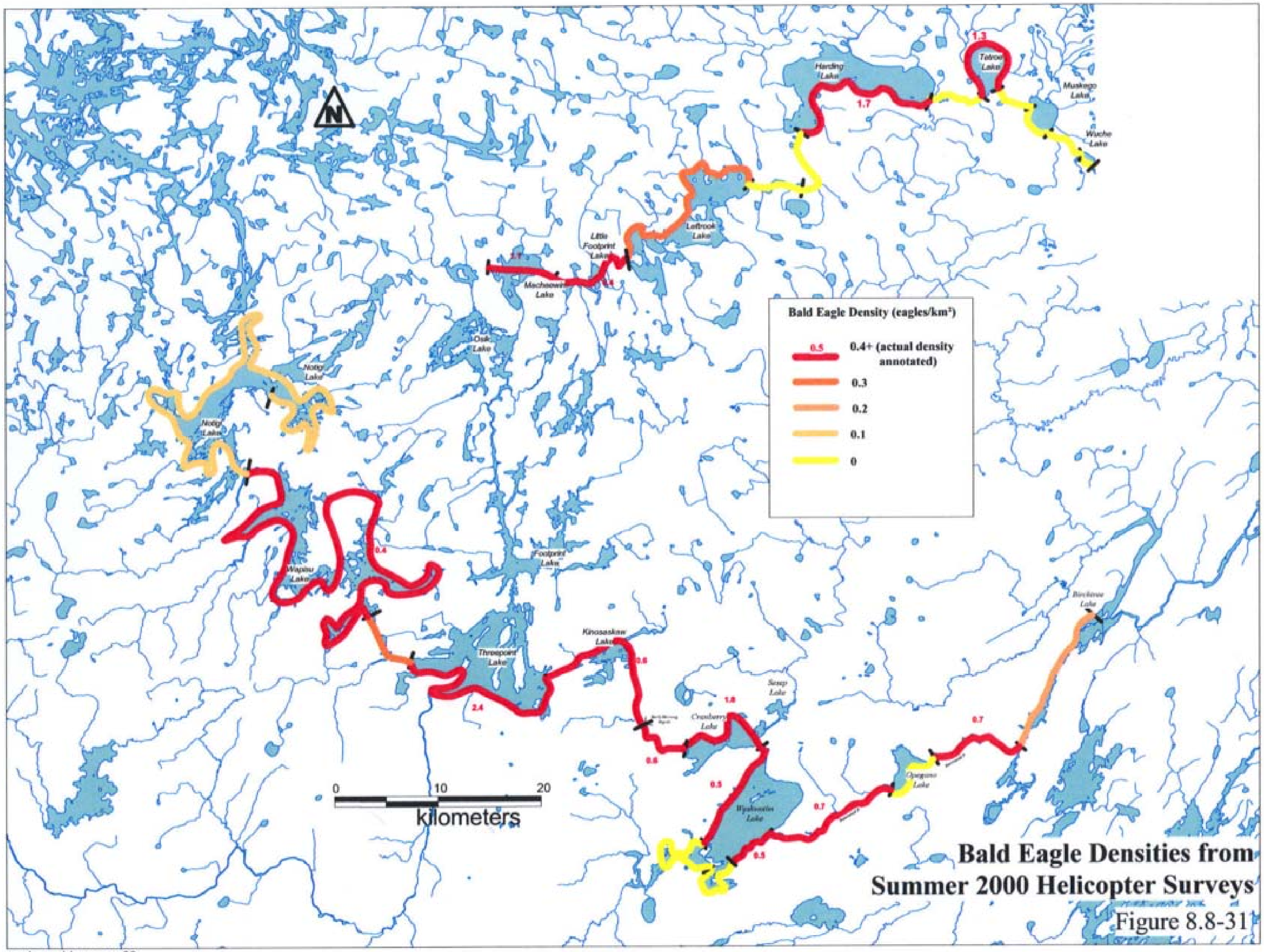
Figure 8.8-29



Bald Eagle Densities from Spring 2000 Helicopter Surveys

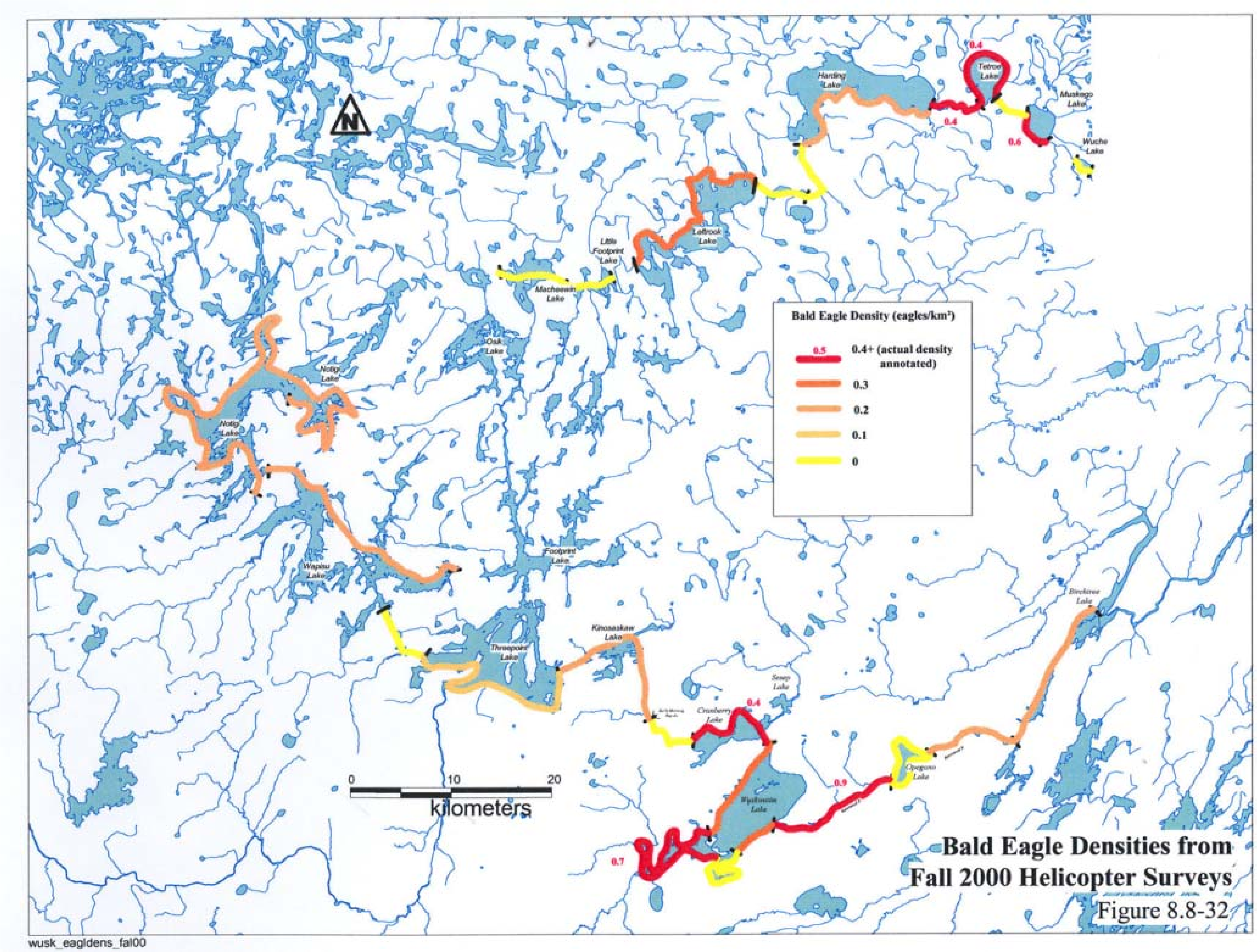
Figure 8.8-30

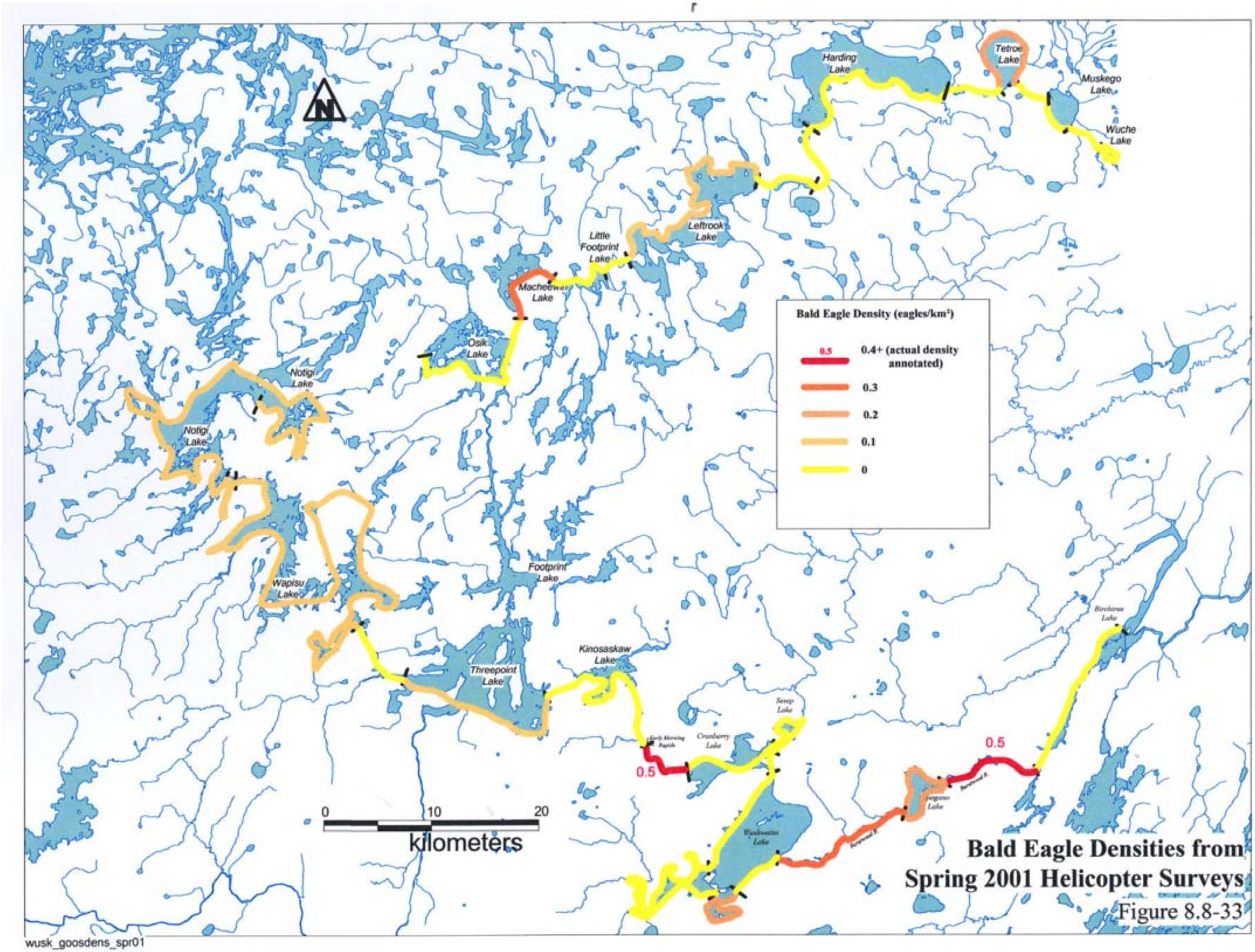
wusk_eagldens_spr00



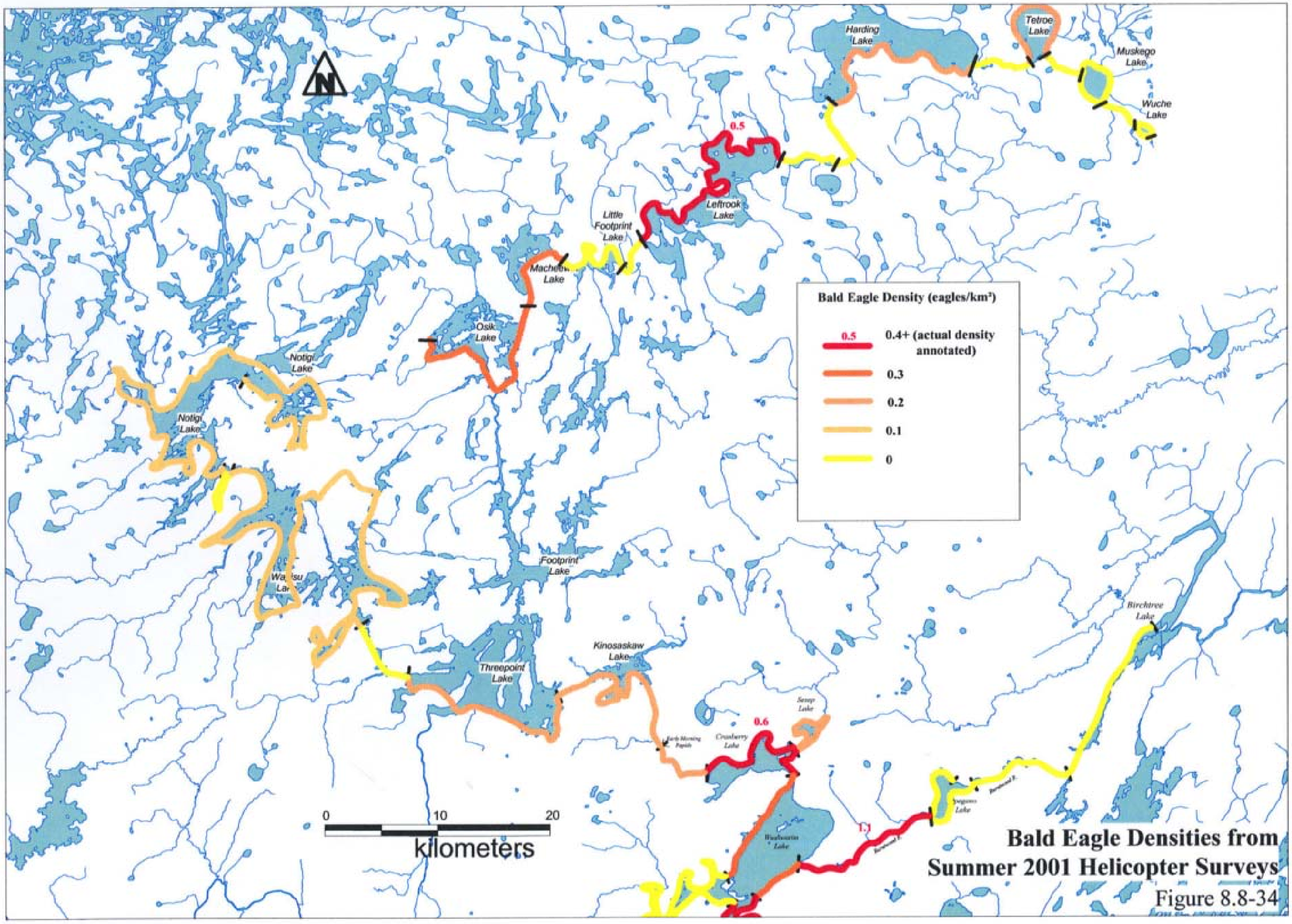
Bald Eagle Densities from Summer 2000 Helicopter Surveys
Figure 8.8-31

wusk_eagldens_sum00


Bald Eagle Density (eagles/km²)
0.4+ (actual density annotated)
0.3
0.2
0.1
0
kilometers
Bald Eagle Densities from Fall 2000 Helicopter Surveys
Figure 8.8-32
wusk_eagldens_fal00

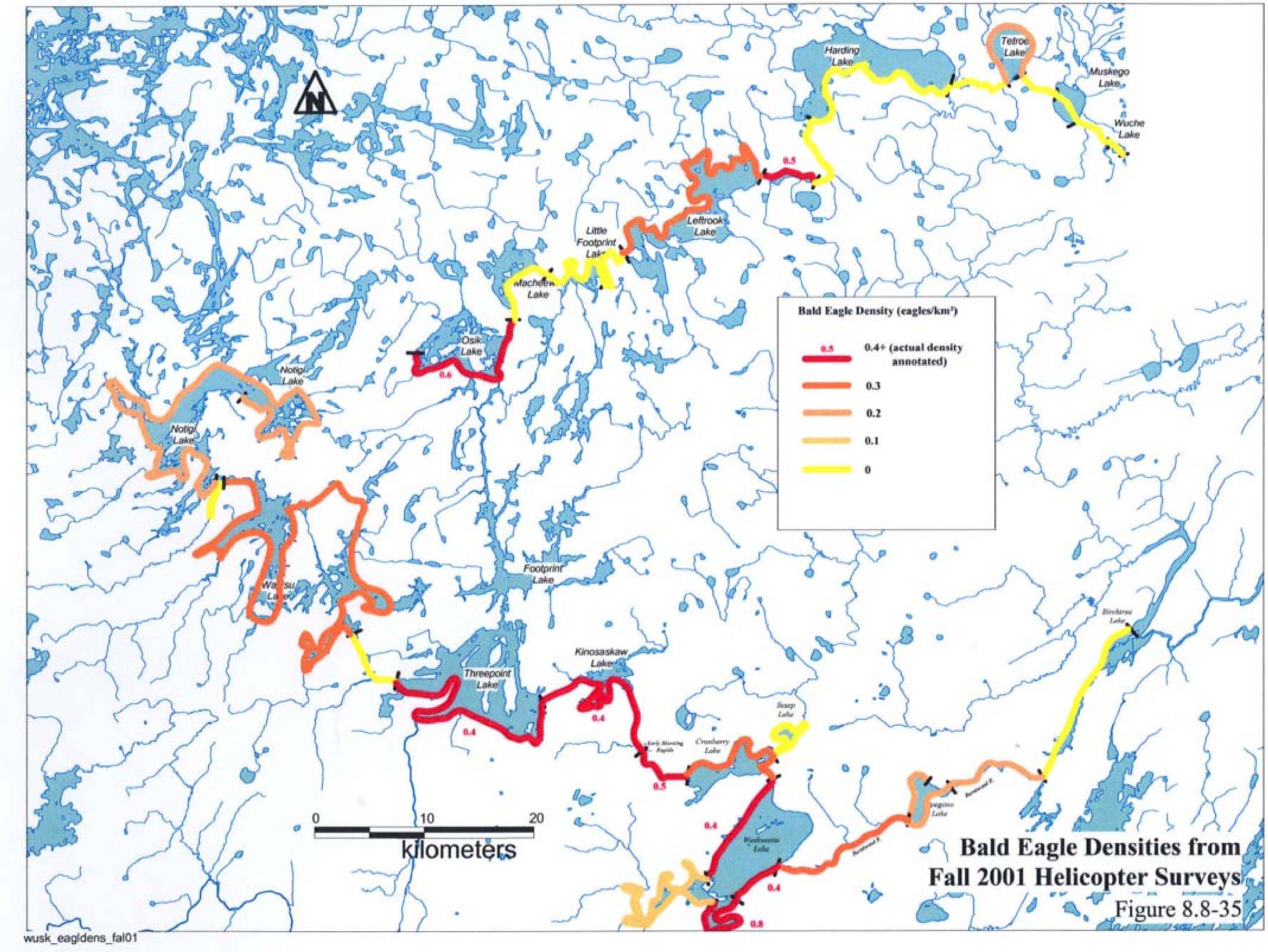


Bald Eagle Densities from Spring 2001 Helicopter Surveys
Figure 8.8-33



Bald Eagle Densities from Summer 2001 Helicopter Surveys
Figure 8.8-34

wusk_eagldens_sum01



Bald Eagle Densities from Fall 2001 Helicopter Surveys

Figure 8.8-35

Since nests may be re-used for 20 or more year (Koonz 1988; Buehler 2000), increased and continued erosion during project operation may result in some currently established nest trees being removed due to erosion (Figures 8.3-8 and 8.3-9 for locations of Bald Eagle nests during 2000 and 2001 field studies). If a nest tree falls due to erosion, impacts to the eagles would be greatest during the nesting period (April through August; Koonz 1988) due to loss of eggs/nestlings. Suitable nesting trees are abundant in the Wuskwatim Lake area and are not a factor limiting nesting Bald Eagles in this area.

In addition to nest site availability, breeding Bald Eagle densities, behaviour and nesting success are also known to be influenced by other factors such as food availability (particularly fish), human disturbance and water **turbidity** (e.g., Fraser *et al*. 1985; Buehler *et al*. 1991; Steidl and Anthony 1996, 2000; Wood 1999). Of these factors, increased human presence and activities (e.g., boating) as a result of project operation will likely be the most important influence on Bald Eagle nest site selection and nesting success (e.g., ability to forage efficiently/undisturbed). However, Bald Eagle reactions to human presence and activities are variable and may or may not affect eagle nesting success (e.g., Fraser *et al*. 1985; Steidl and Anthony 2000).

<u>Feeding Habitat</u>

Bald Eagles prefer to feed on fish when available, but are opportunistic and will forage on a wide variety of other animals and carrion (Buehler 2000). Increased human access and presence in the Wuskwatim Lake area due to the access road may result in the occasional disturbance of some foraging Bald Eagles, particularly due to boating and other activities along the lake and river shorelines (Buehler *et al*. 1991; Steidl and Anthony 1996; Wood 1999). Continued commercial fishing activities in the Wuskwatim Lake area (Volume 7) facilitated by the access road will provide seasonal supplemental foraging sites for Bald Eagles at fish gut piles. Foraging opportunities are also expected to increase in the tailrace reach between Taskinigup Falls and Opegano Lake as eagles will forage on fish that may be stunned or killed as they pass through the generating station turbines (Volume 5). Overall, fish populations (i.e., the primary food of Bald Eagles) are not expected to be substantially affected as a result of the Project (Volume 5).

Brood-rearing Habitat

Young Bald Eagles do not fledge from the nest until they are between eight and 14 weeks old (Buehler 2000). Fledgings follow adults and may be fed by adults for up to six weeks after leaving the nest (Buehler 2000). A critical aspect of young Bald Eagle survival is the ability of the adult Bald Eagle to adequately provide food for their young. Consistent disturbance of foraging adult Bald Eagles and human presence near nest-sites could result in a potential impact on the survival of Bald Eagle young (Steidl and Anthony 2000).

At least one active Bald Eagle nest has been observed within 10 metres of erodible shoreline on the main Wuskwatim Lake (Figures 8.3-8 and 8.3-9). Bald Eagle broods may be vulnerable as a result of nest tree destruction if adult eagles use these established nest sites or other nest sites immediately adjacent to erodible shorelines of the main Wuskwatim Lake during the first five years of project operation when erosion rates are expected to increase (Volume 4).

8.8.5.6 Red-winged Blackbird

During field studies in 2000 and 2001 throughout the Wuskwatim Lake area, Red-winged Blackbirds were common in areas with dense cattail marsh habitat (e.g., Sesep Lake, the south arm of Wuskwatim lake and Wuskwatim Brook; Tetr*ES* 2003a,b). Available Traditional Knowledge indicates that there has been a decline in blackbirds throughout the NCN area (including the Wuskwatim Lake area) since the CRD due to habitat loss along shorelines (Table 8.3-4).

In certain locations in the Wuskwatim Lake area, cattail marsh habitat has persisted due to water level variations that are required for the extensive growth and establishment of cattails. During project operation, water levels in the Wuskwatim Lake area will be relatively stable around 234 m ASL, resulting in a substantial reduction of cattail marsh habitat (Section 5). However, cattail marsh habitat occurs in various locations throughout the bird study area outside the area to be influenced by the Project (as observed during helicopter surveys of the area in 2000 and 2001). Therefore, the total loss of cattail marsh habitat predicted to occur as a result of the Project within the bird study area is not expected to be significant. This information combined with relevant previous research regarding habitat use by Red-winged Blackbirds (see below) has allowed for the formation of the following hypothesis: **The project operation is expected to have a long-term, local and small negative effect on Red-winged Blackbirds** (Figure 8.4-6).

Nesting and Brood-rearing Habitat

Optimal Red-winged Blackbird nesting habitat consists of freshwater marshes and water edges with dense growths of cattails, bulrushes, and similar tall, sturdy emergent vegetation (Goddard and Board 1967; Robertson 1972; Short 1985; Godfrey 1986; Yasukawa and Searcy 1995). Red-winged Blackbirds are a polygynous species (i.e., one male breeding with several females) with the number of females per male varying among different populations (Yasukawa and Searcy 1995).

In the Wuskwatim Lake area, Red-winged Blackbirds were observed in dense cattail marsh habitat during the breeding season (Tetr*ES* 2003a,b). Approximately 65 ha of cattail (i.e., *Typha*) habitat occurs in the Wuskwatim Lake area (Section 5). Other studies of Red-winged Blackbirds nesting in cattail marsh habitat indicate that nest densities average 50 to 100 nests/ha (Goddard and Board 1967; Robertson 1972). This suggests that approximately 3,250 to 6,500 Red-winged Blackbird nests may occur annually in the Wuskwatim Lake area.

Red-winged Blackbird eggs are incubated 11 to 13 days with the hatched young remaining in the nest for approximately the same length of time (Yasukawa and Searcy 1995). Fledgings are fed on the territory for up to two weeks after leaving the nest and up to another three weeks off the territory (Yasukawa and Searcy 1995). Therefore, the brood-rearing habitat is encompassed largely within the nesting habitat (i.e., marsh habitat and adjacent areas).

Stabilized water levels during Project operation are expected to result in the reduction of extensive cattail marsh habitat (Section 5). Red-winged Blackbirds will continue to nest in much lower densities in the Wuskwatim area within the cattail-fringed peatland areas that will remain after the die-off of extensive cattail-marsh habitat.

Stabilized water levels will reduce the risk of nest flooding for those nests located near water level. Red-winged Blackbirds typically place their nests 20 to 100 cm above water level (Short 1985).

Feeding Habitat

Red-winged Blackbirds are primarily insectivorous during the nesting season, with the diet shifting to primarily seeds during migration and in the non-breeding seasons (Yasukawa and Searcy 1995). Red-winged Blackbirds occur in the Wuskwatim Lake area from approximately May to October, during which time they are primarily insectivorous and will forage in a wide variety of habitats. Due to the Red-winged Blackbirds variable diet, foraging habitat is not limited in the Wuskwatim Lake area.

8.8.5.7 Palm Warbler

During field studies in 2000 and 2001 in the Wuskwatim Lake area, Palm Warblers were most commonly observed in boggy forested or edge habitat (TetrES 2003a,b). Communications with NCN people did not reveal any Traditional Knowledge specifically regarding the Palm Warbler (Table 8.3-4). A review of Palm Warbler habitat use (see below) and information regarding how the terrestrial habitat will be affected during project operation (Section 5) has resulted in the formation of the following hypothesis: **The project operation is expected to have a long-term, local and small positive effect on Palm Warblers** (Figure 8.4-7).

Nesting and Brood-rearing Habitat

Palm Warblers are a common neotropical migrant songbird species that nests in association with bog-heath and heath forest habitat throughout the boreal forests of North America (Welsh 1971; Godfrey 1986; Wilson 1996). Smaller clearings adjacent to forest areas or forest edge habitat is preferred for nesting rather than open treeless bog habitat (Welsh 1971). Nests are placed on the ground or low in a short tree or shrub. Incubation is 12 days with young leaving the nest 10 to 11 days after hatching (Welsh 1971; Godfrey 1986). Brood-rearing takes place in the nest during the nestling stage and in adjacent habitat during the fledgling stage (Welsh 1971; Wilson 1996).

More stable water levels as a result of project operation will reduce the probability of nest flooding in low fen and bog habitat that may be inundated by large increases in water levels during the nesting stage. Increased water levels to 234 may flood a very minor proportion of potential Palm Warbler habitat that occurs in low fen and bog habitat immediately adjacent to main waterbodies in the Wuskwatim Lake area. However, increased water levels may increase inshore bog habitat areas due to the increased water table. Peatland habitat is expected to expand in sheltered areas such as in the south arm of Wuskwatim Lake and the Wuskwatim Brook area (Section 5). This will create additional Palm Warbler habitat where the peatland areas are shrubby and immediately adjacent to some forested areas. **Ponding** of water adjacent to the access road may also create additional bog habitat for Palm Warblers in low, wet areas along the access road route.

Feeding Habitat

During the nesting season, Palm Warblers generally forage within established breeding territories (Welsh 1971). Therefore, Palm Warbler feeding habitat is similar to that previously described for the nesting habitat. Palm Warblers are insectivorous during the breeding season (Wilson 1996). The Project is not expected to affect populations of insects that Palm Warblers commonly feed on (e.g., caterpillars, beetles and larvae, various flying insects, spiders; Wilson 1996).

8.8.5.8 Belted Kingfisher

During field studies in 2000 and 2001 in the Wuskwatim Lake area, Belted Kingfishers were most commonly observed along the Burntwood River between Cranberry Lake and Early Morning Rapids, along the shoreline of Cranberry Lake and the north end of Wuskwatim Lake (Section 8.3.7.3). Communications with NCN people did not reveal any Traditional Knowledge specifically regarding Belted Kingfishers (Table 8.3-6). A review of Belted Kingfisher habitat use (see below) and information regarding how the terrestrial and aquatic habitat will be affected during project operation (Volumes 5 and 6) has resulted in the formation of the following hypothesis: **The Project is expected to have a long-term, local and small negative effect on Belted Kingfishers** (Figure 8.4-8).

Nesting and Brood-rearing Habitat

Local abundance of kingfishers is largely influenced by the availability of suitable nest site substrate (i.e., earthen banks where nesting burrows can be excavated; Hamas 1994). Preferred nesting substrate consists of sandy clay soil banks, void of vegetation on the bank face (Hamas 1994). Tunnel entrances are typically 35 to 64 cm below the top of a bank, with the tunnel usually extending one to two metres into the bank (Hamas 1994). Clutches consisting of five to seven eggs are incubated for 22 days; with nestlings leaving the borrow 27 to 29 days after hatching (Hamas 1994). Fledglings remain within/near the nesting territory for approximately three weeks and are fed by the parents (Hamas 1994).

During Project operation, some kingfisher nest burrows may be vulnerable to increased bank erosion that is expected up to five years after the start of project operation (Volume 4). Kingfisher nests and nestlings located in banks along the main Wuskwatim Lake area would be most vulnerable to bank erosion primarily during May and June. At least two active nest burrows were observed in that area in 2000 (Tetr*ES* 2003a).

Foraging Habitat

Belted Kingfishers forage along the banks of streams, rivers and lakes, often using standing dead trees or leaning trees as foraging perches (Hamas 1994; pers. observ.). Kingfishers prefer to forage on relatively large fish (11 to 13 cm long), but will also forage on a variety of prey items such as molluscs, crustaceans and insects. Examples of common prey items taken include white suckers, sticklebacks and crayfish (Eipper 1956; Kelly 1996; Cairns 1998; Hamas 1994).

Proportions of various prey items taken are related to prey abundance and availability influenced by foraging habitat characteristics (e.g., water clarity, amount of vegetation in the shallow [60 cm] littoral zone, etc.; Hamas 1994; Kelly 1996).

Since Belted Kingfishers require relatively clear water for foraging (Hamas 1994), near-shore areas where turbidity will be increased during the first 5 years of project operation may reduce the amount of suitable foraging habitat in the Wuskwatim Lake area. Some gravel or rocky areas near eroding banks may become temporarily covered with fine sediment during the first five years of project operation which would reduce the quality of fish habitat and, therefore, kingfisher foraging habitat (Volume 5).

8.8.5.9 Common Snipe

During field studies in 2000 and 2001 in the Wuskwatim Lake area, Common Snipe were most commonly observed at the south arm of Wuskwatim Lake, Cranberry Lake and in the Wuskwatim Brook area (Section 8.3.7.3). Communications with NCN people did not reveal any Traditional Knowledge specifically regarding Common Snipe (Table 8.3-6). A review of Common Snipe habitat use (see below) and information regarding how the terrestrial habitat will be affected during project operation (Section 5) has resulted in the formation of the following hypothesis: **The Project operation is expected to have a long-term, local and small positive effect on Common Snipe**.

Nesting Habitat

Common Snipe nest on the ground in association with bog, fen and marsh habitat (Mueller 1999). The nest is typically placed on low, wet ground, very close to water (Mueller 1999). Four eggs are usually laid in May with incubation lasting 18 to 20 days. The precocial young are mobile shortly after hatching and remain with the parent birds for about 20 days (Mueller 1999). Stabilized water levels during project operation will reduce the potential for nest flooding in low, wet areas adjacent to main waterbody shorelines. The long-term expected increase in peatland habitat (Section 5) will increase the amount of potential Common Snipe nesting habitat in the Wuskwatim lake area. Ponding of water adjacent to the access road may also create additional bog habitat for Common Snipe in low, wet areas along the access road route.

Foraging and Brood-Rearing Habitat

Common Snipe nesting, foraging and brood-rearing habitats are similar, and consist of wet bog, fen and marsh habitat. Common food items include larval insects, earthworms and molluscs (Green *et al*. 1990; Mueller 1999). The expected long-term increase in peatland habitat resulting from Project operations will increase the amount of foraging and brood-rearing habitat in the Wuskwatim Lake area. As previously stated, pooled water on either side of the access road may create additional bog/wet habitat in low-lying areas that would be suitable foraging and brood-rearing habitat for Common Snipe.

8.8.6 Predicted Number of Baseline Study Years Required for Monitoring Program

8.8.6.1 Background

Section 7.2 of the Draft Scoping Document (MB Hydro and Nisichawayasihk Cree Nation, November 2000) states that: *"Monitoring of the physical and terrestrial* *environments will be conducted during the construction and operation of the Project to confirm impact predictions and to determine whether unexpected impacts are occurring."*

To compare bird populations surveyed during baseline years with bird populations present during construction and monitoring years, sufficient years of baseline data must be obtained in key habitats that will be affected by the Project. To date, two years of baseline bird survey data have been obtained in 2000 and 2001. Due to the typical annual variation in bird populations observed in 2000 and 2001, two years of bird survey data does not provide a sufficient baseline that can be used to detect increases or decreases in bird populations in habitats other than spruce dominant forest habitat (since sufficient data has been collected for breeding birds in spruce dominant forest habitat; Section 8.8.6.2, Table 8.8-3).

8.8.6.2 How Much Baseline Data Needed?

To determine how many years of baseline data are required to detect a substantial change (e.g., 10% decrease) in bird populations, a statistical procedure termed a 'Power Analysis' can be applied using results form the first two years of baseline bird survey data obtained in 2000 and 2001. A Power Analysis is a statistical tool that can be used to determine how many years (and what level of effort) is required to detect trends in population fluctuations. Results of a Power Analysis on the two years of baseline breeding bird data acquired to date are presented in Table 8.8-3.

The Power Analysis was done on four key habitat types in the Wuskwatim/Opegano Lake area that are expected to represent the majority of habitat types that will be affected by increased water levels in the Wuskwatim/Opegano Lake area. Field surveys in 2000 and 2001 suggested that a higher proportion of those key areas would be affected by increased water levels within the 1 km buffer zone (i.e., black spruce and spruce-dominated forest). Therefore, the Power Analysis was applied to those four habitat types listed in Table 8.8-3.

Results of the Power Analysis indicate that at least three to four years of baseline data would be required to be able to detect a 10% decrease in bird populations in terrestrial habitats that are expected to be most affected by increased water levels. A 10% decrease in bird populations is considered to be substantial and would likely be the result of an abrupt change in breeding habitat within the areas surveyed. However, the Power Analysis should be done again using data obtained in 2003 because the standard deviation associated with the average bird densities calculated in each of the key habitats may be reduced with the inclusion of a third year of data. If the standard deviations are sufficiently reduced after the incorporation of a third year of baseline data, it is possible that only three years of baseline data are required. In other words, fewer than three or four years of baseline surveys (or < 3 or 4 years of surveys during the construction phase or < 3 or 4 years of surveys during the operation phase) will not be sufficient to test if bird populations are affected by Project construction or operation.

If inadequate baseline data is obtained prior to the beginning of construction activities, comparisons of bird populations during the construction and operation phases of the Project will be problematic (i.e., EIS predictions may not be accurately testable).

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8.10 GLOSSARY

ASL	above sea level
Amphibian	cold-blooded animal of the Class Amphibian that typically lives on land but breeds in water (e.g., frogs, toads, salamanders).
bog	wetland ecosystem characterized by an accumulation of peat, acid conditions and a plant community dominated by sphagnum moss
Boreal Shield Ecozone	as classified by Environment Canada; an ecological land classification consisting predominantly of boreal forest on soils overlying Precambrian shield rock. This ecozone stretches across more than 1.8 million square kilometers from Newfoundland west to Alberta.
boreal forest	needle-leaved evergreen or coniferous forest bordering sub-polar regions
breeding bird survey	standardized surveys conducted during the breeding season for a given area whereby observers record the number of birds seen or heard along a travel route
brood	the young of an animal produced at one hatching or birth
buffer zone	**1)** an area that protects or reduces impacts to a natural resource from human activity; **2)** a strip of land along roads, trails or waterways that is generally maintained to enhance aesthetic values or ecosystem integrity
COSEWIC	Committee on the Status of Endangered Wildlife in Canada
CRD	Churchill River Diversion

commercial fishing a fishery where the catch is sold

coniferous typically bearing cones and needle-like leaves (often evergreen)

cover **1)** Vegetation such as trees or undergrowth that provides shelter for wildlife; **2)** also the surface area of a stratum of vegetation as based on the vertical projection on the ground of all above-ground parts of the plant; **3)** also the material in or over-hanging the wetland area of a lake or stream which provides fish with protection from predators or adverse flow conditions, e.g., boulders, deep pools, logs, vegetation

cumulative impact the impact on the environment which results from the effects of a project when combined with those of other past, existing and imminent projects and activities

dabbling ducks feet are set farther forward than diving ducks, and typically feed by "tipping-up" so their tails show above the water; their hind toes lack the lobe of skin present in those of diving ducks

deciduous refers to plants, especially trees, which shed their leaves at the end of every growing season

decommissioned to remove infrastructure or equipment from active service

density the number of individuals in relation to the space in which they occur

diversity related to the number of different species or different features in a given location

diving ducks have their feet set far back on the body (a location that facilitates diving) and a lobe of skin on their hind toes, e.g., Common Goldeneye and Bufflehead

ecosystem a functional unit consisting of all living organisms (plants, animals, microbes, etc.) in a give area, and all non-living physical and chemical factors of their environment, linked together through nutrient cycling and energy flow. An ecosystem can be any size (e.g., a log, pond, forest) but always functions as a whole unit.

EIS Environmental Impact Statement. a document setting out the results of an environmental impact assessment (see EIA), including adverse (and sometimes positive) effects of a proposed development. The document is filed as part of an application for environmental approvals under the *Environment Act* (Manitoba) or the *Canadian Environmental Assessment Act.*

Endangered as defined by COSEWIC: a species facing imminent extirpation or extinction.

Environmental Protection Plan (EnvPP) – a document that provides site-specific and detailed information on construction practices that will be followed during project construction so as to avoid or minimize potential environmental effects

endangered species as defined by COSEWIC, a species facing imminent expiration (no longer existing in the wild in Canada, but occurring elsewhere) or extinction (no longer exists)

environment **1)** the total of all surrounding natural conditions that affect the existence of living organisms on earth, including air, water, soil, minerals, climate and the organisms themselves; **2)** the local complex of such conditions that affects a particular organism and ultimately determines its physiology and survival

environmental effect is defined by CEAA, in respect of a project meaning:
(a) any change that the project may cause in the environment, including any effect of such change on health and socio-economic conditions, on physical and cultural heritage, on the current use of lands and resources for traditional purposes by aboriginal persons, or by any structure, site or thing that is of historical, archaeological, paleontological or architectural significance; and
(b) any change to the project that may be caused by the environment, whether any such change occurs within or outside Canada

erosion	the wearing away of the earth's surface by the action of water, wind, current, etc.
fen	low-lying wetland with grassy vegetation, usually is a transition between land and water.
fledged	**1)** refers to the ability of a young bird to acquire the feathers needed for flight; **2)** to raise a young bird to maturity
footprint	the surface area occupied by a structure or activity
foraging	the act of locating, capturing and eating prey
forebay	the portion of a reservoir immediately upstream of a hydroelectric facility
groundwater	the portion of sub-surface water that is below the water table, in the zone of saturation
ha	hectares
habitat	the place where a plant or animal lives; often related to a function such as breeding, feeding, etc.
habitat fragmentation	the division of habitat into isolated "islands" which can considerably impair the ability of a population to use the area because of its small size and discontinuity
hectare	a metric unit of square measure equal to 10,000 square metres or 2.471 acres
impact	a positive or negative effect of a disturbance on the environment or a component of the environment
incubation	the act or process of maintaining eggs at temperature and humidity conductive to development, often involving one or both parents sitting on, or wrapped around, the eggs
km	kilometres

life history the timeline of an organism's life; including development, maturation and reproduction

loafing resting in a stationary position

m metres

MESA *Manitoba Endangered Species Act*

migration the movement of an individual or group of individuals from one area to another

mitigation actions taken during the planning, design, construction and operation of works to reduce or avoid potential adverse effects

model a tool used to help visualize something that cannot be directly observed

monitoring any on-going process or program for measuring the actual effects of constructing or operating a development

NCN Nisichawayasihk Cree Nation

passerine any bird of the order Passeriformes, having feet with three toes pointing forward and one toe pointing backwards and includes warblers, sparrows and other songbirds

point count method a method used to conduct bird surveys whereby the observer stands in one spot and counts/records all birds seen or heard during a set period of time (e.g., three minutes)

ponding formation of a reservoir due to the damming of a river or creek; retention of water to replenish an existing reservoir

population a group of interbreeding organisms of the same species that occupy a particular area or space

precocial young that have their eyes open at hatching or birth and are capable of locomotion soon after hatching or birth

Project	the Wuskwatim Generating Station Project
raptor	any bird of prey (for this study, includes eagles, hawks, falcons, owls and osprey)
reconnaissance	a preliminary survey or inspection
rehabilitate	to carry on or cause a process of rehabilitation
rehabilitation	restoring to a more normal state; when referring to land, restoring the area to promote re-vegetation.
riparian	along the banks of rivers and streams
SARA	*Species at Risk Act*
shorelines	the narrow strip of land in immediate contact with the sea, lake or river
shorebird	any bird that frequents the shoreline between the ocean or large lakes and the land, particularly a bird of the suborder Charadrii, such as sandpipers, plovers or snipe
significant impact	**1)** significant negative impacts are those effects that are predicted to cause an unacceptable environmental change and, therefore, require efforts to avoid, minimize, and/or remediated those effects; **2)** significant positive effects are those effects that would cause a beneficial environmental change that is measurable or obvious
Special Concern	as defined by COSEWIC: a species of special concern because of characteristics that make it particularly sensitive to human activities or natural events.
species	a group of inter-breeding organisms that can produce fertile offspring
stage	**1)** the height of a water surface, usually above sea level; **2)** regarding wildlife, the process of stopping-over during migration

staging area an area where wildlife (particularly birds) stop-over during the process of migration

substrate the surface or material on which an organism lives or to which it is attached

TK Traditional Knowledge

terrestrial living on or in the ground, or related to the ground

threatened species as defined by COSEWIC, a species likely to become endangered if limiting factors are not reversed

transect a long, continuous sample area

turbidity a measure of the relative clarity of water

waterbird a bird commonly associated with water, e.g., waterfowl, terns and gulls

waterfowl ducks, geese and swans (game birds that frequent water)

SECTION 9: MAMMALS

Prepared by:

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VOLUME 6 SECTION 9

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9.0 MAMMALS

9.1 INTRODUCTION

Mammals are integral components of local and regional ecosystems surrounding the proposed Project Areas (Volume 6 Section 5), and many species are culturally and economically important to the Nisichawayasihk Cree Nation. Although NCN members indicated that all mammal species are considered important (Section 2), for the purposes of decision-making related to the Project it was necessary to distinguish those species that are of specific interest to resource users. Ten domestic and commercial mammal species (Section 9.2.2.) were identified as Valued Ecosystem Components (VECs), and they were the focus for assessing the significance of any Project-related effects on the mammal community.

Mammals and their **habitat**s are protected under Manitoba's Wildlife Act, and rare species also receive protection under the Manitoba Endangered Species Act (MESA), the Species At Risk Act (SARA) and through listing by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC). A description of the regulatory process for the Project and the relevant provincial and federal legislation are provided in Volume 1.

Concerns raised by stakeholders with respect to the potential impacts of the Project on mammal populations include human disturbance, water level fluctuations, mercury contamination, **habitat loss**, **habitat alteration** and increased road access. In order to address these concerns, mammal studies were conducted at both the local level and the regional level surrounding the Project Areas.

A summary of the methods used to collect the information outlined above is discussed in Section 9.2. General descriptions of the mammal community are presented in Section 9.3.1. General life histories and information on abundance, habitat use, biological information, and movements for selected species are presented in Section 9.3.2. Construction and operation impacts, effects and mitigation are discussed in Section 9.4 and residual effects, cumulative effects, and environmental follow-up and monitoring are provided in Sections 9.5 to 9.7.

9.2 METHODS

9.2.1 Study Areas

Mammal studies were conducted at both the local level and the regional level in the Project Areas (Volume Section 5). Certain habitats that might be affected by Project activities were selected for investigation. Data collection at the local level targeted sites within the Sub-Region while investigations at the regional level occurred beyond the boundary of the Sub-Region but within the overall project Region (Figure 9.2-1). The mammal study areas correspond closely with the terrestrial habitat assessment.

Mammal study areas at the local level included Wuskwatim Lake, Wuskwatim Brook, Cranberry Lakes, Sesep Lake, Opegano Lake, Birchtree Lake, the Burntwood River and the access route. Mammal study areas at the regional level included Harding Lake, Notigi Lake, Wapisu Lake, Footprint Lake, Threepoint Lake, Bison Lake, Apeganau Lake, and Partridge Crop Hill. The regional level was used primarily for species that have large ranges (e.g., the Wapisu woodland caribou **meta-population**, currently consisting of two or more **subpopulations**, namely Harding Lake, Partridge Crop Hill that move throughout the Region seasonally). The Region was used comparatively for some aquatic species that were affected by the Churchill River Diversion (CRD), and it was also used to collect data that may be required for environmental follow-up and monitoring.

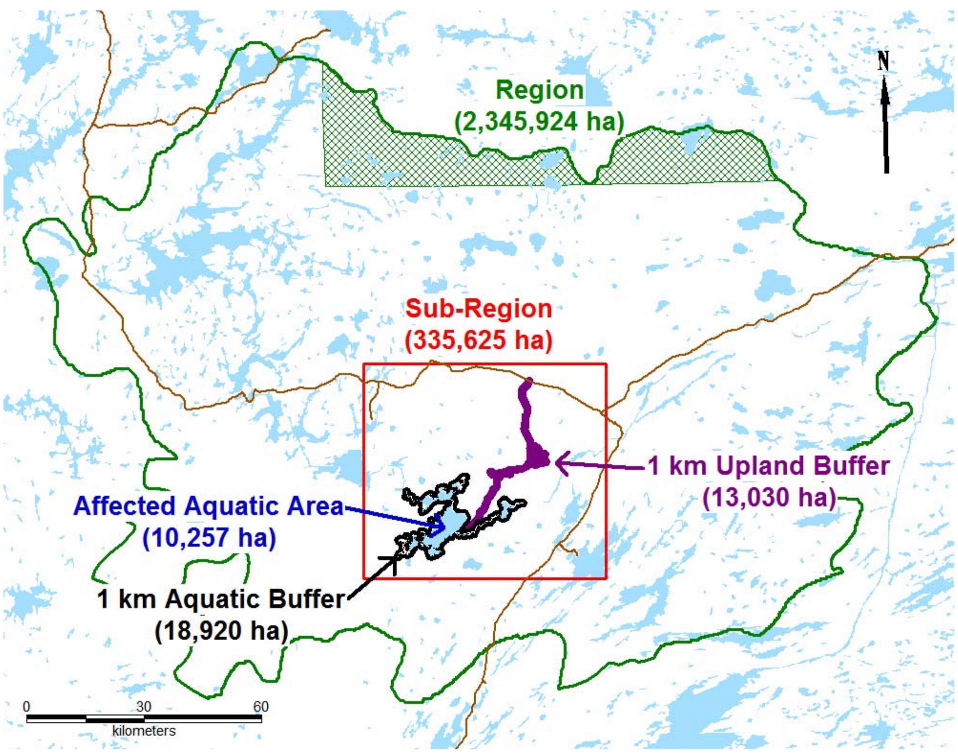


Figure 9.2-1. Habitat study areas (i.e., Project effects comparison areas; Volume 6 Section 5.2) used for mammal studies.

9.2.2 VECs

The selection of mammal VECs was determined through discussions with stakeholders. The rationale and process of VEC selection is addressed in Volumes 1 and 2.

Mammal VECs were characterized in two broad habitat-based groups: **riparian mammals** (semi-aquatic) and **terrestrial mammals** (non aquatic) (Table 9.2-1). VECs were selected to address specific concerns (e.g., importance as a resource or having scientific or regulatory importance) and to provide a selection of indicator species that are closely related to particular environmental conditions or habitat types such that their presence or absence can be used as an indicator of environmental conditions related to the Project. Of the 10 mammal species identified, NCN members emphasized the importance of woodland caribou, moose, muskrat and beaver. The selection rationale for these species is summarized below. Six other VECs were added to assess particular environmental conditions, habitat types and other scientific or social concerns.

Table 9.2-1. Mammal VECs in the Sub-Region.

Riparian VECs	Terrestrial VECs
Muskrat	Woodland caribou
Beaver	Black bear
River otter	Gray wolf
Mink	Pine marten
Moose	Lynx

Woodland Caribou

- Woodland caribou are highly valued by NCN members as an important component of the domestic harvest. Caribou also have high cultural value.
- Woodland caribou were also selected because they frequent terrestrial habitats, which may be affected by Project operation and activities.
- New road access may lead to an increase in hunting by non-NCN members and possibly mortality from caribou-vehicle collisions.
- Woodland caribou have regulatory importance as a Federally listed species (i.e., Threatened, COSEWIC).
- Woodland caribou are wide-ranging herd animals that follow traditional migration routes. They return to traditional sites (i.e., calving areas and core wintering range) year after year. This species also have nomadic foraging habits,

particularly in winter, making them somewhat unpredictable, and possibly more vulnerable to Project activities.

- Woodland caribou are relatively sensitive to changes in terrestrial habitats and are good indicators of habitat associations with intermediate-aged, mature and overmature softwoods, softwood-dominated mixedwoods and treed muskegs.

Moose

- Moose are highly valued by NCN members as a major component of the domestic harvest.
- Moose were also selected because they frequent riparian and aquatic habitat, which may be affected by Project operation and activities.
- New road access may lead to an increase in hunting by non-NCN members and possibly mortality from moose-vehicle collisions.
- Moose are possibly sensitive to changes in riparian habitats and may be a good indicator of habitat associations including marsh/bog and willow/alder.
- Moose also frequent a range of forest stand age-classes including shrub-seedling, pole-sapling and intermediate-aged hardwoods, deciduous-dominated mixedwoods and softwood-dominated mixedwoods, and mature to overmature hardwoods and deciduous-dominated mixedwoods.

Muskrat

- Muskrats are important for both commercial and some domestic trapping.
- NCN members are concerned that mercury accumulation in muskrat muscle may affect domestic use.
- Muskrats are semi-aquatic mammals that live and forage in riparian zones. This species is vulnerable to flooding and dewatering of dens and habitats as a result of changes in lake and river levels. Although muskrat habitat is similar to that of beaver, water fluctuations during winter and early spring are particularly detrimental to muskrats, which rely on off-shore herbaceous vegetation (i.e., peat islands, submergent and emergent vegetation) for food and shelter.

Beaver

- Beavers are important for both commercial and domestic trapping.

- NCN members are concerned that mercury accumulation in beaver muscle may affect domestic use.
- Beaver are semi-aquatic mammals that live and forage in riparian zones. Lodges, bank dens and food caches are susceptible to daily and seasonal water level fluctuations ice conditions, and erosion associated with the Project. The fact that beaver rely on woody vegetation for food and shelter enables them to survive extreme environmental conditions better than other aquatic mammals such as muskrat.
- Beaver may also be an indicator of changes in riparian vegetation, as populations are associated with lakeshores, rivers, creeks, swamps, marsh/bog, treed muskeg, willow/alder and a range of various age-classes of hardwood, hardwood dominated mixedwood and softwood dominated mixedwood stands.

9.2.3 Traditional Knowledge

The majority of TK was obtained from field assistants and incorporated into Section 9. At least 21 NCN members were responsible for identifying **mammal sign** by species, and animal attributes (such as sex, age, habitats, and habitat features (RK Schmidt Environmental (RKSE) and Wildlife Resource Consulting Services MB Inc. (WRCS), Unpubl. Data). Other TK was obtained during interviews with resource harvesters at project meetings and workshops. Information was supplemented with data from the harvest calendar survey, the TK pilot project with NCN Community Consultants (Volume 7) and the Nelson House Woodland Caribou TK Project (Manitoba Conservation, Unpubl. Data).

9.2.4 Scientific Studies

Limited pre-CRD (Slaney & Company 1974) mammal population information exists for the Region. Other than data collected during the course of the mammalian studies (RKSE and WRCS, Unpubl. Data), limited post-CRD information was obtained from the Region regarding moose (Wardrop Engineering et al. 1990; Elliott and Hedman 2001). Some data on mammalian presence and habitat utilization were obtained from Manitoba Conservation district staff, unpublished reports and datasets. Consequently, few published scientific studies of mammal populations can be used to describe current conditions in the area.

A limited number of published scientific articles were used to provide a brief summary of the life history and habitats utilized by mammals, as the general ecology of most species described herein are well known.

9.2.5 EIS studies

An ecosystem-based approach (Volume 6 Section 5) was used to assess the potential effects of the Project on the mammalian community. The research conducted between 2000 and 2002 focused on wildlife habitat use within landforms, shorelines, waterbodies, and specific sites that may be affected by project activities, which in turn may have a direct or indirect impact on individuals, **subpopulation**s, and populations. A number of methods conforming to accepted professional standards and practices were employed to determine species **frequency-per-unit-effort**. These values were used to describe distribution, relative abundance, habitat use and seasonality (Schemnitz 1980; Elzinga et al. 2001).

The following sections (9.2.5.1 - 9.2.5.5) summarize the methods used in each of the mammal studies conducted and provide the rationale for choosing these methods. Summaries of ground and boat-based survey effort by corresponding location are provided (Table 9.2-2, Figure 9.2-2).

9.2.5.1 Shoreline Habitat Surveys

Seventy shoreline surveys were conducted at representative sites in the Affected Aquatic Area and Aquatic Buffer during 2000 and 2001 (Figure 9.2-2). The purpose of these surveys was to evaluate shoreline habitat use by riparian wildlife, particularly aquatic furbearers. **Occurrence**, quantity and age of mammal sign were used to estimate the relative abundance of mammals among shoreline habitats (RKSE and WRCS, Unpubl. Data). Transect-based sampling (Schemnitz 1980; Elzinga et al. 2001) was the primary method used to estimate aquatic furbearer and other riparian mammal abundance. Techniques were modified to reflect the conditions under which sampling occurred. For example, boat-based transects were substituted for shoreline observation (i.e., walking) transects under high water-no shore-no bank conditions, or boats were used to sample peat islands surrounded by water. Shoreline habitat-based sampling included:

- shoreline transects (walking and boat-based, lengths ranging from 100 to 250 m);
- muskrat den surveys (walking and boat-based transects, sample distances ranging from 250 to 13000 metres); and
- peat island surveys (boat-based, whole island, edge coverage).

Transects were distributed on the basis of observed shoreline habitat characteristics in relatively homogenous shore communities (RKSE and WRCS, Unpubl. Data). These criteria, together with common habitat variables (Volume 6 Section 5) and locations were related to the riparian mammal occurrence and relative abundance to produce habitat use, habitat quality, and distribution maps (Section 9.3.2.1.1 to 9.3.2.1.5).

9.2.5.2 Terrestrial Habitat Surveys

Fifty-seven terrestrial surveys were conducted at representative sites bordering lakes and rivers during 2000 and 2001 (Figure 9.2-2). The purpose of these surveys was to compare terrestrial mammal activity among upland habitats, as well as along the gradient between the shoreline into upland habitats. Transect-based sampling (Schemnitz 1980; Elzinga et al. 2001) was the method used to estimate mammal abundance. Similar to the shoreline habitat surveys, occurrence, quantity and age of mammal sign were used to estimate relative differences of mammal use among terrestrial habitats (RKSE and WRCS, Unpubl. Data). Terrestrial habitat-based sampling included:

- terrestrial transects (walking, lengths ranging from 100 to 650 metres);
- ecological transects (walking, lengths ranging from 100 to 650 metres along an ecological gradient); and,
- site-specific transects (walking, lengths ranging from 200 to 6000 metres, baseline data for proposed generating station site, access road, or among adjacent habitats).

Transects were distributed among different terrestrial habitats (Volume 6 Section 5). These criteria, together with other habitat variables and locations were related to the occurrence and relative abundance in order to produce habitat use indices, habitat quality, and distribution maps (Section 9.3.2.2.1 to 9.3.2.2.5).

9.2.5.3 Small Mammal Trapping

A limited small-mammal trapping program was conducted during 2000 and 2001 in riparian habitats at low elevation along the Burntwood River, Wuskwatim Brook and the south bay of Wuskwatim Lake. The purpose of the trapping program was to sample the presence of small mammals that occur in the Aquatic Buffer. The trapping technique used to collect occurrence data on small mammals follows Elzinga et al. (2001).

Table 9.2-2. Summary of survey distances (metres) covered by study method, season and site.

Location	Study									
	2000				**2001**					**2002**
	Jan.-Feb.	**Summer**			**Mar. –Apr.**	**Summer**			**Oct.-Dec.**	**Feb.-Apr.**
	Snowmobile Survey	**Mammal Transects**	**Shore Surveys**	**Peat Island Surveys (# of islands)**	**Snowmobile Survey**	**Mammal Transect**	**Shore Surveys**	**Peat Island Surveys (# of islands)**	**String Survey**	**Snowmobile Survey**
Wuskwatim Brook	-	481	1105	4	-	831	2420	39	-	-
Wuskwatim South Bay	-	770	2146	5	-	960	1705		-	-
Cranberry Lakes	-	1588	922	5	-	1588	3387	10	-	-
Sesep Lake	-	-	40	-	-	150	1583	6	-	-
Wuskwatim Lake (west)	-	2017	13350	-	-	1095	450	-	-	-
Wuskwatim Lake (east)	-	1460	5234	-	-	900	-	-	-	-
Burntwood River	-	1615	-	-	-	1175	-	-	-	-
GS Site	-	-		-	-	13800	-	-	-	-
Laurie River T.L.	-	-	-	-	48000	-	-	-	48000	48000
Mile 17/20 Access Road	21000	-	-	-	-	5817	-	-	-	56400

Note: Ground-based surveys outside the Sub-Region (i.e., Notigi, Wapisu and Three Point Lake and Rat River) that may be used for comparative purposes are not included here. See RKSE and WRCS, Unpubl. Data for details.
'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

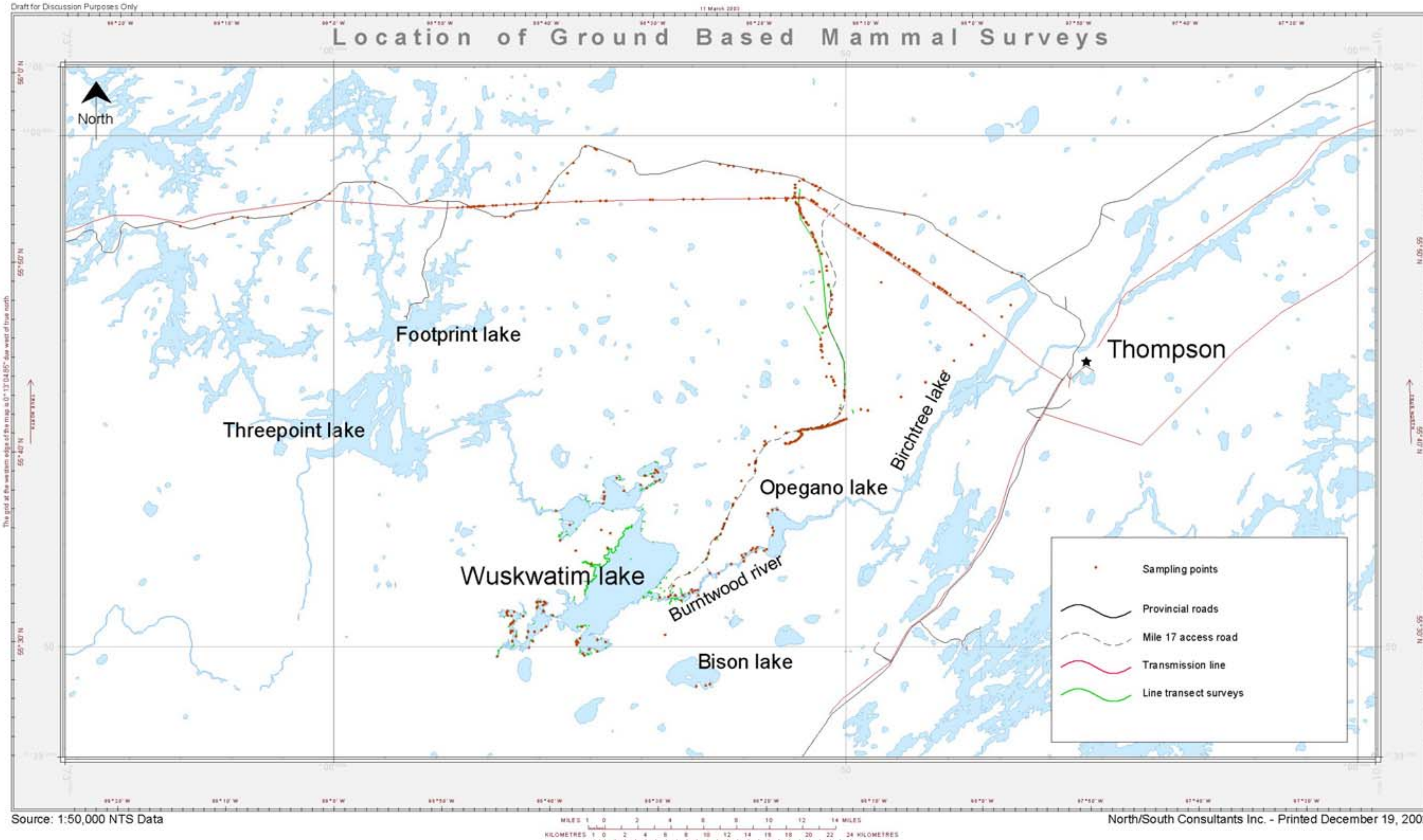


Figure 9.2-2. Locations of ground and boat-based surveys.

Protocols used in this study involved setting one block of 50 baited Victor snap traps for two nights at each of six sites during 2000 and three sites during 2001 along shorelines that were expected to be affected by water level fluctuations. Three of these shoreline trap blocks were supplemented with corresponding sets of upland habitat blocks to be used for comparative purposes (RKSE and WRCS, Unpubl. Data).

9.2.5.4 Aerial Surveys

9.2.5.4.1 Aquatic furbearer surveys

Aerial surveys for muskrat pushups and beaver lodges were conducted by helicopter during late winter 2000 and 2001 and during summer/fall 2001. The purpose of the aerial surveys was to collect baseline data for estimating subpopulation size, seasonal habitat use, other occurrences and survivorship of aquatic furbearers that occur in the Region. These criteria, together with common habitat variables (Volume 6 Section 5) and locations were related to the occurrence and relative abundance to produce habitat use, habitat quality, and distribution maps (Sections 9.3.3.1.1 and 9.3.3.1.2). Aerial survey techniques involving the identification of lodges, push-ups and runs are commonly used to study aquatic furbearers (Schemnitz 1980; Elzinga et al. 2001).

Winter muskrat pushup surveys were split into two groups: surveys that were conducted on lakes affected by CRD, and surveys that were conducted on lakes and ponds not affected by CRD. Helicopter flight altitude was between 90-180 m while flight speed was 100-200 km/hr, depending on the density of muskrat pushups in an area.

Summer helicopter surveys that recorded beaver structures (i.e., lodges, dams and food caches) and muskrat runs were conducted in the Sub-Region along the shores of Bison Lake, Egg Lake, Middle Lake and Opegano Lake; the Burntwood River between Wuskwatim Lake and Opegano Lake; and marshes, creeks and fens that intersect the proposed access route, including Mile 5 and Mile 20 areas. Helicopters maintained a low altitude (24 m) and a speed of 110 km/hr (RKSE and WRCS, Unpubl. Data). The locations of summer and winter aerial surveys for aquatic furbearers are provided in Figure 9.2-3.

9.2.5.4.2 Ungulate surveys

Aerial surveys for **ungulates** were conducted at local and regional levels during late 2001 and 2002. The purpose of these aerial surveys was to collect baseline data for estimating subpopulation size, seasonal habitat use and important use areas, especially for woodland caribou that occur in the Region. Sample sites were predominantly located in potential caribou winter ranges. These criteria, together with common habitat variables (Section 5) and locations were related to the occurrence and relative abundance to produce habitat use indices, habitat quality, and distribution maps (Section 9.3.3.1.5 and 9.3.3.2.1). Aerial survey techniques are commonly used to sample ungulate populations (Schemnitz 1980; Elzinga et al. 2001). Survey areas were selected based on reports (Larche 1972, Johnson 1993, Rebizant et al. 2000) and consultations with NCN and Manitoba Conservation.

The January 2001 survey covered 900 km^2 around Harding Lake, Eagle Hill and Partridge Crop Hill (WRCS, Unpubl. Data). Additional survey areas included an east-west stretch of PR 391, parts of the Harding Lake snowmobile trail, and shoreline segments of Wuskwatim, Cranberry and Threepoint Lakes and the Burntwood River. The helicopter flew transects with a north-south orientation, spaced at 0.8 km intervals, maintaining a speed of 120 km/hour and an altitude of 120 m, providing full coverage of the survey sites.

The 2002 winter aerial survey (WRCS, Unpubl. Data) was used to locate sub-herds of woodland caribou for the proposed monitoring program (Section 9.7) and to collect habitat data. Supplementary data were also collected to support the 2001 subpopulation estimates. Survey coverage extended approximately 2671 km^2 (Figure 9.2-4). Surveying was conducted from a fixed-wing aircraft and extended beyond those areas covered during 2001, east to Opegano Lake, and further southeast of the Partridge Crop Hill. Transects were spaced apart at 1.5 km and flown at 200 m, providing about 50% coverage of the survey sites.

9.2.5.5 Fall/Winter Tracking Surveys

Fall and winter tracking surveys were conducted from 2000 to 2002 by foot, snowmobile or all-terrain vehicle (Figure 9.2-2 and Figure 9.2-5). Tracking surveys were similar to the terrestrial habitat surveys (Section 9.2.5.2), but differed by longer sample lengths (between 21,000 to 56,400 metres), and placement (Schemnitz 1980; Elzinga et al. 2001). The objective of these surveys was to document occurrence, activity, relative abundance and movements of mammals along linear rights-of-way that are useful for predicting mammal responses to linear features such as the access road (RKSE and WRCS, Unpubl. Data). Mammal sign, habitat characteristics and thread breaks were recorded along segments of the Mile 20 winter road, the Mile 17 access road, and segments of the Laurie River transmission line. These estimates were also used to produce habitat use indices and maps (Section 9.3.2.1.1 to 9.3.2.2.5).

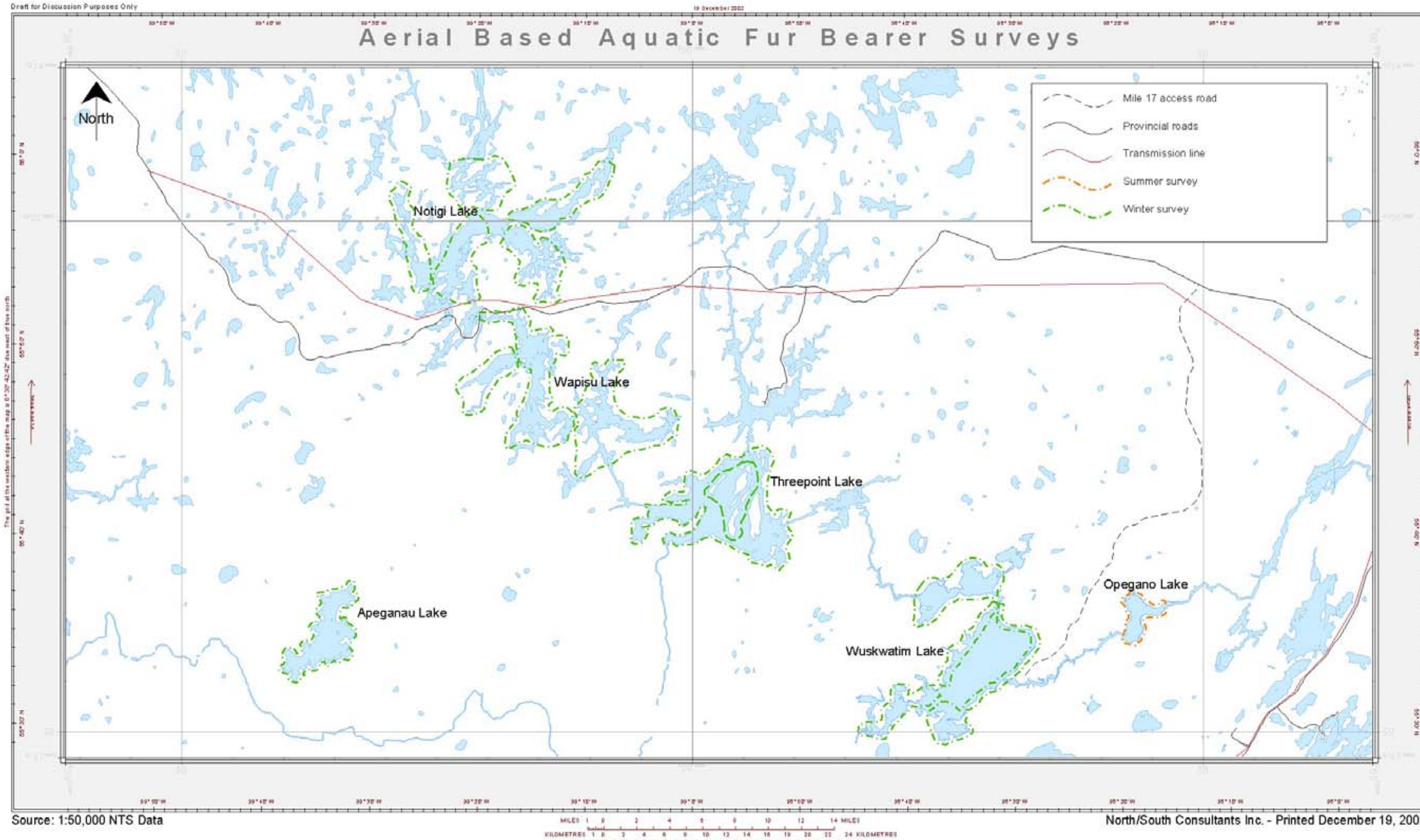


Figure 9.2-3. Locations of aerial surveys for aquatic furbearers.

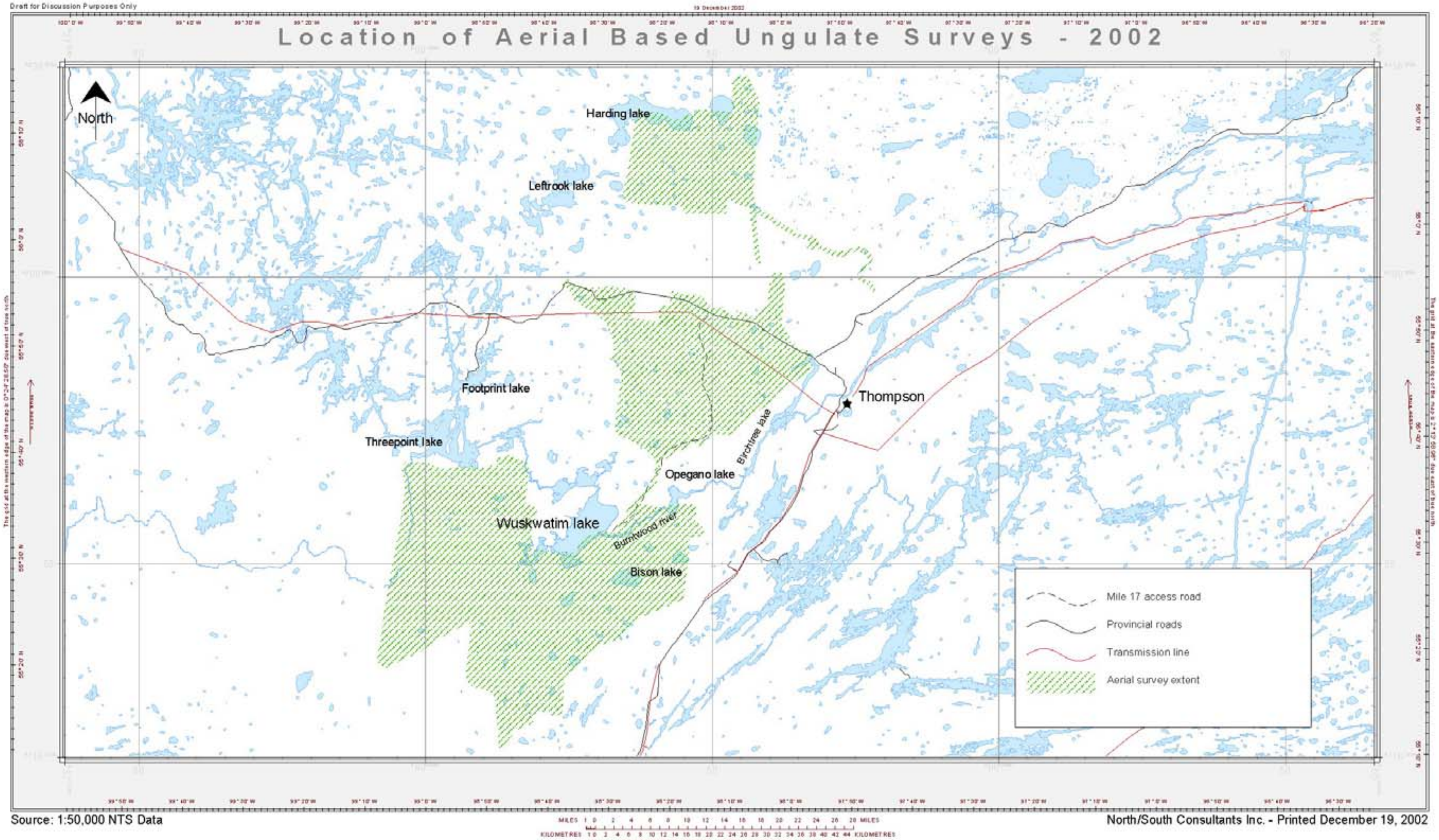


Figure 9.2-4. Locations of aerial surveys for ungulates.

9.2.5.6 Habitat Analysis

Data derived from TK, scientific studies and EIS studies, were entered into a GIS. Habitat data that included many types of habitat components at various spatial scales (Volume 6 Section 5), were incorporated into the spatial analysis (North/South Consultants, Unpubl. Data) for each mammal (Section 9.3.2). A simple model was built for each species using available data and expert opinion to express the species-habitat relationship.

Models were built in the following manner.

- In most cases, important habitat components were selected for each species from a review of scientific literature (RKSE and WRCS, Unpubl. Data) or from expert-based opinion. For example, aspen is considered an important habitat component necessary for the survival of most beaver. It is used for food, and often used in lodge construction.
- For each component, the relationship between habitat use and the levels of use within each habitat component was determined from the literature review or from expert opinion. Habitat components were classified as either 'more important' or 'less important' for the survival of a species (e.g., aspen was considered the most important food for beaver compared to all other available trees).
- The relationship between different habitat components was examined. Combinations of habitat components that were perceived as 'more important' for the survival of a species were distinguished from habitat components that were perceived as 'less important' for the survival of a species. For example, although water velocity may play a role as to where beaver 'prefer' to build lodges (i.e., beaver may prefer low water velocity environments because they might expend less energy swimming in those environments than in high water velocity environments), the proximity and availability of aspen as a food source, which may limit their ability to survive, may be considered more important than water velocity.
- The sample design precluded the development of a quantitative model for each species. Nevertheless, available data from the field studies were adequate to support model construction based on expert opinion. Although not tested statistically, either presence/absence data, frequency data (North/South Consultants, Unpubl. Data) or spatial summary statistics contained within a habitat component (e.g., average distance from the nearest beaver lodge to a stand of aspen) was examined and used to refine an expressed relationship (North/South Consultants, Unpubl. Data).
- Location data were added to preliminary habitat mapping to help explore possible spatial and other relationships. These visual and other relationships were used to help refine the predicted importance of the habitat components.

- Supporting text was developed for each species that explained which habitat components were selected as being more or less important, and which combinations of components were used to group the data that defined a habitat class. Each variable is contained in those habitat types generated and described in Section 5. Two habitat classifications were selected to group the components.
- **Primary habitat** and **secondary habitat** are two habitat classes that were used to express habitat quality for each VEC mammal. When extrapolated over the landscape, these designations can be used to express theoretical habitat availability.
- Known use areas from data sources including TK, scientific studies and EIS studies were added to the habitat use model to express geographical relationships, and in some cases, to express the geographical relationship of important habitat components in relation to the Project parameters.

The final models of habitat quality together with known use areas that were developed for each species were extrapolated across the Sub-Region using GIS habitat data developed in Volume 6 Section 5, and other data from North/South Consultants (Unpubl. Data). Habitats for two species, including woodland caribou and gray wolf, were extrapolated into the Region. Presentation at this scale was necessary due to the large home range size, and the ability of these two mammals to move large distances within their home range. Estimates of habitat quality, together with known use areas for each VEC mammal were presented spatially (Section 9.3.2.1.1 to 9.3.2.2.5).

Figure 9.2-5. NCN members conducting tracking, shoreline, habitat and aerial surveys.

9.3 EXISTING ENVIRONMENT

9.3.1 Overview of the Mammal Community

At least 39 species of mammals occur in the Region representing six taxonomic orders of mammals (Appendix 9.9-1). Twenty-six species of mammals were recorded in the Sub-Region from 2000-2002 (Table 9.3-1). All species and groups occurring within this area are found commonly in the boreal forest. All furbearing and large mammals are used by NCN domestically; some of these are harvested commercially (Volume 7).

Neither MESA or COSEWIC list any mammal found in the area as 'Endangered'. However, woodland caribou and wolverine, which have been respectively designated by COSEWIC as ‘Threatened’ and of ‘Special Concern’, occur in the Region (Table 9.3-2).

A review of the Manitoba Conservation Data Centre (MCDC) electronic and manual files indicate that at least one relatively rare bat species is located in the Sub-Region, the little brown myotis. The little brown myotis is near the northern fringe of its Manitoban range in the Sub-Region. This species is not listed elsewhere. Another relatively rare species in Manitoba, badger, was apparently caught in RTL 1, in 1973-74, well north of its core range in the southern Prairie Provinces. The grizzly bear and wood bison may have inhabited the region about a century ago, but were extirpated from the area (NCN member, pers. comm.). Both bison and grizzly bear are excluded from further analysis.

9.3.2 Distribution, Abundance and Habitat Use

The following section provides a brief overview of the riparian and terrestrial communities. Each broad habitat-based group summarizes TK, known scientific studies, and EIS studies pertaining to the distribution, abundance and habitat use of the mammal VECs specific to the appropriate Project effects comparison area. Habitat components are presented with text and maps that were developed for each species.

Table 9.3-1. Mammal species recorded in the Sub-Region, 2000-2002.

ORDER	SPECIES	COMMON NAME	CREE NAME
INSECTIVORA			
	Sorex cinereus	Masked Shrew	Kinikeschowe Apikoses
CHIROPTERA (Bats)			
	Myotis lucifugus	Little Brown Myotis	Upukwaches
LAGOMORPHA (Hares and Rabbits)			
	Lepus americanus	Snowshoe Hare	Wapos
RODENTIA (Rodents)			
	Tamias minimus	Least Chipmunk	Sasakawapikos
	Marmota monax	Woodchuck	Wenusk
	Tamiasciurus hudsonicus	Red Squirrel	Anikwachas
	Castor canadensis	Beaver	Amisk
	Peromyscus maniculatus	Deer Mouse	Apikoses
	Clethrionomys gapperi	Southern Red-backed Vole	Apikoses
	Ondatra zibethicus	Muskrat	Wuchusk
	Zapus hudsonius	Meadow Jumping Mouse	Kwaskoti Apikoses
CARNIVORA (Carnivores)			
	Canis latrans	Coyote	Woniniewaikunis
	Canis lupus	Gray Wolf	Mahekun
	Alopex lagopus	Arctic Fox	Wapakeseiu
	Vulpes vulpes	Red Fox	Osawahkisew
	Ursus americanus	Black Bear	Kaketi Muskwa
	Martes americana	Pine Marten	Wapistan
	Martes pennanti	Fisher	Ochek
	Mustela nivalis	Least Weasel	Sehkos
	Mustela vison	Mink	Sakwesew
	Gulo gulo	Wolverine	Omethaches
	Lontra canadensis	River Otter	Nikik
	Lynx lynx	Lynx	Pisew
ARTIODACTYLA (Cloven-hoofed Mammals)			
	Rangifer tarandus caribou	Woodland Caribou	Ethinutwatehk
	Rangifer tarandus groenlandicus	Barren-ground Caribou	Utehk
	Odocoileus virginianus	White-tailed Deer	Apischachihkos
	Alces alces	Moose	Mooswa

Table 9.3-2. Current list of Endangered, Threatened, or Species of Special Concern that occur in the Sub-Region.

Common Name	COSEWIC	Manitoba Provincial and/or Federal Status	Manitoba Conservation Data Centre (MCDC) Ranking
Wolverine	Special Concern - Western population	Furbearer, Protected (Prov), Commercial	S4[a]
Woodland Caribou	Threatened - Western population	Big Game, Protected (Prov)	S3S4[b]

[a] - S4 designates widespread, abundant, and apparently secure throughout Manitoba, with many occurrences, but the species is of long-term concern.

[b] - S3S4 designates rare and uncommon to widespread, abundant, and apparently secure throughout Manitoba, with many occurrences, but the species is of long-term concern.

9.3.2.1 Riparian Mammal Community

The **riparian mammal community** in the Sub-Region is extensive. Riparian habitats consist of lakeshore margins, creeks, rivers, beaver floods, swamps, peatlands (including peat islands and fens) and other lowlands and upland boreal forests that are hydrologically linked to lakes and watercourses (Volume 6 Section 5). The Sub-Region contains many types of soils, landforms, topography, vegetation, drainage, water levels, shore sediments, and erosion processes (Volume 4 and Volume 6 Section 5). Any one or combination of these factors can influence riparian habitats.

Emergent grasses, sedges interspersed with low shrubs, young trees and herbs often dominate shore and riverine habitats. Submergent vegetation close to shore is also a riparian feature. Other riparian habitats include tall shrub peatlands, springs, pond margins, and other wetlands. Vegetative cover inland from shores is dominated either by sparsely treed peatland or by forest stands comprised primarily of black spruce, white spruce, aspen, jack pine, balsam poplar, white birch, balsam fir, and tamarack, with black spruce dominant in land cover throughout the Sub-Region (Volume 6 Section 5).

Shoreline types that could be impacted by the Project were surveyed (Section 9.2.5.1.). Shore-types were characterized for mammal habitat as:

- stable, well-drained silts and clays with gentle to moderately sloping banks; emergent aquatic plants present; submerged plants present in the littoral zone;
- saturated to flooded foreshores over silt/clay/mud substrates; low, gently sloping banks; emergent and submergent aquatic plants present;
- flooded foreshores underlain by silt; backshore level and saturated; no discernible banks; emergent and submerged aquatic plants present;
- steep, eroded/eroding banks; permafrost degradation evident at many sites;
- bedrock-controlled shores interspersed with silt/clay sediments with erodible pockets of materials;
- composite shores featuring eroding slopes, bedrock exposures, and silt/clay pockets stocked with emergent and submergent aquatic plants; and
- offshore peat-islands where vegetation consists of varying combinations of cattails, sedges, grasses, small trees and low to tall shrubs.

Approximately one quarter of the mammal species in the Sub-Region are strongly associated with riparian habitats. Muskrat, beaver, river otter, mink and moose represent the majority of mammals found in the riparian community, although other mammals also use riparian habitats (Section 9.3.2.2).

Riparian mammal species occupy different habitat types. For example, muskrat (or 'rats') are predominantly aquatic, feeding mainly on herbaceous plants close to water. Variation in the type of soils forming shores and banks can produce an associated variety in the quality of den habitat available to this species. Beaver are also semi-aquatic, but rely on terrestrial resources such as trees and shrubs for food and cover. The river otter spends most of its life in and around creeks and shores, but approximately 98% of the otter's diet is fish and other aquatic life. Mink primarily live on land but forage in wet areas along creeks. Most of their diet consists of small mammals but it may contain fish and crustaceans. Moose forage on aquatic plants during summer and fall, as well as on browse plants such as willow, poplar, birch, and alder that can produce more biomass near watercourses and lakeshores. Of these species, muskrat, beaver and otter are the most commonly trapped for commercial purposes, while beaver and muskrat may also be trapped for domestic purposes (Volume 7). VEC Riparian mammals are profiled in Sections 9.3.2.1.1 to 9.3.2.1.5.

9.3.2.1.1 Muskrat (*Ondatra zibethicus*)

General life history

Muskrats prefer lentic or slightly lotic waters that are lined with the sedge, reed or cattail species that are their primary food source (Perry 1990). In subarctic regions, muskrats make their dens in banks bordering lakes, streams and marshes that are deep enough to prevent freezing to the bottom, but shallow enough to support emergent vegetation (Wrigley 1986). Den entrances generally lie below the water level (Schwratz and Schwratz 1959). During freeze-up and early winter, muskrats establish winter feeding stations in the form of "pushups," piles of aquatic vegetation near plunge holes at the ice surface. Muskrat have a relatively high reproductive rate. In northern regions, they typically bear two litters per summer, each consisting of one to eleven young (average of seven). The female cares for the young for one month, after which they disperse. Muskrats typically begin breeding at one year of age, and have a lifespan of three to four years in the wild (Wrigley 1986).

Muskrat populations in Canada fluctuate according to a six to ten year cycle (Butler 1953). During peaks in the cycle, densities are so great that muskrats **eat-out** most of the surrounding vegetation and are forced to disperse (Wrigley 1986; Perry 1990). Water levels also play a major role in determining the abundance of muskrat populations. Low water elevations are particularly critical in winter, when muskrats may have to seek food outside their normal range (Perry 1990). Cold weather combined with low water may also result in a “freeze-out” that would force muskrats to disperse or die. Muskrats may vacate habitats if water levels in winter drop to the point where access to offshore feeding sites is severely impeded. However, it may take several low-water seasons to achieve total abandonment as, to some degree muskrats can adapt to sudden changes in water conditions, compensating through local migration and high reproductive rates (Welch et al. 1984; Perry 1990; Thurber et al. 1991). Other factors limiting populations include diseases, parasites, predators (primarily mink, red fox, and **raptor** species) accidents, climatic factors and harvesting (Perry 1990).

Muskrat (Wuchusk)

Regional abundance

Manitoba Conservation lists the muskrat as demonstrably widespread, abundant, and secure throughout Manitoba, and essentially ineradicable under present conditions. The species distributional trends, over its' range, tend to be stable (MCDC 1996). Trapping records from 1979 to 2001 in NCN's Registered Trapline District generally support this assessment, although populations have fluctuated historically (MC Trapping Data Unpubl., Volume 7).

Within the Region, both local population declines and increases can be demonstrated. For example, the Rat River’s population is considered by some NCN members to have declined since CRD to such a point that the river is now dubbed “Ratless River.” Before CRD, “no one came back without [trapping] a thousand animals. The muskrats in the Rat River have almost been eliminated, and nowadays, people only come back with the odd animal” (NCN member, pers. comm.). A few people interviewed stated that in some parts [of the Region] muskrat numbers have increased (Volume 7), especially "in ponds outside (i.e., not affected) by CRD ” (NCN member, pers. comm.). Aerial surveys and ground burrow survey data demonstrated this highly variable and possibly widespread phenomenon (Table 9.3-3). The Burntwood River and the Rat River generally have few muskrat. Apeganau, Bison, Egg and Middle Lakes and small ponds surrounding Wuskwatim Lake, have much higher abundances, especially during winter (NCN member, pers. comm.).

Table 9.3-3. Summary table of muskrat push-ups and burrows in the Region.

Location	Aerial surveys (total # of push-ups)		Ground-based surveys (mean # burrows/100m)	
	2000	2001	2000	2001
Wuskwatim, Cranberry, Sesep, Lakes and Wuskwatim Brook	5	0	2.6 (range 0-37.5)	1.4 (range 0-11.5)
Wapisu Lake	10	5	-	2.7 (range 0-7.0)
Notigi Lake	0	0	8.1 (range 3.6-23.3)	0
Threepoint Lake	0	0	-	-
Rat River	-	-	3.2 (range 0-7.0)	0
Apeganau, Bison, Egg & Middle Lakes and surrounding ponds	134	68	-	-

'-' indicates that no survey was conducted at that location during the corresponding time of year.

Sub-Regional abundance

Summer shoreline transect data (Table 9.3-4) demonstrate that muskrat abundance and distribution were variable between sites and between years. A general decline of muskrat sign was observed between 2000 and 2001 (RKSE and WRCS, Unpubl. Data). The decline in the number of active burrows from 597 during 2000 to 138 during 2001, for example, constitutes a four-fold decrease. Winter aerial surveys for muskrat pushups support this trend. Concurrently, the relative abundance of muskrat sign recorded on peat islands in the same area increased about six-fold between 2000 and 2001.

In the Sub-Region, higher abundances of muskrat appear to be concentrated in the creeks and bays around Wuskwatim Brook, the areas around the southern bay and the west shore of Wuskwatim Lake, Cranberry Lakes and Sesep Lake. No muskrat sign was observed on the east shore of Wuskwatim Lake. Muskrat abundance is usually high on peat islands (RKSE and WRCS, Unpubl. Data). The Burntwood River between Wuskwatim Lake, up to and including Opegano Lake, has a very low abundance of muskrat (RKSE and WRCS, Unpubl. Data).

Access road corridor and borrow sites abundance

Muskrat sign was uncommon (0.006 sign/100m) along the access road corridor and borrow site areas (Table 9.3-4). The highest average muskrat sign of 0.040 sign/100 m (range 0-0.500) was recorded in creek habitat. Muskrat were not found along the existing winter road during fall and winter surveys (RKSE and WRCS, Unpubl. Data).

Table 9.3-4. Summary table of muskrat sign frequency (sign/100m/survey unless stated otherwise).

<table>
<tr><th rowspan="3">Location</th><th colspan="6">Study</th></tr>
<tr><th colspan="3">Summer 2000</th><th colspan="3">Summer 2001</th></tr>
<tr><th>Mammal Transects</th><th>Shore Surveys</th><th>Peat Island Surveys (signs/island)</th><th>Mammal Transect</th><th>Shore Surveys</th><th>Peat Island Surveys (signs/island)</th></tr>
<tr><td>Wuskwatim Brook</td><td>0.208</td><td rowspan="2">5.414</td><td>4.500</td><td>0.361</td><td>1.322</td><td rowspan="2">14.307</td></tr>
<tr><td>Wuskwatim South Bay</td><td>0</td><td>-</td><td>0</td><td>0.938</td></tr>
<tr><td>Cranberry Lakes</td><td>0</td><td rowspan="2">10.083</td><td>0.135</td><td>0</td><td>1.890</td><td>27.800</td></tr>
<tr><td>Sesep Lake</td><td>-</td><td>7.500</td><td>0</td><td>0.821</td><td>30.000</td></tr>
<tr><td>Wuskwatim Lake (west)</td><td>0</td><td>2.435</td><td>0</td><td>0.091</td><td>2.889</td><td>-</td></tr>
<tr><td>Wuskwatim Lake (east)</td><td>0</td><td>0</td><td>0</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Burntwood River</td><td>0</td><td>-</td><td>-</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>GS Site</td><td>-</td><td>-</td><td>-</td><td>0.007</td><td>-</td><td>-</td></tr>
<tr><td>Mile 17/20 Access Road</td><td>-</td><td>-</td><td>-</td><td>0.006</td><td>-</td><td>-</td></tr>
</table>

‘-’ indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

Generating station site abundance

Muskrat sign was absent within the proposed footprint of the generating station site. Only one muskrat track or an average of 0.007 sign/100 m (Table 9.3-4) was recorded adjacent to the site along the shoreline of the Burntwood River (RKSE and WRCS, Unpubl. Data).

Overview of distribution, abundance and habitat associations

Muskrat are generally widespread, abundant and secure throughout Manitoba. However, only a few muskrat are distributed in Cranberry Lakes, Sesep Lake, Wuskwatim Brook, and the southern bay or west shore of Wuskwatim Lake in small bays or creeks. The greatest muskrat abundance was observed at Cranberry Lakes and Sesep Lake during summer. The winter population is much lower. The Burntwood River and the Rat River generally have few muskrat. Apeganau, Bison, Egg and Middle Lakes and small ponds surrounding Wuskwatim Lake, have much higher abundances, especially during winter (NCN member, pers. comm.; RKSE and WRCS, Unpubl. Data).

Muskrat sign on a peat island

Primary habitat for muskrat is a combination of riparian and peat islands habitats (Figures 9.3-1 and 9.3-2). Primary riparian environments have low exposure or low water velocity (North/South Consultants, Unpubl. Data), predominantly low slopes with no exposed bedrock, glaciolacustrine clay and silt banks, and vegetation including *Carex* or other beach vegetation. Primary muskrat habitat also includes certain types of peat islands, especially *Typha* with or without submerged fringe, *Carex* and ericaceous shrubs with *Typha* fringe (Volume 6 Section 5) or marsh, muskeg, or beaver flood (Figure 9.3-1). The likelihood of muskrat using water and vegetation located farther than 200 m from shorelines, or upland habitats located farther than 100 m from shorelines is assumed to be low, and therefore, habitats outside this boundary are not considered (RKSE and WRCS, Unpubl. Data). Primary habitats in the Aquatic Buffer area likely provide muskrat with better availability and abundance of common food items (Fassett 1957; Slaney & Company 1974; Perry 1990) such as *Calla palustris*, *Carex rostrata*, *Calamagrostis* spp., *Glyceria* spp., *Potamogeton* spp. or *Typha* spp., or shelter for dens (Volume 6 Section 5). Approximately 12% of the area delineated by the Aquatic Buffer, 6% of the Upland Buffer, and 2% of the Upland Project Areas contain primary muskrat habitat (RKSE and WRCS, Unpubl. Data).

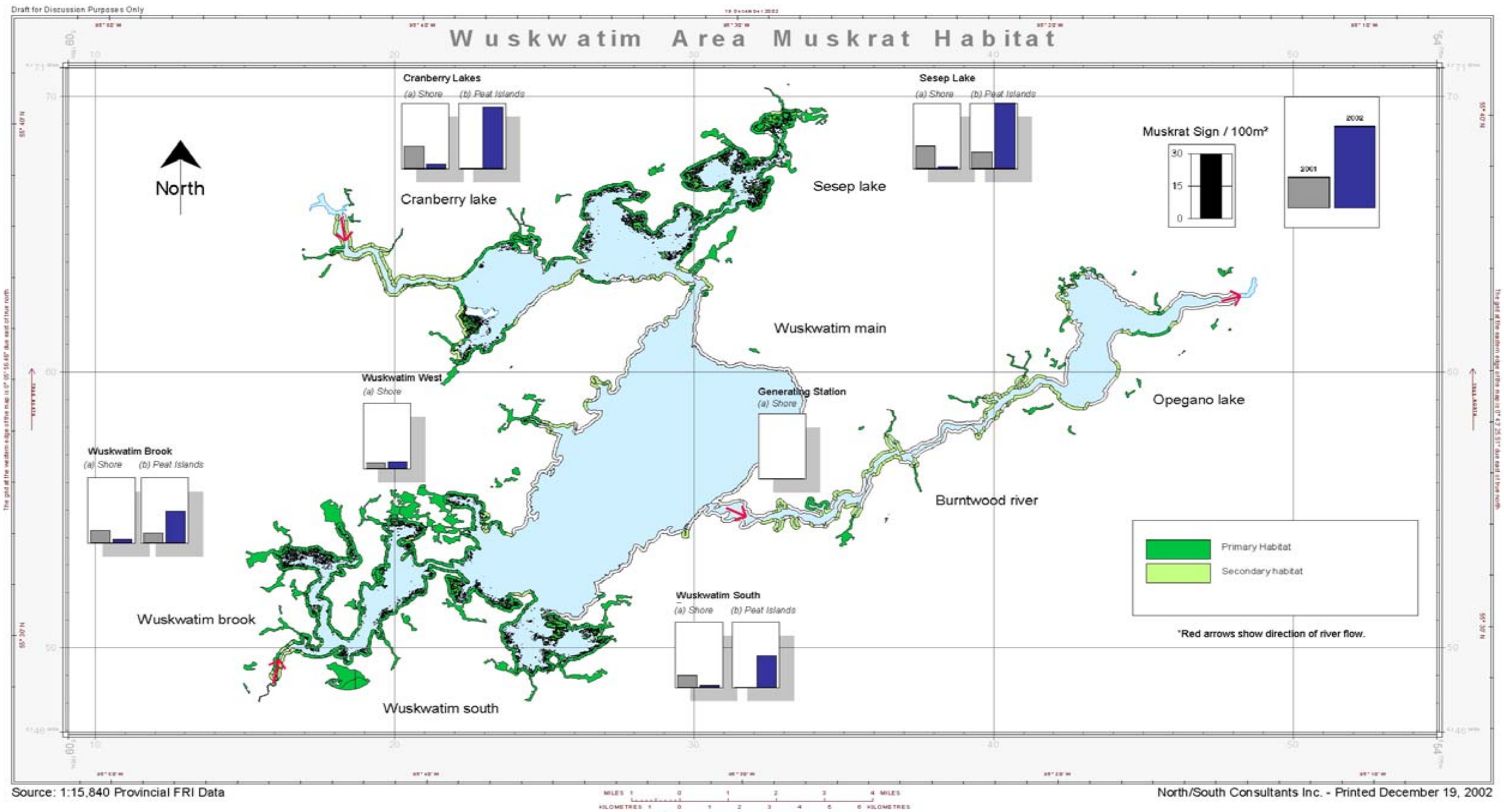


Figure 9.3-1. Muskrat habitat in the Aquatic Buffer.

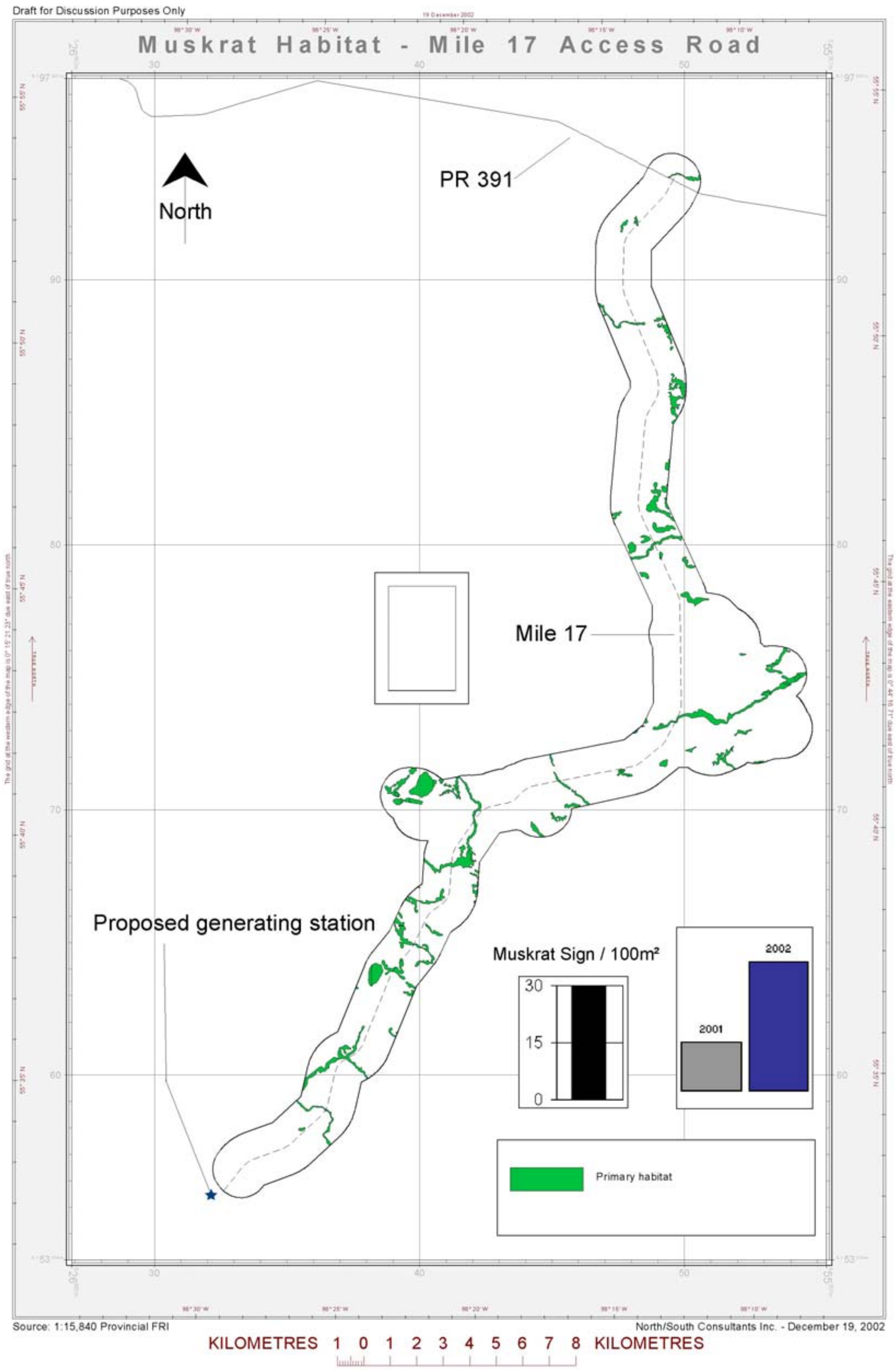


Figure 9.3-2. Muskrat habitat in the Upland Buffer.

Secondary habitat for muskrat is similar to primary habitat (Figure 9.3-1), but does not contain preferred beach vegetation (Volume 6 Section 5). Approximately 3% of the area bounded by the Aquatic Buffer, 0% of the Upland Buffer, and <1% of the Upland Project Areas contain secondary muskrat habitat. The large majority or 85% of the Aquatic Buffer, 94% of the Upland Buffer and 98% of the Upland Project Areas do not contain muskrat habitat (RKSE and WRCS, Unpubl. Data).

NCN trappers have long observed changes in the distribution and abundance of muskrat, stating, "During high water on lakes affected by CRD, muskrat are seen on roadsides and highways looking for shallower water. When water levels are high, muskrat numbers are lower. Muskrats prefer the small ponds away from the lakes affected by CRD" (NCN member, pers. comm.). The relative abundance of muskrat in the Sub-Region varies widely, and likely depends upon a combination of factors such as phase of the population cycle, habitat type and condition, social pressures, competition, harvest, predation and geographical area (Perry 1990). Under existing environmental conditions, only a portion of the observed distribution and abundance of muskrat could be explained by seasonal water levels fluctuations on Wuskwatim Lake, which is considered an important local factor in determining muskrat movements and habitat use (RKSE and WRCS, Unpubl. Data).

Increases in mean frequency of muskrat sign on peat islands between 2001 and 2002 suggest that muskrats may disperse from primary near-shoreline habitat to primary peat island habitat during low water years, while using near-shoreline or other available habitat during high water years (Table 9.3-4 and Figure 9.3-1). Similar movements and habitat use occur elsewhere in the region (RKSE and WRCS, Unpubl. Data). Under relatively stable water conditions sampled in lakes not affected by CRD, average muskrat abundance appeared to be higher than along on CRD affected lakes. However, a large population decline was observed between the two sample years, which suggests factors other than just seasonal water level fluctuations limit the relative abundance of muskrat (Perry 1990).

9.3.2.1.2 Beaver (*Castor canadensis*)

General life history

Beavers are semi-aquatic rodents that require water, woody vegetation for food and construction material, and suitable lodge location. Their diet includes herbaceous as well as woody vegetation, however poplars and willows are preferred for food and construction (Banfield 1974; Novak et al. 1987; Wheatley 1989; Wheatley 1994). In the fall, beavers prepare food caches for winter, which they store on the pond or river bottom and access from underwater (Wrigley 1986). Breeding females produce one litter per year, averaging 3.2 kits but varying depending on food quality (Novak et al. 1987). Beavers appear to have an innate tendency to disperse from the natal colony in their second or third year upon reaching sexual maturity (Wheatley 1989; Hill 1990; Wheatley1994).

Foraging by beaver can alter forest structure and composition (Donkor and Fryxell 1999) and can act as a keystone species, i.e., have ecological effects that are disproportionate to their abundance. Indeed, beaver can have a major influence on landscape (Broschart et al. 1989, Johnston and Naiman 1990) that generally is highly beneficial to wildlife. For example, moose, otters, mink, and muskrats are commonly found associated with beaver impoundments. Hydrology is altered by beaver dams (Gurnell 1998), and in **xeric** areas raising the water table can enhance forage production for wildlife. Beaver populations can have major consequences to the long-term capacity of a landscape to support a diversity of wildlife.

Beaver (Amisk)

While beavers are quite adaptable to flooding and water fluctuations, they may be more susceptible to starvation and increased predation during winter water fluctuations (Smith and Peterson 1991; Breck et al. 2001). Caches can become inaccessible if they are frozen in ice or surrounded by collapsed ice. Beavers are more likely to forage above ice when their food caches become frozen in ice or underwater access to them becomes blocked. There is also a greater rate of lodge abandonment in regions with large unseasonable water draw down. Predation risks, especially from wolves and coyotes, increase when beavers are forced to leave their dens during baseflow and/or ice cover conditions (Smith and Peterson 1991). Other factors limiting populations include disease (especially **tularemia**) and trapping (Perry 1990).

Regional abundance

Manitoba Conservation lists the beaver as demonstrably widespread, abundant, and secure throughout Manitoba, and essentially ineradicable under present conditions. The species distributional trends, over its' range, tend to be stable (MCDC 1996). Trapping records from 1979 to 2001 in NCN's Registered Trapline District generally supports this assessment (MC Trapping Unpubl Data, Volume 7).

The number of beavers in the Region may have increased in recent years (Volume 7). Their activity was documented for Threepoint Lake, Wapisu Lake, Notigi Lake, Rat-Burntwood Rivers, Wuskwatim Lake, Cranberry Lakes, Sesep Lake, Opegano Lake, and a select number of small ponds and creeks. Many active lodges (total of 104) were observed during 2001 (RKSE and WRCS, Unpubl. Data).

Sub-Regional abundance

Beavers are common but highly variable in number, as confirmed by shoreline surveys (Table 9.3-5). Beaver abundance tended to be lower in upland habitats adjacent to shorelines. The 2001 summer boat surveys that identified 33 active beaver lodges confirmed that beavers are relatively common, but may be restricted in geographic extent towards suitable habitats. Lodges have highly variable spacing patterns. In some circumstances, a number of lodges can form a cluster near suitable habitat. About one-half of the lodges (16) were located in the Wuskwatim Brook area. The mean distance to the nearest lodge in the Wuskwatim Brook area of 9400 m (range 600-15,000 m) was smaller than that in the Cranberry Lakes area where the mean value was 12,000 m (range 750-17,000 m). Seven other lodges that were observed during ground and aerial surveys appeared to be inactive (RKSE and WRCS, Unpubl. Data).

Beavers are common along the Burntwood River and the north shore of Opegano Lake as measured during 2001 summer aerial surveys of beaver lodges. Beaver sign was not present in upland habitat outside the GS site (Table 9.3-5). The aerial survey identified 28 active and two inactive beaver lodges downstream of Taskinigup Falls averaging 0.133 lodges/100 m. Beaver lodges along the Burntwood River appear to be restricted in their geographical extent, with clustering near trembling aspen stands and near creek mouths. Seven active lodges were identified on Opegano Lake all along the north shore, averaging 0.071 lodges/100 m surveyed (RKSE and WRCS, Unpubl. Data).

Access road corridor and borrow sites abundance

Beaver sign is common along the access road corridor in summer. It averaged 0.506 sign/100m (range 0-10.50), but was generally restricted to creeks, bogs, ponds or small lakes. The average beaver sign along the existing winter road during fall surveys was 0.050 beaver sign/100m (range 0-0.12). Beaver sign was not recorded along the access route during winter surveys (RKSE and WRCS, Unpubl. Data).

Aerial surveys from the proposed generating station at Taskinigup Falls to the junction of Mile 17 and PR 391 documented 48 beaver lodges averaging 0.136 lodges/100 m. The former alternate route along Mile 5, surveyed from the junction of Mile 5 at PR 391 to the junction of Mile 5 and Mile 17, documented 60 beaver lodges or 0.278 lodges/km.

Table 9.3-5. Summary table of beaver sign frequency (sign/100m/survey unless stated otherwise).

	Study					
	Summer 2000			**Summer 2001**		
Location	**Mammal Transect**	**Shore Surveys**	**Peat Island Surveys (signs/island)**	**Mammal Transect**	**Shore Surveys**	**Peat Island Surveys (signs/island)**
Wuskwatim Brook	0.832	1.138	0.250	0.120	0.041	0.103
Wuskwatim South Bay	0		0.500	0.104	0.057	
Cranberry Lakes	0	0.728	0.400	0.063	0.379	0.200
Sesep Lake	-		-	0	0.444	1.333
Wuskwatim Lake (west)	0.050	0.187	-	0.183	0	-
Wuskwatim Lake (east)	0.137	0	-	0	-	-
Burntwood River	0	-	-	-	-	-
GS Site	-	-	-	0.246	-	-
Mile 17/20 Access Road	-	-	-	0.506	-	-

'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

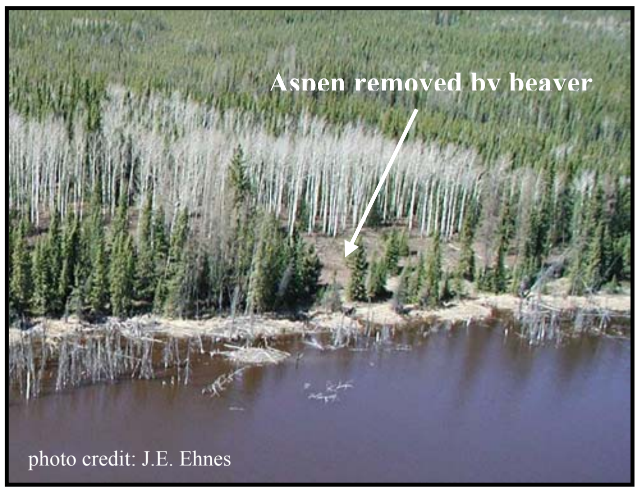
This area has approximately twice as many lodges as the proposed Mile 17 route. Lodges were concentrated in creeks, ponds and small lakes (RKSE and WRCS, Unpubl. Data

Generating station site abundance

Beaver sign is common within the proposed footprint of the generating station site. An average of 0.246 sign/100 m (Table 9.3-5) was recorded within and adjacent to the site along the shorelines and near shore forested habitat of the Burntwood River. Additional beaver sign were identified in five wetland habitats during surveys within and adjacent to the proposed generating station site (RKSE and WRCS, Unpubl. Data).

Overview of distribution, abundance and habitat associations

The beaver is widespread, abundant, and secure throughout Manitoba. In the Sub-Region, beaver are found in most small ponds, creeks, rivers and lakes (Figures 9.3-3 and 9.3-4). Beaver are predominantly distributed in Cranberry Lakes, Sesep Lake, Wuskwatim Brook, and the southern bay of Wuskwatim Lake in small bays or creeks. The distribution and relative abundance of beaver often corresponds with the distribution of aspen trees near water. The greatest beaver abundance was observed at Wuskwatim Brook, the southern bay of Wuskwatim Lake and the Burntwood River into Opegano Lake (RKSE and WRCS, Unpubl. Data).



Beaver habitat

Primary habitat for beaver (Figure 9.3-3) is near shorelines. Primary riparian environments have low exposure or low water velocity (North/South Consultants, Unpubl. Data) located near trembling aspen. Primary beaver habitat also includes tall shrub wetland, marsh, muskeg, or beaver flood (Figure 9.3-4). The likelihood of beaver using water and vegetation located farther than 200 m from shorelines, or upland habitats located farther than 100 m from shorelines is assumed to be low and, therefore, habitats outside this boundary are not considered (RKSE and WRCS, Unpubl. Data). Primary habitats in the Sub-Region likely provide beaver with better availability and abundance of common food items (Fassett 1957; Slaney & Company 1974; Perry 1990) such as *Alnus* spp., *Populus* spp., or *Salix* spp. materials for lodge or dam construction or shelter for bank dens (Volume 6 Section 5). Approximately 5% of the area delineated by the Aquatic Buffer and 4% of the Upland Buffer and 2% of the Upland Project Areas contain primary beaver habitat (RKSE and WRCS, Unpubl. Data).

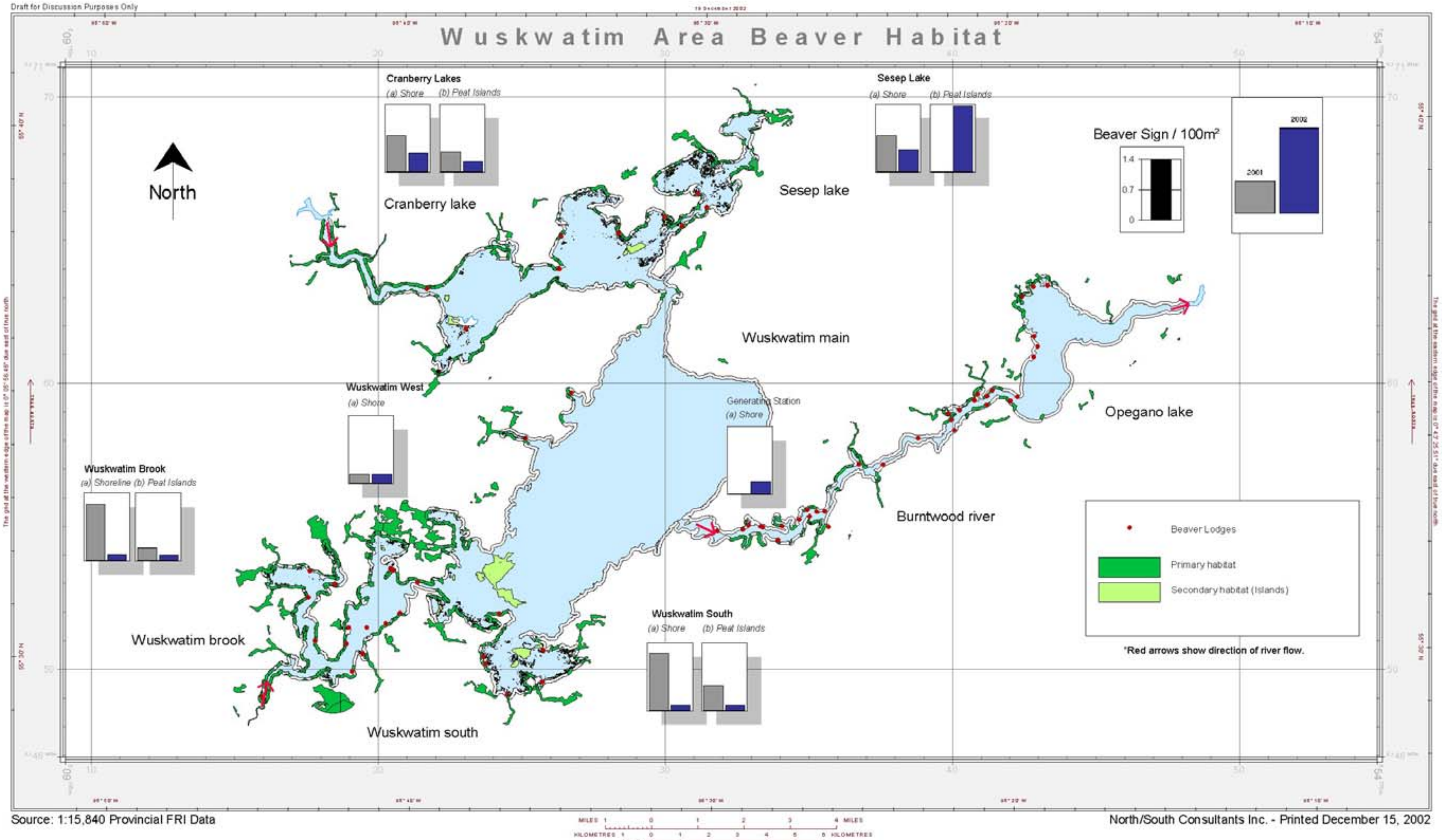


Figure 9.3-3. Beaver habitat in the Aquatic Buffer.

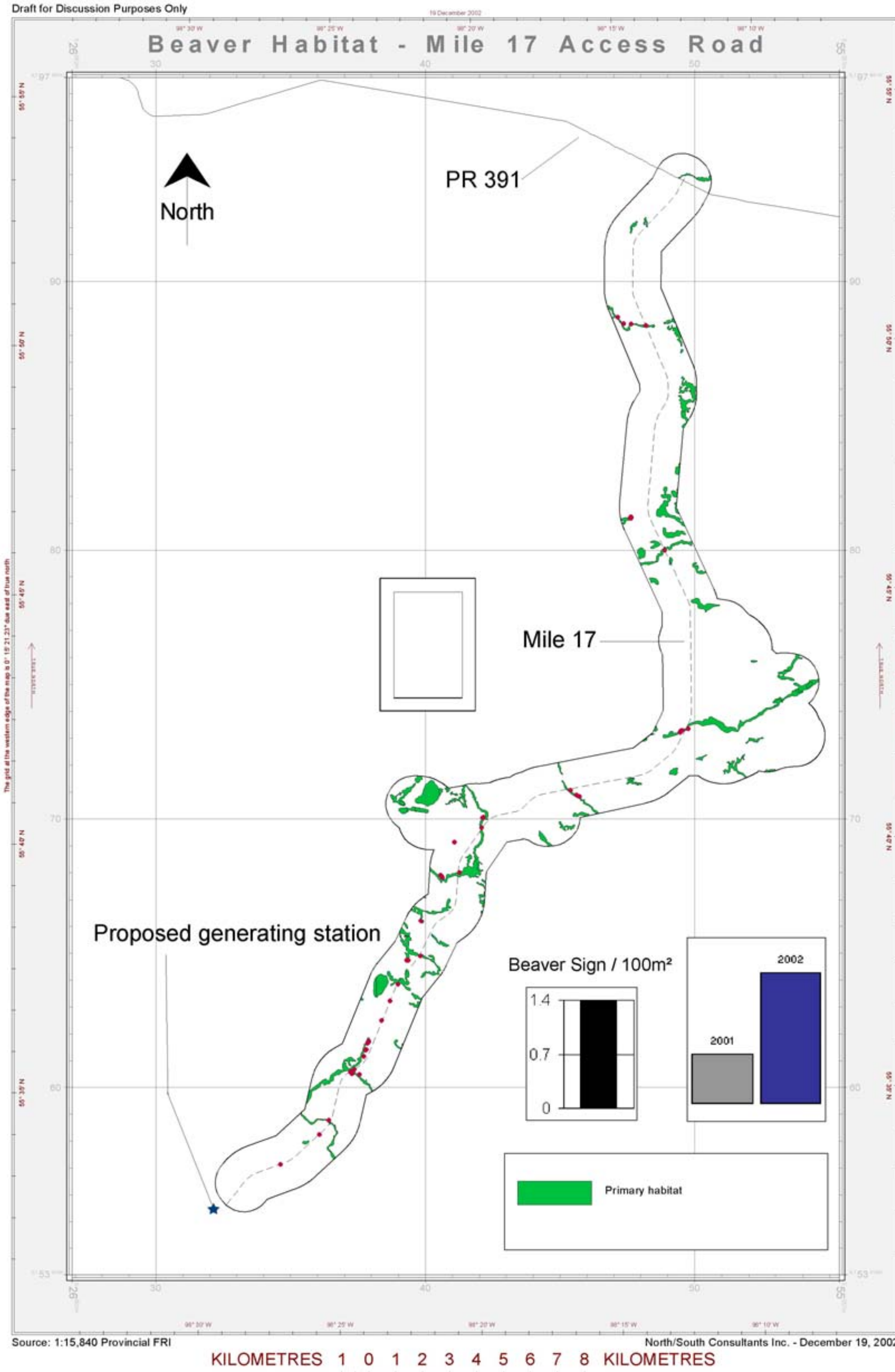


Figure 9.3-4. Beaver habitat in the Upland Buffer.

Secondary habitat for beaver consists of peat or mineral islands (Figure 9.3-3.). Although not mapped, other secondary habitat in the Buffers may consist of moderate water velocity and a variety of bank conditions. Less than 1% of the area bounded by the Aquatic Buffer, 0% of the Upland Buffer, and 0% of the Upland Project Areas contain secondary beaver habitat (RKSE and WRCS, Unpubl. Data). The large majority or 95% of the Aquatic Buffer, 96% of the Upland Buffer and 98% of the Upland Project Areas are not beaver habitat.

Elongated beaver lodge anchored to river shoreline; possible adaptation to water-level fluctuations or bank condition

9.3.2.1.3 River otter (*Lontra canadensis*)

General life history

Otters inhabit riparian communities, including rivers and lake shores, ponds, beaver floods and wetlands (Melquist and Hornocker 1983; Novak et al. 1987). Habitat selection depends heavily on the availability of den sites and resting areas such as logjams, streamside vegetation, brush piles, undercut banks, and deadfall/debris (Wrigley 1986). River otters feed primarily on fish, though other aquatic animals such as crayfish, frogs, snakes and waterfowl are eaten (Toweill and Tabor 1990). In the north, female otters breed during spring following parturition, and after fertilization, embryos cease development until late winter. During spring, females give birth to two or three young, which remain at the natal site for a six or seven month period before dispersing. Otters reach sexual maturity at age two, and live up to 14 years in the wild (Wrigley 1986).

Human activities, particularly trapping and modification of required habitat are the main cause of otter mortality, (Larson et al. 1983; Toweill and Tabor 1990). Other examples include drowning in gill nets, (Mobray et al. 1979), road kills (Melquist and Hornocker 1983), and contamination of animals and habitats by industrial pollutants, including heavy metals, PCBs (polychlorinated biphenyls), and chlorinated hydrocarbons (Toweill and Tabor 1990). Mercury has been reported from river otter tissues (Kucera 1982, 1983). Otters are preyed upon by lynx, wolves, coyotes and bears (Toweill and Tabor 1990).

Regional abundance

Manitoba Conservation lists the river otter as demonstrably widespread, abundant, and secure throughout Manitoba, and essentially ineradicable under present conditions. The species distributional trends, over its' range, tend to be stable (MCDC 1996). Trapping records from 1979 to 2001 in NCN's Registered Trapline District supports this assessment (MC Trapping Data Unpubl., Volume 7).

Areas in the Region appear to contain adequate otter habitat. "The creek that runs on the west side flowing east into Bison Lake, for example, is very good for otter" (NCN member, pers. comm.). An increase in the number of otters south of Bison Lake was also reported (Volume 7).

Sub-Regional abundance

Otter appear to be relatively uncommon in the Sub-Region, but widespread wherever habitat occurs (RKSE and WRCS, Unpubl. Data). The presence of otter is likely habitat specific as it ranges widely from 0 to 0.538 sign/100 m. Most otter sign was found at riparian sites and/or wetland sites around the south bays of Wuskwatim Lake and at Cranberry Lakes. Otter appear to be avoiding upland habitats. With the exception of the east side of Wuskwatim Lake, average otter abundance is nearly zero. Other inland habitats rarely contained otter sign. Otter activities by location and season are summarized in Table 9.3-6.

Little is known about the Burntwood River otter population downstream of Wuskwatim Lake, up to and including Opegano Lake, but it is likely similar to other rivers and lakes in the Region (RKSE and WRCS, Unpubl. Data). NCN reports that otter populations are likely stable along this section of the Burntwood River. No one can confirm this since trapping is sparse because of limited access into the area.

Access road corridor and borrow sites abundance

General otter abundance along the Mile 17 access road corridor appears low, averaging 0.078 sign/ 100 m during summer (Table 9.3-6). However, high quality summer habitat near creeks had higher otter abundance, averaging 0.50 sign/100m (range 0-2.50) (RKSE and WRCS, Unpubl. Data). These figures correspond to increased numbers of otter [observed] around Mile 17 (Volume 7). Otter sign was not observed during fall surveys, and low numbers of otter tracks, ranging from 0 to 0.003 sign/100m were recorded during 2000 and 2001 snowmobile surveys.

Table 9.3-6. Summary table of river otter sign frequency (sign/100m/survey).

<table>
<tr><th rowspan="4">Location</th><th colspan="8">Study</th></tr>
<tr><th colspan="3">2000</th><th colspan="4">2001</th><th>2002</th></tr>
<tr><th>Jan.-Feb.</th><th colspan="2">Summer</th><th>Mar. –Apr.</th><th colspan="2">Summer</th><th>Oct.-Dec.</th><th>Feb.-Apr.</th></tr>
<tr><th>Snowmobile Survey</th><th>Mammal Transects</th><th>Shore Surveys</th><th>Snowmobile Survey</th><th>Mammal Transect</th><th>Shore Surveys</th><th>String Survey</th><th>Snowmobile Survey</th></tr>
<tr><td>Wuskwatim Brook</td><td>-</td><td>0</td><td rowspan="2">0.062</td><td>-</td><td>0</td><td>0.041</td><td>-</td><td>-</td></tr>
<tr><td>Wuskwatim South Bay</td><td>-</td><td>0</td><td>-</td><td>0</td><td>0.117</td><td>-</td><td>-</td></tr>
<tr><td>Cranberry Lakes</td><td>-</td><td>0</td><td rowspan="2">0.263</td><td>-</td><td>0</td><td>0.020</td><td>-</td><td>-</td></tr>
<tr><td>Sesep Lake</td><td>-</td><td>-</td><td>-</td><td>0</td><td>0</td><td></td><td></td></tr>
<tr><td>Wuskwatim Lake (west)</td><td>-</td><td>0.050</td><td>0</td><td>-</td><td>0</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>Wuskwatim Lake (east)</td><td>-</td><td>0.548</td><td>0</td><td>-</td><td>0</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Burntwood River</td><td>-</td><td>0</td><td>-</td><td>-</td><td>0</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>GS Site</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.043</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Laurie River T.L.</td><td>-</td><td>-</td><td>-</td><td>0.002</td><td>-</td><td>-</td><td>0.001</td><td>0.004</td></tr>
<tr><td>Mile 17/20 Access Road</td><td>0</td><td>-</td><td>-</td><td>-</td><td>0.078</td><td>-</td><td>-</td><td>0.003</td></tr>
</table>

'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

Generating station site abundance

River otter sign was uncommon within the proposed footprint of the generating station site. An average of 0.043 sign/100 m (Table 9.3-6) was recorded within and adjacent to the site along the shorelines and near shore forested habitat of the Burntwood River (RKSE and WRCS, Unpubl. Data).

Overview of distribution, abundance and habitat associations

Otter are widespread, abundant, and secure throughout Manitoba. In the Sub-Region, they are widely scattered and mainly distributed in or near water (Cranberry Lakes, Sesep Lake, Wuskwatim Brook, Wuskwatim Lake) and elsewhere. Highly variable otter densities (none to low) can be expected in the Sub-region (RKSE and WRCS, Unpubl. Data).

Primary habitat for otters (Figure 9.3-5) is a combination of riparian, peat island and aquatic habitats. Primary riparian environments have access to den sites in upland areas, and are adjacent to feeding areas. Primary otter habitat also includes tall shrub wetland, marsh, muskeg, beaver flood, peat, or mineral islands (Figures 9.3-5 and 9.3-6). The likelihood of otters using feeding habitat located farther than 200 m from shorelines, or upland habitats located farther than 100 m from shorelines is assumed to be low (RKSE and WRCS, Unpubl. Data). Primary habitats in the Sub-Region likely provide otter with shelter for dens and better availability and abundance of common food items (Toweill and Tabor1990) such as slow moving, common fish species (Volume 5) like suckers (*Catostomus* spp.), redhorses (*Moxostoma* sp.) and shiners (*Notropis* spp.). Approximately 17% of the area delineated by the Aquatic Buffer, 6% of the Upland Buffer, and 5% of the Upland Project Areas contain primary otter habitat (RKSE and WRCS, Unpubl. Data).

Secondary habitat for otter consists of shorelines that have lower potential for den sites. Habitat located farther than 100 m from shorelines are occasionally occupied, and therefore, all forest stands are considered secondary (Figure 9.3-5). Many of these forested habitats are occasionally used in winter. Approximately 83% of the area bounded by the Aquatic Buffer, 94% of the Upland Buffer, and 95% of the Upland Project Areas contain secondary otter habitat (RKSE and WRCS, Unpubl. Data).

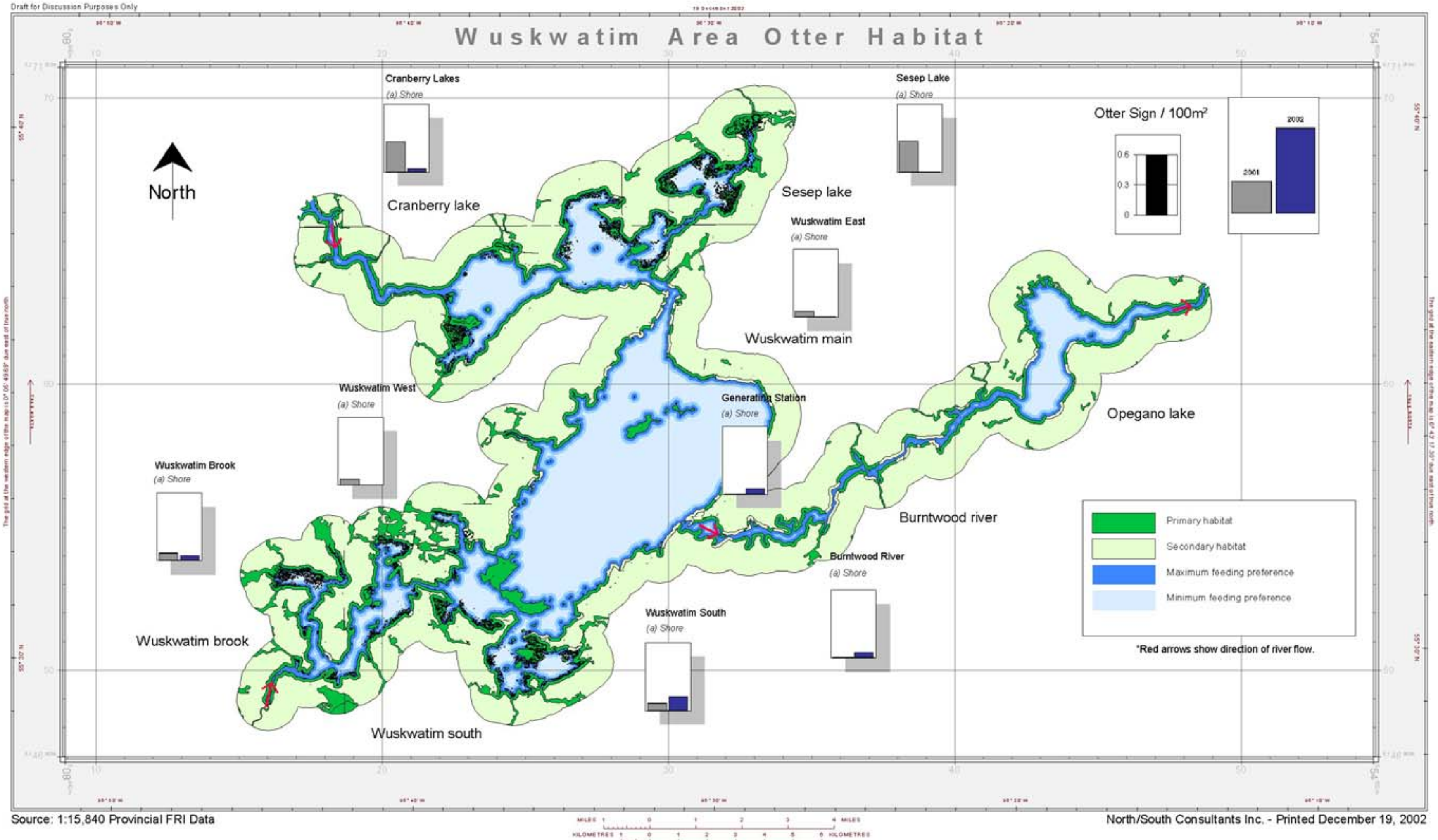


Figure 9.3-5. Otter habitat in the Aquatic Buffer.

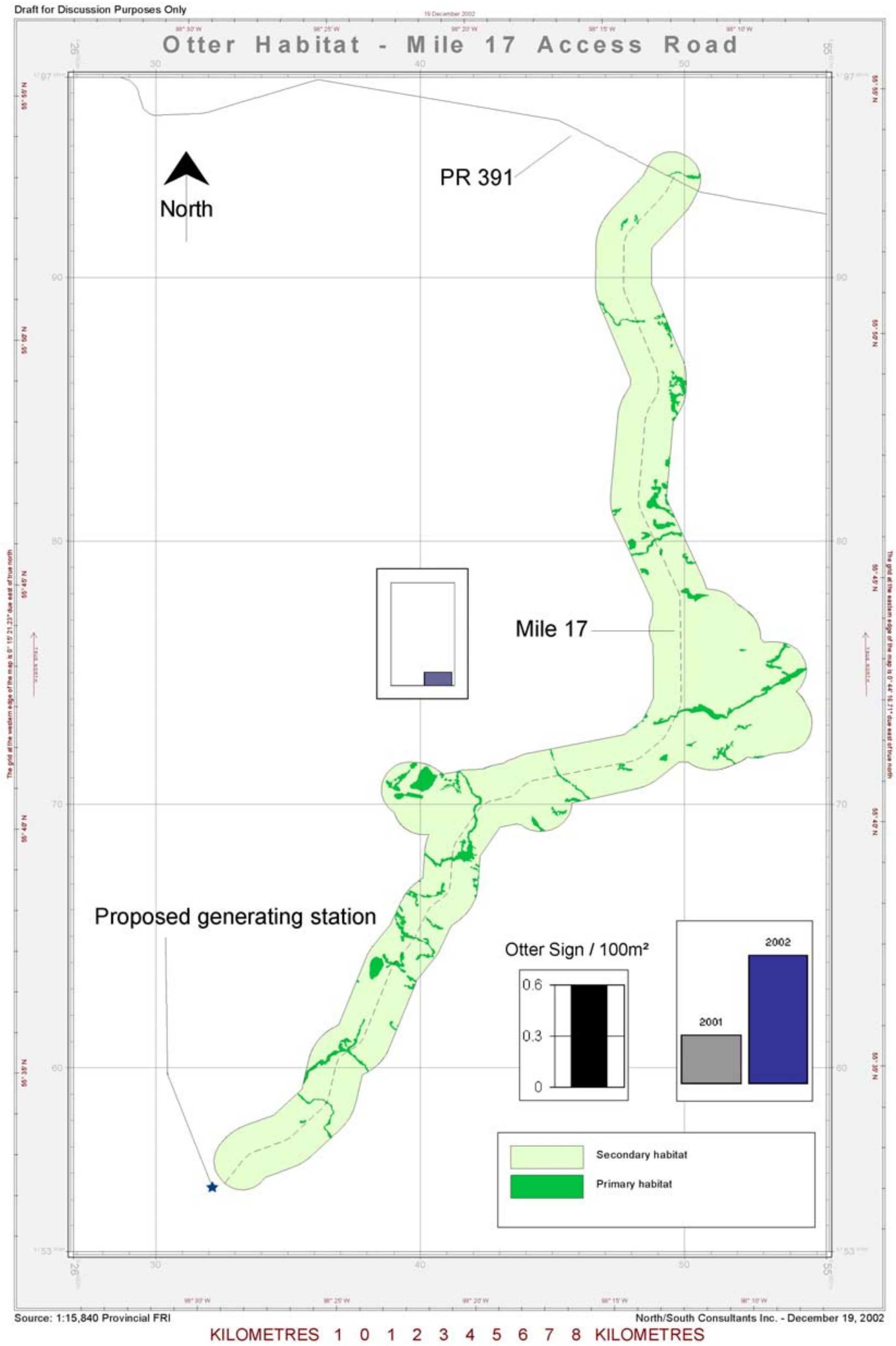


Figure 9.3-6. Otter habitat in the Upland Buffer.

9.3.2.1.4 Mink (*Mustela americana*)

General life history

Mink are members of the weasel family that inhabit riparian zones. Availability of den sites is an important habitat feature for mink, as some family groups will utilize multiple den sites (Shladweiler and Storm 1969). Mink will also use muskrat burrows and beaver lodges for den sites (Linscombe et al. 1990). Small animals of any sort constitute the mink's diet, including voles, mice, shrews, birds, frogs, insects, and crustaceans (Banfield 1974; Linscombe et al. 1982). Mink mate during late winter to early spring, after which development of the embryo ceases until the following year. Typically, five young are born during April or May following a 30-day gestation period. Young disperse during their first fall, and reach sexual maturity at one year. Mink seldom live longer than four years in the wild (Wrigley 1986).

Human activity, particularly trapping, is one of the main causes of mink mortality. They may occasionally fall prey to fisher, red fox, lynx and wolf (Linscombe et al. 1990). As high-level predators, mink are vulnerable to mercury contamination (Borg 1975; Wobeser et al. 1976). They are sensitive to methyl mercury, phenyl mercuric acetate, PCBs and other pollutants (Karstad 1973; Kucera 1982, 1983; Linscombe et al. 1990).

Regional abundance

Manitoba Conservation lists the mink as demonstrably widespread, abundant, and secure throughout Manitoba, and essentially ineradicable under present conditions. The species distributional trends, over its' range, tend to be stable (MCDC 1996). Trapping records from 1979 to 2001 in NCN's Registered Trapline District supports this assessment (MC Trapping Data Unpubl.; RKSE and WRCS, Unpubl. Data).

Sub-Regional abundance

Mink appear to be relatively uncommon in the Sub-Region, but widespread wherever habitat occurs (RKSE and WRCS, Unpubl. Data). The presence of mink ranges widely from 0 to 0.274 sign/100 m. Mink sign was found at riparian sites, other wetlands and also in upland sites around Wuskwatim Lake and Wuskwatim Brook. With the exception of the east side of Wuskwatim Lake, average mink abundance is nearly zero. Mink activities are summarized in Table 9.3-7 (RKSE and WRCS, Unpubl. Data).

Little is known about the Wuskwatim Lake and Burntwood River mink population, but it is likely similar to other rivers and lakes in the Region (RKSE and WRCS, Unpubl. Data). Mink populations are likely stable along the Burntwood River. No one can confirm this because trapping is sparse because of limited access into the area (NCN member, pers. comm.).

Table 9.3-7. Summary table of mink sign frequency (sign/100m/survey).

<table>
<tr><th rowspan="4">Location</th><th colspan="8">Study</th></tr>
<tr><th colspan="3">2000</th><th colspan="4">2001</th><th>2002</th></tr>
<tr><th>Jan.-Feb.</th><th colspan="2">Summer</th><th>Mar. –Apr.</th><th colspan="2">Summer</th><th>Oct.-Dec.</th><th>Feb.-Apr.</th></tr>
<tr><th>Snowmobile Survey</th><th>Mammal Transects</th><th>Shore Surveys</th><th>Snowmobile Survey</th><th>Mammal Transect</th><th>Shore Surveys</th><th>String Survey</th><th>Snowmobile Survey</th></tr>
<tr><td>**Wuskwatim Brook**</td><td>-</td><td>0</td><td rowspan="2">0.031</td><td>-</td><td>0</td><td>0.041</td><td>-</td><td>-</td></tr>
<tr><td>**Wuskwatim South Bay**</td><td>-</td><td>0</td><td>-</td><td>0</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>**Cranberry Lakes**</td><td>-</td><td>0</td><td>0</td><td>-</td><td>0</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>**Sesep Lake**</td><td>-</td><td>-</td><td>0</td><td>-</td><td>0</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>**Wuskwatim Lake (west)**</td><td>-</td><td>0.050</td><td>0</td><td>-</td><td>0</td><td>0</td><td>-</td><td>-</td></tr>
<tr><td>**Wuskwatim Lake (east)**</td><td>-</td><td>0.274</td><td>0</td><td>-</td><td>0</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>**Burntwood River**</td><td>-</td><td>0</td><td>-</td><td>-</td><td>0</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>**GS Site**</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.007</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>**Laurie River T.L.**</td><td>-</td><td>-</td><td>-</td><td>0.001</td><td>-</td><td>-</td><td>0.006</td><td>0.003</td></tr>
<tr><td>**Mile 17/20 Access Road**</td><td>0.005</td><td>-</td><td>-</td><td>-</td><td>0.011</td><td>-</td><td>-</td><td>0.002</td></tr>
</table>

'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

Access road corridor and borrow sites abundance

General mink abundance along the Mile 17 access road corridor appears low, averaging 0.011 sign/ 100 m during summer (Table 9.3-7). However, high quality summer habitat near creeks had higher mink abundance, averaging 0.07 sign/100m (range 0-1.00). Limited mink sign was observed during fall surveys, and low numbers of mink tracks, ranging from 0.002 to 0.005 sign/100m were recorded during 2000 and 2001 snowmobile surveys (RKSE and WRCS, Unpubl. Data).

Generating station site abundance

Mink sign was uncommon within the proposed footprint of the generating station site. An average of 0.007 sign/100 m (Table 9.3-7) was recorded within and adjacent to the site along the shorelines and near shore forested habitat of the Burntwood River (RKSE and WRCS, Unpubl. Data).

Overview of distribution, abundance and habitat associations

Mink are widespread, abundant, and secure throughout Manitoba. In the Sub-Region, they are widely scattered and mainly distributed near water (Wuskwatim Brook and Wuskwatim Lake) and sporadically elsewhere. The greatest mink abundance was observed along the east shore of Wuskwatim Lake (RKSE and WRCS, Unpubl. Data).

Primary habitat for mink (Figure 9.3-7) is a combination of riparian and peat island habitats. Primary riparian environments have access to den sites in upland areas and are adjacent to abundant food sources. Primary mink habitat also includes tall shrub wetland, marsh, muskeg, beaver flood, peat, or mineral islands (Figures 9.3-7 and 9.3-8). The likelihood of mink using upland habitats located farther than 100 m from shorelines is low (RKSE and WRCS, Unpubl. Data). Primary habitats in the Sub-Region likely provide mink with better availability and abundance of common food items (Linscombe et al. 1990) such as mice, voles, hares, muskrats, fishes, birds, amphibians, crustaceans, reptiles and insects (Volume 6 Sections 6, 7 and 8). Approximately 15% of the area delineated by the Aquatic Buffer, 6% of the Upland Buffer, and 3% of the Upland Project Areas contain primary mink habitat (RKSE and WRCS, Unpubl. Data).

Secondary habitat for mink consists of forest stands and peatlands located farther than 100 m from shorelines (Figures 9.3-7 and 9.3-8). Approximately 85% of the area bounded by the Aquatic Buffer, 94% of the Upland Buffer, and 97% of the Upland Project Areas contain secondary mink habitat (RKSE and WRCS, Unpubl. Data).

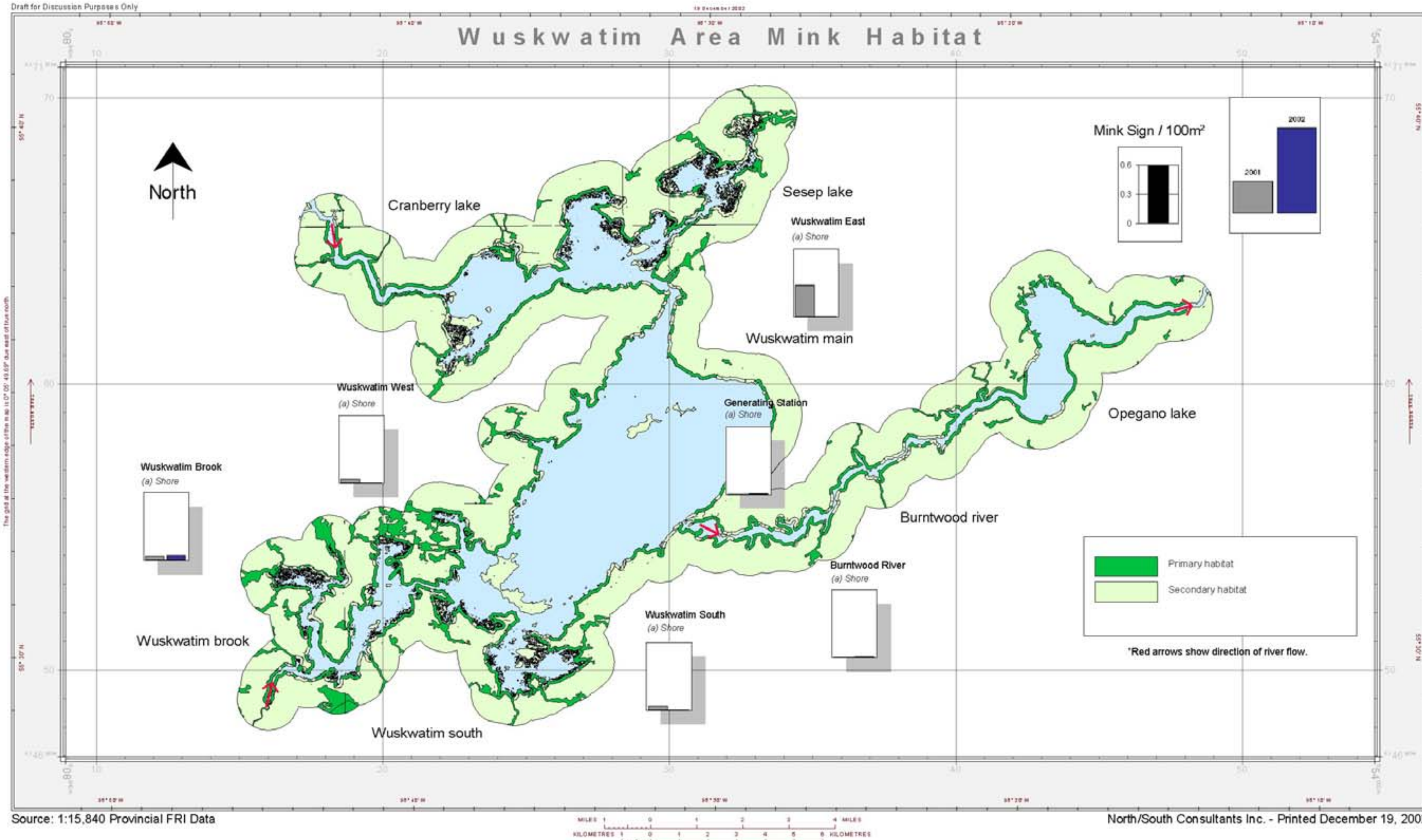


Figure 9.3-7. Mink habitat in the Aquatic Buffer.

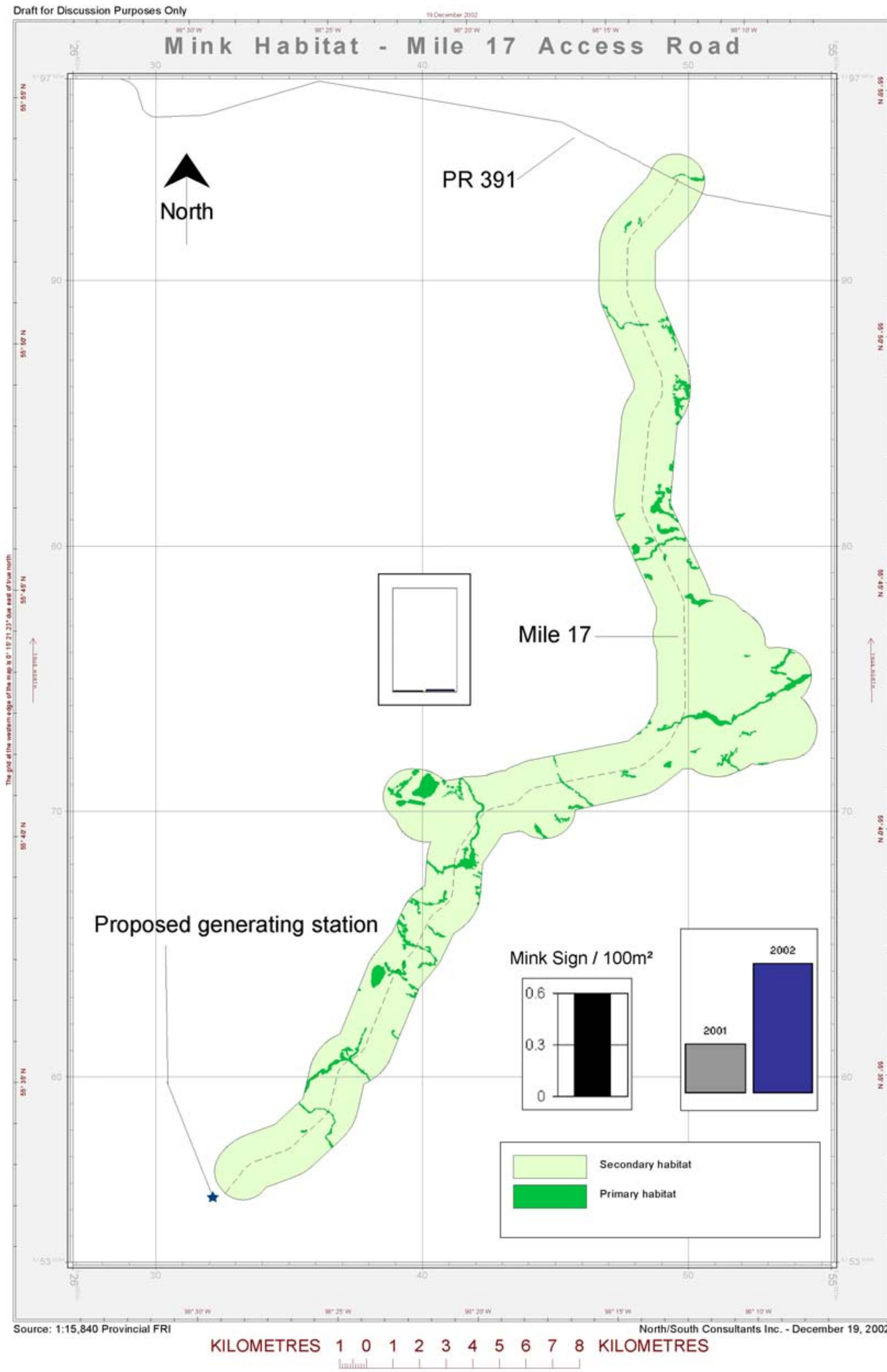


Figure 9.3-8. Mink habitat in the Upland Buffer.

9.3.2.1.5 Moose (*Alces alces*)

General life history

Preferred moose habitat includes upland mixed forest communities and riparian zones around waterbodies that contain an ample supply of sodium-rich aquatic plants. Moose also forage on new growth of shrubs and trees during summer, and woody twigs in winter (Palidwor et al. 1995). Former burns sites, ideally aged between 11 and 30 years, create particularly productive moose forage sites (Peterson 1955; Kelsall 1977). Moose home range size varies according to sex, season, geography, and migratory status of the population, however average summer home range of in central Canada ranges from 6.8 to 42 km^2, considerably smaller than the winter home range size of 48 to 111 km^2 (Addison et al. 1980; Hauge and Keith 1981; Lynch and Morgantini 1984). In May and June, approximately 240-246 days after the fall rut, female moose bear one or two calves. Sexual maturity is attained during the second or third fall after birth (16 – 28 months), and females typically breed on an annual basis. On average, moose live to ten years in the wild (Wrigley 1986).

Moose (Mooswa) calves

Malnutrition, predation by the gray wolf, hunting, or a combination of these factors account for the majority of moose mortalities in North America (Coady 1990). Parasites (especially ticks in Manitoba), fighting, accidental abandonment of calves, and drowning are other mortality factors. Moose-vehicle collisions related to poor visibility during dusk and dawn foraging periods, the prevalence of new growth along rights-of-ways, and the tendency for moose to use roads as a travel lane can also have a large impact on moose mortality. New road and right-of-way access by hunters into previously inaccessible moose habitat increases hunting pressure, and moose habitats without access support greater densities of moose than those with road access (Palidwor et al. 1995).

Regional abundance

Manitoba Conservation lists the moose as demonstrably widespread, abundant, and secure throughout Manitoba, and essentially ineradicable under present conditions. The species distributional trends, over its' range, tend to be stable (MCDC 1996). A current estimate for the regional density of moose is approximately 0.16 moose /km^2. This estimate is based on a sample area much larger than the Region, including Game Hunting Areas (GHA) 9 and 9A. Moose estimates in burn habitats are higher 0.21 moose /km^2 than undisturbed forest 0.09 moose /km^2 or logged areas 0.07 moose /km^2 (Elliott and Hedman 2001). Slaney & Company (1974) estimated moose densities between 0 to 0.80 moose /km^2.

Moose numbers may have decreased slightly as "moose are harder to find now" (NCN member, pers. comm.). "Moose are still here [near Nelson House], but sometimes we have to go further to get moose" (NCN member, pers. comm.). Some harvesters make special trips in winter to Wuskwatim Lake and Kinosaskaw Lakes to hunt moose (Volume 7).

Sub-Regional abundance

The average moose population density estimate for the Sub-Region is approximately 0.12 moose/km^2. This estimate is based on data collected from provincial aerial surveys (Elliott and Hedman 2001). A moose density estimate of 0.03 moose/km^2 for low quality moose habitats was obtained using those methods described in Section 9.2.3.4.2 (RKSE and WRCS, Unpubl. Data).

Moose are considered common in the Sub-Region, as moose sign averaged 2.4 sign/100 m (range 0 - 4.168) in all samples (RKSE and WRCS, Unpubl. Data). Abundance, however, was highly variable between sites and between years (Table 9.3-8). Moose abundance was higher in upland transects near the Burntwood River, along the east side of Wuskwatim Lake, and Wuskwatim Brook during 2000. Moose abundance along shorelines was nearly zero. Moose abundance shifted between 2000 and 2001, where relative abundance decreased in upland sites near the Burntwood River, along the east side of Wuskwatim Lake, and Wuskwatim Brook, while increasing at Cranberry Lakes and along all shorelines sampled. Higher water levels, narrower shorelines and debris, may have made it difficult for moose in 2000 to forage and travel on the shoreline itself. These factors may account for the differences in sign abundance between years (RKSE and WRCS, Unpubl. Data).

Table 9.3-8. Summary table of moose sign frequency (sign/100m/survey).

<table>
<tr><th rowspan="4">Location</th><th colspan="9">Study</th></tr>
<tr><th colspan="3">2000</th><th colspan="4">2001</th><th>2002</th></tr>
<tr><th>Jan.-Feb.</th><th colspan="2">Summer</th><th>Mar. –Apr.</th><th colspan="2">Summer</th><th>Oct.-Dec.</th><th>Feb.-Apr.</th></tr>
<tr><th>Snowmobile Survey</th><th>Mammal Transects</th><th>Shore Surveys</th><th>Snowmobile Survey</th><th>Mammal Transect</th><th>Shore Surveys</th><th>String Survey</th><th>Snowmobile Survey</th></tr>
<tr><td>Wuskwatim Brook</td><td>-</td><td>4.168</td><td rowspan="2">0.062</td><td>-</td><td>1.324</td><td>0.455</td><td>-</td><td>-</td></tr>
<tr><td>Wuskwatim South Bay</td><td>-</td><td>0</td><td>-</td><td>0.104</td><td>0.186</td><td>-</td><td>-</td></tr>
<tr><td>Cranberry Lakes</td><td>-</td><td>1.826</td><td>0</td><td>-</td><td>0.945</td><td>0.736</td><td>--</td><td>-</td></tr>
<tr><td>Sesep Lake</td><td>-</td><td>-</td><td>0</td><td>-</td><td>0</td><td>0.667</td><td>-</td><td>-</td></tr>
<tr><td>Wuskwatim Lake (west)</td><td>-</td><td>0.496</td><td>0</td><td>-</td><td>0.548</td><td>1.333</td><td>-</td><td>-</td></tr>
<tr><td>Wuskwatim Lake (east)</td><td>-</td><td>3.151</td><td>0</td><td>-</td><td>1.222</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Burntwood River</td><td>-</td><td>3.096</td><td>-</td><td>-</td><td>1.957</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>GS Site</td><td>-</td><td>-</td><td>-</td><td>-</td><td>0.522</td><td>-</td><td>-</td><td>-</td></tr>
<tr><td>Laurie River T.L.</td><td>-</td><td>-</td><td>-</td><td>0.006</td><td>-</td><td>-</td><td>0.013</td><td>0.007</td></tr>
<tr><td>Mile 17/20 Access Road</td><td>0.005</td><td>-</td><td>-</td><td>-</td><td>0.294</td><td>-</td><td>-</td><td>0.001</td></tr>
</table>

‘-’ indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

Access road corridor and borrow sites abundance

General moose abundance along the Mile 17 access road corridor appears moderate, averaging 0.294 sign/ 100 m during summer (Table 9.3-8). However, high quality summer habitat near creeks had greater moose abundance, 0.93 sign/100m (range 0-4.00), especially in upland aspen or mixedwood forest and willow/alder habitat. Limited moose sign was observed during fall surveys averaging 0.013 sign/100m, and low numbers of moose tracks, ranging from 0.005 to 0.007 sign/100m were recorded during 2000 and 2001 snowmobile surveys (RKSE and WRCS, Unpubl. Data).

Generating station site abundance

Moose sign was common within the proposed footprint of the generating station site. An average of 0.522 sign/100 m (Table 9.3-8) was recorded within and adjacent to the site along the shorelines and forested habitat of the Burntwood River (RKSE and WRCS, Unpubl. Data).

Overview of distribution, abundance and habitat associations

Moose are widespread, abundant, and secure throughout Manitoba. In the Sub-Region, they are widely scattered and often distributed near water (Cranberry Lakes, Sesep Lake, Wuskwatim Brook, Wuskwatim Lake, the Burntwood River) and elsewhere. Highly variable moose densities (none to medium) can be expected in the Sub-region (Slaney & Company 1974; Elliott and Hedman 2001; RKSE and WRCS, Unpubl. Data).

The greatest moose abundance was observed at Wuskwatim Brook, on the east side of Wuskwatim Lake and along the Burntwood River (RKSE and WRCS, Unpubl. Data). Moose numbers may have decreased slightly - "moose are harder to find now. Moose are still here [near Nelson House], but sometimes we have to go further to get moose" (NCN member, pers. comm.).

Preferred moose habitat consists of open deciduous cover, fens or recent burns (Wardrop et al. 1990). It may also include a combination of riparian and upland habitats (Figure 9.3-9). Primary habitats in the Sub-Region likely provide moose with better availability and abundance of common food items (Slaney & Company 1974; Coady 1990) such as *Equisetum fluviatile*, *Calamagrostis Canadensis*, *Potamogeton* spp., *Cornus stolonifera*, *Alnus* spp., and *Salix* spp., or common tree species such as *Picea marianna*, *Larix laricianna* and *Pinus banksianna* (Volume 6 Section 5) for shelter.

Forest stands that provide moose with primary winter or summer food requirements include younger stands of open softwood-dominated mixedwood, hardwood dominated mixedwood or hardwoods. Tall shrub wetland, marsh, muskeg, or beaver flood also supply moose with an important food source. Summer cover is provided by spruce or tamarack dominated forest stands, while winter cover is found in intermediate to older-aged spruce, fir, pine or tamarack dominated stands, as well as in willow communities (Palidwor et al. 1995). The likelihood of moose using water and vegetation located farther than 50 m from shorelines, or upland habitats located farther than 500 m from shorelines is assumed to be less than other upland habitats (Figure 9.3-9, RKSE and WRCS, Unpubl. Data). However, "moose are no longer found close to shores because of difficulty [they have] walking in the debris found on the shores, but they are still there, away from the water" (NCN member, pers. comm.). Approximately 49% of the Sub-Region, 63% of the area delineated by the Aquatic Buffer, 45% of the Upland Buffer, and 45% of the Upland Project Areas contain primary moose habitat (RKSE and WRCS, Unpubl. Data).

Secondary habitat for moose consists of those forest types located greater than 500 m from water (RKSE and WRCS, Unpubl. Data), or all other forest stands not described as primary habitat (Figure 9.3-9), (Palidwor et al. 1995). Habitats generally avoided by moose may include bog or closed conifer stands (Wardrop et al. 1990). Approximately 50% of the Sub-Region, 37% of the area delineated by the Aquatic Buffer, 55% of the Upland Buffer, and 55% of the Upland Project Areas contain primary moose habitat (RKSE and WRCS, Unpubl. Data).

9.3.2.2 Terrestrial Mammal Community

The **terrestrial mammal community** in the Sub-region is extensive. The upland habitat is composed primarily of forested areas and peatlands (Volume 6 Section 5). The quality of terrestrial habitats is individually and collectively influenced by soils, vegetation, landforms, topography, and drainage processes. Broad habitat types (Volume 6 Section 5) that influence mammal distribution and abundance the most include sparsely treed peatland and combinations of black spruce forest that dominate the landscape. Other forest types that define terrestrial habitat include white spruce-dominated forest, hardwood forest (e.g., aspen, balsam poplar, white birch), hardwood-mixed, pine, and pine-mixedwood. As described by cut class, productive forest types in the Sub-Region have a higher proportion of intermediate and mature forest than the surrounding Region (Volume 6 Section 5).

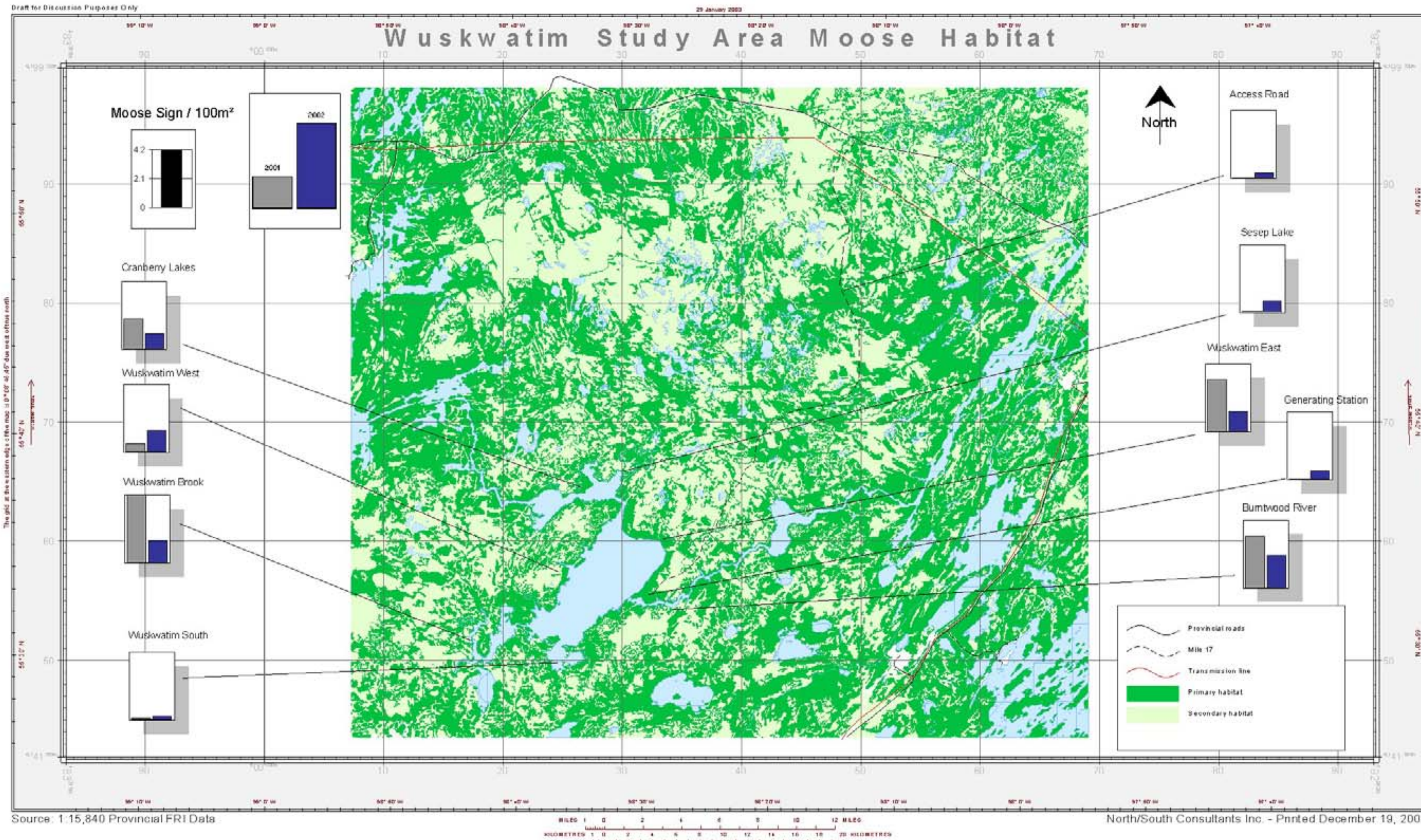


Figure 9.3-9. Moose habitat in the Sub-Region.

About two-thirds of the species diversity in the Sub-Region is associated with terrestrial habitats. This figure is not precise because many terrestrial mammals have general habitat associations, while others are considered to be habitat specialists. Habitat generalists may also occupy habitat near shorelines, and in some respects, may also be considered riparian mammals.

In terms of relative abundance, rodents constitute the dominant mammal group in the Sub-Region. The deer mouse and Gapper's red-backed vole inhabit well-drained forest-shrub habitats. The northern bog lemming and heather vole inhabit sphagnum bogs. The heather vole also ranges into upland forest-shrub communities. The habitats favoured by meadow voles include grassy areas, disturbed sites, marshes, and shrubby areas. The meadow jumping mouse mainly inhabit riparian zones and moist grassy areas, but can be found in upland habitat as well.

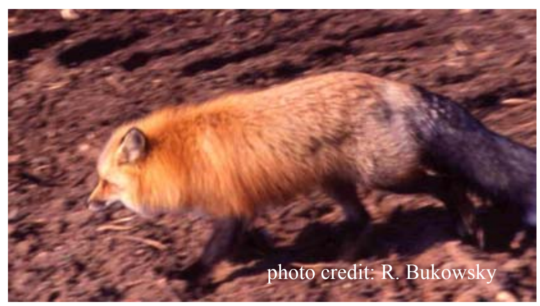
Three species of shrew occur in the Sub-Region, with the masked shrew being the most abundant. The masked shrew is a habitat generalist, occupying a range of habitats from grassy areas to forests and dry open areas. The arctic shrew inhabits boggy areas, marshes, and alder and willow shrub zones. The pygmy shrew is found in boreal forest communities that include bogs, and open, grassy sites. In 2000, small mammal trapping studies only captured deer mice, Gapper's red-backed voles, meadow jumping mice and masked shrews (RKSE and WRCS, Unpubl. Data).

Of the three species of bat in the Sub-Region, the little brown myotis is most frequently observed. A forest dweller by nature, this cave-hibernating species also uses manmade structures for summer roosting habitat. The red bat and hoary bat are solitary species that live in trees but also find shelter in manmade structures. All three species inhabit northern coniferous forests but also occur farther south.

Four species of squirrels occur in the Sub-Region. The least chipmunk inhabits forest edges, open areas, riparian areas, and dry, rocky sites on jack pine ridges. The woodchuck lives in burrows and spends the winter hibernating in dens. It's habitat consists of forest openings, fencerows and roadside verges. The red squirrel occupies a wide range of boreal forest communities and eats the seeds of spruce, jack pine, balsam fir and tamarack as well as hardwood nuts and seeds. The northern flying squirrel is a nocturnal species that inhabits boreal habitats, and feeds primarily on leaves, insects, seeds, lichens, fruits, buds, and nuts.

The porcupine, a common species throughout Manitoba, used to occur in the Sub-Region, but has not been documented since 1967 (Volume 7). This extirpation may result from extensive wild fires that eliminated or significantly reduced porcupine habitat 30 to 40 years ago (NCN member, pers. comm.).

In addition to the carnivores described in Section 9.3.2.2.2 to 9.3.2.2.5, a number of representatives from the weasel family also occur in the Sub-Region. The fisher inhabits climax coniferous forest communities and frequents riparian habitat. Fishers prey upon red squirrels, snowshoe hares, porcupines and small mammals. The pine marten inhabits climax coniferous forest communities. Pine marten numbers have increased in the Region since the 1980's (Volume 7), possibly because of habitat changes and other factors (WRCS, Unpubl. Data). Ermines and least weasels inhabit virtually all boreal communities, including bogs, creeks, rivers, and lakeshores. Both species feed primarily on small mammals. Wolverines live in remote regions of the boreal forest and taiga zones. As omnivores, they feed on a range of items including roots, berries, squirrels, small mammals, fish, porcupine, eggs, moose and caribou. Many other species of furbearers and predators such as red fox are common. Striped skunks may occur in the Sub-Region, but not in significant numbers. This species has not been observed for many years (Volume 7).



Red fox

Profiles of local woodland caribou that live in the Region are addressed in Section 9.3.2.1.1. Woodland caribou inhabit late-succession coniferous forest and peat bogs. Caribou from the Penn Island herd (i.e., migratory woodland caribou) and the barren-ground Beverly caribou herd, occasionally migrate into the northern and western Region for a brief period in mid-winter, but they are not found generally in the Region. Moose are common in the Sub-Region. They inhabit a variety of habitats including immature and mature coniferous and deciduous forest. White-tailed deer were first noticed in Nelson House around 1997, and recently, there have been more deer sightings (Volume 7). A deer was harvested recently near the Footprint bridge (NCN member, pers. comm.). Few deer tracks were observed in the Sub-Region during surveys.

9.3.2.2.1 Woodland caribou (*Rangifer tarandus caribou*)

General life history

Woodland caribou are generally associated with late-succession coniferous forest ecosystems with a stand age of over 50 years (Berger et al. 2000). While some woodland caribou herds exhibit migratory tendencies, others are sedentary, utilizing areas without exhibiting strong seasonal preferences (Miller 1990). Caribou have a diverse diet that consists mostly of ground and arboreal lichens, but can also include young balsam fir and white spruce, high-bush cranberry, alders, and red-osier dogwood (I.D. Systems Ltd. 1993; Berger et al. 2000). Woodland caribou are gregarious in fall, winter and early spring and primarily solitary during the summer. In spring, females move to calving areas, often islands on lakes or bogs. Calving females and their young usually remain at these sites throughout the summer. Rutting occurs during September and October, when caribou congregate near semi-open and open bogs (Berger et al. 2000). Female caribou reach sexual maturity at 16 months, and while males mature at 18-20 months, they seldom mate until their third or fourth year (Miller 1990).

Woodland caribou in North America populations may be in decline due to habitat modifications that compromise the species' ability to find food and cover. Factors that influence woodland caribou populations by affecting habitat or influencing the number of individuals in a population include fire, predation (especially by wolves, NCN member, pers. comm.), hunting, winter snow conditions, parasites, disease and accidents (Berger et al. 2000; Rebizant et al. 2000).

Regional abundance

Manitoba Conservation lists woodland caribou in the province as lying somewhere between rare and uncommon to widespread, abundant, and apparently secure throughout Manitoba, with many occurrences, but the species is of long-term concern. The species distributional trends, over its' range, tend to be stable (MCDC 1996). The range of the Wapisu woodland caribou is currently listed as low risk in terms of real and potential threats to the continued viability of this herd, estimated to be a minimum of 100 animals (Rebizant et al. 2000).

Surveys conducted during January 2001 focused on areas around Harding Lake, Eagle Hill, and Partridge Crop Hill area. An estimated 173 caribou were observed in the survey area (Berger et al. 2001). Based on these numbers, and assuming known but uncounted animals further south, a better population estimate would likely be greater than 200 animals (WRCS, Unpubl. Data). NCN also indicates that about 200 animals live in the area, and that woodland caribou numbers have increased (Volume 7). NCN has managed caribou in the area for a long time by limiting harvest to about six animals per year (NCN member, pers. comm.). Some harvesters make special winter trips to Wuskwatim Lake and Kinosaskaw Lakes to hunt caribou (Volume 7). Caribou have also been seen at Threepoint Lake, Wapisu Lake, Nelson House and lands and south of Opegano Lake (NCN members, pers. comm.).

Sub-Regional abundance

An average caribou population density estimate for the Sub-Region is about 0.030 caribou/km^2, but ranges from approximately 0.007 caribou/km^2 (in summer) to about 0.044 caribou/km^2 in winter. These estimates were based on the methods described in Section 9.2.5 (Berger et al. 2001; RKSE and WRCS, Unpubl. Data).

Woodland caribou are uncommon in the Sub-Region, as caribou sign averaged 0.291 sign/100 m (range 0-0.851). Their abundance was highly variable between sites and between years (Table 9.3-9). Caribou were most abundant in sparsely treed peatland transects near the glacial outwash plain by the proposed access road, along the east side of Wuskwatim Lake, Wuskwatim South Bay and Wuskwatim Brook. They seldom visited the shorelines (RKSE and WRCS, Unpubl. Data).

Access road corridor and borrow sites abundance

Caribou were relatively abundant along the Mile 17 access road corridor where signs averaged 0.472 sign/ 100 m (range 0-17.00) in summer (Table 9.3-9; RKSE and WRCS, Unpubl. Data). Caribou sign was low along the access road and it ranged from low to moderate adjacent to Mile 17 in upland habitats. Caribou sign was abundant in habitats greater than one kilometre from the access road. These occurred in sparsely treed peat bogs. Limited caribou sign was observed during fall surveys averaging 0.021 sign/100m (range 0.08-0.12), and few caribou tracks, ranging from 0 to 0.003 sign/100m were recorded during the 2000 and 2001 snowmobile surveys (RKSE and WRCS, Unpubl. Data). The slight increase between the 2000 and 2001 winter surveys corresponds to NCN's statement of increased numbers of caribou in the area around Mile 17 (Volume 7). Caribou calf tracks were recorded west of the access road (RKSE and WRCS, Unpubl. Data).

Generating station site abundance

Woodland caribou sign was common within the proposed footprint of the generating station site. An average of 0.283 sign/100 m (Table 9.3-9) was recorded within forested habitats. Caribou calf tracks were recorded on both the north and south sides of the Burntwood River during 2000 and 2001 (RKSE and WRCS, Unpubl. Data).

Table 9.3-9. Summary table of woodland caribou sign frequency (sign/100m/survey).

Location	Study							
	2000			2001				2002
	Jan.-Feb.	Summer		Mar. –Apr.	Summer		Oct.-Dec.	Feb.-Apr.
	Snowmobile Survey	Mammal Transects	Shore Surveys	Snowmobile Survey	Mammal Transect	Shore Surveys	String Survey	Snowmobile Survey
Wuskwatim Brook	-	0.208	0	-	0.842	0	-	-
Wuskwatim South Bay	-	0.130	0	-	0.104	0	-	-
Cranberry Lakes	-	0.063	0	-	0.125	0	-	-
Sesep Lake	-	-	0	-	0	0	-	-
Wuskwatim Lake (west)	-	0.099	0	-	0.183	0	-	-
Wuskwatim Lake (east)	-	0.616	0	-	0.556	-	-	-
Burntwood River	-	0.124	-	-	0.851	-	-	-
GS Site	-	-	-	-	0.283	-	-	-
Laurie River T.L.	-	-	-	0	-	-	0.021	0.003
Mile 17/20 Access Road	0	-	-	-	0.472	-	-	0

'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

Overview of distribution, abundance and habitat associations

About 200 woodland caribou live in the Region (NCN members, pers. comm.; Berger et al. 2001; RKSE and WRCS, Unpubl. Data). During winter, the majority of animals live near Partridge Crop Hill, while moderate numbers live near Harding Lake (Figure 9.3-10), and small numbers occur near Eagle Hill. Other small, scattered herds are likely distributed throughout the Region. During summer, caribou are widely scattered in the Region as individuals, or in small groups. A highly variable range of caribou densities (none to high) can be expected at any location in the Region, while densities of none to low can be expected for the Sub-region (RKSE and WRCS, Unpubl. Data).

Upland areas are primary habitat for woodland caribou, although caribou do use riparian habitats (Figure 9.3-10). Although caribou are adaptable, mature upland forest environments may be preferred because they provide abundant food sources. Wetter sites are preferred for predator avoidance**.** Caribou winter range and calving habitat are also considered important. Forested habitats and wet sites such as sparsely treed peatland are considered primary habitat; hardwood-dominated mixedwood forests or young forests (i.e., recent burns) are poor habitat (RKSE and WRCS, Unpubl. Data). These primary habitats likely provide woodland caribou with better availability and abundance of lichens such as *Cladina* spp. or *Cladonia* spp. during summer, or protection from predators, especially during calving (Miller 1990). During the summer, woodland caribou were reported to stay around the 'muskegs' (NCN member, pers. comm.), likely for this reason**.** Woodland caribou have been observed at Wuskwatim Brook, Wuskwatim South Bay, Wuskwatim Lake, Cranberry Lakes, and the Burntwood River. Approximately 73% of the Region and 75% of the Sub-region contain primary woodland caribou habitat. About 93% of the area delineated by the Aquatic Buffer, 84% of the Upland Buffer, and 92% of the Upland Project Areas contain primary woodland caribou habitat (RKSE and WRCS, Unpubl. Data). A combination of TK, aerial surveys and radio-collar tracking has been used to identify important use areas (including winter range and calving sites), and currently known use areas (Figure 9.3-10).

Secondary habitat for woodland caribou consists of younger-aged forest (excluding hardwood-dominated mixedwood) or water/ice that may be used occasionally for feeding, predator avoidance or travel (Figure 9.3-10). Approximately 23% of the Region and 19% of the Sub-region, 3% of the area bounded by the Aquatic Buffer, 9% of the Upland Buffer, and 4% of the Upland Project Areas contain secondary woodland caribou habitat (RKSE and WRCS, Unpubl. Data).

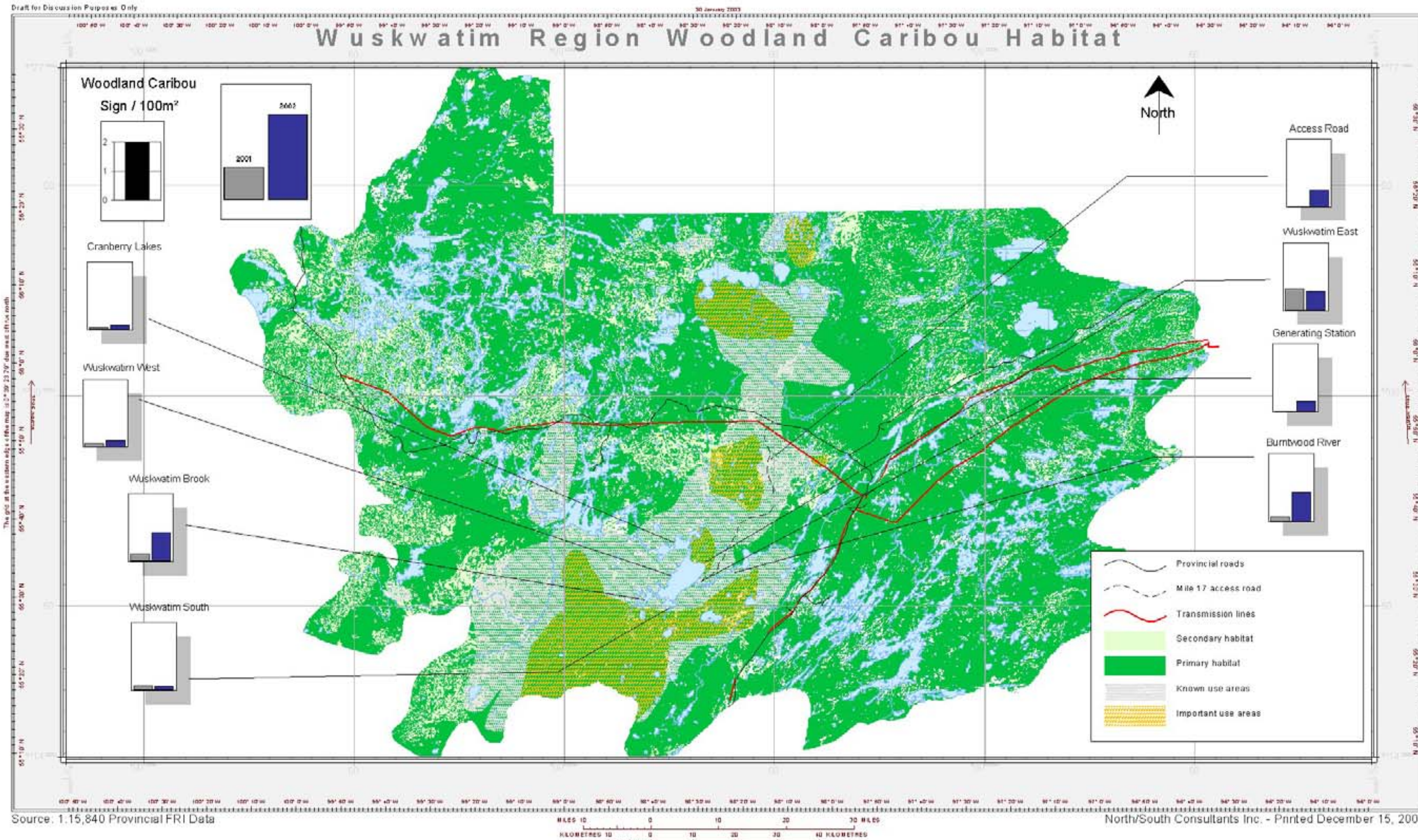


Figure 9.3-10. Woodland caribou habitat in the Region, including known use and important use areas (such as calving and winter ranges). Movement corridors are not shown.

9.3.2.2.2 Black bear *(Ursus americanus)*

General life history

In boreal Canada, black bears typically occupy forests dominated by aspen stands, and forage along rivers and lakeshores. They tend to avoid muskegs and spruce stands in spring and summer but visit them in the fall when the berries are ripe (Young and Ruff 1982). Plants constitute the majority of their diet but foods including carrion, fish, small mammals, and occasionally sick or injured offspring of ungulates may be eaten (I.D. Systems Ltd. 1993). Bears over-winter in dens for five to seven months beginning in early October. They establish a new den every year (Tieje and Ruff 1980), or by digging into the ground or under tree roots, either in a natural cavity such as cave or hollow logs. Black bears have low reproductive rates as they are slow to mature (four to six years), have prolonged reproductive cycles (two years), and have relatively small litter sizes (one to two cubs). Cubs are usually born during winter denning, and remain with the mother for their first year after which they are forced to disperse (Pelton 1990).

Black bears have few natural enemies but are attacked occasionally wolves (Rogers 1987). Most black bear mortality occurs as a result of hunting, trapping, and the removal of ‘nuisance’ bears. Other human-related causes include bear-vehicle collisions and cub abandonment following den disturbance (Elowe and Dodge 1989). Natural bear mortality includes starvation of cubs and yearlings before or after hibernation (Rogers 1987), incidences of cannibalism (LeCount 1982; LeCount 1987; Schwartz and Franzmann 1991), and lethal injuries as a result of fighting.

Regional abundance

Manitoba animal conservation status rank lists the black bear as demonstrably widespread, abundant, and secure throughout Manitoba, and essentially ineradicable under present conditions. The species distributional trends, over its' range, tend to be stable to increasing (MCDC 1996). Trapping records from 1979 to 2001 in NCN's Registered Trapline District also indicate that black bear occur throughout the Region

(MC Trapping Data Unpubl.; RKSE and WRCS, Unpubl. Data). NCN members stated that there are large numbers of black bear throughout the Region, especially during summer. The garbage dump near Nelson House was identified as a place where bears were commonly found (NCN member, pers. comm.).

Sub-Regional abundance

Black bear appear to be relatively common and widespread in the Sub-Region, wherever habitat occurs (RKSE and WRCS, Unpubl. Data). Bear presence was evenly distributed, as sign was observed in 40 to 75% of the upland transects at Wuskwatim Lake in 2000 and 2001, but the frequency of occurrence ranges widely between habitats (0 to 2.000 sign/100 m). While bear sign was not observed during the 2000 shore surveys, some sign was observed in 2001 (Table 9.3-10).

Most bear sign was found at upland sites and/or riparian sites along the east side of Wuskwatim Lake, Wuskwatim Lake South Bay, Wuskwatim Brook, Sesep Lake and at Cranberry Lakes. Burntwood River habitat also contained frequent sign. Bear activities by location and season are summarized in Table 9.3-10.

Access road corridor and borrow sites abundance

General black bear abundance along the Mile 17 access road corridor appears moderate, averaging 0.144 sign/ 100 m (range 0-1.500) in summer (Table 9.3-10). The habitats with the highest bear sign were creek bottoms, upland areas adjacent to creeks and trembling aspen forest (1.50 sign/100m). One bear track was observed along the Mile 17 access road as early as mid-April, 2002 (RKSE and WRCS, Unpubl. Data).

Generating station site abundance

Black bear sign was uncommon within the proposed footprint of the generating station site (RKSE and WRCS, Unpubl. Data). An average of 0.094 sign/100 m (Table 9.3-10) was recorded within forested habitats.

Table 9.3-10. Summary table of black bear sign frequency (sign/100m/survey).

Location	Study							
	2000			2001				2002
	Jan.-Feb.	Summer		Mar. –Apr.	Summer		Oct.-Dec.	Feb.-Apr.
	Snowmobile Survey	Mammal Transects	Shore Surveys	Snowmobile Survey	Mammal Transect	Shore Surveys	String Survey	Snowmobile Survey
Wuskwatim Brook	-	1.871	0	-	0.842	0.165	-	-
Wuskwatim South Bay	-	0.520	0	-	0.313	0.313	-	-
Cranberry Lakes	-	0.630	0	-	0.315	0.379	-	-
Sesep Lake	-	-	0	-	2.000	0.190	-	-
Wuskwatim Lake (west)	-	0.248	0	-	0.274	0	-	-
Wuskwatim Lake (east)	-	1.986	0	-	0.667	-	-	-
Burntwood River	-	0.681	-	-	0.170	-	-	-
GS Site	-	-	-	-	0.094	-	-	-
Laurie River T.L.	-	-		0	-	-	0	0
Mile 17/20 Access Road	0	-	-	-	0.144	-	-	0.001

'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

Overview of distribution, abundance and habitat associations

Black bear are widespread, abundant, and secure throughout Manitoba. In the Sub-Region, they are widely scattered and common in upland habitats, but often distributed near water (Wuskwatim Brook, Wuskwatim South Bay, Wuskwatim Lake, Cranberry Lakes, Sesep Lake and the Burntwood River) and elsewhere. Highly variable bear densities (none to medium) can be expected in the Sub-region (RKSE and WRCS, Unpubl. Data). The greatest black bear abundance was observed at Sesep Lake, Wuskwatim Brook and the east shore of Wuskwatim Lake (RKSE and WRCS, Unpubl. Data).

Primary habitat for black bear consists of terrestrial habitats (Figure 9.3-11). Bears are very adaptable, but may prefer primary upland environments where they have access to den sites and are near abundant food sources. These habitats are described by all land cover classifications less than 11 (Volume 6 Section 5), excluding wet habitats such as black spruce or tamarack on peat (RKSE and WRCS, Unpubl. Data). Primary habitats in the Sub-Region likely provide black bears with better availability and abundance of common food items (Pelton 1990) such as forbs, soft mast, fruits and animal matter in the form of colonial insects or carrion (Sections 5 and 6), or dens. During surveys, aspen-spruce and black spruce-feathermoss habitats accounted for the majority of bear sign recorded. Approximately 44% of the Sub-Region, 61% of the area delineated by the Aquatic Buffer, 55% of the Upland Buffer, and 82% of the Upland Project Areas contain primary black bear habitat (RKSE and WRCS, Unpubl. Data).

Secondary habitat for black bear consists of wet forest stands, peatland, sparsely treed rock, tall shrub wetland, marsh, muskeg, and beaver flood that may be used for feeding was well as travel corridors (Figure 9.3-11). Bears often feed in these habitats during fall due to the availability of berries. Approximately 48% of the Sub-Region, 38% of the area bounded by the Aquatic Buffer, 44% of the Upland Buffer, and 18% of the Upland Project Areas contain secondary black bear habitat (RKSE and WRCS, Unpubl. Data).

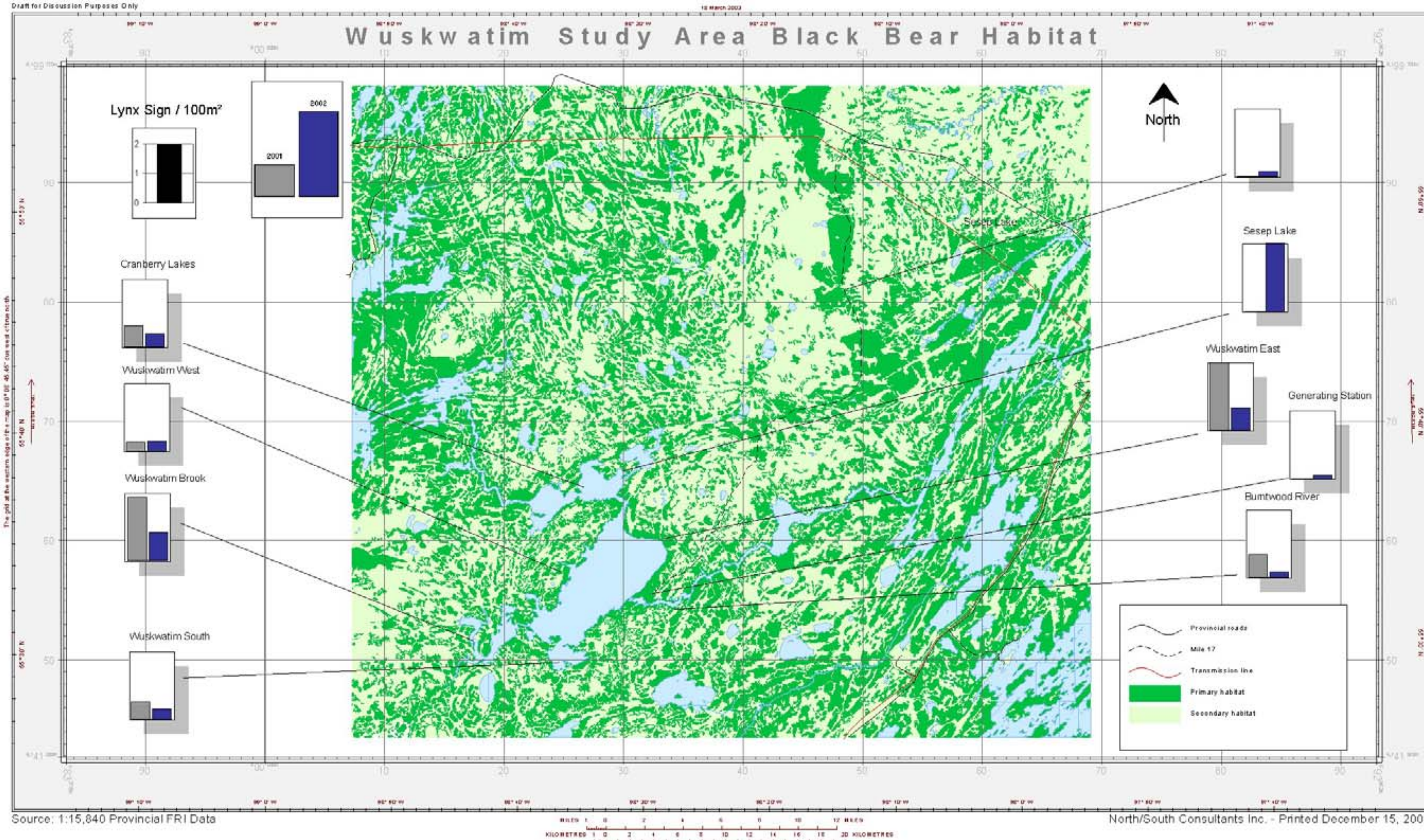


Figure 9.3-11. Black bear habitat in the Sub-Region.

9.3.2.2.3 Gray wolf (*Canis lupus*)

General life history

In boreal regions, gray wolves are closely associated with the habitat of their primary prey, typically moose. They also prey upon woodland caribou, beaver and small mammals, and sometimes eat berries, fruits, insects, and carrion. Gray wolves are highly social and travel, hunt and defend territories with a cohesive family group consisting of one dominant, breeding pair, yearling cubs and other non-breeding adults. Packs range in size from 2 to thirty, depending on their primary prey (Paradiso and Nowak 1990). Wolves are most sedentary during breeding, and a pack will use the same dens from year to year. Den sites tend to be close to water on ridges, in hollow logs, or rock crevices (Mech 1970; Stephenson 1974). Pups are born in late spring and litters average six pups, but vary from one to 14 (Banfield 1974; Wrigley 1986). They are moved to a second den after about two months and by fall juveniles join the pack in their first hunt. Females reach sexual maturity at about age two or three, while males do not reach sexual maturity until age three (Banfield 1974).

Human activity is responsible for most wolf mortality in North America (Rausch 1967; Keith 1983; Peterson et al. 1983). Other factors include malnutrition, competition between wolves, predation, accidents and disease. A wide range of parasites afflicts wolves and may weaken or stress animals (Paradiso and Novak 1990).

Regional abundance

Manitoba Conservation lists the gray wolf as widespread, abundant, and apparently secure throughout Manitoba, with many occurrences, but the species is of long-term concern. The species distributional trends, over its' range, tend to be stable (MCDC 1996). Trapping records from 1979 to 2001 in NCN's Registered Trapline District generally support this assessment (MC Trapping Data Unpubl.; RKSE and WRCS, Unpubl. Data). NCN indicates that wolf numbers have decreased (Volume 7). At least four packs were recorded during surveys, and up to 20 may occur in the Region (WRCS, Unpubl. Data).

Sub-Regional abundance

Gray wolves are widely distributed and common in the Sub-Region, where wolf sign averaged 0.501 sign/100 m (range 0-1.444). Their abundance varied widely between sites and between years but was higher along the east side of Wuskwatim Lake, Wuskwatim Brook and Sesep Lake. Some areas along the south side of the Burntwood River also had frequent sign. Wolf abundance along shorelines is generally lower than in the upland habitats (RKSE and WRCS, Unpubl. Data). Wolf sign was relatively uncommon in the fall, and during the two winter surveys (Table 9.3-11).

Access road corridor and borrow sites abundance

In summer, gray wolf abundance along the Mile 17 access road corridor was moderate, averaging 0.072 sign/100m (range 0-1.50) during summer (Table 9.3-11; RKSE and WRCS, Unpubl. Data). The habitat with the highest wolf sign was in burned (i.e., young) jack pine. Wolf pup and adult tracks were observed along the access road corridor on the outwash plain during summer (RKSE and WRCS, Unpubl. Data). During winter, average wolf sign was relatively low, ranging from 0.001 to 0.031 sign/100m.

Generating station site abundance

Adult gray wolf sign was common within the proposed footprint of the generating station site. An average of 0.116 sign/100 m (Table 9.3-11) was recorded within forested habitats (RKSE and WRCS, Unpubl. Data).

Overview of distribution, abundance and habitat associations

Gray wolves are widespread, abundant, and secure throughout Manitoba. In the Sub-Region, they are widely scattered in at least four small to moderate-sized packs. They are common in upland habitats, but occasionally distributed near water (Wuskwatim Brook area, Wuskwatim South Bay, Wuskwatim Lake, Cranberry Lakes, Sesep Lake and the Burntwood River) and elsewhere. The Southwest pack is particularly abundant in the Wuskwatim Brook area. The North pack has at least one den and a rendezvous site near the proposed access road (NCN member, pers. comm., RKSE and WRCS, Unpubl. Data)

Upland areas are primary habitat for gray wolves, although wolves do use riparian habitats, especially for movements. Although wolves are adaptable, upland environments may be preferred for den sites and easy to access food sources (Paradiso and Nowak 1990). These habitats are described by all land cover classifications less than 11 (Volume 6 Section 5), excluding wet habitats such as black spruce or tamarack on peat. Aspen-spruce and black spruce-feathermoss habitats accounted for the majority of wolf sign recorded (RKSE and WRCS, Unpubl. Data). Approximately 40% of the Region, 43% of the Sub-Region, 61% of the area delineated by the Aquatic Buffer, 55% of the Upland Buffer, and 81% of the Upland Project Areas contain primary gray wolf habitat (RKSE and WRCS, Unpubl. Data).

Table 9.3-11. Summary table of gray wolf sign frequency (sign/100m/survey).

Location	Study							
	2000			2001				2002
	Jan.-Feb.	Summer		Mar. –Apr.	Summer		Oct.-Dec.	Feb.-Apr.
	Snowmobile Survey	Mammal Transects	Shore Surveys	Snowmobile Survey	Mammal Transect	Shore Surveys	String Survey	Snowmobile Survey
Wuskwatim Brook	-	1.040	0	-	1.444	0.083	-	-
Wuskwatim South Bay	-	0.520	0	-	0.104	0	-	-
Cranberry Lakes	-	0.252	0	-	0.189	0.236	-	-
Sesep Lake	-	-	0	-	0.667	0.379	-	-
Wuskwatim Lake (west)	-	0	0	-	0	0.444	-	-
Wuskwatim Lake (east)	-	1.096	0	-	0.667	-	-	-
Burntwood River	-	0.495	-	-	0.426	-	-	-
GS Site	-	-	-	-	0.116	-	-	-
Laurie River T.L.	-	-	-	0.002	-	-	0.054	0.002
Mile 17/20 Access Road	0.031	-	-	-	0.072	-	-	0.001

'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

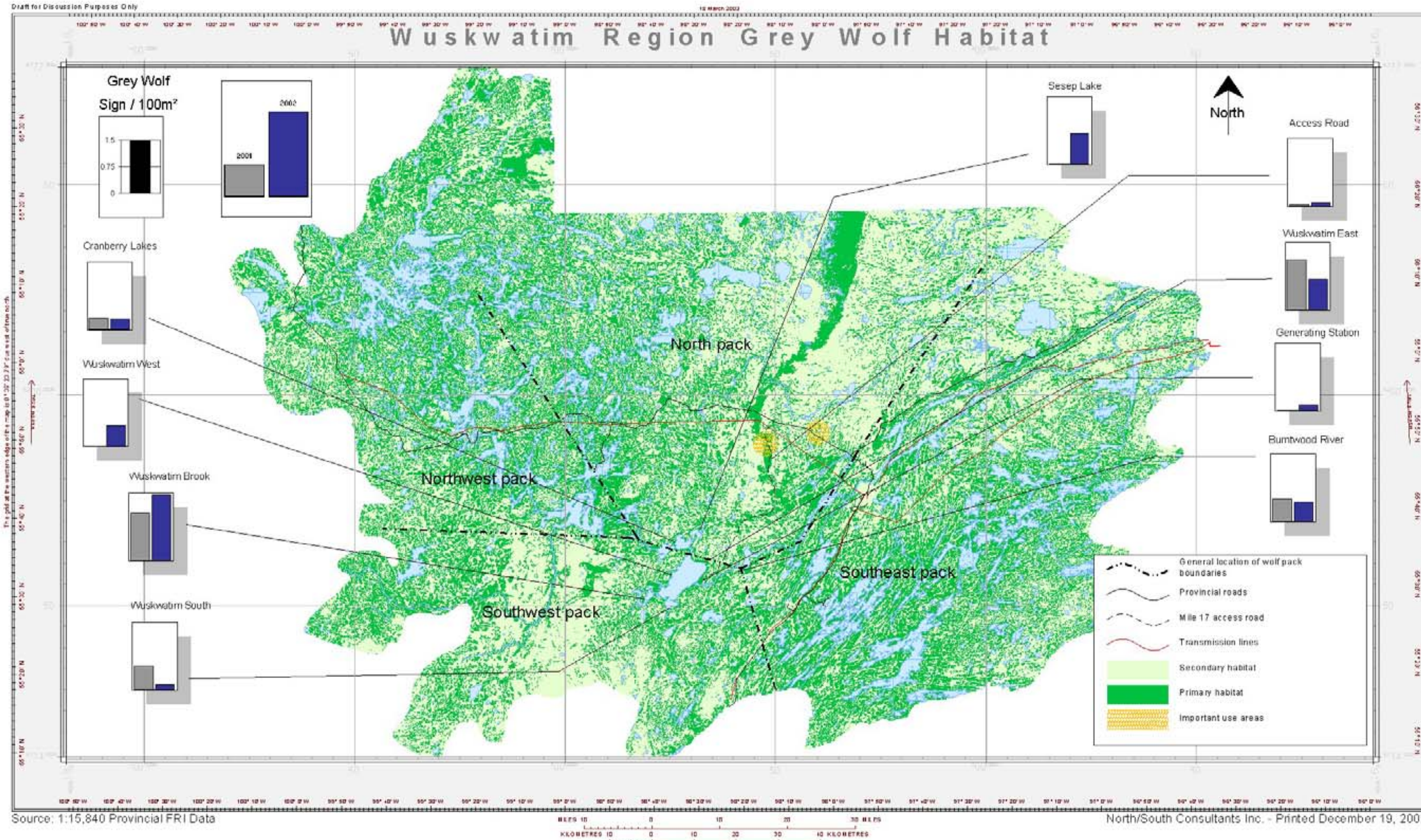


Figure 9.3-12. Gray wolf habitat in the Region.

Secondary habitat for the gray wolf consists of wet forest stands, peatland, sparsely treed rock, tall shrub wetland, marsh, muskeg, beaver flood or lakes that may be used for feeding and as winter travel corridors (Figure 9.3-12). Approximately 60% of the Region, 57% of the Sub-Region, 38% of the area bounded by the Aquatic Buffer, 45% of the Upland Buffer, and 19% of the Upland Project Areas contain secondary gray wolf habitat (RKSE and WRCS, Unpubl. Data).

9.3.2.2.4 Pine marten *(Martes americana)*

General life history

In North America, martens are restricted to boreal forests where they prefer mature conifer or mixedwood habitats (Novak et al. 1987). They avoid forests disturbed by clear-cutting and wildfires (Snyder 1984). The diet of pine martens in the north is diverse but its mainstays are snowshoe hares, voles, mice and red squirrels (Thompson 1986; Novak et al. 1987). Hares, when abundant, account for the largest proportion of the marten's caloric intake (Novak et al. 1987). Martens mate in July and August, after which development of the fertilized eggs is suspended until February (Banfield 1974; Novak et al. 1987). Females give birth to litters of one to four young in mid-March to late April. Juveniles typically reach sexual maturity at two years, but most do not breed until their third year (Banfield 1974).

Trapping is the most significant source of mortality to martens (Novak et al. 1987), which also fall prey to wolves, coyotes, fishers, lynx, great horned owls and eagles, on occasion (Banfield 1974; Strickland et al. 1990). Between-species competition with lynx and other predators for food is a mortality factor, especially during late winter (Strickland et al. 1990). Marten are host to many external and internal parasites which do not appear to increase marten mortality (Novak et al. 1987).

Regional abundance

Manitoba Conservation lists the pine marten as demonstrably widespread, abundant, and secure throughout Manitoba, and essentially ineradicable under present conditions. The species distributional trends, over its' range, tend to be stable (MCDC 1996). Trapping records from 1979 to 2001 in NCN's Registered Trapline District generally support this assessment (MC Trapping Data Unpubl.; RKSE and WRCS, Unpubl. Data), however, local resource harvesters suggest that the local pine marten population has increased (Volume 7) either due to the long-term maturation of forest in the Region, or the northern expansion of populations in the 1970's (MC Unpubl. Data).

Sub-Regional abundance

Pine martens are widely distributed and common in the Sub-Region where marten sign averaged 0.247 sign/100 m (range 0-1.040). Their abundance varied widely between sites and between years but was higher along the east side of Wuskwatim Lake and Wuskwatim Brook (Table 9.3-12). Marten sign was not present along Burntwood River and was rare along shorelines compared to the upland habitats (RKSE and WRCS, Unpubl. Data). Marten sign was relatively uncommon during fall and winter (Table 9.3-12).

Access road corridor and borrow sites abundance

Pine marten sign was not recorded during summer and fall tracking surveys along the access road corridor and in borrow site areas (RKSE and WRCS, Unpubl. Data). During winter, marten sign was uncommon, ranging from 0.001 to 0.031 sign/100 m (Table 9.3-12).

Generating station site abundance

Pine marten sign was uncommon within the proposed footprint of the generating station site. An average of 0.022 sign/100 m (Table 9.3-12) was recorded within forested habitats (RKSE and WRCS, Unpubl. Data).

Overview of distribution, abundance and habitat associations

Pine marten are widespread, abundant, and secure throughout Manitoba. In the Sub-Region, they are widely scattered and common in upland habitats, but occasionally distributed near water near mature trees (Wuskwatim Brook, Wuskwatim South Bay, Wuskwatim Lake, and Cranberry Lakes) and elsewhere.

The distribution and relative abundance of pine martens is likely underestimated due to difficulties in locating sign during summer The greatest pine marten abundance is observed at Wuskwatim Brook and the east shore of Wuskwatim Lake (RKSE and WRCS, Unpubl. Data).

Martens are somewhat adaptable but may prefer upland environments as primary habitat that include mature mixedwood and coniferous forest and areas that offer easy to access food sources (MFWMP 1994; RKSE and WRCS, Unpubl. Data). These habitats are described by subtypes ranging from 04 to 87, with a tree maturity of cutting classes 4 or 5 (Volume 6 Section 5), often excluding wet habitats such as black spruce or tamarack on peat (Figure 9.3-13). Mature mixedwood habitats and black spruce-feathermoss habitats accounted for the majority of marten sign recorded in the Sub-Region (RKSE and WRCS, Unpubl. Data).

Table 9.3-12. Summary table of pine marten sign frequency (sign/100m/survey).

Location	Study							
	2000			2001				2002
	Jan.-Feb.	Summer		Mar. –Apr.	Summer		Oct.-Dec.	Feb.-Apr.
	Snowmobile Survey	Mammal Transects	Shore Surveys	Snowmobile Survey	Mammal Transect	Shore Surveys	String Survey	Snowmobile Survey
Wuskwatim Brook	-	1.040	0.031	-	0.241	0	-	-
Wuskwatim South Bay	-	0		-	0	0	-	-
Cranberry Lakes	-	0.378	0	-	0.063	0	-	-
Sesep Lake	-	-	0	-	0	0	-	-
Wuskwatim Lake (west)	-	0.198	0	-	0	0	-	-
Wuskwatim Lake (east)	-	0.822	0	-	0.222	-	-	-
Burntwood River	-	0	-	-	0	-	-	-
GS Site	-	-	-	-	0.022	-	-	-
Laurie River T.L.	-	-	-	0.001	-	-	0.017	0.004
Mile 17/20 Access Road	0.031	-	-	-	0	-	-	0.004

'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

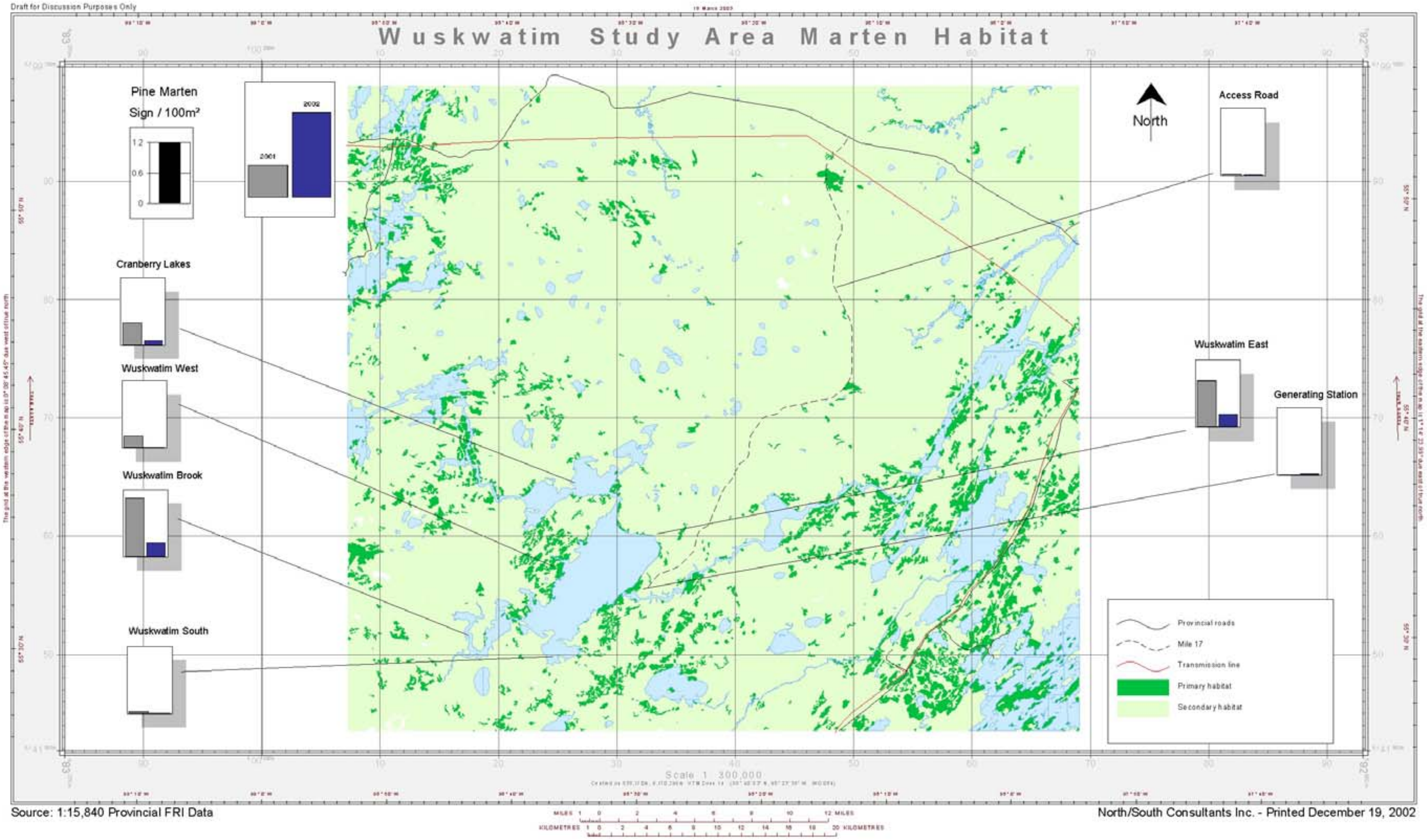


Figure 9.3-13. Pine marten habitat in the Sub-Region.

Primary habitats likely provide martens with better access to mice, voles, shrews, red squirrels or snowshoe hares (RKSE and WRCS, Unpubl. Data), birds (Volume 6 Section 8), or fruits from low-growing plant species (Volume 6 Section 5). Approximately 8% of the Sub-region, 14% of the area delineated by the Aquatic Buffer, 3% of the Upland Buffer, and 9% of the Upland Project Areas contain primary pine marten habitat (RKSE and WRCS, Unpubl. Data).

Secondary habitat consists of all other available forest types of all age classes (Figure 9.3-13.). In winter, marten probably use sparsely treed peatland habitat located no farther than 300 m from nearby upland habitats due to increased access to hares and voles, and the adjacency of nearby escape and thermal cover (RKSE and WRCS, Unpubl. Data). Approximately 84% of the Sub-Region, 86% of the area bounded by the Aquatic Buffer, 96% of the Upland Buffer, and 91% of the Upland Project Areas contain secondary pine marten habitat (RKSE and WRCS, Unpubl. Data). About 8% of the Sub-Region does not have marten habitat.

9.3.2.2.5 Lynx (*Lynx lynx*)

General life history

Lynx are most common in northern environments in closed canopy mixed forests, shrubby openings or swamps where their primary prey species, snowshoe hare, is abundant. Snowshoe hares comprise a significant portion of the winter and summer diet of the lynx. Other prey species include deer mice, red squirrels, voles, flying squirrels, ptarmigan, and grouse (McCord and Cardoza 1990). Lynx breed in March and April and one to five young are born in late May to June following a nine-week gestation period (Saunders 1963; Brand et al. 1976; Wrigley 1986). Dens sites are typically in stumps, hollow logs, deadfalls, and caves (McCord and Cardoza 1990). Young remain with their mother until the following spring. Females reach sexual maturity at one year, and males at two (Wrigley 1986).

Lynx populations in Canada fluctuate according to a ten year cycle. During the cycle, lynx densities reflect the fluctuations in prey populations. Major causes of lynx mortality are trapping and starvation. However, predation by wolves is also a cause of mortality. Lynx are susceptible to parasites and disease such as tapeworms, roundworms, rabies, and feline distemper (Quinn and Parker 1987; McCord and Cardoza 1990).

Regional abundance

Manitoba Conservation lists the lynx as demonstrably widespread, abundant, and secure throughout Manitoba, and essentially ineradicable under present conditions. The species distributional trends, over its' range, tend to be stable (MCDC 1996). Trapping records from 1979 to 2001 in NCN's Registered Trapline District supports this assessment (MC Trapping Data Unpubl.; RKSE and WRCS, Unpubl. Data). An NCN member (pers. comm.) indicates the number of lynx, especially in the area south of Bison Lake has increased recently (Volume 7).

Sub-Regional abundance

Numbers and locations of lynx sign are summarized in Table 9.3-13. No lynx sign was found during the summer of 2000 or 2001 in upland habitats. A few tracks were recorded during shore surveys, especially along the west shore of Wuskwatim Lake (0.667 sign/ 100m).

Access road corridor and borrow sites abundance

Lynx sign was not recorded during summer and fall tracking surveys along the access road corridor and in borrow site areas (Table 9.3-13; RKSE and WRCS, Unpubl. Data). It was common during winter, ranging from 0.011 to 0.102 sign/100 m. An NCN member (pers. comm.) indicates the number of lynx, especially in the area around Mile 17 has increased recently (Volume 7).

Generating station site abundance

No lynx sign was found within the proposed footprint of the generating station site. (Table 9.3-13; RKSE and WRCS, Unpubl. Data).

Overview of distribution, abundance and habitat associations

Lynx are widespread, abundant, and secure throughout Manitoba; however, numbers are highly variable as the population cycles. In the Sub-Region, they are widely scattered, relatively uncommon, and mainly in upland areas, but they are occasionally distributed near water (Wuskwatim Lake, Sesep Lake, and Cranberry Lakes) and elsewhere.

The distribution and abundance of lynx is likely underestimated due to difficulties in locating sign during summer. The relative abundance of lynx may range from rare to common. The greatest lynx abundance is observed along the west shore of Wuskwatim Lake (RKSE and WRCS, Unpubl. Data).

Primary habitat for lynx consists of terrestrial habitats (Figure 9.3-14). Primary upland environments include a variety of young and old mixedwood and coniferous forest or 'rabbit scrub' habitats (RKSE and WRCS, Unpubl. Data).

Table 9.3-13. Summary table of lynx sign frequency (sign/100m/survey).

Location	Study							
	2000			2001				2002
	Jan.-Feb.	Summer		Mar. –Apr.	Summer		Oct.-Dec.	Feb.-Apr.
	Snowmobile Survey	Mammal Transects	Shore Surveys	Snowmobile Survey	Mammal Transect	Shore Surveys	String Survey	Snowmobile Survey
Wuskwatim Brook	-	0	0	-	0	0	-	-
Wuskwatim South Bay	-	0	0	-	0	0	-	-
Cranberry Lakes	-	0	0	-	0	0.059	-	-
Sesep Lake	-	-	0	-	0	0.126	-	-
Wuskwatim Lake (west)	-	0	0	-	0	0.667	-	-
Wuskwatim Lake (east)	-	0	0	-	0	-	-	-
Burntwood River	-	0	-	-	0	-	-	-
GS Site	-	-	-	-	0	-	-	-
Laurie River T.L.	-	-	-	0.007	-	-	0.102	0.016
Mile 17/20 Access Road	0.029	-	-	-	0	-		0.011

'-' indicates that no survey was conducted at that location during the corresponding time of year.
'GS' = generating station (proposed site) includes 2 shoreline transects and 'T.L.' = Transmission Line (Laurie River T.L. existing transmission line that parallels highway 391)

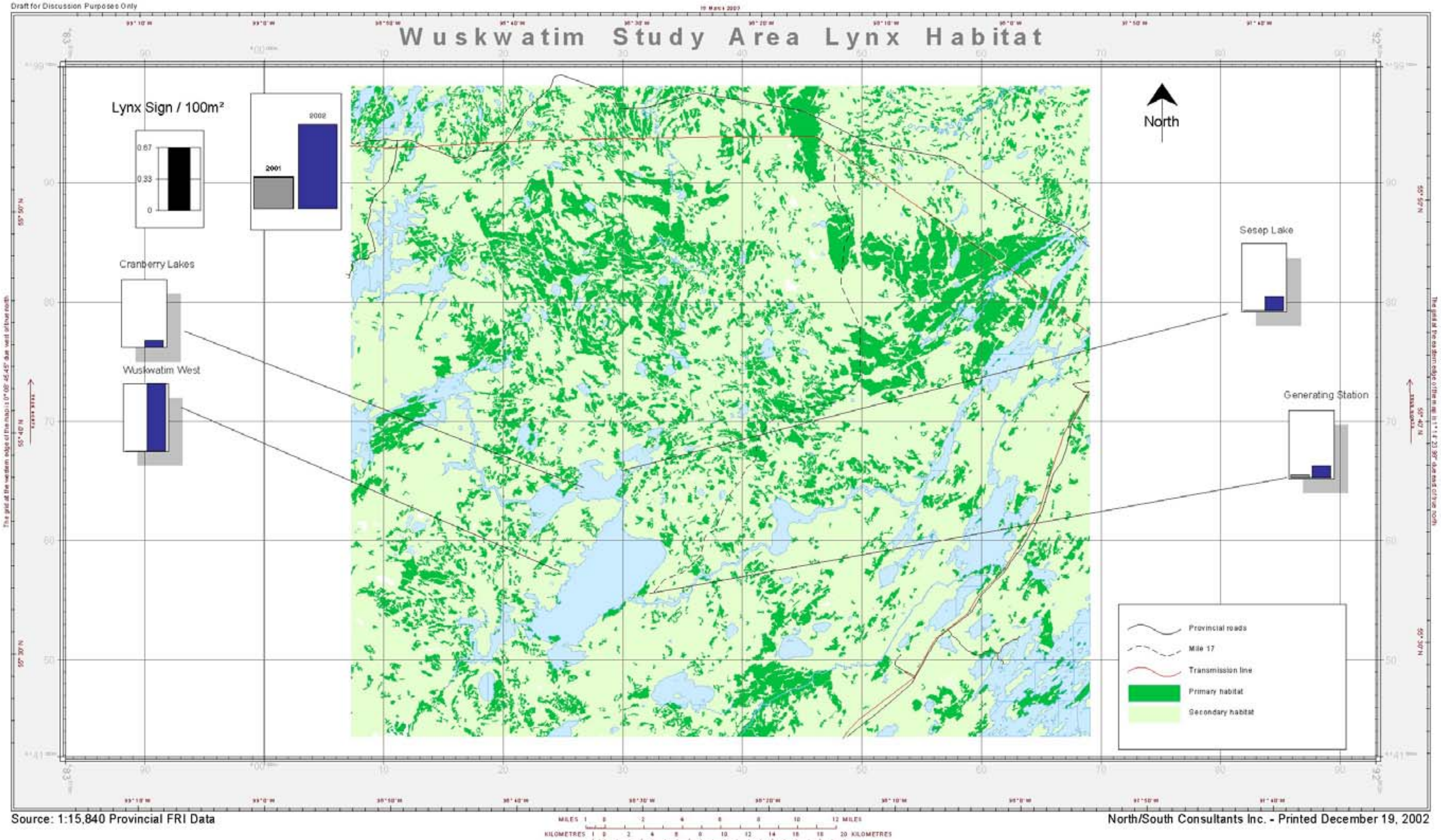


Figure 9.3-14. Lynx habitat in the Sub-Region.

Primary habitat also includes forest subtypes ranging from 04 to 50, site classes 1 or 2, with a tree maturity of cutting classes 0, 1, 2 or 5 (Volume 6 Section 5). Primary habitats in the Sub-Region likely provide lynx with better access to common prey items (McCord and Cardoza 1990) such as mice, voles, snowshoe hares, grouse (Volume 6 Section 8) and possibly caribou calves (Section 9.3.2.2.1). Approximately 21% of the Sub-Region, 18% of the area delineated by the Aquatic Buffer, 34% of the Upland Buffer, and 52% of the Upland Project Areas contain primary lynx habitat (RKSE and WRCS, Unpubl. Data).

Secondary habitat consists of all other available forest types of all age classes (Figure 9.3-14.). In winter, lynx probably use sparsely treed peatland habitat located no farther than 300 m from nearby upland habitats due to increased access to hares and voles, and the adjacency of nearby escape and thermal cover. Approximately 71% of the Sub-Region, 82% of the area bounded by the Aquatic Buffer, 66% of the Upland Buffer, and 48% of the Upland Project Areas contain secondary lynx habitat (RKSE and WRCS, Unpubl. Data). About 8% of the Sub-Region does not have lynx habitat.

9.4 IMPACT ASSESSMENT AND MITIGATION

9.4.1 Summary of Impact Assessment and Mitigation

Negative effects to mammals are expected from habitat loss (Volume 6 Section 5), habitat alteration, and disturbances associated with the Project; however, mitigation measures will be taken to reduce or avoid these effects.

During construction and operation, mammal species may experience, to differing degrees, the following types of effects:

- habitat effects including the direct loss or gain of habitat by removal or alteration at the generating station footprint, along the access road right-of-way (RoW), at borrow areas, and flooding and water level regulation at shorelines;
- sensory disturbance, **habitat effectiveness** and **habitat fragmentation** effects including physiological stress resulting from visual, auditory and physical (i.e., vibrations) stimuli related to human presence and machinery, and activities such as blasting and vehicle traffic;
- access effects including increased mortality due to hunting, **wildlife control actions**, predation and disease associated with the creation of new roads, trails or other facilities in **contiguous habitat**;
- mercury effects where increased mercury concentrations in aquatic mammals may affect their suitability as a food source for humans and at extreme levels, can be harmful to the animal's health. Mercury concentrations can increase in fish-eating

mammals such as mink and otter as the concentrations increase in consumed fish. Limited historic data from the study area following CRD indicated elevated, but not toxic, mercury concentrations in mammals. Only minor changes in mammal mercury concentrations are expected due to the small amount of flooding associated with the proposed Project; and

- accidental events such as chemical spills, fires or wildlife-vehicle collisions.

It is important to note that while individual animals living in the Project Area are expected to experience any one or combination of these effects, the focus of concern is on effects at the population level. The application of mitigation measures may not prevent all individuals from experiencing any of these effects; however, mitigation is expected to minimize the population–level effects.

9.4.1.1 General Description of Effects with Mitigation

During construction, effects to the terrestrial and riparian communities will include the loss and alteration of mammal habitat at the generating station, at the borrow pits and along the access road (Volume 6 Section 5). Direct long-term habitat losses are associated with permanently clearing or altering vegetation in the access road RoW, and indirect changes in soil moisture and fertility that would affect adjacent primary and secondary habitat for mammals. Habitat alteration may result in the loss of cover and food resources for some species and possibly, a gain in such resources for others. A small area of **critical habitat** will be altered at the generating station site. Physical habitat areas altered due to construction (excluding site rehabilitation) are described in Table 9.4-1.

The most important effects to the riparian communities during operation will be the expected alteration of riparian mammal habitat upstream and downstream of the dam due to changes in water regimes (flooding in the forebay, downstream water level fluctuations, and stabilization of Wuskwatim Lake levels) that will affect some of the existing shorelines. More stable water levels in shoreline and riparian mammal habitats may result in increased habitat for some species and reduced habitat for others. Riparian mammals are expected to incorporate the changes resulting from erosion, debris or changes in beach width into their daily and seasonal movements and use of those habitats. The areas of flooded habitat are presented in Table 9.4-2; shoreline habitat lengths for riparian VECs are presented in Table 9.4-3.

Other potential effects to mammal habitat will be highly localized. Limited areas will be flooded immediately upstream of the proposed dam. Small areas of riparian mammal habitat at creek crossings along the access road will be altered (Volume 6 Section 5) by road construction. Small areas of riparian habitats may be affected by sedimentation during the construction and removal of the cofferdams. The twice-yearly discharge of sewage lagoon water into the Burntwood River would not likely affect riparian mammal habitat because discharge from the sewage lagoon will meet Provincial standards.

VEC habitat considerations during the access road routing process mitigated some potential habitat loss in terrestrial communities. Many types of site-specific habitat alterations are also mitigable (Volumes 3 and 11). For example, post-construction re-establishment of natural vegetation communities in disturbed areas, especially in borrow areas, work sites, and rock disposal areas may replace habitat that was lost during the construction period for some mammals. The long-term re-establishment of vegetation, especially in ditches, borrow areas and the sewage lagoon may marginally increase habitat for a few riparian mammals. However, it is unlikely habitat will return to pre-disturbance conditions within the time frame of the Project. Changes to terrestrial habitat may subsequently produce small changes in the mammal species composition of the community.

Sensory disturbances, particularly vehicle traffic, machinery operation and blasting, may affect mammals by increasing physiological stress on directly impacted individuals or by displacing individual mammals from certain habitats, particularly during construction. Increased access may cause increased sensory disturbances to wildlife from snowmobiles, ATVs and watercraft involved in recreational, commercial and domestic harvest activities. Construction-related disturbances will be localized around the generating station, the access road and borrow areas, while disturbances from recreational and commercial activity may be experienced over a wider area during operation. Mammals may avoid habitat in the vicinity of these activities extending into the 1 km Upland and/or Aquatic Buffers. The magnitude of these effects will depend on concurrence of the affecting activity with a sensitive wildlife period such as calving. While mammals are often able to shelter themselves from sensory disturbances by escaping to cover or to a distance to avoid the disturbance, sudden vibrations created from intense disturbance such as blasting may affect individuals, or possibly affect den or burrow stability at a limited number of sites in adjacent habitat. Project planning, normal practices and requirements of the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters, such as charge sizing and back-filling blast holes to confine the blast, are expected to mitigate some of these effects.

Table 9.4-1. Primary and secondary habitat for mammals in the Project Area compared to ecological study areas.

Species	Study Areas	Primary Habitat			Secondary Habitat			Non-habitat		
		Area (km^2)	Prop. of Area	% Change	Area (km^2)	Prop. of Area	% Change	Area (km^2)	Prop. of Area	% Change
Woodland caribou	Region	17084.0	0.73	0.11	5438.0	0.23	<0.01	937.0	0.04	0.06
	Sub-Region	2521.5	0.75	0.72	639.3	0.19	0.02	211.6	0.06	0.18
	Aquatic Buffer	176.1	0.93	2.12	6.5	0.03	0.02	7.3	0.04	8.05
	Upland Buffer	109.6	0.84	14.79	12.1	0.09	2.59	9.2	0.07	3.61
	Upland Project Areas *	14.8	0.92		0.7	0.04		0.6	0.04	
Moose	Sub-Region	1665.6	0.49	0.39	1690.0	0.50	0.57	16.8	<0.01	0
	Aquatic Buffer	120.1	0.63	<0.01	69.6	0.37	<0.01	0	0	0
	Upland Buffer	59.5	0.46	11.98	71.2	0.54	12.54	0	0	0
	Upland Project Areas	7.2	0.45		8.8	0.55		0	0	
Muskrat	Aquatic Buffer	21.4	0.12	0.15	5.9	0.03	<0.01	153.0	0.85	11.99
	Upland Buffer	8.1	0.06	0.72	0	0	0	123.0	0.94	13.32
	Upland Project Areas	0.2	0.02		0.1	0.01		15.7	0.98	
Beaver	Aquatic Buffer	9.6	0.05	0.16	0	0	0	180.3	0.95	<0.01
	Upland Buffer	5.6	0.04	1.54	0	0	0	125.2	0.96	12.99
	Upland Project Areas	0.2	0.02		0	0		15.8	0.98	

Habitat in the study areas (used for ecological unit comparisons)
* Total habitat lost or altered (by construction) including borrow sites, access road and GS site. Totals do not include site remediation.

Table 9.4-2. Primary and secondary habitat for terrestrial species by flooded habitat in the Project Area.

Species	Study Areas	Primary Habitat			Secondary Habitat			Non-habitat		
		Area (km^2)	% of Area	% change	Area (km^2)	% of area	% change	Area (km^2)	% of area	% change
Woodland caribou	Aquatic Buffer	176.13	93	<0.3	6.51	3	0	7.30	4	<0.1
	Total Flooded	0.38	99		0.00	0		0.01	1	
Moose	Aquatic Buffer	120.14	63	<0.4	69.59	37	<0.1	0.00	0	0
	Total Flooded	0.34	88		0.05	12		0.00	0	
Muskrat	Aquatic Buffer	21.37	12	0	5.89	3	0	153.00	85	<0.3
	Total Flooded	0.00	0		0.00	0		0.39	100	
Beaver	Aquatic Buffer	9.61	5	0	0.00	0	0	180.33	95	<0.3
	Total Flooded	0.00	0		0.00	0		0.39	100	

Habitat in the Study Areas (used for ecological unit comparisons)
Total habitat lost or altered (by operation)

Table 9.4-3. Projected habitat alterations to riparian mammals from changes along shorelines.

Species	Study Areas	Primary Habitat		Secondary Habitat		Non-habitat	
		Length (km)	% of Length	Length (km)	% of Length	Length (km)	% of Length
Moose	Total Shoreline Changes (without Peat or Mineral Islands)	224.0	79	61.0	21	0.0	0
	Upstream of GS *	166.0	75	55.0	25	0.0	0
	Downstream of GS *	58.0	91	6.0	9	0.0	0
	Peat Islands **	358.0	100	0.0	0	0.0	0
Muskrat	Total Shoreline Changes (without Peat or Mineral Islands)	139.7	49	62.0	22	81.0	29
	Upstream of GS	136.0	62	35.0	16	50.0	23
	Downstream of GS	3.7	6	27.0	44	31.0	50
	Peat Islands	524.2	100	0.0	0	0.0	0
Beaver	Total Shoreline Changes (without Peat Islands)	84.0	25	22.0	7	231.0	69
	Upstream of GS	68.0	25	22.0	8	182.4	67
	Downstream of GS	16.0	25	0.0	0	48.6	75
	Peat Islands	0.0	0	212.0	100	0.0	0

[shaded] Total shoreline habitat length affected by 234 m water level
* Sub-totals of shoreline habitat length affected by 234 m ASL
**Total of peat island perimeter affected by 234 m ASL
Note: net difference of shoreline lengths between existing environment and project operation is calculated here without changes to Opegano Lake shoreline (refer to Volume 6 Section 5 for precise changes).

Habitat alienation and fragmentation may occur if activities prevent animals from utilizing habitat. Sensory disturbance effects such as vehicle and machinery noise and dust, for example, prevent terrestrial animals from using habitat near the access road causing spatial and temporal habitat loss. Differences in habitat effects occur because certain species are more sensitive to disturbances than others, and because certain species habituate to sensory disturbance better than others. Although unlikely, the construction of one access road may cause habitat fragmentation if populations become more isolated from each other. Effective habitat loss will be reduced by limiting traffic volumes, preventing unnecessary access, and Project planning. Effective habitat loss should be lower during operations when many disturbance factors are reduced or terminated.

If construction or operation affect important wildlife movements within an individual's territory, it is possible that habitat abandonment may occur (e.g., areas separated by the access road or generating station site). The importance of these effects is reduced because most mammals have the ability to bypass or cross the affected areas.

Terrestrial and riparian communities may be affected by increased access contributing to increased mortality from hunting, trapping, or wildlife control during generating station construction and operation. Access effects are expected to be at a lower level during construction than during operation. Species such as moose and caribou, which have low population recruitment rates, are most likely to be affected by access. If increased harvest mortalities exceed sustainable levels the number of individuals in a population will be reduced. Access effects have the potential to become wide-spread throughout the Sub-Region during the operation period. The implementation of harvest restrictions along the access road that will be identified in the Access Management Plan (Volume 3) will reduce the effects. Human/wildlife encounters requiring control actions are not expected to be an issue for most species with the possible exceptions of black bear and beaver. Consultation and permits from a Natural Resource Officer are required for removal of problem wildlife.

During the early years of the operation of the Project, the small newly flooded area and the leaching of peat vegetation due to the changed water regime are expected to cause a small, increase in mercury levels. There is a possibility that mercury levels in riparian mammals may increase above current levels as a result of bio-magnifications through the food web. It is recommended that mercury concentrations should be monitored in species such as muskrat, beaver, mink and otter (Section 9.7).

Effects of accidental spills, vehicle-wildlife collisions, or fire may affect individual mammals or mammal habitats. Accidental hazardous material spills such as fuel can affect habitat, or possibly decrease the fitness of individuals if spilled substances come in contact with animals. Procedures for storing, handling, and transporting fuels, oils, and other hazardous materials are regulated under the Dangerous Goods Handling and Transportation Act (Volume 11). Emergency response plans and equipment will be required at all work sites. These provisions will be implemented during construction and operation, thereby mitigating potential effects.

Accidental fires resulting from construction activities or human activity may affect preferred food, cover or may cause mammal mortality. Habitat changes due to fires could also affect the numbers of individuals present. Planned mitigation measures such as access restrictions, training in fire response protocols, and the presence of fire suppression equipment (i.e., at the generating station site and Thompson) will reduce the risk of fire damage.

Accidental vehicle-wildlife collisions can result in animal injury or mortality. Potential collision impacts to terrestrial mammals may be occur anywhere along the access road, whereas impacts to riparian mammals would be localized near stream crossings or ponds and ditch habitat. The possibility of vehicle and wildlife collisions will be reduced by vehicles complying with posted speed limits and installing wildlife warning signs, where appropriate (Access Management Plan). Potential collision effects will probably be lower during the operational phase due to lower traffic volumes.

9.4.1.2 Effects on VECs

9.4.1.2.1 Woodland Caribou (Ethinutwatehk)

Potential construction and operational effects on woodland caribou are expected to be negative, small, regional, long-term and, therefore, insignificant.

Most expected effects are mitigable or reversible. Certainty regarding the potential effects is moderate, because of uncertainty concerning harvest mortality and accidental effects such as large fires that may affect caribou habitat.

Woodland caribou will experience a small loss and alteration of habitat at the generating station footprint, access road, and borrow areas compared to the large area these animals use. Primary caribou habitat, which covers 73% of the Region, is concentrated in peatland habitats. The maximum extent of physical losses of primary habitat (excluding future site rehabilitation) in the Upland Project Areas is less than 0.2% of the Region. The proposed generating station site has a small amount of calving habitat (one of an estimated 100 or more sites), and therefore, the loss of this site should not be significant. Other known calving areas were avoided during access road routing. Early winter range, utilized by approximately 16 of an estimated 200 animals, and movement corridors in the Sub-Region will be affected by the access road. Limited caribou summer range will also be affected. Current scientific uncertainty will be managed by monitoring.

Woodland caribou will experience small effects from sensory disturbances (e.g., traffic, machinery, blasting), a loss of habitat effectiveness and possibly habitat fragmentation. The maximum extent these effects involving primary habitat is less than 1% of the Region. Scientific uncertainties concerning access effects (i.e., increased mortality due to hunting, predation and disease) are manageable through Project planning and monitoring. Accidental events such as spills, fires or wildlife-vehicle collisions may affect woodland caribou abundance or caribou habitat, but the risk of these events occurring is small.

9.4.1.2.2 Moose (Mooswa)

Potential construction and operational effects on moose are expected to be negative, small, site-specific to local, long-term and, therefore, insignificant.

Effects on the moose population due to habitat loss or alteration at the generating station, access road, borrow areas and along shorelines will be small compared to the large area these animals use. Primary moose habitat, which covers 49% of the Sub-Region, is concentrated in riparian habitats. The maximum extent of physical losses of primary habitat (excluding site rehabilitation) in the Upland Project Areas is about 0.4% of the Sub-Region. Some summer and winter habitats are impacted but neither include critical moose habitat.

Moose will experience small effects from sensory disturbances (e.g., traffic, machinery, blasting), a loss of habitat effectiveness and possibly some habitat fragmentation. The maximum extent of these effects on primary habitat is about 3.4% of the Sub-Region. Harvest levels due to increased access are expected to increase. Certainty regarding the potential effects is moderate, because of less certainty concerning harvest mortality. Scientific uncertainties concerning access effects (i.e., hunting, predation and disease) are manageable through Project planning and access road management. Accidental events such as chemical spills, fires or wildlife-vehicle collisions may affect moose abundance or moose habitat, but the risk of these events occurring is small.

9.4.1.2.3 Muskrat (Wuchusk)

Potential construction and operational effects on muskrat are expected to be neutral, small, site-specific, long-term and, therefore, insignificant.

Muskrats and muskrat habitat in areas affected by water level stabilization upstream of the generating station, and in areas of daily water level fluctuations downstream of the generating station and at creek crossings along the access road, will experience both positive and negative effects. More stable water levels should benefit muskrat and muskrat habitat but it will depend on the timing of drawdowns. The infrequent 1 m drawdowns will generally occur in summer or fall which will create less of an effect than winter drawdowns. Some sources of shoreline food and cover will change over the long-term. Negative changes to downstream muskrat habitat may result from an increased frequency of daily water level fluctuations. The limited areas of muskrat habitat near the generating station will be affected more than those further downstream; effects are expected to be undetected at Opegano Lake, unless effects on primary and secondary peatland habitats are greater than expected (Volume 6 Section 5). Possible changes to the muskrat population and habitat are small when compared to the large area used by these animals; especially the numerous ponds, creeks and lakes outside the area affected by the Project. Certainty regarding the potential effects is moderate, because of less certainty concerning the magnitude of the opposing positive and negative habitat effects upstream and downstream of the proposed generating station.

As with all mammals, muskrat may experience some sensory disturbances. Access effects may include increased mortality from increased trapping. Mercury levels in muskrat are not expected to increase, but precautionary monitoring of mercury levels, especially for those aquatic mammals that are consumed by NCN, is recommended in conjunction with the fish mercury monitoring program. Accidental events such as chemical spills may affect muskrat or muskrat habitat, but the risk of these events occurring is small.

9.4.1.2.4 Beaver (Amisk)

Potential construction and operational effects on beaver are expected to be negative to neutral, small, site-specific, long-term and, therefore, insignificant.

Beaver and beaver habitat in those areas affected by water level stabilization upstream of the generating station, and affected by daily water level fluctuations below the generating station and at creek crossings along the access road, will experience both positive and negative effects. Stable water levels will benefit beaver and beaver habitat but it will depend on the timing of draw downs. The infrequent 1 m drawdowns will generally occur in summer or fall which will create less of an effect than winter draw downs. Some sources of shoreline food and cover will change over the long-term. Negative changes to downstream beaver habitat may result from an increased frequency of daily water level fluctuations. The beaver colonies near the generating station will be affected more than those further downstream; effects are expected to be undetected at Opegano Lake, unless effects on peatlands are greater than expected (Volume 6 Section 5). Possible changes to the beaver population and habitats are small when compared to the large area these animals use; especially in ponds, creeks and lakes outside the area affected by the Project. Certainty regarding the potential effects is moderate, because of less certainty concerning opposing positive and negative habitat effects upstream and downstream of the proposed generating station.

As with all mammals, beaver may experience some sensory disturbances. Access effects may include increased mortality from increased trapping. Mercury levels in beaver are not expected to increase, but precautionary monitoring of mercury levels, especially for those aquatic mammals that are consumed by NCN, is recommended in conjunction with the fish mercury monitoring program. Accidental events such as chemical spills or fire may affect beaver or beaver habitat, but the risk of these events occurring is small.

9.4.1.2.5 Other Mammals

Potential construction and operational effects on other mammals including black bear, wolf, pine marten, lynx, mink and otter are expected to be negative, small, site-specific to Sub-Regional, and long-term.

Effects on other mammals due to habitat loss or alteration at the generating station, access road, borrow areas and along shorelines should be small compared to the large area these animals use. Some summer and winter habitats are impacted but neither include critical habitat.

Black bear, wolf, pine marten, lynx, mink and otter may experience some sensory disturbance effects, a small loss of habitat effectiveness and small habitat fragmentation effects. Access effects may include increased mortality from hunting, trapping, wildlife control actions, predation and disease associated with the creation of new roads, trails or other facilities. Certainty regarding the potential effects is moderate, because of less certainty concerning hunting and trapping mortality. Riparian mammals including mink and otter may experience a very small increase in mercury, and precautionary monitoring of mercury levels is recommended in conjunction with the fish mercury monitoring program.

9.4.2 Effects Assessment for Construction

This section focuses on impacts and mitigation related to the construction phase of the Project. Construction activities are detailed in Volume 3. Negative impacts are expected from habitat loss, habitat alteration and disturbances associated with the Project; however, mitigation measures described herein may reduce or avoid such impacts. In assessing how riparian and terrestrial mammal communities will respond to specific impacts and mitigation measures, this section will focus on the 10 mammal VECs described in Section 9.3 and selected according to the process outlined in Volume 6 Sections 2 and 9.2.2. During the construction period, mammal species may experience, to differing degrees, the following types of impacts:

- Sensory disturbances from construction equipment, blasting, vehicle traffic, human presence and recreational activity may negatively impact mammal communities by increasing physiological stress on individuals or causing them to avoid habitats. Disturbances will be localized around the generating station, along the access road and in borrow areas (Volume 3). The degree that habitat alienation could occur will depend on the amount of overlap of the activity with a sensitive wildlife period, such as calving.

- Recreational, domestic and commercial watercraft, snowmobiles and ATV's can also disturb mammals. Aquatic furbearers such as muskrat are often able to shelter themselves from sensory disturbances by entering burrows, diving or escaping to cover. Terrestrial furbearers such as pine marten are also able to shelter themselves from sensory disturbances by climbing trees or escaping to cover.
- Vibrations caused by blasting, may adversely affect individuals, or den stability at a few sites near the Upland Project Areas. Direct mortality is not expected from blasting due in part to pre-blasting displacement of animals by the presence of equipment and people. Project planning, normal practices and requirements of the Guidelines for the Use of Explosives In or Near Canadian Fisheries Waters are expected to mitigate some of the effects.
- Mammals could potentially be affected by the direct loss of habitat by removal or alteration at the generating station footprint, along the access road RoW, and at borrow areas. As well, animals may be prevented from using habitat by the presence of people. For example, sensory disturbance effects such as vehicle and machinery noise and dust, may prevent mammals from using habitat near the access road. Habitat fragmentation may occur if wildlife movements within an individual's territory are affected for a long period of time by the access road. Some species are more sensitive to disturbances, while others habituate more easily. Habitat loss can be reduced by limiting traffic volumes and preventing unnecessary access.
- Access effects include increased mortality from hunting, trapping, or wildlife control. Species such as moose and woodland caribou are more likely to be affected by increased harvesting because of their low rates of recruitment. The implementation of the Access Management Plan (Volume 3) should minimize moose and caribou population effects. Human wildlife encounters that require control actions are not expected to be an issue for most species, with the possible exceptions of beaver and black bear.
- Accidental effects from spills, vehicle-wildlife collisions or fire have the potential to affect mammal populations or their habitats. Accidental spills of hazardous

materials such as fuel can degrade habitat, or could detrimentally affect the health of individuals if these substances are consumed. Procedures for storing, handling, and transporting fuels, oils, and other hazardous materials as required under the Dangerous Goods Handling and Transportation Act will be implemented during construction, thereby mitigating these potential effects.

- Accidental fires resulting from construction activities could affect preferred wildlife food and cover or can cause direct mortality. Planned mitigation measures, which include access restrictions and nearby fire suppression equipment (i.e., at the generating station site and Thompson), should reduce the risk of fire dramatically.
- Accidental vehicle-wildlife collisions along the access road can result in animal mortality. Potential impacts were mitigated during the access road routing process, and can be further minimized by including speed limits and possibly posting wildlife warning signs (EnvPP).

While individual mammals living in the Sub-Region may experience any combination of these impacts, the focus of concern is on population level effects. Although the application of mitigation measures may not prevent all individuals from experiencing any of these effects, mitigation is expected to minimize the population–level effects.

An examination of the impacts related to specific activities during construction for each of the riparian and terrestrial mammal VECs, and specific mitigation measure for those impacts, follows.

9.4.2.1 Riparian Mammal Community

The loss or alteration of habitat at the generating station, and at creek crossings along the access road (Volume 3 and Volume 6 Section 5) have the potential to impact riparian communities (Table 9.4-4). For example, clearing or altering vegetation along the access road RoW may alter food and cover for riparian species Some habitat loss in riparian communities has been mitigated through the routing process for the access road while other effects, such as the removal of white spruce or balsam fir are mitigable (Volume 6 Section 5). Ditches and other features may create some riparian habitat adjacent to the access road and borrow areas or low-lying areas in bogs that fill with water and establish vegetative cover may also produce habitat for some species.

Sedimentation during the construction and demobilization of the cofferdams, may temporarily alter riparian habitats. The discharge of water from the sewage lagoon into the Burntwood River will meet Provincial Standards (Volume 3) and is unlikely to affect riparian mammal habitat.

Table 9.4-4. Primary and secondary habitat for riparian mammals in the Project Area compared to ecological study areas.

Species	Study Areas and Project Features	Primary Habitat			Secondary Habitat			Non-habitat		
		Area (km2)	Prop. of Area	%	Area (km2)	Prop. of Area	%	Area (km2)	Prop. of Area	%
Muskrat	Aquatic Buffer	21.4	0.12	0.03	5.9	0.03	1.35	153.0	0.85	2.90
	Upland Buffer	8.1	0.06	0.72	0	0	0	123.0	0.94	13.32
	Upland Project Areas *	0.24	0.02		0.10	0.01		15.71	0.98	
	Borrow Pits	<0.1	0.01		0	0		7.1	0.99	
	Access Road	0.1	0.03		0	0		4.7	0.97	
	GS Footprint	0.1	0.01		0.1	0.03		3.9	0.96	
Beaver	Aquatic Buffer	9.6	0.05	0.16	0	0	0	180.3	0.95	2.31
	Upland Buffer	5.6	0.04	1.54	0	0	0	125.2	0.96	12.99
	Upland Project Areas	0.24	0.02		0	0		15.81	0.98	
	Borrow Pits	<0.1	0.01		0	0		7.1	0.99	
	Access Road	0.1	0.03		0	0		4.7	0.97	
	GS Footprint	0.1	0.01		0	0		4.0	0.99	
River otter	Aquatic Buffer	32.0	0.17	1.55	157.9	0.83	2.28	0	0	0
	Upland Buffer	8.1	0.06	7.35	122.7	0.94	12.64	0	0	0
	Upland Project Areas	0.77	0.05		15.28	0.95		0	0	
	Borrow Pits	<0.1	0.01		7.1	0.99		0	0	
	Access Road	0.1	0.03		4.7	0.97		0	0	
	GS Footprint	0.6	0.14		3.5	0.86		0	0	
Mink	Aquatic Buffer	28.0	0.15	0.62	161.9	0.85	2.50	0	0	0
	Upland Buffer	8.1	0.06	3.23	122.7	0.94	13.07	0	0	0
	Upland Project Areas	0.51	0.03		15.54	0.97		0	0	
	Borrow Pits	<0.1	0.01		7.1	0.99		0	0	
	Access Road	0.1	0.03		4.7	0.97		0	0	
	GS Footprint	0.3	0.08		3.7	0.92		0	0	
Moose	Sub-Region	1665.6	0.49	0.39	1690.0	0.50	0.57	16.8	<0.01	0
	Aquatic Buffer	120.1	0.63	4.23	69.6	0.37	0.19	0	0	0
	Upland Buffer	59.5	0.46	11.98	71.2	0.54	12.54	0	0	0
	Upland Project Areas	7.22	0.45		8.83	0.55		0	0	
	Borrow Pits	1.4	0.19		5.8	0.81		0	0	
	Access Road	2.2	0.46		2.6	0.54		0	0	
	GS Footprint	3.6	0.89		0.4	0.11		0	0	

Habitat in the study areas (used for ecological unit comparisons)

* Total habitat lost or altered (includes borrow sites, access road & GS)

% = Percent change of area compared with Project feature

9.4.2.1.1 Muskrat

Habitat Effects

The Project will result in loss and alteration of muskrat habitat primarily in the vicinity of the generating station, the sewage lagoon, borrow areas and access road stream crossings (Volume 3 and Volume 6 Section 5).

Of the 16 km2 of Upland Project Areas that may be lost or altered during construction, only 0.2 km2 (1%) is considered to be primary and 0.1 km2 (<1%) to be secondary muskrat habitat (Table 9.4-4). Of the total muskrat habitat available within the 1 km Upland Buffer (8.1 km2), about 0.1 km2 (1%) may be lost to the access road RoW. Within the 1 km Aquatic Buffer (21.4 km2) at the generating station site, about 0.2 km2 (<1%) may be lost. Losses at the borrow areas are also less than 1%. These habitat losses will continue through the operation phase, with the exception of rehabilitated sites in the decommissioned areas such as the work camp, the sewage lagoon, or ditches beside the access road. Critical habitat for muskrat will not be lost or altered.

While some primary muskrat habitat is located in streams or creeks crossed by the access road and shorelines surrounding the generating station site, the uplands offer poor habitat for muskrat (Section 9.3.2.1.1). The total loss or alteration of primary habitat available to muskrat in either the Upland (<1%) or Aquatic Buffers (<1%) during the construction phase is not substantial. Alternative food and cover are available and the few muskrats that use these areas will likely find alternative habitat elsewhere.

Construction of the access road ditches and the sewage lagoon will likely result in small, site-specific and long-term, positive effects to muskrat habitat, especially if they are constructed (Mathiak and Linde 1956) or decommissioned in ways that enhance habitat quality. Wetted roadside ditches may contain some valued food items, and provide seasonal habitat for muskrats. Bank grading and depth enhancements of ditches at certain locations during the construction period may produce higher quality habitats year round. Muskrats will use small impoundments such as lagoons as habitat. However, the quality of this habitat for muskrat may be affected by water quality and the availability of vegetation in the lagoon.

Other potential impacts to muskrat habitat will be highly localized, with a very low probability of occurrence. Potential impacts can result from sedimentation during the construction and demobilization of cofferdams (Volume 3), but only if preferred food items such as aquatic or shoreline vegetation are affected, or visibility is impaired (Volume 5 and Volume 6 Section 5). Because neither aquatic nor shoreline vegetation impacts are anticipated, there will likely be no effect to muskrat habitat. Turbidity impacts are also unlikely to affect a muskrat's ability to locate food or cover.

The discharge of sewage lagoon water into the Burntwood River may affect water quality, and subsequently affect habitat. Sewage lagoon discharge will meet Provincial Standards and is therefore not expected to affect muskrat or muskrat habitat.

The access road may create a small barrier to muskrat movements, but habitat fragmentation will be minimal because road culverts will be large enough to accommodate the passage of muskrats, and muskrats can move overland. These negative impacts are considered small, neutral to negative, site-specific and long-term.

As few muskrat likely move either upstream or downstream of Taskinigup Falls under existing conditions, the generating station infrastructure will have no effect on muskrat movements.

Sensory Disturbance Effects

Because only limited muskrat habitat is present near the access road and the generating station, blasting is likely to affect only a few individuals in the short-term, and have a small, site-specific negative effect on muskrats in the Aquatic and Upland Buffers.

The negative impacts of sensory disturbance events caused by vehicles, construction equipment or the presence of people near individual muskrat are short-term, site-specific and small, and should have no effect on the muskrats in the Upland or Aquatic Buffers. Most muskrats will habituate to vehicles passing within 50 metres, but will often show a startle response when people emerge from vehicles at that distance (WRCS, Unpubl. Data). Individual muskrat may avoid using habitat at the eight stream crossings when sensory disturbance are excessive. This habitat loss will be limited to between 0 to 100 m on either side of the stream crossing and possible in a few areas adjacent to the road.

Recreational watercraft and possibly domestic or commercial fishing boats may create more widespread, but likely small, negative, short-term disturbances to individual muskrats in the Aquatic Buffer. However, aquatic furbearers such as the muskrat are able to shelter themselves from sensory disturbance and human presence by entering burrows or escaping to cover.

Access Effects

Muskrat are trapped in the Region for domestic and commercial purposes (Volume 7). On average, the Registered Traplines (RTLs) that lack road access harvest fewer muskrat than those that do. Data from 1976/1977 to 2000/2001 (Volume 7) indicate that 2.6 times as many muskrat were harvested on road accessible traplines as compared to non-road accessible traplines. Therefore, improved access may result in a small increase in the muskrat harvest by local trappers. Traditional sustainable harvest practices will ensure that any population effect is limited and access during construction will be limited due to safety concerns (Volume 3). As a result, increased access during construction is expected to have only a small, negative, Sub-Regional and long-term impact on the muskrat population.

Predation should not increase substantially as a result of road construction and is therefore considered small, negative, and long-term effect in the Upland Buffer.

Accidental Events

Accidental spills would affect site-specific areas over the short-term and have a small, negative impact on muskrat or muskrat habitat. Given the low probability of occurrence and the regulation requirements for storing, handling, and transporting fuels, oils, and other hazardous materials under the Dangerous Goods Handling and Transportation Act (Volume 11), there will likely be no effect on the muskrat population.

Accidental fires may have a site-specific, short-term, negative impact on muskrat and muskrat habitat, possibly followed by a short-term benefit. When emergent shoreline vegetation is burnt, re-growth is often quick and vigorous (J. Ehnes, pers. comm.). This new growth can temporarily increase the supply of high quality food. Mitigation measures including access restrictions (Access Management Plan) and nearby fire suppression equipment (i.e., at the generating station site and Thompson) should dramatically reduce the risk of fire. Given the low probability of occurrence, there will likely be no effect on the muskrat population.

Vehicle-muskrat collisions may occur but the negative effects will be small, site-specific and long-term, and will have no effect on the muskrat population in the Upland Buffer. Any road mortalities will likely be limited to the eight stream crossings, and to small areas near ponds or other minor riparian habitats adjacent to the access road (e.g., ditches).

Summary of Effects

Effects on muskrats from construction impacts are expected to be positive to negative, small, site-specific, short-term to long-term and insignificant.

The loss or alteration of habitat at the generating station, creek crossings along the access road and borrow areas will be small but negative. Possible changes to the muskrat population are small when compared to the large area used by these animals; especially the numerous ponds, creeks and lakes outside the area affected by the Project.

Muskrats may experience some sensory disturbances and access effects may include increased mortality from increased trapping and a minor increase in predation. Accidental events such as chemical spills or fire may affect muskrat or muskrat habitat, but the risk of these events occurring is small.

9.4.2.1.2 Beaver

Habitat Effects

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, only 0.2 km^2 (1%) is considered to be primary and 0% to be secondary beaver habitat (Table 9.4-4). Of the total beaver habitat available within the 1 km Upland Buffer (5.6 km^2), about 0.1 km^2 or 2% may be lost to the access road RoW. Within the 1 km Aquatic Buffer (9.6 km^2) at the generating station site, about 0.1 km^2 or (1%) may be lost. Losses at the borrow areas are less than 1%. With the exception of rehabilitated sites, these habitat losses will continue through the operation phase (Volume 6 Section 5). Critical habitat for beaver will not be lost or altered.

While some primary beaver habitat is located in streams or creeks crossed by the access road and shorelines surrounding the generating station site, the uplands offer poor habitat for beaver (Section 9.3.2.1.2). The total loss or alteration of primary habitat available to beaver in either the Upland (1.5%) or Aquatic Buffers (<1%) during the construction phase is not substantial. Alternative food and cover are available and the few beavers that use these areas will likely find alternative habitat elsewhere.

The predicted impacts of changes to beaver habitats, sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as for the muskrat (Section 9.4.2.1.1), with two exceptions. First, if beavers create unsafe road or working conditions by blocking culverts or creating impoundments beside roadways, beaver dams, lodges and occasionally individuals will have to be removed (under consultation, approval and permitting from Manitoba Conservation). This is not expected to have an overall effect on the beaver population in the Upland Buffer.

Second, accidental fires may have a greater effect on beaver than muskrat, as the regeneration of trees will take longer than most plants used by muskrats. With mitigation, no effect to beaver abundance is anticipated.

Summary of Effects

Effects on beavers from construction impacts are expected to be positive to negative, small, site-specific, short-term to long-term and insignificant.

Beavers in those areas affected by habitat loss or alteration at the generating station, creek crossings along the access road and borrow areas will experience some negative effects. Possible changes to the beaver population are small when compared to the large area used by these animals; especially the numerous ponds, creeks and lakes outside the area affected by the Project. Uncertainty regarding these potential effects is small, because of the confidence regarding the amount of habitat loss or alteration in Upland Project Areas.

Beaver may experience some sensory disturbances. Access effects may include mortality from increased trapping, increased predation. Accidental events such as chemical spills or fire may affect beaver or beaver habitat, but the risk of these events occurring is small.

9.4.2.1.3 River otter

Habitat Effects

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, only 0.8 km^2 (5%) is considered to be primary and 15.3 km^2 (95%) to be secondary otter habitat (Table 9.4-4). Of the total otter habitat available within the 1 km Upland Buffer (8.1 km^2), about 0.1 km^2 or 1.2% may be lost to the access road RoW. Within the 1 km Aquatic Buffer (32.0 km^2) at the generating station site, about 0.6 km^2 or (1.9%) may be lost; losses at the borrow areas are less than 1%. These habitat losses will continue through the operation phase, with the exception of rehabilitated sites that should reduce otter habitat loss (Volume 6 Section 5). Critical habitat for otter will not be lost or altered.

While some primary otter habitat is located in streams or creeks crossed by the access road and shorelines surrounding the generating station site, the uplands offer only secondary habitat, which rarely contains otters (Section 9.3.2.1.3). The total loss or alteration of primary habitat available to otter in either the Upland (7.4%) or Aquatic Buffers (1.6%) during the construction phase is not substantial. Alternative food and cover are available and the few otters that these areas will likely find alternative habitat elsewhere.

Impacts may result from habitat fragmentation caused by the access road, increased turbidity from cofferdam construction and removal, as well as effects on water quality from sewage discharges. These impacts have the same temporal and geographical scope and magnitude as discussed for muskrat (Section 9.4.2.1.1).

Sensory Disturbance Effects

Blasting of outcrops at a few locations on the north portion of the access road and at the rock quarry near the camp may occur in the summer or fall of 2004 (Volume 3). This blasting period should not interfere with otters that are located in streams or creeks near the Project Areas. Blasting in the fall of 2005 at generating site may overlap with the pup-rearing period for some otter, causing some stress and temporary displacement for animals in the blast vicinity. The removal of the rock plugs in the spring of 2008 may coincide with the otter denning season. Because otter habitat (including den sites) is limited near the generating station, blasting will affect a relatively small number of animals. Further, these rock plug removal blasts will be very small. It is expected that effects will be short-term, small, and site-specific in the Aquatic Buffer.

Sensory disturbances caused by vehicles etc. along the access road should be short-term, site-specific, small, and have a negligible effect on the otters in the Upland or Aquatic Buffers. Watercraft, ATV's and snowmobiles may create a more widespread, but similar negative effect. Temporary effective habitat loss may occur between 0 to 100 m on either side of the access road at stream crossings and possibly in a few areas adjacent to the road.

Access Effects

Otter are currently trapped in the Region for commercial purposes, and trapping is one of the main causes of otter mortality (Larson et al. 1983; Toweill and Tabor 1990). On average, the RTLs that lack road access harvest fewer otter than those that do. Data from 1976/1977 to 2000/2001 (Volume 7) indicate that traplines with road access harvest 2.2 times as many otter as traplines without road access. As with muskrat, effects resulting from increased access are expected to be small, negative, Sub-Regional and long-term.

Because fish populations are not expected to change substantially during construction, effects on otter food sources, if any, will be small, site-specific and short-term (Volume 5 and Volume 6 Section 6). Wetted roadside ditches or the lagoon may contain muskrat or beaver, and therefore, provide food for otter. Movement paths along the access road may benefit otter by increasing hunting efficiency and prey-rate encounters. These effects will be positive, small, site-specific and long-term.

Accidental Events

The predicted impacts of accidents have the same period, scope, and magnitude as described for muskrat (see Section 9.4.2.1.1), with two minor differences. First, mortality from vehicle collisions is expected to be uncommon and would have no effect on the overall otter population in the Upland Buffer. Second, increased commercial and domestic fishing on Wuskwatim Lake (Volumes 5 and 7) may increase the potential for otter to drown in gill nets (Mobray et al. 1979).

Summary of Effects

Potential construction effects on river otter are expected to be positive to negative, small, site-specific to local, short-term to long-term and insignificant.

No significant population-level effects are expected for otters as a result of construction activities. During construction, most effects to individual otter will occur in the Aquatic and Upland Buffers. These effects may include direct loss of cover and forage, habitat alienation from sensory disturbances, deflection or disruption of movements, some stress and increased energy expenditure for a few individuals, mortality from harvest or accidents, and changes to habitat or other factors from accidental events. Some or all of the positive habitat impacts associated with the road may be offset to by other road related impacts such as traffic, trapping, and increased risk of vehicle collisions.

9.4.2.1.4 Mink

Habitat Effects

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, only 0.5 km^2 (3%) is considered to be primary and 15.5 km^2 (97%) to be secondary mink habitat (Table 9.4-4). About 0.1 km^2 or 1.2% of the total mink habitat available within the 1 km Upland Buffer (8.1 km^2), may be lost to the access road RoW. Within the 1 km Aquatic Buffer (28.0 km^2), about 0.3 km^2 or (1.1%) of the mink habitat may be lost at the generating station site. Habitat losses at the borrow areas are about 1%. These habitat losses will continue through the operation phase, with the exception of rehabilitated sites that should reduce mink habitat loss (Volume 6 Section 5). Critical habitat for mink will not be lost or altered.

While some primary mink habitat is located in streams or creeks crossed by the access road and along shorelines surrounding the generating station site, the uplands areas offer only secondary habitat, which rarely contains minks (Section 9.3.2.1.4). The total area of primary mink habitat lost or altered in the Upland (3.2%) or Aquatic Buffers (<1%)

during the construction phase is not significant. Alternative food and cover are available to mink throughout these areas and in the Sub-Region. The few minks that use habitat in these Upland and Aquatic Buffer areas will likely find alternative habitat elsewhere.

The predicted impacts of changes to mink habitats, of sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as previously described for the otter (see Section 9.4.2.1.3), with one exception. Because fish are not a large part of the mink's diet (Erlinge 1972), any anticipated effects to fish populations should affect mink less than otter. With mitigation, no effect to mink abundance is anticipated.

Summary of Effects

Effects on mink from construction impacts are expected to be positive to negative, small, site-specific to local, short-term to long-term and insignificant.

No significant population-level effects are expected for mink as a result of construction activities. During construction, most effects will occur to individual mink in the Aquatic Buffers. These effects to a few individuals may include direct loss of cover and forage, habitat alienation from sensory disturbances, den relocations, deflection or disruption of movements, stress and increased energy expenditure, mortality from harvest or accidents, and changes to habitat or other factors from accidental events. Some or all of the positive impacts of the additional habitat associated with the road may be offset by other negative road-related impacts such as traffic and trapping.

9.4.2.1.5 Moose

Habitat effects

The Project will result in loss and alteration of moose habitat in the vicinity of the generating station and in the access road RoW (Volume 3 and Volume 6 Section 5).

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, 7.2 km^2 (45%) is considered to be primary and 8.8 km^2 (55%) to be secondary moose habitat (Table 9.4-4). Of the total moose habitat available within the 1 km Upland Buffer (59.5 km^2), about 3.6 km^2 (6.1%) may be lost to the access road RoW. Within the 1 km Aquatic Buffer (120.1 km^2), about 3.6 km^2 (3%) may be lost at the generating station site. These habitat losses will continue through the operation phase, with the exception of rehabilitated work camp sewage lagoon sites, and ditch environments beside the access road. For a few moose, some important winter habitat (i.e., thermal cover) will be lost or altered primarily at the generating station and along the access road; however, other important winter habitat is found elsewhere throughout the Sub-Region. The selection of the Mile 17 Access Road option as opposed to the Mile 5 option mitigated negative impacts by avoiding more primary moose habitats in the Sub-Region.

While some primary moose habitat exists in streams or creeks crossed by the access road and along the shorelines surrounding the generating station site, adjacent uplands also offer habitat for moose (Section 9.3.2.1.5). The estimated total loss or alteration of <1% of the primary habitat available to moose in the Sub-Region is not significant. Alternative food and cover are available to moose throughout the Sub-Region. The few moose that use habitat in the lost or altered areas will likely find suitable alternative habitat elsewhere and therefore, only a small effect is expected. The effect of habitat loss and alteration on moose is expected to be negative, site-specific and long-term.

Construction of the access road ditches will likely result in small, site-specific and long-term, positive effects to moose habitat, especially if they are constructed and decommissioned to enhance habitat quality through encouragement of low-growing and shrubby vegetation used as forage. Moose may also benefit from the road through improved access to minerals and to some foraging habitat. Salt used in winter maintenance of the access road may alter habitat by increasing the availability of minerals to moose and other ungulates, thereby affecting habitat use patterns. Moose home ranges often converge and overlap at roadside salt pools, and animals will congregate at these areas. The concentration of sodium and other minerals in the roadside pools is much higher than naturally occurs in aquatic plants, making the use of roadside salt licks more energetically efficient than feeding on aquatic plants. Moose can then increase the time spent foraging on higher-energy terrestrial plants (Miller and Litvaitus 1992).

The predicted impacts of potential changes to moose habitats, including water quality impacts from sedimentation and turbidity effects of the coffer dams, and the discharge effects of the sewage lagoon and how water quality may affect preferred food items of moose (e.g., shoreline plants), have the same period, scope, and magnitude as for the muskrat (Section 9.4.2.1.1).

The road can create a small barrier to moose movements (e.g., Jalkotzy et al. (1997) state that movements may be deflected by snow berms that are higher than about 65 cm), but this negative effect is small, site-specific and short-term. More likely, moose movements will not be deflected by the snow berms, and moose will experience increased ease of movement and energy efficiency when travelling along the access road and RoW where adjacent habitat is densely vegetated or covered in deep snow. The effect of using the road as a movement corridor in the Upland Buffer should be small, positive and short-term to long-term.

Sensory Disturbance Effects

Moose are perhaps more tolerant of sensory disturbance than other ungulate species and may habituate to repeated disturbances that are not associated with unpleasant experiences. Factors that influence moose response to disturbance include distance from the stimulus, reproductive condition, sex and age class, habitat type and previous experience. Cow and calf grouping are the most sensitive segments of the population, as calves may be particularly susceptible due to death from injury or separation from their mother while escaping disturbance. Moose are most sensitive to disturbance during or shortly after calving and during cold periods in late winter. Disturbances will also elicit a greater response in moose that are in open or sparse habitat, or that have had previous stressful experiences related to disturbance (RRSC 1994).

The primary effect of disturbance on moose is disruption of the energy balance through interruption of foraging activities or increase of metabolic costs associated with particular responses such as rising from a lying position or running (Colescott and Gillingham 1998). These responses are contrary to the energy conservation strategy used by moose in winter. Even slight changes in energy expenditure during critical times such as late winter or during gestation and milk production may have important negative impacts.

Habitat alienation due to disturbance appears to be short-term. Moose show a high level of site fidelity and will not easily abandon suitable areas due to disturbance useless they are actively pursued (RRSC 1994). They will often return to disturbed areas once the disturbance ends (Colescott and Gillingham 1998).

Blasting of outcrops at a few locations on the north portion of the access road and at the rock quarry near the camp may occur in the summer or fall of 2004. The major period of blasting, is scheduled to occur from August to November 2005 at the generating station site. This will occur in the moose rutting season, causing some stress and temporary displacement for animals in the blast vicinity. Only a small number of moose will be affected. The removal of the rock plugs in the spring of 2008 will occur during the calving season. Based on the distances from the generating station blast site to the nearest probable calving habitats, calving activities will not likely be disturbed by blasting activities. Further, these rock plug removal blasts will be very small. Nevertheless, as an added precaution, blasting activities are to be minimized throughout the Sub-Region during late May to mid-July period. Overall, blasting activity will be short-term and have small, negative effect on a few moose found in the Upland and Aquatic Buffers.

Habitat effectiveness may be reduced at locations where sensory disturbance events, such as equipment and human activity occur. It is possible that individual moose may occasionally avoid using available habitat along the access road or near the generating station, but only during periods in which sensory disturbance events occur. The effects of vehicle traffic disturbances on moose appear to vary depending on traffic volumes and degree of habituation. Responses to disturbance from traffic can range from quite overt reactions (e.g., escape response) by moose with little experience with traffic to a very subtle shift of grazing direction toward cover (Jalkotzy 1997; Kunkel and Pletscher 2000). Even if traffic levels are not high enough on the road to deter moose, they may still avoid areas adjacent to roads if unrestricted hunting occurs (Belant 1995).

Effective habitat loss may occur between 0 to 500 m on either side of the access road. Given the large size of moose home ranges, only a few animals will be affected. Disturbance from traffic on the access road, especially during peak traffic flows, may cause some moose to avoid adjacent habitat. The negative effects to individual moose of sensory disturbance events caused by vehicles, construction equipment or by the presence of people are considered short-term, small, and should have limited effects on the moose populations in the Upland or Aquatic Buffers.

Use of recreational watercraft and possibly domestic or commercial fishing boats may create more widespread, but likely small, negative, short-term, disturbances to individual moose in the Aquatic Buffer. Snowmobile traffic does influence the behavior of moose positioned within 300 m of a trail (Colescott and Gillingham 1998). The impact of such disturbance can exert particularly harsh demands on energy balance if a moose must repeatedly rise from a bedded position or if it is displaced from important winter habitat during the most severe winter conditions. Overall, moose occupy areas near winter recreation trails less frequently than the surrounding habitat (Colescott and Gillingham 1998). Off-site recreational activities will be limited by the Project's six-day workweek. The negative impact of non-consumptive recreation will therefore be small, short-term, disturbances to individual moose in the Upland and Aquatic Buffers.

Access effects

The all-weather access road will make it easier to hunt in the Sub-Region and may lead to an increase in moose mortality. In areas where hunting is allowed from roads, most moose kills occur within 1.6 km of the road, and the most successful hunters tend to use all-terrain vehicles (Jalkotzy et al. 1994). Moose congregating at salt licks also tend to be more tolerant of human presence, which increases their susceptibility to hunters (Miller and Litvaitis 1992).

Moose are a major component of NCN's domestic harvest in the Region (Volume 7). Increased access to the Sub-Region may initially increase the moose harvest by NCN resource harvesters, outside user groups, licensed hunters and illegal harvesters. Four outfitters operate in the Region, and the road will provide improved access to areas previously less accessible for these operations.

NCN and Manitoba Hydro, in consultation with the Nelson House Resource Management Board, are developing the Access Management Plan (Volume 3) to manage the effects of legitimate resource use in the area. During construction, access restrictions to the construction sites and the implementation of the Access Management Plan should keep negative impacts on the Sub-Regional moose population small and long-term

Moose on road

The creation of new linear corridors, such as the access road, may alter the population dynamics between moose and their predators during construction and in the foreseeable future. If moose travel on the access road or are attracted to habitat nearby, they may be more susceptible to predation by wolves (Jalkotzy et al. 1997). If this were to occur, the negative impacts would be expected to be small and long-term, and primarily restricted to the Upland Buffer population, but much scientific uncertainty exists with this hypothesis, especially concerning measurable population effects.

Moose using the new linear corridors may be more likely to encounter white-tailed deer (Miller and Litvaitus 1992), which are host to meningeal worm (*Parelaphostrongylus tenius*), a parasite that infects deer but often kills moose. At present, however, few white-tailed deer live in the Sub-Region (RKSE and WRCS, Unpubl. Data), and meningeal worm has not been detected in the Region (V. Crichton, pers. comm.). Increased contact between moose and deer as a result of construction of linear corridors should therefore have no effect on the moose population in the Sub-Region.

Accidental events

The predicted impacts of accidental spills on moose have the same period, scope, and magnitude as for the muskrat (Section 9.4.2.1.1).

Accidental fires that occur during construction could have a site-specific to Sub-Regional impact on moose that would likely be negative in the short-term but positive in the long-term. Individual mortalities and losses of cover and forage would be offset by the long-term benefits of habitat regeneration. Fires in moose habitat generally increase productivity and availability of deciduous woody plants and the early-successional habitats provide higher quality forage than those in later stages of succession (Weixelman et al. 1998). Patterns of forest succession caused by fire increase the productivity of moose populations in habitats with deciduous understories, but have less effect in habitats such as black spruce forest (Wiexelman et al. 1998). As with muskrat (Section 9.4.2.1.1), mitigation should dramatically reduce the risk of fire, and given the low probability of fire occurrence, there will likely be no effect on the moose population.

Site-specific and long-term negative impacts to the moose population in the Upland Buffer may occur as a result of moose-vehicle collisions. Both traffic volume and vehicle speed have been positively linked to the number of moose accidents (Del Frate and Spraker 1991; Miller and Litvaitus 1992; Belant 1995), as has the presence of roadside salt licks (Fraser and Thomas 1982; Jolicoeur and Crete 1994). Accidents are also more likely to occur during the periods of peak moose activity at dawn, night and dusk when roadside visibility is poor for vehicle operators (Joyce and Mahoney 2001).

Moose-vehicle collisions appear to be uncommon in the Sub-Region as there is only one report of a moose-vehicle collision between 1995-2001 along PR 391 (Traffic Safety Engineer, Manitoba Transportation) and elsewhere (one report of a moose-vehicle collision on Hwy 290 during the construction of the Limestone generating station) (D. Windsor, pers. comm.). Measures to prevent collisions such as posting wildlife warning signs in high-risk areas may mitigate the negative impact of vehicle-moose collisions. Therefore, the effects of this impact remain small, site-specific and long-term.

Summary of Effects

Potential construction effects on moose are expected to be negative, small, site-specific to local, short-term to long-term and insignificant.

Effects on the moose population due to habitat loss or alteration at the generating station, access road, borrow areas and along shorelines should be small compared to the large area these animals use. Primary moose habitat, which comprises about half of the Sub-Region, is concentrated in riparian habitats. The maximum extent of primary habitat loss (excluding rehabilitated sites) in the Upland Project Areas is less than 1% of the Sub-Region. Some summer and winter habitats are impacted, but critical moose habitat should not be included with the habitat losses.

Moose will experience small effects from sensory disturbances (e.g., traffic, machinery operation, blasting), a loss of habitat effectiveness and possibly some habitat fragmentation. Harvest levels are expected to increase due to increased access. Certainty regarding the potential effects is moderate because of lower certainty concerning harvest mortality. Uncertainties concerning the magnitude of access effects (i.e., hunting, predation and disease) are manageable through Project planning and access road management. Accidental events such as chemical spills, fires or wildlife-vehicle collisions may affect moose abundance or site-specific moose habitat, but the risk of these events occurring is small.

9.4.2.2 Terrestrial Mammal Community

About two-thirds of the mammal species in the Sub-Region are found in terrestrial communities. These communities include some species that are mainly aquatic, but terrestrial species such as woodland caribou, black bear, pine marten, gray wolf and lynx are in the majority. Habitat areas for terrestrial VECs are presented in Table 9.4-5.

The loss or alteration of habitat at the generating station, borrow pits, and along the access road (Volume 3 and Volume 6 Section 5) are important impacts of construction on terrestrial communities. Clearing or altering vegetation along the access road RoW may alter food and cover for several terrestrial species. Some potential habitat loss in terrestrial communities was mitigated by considering terrestrial VECs during the access road routing process. Some types of unavoidable habitat alterations such as the removal of white spruce or balsam fir are also mitigable (Volume 6 Section 5). Ditches, borrow areas and other features may create some habitat adjacent to the access road that may be used by terrestrial mammals.

Table 9.4-5. Primary and secondary habitat for terrestrial species in the Project Areas and other study areas.

Species	Study Areas and Project Features	Primary Habitat			Secondary Habitat			Non-habitat		
		Area (km2)	Prop. of Area	%	Area (km2)	Prop. of Area	%	Area (km2)	Prop. of Area	%
Woodland caribou	Region	17084	0.73	0.11	5438	0.23	<0.01	937	0.04	0.06
	Sub-region	2521.5	0.75	0.72	639.3	0.19	0.02	211.6	0.06	0.18
	Aquatic Buffer	176.1	0.93	2.12	6.5	0.03	0.02	7.3	0.04	8.05
	Upland Buffer	109.6	0.84	14.79	12.1	0.09	2.59	9.2	0.07	3.61
	Upland Project*	14.8	0.92		0.7	0.04		0.6	0.04	
	Borrow Pits	6.9	0.96		0.1	0.01		0.2	0.03	
	Access Road	4.1	0.86		0.6	0.12		0.1	0.02	
	GS Footprint **	3.8	0.92		<0.1	0.00		0.3	0.07	
Black bear	Sub-region	1457.5	0.44	1.65	1571.6	0.48	0.07	252.3	0.08	<0.01
	Aquatic Buffer	116.6	0.61	3.86	72.9	0.38	0.45	0.4	<0.01	<0.01
	Upland Buffer	71.8	0.55	27.10	57.9	0.44	2.11	1.1	0.01	0.15
	Upland Project	13.1	0.82		2.9	0.18		<0.1	<0.01	
	Borrow Pits	6.9	0.96		0.3	0.04		<0.1	<0.01	
	Access Road	2.9	0.59		2.0	0.41		<0.1	<0.01	
	GS Footprint	3.4	0.82		0.7	0.18		<0.1	<0.01	
Gray wolf	Region	9294	0.40	0.29	14165	0.60	0.01	0	0	0
	Sub-region	1459.8	0.43	1.68	1912.4	0.57	0.05	0	0	0
	Aquatic Buffer	116.7	0.61	3.79	73.1	0.39	0.46	0	0	0
	Upland Buffer	71.8	0.55	27.00	59.0	0.45	2.07	0	0	0
	Upland Project	13.1	0.81		3.0	0.19		<0.1	0	
	Borrow Pits	6.9	0.96		0.3	0.04		<0.1	0	
	Access Road	2.9	0.59		2.0	0.41		<0.1	0	
	GS Footprint	3.3	0.82		0.7	0.18		<0.1	0	
Pine marten	Sub-region	259.1	0.08	0.59	2765.2	0.84	0.57	257.1	0.08	<0.01
	Aquatic Buffer	25.6	0.14	7.41	163.9	0.86	1.61	0.4	<0.01	<0.01
	Upland Buffer	3.7	0.03	113.40	126.0	0.96	11.02	1.1	0.01	0.15
	Upland Project	1.4	0.09		14.6	0.91		<0.1	<0.01	
	Borrow Pits	0.2	0.02		7.0	0.98		<0.1	<0.01	
	Access Road	0.2	0.04		4.6	0.96		<0.1	<0.01	
	GS Footprint	1.0	0.25		3.0	0.75		<0.1	<0.01	
Lynx	Sub-region	696	0.21	2.93	2328.3	0.71	0.22	257.1	0.08	<0.01
	Aquatic Buffer	34.4	0.18	1.67	155.2	0.82	2.27	0.4	<0.01	<0.01
	Upland Buffer	43.9	0.34	29.44	85.8	0.66	6.56	1.1	0.01	0.15
	Upland Project	8.3	0.52		7.7	0.48		<0.1	<0.01	
	Borrow Pits	5.9	0.83		1.2	0.17		<0.1	<0.01	
	Access Road	1.8	0.36		3.1	0.64		<0.1	<0.01	
	GS Footprint	0.6	0.16		3.4	0.84		<0.1	<0.01	

Habitat in the study areas (used for ecological unit comparisons)
* Total habitat lost or altered (includes borrow sites, access road and GS)
**GS footprint used to compared with habitat change in Aquatic Buffer
% = Percent change of area compared with Project feature

9.4.2.2.1 Woodland caribou

Habitat Effects

The Project will result in loss and alteration of caribou habitat primarily in the vicinity of the generating station and in the access road RoW (Volume 3 and Volume 6 Section 5).

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, 14.8 km^2 (92%) is considered to be primary and 0.7 km^2 (4%) to be secondary caribou habitat (Table 9.4-5). Of the total caribou habitat available within the 1 km Upland Buffer (109.6 km^2), about 11 km^2 (10%) may be lost in the access road RoW. Within the 1 km Aquatic Buffer (176.1 km^2) at the generating station site, about 3.8 km^2 (2.2%) may be lost. These habitat losses will continue through the operation phase, with the exception of rehabilitated sites in decommissioned areas such as the work camp, borrow areas or roadside ditches.

Habitat along the access road is not considered critical, as it may only be used occasionally for summer foraging, possibly for limited winter use and for travel. Potential significant negative impacts to critical woodland caribou calving habitat were mitigated by adjusting the alignment of the access road, thereby avoiding this habitat, and providing a buffer against sensory disturbances and possible habitat alienation.

The proposed generating station site includes a small amount of calving habitat (one of an estimated 100 or more sites). Although critical calving habitat suitable for at least one woodland caribou cow will be lost at the generating station site, the large majority (about 98%) of estimated critical calving habitat for the Wapisu woodland caribou population is found elsewhere in the Region and predominantly outside the Sub-Region.

Although the loss or alteration of any primary habitat in the Upland Project Area is substantial for a Threatened species, woodland caribou utilize extensive areas of habitat to meet their life-requisites. The total loss or alteration of primary habitat available to caribou in either the Sub-Region (0.6%) or Region (0.1%) is not significant. Alternative food and cover are available to caribou throughout the Sub-Region, so individual caribou will likely find suitable habitat elsewhere outside the disturbed sites. The negative loss of habitat is considered small, site-specific and long-term.

Construction of the access road will result in a neutral to negative, small, site-specific and long-term alteration of caribou habitat in the RoW. Roadside ditches may contain some valued food items, especially during spring and summer, but overall, food resources such as lichens may be reduced in areas where forest cover is removed.

During construction, the addition of salt and sand on the road during winter may have a positive impact on woodland caribou habitat providing mineral licks. The increased availability of sodium to individual caribou in the Upland Buffer should be a small, site-specific and short-term benefit.

The physical presence of the road does not create a barrier to caribou movements during summer (NDLEA et al. 2001). During winter, the presence of ploughed snow berms may create a minor obstruction to cross-road movements. Currently, few caribou cross the access road RoW in an east-west direction. Most of the caribou movements observed to date in this area have been north-south (RKSE and WRCS, Unpubl. Data). These movements generally occur in late-fall and early winter, when snow berms should be low or absent, and therefore, no effect is expected.

If their movements are not deflected by snow banks, caribou may find it easier and more energy efficient to travel along the access road in areas where adjacent habitat is densely vegetated or covered in deep snow. The impact of use of the road as a travel corridor on the sub-population of caribou in the Upland Buffer will be small, positive and short-term to long-term.

Understanding of caribou movements in the Sub-Region is limited, recent and based on low sample size. Additional research is underway to more specifically define movement patterns. Early winter range and movement corridors, utilized by approximately 16 of an estimated 200 animals in the Sub-Region will be affected by the access road (RKSE and WRCS, Unpubl. Data). If movement patterns are changed, or appear to change in a negative manner as a result of road presence, snow berms or habitat changes, mitigation measures will be prescribed or modified as data become available from the monitoring program (Section 9.7).

Sensory Disturbance Effects

Caribou exposed to loud noises tend to move significantly faster, but not significantly farther (Bradshaw et al. 1997). They cross habitat boundaries more often, possibly to locate cover or escape terrain. Loud noise does not appear to affect the proportion of time allocated to feeding. Similar to moose (Section 9.4.2.1.5), however, pregnant cows and cow-calf groupings may be more susceptible to death due to injury or separation while escaping disturbance, and are more sensitive during cold periods in winter (Jalkotzy et al. 1997).

Blasting of outcrops at a few locations on the north portion of the access road and at the rock quarry near the camp may occur in the summer or fall of 2004. This may coincide with some caribou's movements from summer ranges to winter ranges, and may also fall within the commencement of the rutting period. Temporary deflection of travel, displacement behaviour or habitat alienation may occur at this time near blasting sites. The major period of blasting is scheduled to occur from August to November 2005 at the generating station site. Summer cow-calf range at the generating station however, will likely be abandoned due to pre-blast displacement of animals during vegetation clearing and the continued presence of equipment and workers at the site. The removal of the rock plugs in the spring of 2008 will occur during the calving season. Based on the distances from the generating station blast site to the nearest probable calving habitats, calving activities will not likely be disturbed by blasting activities. Further, these rock plug removal blasts will be very small. Nevertheless, as an added precaution, blasting activities are to be minimized throughout the Sub-Region during late May to mid-July period. Overall, blasting will occur over the short-term, and have small, negative impacts on a few individuals in the Upland and Aquatic Buffers.

Habitat effectiveness may be reduced at locations where sensory disturbances, such as equipment operation and human activities, occur. Caribou tend to avoid habitat adjacent to linear corridors, but overall displacement varies because of differences in corridor type, habitat, traffic volumes and other factors (Jalkotzy et al. 1997; Martinez 1998; Dyer 1999; Berger et al. 2000, James and Stuart-Smith 2000). Potential significant negative impacts to critical woodland caribou calving habitat were mitigated by adjusting the alignment of the access road on the glacial outwash plain to avoid critical habitat, to provide a buffer against sensory disturbances, and to reduce the loss of habitat effectiveness. The road alignment is greater than 1 km from the nearest known critical calving habitat. Because the alignment runs along the far side of a hill near the site, the effectiveness of the buffer against visual and noise-related sensory disturbances is increased.

Although caribou are probably somewhat less tolerant to sensory disturbances than moose, the predicted impacts for the loss of habitat effectiveness, and other sensory disturbance effects, have the same period, scope, and magnitude as for the moose (Section 9.4.2.1.5).

Access Effects

Caribou from the Cape Churchill, Penn Island and Beverly herds are generally harvested during in winter outside the Region, while a few resident woodland caribou are harvested by NCN within the Region (Section 9.3.3.2.1). Hunting licenses are not issued for resident, non-migratory woodland caribou.

Predation and hunting are two main causes of mortality for woodland caribou. However, the predation rate is often linked to other factors such as weather (i.e., snow conditions); habitat disturbances (i.e., fire, insects, or developments) that result in early seral stage forests that offer a higher density of alternate prey species and support a larger, more stable wolf population; and improved access on trails and roads (Edmonds 1988; Rettie and Messier 1998; Thomas and Gray 2001). Woodland caribou populations in Canada that have increased in the 1990s, are those where habitats remain relatively pristine and wolves are absent or at low densities (Thomas and Gray 2001).

Caribou may be able to endure major changes to their range caused by development if predators are managed and all hunting is strictly controlled (Thomas and Gray 2001). Otherwise, the expansion of access may indirectly affect caribou mortality by altering the predator-prey balance. Some linear features such as roads serve as travel corridors for predators, facilitating movements into previously inaccessible woodland caribou habitats (Thomas 1992; Thurber et al. 1994; Dyer 1999). If woodland caribou also use linear features for travel, encounter rates with predators may increase.

Current harvest levels for resident Wapisu woodland caribou appear to be sustainable because of selective harvest traditionally practiced by NCN. Great respect is shown for caribou by NCN. Only NCN Elders harvest this caribou population (NCN members, pers. comm.). Any deviation from these practices may result in the over-harvest of this population during the construction phase of the Project. The presence of the access road may provide local NCN residents and others with a means of reaching summer caribou ranges, and provide an improved alternative access to winter ranges. Persons from Thompson may also hunt in the area. Woodland caribou harvest is to be considered in the Access Management Plan. Although some scientific uncertainty exists regarding the magnitude of harvest, improved access afforded to hunters by the road should have limited negative effects on caribou which are small, Sub-Regional and long-term.

The creation of new linear corridors such as the access road may alter the population dynamics between woodland caribou and their predators during construction and the foreseeable future. Several caribou mortalities have been attributed to wolves in the Region (WRCS, Unpubl. Data). If woodland caribou travel on the access road, or are attracted to habitat nearby, they may be more susceptible to predation by wolves (James and Stuart-Smith 2000; Manitoba Conservation 2000; Manitoba Hydro 2001). These negative impacts will likely be small, Sub-Regional and long-term, but are qualified with scientific uncertainty. The low number of caribou currently using habitat near the access road, the availability of other primary prey species such as moose, and the effect of the access road on the distribution of wolves will affect the outcome. However, the most likely scenario is that sensory disturbance impacts that occur during construction will alienate both caribou and their predators from habitat adjacent to the access road, and this will reduce the number of predator-prey encounters along the RoW and in the adjacent buffer.

The spread of parasites within the regional woodland caribou population, and the transfer or spread of parasites or disease from other ungulates, such as white-tailed deer or moose, to woodland caribou may increase if these species use the linear corridors and interact more often. As brainworm is not found in northern Manitoba, the Project is expected to have no effect on the spread of this parasite (Section 9.4.2.1.5). While other similar parasites such as *P. andersonii* occur in the Regional caribou population (V. Crichton, pers. comm.), creation of the access road is not expected to contribute to their spread. Caribou in the Region already move well beyond the access road area - from Harding Lake to the Partridge Crop Hill area.

Accidental Events

The predicted impacts to caribou due to accidental spills have the same period, scope, and magnitude as for the muskrat (Section 9.4.2.1.1). Given the low probability of occurrence, there will likely be no effect on caribou.

Fires are common and recurrent in the boreal forest and are a natural component of caribou ecology. Accidental fires that occur as a result of construction activities may have a site-specific to Regional, long-term, negative impact on woodland caribou habitat if the burn(s) are large enough or frequent enough to affect caribou range in the Sub-Region. Given the low probability of occurrence, there will likely be no effect on the caribou population.

Roads in caribou ranges can contribute to animal mortality, but such mortality appears to be highly localized and uncommon in Manitoba and elsewhere (Johnson and Todd 1977; Mercer et al. 1985; Manitoba Conservation 2000; WRCS Unpubl. Data). The predicted impacts of vehicle collisions have the same period, scope, and magnitude for caribou as for the moose (Section 9.4.2.1.5), but the risk of occurrence should be smaller. As there is moderate scientific uncertainty, proposed mitigation measures may be modified as data becomes available from the woodland caribou monitoring program (Section 9.7).

Summary of Effects

Potential construction effects on woodland caribou are expected to be negative, small, Regional, long-term and insignificant.

Most expected effects are mitigable or reversible. Certainty regarding the potential effects is moderate, because of uncertainty concerning harvest mortality and accidental effects such as large fires that may affect caribou habitat.

Woodland caribou will experience a loss and alteration of a small area of habitat at the generating station footprint, access road, and borrow areas, compared to the large area these animals use. Primary caribou habitat, which covers 73% of the Region, is concentrated in peatland habitats. The maximum extent of physical losses of primary habitat (excluding future site rehabilitation) in the Upland Project Areas is less than 0.2% of the Regional habitat. The proposed generating station site has a small area of critical calving habitat (one of an estimated 100 or more sites), and therefore, the loss of this site should not be significant. Other known calving areas were avoided during access road routing. Early winter range, utilized by approximately 16 of an estimated 200 animals, and movement corridors in the Sub-Region will be affected by the access road. Limited caribou summer range will also be affected. Current scientific uncertainty regarding specific impacts will be managed by monitoring.

Woodland caribou will experience small effects from sensory disturbances (e.g., traffic, machinery, operation, blasting), a loss of habitat effectiveness and possibly habitat fragmentation. The maximum extent these effects involving primary habitat is less than 1% of the Region. Scientific uncertainties concerning access effects (i.e., increased mortality due to hunting, predation and disease) are manageable through Project planning and monitoring. Accidental events such as spills, fires or wildlife-vehicle collisions may affect woodland caribou abundance or caribou habitat, but the risk of these events occurring is small.

9.4.2.2.2 Black bear

Habitat effects

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, 13.1 km^2 (82%) is considered to be primary and 2.9 km^2 (18%) to be secondary bear habitat (Table 9.4-5). Of the total bear habitat available within the 1 km Upland Buffer (71.8 km^2), about 9.8 km^2 (14%) may be lost to the access road RoW. Within the 1 km

Aquatic Buffer (116.6 km^2), about 3.4 km^2 (3%) may be lost at the generating station site. These habitat losses will continue through the operation phase, with the exception of rehabilitated sites in the decommissioned areas such as the work camp, or ditches. Important habitat, such as dens, is unlikely to be associated with either habitat loss or alteration.

While some primary bear habitat is located in uplands, the streams or creeks crossed by the access road and the shorelines surrounding the generating station site also offer habitat for bear (Section 9.3.2.2.2). The estimated total habitat loss or alteration in the study areas is, <2% of the primary habitat available to bear in the Sub-Region and is not significant. Alternative food and cover are available to bear throughout these areas and in the Sub-Region, so the few bear that use these areas will likely find suitable habitat elsewhere outside of the disturbed site. The negative effect of habitat loss and alteration on black bear is expected to be site-specific and long-term.

The predicted impacts to bear of the access road ditches, as well as construction and demobilization of coffer dams have the same period, scope, and magnitude as for the mink (Section 9.4.2.1.4). The physical presence of the road itself is unlikely to create a barrier to black bear movements. The predicted impacts are the same period, scope and magnitude as for the moose (Section 9.4.2.1.5), except when bears hibernate in winter, there will be no effect.

Sensory Disturbance Effects

Black bears are sensitive to disturbance but show a high level of adaptability and habituation. They have a highly developed sense of smell making them particularly sensitive to odor disturbances. Though less sensitive to high frequency sounds than other carnivores, black bears have an acute sense of hearing. Sensitivity of bears to disturbance appears to depend on the season, the region, the extent of activity, and whether the population is harvested (Goodrich and Berger 1994; Jalkotzy et al. 1997). Habituation to disturbance is most likely to occur where disturbances are frequent and animals are not hunted (Goodrich and Berger 1994). The availability of food “rewards” also facilitates the habituation process, as black bears frequenting garbage dumps become tolerant to disturbance (RRCS 1994).

Black bears are most sensitive to disturbance between October and April, when denning occurs and cubs are born. Dens are usually constructed in crevasses or excavated burrows in ground materials that shelter bears from most disturbances; however, they will abandon dens in the event of disruptive intrusion (Goodrich and Berger 1994, RRCS 1994). Disturbed bears will usually select new dens but instances of cub abandonment due to disturbance are known (Goodrich and Berger 1994). Bears that are disrupted in fall tend to lose more weight over the winter than undisturbed bears (Tietje and Ruff 1980).

Blasting along the northern sections of road in 2004 and the intensive blasting scheduled to occur from August to November 2005 at the generating station site may interfere with some bears' ability to maximize fat storage prior to denning. Bears will, however, have several months to either habituate to the blasting or to move to secondary den locations. Most bears will have emerged from dens before the minor blasting from May to July 2008 to remove rock plugs. Pre-blast activity at this site will preclude the use of the area for denning but if bears are present they may exhibit stress or habitat alienation in response. This will likely affect only a very small number of bears. Negative effects will be short-term, and have small, site-specific impacts.

There is evidence that black bears will avoid areas within 100 m of open roads and that they tend to avoid high-use roads more than low use roads (Jalkotzy et al. 1994). The predicted impacts for the loss of habitat effectiveness, and other sensory disturbance effects, have the same period, scope, and magnitude as for the moose (Section 9.4.2.1.5), except in winter, when there will be no effect to bears as they are in their dens.

Access effects

Domestic use of black bear by NCN resource harvesters is very low (Volume 7). Bear mortality may increase slightly due to increased trapping and hunting activities (Kolenosky 1986) by NCN members in the area but this should have no effect on bears in the Sub-Region

Bears may experience some benefit with respect to their opportunity for travel and hunting along the access road RoW during periods when vehicle traffic is low and hunting of bears is restricted (Jalkotzy et al. 1994) but much scientific uncertainty exists with this hypothesis, (Brody and Pelton 1989). The predicted impacts of changes to access have the same period, scope, and magnitude as for the mink (Section 9.4.2.1.4) with one exception.

Black bears will experience more frequent encounters with humans and have a greater attraction to food and waste than many other animals. Most encounters will be uneventful; however, bears may become aggressive when they are surprised, defending cubs or guarding a food source. Frequent encounters may also cause bears to lose their fear of humans and respond unpredictably when encountered (Herrero 1985). These situations may result in the need for control actions such as electric fencing and bear-proof caging for waste storage and disposal sites. In some cases, the relocation or removal of "problem" black bears, after consultation, with and procurement of approval and permits from Manitoba Conservation. These actions will likely have no effect on the bear population in the Upland Buffer.

Accidental events

The predicted negative impacts for accidental events such as spills and vehicle collisions, have the same period, scope, and magnitude as for moose (Section 9.4.2.1.5), except in winter, when there will be no effect to bears as they are in their dens. Also, as with moose, accidental fires have both positive and negative effects on bears. The vigour of black bear populations has been linked to increases in moose populations associated with early post-fire successional stages (Schwartz and Franzman 1991). Given the low probability of occurrence, there will likely be no effect on the black bear population.

Summary of Effects

Potential construction effects on black bear are expected to be negative, small, site-specific to Sub-Regional, long-term and insignificant.

No significant population-level effects are expected for black bears. During construction, most effects to individual black bears will occur in the Aquatic and Upland Buffers. These effects may include direct loss of cover and forage, habitat alienation from sensory disturbances, den relocations, deflection or disruption of movements, some stress and increased energy expenditure for a few individuals, mortality from harvest or accidents, and changes to habitat or other factors from accidental events. Some or all of the positive habitat impacts associated with the road may be offset by other negative road related impacts such as traffic, hunting, and increased risk of vehicle collisions.

9.4.2.2.3 Gray wolf

Habitat Effects

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, 13.1 km^2 (81%) is considered to be primary and 3.0 km^2 (19%) to be secondary wolf habitat (Table 9.4-5). Wolves use these habitats in summer and winter. In summer, habitat along the access road contains one known rendezvous site, and some sites are used as travel corridors. Of the total wolf habitat available within the 1 km Upland Buffer (71.8 km^2), about 9.8 km^2 (14%) may be lost to the access road RoW. Within the 1 km Aquatic Buffer (116.7 km^2), about 3.3 km^2 (3%) may be lost at the generating station site. Critical habitat such as denning sites for wolf is unlikely to be associated with either habitat loss or alteration. These habitat losses will continue through the operation phase, with the exception of rehabilitated sites in the decommissioned work camp, borrow areas or ditches.

Although the loss or alteration of primary habitat in the Upland Project Area is significant in comparison to the Upland Buffer (27%), wolves utilize extensive habitat and range to meet their life-requisites. The total loss or alteration of primary habitat available to wolf in either the Sub-Region (1.7%) or Region (0.3%) is not significant. Alternative food and cover are available to wolf throughout these areas and in the Region, so individuals that use these areas will likely find suitable habitat elsewhere. The negative loss of habitat is considered small, site-specific and long-term.

The predicted impacts to wolves of the access road, RoW ditches, and construction and demobilization of coffer dams have the same period, scope, and magnitude as for the moose (Section 9.4.2.1.5).

Sensory Disturbance Effects

Wolves are generally sensitive to human disturbance and may alienate habitat in response (Stein 2000). Roads can have a significant effect on their movements and behaviour, and, ultimately, survival. Conversely, the access road may also benefit wolves by influencing distribution, movements and possibly population dynamics (Jalkotzy et al. 1997, James and Stuart-Smith 2000), especially as they relate to the predator-prey relationships. Wolves in wilderness areas can have a low tolerance for human disturbance near their dens and pups, but the gray wolf shows some adaptability to and tolerance of human disturbance, even during the denning period (Thiel et al. 1998).

Blasting that is scheduled to occur in 2004 may interfere with some wolf movements in the vicinity of the access road. Temporary deflection, displacement behaviour or some habitat alienation may occur at this time. The major blasting that is scheduled at the generating station site in 2005 may have a similar effect. The blasting of the rock plugs in May to July 2008 at the generating station coincides with the end of denning, which is considered a sensitive period during the wolves' life-cycle. However the blasts will be small and the nearest known wolf den is over 40 km from the generating station. This distance is expected to provide an adequate buffer that will reduce blasting to a no effect level. One or more of the known wolf packs in the Sub-Region, may den in the vicinity of the generating station, and if so, will be affected by disturbances at that site. The probability of a wolf den(s) occurring near the generating station is low, and wolves show adaptability to and tolerance of, noise disturbances. These negative effects should be small, site-specific and short-term.

The negative impacts of sensory disturbance events caused by vehicles, etc. along the access road that is near the known territory of two wolf packs should be short-term, site-specific and small, and have a negligible effect on the wolves in the Upland or Aquatic Buffers. Wolves can be attracted to or avoid (Thurber et al. 1994) habitats having sensory disturbances nearby, but it depends on factors such as traffic volumes and degree of habituation (Ballard et al. 1987; Thiel et al. 1998). Watercraft, ATV's and snowmobiles operation may create a more widespread, but similar negative effect by causing physiological stress (Creel et al. 2002). Temporary effective habitat loss may occur between 0 to 800 m on either side of the access road and elsewhere.

Access Effects

Wolves are trapped in the Region primarily for commercial purposes (Volume 7). On average, RTLs that lack road access harvest fewer (data from 1976/1977 to 2000/2001 (Volume 7) indicate a ratio of 1:6) wolves than those that do. Improved access to the Sub-Region may result in a large increase in the wolf harvest by local trappers. Traditional sustainable harvest practises and the Access Management Plan will ensure that any population effect is limited. A small, negative, Sub-Regional and long-term impact is expected on the wolf population as a result of increased access during construction.

The creation of new linear corridors, such as the access road, may alter the population dynamics between wolves and their prey during construction and in the foreseeable future. If wolves travel on the access road or are attracted to habitat nearby, they may increase opportunistic predation of moose or caribou (Jalkotzy et al. 1997). The positive impacts of this may be small and long-term, primarily restricted to the Upland Buffer population, but much scientific uncertainty exists with this hypothesis, especially concerning measurable population effects.

Accidental Events

The predicted impacts of accidental spills, fire (Ballard et al. 2000), or vehicles collisions, (one wolf mortality was reported on PR 391 between Thompson and Nelson House in 2001 (NCN member, pers. comm.)) have the same period, scope, and magnitude as for moose (Section 9.4.2.1.5).

Summary of Effects

Potential construction effects on gray wolf are expected to be negative, small, site-specific to Sub-Regional, long-term and insignificant.

No significant population-level effects are expected for wolves as a result of construction activities. During construction, most effects to individual wolf will occur in the Aquatic and Upland Buffers, particularly at the generating station site. These effects may include direct loss of cover and forage, habitat alienation from sensory disturbances, den relocations, deflection or disruption of movements, some stress and increased energy expenditure for a few individuals, mortality from harvest or accidents, and changes to habitat or other factors from accidental events. Some or all of the positive habitat impacts associated with the road may be offset by other road related impacts such as traffic, hunting, and increased risk of vehicle collisions.

9.4.2.2.4 Pine marten

Habitat effects

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, 1.4 km^2 (9%) is considered to be primary and 14.6 km^2 (91%) to be secondary marten habitat (Table 9.4-5). Of the total marten habitat available within the 1 km Upland Buffer (3.7 km^2), about 0.4 km^2 (11%) may be lost to the access road Row. Within the 1 km Aquatic Buffer (25.6 km^2), about 1.0 km^2 (4%) may be lost at the generating station site. These habitat losses will continue through the operation phase, with the exception of rehabilitated sites in the decommissioned work camp, or ditches. Some important marten habitats (MFWMP 1994b; Clevenger et al. 2001) such as dens and mature forest (i.e., cover and food supply) are associated with habitat loss and alteration.

While some primary marten habitat is located in uplands, adjacent streams or creeks crossed by the access road and shorelines surrounding the generating station site also offer habitat for marten (Section 9.3.2.2.4). Although the loss or alteration of primary habitat in the Upland Project Area is significant when compared to the area of the Upland Buffer (>100%) (Volume 6 Section 5), the total loss or alteration is only <1% of the primary habitat available to marten in the Sub-Region and is not significant. Alternative food and cover are available to marten throughout these areas and in the Sub-Region so the few marten that these areas will likely find alternative habitat elsewhere The negative effect of habitat loss and alteration on pine marten is expected to be site-specific and long-term.

The predicted impacts of these changes to marten habitats, of sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as for the muskrat (Section 9.4.2.1.1), with the following exceptions.

Habitat fragmentation effects will be different as marten primarily use uplands habitats. Marten are less tolerant of open habitats (Chaplin et al. 1998) but they do cross these barriers (MFWMP 1994b). Because marten also occasionally use lowland habitats, the spatial placement of drainage culverts along roads can be used as an indirect mitigation measure, and it has been shown to minimize habitat fragmentation (Clevenger et al. 2001).

Marten may respond to disturbance by avoidance and have been shown to reduce their activity near highways or alienate roadside habitat altogether (Robitaille and Aubry 2000; Clevenger et al. 2001). Effective habitat loss may range between 0 to 200 m on either side of the access road. Blasting impacts should be the same as for black bear (Section 9.4.2.2.2). Overall, pine marten appear to be relatively tolerant of disturbance even during the denning period (RRSC 1994) if they are not actively pursued. Marten were present in the Sundance townsite during the construction of the Limestone Generating Station (D. Windsor, pers. comm.).

The predicted impacts arising with increased access and trapping effects should be more similar to wolf (Section 9.4.2.2.3) than to muskrat.

Accidental fires that may occur as a result of construction activities may have a site-specific, long-term, negative impact on marten, which use mature trees, such as spruce, that are slower to recover from fire than most plants used by muskrats. Some marten may use early to mid-successional post-burn habitat, but usage is restricted to primarily non-breeding individuals (Paragai et al. 1996). With mitigation, no effect to marten abundance is anticipated.

Summary of Effects

Potential construction effects on pine marten are expected to be negative, small, site-specific to Sub-Regional, long-term and insignificant.

No significant population-level effects are expected for pine marten as a result of construction activities. During construction, most effects to individual marten will occur in the Aquatic and Upland Buffers. These effects may include direct loss of cover and forage, habitat alienation from sensory disturbances, den relocations, deflection or disruption of movements, some stress and increased energy expenditure for a few individuals, mortality from harvest or accidents, and changes to habitat or other factors from accidental events. Some or all of the positive habitat impacts associated with the road may be offset by other road related impacts such as traffic and trapping.

9.4.2.2.5 Lynx

Habitat effects

Of the 16 km^2 of Upland Project Areas that may be lost or altered during construction, 8.3 km^2 (52%) is considered to be primary and 7.7 km^2 (48%) to be secondary lynx habitat (Table 9.4-5). Of the total lynx habitat available within the 1 km Upland Buffer (43.9 km^2), about 7.7 km^2 (17%) may be lost to the access road RoW. Within the 1 km Aquatic Buffer (34.4 km^2), about 0.6 km^2 (2%) may be lost at the generating station site. These physical habitat losses will continue through the operation phase, with the exception of rehabilitated sites in the decommissioned work camp, or ditch environments beside the access road. At least one lynx den site was known to occur near the proposed access road, but this habitat is not considered critical. Lynx rarely re-use dens from year to year (Slough 1999).

While some primary lynx habitat is located in uplands, adjacent streams or creeks crossed by the access road and shorelines surrounding the generating station site also offer habitat for lynx (Section 9.3.2.2.5). Although the loss or alteration of primary habitat in the Upland Project Area is significant when compared to the Upland Buffer (29.4%), the total loss or alteration of only 2.9% of the primary habitat available to lynx in the Sub-Region is not significant. Alternative food and cover are available to lynx throughout these areas and in the Sub-Region so that the few lynx that use these areas will likely find alternative habitat elsewhere. The negative effect of habitat loss and alteration on lynx is expected to be site-specific and long-term.

The predicted impacts of these changes to lynx habitats, of sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as for the wolf (Section 9.4.2.2.3), with some exceptions. The period of use may differ, for example, such that lynx will use post-fire seres in burns 5 to 50 years old, but optimal lynx habitat is usually achieved between 15 to 30 years (Slough 1999).

Few data exist regarding lynx sensitivity, response and habituation to disturbance. Lynx may respond to disturbance by avoiding developed areas and frequently used, wide roads (RRSC 1994; Jalkotzy et al. 1997; Slough 1999). Effective habitat loss may range between 0 to 500 m on either side of the access road. Other sensory disturbance effects such as recreational activities, and especially the use of snowmobiles nearby, may influence natality and survival of lynx (Olliff et al. 1999; BC Ministry of Water, Land and Air Protection 2002). Although negative effects should be small, site-specific and short-term to long-term, moderate scientific uncertainty exists for understanding sensory disturbance effects.

The predicted impacts to lynx resulting from increased access as it relates to trapping effects should be more similar to the muskrat (Section 9.4.2.1.1) than to the wolf.

Summary of Effects

Potential construction effects on lynx are expected to be positive to negative, small, site-specific to Sub-Regional, long-term and insignificant.

No significant population-level effects are expected for lynx as a result of construction activities. During construction, most effects to individual lynx will occur in the Upland Buffers. These effects may include direct loss of cover and forage, habitat alienation from sensory disturbances, den relocations, deflection or disruption of movements, some stress and increased energy expenditure for a few individuals, mortality from harvest or accidents, and changes to habitat or other factors from accidental events. Some or all of the positive habitat impacts associated with the road may be offset by other road related impacts such as traffic and trapping.

9.4.3 Effects Assessment for Operation

This section focuses on impacts and mitigation actions related to the operation of the Project. The Project activities are detailed in Volume 3. Over the operating period, mammals may continue to experience effects that are similar to construction impacts (Section 9.4.2), including habitat effects, sensory disturbance effects, access effects, and accidental events, but with possible changes in magnitude, duration and scale. Other potential impacts over the operating period that are not present during construction include:

- mercury effects where increased mercury concentrations in aquatic mammals may affect their suitability as a food source for humans and at extreme levels, can be harmful to the animal's health. Mercury concentrations can increase in fish-eating mammals such as mink and otter as the concentrations increase in the consumed fish. Limited historical data from the study area following CRD indicated elevated, but non toxic, mercury concentrations in mammals. Only minor changes in mammal mercury concentrations are expected due to the small amount of flooding associated with the proposed Project.

Mammals will not be affected by sensory disturbances from construction equipment activity and blasting, which will not occur over the operation period. Vehicle traffic and human presence associated with operations will be relatively low, but recreational and domestic activities associated with improved access may increase, or at least, sensory disturbances will remain the same. The magnitude of these impacts may depend on concurrence of the activity with a sensitive species life period, such as calving.

Effective habitat loss and other access effects (e.g., hunting, trapping) can be reduced by limiting traffic volumes and preventing unnecessary access. Species such as moose and woodland caribou will continue to be most affected by long-term access because of their low rates of recruitment. Mitigation of these effects will be addressed in the Access Management Plan.

Accidental impacts from spills, vehicle-wildlife collisions or fire that may affect individuals or the occupied habitats, will continue over the Project operation period. Effects on mammals are expected to be similar to accidental impacts during construction (Section 9.4.2), but the risk of these occurrences should be lower due to lower traffic volumes and people. The mitigation measures planned and implemented over the Project construction period will continue during operations with adjustments as necessary to reflect new information procured during monitoring programs.

An examination of the impacts related to specific activities during operations for each of the riparian and terrestrial mammal VECs, and specific mitigation measure for those impacts, follows.

9.4.3.1 Riparian Mammal Community

The impacts to the riparian community during operation will be the alteration of riparian mammal habitat both upstream and downstream of the dam from flooding, the stabilization of Wuskwatim Lake at about the 234 m ASL which may affect the existing shorelines, and the increased frequency of daily water level fluctuations downstream of the generating station (Volume 3 and Volume 6 Section 5).

Flooding is expected to convert a small amount of terrestrial habitat to riparian habitat (Volume 6 Section 5) immediately upstream of the generating station on the Burntwood River, resulting in minor habitat losses for some species and gains for others. Minor changes to the riparian mammal community may occur as a result of changes to shoreline lengths. Shoreline length will increase minimally due to the limited flooding.

Shoreline habitats that are affected by stabilization of the water at about 234 m ASL may alter riparian mammal habitats, increasing it marginally for some species while marginally reducing it for others. The infrequent 1 m drawdowns will generally occur in summer or fall, which will create less of an effect on mammals than winter drawdowns. Shoreline habitat length will increase on the mainland but this will be mostly offset by a decrease on the islands that will be inundated or removed. Mainland shoreline increases include some shore types that support vegetation while island shoreline losses all occur on shore types that do not support vegetation (Volume 6 Section 5).

The increased frequency of daily water level fluctuations downstream of the generating station will affect riparian mammal habitats. These effects should be greater near the generating station and dissipate further downstream, until they are nearly undetectable by Opegano Lake. The effects should be minor unless peatland habitat is affected.

Long-term habitat changes possibly resulting from ice-scour, erosion, debris or changes in beach width (Volume 4) may alter riparian mammal habitats. Many of these impacts are similar to those that occur with existing conditions, and should have no effect on mammal habitat (Volume 6 Section 5). Riparian mammals will continue to incorporate these effects into daily and seasonal movements and use of habitats along the shorelines.

During the operation phase, the small area to be flooded should not cause a measurable increase in mercury levels. Mercury levels may however, increase as a result of leaching of materials from terrestrial vegetation (in particular areas of peat) after water levels are stabilized at the upper end of the current range. Peatlands should not die as a result of these water level changes (Volume 6 Section 5) so increases in mercury levels should be much less than if these areas were flooded to a greater extent. If some mercury is released into the riparian community, mercury levels in fish (Volume 5) and aquatic furbearers may increase slightly above current baseline levels as a result of biomagnifications through the food web.

Habitat alterations to riparian communities that began during the construction period should continue into the operation period. The long-term re-establishment of vegetation, especially in ditches, borrow areas and the sewage lagoon may marginally increase habitat for a few individuals in the riparian communities during the operation period.

Habitat areas altered due to flooding are presented in Table 9.4-6. Shoreline length habitats for riparian VECs are presented in Table 9.4-7.

Table 9.4-6. Projected habitat alterations from flooding.

Species	Study Areas	Primary Habitat			Secondary Habitat			Non-habitat		
		Area (km^2)	% of Area	% change	Area (km^2)	% of area	% change	Area (km^2)	% of area	% change
Muskrat	1 km Aquatic Buffer	21.37	12	0	5.89	3	0	153.00	85	<0.3
	Total Flooded	0	0		0	0		0.39	100	
Beaver	1 km Aquatic Buffer	9.61	5	0	0	0	0	180.33	95	<0.3
	Total Flooded	0	0		0	0		0.39	100	
River otter	1 km Aquatic Buffer	32.01	17	2.9	157.93	83	<0.1	0	0	0
	Total Flooded	0.25	64		0.14	36		0	0	0
Mink	1 km Aquatic Buffer	28.00	15	6.2	161.94	85	<0.1	0	0	0
	Total Flooded	0.32	82		0.07	18		0	0	
Moose	1 km Aquatic Buffer	120.14	63	<0.4	69.59	37	<0.1	0	0	0
	Total Flooded	0.34	88		0.05	12		0	0	

Habitat in the Study Areas (used for ecological unit comparisons)
Total habitat lost or altered (by operation)

Table 9.4-7. Projected habitat alterations from changes along shorelines.

Species	Study Areas	Primary Habitat		Secondary Habitat		Non-habitat	
		Length (km)	% of Length	Length (km)	% of Length	Length (km)	% of Length
Muskrat	Total Shoreline Changes (without Peat or Mineral Islands)	139.7	49	62.0	22	81.0	29
	Upstream of GS *	136.0	62	35.0	16	50.0	23
	Downstream of GS *	3.7	6	27.0	44	31.0	50
	Peat Islands **	524.2	100	0.0	0	0.0	0
Beaver	Total Shoreline Changes (without Peat Islands)	84.0	25	22.0	7	231.0	69
	Upstream of GS	68.0	25	22.0	8	182.4	67
	Downstream of GS	16.0	25	0	0	48.6	75
	Peat Islands	0	0	212.0	100	0	0
River otter	Total Shoreline Changes (without Peat Islands)	284.0	84	53.0	16	0	0
	Upstream of GS	234.4	86	38.0	14	0	0
	Downstream of GS	49.6	77	15.0	23	0	0
	Peat Islands	524.2	100	0	0	0	0
Mink	Total Shoreline Changes (without Peat Islands)	210.0	62	127.0	38	0	0
	Upstream of GS	159.0	58	113.4	42	0	0
	Downstream of GS	51.0	79	13.6	21	0	0
	Peat Islands	0	0	524.2	100	0	0
Moose	Total Shoreline Changes (without Peat or Mineral Islands)	224.0	79	61.0	21	0	0
	Upstream of GS	166.0	75	55.0	25	0	0
	Downstream of GS	58.0	91	6.0	9	0	0
	Peat Islands	358.0	100	0	0	0	0

[shaded box] Total shoreline habitat length affected by 234 m ASL
* Sub-total shoreline habitat length affected by 234 m ASL
** Total peat island perimeter (shorelines) affected by 234 m ASL

Note: net difference of shoreline lengths between existing environment and project operation is calculated here without changes to Opegano Lake shoreline (refer to Volume 6 Section 5 for precise changes).

9.4.3.1.1 Muskrat

Habitat Effects

Forebay flooding will create new muskrat habitat (approximately 37.5 ha) mainly along the shoreline upstream of the dam (Table 9.4-6). About 0.39 km^2 or <1% of the habitat within the 1 km Aquatic Buffer (153.0 km^2) that did not support muskrat prior to the project may be converted to either primary or secondary muskrat habitat. This habitat alteration will be considered positive, small, site-specific and long-term if appropriate habitat is established and muskrat colonize the site.

About 136.0 km of primary and 35.0 km of secondary muskrat habitat along the 272 km of shorelines upstream of the generating station may be affected by the Project (Table 9.4-7). Small, short-term and long-term changes to shoreline length and to changes in beach width (Volume 6 Section 5) should not significantly alter muskrat use of these habitats. The immediate negative effects will be the small, site-specific reduction of muskrat habitat. When site-specific habitat changes occur in the long-term, they should be positive and benefit muskrat upstream of the generating station.

Operation of the Project will result in a neutral to positive, small, site-specific and long-term alteration of muskrat habitat associated with water level stabilization in Wuskwatim Lake, Cranberry Lakes, Sesep Lake, Wuskwatim Brook and South Bay (Volume 3 and Volume 6 Section 5). The stabilization of water levels at about 234 m ASL should benefit muskrat in the short-term and long-term by increasing the availability of specific habitat components (i.e., stable wetted runway access to shoreline dens and push-ups). Another positive impact of stable water levels is the effect of reducing the likelihood of 'freeze-out.' Muskrats may vacate habitats if water levels in winter drop to the point where access to offshore feeding sites is severely impeded. Conversely, unexpected rises in water levels may drown muskrat kits in dens (Welch et al. 1984; Perry 1990; Thurber et al. 1991). With the Project, this should no longer occur to the same extent, and it will provide positive, small, site-specific benefits to muskrat in the long-term. The positive effects of stable water levels will be reduced when infrequent 1 m drawdowns occur in summer or fall. This, however, will create less of an effect on the muskrat sub-population than winter drawdowns.

Small habitat benefits are expected from water level stabilization and the formation of peatlands along shorelines that may increase muskrat forage (i.e., sedges, ericaceous plants), or at least remain unchanged over the long-term. Cattails and sedges are important muskrat food sources that are relatively abundant in the Cranberry Lakes, Sesep Lake, Wuskwatim Brook and South Bay. Most cattails grow on the peat islands and the sunken fringes of peatlands (Volume Section 5). Because no change is expected in the rate of peat island disintegration, no effect from the Project is expected on muskrat habitat. However, there may be a short-term, small decline in cattails that grow along mainland shorelines but are absent along the shorelines of mineral islands (Volume 6 Section 5). This localized loss of cattails may negate some of the benefits to muskrat. Shoreline sedges may, however, increase and provide a stable food source. In the long-term, cattails and sedges should reestablish along the sunken fringes of peatlands, and elsewhere, that form during stable water level conditions. Shoreline peatlands may not produce as much cattail forage but may produce more sedges, thereby either benefiting muskrat, or having no effect.

Operation of the generating station will result in a site-specific alteration of muskrat habitat along the Burntwood River and Opegano Lake (Volume 6 Section 5). Some primary and secondary muskrat habitat (i.e., 3.7 and 27 km respectively), and few muskrat, occur along the shorelines of the Burntwood River below Wuskwatim Falls, the creeks, and shorelines of Opegano Lake (Table 9.4-7). The limited areas of muskrat habitat near the generating station will be affected more than those further downstream; effects are expected to be undetectable at Opegano Lake, unless effects on primary and secondary peatland habitats are greater than expected (Volume 6 Section 5). Potential negative effects of daily water level fluctuations on muskrat habitat downstream the generating station should be negative, small, site-specific and long-term.

Other than forebay flooding, and long-term changes to vegetation in decommissioned areas, gains or losses of muskrat habitat, as measured by changes in the vegetation that provides food and cover for muskrats, are not expected during the operational phase.

Movements and habitat attributes for species such as muskrat can be affected by changes to water flow and ice regimes or in the volume of debris along shorelines. Changes in bank erosion may also affect muskrat denning sites (Volume 4). However, water flow, ice regime, erosion rates, or debris volumes are expected to change significantly in the Aquatic Buffer. With some scientific uncertainty, these changes should have either no effect, or a small, site-specific and long-term negative impact on muskrat habitat.

Decommissioned areas such as borrow pits should show small, site-specific, and long-term positive habitat alterations with mitigation for the muskrat (Volume 6 Section 5). Altered habitats, such as borrow pits that eventually fill with water and become re-vegetated, may provide a few muskrat with food and cover, and result in a small net gain of muskrat habitat.

The access road RoW will result in small, site-specific and long-term benefits to muskrat habitat. Roadside ditches will continue to grow valued muskrat food items such as sedges and cattails, especially during spring and summer. Ditch water may not be deep enough to support muskrats over winter, thereby negating part of the benefits.

Other than sensory disturbance effects that may contribute to some habitat alienation, the long-term presence of the access road or generating station infrastructure will likely have no effect on muskrat movements.

Sensory Disturbance Effects

Fewer sensory disturbances should occur along the access road during operation than construction. These events will be caused by mechanical noise at the generating station, human presence, and operation of occasional recreational and watercraft vehicles and have small, short-term and site-specific negative effects on muskrat. Wildlife such as muskrat are able to shelter themselves from sensory disturbances by entering burrows or escaping to cover. A few individuals may be affected, but there should be no effect on the muskrat population.

Access Effects

The small, Sub-Regional and long-term negative impact on the muskrat population as a result of increased access during construction (Section 9.4.2.1.1) will continue during operation.

Mercury Effects

As a result of the preliminary sampling program (RKSE and WRCS, Unpubl. Data), no effect is anticipated for the muskrat population in the Project area. A moderate level of scientific uncertainty remains. Ongoing monitoring will be conducted.

Accidental Events

The impacts of accidents that occur during operation should not differ from those during the construction period (Section 9.4.2.1.1). Given their low probability of occurrence, accidental spills, collisions and fires should have no effect on the muskrat population.

Summary of Effects

Effects on muskrats from operation impacts are expected to be positive to negative, small, site-specific to local, long-term and insignificant.

Muskrats and muskrat habitat will be affected by water level stabilization upstream of the generating station, and by daily water level fluctuations downstream of the generating station. More stable water levels should benefit muskrat and muskrat habitat but will depend on the timing of drawdowns. The infrequent 1 m drawdowns will generally occur in summer or fall, which will create less of an effect than winter drawdowns. Some sources of shoreline food and cover will change over the long-term. Negative changes to downstream muskrat habitat may result from an increased frequency of daily water level fluctuations. The limited areas of muskrat habitat near the generating station will be affected more than those further downstream; effects are expected to be undetectable at Opegano Lake, unless effects on primary and secondary peatland habitats are greater than expected. Possible changes to the muskrat population and habitat are small when compared to the large area used by these animals; especially the numerous ponds, creeks and lakes outside the area affected by the Project. Certainty regarding the potential effects is moderate, because of uncertainty concerning the magnitude of the opposing positive and negative habitat effects upstream and downstream of the proposed generating station.

Muskrat may experience some sensory disturbances. Access effects may include increased mortality from increased trapping, and small effects from increased predation related to the access road. Mercury levels in muskrat are not expected to increase, but some scientific uncertainty about the mercury release and accumulation processes remains. Accidental events such as chemical spills or fire may affect muskrat or muskrat habitat, but the risk of these events occurring is small.

9.4.3.1.2 Beaver

Habitat Effects

Forebay flooding will create new beaver habitat mainly along the shoreline upstream of the dam (Table 9.4-6). About 0.39 km^2 or <1% of the habitat within the 1 km Aquatic Buffer (153.0 km^2) that did not support beaver prior to the Project may be converted to either primary or secondary beaver habitat. This habitat alteration will be considered positive, small, site-specific and long-term if appropriate habitat is established and beaver colonize it.

About 68.0 km of primary and 22.0 km of secondary beaver habitat along the 272 km of shorelines upstream of the generating station may be affected by the Project (Table 9.4-7). Small short-term and long-term changes to shoreline length and to beach width (Volume 6 Section 5) should not significantly alter beaver use of these habitats. The immediate negative effects will be a small, site-specific reduction of beaver habitat.

When site-specific habitat changes occur in the long-term, they should be positive and benefit beaver upstream of the generating station.

Operation of the Project will result in a neutral to positive, small, site-specific and long-term alteration of beaver habitat associated with water level stabilization, similar to muskrat (Section 9.4.3.1.1). While aspen trees are beaver's primary food source, willow, and some ericaceous shrubs are also important beaver food sources. Beaver habitat benefits are expected from water level stabilization and the formation of peatlands along shorelines that may increase beaver forage in the beach/upland edge transition zone (Volume 6 Section 5). No effect from the Project is expected on beaver habitat as a result of changes to secondary peat island habitat.

Operation of the generating station will result in a site-specific alteration of beaver habitat along the Burntwood River and Opegano Lake (Volume 6 Section 5). Some primary and secondary beaver habitat (i.e., 16.0 and 0 km respectively), and several beaver colonies occur along the shorelines of the Burntwood River below Wuskwatim Falls, the creeks, and at Opegano Lake (Table 9.4-7). The limited areas of beaver habitat near the generating station will be affected more than those further downstream; effects are expected to be undetectable at Opegano Lake, unless effects on primary and secondary peatland habitats are greater than expected (Volume 6 Section 5). Beaver that occupy habitat near the generating station where daily water level fluctuations are greatest are expected to abandon these sites and relocate to better habitat. Potential negative effects of daily water level fluctuations on beaver habitat downstream the generating station should be negative, small, site-specific and long-term.

The predicted impacts of these changes to beaver habitats, of sensory disturbances, changes in access, mercury effects and accidents have the same period, scope, and magnitude as for the muskrat (Section 9.4.3.1.1), with two exceptions. As in Section 9.4.2.1.1, if beavers create unsafe road or working conditions by blocking culverts or creating impoundments beside roadways, beaver dams, lodges and occasionally individual animals or families will have to be removed. These actions will likely have no effect on the beaver population in the Upland Buffer.

Second, accidental fires that may occur as a result of operation activities may have a site-specific, short-term to long-term, negative impact on beavers which use trees, such as aspen that are slower to recover from fire than most plants used by muskrats. With mitigation, no effect to beaver abundance is anticipated.

Summary of Effects

Potential operational effects on beaver are expected to be negative to neutral, small, site-specific to local, long-term and, therefore, insignificant.

Beaver and beaver habitat in those areas affected by water level stabilization upstream of the generating station, and affected by daily water level fluctuations below the generating station, will experience both positive and negative effects. Stable water levels will benefit beaver and beaver habitat but will depend on the timing of drawdowns. The infrequent 1 m drawdowns will generally occur in summer or fall, which will create less of an effect than winter drawdowns. Some sources of shoreline food and cover will change over the long-term. Negative changes to downstream beaver habitat may result from an increased frequency of daily water level fluctuations. The beaver colonies near the generating station will be affected more than those further downstream; effects are expected to be undetected at Opegano Lake, unless effects on peatlands are greater than expected (Volume 6 Section 5). Possible changes to the beaver population and habitats are small when compared to the large area these animals use; especially in ponds, creeks and lakes outside the area affected by the Project. Certainty regarding the potential effects is moderate, because of less certainty concerning opposing positive and negative habitat effects upstream and downstream of the proposed generating station.

Beaver may experience some sensory disturbances. Access effects may include increased mortality from increased trapping. Mercury levels in beaver are not expected to increase, but some scientific uncertainty remains. Accidental events such as chemical spills or fire may affect beaver or beaver habitat, but the risk of these events occurring is small.

9.4.3.1.3 River otter

Habitat Effects

Forebay flooding will change otter habitat mainly along the shoreline upstream of the dam (Table 9.4-6). About 0.25 km^2 or <3% of the habitat within the 1 km Aquatic Buffer (32.0 km^2) that contained otter habitat will remain primary or be converted to secondary habitat. This potential change will likely have no effect on otter or otter habitat.

About 234.4 km of primary and 38.0 km of secondary otter habitat along the 272 km of shorelines upstream of the generating station may be affected by the Project (Table 9.4-7). Small, short-term and long-term changes to shoreline length and beach width (Volume 6 Section 5) should not significantly alter otter use of these habitats. The immediate effects will be neutral. When site-specific habitat changes occur in the long-term, they should be neutral to positive, and either have no effect or benefit otter upstream of the generating station.

Operation of the Project will result in a neutral to positive, small, site-specific and long-term alteration of otter habitat associated with water level stabilization, similar to muskrat (Section 9.4.3.1.1). Primary otter food sources such as fish, crayfish and clams should not be impacted significantly by water level stabilization (Volume 5) while other foods such as muskrat or beaver kits are expected to remain stable or possibly increase. Stabilized water levels may result in other positive effects such as easier access to shoreline bank dens in summer. No effect from the Project is expected on otter habitat as a result of changes to peat island habitat.

Operation of the generating station will result in a site-specific alteration of otter habitat along the Burntwood River and Opegano Lake (Volume 6 Section 5). Some primary and secondary otter habitats (i.e., 49.6 and 15.0 km respectively) occur along the shorelines of the Burntwood River below Wuskwatim Falls, the creeks, and at Opegano Lake (Table 9.4-7). Primary otter food sources such as fish, crayfish and clams should not be impacted significantly by daily water level fluctuations (Volume 5) while other foods such as muskrat or beaver kits are expected to remain stable or possibly decrease. Neutral to negative effects of daily water level fluctuations on otter habitat downstream of the generating station are expected to be small, site-specific, long-term, and have no effect on the otter sub-population.

The predicted impacts of sensory disturbances, changes in access, mercury effects and accidents have the same period, scope, and magnitude as for the muskrat (Section 9.4.3.1.1), with one exception. While some mercury will be added to the aquatic environment, high level predators that eat fish (such as otter), will be at a slightly higher risk for mercury accumulation than mammals such as muskrat. With moderate scientific uncertainty, a very small, local, long-term negative effect on otter is anticipated.

Summary of Effects

Potential operational effects on otter are expected to be positive to negative, small, site-specific to local, long-term and insignificant.

Otter and otter habitat in those areas affected by water level stabilization upstream of the generating station, and affected by daily water level fluctuations below the generating station, will experience both positive and negative effects. These effects should be small compared to the large area these animals use. Some summer and winter habitats are impacted but neither include critical habitat.

Otter may experience some small sensory disturbance effects. Access effects may include increased mortality from increased trapping. Accidental events such as chemical spills or fire may affect otter or otter habitat, but the risk of these events occurring is small. Riparian mammals such as otter may experience a very small increase in mercury. Certainty regarding the potential effects is moderate, because of less certainty concerning trapping mortality and mercury.

9.4.3.1.4 Mink

Habitat Effects

Forebay flooding will change mink habitat mainly along the shoreline upstream of the dam (Table 9.4-6). About 0.32 km^2 or 6.2% of the habitat within the 1 km Aquatic Buffer (28.0 km^2) that contained mink habitat will remain primary or be converted to secondary habitat. This potential change will likely have no effect on mink or mink habitat.

About 159.0 km of primary and 113.4 km of secondary mink habitat along the 272 km of shorelines upstream of the generating station may be affected by the Project (Table 9.4-7). Small, short-term and long-term changes to shoreline length and beach width (Volume 6 Section 5) should not significantly alter mink use of these habitats. The immediate effects will be neutral. When site-specific habitat changes occur in the long-term, they should be neutral to positive, and either have no effect or benefit mink upstream of the generating station.

Operation of the generating station will result in a site-specific alteration of mink habitat along the Burntwood River and Opegano Lake (Volume 6 Section 5). Some primary and secondary mink habitats (i.e., 51.0 and 13.6 km respectively) occur along the shorelines of the Burntwood River below Wuskwatim Falls, the creeks, and at Opegano Lake (Table 9.4-7). Neutral to negative effects of daily water level fluctuations on mink habitat downstream of the generating station are expected to be small, site-specific, long-term, and have no effect on the mink sub-population.

The predicted impacts of sensory disturbances, changes in access, mercury effects and accidents have the same period, scope, and magnitude as for the otter (Section 9.4.3.1.3).

Summary of Effects

Potential operational effects on mink are expected to be positive to negative, small, site-specific to local, long-term and insignificant.

Mink and mink habitat in those areas affected by water level stabilization upstream of the generating station, and affected by daily water level fluctuations below the generating station, will experience both positive and negative effects. These effects should be small compared to the large area these animals use. Some summer and winter habitats are impacted but neither include critical habitat.

Mink may experience some small sensory disturbance effects. Access effects may include increased mortality from increased trapping. Accidental events such as chemical spills or fire may affect mink or mink habitat, but the risk of these events occurring is small. Riparian mammals such as mink may experience a very small increase in mercury. Certainty regarding the potential effects is moderate, because of less certainty concerning trapping mortality and mercury.

9.4.3.1.5 Moose

Habitat effects

Forebay flooding will change moose habitat mainly along the shoreline upstream of the dam (Table 9.4-6). About 0.34 km^2 or <1% of the habitat within the 1 km Aquatic Buffer (120.1 km^2) that contained moose habitat will remain primary or be converted to secondary habitat. This neutral, small, site-specific and long-term change will likely have no effect on moose or moose habitat.

About 166.0 km of primary and 55.0 km of secondary moose habitat along the 272 km of shorelines upstream of the generating station may be affected by the Project (Table 9.4-7). Small, short-term and long-term changes to shoreline length and beach width (Volume 6 Section 5) should not significantly alter moose use of these habitats. Immediate and long-term effects are similar to muskrat and beaver (Sections 9.4.3.1.1 and 9.4.3.1.2) as moose eat similar foods (e.g., browse such as willow, alder and some ericaceous shrubs).

Operation of the generating station will result in a site-specific alteration of moose habitat along the Burntwood River and Opegano Lake (Volume 6 Section 5). Some primary and secondary moose habitats (i.e., 58.0 and 6.0 km respectively) occur along the shorelines of the Burntwood River below Wuskwatim Falls, the creeks, and at Opegano Lake (Table 9.4-7). Daily water level fluctuations on moose habitat downstream of the generating station will have no effect on the moose sub-population.

The predicted impacts of these physical changes to moose habitats, of sensory disturbances, changes in access, mercury effects and accidents have the same period, scope, and magnitude as for the beaver (Section 9.4.3.1.2). Mitigation measures during the construction period for moose (Section 9.4.2.1.5) will remain. Certainty regarding the potential effects is moderate, because of less certainty concerning harvest mortality.

Summary of Effects

Potential operational effects on moose are expected to be positive to negative, small, site-specific to local, long-term and, therefore, insignificant.

Moose and moose habitat in those areas affected by water level stabilization upstream of the generating station, and affected by daily water level fluctuations below the generating station, will experience both positive and negative effects. These effects should be small compared to the large area these animals use. Some summer and winter habitats are impacted but neither include critical habitat.

Moose will experience small effects from sensory disturbances. Harvest levels may increase as a result of increased access. Certainty regarding the potential effects is moderate, because of less certainty concerning harvest mortality. Scientific uncertainties concerning access effects (i.e., hunting, predation and disease) are manageable through Project planning and access road management. Accidental events such as chemical spills, fires or wildlife-vehicle collisions may affect moose abundance or moose habitat, but the risk of these events occurring is small.

9.4.3.2 Terrestrial Mammal Community

Water stabilization upstream of the generating station, and habitat changes downstream are considered for the riparian mammal community (Section 9.4.3.1). These habitat changes are not expected to affect the terrestrial mammal community other than the limited amount of flooding (37.5 hectares) during the operational phase (Table 9.4-8). Mercury effects are not expected for terrestrial mammals.

Habitat that was altered by construction will remain so during operation, and continue to affect the terrestrial community. The long-term re-establishment of vegetation, especially in rehabilitated borrow areas, work sites, and rock disposal areas may replace habitat that was lost during the construction period, but it may not return it to pre-disturbance conditions. Changes to terrestrial habitats may slightly alter the mammal species composition of the community. Critical habitats are not associated with longer-term alterations.

Table 9.4-8. Primary and secondary habitat for terrestrial species by flooded habitat in the Project Area.

Species	Study Areas	Primary Habitat			Secondary Habitat			Non-habitat		
		Area (km^2)	% of Area	% change	Area (km^2)	% of area	% change	Area (km^2)	% of area	% change
Woodland caribou	1 km Aquatic Buffer	176.13	93	<0.3	6.51	3	0	7.30	4	<0.1
	Total Flooded	0.38	99		0.00	0		0.01	1	
Black bear	1 km Aquatic Buffer	116.64	61	<0.5	72.94	38	<0.1	0.36	1	0
	Total Flooded	0.34	87		0.05	13		0.00	0	
Gray wolf	1 km Aquatic Buffer	116.70	61	<0.5	73.12	39	<0.1	0.00	0	0
	Total Flooded	0.33	86		0.05	13		0.00	1	
Pine marten	1 km Aquatic Buffer	25.64	14	<0.7	163.92	86	<0.2	0.38	1	0
	Total Flooded	0.10	25		0.29	75		0.00	0	
Lynx	1 km Aquatic Buffer	34.36	18	<0.1	155.20	82	<0.3	0.38	1	0
	Total Flooded	0.01	3		0.37	97		0.00	0	

Habitat in the Study Areas (used for ecological unit comparisons)
Total habitat lost or altered (by operation)

9.4.3.2.1 Woodland caribou

Habitat Effects

Forebay flooding will remove about 37.5 ha of woodland caribou habitat (Table 9.4-8). This includes some critical calving habitat but not important winter habitat. About 0.38 km^2 or <0.3% of the habitat within the 1 km Aquatic Buffer (176.1 km^2) that support woodland caribou will be converted to non-habitat. This habitat loss will be considered negative, small, site-specific and long-term. Individual caribou that use this habitat during the calf-rearing period should find primary habitat elsewhere in the Region (Section 9.3.3.2.1).

During operation, the reclamation of decommissioned areas such as borrow sites, temporary construction camps or buildings, work areas and facilities, the excavated overburden site, the access road ditches and possibly other areas affected by construction activities (Volume 6 Section 5) will result in small, site-specific, long-term positive changes to caribou habitat. These habitats should provide woodland caribou with food and cover, albeit changed from present conditions, and may reduce net loss of habitat from construction.

The predicted impacts of these physical changes to caribou habitats, of sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as for the caribou during construction (Section 9.4.2.2.1), with three exceptions. First, sensory disturbances along the access road are expected to be lower during operation than during the construction period. Second, as a result of lower sensory disturbances near the access road RoW, caribou may benefit from increased access to food along the RoW but become more susceptible to predation from wolves. Third, the risk of accidental events should be lower due to completed construction activity.

Mitigation measures from construction for caribou will remain during operation. Certainty regarding the potential effects is moderate, because of less certainty concerning the effective implementation of the long-term Access Management Plan that is expected to reduce harvest mortality, effects of predator-prey relationships, and sensory disturbances resulting from a potential increase of domestic and recreational access.

Summary of Effects

Effects on woodland caribou from operation impacts are expected to be positive to negative, small, Regional, long-term and insignificant.

Flooding will have negative effects on woodland caribou habitat. Long-term revegetation of disturbed sites and changes to vegetation in the access road RoW and at other sites will have positive effects. These effects should be small compared to the large area these animals use. Some summer and winter habitats will be impacted. A small amount of calving habitat will be lost near the generating station.

Caribou will experience small effects from sensory disturbances. Harvest levels due to increased access may increase. Certainty regarding the potential effects is moderate, because of less certainty concerning harvest mortality. Scientific uncertainties concerning access effects (i.e., hunting, predation and disease) are manageable through Project planning and access road management. Accidental events such as chemical spills, fires or wildlife-vehicle collisions may affect caribou abundance or caribou habitat, but the risk of these events occurring is small.

9.4.3.2.2 Black bear

Habitat effects

Forebay flooding will remove some black bear habitat (Table 9.4-8). About 0.34 km^2 or <0.5% of the habitat within the 1 km Aquatic Buffer (116.4 km^2) that support black bear will be converted to non-habitat. This habitat loss will be considered negative, small, site-specific and long-term. Individual bear that use this habitat should find primary habitat elsewhere in the Sub-Region (Section 9.3.3.2.2).

The predicted impacts of these physical changes to bear habitats, of sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as for bear during construction (Section 9.4.2.2.2), with two exceptions. First, bears may benefit from increased access to more food as a result of lower sensory disturbances near the access road RoW. Second, if licensed game harvest by out-fitters operating in the Sub-Region is allowed to increase, it may result in increased harvest mortality and negatively affect bear populations.

Mitigation measures from construction for bear will remain during operation. Certainty regarding the potential effects is moderate, because of less certainty concerning the effective implementation of the long-term Access Management Plan that is expected to reduce harvest mortality, and sensory disturbances resulting from a potential increase of domestic and recreational access.

Summary of Effects

Effects on black bear from operation impacts are expected to be positive to negative, small, Sub-Regional, long-term and insignificant.

Flooding will have a small negative effect on black bear habitat. Long-term revegetation of disturbed sites and changes to vegetation in the access road RoW will have positive effects. These effects should be small compared to the large area these animals use. Some summer habitats are impacted but do not include critical habitat.

Bears will experience small effects from sensory disturbances. Harvest levels may increase due to increased access. Certainty regarding the potential effects is moderate, because of less certainty concerning harvest mortality. Scientific uncertainties concerning access effects (i.e., hunting, predation and disease) are manageable through Project planning and access road management. Accidental events such as chemical spills, fires or wildlife-vehicle collisions may affect bear abundance or bear habitat, but the risk of these events occurring is small.

9.4.3.2.3 Gray wolf

Habitat Effects

Forebay flooding will remove some gray wolf habitat (Table 9.4-8). About 0.33 km^2 or <0.5% of the habitat within the 1 km Aquatic Buffer (116.7 km^2) that support wolves will be converted to non-habitat. This habitat loss will be considered negative, small, site-specific and long-term. Individual wolf that use this habitat should find primary habitat elsewhere in the Region (Section 9.3.3.2.3).

The predicted impacts of these changes to wolf habitats, of sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as for the wolf during construction (Section 9.4.2.2.3), with one exception. Wolves may benefit slightly from increased access to more food as a result of lower sensory disturbances near the access road RoW.

Mitigation measures from construction for wolf will remain during operation. Certainty regarding the potential effects is moderate, because of less certainty concerning the effective implementation of the long-term Access Management Plan that is expected to reduce harvest mortality, and sensory disturbances resulting from a potential increase of domestic and recreational access.

Summary of Effects

Effects on wolves from operation impacts are expected to be positive to negative, small, Regional, long-term and insignificant.

Flooding will have a small negative effect on wolf habitat. Long-term revegetation of disturbed sites and changes to vegetation in the access road RoW will have positive effects. These effects should be small compared to the large area these animals use. Some summer and winter habitats are impacted but neither include critical habitat.

Wolves will experience small effects from sensory disturbances. Harvest levels may increase due to increased access. Certainty regarding the potential effects is moderate, because of less certainty concerning harvest mortality. Scientific uncertainties concerning access effects (i.e., trapping and predation) are manageable through Project planning and access road management. Accidental events such as chemical spills, fires or wildlife-vehicle collisions may affect wolf abundance or wolf habitat, but the risk of these events occurring is small.

9.4.3.2.4 Pine marten

Habitat effects

Forebay flooding will remove some pine marten habitat (Table 9.4-8). About 0.1 km^2 or <0.7% of the habitat within the 1 km Aquatic Buffer (25.64 km^2) that support martens will be converted to non-habitat. This habitat loss will be considered negative, small, site-specific and long-term. Individual marten that use this habitat should find primary habitat elsewhere in the Sub-Region (Section 9.3.3.2.4).

The predicted impacts of these changes to marten habitats, of sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as for the marten during construction (Section 9.4.2.2.4), with one exception. Forested habitats that become revegetated may not be suitable for pine marten for several decades. Young or transient marten may make use of these areas at earlier successional stages than reproducing adults (Paragai et al. 1996).

Mitigation measures from construction for marten will remain during operation. Certainty regarding the potential effects is moderate, because of less certainty concerning the effective implementation of the long-term Access Management Plan that is expected to reduce trapping mortality, and sensory disturbances resulting from a potential increase of domestic and recreational access.

Summary of Effects

Effects on martens from operation impacts are expected to be positive to negative, small, Sub-Regional, long-term and insignificant.

Flooding will have a small negative effect on marten habitat. Long-term revegetation of disturbed sites and changes to vegetation in the access road RoW will have positive effects. These effects should be small compared to the large area these animals use. Some summer and winter habitats are impacted but neither include critical habitat.

Martens will experience small effects from sensory disturbances. Harvest levels may increase due to increased access. Certainty regarding the potential effects is moderate, because of less certainty concerning harvest mortality. Scientific uncertainties concerning access effects (e.g., trapping) are manageable through Project planning and access road management. Accidental events such as chemical spills, fires or wildlife-vehicle collisions may affect marten abundance or marten habitat, but the risk of these events occurring is small.

9.4.3.2.5 Lynx

Habitat effects

Forebay flooding will remove some lynx habitat (Table 9.4-8). About 0.01 km^2 or <0.1% of the habitat within the 1 km Aquatic Buffer (25.64 km^2) that support lynx will be converted to non-habitat. This habitat loss will be considered negative, small, site-specific and long-term. Individual lynx that use this habitat should find primary habitat elsewhere in the Sub-Region (Section 9.3.3.2.5).

The predicted impacts of these changes to lynx habitats, of sensory disturbances, changes in access, and accidents have the same period, scope, and magnitude as for the lynx during construction (Section 9.4.2.2.5).

Mitigation measures from construction for lynx will remain during operation. Certainty regarding the potential effects is moderate, because of less certainty concerning the effective implementation of the long-term Access Management Plan that is expected to reduce trapping mortality, and sensory disturbances resulting from a potential increase of domestic and recreational access.

Summary of Effects

Effects on lynx from operation impacts are expected to be positive to negative, small, Sub-Regional, long-term and insignificant.

Flooding will have a small negative effect on lynx habitat. Long-term revegetation of disturbed sites and changes to vegetation in the access road RoW will have positive effects. These effects should be small compared to the large area these animals use. Some summer and winter habitats are impacted but neither include critical habitat.

Lynx will experience small effects from sensory disturbances. Harvest levels may increase due to increased access. Certainty regarding the potential effects is moderate, because of less certainty concerning harvest mortality. Scientific uncertainties concerning access effects (e.g., trapping) are manageable through Project planning and access road management. Accidental events such as chemical spills, fires or wildlife-vehicle collisions may affect lynx abundance or lynx habitat, but the risk of these events occurring is small.

9.5 RESIDUAL EFFECTS

Residual effects on mammal VECs are summarized in Table 9.5-1. Insignificant residual effects range from short-term to long-term, small, and site-specific to regional, for mammal VECs assessed. By implementing a few specific mitigation measures to those that were already discussed in Sections 9.4.2 and 9.4.3, the risk of potential effects can be reduced further. These recommendations were added to reduce outstanding scientific uncertainties concerning potential sensory disturbance and access effects.

9.5.1 Woodland Caribou

During construction, blasting will not occur within 5 km of the calving area along the access road from mid-May to early-July. No temporary roadbed borrow operations will occur within 2 km of the known calving area along the access road from mid-May to early-July.

During operation, NCN and Manitoba Hydro will ask the Province of Manitoba to establish a Wildlife Road Refuge under *The Wildlife Act*.

9.5.2 Moose

During operation, NCN and Manitoba Hydro will ask the Province of Manitoba to establish a Wildlife Road Refuge under *The Wildlife Act*.

9.5.3 Aquatic and Terrestrial Furbearers

During operation, NCN and Manitoba Hydro will ask the Province of Manitoba to establish a Wildlife Road Refuge under *The Wildlife Act*.

Table 9.5-1. Residual effects to mammals.

VEC SPECIES	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
Woodland caribou	**CONSTRUCTION**			
	Clearing and construction of access roads, borrow areas, GS area; sensory disturbances from noise and people; access-related events; possible accidental events from collisions, spills or fire.	Small loss of primary and secondary habitat; loss of one known calving site at GS; possible changes to movements and habitat use (including loss of habitat effectiveness and fragmentation near the road); possible mortality from hunting, collisions, fire or increased predation risk.	Measures identified in the Project Description, and measures that will be identified in the Access Management Plan and EnvPP, such as minimizing clearing, encouraging re-growth of vegetation, and posting wildlife warning signs where necessary, will reduce the effects to caribou. Additional mitigation measures recommended include: no blasting within 5 km of the calving area along the access road from mid-May to early-July. No temporary roadbed borrow operations will occur within 2 km of the known calving area along the access road from mid-May to early-July.	Negative and insignificant (short-term, small, and regional)
	OPERATION			
	Wuskwatim Lake water level increased to 234 m ASL; small flooded area; sensory disturbances from noise and people; access-related events; possible accidental events from collisions, spills or fire.	Small loss of primary and secondary habitat; possible changes to movements and habitat use (including loss of habitat effectiveness and fragmentation near the road); possible mortality from hunting, collisions, fire or increased predation risk.	Measures identified in the Project Description and measures that will be identified in Access Management Plan will reduce the effects to caribou. Additional mitigation measures recommended include: NCN and Manitoba Hydro will ask the Province of Manitoba to establish a Wildlife Road Refuge under *The Wildlife Act*.	Negative and insignificant (long-term, small, and regional)
Moose	**CONSTRUCTION**			
	Clearing and construction of access roads (ditches), borrow areas, GS area; sensory disturbances from noise and people; access-related events; possible accidental events from collisions, spills or fire.	Small loss of primary and secondary habitat; possible changes to movements and habitat use (including possible loss of habitat effectiveness and fragmentation near the road); possible mortality from hunting, collisions, fire or increased predation risk.	Measures identified in the Project Description, and measures that will be identified in the Access Management Plan and EnvPP, such as minimizing clearing and encouraging re-growth of vegetation, will reduce the effects to moose.	Negative and insignificant (long-term, small, site-specific to local)

	OPERATION			
	Wuskwatim Lake water level stabilized up upper end of current range; water-level variations below the dam; small flooded area; long-term increase in shoreline peatland, incremental erosion; incremental debris; sensory disturbances from noise and people; access-related events; possible accidental events from collisions, spills or fire.	Small loss of primary and secondary habitat; possible changes to movements and habitat use (including possible loss of habitat effectiveness and fragmentation near the road); potential mortality from hunting, collisions, fire or increased predation risk.	Measures identified in the Project Description, and that will be identified in the Access Management Plan and EnvPP, will reduce the effects to moose. Additional mitigation measures recommended include: NCN and Manitoba Hydro will ask the Province of Manitoba to establish a Wildlife Road Refuge under *The Wildlife Act*.	Negative and insignificant (long-term, small, site-specific to local)
Aquatic furbearers - muskrat and beaver	**CONSTRUCTION**			
	Clearing and construction of access roads (ditches), borrow areas, GS area; sensory disturbances from noise and people; access-related events; possible accidental events from spills or fire.	Small gain of primary and secondary habitat; possible changes to movements and habitat use, possible mortality from trapping, wildlife control actions, fire or increased predation risk.	Measures that will be identified in the EnvPP, such as encouraging re-growth of vegetation, and materials handling and storage, will reduce the effects to muskrat and beaver.	Neutral to positive and insignificant (long-term, small, site-specific)
	OPERATION			
	Wuskwatim Lake water level stabilized near upper end of current range; water-level variations below the dam; small flooded area; long-term increase in shoreline peatlands, incremental erosion; incremental debris; sensory disturbances from noise and people; access-related events; possible accidental events from spills or fire.	Gains and losses of primary and secondary habitat above the GS from water level stabilization versus periodic draw-downs of up to 1 m; possible changes to movements and habitat use, including displacement of beavers between the GS and Opegano Lake; possible mortality from increased trapping, fire or predation.	Measures that will be identified in the EnvPP, such as materials handling and storage will reduce the effects to muskrat and beaver.	Neutral to negative and insignificant (long-term, small, site-specific to local)
Other mammals - black bear, wolf, pine marten, lynx, mink and otter	**CONSTRUCTION**			
	Clearing and construction of access roads (ditches), borrow areas, GS area; sensory disturbances from noise and people; access-related events; possible accidental events from collisions, spills or fire.	Small loss of primary and secondary habitat; possible changes to movements and habitat use (including possible loss of habitat effectiveness and fragmentation near the road); mortality from hunting, trapping, collisions, or fire.	Measures that will be identified in the EnvPP, such as encouraging re-growth of vegetation and materials handling and storage, will reduce the effects to wildlife.	Negative and insignificant (short-term to long-term, small, mainly site-specific to local)
	OPERATION			
	Wuskwatim Lake water level stabilized near upper end of current; water-level variations below the dam; small flooded area; long-term increase in shoreline peatlands, incremental erosion; incremental debris; sensory disturbances from noise and people; access-related events; possible accidental events from collisions, spills or fire.	Small loss of primary and secondary habitat; possible changes to movements and habitat use (including possible loss of habitat effectiveness and fragmentation near the road); potential mortality from hunting and trapping, wildlife control actions, collisions, or fire.	Measures that will be identified in the EnvPP such as materials handling and storage will reduce the effects to wildlife.	Negative and insignificant (long-term, small, mainly site-specific to local)
Rare wildlife species - see caribou	**CONSTRUCTION**			
	OPERATION			

9.6 CUMULATIVE EFFECTS

The cumulative effects assessment for mammal VECs considered those developments/ activities, or portions thereof, that would be expected within the Sub-Region in the foreseeable future (decades). Effects of developments/activities outside the Sub-Region were not expected to compound Project effects within the Sub-Region except in the case of wider-ranging mammals such as woodland caribou (Volumes 6 & 10). Potential developments or activities included in the cumulative effects assessment for mammal VECs were:

- Wuskwatim Transmission Project;
- forestry activities; and
- climate change.

9.6.1 Woodland Caribou

Effects to woodland caribou are expected to be negative, short-term, small, and regional during construction, and long-term, small and regional during the operation of the Project. Impacts from habitat disturbance, sensory disturbance, access, and accidental events will cause a small loss of caribou habitat, may cause changes to movements and habitat use, and could reduce caribou abundance from mortality related to hunting, collisions, fire or increased predation risk.

Long-term impacts of the Wuskwatim Transmission Project will include modification of a band of vegetation (Volume 6 Section 5) in the right-of-way. Small, incremental negative changes to woodland caribou habitat are expected for the Sub-Region, and small, incremental negative changes to wintering and calving habitat are expected for the Region. Short-term sensory disturbances will occur during construction, while long-term sensory disturbances related to increased winter access along the RoW, and possible incremental changes to loss of habitat effectiveness and fragmentation will occur near the RoW. The largest potential effect is mortality related to winter access and caribou harvest near the core range south of Partridge Crop Hill. Mitigation during construction and operation, including access control measures that will be identified in the Access Management Plan, co-operative agreements, and Resource Management Board decisions concerning sustainable harvest are expected to minimize effects to caribou.

If the Partridge Crop Hill area of special interest (ASI) was designated as a protected area this action would have a large positive impact for woodland caribou in the Region. A large portion of the current core range (including critical winter habitat and critical calving habitat) would be protected from potential habitat-related effects, sensory disturbances, habitat effectiveness and habitat fragmentation effects, access effects and accidental events.

The locations and timing of forestry activities in the Region are highly uncertain, especially if the Partridge Crop Hill ASI was to be protected (Volume 7). Sustainable forestry practices are considered generally not to have significant environmental effects. Unless a high activity threshold is reached, negative habitat effects would remain insignificant. If this currently unknown activity threshold is reached, it might affect the abundance and/or seasonal movements of woodland caribou in the Region.

Replanting and avoidance of unique wildlife features would minimize potential effects. Negative sensory disturbance effects related to winter access, and changes to and loss of habitat effectiveness and fragmentation could occur near harvest sites. Mortality due to winter access and caribou harvest could occur. Forestry mitigation measures, including possible access control measures, co-operative agreements, and Resource Management Board decisions concerning sustainable harvest would minimize effects to caribou. Changes in future forestry practices (e.g., harvest techniques) adds uncertainty about the nature of the effects and how the effects will interact with this Project.

Climate change could have the largest effect on caribou over the long-term as it would occur throughout the Region. Although there is uncertainty in regards to whether precipitation will increase or decrease, there appears to be a consensus that temperatures will increase and boreal forest areas will decrease (Volumes 3 and 6). If climate change does reduce the extent of boreal forest in Manitoba, woodland caribou abundance and movements could change considerably. An increase in the frequency of fire (Section 7.11) would have the largest effect on caribou abundance, movements and habitat use.

9.6.2 Other Mammals

Effects on other mammals are expected to be negative, short-term, small, regional, and insignificant during construction, and long-term, small and regional during the operation of the Project. Effects on other mammals due to local habitat losses or alterations associated with other potential developments or activities would be small compared to the large area these animals use in the Sub-Region. Most wildlife populations are more resilient to anticipated effects than caribou for example, have relatively high reproductive abilities, and would require extensive habitat changes before development impacts would substantially affect abundance or distribution of these wildlife populations. Terrestrial, riparian and aquatic habitats would be impacted by the Wuskwatim Transmission Project and from forestry activities. As the timing and locations for forestry activities are unknown, it is uncertain whether or not important wildlife habitats would be associated with these habitat losses.

Muskrat, beaver, moose, otter, mink, black bear, wolf, pine marten and lynx, would be affected temporarily by sensory disturbances during construction, and long-term operation of any development, combination of developments or activities. Incremental changes to loss of habitat effectiveness and fragmentation would occur near potential transmission lines, roads, and forest harvest sites, although potential effects to wildlife and habitat may be mitigated by avoiding unique wildlife features, implementing site-remediation, access control, and by establishing co-operative agreements.

Climate change may have the largest effect on any given VEC over the long-term as it will be a wide spread perturbation. If climate change reduces the extent of the boreal forest in Manitoba, species abundance and movements could change considerably.

9.6.3 Cumulative Effects On VECs

Assessment of cumulative effects on VECs found that, with the exception of woodland caribou and the possible effects of climate change, all other insignificant residual effects at the Sub-Regional level were unchanged by cumulative effects. The negative effects on woodland caribou in the Region will remain insignificant unless climate change has a larger than expected effect and/or other developments do not provide appropriate and effective mitigation. The magnitude of negative effects ranges from small to large. The probability of occurrence criterion to determine the potential change from insignificant to significant negative effects to woodland caribou is low.

The combined effects of the Project and other potential developments or activities are expected to influence woodland caribou abundance and seasonal movements in the Region, but not in the Sub-Region. The effects of climate change would be on a Regional scale.

The reliability of information regarding the timing, spatial extent and geographic location of the assessed developments/ activities varies from low to high. The scientific certainty is low for projected Regional declines in woodland caribou populations and possible changes to seasonal movements, because there is a high degree of uncertainty in the variables that affect caribou, such as access-related mortality, loss of habitat effectiveness and habitat fragmentation effects, and because of the highly uncertain nature of impacts that may result from climate change. Changes in future forestry practices (e.g., harvest techniques) adds uncertainty about the nature of the effects and how the effects will interact with this Project. These factors could change the magnitude, scale, and duration of potential effects in either a positive, neutral or negative direction. The designation of a Partridge Crop Hill Protected Area would reduce the risk of long-term negative cumulative effects to caribou in the Region.

9.7 ENVIRONMENTAL FOLLOW-UP AND MONITORING

9.7.1 Woodland Caribou

Radio-collaring a woodland caribou to monitor movements.

There is a need to collect additional data, monitor, and assess the outstanding scientific uncertainties regarding Project effects on the Wapisu woodland caribou population. NCN, Manitoba Hydro and Manitoba Conservation have developed and initiated a program to monitor caribou during the Project. Both VHF and GPS radio-collars are deployed in the range of caribou that may be impacted during construction and operation. Caribou will be monitored yearly during construction, and periodically during operation. The need for, and type of, any additional mitigation measures will be assessed based on the findings of this monitoring program.

In addition to the above, traditional knowledge will also form a major component of the monitoring program. Information will be collected from NCN Elders and resource harvesters during both the construction and operational phases of the Project. Any changes in either the behaviour, distribution, or abundance of woodland caribou (as documented through TK) will be documented and used to design additional monitoring programs if required.

9.7.2 Aquatic furbearers

Mercury levels in aquatic furbearers; particularly those consumed for domestic purposes are unknown and should be monitored and assessed. NCN, Manitoba Hydro, and Manitoba Conservation have initiated a wildlife sampling program in conjunction with the fish mercury sampling program to monitor mercury levels in beaver and muskrat, and to opportunistically measure mercury levels in higher trophic level predators such as mink and otter, prior to and during the Project. The need for, and type of, specific mitigation measures, if any, will be determined based on the findings of this monitoring program.

Beaver and muskrat populations in Project affected areas will be monitored at least once before Project completion, and about every fifth year after the Project to determine if/how aquatic furbearer populations are being affected by the Project operations.

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9.9 GLOSSARY

contiguous habitat - distributed continuously or nearly continuously across the landscape, with boundaries that make contact, but do not overlap with other habitats, and is capable of supporting the life needs of the species.

critical habitat (1) - (**as it relates to endangered species**) the specific areas within which the geographic area occupied by a listed species on which are found physical and biological features essential to the conservation of the species, and that may require special management consideration or protection; and specific areas outside the geographic area occupied by a listed species, when it is determined that such areas are essential for the conservation of the species.

critical habitat (2) - (**as it generally relates to wildlife**) part or all of an ecosystem occupied by wildlife species, or a population of such species, that is recognized as essential for the maintenance and long-term survival of the population.

eat-out - term for ecosystem disruption, often used for muskrats. When muskrats become over-populated, excessive feeding occurs and an area is ruined for several years.

frequency-per-unit-effort - standard units that describe the recurrence rate of mammals. Recurrence rates are based on counts of mammal sign within the context of the area sampled. Ground-based transect sample units were standardized to the relative unit of mammal sign per 100 metres [sampled].

habitat alienation - occurs when wildlife habitat is used by people in ways that prevent animals from using it.

habitat alteration - modification of wildlife habitat by people from one form into another (e.g., a post-harvest forest stand where natural tree regrowth is inhibited by people over a long period of time would change wildlife habitat from forest to a grassland or shrubland habitat).

habitat effectiveness - is the amount of **realized habitat** expressed as a percentage of the landscape’s potential. Habitat effectiveness for animals depends on the interactions of habitat quality, as described by vegetation, food availability, and abiotic factors and human activities.

habitat fragmentation - occurs when natural topographic features (e.g., rivers) or human disturbances break up wildlife habitat into smaller, relatively ineffective fragments. Habitat fragmentation results in the loss or isolation of effective wildlife habitat and is widely recognized as a leading cause in the loss of biodiversity. Fragmentation occurs at two scales: Landscape (within home ranges of individual animals) and Regional (interbreeding populations are cut off from each other, forming smaller 'island' populations).

habitat loss - the removal of habitat available to wildlife as a result of 'permanent' changes, such as in the development of a human settlement, flooding for a reservoir, or other relatively irreversible, long-term changes to the land.

habitat - the place where a plant, animal or microorganism lives; often related to a function such as breeding, feeding, etc.

mammal sign - may include tracks, fecal material, food consumption evidence, special habitat use resources such as dens, burrows etc. Sign can be highly variable between species. NCN community members and other EMT members were responsible for differentiating between sign types and for recording occurrences.

meta-population - a population consists of several local populations that are spatially separated but linked by migrants, allowing for recolonization of unoccupied habitat patches after local extinction events.

occurrence (data) - the presence or absence of mammals in particular habitats or areas.

primary habitat - important parts of the environment, often typified by a dominant plant form or physical characteristic, on which an organism depends, directly or indirectly, in order to carry out its life processes.

raptor - any bird of prey (for this study, includes eagles, hawks, falcons, owls and osprey).

realized habitat - is land that wildlife wary of humans will continue to use after the effects of human disturbance have been accounted for.

riparian mammal community - in an ecological sense, the organisms living in the lowland or wetland ecosystem: the plants, animals, fungi and microbes of a given seral stage, typically interacting within a framework of horizontal and vertical linkages, such as competition, predation and mutualism.

riparian mammals - animals such as beaver that continuously or seasonally rely on water and shorelines for food, shelter and reproduction.

secondary habitat - specific, but less important environmental conditions than primary habitats in which organisms may need to thrive in the wild.

subpopulation - a well-defined group of interacting animals of the same species that are part of a larger, interbreeding **meta-population**.

terrestrial mammal community - in an ecological sense, the organisms living in the upland ecosystem: the plants, animals, fungi and microbes of a given seral stage, typically interacting within a framework of horizontal and vertical linkages, such as competition, predation and mutualism.

terrestrial mammals - animals such as wolves that predominately rely on upland (non aquatic) habitats for food, shelter, and reproduction.

tularemia - an infectious disease caused by the bacterium *Pasteurella tularense*, that can cause widespread mortality among populations of beaver and other species.

ungulates - any animal in the group *Ungulata*: hoofed, grazing mammals, many of which have antlers (e.g., deer, moose caribou).

wildlife control actions - human-wildlife interactions that result in the displacement or mortality of "problem" animals or their habitats (e.g., a beaver dam that plugs a culvert may cause road flooding, and therefore, the beaver dam needs to be removed, or a bear that is attracted to work camps and threatens people, may have to be trapped, relocated and released, or possibly destroyed). All wildlife control actions occur through Manitoba Conservation.

xeric - characterized by, or relating to a small amount of moisture.

9.10 APPENDIX

Appendix 9.9-1. Mammal distribution in the Region.

Common Name	Scientific Name	Occurrence in the Study area	Degree of Confidence	Nature of Occurrence	Breeds in MB	MB Distribution	Breeding Status in Study area	Distribution in study area	Notes/Comments
ORDER: INSECTIVORA (Insectivores)									
Masked Shrew	*Sorex cinereus*	Abundant (B)	B	Resident	YES	Even	Breeding	Even	NA
Water Shrew	*Sorex palustris*	Common (B)	C	Resident	YES	Even	Breeding	Even	NA
Arctic Shrew	*Sorex arcticus*	Common (B)	C	Resident	YES	Even	Breeding	Even	NA
Pygmy Shrew	*Sorex hoyi*	Common (B)	C	Resident	YES	Even	Breeding	Even	NA
ORDER: CHIROPTERA (Bats)									
Little Brown Myotis	*Myotis lucifugus*	Uncommon (B)	C	Resident	YES	Even	Breeding	Even	NA
Eastern Red Bat	*Lasiurus borealis*	Uncommon (B)	C	Migratory	YES	Even	Breeding	Even	NA
Hoary Bat	*Lasiurus cinereus*	Uncommon (B)	C	Migratory	YES	Even	Breeding	Even	NA
ORDER: LAGOMORPHA (Hares and Rabbits)									
Snowshoe Hare	*Lepus americanus*	Abundant (B)	B	Resident	YES	Even	Breeding	Even	Extreme population cycles
ORDER: RODENTIA (Rodents)									
Least Chipmunk	*Tamias minimus*	Abundant (B)	C	Resident	YES	Even	Breeding	Even	NA
Woodchuck	*Marmota monax*	Uncommon to Common (B)	C	Resident	YES	Even	Breeding	Even	NA
Red Squirrel	*Tamiasciurus hudsonicus*	Abundant (B)	B	Resident	YES	Even	Breeding	Even	Partly cyclic populations based on cone crop availability.
Northern Flying Squirrel	*Glaucomys sabrinus*	Common to Possibly Abundant (B)	C	Resident	YES	Even	Breeding	Even	NA
Beaver	*Castor canadensis*	Abundant (B)	B	Resident	YES	Even	Breeding	Even	NA
Deer Mouse	*Peromyscus maniculatus*	Abundant (B)	C	Resident	YES	Even	Breeding	Even	NA
Southern Red-backed Vole	*Clethrionomys gapperi*	Abundant (B)	C	Resident	YES	Even	Breeding	Even	NA
Northern Bog Lemming	*Synaptomys borealis*	Common to Possibly Abundant (B)	C	Resident	YES	UnEven	Breeding	Even	NA
Heather Vole	*Phenacomys intermedius*	Common (B)	C	Resident	YES	Even	Breeding	Even	NA
Muskrat	*Ondatra zibethicus*	Common to Abundant (B)	B	Resident	YES	Even	Breeding	Even	Subject to extreme fluctuations with habitat conditions
Meadow Vole	*Microtus pennsylvanicus*	Abundant (B)	C	Resident	YES	Even	Breeding	Even	NA
Meadow Jumping Mouse	*Zapus hudsonius*	Abundant (B)	C	Resident	YES	Even	Breeding	Even	NA
Porcupine	*Erethizon dorsatum*	Extirpated	C	Resident?	YES	Even	Non-breeding?	Absent. Former resident	NA

Common Name	Scientific Name	Occurrence in the Study area	Degree of Confidence	Nature of Occurrence	Breeds in MB	MB Distribution	Breeding Status in Study area	Distribution in study area	Notes/Comments
ORDER: CARNIVORA (Carnivores)									
Coyote	*Canis latrans*	Rare (B)	C	Resident	YES	Even	Breeding?	UnEven	Population recovering from sarcoptic mange in 1980's. Northern extent of range.
Wolf	*Canis lupus*	Uncommon to Common (B)	B	Resident	YES	Even	Breeding	Even	Possible recent population increases.
Arctic Fox	*Alopex lagopus*	Absent to Common (M)	B	Resident - Nomadic? Occasional	YES	UnEven	Non-breeding?	UnEven	Migratory at peaks in cycle. Trapping records under white fox.
Red Fox	*Vulpes vulpes*	Common (B)	B	Resident	YES	Even	Breeding	Even	Trapping records include blue, cross and silver fox.
Black Bear	*Ursus americanus*	Common to Abundant (B)	B	Resident	YES	Even	Breeding	Even	NA
Grizzly Bear	*Ursus arctos*	Extirpated	A	Resident - Nomadic? Occasional	NO	Absent	Non-breeding	Absent. Possible former resident	Formerly at extreme eastern edge of North American range
Raccoon	*Procyon lotor*	Very Rare (B)	B	Resident?	YES	Even	Breeding?	UnEven	Northern limit of range. Range advances or retreats may correlate with mild or severe winters
Pine Marten	*Martes americana*	Rare to Abundant (B)	B	Resident	YES	Even	Breeding	Even	Recent range expansions and population increases
Fisher	*Martes pennanti*	Common (B)	B	Resident	YES	Even	Breeding	Even	Possible population increase (last 30 years)
Ermine	*Mustela erminea*	Common to Abundant (B)	B	Resident	YES	Even	Breeding	Even	Possible long-term population decline (possibly due to cycle?)
Least Weasel	*Mustela nivalis*	Common (B)	B	Resident	YES	Even	Breeding	Even	NA
Mink	*Mustela vison*	Common to Abundant (B)	B	Resident	YES	Even	Breeding	Even	Possible mink reduction province-wide since the late 1970's
Wolverine	*Gulo gulo*	Rare to Uncommon (B)	B	Resident	YES	UnEven	Breeding	Even	Generally rare throughout the province
Badger	*Taxidea taxus*	Rare to Uncommon (B)	B	Resident?	YES	UnEven	Non-breeding	One individual trapped in 1973-74 in southern fringe of study area	Limited range, possible declines in density
Striped Skunk	*Mephitis mephitis*	Rare to Uncommon (B)	B	Resident	YES	Even	Breeding	Uneven	Relatively recent invader into northern areas
River Otter	*Lutra canadensis*	Uncommon to Abundant (B)	B	Resident	YES	Even	Breeding	Even	Recent increases in provincial population
Lynx	*Lynx lynx*	Common (B)	B	Resident	YES	Even	Breeding	Even	Extreme population cycles; possible long-term population

Common Name	Scientific Name	Occurrence in the Study area	Degree of Confidence	Nature of Occurrence	Breeds in MB	MB Distribution	Breeding Status in Study area	Distribution in study area	Notes/Comments
									decline
ORDER: ARTIODACTYLA (Cloven-hoofed Mammals)									
Woodland Caribou/ Barren-ground Caribou	*Rangifer tarandus caribou/groenlandicus*	Uncommon (B)	B	Resident - Nomadic/ Migratory	YES	Uneven	Breeding	Uneven; spotty	Use of islands for calving. One range in the study area includes the Wapisu herd of 200 animals.
White-tailed Deer	*Odocoileus virginianus*	Absent to Uncommon (B)	B	Resident	YES	UnEven	Breeding	UnEven. Southern half of Region	Population highly regulated by temperature, snow and food abundance. Relatively recent invader into northern areas.
Moose	*Alces alces*	Uncommon to Common (B)	B	Resident	YES	Even	Breeding	Even	NA
Bison (Wood?)	*Bos bison*	Extirpated	A	Resident - Nomadic?	NO	Absent	Non-breeding	Absent. Possible former southern fringe resident	NA

Occurrence within the Regional study area:

Very Abundant - can be observed on all visits in preferred habitat during the proper season, usually in large numbers. **Abundant** - can be observed on all visits in preferred habitat during the proper season, usually in large numbers. **Common** - can be observed on most visits in preferred habitat during the proper season; numbers vary considerably. **Uncommon** - infrequently observed in preferred habitat, usually in low numbers. **Rare** - seldom observed but can be expected to occur annually. **Very Rare** - seldom observed but can usually be expected to occur annually.
Occasional - a few confirmed sightings but not seen every year; or, out-of-season occurrences of regular species. **Extirpated** - see legal parameters **Extinct** - see legal parameters

'**NA**' - Not Available and/or Not Applicable

M - Migrant or a species that can be seen only during brief periods in a season. It may or may not breed here. **B** - Breeding: Refers to a breeding population of this species in the study area.

Furbearers - Abundance, range and trends from Stardom (1986). Five categories of density are based on relative abundances (Abundant = High, Common = Moderate, Uncommon = Low, Rare = Rare and Absent)

Degree of Confidence in Manitoba Data: **A** - high degree of confidence, **B** - reliable but data limited, **C** - unreliable

Nature of Occurrence

Resident - a species which remains year-round **Resident?** - - A species that would remain year-round if it definitely occurred in the study area.

Migratory - a species that can be seen only during brief periods during spring, summer and/or fall. It may or may not breed here.

Nomadic - Occasionally equivalent to migratory, but species movements may occur as either less predictable patterns, or total distances moved are not as long as traditional migrants.

Breeding Status in the study area

Using the following scale of probabilities (i.e., Breeding, Breeding?, Non-breeding? Non-breeding), whether or not a species breeds in the study area. Probabilities are based on an expert review of available materials.

Non-breeding and breeding = 100% probability Non-breeding? = < 50% chance, Breeding? = > 50% chance.