WUSKWATIM GENERATION PROJECT

ENVIRONMENTAL IMPACT STATEMENT

Manitoba Hydro
and
Nisichawayasihk Cree Nation

April 2003

Volume 1

NISICHAWAYASIHK CREE NATION

Manitoba Hydro

Available in accessible formats upon request.

PREFACE

The Environmental Impact Statement (EIS) for the Wuskwatim Generation Project was prepared by Manitoba Hydro and Nisichawayasihk Cree Nation (NCN) with the assistance of the Environmental Management Team (EMT) jointly selected by Manitoba Hydro and NCN. On a concurrent basis, an EIS for the Wuskwatim Transmission Project has been prepared by Manitoba Hydro with the assistance of NCN and the EMT. Each EIS has been prepared in accordance with Final EIS Guidelines issued in April 2002 in response to applications for environmental approvals for these Wuskwatim projects.

In 2001, NCN and Manitoba Hydro ratified an Agreement-in-Principle (AIP) regarding possible development of the Wuskwatim projects. The AIP is not legally binding, but sets out a series of topics to be discussed between the parties to develop a binding Project Development Agreement (PDA) and related agreements. When completed in 2003, the PDA will also be subject to a ratification vote of NCN members and approval of the Manitoba Hydro-Electric Board. No decisions will be made to proceed with the Wuskwatim projects pursuant to the current environmental applications until a PDA is completed and ratified by NCN and Manitoba Hydro.

Volume 1 provides the Environmental Impact Statement for the Wuskwatim Generation Project. Supporting volumes provide additional information and technical supporting analysis on specific topics.

EIS PARTICIPANTS

The key individuals and responsible authorities for Manitoba Hydro, Nisichawayasihk Cree Nation (NCN), and the Environmental Management Team (EMT) are provided below. A list of organizations and key individuals involved in the environmental assessment of the Wuskwatim Generation Project (the Project) is provided in Appendix I.

Manitoba Hydro

E. Wojczynski	Division Manager, Power Planning and Development Division
J. Markowsky	Manager, Major Projects Department
N. Barnes	Environmental Specialist, Environmental Licensing and Protection Department

Nisichawayasihk Cree Nation

Chief J. Primrose	NCN Chief
E. Thomas	NCN Councillor (Future Development Portfolio)
D. Linklater	NCN Councillor
N. Linklater	Co-Manager, NCN Future Development
M. Moody	Co-Manager, NCN Future Development

Environmental Management Team

The EMT is a team of consultants jointly selected by NCN and Manitoba Hydro to manage the environmental planning and assessment studies for the Wuskwatim Generation and Transmission Projects and to prepare the environmental impact statement for each of these Projects. The EMT reports to both NCN and Manitoba Hydro.

TetrES Consultants Inc.

G. Rempel, M.Sc., P. Eng. — Study Coordinator

North/South Consultants Inc.

S. Davies, B.Sc. — Study Leader: Generation

ND LEA

D. Hicks, MCIP, P.Eng. — Study Leader: Transmission

InterGroup Consultants Ltd.

C. Osler, M.A. — Study Leader: Socio-Economics and Public Involvement

ACKNOWLEDGMENTS

Manitoba Hydro, NCN, and the EMT would specifically like to thank the Elders and other Nisichawayasihk Cree Nation members who shared their traditional knowledge and insights with us and worked side by side with us. We are also indebted to NCN's Community Consultants who provided ongoing support to our efforts and ensured that communication with NCN members regarding the Project was both extensive and timely.

We would like to extend our sincere thanks to the community leaders and representatives who invited us into their communities and shared their knowledge with us during the implementation of the Public Involvement Plan.

We would like to thank the numerous individuals and representatives of private and government organizations who have provided their time and knowledge to assist with the preparation of this document.

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1.0 INTRODUCTION

1.1 BACKGROUND

The Wuskwatim Generation Project (the Project) involves development of a **200 megawatt (MW) generating station (GS)** at Taskinigup Falls on the Burntwood River, and associated access road, construction camp and other infrastructure (Figure 1.1-1). The Project is located in the **Nelson House Resource Management Area (RMA)** southwest of Thompson and southeast of Nelson House. A separate project, the Wuskwatim Transmission Project, involves development of associated transmission lines and stations to connect the new generating station to the existing Manitoba Hydro transmission system. These transmission facilities extend beyond the Nelson House RMA to Thompson, Snow Lake and The Pas.

Manitoba Hydro and the Nisichawayasihk Cree Nation (NCN) have jointly been undertaking all the necessary engineering, environmental, consultation and other related activities to allow for the decision to commence construction of the Wuskwatim projects in December 2003, with a targeted first power in-service date as early as 2009. No decisions have been made at this time to proceed with these Wuskwatim projects.

Separate **Environmental Impact Statement (EIS)** submissions have been prepared for the Wuskwatim Generation Project and the Wuskwatim Transmission Project. Each EIS has been prepared in accordance with **EIS Guidelines**[1] issued in April 2002, setting out the information required by government agencies. Provincial and federal regulatory approvals are needed, after review of the EIS filings, before any construction activities can be undertaken.

No decisions will be made to proceed with the Wuskwatim projects pursuant to the current environmental applications until a Project Development Agreement is completed and ratified by NCN and Manitoba Hydro, which is expected by mid-October 2003. Under current understandings between NCN and Manitoba Hydro, NCN has an option to be a partner in the Project with an interest of up to 33 per cent.[2]

[1] See Section 1.5.1 and Appendix 2 regarding EIS Guidelines for the Project.
[2] If the Project proceeds and NCN chooses to participate in ownership, NCN and Manitoba Hydro would jointly own the generating station under a partnership arrangement, possibly a Limited Partnership.

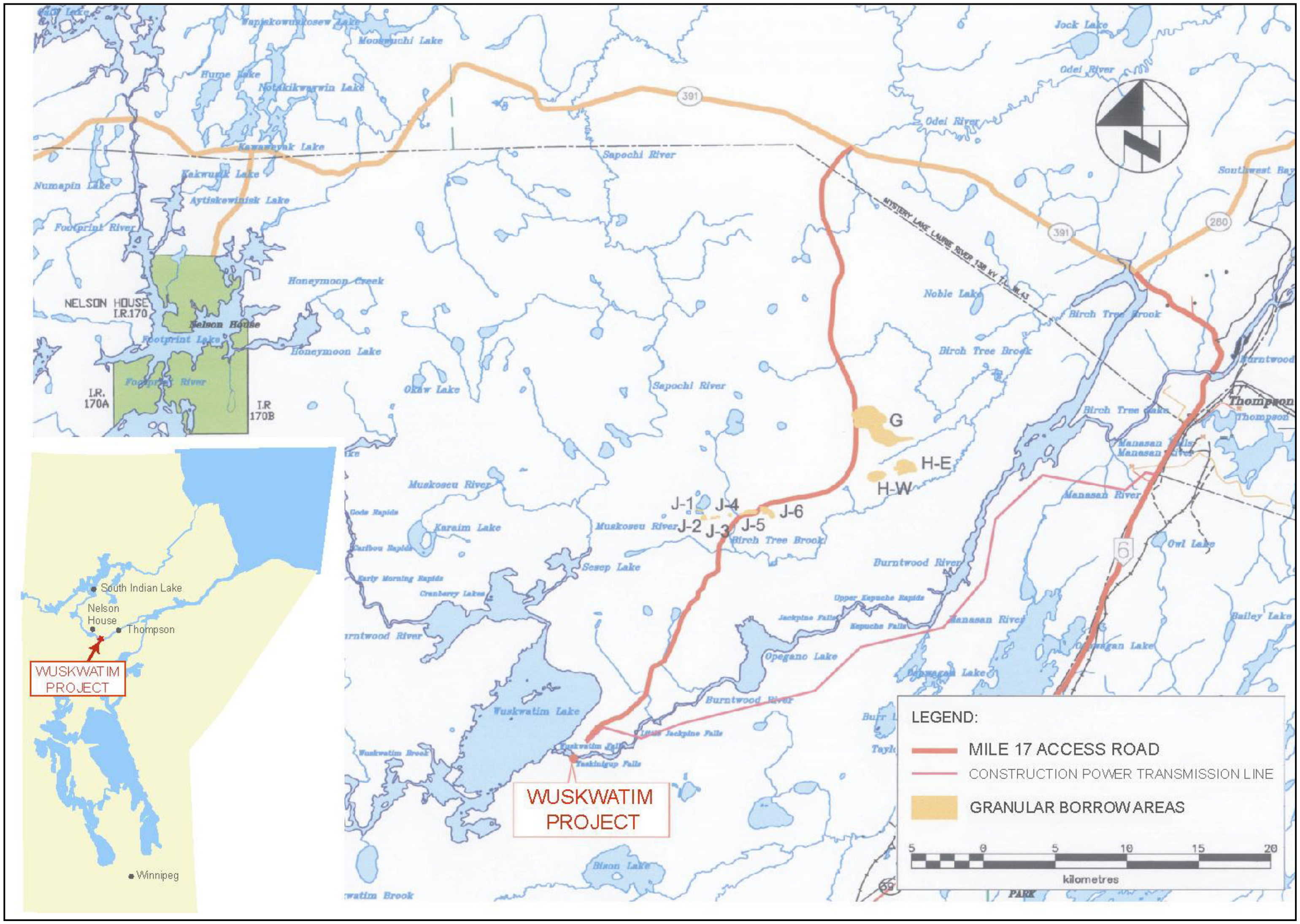


Figure 1.1-1. Location of the Wuskwatim Generation Project.

Although decisions have not as yet been made to proceed with the development, discussions between Manitoba Hydro and NCN regarding the Project have been ongoing for several years. **Article 8 of the 1996 NFA Implementation Agreement**, which was signed by NCN, Manitoba Hydro, Manitoba, and Canada, sets out the process for NCN and Manitoba Hydro to discuss potential projects such as the Wuskwatim Generation Project that qualify as **Future Developments** affecting a water body within the Nelson House RMA.

Among other things, Article 8 of the 1996 NFA Implementation Agreement requires Manitoba Hydro to consult with NCN regarding various options for Future Developments.[3] Unless Manitoba Hydro is relieved of the obligation by the Arbitrator,[4] Manitoba Hydro will not construct any Future Development until Nelson House and Manitoba Hydro agree on a compensation agreement or one has been approved by the Arbitrator.

To achieve the consultations set out in Article 8, in 1997 NCN and Manitoba Hydro established a Working Group to exchange information and facilitate consultation regarding the proposed developments at Taskinigup Falls (the Wuskwatim Generation Project) and at the Notigi Control Structure (the Notigi Generating Station). In 1999, the Manitoba Hydro Board made a decision to explore potential business partnerships with First Nations in the vicinity of new hydroelectric generation projects and the Working Group began to consider a potential partnership arrangement for the development of the Project. In May 2001, NCN members voted to support an **Agreement-In-Principle (AIP)** that describes this relationship between NCN and Manitoba Hydro. NCN and Manitoba Hydro formally signed the AIP on September 25, 2001. The AIP is not legally binding, but sets out a series of topics to be discussed between the parties to develop a binding **Project Development Agreement (PDA)** and related agreements.

Later in 2001, the earliest **in-service date (ISD)** for the Notigi Generating Station was re-scheduled for 2014 and efforts were subsequently focused on the Wuskwatim Generation Project (with the earliest ISD of 2009).

Completion of the PDA is scheduled for summer 2003, at which time it will be submitted

[3] These include: consultations to identify issues of particular concern to NCN and to review potential positive and negative effects; studies to understand potential effects and to consider modifications that could mitigate negative effects; consultations to identify potential benefits for NCN, including training, employment and business opportunities; and consultations to determine which Future Development options, if any, NCN may prefer. Manitoba Hydro and NCN also agreed to try to work cooperatively on joint studies required for Future Developments.
[4] The “Arbitrator” as provided for in the 1996 NFA Implementation Agreement.

for ratification of the NCN membership and approval by the Manitoba Hydro-Electric Board. These decisions are expected by mid-October.

In November 1999 NCN and Manitoba Hydro jointly selected a team of environmental and socio-economic consultants **(the Environmental Management Team or EMT)**. The EMT consists of principals from Tetr*ES* Consultants Inc., North/South Consultants Inc., ND LEA (formerly DS-Lea Consultants Ltd.), and InterGroup Consultants Ltd. A number of specialist firms were retained by the EMT to assist with the environmental assessment.

Following a series of workshops with NCN Elders, resource users and representatives of both NCN and Manitoba Hydro in early 2000, the EMT developed a preliminary study plan for both the Generation and Transmission Projects that is referred to as the Joint Study Program (see Section 2.2.2). The Joint Study Program (which includes both Traditional Knowledge (TK) and science-based studies) was developed initially to address concerns expressed by NCN; collect and document sufficient Traditional Knowledge and science-based information to prepare an EIS; and address provisions of Article 8 of the 1996 NFA Implementation Agreement. A second version of the plan was prepared in mid 2001 to address additional information requirements identified by Manitoba Hydro, NCN, and the specialist conducting the studies.

In June 2001, NCN and Manitoba Hydro met with provincial and federal regulatory agencies to describe the Wuskwatim projects, the Joint Study Program and on-going plans for public involvement and consultation. In the fall of 2001, NCN and Manitoba Hydro expanded their joint consultations to introduce the Wuskwatim projects to elected officials in First Nations, Northern Affairs communities and Incorporated Municipalities in the northern region associated with the projects. Public consultation and involvement, both with NCN members and beyond NCN, has been ongoing since that time (Section 3).

In the fall of 2001, NCN and Manitoba Hydro (with the assistance of the EMT) also drafted scoping documents that provided useful background to the provincial and federal **Project Administration Team**[5] responsible for managing the cooperative environmental assessment of these projects.

A formal provincial and federal environmental review process was initiated in December

[5] See section 1.5.

2001 and has resulted, among other things, in review and finalization of the EIS Guidelines by April 2002 (Section 1.5 and Appendix 2).

1.2 PURPOSE OF THE DOCUMENT

This document constitutes the EIS for the proposed Wuskwatim Generation Project. It describes the Project, the purpose of the Project, and the process that has been undertaken to assess environmental effects of the Project in accordance with the EIS Guidelines. The results of the environmental assessment are presented. In addition, results are summarized of field investigations, literature reviews, and consultations with NCN members, members of other communities and the public, resource managers, regulatory officials and discipline practitioners compiled over the past three years. TK is an integral part of this EIS and was particularly important in the selection of alternatives, the siting of infrastructure, and the interpretation of the importance of impacts associated with the Project.

Section 1 provides background on the Project, the scope and intent of this assessment, the purpose of the Project, alternative means of Project development, the regulatory context (including implications of the Project in terms of land and resource-related agreements), and the sustainable development approach of Manitoba Hydro and NCN. Section 2 provides an overview of the assessment approach, including descriptions of the sources of information used in the assessment, and the methodology used to assess **cumulative effects** and the significance of adverse environmental effects after **mitigation** has been implemented (i.e., **residual effects**). Section 3 reviews the public consultation and involvement activities. Section 4 provides a more detailed description of the Project. Sections 5 through 9 provide a comprehensive environmental assessment of the Project (including existing environment, effects and mitigation, cumulative effects, residual effects, and monitoring and follow-up) separately for the physical environment (Section 5), aquatic environment (Section 6), terrestrial environment (Section 7), resource use (Section 8), socio-economic environment (Section 9) and heritage resources (Section 10).

This document includes a number of appendices which provide general supplementary material for the main body of text. Comprehensive technical reports that provide details on the research and analysis of individual categories of biophysical, socio-economic and cultural considerations are provided in the following separate technical supporting volumes.

- 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).

1.3 INTENT AND SCOPE OF THE ASSESSMENT

The intent and scope of the environmental assessment is to describe for provincial and federal regulatory agencies the expected effects related to the construction and operation of the Project and other matters as set out in the EIS Guidelines, including the factors set out in Section 2.3 of the EIS Guidelines.[6] The EIS includes consideration of the significance of any adverse environmental effects that are expected to occur after mitigation has been implemented (i.e., residual effects), as well as the need for (and requirements of) any monitoring and follow-up program in respect of the Project.

The assessment process has emphasized consultation with potentially affected communities and interest groups. Accordingly, the assessment approach for the Project utilizes scientific analysis and evaluation of environmental effects, along with **Traditional Knowledge (TK)**, local knowledge, and other public and interest group perspectives to assess likely effects as well as measures for avoidance, minimization and mitigation of potential adverse environmental effects and enhancement of positive environmental effects.

The EIS Guidelines require that the environmental assessment for the Project include consideration of the environmental effects of all undertakings associated with site preparation, construction, operations and maintenance, and final decommissioning of the facilities. The scope of the environmental assessment includes an examination of the potential changes to the environment (i.e., the "existing or baseline environment" as it is expected to evolve in the future if the Project were not to occur) that may result from the Project, and any change to the Project that may be caused by the environment, including

[6] A similar environmental assessment is being carried out and reported for the Wuskwatim Transmission Project for associated transmission facilities required by the Project.

consideration of effects related to:

- physical environment – land, water, and air;
- biological environment – aquatic and terrestrial species and habitat (and the capacity of renewable resources);
- present and planned resource use, including land and water; and
- human health, socio-economic and cultural conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance.

The use of TK is an integral part of the environmental assessment process of the Project, particularly in identifying potential effects and assessing the significance of the effects on the well- being of the environment and the affected communities within the study area. Section 2 provides an outline of the methodology used to collect TK and how it was used in the preparation of the EIS.

The study area (i.e., the geographic scope of the investigations) included those local areas directly impacted by the Project, and the zones of influence within which there may be environmental effects of a more regional or global nature. The assessment of Project effects on environmental and socio-economic conditions also incorporated a cumulative effects assessment (CEA).

The intent of this assessment within each specific environment is to:

- provide a description of the proposed Project in sufficient detail to allow for a determination of potential linkages between the Project and the existing (or baseline) environment;
- provide a detailed description of the existing physical, chemical, biological, and socio-economic baseline environments (including heritage resources and culture) and what each would be expected to be like in the future without the Project;
- provide sufficient information to understand the nature and extent of the expected environmental, socio-economic, and cultural effects (including effects on heritage

resources) associated with the construction, operation, and eventual decommissioning of the Project;[7]

- as an integral part of this assessment, in accordance with the EIS Guidelines, explain the approach used to identify and assess the cumulative effects of the Project when anticipated to occur in combination with other projects or activities that have been, or will be carried out;
- describe mitigation and remedial measures that will be undertaken to reduce effects associated with the Project as well as enhancement measures to improve positive effects of the Project;
- describe any residual effects, and the significance of any **adverse effects**, that will remain after mitigation and remedial activities and consideration of any cumulative effects; and
- describe monitoring activities that will be undertaken during the construction and operation of the Project to determine actual effects, verify predictions, manage effects, and document the effectiveness of mitigation measures.

The intent is to provide the above information in sufficient detail to address the EIS Guidelines, demonstrate compliance with regulatory requirements for the Project, and address concerns raised by residents of Aboriginal and other communities as well as other interested parties as identified through the consultation and public involvement program.

1.4 PROJECT DEFINITION

1.4.1 Purpose of the Project

The purpose of the Project is to construct and operate a hydroelectric generating station at the Wuskwatim site (Taskinigup Falls) on the Burntwood River to provide electricity into the Manitoba Hydro system. The electricity initially produced will be marketed for export; in time, with anticipated load growth, the power generated at the site will be used to supply the domestic (provincial) requirements.

The Project will assist Manitoba Hydro to fulfill its mission: "To provide for a continuance of a supply of energy adequate for the needs of the province, to promote

[7] Changes to the water regime and flooding begin during the construction phase; however, as these changes last for the lifespan of the Project (rather than just the construction period) they are discussed under operation of the generating station.

economy and efficiency in the development, transmission, distribution, supply and end-of-use of energy, and to provide and market energy related products and services, within and outside the province." Growing domestic energy demands require that Manitoba Hydro consider means of providing additional energy in its system to meet projected needs within the next two decades. Export opportunities also are available to Manitoba Hydro through inter-ties with neighboring markets in Canada and the USA.

Manitoba Hydro's 2002/03 Power Resource Plan indicates a requirement for new generation to meet the current forecast of firm requirements in the year 2020, and identifies Wuskwatim as the next generating project to satisfy this requirement. Advancement of Wuskwatim in-service from 2020 to 2009 would be primarily to obtain additional export revenues and profits. The additional power from Wuskwatim would assist in offsetting the decline in exports as Manitoba load continues to grow. Such advancement would also contribute in the early time period to domestic customer supply reliability and would assist in providing additional power in the event of higher than expected load growth.

Current economic evaluations of the Project show an attractive rate of return on investment consistent with the relatively low risks associated with the Project.

The attractiveness of the Project is further enhanced by the support from NCN, which has indicated interest in becoming a potential partner with Manitoba Hydro in the development and operation of the Project in order to fulfill its own mission. NCN's Vision Statement is "*To exercise sovereignty that sustains a prosperous socio-economic future for the Nisichawayasihk Cree Nation.*"

1.4.2 Scope of the Project

The Wuskwatim Generation Project would consist of the various physical works and activities associated with constructing and operating the new generating station and its supporting infrastructure.[8]

The primary and secondary structures comprising the Project are shown in Figure 1.4-1.

[8] A detailed description of the various components of the Project, including the proposed construction schedule, is provided in Section 4 (Volume 1) and in Volume 3. The associated transmission facilities are addressed separately under the Wuskwatim Transmission Project. Cumulative effects of the generation and transmission facilities (as well as other developments) are addressed in Section 2 and in Sections 5 through 10.

The supporting infrastructure required for construction includes the access road, construction camp, and construction power (Figure 1.1-1).

The Project's permanent facilities will include three turbine units in a powerhouse complex, a spillway, and a main dam and dyke to contain the immediate forebay. The immediate forebay would be formed between Wuskwatim Falls (the natural outlet of Wuskwatim Lake) and the proposed structures located at the current site of Taskinigup Falls. The immediate forebay area and Wuskwatim Lake together form a reservoir that is typically referred to as the forebay. Channel improvements will be made at Wuskwatim Falls to increase the outflow capability of the lake.

The normal Full Supply Level (FSL) for the reservoir/forebay will be 234 m above sea level (ASL), which is near the upper range of the post-Churchill River Diversion (CRD) water levels on Wuskwatim Lake. The resulting head at the site will normally vary between 21 m and 22 m and the rated plant discharge capacity will be 1100 cubic metres per second.

The plant will normally be operated as a run-of-the-river plant on a daily average basis, in what is referred to as a "modified" run-of-the-river mode of operation (also referred to as shaping). The plant outflows are "shaped" as a practical measure to generally maximize efficient operation (generally peak efficiency). The outflow pattern will normally result in fairly stable water levels on Wuskwatim Lake at or near 234 m ASL. The lake will normally be managed within the first 25 cm, from 233.75 to 234 m ASL, with typical maximum daily changes of less than 13 cm. Downstream of the plant, daily water level variations will diminish until they are not noticeable through Birch Tree Lake (approximately 40 km downstream of Wuskwatim Lake and 14 km upstream of Thompson).[9]

Up to one metre of storage has been designated for utilization under abnormal conditions when power demand is high in either the Manitoba Hydro system or that of its neighbours and inflows are very low. During these times, there will be increased usage of the storage to supplement inflows, drawing Wuskwatim Lake as low as 233 m (Section 4).

[9] Project-related daily water level fluctuation at Birch Tree Lake will be less than 0.10 m during open water and 0.15 m during winter conditions.

1.4.3 Alternative Means of Carrying out the Project

Several alternative means of carrying out the Project were considered that are technically and economically feasible.

The most significant design choice was the selection of the reservoir level which determines the amount of energy the station can produce as well as the extent of flooding and, therefore, the magnitude of environmental impact (Section 4.3.1). A range of high and medium reservoir elevations (up to 244 m ASL) was considered but was eliminated due to evident upstream environmental impacts associated with extensive flooding. Instead, a reservoir elevation at the upper end of the range of water levels experienced on Wuskwatim Lake in recent years was selected. As a result, a significant amount of the station's potential energy production has been foregone, which could be regained, in part, if a generating station were to be constructed sometime in the future at Early Morning Rapids.

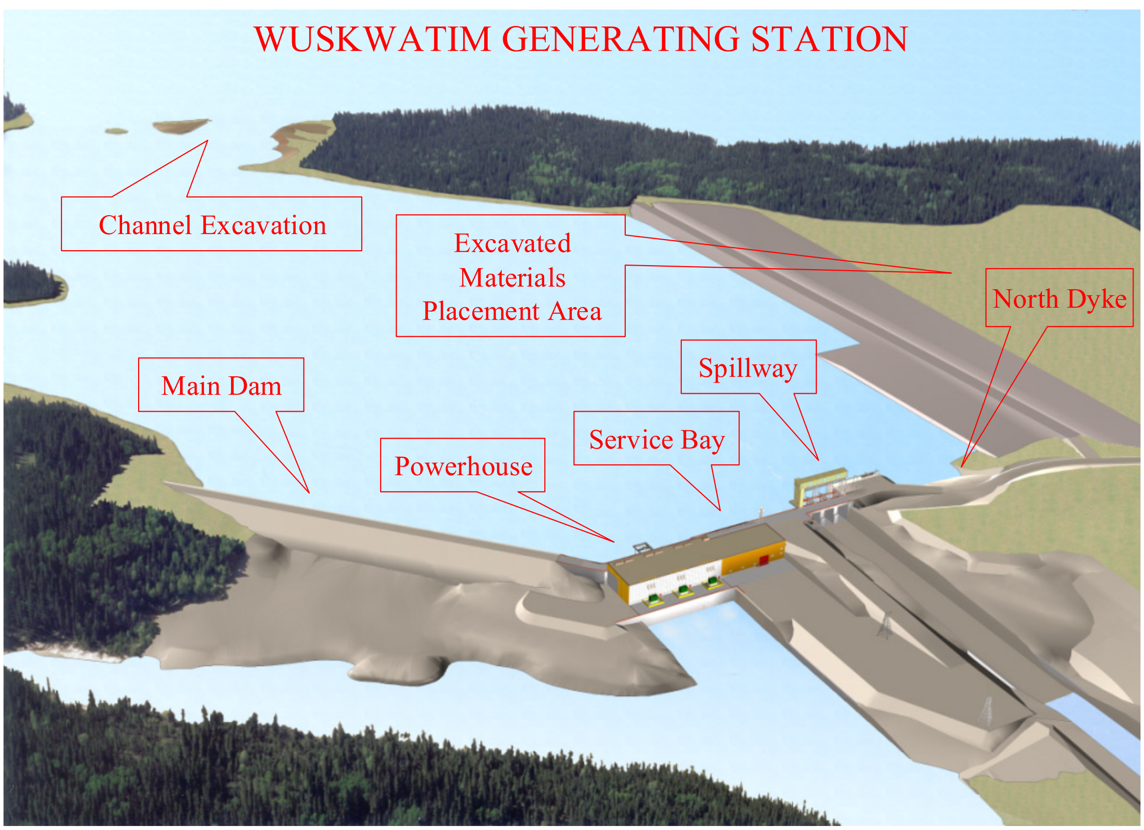


Figure 1.4-1. Computer 3D rendering showing the general arrangement of primary and secondary structures of the Wuskwatim Generation Project.

A second major decision involved the operating regime for the generating station (Section 4.3.2). An aggressive operating mode could maximize energy output at the selected forebay elevation but would result in frequent and severe forebay drawdowns and erratic downstream discharges. Again, output was sacrificed to minimize environmental impacts. The selected operating mode (shaping) is nearly run-of-the-river, with daily average outflows closely matching inflows to maintain levels on Wuskwatim Lake within a narrow range and downstream levels and flows typically within historic ranges.

A third major choice has been the siting of the access road (Section 4.3.3). Several route alternatives were considered based on environmental, community, and technical considerations with the final selection being the best overall option when considering effects to the environment, NCN and the Project.

A fourth major choice involved the selection of a location for the main construction camp as well as other alternatives relating to the camp facilities (Section 4.3.4). Three different location alternatives were considered with the final selection being the most acceptable to both NCN and Manitoba Hydro.

As is normal for major development projects, there will be many choices to be made, including selection of contractors, suppliers, equipment, and construction techniques. These choices will be based on several factors (e.g., quality, costs, availability, and schedule). Manitoba Hydro will be contracted by the Partnership to manage the construction of the Project and to manage the contract processes to ensure that workmanship and materials meet their standards and achieve their Project development goals.

1.5 REGULATORY FRAMEWORK

Before the Project can be built, both federal and provincial regulatory requirements will need to be met and licenses obtained. The relevant regulatory framework for the Project is outlined in this section in response to Section 3 of the EIS Guidelines for the Project.

In broad terms, federal and provincial regulatory requirements for the Project are coordinated through a cooperative assessment process which respects each government's relevant legislation. Under this cooperative process, a joint Project Administration Team (PAT) and a **Technical Advisory Committee (TAC)** are comprised of representatives from federal and provincial departments with an interest in the Project (Figure 1.5-1). Canada's requirements are set out in the *Canadian Environmental Assessment Act (CEAA)* and are triggered by the need for permits under the *Navigable Waters Protection Act (NWPA)* and under the *Fisheries Act.* Manitoba's requirements for environmental and license review are set out in *The Environment Act (Manitoba).*The Project will also require a license under *The Water Power Act* and other specific land use permits.

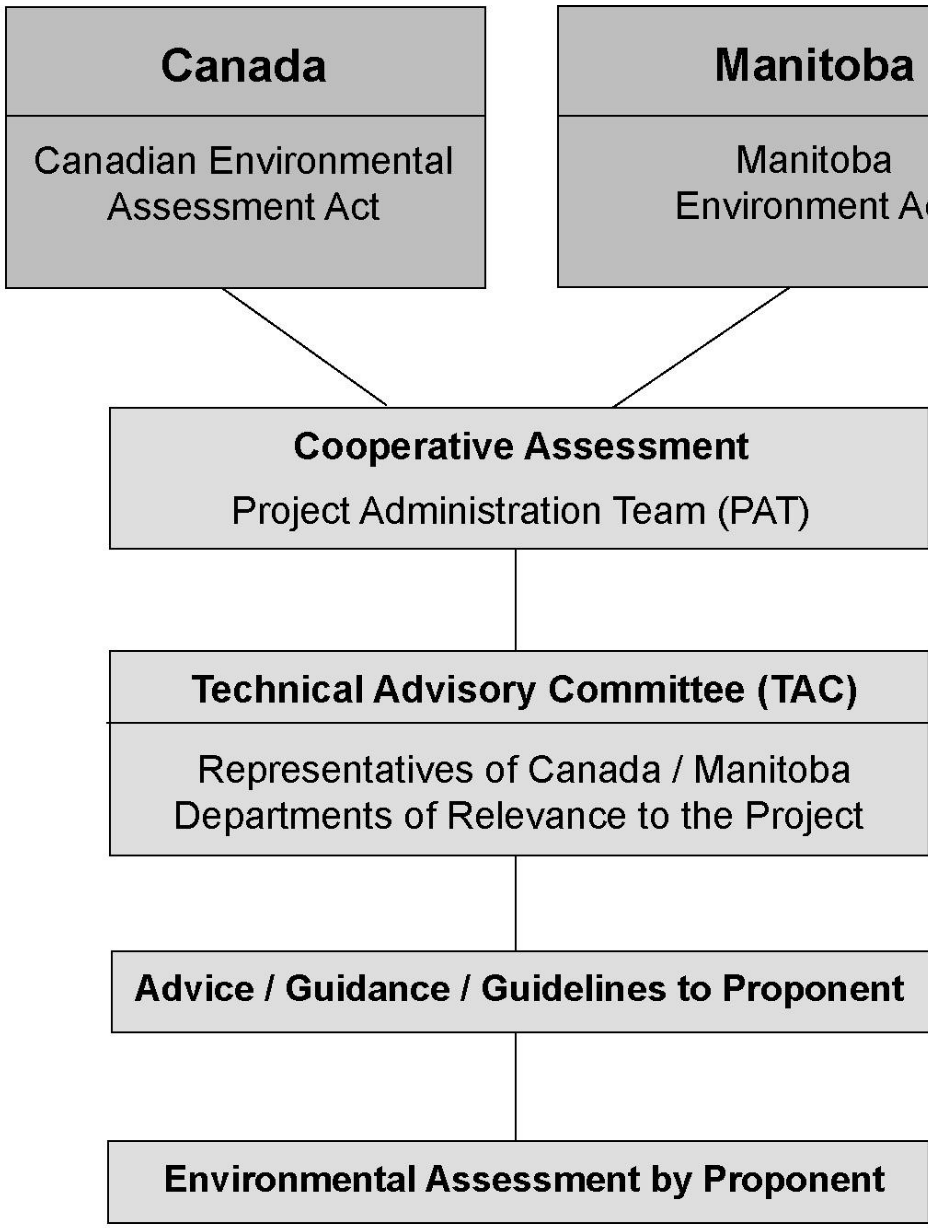


Figure 1.5-1. Federal/Provincial Regulatory Framework.

The Project will be reviewed under the provisions of "*The Canada-Manitoba Agreement on Environmental Assessment Cooperation"*, signed by the two governments in May of 2000. Canada and Manitoba have agreed that, when an environmental assessment of a project is required by Canada pursuant to CEAA and an environmental assessment is required by Manitoba pursuant to *The Environment Act (Manitoba)*, a cooperative environmental assessment will be undertaken to generate the type and quality of information and conclusions on environmental effects required by all parties making decisions.

Separate from the federal and provincial regulatory reviews, additional reviews of the Project are carried out jointly by Manitoba Hydro and Nisichawayasihk Cree Nation as required under the 1996 NFA Implementation Agreement and the 2001 Agreement-in-Principle in order to negotiate and ratify, as a precondition to proceeding with the Project, a Project Development Agreement (Section 1.1). In accordance with the 1996 NFA Implementation Agreement, the Nelson House Resource Management Board (which includes Provincial and NCN representation) also carries out reviews related to the Project. In addition, reviews and consultations are conducted as required under other agreements involving Manitoba Hydro.[10]

For environmental review and licensing purposes, provincial and federal regulators have determined that the Wuskwatim Generation Project and the Wuskwatim Transmission Project are considered to be two separate projects. Accordingly, separate licensing applications were filed in December 2001 for each of these projects and separate Environmental Impact Statement Guidelines have been established for each of these projects. It is expected, however, that the EIS review and the provincial public hearings process for the two projects will occur at the same time.

The Project, with 200 MW of hydroelectric generating capacity, requires a comprehensive study level environmental assessment under *The Canadian Environmental Assessment Act*.[11] The Project is also a Class 3 development, as defined in the *Classes of Development Regulation 164/88,* under *The Environment Act (Manitoba)*.

The Manitoba Minister of Conservation has determined that there will be public hearings

[10] For example, other agreements include the **Northern Flood Agreement (NFA)** and related NFA implementation agreements as well as agreements with the City of Thompson, the Community Association of South Indian Lake, Fox Lake Cree Nation, and War Lake First Nation, all of which contain dispute resolution mechanisms.
[11] No similar federal requirement has been determined to apply for the Wuskwatim Transmission Project.

for the Wuskwatim Generation and Transmission Projects which will be conducted by the **Clean Environment Commission (CEC)** in accordance with Section 6(5) of *The Environment Act (Manitoba)*. The hearings will be conducted in order for the Commission to review the EIS and supporting documentation within the scope of the EIS Guidelines, to address issues raised in the environmental assessment process (based on the public's input and the EIS), and to provide advice and recommendations to the Minister in a report to be prepared subsequent to the hearings.

The federal government participates in the overall environmental review process for these projects through the joint PAT and TAC. In addition, the federal Responsible Authority (the Department of Fisheries and Oceans) is to prepare a Comprehensive Study Report (CSR) for the Project that will be made available for public review and comment before any final *CEAA* determination is made.

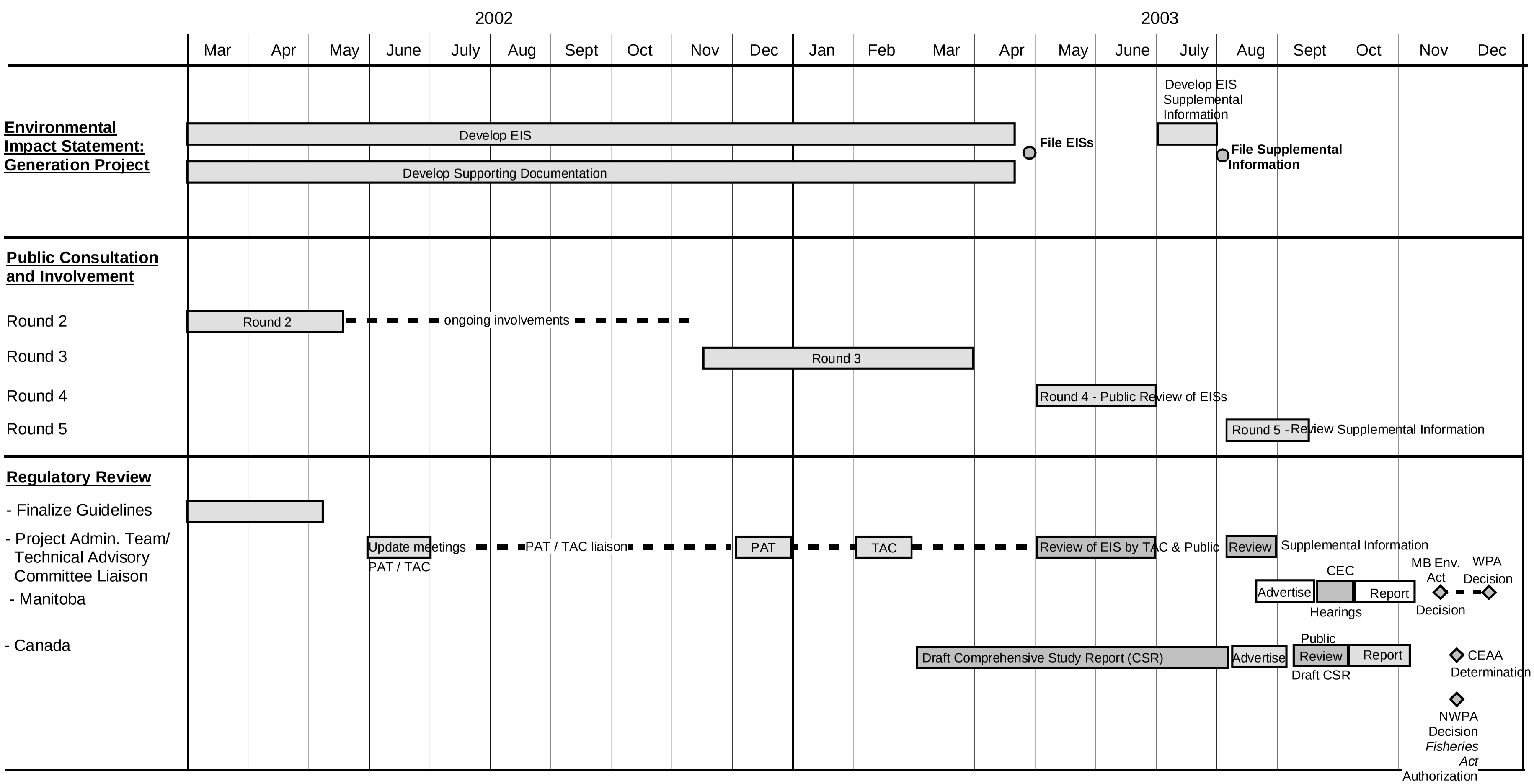
An overview of the expected regulatory schedule that reflects the results of activities taken to date is provided in Figure 1.5-2. Additional designation of the cooperative review activities is provided in Section 1.5.2.[12]

1.5.1 Canada-Manitoba Environmental Assessment

Manitoba Hydro and NCN initially approached Manitoba Conservation early in the conceptual stage of the Project. A TAC consisting of both provincial and federal officials was developed, and three meetings with the Manitoba Hydro/NCN study team subsequently occurred on June 25, 2001, June 25, 2002 and February 6, 2003. A listing of the individual representatives is provided in Appendix 3. These meetings involved the provision of background information and progress updates to TAC representatives with respect to the environmental assessment and scheduling issues.

"The Canada-Manitoba Agreement on Environmental Assessment Cooperation" provides that the Lead Party in a cooperative environmental assessment process will establish and chair a PAT with membership representing the federal responsible authority(ies) and representatives of Manitoba Conservation. The PAT is then responsible for managing the cooperative environmental assessment. Manitoba is the lead party for the Project.

[12] A separate review process is being established by the Government of Manitoba to provide a public examination of the need for the Project and alternatives to developing proposed new hydroelectric projects.



CEAA - Canadian Environmental Assessment Act
WPA - Water Power Act
NWPA - Navigable Waters Power Act

Note: This schedule is for illustrative purposes; the final regulatory schedule will be determined by regulators.

Wuskwatim Generation Project: Regulatory Review Process

Figure 1.5-2. Wuskwatim Generation Project: Regulatory Review Process.

In September 2001, Manitoba Hydro and NCN drafted a scoping document that provided background information to assist the PAT in the development of separate Draft EIS Guidelines for the Wuskwatim Generation and Transmission Projects. On December 7, 2001, Manitoba Hydro submitted *Environment Act* Proposal Forms (EAPFs) for the two Wuskwatim projects to Manitoba Conservation. These documents were received by Manitoba Conservation and placed on the appropriate Public Registry file system that has been established to accommodate public access to environmental assessment information about the Wuskwatim projects. Manitoba Conservation also placed on the Public Registry the Draft Scoping Documents, that had been provided by NCN and Manitoba Hydro for each project.

In mid-December 2001, the PAT released for public comment draft "*Guidelines For The Preparation of an Environmental Impact Statement for the Wuskwatim Generation Project*", as well as draft Environmental Impact Statement Guidelines for the Wuskwatim Transmission Project, in accordance with the provisions of "*The Canada-Manitoba Agreement on Environmental Assessment Cooperation*". Manitoba Conservation also placed an advertisement in local newspapers inviting interested parties to provide their comments and concerns about the projects and the draft guidelines during a 90-day review period. The Minister responsible for Manitoba Conservation referred the matter to the CEC for further consideration. The CEC subsequently convened four public meetings on the Draft EIS Guidelines in February 2002,[13] and in April 2002 released a "*Report to the Minister of Conservation on Public Meetings: Draft Environmental Impact Statement Guidelines for the Wuskwatim Generation and Transmission Projects*". After review by PAT, the final "*Guidelines for the Preparation of an Environmental Impact Statement for the Wuskwatim Generation Project*" was then released by Manitoba Conservation on April 29, 2002 (Appendix 2).[14] All these documents were placed in the **Public Registry**.

A CEC hearing will be held in the future to consider the environmental assessment of the Wuskwatim projects. A **Participant Assistance Program** has been established for the assessment of these projects to provide financial assistance to groups or individuals participating in the environmental hearing process for the Wuskwatim projects. The latest information on the Participant Assistance Program is provided for on the CEC website at: www.cecmanitoba.ca.

[13] The CEC held public meetings on the Draft Guidelines in Thompson (February 11, 2002), Nelson House (February 12, 2002), Winnipeg (February 18, 2002) and The Pas (February 19, 2002).
[14] Similar final EIS guidelines were also issued in late April 2002 for the Wuskwatim Transmission Project.

1.5.2 Cooperative Regulatory Review Activities

After the EIS has been submitted for review by the regulatory authorities (Figure 1.5-2), it will be placed in the provincial public registries and the federal registry and will be made available for public review and comment. Another TAC meeting will be held shortly after the submission of the EIS to assist TAC members in their review and to receive comments from TAC representatives. After an initial 60-day public review period for the EIS submissions, it is anticipated that PAT may request certain supplementary information from Manitoba Hydro and NCN which will be provided as soon as possible. During this time, it is expected that the CEC will announce the time frame for public hearings on the proposed Project; after completion of the hearings, the CEC will release its report to the Manitoba Minister of Conservation.

The Manitoba Minister of Conservation will make a decision regarding licensing of the Wuskwatim Generation Project. Independent of this action, the federal authorities will need to apply the provisions of *CEAA* and make a decision regarding the issuance of federal approvals such as *Fisheries Act* authorization for alteration of fish habitat and approvals under *The Navigable Waters Protection Act*. Similarly, Manitoba will need to make a decision as to approvals of the Project under *The Water Power Act*. During this decision-making process both governments expect to undertake appropriate consultation.

1.5.3 Manitoba and Federal Legislation

A listing and detailed description of the provincial and federal legislation that is applicable to this Project is provided in Appendix 3. Project assessment by regulatory authorities will also involve the review of available fisheries, forestry and wildlife-related provincial guidance documents, as well as a review of the draft Manitoba Water Quality Standards, Objectives, and Guidelines.

1.5.4 Participant Assistance

The Manitoba Minister of Conservation established a program under the Manitoba *Environment Act*'s *Participant Assistance Regulation* to provide initially up to $100,000 in total in funding to groups to help them review and be involved in the project regulatory process. The total amount of participant funding available was subsequently increased to $150,000. Eight applications for this program were received up to November 15, 2002.

1.5.5 Current Planning Initiatives – Resource Management Board

Article 6 of the 1996 NFA Implementation Agreement sets out the process for land use and resource management planning by NCN and Manitoba for 5.6 million acres (2.3 million hectares) of land in the Nelson House RMA, and defines the role in this process of the Nelson House Resource Management Board which is composed of representatives of NCN and Manitoba. This Resource Management Board is incorporating the Wuskwatim Generation and Transmission Projects into its ongoing planning initiatives that also will include consideration of:

- Tolko's Forest Management Plan;
- 2020 – Manitoba's Transport Vision initiative;
- ongoing activities related to parks and other protected areas planning, particularly with respect of "Areas of Special Interest" in the region; and
- Manitoba's Climate Change Action Plan – 2002.

1.6 EFFECT OF THE GUIDELINES ON EIS ORGANIZATION AND CONTENT

The *EIS Guidelines* are, for the most part, directly reflected in the structure and content of the EIS. However, certain more generic aspects (e.g., those described under "intent" in section 2.3.1 of the *Guidelines*) are not separately and explicitly addressed, but have more broadly influenced EIS development and presentation. EIS treatment of several such generic aspects is addressed in the following subsections.

1.6.1 Scientific Analysis of Effects

The assessment and characterization of potential environmental effects of the Project have used an ecosystem-based approach. This approach has been an important part of the environmental assessment process, particularly in judging the significance of the potential effects of the Project. Section 6 addresses this approach for the aquatic environment. Section 7 provides a brief overview of this approach for the terrestrial environment, how it was used and the results of the impact assessment for the Project.

1.6.2 Traditional Knowledge and Use of Valued Ecosystem or Environmental Components

Preparation of the EIS has relied heavily on the input of local and Traditional Knowledge in identification of issues and concerns, in the comparative evaluation of alternative access routes and camp site locations, in the selection of preferred options, and in the characterization of effects associated with development of the Project. Section 2 (Assessment Approach), Section 3 (Public Consultation and Involvement) and Sections 5 through 10 (assessments of specific environments) provide more detail as to consultation with Elders, resource harvesters, and community residents generally.

In general, the EIS approach and findings have addressed potential effects in the context of established issues and concerns. In this way, the assessment focuses on valued ecosystem components, or more generally (including non-biophysical components) **valued environmental components (VECs)**. Although not always explicitly presented as a VEC-based approach in every instance, the result is characterization of potential effects in the context of both scientifically-based ecosystem concerns (per Section 1.6.1) and local and traditional environmental values, as described through individual and community inputs to the public involvement program. VECs are identified separately where appropriate in each assessment section.

1.6.3 Environmental Stewardship and Sustainable Development

Manitoba Hydro and NCN are both guided by the principles of sustainable development and practice environmental stewardship in their activities and operations.

Manitoba Hydro has its own environmental management policy, stating the Corporation's commitment to protecting the environment and recognizing that its facilities and activities affect the environment. Manitoba Hydro integrates environmentally responsible practices into its business, including:

- preventing or minimizing adverse impacts, and enhancing positive impacts;
- complying with regulatory requirements;
- considering the interests and utilizing the knowledge of affected customers, employees, communities and stakeholders;
- reviewing environmental objectives and targets to ensure improvements in environmental performance;
- improving Environmental Management Systems;

- documenting and reporting environmental activities and performance; and
- the Corporation has registered its ISO 14001 Environmental Management System.

Manitoba Hydro is an active participant in the Canadian Electricity Association's Environmental Commitment and Responsibility Program (ECR) which includes four environmental principles: i) efficient use of resources; ii) reduction of adverse impacts; iii) accountability to stakeholders; and iv) ensuring that employees understand the environmental implications of their actions and have the knowledge and skills to protect the environment.

Manitoba Hydro has operated according to its Sustainable Development Principles for many years. These 13 supporting principles have been applied in all aspects of its planning and operations to achieve environmentally sound and sustainable economic development. Through its decisions and actions, the Corporation endeavors to meet the needs of the present without compromising the opportunities for future generations (Appendix 3).

Manitoba Hydro requires that its contractors and suppliers meet the Corporation's environmental principles.

NCN has practiced sustainable development and stewardship of the environment throughout its long history in the region. The land and its resources are inextricably linked to its culture, traditional lifestyle, and economic well-being. NCN's definition of Traditional Knowledge includes the "stewardship of the environment" and "Aboriginal law regarding how the environment works".

NCN's consideration of impacts associated with the Project was conducted with full recognition of their historic and current positions on environmental stewardship. Future activities will be conducted in keeping with their Traditional Knowledge and the value that NCN places on their environment.

The concepts of sustainable development have been considered throughout the assessment of environmental impacts associated with the proposed Project and in the development of mitigation programs as required in the EIS Guidelines. The proposed Project is consistent with Manitoba's Water Policies regarding water quality, conservation, use and allocation, water supply, and education.

2.0 ASSESSMENT APPROACH

2.1 OVERVIEW OF APPROACH

The assessment approach adopted by Manitoba Hydro and NCN for the Project utilizes scientific analysis and evaluation of environmental effects and socio-economic analysis, along with Traditional Knowledge, local knowledge, and other public and interest group perspectives. This approach is used to assess likely effects as well as measures for avoidance, minimization and mitigation of potential adverse effects and enhancement of potential positive effects on both the biophysical and socio-economic environments.

The assessment approach has been structured to address the categories and types of environmental effects set out in the EIS Guidelines, i.e., effects at distinct phases of the Project (site preparation and construction, operation and maintenance, and final disposition and decommissioning) and effects on distinct biophysical (e.g., physical, aquatic and terrestrial), socio-economic (e.g., resource use and other socio-economic) and heritage resource components of the environment.[1]

The assessment process for the Project has emphasized consultation and involvement with potentially affected communities and interest groups (Section 3). Starting with NCN, and then moving beyond NCN, early and meaningful ongoing opportunities have been provided for different segments of the public to receive information on, and provide views and information about the Project and the environmental planning and assessment process.

As described in Section 4, NCN's involvement in the assessment process with respect to effects within the Nelson House RMA has had a major impact on final selection of many key features of the Project, including the low head reservoir design, the low impact operating regime for the generating station, and the siting of the access road and main construction camp. Each of these environmental planning outcomes from the assessment process has contributed to mitigation of adverse environmental and socio-economic effects that could potentially have been associated with the Project.

The assessment approach focuses on effects of Project construction (including planning and site preparation activities) and Project operation. As explained in Section 4.5.3, there is no timetable for decommissioning the facilities. If the plant were to be decommissioned, the earliest timeframe would be in 50 to 100 years. The design life of

[1] The assessment's intent and scope is provided in Section 1.3 and the regulatory framework in Section 1.5.

the plant is 100 years. This is so far into the future that it is not feasible today to provide meaningful assessment of likely plans or their effects, based on available information and agreements.[2] If at a later date it is decided, pursuant to the 1996 NFA Implementation Agreement, that the plant would no longer be utilized for power generation, then Manitoba Hydro would develop a decommissioning plan that would include details on proposed site rehabilitation, and would submit this plan for regulatory review and approval prior to its implementation. Accordingly, the EIS does not provide any further assessment of Project decommissioning and final disposition.

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.

Important elements of this assessment approach are highlighted below (discipline-specific information is provided in sections 5 to 10).

- <u>Information Sources</u>: A wide range of information sources were used to conduct the assessment approach (Section 2.2).
- <u>Valued Ecosystem or Environmental Components</u>: The effects assessment approach focuses on valued ecosystem components, or more generally (including non-biophysical components) valued environmental components (VECs). In this way, the approach and findings address potential effects in the context of established issues and concerns (Section 1.6.2).
- <u>Links or Sources of Effect</u>: Potential environmental effects of the Project on VECs are considered through an analysis of links between the Project and each environmental component.
- <u>Methods of Assessment</u>: Specific methods to determine Project environmental and socio-economic effects are described separately, as appropriate, in each assessment chapter.

[2] Article 2.9 of the 1996 NFA Implementation Agreement states that if "the Project [which is defined to include Future Development such as the Wuskwatim Generation Project] is no longer utilized for the production of hydro-electric power, Hydro ... covenants and agrees to operate and maintain all such works, structures and improvements, within its legal authority and control, as may be necessary to avoid, to the extent reasonably possible, changes from the parameters of the Compensated Range or such other Daily Average Water Levels and Rates of Change as may be agreed upon in writing by Nelson House ...".

- Study Area and Temporal Boundaries: Study area boundaries and temporal boundaries for Project effects are identified separately, as appropriate, in each assessment chapter (Sections 5 through 10), based on predicted links between the Project and each environmental component. The time periods examined include the Project construction period (2004-2009), and the operations period (after 2009 and extending 50 to 100 years or more).[3] Examples of different study areas include: (a) waterway impact area (Project effects on the water regime as discussed in Sections 5 and 6 are predicted to extend along the Burntwood River and associated lakes from Early Morning Rapids upstream of the generating station site down to and including Opegano Lake); (b) biophysical sub-region (Project effects on the biophysical environment as discussed in Sections 7 and 8, including the access road effects, are assessed within a sub-region represented by a rectangle bounded approximately by Nelson House to the west; Thompson to the east; PR 391 to the north; and just south of Wuskwatim Lake to the south); and (c) socio-economic Local and Project Regions (Project effects on people as discussed in Section 9 are assessed separately for several different regions, including a Local Region, which includes Nelson House and NCN members living at other locations such as South Indian Lake, and a broader Project Region which includes communities throughout the Burntwood and Nelson Rivers area).
- Mitigation: Ways to reduce adverse effects (i.e., mitigation) and improve positive effects are considered throughout the effects assessments (Sections 5 through 10 set out mitigation measures beyond those already included in the Project Description in Section 4). The significance of environmental and socio-economic effects are assessed after consideration of planned or anticipated mitigation.
- Cumulative Effects Assessment (CEA): Cumulative effects assessment forms an integral part of the assessment approach, looking at all effects that are likely to result from the Project when they are anticipated to occur in combination with other past, existing, and future projects and activities (Section 2.3).
- Residual Effects and Significance: The nature and extent of any residual environmental effects, and the significance of these residual effects, are determined (based on all of the above considerations, including mitigation) separately for each

[3] Biophysical assessments examine the extent to which effects are predicted to vary during distinct segments of the operations period. For example, Project-related Wuskwatim Lake shoreline erosion rates are predicted to be greatest during the first five years of Project operations, and then are expected to gradually decline over the next 20-years, with shoreline erosion rates after 25 years of Project operations expected to be the same as they would be without the Project.

environmental component. The assessment approach describes both positive and adverse residual effects of the Project, recognizing that under the EIS Guidelines significance is required to be determined only for adverse environmental effects.

- Monitoring and Follow-Up: The EIS also describes monitoring and follow-up activities that will be carried out if the Project is constructed.

The assessment approach is applied separately to each different component of the environment as set out in the EIS Guidelines, e.g., physical (Section 5), aquatic (Section 6), terrestrial (Section 7), resource use (Section 8), socio-economic (Section 9) and heritage resources (Section 10). Detailed information on these assessments is provided in the supporting volumes.

2.2 SOURCES OF INFORMATION

The EIS incorporates Traditional Knowledge (Section 2.2.1), scientific information collected through the Joint Study Program (Section 2.2.2), other information provided through the involvement of NCN and other communities (Section 2.2.3), and published and unpublished information (Section 2.2.4).

2.2.1 Traditional Knowledge

NCN's Future Development Team believes that Traditional Knowledge is vital when considering future development projects. Manitoba Hydro shares this view, and from the outset of the study program Traditional Knowledge has been incorporated into the design and implementation of the environmental and planning studies for the Project.

To NCN, Traditional Knowledge is:

- the observation and experience of the land;
- Aboriginal law regarding how the environment works;
- the understanding of NCN's place in the world – how things are connected, including spirituality, and the relationship to the land;
- the goals and aspirations of NCN;
- the outlook on the proposed Projects – concerns, acceptability;
- NCN's identity and culture;
- the stewardship of the land; and,
- a base for natural resource management.

NCN feels that TK comes from Elders and other people with both traditional and modern perspectives.

Once the environmental and planning studies were initiated, NCN members shared TK about the local area through a variety of mechanisms. This included collaboration between study scientists and NCN members in field programs and a full-scale opinion survey of members to determine their outlook on the proposed development and their priorities in planning for development. In addition, NCN developed its own TK study that included interviews with resource harvesters, Elders and others. A committee, made up of representatives from the community, was struck to guide the interview process (including establishing the principles and guidelines for how TK should be collected and used).

Beyond NCN, consultation and public involvement activities were carried out with other Aboriginal communities in the region (see Section 3). One element of these activities was to provide opportunity for members of other Aboriginal communities to share TK on any matters relating to effects from the Project. Concerns and comments from other Aboriginal communities have been recorded and reflected in the EIS.

2.2.2 Joint Study Program

In November 1999, NCN and Manitoba Hydro jointly selected the EMT. In accordance with Article 8 of the 1996 NFA Implementation Agreement, the EMT assisted in developing and conducting the environmental assessment study program for the proposed Wuskwatim and Notigi Generation and Transmission Projects. The study program was designed to collect TK and scientific information to:

- address concerns and issues identified by NCN and Manitoba Hydro with respect to the proposed developments;
- provide information that assisted NCN and Manitoba Hydro in making their respective decisions regarding the proposed developments;
- identify opportunities for NCN associated with the developments;
- assist in the planning of the developments by identifying and assessing impacts of alternatives identified by NCN and Manitoba Hydro;
- identify environmental issues that need to be considered during planning of the developments (e.g., identify possible negative effects so they can be avoided or reduced wherever possible);

- provide information to conduct an Environmental Impact Assessment (EIA) and prepare an EIS in sufficient detail to meet or exceed regulatory requirements; and
- provide baseline information to allow for future monitoring studies to determine the environmental and socio-economic effects of the Project.

The initial study program, which is referred to as the Joint Study Program, was developed through a series of three, two-day workshops in 2000 that were attended by NCN Elders, members of NCN's Future Development Team, Manitoba Hydro, and study team specialists. A second series of workshops were held in March 2001. A holistic approach was used to examine the environment and visual aids, such as Figure 2.2-1 (which illustrates some of the potential pathways or linkages between upstream water level changes caused by the Project and the environment) were used to help focus the discussions. The workshops looked at:

- the aquatic environment including: water quality, lower trophic levels, fish, fish habitat, and domestic and commercial fishing;
- the terrestrial environment including: plants, birds, small and large mammals, and resource harvesting;
- cultural and heritage resources including: sacred sites, burial sites, and archaeological sites; and
- the socio-economic environment including: the people and their community, including business and employment, recreation, transportation, community health, culture, and family life.

NCN members who did not attend the workshops also had the opportunity to have input into the study program during public meetings, open house presentations, and by participating in surveys and questionnaires. Numerous meetings regarding various aspects of Project planning were held with NCN representatives. Advice and information received from federal and provincial biologists, research scientists, and managers (through meetings with the Technical Advisory Committee and other specialists) and external experts also were used in the development and implementation of the Joint Study Program and related environmental and socio-economic studies.

Study Plan Implementation meetings were held with NCN and Manitoba Hydro to receive regular input on the Joint Study Program. The meetings initially were held on a monthly to semi-monthly basis; towards the end of the Program, meetings were scheduled to cover milestone activities (e.g., to discuss the results of the studies).

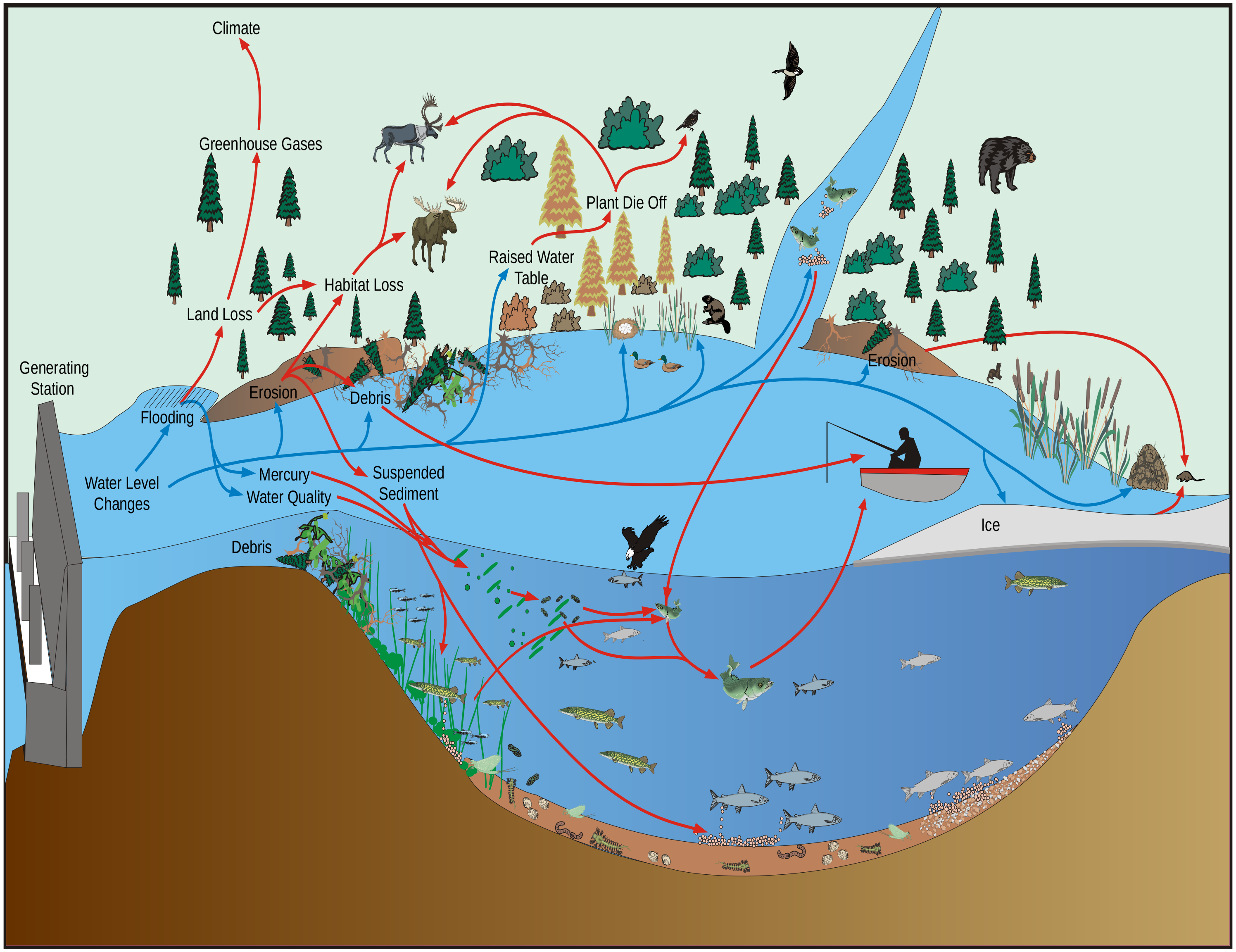


Figure 2.2-1. Example of a linkage diagram used to assist in the development of the Joint Study Program.

During the course of the studies, additional activities were included in response to information and issues identified by the EIS Guidelines, and by public consultation and involvement activities.

Meetings with regulatory agencies (PAT and TAC), as well as provincial and federal government departments, were also held to discuss the status of the environmental and socio-economic studies and provide information to assess ongoing changes to this program

2.2.3 Involvement of NCN and Other Communities

The assessment process for the Project has emphasized consultation and involvement with potentially affected communities.

The involvement of NCN members and other communities in the region of the Project has provided the EIS with important information with regard to the concerns, interests and local knowledge of Aboriginal and other communities.

As described in Sections 1 and 3.2, NCN members (particularly residents of Nelson House) have provided information to the EIS through a wide range of processes. Involvement of communities beyond NCN has occurred primarily through the meetings with elected leaders and other representatives, as well as open houses held at Thompson and meetings held in several Aboriginal communities (Section 3.3). Key person interviews have also been undertaken.

Information sources from NCN, other communities, and key person interviews are cited in supporting volumes.

2.2.4 Existing Published and Unpublished Information

Detailed literature searches were conducted to identify both published and unpublished information. A list of the documents utilized and depended on in this assessment is provided in the 'literature cited' sections of each supporting volume of the EIS.

2.3 CUMULATIVE EFFECTS ASSESSMENT

The EIS Guidelines (Section 7) indicate that *"Cumulative Effects Assessment (CEA) shall form an integral part of the environmental and socio-economic assessment. The cumulative effects assessment shall look at all effects that are likely to result from the* *project when they are anticipated to occur in combination with other projects or activities that have been, or will be carried out."*

CEA also is required under the *Canadian Environmental Assessment Act (CEAA)* that came into force in 1995. Section 16 of *CEAA* states that every screening or comprehensive study of a project, and every mediation or assessment by a review panel, shall include consideration of the following:

(A) "the environmental effects of the project, including … any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out"; and

(B) "the significance of effects referred to in paragraph (A)".

Cumulative effects assessment is defined in the Cumulative Effects Practitioner's Guide (Hegmann et al. 1999) as:

> *"… changes to the environment that are caused by an action in combination with other past, present and future human actions."*

"Actions" are defined as "projects and activities".

The Cumulative Effects Working Group, established to provide guidance for the conduct of CEA in Canada, has recently provided additional guidance regarding the ultimate goal of CEA:

> *"… an assessment of a single project (which is what almost all assessments do) must determine if that project is incrementally responsible for adversely affecting a VEC beyond an acceptable point (by whatever definition). Therefore, although the cumulative effect on a VEC due to many actions must be identified, the CEA must also make clear to what degree the project under review is alone contributing to that total effect. Regulatory reviewers may consider both of these contributions in their deliberation on the project application"* (Hegmann et al. 1999).

The inclusion of CEA in the biophysical and socio-economic assessment process works towards the goal of maintaining ecological and socio-economic integrity into the future. CEA, as conducted in this EIS, therefore embodies the concept of sustainability and sustainable development.

The CEAA Practitioners Guide (Hegmann et al. 1999) suggests the application of a five step framework for CEA: scoping; analysis of effects; identification of mitigation; evaluation of significance; and follow-up. The first step, scoping, is comprised of the following five general components:

1. issues identification;
2. VEC selection;[4]
3. spatial bounding;
4. temporal bounding; and
5. identification of included projects.

The scoping requirements recognize that cumulative environmental effects must qualify as "environmental effects" of the Project (i.e., must fall within the spatial and temporal boundaries applicable for Project effects and must be caused at least in part by the Project), and must be "*likely* to result from the project when they are anticipated to occur *in combination with other projects or activities* that have been, or *will be* carried out." (italics added for emphasis). In identifying **future projects** to be included in a CEA, the following should be noted:[5]

- at a minimum, otherwise eligible projects or activities that have already been approved must be taken into account;
- it would be prudent also to consider otherwise eligible projects or activities that are already in a government approvals process;
- other eligible projects or activities not subject to a formal government approvals process should be included if there is a high level of certainty that they will occur; and
- the environmental effects of uncertain or hypothetical projects need not be considered.

Scoping for the CEA[6] was conducted through a combination of three workshops with NCN and Manitoba Hydro (both TK and scientific information were used), and literature reviews, and input from an external expert (Dr. P. Duinker, Dalhousie University). Prior to the workshops, background documents (see Volume 10) were provided to participants to facilitate the scoping exercise. At the workshops, a list of activities that could

[4] Section 1.6.2 reviews the approach to VECs (including Valued Environmental Components) in this EIS.
[5] See the document entitled: *Addressing Cumulative Environmental Effects, A Reference Guide for the Canadian Environmental Assessment Act (available from Federal Environmental Assessment Review Office).*
[6] The CEA workshops addressed both the Wuskwatim Generation and Transmission Projects.

potentially overlap with the Project were identified. Results of the workshops, and a description of these activities, along with their spatial and temporal scale and how they were addressed in the CEA, are further discussed in Volume 10.

2.3.1 Past and Current Projects and Activities

Past and current projects and activities were generally considered to form an integral part of the existing biophysical/ecological environment against which predicted effects are assessed. As such, these past and current projects and activities, along with their projected future levels, are properly accounted for in the initial assessment of Project effects.

Past and current projects and activities considered as part of the baseline setting conditions (as required for assessment of each specific environmental component), and excluded from the CEA, include the following.

- Churchill River Diversion, developed in the 1970s,[7] and other existing Manitoba Hydro facilities (e.g., generating stations, transmission facilities, water regulation facilities).
- Provincial Road (PR) 391, developed in 1969, and other existing public or forestry roads and exploration trails/cut lines (it is assumed that the new trails will be balanced by vegetation regeneration of old ones, though regeneration may not be identical to original vegetation).
- INCO Ltd.'s Thompson Operations, ongoing since 1961, and ongoing mineral exploration activities (assumed at current levels).
- Ruttan Mine Closure (occurred in June 2002).
- Current forestry plans by Tolko (Tolko's Forest Management Plan describes plans and impacts of proposed harvest; annual cutting plans incorporated into forestry baseline assessment[8] – future plans are addressed below).
- Population growth as it normally affects communities in Project Region (e.g., Nelson House and Thompson).
- NCN projects and activities, including: developments within Nelson House and within the Nelson House RMA (except those future activities explicitly noted below

[7] CRD is expected to continue to operate as it is operated today, under current rules and regulations. In the long term, CRD inflow conditions are expected to be wetter than the observed historic CRD inflows – this long-term change is not attributable to the Project and constitutes part of the long-term baseline.
[8] If the status of the Area of Special Interest at Partridge Crop Hill and other issues affecting harvest in the Nelson House RMA to the south of the Burntwood River are resolved in the near future then some harvesting may begin prior to 2009. There is currently a legal challenge to Tolko's licence. As of today, the licence is valid.

for certain CEA analysis); resource use activities within the Nelson House RMA (e.g., domestic harvest, commercial fishing, commercial trapping, and ecotourism (which is expected to target off-system waterways)).

- The effects on NCN of past factors such as the *Natural Resources Transfer Act*, establishment of an elected Chief and Council, the residential school system, television and other media, emergence of self-governing institutions within the community (education, health programming, and child and family services), and Bill C-31 (an *Act to Amend the Indian Act*).

2.3.2 Future Projects and Activities

Based on the scoping exercises, the following list of future activities was considered in the CEA for the Project.

- Wuskwatim Transmission Project: This project, of necessity, will be developed concurrently with the Project. In at least some areas (mainly related to the linear corridors associated with these transmission lines), and for at least some VECs, its environmental effects will overlap with the environmental effects of the Project.
- Gull/Keeyask, Conawapa or Notigi generating station projects (and related transmission facilities) and the Bipole III HVDC transmission facility: These projects are being considered by Manitoba Hydro for possible construction starting within the next five to ten years. Except for Bipole III, none of these projects has yet been committed for development by Manitoba Hydro, and neither Bipole III nor any other of these projects is yet in any government approvals process. For the physical and biophysical Project CEA, these projects, together with maintenance activities that contribute to Supply Side Enhancements, such as the Kelsey upgrade, were excluded due to being outside the Project's spatial boundary for likely environmental effects. These projects were explicitly considered when addressing socio-economic effects (Section 9) in order to consider potential cumulative effects related to construction with respect to either the Local Region (specifically, NCN members at Nelson House) or the Project Region (specifically, the parts of this region involving Thompson and Aboriginal communities downstream of the Project) if one or more of these projects began to be built within the next five to ten years.

- Tolko future forest harvest plans:[9] Projected future harvests that could overlap with the Project's spatial boundaries are considered in the biophysical CEA based on discussions with key persons and two potential scenarios (with and without designation of Area of Special Interest (ASI) at Partridge Crop Hill[10]); the terrestrial habitat analysis focuses on the Biophysical sub-region[11] during the fifty-year period from 2009 to 2059. These future forest plans are also considered in the CEA for mammals and for the socio-economic environment (Local Region (NCN and Nelson House RMA) Economy, and Personal, Family and Community Life) during the operating period of the Project.
- NCN – increased number of cabins in Biophysical sub-region (particularly the Waterway[12] during the Transition Period (2009-2034)): This potential activity, which may be stimulated by the Project, is considered in the Resource Use (Section 8) assessment; indirect effects to other assessment components are included in CEA.
- NCN Treaty Land Entitlement (TLE) in Wuskwatim Lake and adjoining area: Although specific TLE plans are not developed, biophysical and resource use CEA considers how the Project could affect potential future uses.
- Climate change: Climate change is neither a project nor an activity, and therefore does not qualify for CEA analysis. It is also highly uncertain. However, climate change may have an effect on the environment and is addressed to the extent possible (given the high degree of uncertainty) in the biophysical CEA with respect to long-term effects of the Project.

CEA analysis for the Project does not include future hydroelectric generating station projects that may be developed in the vicinity of the Project, i.e., Early Morning and Kepuche/Birchtree generating station projects (and any related transmission facilities). There are no current known plans to develop any of these projects within the next 10 to 20 years, nor any applications or plans for applications for government approvals. These potential projects are too uncertain and/or hypothetical to be included in the CEA for the Project.

In addition to the above projects, NCN also has plans for a number of projects and activities that may influence the future. These include economic development plans, a

[9] There is currently a legal challenge to Tolko's licence. As of today, the licence is valid.
[10] Partridge Crop Hill has spiritual importance to NCN. NCN has indicated that it would object to forestry operations in this area.
[11] The Biophysical sub-region is a rectangle bounded approximately by Nelson House to the west; Thompson to the east; PR391 to the north, and just south of Wuskwatim Lake to the south (Section 7) (includes terrestrial as well as aquatic areas).
[12] The Waterway area is along the Burntwood River and associated lakes from Early Morning Rapids down to and including Opegano Lake (Section 6) (includes terrestrial riparian as well as aquatic areas).

community development planning process and plans for future housing and infrastructure developments. Most of these plans are either community-based (and in some cases part of the baseline setting) or involve economic activity that does not tend to involve the Wuskwatim area; these plans are often also confidential to NCN and not available to be reported on in this EIS. These projects and activities have not been included in the cumulative effects assessment set out in this EIS; aside from confidentiality and other limits, these are excluded primarily because they are not sufficiently developed to allow comment on the possibility of cumulative effects from the Project. It is understood, though, that NCN's internal reviews of the Project will fully consider any such other plans and projects to the extent that they may have any cumulative effects associated with the Project.

Other possible future activities such as mining operations were not included as there are no known plans currently in place for future developments in the areas physically affected by the Project.

In dealing with uncertain future projects or activities, it is important to note that any such project would typically be subject to its own regulatory review and approvals. Issues related to the cumulative effects of such new future developments in combination with the Project can therefore be best and most properly assessed when and if new government approvals are sought for such projects.

For future projects and activities included in the CEA, specific time periods and VECs are addressed separately for each environmental component. The analysis of cumulative environmental effects for specific VECs within the aquatic, terrestrial, resource use, and socio-economic environments are summarized in Sections 6 to 9 and provided in greater detail in Volumes 5, 6, 7, and 8 respectively.

2.4 DETERMINING SIGNIFICANCE OF ENVIRONMENTAL EFFECTS

Predicted environmental effects of the Project on the biophysical, socio-economic and cultural environments are set out in the EIS. The assessment approach describes both positive and adverse predicted residual environmental effects after implementation of mitigation measures and the consideration of any relevant cumulative effects as a result of other projects or activities. As required in Section 8 of the EIS Guidelines, the description of residual effects includes a characterization as to whether residual environmental effects "are significant or insignificant, and the rationale for such characterization".

The EIS Guidelines (Section 7) set out criteria that have been used to evaluate the significance of adverse effects and the likelihood of significance of such effects. In accordance with the EIS Guidelines, the assessment approach has also considered scientific analysis of effects, along with TK, local knowledge and available experience in determining the significance of potential effects.

The concept of significance is central to environmental assessment. For example, the central test of *CEAA* is whether a project is likely to cause significant adverse environmental effects (based on the definition of "environmental effects" as set out in *CEAA*).[13] In the context of *CEAA*, the concept of "significance" cannot be separated from the concepts of "adverse" and "likely".

Although a broad range of environmental components are considered in the environmental impact assessment, the determination of whether or not effects are "significant" focuses on specific environmental components (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 on a broader assemblage of animals (Sections 1.6.2 and 2.1).[14] Potential effects on VECs were evaluated on the basis of the following criteria:

- nature of the effect (positive, neutral, or negative/adverse);
- magnitude of the effect (size of the effect – see below);
- duration of the effect (how long the impact would last – see below);
- frequency of the effect (how often and when would the impact occur);
- spatial boundaries or geographical extent of the effect (would the effect be limited to a small area 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 the disturbance).

[13] See the document titled: *Determining Whether a Project is likely to cause Significant Adverse Environmental Effects: A Reference Guide for the Canadian Environmental Assessment Act (available from Federal Environmental Assessment Review Office)*, which explains that under *CEAA*, for example, environmental effects include socio-economic effects caused by a change in the biophysical environment which in turn is caused by the project, e.g., resource use or job losses due to a loss of fish habitat. If a socio-economic change is not caused by a change in the environment, however, but by something else related to the project (e.g., effects caused by employment or purchasing related to the project), the socio-economic effect is not an environmental effect within the meaning of *CEAA* and cannot be considered in the determination of significance and related matters.

[14] Valued Ecosystem Components or Valued Environmental Components (VECs) are identified as relevant in each assessment section. For example, no VECs are identified for the physical environment (Section 5); in contrast, water quality and certain fish species are identified as VECs in the aquatic environment (Section 6).

In discussing environmental effects, the EIS Guidelines specify:

> *"The following criteria will be used to determine the likelihood of significance of the effects:*
> - *probability of occurrence, and*
> - *scientific uncertainty."*

Mitigation strategies (e.g., access management plans to manage potential adverse effects related to new road access) are important in this analysis.

The assessment approach in each section describes both positive and adverse environmental effects. The assessment then analyses whether or not residual effects (effects after mitigation) are significant. The "likelihood of significance" is evaluated. Finally, a conclusion is drawn as to whether or not there is a likely significant residual adverse effect.

With respect to the assessment of significance for biophysical effects on VECs, the three key assessment components were as follows.

- Duration: short-term (effects that last no more than a one-generation span of the species affected or five years for other 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[15]); and large (impact would be large enough to be readily noticed without a monitoring program).
- Geographic extent: site (effect confined to a small area and not transportable to other areas); local (the area physically impacted by the generating station or access road 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 effects on biophysical environments based on duration, magnitude, and geographic extent is provided in Figure 2.4-1; it should be noted that, while this matrix guides the

[15] Implies that effects are statistically significant as determined by a well-designed monitoring program.

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 effect. Conversely, effects 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.

The study area for biophysical assessments is generally defined as the area physically affected by the Project. The study area for each VEC, however, will differ based on the characteristics of the VEC. For example, the study area for woodland caribou (which have large home ranges) is larger than the study area for muskrat (which have small home ranges)

The study area for water quality for this Project consists of the area where water quality effects have the potential to occur. However, the area in which data have been collected has been expanded in response to concerns expressed by downstream communities to include areas that are not expected to be affected by the Project in order to provide baseline data for future monitoring.

Compared to assessment of significance for effects on VECs of the biophysical environment, the assessment of significance for socio-economic VECs considered:

- differing perspectives and values among different groups of people about their community and region, as well as their individual and family circumstances; and
- the problems inherent in assessing separately effects on different aspects or components of people’s lives that each contribute to an overall “effect” on any group of people, i.e., effects may be either positive and negative, depending on the group affected, and may be both positive and negative when different groups are differentially affected.

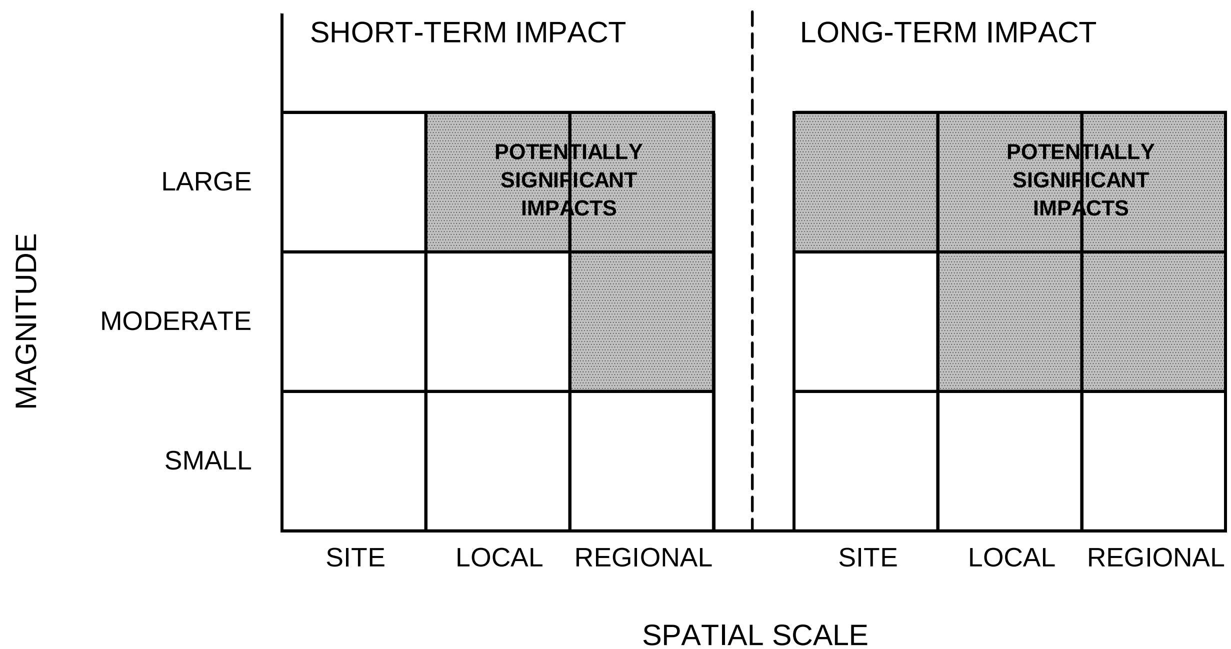


Figure 2.4-1. Matrix illustrating the definition of “significant” effects on biophysical VECs (*In addition to the above, effects are assessed in terms of their “frequency of occurrence”, “confidence in the assessment”, “resilience”, and “ecological content”.)

Similar to the biophysical assessments, the socio-economic significance analysis in effect focused on three key assessment components for any specific component of the socio-economic environment that is affected by the Project.

- Duration: short-term (effects do not last materially beyond the construction phase or last only during the first few years of the Project's operations phase); medium-term (last throughout the construction phase and beyond the first few years of the operations phase, or only during the operations phase and beyond the first few years but not for a major portion of the operations phase); and long-term (effects last throughout a major portion of the operations phase or are irreversible).
- Magnitude: small (no definable or measurable effect on the socio-economic environment under consideration); moderate (effect could be measured, i.e., be statistically significant, with a well-defined monitoring program); and large (effects are readily discernible, i.e., likely to be readily noticeable without a monitoring program).
- Socio-economic "geographic" extent: localized (effects confined to a small number of people within a very localized area of one of the socio-economic regions); partial community (effects extend to at least a moderate number of people within a larger definable group in any of the socio-economic regions); and whole community or regional (effects extend to an entire definable group of people, i.e., a whole community, in any of the socio-economic regions).

The significance of socio-economic effects was evaluated separately with respect to effects within each socio-economic region as defined in Section 9. Furthermore, similar to the biophysical approach, the socio-economic assessment approach recognized that focusing on the above three components can guide the analysis. The socio-economic approach also helped to identify effects where additional assessment components should be considered (see "moderate" effects below).

Based on these factors, a summary guide was developed similar to that used for the biophysical assessment (Figure 2.4-1). The socio-economic assessment guide used the following definitions for an initial rating of residual positive and negative effects on the socio-economic environment for the purpose of determining significance of these effects within a socio-economic region were as follows.[16]

[16] See Volume 8, Section 2.2.8 for additional detail, including more detailed definitions provided in Table 2.3 of this section.

- Significant – Major Residual Effect: Effects are long-term, major and affect a whole community.
- Potentially Significant – Moderate Residual Effect: Effects which fall between "major" and "minor", and thus are "potentially significant" (as this term is used in Figure 2.4-1 for biophysical effects). Essentially, the effect is either (a) medium or long-term, moderate and affecting a partial community, or (b) short-term, major and affecting a whole community. In order to determine significance of these effects, additional factors will often need to be considered, e.g., concurrent effects on other socio-economic components affecting the same group of people or others in the same socio-economic region, effectiveness of mitigation measures and the degree to which the affected people have any control over mitigation (which may reflect "vulnerability" in socio-economic terms), the extent to which the socio-economic component is affected by the Project (magnitude, frequency, and reversibility of the effect), and overall confidence in the assessment after consideration of potential mitigation and other factors.
- Not Significant or Insignificant - Minor Residual Effect: Effects are either (a) short-term and not major, or (b) localized and not moderate or major.
- Not Significant or Negligible (insignificant) Residual Effect: No definable effect at any level or is insufficient to be termed a minor effect, and generally indistinguishable from projected baseline conditions.

Determining the significance of Moderate Residual Effects in many instances required assessment of additional factors. For example, increased employment and training opportunities in a community (a positive moderate effect) may also lead to in-migration that places stress on community infrastructure such as housing (an adverse moderate effect to the extent that materially increased overcrowding is likely to occur). When assessing the "significance" of the moderate adverse effect (stress on community infrastructure) in this example, it is relevant:

- to note that in-migration is expected to be associated with people who are seeking to secure employment and/or training opportunities;
- to review carefully the mitigation measures committed (e.g., will people who move be well aware of the problems and elect to move anyway or will they be surprised by the problems; will steps be taken to the extent that is reasonable by the community to mitigate the adverse effect); and

- to review carefully the extent to which the people affected by the overcrowding and/or the affected community are able to exert controls to mitigate these effects.

On balance, for the above type of example, the “moderate adverse effect” would not be assessed as “significant” when the affected community and/or group can control the commitment of reasonable mitigation measures to address the adverse effect.

While the significance of all socio-economic effects is important for many purposes, the *CEAA* Reference Guide (see above at footnote 13) points out that not all socio-economic adverse effects are defined as “environmental effects” under *CEAA*. The *CEAA* test requires a determination as to whether a residual effect is a “significant adverse environmental effect” that is likely to be caused by the Project. Only socio-economic effects caused by a change in the biophysical environment which, in turn, has been caused by the Project are “environmental effects” as defined in *CEAA*. In the above example, the adverse in-migration effect would not be caused by a change in the biophysical environment but rather by another type of change related to the Project; accordingly, this adverse effect is not an “environmental effect” and therefore, regardless of its significance, could not be a “significant adverse environmental effect” within the meaning of *CEAA*.

3.0 PUBLIC CONSULTATION AND INVOLVEMENT

3.1 OVERVIEW - PURPOSE AND OBJECTIVES

Manitoba Hydro and NCN, in response to Section 4 of the EIS Guidelines, developed a **Public Involvement Plan (PIP)** outlining an integrated approach to public consultation for the Wuskwatim Generation Project and the Wuskwatim Transmission Project (Volume 2). This plan was submitted to federal and provincial regulators in August 2002 and was placed on the public registry.

The Public Involvement Plan approach reflects the experience of both Manitoba Hydro and NCN, current practice and principles for consultations in the environmental assessment context, and current Public Participation Guidelines provided by Manitoba Conservation and the Clean Environment Commission to achieve effective and timely decisions and results which respect the knowledge, values and rights of all interested parties (see Manitoba Conservation Information Bulletin No. 97-02E, April 1997).

The overall purpose of the integrated Public Involvement Plan is to provide different segments of the public, particularly those who may be potentially affected[1] by the Wuskwatim projects, with meaningful opportunities to receive information on and provide their views about these projects. The PIP aims to achieve the following objectives with respect to such interested parties prior to the start of Clean Environment Commission public hearings on these projects.

- Opportunities for early involvement: This includes providing early notice and information about the projects and the consultation/involvement process so that parties can assess their interests and provide early comment, as well as become involved in ongoing planning and environmental review activities.
- Opportunities for ongoing involvement: This includes providing ongoing opportunities to learn about the projects and key design and planning assessments, to provide input with respect to any concerns or options, to resolve issues raised about the projects, to have views and inputs recorded, and to learn about actions or results that occur as a result of ongoing studies and planning activities.

[1] A potentially affected segment of the public was defined initially (prior to completing the EIS) as those who potentially might see themselves as being affected by Project-induced biophysical changes (e.g., by upstream or downstream water-based effects, by effects on land or air, or by related biophysical or resource effects) from any component of project construction or operation. Being defined as a potentially-affected community does not necessarily mean that significant environmental effects are in fact predicted in this EIS.

- Opportunities at various stages: This includes an opportunity to provide inputs: (a) when initial issues are identified; (b) when alternative ways of undertaking the project are considered (including alternative routes); (c) when initial effects assessments are reviewed and ways are considered to mitigate or enhance identified effects; (d) when EISs have been filed with regulators for review and comment; and (e) when supplementary EIS information may be filed with regulators.
- Variety of mechanisms: This includes a variety of mechanisms (appropriate for different segments of the public) to communicate, receive feedback, and engage in ongoing meaningful dialogue.
- Proper consultation with Aboriginal Peoples: This includes recognizing the unique status of First Nations and other Aboriginal communities who may be affected if the projects are developed, and making proper consultation with Aboriginal peoples an goal independent of the public involvement process. With respect to Aboriginal peoples affected by the projects, it includes becoming fully informed about their practices and views as these relate to potential effects from the projects and demonstrably working to integrate their concerns into project plans.
- Adaptive approach: This includes adjusting the public involvement program, as required and feasible, throughout the course of the environmental review and planning process, in response to issues, concerns and challenges.

Public involvement and consultation activities undertaken by Manitoba Hydro and NCN distinguished between two main publics:

- NCN communities and members; and
- communities and individuals beyond NCN.

NCN has been involved with Manitoba Hydro in all aspects of planning of the Wuskwatim projects. The PIP aspects of this involvement focus on Manitoba Hydro and NCN consultation with NCN community members.

NCN's community-driven approach has made community involvement a key component of their planning for the Project. As a result, prior to mid 2001, initial PIP consultation activities focused on NCN members resident at Nelson House, South Indian Lake, Thompson and other locations. This stage of consultation, which was carried out over several years, identified and discussed initial planning issues relevant to NCN and Manitoba Hydro. It resulted in the development and ratification of an Agreement-in-

Principle that sets out a series of topics to be discussed between the parties as part of an ongoing, collaborative planning process. Specific planning issues addressed and resolved during this initial stage included the preference for a low head design for the facility (with more limited environmental impacts than other design options), joint selection of an Environmental Management Team, design and implementation of a Joint Study Program (Section 2.2.2), and design and implementation of a joint public involvement process. Consultations with NCN are ongoing and led by NCN's Future Development Team, with assistance provided by Manitoba Hydro and the EMT.

Starting in mid 2001, public involvement activities were initiated by Manitoba Hydro and NCN for communities and individuals beyond NCN. These PIP activities have been organized under a single integrated program for the two Wuskwatim projects; three stages or rounds were carried out prior to initial filing of the EISs and two stages are planned to occur after filing of the EIS documents and prior to the CEC public hearings. Consultation and public involvement also provides for consultation with two broad groups: i) potentially affected publics beyond NCN; and ii) other interested groups and individuals who may be interested in the Wuskwatim projects.

Although the public involvement activities typically provide information on both the Wuskwatim Generation and Transmission Projects, this EIS focuses on activities associated with the Generation Project. Further information regarding consultation and involvement activities associated with the Transmission Project can be found in Volume 1 of the Transmission Project EIS.

Sections 3.2 and 3.3 provide additional detail on public involvement activities with NCN and with other communities and segments of the public beyond NCN. These sections outline the basic approach to the involvement of these groups in the environmental assessment and Project planning process, including key methods and outcomes. Additional details are provided in Volume 2.

3.2 INVOLVEMENT OF THE NISICHAWAYASIHK CREE NATION

The Nisichawayasihk Cree Nation, whose members live primarily in Nelson House (the closest community to the Project) and South Indian Lake, is a prospective partner with Manitoba Hydro in the Project. Further, Article 8 of the 1996 NFA Implementation Agreement sets out a process for NCN and Manitoba Hydro to discuss potential Manitoba Hydro future developments that could affect water bodies within the Nelson House RMA. As a result, NCN has been able to influence the way the Project will be undertaken and has been directly involved in advance planning for mitigation of negative effects and enhancement of positive effects.

Involvement of the community by NCN and Manitoba Hydro began in early 1999, and has continued throughout the environmental assessment and planning process. Consultation and involvement activities with NCN have been, and will continue to be, community driven. Sections 3.2.1 and 3.2.2 below describe key consultation and involvement activities undertaken to date with NCN and consultation and involvement activities planned following filing of the EIS.

3.2.1 Key Consultation and Involvement Activities to Date with NCN

Community involvement of NCN members has included a broad range of activities designed to provide information and elicit input on the environmental assessment and Project planning processes. These activities include, but are not limited to: the establishment of a Future Development Team; the hiring of local residents to act as Community Consultants to collect and share information in Nelson House and South Indian Lake; open houses and community meetings; Future Development Newsletters and other materials; NCN Opinion Surveys of on- and off-reserve members; a ceremony at an original settlement site on Wuskwatim Lake; and participation in Project studies.

3.2.1.1 NCN's Future Development Team

NCN's Future Development Team was established in 1997 to facilitate discussion between NCN and Manitoba Hydro regarding proposed future hydroelectric developments within the Nelson House RMA. The Future Development Team engages in discussions with Manitoba Hydro, conducts research on an array of topics, and guides the community involvement process. The Future Development Team (as well as NCN Elders and other NCN members), was involved in the design of the Joint Study Program, and has reviewed and provided comments on the EIS.

The Future Development Team consists of: two co-managers; an office manager; seven Community Consultants in Nelson House and two in South Indian Lake; an Elder liaison; two Elder consultants; a liaison worker; a recording secretary; and legal, engineering, and financial assistance.

3.2.1.2 Community Consultants

Future Development offices were established in Nelson House and South Indian Lake, and were staffed by local residents hired as Community Consultants. The Community Consultants were hired to assist in planning for the Project and in carrying out community consultation activities. The Community Consultants provide information (in both Cree and English) to local residents on a one-on-one basis and to special interest groups (e.g., commercial fishers) on a variety of topics. The specific duties of the Community Consultants are to:

- meet with Manitoba Hydro and the EMT to receive up-to-date information on all aspects of the Project for distribution to community members;
- organize meetings with NCN members on- and off-reserve to discuss future development issues, including environmental assessment activities;
- prepare information packages regarding future development issues;
- conduct door-to-door meetings with members on- and off-reserve;
- disseminate information to NCN members;
- obtain information from members through formal meetings, interviews, neighborhood meetings, surveys, etc.;
- assist the Future Development Team with community meetings;
- analyze information and interpret it for community members;
- act as liaison between Chief and Council, the Future Development Team, advisors, and Manitoba Hydro;
- assist the Community Liaison Person in developing multi-media strategies for providing instruction to NCN members;
- summarize information obtained from meetings, surveys, and interviews and provide the information to NCN Chief and Council, the Future Development Team, advisors, and Manitoba Hydro; and
- conduct radio and TV discussions on Future Development and other issues.

Further information on the community consultants is provided in Volume 2.

3.2.1.3 Open Houses and Community Meetings

Open houses, community meetings and/or forums are held in the community at key times to provide information to, and receive information from, NCN members for all significant activities or milestones associated with the Project. To date, information has been provided on several issues and topics, including:

- the manner in which NCN is participating in the process;
- a description of the proposed Project;
- design and implementation of the Joint Study Program;
- options for the siting of infrastructure, including the campsite and the access road;

- the Agreement-in-Principle;
- the results of the Joint Study Program, including initial EIS findings and conclusions (November 2002) and updated EIS findings prior to completion of the EIS documents (January-March 2003).

Planning for each open house and community meeting was conducted by the Future Development Team and the Community Consultants with assistance from Manitoba Hydro and the EMT. An invitation to each open house was distributed to NCN members through the mail and via household visits by Community Consultants. Transportation to the open houses was also provided to any individuals who required assistance. The Community Consultants actively participated in the organization and running of each open house or community meeting. Although the storyboards were in English, the information was presented to the Elders in Cree by the Community Consultants. Manitoba Hydro staff and the EMT also were present at each open house to answer specific technical questions.

Brief questionnaires (see Volume 2) were provided to open house participants to gather input on the open house format and to identify any outstanding questions. Questions and concerns not easily answered at a particular open house were tracked for follow-up and responded to in NCN's Future Development Newsletter or through the Community Consultants.

The open house and community meeting format has also been used in other locations to share information about the Project with off-reserve NCN members. Prior to the vote on the AIP, information was provided by NCN's Future Development Team and the Community Consultants to NCN members residing in South Indian Lake, Thompson, Brandon, and Winnipeg.

In addition, the Community Consultants made special efforts to involve Winnipeg-based NCN members in a Winnipeg open house on January 29, 2003. The purpose of the open house was to provide information on the preliminary findings from the environmental studies. The Community Consultants made home visits in advance of the open house to provide NCN members in Winnipeg with information on the Project and to invite them to the upcoming open house. Transportation to and from the Winnipeg open house was arranged for interested NCN members resident in Winnipeg. During the open house, Community Consultants presented the storyboards and answered any questions that arose.

Manitoba Hydro and the EMT held several workshops with the Community Consultants in late 2002 to review the initial findings of the EIS and to gain input on presenting the information to the community. Following this, additional community meetings on the EIS were held at Nelson House in early 2003.

A description of information provided at each open house is provided in supporting Volume 2.

3.2.1.4 Future Development Newsletters and Other Written Materials

Future Development Newsletters

Newsletters highlighting the planning activities for the Project are produced and distributed on a regular basis by Community Consultants in Nelson House and South Indian Lake. A newsletter has been produced by the Future Development Team approximately every three to four months since March 2000 (a total of ten newsletters have been produced to March 2003). The newsletters provide information on a number of topics including, but not limited to: the relationship between the 1996 NFA Implementation Agreement and the proposed Project; NCN's participation in the process, including the roles of the Future Development Team and Community Consultants; ongoing activities related to the Project; the Joint Study Program (planning, conduct of the studies, results of the studies etc.); the community consultation process; the regulatory process; potential training and job opportunities; and potential business opportunities.

Two separate newsletters have been produced and distributed at South Indian Lake: (a) a joint NCN and O-Pipon-Na-Piwin Cree Nation/South Indian Lake newsletter providing information on the Project and planning process prior to the AIP (January, 2001); and (b) an NCN Future Development Newsletter providing highlights from the South Indian Lake Opinion Survey (April, 2002).

Initial EIS Findings Newsletter

In November 2002, an NCN Newsletter on "Initial Findings of Environmental Studies about the Wuskwatim Project" was circulated by the Community Consultants to all households in Nelson House and South Indian Lake. The newsletter included the Round 3 PIP Newsletter that was used in subsequent Round 3 consultations with other publics beyond NCN. This document was utilized in a series of small group sessions subsequently conducted by the Community Consultants with Elders, youth, resource harvesters, women, and other groups in the NCN community and in a session with leaders of South Indian Lake. It was also used in a community forum held in December at Nelson House.

Public Information on Environmental Studies Conducted in 1998 and 1999

In addition to the technical reports that were produced under the Joint Study Program, a brief summary document entitled, "Environmental Studies Near Nelson House: 1998 and 1999" was produced and provided to the community (see Volume 2).

Public Information Documents on the Joint Study Program

A document entitled, "Executive Summary: Notigi and Wuskwatim Generation and Transmission Facilities: Joint Nisichawayasihk Cree Nation/Manitoba Hydro Study Program" was prepared in April 2000 and updated in July 2000 (see Volume 2). The document provided information, in a manner suitable for the general public, on the following:

- NCN's participation in the Future Development process;
- the scoping and objectives of the Joint Study Program;
- the study approach and study components;
- community consultation activities;
- study schedule and products; and
- a brief description of the proposed Projects.

The documents were made available at the second (July 12 and 13, 2000) and third (August 2 and 3, 2000) open houses in Nelson House.

A number of brochures that summarize the results of the Joint Study Program were written in a manner suitable for the general public. The following brochures (which are provided in Volume 2) were produced and distributed at the Nelson House open house in February 2002.

- Fish Population Studies: Fish Biology.
- Fish Population Studies: Fish Habitat.
- Fish Population Studies: Mercury in Fish.
- Mercury in People.
- Fish Population Studies: Fish Movements.
- Fish Population Studies: Fish Presence and Abundance.

- Vegetation.
- Forestry.
- Bird Populations.

Agreement-in-Principle Documents

Several documents were produced to explain the AIP to NCN members and were distributed both on- and off-reserve. These included the following:

- the AIP;
- the AIP Guidebook;
- the AIP Overview;
- answers to key questions regarding the AIP; and
- highlights from the 1996 NFA Implementation Agreement.

Information on the AIP was also provided in Future Development newsletters.

3.2.1.5 NCN Opinion Surveys

Surveys of members living in Nelson House (2000), South Indian Lake, Thompson, and Winnipeg (2001) were undertaken to canvass the opinions and concerns of NCN members about possible future hydroelectric development, previous agreements with Manitoba Hydro, and community development planning (see Volume 8, Appendix 3, for summaries of the NCN Opinion Surveys.)

3.2.1.6 Wuskwatim Site Ceremonies

Wuskwatim site ceremonies were organized in 2000 by the community to further the process of healing from previous hydro developments. These ceremonies also helped to establish a positive relationship between NCN, the governments, and Manitoba Hydro.

3.2.1.7 Participation in Field Studies

NCN members participated extensively in the field components of the Joint Study Program with approximately two-thirds of all field staff being NCN members. Traditional Knowledge was shared by many NCN members who worked with biologists and technical specialists in the field. The NCN members working on the studies also provided a direct link between the scientific studies and the community.

3.2.1.8 Other Communications Tools

Several other methods were used to provide information to the community. These included, but were not limited to, the following (greater detail is provided in Volume 2).

School Presentations

Presentations on the aquatic studies conducted under the Joint Study Program were provided to students at Nelson House. The presentations occurred over a four day period in late February/early March 2001.

NCN Career Fair

The EMT assisted NCN with the organization of a Career Fair at Nelson House in November 2000. The career fair provided the opportunity, among other things, to inform the community of plans for potential training programs and jobs that could be associated with the Project.

Committee Meetings

NCN members attending committee meetings frequently raised issues and shared Traditional Knowledge and other valuable information. Although these were conducted in an informal fashion, they were an important part of the consultation process.

Cree Nation Gathering

The EMT assisted NCN with the development of storyboards displayed at the Cree Nation Gathering (summer 2002). This provided the opportunity for NCN to share information about the Project and possible positive economic benefits with Cree communities from across North America.

3.2.2 Next Steps in the Consultation and Involvement Process with NCN

Consultation and involvement activities with NCN will continue beyond the filing of the EIS. It is anticipated that activities will be organized and held between filing the EIS and the CEC Hearings, and also following the CEC Hearings. The exact format of these consultation and involvement activities will be determined by NCN at a later date.

Manitoba Hydro and NCN are in the process of negotiating a Project Development Agreement that will document the overall arrangements for the development of the Project and will be legally binding on both Manitoba Hydro and NCN. Once drafted by the parties, NCN members will have the opportunity to vote on whether to accept or reject the terms and conditions. It is anticipated that there will be significant future consultation with NCN members (including provision of various information materials and other consultation practices adopted to date) prior to the vote on the PDA. All NCN members 18 years of age and over will have the opportunity to vote on the PDA before it is signed.

If the Project proceeds, biophysical and socio-economic monitoring will be conducted during both the construction and operation of the Project. The results of the monitoring activities will be communicated to NCN members on a regular basis.

3.3 PUBLIC CONSULTATION AND INVOLVEMENT BEYOND NCN

Beginning in fall 2001, public involvement activities were extended beyond NCN to include interested segments of the broader public. This section describes how Manitoba Hydro and NCN have provided these other segments of the public with information on and obtained input to the environmental assessment and planning process. The specific items addressed below include:

- the manner in which Manitoba Hydro and NCN defined the different segments of the publics included in public consultation and involvement activities beyond NCN;
- Manitoba Hydro's and NCN's overall approach to, and specific methods of, public consultation and involvement;
- results of consultation and involvement activities to date; and
- impact of the PIP on the environmental assessment and planning process.

3.3.1 Defining the Public

Beyond NCN, the PIP provides for consultation with two broad groups.

- <u>Potentially-affected communities and segments of the public in the Project Region</u>: Potentially affected communities and segments of the public were defined initially for the PIP (prior to completing the EIS) as those who potentially could see their members being affected by project-induced biophysical changes (e.g., by upstream or downstream water-based effects, by effects on land or air, or by related biophysical or resource effects) from any component of project construction or operation. Where relevant, potentially affected communities also included any communities having interests that may be affected pursuant to current agreements with Hydro (e.g., communities that are signatories to the Northern Flood Agreement).

To allow for all potential concerns about environmental impacts to be identified and discussed, a broad "Project Region" was identified to include communities that may be potentially affected or have an anticipated interest in reviewing potential effects from the Wuskwatim projects. Identification as a potentially affected public did not necessarily mean that significant environmental effects are in fact expected or possible on the basis of any findings of the Manitoba Hydro and NCN environmental studies.

- Other interested groups and individuals: this includes others, outside the federal and provincial governments, who may be interested in the project (Environmental Non-Governmental Organizations, interested groups in the northern region of the province, and other individuals/organizations in the public-at-large that request information about the Project).

Distinguishing between these two groups allowed NCN and Manitoba Hydro to focus public involvement activities at an early stage on elected officials in First Nations, Northern Affairs communities and incorporated municipalities in the Project Region.

To recognize and address the unique constitutional rights held by Aboriginal communities, potentially affected publics in the Project Region were broken into two community groupings.

- Potentially affected Aboriginal Communities: these include any First Nation or other Aboriginal communities (e.g., Northern Affairs Communities with predominantly Aboriginal population) in the Project Region; one possible pathway for these communities to be affected by the Project is for their traditional resource use area (as evidenced, for example, by registered trapline areas assigned to communities or other information derived from consultation with communities) or their legitimate rights and interests (as evidenced, for example, by hunting, fishing or other such activities or by any existing agreements with Manitoba Hydro) to be significantly affected by any environmental impacts from the Project.
- Potentially affected non-Aboriginal Communities: these include non-Aboriginal communities in the Project Region, as well as their residents.

NCN members at Nelson House were identified at the outset as an affected Aboriginal community, since the Wuskwatim Generation Project (and significant segments of the Wuskwatim Transmission Project) would be built in their traditional use area. Other communities in the Project Region potentially affected (as this term is used in the PIP) by the Generation Project were identified (Figure 3.3-1); some of these communities (e.g., Thompson) are also potentially affected by the Transmission Project. Other communities in the overall PIP Project Region were identified as being potentially affected only by the Transmission Project (e.g., Snow Lake, Cormorant, and The Pas).

The Project Region (Figure 3.3-1) is a broad area defined for the purposes of the PIP. It includes communities and individuals who could potentially see themselves as being affected by the Project. Inclusion in this region does not necessarily mean that effects will occur as a result of the Project.

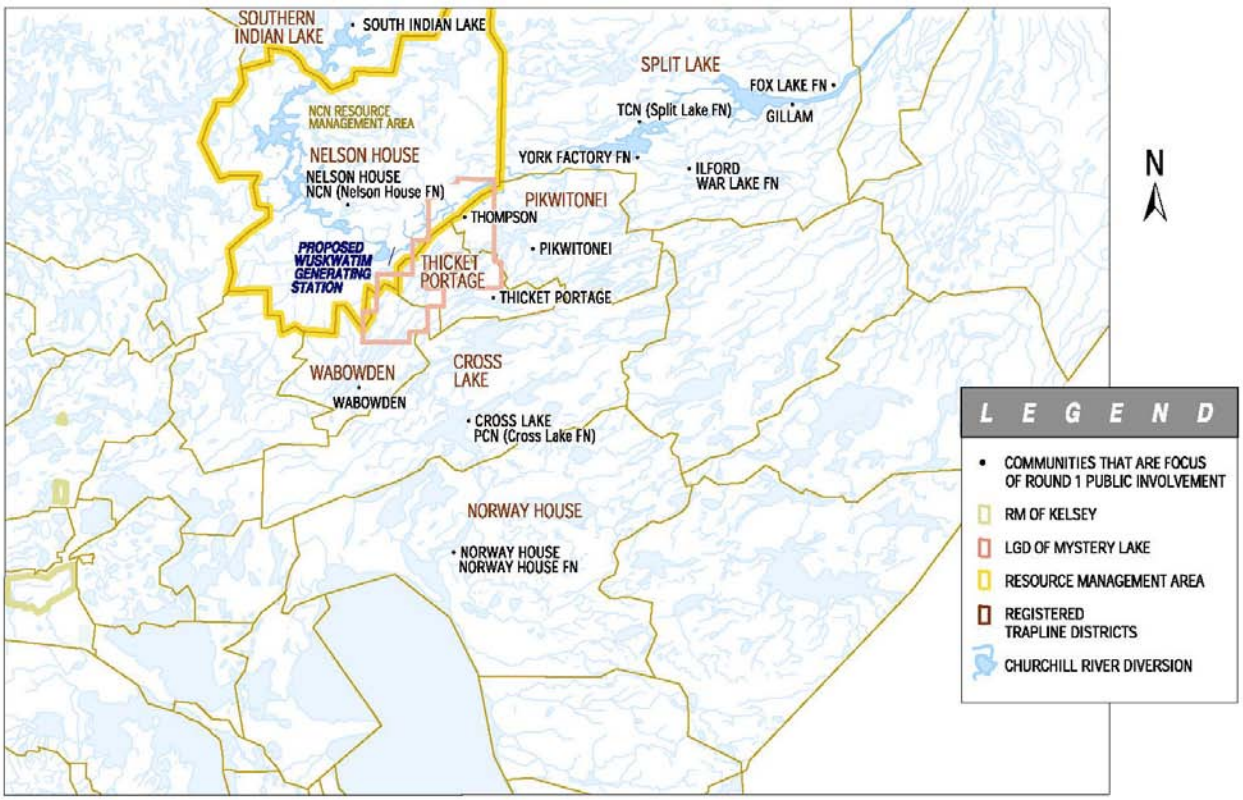


Figure 3.3-1. Communities in the Project Region.
(Includes only communities involved in Generation Project public involvement)

3.3.2 Approach and Methods

This section outlines the staged approach taken to, and specific methods employed in, public consultation and involvement activities associated with publics beyond NCN.

3.3.2.1 Staged Approach

One of the primary objectives of the PIP is to provide ongoing opportunities for public input at key stages of the environmental review and planning process. In total, the PIP outlines five rounds of public involvement: three rounds prior to filing of the EIS (from fall 2001 to March 2003), and two rounds following filing (Figure 3.3-2). The participants in each round of public involvement have varied, and will continue to vary, depending on the subject matter being discussed.

The scope and results of the three rounds conducted to date are reviewed in Section 3.3.3.

Round Four (targeted for spring, 2003) will follow filing of the Project EIS. This round will communicate the format and content of the EIS documents to communities in the Project Region, as well as to others who show an interest in the information.

Round Five (targeted for summer 2003) will focus on communicating any supplemental information prepared and filed with the regulators, after review of the EIS documents. This round will focus on those directly interested in the supplemental information.

3.3.2.2 Public Involvement Methods

The PIP provides for a variety of methods to communicate with potentially affected publics and other interested groups and individuals. The selection of methods has been guided by the effectiveness of communication to various individuals and groups and has considered advice from elected leaders in potentially affected communities. There has been, and will continue to be, flexibility in the design of each round of consultation in response to changing circumstances (e.g., seasonality), scope of subject matter and the interests of potentially affected publics.

In general, the methods considered for the five rounds of consultation involving non-NCN members are as follows (several of these methods are often used at the same time and/or in consultations with the same publics).

- Newsletters: Newsletters are used to provide all interested parties with basic information applicable to each stage of the PIP process (Volume 2).

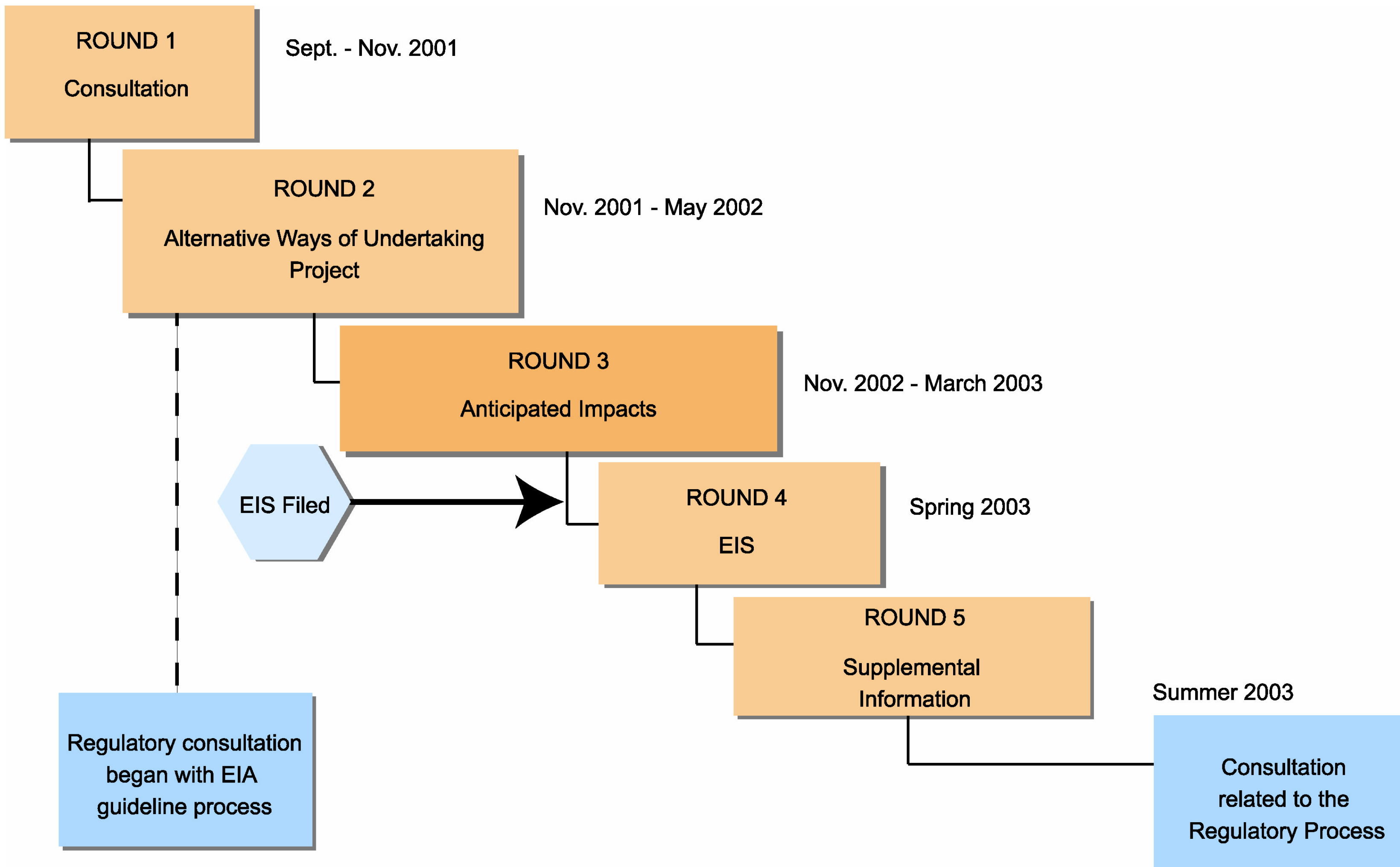


Figure 3.3-2. Public Involvement Stages for the Wuskwatim Projects.

- Meetings with elected officials in the Project Region: Meetings with elected officials have predominantly been used during Round One to introduce the Project and to hear any initial issues the public may have. However, these meetings have been, and will continue to be, used throughout the process as requested by communities in the Project Region. Following meetings with elected officials, draft meeting notes are sent to participants for review and comment before being finalized.
- Meetings in Project Region Communities: In some potentially affected communities, elected officials invited representatives of Manitoba Hydro, NCN and the environmental study team to participate in community meetings pertaining to the Project (to date, community meetings have occurred as part of Rounds Two and Three of public involvement). In these cases, a presentation on the subject matter of the round was provided. Following community meetings, draft meeting notes are sent to participants for review and comment before being finalized.
- Distribution of Informational Letters: Informational letters (including an invitation to meet) and newsletters are sent to communities not requesting meetings (e.g., Norway House Northern Affairs community) during each round of public involvement.
- Open Houses: The open house format is currently considered to be best suited to display alternative transmission line routes and to provide an opportunity to discuss the perspectives of individuals one-on-one. Public open houses that included the Generation Project as a major focus have been held in Thompson (during Rounds Two and Three), as well as in Winnipeg (during Round Three). Open houses are advertised in the appropriate newspapers in advance of the event, and invitations are also distributed directly to interest groups in the vicinity.
- Forum for Environmental Non-Governmental Organizations: As part of Round Three, a Forum for Environmental Non-Governmental Organizations was held in Winnipeg. The Forum provided participants with an opportunity to preview storyboards, hear a presentation on the Wuskwatim Projects and participate in a question and answer period. Following the Forum, draft meeting notes were distributed to participants for review and comment before being finalized.
- Web Site: A Wuskwatim Web site has been developed to link from the Manitoba Hydro web site (www.hydro.mb.ca/wuskwatim). The site includes key documents prepared to date (e.g., each of the newsletters, the Agreement-in-Principle, samples of each of the community presentations and key documents submitted to the regulators) and links to the Clean Environment Commission site and the Manitoba Conservation

site. The Web site includes a mechanism for the public to submit questions or concerns. The site is updated on a regular basis by Manitoba Hydro and NCN.

- Contacts for Follow-Up: Four contacts have been identified in the PIP newsletters and presentations as available for follow-up questions or comments about the Project. These include a Manitoba Hydro representative from the generation group, a Manitoba Hydro representative from the transmission group and the co-managers of the NCN Future Development process. Questions and comments received from the public, and where appropriate the responses provided, are being recorded.
- Special Additional Meetings or Studies with Potentially Affected Communities: Manitoba Hydro and NCN review issues and concerns arising from consultations. Where relevant, special additional meetings are held with potentially affected communities in the Project Region (including, in particular, potentially-affected First Nation and other Aboriginal communities) to examine, together, ways to address specific concerns, including additional studies, mitigation or monitoring.
- Advertising: In-community advertising is undertaken for all meetings and open houses. Mechanisms to date for in-community advertising include poster advertisements, personal contacts, print advertising in regional newspapers, press releases, media briefings and local access radio. In addition, letters of invitation and confirmation are sent out jointly by Manitoba Hydro and NCN to community representatives prior to any event.
- Tracking of Issues and Follow-up: All issues and concerns raised by members of the public are tracked, assessed and formally responded to once the information is available. All questions and issues raised during a meeting that could not be answered at the time are recorded and tracked for follow-up.

3.3.3 Results of the Consultation and Involvement to Date

3.3.3.1 Meetings with Tataskweyak Cree Nation

Table 3.3-1 presents meetings held with Tataskweyak Cree Nation on the subject of the Wuskwatim Generation Project.

Table 3.3-1. Meetings with Tataskweyak Cree Nation.

MEETING	SUBJECT
October 2001	• initial meeting with elected officials to present the Wuskwatim Projects, proposed environmental studies and plans for public involvement
March 2002	• meeting to discuss issues respecting the Wuskwatim Generation Project
December 2002	• meeting to discuss initial findings of environmental studies and plans for reviewing upcoming EIS documents

3.3.3.2 Other Consultation Activities: Rounds One, Two and Three

Table 3.3-2 presents an overview of consultation activities carried out by Manitoba Hydro and NCN with specific communities and groups during each of the three PIP Rounds to date. Highlights are summarized below for each Round.

Table 3.3-2. Public Consultation and Involvement Activities to Date for Project: Rounds One, Two and Three

COMMUNITY OR INTEREST[1]	MEETING		
	Round One (Elected Official)	Round Two (Communities)	Round Three (Communities)
GENERATION STATION PROJECT – Potentially Affected Communities in Project Region			
Within 45 km – Transmission Project also			
Nisichawayasihk Cree Nation	*Through NCN's joint planning activities with Manitoba Hydro and the Environmental Study Team, there has been substantial communication with members via open houses, meetings, local access broadcast and other means*		
Nelson House (NA)	X	X	Invited to Community Forum in Nelson House
LGD of Mystery Lake	X	Invited to Open House in Thompson	Invited to Open House in Thompson
City of Thompson	X	Open House[4]	Open House[5]
Other within 80 km			
Wabowden (NA)	X	X	X
Thicket Portage (NA)	X	X	X
Pikwitonei (NA)	X	X	X
Other upstream and downstream			
South Indian Lake (NA and through NCN)	X	-	Two community Forums scheduled in Dec. 02: postponed by community
Town of Gillam	X	Offer to meet and newsletter provided[3]	Waiting to hear if interest in community meeting
York Factory First Nation	X6	Invitation letter and newsletter3	X
Fox Lake Cree Nation	X	Career Symposium	Community meeting delayed at request of the community
War Lake First Nation	X	X	Representative attended meeting in Winnipeg; continue to look at possibility of community meeting

Table 3.3-2. Public Consultation and Involvement Activities to Date for Project: Rounds One, Two and Three Cont'd

COMMUNITY OR INTEREST[1]	MEETING		
	Round One (Elected Official)	Round Two (Communities)	Round Three (Communities)
Other upstream and downstream Cont'd			
Ilford (NA)	Invitation letter and newsletter[3]	Invitation letter and newsletter[3]	Invitation letter and newsletter[3]
Other Nelson River			
Pimicikamak Cree Nation (Cross Lake First Nation)	Invitation letter and newsletter[3]	Invitation letter and newsletter[3]	Continue to ask for community meeting or meeting with elected officials; newsletter sent to community
	NFA Article 9 consultations with Manitoba Hydro[7]		
Norway House Cree Nation	X	Invitation letter and newsletter[3]	Invitation letter and newsletter[3]
Cross Lake (NA)	Invitation letter and newsletter[3]	Invitation letter and newsletter[3]	Invitation letter and newsletter[3]
Norway House (NA)[2]	Invitation letter and newsletter[3]	Invitation letter and newsletter[3]	Invitation letter and newsletter[3]
OTHER INTERESTS			
Northern			
Mosakahiken Cree Nation	-	Response to concerns raised at CEC meetings	Invited to transmission open houses
Mathias Colomb Cree Nation	-	-	X Meeting with representatives in Winnipeg: response to concerns
Thompson Chamber of Commerce	-	Invited to Thompson Open House	Invited to Thompson Open House
Other			
Environmental and other Non-Governmental Organizations	Forum held in Winnipeg on January 28, 2003 by invitation only; (62 invitations sent) Newsletters #1 and #2 distributed to Manitoba Eco-Network and select member organizations during Rounds One and Two		
Manitoba Metis Federation	-	Invitation (sent with Round Two newsletters) to Open House in Thompson	Invitation (sent with Round Three newsletters) to Open House in Thompson and in Winnipeg
General Public	-	-	Open House in Winnipeg on January 29, 2003

Notes:

1 - Does not include individual members of the public.

2 - NA = Northern Affairs community.

3 - N/R = No meeting requested in response to letter of invitation (newsletter enclosed).

4 - Invitation to Round Two Open House in Thompson sent (with Round Two Newsletter) to elected officials in Ilford (NA), Nelson House (NA), Gillam, Pikwitonei, Fox Lake Cree Nation, Tataskweyak Cree Nation, Thicket Portage, Wabowden, War Lake First Nation, York Factory First Nation, South Indian Lake, Norway House First Nation, Cross Lake First Nation, Cross Lake (NA) and Norway House (NA).

5 - Invitations to Round Three Open House in Thompson sent (with Round Three Newsletter) to elected officials in Ilford (NA), Nelson House (NA), Gillam, Pikwitonei, Fox Lake Cree Nation, Tataskweyak Cree Nation, Thicket Portage, Wabowden, War Lake First Nation, York Factory First Nation, South Indian Lake, Norway House First Nation, Cross Lake First Nation, Cross Lake (NA) and Norway House (NA).

6 - York Factory First Nation felt that this meeting should not be considered as a formal Public Involvement Meeting; nevertheless the meeting reviewed the Wuskwatim Project and associated environmental studies.

7 - The NFA includes a mandatory dispute resolution mechanism.

3.3.3.3 Round One (September and November 2001)

The Project was introduced to elected officials of communities in the Project Region. In total during Round One, five meetings on the Project were held with elected officials from 12 communities beyond NCN (see Table 3.3-2). In cases where these meetings took place outside the local community (i.e., in Thompson or in Winnipeg), participants from these communities were reimbursed by Manitoba Hydro and NCN for reasonable out-of-pocket expenses in connection with their travel. A joint NCN/Manitoba Hydro press release was issued by Manitoba Hydro Public Affairs discussing the Thompson meeting and mentioning all meetings.

A newsletter was also prepared and distributed during Round One to introduce the Projects, the environmental review process and the proposed public involvement program. Contact names and phone numbers were listed for each project in the newsletter. This newsletter was provided either directly to elected leaders at Round One meetings or was mailed along with an invitation to respond with issues, concerns or an expression of interest in meeting. The introductory newsletter about the projects was provided to the Manitoba Eco-Network Inc., an umbrella environmental organization based in Winnipeg, and to their member organizations expressing an interest in the Projects.

3.3.3.4 Round Two (Generally between November 2001 and May 2002)

Discussion on the Project was extended, where feasible, to broader segments of the public in the Project Region; information was provided on alternative means of carrying out the Project and alternative routes for the Transmission Project. During Round Two, six meetings on the Project were held involving six different communities beyond NCN (see Table 3.3-2). In addition to community meetings, a public open house was held in Thompson displaying information on both the Transmission and Generation Projects. The open house was advertised in the local newspapers (Nickel Belt News and Thompson Citizen), and invitations were sent to elected officials, resource users and others in the Project Region.

A Round Two newsletter summarized the highlights of Round One and status of the environmental assessment and planning process. The Round Two newsletter was used, along with the first newsletter, in meetings and at the Thompson open house. It was also sent with a joint NCN/Manitoba Hydro informational letter to communities that did not express an interest in meeting. In some cases, newsletters were provided by specific groups to the general public (e.g., City of Thompson made copies available at City Hall).

Round One and Two newsletters were again provided to the Manitoba Eco-Network and selected member organizations.

By February, 2002 a new Wuskwatim Project web page had been developed and linked to the Manitoba Hydro Web site; this created an additional feedback mechanism for the public. Both the Round One and Round Two newsletters were provided on the Web site.

3.3.3.5 Round Three (late November 2002 to February/March 2003)

Preliminary EIS findings were presented, as well as preferred transmission routes, and discussion was extended beyond the Project Region. In total during Round Three, six meetings on the Project were held involving seven different communities beyond NCN (Table 3.3-2). Four of these were community meetings, while the remaining two meetings were held in Winnipeg. One open house that included the Generation Project as a major focus was held in Thompson and in Winnipeg. These events were advertised in the appropriate local newspapers (Nickel Belt News (of Thompson), Thompson Citizen, Winnipeg Free Press and Winnipeg Sun). The Winnipeg public open house was also advertised on Manitoba Hydro's Web site and in the relevant university departments through poster notice (both University of Winnipeg and the University of Manitoba).

Also part of Round Three, a Forum was held in Winnipeg for Environmental Non-Governmental Organizations. Overall, 62 invitations were sent, including all Manitoba Eco-Network members organizations as well as other organizations identified as having an interest in the Project. A total of 25 individuals participated from these groups. The Forum included a preview of the Winnipeg open house storyboards, a meal and a presentation with a question and answer period.

A Round Three newsletter provided an overview of the Wuskwatim projects, an update on activities related to these projects, a review of initial EIS findings regarding the projects' predicted impacts, and maps illustrating routes for the Wuskwatim Transmission lines. It was used, along with the other two newsletters, in meetings and open houses and was sent with a joint Manitoba Hydro informational letter to communities that did not express an interest in meeting.

The Wuskwatim Web site was updated to include a wide range of documents (e.g., presentations from the Rounds One, Two and Three meetings with communities; informational pamphlets distributed at Nelson House; the Round Three Newsletters; and various documents relating to the regulatory process).

3.3.3.6 Key Issues Heard To Date

Participants in the public involvement process voiced a wide range of questions and concerns throughout Rounds One, Two and Three.

Some of the major themes heard during the process are noted below (see Volume 2 for detailed reporting on what was heard at different sessions and from different groups).

- Communities were interested in employment and training opportunities. People asked questions about the timing, location and preference policy of training programs, as well as the number, type and distribution of job opportunities. Also, a number of individuals asked about job and business opportunities once the generating station is in operation.
- Interest was expressed in other economic spin-offs, including contracting opportunities and the Transmission Development Fund.
- Communities asked whether the generating station would change the current operation of the CRD or other water regimes. Concern was expressed that the Project would worsen effects from the CRD or possibly cause new effects. Concerns raised by communities downstream of the generating station pertained to possible water quality and water level changes, erosion, mercury, changes and decline in fish populations, fish habitat, flooding and loss of livelihood. Similar questions were asked about effects on Wuskwatim Lake and other upstream areas, as well as about effects on the upper Nelson River area or other areas due to any changes in the operation of Manitoba Hydro's overall water power system due to the Project.
- Communities asked whether processes would be in place to deal with any unanticipated adverse impacts of the Project.
- Communities asked about the need for new transmission lines and the possibility of upgrading existing facilities to avoid the construction of new rights-of-way.
- Questions were asked about:
    - what would be done with the trees removed during construction of the access road and clearing of shoreline areas;
    - the nature and timing of the environmental studies;
    - the commercial fishery on Wuskwatim Lake, and what impact the Project would have, if any, on fishing activities;
    - cumulative effects, including how socio-economic impacts would be assessed;

- climate change, how the Project would affect climate change, and what affect climate change would have on the Project;
- potential impacts on wildlife;
- the Public Utilities Board review, including how need and alternatives will be defined and reviewed; and
- the availability of the EIS documents for review, as well as the availability of funding for independent review.

3.3.4 Impact of the Consultation and Involvement

All concerns, questions and issues raised by the public were given careful consideration in the environmental assessment process, and as appropriate, incorporated into planning for the two Wuskwatim Projects. This has included the following.

- The design of the public involvement program was directly influenced by the input of elected officials. Participants were asked how they would like to be consulted and what type of information would be most useful. Discussion on methods of consultation with local communities is ongoing.
- As a result of issues raised, water quality sampling sites were extended from Birch Tree Lake to downstream of Thompson. Concerns raised by downstream communities led to a further expansion of the water quality sampling sites between Thompson and Split Lake.
- Public input was important for the identification and evaluation of alternative transmission line routes. In particular, public input helped to identify sensitive areas and possible routing opportunities. It also helped in the comparison and evaluation of alternative routes.

3.3.5 Next Steps in Consultation and Involvement Beyond NCN

Consultation with potentially affected communities in the Project Region will continue after the EIS has been filed. Rounds Four and Five of public involvement are designed specifically to maintain an open flow of information and dialogue with the public. During Round Four, Manitoba Hydro and NCN will return to talk with interested parties about topics of specific interest or concern identified in previous communication. During Round Three, communities and their representatives were asked whether there were any issues they would like to talk about further in Round Four. In cases where issues were raised, they were documented for follow-up. Round Five will focus on communicating any supplemental information that is prepared and filed with the regulators following initial review of the EIS documents. Discussions taking place as part of Round Five will be focused on parties with an identified interest in the materials.

There is an ongoing commitment to meet with interested communities in the Project Region to examine, together, ways to address specific concerns. In this regard, Manitoba Hydro and NCN are seeking to develop joint consultation plans with interested Aboriginal communities to focus on specific impact issues relevant to each Aboriginal community. Completion of the EIS will allow all parties to review technical studies and findings. In special circumstances where joint review of technical issues is concluded to be useful in resolving a concern, and there is a reasonable basis for such a requirement, Manitoba Hydro will consider providing support to enable an Aboriginal community (or communities) to retain specialist assistance to better understand the Project (and the studies reported on in the EIS) and to consult further with Manitoba Hydro and NCN prior to the Clean Environment Commission hearings.

4.0 PROJECT DESCRIPTION

This section summarizes the main components of the project description as outlined in Section 5 of the "Guidelines" for the preparation of an Environmental Impact Statement for the Wuskwatim Generation Project. Additional details regarding the project description are provided in Volume 3 of this EIS.

4.1 MANITOBA HYDRO'S NORTHERN GENERATION SYSTEM

Manitoba Hydro has a total installed generating capacity of 5,406 **megawatts** (**MW**), from 14 **hydroelectric** generating stations (GS) (representing over 95% of the total generation) and 2 thermal generating stations (Volume 3, Section 1.4). Figure 4.1-1 shows the location of Manitoba Hydro's generating stations in the north, including the site of the proposed Wuskwatim **Generating Station**. The majority of the power generation comes from the three plants on the lower Nelson River (i.e., Kettle GS, Long Spruce GS and Limestone GS) which contribute more than 70% of the average annual hydroelectric generation. The remaining generation comes from: two sites on the upper Nelson River (Jenpeg and Kelsey); two small sites on the Laurie River; one site on the Saskatchewan River at Grand Rapids; six sites on the Winnipeg River; and two **thermal plants** (Brandon and Selkirk).

An integral part of Manitoba Hydro's northern generation system are two water control projects built by Manitoba Hydro in the mid 1970s: **Lake Winnipeg Regulation** (LWR) and **Churchill River Diversion** (**CRD**; Figure 4.1-1 and Volume 3, Section 1.5). The primary purpose of both LWR and CRD is to provide power-generation benefits downstream on the lower Nelson River. A secondary benefit of LWR is flood control on Lake Winnipeg.

The CRD diverts a large portion of the flow from the Churchill River into the Nelson River via the Rat/Burntwood River system. A control structure at Notigi regulates flows into the Rat/Burntwood System under the terms of the CRD 1973 Interim Water License as modified by the annual **Augmented Flow Program**.

The proposed development of a 200 MW generating station at Taskinigup Falls (i.e., the Wuskwatim GS) is possible because of the combined 22-metre drop in water levels at Wuskwatim Falls and Taskinigup Falls. With this Project, the CRD and LWR will continue to operate as they are operated today. This means that the Wuskwatim Generation Project will operate under all relevant existing licenses and permits (Section 1).

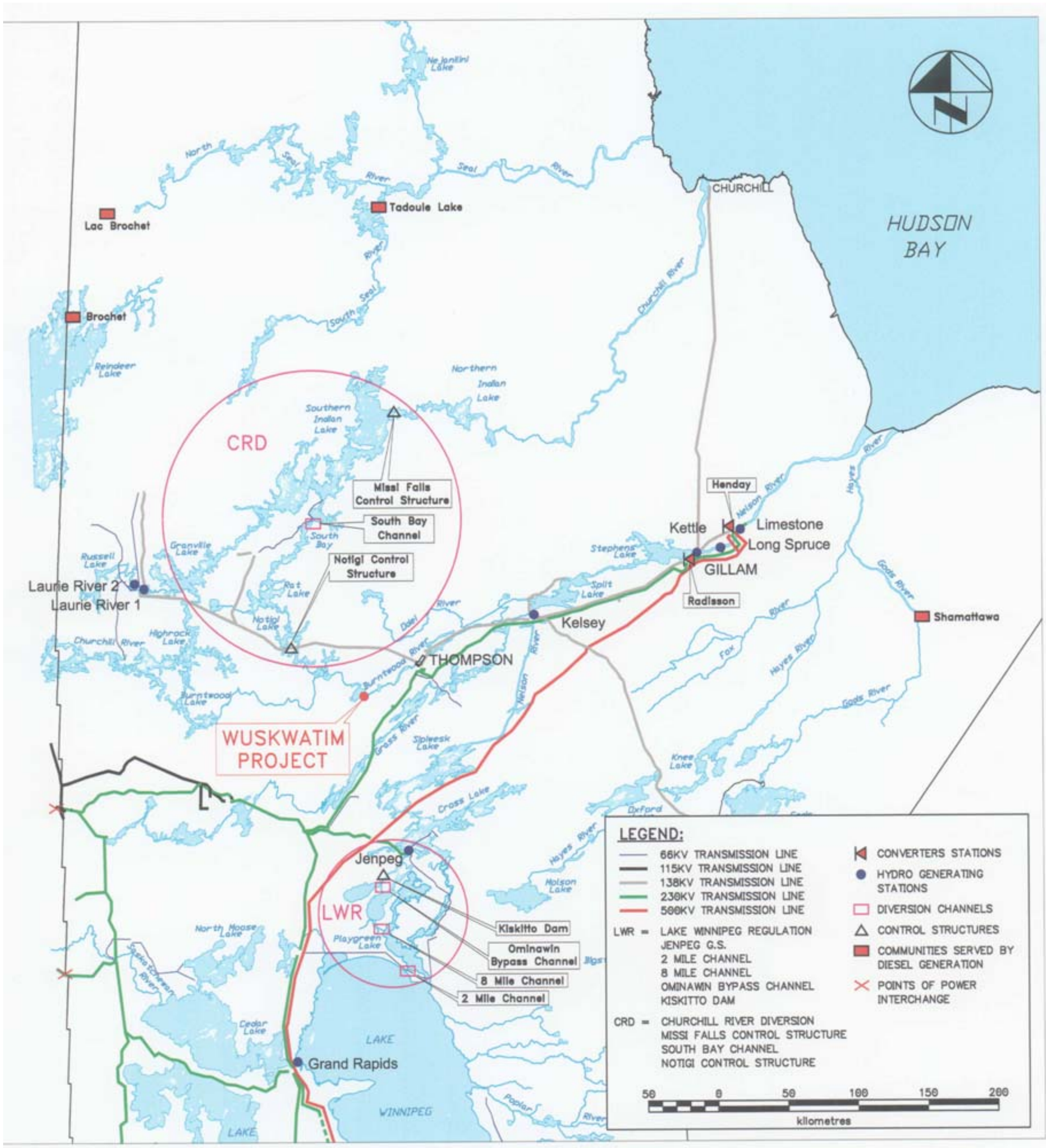


Figure 4.1-1. Manitoba Hydro system in Northern Manitoba.

4.2 WUSKWATIM GS PROJECT DESCRIPTION OVERVIEW

The proposed Wuskwatim Generating Station and associated **infrastructure** would be located on the Burntwood River at Taskinigup Falls, which is about 1.5 km downstream of the outlet of Wuskwatim Lake, 48 km southwest of Thompson (and 37 km southeast of Nelson House) (Figure 1.1-1). A 200 MW station would be built to utilize the CRD flow that currently passes over the combined 22 m elevation drop at Wuskwatim and Taskinigup Falls. The generating station is expected to produce an average of about 1,**550 gigawatt** hours (**GW.h**) of electricity per year (resulting in a **capacity factor** of over 85%) that will be fed into the northern **AC** transmission system. The electricity produced will be initially marketed for export. In time, with anticipated domestic (provincial) load growth, the power generated at the site will be used to supply domestic requirements.

It is currently anticipated that initial construction activities would begin in late 2003 or early 2004, after all regulatory approvals are obtained. The Project is expected to take 6 years to construct, finishing in the fall of 2009.

The proposed generating station would include: a main **dam** across Taskinigup Falls; a **powerhouse/service bay** complex (housing three **turbines**); and a three-bay **spillway** that would be built into the north bank of Taskinigup Falls (Figure 4.2-1 and Figure 1.2-2 previously). The generating station would increase water levels in the immediate **forebay** between Wuskwatim Falls (the natural outlet of Wuskwatim Lake) and the proposed structures located at the current site of Taskinigup Falls. A new channel would be excavated on the north side of the river at Wuskwatim Falls to improve the outflow conveyance from the lake into this immediate forebay area.

The supporting infrastructure required to build the Wuskwatim Generating Station includes, but is not limited to: an access road to the site; a construction camp; contractor's work area; and construction-power services (Section 4.4.1). While this Generating Station EIS discusses the footprint of the **switching station**, all other **transmission-**line facilities associated with construction and operational power transfer are addressed within the Wuskwatim Transmission Project EIS.

The generating station would normally be operated to keep Wuskwatim Lake at or very near 234 m **ASL**, which is near the upper range of the **post-CRD (existing**) water levels on Wuskwatim Lake. Under post-CRD conditions Wuskwatim Lake has varied between 232.6 m and 234.3 m, with an average of 233.6 m (Figure 5.3-2). Flooding from the

Project will be less than half a square kilometre (37 ha) and will be limited to the immediate forebay area between Wuskwatim and Taskinigup Falls. Prior to **impoundment**, the immediate forebay area will be cleared.

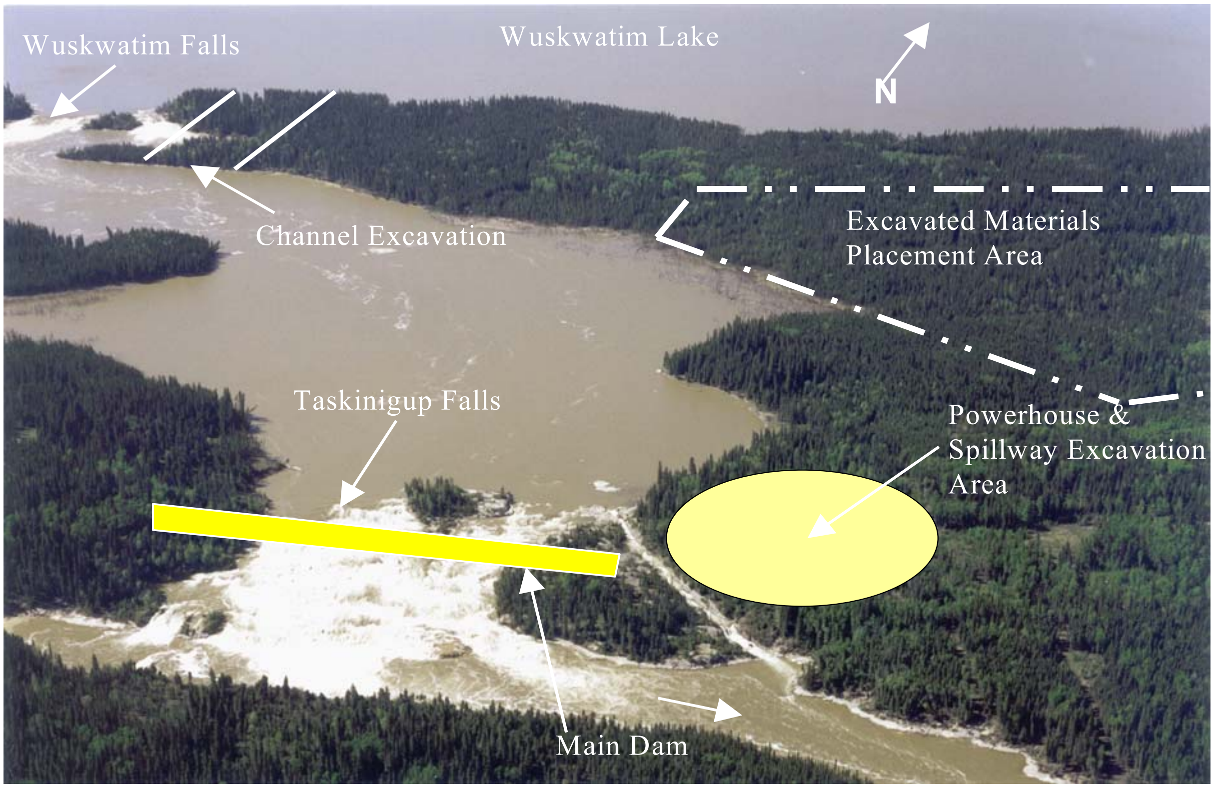


Figure 4.2-1. General location of where Wuskwatim Generating Station components would be built.

4.3 PROJECT PLANNING AND EVALUATION OF ALTERNATIVES

Since the late 1960's, various studies have been conducted to investigate potential sites for hydroelectric development on the Burntwood River (Volume 3, Section 3.2). One of the first environmental studies on the river was done for the Lake Winnipeg, Churchill and Nelson River Study Board (1971-75) as an addendum report. This addendum report provided an initial assessment of the environmental impacts of 3 potential hydroelectric sites on the Burntwood River (Wuskwatim, Manasan and First Rapids). In 1978, Manitoba Hydro produced updated concepts of these three Burntwood River projects. Throughout the 1980's, studies were done to assess the environmental, socio-economic, and engineering factors associated with various potential Wuskwatim Generating Station forebay options.

In 1997, following ratification of the Nelson House NFA Implementation Agreement in 1996, NCN and Manitoba Hydro established a Working Group to exchange information and facilitate consultation regarding the potential hydroelectric developments at Wuskwatim and the Notigi Control Structure (Section 1.1).

In 1998/99, Manitoba Hydro reviewed the various options for forebay elevations and **modes of operation** and recommended a preferred option (as discussed in the following sections) for additional consultations with NCN and to advance to the detailed engineering design stage (Stage 4 - pre-investment). In Stage 4, decisions were made with respect to finalizing mode of operation, turbine selection and location and alignment of the generating station structures (i.e., powerhouse, spillway, main dam etc.) as well as the location for the construction camp and access road. Project description information developed in Stage 4 forms the basis of this EIS.

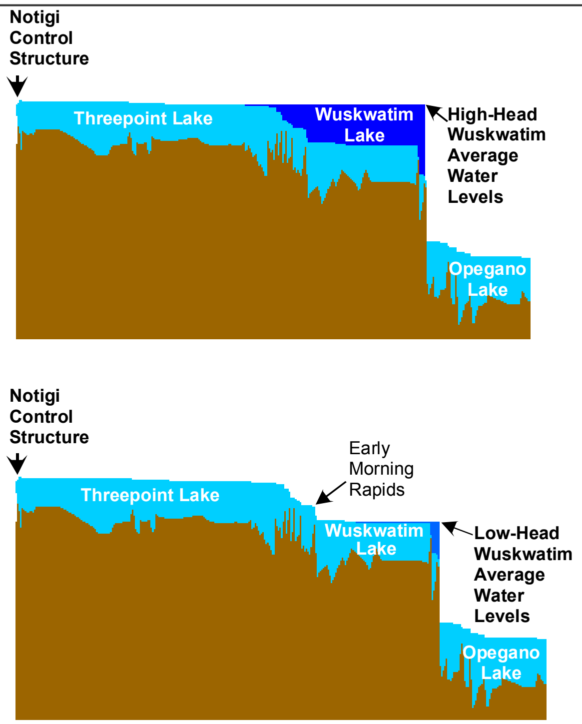
4.3.1 Forebay Elevation

Starting in Stage 2 (feasibility stage) of the engineering studies, there was a progressive evaluation of alternatives that led to the refinement and selection of a preferred forebay elevation for Stage 4 (detailed engineering design; Volume 3, Section 3.3). Four forebay elevation options were investigated at the Stage 2 level, ranging from 235 m (which is about 1.4 m above the post-CRD (existing) average water level of 233.6 m) up to elevation 246.9 m (13.3 m higher than post-CRD levels, which would require additional easements and re-negotiation of the water level constraints contained within the NFA).

Two forebay options were advanced from Stage 2 to Stage 3, a "**low-head**" option of 235 m and a reduced "**high-head**" option of 243.2 m (Figure 4.3-1). Based on these studies, Manitoba Hydro concluded:

- while the 243.2 m high-head option could produce 350 MW and have a lower per-kilowatt capital cost and a lower per kW.h energy cost, it would result in 140 square kilometres of flooding and would have greater environmental impacts;

- a forebay elevation of 234.0 m (i.e., 1-m lower than the initial low 235 m option) would only produce 200 MW and have a higher capital cost per kilowatt. However, this option would not result in any additional flooding of Wuskwatim Lake as the elevation chosen occurs under existing conditions (such as what occurred in the year 2000). The only new flooding associated with the low-head option would be less than half a square kilometre of land in the immediate forebay between Wuskwatim and Taskinigup Falls.



High-Head Design (Not Selected)

Shows average water levels on the Burntwood River between the Notigi Control Structure and Opegano Lake as they would have been with a high-head Wuskwatim generation project. Compared to the existing water levels, a high-head project would have caused an increase in water levels from Taskinigup Falls to Threepoint Lake, resulting in flooding of 140 square kilometres of land.

Low-Head Design (Selected)

Shows average water levels on the Burntwood River between the Notigi Control Structure and Opegano Lake as will exist in the future with a low-head Wuskwatim generation project. The only change from existing water levels is an increase in water levels between Taskinigup Falls and Wuskwatim Falls, resulting in flooding of about 1/2 of a square kilometre of land.

Figure 4.3-1. Potential high and low head options for Wuskwatim Lake.

In late 1998/early 1999, Manitoba Hydro and NCN discussed the merits of the low-head and high-head options. Both Hydro and NCN were concerned over environmental impacts of the high-head option. The 234 m low-head option was considered more favourable as it would minimize environmental impacts and it was still technically and economically feasible.

In the summer of 1999, Manitoba Hydro and NCN agreed that the 234 m low-head option should be pursued. As a result of this decision, a significant amount of the station's potential capacity and energy production was foregone.

4.3.2 Mode of Operation and Turbine Unit Selection

There are a variety of operating modes for a generating station ranging from a "**run-of-river**" to "**peaking**"**.** The run-of-river mode of operation does not cause any fluctuations of the outflow, but does not match generation to demand, thereby reducing benefits. To run effectively in this mode requires a special type of turbine (i.e., adjustable blade turbines or Kaplan turbines), which have increased capital and operating costs. The peaking mode of operation closely matches generation with demand, thereby maximizing benefits, but it can cause more significant and irregular fluctuations in outflows and associated dewatering and rewatering of the downstream river channel. This mode of operation does not restrict turbine selection and therefore costs are minimized.

A "compromise" operating option that is in between both options is a "**modified run-of-river**" [**shaping**] mode. Flow changes associated with this mode are not as dramatic as the peaking mode. The modified run-of-river mode is less disruptive to the environment than a peaking mode and provides more useable energy when it is required than a run-of-river mode, capturing some of the peaking benefits. Through an evaluation of a number of factors (on-peak energy production requirements, environmental concerns, and project costs), Manitoba Hydro and NCN concluded that the modified run-of-river mode of operation was best suited for this site (Volume 3, Section 3.4).

Integrated with the mode of operation decision is the selection of the type, number and flow capacity of the turbines. In the turbine evaluation, over 20 different combinations were considered, including:

- the type of turbines (vertical-shaft propeller - adjustable [Kaplan] or fixed blade);
- the mode of operation (run of river, modified run of river [shaping], peaking);
- the number of units (2, 3 or 4); and
- the rated plant discharge (1050, 1100, 1200 and 1400 m^3/s).

A three-unit fixed-blade turbine design with a total **rated discharge capacity** of 1,100 m^3/s was chosen. Some of the rationale behind the decision is as follows:

- the fixed-blade turbine design was selected because it had lower capital and operating costs than a Kaplan turbine and it would fit within the proposed mode of operation;

- the modified run-of-river mode of operation matches the efficiency characteristics of the fixed-blade turbine, provides increased on-peak power generation and produces only modest changes to the upstream and downstream water regimes;
- three units were selected as a compromise between costs and downstream flow fluctuations; and
- the 1,100 m^3/s rated plant discharge was selected because it was within and near the upper end of the existing flow regime of Wuskwatim Lake, 990 m^3/s is the most efficient flow setting for the turbines and is near the most common inflow condition (Section 4.5.1.1). This means that there is sufficient inflow to run all 3 units the majority of the time (Section 4.5.1.1), which results in less outflow changes at the generating station and less downstream water level fluctuations.

4.3.3 Access Road

An access road to the site is required for both construction and operation of the Project. Manitoba Hydro and NCN have worked collaboratively to select the best access route to the generating station site. Following some preliminary work to develop appropriate criteria for evaluating alternative road corridors, an Alternatives Committee with representatives and advisors from Manitoba Hydro and NCN was formed on August 15, 2000. This committee developed and evaluated options and then selected a preferred route for the proposed Wuskwatim access road. The overall objective was to choose a route that best met the environmental, economic and community goals of NCN and Manitoba Hydro. To accomplish this, the Alternatives Committee screened the following regional corridors:

- Taylor River (from PTH 6);
- Mile 5;
- Mile 20;
- Mile 33;
- Mile 37; and
- Nelson House (3 Alternatives).

("Mile" refers to distance along PR 391 measured from Thompson)

Initial analyses of road options involved input from technical specialists (including overflights and ground-based environmental investigations of potential routes) and NCN consultation through two open house events. Following these initial analyses, the potential corridors were screened down to routes between Mile 5 and Mile 33 along PR 391. From this initial screening, six possible centreline right-of-way alternatives were developed as shown in Figure 4.3-2. The Alternatives Committee assessed these centreline right-of-way alternatives using the following three main criteria:

- impact on NCN (the benefits and drawbacks for NCN);

- impact on the environment (how the environment would be affected); and
- impact on the Project (a comparison of the cost, technical considerations and schedules of the various route options)

The selection of a preferred centreline involved the evaluation and interpretation of results from: cost/benefit analysis; environmental studies; in-depth meetings and workshops; and consultation with NCN members. In selecting potential routes, particular attention was given to avoiding sites identified by NCN as being culturally sensitive. The process concluded “Mile 17 route” (which begins at Mile 17 on PR 391, about 32 km west of Thompson) to be the preferred option.

This route:

- maximized benefits to NCN;
- minimized potential adverse effects to the environment;
- remained cost-effective and has good technical potential for a safe route design; and
- potentially posed fewer construction schedule risks compared to other options.

The evaluation also revealed that the unavoidable provision of access into the area/site was a key issue common to all of the alternative road alignments. An Access Management Committee (including Manitoba Hydro and NCN members) was therefore subsequently formed to address access-related issues and concerns and have agreed on objectives for the management of access. The Limited Partnership for this project (which includes representation from both Manitoba Hydro and NCN) will develop the Access Management Plan. The Limited Partnership will finalize the construction portion of the Access Plan before construction begins in late 2003/early 2004 and will include among other measures, a security gate (staffed 24 hours per day) at the junction with PR 391 to control access to the site. By 2008, the Limited Partnership is scheduled to complete an access plan to address the post construction period (i.e., operational phase of the generating station). This plan will be developed in consultation with the Nelson House Resource Management Board (to account for their land use/resource plans yet to be developed). To date, the parties have identified a range of possible options to meet their management objectives and a process to develop the details of the overall Access Management Plan (Volume 3, Appendix 3).

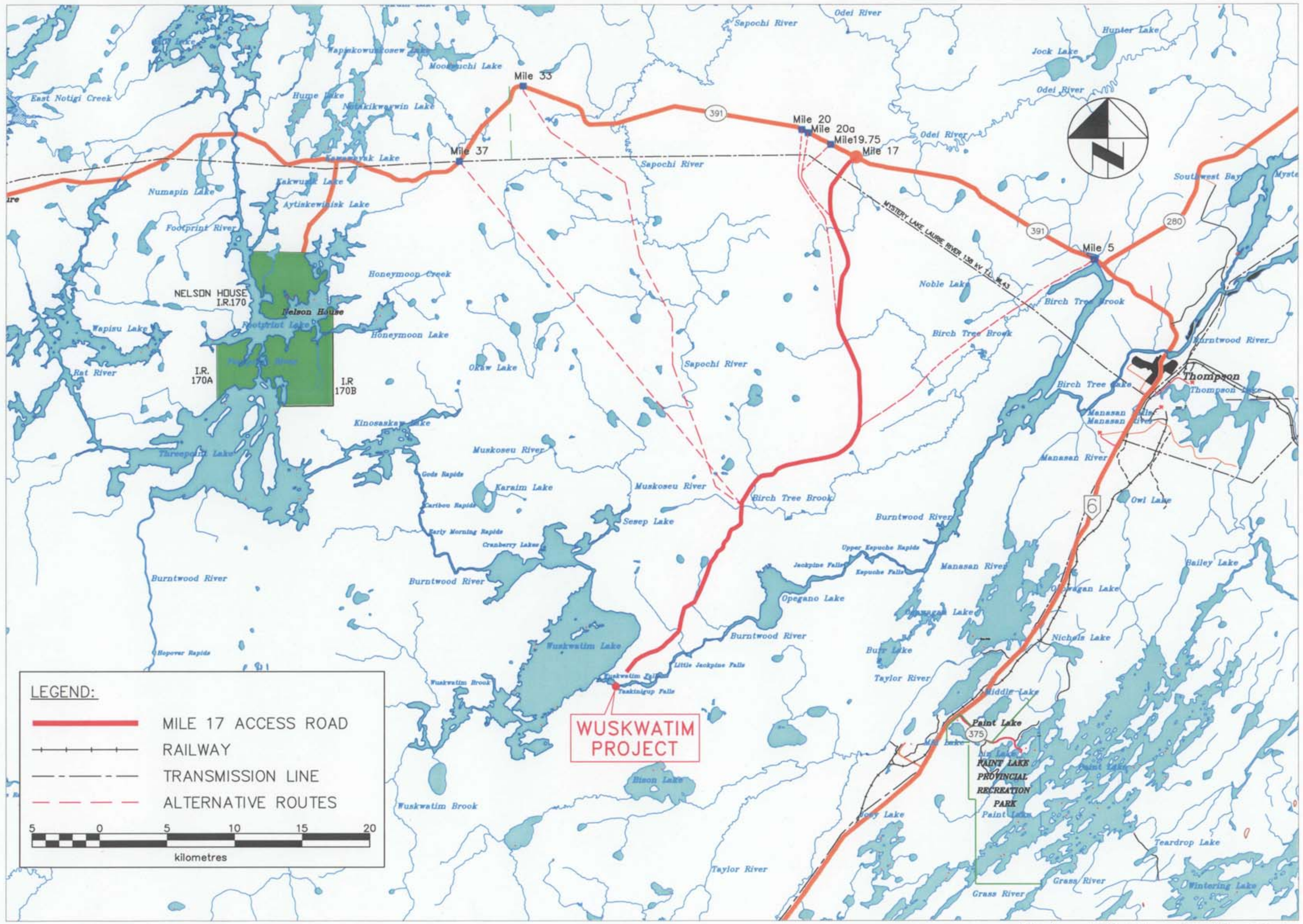


Figure 4.3-2. Proposed Access Road Route and Alternatives.

4.3.4 Construction Camp Location

The Alternatives Committee, that evaluated potential access road routes (Section 4.3.3), also assessed potential locations for the proposed Wuskwatim Generating Station main construction camp. The same criteria used to evaluate access road options were used in the construction camp location selection process (Section 4.3.3).

The Alternatives Committee evaluated and compared the following construction camp location options:

- full camp at the Wuskwatim Generating Station site;
- split camp - with a main camp at the Wuskwatim Generating Station and with sleeping accommodations and second kitchen etc. located remotely from the work area near:
  - Nelson House; and
  - the junction of PR 280 and PR 391, approximately eight kilometres north-west of Thompson.

The Alternatives Committee determined that a construction camp at the Wuskwatim site was considered the preferred option. It avoided the cost of duplicating some of the facilities in two locations and avoided concerns about potential adverse social effects associated with having a camp near a community. It also avoided effects on workers due to the long daily commute from the second camp to the Project work site. Finally, NCN's anticipated economic benefits from a second camp appeared not to be as great as initially thought. Therefore, a camp location at the Project site was selected.

4.3.5 Material Sources

Construction of the Wuskwatim Generating Station and local supporting infrastructure will involve the use of naturally occurring materials such as sand (**granular fill**) and silty clay (**impervious fill**) or manufactured rock material (i.e., **rock fill, riprap** and **concrete aggregate**) from ***in situ*** excavations. The initial construction of site infrastructure may require the development of a temporary local rock quarry. The required excavation of the **overburden** and rock for the powerhouse and spillway structures will likely provide all of the impervious fill and will provide all of the rock requirements for the GS. If required, a secondary impervious-fill site has been identified on the south side of the Burntwood River (Volume 3, Figure 3.8-2). The only material not available on-site is granular (sand). Manitoba Hydro has identified a number of local sources of these materials.

Figure 4.3-3 illustrates granular deposits within close proximity to the site that could potentially be used. Deposit J is the closest deposit, approximately 18-23 km northeast of the site. It consists of six separate areas. Engineering studies indicated that Deposit J-6 could provide all the granular requirements for the infrastructure requirements of the Project (i.e., lagoon, roads, etc.) and some of the granular fill requirements for the generating station. Engineering investigations also indicated that site J-4 could provide the fine aggregate for concrete production, as well as provide a portion of the granular fill requirements of the generating station (Volume 3, Table 4.5-1).

Access road construction will maximize the use of impervious materials obtained from sources located within or adjacent to the access road **Right-of-Way** (**RoW**). Additional granular materials could come from granular **borrow areas** G or J (Figure 4.3-3).

The Contractor(s), in consultation with Manitoba Hydro, will make the final decision with respect to the extent of utilization of borrow areas identified in the EIS. The Environmental Protection Plan (**EnvPP)** will provide guidance regarding the protection of features such as stream and riparian habitats in the active borrow areas. Manitoba Hydro will rehabilitate borrow areas in accordance with Provincial permits.

4.4 PROJECT CONSTRUCTION

The EIS Guidelines require that *"the environmental impact statement shall describe all elements of the construction of the proposed Wuskwatim project. Detailed descriptions of timing and the methods proposed for the various undertakings related to the construction of the generating station and related facilities"* should be included (Section 5.3.2, Appendix 2). The following section provides a general overview of the construction of the Project, the various components, and the time frame in which they would be built. More specific details relevant to Project construction are provided in Volume 3 (Section 4) of the EIS. This section also summarizes other pertinent aspects of Project construction that are relevant to the assessment of potential environmental impacts.

4.4.1 Construction Schedule and Tasks

Assuming regulatory approval is obtained by mid December 2003, preliminary construction of an access road to the site would start immediately thereafter. With a six-year construction schedule, the last turbine is scheduled to be **commissioned** in late September 2009.

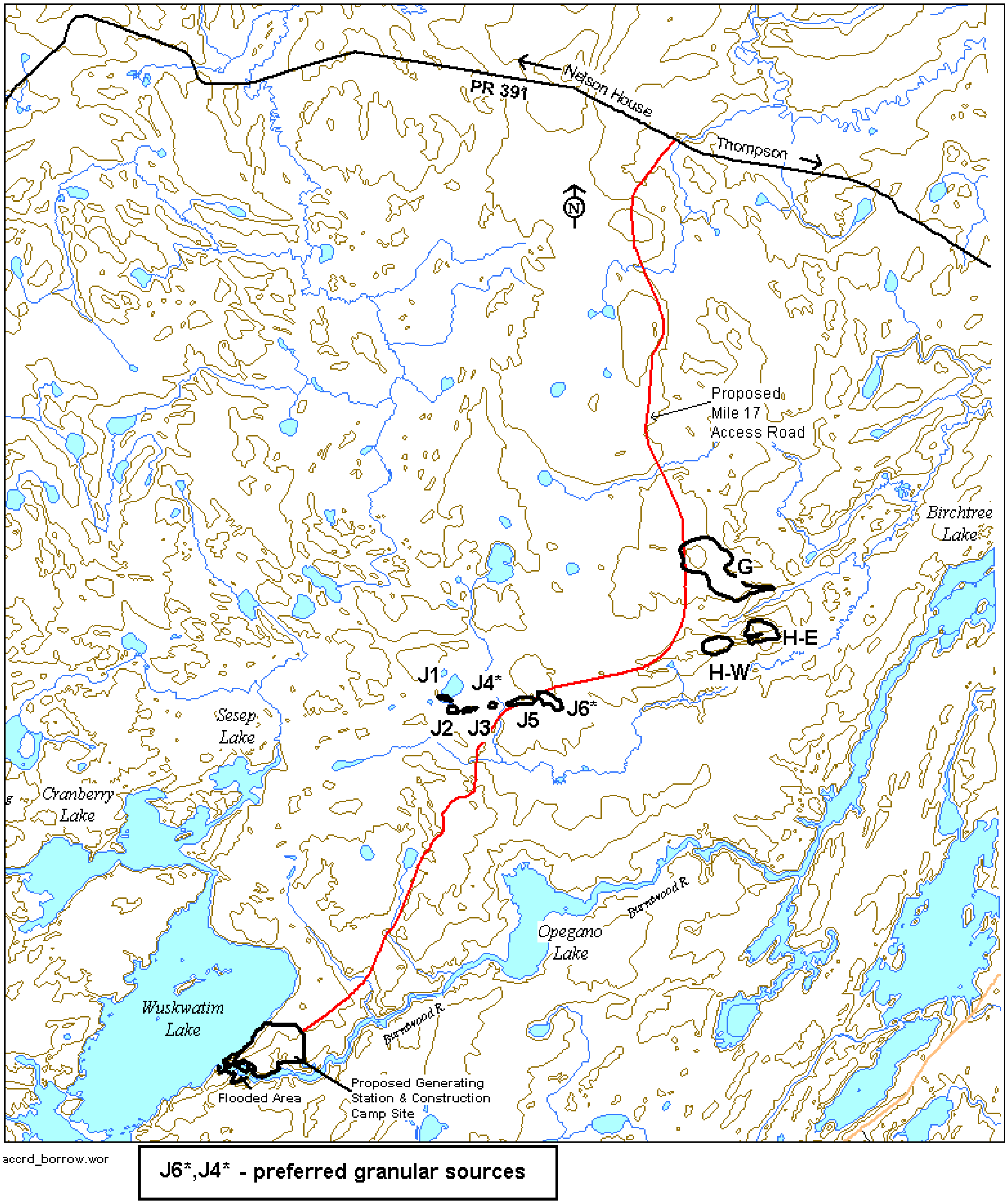


Figure 4.3-3. Granular-borrow areas along access road route.

The construction of the generating station first requires the construction of supporting infrastructure (i.e. access road, construction camp and construction power). The actual construction of the generating station is divided into 2 stages: the 1st stage involves the construction of the powerhouse and spillway and the 2nd stage involves diverting the Burntwood River through the fully open spillway to allow the main dam to be constructed across Taskinigup Falls.

The following subsections outline the construction schedule (Figure 4.4-1) and activities associated with various components of the Project, assuming all approvals are obtained by the end of 2003.

Year 2004

Immediately following Project approval and licensing (i.e., mid December 2003), clearing and construction of a 48 km access road from PR 391 to the generating station site would commence and be completed by end of August 2005 (Volume 3, Section 4.6.3). As soon as a winter trail is available to the generating station site (approximately mid January 2004), the construction site will be cleared and a self-contained start-up camp will be erected. At the same time as the access road is cleared, the Thompson Birchtree Station to the Wuskwatim Switching Station 230 kV transmission line will be cleared. Following the transmission corridor clearing, a line will be erected to provide construction power to the site by the end of March 2005.

The clearing requirements for the above components are scheduled to occur between January and March 2004. The estimated areas are as follows:

- access road (479 ha) and associated borrow areas (207 ha), for a total of 686 ha;
- construction site including permanent generating station facilities (147 ha); and
- construction power (270 ha).

In addition to clearing, a portion of the access road and the construction site will be grubbed (i.e., the removal of the trees roots and organic layer). The top organic layer will be stockpiled for post-construction site **rehabilitation** where required (Section 4.4.6).

Following site clearing and grading, construction will start on a 625-person camp and associated infrastructure, including: sewer and water services and an overhead power distribution system. A plan of the local infrastructure and camp is shown in Figure 4.4-2, with more specific details provided in Volume 3, Section 4.6.4. The construction of the

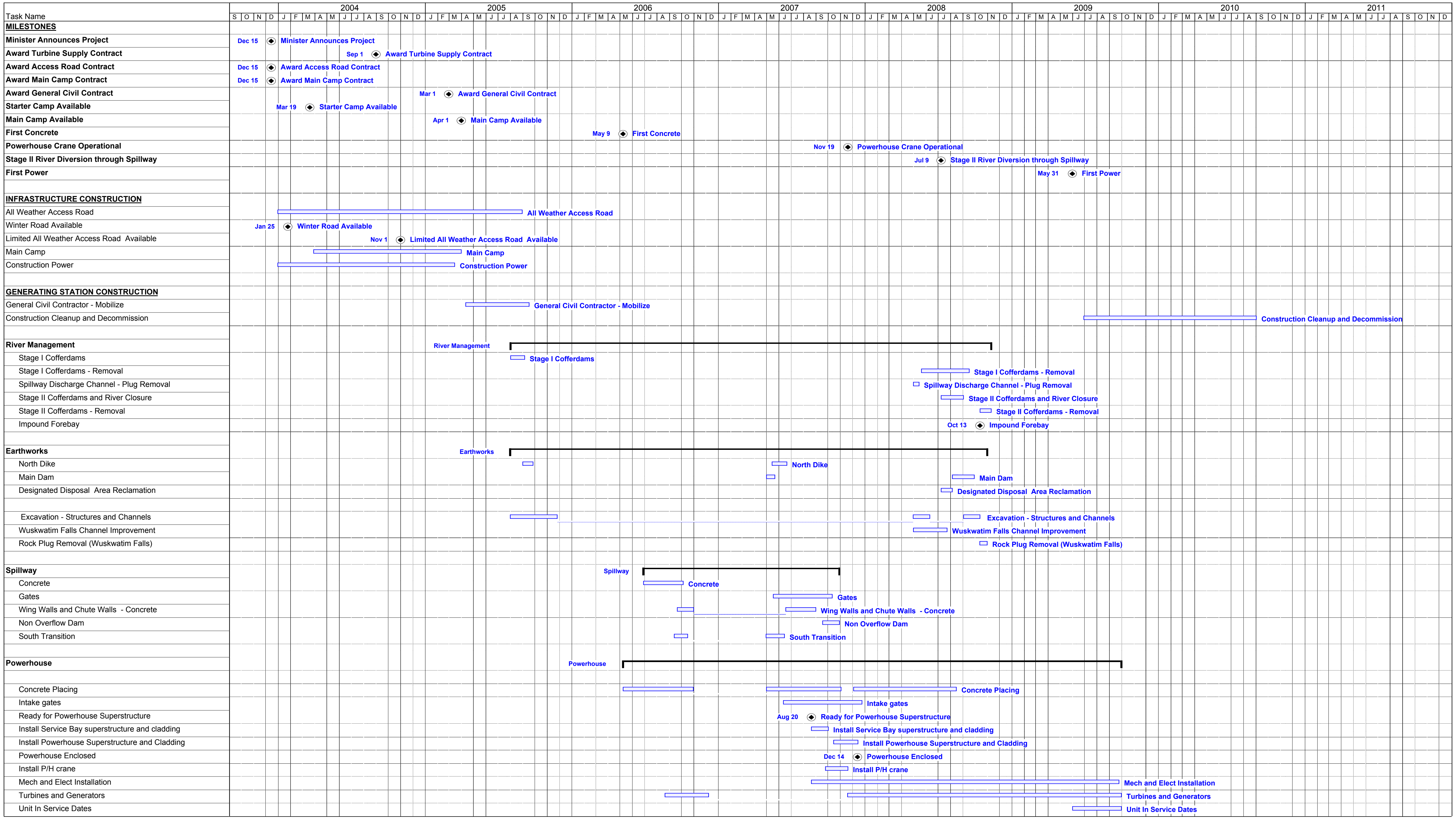


Figure 4.4-1. Summary construction schedule.

camp, lagoon and local site roads will require approximately 169,000 m^3 of granular fill and 128,000 m^3 of rockfill (Volume 3, Table 4.5-1). The majority of this material will be sourced from areas identified in Section 4.3.5

Year 2005

Initial clearing along the water's edge between Wuskwatim and Taskinigup Falls is expected to occur in the first few months of 2005 to accommodate a potential one metre rise in water levels during the Stage I and Stage II river-management activities (Section 5.3.2.1).

The general civil contractor is scheduled to begin mobilizing at the beginning of April 2005, and commence construction of the general contractor's work area (office, garage, concrete batch plant, crushers, stockpiles and wash-water settling ponds, as described in Volume 3, Figure 4.6-10). In August 2005, actual construction of the generating station will begin with development of the Stage I **cofferdam**. Material for the cofferdam construction will come from the areas excavated for the powerhouse and spillway structures.

Cofferdam construction involves the hauling and end dumping of large rock into the river, followed by placing of smaller rock sizes and then granular and clay seal materials (Volume 3, Section 4.6.8). To reduce erosion of the Stage I cofferdam face during construction, a rock-fill deflector **groin** will be constructed to create a low-velocity tranquil area adjacent to the cofferdam (Volume 3, Figure 4.6-22). Closure of the north portion of the river at Taskinigup Falls (Figure 4.4-3) by the Stage I cofferdam will allow excavation of the powerhouse, spillway and the approach and exit channels to take place in dry conditions.

The construction of the powerhouse and spillway structures (Figure 4.2-1) will require the excavation of about 817,000 m^3 of overburden and 806,000 m^3 of rock from a footprint area of 18 ha. A portion of the silty-clay overburden will be used as impervious fill for the Project, while some of the rock will be used in various aspects of the Project. Approximately 1,060,000 m^3 of surplus material will be placed in the excavated material placement area (43 ha) (Figure 4.2-1). Rock will be excavated by daily blasting from August through November 2005. Blasting will initially be conducted on high ground on the north bank of the river (Figure 4.2-1) and then eventually behind Stage I cofferdams (Figure 4.4-3), away from the river.

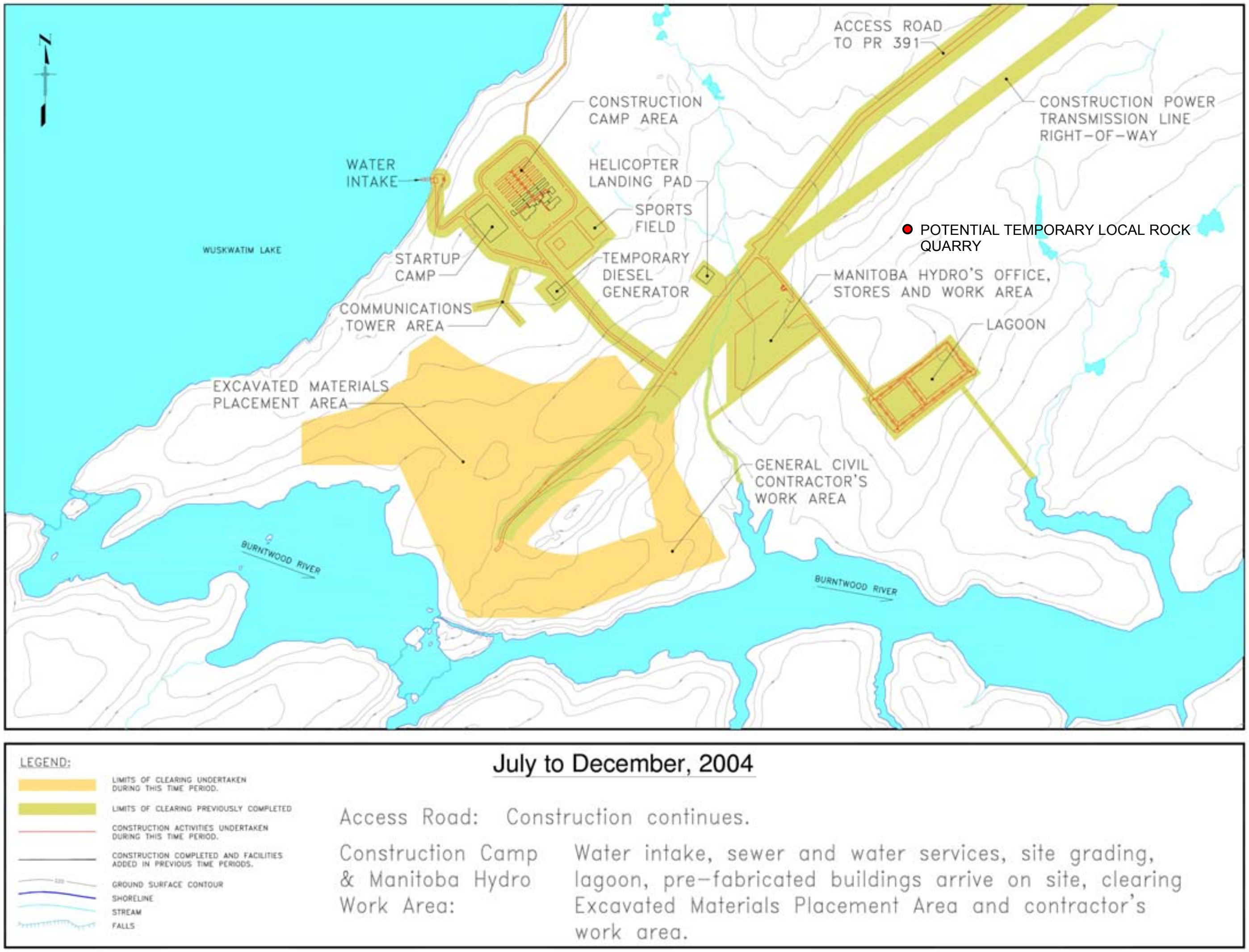


Figure 4.4-2. Layout of Project infrastructure.

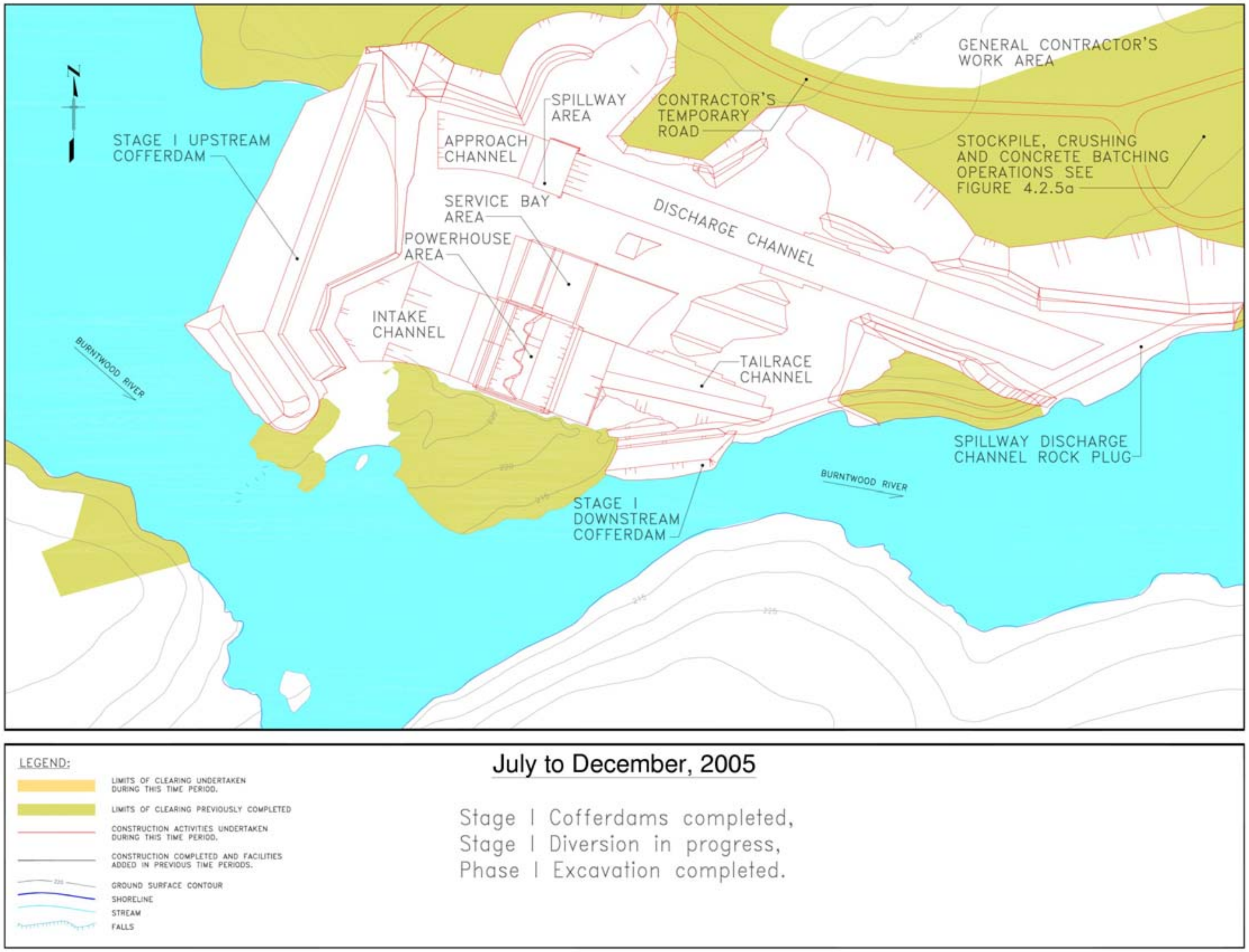


Figure 4.4-3. Layout of Stage I construction components.

Year 2006

Following excavation, placement of concrete for the powerhouse will begin in mid-May and placement of concrete for the spillway will begin in late June 2006. The durations for concrete placement for the spillway and powerhouse structures are one year and three years, respectively.

Concrete for the Project will be produced on site using sand, coarse aggregate and cement hauled to and stockpiled in the Contractor's work area (Figure 4.4-1). The sand will likely be secured from borrow site J-4 (Figure 4.3-2). Coarse aggregate will be produced from on-site rock crushing. Some materials may be washed prior to being used. All waste water from the production of concrete will be passed through two settling ponds prior to being discharged back into the Burntwood River (Volume 3, Section 4.6.6.2). Cement will be hauled to the site by truck from either the Thompson railhead or directly from the regional cement-manufacturing plant in Alberta.

Year 2007

Spillway and powerhouse construction, including placement of concrete, will continue in 2007. At the end of 2007, the powerhouse will be enclosed to allow year-round mechanical and electrical work which includes the installation of turbines and generators (this activity continues through to 2009). Prior to enclosure, the majority of the on-site generating station construction work would likely only be undertaken in the summer months.

Year 2008

During the 2008 winter period, the remaining portion of the immediate forebay area will be cleared of trees.

Construction of the powerhouse will continue throughout 2008. The Stage I cofferdam and spillway plug will be removed in the spring, thereby opening up the spillway channel. Diversion of the river flow through the spillway will allow construction of the Stage II upstream cofferdam, (Figure 4.4-4) which will be followed by construction of the main dam.

During removal of the Stage I cofferdam, as much of the material as possible will be removed in the "dry", with the remaining material removed in the "wet" using backhoe and/or dragline. Dispersion of fines will be reduced by **backflooding** the cofferdam

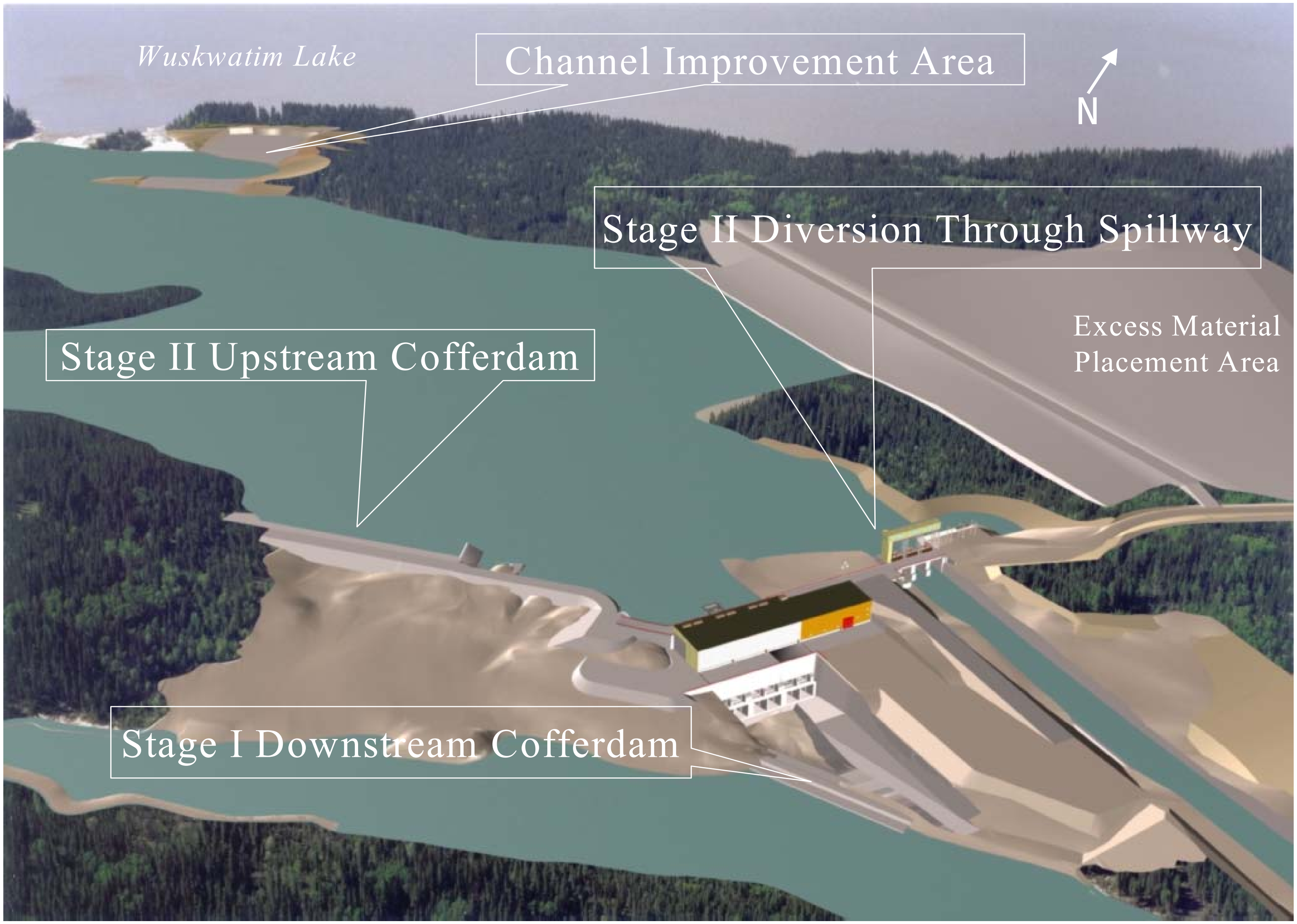


Figure 4.4-4. Stage II river management in 2008

before its removal. As discussed in Section 5.6.2.1, the initial flow through the spillway (i.e., Stage II diversion) will potentially result in localized erosion of the existing river channel and remnants of the Stage I cofferdam (Section 5.6.2.1).

Between the beginning of May and through to July, excavation of overburden and rock in the Wuskwatim Falls channel improvement area will be done mostly in the dry. Following impoundment of the immediate forebay in mid-October, the upstream rock plug will be removed in the wet. Overburden and rock excavated from the 5.5 ha channel excavation area will be placed in the excavated material placement area shown in Figure 4.4-4.

Year 2009

Work within the powerhouse is scheduled to be completed in Year 2009. The first turbine unit will be commissioned in May 2009 and the last unit in September 2009. Once construction of the generating station is completed, the camp and contractor's work area will be **decommissioned** and the area rehabilitated to the extent possible (Section 4.4.6). The decommissioning work will likely extend into 2010. A 3-D rendering of the completed plant is shown in Section 1.

4.4.2 Workforce

Figure 4.4-5 summarizes the contractor's workforce requirements for the construction of the generating station, by quarter, over the course of the construction period. The darker shade area shows the number of Designated Trades (i.e., those positions requiring apprenticeship training). The figure shows the highest, or peak, number of positions estimated to be required during the quarter (not all of these positions would last for the entire duration of the quarter).

Based on workforce estimates presented in Figure 4.4-5, the expected peak workforce in various years will range from 145 to 540 workers (depending on the season and stage of work). The workforce estimates include contractor positions that would be within the scope of the collective bargaining agreement for the Project. Contractors engaged by Manitoba Hydro will employ over 90% of the Wuskwatim construction workforce. A small number of supervisory/management positions will be hired directly by the contractor. Manitoba Hydro will hire the remaining positions internally. The estimates do not include senior contractor supervisory and management staff, Manitoba Hydro staff, camp operation staff or any positions related to transmission line construction (Volume 3, Section 4.3.1).

Provisions for pre-project and on-the-job training are outlined in Section 9.

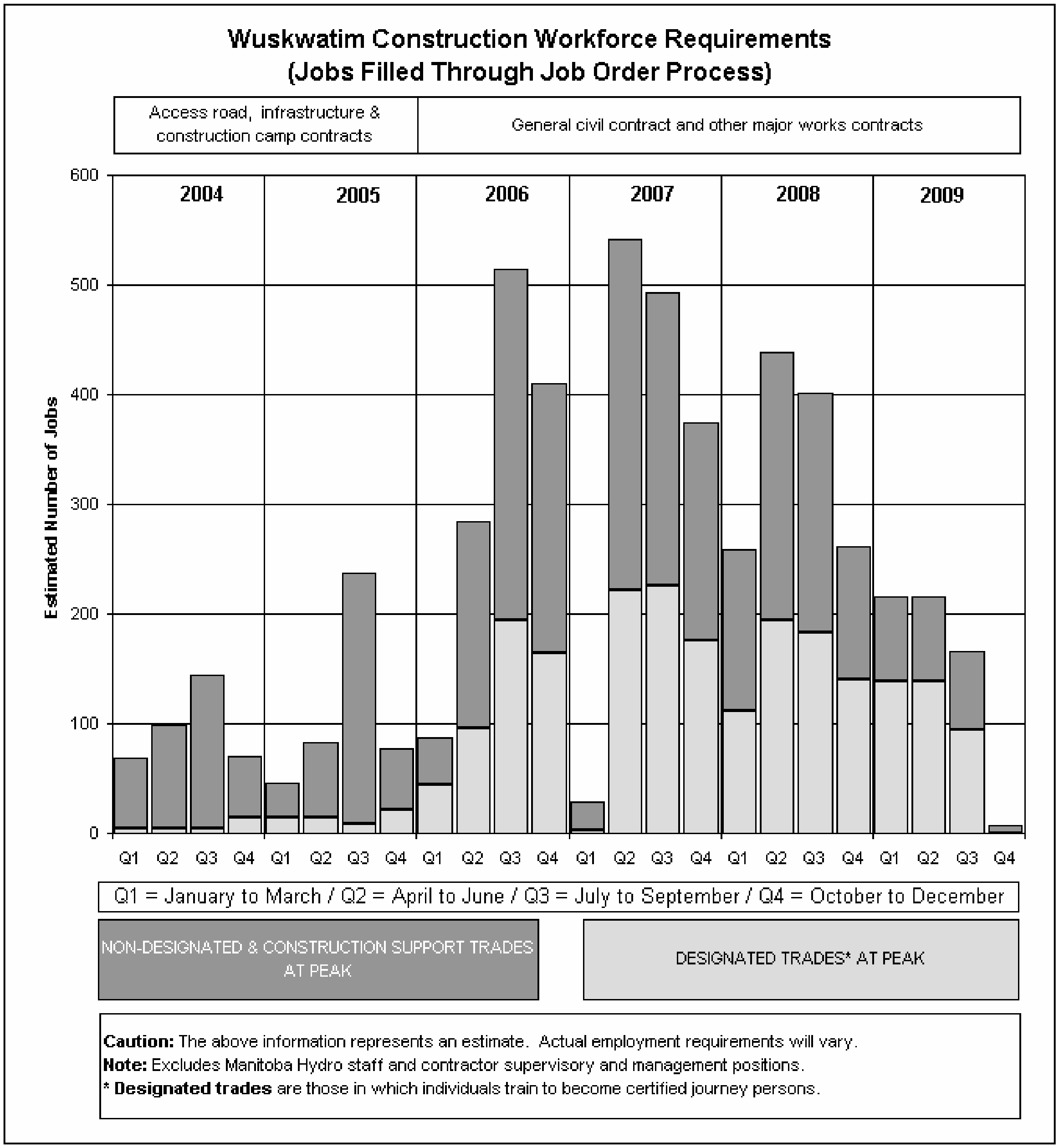


Figure 4.4-5 Wuskwatim workforce requirements.

4.4.3 Safety and Security

All construction activities and specific safety requirements will be outlined in the contract packages. The contractors will be required to comply with current Provincial Health and Safety regulations. It will be the responsibility of the Project Manager employed by

Manitoba Hydro to ensure that all Contractors comply with these requirements. An "on-site" Safety Supervisor will be employed during the construction period to ensure that Manitoba Hydro's on-site staff receive appropriate training and that all Contractors comply with the required regulations.

Emergency response programs will be developed to address all foreseeable situations that may occur during the construction period and station operation. A helicopter landing area will be located at the work site to provide a means for medical evacuation.

During construction, security officers will provide roving security and fire watch patrols throughout the camp and Manitoba Hydro work areas and related facilities. The security personnel will also control access at the PR391 Wuskwatim road intersection on a 24-hour basis for approved project personnel and vehicles (Section 4.3.3). Manitoba Hydro and NCN will develop a permitting process for non-construction activities intending to use the Wuskwatim access road (e.g., NCN trappers, commercial fishers, and those wishing to use traditional cultural sites for ceremonies). Public access will not be permitted.

4.4.4 Environmental Protection Practices and Plans

Manitoba Hydro's policy requires that it undertake projects in an environmentally acceptable manner (Volume 3, Section 1.3). The Project has been designed to avoid potentially significant environmental impacts where practical and possible. Unavoidable impacts will be minimized, to the extent possible, by following environmental practices outlined in the EIS, EnvPP and licence approvals.

A project-specific Environmental Protection Plan (EnvPP) will be developed and submitted to regulatory agencies for review following the receipt of an *Environment Act* License and before the start of construction. The EnvPP will be part of the contract documents and will include the following information:

- a brief project description including any modification to the Project as a result of contractor methods or conditions of the licensing/approvals process;
- a summary and site-specific mapping of the identified environmental sensitivities and mitigative actions;
- a listing of all federal, provincial or municipal approvals, licenses and permits, and reference to site-specific conditions, that are required for the Project;

- a description of general practices and specific mitigating actions relative to project-specific: site clearing, blasting, excavation, earthworks construction, roads, heritage resources, work in water courses, wildlife, on- and off-road travel, hazardous and non-hazardous material (transport, handling, storage and disposal), noise, safety and public access;
- emergency response plans, training and information to address medical and fire events, hazardous material spill response and containment / clean-up; and
- environmental / engineering monitoring plans and reporting protocols.

The EnvPP will include sections that are applicable to Project construction, operation, site clean up / rehabilitation and decommissioning.

4.4.5 Waste Disposal

The EIS guidelines require that the proponent describe the character and volumes of waste streams generated during the construction of the Project and how each waste stream would be handled, including waste oil and other potential hazardous or recyclable material.

To treat wastewater generated from the construction camp, a 2-cell clay-lined lagoon will be constructed. The lagoon will be designed for a 625-person summer capacity and will likely discharge twice per year (spring and fall) through a gravity outfall into the Burntwood River (Volume 3, Section 4.6.4.2) in accordance with Provincial regulations. The lagoon will be fenced off as a safety precaution. Manitoba Hydro will obtain Provincial approval for the design and operation of the lagoon system.

All hazardous and non-hazardous waste will be managed, collected, and disposed of in accordance with current Provincial and/or Federal legislation and guidelines and in a manner outlined in the EnvPP.

Opportunities to reduce, reuse, and recycle the wastes will be taken whenever possible. Wastes will be stored in designated areas and disposed of regularly to reduce potential for unsafe conditions and negative impacts. Non-hazardous waste would be diverted from landfills when possible for reuse and recycling.

It is likely that scrap wood and paper products will be disposed of by burning in a designated area at the construction site under a permit from Manitoba Conservation. Other waste will be disposed of either by creating a new permanent waste disposal site or by haulage from a transfer station to an existing permitted waste disposal site in Thompson. The preferred option will be selected after discussion with the City of Thompson and Manitoba Natural Resources.

Food refuse which is not disposed of through the kitchen garberators and sewage system, as well as those other wastes destined for the waste disposal site, will be stored temporarily in approved containers maintained in a secure location to prevent intrusion by wildlife. The requirements for storage and haulage may be minimized through the use of garbage compactors.

4.4.6 Construction Clean-up, Rehabilitation and Decommissioning

Upon completion of construction and final **commissioning** of the generating station, most buildings (e.g. construction camp) and temporary structures will be removed and the site will be cleaned-up and the site rehabilitated, as shown in Figure 4.4-6. Examination of this figure shows that the construction camp and facilities, the lagoon and the excavated material placement area(s) will be fully rehabilitated. Specific procedures for rehabilitating the site will be provided in the EnvPP.

4.5 PROJECT OPERATION

This section provides an overview of how the proponents will operate and maintain the Wuskwatim Project in accordance with Section 5.3.3 of the Guidelines (Appendix 2). More specific details relevant to Project operation are provided in Volume 3 (Section 5) of the EIS.

4.5.1 Mode of Operation

The EIS Guidelines require that the proponent provide a discussion of river flows and levels, with and without the Project, specifically (Appendix 2):

- "*planned, average hourly discharges at the plant*"; and
- "*under a range of flow and station operating conditions discuss average hourly forebay elevations, tailrace water elevations and water elevations at several downstream locations*".

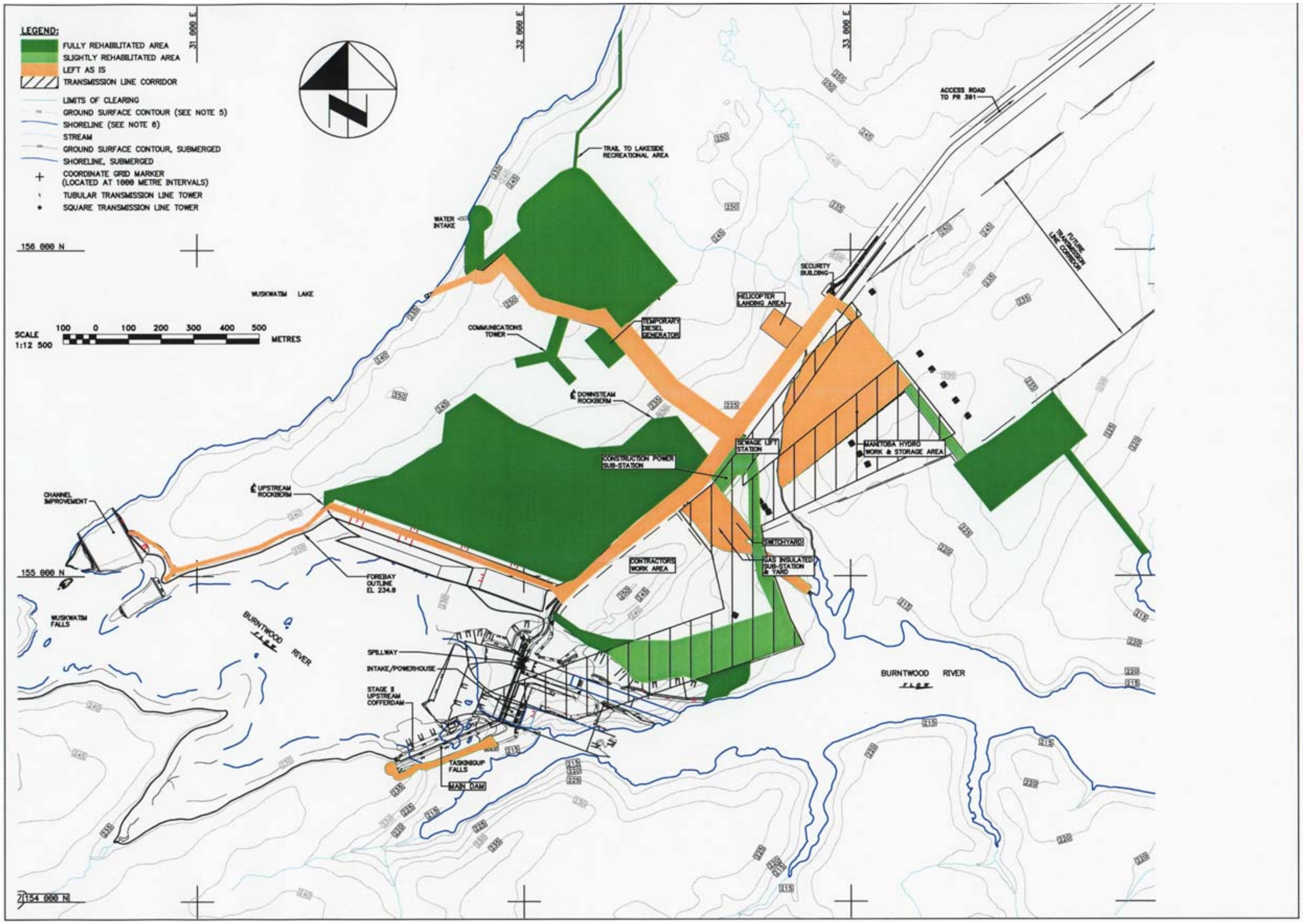


Figure 4.4-6. Rehabilitation plan.

These topics are addressed in the following sub-sections through a discussion of how the plant will be operated throughout the day for a range of flow conditions; and how these variable flow conditions will affect upstream water levels, and water levels at several downstream locations, including the generating station's tailrace channel.

4.5.1.1 Wuskwatim Generating Station Outflow Regime

The Wuskwatim Generating Station will normally operate in a modified run-of-river mode (i.e., estimated at 97.5% of the time; Section 4.3.2 and Volume 3, Section 5.2) with the plant shaping outflows to balance daily inflows. This will be accomplished by turning one unit on and off during the day or by adjusting the turbine flow when all units are on. For the remaining 2.5% of the time, a combination of low-inflow conditions and high or unusual power demands may require deviations from the above normal operation, as discussed in Section 4.5.1.2. A potential emergency scenario is discussed below.

While the Wuskwatim Generating Station turbines can operate over a wide range of flow settings, there is only a narrow range of settings at which the turbine unit will operate most efficiently, called the **"best gate"** setting (Section 4.3.2 and Volume 3, Figure 5.2-2). The generating station outflows will be adjusted to obtain near best gate settings as much as possible, alternating between efficient unit settings to balance outflows with inflows on a daily basis. For this Project (with three fixed-blade turbine units), there are only three probable outflow settings for inflows at or below 990 m^3/s:

- 330 m^3/s, 1 unit operating at "best gate";
- 660 m^3/s, 2 units operating at "best gate"; and
- 990 m^3/s, all 3 units operating at "best gate".

For inflows greater than 990 m^3/s and less than 1100 m^3/s there are a number of options. In a shaping mode, the plant outflow can be modified by either alternating between best gate outflow of 990 m^3/s and **full gate** outflow of 1100 m^3/s or by alternating between best gate outflow of 990 m^3/s and something less than full gate outflow of 1100 m^3/s. Alternatively, under these inflow conditions, the plant can be operated by simply passing the inflow unmodified. For assessment purposes, the option of alternating between best gate outflow of 990 m^3/s and a full gate outflow of 1100 m^3/s was chosen. This is a conservative approach to the assessment, since it would result in larger fluctuations of outflows than is likely to occur.

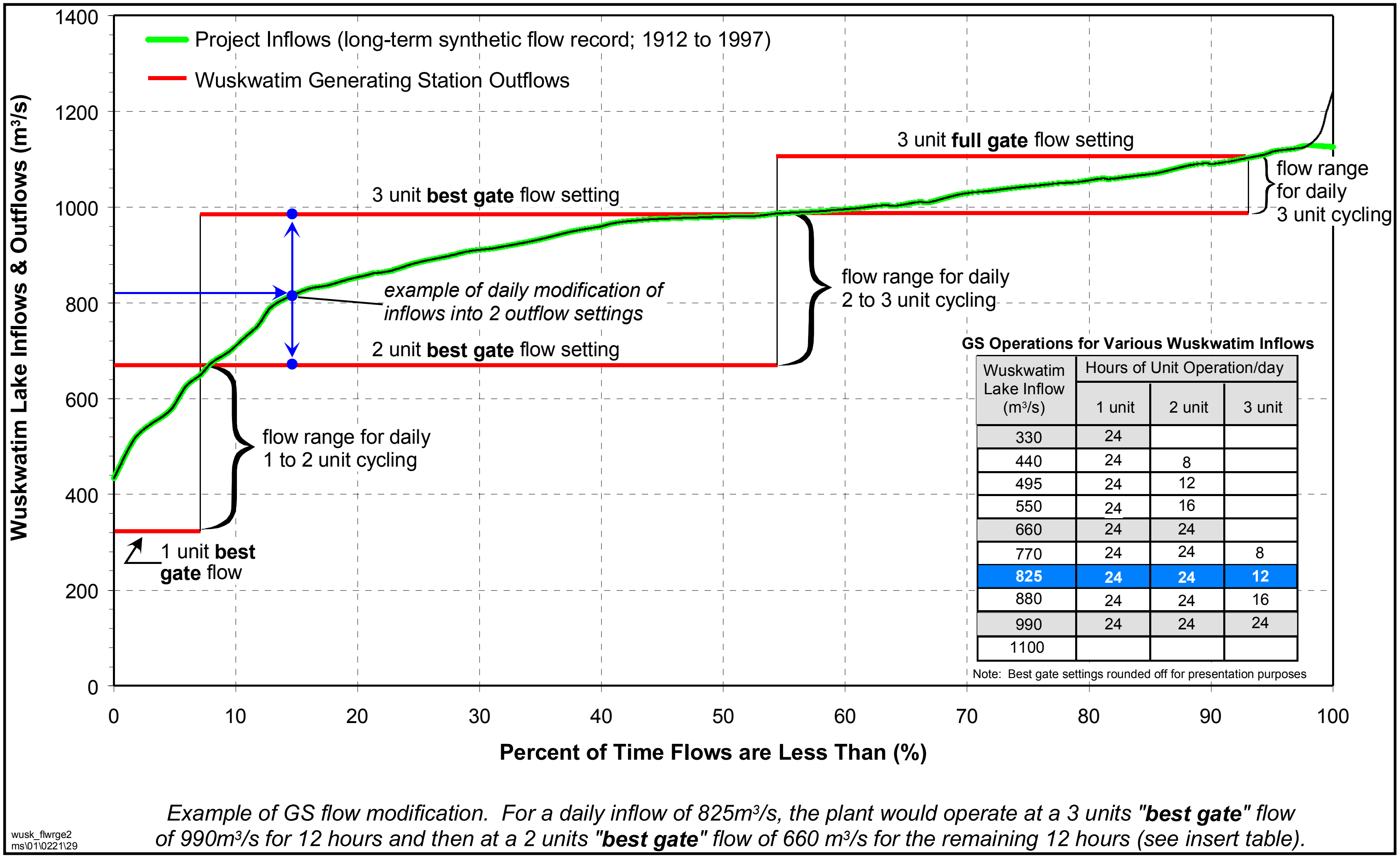
When inflows are greater than 1100 m^3/s, excess flow will be spilled through the spillway structure.

Figure 4.5-1 illustrates the daily generating station outflow modification, relative to a **duration curve** of **Project inflows** (Section 5.3-1). Superimposed on top of the duration curve are the four outflow settings for the generating station (i.e., 1 unit best gate, 2 units best gate, 3 units best gate and 3 units full gate). For a given Wuskwatim Lake inflow, there are two outflow settings; the nearest outflow setting above the inflow (typically during the day time), and the nearest outflow setting below the inflow (typically during the night).

In the example shown in Figure 4.5-1, a daily Wuskwatim Lake inflow of 825 m^3/s would be modified to either a 3-unit best gate outflow of 990 m^3/s (an increase of 165 m^3/s relative to the inflow) for part of the day and then a 2-unit best gate outflow for the remainder of the day. The number of hours that the outflow would be at 990 m^3/s is shown in the insert table of Figure 4.5-1. This table shows that for a Wuskwatim Lake inflow of 825 m^3/s all 3 units are on (i.e., 990 m^3/s outflow) for 12 hours. For the remainder of the day i.e., 12 hours (24-12) only 2 units would operate (i.e., 660 m^3/s outflow).

The amount of time over the life of the project that outflows are estimated to be at specific settings is illustrated in Volume 3, Figure 5.2-7 and summarized below:

- 330 m^3/s - 3% of the time;
- 660 m^3/s - 18%;
- 990 m^3/s - 52%;
- 990 to 1100 m^3/s - 20%; and,
- over 1100 m^3/s - 7%.



GS Operations for Various Wuskwatim Inflows

Wuskwatim Lake Inflow (m^3/s)	Hours of Unit Operation/day		
	1 unit	2 unit	3 unit
330	24		
440	24	8	
495	24	12	
550	24	16	
660	24	24	
770	24	24	8
825	**24**	**24**	**12**
880	24	24	16
990	24	24	24
1100			

Note: Best gate settings rounded off for presentation purposes

*Example of GS flow modification. For a daily inflow of 825m³/s, the plant would operate at a 3 units "**best gate**" flow of 990m³/s for 12 hours and then at a 2 units "**best gate**" flow of 660 m³/s for the remaining 12 hours (see insert table).*

Figure 4.5-1. Modification of Wuskwatim Lake outflows by Generating Station operation.

Table 4.5-1 shows the daily flow fluctuation and resultant maximum open water and winter tailwater fluctuation for various Wuskwatim Lake inflow conditions. A number of observations can be made from this table:

- approximately 54% (i.e., 47% + 7%) of the time a unit will be cycled on or off. Under these conditions, the maximum tailwater fluctuations will be 0.9 to 1.5 m; and
- for approximately 46% of the time (above-average inflow conditions), the tailwater fluctuation may vary between 0 and 0.4 m. As discussed previously and noted on the table, depending on how the plant is operated for flows larger than 990 m^3/s, there may not be any daily fluctuation, which would mean no daily tailwater changes for as much as 46% of the time. As indicated previously, for purposes of this EIS it has been assumed that the units will go from 3-unit best gate to 3-unit full gate setting and result in a 0.4 m or less tailwater fluctuation for about 39% of the time.

Table 4.5-1. Daily Tailwater Fluctuation for On-Peak and Off-Peak Power as a Function of Wuskwatim Lake Inflow.

Wuskwatim Lake Inflows		**Wuskwatim Generating Station Outflows & Levels**				
Flow Range	**Frequency**	**On-Peak Flow**	**Off-Peak Flow**	**Daily Flow Change**	**Maximum Daily Tailwater Fluctutation**	
					Open Water	**Winter**
inflows greater than 1100 m^3/s	7%	3 unit “full gate”- 1100 m^3/s and spilling as required	3 unit “full gate”- 1100 m^3/s and spilling as required	0 m^3/s	0 m	0 m
inflows between 990 m^3/s and 1100 m^3/s	39%	3 unit “full gate”- 1100 m^3/s	3 unit “best gate”- 990 m^3/s	110 m^3/s or 0 m^3/s (see note)	0.3 m or 0 m (see note)	0.4 m or 0 m (see note)
inflows between 660 m^3/s and 990 m^3/s	47%	3 unit “best gate”- 990 m^3/s	2 unit “best gate” – 660 m^3/s	330 m^3/s	1.1 m	0.9 m
flow less than 660 m^3/s	7%	2 unit “best gate” – 660 m^3/s	1 unit “best gate” – 330 m^3/s	330 m^3/s	1.3 m	1.5 m

cf. Volume 3, Section 5.2.5 For flows greater than 990 m^3/s, and less than 1100 m^3/s plant outflow may be adjusted to match inflows resulting in no daily cycling or downstream water level changes.

Hydrodynamic modeling has determined that it takes approximately 0.5 to 2.5 hrs (depending on size of the outflow change, whether the flow is increasing or decreasing and the duration of the change) for a flow change at the generating station to propagate down the 13 km river channel to Opegano Lake (Volume 4, Section 5.3.4). This means that when the outflow changes are shorter than the above time period, downstream water levels will still be adjusting and have not reached equilibrium. During this time, the water level fluctuations in the downstream channel reach will be less than those shown in Table 4.5-1.

The extent of discernible downstream water level changes from the plant operation in Opegano Lake and downstream depends on the size of the flow change that occurred in the day (i.e., whether the change was 110 m^3/s or 330 m^3/s) and the number of hours the extra unit was operating during the day as discussed in Section 4.5.1.3.

There may be unusual situations when the 'normal' mode of operation may be temporarily modified due to high power demands within the Province or the integrated power system. In these situations, plant outflow may be boosted to full plant capacity of 1100 m^3/s to generate more power for short periods (i.e. 10 minutes to 4 hours; Volume 3, Section 5.2.5.3). Table 4.5-1 shows that a change from 2-unit best gate to 3 unit full gate (flow change of 440 m^3/s [110 + 330 m^3/s]) would result in a tailwater level increase of about 1.4 m or less. The tailwater fluctuation is very near the range of fluctuations that would occur under a 1-unit to 2-unit flow change (i.e. about 1.5 m or less).

The duration of the sustained outflow change will depend on the condition that caused the change and will be limited by a Birch Tree Lake daily fluctuation guideline (Volume 3, Section 5.2.5.3). Under this guideline, Manitoba Hydro plans to operate the plant such that the daily water level (wind and wave effects eliminated) on Birch Tree Lake will not fluctuate by more than 0.10 m under open water conditions (or 0.15 m under ice conditions) due to the operation of Wuskwatim Generating Station. At times there may be uncontrollable events, such as local rainstorms or abnormal ice phenomena, which may not allow adherence to this guideline.

Emergency Mode of Operation

The modified run-of-river mode of operation (i.e., typically consisting of flow change corresponding to one generating unit) could be changed under highly unusual conditions which could result in a flow change corresponding to two generating units. This type of operation would be considered an emergency mode of operation. The necessity to operate in this fashion could come about under very infrequent low outflow conditions (about 3% of the time) and coincident failure of Manitoba Hydro's DC transmission system (removing a significant amount of Manitoba Hydro's generation capability). The combination of very low flows and loss of the DC transmission system is estimated to have very low likelihood of occurring (less than once in about 90 years). If such an emergency situation did occur, Manitoba Hydro would take extraordinary measures to keep the electrical system functioning, such as maximizing imports, maximizing thermal generation, cutting curtailable loads and other emergency management options. Such circumstances could result in a change from 1 unit best gate to 3 units full gate operation at Wuskwatim which would cause an outflow increase of 770 m^3/s and a tailwater level increase of 2.75 m. The use of the Wuskwatim plant under such emergency conditions is likely to be of short duration, i.e., 10 minutes to 1 hour. The short-term increase in tailwater water levels will be largely dampened out by Opegano Lake. If the Wuskwatim plant full gate operation was required for longer periods, the water levels at Birch Tree Lake could be affected. Hydro would take all practicable measures to keep within operating guideline for Birch Tree Lake.

4.5.1.2 Upstream Water Levels

Near the end of the Wuskwatim Generating Station construction period, upstream water levels will be raised to elevation 234 m. This will result in water levels rising about 7 m in the "immediate forebay" area between Wuskwatim Lake and Taskinigup Falls, which will result in the flooding of 37 ha of previously cleared land. With impoundment, Wuskwatim Falls will be flooded and the velocity through the falls will be reduced from a range of 4 to 10 m/s to a range of 0.5 to 0.7 m/s (Volume 4, Section 4.3.3).

On Wuskwatim Lake, water levels will be maintained at or near the 234 m elevation (i.e., the upper end of the existing regulated range as shown in Figure 5.3-3). It is not expected that water levels will exceed the elevation 234 m level as they have in the past due to the channel conveyance improvements at Wuskwatim Falls and the operation of the Project.

The daily operation of the Wuskwatim Generating Station will not result in an appreciable change in Wuskwatim Lake water levels, due to the relatively large surface area of the forebay (88 km^2) and the daily balancing of Wuskwatim Generating Station outflows to match daily inflows. The lake levels will normally stay within the top 25 cm of the specified operating range (97.5% of the time), with an average daily fluctuations of 0.06 m (and maximum daily changes of less than 0.13 m; Volume 3, Section 5.2.5.2).

Abnormal Mode of Operation

Up to one metre of storage within the forebay has been designated for utilization under abnormal conditions, i.e., when power requirements are high in either the Manitoba Hydro system (or that of its neighbours) and when inflows are very low. The storage can only practically be utilized under low flows, and increased draw down would be used under progressively lower flows, and more prolonged energy requirements to supplement existing inflows.

The project inflow record indicates that low flow periods have a tendency to "cluster" for example, a grouping of five or six consecutive low flow years followed by an extended period of more normal flows. Under low inflow scenarios (i.e., below 660 m^3/s which is a 7 percentile inflow condition) the plant will be cycling between 1 and 2 unit operation (Table 4.5-1). One unit operation accounts for 2.5% of the time, and 2 unit operation accounts for the remaining 4.5% (7 – 2.5%) of the time.

During a low flow period and one unit operation, and coincident high system power requirements there could be increased usage of the storage in Wuskwatim Lake to supplement inflows to allow extended 2 unit operation. During these situations Wuskwatim Lake could be drawn below 233.75 m to as low as 233.0 m. In Volume 3, Section 5.2.5.3 this range of storage has been divided into three zones: Zone 3 –ranges from 233.75 to 233.5 m; Zone 4 ranges from 233.50 to 233.25 m; and, Zone 5 from 233.25 to 233.0 m. It is anticipated that Wuskwatim Lake would be drawn into Zone 5 only under extreme low flows and unusual prolonged loading conditions and is expected to occur only about 1 in 20 years. If these conditions occurred the reservoir would likely be in Zone 5 for a period of four to seven weeks and likely take four to seven weeks to repond.

4.5.1.3 Downstream Water Levels

The largest fluctuations in downstream water levels will occur in the 9 km river reach from the tailrace to the set of rapids 4 km upstream of Opegano Lake (Figure 5.3-1). The daily operation of the plant will result in the largest water-level fluctuations at the tailwater, ranging from 0 m to 1.5 m, and will decrease further downstream (Table 4.5-1). Volume 4, Section 4.3.4 outlines the expected changes in water-level profile, wetted area, and velocities for the four outflow conditions (Section 4.5.1).

For Wuskwatim Lake inflows of less than 660 m^3/s (which have a frequency of occurrence of 7% of the time Table 4.5-1), the daily cycling from 2 units to 1 unit will result in a temporary low flow of 330 m^3/s and corresponding low water levels, for this section of the river, for part of the day. This is expected to occur about 3% of the time (Section 4.5.1.1).

In Opegano Lake**,** the daily water level fluctuations resulting from flow changes at the Wuskwatim Generating Station will be **dampened** by the available storage in Opegano Lake. Water level changes on Opegano Lake are a function of daily outflow change (i.e. ranging from 0 m^3/s to 330 m^3/s) and the number of hours per day of operation at each outflow setting. Figure 4.5-2 shows the maximum daily water level fluctuation of Opegano Lake for a variety of Wuskwatim Lake inflows. For inflows near 660 m^3/s and 990 m^3/s there would be minimal daily moderation of plant outflows and therefore no

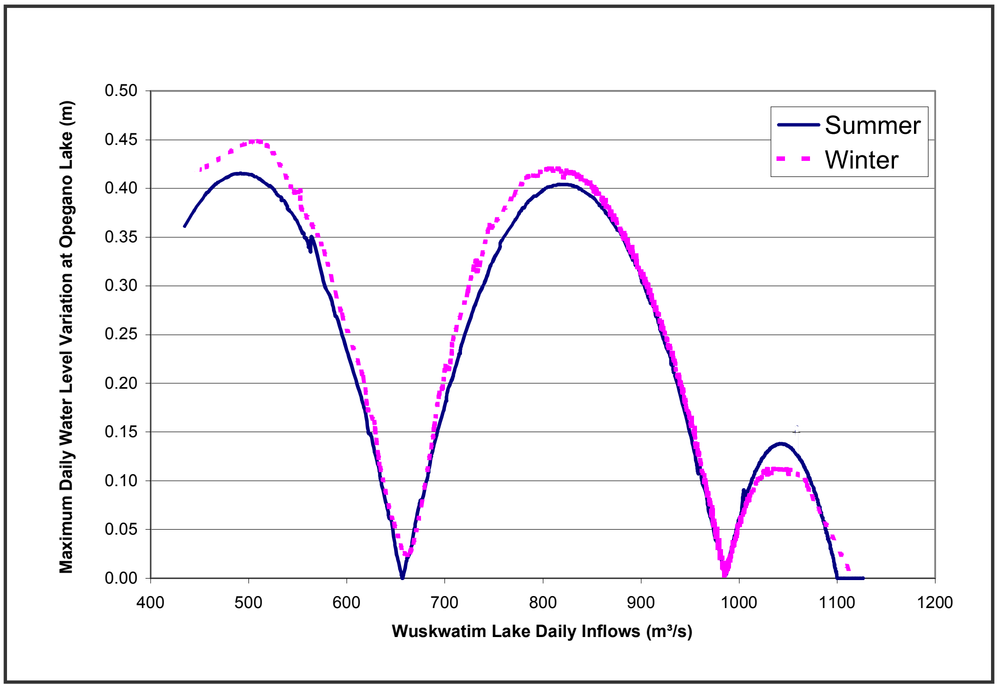


Figure 4.5-2. Maximum daily water level fluctuation at Opegano Lake from Wuskwatim GS operation.

daily water-level fluctuations would occur in Opegano Lake. For inflows greater than 1100 m^3/s, there will be no changes in plant outflows and therefore no water-level fluctuations. The largest daily water-level fluctuations would occur for inflows that are in the mid-range between these flows. For example, for an inflow condition of 825 m^3/s, as previously described in Section 4.5.1.1, the plant would operate for 12 hours above and then 12 hours below the inflow.

The decrease in water-level fluctuations due to attenuation of the Wuskwatim outflows by channel and lake storage is illustrated in Figure 4.5-3. This figure shows that the 50-

percentile water-level fluctuation is 0.1 m at Opegano Lake and not noticeable at Birch Tree Lake. The reason the 50-percentile fluctuation is small is that, for approximately 50% of the time, no units are cycled off (Table 4.5-1). Under a maximum water-level fluctuation scenario, as described above, the Birch Tree Lake water-level fluctuation would be about 0.10 m in open water conditions and 0.15 m in the winter.

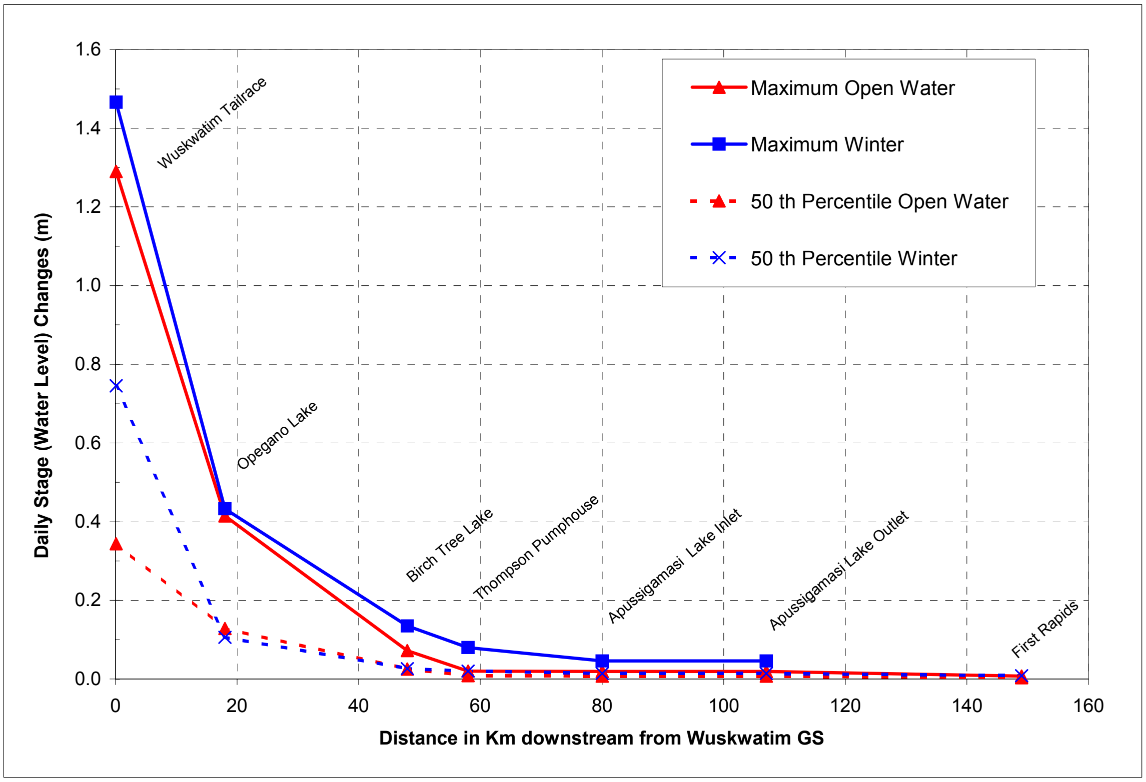


Figure 4.5-3. Median and maximum water-level fluctuations downstream of Wuskwatim GS.

4.5.2 Permanent Facility Operation

4.5.2.1 Operational Compliance

Manitoba Hydro will operate the station in accordance with the terms and conditions of the Provincial issued Water Power License and any other regulatory requirements and licenses.

Manitoba Hydro is committed to the practice of environmental stewardship and will ensure that employees operating the station will continue to integrate environmental practices and enhancement measures into the station's daily operation, in accordance with the Hydro's Environmental Management Systems (EMS). Manitoba Hydro's existing facilities have received ISO 14001 registration (environmental management systems) and it is expected that Wuskwatim will be included once it is commissioned.

Manitoba Hydro will incorporate existing documented procedures and codes of practices and will train its employees in its management systems so that the employees can perform the operation and maintenance tasks safely, efficiently and effectively.

4.5.2.2 Operational Workforce

The Wuskwatim Generating Station is being designed to operate remotely, i.e., unmanned, through the use of state-of-the-art electronic control systems linked to various telecommunication systems. The overall operation and administration of the proposed generating station will be the responsibility of the Generation North Division of Manitoba Hydro's Power Supply Business Unit located in Gillam. A workforce of 3 to 4 technicians and 2 utility workers will be required for routine operation and maintenance at the plant. Generally there will be two workers travelling to Wuskwatim everyday during the week.

Additional staff may be required from time to time, during inspection and maintenance programs, as described in Volume 3, Section 5.3.1. These additional staff will be supplied from other work sites and facilities (usually located throughout northern Manitoba) and accommodated for these short-term assignments in Thompson (commuting to Wuskwatim daily). Accommodations have been incorporated into the generating station for short-term stays when required by operation and maintenance staff.

4.5.3 Activities During Operations and Maintenance

To ensure the safe and efficient operation of the generating station, a variety of management and maintenance activities are proposed (Volume 3, Section 5.3.3) and are summarized in Table 4.5-2.

4.5.3.1 Access and Safety

Access to the generating station site and use of the access road will be restricted and controlled through the use of various measures, including, secure fencing, signage and monitoring systems. An Access Management Plan will be developed by the Limited Partnership in consultation with the Nelson House Resource Management Board (Section 4.3.3).

Potentially hazardous areas at the Project site (e.g. slopes leading to the spillway discharge and tailrace channels) will be fenced off as a safety precaution. Safety railings will be installed on the spillway deck, powerhouse forebay deck, the main dam and tailrace deck.

Signs will be posted on both sides of the shoreline on the upstream and downstream side of the generating station facilities warning of the potentially dangerous boating and swimming conditions. A siren system will be installed to provide advance warnings of the movement of the spillway gates.

A boat landing dock and launch area would be located approximately 1.8 km from the generating station facilities on Wuskwatim Lake. A similar landing area would be located on the first creek downstream of the generating station on the north side of the river.

4.5.3.2 Emergencies

An Emergency Preparedness Plan will be prepared for the Wuskwatim Generating Station to deal with potential major emergency scenarios, which may occur during the life of the plant. In addition, Manitoba Hydro has developed an Environmental Management Systems (EMS) to document operating procedures such as spill containment and response. Part of the EMS procedures is a training component in implementing these procedures.

4.5.3.3 Plant and Site Security.

The generating station and adjacent areas will be secured in accordance with Manitoba Hydro's standards and operating procedures (SOPs). For security reasons, this information will not be made available to the public.

Table 4.5-2 List of Typical Operations and Maintenance Activities

ACTIVITY	PURPOSE	LOCATION	ACTIVITY & METHODS DESCRIPTION
Water Management	To operate the generating station such that water is available to downstream users as well as for power generation, and such that extreme flow conditions (high or low) can be managed. Water level and flow data to verify reservoir management models	Wuskwatim Lake and Burntwood River upstream and downstream of the generating station	Continuous monitoring of water levels upstream and downstream of GS, and flow through the Generation Station (through on-site sensors)
Reporting of Emergencies, Accidents and Malfunctions	To ensure safe and environmentally responsible operation of the generating station	Generating station and associated facilites	In accordance with Manitoba Hydro's Environmental Management System, Manitoba Hydro will develop an Emergency Preparedness Plan and monitoring system for the generating station and will train staff accordingly
Environmental Monitoring	(a) to verify the scope of the impacts forecast by the impact study (b) to assess the effectiveness of remedial measures (c) to improve the techniques for forecasting impacts for future projects and (d) to ensure compliance with the terms and conditions of the licence	Generating station site and Project study area	As specified in the EIS and the environmental licence for the Project
Plant Equipment Maintenance	To ensure safe and efficient operation of generating station	Generating station and associated facilites	Equipment is monitored and maintained to operate in compliance with manufacturer and Corporate standards. Mechanical failures and reduced performance are recorded and remedial actions initiated as required
Spillway and Powerhouse Structures; Maintenance	To ensure safety and effective operation of plant facility	Generation station	Maintenance could include: piezometer replacements and grouting and exterior concrete repair work. Infrequent maintenance to be conducted as required and as stipulated by Corporate operating and maintenance protocol
Earth Dams Maintenance	To ensure safe and efficient operation of the generating station	Generation station site	Vegetation management and general repairs to earth dams. Maintenance to be conducted as required and as stipulated by Corporate operating and maintenance protocol
Distribution Lines; Maintenance	to ensure dependable power required for onsite buildings	Generation station site	Maintenance could include: change over of poles, insulators, pole-mounted transformers and/or other hardware. Maintenance to be conducted as required
Ice Management	To monitor ice formation and development, for public safety and to maintain efficient flows. Monitor ice effects on permanent structures	Wuskwatim Lake and Burntwood River, upstream and downstream of the generating station	Implement procedures to assist the formation of a stable ice cover on the forebay (e.g. stabilize forebay level during freeze-up, monitoring ice thickness, and air and water temperatures)
Access Road Maintenance	To ensure worker safety and efficient access	Access road from PTH 391 to the generating station and associated work areas	Road maintenance, erosion control, dust control, snow removal, and maintenance of ditches and culverts in accordance with plant operation and maintenance plan
Stream Crossings Maintenance	To assure proper water flow, fish passage, limited ponding of water, and to minimize the potential for erosion and sedimentation	Streams associated with the access road	Regular inspection and maintenance of the stream crossings along the access road in accordance with plant operation and maintenance plan
Stockpiling of Materials	To provide gravel, sand and rockfill stockpiles for maintenance of the dams and road repair	Designated areas at the generating station site	Stockpiling will comply with all regulatory requirements
Potable Water	To ensure worker health and safety, and environmentally responsible operation of the generating station	Will be drawn from the immediate forebay	Potable water will be treated to meet all provincial and federal guidelines
Waste Management	To ensure safe and environmentally responsible operation of the generating station	Generation station site	Reuse and recycling when possible. Where landfill disposal is used, disposal methods will comply with local and provincial regulatory requirements; may be transported to off-site designated sites
Sewage Treatment	To ensure safe and environmentally responsible operation of the generating station	Generating station sewage treatment facility	Sewage generated by staff at the generating station will be treated to meet all provincial and federal regulatory requirements
Hazardous Materials/Petroleum Handling and Storage	To ensure safe and environmentally responsible operation of the generating station	Generating station and associated facilities	Proper use, handling and storage as recommended by manufacturers and in compliance with Corporate Environmental Management System
Work Yard Maintanance	To ensure designated sites are used to marshal and store corporate and contractor construction equipment, machinery and parts, fuels, oils and other equipment required for major maintenance programs	Designated areas at the generating station site	Yards will be kept tidy and organized. A current inventory and materials management program will be kept on site. Comply with all regulatory requirements for storage and spill control for fuels and other hazardous materials
Vegetation Management / Landscaping	To ensure safe operation of the generating station and site aesthetics	Rights-of way, fire breaks, station yards and earth fill dams	Removal of new growth, cutting grass and spraying for disease and insect control Mechanical (preferred method) or chemicals (only used if mechanical methods unsuccessful and only when authorized by the appropriate authorities)

4.5.3.4 *Environmental Monitoring*

Once the construction of the Wuskwatim Generating Station has been completed and the units placed into commercial service, Manitoba Hydro will implement additional and/or carry on with existing monitoring programs for the purpose of:

- verifying the scope of the impacts forecast by the impact study (or addressing uncertainties);
- assessing the effectiveness of remedial measures;
- improving on techniques for assessing impacts for potential future projects; and
- if required, for compliance with terms and conditions of the license.

Proposed monitoring plans are outlined in Sections 5 to 10.

4.5.4 Decommissioning and Final Disposition

The Guidelines (Appendix 2, Section 5.3.3), call for a discussion as to whether there would be any progressive decommissioning of components of the generating station during the operation of the Project. Due to the nature of generating station construction and operation, it is not anticipated that progressive decommissioning would occur.

The plant has been designed for a 100-year life. However, if at any time in the future Manitoba Hydro or the Wuskwatim Power Partnership conclude that the Wuskwatim Generating Station is no longer required for the production of hydroelectric power, then Manitoba Hydro is legally obligated under the 1996 Nelson House NFA Implementation Agreement (Section 2.9.1 – Maintenance of the **Water Regime**) requires the overall water regime range established as a result of the Wuskwatim Generating Station be maintained. The plan for the eventual disposition of the facilities and its execution could only be made by the signatories of the 1996 Nelson House Agreement and jointly submitted for regulatory review and approval prior to its implementation.

5.0 PHYSICAL ENVIRONMENT

The physical environment includes the **surficial geology** of the land (soils, overburden, rock outcrops etc.), waterbodies (lakes, rivers, streams, creeks etc.) and air (air quality and climate). The following subsections describe the physical environment of the proposed Wuskwatim Generation Project ("the Project") study area as it presently exists, the anticipated effects as a result of the Project, and proposed mitigation measures as required by the "Guidelines" (Section 6.1) for the preparation of this EIS (Appendix 2).

Anticipated effects of the Project on the physical environment, are described in terms of their:

- *magnitude* – meaning the size of the effect relative to the parameter being measured in the physical environment; could be a small, moderate, or large effect
- *duration* – meaning how long the effect is expected to last, with:
  - "short-term" defined as lasting no more than five years;
  - "moderate-term" defined as lasting more than 5 years but less than 25 years; and
  - "long-term" defined as lasting more than 25 years.
- *geographical extent* – meaning the spatial extent of the effect, with:
  - "site" meaning that the effect is confined to a small area and is not transportable to other areas;
  - "local" (or "localized") meaning the effect extends slightly to moderately beyond the Project site; and
  - "regional" meaning the effect extends to an area well beyond the Project site.

The implications of the described physical effects to other environments (e.g., aquatic, terrestrial, socioeconomic, etc.) are discussed in those respective sections.

5.1 CLIMATE

5.1.1 Existing Environment

The Wuskwatim site is located in a subdivision of the **High Boreal Eco-Climatic Region** in Manitoba. While this subdivision is warmer and more humid that the Region as a whole, it is generally characterized by short cool summers and cold long winters, as described in detail in Volume 4, Section 2 and summarized below.

5.1.1.1 Temperature

The nearest climate station that maintains a comprehensive long-term record is located at the Thompson Airport, approximately 50 km NE of Wuskwatim Lake. A review of the climate data from this station for the period of 1971-2000 (inclusive) indicates that the Thompson area exhibits the broad annual temperature range characteristic of a northern temperate, mid-continental climate. The annual mean temperature during the period of record was –3.2°**C**. Daily mean temperatures range from an average high of 15.8°C in the month of July to an average low of –24.9°C in January (an annual range of 40.7°C). Winter conditions are considered to exist during the five-month period of November through March when the mean daily maximum temperatures stay below 0^0C. Summer conditions can correspondingly be ascribed to the four-month period of June through September when the mean daily minimum temperatures exceed 0°C. April, May and October comprise short intermediary periods between the dominant seasonal conditions of winter and summer and are characterized by mean daily maximum temperatures above 0°C and mean daily minimum temperatures below 0°C (Volume 4, Section 2.3.2.1).

5.1.1.2 Precipitation

Rainfall accounts for about 67% of the total annual precipitation in the Thompson area, with the majority occurring between June and September (approximately 86% of the annual rainfall total; dataset 1971-2000 inclusive). Snowfall has been recorded in measurable amounts throughout nearly the entire year, with the only exception being the month of July. The five-month winter period (November through March) accounts for about 68% of the total average yearly snowfall (Volume 4, Section 2.3.2.2).

5.1.1.3 Wind

An analysis of **wind-rose** data and climate-norm data indicate that prevailing winds are:

- westerly (W) for the 9 months from July through to March;
- shifting to north-easterly (NE) for 2 months from April through to May; and
- then shifting to easterly (E) for during June.

While the prevailing wind conditions are as described above, winds originating from all other directions were observed during the monthly periods of record (1971-2000 inclusive). Wind speed is quite consistent throughout the year, fluctuating from an average high of 14 km/hr during April and May to an average low of 10 km/hr in December. Average monthly windrose patterns observed at the Thompson Airport weather station during the 30-year period of record between 1971 and 2000 are provided in Volume 4, Section 2.3.2.3, Figure 2-6.

5.1.1.4 Air Quality

Air-quality **monitoring** is primarily associated with large urban centers and industrial point sources where pollution concerns become an issue of public safety. Industrial emission monitoring (primarily sulphur dioxide emissions) of smelting operations in Thompson (the nearest industrial center) has been conducted during the past decade (Volume 4, Section 2.3.2.5). The BOREAS (BOReal Ecosystem–Atmosphere Study) project's Northern Study Area, which was located to the northeast of the community of Nelson House, included studies of general atmospheric conditions and other **parameters** like ambient levels of certain greenhouse gases (principally carbon dioxide and methane; Volume 4, Section 2.3.2.5).

Based on the prevailing wind data recorded at the Thompson climate station (Section 5.1.1.3), it is not expected that the study area would be subject to deposition from industrial facilities operating in Thompson. It is noted, however, that Opegano Lake is considered to be within the secondary deposition zone of emissions from INCO smelter. Existing air quality at the Project site is considered to be good to excellent.

5.1.1.5 Ice Fog

The **turbulence** created by water flowing over Taskinigup and Wuskwatim Falls creates a mist at these sites that turns into an ice fog, which is clearly visible from the air 20 km away from the site during the winter (Volume 4, Section 2.3.2.6). When the fog comes in contact with the cooler surrounding land and vegetation, the surfaces become coated with layers of ice that gradually build up over the winter.

5.1.1.6 Global Climate Change

Climate change is defined as a long-term shift or alteration in the climate of a specific region and is manifested as changes in temperature, precipitation, atmospheric processes and overall variability in weather patterns and extremes. It is recognized that climate change is driven by natural processes such as solar activity, alterations in the earth's orbit and volcanic activity. In addition, there is consensus among scientists that anthropogenic (man-made) activities are having a discernible impact on the global climate.

However, there is uncertainty regarding the degree to which specific causal mechanisms drive climate change. Anthropogenic activities such as burning of fossil fuels producing **Greenhouse Gas (GHG)** emissions, deforestation and other land-management practices are believed to contribute to global climate change.

Climate change, whether natural or anthropogenic, will result in changes to temperature, precipitation, wind and other weather related phenomenon. There is uncertainty as to the timing and degree of such change. **Due to the level of uncertainty relating to the potential effects of climate change, Manitoba Hydro cannot project a specific climate scenario for the Wuskwatim Generation Project Area.** Information on the potential impacts of various scenarios of climate change on the physical environment in the Wuskwatim region is provided in Volume 4 (Section 2.3.3).

5.1.2 Effects and Mitigation

5.1.2.1 Construction

Construction activities may result in temporary localized changes to air quality, particularly dust impacts relating to road traffic and blasting and crushing operations (Volumes 3 and 4). The factors influencing dust creation from each of these activities are discussed in Volume 4, Section 2.4.1.

To minimize dust emissions from road traffic, the Contractor will be required to keep roads well maintained to facilitate efficient traffic flow, using such measures as surface improvement (e.g., grading) and/or surface treatment (e.g., watering, chemical-dust suppressants). **Dust effects from vehicular road traffic are therefore considered to be localized, short-term, and mitigable with respect to air quality.**

Dust emissions from rock-crushing and blasting operations are largely unavoidable, but are expected to be localized and brief with respect to air quality.

5.1.2.2 Operation

Ice Fog

The only foreseeable climatic effect from Project operations relates to ice fog. Once Wuskwatim and Taskinigup Falls are flooded by the impoundment of Wuskwatim Generating Station, the formation of ice fog at the site will be greatly diminished (Volume 4, Section 2.4.2). **This decrease in ice fog will be a site-specific, long-term unavoidable effect of Project operations.**

Greenhouse Gas Effects

The greenhouse gas implications of the Project are very small. Compared with most Canadian or international hydro projects the amount of flooding and potential for increased greenhouse gas emissions is extremely low. In fact the Project was redesigned to reduce flooding to less than 0.5 km^2 to minimize environmental impacts including the potential for greenhouse gas emissions.

The Pembina Institute for Appropriate Development recently completed a comparison of lifecycle greenhouse gas emissions (GHG) for seven prominent electricity supply options for the Province of Manitoba, including the proposed Wuskwatim Generating Station (2003; Volume 4, Section 2.3.4). This study found that even if it is assumed that a very large portion of flooded biomass does decompose, the reservoir GHG emissions would account for about 5% of the Project's total lifecycle GHG emissions. The other 95% of the GHG emissions from the Project would be generated as a result of the manufacturing of the generating station components, the transportation of materials to the site, site clearing, on-site construction activities and any equipment replacement or maintenance. Furthermore, the total lifecycle emissions from the Project would be lower than all of the other electricity supply generation options studied (Volume 4, Section 2.3.4).

Determining the net impact of reservoirs on the carbon cycle is a complex proposition. Manitoba Hydro is working with others including Environment Canada, Federal Department of Fisheries and Oceans, and Hydro Quebec and researchers to better understand the complete greenhouse gas implications of reservoirs and, if appropriate to develop national and international rules to account for these implications.

While the construction and operation of the Project will not result in significant emissions relative to other forms of electricity production, it will have a significant net impact of reducing global GHG emissions. The electricity produced by Wuskwatim generating station will displace GHG intensive natural gas and coal fired resources, predominantly outside of Manitoba. Assuming the Project displaces only the most efficient combined cycle natural gas generation, then the average GHG emission reduction is expected to be greater than 750,000 tonnes of CO_2 emissions per year.

In addition to GHG emission reductions there would also be global emission reductions in nitrogen oxides, sulfur oxides, mercury and particulates. A detailed description about the uncertainty around reservoir emissions is provided in Volume 4, Section 2.3.4.

5.2 PHYSIOGRAPHY, GEOLOGY AND SOILS

5.2.1 Existing Environment

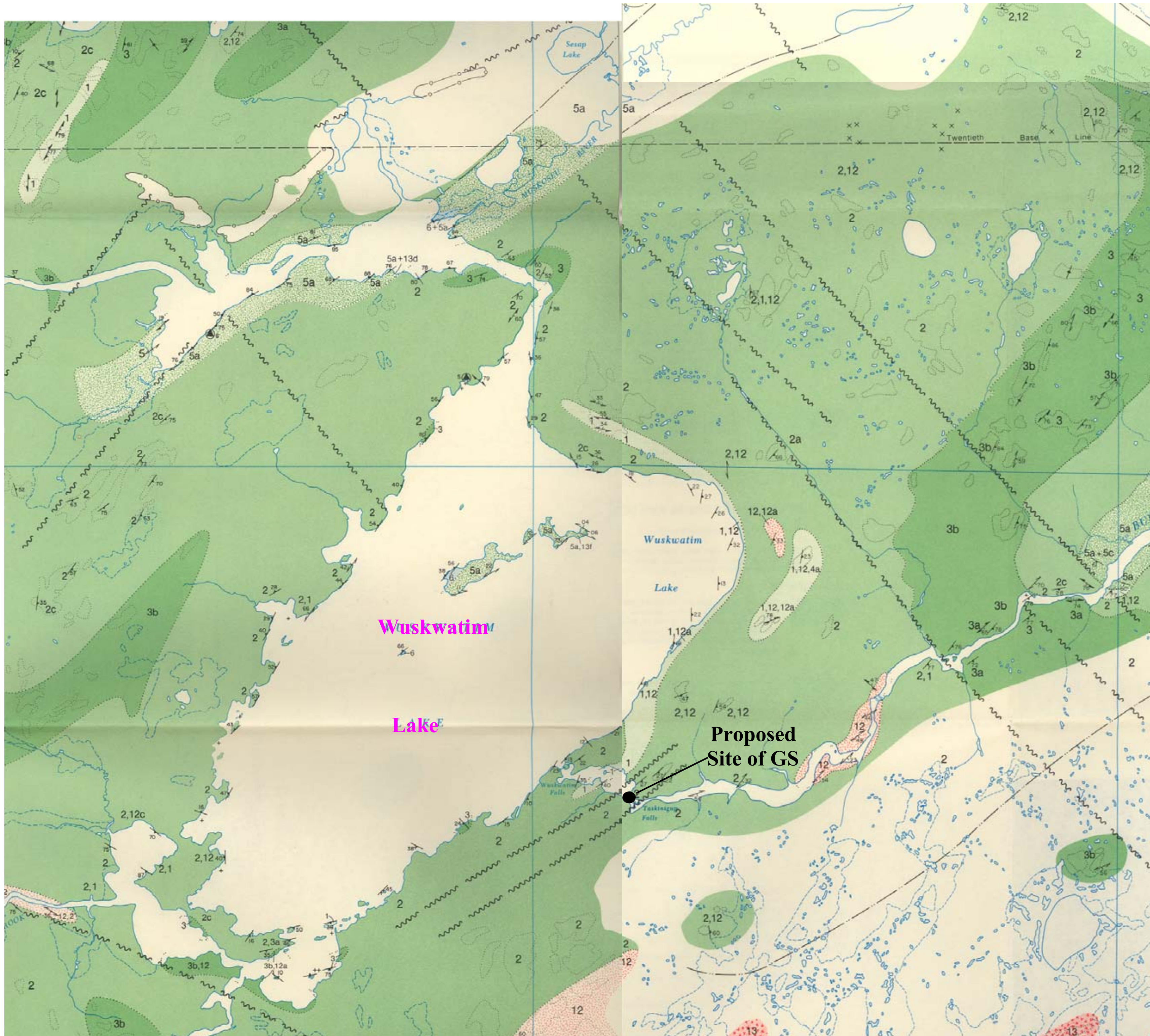
The Wuskwatim Lake area is part of the **Threepoint Lake Ecodistrict** (Volume 4, Section 3.3.3). The area is underlain by **Precambrian bedrock** (complex of **gneisses** and younger **intrusive** material), which controls the physiography. The bedrock has good interlocking **crystalline texture**, resulting in excellent rock-strength characteristics, and is generally considered to be competent throughout the area. A detailed overview of the regional geology is provided in Volume 4, Section 3.3.2.1. An overview of the geology of the Wuskwatim Lake area is shown in Figure 5.2-1.

Figure 5.2-2 shows the distribution of primary and secondary surface materials in the Sub-Region. The bedrock is generally masked by fine textured **glaciolacustrine sediments**, and consequently extensive bedrock outcrops are uncommon. Clayey and fine silty, varved, **calcareous** glaciolacustrine sediments ("impervious materials"; Volume 3, Section 3.7) in the form of deep blankets and shallow veneers characterize the uplands. Course textured non-calcareous to weakly calcareous surficial materials are limited. The district contains some sandy and gravelly glaciofluvial deposits and associated sandy glaciolacustrine sediments ("granular materials"; Volume 3, Section 3.7), and very limited areas of non-calcareous, sandy and cobbly till in the form of **veneers** and **pockets**. The access road to the Project site is located on the eastern side of the southern end of a long, roughly north-south to north-northeast trending **interlobate ridge** (glacial feature). A more detailed description of the **shore**lines around Wuskwatim Lake is discussed in Section 5.5.1.

The general land cover in the Wuskwatim Study Area consists predominantly of closed forest with open treed areas, beaver flood and treeless wetlands and water (Volume 4, Section 3.3.3). Shallow and deep **peatlands** are found in large and small basins and depressions and on lower slopes of uplands. These peatlands invariably overlie clayey, glaciolacustrine sediments and are derived from sedges and brown mosses as well as from Sphagnum and feather mosses and forest debris.

High ice-content **permafrost** is associated with the moderately-deep and deep **bogs** (**peat-plateau** and **palsa bogs**), with the lower slopes of shallow bogs, and in shallow depressions (veneer bogs). Discontinuous permafrost may also occur under mature, closed forest cover, but ice content is generally low (Volume 4, Section 3.3.3).

The organic soils are predominantly complexes of very poorly drained deep and shallow **Mesisols** and **Fibrisols** in **fens** and Fibrisols and **Organic Cryosols** in bogs. Shallow peatlands on lower slopes usually are a complex of **Terric** Mesisols and Fibrisols, Terric Organic Cryosols, and peaty **Gleysols** (Volume 4, Section 3.3.3). Common soils encountered on the glaciolacustrine areas are **Gray Luvisols** and **Humic Gleysols**, the latter generally occur in the transition zone between peatlands and uplands, or in complexes with shallow organic soils. Well to excessively drained **Dystric Brunisols** are associated with the sandy, glaciofluvial and glaciolacustrine materials, and with shallow to deep, sandy textured, stony veneers of water-worked glacial till.



LEGEND

5 Amphibolitic gneiss; dark grey and black, fine to coarse-grained gneiss; occurs as discontinuous layers, lenses and/or boudins; **5a** layered hornblende-diopside gneiss ± hypersthene; **5b** hornblende, plagioclase gneiss ± garnet, hypersthene; **5c** garnet amphibolite -meta-iron formation; coarse grained, thinly layered garnet-horn-blende-hypersthene-diopside-quartz-plagioclase gneiss, local skarn; **5d**, 5c without garnet; **5e**, 5a + quartzite

4 Basic gneiss; dark grey. brown and green to black, fine- to medium-grained gneiss. Occurs as thin discontinuous layers and boudins within units 1-3 and 12; **4a** pyroxene amphibolite; **4b** pyroxene gneiss; **4c** hornblende-plagioclase gneiss

3 Diatectic greywacke gneiss (Diatexite); granitic to tonalitic gneisses with less than 25% rafts or schlieren of paragneiss (units 1 and 2). Granitoid fraction ranges from white pegmatite and/or aplite to grey coarsely granular segregations containing feldspar, biotite, garnet and cordierite; **3a** agmatite complex; mesocratic mobilizate; **3b** agmatite complex, leucocratic mobilizate; **3c** schlieren complex; **3d** nebulitic complex

2 Metatectic greywacke; interlayered sequence of paragneiss restite (unit 1) with 25-750;0 aplitic to pegmatitic segregations of garnetiferous tonalite to granite; **2a** psammite, semipelite and pelite restite; **2b** mainly semipelite restite; **2c** sheet complex with local dominant 'granitic' component; **2d** agmatite complex

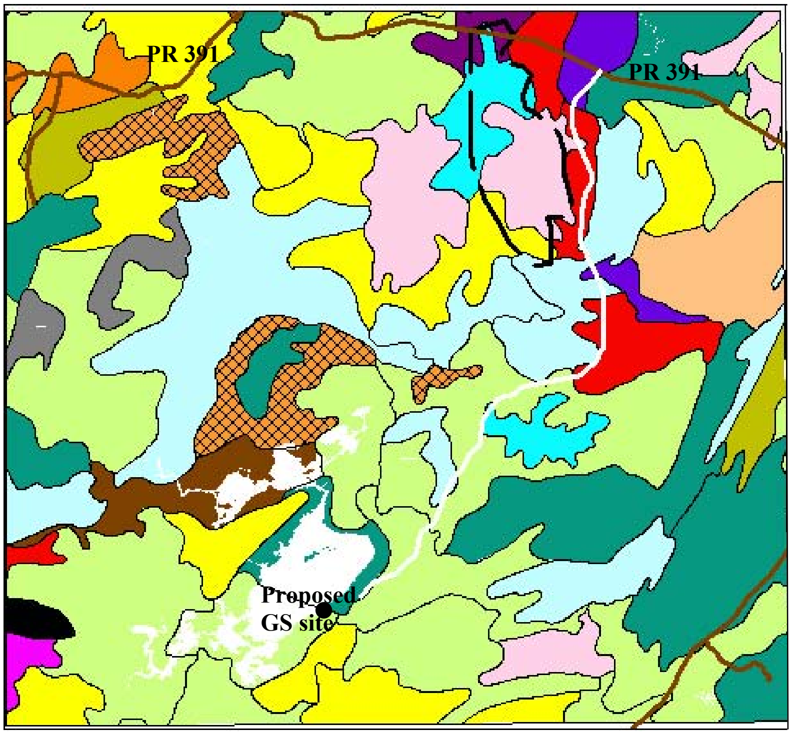
1 Meta-greywacke gneiss; interlayered grey psammitic and semi-pelitic gneiss and pelitic schist with minor calc-silicate layers and boudins. Up to 250;0 vein lets, sills and dykes of granitic segregations; **1a** psammitic gneiss dominant; **1b** pelitic and/or semipelitic schist and gneiss dominant; **1c** weakly layered biotite gneiss ± garnet; **1d** quartz.plagioclase.hypersthene-biotite gneiss

13 Porphyritic pink quartz monzonite to monzonite; **13a** porphyroblastic quartz mon-zonite with magnetite and hornblende; **13b** porphyroclastic 13a with sillimanite and hematite; **13c** foliated quartz monzonite with magnetite, hornblende ± diopside ± hypersthene; **13d** pegmatitic complex with magnetite and hornblende; **13e** mon-zonite; **13f** pink equigranular gneissic quartz-rich quartz monzonite with pegmatitic and nebulitic patches

12 Granite to quartz diorite; white or pink foliated stocks, sills, dykes and veins oc-curring as mobilizate in migmatite (units 1,2 and 3), and larger independent bodies; **12a** white alaskite leucotonalite/leucogranite characterized by isolated garnet clots and bimodal pegmatite/granite fractions; **12b** grey, medium grained equigranular homogeneous biotite-rich granodiorite; **12c** pink sporadically porphyritic quartz monzonite; **12d** white, coarse grained leucotonalite/leucogranodiorite containing large isolated garnet clots surrounded by leucocratic haloes; **12e** light grey 'speckled' granodiorite; **12f** sillimanite-hematite bearing cataclastic derivative; **12g** augen gneiss

fault (defined - unbroken line or approximate - broken line)

Figure 5.2-1: Geology of the Wuskwatim Area



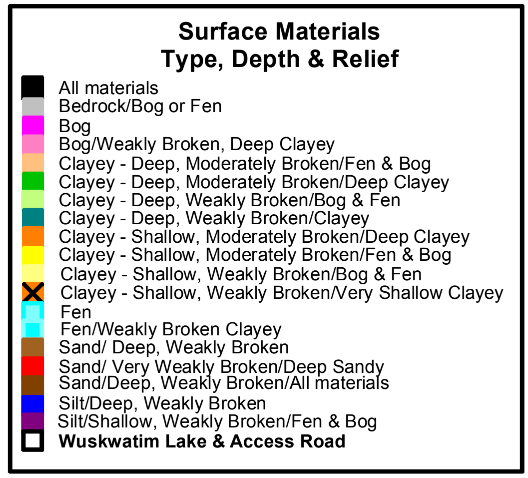


Figure 5.2-2: Distribution of primary and secondary surface materials in the Sub-Region

5.2.2 Effects and Mitigation

5.2.2.1 Construction

The Generating Station's structures (i.e., spillway, powerhouse, main dam, etc.) will have a final footprint of approximately 18 ha and the area within which excavated materials will be placed will occupy an estimated additional 43 ha (Volume 4, Section 3.4.1). The gravel surfaced, all-weather access road, leading from Provincial Road 391 to the site, will be approximately 48 km in length (Volume 3, Section 4.6.3).

The following components from the construction of the Wuskwatim Generating Station will create changes to the physical environment:

- access road(s);
- site clearing for Project infrastructure (including construction camp and contractor work site), immediate forebay and generating station;
- off-site construction-material extractions (e.g., granular materials);
- generating-station construction (excavation, powerhouse and spillway structures, dyke, main dam);
- excavated material placement area (i.e., excess rock and overburden); and,
- channel excavations at Wuskwatim Falls to improve flow conveyance.

These are discussed in detail in Volume 4, Section 3.4.1.

The estimated quantity of the granular materials to be used in construction is 5.6% of local available granular materials (Volume 3, Table 4.4-1). **This effect is considered to be long-term, localized and small with respect to granular resources in the area.**

Following Project construction, much of the supporting infrastructure used to build the Generating Station will be removed and the areas impacted by this infrastructure will by **rehabilitated** as defined in the EnvPP. Borrow areas (i.e., areas where granular and impervious materials have been removed for construction purposes) will also be rehabilitated as defined in the EnvPP and the Manitoba *Mines & Minerals Act* (C.C.S.M. c.M162; 1991). **The effects of the Project infrastructure on the physical environment are therefore considered to be localized and short-term.**

5.2.2.2 Operation

The resulting final footprint of the Wuskwatim Generating Station on the physical landscape (both land and river bottom) will create an unavoidable, long-term, localized effect on the physical environment. The significance of this effect to the aquatic, **terrestrial**, and socioeconomic environments and resource use is discussed in Sections 6 through 9.

Additionally, the completion of the Project will result in water levels rising 7 m the in the immediate forebay of the Generating Station and the flooding of 37 ha of previously cleared land between Wuskwatim Falls and Taskinigup Falls (Volume 3, Table 4.4-1 and Figure 4.2-8b). **As a result of the Project, Wuskwatim Falls and Taskinigup Falls will no longer exist. This is an unavoidable effect of the Project.** The significance of this effect to the aquatic, terrestrial, and socioeconomic environments and resource use is discussed in Sections 6 through 9.

5.3 WATER REGIME

5.3.1 Existing Environment

The Rat and Burntwood Rivers drop approximately 90 m along the course between the Notigi Control Structure and the downstream confluence with the Nelson River at Split Lake (Figure 4.1-1). The river system is characterized by a series of lakes, separated by river **reach**es that are hydraulically controlled by narrow constrictions and rapids (Figure 5.3-1). The water-level profile for the Burntwood River (i.e., extending from the base of

Notigi Control Structure [about 90 km upstream of the proposed Project] to Thompson [about 65 km downstream of the proposed Project]) is shown in Figure 5.3-2.

The Wuskwatim Generation Project would be located at Taskinigup Falls, which is 1.5 km downstream of Wuskwatim Falls at the outlet of Wuskwatim Lake (Figure 5.3-1). The drop at Wuskwatim Falls is approximately 7 m and the drop at Taskinigup is approximately 15 m, for a combined drop of about 22 m. Downstream of Taskinigup Falls to Opegano Lake, the 13-km stretch of river is characterized by a series of relatively flat river reaches and three sets of small rapids. Water levels in the last 4 km of this river channel are controlled by Opegano Lake. The 22-km reach further downstream between Opegano and Birch Tree Lakes is similar to the preceding 14-km stretch, consisting of a series of relatively flat river reaches and two sets of falls (drop of about 7.5 m at Jackpine Falls and a small, approximately 3 m drop at Kepuche Falls; Figure 5.3-2).

As discussed in Section 4.1, the Burntwood River is part of the Churchill River Diversion (CRD), a regulated waterway since 1977. The primary purpose of the CRD is to enhance power production on the lower Nelson River by diverting a large portion of the flow from the Churchill River into the Nelson River via the Rat/Burntwood River system (Volume 3, Section 1.5). Releases into the Rat/Burntwood system are controlled by the Notigi Control Structure (Figure 4.1-1). Implementation of the CRD resulted in the rise of Wuskwatim Lake water levels by approximately 3 m. Figure 5.3-3 shows that the post-CRD elevation of Wuskwatim Lake has varied between 232.7 m ASL and 234.3 m ASL.

5.3.2 Effects and Mitigation

5.3.2.1 Construction

A portion of the river will be isolated and dewatered through the construction of the upstream and downstream cofferdams and through the diversion of the flow around Taskinigup Falls and through the spillway during the construction of the main dam (Section 4.4.1). During Stage I and II Diversion, water levels between Wuskwatim Falls and Taskinigup Falls are expected to rise approximately 0.2 to 0.7 m and approximately 0.5 to 1.0 m, respectively, depending on the flow during the open-water season. The water levels will be about 0.1 m higher in the winter (Volume 4, Section 4.3.2). There will be no **ponding** on Wuskwatim Lake and no downstream flow changes (therefore no water-level changes). **The water-level effects due to cofferdam construction are considered to be short-term and localized with respect to the physical environment.** The significance of these effects with respect to the aquatic and terrestrial environments is discussed in Sections 6 and 7.

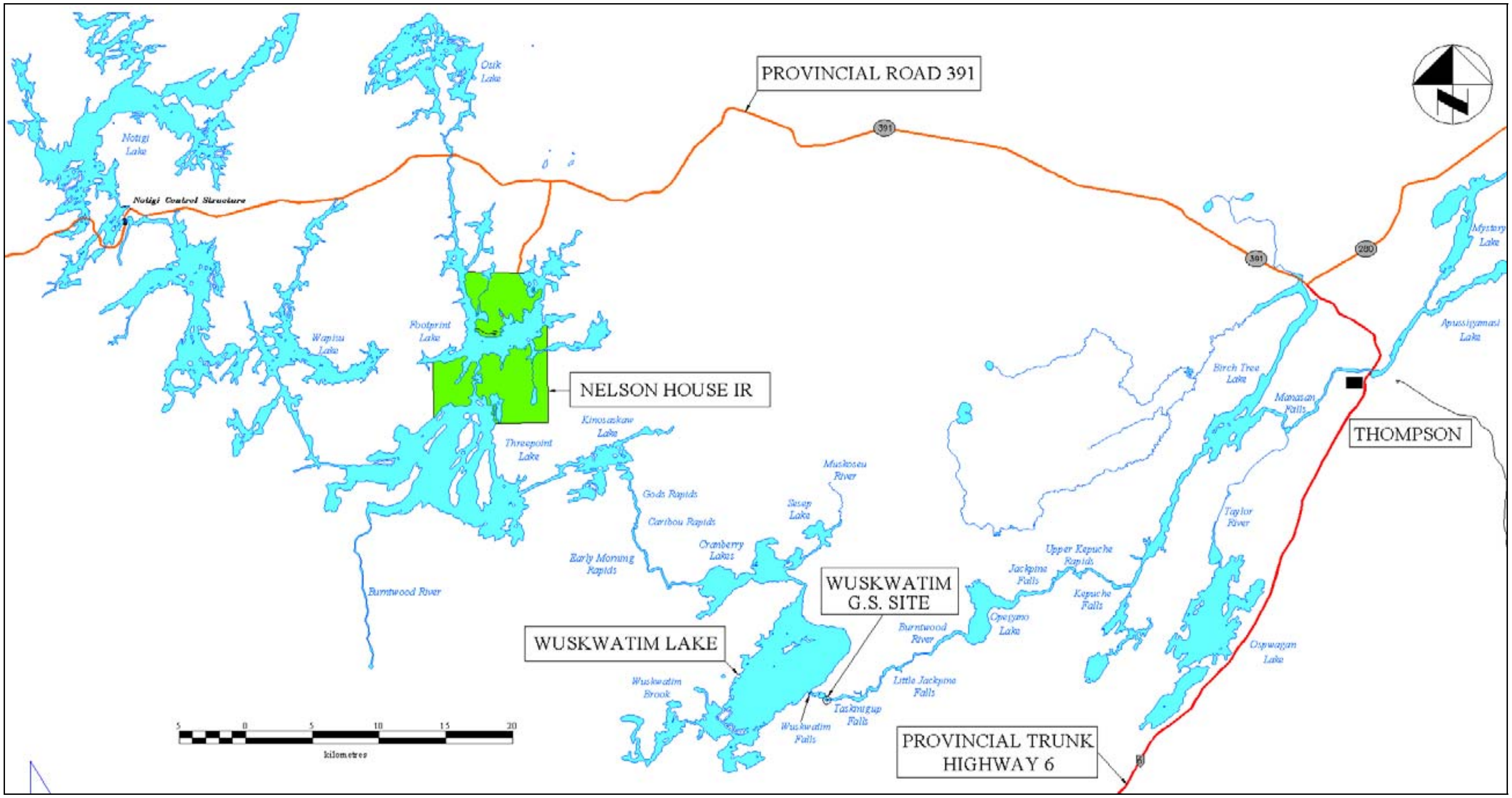


Figure 5.3-1: Important Waterbodies, Rapids and Falls in the Study Area

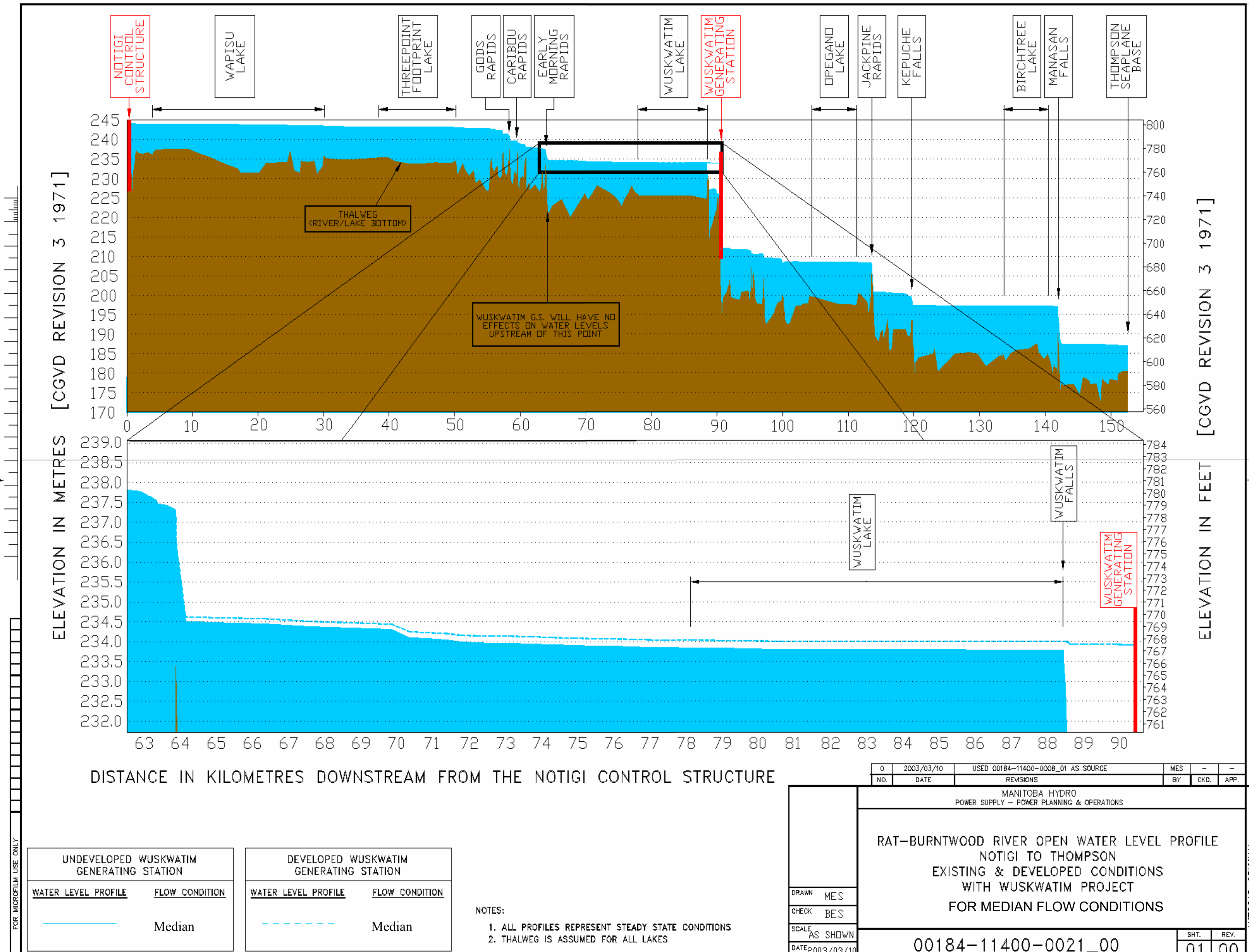
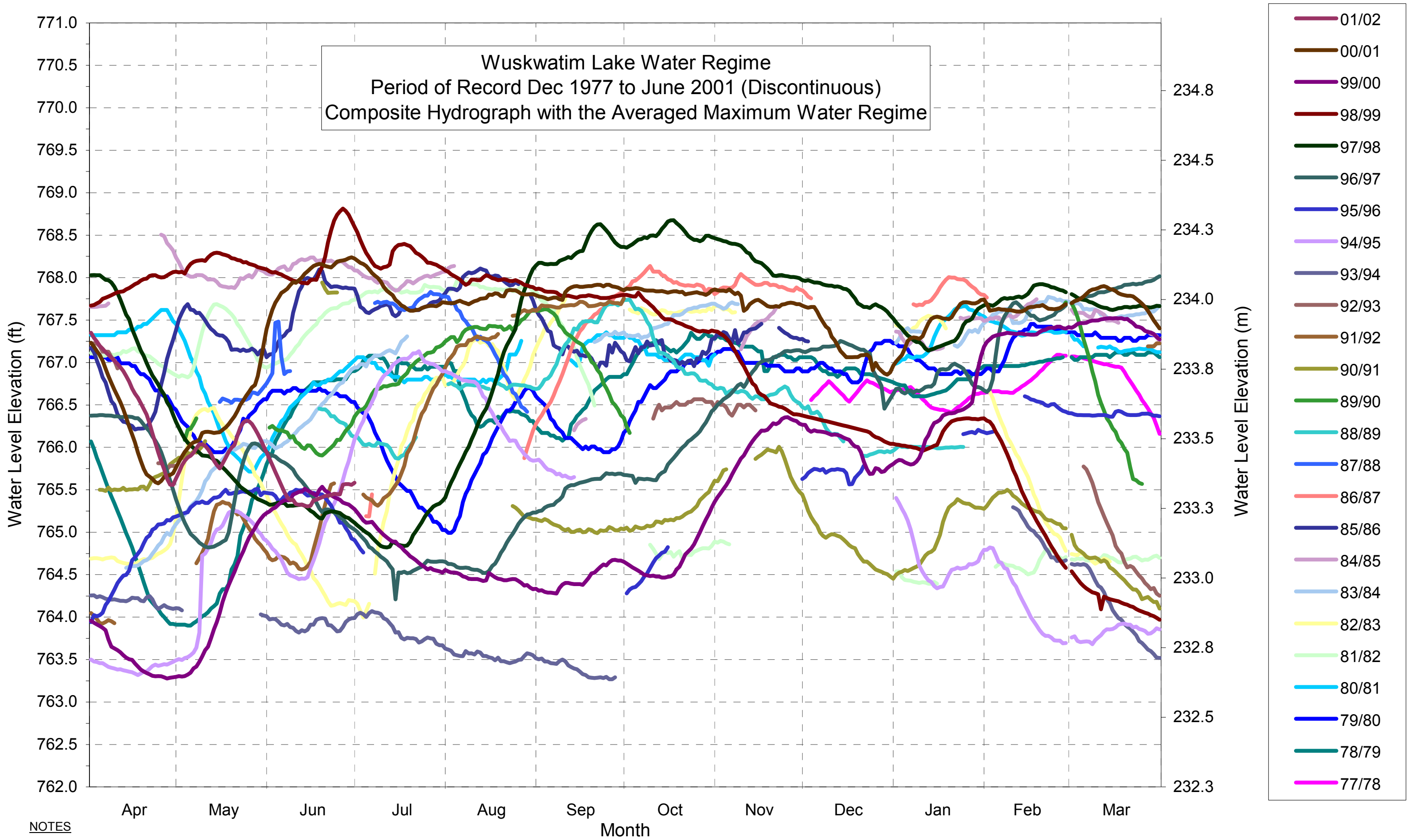


Figure 5.3-2: Rat-Burntwood River Open Water Level Profile



NOTES

- Source: Manitoba Hydro (Raw Data)
- Conversion : 1 foot = 0.3048 metres
- Period of Record: Dec 1977 to June 2001
- Water levels are referred to as Canadian Geodetic Vertical Datum (CGVD) (1971 Rev. 3) above sea level. (Also referred to as the 1969 local adjustment)
- The historical water level elevation data is discontinuous for most years from 1977-1996. In some cases there are fewer than 20 data points for an entire year.
- Data is presented in terms of a 'water year' (Apr 1 to Mar 31) as opposed to a 'calendar year' (Jan 1 to Dec 31)

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Memorandum W-7.2.2 Rev. A

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Figure 5.3-3: Wuskwatim Water Levels (September 1977 to June 2001)

5.3.2.2 Operation

Operation of the Wuskwatim Generating Station will not cause changes in the operation of the CRD. Water levels and flows along the Rat and Burntwood River systems will continue to vary from year-to-year and month-to-month as they do now, except in the area between Early Morning Rapids and Opegano Lake (those areas noticeably affected by the Project), as described in the subsections below.

Flow Regime

The Wuskwatim Generating Station will normally operate in a modified run-of-river mode, where the generating station will produce more power during the day and less during the night (accomplished by varying the **flow** through the generating station; Section 4.5.1.1). Over a 24-hour (daily) period, the amount of water entering Wuskwatim Lake will typically equal the amount leaving.

For planning purposes, Manitoba Hydro has developed a long-term (86 year) **simulated flow** record of inflows to Wuskwatim Lake, to assess the performance of the Wuskwatim generating station under a much wider range of flow conditions than is available using the 25-year post-CRD (existing) record. The simulated flow record (referred to as the project inflow) was developed to be representative of today's operating constraints on the CRD. A comparison of the project inflow (1912-1997) and the existing (post CRD) inflow period (1977-2001) is shown in Figure 5.3-4 (Volume 4, Section 4.3). This figure indicates that the minimum and maximum flows are approximately the same. The average annual flow for the longer simulated period is, however, approximately 100 m^3/s higher than the average post-CRD flow. It was judged that the project inflow record is the best representation of future inflows in assessing the impact of the project on the environment.

For the purpose of the assessment, hydraulic models were developed to simulate the water levels and flows (water regime) along the Burntwood River waterway with and without the Project.

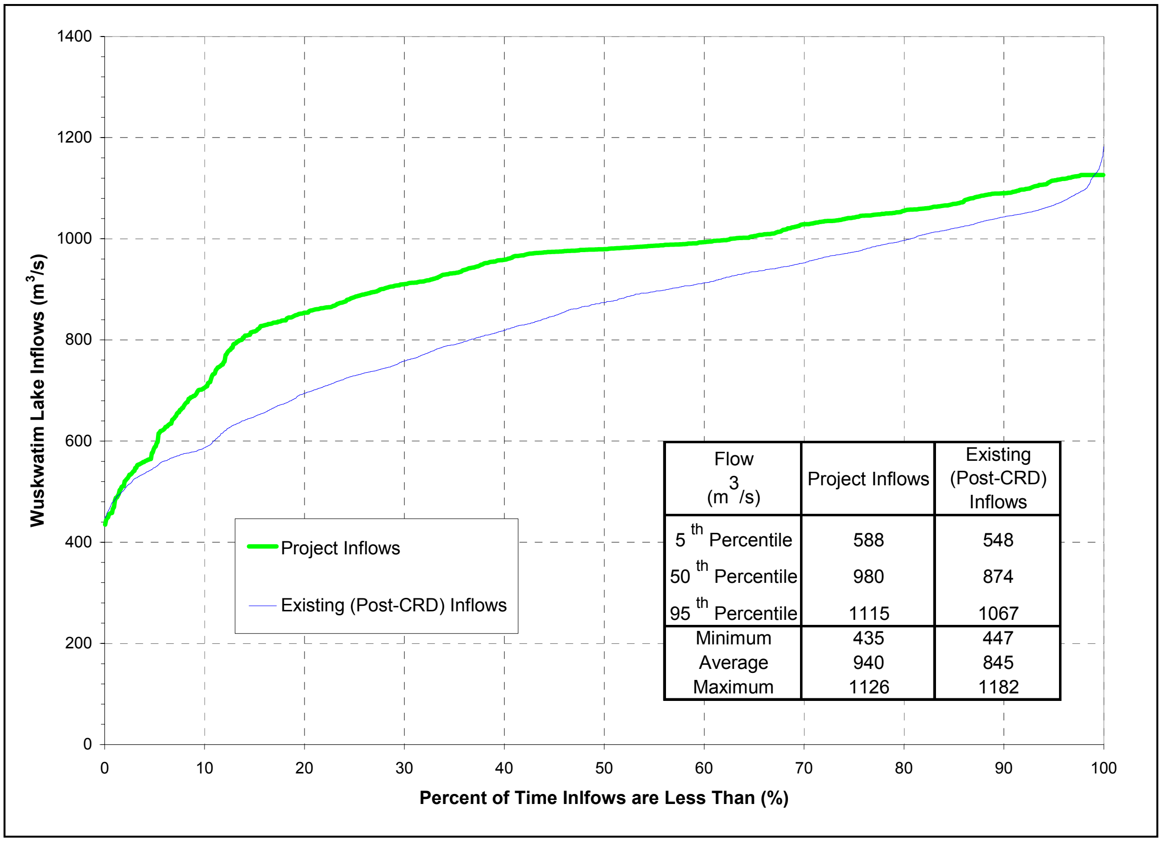


Figure 5.3-4: Flow Distribution at Wuskwatim Lake

Upstream Water Levels

As indicated in Section 4.5.1.2:

- water levels in the immediate forebay area will be raised 7 m between Wuskwatim Falls and Taskinigup Falls;
  - velocities through Wuskwatim Falls will be reduced from 4 to 10 m/s to between 0.5 to 0.7 m/s with impoundment;
  - the water-level rise will result in the permanent flooding in the immediate forebay area of less than ½ km^2 of previously cleared land
  - flooding in this area has been minimized by locating the excavated material placement area with the associated berms closer to the shoreline to contain flooding (Section 4.4.1);
- water levels on Wuskwatim Lake will be stabilized within the existing water regime at or near 234 m ASL by the construction of the channel-excavation area at

Wuskwatim Falls (which improves outflow capability from Wuskwatim Lake) and the operation of the Project;

  - the selection of a forebay level that is within the existing water regime (at or near 234 m ASL; Section 4.3.1) results in no flooding effects in this area;
  - the selection of a forebay level that is within the existing water regime also results in no backwater effects upstream of Early Morning Rapids;
- daily water-level fluctuations on Wuskwatim Lake will occur and be relatively small (i.e., typically less than 0.06 m – wind and wave effects eliminated) because of the modified run-of-river mode of operation and the relatively large surface area of this reservoir (88 km^2);
  - monthly and seasonal water-level changes on Wuskwatim Lake due to CRD operation will no longer occur; and
  - very small water-level fluctuations will occur on Wuskwatim Lake and upstream to Early Morning Rapids but will not propagate further upstream.

The water-level increases (and associated flooding and loss of land area) and daily water-level fluctuations will be an unavoidable impact of the Project. With respect to the physical environment, the flooding effects from the Project in the immediate forebay area are considered to be long-term, large in magnitude, and localized. The daily water-level fluctuations on the immediate forebay and Wuskwatim Lake are considered to be long-term, localized and small in magnitude (i.e., no change to existing range) with respect to the physical environment. The significance of these effects on aquatic and terrestrial habitats and biota is discussed in Sections 6 and 7.

Downstream Water Levels

As indicated in Section 4.5.1.3:

- in the 9 km river reach from the tailwater of the Project to the set of rapids 4 km upstream of Opegano Lake, daily water-level fluctuations will occur as a result of operations;
  - the largest daily water-level fluctuations will occur at the tailwater (0 m to 1.5 m) and will decrease downstream because outflows are attenuated by channel storage;
- in the same river reach, occasional low outflows and corresponding low water levels will occur as a result of generating station operations;

  - the 330 m^3/s outflow (the 1 unit operation, which is expected to occur 3% of the time) is lower than the lowest expected inflow and results in lower downstream water levels than what would occur without the Project;
- in Opegano Lake, daily water-level fluctuations, which will occur as a function of daily outflow changes (0 m^3/s to 330 m^3/s) and the duration of each outflow setting, will be dampened by the available storage in the lake;
  - for inflows near 660 m^3/s and 990 m^3/s there would be minimal daily moderation of plant outflows and no daily water-level fluctuations in Opegano Lake;
  - for inflows greater than 1100 m^3/s, there will be no changes in plant outflows and no water-level fluctuations;
  - the largest daily water-level fluctuations on the Lake (approximately 0.4 m) will occur for inflows that are in the mid-range between the 660 m^3/s and 990 m^3/s flow conditions.
- downstream of Opegano Lake, daily water-level fluctuations will be further dampened by the attenuation of flows by channel and lake storage;
  - the median water-level fluctuation will not be noticeable at Birch Tree Lake (i.e., indistinguishable from wind and wave effects);
  - under a maximum water-level fluctuation scenario, the Birch Tree Lake water-level fluctuation would be about 0.10 m in open-water conditions and 0.15 m in the winter and not noticeable downstream (i.e., indistinguishable from wind and wave effects);
- with or without the Project, the duration of water levels at Opegano Lake and downstream will not change except for the low-outflow condition described above for 1 unit operation (3% of the time); and
- monthly and seasonal water-level changes due to CRD operation will continue to occur downstream of the Project.

The effect of daily flow and water-level changes on downstream river channels and lakes is considered to be long-term, of moderate magnitude, local in spatial scale. The potential implications of these changes to the aquatic and terrestrial environments is discussed in Sections 6 and 7.

5.4 ICE PROCESSES

5.4.1 Existing Environment

Ice cover begins to form with the onset of cold winter temperatures. The nature of the cover will vary with location and water velocity, but generally can be described as either a smooth "lake ice" or a rougher more dynamic "river ice".

Lake ice usually forms very quickly in areas of very low flow velocity, such as lakes, or deep, slow-moving river sections. It forms when cold air temperatures cool the water surface to freezing at the beginning of the winter. The thickness of lake ice is primarily governed by air temperature and the depth of snow cover on the ice.

In more swiftly moving sections of a river, the nature of the ice cover is significantly different. In these areas, the cover evolves based on four basic processes (ice generation, ice-front progression and formation of hanging **ice dams**, **border ice** formation, and **anchor ice** formation), as depicted in Figure 5.4-1 and as described in detail in Volume 4, Section 5.3.

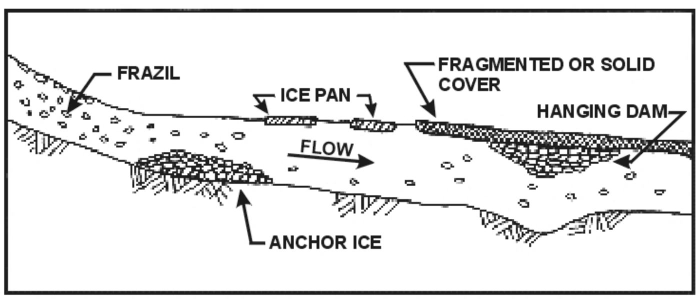


Figure 5.4-1: Typical River Ice Processes

Ice formation and movement is largely attributable to the riverine conditions outlined in Section 5.3. Along the Burntwood River, ice processes have been studied in detail by Manitoba Hydro for the past 30 years (Volume 4, Section 5.2). These studies have included the development of i) a comprehensive field-observation program; and ii) a detailed computer model, which has been successfully used to simulate the complex ice conditions along the river. River ice conditions currently experienced both upstream and downstream of the proposed Wuskwatim Generation Project site are variable, and depend on factors such as the magnitude of CRD flow and the type of winter (i.e., colder or warmer than normal).

The major ice processes observed along the river, from the Notigi Control Structure (upstream of the Project site) to Manasan Falls (downstream of the Project site), are described in detail in Volume 4, Section 5.4.1. Each year, on the major lakes in this reach (i.e., Wapisu Lake, Threepoint Lake, Wuskwatim Lake, Opegano Lake, and Birch Tree Lake), a competent ice cover forms quickly (Figure 5.3-1). The river sections (both upstream and downstream of the Project site) typically remain open and produce large volumes of **frazil ice**, ice crystals that start out small and then agglomerate to create **floating ice pans** (Figure 5.4-1). These ice pans either accumulate on the leading edge of the ice cover on downstream lakes, resulting in advancement of the cover upstream, or, if velocities are too high, deposit under the cover forming a hanging ice dam. An ice dam typically forms at the base of Early Morning Rapids at the entrance to Wuskwatim Lake, which can cause a localized rise (or staging) of water levels in the immediate upstream area (Figure 5.3-1). A similar ice dam forms at the inlet to Opegano Lake, and also immediately downstream of Kepuche Falls. Also in the river sections, there is a growth of anchor ice at many of the rapids. It has been observed to form at a number of locations along the Burntwood River, including Gods Rapids, Upper and Lower Caribou Rapids, Early Morning Rapids, Jackpine Falls, and Kepuche Rapids (Figure 5.3-1). The formation of anchor ice can cause upstream staging of water levels in the river sections and lakes due to a reduction in the cross-sectional flow area of the river. For example, anchor ice at Gods Rapids causes the staging of water levels on Threepoint Lake during the winter.

5.4.2 Effects and Mitigation

5.4.2.1 Construction

Cofferdam construction will not result in any change in ice formation in the immediate forebay area and this area will remain open during the winter. There will also be no changes in the amount of open water downstream of the Project site. **No measurable changes in ice processes are expected during the construction phase** (Volume 4, Section 5.5.1).

5.4.2.2 Operation

Winter water levels on Threepoint Lake, located upstream of Wuskwatim Lake (near the NCN community), will be unaffected by the operation of the Wuskwatim Generating Station. Anchor ice will continue to form at Gods Rapids, Caribou Falls and Early Morning Rapids, and a hanging ice dam will continue to form at the base of Early Morning Rapids. The most upstream set of rapids (i.e., Gods Rapids) will continue to be the control for water levels on Threepoint Lake (Section 5.4.1). The hanging ice dam, which typically forms below Early Morning Rapids, will not be appreciably different in size or nature following Project construction, and the control at the rapids will not allow the ice cover to advance any further upstream. Therefore, Early Morning Rapids forms the upstream limit of the hydraulic zone of influence for the Wuskwatim reservoir (Volume 4, Section 5.5.2.1).

Wuskwatim Lake will continue to develop a solid ice cover each winter season following completion of the Project. Wuskwatim Falls and the proposed channel-excavation area will likely remain open over the winter season, however, due to the higher localized velocities in these areas (Volume 4, Section 5.5.2.2). With the exception of this local area, a partial ice cover is anticipated to form over the rest of the immediate forebay area.

Downstream areas that currently remain open during the winter season are anticipated to remain open, and areas where an ice cover currently forms are anticipated to continue to form an ice cover. Operation of the Wuskwatim Generating Station may lead to the cyclic breakage and refreezing of some border ice growth during the early winter in the reach between the Wuskwatim Generating Station and Opegano Lake. Locations of anchor ice accumulation are not anticipated to change. The large hanging ice dam will continue to form downstream of Little Jackpine Rapids, at the inlet of Opegano Lake (Volume 4, Section 5.5.2.3) and cause localized scour and erosion in this area (Section 5.6.1).

No measurable changes in ice processes either upstream or downstream are expected during Project operations.

5.5 WUSKWATIM LAKE EROSION

This section describes the existing **erosion** processes at Wuskwatim Lake and expected changes as a result of the Project. Riverine-erosion processes and the anticipated Project effects on these processes are discussed in Section 5.6.

5.5.1 Existing Environment

Lakeshore erosion is a complex natural process involving many interrelated factors that may act alone or in combination (Volume 4, Section 6.3.1). **Bank-recession rates** are influenced by variable wind and wave energy conditions, fluctuating lake levels, shoreline geometry, variable bedrock exposure around the shoreline, the presence of shoreline debris and other obstructions to incoming wave energy, and episodic bank failures. Erosion measurements by Manitoba Hydro at 45 sites (15 sites with 3 profiles for each site on Wuskwatim Lake) for the past 10 to 12 years show that there is both **temporal** and spatial variation in erosion rates (Volume 4, Section 6.2.2.2).

About 30% of shorelines on Wuskwatim Lake and adjoining water are considered to be erodible. These shorelines are generally silty-clay banks and silty-clay banks overlying low bedrock. Erosion does not occur on bedrock-controlled shorelines or very flat, fen/marsh shorelines. It is predicted that the silty-clay banks will continue to erode under post-CRD conditions and that the silty-clay banks overlying low bedrock will continue to erode until the bedrock becomes sufficiently exposed along these shoreline reaches to arrest the erosion (i.e., when these shorelines become bedrock controlled).

With the commissioning of the CRD in 1977, and the resulting rise in average Wuskwatim Lake water levels of approximately 3 m (Volume 4, Section 6.3.2), there was a related increase in bank-recession rates around the shoreline. During the early stages of the shore-erosion process, erosion of the toe-of-bank dominates (Volume 4, Figure 6-7). Airphoto measurements (1993) of pre-and post-CRD erosion rates indicate that:

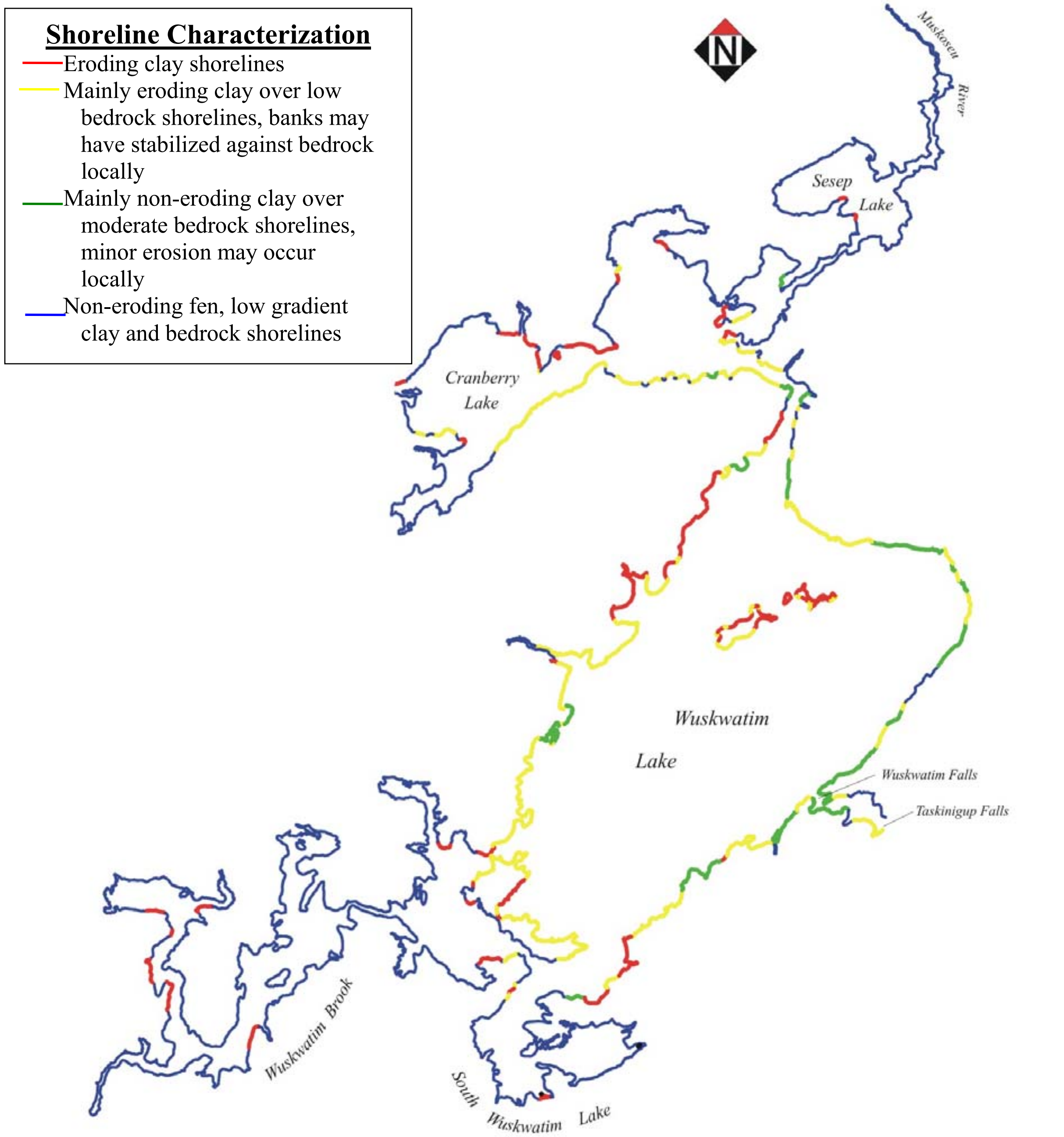
- pre-CRD erosion rates (shoreline recession) in Wuskwatim Lake were in the range of 0-2 m/yr, depending on shoreline type and wave energy exposure, with an overall average of 0.7 m/yr; and
- initial post-CRD rates (shoreline recession measured from 1978 and 1985 airphotos) range from 0-5 m/yr, with an overall average of 2.0 m/yr.

Over the past 25 years, shoreline-erosion rates have been declining through the development of nearshore beaches and a related increase in the prevalence of **nearshore downcutting** (Volume 4, Figure 6-7). Current erosion rates in Wuskwatim Lake, as measured in the field, are approaching the long-term pre-CRD rates.

The majority of eroding shorelines are concentrated in the main part of Wuskwatim Lake and represent about 75% of that shoreline (Figure 5.5-1). Of the 75% of the shoreline that is erodible, 50% is in a high wave-energy environment (i.e., exposed to prevailing winds [Section 5.1.1.3] and long stretches of open water; east and south shores of Wuskwatim Lake). The remainder is in a mostly moderate wave-energy setting (Volume 4, Figure 6-19).

The erosion-monitoring data from the past 10 years, in the main part of Wuskwatim Lake, indicate that:

- in high wave-energy locations (i.e., east and south shores) the two erodible shore types are currently receding at average rates of 0.5 m/yr for silty-clay overlying low bedrock shorelines and 1 m/yr for silty-clay shorelines;



1 0 1 2 3 4 5 kilometres

Figure 5.5-1: Distribution of eroding and non-eroding shorelines in Wuskwatim Lake area

- in moderate wave-energy locations (i.e., west shores), the two erodible shore types are currently receding at average rates of 0.35 m/yr for silty-clay overlying low bedrock shorelines and 0.65 m/yr for silty-clay shorelines (i.e., rates that are approximately 2/3rd of those in high wave-energy environments); and
- on average, 2.9 ha of shoreline area is lost each year to shoreline erosion.

Additional details regarding Wuskwatim Lake shoreline characterization, erosion dynamics and the general approach used to assess shoreline erosion are provided in Volume 4, Section 6.

5.5.2 Effects and Mitigation

5.5.2.1 Construction

There will be no change in upstream water levels on Wuskwatim Lake due to the Project and therefore **no change in shoreline erosion is anticipated** (Volume 4, Section 6.4.1).

5.5.2.2 Operation

The main difference between existing conditions and post-Wuskwatim development conditions in terms of shoreline erosion is a change from the existing pattern of lake-level fluctuation to a relatively constant level at the upper end of the post-CRD water-level range. Following the proposed development, the Wuskwatim Lake level will be held relatively constant at or near 234.0 m ASL.

Because post-Project water levels will be within the post-CRD operating range, the percentage of eroding shorelines will not change significantly with the Project. However, because water levels will be kept constant at the upper end of the post-CRD range, an initial increase in average erosion rates is expected because the erodible shorelines will be exposed more frequently to wind-driven wave action than they have been in the past. This will result in an initial increase in average erosion rates in erodible silty-clay banks and silty-clay banks overlying low bedrock shoreline types (approximately 30% of the Wuskwatim Lake area shorelines). The largest increase in erosion will occur during the first 5 years of Project operation. For example, average annual bank-recession rates in silty-clay banks and silty-clay banks overlying low bedrock, located in the most susceptible high-wave energy settings, are expected to increase from 1.0 to 1.5 m/yr and from 0.5 to 1.5 m/yr, respectively, in the first 5 years of Project operation. Erosion rates in silty-clay banks will then decrease to an average of 1.2 m/yr during the following 20 years of Project operation, while rates in silty-clay banks overlying low bedrock are expected to decrease to an average of 0.65 m/yr during this period (Figures 5.5-2 and 5.5-

3; Volume 4, Section 6.4.2.1). After 25 years, it is expected that bank recession rates in erodible materials will be the same as they would have been without the Project.

Over the initial 25-year period after the Project is in place, silty-clay shorelines in high wave-energy environments are predicted to recede, on average, about 32 m, versus 25 m without the Project. Silty-clay shorelines overlying low bedrock in high wave-energy settings will recede, on average, about 21 m, versus 13 m without the Project. Erodible shorelines in moderate wave-energy environments are expected to recede 2/3rd of the above recession distances, on average. No appreciable change in erosion rates is expected in other shorelines, which are considered stable.

The stretch between Wuskwatim Lake and Taskinigup Falls will be converted from a river to a lake environment and will become the immediate forebay area for the Project. This area is expected to be a low-wave energy environment resulting in only modest erosion relative to the other areas discussed above. The majority of the north shore will not undergo erosion because of the placement of rock materials associated with the excavated material placement area and the construction of the road to the channel-excavation area at Wuskwatim Falls (Volume 3, Section 4.).

In summary, the effect of the Wuskwatim Project will be to stabilize water levels at the upper end of the post-CRD operating range (i.e., at or near 234.0 m ASL), which will result in an acceleration of the ongoing shore erosion that is now occurring on Wuskwatim Lake. Shoreline-erosion rates will be highest initially and decline over time to existing (i.e., post-CRD) erosion rates at the end of 25 years of the Project. **Since the incremental erosion impacts are declining over a moderate timeframe, the effects on the physical environment are also expected to be moderate** (Volume 4, Section 6.4.4). The potential implications to the aquatic and terrestrial environments are discussed in Sections 6 and 7.

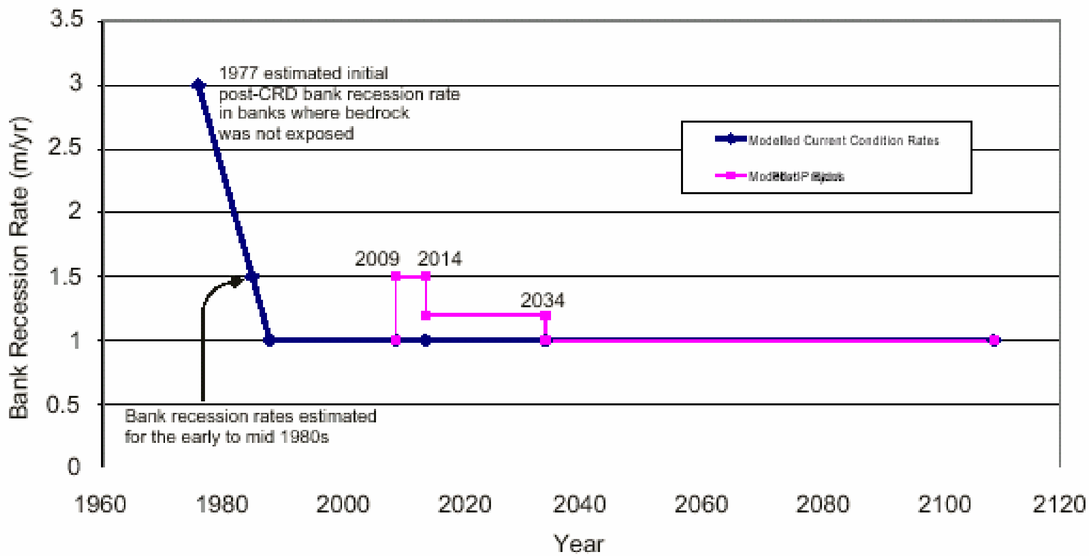


Figure 5.5-2: Predicted change in average bank-recession rates in clay and silt shorelines exposed to high wave energy – Wuskwatim Lake

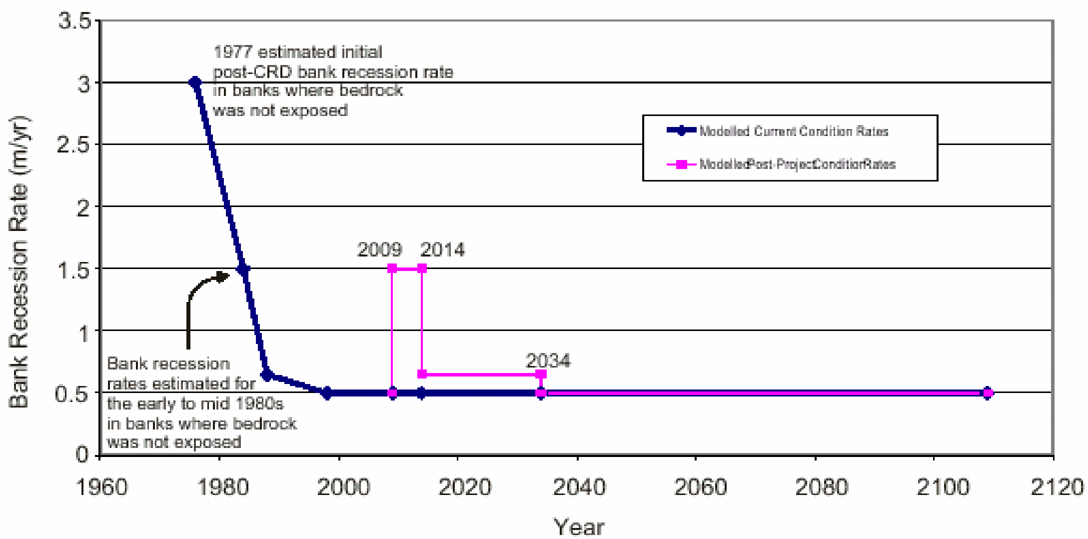


Figure 5.5-3: Predicted change in average bank-recession rates in shorelines where clay and silt overlie bedrock exposed to high wave energy – Wuskwatim Lake

5.6 RIVERINE EROSION

This section describes the existing erosion processes in riverine reaches in the study area (Section 5.5) and expected changes as a result of the Project.

5.6.1 Existing Environment

Riverbank erosion accompanying channel migration, widening or downcutting is often initiated by scour and undermining of the toe of the bank, rather than by direct erosion of the slope by wind-generated wave action (i.e., the toe of the riverbank is undercut and the upper portion of the riverbank [cohesive-silt/clay material] collapses downwards). Where banks are underlain by permafrost, thawing may also play a role, resulting in large bank failures. Factors such as loss of vegetation, thawing of permafrost, or surface waves affect mainly the upper levels of the bank (Volume 4, Section 7.2).

Commissioning of the CRD in 1977 increased mean flows about 8 times, increased yearly maximum channel-forming flows by about 3 times, and greatly reduced the variability of flows through the year. Over the last 25 years, the river has adapted to these higher channel-forming flows.

The Burntwood River has a slightly sinuous, irregular **planform** with widths ranging from about 100 m to 330 m. Most of the discharge in the wider reaches is contained in a sinuous central stream averaging about 100 m wide with velocities mostly in the range of 0.5 to 1.5 m/s. In areas outside this central stream, velocities range from zero to 0.5 m/s and account for quite a small proportion of the discharge. In the narrower reaches where the overall width is around 100 m, the central stream occupies the entire width and midstream velocities reach 2.0 m/s or greater. Velocities alongside banks (except in these narrower reaches) are generally very low (Volume 4, Section 7.4).

From air photo analysis (1985 to 1998) and recent video footage (2000), the stretch of river between Taskinigup Falls and Opegano Lake has been classified, with the following observations (Volume 4, Section 7.4):

- riverbank heights are generally low (1 m or less);
- approximately 45% of the total length of banks is viewed as eroding to some degree, and the rest is described as "**water-washed**";
- over substantial lengths, even in wider reaches, some shoreline recession is occurring on both banks simultaneously;

- riverbank recession varies locally from 0 to <1.0 m/yr, with a spatial average of approximately 0.2 m/yr; and
- the bank materials are generally classed as fine-grained glaciolacustrine sediments at locations where active recession is occurring.

In some areas, bank recession is occurring in "over-wide" reaches where bank velocities are very low, and it is unlikely that this is a result of normal fluvial processes, such that occur in more regular types of river channels (e.g., meandering alluvial rivers). Depending on the degree of exposure to wind, this may represent a surficial response to wave action and/or the thawing of permafrost, if present. Even a river reach approaching a stable regime condition will continue to exhibit local erosion and deposition changes. Accordingly, while the system may eventually reach a **dynamic equilibrium**, it will always be changing.

In certain areas, localized riverbank erosion may be exacerbated due to the formation of large hanging ice dams during the winter period. This is particularly evident at the inlet to Opegano Lake (Volume 4, Section 7.4). Erosion rates along the eastern shores of Opegano Lake appear to be somewhat higher than rates on the western shore.

5.6.2 Effects and Mitigation

5.6.2.1 Construction

During both Stage I and II diversion (Section 4.4.1), the riverbanks in the immediate upstream reach between Wuskwatim Falls and Taskinigup Falls will be exposed to slightly higher water levels as discussed in Section 5.3.2.1. This may result in some minor erosion of the upstream riverbank (i.e., 1 to 2 km of shoreline) prior to impoundment.

The construction and removal of cofferdams is expected to cause temporary rises (up to 6 weeks in duration during any one operation) in **Total Suspended Sediments (TSS)** levels of 25 mg/L or less (Volume 4, Section 7.5.1). "Best construction practices" will be employed during cofferdam placement and removal activities to minimize the amount of fine material that is entrainable in the river flow.

The initial operation of the spillway at the commencement of Stage II diversion (Section 4.4.1) will result in some erosion of the river channel and Stage I cofferdam remnant in the area of the approach channel. The riverbed in these areas will be exposed to higher velocities than have occurred under existing conditions. A review of the literature indicates a range of critical **shear strength**s for the riverbed materials and a range of potential erosion coefficients are possible. The duration of the elevated TSS levels is dependent on these two factors. A combination of different critical shear strengths and different erosion coefficients could yield a range of TSS increases from negligible up to approximately 100 mg/L. Based on a probable strength of material and a probable erosion coefficient, a TSS increase of around 30 mg/L is considered to be likely (Volume 4, Section 7.5.1). To address the uncertainty in the potential erosion rates, investigations will be carried out during the construction period, to determine the in-situ erosion resistance of the riverbed materials. This type of testing is planned to occur after access to the Project site has been established. If investigations indicate that the riverbed is composed of a weak, erodible material, then mitigative strategies will be developed (e.g., armouring the riverbed with small stone). The results of these investigations and any proposed mitigative strategies will be discussed with the regulators prior to implementation.

The initial release of powerhouse flows over the downstream Stage II cofferdam remnant (Section 4.4.1) may also result in some erosion of this structure. The volume of material eroded would be relatively small, and this local section would quickly reach a stable configuration following powerhouse operation.

Riverbank erosion during construction will be mitigated to the extent possible by the methods described above. Resulting erosion will be short-term and localized with respect to the physical environment. The implication of riverine erosion on the aquatic environment is discussed in Section 6.

5.6.2.2 Operation

The immediate forebay area created by the Project will become a lake environment and therefore erosion in this area is discussed in Section 5.5.2.2.

Bank-erosion rates along the Burntwood River are generally not expected to change downstream of the proposed Generating Station. There will be no change in the peak flood flows as a result of the Project that define the river channel-forming processes. The daily fluctuations in water levels as a result of Project operations are not expected to decrease the existing shear strength of the riverbanks.

Riverbank-erosion during Project operations is therefore not expected to have an effect on the physical environment.

5.7 SEDIMENTATION

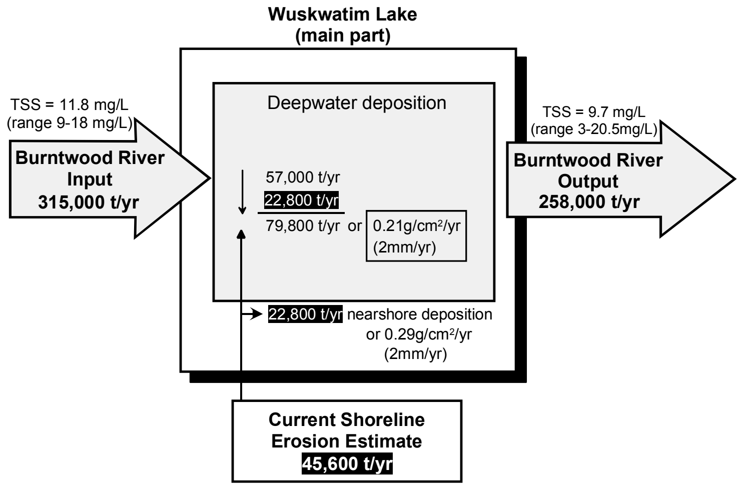
5.7.1 Existing Environment

Sedimentation and Total Suspended Sediments (TSS) in the water column are the end results of several processes, including: erosion, sediment production, deposition and/or transport, and in-stream morphological processes. As in other lakes, inflowing rivers with sediment loads and localized erosional processes within Wuskwatim Lake are predominantly responsible for existing sedimentation processes and rates (Volume 4, Section 8.3.1).

Long-term TSS data has been collected on the Burntwood River near Thompson for pre- and post-CRD conditions. The data indicates that during and just after the commissioning of the CRD in 1977, TSS levels rose to 20 mg/L and then returned back to pre-CRD levels of 13 mg/L in the 1987 to 1992 reporting period (Volume 4, Section 8.2). Additional data collected by Manitoba Conservation from 1992 through to 2002 shows average TSS levels continue to be approximately 13 mg/L. While TSS concentrations appear to have returned to pre-CRD conditions, total sediment loads have increased about 8 times due to the increased volume of water flowing down the CRD.

A preliminary sediment budget for existing post-CRD conditions can be estimated for the main part of Wuskwatim Lake based on the TSS data collected from 1999 to 2001 (Figure 5.7-1). TSS data for the surrounding lakes (i.e., Cranberry and Sesep lakes) are lower than the main CRD river/lake flow area. The three years represent a range of flow and lake conditions (i.e., low, medium and high water levels). It is noteworthy that Wuskwatim Lake levels in 2000 were mostly at 234 m ASL, the proposed operation level of the Wuskwatim Generating Station. An average of the 3 years of data shows that the TSS levels entering into the Wuskwatim Lake are approximately 12 mg/L and the TSS levels leaving Wuskwatim Lake are about 10 mg/L (based on 2 recording stations in the lake as a surrogate of outflows), indicating sediment deposition is currently occurring within Wuskwatim Lake. Using a post-CRD average annual flow of 845 m^3/s, it is calculated that approximately 57,000 tonnes/year of sediment are currently being deposited within the main part of Wuskwatim Lake based on an inflow-outflow **sediment balance** only.

The above estimation does not account for any additional localized erosion occurring within Wuskwatim Lake (Volume 4, Section 8.3.1). Accordingly, in the main part of Wuskwatim Lake, it is estimated that 38,000 m^3/yr (or approximately 45,600 tonnes/yr) of soil are currently being added to the lake due to the erosion of Wuskwatim Lake shorelines (Figure 5.7-1 and Volume 4, Appendix A6.1).



Current Conditions

Incoming Sediment Load to Lake		Outgoing Sediment Load from Lake		Inflow - Outflow Deposition to Lake
mg/l	tonnes/yr	mg/l	tonnes/yr	tonnes/yr
11.8	315,000	9.7	258,000	57,000

Current Wuskwatim Lake Deposition Scenario

Current

total shore erosion (t/yr)	nearshore deposition (%)	nearshore deposition (t/yr)	deepwater deposition (t/yr)	total deepwater deposition (t/yr)
45,600	50%	22,800	22,800	79,800

Figure 5.7-1: Current Condition: Sedimentation Estimates for Wuskwatim Lake

Data collected from Southern Indian Lake in the early 1980s indicates that 50% to 80% of the material eroded from shorelines is deposited in a zone near the eroding shoreline, approximately in the first 150 to 300 m from shore ("nearshore" area; Volume 4, Section 8.2). The remaining portion of the eroded material becomes part of the solids suspended in the water further out in the lake, where it will either settle out ("deepwater" deposition) or be carried downstream. In terms of the potential transport of shoreline-erosion sediment into deep water and its potential fate afterwards, measurements in Southern Indian Lake indicate that deepwater transport and deposition could range from a low of 20% up to 50% (Volume 4, Section 8.2). Accordingly, it is conservatively estimated that 22,800 tonnes/yr are currently being deposited in the nearshore area around the shorelines of Wuskwatim Lake and the other 50% or 22,800 tonnes/yr are being transported out into the deepwater section of the Lake, where it joins with the other material coming into the lake via the river and is deposited in the water for a total net deposition rate of 79,800 tonnes/yr (Figure 5.7-1).

In terms of deposition rates, potential nearshore deposition has been estimated to be approximately 0.29 g/cm^2/yr (based on 52.6 km of eroding mainland shoreline and a conservatively low deposition width of 150 m; Volume 4, Section 6 and Table A6.1-1). Deepwater deposition has been estimated to be approximately 0.21 $g/cm^3/yr$ (based on an effective lake area of the main part of Wuskwatim Lake of 38 km^2; Volume 4, Section 8.3.1).

5.7.2 Effects and Mitigation

5.7.2.1 Construction

During construction, there will be no changes in upstream water levels on Wuskwatim Lake and therefore no changes in erosion/sedimentation rates in the lake are expected (Volume 4, Section 8.4.1).

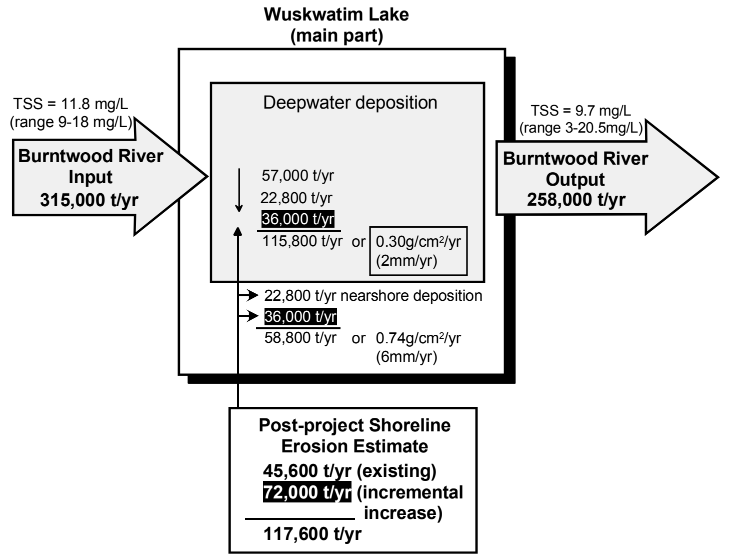
Section 5.6.2.1 discusses the in-river construction and the potential effects on TSS levels as a result of erosion.

Additionally, there will be minimal sedimentation-related impacts to stream crossings from the construction of the access road. The road and associated structures (e.g., culverts) will be developed in accordance with the Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat (DFO and MNR 1996), as discussed in the EnvPP. The EnvPP recommends erosion-control measures along access road and borrow areas to mitigate some of the potential for sediments to be transported to waterbodies.

5.7.2.2 Operation

It is estimated that the incremental increase in erosion in the main part of Wuskwatim Lake will be about 72,000 tonnes/yr in the first 5 years after the Project (Figure 5.7-2). For the initial assessment of effects, it was assumed that this incremental increase in erosion would not result in a change in sediment outflow (Volume 4, Section 8.4.2). Using the estimated existing 50/50 split with respect to nearshore/farshore deposition, 36,000 tonnes/yr would be added to the nearshore area of the lake and a similar amount added to deepwater deposition. It should be noted that this estimated incremental increase of 72,000 tonnes in shoreline erosion is likely similar to what occurred in the year 2000 when water levels were at the 234-m level during the open-water period. Based on this analysis, it is estimated that the deepwater deposition could be in the range of 0.30 $g/cm^2/yr$ or approximately 2 mm/yr.

If the increased sediment is considered to be transported downstream, a 25% incremental increase in sediment outflow from Wuskwatim Lake is assumed, TSS levels in the outgoing flow would rise by less than 1 mg/L, which is unlikely to be detectable given the range of existing variation. Under this scenario, with a portion of the lake eroding sediment being transported downstream, the deepwater deposition in the lake would reduce from 0.30 g/cm^2/yr down to 0.26 g/cm^2/yr (Volume 4, Section 8.4.2).



Current Conditions

Incoming Sediment Load to Lake		Outgoing Sediment Load from Lake		Inflow - Outflow Deposition to Lake
mg/l	tonnes/yr	mg/l	tonnes/yr	tonnes/yr
11.8	315,000	9.7	258,000	57,000

Current Wuskwatim Lake Deposition Scenario

Current

total shore erosion (t/yr)	nearshore deposition (%)	nearshore deposition (t/yr)	deepwater deposition (t/yr)	total deepwater deposition (t/yr)
45,600	50%	22,800	22,800	79,800

Incremental Increase
with project - 1st 5 years only (50% deepwater deposition)

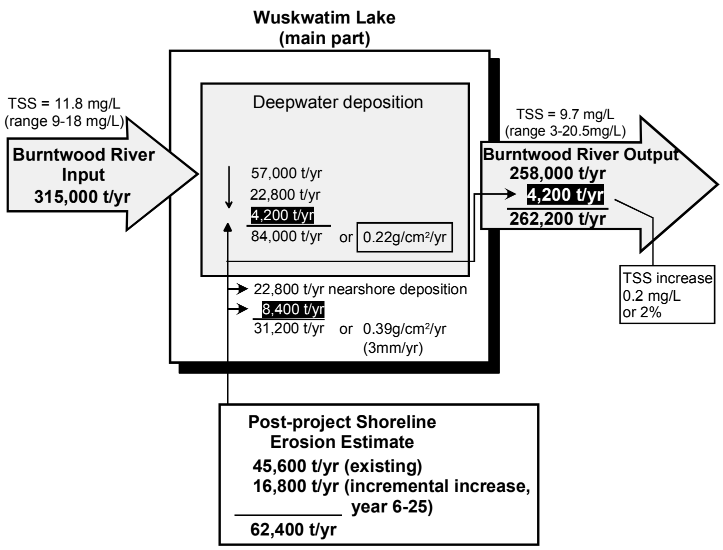
incremental shore erosion (t/yr)	nearshore deposition (%)	nearshore deposition (t/yr)	deepwater deposition (t/yr)	total deepwater deposition (t/yr)
72,000	50%	36,000	36,000	115,800

in year 6-25 incremental increase 17,000 t/yr

Note: Incremental increase is comparable to Year 2000 conditions

Figure 5.7-2: Predicted Sedimentation Estimates: First 5 Years Post-Project (assuming no change in outflow sediment)

In summary, it is expected that the estimated large increases in sedimentation in the nearshore and the estimated minor increase in deepwater areas (within the main part of Wuskwatim Lake) will decrease significantly after the first 5 years of the Project and return, in the following 20 years, to background levels (e.g., Figure 5.7-3). Areas near the shore where erosion is currently occurring are anticipated to be slightly more "muddy" during wind/wave-induced erosion events in the first 5 years of operations. **The effects of sedimentation are expected to decline over a moderate timeframe.** The potential implications of these changes in sedimentation on the aquatic environment are discussed in Section 6.



Current Conditions

Incoming Sediment Load to Lake		Outgoing Sediment Load from Lake		Inflow - Outflow Deposition to Lake
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Current Wuskwatim Lake Deposition Scenario

Current

total shore erosion (t/yr)	nearshore deposition (%)	nearshore deposition (t/yr)	deepwater deposition (t/yr)	total deepwater deposition (t/yr)
45,600	50%	22,800	22,800	79,800

Incremental Increase with project year 6-25 (25% deepwater deposition/25% outflow)

incremental shore erosion (t/yr)	nearshore deposition (%)	nearshore deposition (t/yr)	deepwater deposition (t/yr)	total deepwater deposition (t/yr)
16,800	50%	8,400	4,200	84,000

incremental increase in Wuskwatim outflow	
(t/yr)	(mg/L)
4,200	0.2

Figure 5.7-3: Predicted Sedimentation Estimates: Years 5 to 25 Post-Project (assumes 25% sediment outflow from Wuskwatim Lake)

5.8 WOODY DEBRIS

5.8.1 Existing Environment

Debris, in the context of Manitoba hydroelectric developments, is defined as "*woody or other organic material that impedes desired uses of a waterway*" (Volume 4, Section 9.1). Debris can be either fixed (trees or tree parts that remain rooted) or loose (either floating freely or deposited on a shoreline; Manitoba Hydro 2000). There are various sources of debris entering the water. Natural occurring phenomena such as floods and eroding banks will add debris (e.g., from fallen shoreline trees) to almost all waterways over time. The current debris environment is the product of a number of additional factors, including (Volume 4, Section 9.1):

- pre-CRD clearing programs;
- CRD water-regime increases;
- natural ice-clearing processes loosening/removing standing trees in open areas;
- post-CRD floating debris-management programs; and
- accelerated bank-erosion processes due to CRD water-regime increases.

A review of the CRD project as it relates to clearing and post-project debris management was done to provide insight on the current debris environment (Volume 4, Section 9.3.2).

Boat and helicopter surveys were also conducted during the 2000 and 2001 field seasons to define the current debris environment for Wuskwatim Lake and downstream lakes and rivers. Details of these surveys are provided in Volume 4 (Section 9.2 and Appendix 9A, Table 9A-1) and are graphically depicted in Figure 5.8-1.

The predominant debris type in the main part of Wuskwatim Lake under post-CRD conditions is beached debris. This occurs in low (0.1 m^3 or less of debris per metre of shoreline) to medium (0.3 to 1 m^3 per metre of shoreline) densities. Debris concentrations are highest in the southern portions of Wuskwatim Lake and are correlated with the location of erodible soils (Section 5.5). These areas involve combinations of beached, rafted and floating debris in low to medium densities for each debris type. In the other portions of Wuskwatim Lake, rafted debris is noted sporadically in low to moderate densities.

In the creeks and embayments of Wuskwatim Lake and in Wuskwatim Brook, southern arm of Wuskwatim Lake, Cranberry Lake and Sesep Lake, the most common debris involves standing dead trees in moderate-to-high densities (high densities being >2 m^3 per metre of shoreline), along with moderately dense rafted and submerged debris. These areas have very low amounts of beached debris due to the presence of standing dead trees, which prevent the debris from being washed up on shore due to wind and wave action. Along small bays (or embayments), as debris has become deposited in these areas over time, there is moderate to heavy deposition of rafted debris.

Downstream of Wuskwatim Falls, between Wuskwatim Falls and Thompson, waterbodies affected by the CRD are mostly associated with river habitat (i.e., Burntwood River) and Opegano and Birch Tree Lakes. A description of the surveys undertaken in this section of the CRD is provided in Volume 4 (Section 9.2). Along the Burntwood River, beached debris is located along the edges of the channel, either on the banks or in shallow water (depending on flow water level conditions). Debris densities are typically low, particularly between Wuskwatim Falls and Opegano Lake, and varies between moderate to heavy density between Opegano and Birch Tree lakes. In the small embayments off the river, there are a variety of debris types including beached, floating and standing dead. Densities in these areas typically vary from medium to high.

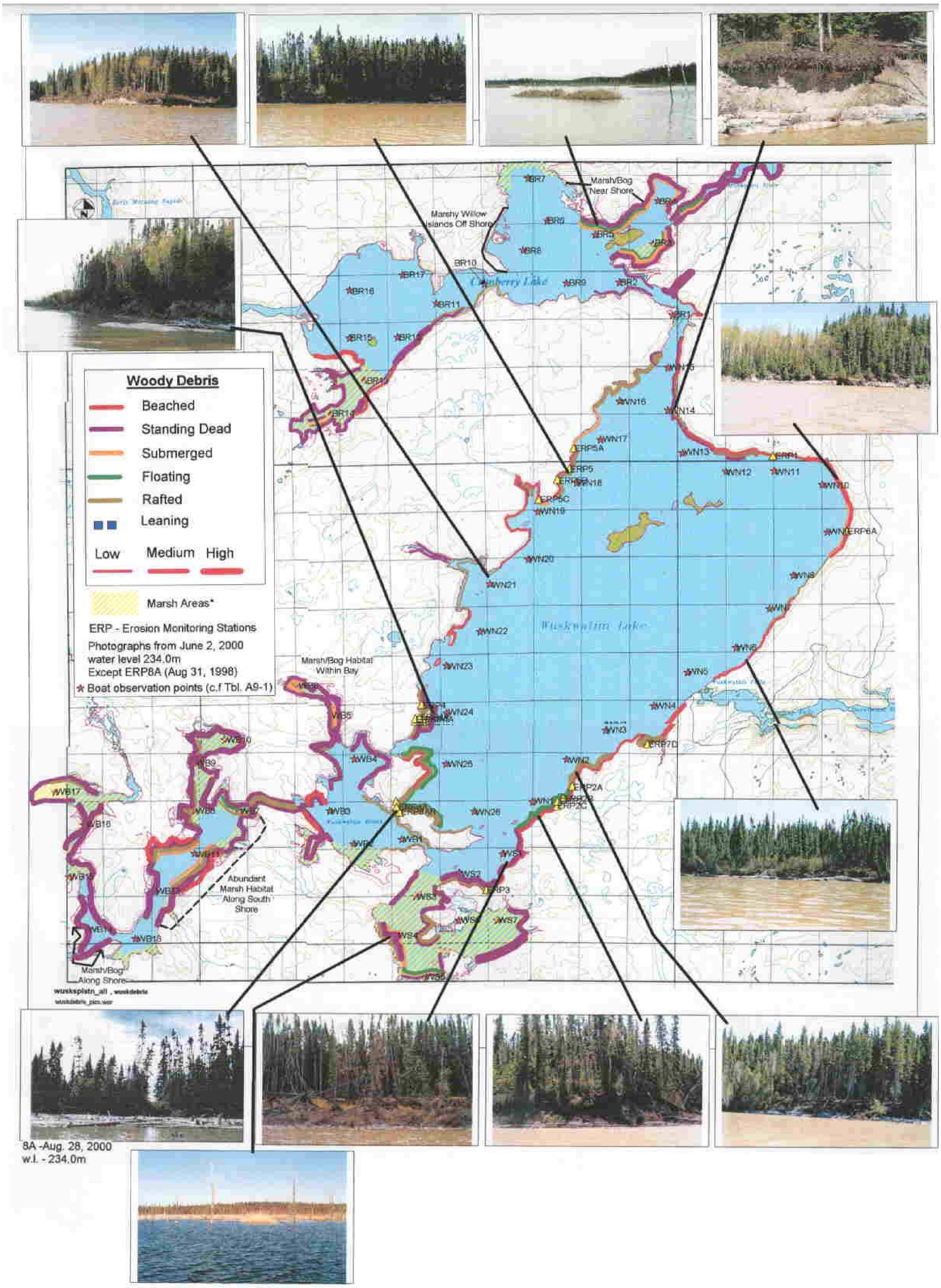


Figure 5.8-1: Wuskwatim Lake Debris Mapping

There is some limited potential that the river current or ice action can pick up some of the shoreline debris and move it downstream. Given that debris is situated along the shore of the river; the majority of the debris will likely to continue remain in place.

Results of roving boat surveys in 2001 by Manitoba Hydro on Wuskwatim Lake indicated that the majority of observed floating debris was "deadheads", with limited mobility, rather than freely floating logs (Volume 4, Section 9.3.3.3). Only a very limited amount of floating debris was observed in this survey or in the 2000 boat-based debris surveys (i.e., when the lake was at 234 m; the proposed operating level for the Wuskwatim Project).

5.8.2 Effects and Mitigation

5.8.2.1 Construction

Very modest water-level staging is expected between Wuskwatim Falls and Taskinigup Falls as a result of Project construction as discussed in Section 5.3.2.1. This water-level change is not expected to change the current local debris environment due to low levels of existing debris present (Section 5.8.1). The Project will not affect debris generation or accumulation upstream on Wuskwatim Lake or downstream of Taskinigup Falls.

It is possible that recreational use of Wuskwatim Lake will increase during Project construction. Debris issues will be monitored and mitigated as required.

During construction, the effects of woody debris on the physical environment are considered to be small, short-term, localized in nature and capable of being mitigated. The potential implications of debris on the aquatic and terrestrial environments are discussed in Sections 6 and 7.

5.8.2.2 Operation

The completion of the Wuskwatim Generating Station will result in the flooding of less than ½ km^2 (about 37 ha) of land between Wuskwatim Falls and Taskinigup Falls (Volume 3, Section 3.3). To mitigate the short-term increase in debris levels and the aesthetic issues resulting from this flooding, this area will be cleared prior to impoundment (Volume 4, Section 9.4.2). Current plans call for clearing to be done in stages. The initial clearing would occur before the placement of the Stage I cofferdam (which will cause water levels to rise in this section of the river; Section 5.3.2.1) and a final clearing just before final impoundment (Section 4.4.1).

In the main part of Wuskwatim Lake, the most predominant type of debris type consists of dead dislodged spruce tree trunks that are beached on the shoreline in low to moderate densities relative to other forebays/reservoirs where debris has been quantified. In those areas with actively eroding shorelines, debris density is moderate and consists of beached, rafted and nearshore floating debris (Volume 4, Section 9.4.2). The Project will cause an increase in erosion of the erodible shorelines in the main part of Wuskwatim Lake over the next 25 years. As a result of the increased rate of erosion, additional debris will accumulate along these shorelines. It is expected that most of the new debris inputs will be trapped against the existing debris fields, and be relatively immobile. This may result in a small increase in difficulty in accessing some shorelines. NCN Elders have stated that they believe some additional debris may be mobilized as a result of the Project. The incremental increase in shoreline debris is not expected to affect navigation. Navigational debris hazards will be monitored and mitigated as required. **Changes in debris accumulation are expected to be short-term, localized, and small in magnitude (relative to existing debris levels), with respect to the physical environment.** The potential implications of debris on the aquatic and terrestrial environments and resource use are discussed in Sections 6, 7 and 8.

In the back-bay areas of Wuskwatim Lake and the adjoining lakes (e.g., Sesep and Cranberry Lakes), there is very little active erosion occurring now and the Project is not expected to change this; therefore, **no change is expected in debris inputs**.

Downstream of Wuskwatim Lake on the Burntwood River, no appreciable changes are expected in existing erosion conditions and, therefore, **no changes in debris levels are expected**.

5.9 RESIDUAL EFFECTS

5.9.1 Climate

The Project will not result in significant emissions relative to other forms of electricity production. The net impact of the Project will be a significant reduction in global GHG emissions. The electricity produced by Wuskwatim will displace GHG intensive, natural gas and coal fired resources, predominantly outside of Manitoba. Assuming the Project displaces only the most efficient combined cycle natural gas generation, then the average GHG emission reduction due to Wuskwatim is expected to be greater than 750,000 tonnes of CO_2 emissions per year. In addition to GHG emission reductions there would also be global emission reductions in nitrogen oxides, sulfur oxides, mercury and particulates. **Therefore the Project will have a net positive residual effect on global GHG emissions.**

5.9.2 Physiography, Geology and Soils

The resulting final footprint of the Wuskwatim Generating Station on the physical landscape (both land and river bottom) will create an unavoidable, long-term, localized effect on the physical environment. The Project will also result in the unavoidable loss of Taskinigup and Wuskwatim Falls. The significance of these residual effects to the aquatic, terrestrial, and socioeconomic environments and resource use is discussed in Sections 6 through 9.

5.9.3 Water Regime

In the "immediate forebay" between Wuskwatim and Taskinigup Falls, water levels will be raised to 234 m ASL elevation (an increase of about 7 m in this upstream area), which will result in the flooding of less than ½ km^2 (about 37 ha) of previously cleared land. **With respect to the physical environment, the residual effects are considered to be unavoidable, long-term, large in magnitude, and localized.** The potential residual implications of these residual effects to the aquatic and terrestrial environment are discussed in Sections 6 and 7.

The residual effect of daily flow and water-level changes as a result of the Project on the reservoir of Wuskwatim Lake and downstream river channels **are considered to be long-term, localized, and small to moderate in magnitude with respect to the physical environment.** The potential residual implications to aquatic and terrestrial habitats and biota are discussed in Sections 6 and 7.

5.9.4 Ice Processes

There will be no measurable changes to ice processes and therefore no residual effects as a result of the Project.

5.9.5 Wuskwatim Lake Erosion

The Project will result in a short-term, moderate increase in bank-recession rates of erodible shores in localized areas that will decline to existing levels over the moderate term (i.e., <25 years). This will result in a moderate increase in total land area and volume of material being eroded around Wuskwatim Lake over the next 25 years. The potential residual implications to aquatic and terrestrial environments are discussed in Sections 6 and 7.

5.9.6 Riverine Erosion

No change in channel-forming flows is predicted and therefore riverbank-erosion during Project operations is not expected to have a residual effect on the physical environment.

5.9.7 Sedimentation

It is expected that the estimated large increases in sedimentation in the nearshore and the estimated minor increase in deep-water areas (within the main part of Wuskwatim Lake) will decrease significantly after the first 5 years of the Project and return, in the following 20 years, to background levels. **The effects of sediment deposition are expected to decline over a moderate timeframe.** The potential residual implications of these changes in sedimentation on the aquatic environment are discussed in Section 6.

5.9.8 Woody Debris

The Project will result in a small incremental increase in debris accumulation on those localized Wuskwatim shores where active erosion and debris accumulation is now occurring. The potential residual implications to the aquatic and terrestrial environments and resource use are discussed in Sections 6, 7 and 8.

5.10 CUMULATIVE EFFECTS

The effects of the Project were assessed in combination with the effects of other projects that have or will be carried out, which potentially could affect the physical environment (land, water or air). A dominant project that has already been completed in the area is the Churchill River Diversion (CRD). The interaction of the existing CRD and the Wuskwatim Generation Project has been reviewed in the preceding sections, with the evolving post-CRD conditions representing the existing baseline conditions that the Project could affect. The CRD is therefore not considered as part of this Cumulative Effects Assessment. Other known or potentially foreseeable projects that could affect the physical landscape include other hydroelectric generation and transmission projects (i.e., Wuskwatim Transmission Project, Gull/Keeyask Generation Project or the Conawapa Generation Project, and Notigi Generation Project) and any other industrial projects (e.g., Tolko Forestry activities).

The Wuskwatim Transmission Project will be developed in the vicinity of, and concurrently with, the Project (i.e., it overlaps in space and time). This Transmission Project, however, is not anticipated to interact with the effects of the Project on the physical environment (e.g., erosion, sedimentation, etc.).

Construction of the Gull/Keeyask and Conawapa Generation Projects, if developed, could overlap or be sequential in time, but would not overlap in space, with the construction of the Wuskwatim Generation Project. The Gull/Keeyask and Conawapa projects would be located on the Nelson River downstream of where the CRD enters the Nelson. The Wuskwatim Project will not change the overall CRD water regime. Accordingly, it will not effect the operation of a potential downstream Gull/Keeysask or Conawapa Project if they are constructed. As well, these potential projects would not interact with the physical environment effects of the Project as documented in the preceding sections.

A potential Notigi Generation Project would be located adjacent to the Notigi Control Structure upstream of the Wuskwatim Project (Figure 4.1-1). The potential Notigi generating station would operate similar to the Wuskwatim Project (i.e., there would be no change to the current daily or seasonal flow patterns on the CRD) and therefore it would not interact with the effects of the Project on the physical environment.

If Tolko winter-road building and harvesting activities are pursued south of the Burntwood River, this would overlap in space and time with the Project. If Tolko activity in this area did proceed, forest cutting would be required to abide by a 30-m buffer around waterbodies and would, therefore, not affect current or projected Wuskwatim Lake shoreline-erosion estimates.

In terms of global greenhouse gas emissions, the net effect of the Project will be a significant reduction in global GHG emissions (Section 5.9.1). The cumulative effect of Tolko's forestry activities would not influence this significant net GHG benefit. The cumulative effect of other potential hydro projects such as Notigi, Gull Rapids and Conawapa, if they are undertaken, would not affect the GHG benefit from the Project, and is expected to result in a significant reduction in global GHG emissions.

On this basis, no negative cumulative effects are anticipated with respect to changes in the physical environment and the combination of these potential developments with the Wuskwatim Generation Project.

5.11 ENVIRONMENTAL MONITORING & FOLLOW-UP

This section provides an overview of the monitoring activities to occur during Project construction and operation in order to verify predictions, clarify uncertainties and generally track changes to the physical environment as a result of the Project. Details regarding monitoring design (e.g., equipment used, parameters measured, methods and reporting mechanisms) are outlined in Volume 4.

5.11.1 Climate

Manitoba Hydro will monitor changes in the regional climate of the Wuskwatim Generation Project area using climate information, which includes measurements of temperature, precipitation and wind speed provided by the Meteorological Service of Canada. In addition, Manitoba Hydro will monitor research work from the scientific community in the area of global climate change, to assess the degree at which climate change is occurring in the Wuskwatim Generation Project area.

A significant challenge to the scientific community will be to determine the degree to which global climate is changing due to anthropogenic (man-made) causes such as increased greenhouse gas concentrations in the atmosphere as opposed to natural causes such as volcanic and solar activity. Manitoba Hydro will continue to monitor the capability of Global Climate models and Regional Climate models from the perspective of being able to duplicate climate change within the current climate regime. Once these models are calibrated to predict current climate regimes, they can be used with confidence to predict future climate trends and may potentially be able to predict the frequency and magnitude of extreme events in the Wuskwatim Generation Project area (e.g. severe storms, wind events, ice storms).

Manitoba Hydro will also continue to be involved in research projects aimed at assessing past variability in climate and particularly streamflow to gain a better understanding relating to extremes which may have occurred in past centuries, prior to the current period of record (\ This will assist in determining if future climate extremes are part of a naturally occurring cycle or whether climate change is contributing to wider extremes and greater variability.

5.11.2 Physiography, Geology and Soils

Following construction, the geology of the newly exposed rock faces will be mapped. During operations, sites proposed for **rehabilitation** will be monitored to determine the success of natural revegetation for the purposes of safety (i.e., erosion prevention) and aesthetics. Erodible soils along the access road to site, as well as the general Wuskwatim site, will also be monitored to determine whether additional slope protection is required.

5.11.3 Water Regime

From the perspective of energy production, Manitoba Hydro will record forebay elevation, tailrace elevation and flow through the Wuskwatim Site. Additionally, Manitoba Hydro currently records water levels on the three lakes (Wuskwatim Lake, Opegano Lake and Birch Tree Lake) through the use of Data Collection Platforms (DCPs). Manitoba Hydro will also add tailrace water-level recording to the information it currently collects in the local vicinity.

5.11.4 Ice Processes

Periodic ice and water-temperature monitoring upstream and downstream of the Project site will be carried out for safety purposes and to maintain efficient flows.

5.11.5 Wuskwatim Lake Erosion

Follow-up monitoring and analysis related to shoreline-erosion processes and effects in Wuskwatim Lake, to periodically update GIS model input parameters and re-calibrate erosion model estimates, would likely include the following:

- continuing to monitor bank recession at the Manitoba Hydro erosion-monitoring sites;
- analyzing wind data from Manitoba Hydro's Wuskwatim Lake weather-monitoring site, combined with water-level data and bank-recession rate data from the erosion monitoring sites, to better model factors causing variability in bank recession rates;
- reclassifying the shoreline shortly before impoundment and making necessary adjustments to the GIS database and erosion-model estimates;
- reclassifying the shoreline at regular intervals (e.g., every 10 years) after impoundment, as required; and
- analyzing and monitoring debris conditions, erosion rates, and wind and water-level data to better understand the relationship between debris conditions and bank recession rates.

5.11.6 Riverine Erosion

Follow up monitoring and analysis related to riverbank erosion would consist of the following activities:

- periodic review of riverbank-recession calculations from the Project site to downstream Opegano Lake;
  - this review would be conducted based on updated GIS mapping and review of data collected at existing monitoring stations; and
  - the purpose of the periodic review will be to verify predictions; and

- continuation of riverbank-erosion monitoring activities in downstream Opegano and Birch Tree Lakes.

5.11.7 Sedimentation

Follow-up monitoring and analysis related to sedimentation and TSS processes would likely include the following:

- the implementation of a long-term sediment-monitoring program to develop site-specific sediment-deposition characteristics for the lake, and to monitor deposition in other downstream lakes such as Opegano and Birch Tree Lakes;
- the expansion of the TSS monitoring program (both temporally and spatially) to better understand the variation in TSS data; and
- the continuation of the collection of sediment plate data including re-establishment of deep-water sites on Wuskwatim Lake.

5.11.8 Woody Debris

Shoreline debris survey as described in Volume 4, Section 9.2 will be carried out shortly before impoundment to determine whether there are any substantial changes in shoreline debris (e.g., a change from moderate to heavy debris).

6.0 AQUATIC ENVIRONMENT

6.1 INTRODUCTION

This section describes the existing aquatic environment and assesses the anticipated impacts of the construction and operation of the Project on the aquatic environment. NCN identified water quality (upon which all life depends) and certain fish (specifically lake whitefish, walleye, northern pike, and lake cisco) due to their importance to the domestic and commercial fisheries as key components of interest. The assessment also focused on fish habitat due to its importance to fish species and to address requirements under the federal *Fisheries Act*. Fish habitat is defined in the *Fisheries Act* as "spawning grounds and nursery, rearing, food supply and migration areas on which fish depend directly or indirectly in order to carry out their life processes." These studies also addressed requirements pertaining to the Manitoba Fishery Regulations and the Manitoba *Endangered Species Act*.

The assessment included a range of components of the aquatic ecosystem, to ensure that major potential linkages between project-induced effects and their ultimate impacts on fish were addressed. This approach is consistent with NCN's holistic view of the environment, that all parts are interconnected and important.

The existing aquatic environment is a regulated system in which water flows are managed for the purposes of providing water to several large hydroelectric facilities downstream on the lower Nelson River (Section 5.3); therefore, the existing water regime does not follow a natural seasonal pattern. Diversion of the Churchill River in the mid-1970s increased flows through the study area approximately 8-fold and raised the level of Wuskwatim Lake an estimated 3 m (Section 5.3), disrupting the existing aquatic environment and riparian areas, and flooding terrestrial areas.

The baseline for the assessment of the Wuskwatim Generation Project is this regulated environment and, therefore, includes categories such as "flooded terrestrial vegetation" which are not common in natural systems. Information collected from pre-diversion studies and in the decade following diversion are of limited value to describe current conditions, as over time new shorelines have formed and fish populations have established in the altered environment. For the purposes of this EIS, it was assumed that the existing aquatic environment represents a relatively stable state. This assumption was based on studies from other regulated systems where the post-development fish community was no longer experiencing significant annual changes in terms of abundance and species composition 20-25 years after development (e.g., Long Spruce Forebay), as well as the stability observed over the last decade or more in non-biological parameters (e.g., erosion rates, Volume 4 and water quality Volume 5). However, it should be noted that the aquatic system may still be undergoing some changes as a result of CRD; these changes may be masked by other activities (e.g., annual variation in commercial fish harvests) which would introduce a larger amount of variation into the system.

Water levels and flows are described in Section 5.3. The following components of the aquatic environment are described in this section.

Water quality is important to both humans and aquatic biota. In response to concerns raised by NCN and other communities regarding the effects of hydroelectric development on water quality, and in consideration of the importance of water quality to the local communities and aquatic biota, water quality has been designated a VEC. Information on current water quality was collected and effects on water quality have been considered in terms of its use as a drinking water source and for other human uses, and its suitability for aquatic biota and wildlife.

Aquatic habitat is defined as the environment in which fish and other aquatic organisms live, including the interacting physical, chemical, and biological constituents that form a particular environment. The aquatic habitat section provides a quantitative description of the physical habitat [i.e., water depth and velocity, substratum type, and the presence or absence of cover (e.g., aquatic vegetation, terrestrial debris, and riparian vegetation)] and forms the basis upon which effects to the biological components of the aquatic environment are assessed.

Lower trophic levels include all organisms apart from fish that occupy the aquatic environment, including **algae**, rooted plants, **zooplankton**, and **benthic invertebrates**. Changes in the abundance and distribution of these groups as a result of physical changes in habitat are an important linkage to effects to fish. Although bacteria and other microscopic forms (e.g., **meiofauna**) are included in the lower trophic levels, these forms were not considered directly in this assessment.

Fish community includes all groups of fish. Although NCN members indicated that all fish species are considered important, 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. Key domestic and commercial fish species, including walleye, lake whitefish, lake cisco, and northern pike, were identified as VECs and were the focus for assessing the significance of any Project-related effects on the fish community.

Fish quality studies focused on parameters that affect the suitability of fish for consumption by humans, specifically levels of mercury, other heavy metals, and parasites (cysts in whitefish), and taste/texture.

Summary discussions of each aquatic component are presented in Sections 6.5 to 6.9. Utilization of these aquatic resources is described in Section 8.0. Study areas, linkages between ecosystem components and the project activities and operations are described and the methods used in collecting and assessing information are outlined in Section 6.2 to 6.4. Cumulative effects of the varied development activities within the region are discussed in Section 6.11 while the proposed monitoring and follow-up program for the aquatic environment is outlined in Section 6.12. The agencies and individuals who conducted and reported the aquatic investigations are identified in Appendix 1.

6.2 STUDY AREA

The aquatic environment studies focused on waterbodies to be directly affected by changes in water levels and flows as a result of the Project, i.e., the Burntwood River downstream from Early Morning Rapids up to, and including, Opegano Lake (Figure 6.2-1). Downstream of Opegano Lake, the expected effects of the Project on water regimes are minimal, i.e., less than current wind and wave effects. Aquatic environment studies were also conducted on the streams crossed by the proposed access road.

The degree of physical change (e.g., change in water levels and flows) differs substantially from one portion of the study area to another. To facilitate descriptions and discussions the Burntwood River was divided into four distinct reaches (Figure 6.2-1). A fifth area was identified to include the streams crossed by the access road. These reaches are delineated as follows:

Reach 1 - Wuskwatim: The 22 km reach from Early Morning Rapids to the crest of Wuskwatim Falls, including an 8 km reach of the Burntwood River, and Wuskwatim Lake and adjacent waterbodies (Cranberry Lakes, Sesep Lake, and Wuskwatim Brook). This reach will comprise the reservoir for the proposed GS. The full-supply level will be 234 m ASL;

Reach 2 - Falls: The 1 km reach between the crest of Wuskwatim Falls and the tail-water of Taskinigup Falls. This reach corresponds to the immediate forebay of the proposed GS; it will have an increased water level up to the 234 m ASL (reservoir operating elevation);

Reach 3 - Burntwood: The 14 km reach, including the Burntwood River mainstem and several small backwater inlets, between the tail-water of Taskinigup Falls and Opegano Lake. This reach will be subjected to daily water level and discharge fluctuations from operation of the GS superimposed on the existing fluctuations due to CRD operation and seasonal events;

Reach 4 - Opegano: The 8 km reach from the inlet of Opegano Lake to the crest of Jackpine Falls, immediately downstream of Opegano Lake. This reach will be subjected to detectable daily water level fluctuations, although the magnitude of the fluctuations will be much less than those experienced in the upstream river reach; and

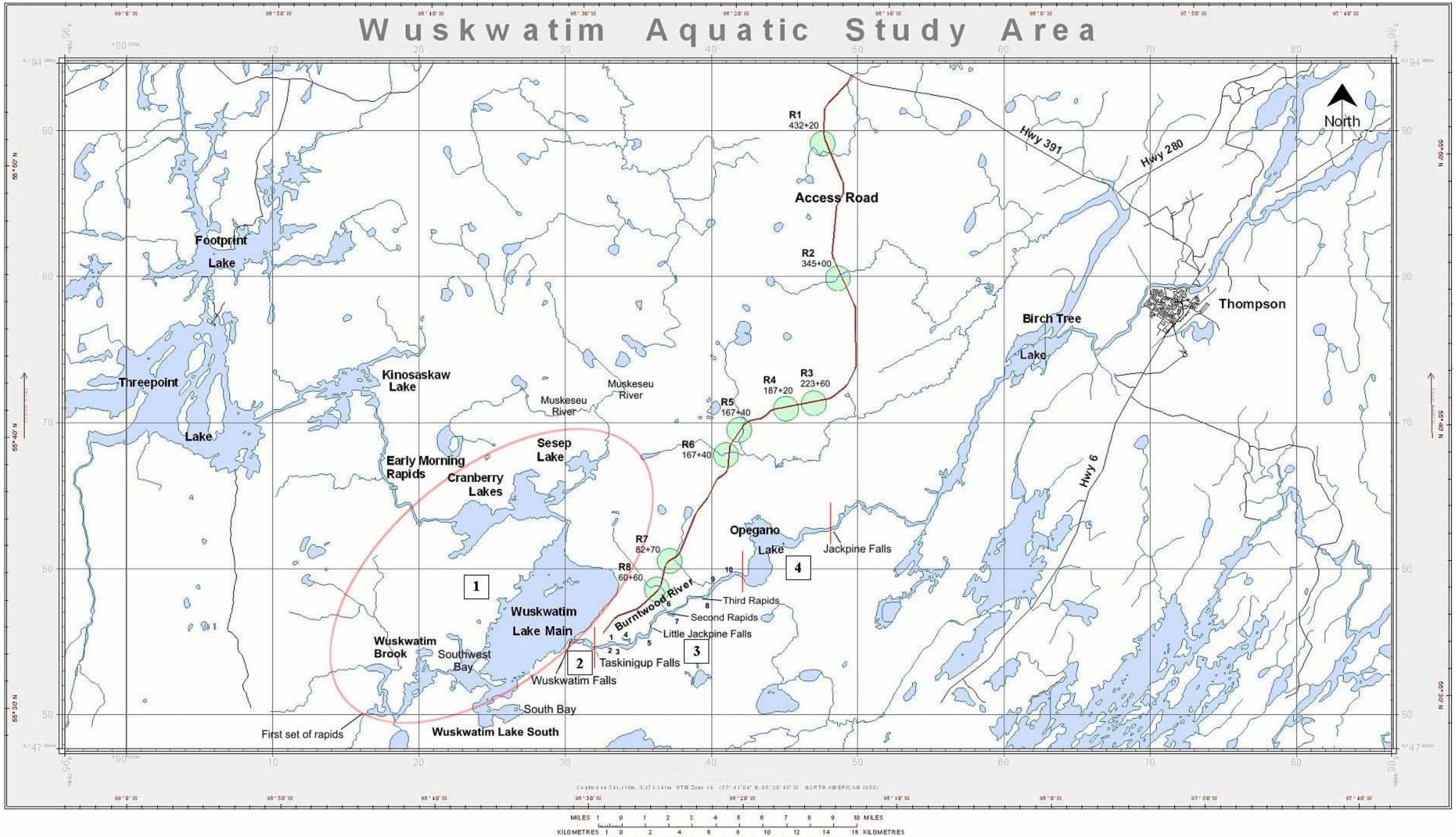


Figure 6.2-1. Wuskwatim Generation Project aquatic study area.

Stream Crossings: Reaches of streams crossed by the access road linking the proposed GS site to Provincial Road #391 (Access Road).

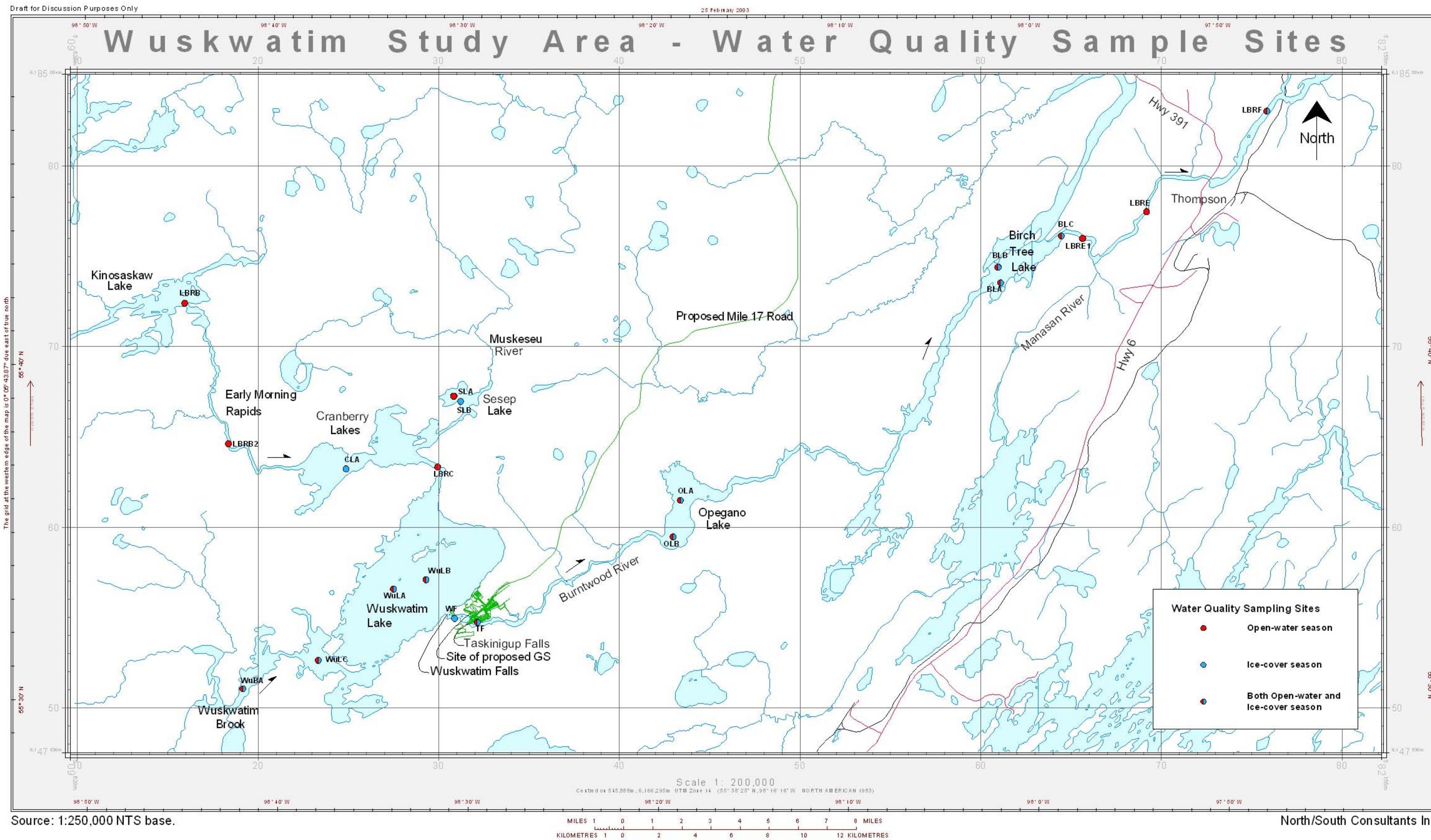
Water quality studies were carried out on the Burntwood River as far downstream as Split Lake (approximately 180 km) (Figure 6.2-2) because: (i) impacts to water quality can be carried downstream beyond the extent of the direct physical changes caused by the Project (e.g., sediments suspended in the water); and (ii) downstream communities raised concerns pertaining to potential impacts to local water quality. Water samples were also taken from one site at the outlet of Kinosakaw Lake, 8.5 km upstream of any potential physical effects of the Project. The additional downstream reaches were designated as follows for the water quality studies:

Reach 5 - Downstream of Opegano: The 25 km reach of the Burntwood River from Jackpine Falls, through Birch Tree Lake, to the City of Thompson; and

Reach 6 - Downstream of Thompson: The approximately 100 km reach of the Burntwood River downstream of the City of Thompson to the inlet at Split Lake.

Most of the sites in Reach 6 were sampled for the first time in 2002 and, as the data are being collected to establish a pre-Project baseline, results of this sampling program are presented in data monitoring reports (Cooley and Shipley 2003) and are not included in this EIS.

Additional detailed descriptions of information related to the aquatic environment study areas are provided in Volume 5, sections 5.1 (surface waters and sediments), 6.1 (aquatic habitat), 7.1 (lower trophic levels), 8.1 (fish community and movement studies), and 9.1 (fish quality).



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North/South Consultants Inc.

Figure 6.2-2. Water quality sampling sites in the study area.

6.3 LINKAGES

This section provides an overview of the major impacts from the construction and operation of the GS that were considered in the assessment of effects to the aquatic environment. Additional information and a complete list of impacts are provided in Volume 5. The potential effects of these activities and mitigation measures for components of the aquatic environment are discussed in sections 6.5 to 6.9.

6.3.1 Construction-Related Impacts

The majority of impacts during construction will be related to releases of substances affecting water quality and, indirectly, aquatic biota. As described in Section 4.4, measures employed during construction will reduce impacts and subsequent effects to aquatic biota. The major inputs are suspended sediments, arising from a range of sources, including: in-stream excavation; surface run-off and discharges from settling ponds; metals (primarily related to the same sources as suspended sediments); treated effluent from the sewage lagoon; and an increase in riverbed and riverbank erosion during some stages of river management. It should be noted that, based on handling procedures for hazardous materials and emergency response measures (Section 4.4), the potential for significant contamination of the aquatic environment as a result of a spill is considered negligible.

Blasting near and in the aquatic environment is another potential source of impact. As described in Section 4.4, the majority of blasting will be conducted in the dry and will meet guidelines prepared by the Department of Fisheries and Oceans (Wright and Hopkey 1998). However, removal of the final rock plugs for the channel improvement, spillway and GS is not expected to meet guidelines (it should be noted that these will each involve a single blast).

The presence of a large workforce, as well as the access road to Wuskwatim Lake, have the potential to affect the fisheries. NCN and Manitoba Hydro, in consultation with the Nelson House Resource Management Board, are developing an Access Management Plan (Section 4.3). Measures taken to control access through the Access Management Plan and measures taken by Manitoba Conservation (which is responsible for managing the fishery) will determine the magnitude and duration of the impact.

Changes to the water regime and flooding, two impacts that begin during construction, are considered below under operation.

6.3.2 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 and sedimentation), the presence of the generating station itself, and the provision of road access.

Water Regime

The following was derived from information presented in sections 4.3.1 and 5.3 in volumes 3 and 4. In assessing the potential effects of the post-Project water regime on the aquatic 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 (Figure 5.3-4). 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.

Reach 1: Wuskwatim

As discussed in Section 6.1, regulation results in month-to-month and interannual changes in water levels that do not follow a consistent seasonal pattern (Figure 5.3-3). Water levels range from 232.88 m ASL (5th percentile) to 234.09 m (95th percentile) creating a relatively large area that is intermittently exposed. The GS will generally stabilize water levels near 234 m, though levels will vary somewhat (the 2.5th percentile elevation is expected to be 233.75 m). For the purposes of the assessment, the post-Project intermittently exposed area was taken to lie between the elevations of 233.75 and 234.0 m ASL. Post-Project, the median lake level will increase by approximately 0.3 m, and the zone of fluctuating water levels will be reduced. Operation of the station will cause small stage variations within the day (median 0.06 m, up to 0.13 m in the immediate forebay).

During periods of low flow, conditions could arise when water levels in the reservoir would be drawn to below 233.75 m (Volume 3). 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. The effect of use of reservoir storage on the aquatic environment is considered in Section 6.10.

Reach 2: Falls

Water levels in this reach (the immediate forebay) will be raised approximately 7 m, flooding about 37 ha of terrestrial area. Water levels will tend to be slightly lower than in Reach 1, and water level changes within the day will be greater. Water velocity in the reach will be reduced: immediately upstream of the GS maximum velocity will be approximately 0.6 m/s, while the inundation of Wuskwatim Falls will reduce velocities at the outlet of Wuskwatim Lake into the range of 0.5 – 0.7 m/s.

Changes in the spatial extent of aquatic habitat due to flooding and the presence of the GS itself were assessed based on maps provided in Volume 4.

Reaches 3 and 4: Burntwood and Opegano

Operation of the station would involve cycling between the 3 units, each of which would generally be operated at the discharge for maximum efficiency or "best gate" (Section 4.5). The variation in the number of units operating during various periods within the day will superimpose water level changes within the day on 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 (as discussed in Section 4.5.1.1, 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: 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 water levels in this reach will decrease, as the discharge of 1 unit (328 m^3/s) is considerably lower than the post-CRD minimum of 440m^3/s and the 5th percentile flow (600 m^3/s). These minimum water levels will occur when inflow is less than approximately 660 m^3/s (7th percentile flow), and operation will consist of cycling between 1 and 2 units within the day (Section 4.5), resulting in several hours of minimum water levels each day.

Median and greater flows are higher in the post-Project period, and areas that are currently considered terrestrial (above the 95th percentile) will fall into the upper portion of the aquatic zone in the post-Project environment [it should be noted that terrestrial species also occur below the 95th percentile (Section 7.5)].

Daily fluctuations in discharge will cause shifts in velocity within the river. The assessment of these effects is based on the results of 2-D flow modeling (Volume 4).

Ice Conditions

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

Erosion and Sedimentation

Approximately 30% of the shoreline in Reach 1 is currently eroding, mostly in Cranberry Lakes and Wuskwatim Lake (75% of the shoreline of Wuskwatim Lake main is eroding) (Section 5.5). The altered water regime will increase the rate of erosion on these shorelines, resulting in an estimated 2.5-fold increase in the amount of eroded material during the first five years of the Project (Volume 4). It is expected that approximately 50% of this material would settle in the nearshore environment and an additional 25% would settle in deeper waters, with the remainder staying in suspension and moving downstream (Section 5.7).

Erosion downstream of the GS is not expected to change within the majority of the river channel (Section 5.6).

Debris

The increased rate of erosion will result in additional debris; however, the majority of this debris is expected to be trapped within existing debris fields (Section 5.8) and therefore, would not affect the aquatic environment.

Presence of the GS

Fish passing downstream in the post-Project environment would generally pass through the turbines of the GS. Information on turbines is provided in Volume 4.

Increased Fishery

Provision of road access is expected to increase the domestic, commercial, and recreational fisheries on Wuskwatim Lake (Sections 8). To reduce potential negative effects of increased harvesting, NCN and Manitoba Hydro, in consultation with the Nelson House Resource Management Board, will develop an Access Management Plan prior to construction (Section 4.3). Measures included in the Access Management Plan will determine the extent of impact related to changes in harvesting activity. It should be noted that Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest.

6.4 METHODS

The aquatic environment studies were developed and implemented to respond to information requirements identified in the Joint Study Program (Section 2.2.2). These studies were conducted by discipline-specific professionals assisted by competent technical staff and informed NCN members using proven techniques and procedures. Over the course of conducting the studies adjustments were made to the scope of work in response to findings and expressed concerns.

All discipline-specific study teams employed common general methods to carry out their work:

- collection and review of published information relevant to the study area;
- consultation with NCN leadership and members regarding Traditional Knowledge (TK) and resource use, and their concerns about and expectations from the Project;
- consultation with regulatory authorities and local resource managers;
- review of information and consultation with Manitoba Hydro about the proposed development including, locations of potential disturbance, construction schedule and activities, temporary and permanent facilities, planned operations, environmental protection practices, and mitigation programs;
- field investigations and monitoring;
- review of information and data regarding previous hydroelectric development in the region and in other similar situations; and
- study team meetings and discussions.

To the extent possible, study information and data were recorded and presented using **Geographic Information System (GIS)** techniques, i.e., mapped at the appropriate scale, with supporting text and tabular presentations. Reports have been prepared in both electronic and hard copy formats.

effects of increased harvesting, NCN and Manitoba Hydro, in consultation with the Nelson House Resource Management Board, will develop an Access Management Plan prior to construction (Section 4.3). Measures included in the Access Management Plan will determine the extent of impact related to changes in harvesting activity. It should be noted that Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest.

6.4 METHODS

The aquatic environment studies were developed and implemented to respond to information requirements identified in the Joint Study Program (Section 2.2.2). These studies were conducted by discipline-specific professionals assisted by competent technical staff and informed NCN members using proven techniques and procedures. Over the course of conducting the studies adjustments were made to the scope of work in response to findings and expressed concerns.

All discipline-specific study teams employed common general methods to carry out their work:

- collection and review of published information relevant to the study area;
- consultation with NCN leadership and members regarding Traditional Knowledge (TK) and resource use, and their concerns about and expectations from the Project;
- consultation with regulatory authorities and local resource managers;
- review of information and consultation with Manitoba Hydro about the proposed development including, locations of potential disturbance, construction schedule and activities, temporary and permanent facilities, planned operations, environmental protection practices, and mitigation programs;
- field investigations and monitoring;
- review of information and data regarding previous hydroelectric development in the region and in other similar situations; and
- study team meetings and discussions.

To the extent possible, study information and data were recorded and presented using **Geographic Information System (GIS)** techniques, i.e., mapped at the appropriate scale, with supporting text and tabular presentations. Reports have been prepared in both electronic and hard copy formats.

Discipline-specific methods are summarized below.

6.4.1 Surface Waters and Sediments

Detailed descriptions of sampling methods and rationale for water quality parameter selection are provided in Volume 5, Section 5.2 and are summarized below. Sampling locations are show on Figure 6.2-2.

A suite of physical and chemical variables used to describe the quality of surface waters in the study area were analysed with measurements taken in the field (*in situ*) and by laboratory analyses according to recognized procedures. Data presented in this document describe water quality in samples collected during the open-water seasons in 1999, 2000, and 2001, and in the ice covered periods of 2001 and 2002. Not all parameters were tested or all sites sampled during each period. Sites and parameters were added as the study progressed in accordance with analysis results and identification of additional information requirements. Sediments were collected for chemical analysis in July 2001, and August 2002. Water quality samples were collected at access road stream crossing sites in June 2002, and at tributary streams along the Burntwood in September 2002.

Results of water quality and sediment analyses were compared to provincial (Williamson 2002) and national (CCME 1999) guidelines and objectives, where available. The results were also evaluated for compliance with criteria for the protection of aquatic life and wildlife, and the criteria for various human usages (drinking water, recreation, and aesthetics).

6.4.2 Aquatic Habitat

Aquatic habitat in reaches 1 through 4 was surveyed during field investigations and mapped using a GIS-based system. Key characteristics included: water levels and level fluctuations (as defined by recorded elevations); substrata type (e.g., hard or soft silt/clay, boulder-cobble, flooded terrestrial); presence/absence of rooted submergent aquatic plants; and water velocity. The classification system for the large lakes (Wuskwatim and Opegano) differed somewhat from that for riverine sections in terms of water elevation and velocity characteristics.

Lacustrine (i.e., lake) habitats were classified into three zones with respect to elevation for the existing environment (Figure 6.4-1):

- Intermittently Exposed Zone – the shore zone bounded by the 5th and 95th water level percentiles. This area represents a band along the edge of a lake that has experienced exposure, i.e., dewatering 5 to 95 % of the time since 1977;
- Nearshore Zone – the shore zone that is effectively wetted all the time. The upper border of the zone corresponds to the 5th percentile water elevation and the lower border of the nearshore zone was identified visually and defined using bathymetric data. The selected contour (229 m ASL for Wuskwatim Lake and 203 m for Opegano Lake) separated most shallow areas and bays from the main basin of the lake; and
- Offshore Zone – all areas of a lake between the nearshore zone and the deepest area of the lake (minimum lake-bed elevation).

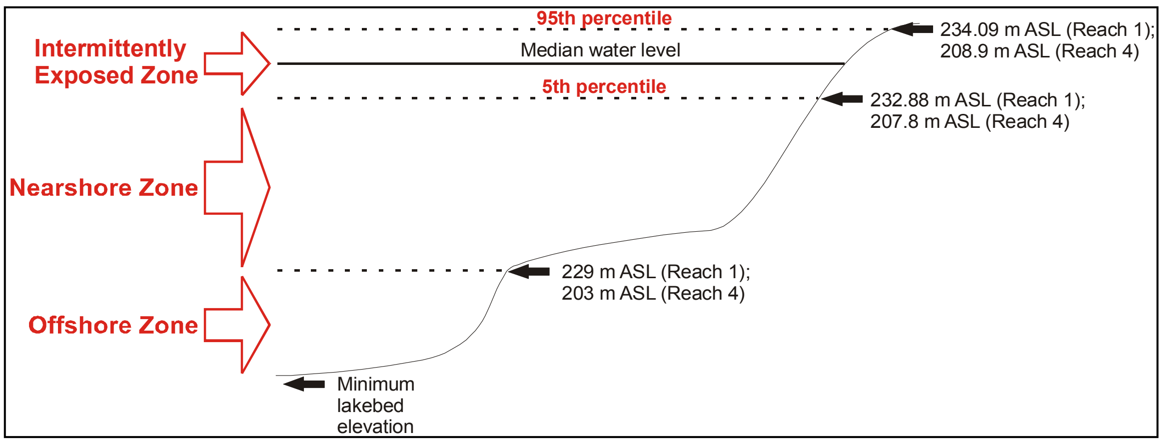


Figure 6.4-1. Classification of lacustrine habitat into zones with respect to water level in the pre-Project environment.

The riverine reaches were divided into intermittently exposed (bounded by the 5th and 95th water level percentiles) and permanently wetted areas. Habitat in the river sections was also described as mainstem or backwater inlet areas.

Eight stream crossings were identified along the access road and surveyed (Figure 6.2-1). Assessments of fish habitat value and sensitivity were developed using the rationale described in Habitat Conservation and Protection Guidelines (DFO 1998).

Detailed discussions of survey methodology for the quantification of aquatic habitat, as well as rationale for the classification system, are provided in Volume 5, Section 6.2.

6.4.3 Lower Trophic Levels

Detailed descriptions of sampling methods and rationale for studies are provided in Volume 5, Section 7.2 and are summarized below. Lower trophic studies targeted four important groups:

Phytoplankton

Algae were sampled in the water column at selected lake sites in conjunction with the water quality sampling program. Algae were identified to genus/species and enumerated, and biomass in mg/m^3 wet-weight was determined. Chlorophyll *a* concentration, a relative measure of phytoplankton biomass, was also measured at the majority of water quality sampling locations.

Attached Algae and Rooted Aquatic Plants

Information on rooted submergent aquatic plant abundance, species composition, and distribution (i.e., location of areas supporting rooted plants visible from the surface) was recorded during the boat-based aquatic habitat surveys. This information was supplemented with observations during aerial surveys and with detailed sampling along transects at selected sites where plants were present.

Zooplankton

Zooplankton samples were collected at selected lake sites in conjunction with the water quality sampling program with a 63 µm mesh net and identified to genus/species.

Benthic invertebrates

Benthic invertebrate organisms provide a relative measure of the productivity of aquatic habitat. Over 700 samples were collected in the 1998 to 2001 period along transects in the aquatic habitat types found in each reach. All samples were identified to major group with a sub-set further identified to genus/species to create an index of biodiversity for selected aquatic habitat types. Drift traps were also used to supplement the survey of the benthic invertebrate community in areas where other sampling methods were not possible due to safety concerns (e.g., immediately upstream and downstream of Wuskwatim and Taskinigup falls).

6.4.4 Fish Community and Movement Studies

Detailed descriptions of sampling methods and rationale for studies conducted are provided in Volume 5, Section 8.2 and are summarized below. The fish community and movement field program included six primary components with overlapping activities as follows:

Habitat-Based Fish Community Assessment

The objective of this study was to provide a replicable, habitat-based description of the fish community. **Standard-gang index gill nets,** consisting of six 25 yd (22.9 m) twisted nylon panels of 1.5 in (38 mm) to 5.0 in (127 mm) stretched mesh, were set in the most common habitat types where net sets were possible (i.e., not in medium and high velocity habitat). As Wuskwatim Lake supports a commercial fishery, sampling effort within each year was limited so to not exceed a target catch of 200 individuals of each VEC (sample sizes of infrequently caught VEC species such as northern pike and whitefish were smaller).

In addition to fish species composition, relative abundance, and quantitative **catch-per-unit-effort** data, information on fish size, age, condition, sex and state of maturity, and diet were also obtained from fish captured in index gill nets.

Spring Spawning

Traditional Knowledge (TK) identified potential spawning habitat for walleye and northern pike in the first phase of the study; field sampling results supplemented this information as the study progressed. Short duration (2-4 hours) sets of large mesh twisted nylon gill nets (3.0 in to 5.0 in [76 mm to 127 mm]) were used in mid-May to mid-June to capture target species. Captured fish were assessed for sexual maturity to infer the location of spawning habitat. Potential spawning habitat in tributaries was assessed with **larval drift traps** (Burton and Flannagan 1976) and **kick-nets** to capture eggs and larvae. Larval drift traps were also set in the mainstem of the Burntwood River at selected locations between Wuskwatim Falls and Opegano Lake and in Wuskwatim Lake immediately upstream of Wuskwatim Falls.

Information from the radio-tagging studies was also used to infer potential spawning sites (see Fish Movements study).

Fall Spawning

As with the spring spawning study, TK, supplemented by field study results, was used to identify potential spawning locations for lake whitefish and lake cisco. At the onset of the open water season (usually mid-May), a **modified neuston sampler** (Mason and Philips 1986) was used from 1999 to 2002 in **lentic** habitats and **floating drift traps** (designed after Burton and Flannagan 1976) were used during 2001 and 2002 in **lotic** habitats to capture larval cisco and whitefish as they emerged from the substrate.

Potential spawning sites were also assessed indirectly through radio-tagging studies.

Overwintering

The intent of this study was to identify habitat presently used by fish for overwintering. It focused on areas where the Project could potentially adversely affect some characteristic of overwintering habitat (e.g., water velocity, dissolved oxygen). Gillnet gangs, consisting of two 25 yd (22.9 m) twisted nylon panels of each of 1.5 in (38 mm) and 4.25 in (108 mm) stretched mesh, were set under the ice at eight sites. At each location, dissolved oxygen concentrations were measured using a **YSI meter**. Radio-tracking studies were also used to identify overwintering habitat for lake whitefish, lake cisco, and walleye.

Tributary Streams

The tributary stream study assessed fish utilization of several tributaries, including streams flowing into the Burntwood River between Taskinigup Falls and Opegano Lake (Reach 3) and streams crossed by the access road (Figure 6.2-1). Fish species composition and abundance within the most downstream 100 m of each stream flowing into Reach 3 were assessed during September 2001 by sampling with a **backpack electrofisher**.

Fish species composition and abundance data within the streams crossed by the access road during the open water period was obtained by sampling 100 to 300 m long sections of each stream in early spring 2002. During March 2002, dissolved oxygen concentrations were measured at three of the eight crossings to provide information on the potential of these streams to overwinter fish.

Fish Movements

The objective of this study was to assess general movement patterns of VEC fish species to determine if, and to what extent, fish are moving between reaches of the study area. Two methods were employed:

Floy tagging: A total of 1,259 fish were tagged, including 69 lake whitefish, 361 lake cisco, 146 northern pike, and 683 walleye. The majority of the fish (1,057) were tagged in Wuskwatim Lake.

Radio-tagging: 14 walleye, 20 lake whitefish, and 8 lake cisco captured in Wuskwatim Lake were tagged with radio-transmitters in fall 1999, and spring and fall, 2000. Tagged fish were relocated using an aircraft borne receiver.

6.4.5 Fish Quality

Detailed descriptions of sampling methods and rationale for studies conducted are provided in Volume 5, Section 9. Fish quality studies were undertaken to enable assessment of several indicators of fish quality: mercury concentrations; trace metal concentrations; whitefish cysts; and fish palatability.

Mercury analyses were carried out on **length-stratified** samples of lake whitefish, lake cisco, northern pike, and walleye. Mean mercury concentrations (expressed as µg mercury per gram of body wet weight; ppm) were standardized to facilitate comparisons between samples of fish from the same lake or between samples of fish from different waterbodies over time. The standards used in the federal/provincial Program for Monitoring of Mercury Concentrations in Fish in Northern Manitoba Reservoirs was followed in these studies.

Lake whitefish and walleye taken from study area waterbodies in 2001 and 2002 were also dressed, sectioned, and frozen to enable laboratory analyses for 29 trace metals.

Lake whitefish taken from Wuskwatim Lake in 2001 and 2002 were inspected for the presence of cysts of *Triaenophorus crassus* in the body musculature following the "Whitefish Inspection Protocol" used by the Freshwater Fish Marketing Corporation.

In October 2002 the University of Manitoba Food Sciences Faculty involved 49 panelists from Nelson House in an evaluation of the taste acceptability of cooked walleye, northern pike, and lake whitefish from Burntwood River lakes and Baldock Lake (an "**off-system**" lake).

6.5 WATER AND SEDIMENT QUALITY

6.5.1 Summary of Existing Environment

The following presents a synopsis of results for analysis of the physical and chemical properties of surface waters and sediments in the Wuskwatim study area for the years 1999 – 2001 and winter 2002. A detailed presentation of results can be found in Section 5, Volume 5, including information on parameters not presented below (e.g., hydrocarbons, protozoan parasites, fecal coliform bacteria, and sediment chemistry).

6.5.1.1 Water Chemistry

Wuskwatim, Opegano, and Birch Tree lakes can be broadly described as:

- meso-eutrophic to eutrophic (total phosphorus ranged from 0.018 to 0.048 mg/L);
- highly oxygenated (in ice-free and ice-cover seasons dissolved oxygen (DO) typically in excess of 9 mg/L);
- soft-water (water hardness ranged from 47 to 59 mg/L as CaCO3);
- slightly alkaline (lab pH ranged from 7.4 to 8.1);
- low transparency (Secchi disk depths ranged from 0.2 to 1.2 m); and
- **total suspended solids** (**TSS**) typically ranging from < 2 mg/L to 24 mg/L.

The lower Burntwood River in the study area can be described in similar terms:

- highly **turbid** (turbidity ranged from 18 to 63 NTU,);
- total suspended solids typically ranging from < 5 mg/L to 24 mg/L;
- soft (water hardness ranged from 51 – 63 mg/L as $CaCO_3$);
- slightly alkaline (lab pH ranged from 7.4 to 7.9); and
- highly oxygenated (the majority of measurements of dissolved oxygen in excess of 9 mg/L and all were above 6 mg/L).

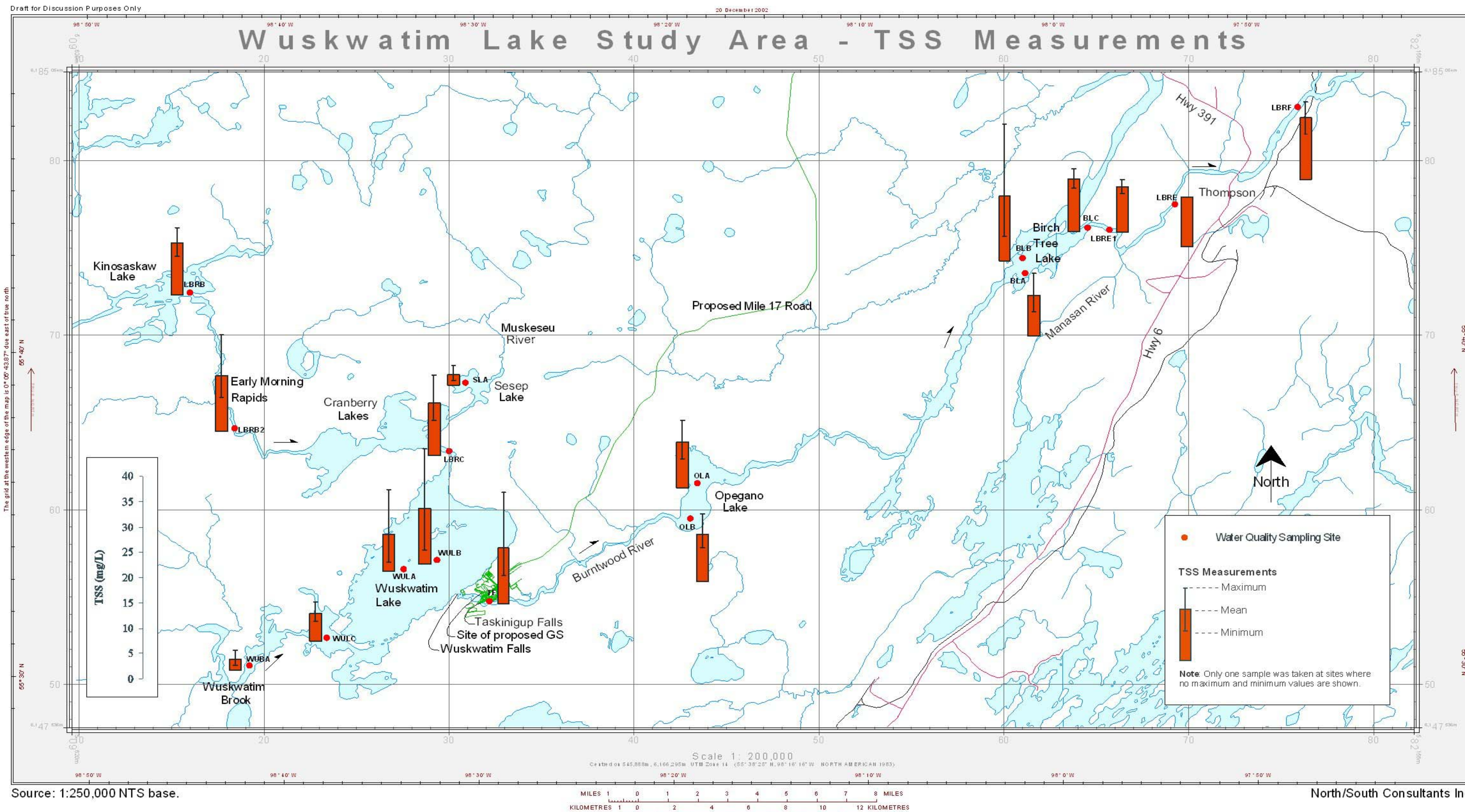
Concentrations of nitrogen and phosphorus are moderately high in the study area and the area is characterized by moderate levels of **organic carbon**. Most measurements of total phosphorus in the lakes and at locations on the lower Burntwood River at the point of entry to the lakes exceeded the Manitoba Water Quality Standards, Objectives, and Guidelines (MWQSOGs) for total phosphorus of 0.025 mg/L for the prevention of nuisance plant growth (Williamson 2002). Conditions, in general, appeared to indicate that of the two major plant nutrients (nitrogen and phosphorus), conditions were generally nitrogen limiting. However, due to the **hydraulic** conditions (i.e., high turbulence, high velocities, high flushing rates and low river travel times) and the low water transparency at most sites along the mainstem of the study area, **phytoplankton** growth is likely limited (or co-limited) by light and/or physical characteristics of the aquatic environment.

Water chemistry at sites not lying along the mainstem of the study area including Sesep Lake, Wuskwatim Brook, and Wuskwatim Lake south, differs somewhat from conditions along the mainstem of the study area. Sesep Lake and Wuskwatim Brook contain higher levels of **total kjeldahl nitrogen**, organic carbon, and **chlorophyll** *a*, lower concentrations of total phosphorus and total suspended solids (TSS) (Figure 6.5-1), and are more clear (less turbid, and higher secchi depths) and acidic than Wuskwatim, Opegano, or Birch Tree lakes. **Conductivity** in Sesep Lake is also higher than other sites evaluated on the mainstem of the study area. Water chemistry in Wuskwatim Lake south (WuLC), which is influenced by Wuskwatim Brook water, is similar to conditions encountered in Wuskwatim Brook; generally, levels of nitrogen, organic carbon, and chlorophyll *a* are higher, pH is lower, and water clarity (lower turbidity and higher secchi depths) is greater at this site, relative to Wuskwatim Lake main and the remainder of the study area on the mainstem. In addition, off-current areas in Wuskwatim Lake south and in waterbodies adjacent to Wuskwatim Lake (Wuskwatim Brook, Sesep Lake, Muskeseu River) experience lower concentrations under ice cover. At some sites in these areas, DO occurred at levels below acute and chronic MWQSOGs for the protection of aquatic life; near **hypoxic** conditions were observed in the Muskeseu River and Wuskwatim Brook in March 2002.

Relative to the mainstem of the study area, tributary streams in Reach 3 were, in general, more nutrient-rich (ammonia, nitrate/nitrite, **organic nitrogen** [ON], TKN, total nitrogen (TN), dissolved phosphorus, total phosphorus), had higher concentrations of organic carbon, **total dissolved solids**, and TSS, and higher levels of water hardness and true **colour**. Streams were also less oxygenated, although DO was higher than water quality objectives, and more acidic than the mainstem Burntwood River. As these streams drain bogs, these observations are as expected.

Some seasonal differences in certain water chemistry parameters were observed throughout the study area. In general, concentrations of inorganic forms of nitrogen and phosphorus were higher, while total concentrations of nitrogen and phosphorus were lower in winter. Furthermore, water clarity was greater and pH was lower (due to reduced photosynthetic activity and entrapment of carbon dioxide by ice cover) under ice.

Concentrations of some metals were elevated in the study area, most notably aluminum and iron; levels of both these metals are typically at least an order of magnitude above



Source: 1:250,000 NTS base.

North/South Consultants Inc.

Figure 6.5-1. Mean surface total suspended solids (TSS) concentrations measured in the study area in the open-water season, 2001.

MWQSOGs for the protection of aquatic life, and have been elevated in this system for decades (Ramsey 1991). Iron also exceeds the aesthetic objective for drinking water quality throughout the study area. Several other metals/metalloids were, at times, elevated above MWQSOGs for the protection of aquatic life including copper (three measurements at Birch Tree Lake, one measurement at Wuskwatim Lake, and one measurement at Opegano Lake), lead (two measurements at Birch Tree Lake, one measurement in the lower Burntwood River downstream of Birch Tree Lake, and one upstream of Wuskwatim Lake), nickel (one measurement in Birch Tree Lake), and selenium (one measurement at Wuskwatim Lake and one at Taskinigup Falls). The most exceedences of criteria for metals and metalloids occurred in Birch Tree Lake. The occurrence of high levels of iron and aluminum, and occasionally high concentrations of other metals, in the study area has been described as 'natural' (Ramsey 1991) and exceedences have been observed for many metals and metalloids in the lower Burntwood River at Thompson at the MB Conservation monitoring site WQ 0093.00 (See Section 5.0, Volume 5).

Inorganic elements were measured at two tributary streams in Reach 3. Results were similar to the mainstem; aluminum, iron, zinc, and lead exceeded MWQSOGs for the protection of aquatic life and iron exceeded the aesthetic objective for drinking water. Concentrations of aluminum and iron measured in Stream 4 were the highest measurements recorded for the entire Wuskwatim study area.

The Canadian Water Quality Index (CWQI) (CCME 200b) was applied to water quality data collected in the study area during the open-water season 2001 for Birch Tree Lake, Wuskwatim Lake, the lower Burntwood River downstream of Taskinigup Falls, and the lower Burntwood River downstream of Early Morning Rapids. The water quality index (WQI) value for Birch Tree Lake, ranked as 'marginal', reflects water quality conditions that are consistently in non-compliance with objectives for iron, phosphorus, and aluminum, and two values for lead that were above the water quality objectives. Aluminum concentrations were in the range of 10 – 25 times the water quality objective.

The WQI value for Wuskwatim Lake, ranked as 'fair', is slightly higher than that for Birch Tree Lake. All concentrations of iron and aluminum and three of the four measurements of phosphorus obtained for this site did not comply with objectives.

Values for the WQI for both sites on the lower Burntwood River for the year 2001 are ranked as 'fair'. These values reflect consistent non-compliance with objectives for iron and aluminum. One measurement of lead in water collected at the lower Burntwood River downstream of early morning rapids was also above the corresponding water quality objective. As observed at the two lake sites, all but one measurement of aluminum fell in the range of 10 – 25 times the objective.

6.5.2 Impact Assessment and Mitigation

The following assessment describes predicted effects to water quality. The "significance" of effects is described in terms of the duration, magnitude, and spatial extent of exceedence of water quality objectives and guidelines described in the MWQSOGs for specific uses. The applicable uses varied depending on location (for example, surface waters are used as a source of drinking water by resource users on Wuskwatim Lake, but limited or no resource use occurs in the Burntwood River immediately downstream of the proposed GS).

6.5.2.1 Construction

Construction-related pathways considered in the impact assessment for water quality include: discharge of treated sewage; blasting; leachate from waste rock piles and/or dam structures; construction and removal of cofferdams; runoff from the camp site and work area; discharge of wastewaters from processing of aggregate materials and concrete; placement of concrete structures in the local surface water environment; clearing; increased riverbed and bank erosion during diversion of the river; removal of spillway and channel improvement rock plugs and initial start-up; and, access road construction (i.e., stream crossings).

In general, waters (i.e., aggregate processing wastewaters, site runoff) will be treated to minimize adverse effects to water quality prior to discharge to local surface waters.

The likelihood of accidental spills and releases exerting a significant impact on the aquatic environment during construction and operation of the project is low due to application of good management practices, including safety and handling procedures, emergency response plans, and spill containment measures, as described in Section 4 and Volume 3.

The following is a summary of predicted effects of major construction activities on water quality. There are no construction-related activities that are likely to affect water quality in Reach 1. Effects to downstream reaches are discussed below.

Reach 2: Falls

Measures described in Section 4 and Volume 3, as well as standard practices that will be described in the EnvPP will be taken with the intent of limiting the increase in TSS to less than a daily average of 25 mg/L above background conditions at a fully mixed point in the Burntwood River (i.e., immediately upstream of Opegano Lake). This increase would represent the net effect of all construction-related activities, including discharge of camp site runoff, excavation for permanent works, site clearing, cofferdam construction and removal, and removal of rock plugs, as well as sediments arising from erosion of the riverbank and riverbed as flow patterns are altered during river management (Volume 5, Section 6). This increment above background TSS is consistent with the Manitoba short-term water quality objective, which applies for a 1-day averaging duration for surface waters where total background concentrations of TSS less than or equal to 250 mg/L (Williamson 2002). It is expected that there may be periods during construction when the 30-day averaging duration of an increase in TSS of 5 mg/L above background may be exceeded; however, exceedence of this 30 day guideline for several weeks during the construction period is not expected to cause a significant change in the aquatic biota due to its short–term nature (in the order of 8 weeks) and given the range of background concentrations of TSS in the Burntwood River.

In the event that on-going planning activities indicate that mitigation measures may not be sufficient to maintain the increase in TSS levels to within 25 mg/L over background, the Proponent will: a) estimate the magnitude and duration of the period when this will occur; b) determine if these elevated levels will affect aquatic biota; c) investigate the possibility of implementing additional mitigative measures; and d) consult with appropriate regulatory authorities.

The levels of metals and metalloids associated with the sediments described above will also increase in Reach 2. The significance of these increases to aquatic biota varies among parameters, depending on guideline levels for the specific parameter and background concentrations in the Burntwood River (detailed assessment provided in Volume 5).

There are no anticipated significant effects on dissolved oxygen, water temperature, or bacteria and parasites; thermal effluents are not expected to be released in Reach 2.

Blasting will use ammonium nitrate-fuel oil (ANFO), but it is not expected to cause significant increases in nutrients (i.e., ammonia and nitrate) in surface waters because the EnvPP will specify that efforts will be made to remove all unspent charges, leaving negligible quantities of ammonia and nitrate to be introduced to surface waters.

The potential for waste rock placed in the Excavated Materials Placement Area and the main dam to generate acidic leachate which could subsequently affect pH and/or metal concentrations in the local surface water environment was assessed (Volume 3). Based on proposed mitigation (Volume 3), no effects of acid leachate on water quality are expected.

Reach 3: Burntwood

Backwater Inlet of Stream 4

The proposed sewage treatment will meet Provincial standards for this type of facility and treated effluent will be discharged into a small (approximately 9 ha) backwater inlet on the Burntwood River downstream of Taskinigup Falls. Discharge of treated effluent into this backwater inlet is predicted to cause some measurable changes due to the small volume of water in the inlet. The discharge is planned to occur twice per year for a period of 5 days in spring and 10 days in late fall. The effluent will not be thermal. The increase in TSS is not expected to cause an exceedence of the 1-day MWQSOG (25 mg/L) or the chronic objective (5 mg/L), which is applicable to a 30-day averaging period. Effluent discharges will result in declines in DO; however, DO concentrations were observed to be quite high in the winter 2002 (See Section 5.3.4.3) and the inlet does not appear to be particularly vulnerable to critical over-winter lows of DO. The increases in nitrogen and phosphorus that occur during periods of effluent release may stimulate plant and algal growth, though effluents will be released when growth of these groups may be limited by other environmental factors. Effluent discharges are not expected to raise ammonia and nitrate concentrations to levels considered toxic. Concentrations of fecal coliform bacteria may measurably increase but levels would remain below water quality guidelines for recreation.

Mainstem of the Burntwood River

Discharge of treated sewage effluent will not cause a measurable change in the Burntwood River due to dilution.

Change in flow patterns as a result of river flow management (i.e., construction of cofferdams, diversion through spillway channel) is not expected to affect dissolved oxygen levels in Reach 3 due to the high velocities and large volumes of water. Water temperature will not be affected in Reach 3 due to an absence of effects upstream and because no thermal effluents will be discharged.

As discussed for Reach 2, construction activities are expected to result in increases in TSS along the mainstem of the Burntwood River in the order of approximately 8 weeks.

Levels of metals associated with these sediments would also increase. Wastewater generated from processing of aggregate materials and concrete will be treated prior to discharge to the aquatic environment and will be managed to prevent adverse effects to water quality. Therefore, this pathway is not predicted to cause significant increases in trace elements.

Reaches 4, 5, and 6: Opegano and Downstream

Based on existing information, no effects of construction activities are expected downstream of Reach 3, with the possible exception of short-term (up to 8 weeks) effects to TSS/turbidity and related parameters. Increases of TSS will be mitigated with the intent to maintain below 25 mg/L, which given that concentrations will only be elevated in the order of 8 weeks, is not expected to result in significant effects to aquatic life.

Overall, construction-related increases in TSS and related parameters are expected to cause negative and not significant (short-term, moderate (decreasing to small with distance downstream), local to regional) effects on the suitability of water for aquatic life. Effects to parameters such as ammonia, nutrients, and oxygen are also expected to be not significant (short-term, small to moderate, and site-specific). There is not likely to be a significant adverse effect due to spills, given the small potential for the release of harmful quantities to the environment.

Stream Crossings

Construction of the access road will entail excavation and crossing (i.e., installation of culverts) of eight streams and clearing along the right-of-way. Potential effects to water quality are limited to temporary total increases in downstream TSS/turbidity due to sediment re-suspension during construction of stream crossings and erosion of soils in cleared areas. Stream crossing design and installation will incorporate the "Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat" (Department of Fisheries and Oceans and Manitoba Natural Resources 1996). Potential effects to water quality during construction of stream crossings are expected to be minimal because excavation of materials (i.e., streambeds) and placement of culverts and associated stabilization materials (i.e., rip rap) will occur during winter when flows are low.

Overall, construction is expected to result in negative and not significant (short-term, small to moderate, site specific) effects to water quality downstream of crossings. There is not likely to be a significant adverse effect due to spills, given the small potential for the release of harmful quantities to the environment.

6.5.2.2 Operation

Operation-related pathways that were assessed for potential effects to water quality include: flooding of the terrestrial environment; conversion of intermittently wetted to permanently wetted habitat; changes to water levels and flows; erosion; changes to thermal regimes; design considerations of the GS (e.g., water intake depth); generation of acid leachate from the GS structures; road maintenance activities; and accidental spills (Volume 5). Only major linkages are discussed below.

Reach 1: Wuskwatim

Effects of increased erosion in Wuskwatim Lake were considered in two manners: (1) the predicted maximum increase in TSS in Wuskwatim Lake main due to erosion in Wuskwatim Lake and surrounding water bodies; and, (2) the predicted increase in TSS in the nearshore zone of Wuskwatim Lake due to erosion in Wuskwatim Lake main only.

It is expected that 50% of eroded materials in Wuskwatim Lake main will settle in the nearshore zone and the remaining 50% will enter deeper waters, with half (i.e., 25% of the total) potentially transported downstream (Section 5.7).

The maximum predicted project-related increase in TSS within Wuskwatim Lake main (i.e., at the outlet of the lake) is below the chronic MWQSOG for TSS (i.e., the 30-day averaging objective), which indicates an allowable increase of 5 mg/L above background and the one day MWQSOG, which allows for an increase of 25 mg/L above background.

The predicted project-related increase in TSS in the nearshore zone, assuming full mixing, exceeds the chronic water quality objective for TSS (5 mg/L) for the first 5 years of operation, when the largest increase in erosion is predicted. Predicted effects are smaller for the 6 to 25 year period. These increases in TSS would be expected to be associated with concurrent increases in certain metals (e.g., aluminum and iron). A larger effect to TSS is expected during storm events, however the frequency of these events is low.

Operation-related linkages to dissolved oxygen in Reach 1 include conversion of intermittently exposed to permanently wetted habitat, erosion and trophic upsurge (i.e., increased production due to nutrient enrichment). Effects of operation may result in oxygen depletion, in particular in winter where some areas within the tributary waters (Wuskwatim Brook and Sesep Lake) and Wuskwatim Lake south already exhibit oxygen depletion to critically low levels (i.e., below the objective for the protection of aquatic life).

Concentrations of nutrients are not expected to be affected in Wuskwatim Lake main (i.e., in the main basin), but may be affected in nearshore areas adjacent to eroding banks and in areas where shoreline vegetation has become permanently submerged (e.g., shallow bays of Sesep Lake, Wuskwatim Brook and Wuskwatim Lake). The effects of nutrient enrichment on algal growth is discussed in Section 6.7.

There are no expected measurable effects of operation on pH and alkalinity to Wuskwatim Lake main or the lower Burntwood River upstream of Wuskwatim Lake due to high dilution and flushing rates, because these areas exhibit a moderate buffering capacity, and are characterized as systems with a low to very low sensitivity to acidification.

Increases in total suspended solids and related parameters are expected to have a negative and not significant (short-term, moderate, site-specific to local) effect on use of water for drinking[1], suitability for aquatic life, navigation and aesthetics. Increases in nutrients and decreases in oxygen are expected to have a negative and not significant (short-term, moderate, site-specific to local) effect on use of water for drinking[1], suitability for aquatic life and aesthetics.

Reach 2: Falls

As indicated above, the maximum predicted project-related increase in TSS at the outlet of Wuskwatim Lake falls within water quality objectives. Increased water levels in Reach 2 are expected to cause only a modest increase in erosion compared to upstream areas because of the low wave energy environment (Section 5.5); therefore the input of additional TSS due to erosion in this reach is expected to be minimal.

Flooding of approximately 25 ha of natural terrestrial habitat (containing organic materials) due to creation of the immediate forebay will cause reductions in dissolved oxygen in the near-shore due to decomposition of organic matter. The largest effects (i.e., moderate effects) will occur in flooded peat (approximately 4.4 hectares) where there are large organic carbon stores (Section 2, Volume 4). Dissolved oxygen depletion in these areas is expected to be moderate and long-term as carbon stores are large enough to supply decomposition processes for many years. However, measurable effects are expected to be restricted to the flooded area and not extend through most of Reach 2 due to the high flows.

[1] Drinking water use refers to use of surface waters by resource users. Note that all surface water should be sterilized prior to human consumption.

Nutrient concentrations will also increase over flooded areas in the nearshore. Following conversion of the river environment to a forebay, current levels of phosphorus will exceed the criteria for reservoir environments, even without project-related increases in nutrients (i.e., current levels in the river are above the MWQSOG for reservoirs). There will also be some initial release of trace elements from flooded peat and soils, causing a small site-specific increase in the concentrations of some metals and metalloids.

In consideration of the existing conditions in Reach 2 with respect to acid neutralizing capacity and the relatively low water residence time, effects of flooding on pH are expected to be small or negligible and limited to the nearshore flooded environment (i.e., off-current areas).

Overall changes to water quality in Reach 2 are expected to have a negative, not significant (long-term, moderate, site-specific) effect to the suitability of water for aquatic life.

Reach 3-6: Burntwood, Opegano and downstream

No significant changes to total suspended solids or turbidity are expected in Reach 3-6 during operation, though there may be some increases due to inputs from upstream in association with storms, when erosion is increased on Wuskwatim Lake (these increases are generally expected to be within the MWQSOGs). In general, the altered water regime is not expected to increase erosion downstream of the GS. There may be some short-term increases in TSS immediately after the station is commissioned, due to the mechanisms discussed under construction (i.e., erosion of the riverbanks and riverbed as the channel adjusts to the new water regime).

Localized reductions in dissolved oxygen may occur in the backwater inlets of tributary streams and along the north shore of Opegano Lake where peatlands may break up (Section 7.5) and possibly die and decompose due to increased water levels and water level fluctuations. Oxygen depletion may be more pronounced in winter, where affected areas develop full ice-cover.

No significant effects of operation on nutrient concentrations are expected due to high flows and negligible effects to nutrients upstream in Reach 2. Small quantities of nutrients may be released from the die-off of peatlands.

Overall changes to water quality in reaches 3-6 are expected to have a negative, not significant (long-term, moderate, site-specific) effect to the suitability of water for aquatic life. In addition, there may be some negative and not significant (short-term, small to moderate, and local to regional) effects to the suitability of water for aquatic biota during the period of initial station operation.

Stream Crossings

Minor increases in TSS may occur immediately downstream of stream crossings in the open-water season; effects are expected to be negligible due to implementation of practices to minimize erosion at stream crossings that will be described in the EnvPP.

Negative and not significant (short to long-term, negligible, site-specific) effects to the suitability of water for aquatic life.

6.6 AQUATIC HABITAT

This section describes the aquatic habitat in each of four reaches of the Burntwood River and provides a quantitative classification of habitat using the following categories: water level (defined by elevation); substrata type; presence/absence of rooted submergent aquatic plants; and water velocity. It should be noted that estimates of the spatial extent of aquatic habitat types provided for the existing and post-Project environments are based on extrapolations from topographic and bathymetric maps. The accuracy of the estimates is reduced for those areas with shorelines characterized as having relatively low slope. All water elevation and flow data were derived from information presented in Volume 4 and Section 5.3. Qualitative habitat characteristics of the streams crossed by the proposed access road also are described. This assessment of habitat before and after the Project, in conjunction with information on water and sediment quality (Section 6.5) and lower trophic levels (Section 6.7), forms the basis for the assessment of impacts to the fish community (Section 6.8).

6.6.1 Existing Environment

6.6.1.1 Reach 1: Wuskwatim

The water level in this reach was raised approximately 3 m due to CRD (Volume 4, Section 6.3.2). The majority of resultant flooding occurred in Cranberry Lakes, Sesep Lake, Wuskwatim Brook, and Wuskwatim Lake south. These flooded terrestrial areas are at various stages of vegetation decay and erosion depending on the type of terrestrial vegetation and substrata flooded, and are generally characterized by peat islands and flooded forest areas. Peat islands occupy approximately 19 % of the surface area in the intermittently exposed zone (IEZ) and are described within the terrestrial habitat section (Section 7.5). Substrata within flooded terrestrial areas is generally high in organic material of boreal forest and bog origin and, due to varying rates of erosion, ranges from soft silt/clay-based to bedrock. Since these areas are shallow and typically sheltered, they support the majority of rooted aquatic plant growth for this reach. Rooted submergent aquatic plant distribution, however, is variable and growth is patchy. Poorly established littoral zones often occur in a regulated system as the frequency and extent of water level fluctuations preclude the development of extensive aquatic plant beds. Lake regulation may also affect plant density and distribution, as altering lake levels can influence both light regime and substrata availability or stability (Rørslett 1984).

Aquatic habitat in this section is described at the 95th percentile water level (shoreline elevation 234.09 m) (Volume 5, Section 6.0). Within Reach 1, the intermittently exposed, nearshore, and offshore zones each occupy approximately 2022 ha (23 %), 2579 ha (29 %), and 4372 ha (49 %), respectively (Figure 6.6-1).

The flooded terrestrial area in Reach 1 is approximately 2913 ha, excluding the very small flooded margin of Wuskwatim Lake main. The majority of nearshore and offshore areas in Wuskwatim Lake main are predominantly soft silt/clay-based substrata, with a narrow band of boulder/cobble visible along a portion of some shorelines when water levels are relatively low (Figure 6.6-2). Shoals are typically hard substrata (i.e., bedrock, boulder/cobble). As bank elevation in Wuskwatim Lake south is lower in comparison to the main lake, the flooded terrestrial area occupies a proportionately larger area and is characterized by peat islands, flooded forest, patchy rooted aquatic plant beds, and soft silt/clay-based substrata rich in detritus (Figure 6.6-3).

Figure 6.6-3. Existing floating peat islands and flooded forest in Wuskwatim Lake south.

Rooted submergent aquatic plants occupy approximately 744 ha (9 %) of the area of Reach 1. The majority of submergent aquatic plants are found within the IEZ (77 %), with the remainder found in the nearshore.

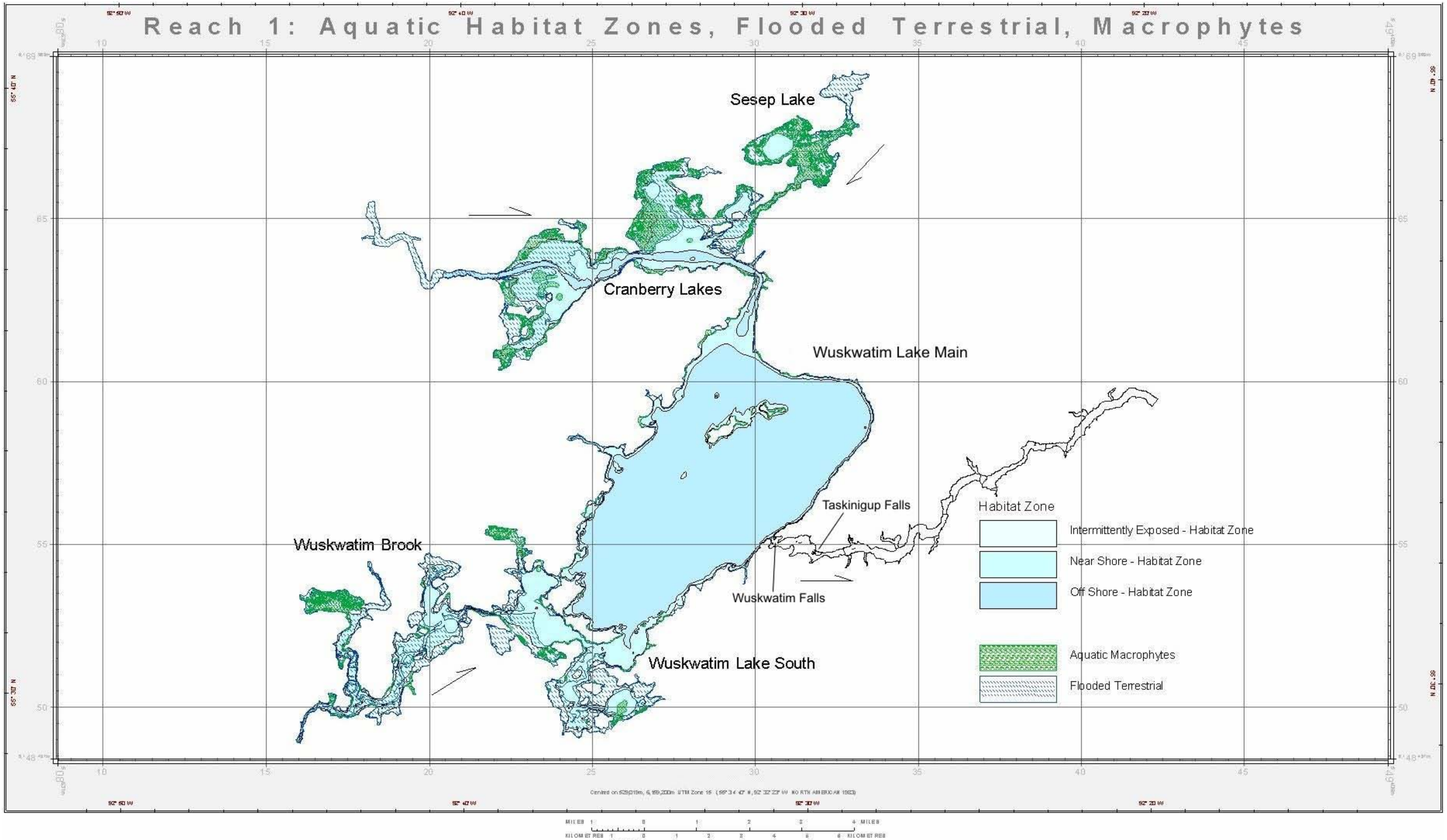


Figure 6.6-1. Existing aquatic habitat zones, flooded terrestrial areas, and distribution of rooted submergent aquatic plants in Reach 1 (shoreline at 234.09 m ASL).

Figure 6.6-2. Existing exposed silt/clay bank along the south-western shore (top), bedrock along the north-eastern shore near the outlet at Wuskwatim Falls (middle), and rooted submergent aquatic plant beds adjacent to a large island in the north end of Wuskwatim Lake main (bottom).

There are two small sections of the Burntwood River in Reach 1: upstream of Cranberry Lakes to Early Morning Rapids; and between Cranberry Lakes and Wuskwatim Lake main. Generally, high (up to 30 m), exposed clay banks along the outside bends and more gradually sloped forested banks along the inside bends characterize the Burntwood River upstream of Cranberry Lakes (Figure 6.6-4). Here the river reaches depths greater than 17 m. The Burntwood River between Cranberry Lakes and Wuskwatim Lake has lower banks that are bedrock controlled at the water's edge and has a maximum depth of about 15 m.

Figure 6.6-4. Existing Burntwood River between Early Morning Rapids and Cranberry Lakes.

6.6.1.2 Reach 2: Falls

The crest of Wuskwatim Falls is the upper extent of this reach and the base of Taskinigup Falls is the lower boundary (Figure 6.6-5). Wuskwatim Falls is about 6 m high from crest to the water surface downstream and Taskinigup Falls is about 15 m high.

Figure 6.6-5. Aerial views of Wuskwatim Falls (top) and Taskinigup Falls (bottom) looking upstream.

Data could not be collected safely near the base of Wuskwatim Falls or the area immediately upstream of Taskinigup Falls. Consequently, the area of Reach 2 that represents the limits of data collected is smaller in size (43.6 ha) than the actual area of the reach (53.3 ha). Aquatic habitat in this section is described at the 95th percentile flow event (discharge at 1066 m^3/s) (Volume 5, Section 6.0). Reach 2 has a surface area of 43.6 ha, a maximum water depth of 19.0 m, a mean water depth of 6.4 m, and a water volume of about 3 million m^3. Aquatic habitat is predominantly found within the wetted zone (90.4 %), with relatively little in the intermittently exposed area (Figure 6.6-6).

The substrata of Reach 2 generally reflect the distribution of water velocities. Off-current areas along the riverbanks and in bays have soft silt/clay-based substrata (22.6 %), in on-current areas within the upstream half of the reach (where water velocities are greatest) the centre of the river is bedrock (20.3 %), and the lower half, including the pools and scour channels, is hard silt/clay-based (29.6 %). The majority of boulder/cobble (13.0 %) is located between the substrata types found in the on-and-off current areas.

There is substantial current through the majority of this reach. Maximum water velocities occur closest to Wuskwatim Falls and dampen out towards Taskinigup Falls. Water velocities are described in detail in Volume 5, Section 6.0.

There are two larger bays midway through the reach, one on the north-side (Figure 6.6-7) and one on the south that were low relief terrestrial areas inundated as a result of CRD. The flooded terrestrial area in Reach 2 occupies approximately 6.4 ha, with the majority (98.0 %) in these two bays. Local runoff enters into each of these bays via small ephemeral drains that have minimal discharge after the spring freshet. Each drain is less than one kilometre in length, has indeterminate channels at the confluence with the river mainstem, and has poorly defined upstream channel margins. Associated with these sheltered bay areas is sparse aquatic plant growth. Relatively high water velocities preclude aquatic macrophyte growth in the remainder of the reach. Rooted submergent aquatic plants occupy an area of 2.2 ha in Reach 2. The majority of submergent aquatic plants are found within the wetted zone (81.2 %).

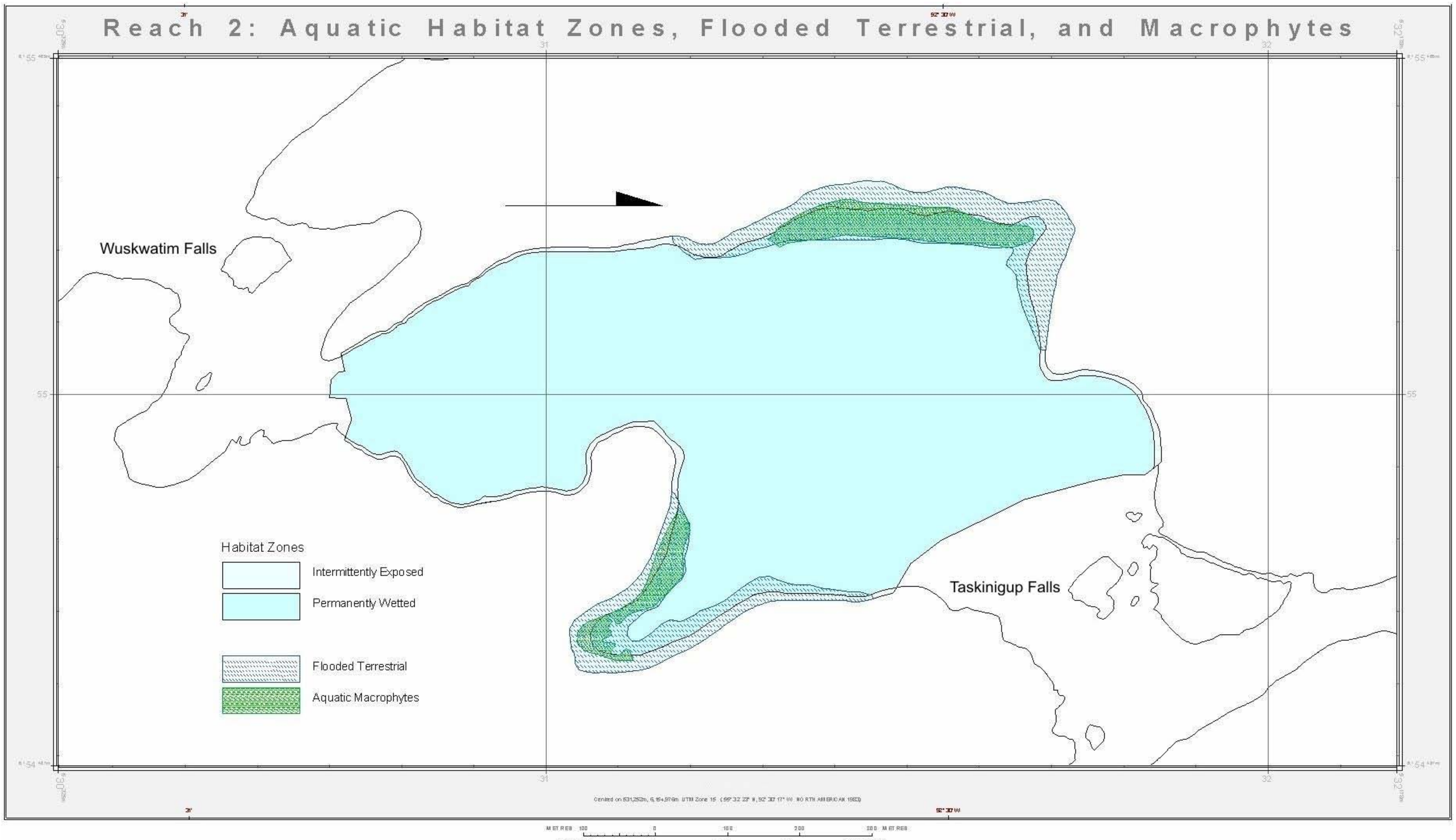


Figure 6.6-6. Existing aquatic habitat zones, flooded terrestrial areas, and distribution of rooted submergent aquatic plants in Reach 2 (95th percentile flow event).

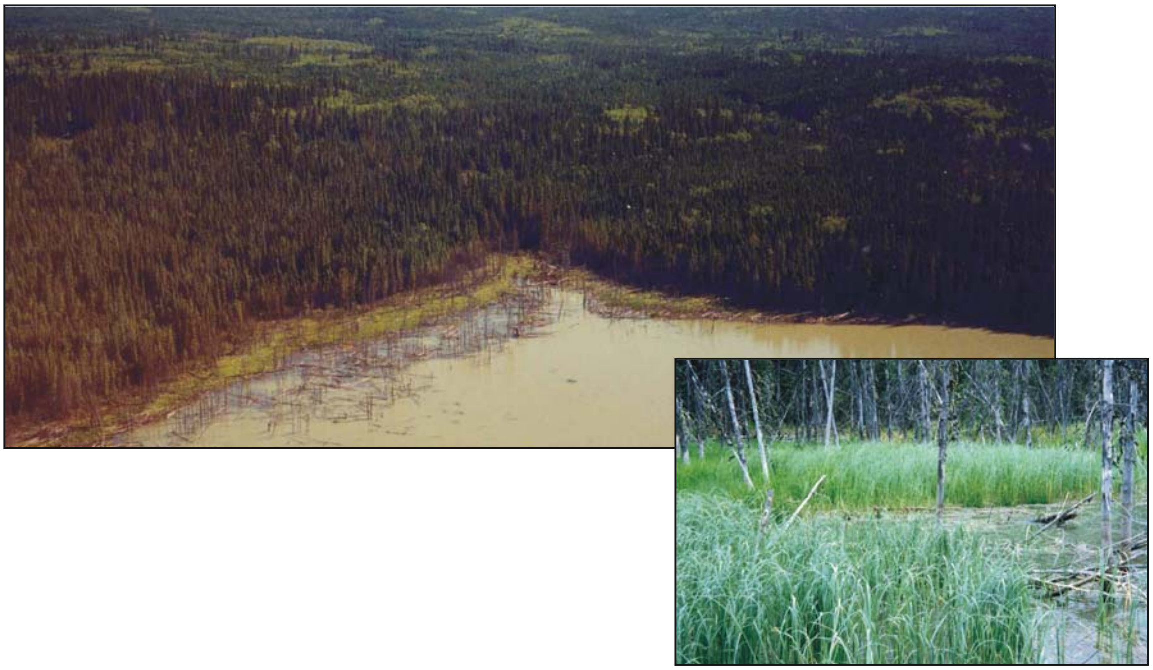


Figure 6.6-7. Existing north-side bay with flooded terrestrial area and aquatic plants (inset).

6.6.1.3 Reach 3: Burntwood

The base of Taskinigup Falls is the upper extent of this reach and the inlet to Opegano Lake is the lower boundary. The Burntwood River between Taskinigup Falls and Opegano Lake is 12 km long with a width ranging from 60 to 300 m. Reach 3 has 10 backwater inlets that receive inflow from **first-order stream**s. The exception to this is inlet 9, which receives water from a **second-order stream**. Drainage areas for these streams are relatively small and discharge into the inlets is low after the spring freshet.

Aquatic habitat in this section is described at the 95th percentile flow event (discharge at 1066 m^3/s) (Volume 5, Section 6.0). Aquatic habitat is predominantly found within the wetted portion of the river mainstem (Figure 6.6-8). The IEZ occupies a larger area within the mainstem than in the backwater inlets; however, a greater proportion of aquatic habitat in the backwater inlets is intermittently exposed (53 %) due to the lower relief and shallower water depths.

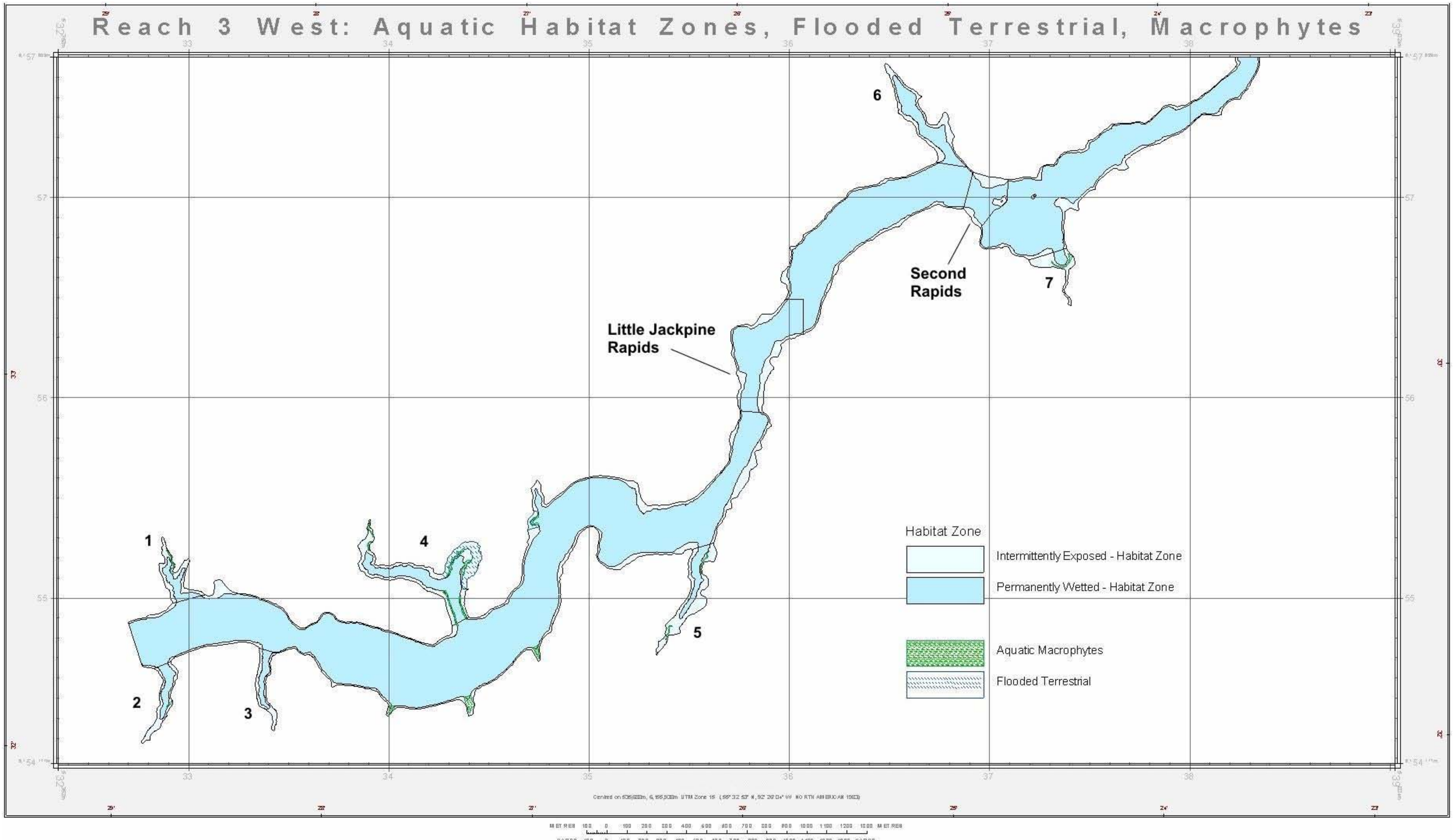


Figure 6.6-8A. Existing aquatic habitat zones, flooded terrestrial areas, and distribution of rooted submergent aquatic plants in the upper portion of Reach 3 (95th percentile flow event).

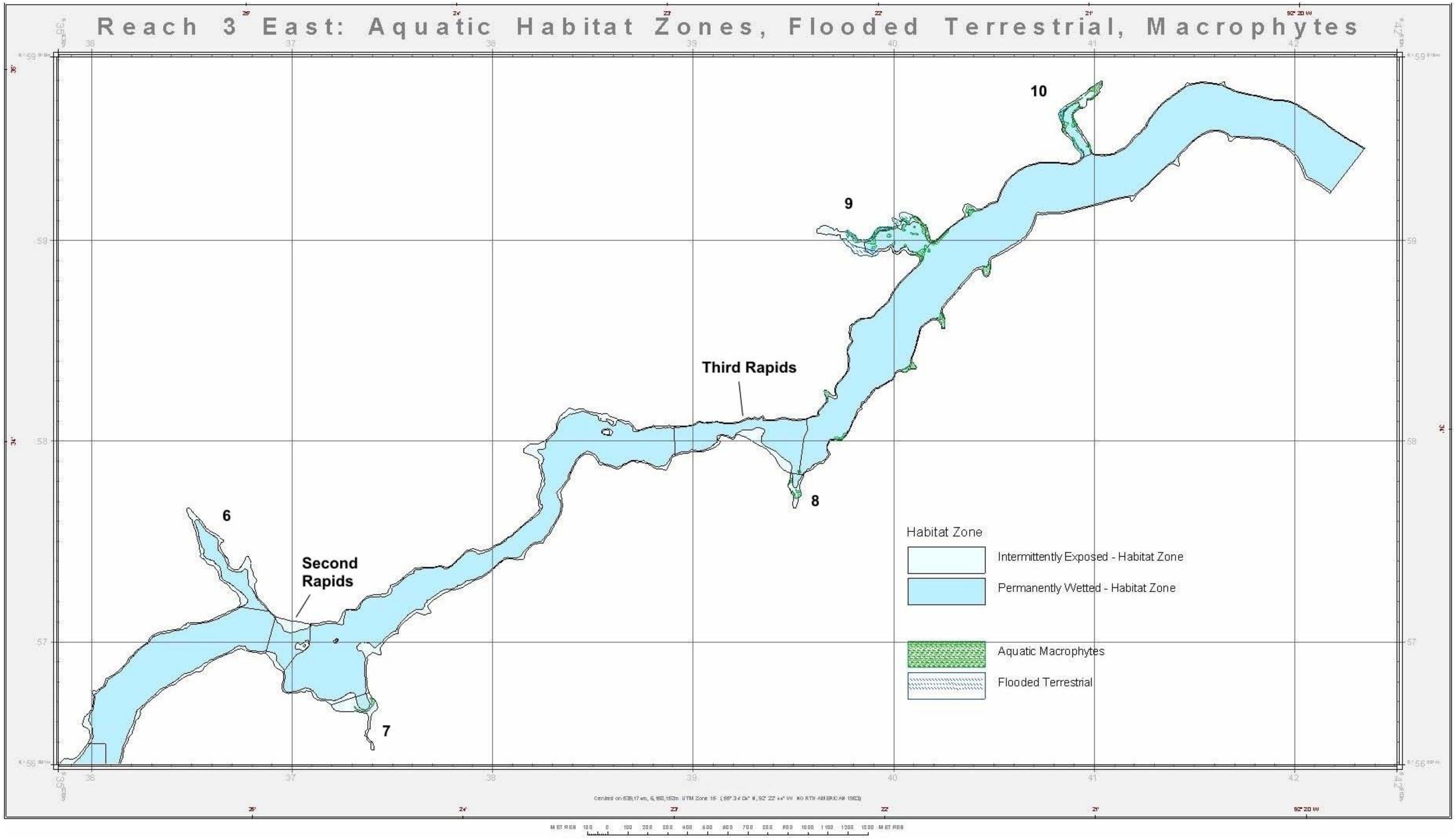


Figure 6.6-8B. Existing aquatic habitat zones, flooded terrestrial areas, and distribution of rooted submergent aquatic plants in the lower portion of Reach 3 (95th percentile flow event).

The Burntwood River mainstem is characterized by a gentle gradient with greater changes in surface elevation occurring at three series of rapids; Little Jackpine Rapids (downstream of backwater inlet 5), Second Rapids (immediately downstream of inlet 6), and Third Rapids (immediately upstream of inlet 8). As in Reach 2, the substrata generally reflect the distribution of water velocities, with soft silt/clay-based substrata in areas of lower velocity, and a mixture of bedrock, boulder/cobble, and hard silt/clay in areas of higher velocity.

The general horizontal pattern of water velocity in the river mainstem is a central band of higher velocities that diminishes towards the banks. In general, faster moving water is associated with the three series of rapids and is visible as a higher velocity tailrace downstream of each set of narrows. Water velocity in the backwater inlets is restricted to areas adjacent to the mainstem and, as such, water movements in the inlets are limited. Water velocities are described in detail in Volume 5, Section 6.0.

Except for inlets 4, 9, and 10, the backwater inlets have relatively small flooded terrestrial areas in their upper ends where relief is low. Inlets 4 and 10 have more extensive flooded marsh-like areas characterized by grasses and sedges and inlet 9 has flooded terrestrial areas characterized by flooded peat and trees. The flooded terrestrial area in Reach 3 occupies approximately 3.4 ha, with the majority (93.0 %) in the backwater inlets. The backwater inlets have soft silt/clay-based substrata throughout; however, inlet 6 has an area of boulder/cobble where the tributary enters the inlet. Typically, the banks of the inlets are silt/clay-based, with the majority having large woody debris (e.g, logs, branches) on shore (Figure 6.6-9).

Figure 6.6-9. Representative silt/clay-based banks of inlet with large woody debris.

Rooted submergent aquatic plants occupy an area of 3.9 ha in Reach 3, predominantly in the IEZ. Areas within the backwater inlets support the majority of submergent aquatic plant growth (64.5 %). Aquatic plants occupy the greatest area in inlets 4, 9 (Figure 6.6-10), and 10. The majority of aquatic plants within the mainstem reside in small notch inlets where water depth is shallower and velocities are reduced.

Figure 6.6-10. Aerial view of backwater inlet 9 with rooted submergent aquatic plant beds.

6.6.1.4 Reach 4: Opegano

Aquatic habitat in this section is described at the 95th percentile water level (shoreline elevation 208.6 m) (Volume 5, Section 6.0). The extents of the intermittently exposed, nearshore, and offshore zones, flooded terrestrial areas, and distribution of rooted submergent aquatic plants in Reach 4 are presented in Figure 6.6-11. Within Opegano Lake, the intermittently exposed, nearshore, and offshore zones each occupy approximately 49.8 ha (6.3 %), 497.9 ha (63.2 %), and 240.6 ha (30.5 %), respectively.

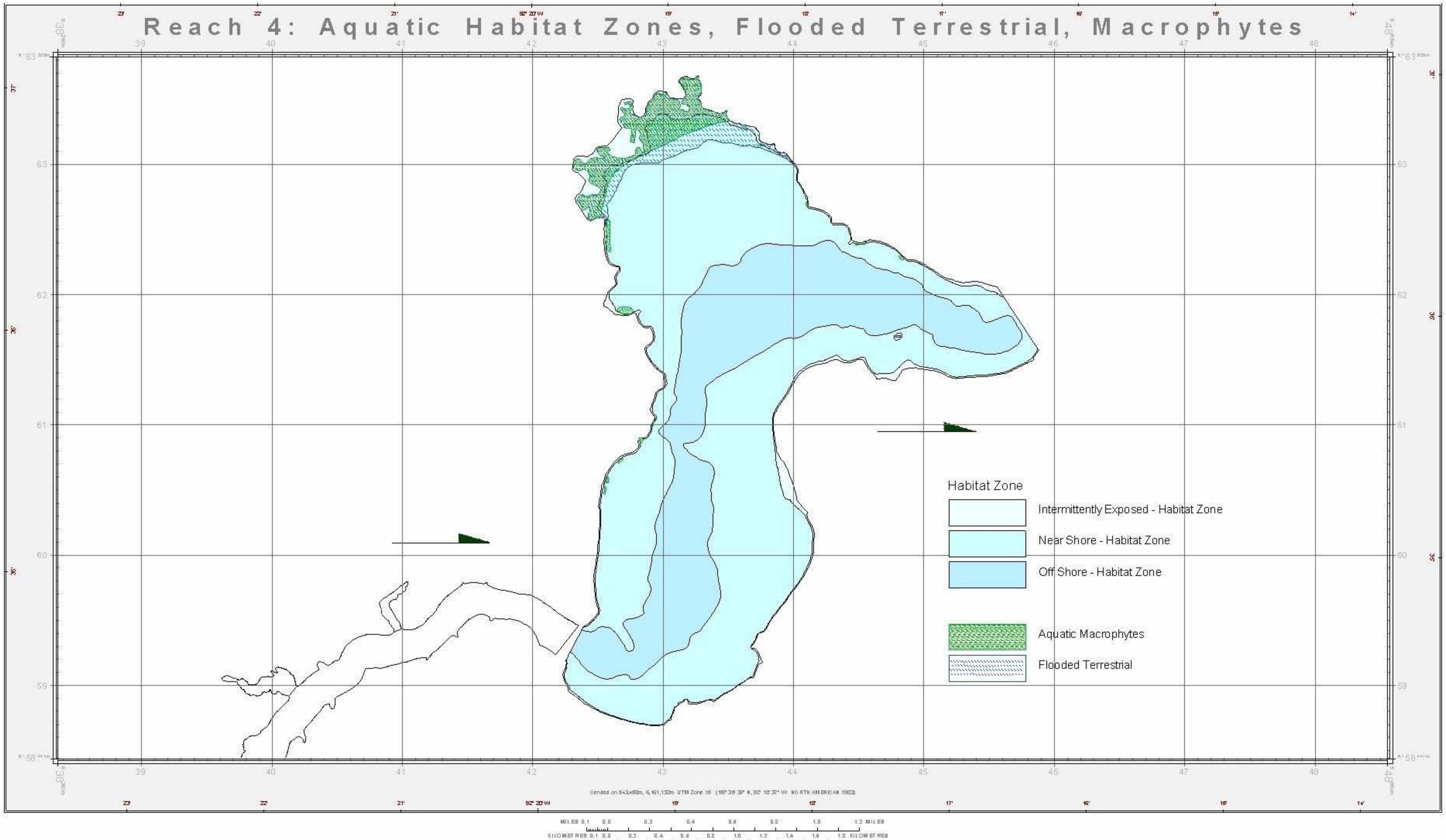


Figure 6.6-11. Existing aquatic habitat zones, flooded terrestrial areas, and distribution of rooted submergent aquatic plants in Reach 4 (shoreline at 208.6 m ASL).

The majority of Opegano Lake's shoreline consists of steep, exposed, silt/clay-based banks.

Rooted submergent aquatic plants are present in 45.5 ha in Opegano Lake, with about 48 % in the IEZ and 52 % in the nearshore. Aquatic plants are predominantly found in the flooded terrestrial areas in the north end of Opegano Lake, with small patches of aquatic plants growing in sheltered areas along the west and east shores (Figure 6.6-12). As in other reaches, the flooded terrestrial areas support the majority of submergent aquatic plant growth.

Figure 6.6-12. Rooted submergent aquatic plants in the flooded terrestrial area in the north end of Opegano Lake.

6.6.1.5 Stream Crossings

The aquatic habitat of streams crossed by the access road is summarized in Volume 5, Section 6.0. These streams originate in poorly drained fens, with the majority classified as having marginal fish habitat and all with a low environmental sensitivity rating. The two exceptions were the stream at R5, a tributary of Birch Tree Brook, and the stream at R8, a tributary of the Burntwood River (backwater inlet 6 in Reach 3) (Figure 6.6-13). The habitat within these two streams is considered adequate to support and over-winter spring-spawners (e.g., white sucker, northern pike), however, spawning potential for fish is probably limited by beaver dams and other obstructions to movements.

Figure 6.6-13. Aerial view of road crossing at R5 (left) and at R8 (right). Line indicates crossing location; arrow indicates direction of water flow.

6.6.2 Impacts and Mitigation

6.6.2.1 Construction

During construction, aquatic habitat will be directly affected in Reach 2 only. The majority of aquatic habitat area disturbed by cofferdam placement is part of an area (about 4.6 ha) that will either be occupied by the GS structure, or within aquatic habitat that will either be modified as part of the intake channel (powerhouse) or the approach channel (spillway) (Volume 3) (Figure 6.6-14).

At each of the eight stream crossings, the footprint of the road, combined with the installation of the culvert(s) will result in several changes in aquatic habitat including the following:

- loss of aquatic habitat due to the footprint of the road;
- depending on the size and method of installation, some changes in water depth for the length of the culvert at some sites, and an increase in depth immediately upstream and downstream of the culvert at most sites;
- introduction of rip-rap at the upstream and downstream ends of the culvert to reduce erosion;
- some increase in sedimentation downstream of the culvert at most sites;
- loss of rooted submergent aquatic plant habitat in the immediate footprint of the road at most sites; and

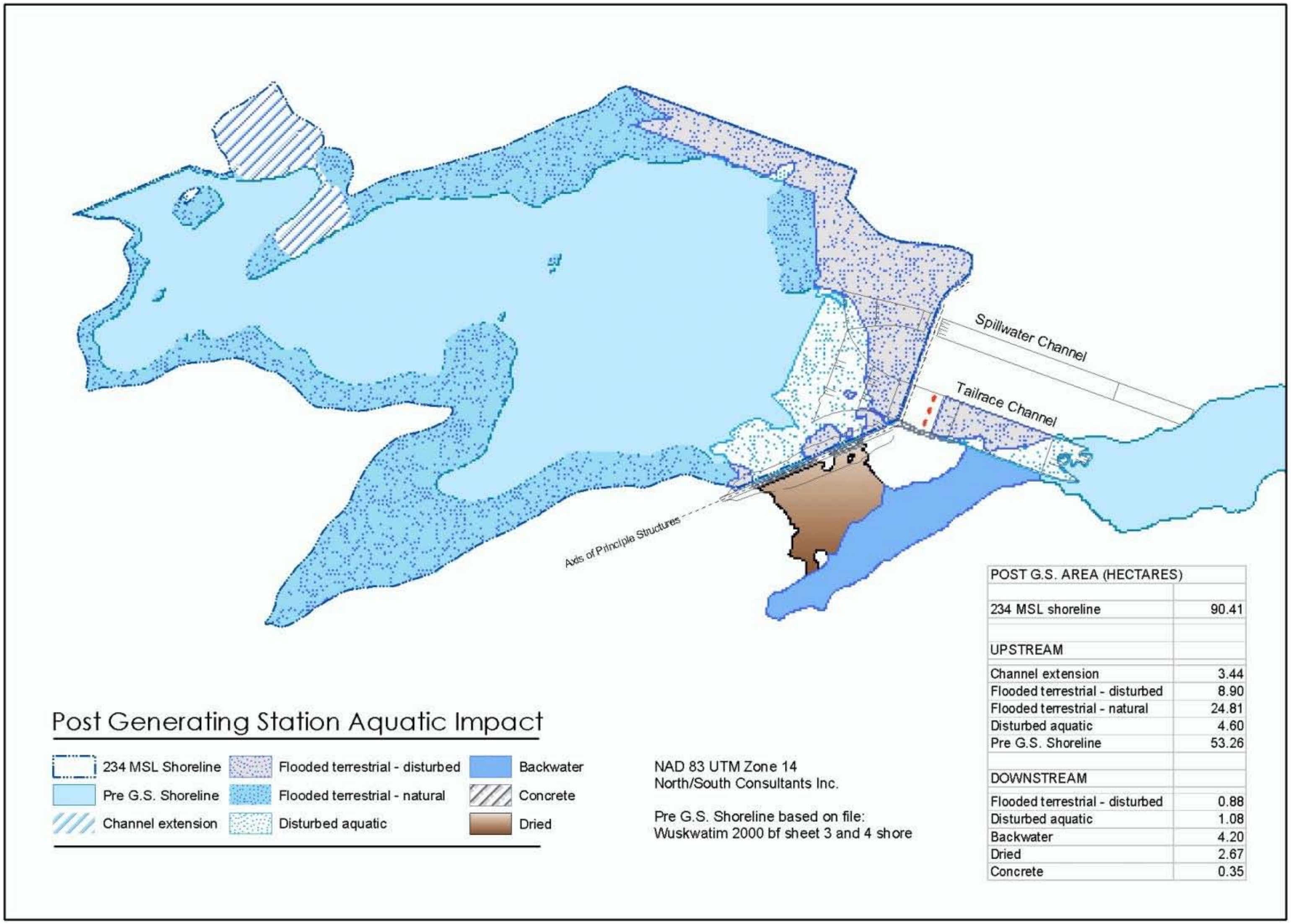


Figure 6.6-14. Post-Project aquatic habitat in Reach 2.

- depending on the size and method of installation, some increase in average water velocity for the length of the culvert, and a short-length immediately upstream and downstream at all sites.

Impacts related to construction will be minimized due to control measures outlined in the Project Description (Volume 3) and practices that will be described in the EnvPP..

6.6.2.2 Operation

Reach 1: Wuskwatim

Aquatic habitat is described at the post-Project shoreline elevation 234.0 m ASL (Table 6.6-1). As water level elevation will fluctuate during normal operation of the GS, an IEZ will exist between 233.75 m and 234.0 m (Figure 6.6-15). The IEZ will decrease in size from 2022 ha to 342 ha (Table 6.6-2). The majority of the pre-Project IEZ will be converted to nearshore habitat; however, a small amount (92 ha) at the upper extent of the zone will be permanently dry.

The nearshore zone will increase in size by 1588 ha, as it will be bounded by the 229 m and the 233.75 m. The area of the offshore zone will not be changed.

Table 6.6-1. Post-Project surface area, and water depth and volume for waterbodies in Reach 1.

Waterbody	234.0 m ASL			
	Surface Area (ha)	Maximum Depth (m)	Mean Depth (m)	Volume (m^3)
Cranberry Lakes	1733.5	14.0	2.6	44275150
Sesep Lake	432.0	-	-	-
Wuskwatim Lake Main	4790.2	13.4	7.9	378704650
Wuskwatim Lake South	1091.0	6.2	2.1	23417050
Wuskwatim Brook	832.9	7.2	1.8	14754947
Reach 1 Total	8879.6	14.0	5.5	461151797

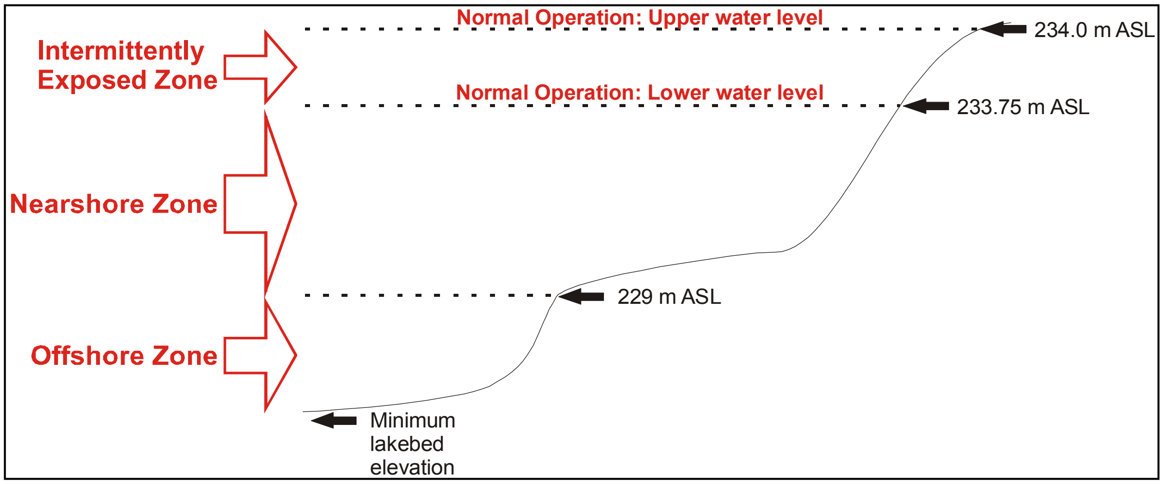


Figure 6.6-15. Classification of aquatic habitat into zones with respect to water level, post-Project.

Table 6.6-2. Areas for the intermittently exposed, nearshore, and offshore habitat zones by waterbody in Reach 1.

	Pre-Project (95th percentile)		
Habitat Zone Waterbody	**Intermittently Exposed Area (ha)**	**Nearshore Area (ha)**	**Offshore Area (ha)**
Cranberry Lakes	597.1	991.8	175.2
Sesep Lake	388.9	56.5	0.0
Wuskwatim Lake Main	167.0	465.7	4181.3
Wuskwatim Lake South	473.4	623.8	9.7
Wuskwatim Brook	395.1	441.5	5.3
Reach 1 Total	2021.5	2579.4	4371.5

	Post-Project (234.0 m ASL)		
Habitat Zone Waterbody	**Intermittently Exposed Area (ha)**	**Nearshore Area (ha)**	**Offshore Area (ha)**
Cranberry Lakes	102.2	1456.1	175.2
Sesep Lake	49.0	383.0	0.0
Wuskwatim Lake Main	31.1	577.8	4181.3
Wuskwatim Lake South	76.5	1004.7	9.7
Wuskwatim Brook	82.6	745.0	5.3
Reach 1 Total	341.5	4166.6	4371.5

Peat islands currently occupy approximately 19 % of the surface area of the IEZ, and are described in Section 7.5.

The majority of nearshore and offshore areas will remain predominantly soft silt/clay (i.e., fine sediments). However, sedimentation rates in the nearshore off of eroding banks and in the offshore will increase resulting in the deposition of sediments on both existing areas of fine sediments and on portions of the narrow, nearshore band of boulder/cobble that currently exists off of some eroding shorelines. The greatest relative increase in sedimentation rates will be in the first five years following construction, however, sedimentation rates will decrease in subsequent years to background levels (Section 5.7).

The reduction in water level fluctuations post-Project will affect the pattern of deposition and resuspension of sediments in the nearshore environment. This is a complex process and is discussed in Volume 5.

The spatial extent of the area where rooted submergent aquatic plants occur now will not change post-Project, however, there may be changes in overall abundance within existing plant beds (Section 6.7).

Reach 2: Falls

Aquatic habitat is described at the post-Project shoreline elevation of 234.0 m (Table 6.6-3). As in Reach 1, water level elevation will fluctuate during normal operation of the GS and an IEZ will exist between 233.75 m and 234.0 m. The IEZ will occupy an area of 0.8 ha and the wetted portion of the reach will be 89.6 ha (Table 6.6-4).

After construction of the GS, the increase in area of aquatic habitat will be 37.2 ha. Of this increase, 3.4 ha will be part of the channel extension adjacent to the existing Wuskwatim Falls, 8.9 ha will be disturbed (due to dyke construction on the north-side) newly flooded terrestrial, and 24.8 ha will be natural (undisturbed) newly flooded terrestrial habitat (Figure 6.6-14). The newly flooded terrestrial will occupy 0.8 ha (100 %) of the IEZ and 33.8 ha (38 %) of the wetted area.

Prior to construction of the GS, the substrata of Reach 2 generally reflected the distribution of water velocities. This distribution of substrata types will not be noticeably altered post-Project, except for the increase in flooded terrestrial area. The rate of shoreline erosion post-Project is not expected to be higher than existing rates. As suspended sediments will be transported from Reach 1 into an area with relatively higher flow and water velocity, deposition of these sediments in Reach 2 is not expected to occur.

Table 6.6-3. Post-Project surface area, and water depth and volume for Reach 2.

Waterbody	234.0 m ASL			
	Surface Area (ha)	Maximum Depth (m) [2]	Mean Depth (m) [2]	Volume (m^3) [2]
Reach 2	90.4	-	-	-
Reach 2a [1]	68.3	25.4	9.4	6378508

[1] the portion of Reach 2 where safe data collection was possible

[2] water depths and volume do not take into account increased depth due to excavation of existing aquatic and terrestrial surfaces

Table 6.6-4. Areas for the intermittently exposed wetted habitat zones in Reach 2.

Waterbody	Intermittently Exposed Area (ha)	Wetted Area (ha)	Total Area (ha)
Pre-Project Reach 2a [1]	4.2	39.4	43.6
Pre-Project Reach 2	-	-	53.3
Post-Project Reach 2a [1]	0.6	67.8	68.3
Post-Project Reach 2	0.8	89.6	90.4

[1] the portion of Reach 2 where safe data collection was possible

Post-Project water velocities in Reach 2 will be lower than the existing ones, as this reach will be characterized by deeper, slower moving water (Section 5.3). As a result, there will be a change in the overall relative proportions of low, medium, and high water velocities (Section 5.3). The existing high water velocities closest to Wuskwatim Falls will be reduced. Water velocities at the GS intake will be lower than the existing condition at Taskinigup Falls. At an elevation of 225.5 m, near the bottom elevation at the existing crest of Taskinigup Falls and about 2 m below the upper limit of the GS intake post-Project, water velocities will be reduced from typically medium (0.5-1.5 m/s) to low (< 0.5 m/s) (Section 5.3).

After construction of the GS, there will be a net loss of about 1.5 ha (about 3 % of existing Reach 2 area) of rooted submergent aquatic plants from Reach 2 (Section 6.7).

Reach 3: Burntwood

After construction of the GS, about 3 ha of aquatic habitat will be lost from the upper extent of Reach 3 due to the concrete footprint of the structure (0.4 ha) and the dewatering of present-day Taskinigup Falls (2.7 ha) (Figure 6.6-14). Immediately downstream of the GS in the tailrace channel, about 0.9 ha will be disturbed newly flooded terrestrial and 1.1 ha will be disturbed aquatic habitat. The bay on the south-side of the river, immediately downstream of the existing Taskinigup Falls, will become part of the post-Project backwater area (4.2 ha) created downstream of the main dam.

Aquatic habitat is described under the post-Project operating regime (Section 6.3) of 1 unit best-gate (1-BG), 2 units best-gate (2-BG), 3 units best-gate (3-BG), and 3 units full-gate (3-FG) (Table 6.6-5, Figure 6.6-16) (Section 4.5 provides a description of station operation). During operation, water level elevation will fluctuate depending on the inflow and changes in the number of units operating. The IEZ will increase in size from 44 ha to 64 ha (Table 6.6-6). The intermittently exposed area gained consists of 17 ha of aquatic habitat that was permanently wetted the majority of the time pre-Project (will become lower quality habitat) and 3 ha of habitat that was considered terrestrial habitat (will remain very low quality habitat). The quality of the post-Project IEZ will be degraded in comparison to the pre-Project due to the increased frequency of water level fluctuations. The wetted zone will occupy a smaller area post-Project (236 ha), as it will extend up to the water level elevation at 1-BG, representing a decrease of 17 ha of aquatic habitat that was more permanently wetted (higher quality) pre-Project.

Peatlands potentially affected by the Project currently occupy about 27 ha within the backwater inlets and a number of notch inlets in the mainstem, and are described in Section 7.5.

As in Reach 2, prior to construction and operation of the GS, the substrata of Reach 3 generally reflected the distribution of water velocities. This distribution of substrata types will not be noticeably altered post-Project, except for the small increase in area (3 ha) that was exposed greater than 95 % of the time pre-Project (will become newly flooded terrestrial). The small increase in sedimentation that may occur in the post-Project backwater area immediately downstream of the GS is not expected to be sufficient to noticeably change the substrata.

Table 6.6-5. Post-Project surface area, and water depth and volume for Reach 3.

Subsystem	3 Units Full-Gate			
	Surface Area (ha)	Maximum Depth (m)	Mean Depth (m)	Volume (m^3)
Mainstem	261.8	25.4	7.6	19983273
Backwater inlets	37.8	6.7	1.9	736030
Reach 3 Total	299.7	25.4	6.9	20719304

Table 6.6-6. Areas for the intermittently exposed wetted habitat zones in Reach 3.

Habitat Zone Subsystem	Pre-Project (95th percentile)		
	Intermittently Exposed Area (ha)	Wetted Area (ha)	Total Area (ha)
Mainstem	24.8	235.3	260.1
Backwater inlets	19.3	17.2	36.6
Reach 3 Total	44.1	252.6	296.7

Habitat Zone Subsystem	Post-Project (3 Units Full-Gate)		
	Intermittently Exposed Area (ha)	Wetted Area (ha)	Total Area (ha)
Mainstem	36.3	225.5	261.8
Backwater inlets	27.8	10.1	37.8
Reach 3 Total	64.1	235.6	299.7

The general horizontal pattern of post-Project water velocity will be similar in comparison to the existing one; however, daily fluctuations in water velocity at certain points within the reach will change considerably following construction of the GS. Water movements in the backwater inlets will remain limited. Post-Project areas of low, medium, and high water velocities in Reach 3 are described in Volume 5, Section 6.0.

After construction of the GS, the altered water regime may result in the loss of a substantial portion of the existing 3.9 ha (about 1 % of existing Reach 3 area) of rooted submergent plant beds (Section 6.7).

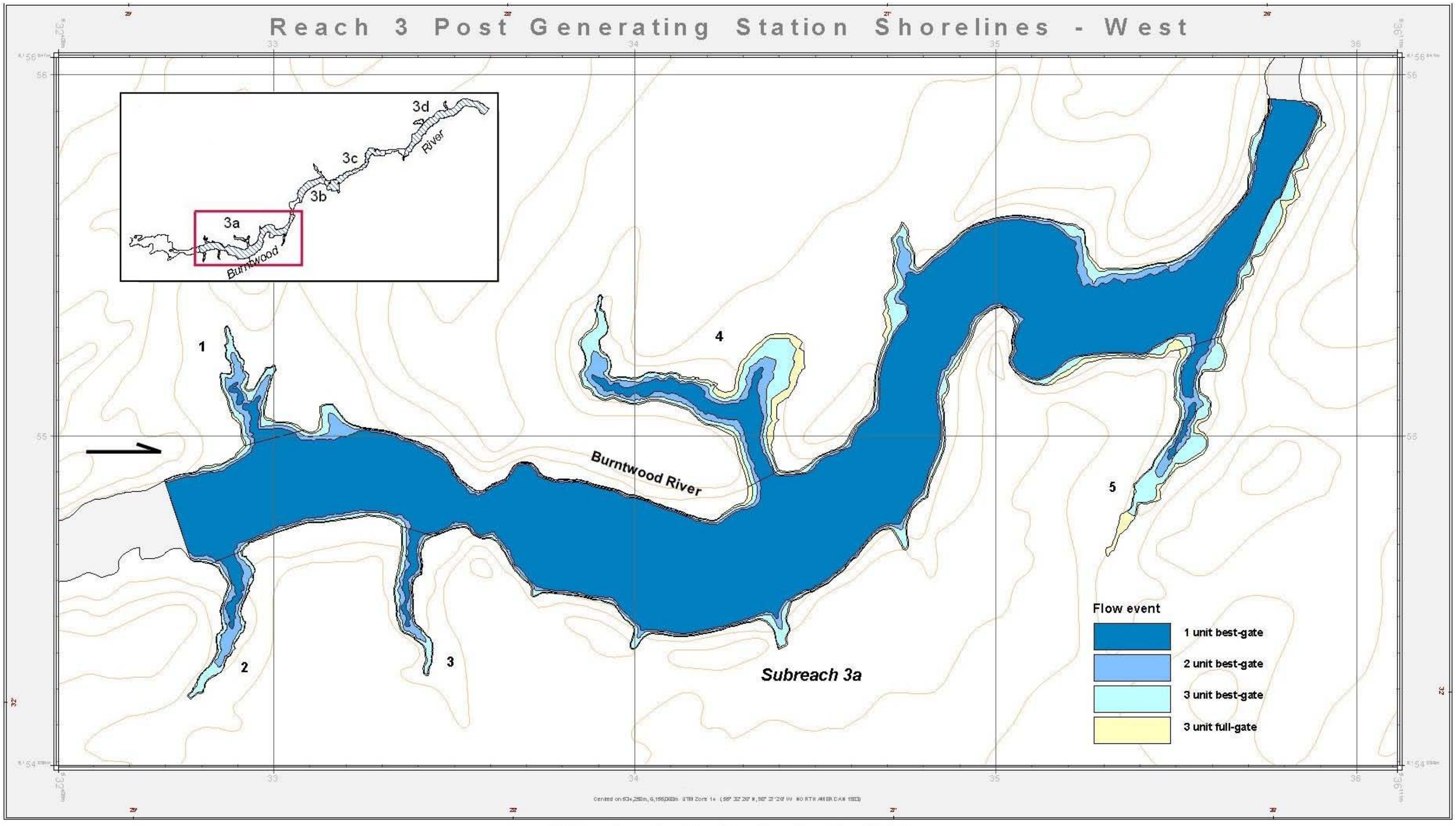


Figure 6.6-16A. Post-Project shorelines under several flow conditions in the upper portion of Reach 3.

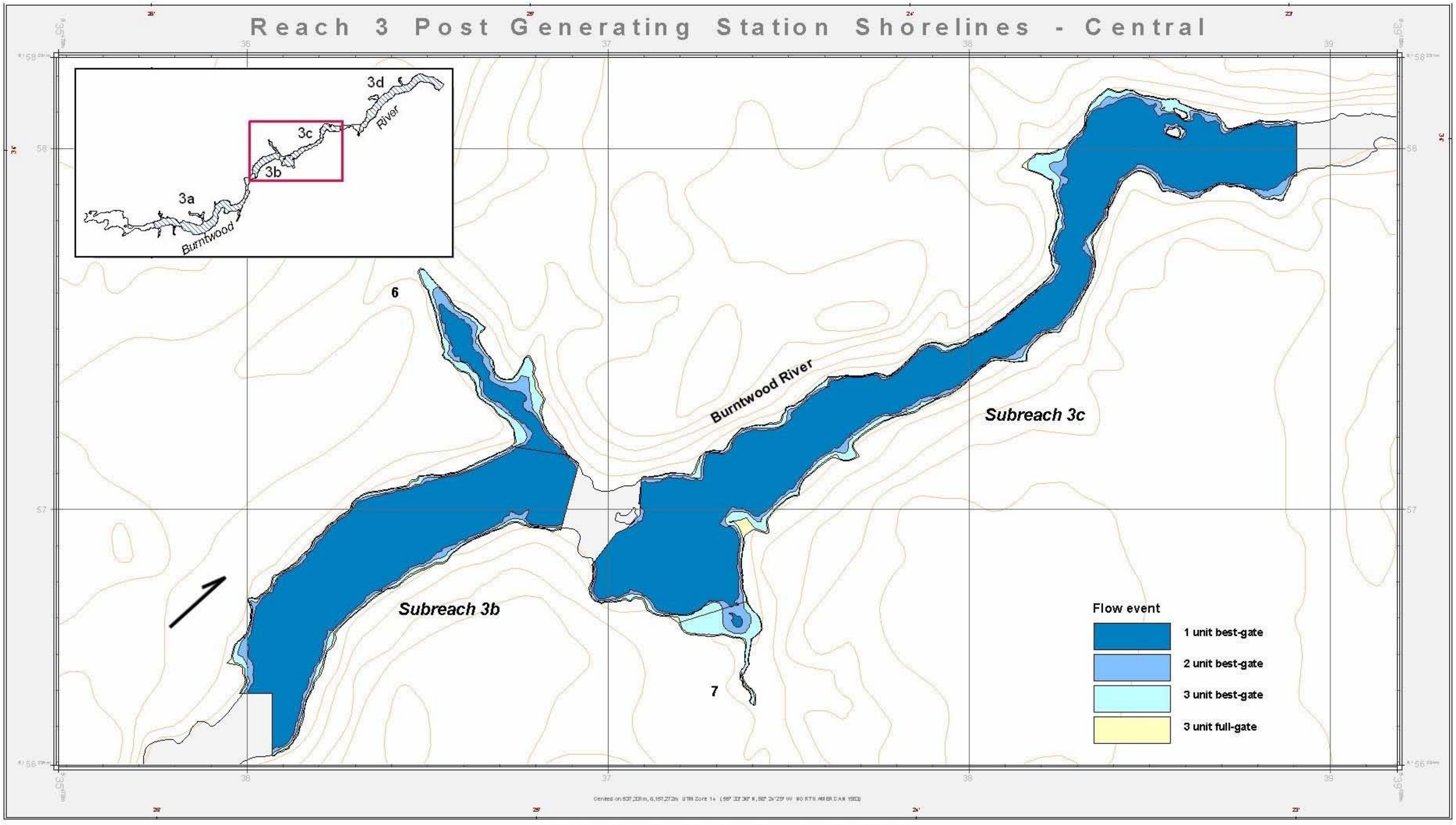


Figure 6.6-16B. Post-Project shorelines under several flow conditions in the middle portion of Reach 3.

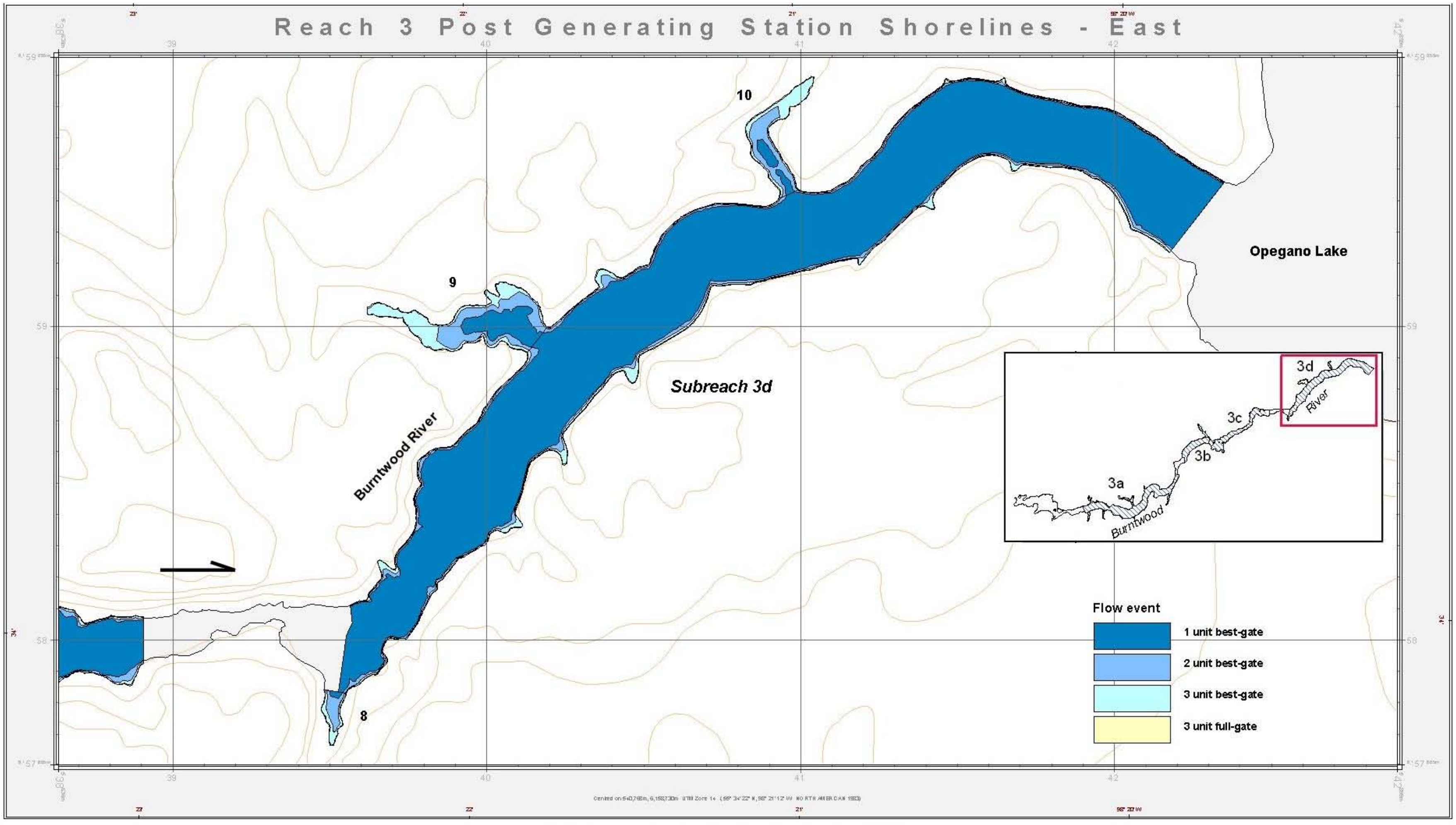


Figure 6.6-16C. Post-Project shorelines under several flow conditions in the lower portion of Reach 3.

Reach 4: Opegano

As for Reach 3, aquatic habitat in Reach 4 is described under the post-Project operating regime (Figure 6.6-17). During operation, water level elevation will fluctuate depending on the number of units operating. The IEZ will increase in size from about 50 ha to 86 ha (Table 6.6-7). The intermittently exposed area gained consists of 27.9 ha of aquatic habitat that was permanently wetted nearshore habitat the majority of the time pre-Project (will become lower quality habitat) and 8.5 ha of habitat that was considered terrestrial habitat (will remain very low quality habitat). The quality of the post-Project intermittently exposed habitat will be degraded in comparison to the existing situation due to the increased frequency of water level fluctuations. The nearshore zone will decrease in size post-Project due to the conversion of 27.9 ha that were more permanently wetted (higher quality) pre-Project to intermittently exposed post-Project. The area of the offshore zone will not be changed.

Peatlands potentially affected by the Project currently occupy about 30 ha in Opegano Lake, and are described in Section 7.5.

Table 6.6-7. Areas for the intermittently exposed, nearshore, and offshore habitat zones in Reach 4.

Waterbody	Pre-Project (95th percentile)			
	Intermittently Exposed Area (ha)	**Nearshore Area (ha)**	**Offshore Area (ha)**	**Total Area (ha)**
Opegano Lake	49.8	497.9	240.6	788.2

Waterbody	Post-Project (3 Units Full-Gate)			
	Intermittently Exposed Area (ha)	**Nearshore Area (ha)**	**Offshore Area (ha)**	**Total Area (ha)**
Opegano Lake	86.2	470.0	240.6	796.8

This distribution of substrata types will not be noticeably altered post-Project, except for the small increase in area (8.5 ha) that was exposed greater than 95 % of the time pre-Project (will become newly flooded terrestrial).

After construction of the GS, the altered water regime may result in the loss of a substantial portion of the existing 45.5 ha (about 6 % of existing Reach 4 area) of rooted submergent aquatic plant beds (Section 6.7).

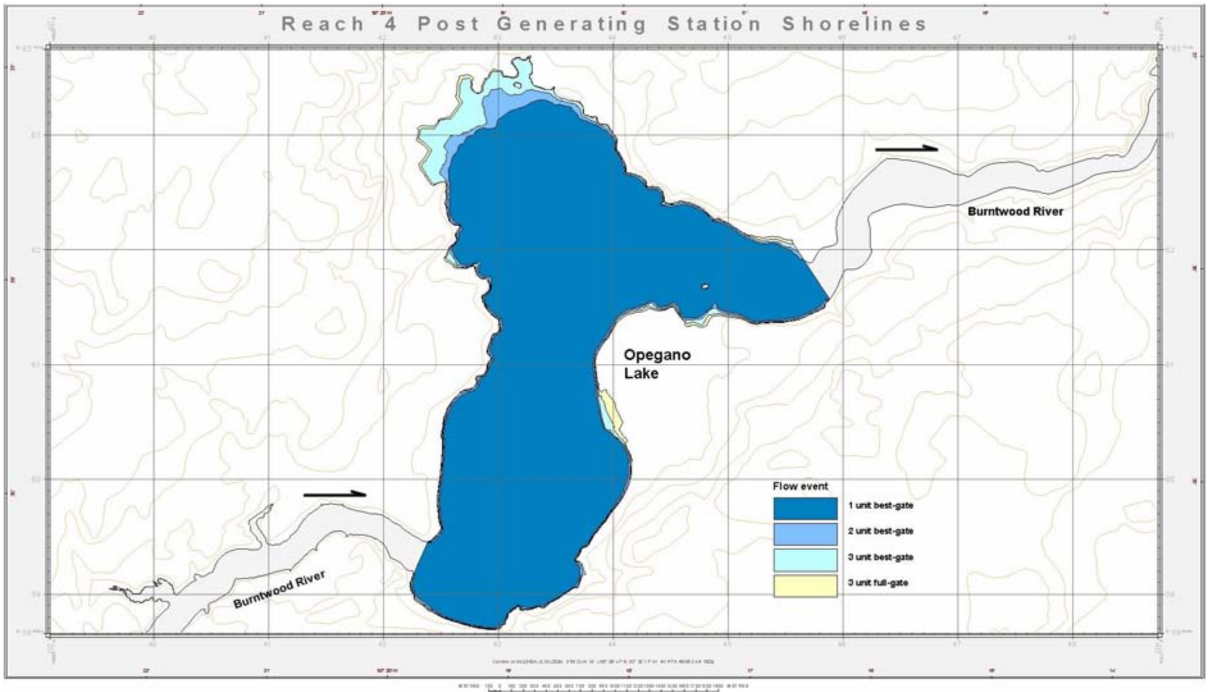


Figure 6.6-17. Post-Project shorelines under several flow conditions in Reach 4.

Stream Crossings

Impacts related to operation will be minimized due to control measures outlined in the Project Description (Volume 3) and practices that will be described in the EnvPP.

6.7 LOWER TROPHIC LEVELS

6.7.1 Existing Environment

Lower trophic levels consist of all organisms apart from fish that occupy the aquatic environment and include algae, rooted submergent plants, zooplankton, and benthic invertebrates. Changes in the abundance and distribution of these groups as a result of physical changes in habitat are an important linkage to the effects to fish (Section 6.8).

The study area encompasses a diverse range of aquatic habitats, from relatively large rivers to streams, a variety of sizes of lakes, and flooded terrestrial areas, and as such harbours many lower trophic groups. In the following discussion, a summary of these different lower trophic groups among study reaches is presented for studies conducted between 1998 and 2001. An overview of the biology, and detailed information on abundance, composition, and distribution or habitat use for each of the lower trophic communities are provided in Volume 5, sections 7.3.2 (phytoplankton), 7.3.3 (attached algae and rooted submergent aquatic plants), 7.3.4 (zooplankton), and 7.3.5 (benthic invertebrates).

From a **biodiversity** and **conservation** perspective, the aquatic environment of the study area is not unique. The area is similar to the aquatic environment in much of the northern **boreal forest** of Manitoba, Ontario, and western Quebec. Within the lower trophic communities investigated between 1998 and 2001 no 'species of conservation concern' were identified. This term includes species that are rare, disjunct (discontinuous or separated distribution), or at risk throughout their range, or the portion of their range within Manitoba, and in need of further research. Also included are species listed under the Manitoba Endangered Species Act (MBESA), the Species at Risk Act (SARA) and those that have special designation by the Committee On the Status of Endangered Wildlife In Canada (COSEWIC). Concern was raised by an external expert with respect to the distribution of the showy pond snail (*Bulimnaea megasoma*) within Manitoba; however, this species has not been evaluated and ranked by the Manitoba Conservation Data Centre and was not observed within the study area.

6.7.1.1 Phytoplankton

Phytoplankton are very small algae that live suspended in the water column of lakes. These algae use energy from sunlight to combine carbon dioxide and water to form organic matter. Phytoplankton biomass in the study area ranged between 243 and 7190 mg/m^3 in Reach 1 (Wuskwatim) and from 195 to 3574 mg/m^3 in Reach 4 (Opegano). In general, phytoplankton biomass was similar between study reaches 1 and 4, although Reach 4 tended to have slightly less biomass than Reach 1. Within Reach 1, the largest amount of biomass occurred in Wuskwatim Lake main and the lowest amount in Sesep Lake.

Biomass at all mainstem sites in Reaches 1 (Wuskwatim Lake main) and 4 (Opegano Lake) tended to be highest in the spring, lowest in the early summer, and intermediate in the late summer and fall; a pattern typical in many temperate and polar waters that are not highly eutrophic (Fogg and Thake 1987). Sesep Lake and Wuskwatim Lake south (tributary sites) did not exhibit a spring peak in biomass, and phytoplankton composition at these locations tended to be more diverse than that at mainstem sites (although this difference was most notable in Sesep Lake).

Chlorophyll *a* concentrations ranged between 1 and 16 μg/L. Concentrations tended to peak in late summer or fall, while the lowest concentrations were generally experienced in the spring. Chlorophyll *a* concentrations in Sesep Lake, Wuskwatim Lake south, and Wuskwatim Brook were the highest, with mean concentrations of 10, 8, and 8 μg/L, respectively, while all other locations in reaches 1, 3, and 4 had mean chlorophyll *a* concentrations in the range of 3 to 4 μg/L. Based on mean chlorophyll *a* readings, water at all locations would be considered to have a mesotrophic (or moderate) level of primary productivity (Weztel 1983), which is in agreement with water quality results (Section 6.5).

While there was some disparity between chlorophyll *a* readings and estimates of phytoplankton biovolume, (i.e., the highest chlorophyll *a* readings occurred at tributary sites which exhibited the lowest phytoplankton biovolumes), both indicators of phytoplankton biomass indicated a similar overall level of algal productivity (i.e., mesotrophic). The lack of direct correlation between these estimators of phytoplankton biomass is not unusual and is most likely related to differences in chlorophyll *a* concentrations among types of algae (e.g., diatoms contain relatively little chlorophyll *a* in comparison to other groups).

The above-noted differences in phytoplankton biomass and composition between mainstem and tributary sites may be related to differences in:

- light quantity and quality, as waters at the tributary sites were noted to be less turbid, but more highly coloured than those at mainstem sites;
- water residence times, as waters at tributary sites likely have longer water residence times; and

- grazing pressure by zooplankton.

Chlorophyll *a* readings obtained at a portion of the stream crossings in June, 2002, were similar in concentration (low) to samples obtained in the spring from all other sampling locations in 1999, 2000, and 2001.

6.7.1.2 Attached Algae and Rooted Aquatic Plants

There were 24 aquatic plant and two macroalgae species collected and identified in the study area (Volume 5, Section 7.0). Emergent plants (e.g., bulrush, cattail) occupying a transitional area between aquatic and terrestrial environments are considered in Section 7.5.

Rooted submergent aquatic plant distribution differs over time in response to inter-annual variation in water levels and other growing conditions. Submergent aquatic plants in Reach 1 were found in areas of relatively low exposure and slope, and a distance from the shore that generally was similar to the peat islands. Aquatic plant distribution generally was sparse with isolated patches of denser growth in each area where they were observed, but was usually widespread. Aquatic plants typically followed the shoreline closely except for relatively large areas of shallower water depths, such as the more central areas of the Cranberry Lakes (Figure 6.6-1). In areas where submergent aquatic plants and peat islands were found together, the plants were usually observed adjacent to the areas of peat rather than interspersed within the voids of the peat.

The abundance of submergent aquatic plants in Reach 2 was relatively low. The plant community was of low diversity and restricted to two bays, one on the north shore of the study reach and one on the south, where the water was relatively shallow and sheltered from currents (Figure 6.6-6).

Submergent aquatic plants in Reach 3 were typically restricted to the shallow margins of stream mouths, or adjacent areas within the mainstem, a few small, sheltered bays within the mainstem, and occasionally more extensive areas within the backwater inlets where the water was relatively shallow and sheltered from currents, particularly in inlets 4, 9, and 10 (Figure 6.6-8). Typically, within these areas, plant distribution was sparse, and the abundance of plants was relatively low and limited to shallow water (less than 1.0 m deep).

Submergent aquatic plants were not markedly abundant anywhere in Opegano Lake. Discontinuous aquatic plant beds with sparse growth were confined to several small bays along the northwest shore and the wetland area on the north end of the lake where the water was relatively shallow and sheltered from currents (Figure 6.6-11).

With the exception of the macroalga *Chara* sp. (stonewort), all species observed at the streams crossed by access road and in adjacent areas were also identified in the four reaches on the Burntwood River.

6.7.1.3 Zooplankton

Zooplankton (e.g., Cladocera, Copepoda) are very small animals without backbones living in the water column and are consumed by some kinds of fish (e.g., lake cisco). The availability and quality of food (e.g., amount and kinds of phytoplankton), the number of predators, and water residence time affect the abundance of zooplankton; in rapidly flushed lakes and rivers little zooplankton biomass accumulates except potentially in areas where there is little current.

Between 19 and 25 different kinds of Cladocera and Copepoda (Figure 6.7-1) were found in reaches 1 and 4. In general, the number of species observed were similar between these two reaches, with the number observed in 2001 being slightly higher, likely due to the larger number of samples collected during the growing season.

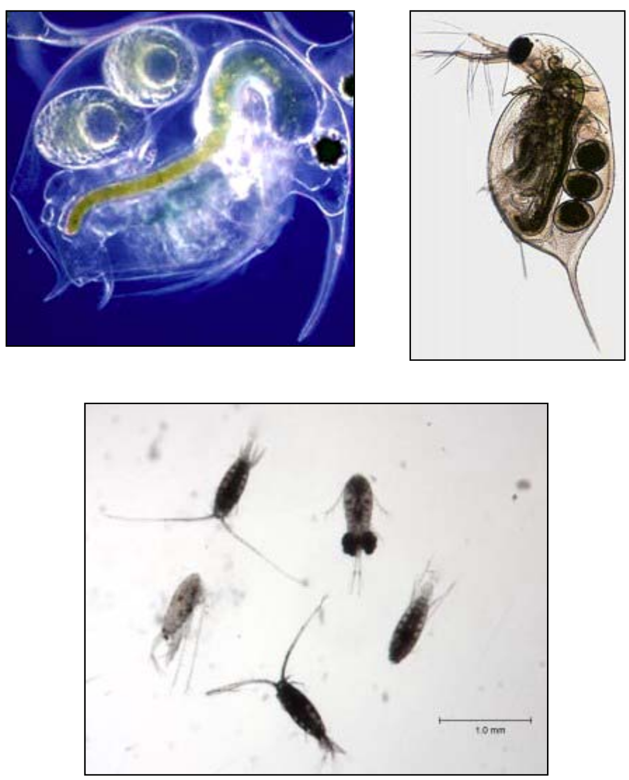


Figure 6.7-1. Common kinds of Cladocera (top left, right) and Copepoda (bottom) found in the study area.

For all years, zooplankton abundance and composition varied among sites and sampling periods. The highest abundance in the study area was recorded in late-August when total zooplankton abundance in Wuskwatim Lake south was 67736 individuals/m^3 and cladocerans formed the majority of the zooplankton. Greater total abundances of zooplankton were observed in both Wuskwatim Lake south and Sesep Lake in comparison to Wuskwatim Lake main sites, likely due to the relatively sheltered conditions in these tributary areas. The differences in zooplankton abundance and community composition observed among sites in Reach 1 at any given sampling period are most likely due to the effects of water movements (e.g., wind direction and strength, currents) on these small organisms resulting in a non-random horizontal distribution of individuals. Horizontal patchiness is a characteristic of the zooplankton community (Horne and Goldman 1994).

Zooplankton data were not collected in the riverine reaches 2 and 3 as zooplankton populations cannot grow well in swiftly flowing water. Total abundances of zooplankton in Opegano Lake were lower than those in Wuskwatim Lake main, likely due to conditions in Opegano Lake being more riverine, as the volume of Opegano Lake is smaller leading to reduced water residence times.

6.7.1.4 Benthic Invertebrates

Benthic invertebrates (benthos) are small animals without backbones living on or in the bottom substrata of lakes and rivers. The benthos are typically a diverse group of animals and are able to live in a variety of aquatic habitat types. Certain kinds of benthic invertebrates are an important food source for a number of fish species (e.g., lake whitefish). The following summarizes benthic invertebrate abundance among aquatic habitat types in the various study area reaches. A description of the index of biodiversity for selected aquatic habitat types (species composition) and information gathered using other sampling methods is provided in Volume 5, Section 7.3.5.

Reach 1: Wuskwatim

Mean total abundance of benthic invertebrates in Reach 1 ranged from a low of 1276 individuals/m^2 in the intermittently exposed zone (IEZ) (soft silt/clay-based substrata, no plants) to a high of 12551 individuals/m^2 in the nearshore (flooded terrestrial substrata, rooted aquatic plants) (Figure 6.7-2). Chironomidae (midges) was the most common taxa in all habitat types, with the exception of the offshore zone where Amphipoda (scuds) and Sphaeriidae (fingernail clams) were most common (Figure 6.7-3). The insect group Ephemeroptera (mayflies) was a relatively important component of the benthos in the

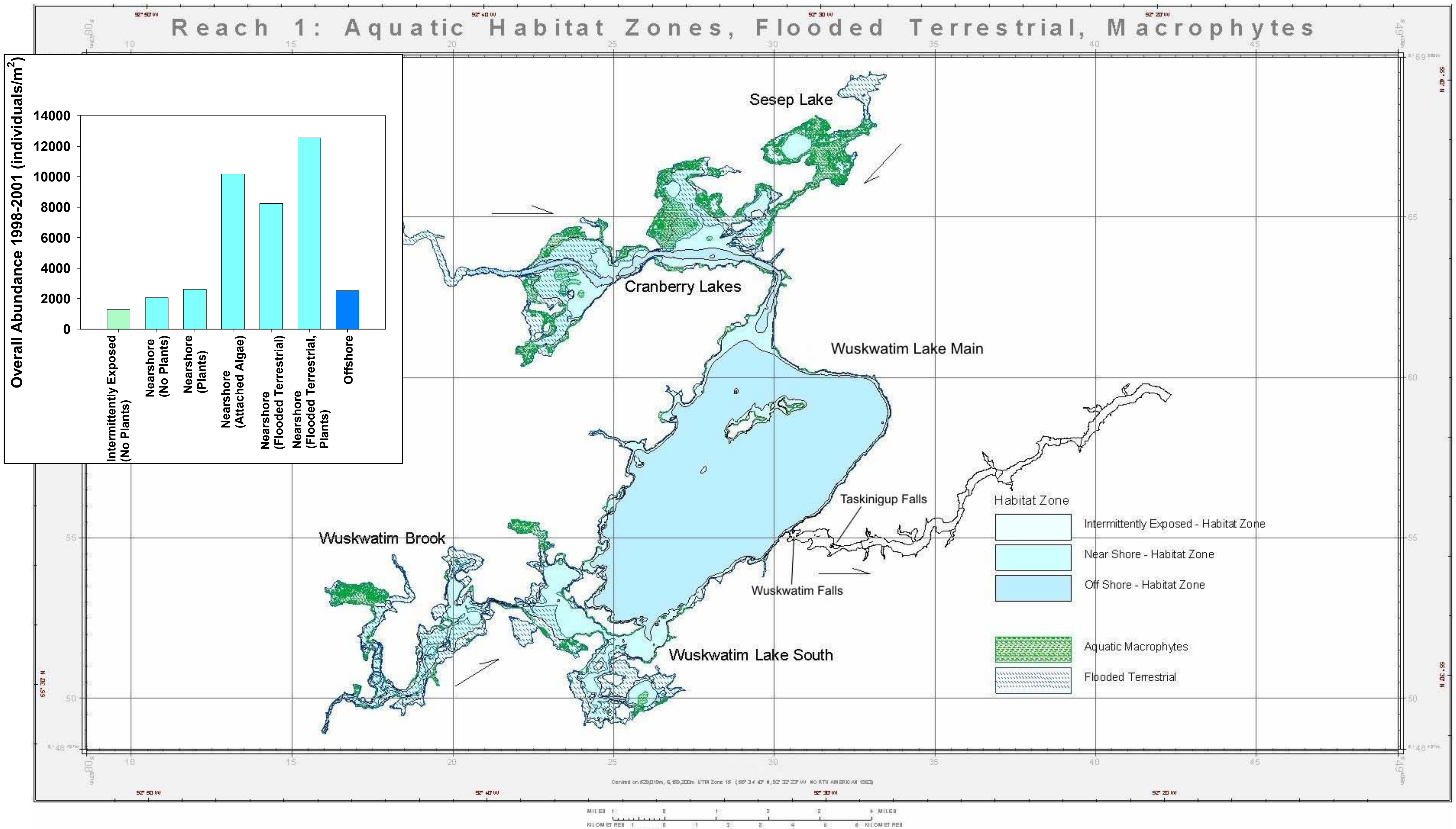


Figure 6.7-2. Mean benthic invertebrate abundance for aquatic habitat types in Reach 1.

Figure 6.7-3. Common kinds of benthic invertebrate groups found in the study area: midge larva (top, left); mayfly larva (top, right); scud (bottom, left); and fingernail clam (bottom, right).

nearshore habitat zone, particularly where there was flooded terrestrial substrata with rooted submergent aquatic plants (Figure 6.7-3).

Reach 2: Falls

Mean total abundance of benthos in Reach 2 ranged from a low of 2071 individuals/m^2 in the wetted mainstem with hard silt/clay-based substrata, low water velocity habitat type to a high of 4793 individuals/m^2 in the wetted mainstem with boulder/cobble substrata, medium water velocity (Figure 6.7-4). Large, stable bottom substrata, such as boulders and cobble, tend to support relatively more productive benthic invertebrate populations. Fingernail clams were the most common taxa in the majority of habitat types sampled, with the exception of the intermittently exposed mainstem with soft silt/clay-based substrata, no plants, low velocity where amphipods were most common. Within the insect groups, mayflies and midges were most common in the habitat types characterized as having soft silt/clay-based substrata and lacking aquatic plants, and Trichoptera (caddisflies) was most common in the habitat types with either boulder/cobble or hard silt/clay-based substrata.

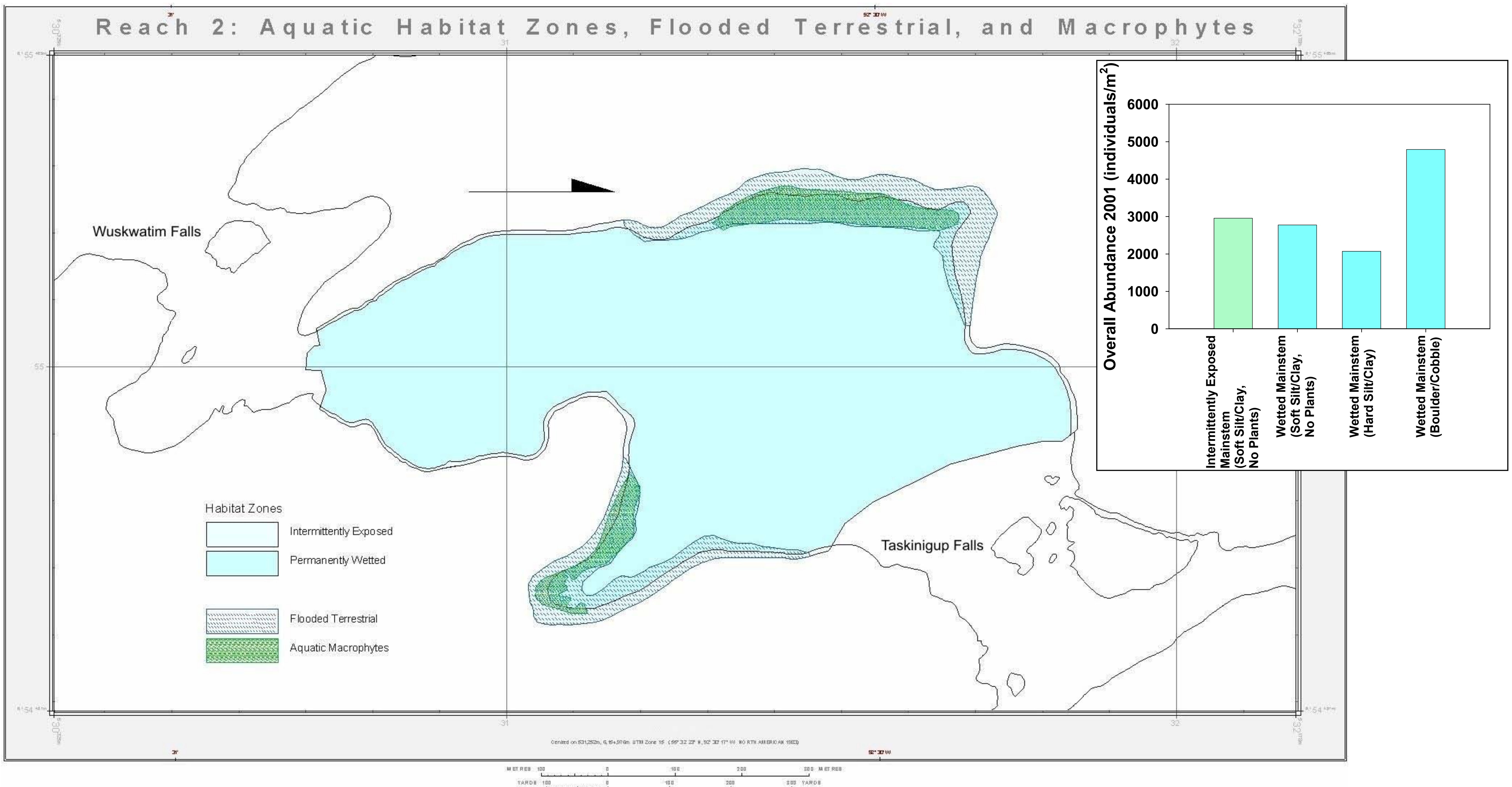


Figure 6.7-4. Mean benthic invertebrate abundance for aquatic habitat types in Reach 2.

Reach 3: Burntwood

Mean total abundance of benthos in Reach 3 ranged from a low of 70 individuals/m^2 in the wetted mainstem with boulder/cobble substrata, medium water velocity to a high of 4652 individuals/m^2 in the intermittently exposed mainstem, soft silt/clay-based substrata, low velocity (Figure 6.7-5). Abundances were substantially less in habitat types characterized as having either boulder/cobble or bedrock substrata (range of 70 to 129 individuals/m^2). It is unlikely that the benthic invertebrate community associated with these bottom substrata was sampled effectively using the air-lift sampler, as the abundances in these habitat types was much reduced in comparison to what is known from other studies of coarse bottom substrata in Manitoba, and to results obtained for the Reach 2 habitat type characterized as having boulder/cobble substrata. Intermittently exposed habitat types were dominated by midges, fingernail clams, and mayflies, with midges most common in the backwater inlets, and fingernail clams and mayflies most common in the mainstem. Midges, fingernail clams, hydrozoans, and mayflies dominated wetted habitat types. Midges were most common in the backwater inlets, while fingernail clams were most common in the mainstem where there were silt/clay-based sediments, and hydrozoans and mayflies were most common on boulder/cobble substrata.

Reach 4: Opegano

Mean total abundance of benthos in Opegano Lake ranged from a low of 2409 individuals/m^2 in the nearshore with soft silt/clay-based substrate, no plants to a high of 9106 individuals/m^2 in the offshore with soft silt/clay-based substrate (Figure 6.7-6). Fingernail clams were the most common taxa in the majority of habitat types, with the exception of the neashore areas with aquatic plants; Oligochaeta (aquatic earthworms) were most common in the nearshore with soft silt/clay-based substrata, while midges were prevalent within areas with flooded terrestrial substrata. Other insect groups were a relatively less important component of the benthos, with the exception of caddisflies, which were more common in the offshore zone with hard silt/clay-based substrata.

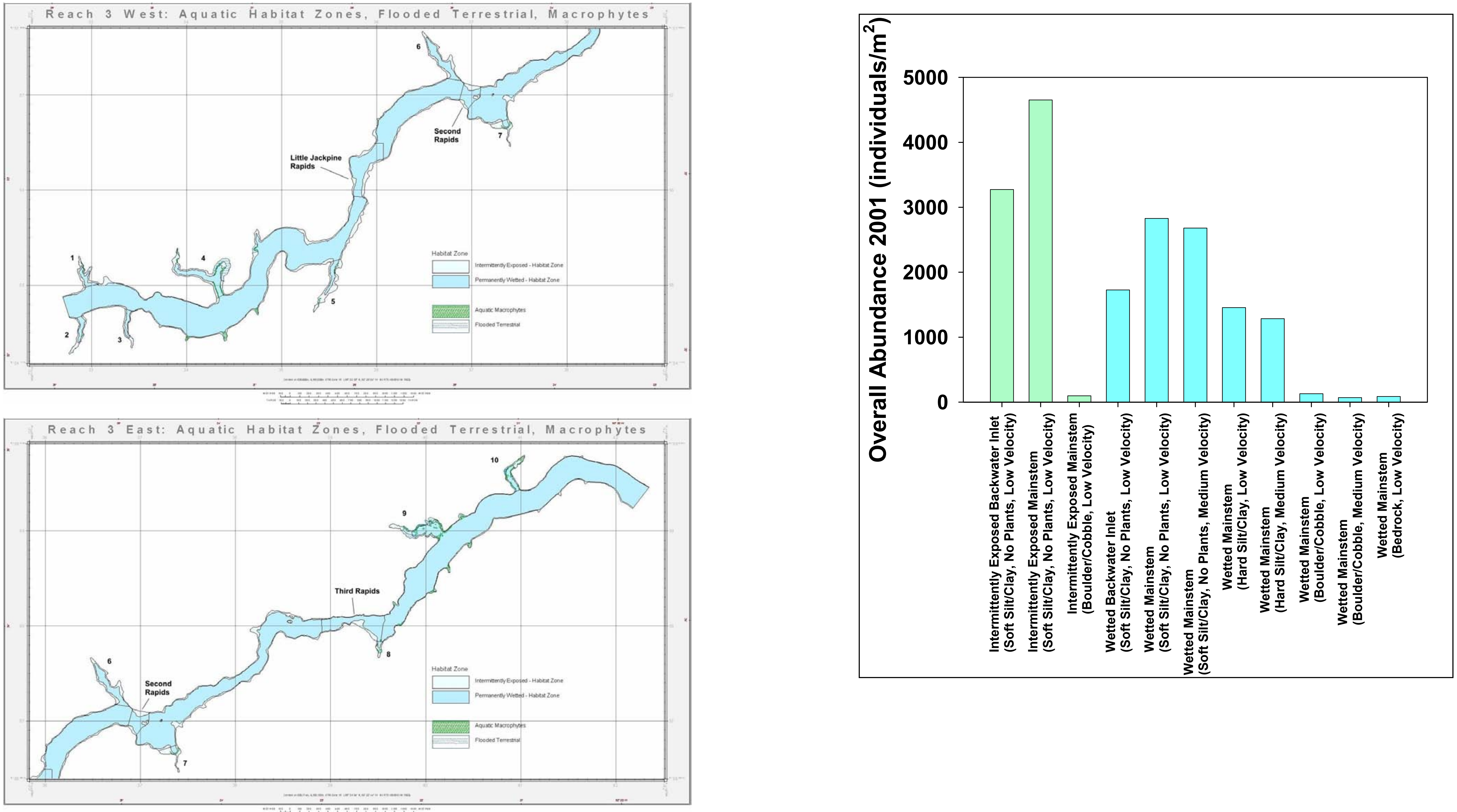


Figure 6.7-5. Mean benthic invertebrate abundance for aquatic habitat types in Reach 3.

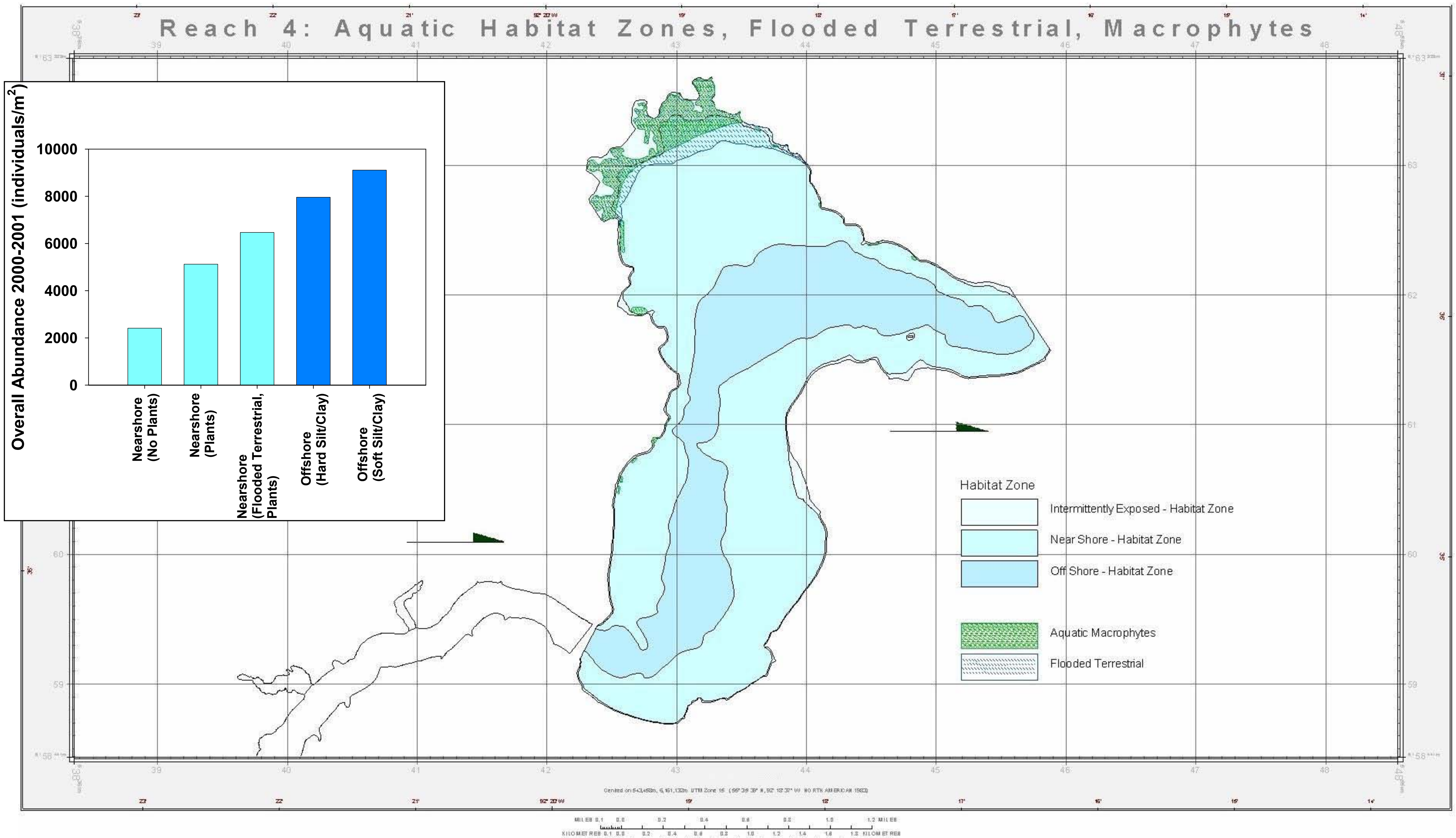


Figure 6.7-6. Mean benthic invertebrate abundance for aquatic habitat types in Reach 4.

With a few exceptions, the majority of habitat types investigated could be considered representative of relatively healthy and diverse aquatic habitat, as there is an extensive list of taxa identified. Taxa expected to be observed in intermittently exposed, nearshore, and offshore zones were present, and the relative proportions are as occur in other waterbodies. At some sites, the groups present were representative of a heterogeneous substrata (a mixture of a variety of substrata types). The co-occurrence of *Hexagenia*, *Ephemera*, *Caenis*, and *Polycentropus* species at a site is typical of a mixture of silt/clay-based, and gravel and cobble substrata, such as those found in the transitional nearshore zone of Lake Winnipeg (MB) (pers. comm. D. Cobb). This can make a clear, single characterization of a site with respect to substrata type difficult, as they are complex in nature. Riverine sites with coarse substrata (hard silt/clay-based, boulder/cobble, bedrock) were more difficult to sample effectively; however, where sites were sampled effectively, they were well represented by taxa typically associated with those substrata types.

Stream Crossings

The streams crossed by the access road were not sampled, but are expected to support less diverse and/or abundant benthic invertebrate communities in comparison to the other reaches. The relatively small extent of wetted area could lower the availability of aquatic habitats and place limitations on the types of benthic invertebrates that could occupy the streams (i.e., fewer taxa present).

6.7.2 Impacts and Mitigation

The majority of impacts to lower trophic levels during construction are related to indirect effects arising from a change in water quality. Operation-related impacts that were assessed include: flooding of the terrestrial environment; conversion of intermittently exposed to more wetted habitat; changes to water levels and flows (water regime); erosion and sedimentation; and, road maintenance activities. A detailed discussion of these impacts is provided in Volume 5, Section 7.0; this section summarizes major changes in the lower trophic communities investigated. Summaries of predicted responses of lower trophic levels to changes resulting from the operation of the GS are presented in Tables 6.7-1 (Reach 1), 6.7-2 (Reach 2), 6.7-3 (Reach 3), 6.7-4 (Reach 4), and 6.7-5 (Stream Crossings).

6.7.2.1 Construction

The majority of impacts to lower trophic levels during construction would be associated with effects to water quality and many will be associated with episodic activities (e.g., cofferdam removal, discharge of sewage lagoon). The duration and magnitude of impacts is not expected to have a substantial effect on lower trophic levels, though there may be some temporary effects. The downstream movement of some benthic invertebrates and the loss of some other individuals exposed to a concentrated suspended sediment plume may occur over a number of weeks during construction. However, benthic invertebrates will likely recolonize any affected areas by the following growing season.

Within Reach 2, a small additional amount of aquatic habitat will be impacted by cofferdam construction, but the majority of habitat affected during construction is also affected by the permanent works (Section 6.7.2.2).

6.7.2.2 Operation

Predicted Responses of Phytoplankton

Light availability is believed to be the primary factor currently limiting phytoplankton production in Reach 1. Existing relatively low water retention times for Wuskwatim Lake main and the Cranberry Lakes likely also limits the net growth of phytoplankton. The anticipated post-Project small increase in retention time for these two waterbodies is not expected to be sufficient to result in an increase in phytoplankton biomass or alteration in phytoplankton species composition. However, there may be a small increase in the total amount of phytoplankton in tributary waterbodies (e.g., Sesep Lake, Wuskwatim Lake south, Wuskwatim Brook), as these areas will experience relatively greater effects from increases in retention times and water volumes, and slight nutrient enrichment. Based on anticipated impacts for mainstem waterbodies in Reach 1, downstream reaches should not experience any notable changes in phytoplankton biomass due to differences in inputs.

Predicted Responses of Attached Algae and Rooted Aquatic Plants

The spatial extent of the area in Reach 1 where rooted submergent aquatic plants occur now is not expected to change post-Project, as growing conditions (i.e., extent of euphotic zone, bottom substrata type) will not be noticeably changed (Figure 6.7-2). However, plant growth in many of these areas is currently very patchy; the overall abundance of plants is expected to increase in areas with a reduction in the extent of ice scour and dewatering. The distribution of submergent aquatic plants is not expected to be affected by increased rates of shoreline erosion, as plant growth is sparse in Wuskwatim Lake main where the majority of the incremental increase in erosion will occur. There is not expected to be any detectable change in the species composition of rooted submergent aquatic plant beds. Emergent plants (e.g., bulrush, cattail) occupying a transitional area between aquatic and terrestrial environments are considered in Section 7.5.

Existing rooted submergent aquatic plant beds in the north and south bays in Reach 2 (total area occupied 2.2 ha) will die-off due to the large increase in water depth (Figure 6.7-4). It is expected that, over time, a bed comparable to the existing one in the south bay (0.7 ha) will develop within the flooded bay at a suitable elevation as a result of stabilization of water levels. Rooted submergent aquatic plants in the north bay (1.5 ha) will not be replaced as the disturbed newly flooded habitat in this area post-Project will largely consist of the surface of a dyke (i.e., rocky substrata), thereby not providing conditions suitable for rooted aquatic plant growth. This will result in a net loss of 1.5 ha of plant beds (about 3 % of existing Reach 2 area). The relative abundance and distribution of rooted submergent aquatic plants may increase in the south bay where other conditions (e.g., water clarity, bottom substrata type) are suitable, as water velocity will decrease. There is not expected to be any detectable change in the species composition of rooted submergent aquatic plant beds.

Presently, there are 3.9 ha (about 1 % of existing Reach 3 area) of rooted submergent aquatic plant beds in Reach 3 (Figure 6.7-5). Rooted submergent aquatic plants are expected to noticeably decrease in relative abundance and distribution as the quality of the IEZ will be degraded in comparison to the existing condition due to the increased frequency of water level fluctuations. Additionally, plants found in the permanently wetted zone will experience poorer growing conditions due to the increased frequency and extent of variation in water depth.

Existing rooted submergent aquatic plants in Reach 4 occupy 45.5 ha (about 6 % of existing Reach 4 area), with about 48 % found in the IEZ and 52 % in the nearshore (Figure 6.7-6). As in Reach 3, there is expected to be a decrease in the relative abundance and distribution of aquatic plants due to an increase in the frequency of water level fluctuations.

Any rooted submergent aquatic plant beds in the immediate footprint of the access road and culvert(s) would be lost. However, aquatic plants were not abundant in any of the eight major streams at the crossings.

Predicted Responses of Zooplankton

The anticipated post-Project increase in retention time for Wuskwatim Lake main and the Cranberry Lakes is not expected to be sufficient to result in an increase in zooplankton abundance or alteration in zooplankton species composition. However, there may be a small increase in the total amount of zooplankton in tributary waterbodies (e.g., Sesep Lake, Wuskwatim Lake south, Wuskwatim Brook), as these areas will experience relatively greater effects from increases in retention times and water volumes, and slight nutrient enrichment. Based on anticipated impacts for mainstem waterbodies in Reach 1, downstream reaches should not experience any notable changes in zooplankton abundance due to differences in inputs.

Truly planktonic crustacean zooplankton tend to be relatively unimportant in small streams as these organisms cannot maintain positive net growth rates due to a variety of reasons, including downstream losses.

Predicted Responses of Benthic Invertebrates

The conversion of about 1588 ha (18 %) of the existing total lake area in Reach 1 that is periodically dewatered as a result of water level fluctuations to more wetted nearshore aquatic habitat is expected to increase the total abundance of benthic invertebrates in this reach. An increase is expected, as the abundance of invertebrates is currently greater in the nearshore than in the intermittently exposed areas (Figure 6.7-2). Most of the increase in more wetted area changes to the abundance and distribution of benthic invertebrates will occur in Cranberry Lakes, Sesep Lake, Wuskwatim Lake south, and Wuskwatim Brook, which are currently the most productive environments for benthic invertebrates.

Approximately 30 % of the shoreline on Wuskwatim Lake main and in adjacent waterbodies is currently eroding and is expected to experience an increase in the rate of erosion and sedimentation. Increased frequency of exposure to highly turbid waters adjacent to eroding shorelines and increased deposition of fine sediments over areas of boulder/cobble and/or bedrock substrates could affect benthic invertebrate abundance and distribution. However, the overall proportion of habitat affected is relatively small and this effect would generally be limited to the first five years of operation when the increase in erosion rates is predicted to be the greatest.

After construction of the GS, approximately 37 ha of new aquatic habitat in Reach 2 will be created due to the construction of the channel extension and the flooding of terrestrial areas. The higher, more stable water level will permit the colonization of the south bay and lead to a moderate increase in benthic invertebrate production within the reach. A change in benthic invertebrate species composition from that typical of riverine aquatic habitat, as occurs now, to a community resembling that of Wuskwatim Lake main is expected. However, the level of species biodiversity is not expected to noticeably change post-Project as benthic invertebrate samples collected from a variety of aquatic habitat types in the existing Reach 1 and Reach 2 indicated that species diversity is comparable between the two reaches (Volume 5, Section 7.0).

Benthic invertebrates are expected to noticeably decrease in abundance and distribution in Reach 3 during operation of the GS as the quality of the IEZ will be degraded in comparison to the existing condition due to the increased frequency of water level fluctuations. Additionally, benthic invertebrates found in the permanently wetted zone will experience poorer growing conditions due to the increased frequency and extent of variation in water depth. The daily fluctuations in water velocity in the mainstem are expected to occur rapidly during operation of the GS, thereby reducing the suitability of a portion of the mainstem for benthic invertebrates as they may not be able to adapt to the rapidly changing water velocity regime.

As in Reach 3, benthic invertebrates are expected to noticeably decrease in abundance and distribution in Reach 4 during operation of the GS as the quality of the IEZ will be degraded in comparison to the existing condition due to the increased frequency of water level fluctuations.

Benthic invertebrates are not expected to be affected by potential small increases in levels of TSS, nutrients, or metals downstream of culverts at most stream crossings. Any benthic invertebrates in the immediate footprint of the road and culvert(s) would be lost. The benthic invertebrate community in adjacent areas is likely to remain undisturbed and experience no change in abundance, composition, or distribution. Alteration of water velocity immediately upstream and downstream of culverts is not expected to affect the benthic invertebrate community. These existing aquatic habitats are characterized as having very low water velocities and the anticipated increase in water velocity will not be sufficient to affect the benthic invertebrate community. The deposition of additional fine material will not affect the benthic invertebrate community, as the quantity deposited is expected to be small and the existing substrate at the eight major stream crossings was predominantly unconsolidated fines.

Table 6.7-1. Summary of predicted responses of lower trophic levels in Reach 1 to chemical and physical changes resulting from the operation of the Generation Project.

Impact	Predicted Responses			
	Phytoplankton	**Attached Algae and Rooted Aquatic Plants**	**Zooplankton**	**Benthic Invertebrates**
Increase in TSS/Turbidity	Too small to measure	Too small to measure	Too small to measure	Small decrease in abundance and distribution in Wuskwatim Lake main
Increase in Nutrient Concentrations	Small increase in production in tributary waterbodies	Too small to measure	No response	No response
Decrease in [DO]	No response	No response	Too small to measure	Too small to measure
Increase in Water Depth and Volume	Small increase in production in tributary waterbodies	Small increase in abundance of plants in Wuskwatim Lake main; moderate[1] increase in tributary waterbodies	Small increase in production in tributary waterbodies	Small increase in abundance and distribution in Wuskwatim Lake main; moderate increase in tributary waterbodies
Stabilization of Water Levels	Small increase in production in tributary waterbodies	Small increase in abundance of plants in Wuskwatim Lake main; moderate increase in tributary waterbodies	Small increase in production in tributary waterbodies	Small increase in abundance and distribution in Wuskwatim Lake main; moderate increase in tributary waterbodies
Decrease in Water Velocity	Too small to measure	Too small to measure	Too small to measure	Too small to measure
Increase in Erosion/Sedimentation	No response	Too small to measure	No response	Small decrease in abundance and distribution in Wuskwatim Lake main
Water Temperature	N/A	N/A	N/A	N/A
Ice Processes	N/A	N/A	N/A	N/A
Increase in Phytoplankton	N/A	N/A	Too small to measure	No response
Increase in Rooted Aquatic Plants	N/A	N/A	No response	Too small to measure
NET RESPONSE	Small increase in production in tributary waterbodies	Small increase in abundance of plants in Wuskwatim Lake main; moderate increase in tributary waterbodies	Small increase in production in tributary waterbodies	Small increase in abundance and distribution in Wuskwatim Lake main; moderate increase in tributary waterbodies

[1] moderate impacts are defined as those which would require a well planned sampling program, using conventional instrumentation and normal statistical procedures, to detect predicted changes

N/A not applicable

Table 6.7-2. Summary of predicted responses of lower trophic levels in Reach 2 to chemical and physical changes resulting from the operation of the Generation Project.

Impact	Predicted Responses			
	Phytoplankton	**Attached Algae and Rooted Aquatic Plants**	**Zooplankton**	**Benthic Invertebrates**
Accidental Spills	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP
Increase in TSS/Turbidity	Too small to measure	Too small to measure	Too small to measure	Small decrease in abundance and distribution
Increase in Nutrient Concentrations	Too small to measure	Too small to measure	No response	No response
Direct Loss of Aquatic Habitat	No response	Moderate[1] decrease in abundance and distribution (north bay)	No response	Moderate decrease in abundance and distribution (north bay)
Increase in Water Depth and Volume (Gain of Aquatic Habitat)	Too small to measure	Growth of rooted aquatic plant bed in the south bay	Too small to measure	Colonization of the south bay; moderate increase in abundance and distribution within reach
Stabilization of Water Levels	Too small to measure	Growth of rooted aquatic plant bed in the south bay	Too small to measure	Colonization of the south bay; moderate increase in abundance and distribution within reach
Decrease in Water Velocity	Too small to measure	Small increase in abundance and distribution	Too small to measure	Change in species composition
Increase in Erosion/Sedimentation	No response	Too small to measure	No response	Too small to measure
Water Temperature	N/A	N/A	N/A	N/A
Ice Processes	N/A	N/A	N/A	N/A
Increase in Phytoplankton	N/A	N/A	Too small to measure	No response
Decrease in Rooted Aquatic Plants	N/A	N/A	No response	Small decrease in abundance and distribution
NET RESPONSE	Too small to measure	Moderate decrease in abundance and distribution; growth of rooted aquatic plant bed in the south bay	Too small to measure	Colonization of the south bay; moderate increase in abundance and distribution; change in species composition

[1] moderate impacts are defined as those which would require a well planned sampling program, using conventional instrumentation and normal statistical procedures, to detect predicted changes
N/A not applicable

Table 6.7-3. Summary of predicted responses of lower trophic levels in Reach 3 to chemical and physical changes resulting from the operation of the Generation Project.

Impact	Predicted Responses			
	Phytoplankton	**Attached Algae and Rooted Aquatic Plants**	**Zooplankton**	**Benthic Invertebrates**
Accidental Spills	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP
Fluctuation in Water Levels	No response	Moderate[1] decrease in abundance and distribution	No response	Moderate decrease in abundance and distribution
Fluctuation in Water Velocities	No response	Too small to measure	No response	Change in species composition
Increase in Sedimentation	No response	Too small to measure	No response	Too small to measure
Water Temperature	N/A	N/A	N/A	N/A
Ice Processes	N/A	N/A	N/A	N/A
Changes in Rooted Aquatic Plants	N/A	N/A	N/A	Small decrease in abundance and distribution
NET RESPONSE	No response	Moderate decrease in abundance and distribution	No response	Moderate decrease in abundance and distribution; change in species composition

[1] moderate impacts are defined as those which would require a well planned sampling program, using conventional instrumentation and normal statistical procedures, to detect predicted changes

N/A not applicable

Table 6.7-4. Summary of predicted responses of lower trophic levels in Reach 4 to chemical and physical changes resulting from the operation of the Generation Project.

Impact	**Predicted Responses**			
	Phytoplankton	**Attached Algae and Rooted Aquatic Plants**	**Zooplankton**	**Benthic Invertebrates**
Accidental Spills	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP
Fluctuation in Water Levels	No response	Moderate[1] decrease in abundance and distribution	No response	Moderate decrease in abundance and distribution
Water Velocity	No response	No response	No response	No response
Sedimentation	No response	No response	No response	No response
Water Temperature	N/A	N/A	N/A	N/A
Ice Processes	N/A	N/A	N/A	N/A
Changes in Rooted Aquatic Plants	N/A	N/A	N/A	Small decrease in abundance and distribution
NET RESPONSE	No response	Moderate decrease in abundance and distribution	No response	Moderate decrease in abundance and distribution

[1] moderate impacts are defined as those which would require a well planned sampling program, using conventional instrumentation and normal statistical procedures, to detect predicted changes

N/A not applicable

Table 6.7-5. Summary of predicted responses of lower trophic levels in streams to chemical and physical changes resulting from the construction and maintenance of the access road.

Impact	Predicted Responses			
	Phytoplankton	**Attached Algae and Rooted Aquatic Plants**	**Zooplankton**	**Benthic Invertebrates**
Accidental Spills	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP	Control measures in Volume 3 and to be described in the EnvPP
Increase in TSS/Turbidity	No response	Too small to measure	No response	Too small to measure
Increase in Nutrient Concentrations	No response	Too small to measure	No response	Too small to measure
Increase in Metal Concentrations	No response	Too small to measure	No response	Too small to measure
Direct Loss of Aquatic Habitat	No response	Small decrease due to road and culvert footprint	No response	Small decrease due to road and culvert footprint
Decrease in Water Depth	N/A	N/A	N/A	N/A
Increase in Water Velocity	No response	No response	No response	No response
Increase in Sedimentation	N/A	Too small to measure	N/A	Too small to measure
Water Temperature	N/A	N/A	N/A	N/A
Ice Processes	N/A	N/A	N/A	N/A
Decrease in Rooted Aquatic Plants	N/A	N/A	N/A	Small decrease due to road and culvert footprint
NET RESPONSE	No response	Small decrease due to road and culvert footprint	No response	Small decrease due to road and culvert footprint

N/A not applicable

6.8 FISH COMMUNITY AND MOVEMENTS

A detailed description of the existing environment, impacts, and mitigation for the Fish Community and Movements Section is provided in Volume 5, Section 8. Figure 6.2-1 provides the locations of all place names referred to in this section.

6.8.1 Existing Environment

6.8.1.1 Overview of the Fish Community of the Study Area

The study area is similar to that of much of the northern **boreal** forest of Manitoba, Ontario, and western Quebec and the fish community is fairly typical of relatively shallow, turbid, northern water bodies. From a **biodiversity** and **conservation** perspective, the fish community of the study area is not unique. A total of 20 fish species were captured in the study area (Table 6.8-1). No fish species listed as endangered, threatened, or of special concern by COSEWIC (Committee on the Status of Endangered Wildlife in Canada) were captured during field studies. The principal fish species captured included walleye, sauger, northern pike, yellow perch, lake whitefish, lake cisco, longnose sucker, white sucker, burbot, spottail shiner, and emerald shiner.

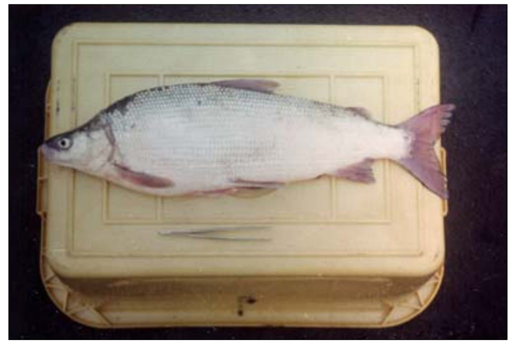
6.8.1.2 Valued Ecosystem Components

Key domestic and commercial fish species, including walleye (pickerel/okow), lake whitefish (whitefish/atihkamek), lake cisco (tullibee/ochonipis), and northern pike (jackfish/osawuskwapis) were identified as VECs (Section 6.1), and were the focus for assessing the **significance** of any Project-related effects on the fish community and fish movements (Figure 6.8-1).

Table 6.8-1. Fish species captured in the study area, 1998-2002.

Common Name	Cree Name	Species	Abbreviation
Northern pike (jackfish)	Osawuskwapis	*Esox lucius*	NRPK
Lake cisco (tullibee)	Ochonipis	*Coregonus artedi*	LKCS
Lake whitefish (whitefish)	Atihkamek	*Coregonus clupeaformis*	LKWH
Goldeye	Wepitcheesis	*Hiodon alosoides*	GOLD
Lake chub		*Couesius plumbeus*	LKCH
Pearl dace		*Margariscus margarita*	PRDC
Emerald shiner		*Notropis atherinoides*	EMSH
Spottail shiner		*Notropis hudsonius*	SPSH
Fathead minnow		*Pimephales promelas*	FTMN
Longnose (red) sucker	Mehkwamepith	*Catostomus catostomus*	LNSC
White sucker	Namepith	*Catostomus commersoni*	WHSC
Shorthead redhorse		*Moxostoma macrolepidotum*	SHRD
Burbot (maria)	Methachos	*Lota lota*	BURB
Brook stickleback		*Culea inconstans*	BRST
Ninespine stickleback		*Pungitius pungitius*	NNST
Trout-perch		*Percopsis omiscomaycus*	TRPR
Yellow perch (perch)	Asawisis	*Perca fluviatilis*	YLPR
Sauger		*Stizostedion canadense*	SAUG
Walleye (pickerel)	Okow	*Stizostedion vitreum*	WALL
Slimy sculpin		*Cottus cognatus*	SLSC

Walleye/pickerel/okow



Lake whitefish/atihkamek

Lake cisco/tullibee/ochonipis

Northern pike/jackfish/osawuskwapis

Figure 6.8-1. Valued Ecosystem Component (VEC) fish species.

Walleye

Presently, walleye are one of the most abundant species found in the study area, accounting for 13.9% of the 1998-2001 index gillnet catch in Reach 1, 37.5% of the 2001 and 2002 index gillnet catch in Reach 2, 35.6% of the 2001 and 2002 index gillnet catch in Reach 3, and 22.4% of the 2000 and 2001 index gillnet catch in Reach 4 (Table 6.8-2). Overall **catch-per-unit-effort** (CPUE) ranged from 24.2 fish/100 m of net/24 hrs in Reach 2 to 9.0 in Reach 4 (Table 6.8-2). Walleye abundance in reaches 2 and 3 is likely lower than indicated, as sampling was limited to peripheral off-current areas where walleye congregate. Much of these two reaches contain habitat that is not suitable for walleye due to water velocities that are greater than their **sustained swimming speeds**. A discussion of walleye swimming speeds can be found in Volume 5, Section 8.3.2.1 and Appendix 8-3.

Table 6.8-2. Relative abundance (RA; %) and catch-per-unit-effort (CPUE; number of fish per 100m of net per 24 hrs), by reach, of VEC fish species and total catch captured in index gillnets, 1998-2002.

Species	Reach 1[a]												Reach 2[b]								
	1998			2000			2001[e]			Mean			2001			2002			Mean		
	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE
Walleye	18	6.4	3.9	16	6.6	5.1	20	28.6	17.6	54	13.9	9.3	2	34.2	27.5	2	43.3	20.9	4	37.5	24.2
Lake whitefish	18	5.5	3.4	16	4.5	3.4	20	5.2	3.3	54	5.1	3.4	2	1.3	1.1	2	-	-	4	0.9	0.5
Lake cisco	18	21.6	13.4	16	17.8	14.1	20	15.3	9.9	54	18.1	12.3	2	10.2	8.3	2	9.4	4.6	4	9.9	6.4
Northern pike	18	6.9	4.5	16	2.6	2.1	20	8.4	5.2	54	5.9	4.0	2	7.1	5.7	2	7.9	3.8	4	7.4	4.8
Total	18	100	62.1	16	100	78.4	20	100	62.0	54	100	66.9	2	100	81.2	2	100	48.3	4	100	64.8

Species	Reach 3[c]									Reach 4[d]								
	2001			2002			Mean			2000			2001			Mean		
	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE	n	RA	CPUE
Walleye	8	35.2	9.9	8	36.0	14.2	16	35.6	12.1	6	16.5	6.2	6	27.5	11.9	12	22.4	9.0
Lake whitefish	8	5.0	1.4	8	6.3	2.7	16	5.7	2.0	6	9.5	3.5	6	8.8	4.1	12	9.1	3.8
Lake cisco	8	10.3	2.9	8	7.3	2.9	16	8.6	2.9	6	2.5	0.9	6	2.2	0.9	12	2.3	0.9
Northern pike	8	19.9	5.2	8	10.2	4.3	16	14.4	4.7	6	10.2	3.7	6	9.1	4.2	12	9.6	4.0
Total	8	100	28.5	8	100	40.1	16	100	34.3	6	100	37.0	6	100	43.5	12	100	40.3

n = number of net sets
a = Wuskwatim Lake and adjacent water bodies
b = Burntwood River between Wuskwatim Falls and Taskinigup Falls
c = Burntwood River between Taskinigup Falls and Opegano Lake
d = Opegano Lake
e = includes 4 sets in Wuskwatim Brook, 2 sets in Sesep Lake, and 4 sets in Cranberry Lakes

Spawning

Based on TK and the results of the EIA studies, walleye **spawning habitat** in Reach 1 is concentrated in Wuskwatim Brook and Wuskwatim Lake south (Volume 5, Figure 8-9). Walleye may also spawn in the Burntwood River above Cranberry Lakes, the Muskeseu River, and along the northeast shoreline of Wuskwatim Lake main. Under existing conditions, the majority of walleye that are found in Reach 2 are generally thought to be transients. However, some evidence to suggest that walleye spawn in Reach 2 was collected during spring, 2002. Larger numbers of **larval** walleye were captured downstream of Wuskwatim Falls as compared to upstream of Wuskwatim Falls, and one male walleye in ripe and running condition was captured in Reach 2. While this reach does support some off-current **nursery habitat**, it is expected that the majority of any **larvae** that may hatch in Reach 2 will drift further downstream.

Based on the location of larval walleye catches in spring 2002, and the presence of suitable spawning habitat, walleye spawn in the tributary draining into Backwater Inlet 6, and may spawn in tributaries flowing into backwater inlets 9 and 10, and in the Burntwood River near the base of the north channel of Taskinigup Falls, near the base of Little Jackpine Rapids, and just upstream of Opegano Lake. Although specific walleye spawning habitat was not identified in Reach 4, the Burntwood River inlet appears to provide suitable conditions. Walleye in Opegano Lake may also travel further up the Burntwood River to spawn.

Feeding and open-water habitat preferences

In all four reaches walleye fed primarily on a variety of fish species but several invertebrate groups were also consumed. Although within a given reach walleye tended to be found (and consequently fed) in all habitat types, some preferences were noted. In Reach 1 walleye appeared to favour the nearshore, no plants habitats with the highest CPUEs recorded in “nearshore, flooded terrestrial, no plants” and “nearshore, soft silt/clay-based, no plants” habitats. Walleye abundance was appreciably lower in “offshore, soft silt/clay-based, no plants” habitat. In Reach 3, walleye preferred “wetted, backwater inlets, soft silt/clay-based, no plants, low water velocity” habitat over “wetted, mainstem, no plants, low water velocity” habitat.

Overwintering

During March 2002, small numbers of walleye were captured in five of eight gillnetting sites. Within Reach 1, walleye were captured in some of the adjacent water bodies but not in others. It is presumed that walleye also **overwinter** in Wuskwatim Lake main due to the abundance of suitable habitat. Although winter sampling could not be conducted within Reach 2, it is expected that suitable overwintering habitat for walleye would be limited to the low velocity bays. Four walleye, accounting for 8.3% of the Reach 3 catch, were captured at two of three locations in Reach 3 where gill nets were set. Two walleye were captured in the northwest corner of Opegano Lake indicating that at least some walleye overwinter in Reach 4.

Movements

Fourteen walleye were **radio-tagged** in the fall of 1999 in Wuskwatim Lake main and all 14 of these fish were relocated at least once. None moved upstream or downstream out of Wuskwatim Lake main although two fish moved extensively within the lake. Between 1999 and 2002, 683 walleye were **Floy-tagged** between Cranberry Lakes and Birch Tree Lake, 584 of which were tagged in Wuskwatim Lake or Wuskwatim Brook. Thirty-three individuals were recaptured, including six fish that moved into a different water body from that where they were tagged. Two fish moved from Wuskwatim Lake main downstream out of Reach 1 between May and September of 2001. One of these walleye was recaptured upstream of Taskinigup Falls; the other downstream of Taskinigup Falls. The remaining four fish moved from Cranberry Lakes into Wuskwatim Lake or vice versa.

During the Wuskwatim EIA studies, Floy-tagging and gillnetting studies were also being conducted in areas upstream of Early Morning Rapids, including Notigi, Wapisu, Threepoint, Footprint, and Leftrook lakes, as part of the NCN/Manitoba Hydro Environmental Monitoring Program. One walleye tagged in Notigi Lake in June 2000, was recaptured in Wuskwatim Lake in September 2001, a downstream movement of 115 km. No radio- or Floy-tagged walleye were observed to move upstream over Wuskwatim Falls, Taskinigup Falls, or Early Morning Rapids. Traditional Knowledge of movements of fish upstream over Wuskwatim Falls and Taskinigup Falls is discussed in Section 6.8.2.2 (Overview of Effects of Operation on Fish Movements).

Lake Whitefish

Lake whitefish accounted for 5.1% of the 1998-2001 index gillnet catch in Reach 1, 0.9% of the 2001 and 2002 index gillnet catch in Reach 2, 5.7% of the 2001 and 2002 index gillnet catch in Reach 3, and 9.1% of the 2000 and 2001 index gillnet catch in Reach 4 (Table 6.8-2). Overall CPUE ranged from 3.8 in Reach 4 to 0.5 in Reach 2 (Table 6.8-2). Although lake whitefish do not appear to be a major component of the fish fauna of the study area based on overall index gillnet catches, they do form an important component of the commercial catch in Wuskwatim Lake (Section 8.3). A discussion of lake whitefish swimming speeds can be found in Volume 5, Section 8.3.3.1 and Appendix 8-3.

Spawning

The section of the Burntwood River immediately downstream of Early Morning Rapids was identified by TK as a pre-CRD spawning location for lake whitefish. The results of EIA studies have shown that lake whitefish appear to spawn along much of the western and eastern shorelines of Wuskwatim Lake main and in Cranberry Lakes, and possibly in the Burntwood River above Cranberry Lakes (Volume 5, Figure 8-16). Information collected during EIA studies suggests that little, if any, lake whitefish spawning presently occurs within Reach 2, including the base of Wuskwatim Falls. Although no direct evidence of lake whitefish spawning in Reach 3 was collected during EIA studies, it is suspected that some spawning may occur within lower velocity habitats near the upstream and downstream ends of the reach. Based on evidence collected from the EIA studies, it is felt that lake whitefish spawn along a small rocky shoal in the northwestern portion of Opegano Lake, while other spawning areas for whitefish in Reach 4 may include small rocky shoals along the southern shoreline of the lake and lower velocity habitat within the most downstream portion of Reach 3.

Feeding and open-water habitat preferences

In all four reaches lake whitefish fed on a variety of invertebrates. Among the most frequently consumed groups were clams, scuds, clam shrimp, and snails. In Reach 1 lake whitefish were most abundant (and consequently fed most frequently) in "offshore, soft silt/clay-based, no plants" habitat. They were much less abundant in "nearshore, soft silt/clay-based, no plants" and "nearshore, flooded terrestrial, no plants" habitats. Information collected from "nearshore, flooded terrestrial, rooted vascular plants" habitat suggests that lake whitefish also favoured this habitat type. In Reach 3, lake whitefish were somewhat more abundant in "wetted, backwater inlets, soft silt/clay-based, no plants, low water velocity" habitat than in "wetted, mainstem, no plants, low water velocity" habitat. No distinct habitat preferences could be established for lake whitefish in reaches 2 and 4.

Overwintering

During March 2002, a total of three lake whitefish were captured from the eight gillnetting sites. Only one whitefish was captured in the adjacent water bodies, suggesting that the majority of the lake whitefish that overwinter in Reach 1 do so in Wuskwatim Lake main. Radio-tagging data support this suggestion. Although one radio-tagged lake whitefish resided within Reach 2 until at least November 30, it is expected that few lake whitefish overwinter within this reach. Whitefish found within Reach 3 during late fall must either move downstream out of the reach into Reach 4 or must find overwintering habitat within Reach 3. One whitefish was captured in a backwater inlet in the lower portion of Reach 3 and one whitefish was captured in the northwest corner of Opegano Lake indicating that lake whitefish do overwinter to some degree within these reaches.

Movements

A total of 69 lake whitefish were Floy-tagged in the study area, 64 of which were tagged in Reach 1. Two of these fish were subsequently recaptured within Wuskwatim Lake main; one was tagged in Wuskwatim Lake main while one had moved downstream from Cranberry Lakes. Nineteen of the 20 lake whitefish fitted with **radio-transmitters** in Reach 1 in the fall of 1999 and in the spring and fall of 2000 were relocated at least once. While the majority of these lake whitefish showed limited movement during October 1999 and between September 24 and November 30, 2000, five individuals moved downstream out of Wuskwatim Lake, with three of these five fish last located downstream of Taskinigup Falls. One radio-tagged whitefish moved upstream into the Muskeseu River system from the Cranberry Lakes. No radio- or Floy-tagged lake whitefish were observed to move upstream over Wuskwatim Falls, Taskinigup Falls, or Early Morning Rapids.

Lake Cisco

Lake cisco accounted for 18.1% of the 1998-2001 index gillnet catch in Reach 1, 9.9% of the 2001 and 2002 index gillnet catch in Reach 2, 8.6% of the 2001 and 2002 index gillnet catch in Reach 3, and 2.3% of the 2000 and 2001 index gillnet catch in Reach 4 (Table 6.8-2). Overall CPUE ranged from 12.3 in Reach 1 to 0.9 in Reach 4 (Table 6.8-2). Cisco are relatively abundant in Reach 1 and in recent years have formed an important component of the commercial catch (Section 8.3). Lake cisco abundance in reaches 2 and 3 is likely lower than indicated, as sampling was limited to peripheral off-current areas. Much of these two reaches contain habitat that is not suitable for cisco due to water velocities that are greater than their sustained swimming speeds. A discussion of lake cisco swimming speeds can be found in Volume 5, Section 8.3.4.1 and Appendix 8-3.

Spawning

The section of the Burntwood River immediately downstream of Early Morning Rapids was identified by TK as a pre-CRD spawning location for lake cisco. The results of the EIA studies have shown that cisco appear to spawn along much of the western and eastern shorelines of Wuskwatim Lake main and in Cranberry Lakes, and possibly in the Burntwood River above Cranberry Lakes (Volume 5, Figure 8-25). Information collected during the EIA studies suggests that little, if any, lake cisco spawning presently occurs within Reach 2, including the base of Wuskwatim Falls. Although no direct evidence of cisco spawning in Reach 3 was collected during the EIA studies, it is suspected that some spawning may occur within lower velocity habitats near the upstream and downstream ends of the reach. Although cisco were not abundant in Reach 4 index gillnet catches, larval cisco were captured from several parts of Opegano Lake during early spring, 2001 and 2002. Based on evidence collected from the EIA studies, it is felt that cisco spawn over small rocky shoals along the western and northern shorelines of Opegano Lake. Other spawning areas for Opegano Lake cisco may include small rocky shoals along the southern shoreline of the lake and low velocity habitat within the most downstream portion of Reach 3.

Feeding and open-water habitat preferences

Lake cisco fed on a variety of invertebrate groups, including mayflies, zooplankton, clams, and water bugs. In Reach 1, cisco were most abundant (and consequently fed most frequently) in "nearshore, soft silt/clay-based, no plants" and "nearshore, flooded terrestrial, no plants" habitats, and less abundant in "offshore, soft silt/clay-based, no plants" habitat. Information collected from "nearshore, flooded terrestrial, rooted vascular plants" habitat suggested that cisco were less abundant in this habitat type. Cisco captured in Reach 3 were more abundant in "wetted, backwater inlets, soft silt/clay-based, no plants, low water velocity" habitat than in "wetted, mainstem, no plants, low water velocity" habitat. The number of cisco captured in reaches 2 and 4 were not sufficient to determine habitat preferences.

Overwintering

During March 2002, lake cisco were captured at seven of eight gillnetting sites. Within Reach 1 cisco were captured in all four sites in the adjacent water bodies, including a large catch in the south bay of Wuskwatim Lake. Five of six cisco radio-tagged during 2000 remained within Wuskwatim Brook or Wuskwatim Lake south until at least November 30, suggesting that these fish likely overwintered there. A large proportion of the cisco in Reach 1 likely overwinter in Wuskwatim Lake main. Although winter sampling could not be conducted within Reach 2, it is expected that, due to the medium and high water velocities found within much of the reach, few cisco overwinter in Reach 2. Cisco that are found within Reach 3 during late fall must either move out of the reach into Opegano Lake or must find overwintering habitat within the reach. A total of three cisco were captured in two of the three gill nets set in backwater inlets suggesting that some cisco do overwinter within the reach. Although cisco are not a large component of open water index gillnet catches in Reach 4, four of 13 fish captured in a gillnet set in the northwest corner of the lake in March 2002 were lake cisco (31% of the catch), suggesting that Opegano Lake may be an important overwintering site for lake cisco.

Movements

A total of 361 lake cisco were Floy-tagged in the study area, 359 of which were tagged in Reach 1. Four of 343 cisco tagged in Wuskwatim Lake or Wuskwatim Brook were recaptured, all within the same water bodies. All eight lake cisco fitted with radio-transmitters in the fall of 1999 and in the spring of 2000 in Wuskwatim Lake were relocated at least once. Results of these studies suggest that most lake cisco move short distances during fall. As with lake whitefish, there was no apparent migration to one or a few discrete areas during fall, suggesting that fish were already at or near potential spawning sites. Fish that were **tracked** over a ten-week period from mid-September to November 30, 2000 generally remained within the area of the peninsula in the southwest corner of Wuskwatim Lake main. Final tracking locations on November 30 suggested that lake cisco overwintered in the same portion of the lake (west and east of the peninsula). One radio-tagged lake cisco moved upstream into Wuskwatim Brook from the southwest bay of Wuskwatim Lake and one cisco that was radio-tagged in Wuskwatim Lake moved downstream over Wuskwatim and Taskinigup falls and was relocated only once, a short distance upstream of Opegano Lake. No radio- or Floy-tagged lake cisco were observed to move upstream over Wuskwatim Falls, Taskinigup Falls, or Early Morning Rapids.

Northern Pike

Northern pike accounted for 5.9% of the 1998-2001 index gillnet catch in Reach 1, 7.4% of the 2001 and 2002 index gillnet catch in Reach 2, 14.4% of the 2001 and 2002 index gillnet catch in Reach 3, and 9.6% of the 2000 and 2001 index gillnet catch in Reach 4 (Table 6.8-2). Overall CPUE for pike was similar among reaches, ranging from 4.8 in Reach 2 to 4.0 in reaches 1 and 4 (Table 6.8-2). However, northern pike abundance in reaches 2 and 3 is likely lower than indicated, as sampling was limited to peripheral off-current areas where pike would be concentrated. Much of these two reaches contain habitat that is not suitable for pike due to water velocities that are greater than their sustained swimming speeds. A discussion of northern pike swimming speeds can be found in Volume 5, Section 8.3.5.1 and Appendix 8-3.

Spawning

Suitable northern pike spawning habitat (shallow, relatively calm water over **inundated** vegetation) is abundant in Reach 1 although no specific spawning sites were identified. The majority of spawning in Reach 1 likely takes place in Cranberry Lakes, Sesep Lake, Wuskwatim Brook, and in Wuskwatim Lake south, although pike probably also use seasonally inundated portions of Wuskwatim Lake main for spawning (Volume 5, Figure 8-30). Although habitat within most of Reach 2 is less than optimal for northern pike spawning, the capture of pike larvae in nearshore areas during spring 2002 indicates that some spawning does occur within the reach. It is expected that the majority of northern pike larvae drift downstream after hatching. Larval northern pike were captured in backwater inlets 1, 4, and 10 in 2002, indicating that some spawning does occur in Reach 3. Other tributaries and backwater inlets in Reach 3 may also provide spawning habitat for pike. Although there is little typical northern pike spawning habitat in Reach 4, larval pike were captured in the bay in the north end of Opegano Lake in the spring of 2002. Flooded backwater inlets located upstream and downstream of the lake probably provide additional spawning habitat for pike in Opegano Lake.

Feeding and open-water habitat preferences

In all four reaches northern pike fed almost exclusively on a variety of fish species, although invertebrates were consumed by some smaller pike. Within Reach 1, data suggested that northern pike were most abundant in “nearshore, flooded terrestrial, rooted vascular plants” habitat, followed by “nearshore, flooded terrestrial, no plants” habitat, and were least abundant in “offshore soft silt/clay-based, no plants” habitat. In Reach 3, pike showed a strong preference for “wetted, backwater inlets, soft silt/clay-based, no plants, low water velocity” habitat, while nearshore habitats were preferred over offshore habitat in Reach 4.

Overwintering

During March 2002, northern pike were captured at all eight gillnetting sites. Within Reach 1, pike were shown to overwinter in the adjacent water bodies and it is presumed that they also overwinter in Wuskwatim Lake main. Although winter sampling could not be conducted within Reach 2, it is expected that suitable overwintering habitat for northern pike would be limited to the low velocity bays. Northern pike accounted for 79% of the 48 fish that were captured in Reach 3, indicating that the backwater inlets provide important overwintering habitat for pike. Four northern pike were captured in the one gill net set in Opegano Lake indicating that overwintering habitat for pike is available in Reach 4.

Movements

Radio-tags were not applied to northern pike as individuals generally do not undertake long distance movements. A total of 146 northern pike were Floy-tagged in the study area, of which 105 were applied to fish captured in the southwest bay of Wuskwatim Lake. Six of these pike were recaptured, all within Wuskwatim Lake. No Floy-tagged northern pike were observed to move upstream over Early Morning Rapids or upstream or downstream over Wuskwatim or Taskinigup falls.

6.8.2 Impacts and Mitigation

6.8.2.1 Construction

Effects of Construction on Valued Ecosystem Components

Although **life histories** of the VEC fish species differ, the potential influence of construction on spawning, feeding, and overwintering habitat for each VEC fish species is similar. Therefore, the effects of Project construction on walleye, lake whitefish, lake cisco, and northern pike are considered together and are summarized in Table 6.8-3.

Table 6.8-3. Summary of impacts to populations of VEC species resulting from Project construction.

Disturbance	Effect
Changes to Water Quality	
Increased TSS	Short-term, small and local (-)
Introduction of trace elements	Ø
Accidental hydrocarbon spills and releases	Ø
Input of treated sewage effluent	Short-term, small, and site-specific (-)
Construction of stream crossings	Short-term, small, and local (-)
Blasting	Short-term, small, and site-specific (-)
Entrainment and impingement of fish due to water intakes	Ø
Assessment of significance: Negative and not significant (short-term, small, and local)	

Water quality

The following summarizes potential impacts to VEC fish species resulting from changes in water quality due to construction of the Project. A detailed discussion of potential effects of Project construction on water quality is found in Section 6.5.2.1.

Increased total suspended solids (TSS)

Increases in TSS levels resulting from construction-related activities are described in Section 6.5.2. Increased TSS is not expected to have a significant effect on VEC fish species due to the low frequency of impact (a few episodes during construction), relatively short duration of impact (several weeks), and the expected level of increase in TSS (i.e., increases well below lethal limits) in the fully mixed zone of the river. Fish within the immediate construction area may be affected by plumes of higher concentration; however, they would be able to avoid these areas. Fish inhabiting most backwater inlets would be exposed to little, if any, increase in TSS. Consequently, increased TSS is expected to have a short-term, small, and local negative effect on VEC fish species.

Introduction of trace elements

It is predicted that there will be a **negligible** to small increase in some metals and/or metalloids due to sediment re-suspension, cofferdam removal, and acid generation from leachate (Section 6.5.2). The predicted level of increase is expected to have no effect on VEC fish species.

Accidental hydrocarbon spills and releases

As discussed in Section 6.5.2, no significant impacts due to accidental spills and releases of hydrocarbons and other hazardous materials are expected due to safe handling and spill containment measures outlined in the Project Description (Section 4). Consequently, accidental hydrocarbon spills and releases are expected to have no effect on VEC fish species.

Input of sewage

Treated sewage effluent from the construction camp will be discharged twice a year (five days in spring and 10 days in late fall) into Backwater Inlet 4 (an approximately 9 ha inlet on the Burntwood River in Reach 3), and small, short-term reductions in dissolved oxygen concentrations in Backwater Inlet 4 are predicted during these periods (Section 6.5.2). The increase in TSS is not expected to affect the fish community, but the reduction in dissolved oxygen may affect the suitability of Backwater Inlet 4 as fish habitat during spring and late fall, particularly for northern pike. Consequently, input of sewage is expected to have a short-term, small, and site-specific negative effect on VEC fish species.

Access road stream crossings

Although measures will be taken to minimize the input of sediments during and after construction (Section 4.5), small, short-term increases in TSS are expected during and immediately after installation of culverts. Additionally, there is a small potential for accidental spills and releases of hydrocarbons at the stream crossings, but spill containment measures that will be described in the spill response plan would minimize the potential for impacts affecting more than the local area. Any negative effect on the fish community at a particular stream crossing would be expected to be short-term, small, and local.

Blasting

Blasting will generally be conducted in accordance with DFO guidelines for the use of explosives in or near Canadian fisheries waters (Wright and Hopky 1998) to ensure compliance with various fish and fish habitat protection provisions of the *Fisheries Act* (including provisions to protect spawning beds during **egg incubation**). The exception will be single blasts conducted for the removal of rock plugs in the **spillway channel**, channel improvement area, and at the station in 2008 and 2009 that may not be able to meet all the criteria in the guidelines. However, these are single events and are not expected to result in the mortality of a large number of fish. Consequently, it is expected that blasting will have a short-term, small, and site-specific negative effect on VEC fish species.

Water Intake

During construction of the Project, water will be required for several uses including potable water for the camp and work areas and water for mixing of concrete. Intake pipes will be screened according to current end-of-pipe fish screening guidelines (DFO 1995) to minimize the **entrainment** and **impingement** of fish. Consequently, it is expected that water intakes will have no effect on VEC fish species.

Assessment of significance

Measures that are described in Section 4.5 are expected to minimize the duration and magnitude of most construction-related impacts on VEC fish species. However, some effects, such as increased TSS due to releases of coffer dams and rock plugs, and blasting of rock plugs will result in short-term and small negative effects to fish abundance within a given area. Overall, it is expected that construction of the Project will have a **short-term, small, local and, therefore, not significant negative effect on populations of VEC fish species within the study area**.

Increased fishing activity

The potential for increased fishing activity due to the presence of construction workers and increased access during Project construction is discussed fully in Section 8.3. To reduce the effects of increased harvesting, NCN and Manitoba Hydro, in consultation with the Nelson House Resource Management Board, will develop an Access Management Plan prior to construction. Measures included in the Access Management Plan will determine the extent of impact related to changes in harvesting activity. It should be noted that Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest.

6.8.2.2 Operation

Overview of Effects of Operation on the Fish Community due to Habitat Alteration

Reach 1: Wuskwatim

The stabilization of water levels in Reach 1 is expected to increase the quantity and quality (conversion of intermittently exposed to wetted habitat) of spawning, feeding, and overwintering habitat available to fish and increase the production of plants, invertebrates, and **forage fish**, particularly in the productive adjacent water bodies of Reach 1, which will increase the amount of food available to fish. Increased erosion and sedimentation in portions of Wuskwatim Lake main may result in short-term losses in the quantity and quality of spawning habitat available to some species (e.g., lake whitefish and lake cisco). Localized reductions in dissolved oxygen concentrations may reduce the quality of overwintering habitat in off-current areas within some of the adjacent water bodies. However, the quantity of suitable overwintering habitat in Reach 1 is not expected to be affected as overwintering habitat is abundant within the reach (e.g., Wuskwatim Lake main).

Reach 2: Falls

An increase and stabilization of water levels in Reach 2 is expected to increase the quantity of feeding and overwintering habitat available to fish and increase the production of invertebrates and forage fish, which will increase the amount of food available to fish.

Reach 3: Burntwood

An increase in the amount and frequency of intermittently exposed habitat is expected to negatively affect the quantity and quality of spawning, feeding, and overwintering habitat available to fish in Reach 3. Daily fluctuations in water levels will also negatively affect the production of aquatic plants, invertebrates, and forage fish, which will result in less food available to fish in Reach 3.

Reach 4: Opegano

The magnitude of water level fluctuations in Opegano Lake will be less than those experienced in Reach 3 and, consequently, the negative effects to spawning and feeding habitat will be smaller. Overwintering habitat is not believed to be limiting fish production in Opegano Lake and, consequently, changes in the quantity of overwintering habitat are expected to have no effect on fish in Reach 4.

Stream Crossings

No VEC species were captured at any of the stream crossings, although fish were captured at all eight sites. The absence of VECs is likely due to the abundance of beaver and debris dams within the streams that restrict access to the crossing sites from larger water bodies such as the Burntwood River or Birch Tree Lake. Appropriately sized and installed culverts will be employed at each of the eight stream crossings (Volume 3). Consequently, none of the habitat alterations are expected to significantly affect the fish community at any of the eight crossings or block movement of fish through the road crossings.

Overview of Effects of Operation on Fish Movements

Fish Movements

The majority of NCN members who provided Traditional Knowledge on fish movements felt that fish did not move upstream over Wuskwatim Falls or Taskinigup Falls either before or after CRD. However, there were several Elders who were familiar with the area who thought fish had been able to move upstream over Taskinigup Falls prior to CRD. Based on both Traditional Knowledge and the environmental assessment studies (radio- and Floy-tagging results), it is felt that fish do not currently move upstream over either Taskinigup Falls or Wuskwatim Falls. Downstream fish movements over Wuskwatim Falls and Taskinigup Falls were documented during the environmental assessment studies (Section 6.8.1).

The reduction of water velocities at Wuskwatim Falls (Volume 5, Section 8) is expected to result in more fish being retained in Reach 1 due to fewer larval fish moving downstream out of Reach 1 and the ability of most non-larval fish to move freely between reaches 1 and 2. Reduction of water velocities at Wuskwatim Falls will allow most fish to move upstream from Reach 2 into Reach 1 and thereby have access to fish habitat within all of Wuskwatim Lake and adjacent water bodies. Additionally, due to less favourable habitat at the downstream end of the forebay, combined with the reduction of water velocities at the GS intake as compared to Taskinigup Falls (Volume 5, Section 8), it is expected that fewer fish will move downstream out of Reach 2 into reaches 3 and 4. Additionally, some proportion of those fish that do move downstream through the GS will be susceptible to **turbine mortality** (discussed below; it should be noted that some unknown level of natural mortality likely exists for fish passing over Taskinigup Falls). Consequently, the fish community in reaches 3 and 4 is expected to be affected by the smaller number of **migrants** from upstream of the GS. Fish movements downstream of Opegano Lake will not be affected by operation of the GS.

Requirement for Upstream and Downstream Fish Passage Facilities

Upstream **fish passage facilities** are not included in the design of the Project for the following reasons:

- upstream fish passage is not required for any important life history functions (i.e., fish do not currently move upstream over Taskinigup Falls); and
- upstream movements are restricted not only by Taskinigup Falls and Wuskwatim Falls but also three sets of rapids between Taskinigup Falls and Opegano Lake and two sets of impassable falls between Opegano Lake and Birch Tree Lake.

Downstream fish passage facilities are not incorporated into the design of the Project for the following reasons:

- there is currently no upstream fish passage; therefore, any fish moving downstream are permanently lost to upstream locations which are utilized by domestic, commercial, and recreational fishers;
- fish located downstream of Taskinigup Falls (e.g., Opegano Lake) are not currently utilized by either domestic, commercial, or recreational fishers due to poor access, unsafe travel conditions, and low fish abundance;
- fish moving downstream would move from an area being positively effected by the Project (e.g., stabilized water levels in Wuskwatim Lake) to an area being negatively effected by the Project (e.g., increased water level fluctuations downstream of the GS); and
- as discussed above, the number of downstream migrants during operation of the Project is expected to decrease relative to the present condition.

Turbine Mortality

The three **turbines** selected for the Project are fixed blade vertical shaft turbines (Section 4.3.2). Information on fish mortalities passing through turbines is limited for fish species typical of boreal lakes and rivers. Mortality estimates are variable between studies, fish species, fish lengths, turbine types, and the specific configurations of the generating stations (Matousek et al. 1994; Navarro et al. 1996). However, for fish lengths between 15 and 40 cm, mortality is generally expected to fall between 10 and 20% of the fish moving downstream through the turbines.

Effects of Operation on Valued Ecosystem Component Species

Walleye

Predicted impacts on the walleye population of the study area resulting from habitat alteration due to operation of the Project are summarized in Table 6.8-4.

Table 6.8-4. Summary of impacts on walleye resulting from habitat alteration due to operation of the Project.[1]

	Changes in water quality	Changes in the quantity and quality of aquatic habitat	Changes in invertebrate production	Changes in forage fish production
Reach 1: Wuskwatim				
Spawning	Ø	+	N/A	N/A
Feeding	Ø	+	+	+
Overwintering	-	Ø	N/A	N/A
Reach 2: The Falls				
Spawning	Ø	-	N/A	N/A
Feeding	Ø	+	+	+
Overwintering	-	+	N/A	N/A
Reach 3: Burntwood				
Spawning	Ø	-	N/A	N/A
Feeding	Ø	-	-	-
Overwintering	-	-	N/A	N/A
Reach 4: Opegano				
Spawning	Ø	Ø	N/A	N/A
Feeding	Ø	-	-	-
Overwintering	Ø	Ø	N/A	N/A

1 Assessments are based on analyses presented in Volume 5, Section 8
\+ The impact is expected to have a positive effect on walleye within the reach
\- The impact is expected to have a negative effect on walleye within the reach
Ø No predicted effect
N/A Not applicable

Reach 1: Wuskwatim

Stabilization of water levels in Reach 1 at the upper end of the existing range will convert 1588 ha of intermittently exposed to wetted nearshore habitat (Section 6.6.2.2). Most of the newly created wetted nearshore habitat occurs in the shallow, productive areas of the adjacent water bodies (Sesep Lake, Wuskwatim Brook, and Wuskwatim Lake south; Section 6.6.2). This change in water level regime is expected to result in a small, long-term increase in the production of aquatic plants and invertebrates (Section 6.7.2), which is expected to result in an increase in the production of forage fish and the amount of food available to walleye. An increase in the amount of spawning (i.e., better access to tributaries such as the Muskeseu River) and feeding habitat available to walleye is also expected.

Fewer larval walleye are expected to drift downstream out of Wuskwatim Lake due to the decrease in water velocity at Wuskwatim Falls (Volume 5, Section 8). While it is expected that the downstream movement of **juvenile** and **adult** walleye out of Wuskwatim Lake will continue at about the same rate as at present, the reduction of water velocities at Wuskwatim Falls will allow most juvenile and adult walleye the opportunity to move back into Reach 1. The combination of less drift of larval walleye out of Wuskwatim Lake, and the ability of most juvenile and adult walleye to move upstream from Reach 2 into Reach 1, are expected to result in fewer walleye leaving Wuskwatim Lake.

Short-term (5-10 years) increases in erosion, turbidity, and sedimentation along eroding shorelines within Wuskwatim Lake main and Cranberry Lakes (Section 6.5.2) may reduce the suitability of these areas for invertebrate production and may result in short-term avoidance of these areas by walleye. However, increased erosion, turbidity, and sedimentation in these areas are not expected to adversely affect walleye because: i) the primary walleye spawning areas in Reach 1 (Wuskwatim Brook and the southwest bay of Wuskwatim Lake) will not be affected; and ii) increased erosion will affect shoreline environments of Wuskwatim Lake main and Cranberry Lakes which are currently not highly productive in terms of **forage**. Although a reduction in the total amount of walleye overwintering habitat in Reach 1 may occur due to reduced oxygen concentrations in off-current areas within some of the adjacent water bodies (Section 6.5.2), walleye abundance within this reach is not expected to be affected as overwintering habitat is abundant within the reach (e.g., Wuskwatim Lake main).

Reach 2: Falls

Inundation of Reach 2 due to operation of the Project will produce substantially higher and more stable water levels than under existing conditions. This change in water level regime will increase the amount of aquatic habitat in Reach 2 (Section 6.6.2), and is expected to increase the amount of feeding and overwintering habitat available to walleye. The higher, more stable water levels are also expected to increase the amount of invertebrate and forage fish production that is expected to result in an increase in the amount of food available to walleye. Overall, water velocities within Reach 2 will be reduced, making more of the reach usable to walleye.

Presently, walleye residing in Reach 2 are restricted from moving further upstream by Wuskwatim Falls. As discussed above, reduction of water velocities at Wuskwatim Falls will allow most juvenile and adult walleye to move upstream from Reach 2 into Reach 1 and thereby have access to aquatic habitat within all of Wuskwatim Lake and adjacent water bodies for spawning, feeding, and overwintering (a detailed discussion of water velocities in reaches 2 and 3 and walleye swimming speeds is found in Volume 5, Section 8). Due to non-preferred habitat immediately upstream of the GS (deep and non-productive in terms of forage) and reduction of water velocities at the GS intake (relative to Taskinigup Falls) (Volume 5, Section 8), it is expected that fewer larval, juvenile, and adult walleye will move downstream out of Reach 2 into reaches 3 and 4.

While it is expected that any spawning habitat that walleye presently use within Reach 2 (i.e., downstream of the base of Wuskwatim Falls) will be likely be lost, and no spawning habitat is expected to be created within the reach, walleye within Reach 2 will be able to access spawning habitat in Reach 1 (Volume 5, Section 8). Some of the overwintering habitat created by flooding within off-current areas of Reach 2 may undergo moderate, short-term reductions in dissolved oxygen concentration (Section 6.5.2) making this habitat unsuitable for walleye. Flooding of terrestrial habitat in Reach 2 is expected to have no other effects on water quality and, therefore, no impacts on walleye.

Reach 3: Burntwood

During operation of the Project, Reach 3 will undergo a conversion of 17 ha of wetted nearshore habitat to intermittently exposed habitat and a reduction in the quality of intermittently exposed habitat (relative to the pre-Project condition) due to the increased frequency of water level fluctuations (Section 6.6.2). Increased water level fluctuations are predicted to negatively affect the quality and quantity of walleye spawning (tributaries draining into backwater inlets 6, 9, and 10), feeding, and overwintering habitat in Reach 3. A further reduction in the quantity and quality of preferred walleye overwintering habitat may occur in Reach 3 due to reduced oxygen concentrations in backwater inlets (Section 6.5.2). Increased water level fluctuations also are expected to negatively affect aquatic plant, invertebrate, and forage fish production, and, consequently, result in less food for walleye in Reach 3.

Alterations in water velocity within Reach 3 are not expected to negatively affect walleye. The amount of low velocity (< 0.5 m/s) habitat present within Reach 3 under 3 units best gate flows (122.1 ha; Section 6.6.2) is comparable to the amount of low velocity habitat present under existing 95%ile conditions (121.9 ha; Section 6.6.1), and 2 units best gate (139.6 ha) and 1 unit best gate (197.4 ha) flow scenarios result in a gain in low velocity habitat (Section 6.6.2). Under existing conditions, walleye likely have difficulty moving upstream through the rapids immediately downstream of Backwater Inlet 3, Little Jackpine Rapids, the second set of rapids, and the third set of rapids. During operation of the Project, more frequent fluctuations in water level and velocity may improve the ability of walleye to move upstream through these rapids.

As discussed above, it is expected that fewer larval, juvenile, and adult walleye will move downstream out of Reach 2 into Reach 3. Additionally, a proportion of those walleye that do move downstream through the GS will be susceptible to turbine mortality. Consequently, due to the reduced number of walleye that move downstream out of Reach 2, and turbine mortality, fewer larval, juvenile, and adult walleye will move into Reach 3 from upstream locations.

Reach 4: Opegano

During operation of the Project, Opegano Lake will undergo a conversion of 27.9 ha of wetted nearshore habitat to intermittently exposed habitat and a reduction in the quality of intermittently exposed habitat (relative to the pre-Project condition) due to the increased frequency of water level fluctuations (Section 6.6.2). The increased frequency of water level fluctuations are predicted to negatively affect the quality and quantity of walleye feeding habitat, although the quality and quantity of spawning and overwintering habitat are not expected to be affected. Water level fluctuations also are expected to negatively affect aquatic plant, invertebrate, and forage fish production, and, consequently, result in less food for walleye in Reach 4. As noted above, reduced water velocities at the inlet and outlet of Reach 2 and turbine mortality are expected to result in fewer walleye migrating into Opegano Lake from upstream of the GS.

Assessment of significance

It is expected that operation of the Project will result in more walleye in reaches 1 and 2 due to greater access to spawning and feeding habitat, more invertebrates and forage fish available as food, unrestricted movement between reaches 1 and 2 for most walleye, and fewer walleye moving downstream out of Reach 2.

It is expected that there will be fewer walleye in reaches 3 and 4 due to an increase in the frequency of water level fluctuations that will affect the quantity and quality of spawning, feeding, and overwintering habitat in Reach 3, and feeding habitat in Reach 4, and result in a reduction in the abundance of invertebrates and forage fish available as food. Additionally, fewer walleye are expected to move downstream into reaches 3 and 4 from upstream of the GS. Although the relative contribution of migrants from Wuskwatim Lake to the total number of walleye in reaches 3 and 4 is not known, given the small amount of aquatic habitat in reaches 3 and 4 relative to that of Wuskwatim Lake and adjacent water bodies, migrants from Reach 1 may comprise a measurable proportion of the number of walleye in reaches 3 and 4.

Overall, it is expected that, since the abundance of walleye in the upstream reaches (particularly Reach 1) is greater than in the downstream reaches, the positive effects to walleye in reaches 1 and 2 will outweigh the negative effects to walleye in reaches 3 and 4 and result in a **long-term, small, local and, therefore, not significant positive effect to the walleye population of the study area**.

Lake Whitefish

Predicted impacts on the lake whitefish population of the study area resulting from habitat alteration due to operation of the Project are summarized in Table 6.8-5.

Table 6.8-5. Summary of impacts on lake whitefish resulting from habitat alteration due to operation of the Project[1]

	Changes in water quality	Changes in the quantity and quality of aquatic habitat	Changes in invertebrate production	Changes in forage fish production
Reach 1: Wuskwatim				
Spawning	Ø	+/-	N/A	N/A
Feeding	Ø	+	+	Ø
Overwintering	Ø	Ø	N/A	N/A
Reach 2: The Falls				
Spawning	Ø	Ø	N/A	N/A
Feeding	Ø	Ø	Ø	Ø
Overwintering	Ø	Ø	N/A	N/A
Reach 3: Burntwood				
Spawning	Ø	-	N/A	N/A
Feeding	Ø	-	-	Ø
Overwintering	Ø	Ø	N/A	N/A
Reach 4: Opegano				
Spawning	Ø	-	N/A	N/A
Feeding	Ø	-	-	Ø
Overwintering	Ø	Ø	N/A	N/A

1 Assessments are based on analyses presented in Volume 5, Section 8
\+ The impact is expected to have a positive effect on lake whitefish within the reach
\- The impact is expected to have a negative effect on lake whitefish within the reach
Ø No predicted effect
N/A Not applicable

Reach 1: Wuskwatim

The small, long-term increase in the production of invertebrates in Reach 1 that will result from stabilization of lake levels at the upper end of the existing range will increase the amount of food available to lake whitefish. The altered water level regime is also expected to increase the quantity of spawning and feeding habitat and eliminate the potential for exposure or **ice-scouring** of eggs and/or larvae due to winter **drawdown** that occurs under existing conditions in years when the water level declines between fall and late winter.

As discussed for walleye, the combination of less drift of larval lake whitefish out of Wuskwatim Lake, and the ability of most juvenile and adult whitefish to move upstream from Reach 2 into Reach 1, are expected to result in fewer lake whitefish leaving Wuskwatim Lake.

Increased erosion and sedimentation in Wuskwatim Lake main and Cranberry Lakes may reduce the quality of lake whitefish spawning habitat along eroding shorelines for the first 5-10 years of operation of the Project (Volume 5, Section 8). Lake whitefish overwintering habitat in Reach 1 is not expected to be affected by localized reductions in dissolved oxygen concentrations in off-current areas as whitefish overwintering habitat appears to be limited to Wuskwatim Lake main.

Reach 2: Falls

Presently, the small number of lake whitefish found within Reach 2 are believed to be transients that have moved downstream over Wuskwatim Falls and will likely move further downstream in the near future as they are not able to move back upstream over Wuskwatim Falls. Reduction of water velocities at Wuskwatim Falls will allow most juvenile and adult whitefish found within Reach 2 to move back upstream into Reach 1 and thereby have access to aquatic habitat within all of Wuskwatim Lake and adjacent water bodies for spawning, feeding, and overwintering (a detailed discussion of water velocities in reaches 2 and 3 lake whitefish swimming speeds is found in Volume 5, Section 8). Due to less suitable habitat immediately upstream of the GS (deep and non-productive in terms of forage) and reduction of water velocities at the GS intake, it is expected that fewer larval, juvenile, and adult lake whitefish will move downstream out of Reach 2 into reaches 3 and 4.

Reach 3: Burntwood

The increased frequency of water level fluctuations is predicted to negatively affect the quality and quantity of lake whitefish spawning (due to the potential for exposure or ice-scouring of eggs and/or larvae) and feeding (exposure of backwater inlets) habitat. The increased frequency of water level fluctuations is also expected to negatively affect invertebrate production, and, consequently, result in less food for lake whitefish in Reach 3. As whitefish do not extensively use the backwater inlets for overwintering, reduced oxygen concentrations nor fluctuating water levels are expected to negatively affect lake whitefish overwintering habitat. As discussed for walleye, alterations in water velocity within Reach 3 due to operation of the Project are not expected to negatively affect lake whitefish. Reduced water velocities at the inlet and outlet of Reach 2 and turbine mortality are expected to result in fewer lake whitefish migrating into Reach 3 from upstream of the GS.

Reach 4: Opegano

The increased frequency of water level fluctuation and reduction in the quality of intermittently exposed habitat are predicted to negatively affect the quantity and quality of lake whitefish feeding habitat (exposure of productive feeding habitat in the north end of the lake), although overwintering habitat is not expected to be affected. There may be a minor reduction in the quantity and quality of spawning habitat due to exposure or ice scour of eggs and/or larvae. Water level fluctuations also are expected to negatively affect invertebrate production (Section 6.7.2) and, consequently, result in less food for lake whitefish in Reach 4. Similar to the above discussion, reduced water velocities at the inlet and outlet of Reach 2 and turbine mortality are expected to result in fewer lake whitefish migrating into Opegano Lake from upstream of the GS.

Assessment of significance

In the short-term (5-10 years after construction of the Project), it is expected that operation of the Project will have positive (more food and an increase in the quantity of spawning habitat) and negative (a decrease in the quality of spawning habitat due to sedimentation of some areas) effects on lake whitefish in Reach 1. However, in the long-term, it is expected that the number of lake whitefish in Reach 1 will increase due to more spawning and feeding habitat, more food, unrestricted movement between reaches 1 and 2 for most individuals, and fewer whitefish moving downstream out of Reach 2.

It is expected that there will be fewer lake whitefish in reaches 3 and 4 due to an increase in the frequency of water level fluctuations that will affect the quality and quantity of spawning and feeding habitat in reaches 3 and 4, and result in a reduction in the amount of food. Additionally, fewer whitefish are expected to move downstream into reaches 3 and 4 from upstream of the GS. As discussed for walleye, migrants from Reach 1 may comprise a measurable proportion of the number of lake whitefish in reaches 3 and 4.

Overall, it is expected that the positive effects to lake whitefish in Reach 1 will outweigh the negative effects to whitefish in reaches 3 and 4 and result in a **long-term, small, local and, therefore, not significant positive effect to the lake whitefish population of the study area**.

Lake Cisco

Predicted impacts on the lake cisco population of the study area resulting from habitat alteration due to operation of the Project are summarized in Table 6.8-6.

Table 6.8-6. Summary of impacts on lake cisco resulting from habitat alteration due to operation of the Project.[1]

	Changes in water quality	Changes in the quantity and quality of aquatic habitat	Changes in invertebrate production	Changes in forage fish production
Reach 1: Wuskwatim				
Spawning	Ø	+/-	N/A	N/A
Feeding	Ø	+	+	Ø
Overwintering	-	Ø	N/A	N/A
Reach 2: The Falls				
Spawning	Ø	Ø	N/A	N/A
Feeding	Ø	+	+	Ø
Overwintering	-	+	N/A	N/A
Reach 3: Burntwood				
Spawning	Ø	-	N/A	N/A
Feeding	Ø	-	-	Ø
Overwintering	-	-	N/A	N/A
Reach 4: Opegano				
Spawning	Ø	-	N/A	N/A
Feeding	Ø	-	-	Ø
Overwintering	Ø	Ø	N/A	N/A

[1] Assessments are based on analyses presented in Volume 5, Section 8
\+ The impact is expected to have a positive effect on lake cisco within the reach
\- The impact is expected to have a negative effect on lake cisco within the reach
Ø No predicted effect
N/A Not applicable

Reach 1: Wuskwatim

The assessment of impacts on lake cisco in Reach 1 is similar to that of lake whitefish and only the differences will be discussed here. Unlike lake whitefish, lake cisco overwinter in some of the off-current areas of Reach 1 that may be affected by localized reductions in dissolved oxygen concentration (Section 6.5.2). However, lake cisco abundance is not expected to be affected as overwintering habitat is abundant within the reach (e.g., Wuskwatim Lake main).

Reach 2: Falls

Unlike lake whitefish, lake cisco are relatively abundant in Reach 2, although the majority of these fish are also believed to be transients. Substantially higher and more stable water levels are expected to increase the amount of feeding and overwintering habitat that would be available to lake cisco in Reach 2. The higher, more stable water levels are also expected to increase the amount of invertebrate production that will result in an increase in the amount of food. As discussed for lake whitefish, reductions in water velocity at Wuskwatim Falls and the GS intake (relative to Taskinigup Falls) will result in access to Reach 1 for cisco in Reach 2, and fewer larval, juvenile, and adult cisco moving downstream out of Reach 2 into reaches 3 and 4 (a detailed discussion of water velocities in reaches 2 and 3 lake cisco swimming speeds is found in Volume 5, Section 8). Some of the overwintering habitat created within off-current areas of Reach 2 may undergo moderate, short-term reductions in dissolved oxygen concentration, making this habitat less suitable for lake cisco.

Reach 3: Burntwood

The assessment of impacts on lake cisco in Reach 3 is similar to that of lake whitefish. Lake cisco appear to make more use of the backwater inlets for overwintering than lake whitefish and, consequently, reduced oxygen concentrations and fluctuating water levels in the backwater inlets will affect lake cisco overwintering habitat in Reach 3. However, it is expected that lake cisco would use other low velocity habitat within Reach 3 or move downstream to Opegano Lake to overwinter. Reduced water velocities at the inlet and outlet of Reach 2 and turbine mortality are expected to result in fewer lake cisco migrating into Reach 3 from upstream of the GS.

Reach 4: Opegano

Impacts of operation of the Project on lake cisco in Reach 4 are identical to those of lake whitefish and will not be discussed further.

Assessment of significance

In the short-term (5-10 years after construction of the Project), it is expected that operation of the Project will have both positive (more food and an increase in the quantity of spawning habitat) and negative (a decrease in the quality of spawning habitat due to sedimentation of some areas) effects on lake cisco in Reach 1. However, in the long-term, it is expected that the number of lake cisco in Reach 1 will increase due to more spawning and feeding habitat, more food, unrestricted movement between reaches 1 and 2 for most individuals, and fewer cisco moving downstream out of Reach 2.

It is expected that there will be fewer lake cisco in reaches 3 and 4 due to an increase in the frequency of water level fluctuations that will affect the quality and quantity of spawning and feeding habitat in reaches 3 and 4, and overwintering habitat in Reach 3, and result in less food. Additionally, fewer cisco are expected to migrate into reaches 3 and 4 from upstream of the GS. As discussed for walleye and lake whitefish, migrants from Reach 1 may comprise a measurable proportion of the number of lake cisco in reaches 3 and 4.

Overall, it is expected that the positive effects to lake cisco in Reach 1 will outweigh the negative effects to cisco in reaches 3 and 4 and result in a **long-term, small, local and, therefore, not significant positive effect to the lake cisco population of the study area**.

Northern pike

Predicted impacts on the northern pike population of the study area resulting from habitat alteration due to operation of the Project are summarized in Table 6.8-7.

Reach 1: Wuskwatim

The assessment of impacts on northern pike in Reach 1 is similar to that of walleye and only the differences will be discussed here. In the short-term, there will be a small to moderate increase in the quantity of spawning habitat for northern pike in Reach 1 due to the inundation of emergent vegetation near the mouths of tributaries resulting from higher water levels. However, in the long-term much of this vegetation will decompose due to the stabilization of water levels and northern pike spawning habitat will be restricted to flooded tributary mouths. While northern pike are less effective swimmers than the other three VEC species, it is believed that large pike will be able to move freely between reaches 1 and 2 in the post-Project environment.

Reach 2: Falls

Substantially higher and more stable water levels are expected to increase the amount of feeding and overwintering habitat for northern pike in Reach 2. As in Reach 1, there will be a short-term small increase in the quantity of spawning habitat due to the inundation of terrestrial vegetation near the south shore tributary. However, in the long-term much of this vegetation will decompose and spawning habitat will be restricted to the flooded

Table 6.8-7. Summary of impacts on northern pike resulting from habitat alteration due to operation of the Project.[1]

	Changes in water quality	Changes in the quantity and quality of aquatic habitat	Changes in invertebrate production	Changes in forage fish production
Reach 1: Wuskwatim				
Spawning	Ø	+	N/A	N/A
Feeding	Ø	+	+	+
Overwintering	-	Ø	N/A	N/A
Reach 2: The Falls				
Spawning	Ø	+/-	N/A	N/A
Feeding	Ø	+/-	+	+
Overwintering	-	+	N/A	N/A
Reach 3: Burntwood				
Spawning	Ø	-	N/A	N/A
Feeding	Ø	-	-	-
Overwintering	-	-	N/A	N/A
Reach 4: Opegano				
Spawning	Ø	-	N/A	N/A
Feeding	Ø	-	-	-
Overwintering	Ø	Ø	N/A	N/A

1 Assessments are based on analyses presented in Volume 5, Section 8
\+ The impact is expected to have a positive effect on northern pike within the reach
\- The impact is expected to have a negative effect on northern pike within the reach
Ø No predicted effect
N/A Not applicable

tributary mouth along the south shore. The loss of the north shore tributary (Section 6.7.2) will result in a loss of spawning habitat. The loss of 1.5 ha of aquatic macrophyte habitat (Section 6.7.2) will result in a reduction in the quality of feeding habitat. As discussed above, large northern pike will be able to move freely between reaches 1 and 2, thereby expanding the amount of spawning, feeding, and overwintering habitat available to individuals resident in Reach 2 (a detailed discussion of water velocities in reaches 2 and 3 northern pike swimming speeds is found in Volume 5, Section 8). Additionally, fewer larval, juvenile, and adult northern pike are expected to move downstream out of Reach 2 into reaches 3 and 4.

Reach 3: Burntwood

Northern pike use the backwater inlets habitat in Reach 3 for spawning, feeding, and overwintering and, consequently, the periodic loss of a substantial proportion of this habitat due to more frequent water level fluctuations will have a negative effect on northern pike in this reach. Substantial daily water level fluctuations during the spring spawning period could result in some pike eggs being laid during high water periods and subsequently being exposed when water levels decline. Reduced water velocities at the inlet and outlet of Reach 2 and turbine mortality are expected to result in fewer northern pike migrating into Reach 3 from upstream of the GS.

Reach 4: Opegano

The increased frequency of water level fluctuations on Opegano Lake are predicted to negatively affect the quantity and quality of northern pike spawning and feeding habitat, particularly in the vicinity of the tributary flowing into the north shore of the lake. As discussed above, daily water level fluctuations could result in exposure of pike eggs and/or larvae. Similar to previous discussions, reduced water velocities at the inlet and outlet of Reach 2 and turbine mortality are expected to result in fewer northern pike migrating into Opegano Lake from upstream of the GS.

Assessment of significance

It is expected that there will be more northern pike in reaches 1 and 2 due to greater access to spawning and feeding habitat, more food, unrestricted movement between reaches 1 and 2 for larger northern pike, and fewer pike moving downstream out of Reach 2.

It is expected that there will be fewer northern pike in reaches 3 and 4 due to an increase in the frequency of water level fluctuations that will affect the quantity and quality of spawning, feeding, and overwintering habitat in Reach 3, and spawning and feeding habitat in Reach 4, and result in less food available to pike. Additionally, fewer northern pike are expected to migrate into reaches 3 and 4 from upstream of the GS. As discussed for the other three VEC species, migrants from Reach 1 may comprise a measurable proportion of the number of northern pike in reaches 3 and 4.

Overall, the greater abundance of northern pike in reaches 1 and 2 is expected to outweigh the reduced abundance of pike in reaches 3 and 4 and result in a **long-term, small, local and, therefore, not significant positive effect to the northern pike population of the study area**.

Increased fishing activity

Increased access to Wuskwatim Lake is expected to result in a substantial increase in domestic harvest and a moderate increase in the recreational harvest of walleye and northern pike over pre-Project levels (see Section 8.3). The extent of this increase will depend on measures taken in the Access Management Plan.

To a large extent, the potential increase in commercial fishing depends on the response of the Freshwater Fish Marketing Corporation (FFMC) to information gathered as a result of the EIA studies. The FFMC does not currently accept walleye from Wuskwatim Lake due to recorded high mercury levels. Sampling conducted during EIA studies indicated that mercury levels in walleye have declined and are now well below the limit for commercial sale. For the purposes of the EIS, it is assumed that FFMC will review the status of Wuskwatim Lake walleye and it is further assumed that FFMC will resume accepting these fish for commercial sale.

Because access to Opegano Lake will remain difficult, no domestic, commercial, or recreational fishing activity is expected to occur as a result of operation of the Project.

Although an increase in the abundance of walleye, lake whitefish, lake cisco, and northern pike in the study area is predicted, the presence of active domestic, commercial, and recreational fisheries during operation of the Project will increase fish mortality and may affect the abundance of the four VEC fish species, particularly in Wuskwatim Lake and adjacent water bodies. Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest.

6.9 FISH QUALITY

6.9.1 EXISTING ENVIRONMENT

Fish are important indicators of ecosystem health and a valuable domestic, commercial, and recreational resource. Deterioration in fish quality may directly or indirectly affect the acceptance and value of fish as a food and may also affect the livelihood of commercial fishers. In recent years, fish consumption advisories have been issued in several jurisdictions in response to the presence of **contaminants**. Indicators of fish quality considered in this assessment include trace metals, internal **parasites**, and fish **palatability**. Emphasis has been given to assessing the relationships between habitat changes and fish **mercury** levels within the broader geographical and historical context of the topic. Four important species (walleye, northern pike, lake whitefish, and lake cisco) were selected to assess the significance of Project-related effects on fish quality.

Other studies of mercury in aquatic systems have produced several important results defining the natural processes associated with this issue. It is known that:

- mercury enters aquatic systems directly through effluents and emissions, and from weathering of rock and/or flooding of terrestrial ecosystems;
- inorganic mercury is converted in the ecosystem to the more toxic **methyl mercury** form through **microbial** action;
- fish take up methyl mercury primarily through their diet;
- elimination of methyl mercury is slower than the rate of uptake;
- mercury is concentrated in skeletal muscle;
- mercury concentrations generally increase with fish age or body size; and
- methyl mercury concentration is **biomagnified** up the food chain.

Monitoring and research have also shown that mercury accumulation is a common consequence of flooding. Mercury concentrations in fish in hydroelectric reservoirs generally show a pattern of increase and decline over time, with maximum values usually occurring six to 11 years after flooding and declining to pre-impact levels after approximately 20-30 years.

The methods used to sample fish and carry out mercury and trace metal analyses, evaluate parasite levels, and to determine taste acceptability are described in Section 6.4.

6.9.1.1 Mercury

A total of 676 fish (155 cisco, 170 whitefish, 156 pike, and 195 walleye) taken from Wuskwatim, Opegano and Birch Tree lakes in the 1998 to 2002 period were analyzed for muscle mercury concentrations (Volume 5, Section 9.0, Table 1).

Generally, mean mercury concentrations in cisco and whitefish were substantially lower than those in pike and walleye. Pike from Opegano and Birch Tree lakes and walleye from Birch Tree Lake had mean mercury concentrations in excess of 0.5 µg/g, the commercial marketing standard. All individual pike and walleye samples from the study area lakes (including lakes not affected by CRD) had mercury concentrations in excess of 0.2 µg/g, the level usually cited in consumption advisories.

Mercury concentrations in cisco, pike, and walleye from Birch Tree Lake were significantly higher than those for the same species from Wuskwatim Lake, and concentrations in pike from Opegano Lake were significantly higher than those in Wuskwatim Lake pike. The results are consistent with current theories on bioaccumulation of mercury in fishes from flooded reservoirs and with a data set of 13 lakes and reservoirs in northern Manitoba (North/South Consultants Inc., unpubl. data).

Mercury levels of pike, cisco and whitefish from all Burntwood River lakes and walleye from Opegano and Birch Tree Lakes were 1.5 to 3.3 times higher than the respective concentrations in the same fish species from the unflooded Leftrook Lake. Walleye from Wuskwatim Lake had only slightly higher mercury concentrations than Leftrook Lake.

Generally, mercury concentrations increased significantly with increasing fish length.

The historical record (1970 - 2002) of mercury in fish from Wuskwatim Lake shows a pattern of concentrations over time consistent with the pattern reported in other flooded reservoirs (Figure 6.9-1).

The Freshwater Fish Marketing Corporation is not currently accepting walleye from Wuskwatim Lake (2000 is the last year this species was accepted). It appears that this decision was based on mercury data that do not reflect current levels in the lake.

6.9.1.2 Other Metals

Concentrations of most metals in tested samples were at, or below, the detection limit of the analytical method. Where metals were detected, they were at very low concentrations.

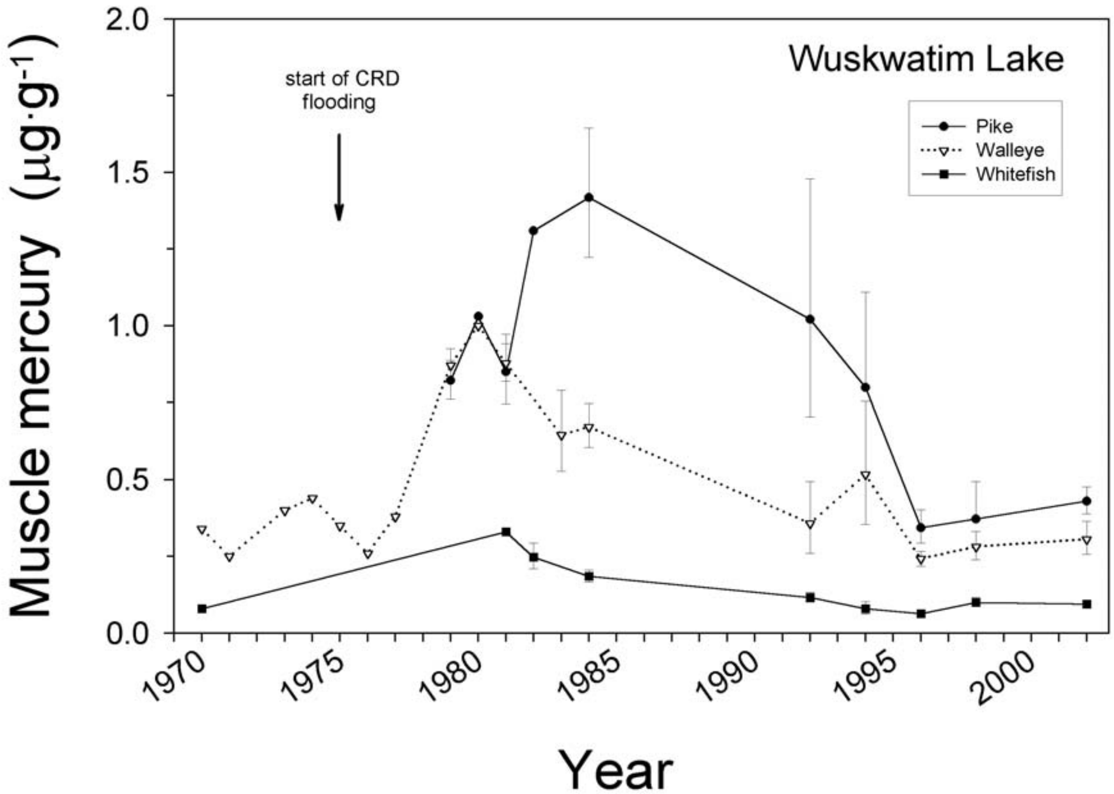


Figure 6.9-1. Mean muscle mercury concentrations for northern pike, walleye, and lake whitefish for the years 1970-2002 from Wuskwatim Lake. Only means for 1979, 1981, and 1984 onwards could be standardized for fish length.

6.9.1.3 Parasites

Wuskwatim Lake whitefish sampled in 2001 had ***Triaenophorus crassus* cysts** but fish tested in 2002 had none (Volume 5, Section 9). Previous inspections of Wuskwatim Lake whitefish had not identified cysts, and the fish catch had been given the highest grade.

6.9.1.4 Fish Palatability

A study was conducted by the University of Manitoba (Ryland et al. 2002) to compare the palatability of walleye, northern pike, and lake whitefish from Wuskwatim, Footprint, Leftrook, and Baldock lakes (Volume 5, Section 9). (Baldock Lake is located approximately 80 km north of Thompson and is not on the Rat/Burntwood River system). The study found that whitefish and walleye from all locations were liked moderately and Wuskwatim Lake had the highest acceptability for whitefish. No significant differences were found among the sampled lakes for any species of fish and none of the lakes consistently gave the highest or lowest mean acceptability values. It should be noted these results might be specific to the season of fish sampling (early winter), and the fish caught during another time of the year may have differing sensory qualities.

6.9.2 Impacts and Mitigation

6.9.2.1 Construction

Construction of the Project is expected to have no effect on the quality of fish in the study area. As discussed in Section 6.5.2, significant releases of substances that may cause tainting (such as hydrocarbons) are not expected due to safe handling procedures, emergency response plans, and spill containment measures.

6.9.2.2 Operation

<u>Mercury</u>

Two scenarios were developed for anticipated mercury production as a result of the Project (Table 6.9-1). The minimum scenario incorporated the effects of the newly flooded area between Wuskwatim Falls and Taskinigup Falls. The maximum scenario incorporated additional inputs into Wuskwatim Lake from the erosion of shorelines and the die-off of peatlands affected by the stabilization of water levels near the upper end of the current range. It should be noted that these peatlands are not expected to die off (Section 7.5.2); therefore, the maximum scenario over-estimates the potential for mercury production. As discussed in Volume 5 (Section 9), the actual changes are expected to be between these two extremes, as follows: mean standardized mercury concentrations in lake whitefish will likely slightly exceed 0.10 µg/g; concentrations may reach 0.35 µg/g in walleye, and could increase to a level slightly below the commercial limit of 0.5 µg/g for pike.

Table 6.9-1. Predicted mercury levels in fish flesh.

Species	Increase due to the Project (µg/g)		Current Hg (µg/g)	Predicted Hg Levels (µg/g)	
	Min	Max		Min	Max
Whitefish	0.006	0.042	0.097	0.10	0.14
Northern pike	0.025	0.184	0.372	0.40	0.56
Walleye	0.015	0.112	0.282	0.30	0.39

If the time course of mercury concentrations in fish follows the typical pattern for northern reservoirs (Jansen et al. 2002), the maximum levels will be observed 3-5 years post-flooding. Considering that the predicted increases in mercury concentrations in fish associated with the Project will be substantially lower than those due to CRD, a period of perhaps up to 10 years will be required for concentrations to return from maximum to pre-impact values.

The impacts on fish mercury concentrations in Wuskwatim Lake and the peripheral smaller lakes are, to some extent, influenced by the amount of mercury imported from upstream waterbodies. The effect of this process is expected to be minor and will be absorbed within the presently observed variability.

As a result of expected increases in fish mercury concentrations, daily consumption limits for walleye and pike from Wuskwatim Lake could be reduced by approximately 100 g or 19% and 23%, respectively from current safe levels. A 70 kg (155 lbs) man would still be able to safely eat one meal of whitefish a day even after the expected maximum post-Project mercury levels have been reached.

Downstream of the station, in backwater inlets of the Burntwood River and along the northern shore of Opegano Lake, changes in the water regime are expected to result in the die-off of some areas of peat (Section 7.5.2). Mercury levels in fish resident near decomposing peatlands may increase slightly; however changes in overall mercury levels are not expected due to the large amount of flow in comparison to the small area affected.

No effects to mercury levels are expected in fish downstream of Jackpine Falls (near the outlet of Opegano Lake).

Other Metals

There may be measurable and possibly large increases in some metals in the nearshore zone of Wuskwatim Lake main, in relation to increased rates of erosion (Section 6.5.2). These increases will be most pronounced in the first five years of operation. This pathway is not expected to result in increases in the concentrations of metals in fish muscle, because metals do not typically accumulate in that tissue (mercury is the notable exception).

Parasites

Operation of the project is expected to result in a small increase in the number of northern pike and lake whitefish in Wuskwatim Lake and adjacent water bodies. Due to the projected increase in pike, a host of the *T. crassus* cyst, the density of the infective stage of the parasite could increase. Lake whitefish is the secondary host of *T. crassus* and, although its abundance is expected to increase, it is difficult to predict whether there will be an increase in the incidence of *T. crassus* infestation. Consequently, cyst density will be monitored in commercial catches.

Fish Palatability

Operation of the Project is not expected to release any substances into the aquatic environment or cause any other changes that will compromise or alter fish palatability.

6.10 EFFECTS OF ABNORMAL OPERATIONS TO THE AQUATIC ENVIRONMENT

The preceding sections describe the predicted impacts of the GS during periods of "normal" operation, i.e., water levels on the reservoir will be maintained between 233.75 and 234.00 m ASL, which is expected for 97.5% of the time. As described in Section 6.3, during periods when inflow to Wuskwatim Lake declines to below 660 m^3/s (7% of time), conditions may arise when storage in the reservoir would be used, with the result that water levels on the lake would be gradually decreased below 233.75 and then re-pond for a period of several days or weeks. It is expected that use of reservoir storage will occur for 2.5% of the time.

The effect of abnormal operation depends to a large extent on the frequency, magnitude and duration of drawdown. The nearshore and intermittently exposed environment will tend to shift towards conditions seen during low flow conditions in the pre-Project environment (the 5th percentile water elevation of 232.88 m ASL is marginally lower than the post-Project minimum). The greatest relative change would occur when a prolonged period of normal operation was followed by an extended period of abnormal operation. In this case, benthic invertebrate abundance and the biomass of aquatic plants in the nearshore and intermittently exposed environments would be reduced, and the die-off of plants could result in localized effects to water quality. Changes in lower trophic levels would also influence the fish community, the relative effect on the fish community depending on the magnitude and duration of the change in the lower trophic levels. Certain fish species could also be directly affected (e.g., access to spawning areas, exposure of spawn.

Periods of abnormal operation would be followed by a period of recovery as the aquatic community returns to the condition typical of the normal operating regime. As these abnormal events are infrequent, they will not affect the overall lake environment in the long term.

6.11 RESIDUAL EFFECTS

6.11.1 Water Quality

Expected residual effects of the Project on water quality are summarized in Table 6.11-1. Additional detail regarding expected residual effects to water quality is provided in Volume 5, Section 5.0. **In summary, the expected residual effects of construction of the Project are expected to be local to regional, small to moderate, short-term, and not significant (extent of effects varies among water quality parameters). The expected residual effects of operation of the Project on water quality are expected to be local, small, short-term, and not significant.**

6.11.2 Aquatic Habitat

Aquatic habitat is not a VEC and the expected residual effects of the Project have not been assessed in terms of significance (Section 2.4). However, expected residual effects of the Project on aquatic habitat were assessed and are summarized in Table 6.11-2. Additional detail regarding expected residual effects to aquatic habitat is provided in Volume 5, Section 6.0.

6.11.3 Lower Trophic Levels

Lower trophic levels are not a VEC and the expected residual effects of the Project have not been assessed in terms of significance (Section 2.4). However, expected residual effects to lower trophic levels were assessed and are summarized in Table 6.11-3. Additional detail regarding expected residual effects to lower trophic levels is provided in Volume 5, Section 7.0.

6.11.4 Fish Community and Movements

Expected residual effects to VEC fish species resulting from construction and operation of the Project are summarized in Table 6.11-4. Additional detail regarding expected residual effects to VEC fish species is provided in Volume 5, Section 8.0. **In summary, the residual effects of construction of the Project on populations of VEC fish species are expected to be negative, short-term, small, local and, therefore, not significant**. **The residual effects of operation of the Project on populations of VEC fish species are expected to be positive, long-term, small, local and, therefore, not significant.**

6.11.5 Fish Quality

Expected residual effects to fish quality resulting from construction and operation of the Project are summarized in Table 6.11-5. Additional detail regarding expected residual effects to fish quality is provided in Volume 5, Section 9.0. **In summary, the expected residual effects of the Project on fish quality are expected to be negative, long-term, small, local and, therefore, not significant.**

Table 6.11-1. Expected residual effects of the Project on water quality. (Note that the significance of effects is described in terms of exceedence of the applicable MWQSOGs.)

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
	CONSTRUCTION			
REACHES 2, 3, AND 4	Suspended solids and sediment inputs due to discharge from wash water settling ponds, cofferdam placement and removal, removal of rock plugs, and erosion of riverbank and riverbed during river management.	Increases in TSS for several weeks at and downstream of the construction site; magnitude of increase varying among activities. Increase in metals associated with sediment suspended solids.	Measures to minimize inputs with the intent to maintain TSS increase to less than 25 mg/L (daily average in fully mixed zone).	Negative and not significant (short-term, moderate [decreasing to small with distance downstream], and local to regional) effects to suitability for aquatic life.
	Blasting causing release of ammonia and nitrate into Reach 2 and upper Reach 3.	Large increases in ammonia may be toxic to aquatic life.	Unspent charges will be removed from blasts conducted in the dry (large majority of blasting).	Negative and not significant (short-term, negligible to small and site-specific) increases in ammonia affecting the suitability for aquatic life. Negative and not significant (short-term, negligible to small and site-specific) increases in nitrate.
	Discharge of treated sewage effluent into backwater inlet of reach 4.	Increases in nutrients, with subsequent effects to algal and plant growth and oxygen levels. Increases in biochemical oxygen demand and decreases in dissolved oxygen. Minor effects to TSS. Increase in faecal coliform bacteria during and immediately after discharge.	Treated sewage effluent will meet provincial standards.	Negative and not significant (short-term, small to moderate, and site-specific (only detectable within inlet)) effects to suitability for aquatic life.
	Potential for rock used during construction to generate acid leachate.	Acid leachate could decrease pH and/or increase metal concentrations in surface waters.	Measures identified in project description.	No effects predicted that can not be mitigated.

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
	Accidental spills	Release of harmful quantities of various deleterious substances, in particular hydrocarbons, into surface waters.	Spill containment areas, safe handling and storage procedures, and spill response measures minimize the risk that harmful quantities will be released.	Small potential for the release of harmful quantities of deleterious substances, not likely to have a significant adverse effect.
STREAM CROSSINGS	**CONSTRUCTION**			
	Sediment inputs downstream of road crossings during construction of crossings and installation of culverts.	Increase in TSS at and downstream of crossings for short periods during and immediately after construction.	Installation during winter will reduce inputs to the water; will follow guidelines.	Negative and not significant (short-term, small to moderate, and site specific increase in TSS) effects on suitability of water for aquatic life.
	Accidental spills	Release of harmful quantities of various deleterious substances, in particular hydrocarbons, into surface waters.	Safe handling procedures and spill response measures minimize the risk that harmful quantities will be released.	Small potential for the release of harmful quantities of deleterious substances, not likely to have a significant adverse effect.

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
REACH 1	**OPERATION**			
	Increase of sediment inputs from presently eroding shorelines, especially in the first five years of operation.	Measurable TSS increase in Wuskwatim Lake as a whole is not expected; suspended sediment levels will be higher adjacent to eroding shorelines, particularly during and after storms. Increases in metals associated with eroded material (e.g., iron and aluminum).	None.	Negative and not significant (short term (5 years), moderate, and site specific to local) effects to use of water for drinking[1], suitability for aquatic life, navigation, and aesthetics. Larger increase in TSS after storms, but frequency is low.
	Stabilization of water levels near the upper end of the existing range and increased input of organics from erosion on erodible shorelines.	Conversion of intermittently wetted to permanently wetted habitat, in particular in tributary waters (e.g., Sesep Lake, Wuskwatim Brook) may cause measurable increases in nutrients; increased levels of organics would decrease oxygen, particularly in winter.	None.	Negative and not significant (short term (5 years), moderate, and site-specific to local) effects to use of water for drinking, suitability for aquatic life, and aesthetics.
REACH 2	**OPERATION**			
	Flooding of approximately 25 ha of natural terrestrial habitat (remainder of flooded area within GS structures) will result in inputs of nutrients, organics, metals, and sediments. No increase in erosion is expected.	Measurable effects of inputs of nutrients, organics, metals and sediments restricted to the immediate flooded area. Localized reductions in oxygen, particularly during winter, may occur.	None.	Negative and not significant (long-term, small to moderate, and site-specific) effects to suitability of water for aquatic life.
	Change in water quality from upstream (Reach 1).	As discussed for Reach 1, no overall changes in water quality are expected therefore, no significant change.	Not applicable.	None.
REACHES 3 - 6	**OPERATION**			
	Increased erosion of riverbanks and riverbed in response to new flow patterns during initial operation. No long term increases in riverbank erosion are predicted.	Increase in TSS will initially occur during construction phase and may extend to initial period of operation.	None (beyond what is conducted during construction phase)	Negative and not significant (short term, small to moderate, and local to regional) effects to suitability of water for aquatic life.

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
	Die-off of peat in backwater inlets and along north shore of Opegano Lake.	Input of organic material and increase in nutrients may decrease oxygen concentrations, particularly in winter, in proximity of the peat areas.	None.	Negative and not significant (long term, small to moderate, site specific) effects to the suitability of water for aquatic life.
STREAM CROSSINGS	**OPERATION**			
	Inputs of sediments at stream crossings.	Minor (negligible) increases in TSS.	Erosion control measures that will be described in the EnvPP.	Negative, not significant (short to long-term, negligible, site-specific) effects to the suitability of water for aquatic life.

[1] drinking water use refers to use of surface waters by resource users. Note that all surface waters should be sterilized prior to human consumption.

Table 6.11-2. Expected residual effects of the Project on aquatic habitat. (Note: Description of effect incorporates assessments presented in Table 6.11-1.)

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
REACHES 2, 3, AND 4	**CONSTRUCTION**			
	Cofferdam placement in Reach 2 and construction of other structures.	The majority of aquatic habitat area disturbed by cofferdam placement will either be occupied by the GS structure or will be modified as part of the intake channel (powerhouse) or the approach channel (spillway).	None	Short-term loss/alteration of aquatic habitat (effect of permanent structures considered under operation), small, site-specific.
STREAM CROSSINGS	**CONSTRUCTION**			
	Footprint of access road (permanent) and installation of culvert(s) at eight stream crossings.	Loss of aquatic habitat; possible changes in water depth and velocity at crossings; introduction of rip-rap; some increase in sedimentation downstream of crossing.	All stream crossings will meet the "Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat".	Long-term (due to construction of permanent structures), small, site-specific.
REACH 1	**OPERATION**			
	Water level will be stabilized near the upper end of the existing range.	The intermittently exposed zone (IEZ) will decrease from 2022 ha to 342 ha and the nearshore zone will increase by 1588 ha. Sedimentation rates will increase.	None	Long-term decrease in IEZ and increase in nearshore zone will be moderate, local. Relatively short-term (first 5 years after construction) increase in sedimentation rates will be small, local.
REACH 2	**OPERATION**			
	Water level will increase (flooding) and stabilize at the same level as that of Reach 1. Habitat loss/alteration at locations of permanent structures.	Aquatic habitat will increase by 37.2 ha. Post-Project water velocities will be lower than existing ones. There will be a net loss of about 1.5 ha of aquatic plant beds.	None.	Long-term increase in aquatic habitat and reduction in water velocities will be moderate, site-specific. Long-term net loss of aquatic plant beds will be moderate, site-specific.

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
REACH 3	**OPERATION**			
	Daily water level fluctuations superimposed on the present fluctuations. Post-Project minimum water level will be lower than existing condition.	The IEZ will increase from 44 ha to 64 ha and habitat quality will decline. The wetted zone will decrease from 253 ha to 236 ha. Most of the existing 3.9 ha of aquatic plant beds may be lost.	None.	Long-term increase in IEZ, degradation of IEZ quality, and decrease in wetted zone will be moderate, local. Long-term potential loss of aquatic plant beds will be moderate, local.
REACH 4	**OPERATION**			
	Daily water level fluctuations superimposed on the present fluctuations. Post-Project minimum water level will be slightly lower than existing condition.	The IEZ will increase from 50 ha to 86 ha and habitat quality will be decline. The nearshore zone will decrease from 498 ha to 470 ha. A substantial portion of the existing 45.5 ha of aquatic plant beds may be lost.	None.	Long-term increase in IEZ, degradation of IEZ quality, and decrease in nearshore zone will be moderate, local. Long-term potential loss of aquatic plant beds will be moderate, local.
STREAM CROSSINGS	**OPERATION**			
	Footprint of access road.	Loss of aquatic habitat.	All stream crossings will meet the "Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat". Impacts related to operation will be minimized due to control measures outlined in the Project Description (Volume 3) and practices that will be described in the EnvPP.	Long-term, small, site-specific.

Table 6.11-3. Expected residual effects of the Project on lower trophic levels. (Note: Description of effect incorporates assessments presented in Tables 6.11-1 and 6.11-2.)

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
REACHES 2, 3, AND 4	**CONSTRUCTION**			
	Cofferdam placement and construction of other structures. Water quality effects in immediate forebay, Burntwood River, and at Backwater Inlet 4, including accidental spills. Blasting.	The majority of aquatic habitat disturbed by cofferdam placement will be occupied by the GS structure, or will be modified as part of the intake channel (powerhouse) or the approach channel (spillway). Short-term changes in water quality will not substantially affect lower trophic communities, although there may be some temporary effects (e.g., downstream movement of invertebrates exposed to a sediment plume). Blasting in or near water may cause some mortality.	Measures to mitigate effects to water quality. Majority of blasting (except single blast removal of rock plugs) will be within guidelines.	Short-term (1-2 years), small decrease in abundance and distribution, local.
STREAM CROSSINGS	**CONSTRUCTION**			
	Footprint of access road (permanent) and installation of culvert(s) at eight stream crossings. Water quality effects, including accidental spills.	Rooted submergent aquatic plants and benthic invertebrates in the footprint of the road and culvert(s) would be lost. Changes in water quality will not substantially affect lower trophic communities.	All stream crossings will meet the "Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat". Measures to mitigate effects to water quality.	Long-term (due to construction of permanent structures), small decrease in abundance and distribution, local.

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
REACH 1	**OPERATION**			
	Water level will be stabilized near the upper end of the existing range.	Small increase in phytoplankton and zooplankton production in tributary waterbodies; small increase in rooted submergent aquatic plants in Wuskwatim Lake and a moderate increase in tributary waterbodies; small increase in abundance and distribution of benthic invertebrates in Wuskwatim Lake, and a moderate increase in tributary waterbodies.	None.	Long-term, small to moderate increase in abundance and distribution, dependant on lower trophic community, local.
REACH 2	**OPERATION**			
	Water level will increase (flooding) and stabilize at the same level as that of Reach 1 . Habitat loss/alteration at locations of permanent structures. Water quality impacts, including accidental spills.	Moderate decrease in abundance and distribution of aquatic plants; and a moderate increase in abundance and distribution, and a change in species composition of benthic invertebrates.	None.	Long-term, moderate decrease in abundance and distribution (aquatic plants) or increase (benthic invertebrates), local.
REACH 3	**OPERATION**			
	Daily water level fluctuations superimposed on the present fluctuations. Post-Project minimum water level will be lower than existing condition. Water quality impacts, including accidental spills.	Potential decrease in abundance and distribution of aquatic plants; and a moderate decrease in abundance and distribution, and a change in species composition of benthic invertebrates.	None.	Long-term, moderate decrease in abundance and distribution, local.
REACH 4	**OPERATION**			
	Daily water level fluctuations superimposed on the present fluctuations. Post-Project minimum water level will be slightly lower than existing condition.	Potential decrease in abundance and distribution of aquatic plants; and a moderate decrease in abundance and distribution of benthic invertebrates.	None.	Long-term, moderate decrease in abundance and distribution, local.

STUDY REACH	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
STREAM CROSSINGS	**OPERATION**			
	Footprint of access road.	Rooted submergent aquatic plants and benthic invertebrates in the footprint of the road and culvert(s) would be lost.	All stream crossings will meet the "Manitoba Stream Crossing Guidelines for the Protection of Fish and Fish Habitat". Impacts related to operation will be minimized due to control measures outlined in the Project Description (Volume 3) and practices that will be described in the EnvPP.	Long-term, small decrease in abundance and distribution, local.

Table 6.11-4. Expected residual effects of the Project on VEC fish species. (Note: Description of effect incorporates assessments presented in Tables 6.11-1 to 6.11-3.)

VEC SPECIES	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
ALL VEC SPECIES	**CONSTRUCTION**			
	Increased TSS, potential for accidental hydrocarbon spills and releases, and input of sewage effluent and trace elements. Blasting	Changes in water quality may affect fish habitat and displace some individuals. Blasting in or near water may cause mortality of some individuals.	Measures to mitigate potential increases in TSS and trace elements, accidental spills and releases of hydrocarbons, and the treatment of sewage effluent are identified in the Project Description. Majority of blasting (except single blast removal of rock plugs) will be within guidelines.	Short-term, small, local and, therefore, not significant negative effect on populations of VEC fish species in the study area.
	Increased domestic, commercial, and recreational fishing activity.	Overharvesting during construction of the GS could affect the abundance of fish in Wuskwatim Lake.	Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest. NCN and Manitoba Hydro, in consultation with the Nelson House Resource Management Board (NHRMB), will develop an Access Management Plan (AMP) to manage, among other things, access to Wuskwatim Lake for domestic, commercial, and recreational fishers.	Mitigation and management will be used to assure that negative effects will not be significant.

VEC SPECIES	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
WALLEYE	**OPERATION**			
	Reach 1: stabilization of water level at upper end of existing range; Reach 2: inundation and stabilization of water level equal to that of Reach 1; localized increases in TSS and reductions in dissolved oxygen concentrations (DO). Reaches 3 and 4: daily water level fluctuations superimposed upon the present fluctuations; GS/turbine mortality; localized reductions in DO.	More spawning and feeding habitat, more food, unrestricted movement between reaches 1 and 2 for most individuals, and more fish retained upstream due to fewer downstream migrants. Reduction in the quality and quantity of spawning (Reach 3), feeding (Reaches 3 and 4), and overwintering (Reach 3) habitat, less food, and fewer migrants from Reach 2.	None	Long-term, small, local and, therefore, not significant positive effect to the walleye population of the study area.
	Increased domestic, commercial, and recreational fishing activity.	Overharvesting during operation of the GS could affect the abundance of walleye in Wuskwatim Lake.	Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest. NCN and Manitoba Hydro, in consultation with the NHRMB, will develop an AMP to manage, among other things, access to Wuskwatim Lake for domestic, commercial, and recreational fishers.	Mitigation and management will be used to assure that negative effects will not be significant.

VEC SPECIES	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
LAKE WHITEFISH	**OPERATION**			
	Reach 1: stabilization of water level at upper end of existing range; Reach 2: inundation and stabilization of water level equal to that of Reach 1; localized increases in TSS and reductions in dissolved oxygen (DO) concentrations. Reaches 3 and 4: daily water level fluctuations superimposed upon the present fluctuations; GS/turbine mortality; localized reductions in DO.	Short-term (5-10 years) negative effect (decrease in the quality of spawning habitat due to sedimentation in some areas) outweighed by a long-term increase in the quantity of spawning and feeding habitat, more food, unrestricted movement between reaches 1 and 2 for most individuals, and more fish retained upstream due to fewer downstream migrants. Reduction in the quality and quantity of spawning and feeding habitat; less food; and fewer migrants from Reach 2.	None	Long-term, small, local and, therefore, not significant positive effect to the lake whitefish population of the study area.
	Increased domestic, commercial, and recreational fishing activity.	Overharvesting during operation of the GS could affect the abundance of lake whitefish in Wuskwatim Lake.	Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest. NCN and Manitoba Hydro, in consultation with the NHRMB, will develop an AMP to manage, among other things, access to Wuskwatim Lake for domestic, commercial, and recreational fishers.	Mitigation and management will be used to assure that negative effects will not be significant.

VEC SPECIES	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
LAKE CISCO	**OPERATION**			
	Reach 1: stabilization of water level at upper end of existing range; Reach 2: inundation and stabilization of water level equal to that of Reach 1 localized increases in TSS and reductions in dissolved oxygen (DO) concentrations. Reaches 3 and 4: daily water level fluctuations superimposed upon the present fluctuations; GS/turbine mortality; localized reductions in DO.	Short-term (5-10 years) negative effect (decrease in the quality of spawning habitat due to sedimentation in some areas) outweighed by a long-term increase in the quantity of spawning and feeding habitat, more food, unrestricted movement between reaches 1 and 2 for most individuals, and more fish retained upstream due to fewer downstream migrants. Reduction in the quality and quantity of spawning and feeding habitat; less food; and fewer migrants from Reach 2.	None	Long-term, small, local and, therefore, not significant positive effect to the lake cisco population of the study area.
	Increased domestic, commercial, and recreational fishing activity.	Overharvesting during operation of the GS could affect the abundance of lake cisco in Wuskwatim Lake.	Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest. NCN and Manitoba Hydro, in consultation with the NHRMB, will develop an AMP to manage, among other things, access to Wuskwatim Lake for domestic, commercial, and recreational fishers.	Mitigation and management will be used to assure that negative effects will not be significant.

VEC SPECIES	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
NORTHERN PIKE	**OPERATION**			
	Reach 1: stabilization of water level at upper end of existing range; Reach 2: inundation and stabilization of water level equal to that of Reach 1 localized increases in TSS and reductions in dissolved oxygen (DO) concentrations. Reaches 3 and 4: daily water level fluctuations superimposed upon the present fluctuations; GS/turbine mortality; localized reductions in DO.	More spawning and feeding habitat, more food, unrestricted movement between reaches 1 and 2 for larger pike, and more fish retained upstream due to fewer downstream migrants. Reduction in the quality and quantity of spawning (Reaches 3 and 4), feeding (Reaches 3 and 4), and overwintering (Reach 3) habitat, less food, and fewer migrants from Reach 2.	None	Long-term, small, local and, therefore, not significant positive effect to the northern pike population of the study area.
	Increased domestic, commercial, and recreational fishing activity.	Overharvesting during operation of the GS could affect the abundance of northern pike in Wuskwatim Lake.	Manitoba Conservation is responsible for the management of fisheries in the province, including avoidance of adverse effects related to over-harvest. NCN and Manitoba Hydro, in consultation with the NHRMB, will develop an AMP to manage, among other things, access to Wuskwatim Lake for domestic, commercial, and recreational fishers.	Mitigation and management will be used to assure that negative effects will not be significant.

Table 6.11-5. Expected residual effects of the Project on fish quality of VEC fish species. (Note: Description of effect incorporates assessments presented in Tables 6.11-1 to 6.11-4.)

ISSUE	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
MERCURY	**OPERATION**			
	Reach 1: peat will come into contact with water more frequently as a result of stabilization of water level at the upper end of existing range; Reach 2: inundation of 34 hectares between Wuskwatim Falls and Taskinigup Falls.	Increase in mercury concentration in VEC fish species (lake cisco, lake whitefish, northern pike, walleye).	None.	Negative, long-term, small, local and therefore, not significant effect to VEC species.
	Reaches 3 & 4: die-off of peatlands in backwater inlets of the Burntwood River and the northern shore of Opegano Lake as a result of daily water level fluctuations superimposed upon the present fluctuations.	Increase in mercury concentration in VEC fish species.	None.	Effect is not expected to be measurable due to the large amount of flow in relation to the small area affected.
OTHER METALS	**CONSTRUCTION**			
	Increase in rate or erosion, acid leachate, and sediment loading.	Increase in metal concentrations in VEC fish species.	None.	No effect is expected on VEC species because metals do not typically accumulate in fish muscle.
	OPERATION			
	Increase in erosion and sediment loading upstream and downstream of the Generating Station.	Increase in metal concentrations in VEC fish species.	None.	No effect expected.

ISSUE	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
PARASITES	**OPERATION**			
	Reach 1 & 2: increase in lake whitefish and northern pike abundance.	Potential increase in *T. crassus* in lake whitefish.	Monitor commercial catches.	Negative, long-term, small, local and therefore, not significant effect.
FISH PALATABILITY	**OPERATION**			
	Project operations (specific source of effect not identified).	Change in fish palatability.	None.	No effect is expected.

6.12 CUMULATIVE EFFECTS ASSESSMENT

This section provides an overview of the potential cumulative effect of impacts of the Wuskwatim Project in conjunction with activities listed in Section 2.3. A description of the approach and scoping of the CEA, as well as information on developments/activities considered in the CEA is provided in Volume 10. Detailed cumulative effects assessments for various components of the aquatic environment are provided in Volume 5.

The CEA considered three phases of the Project:

(i) construction (2004-2009);

(ii) transition (2009-2034) – period when environment is adjusting to new water regime; effects are greatest during the initial part of this period and diminish thereafter; and

(iii) stabilized (2034+) – after the adjustment period and extending for the lifespan of the Project.

The following activities were considered in the CEA for the aquatic environment:

- Wuskwatim Transmission Project;
- Tolko Forestry, including projected future forestry operations with and without the establishment of an ASI at Partridge Crop Hill;
- increased cabin development at Wuskwatim Lake;
- TLE development at Wuskwatim Lake; and
- climate change.

Future hydroelectric development at Notigi, Gull/Keeyask, and Conawapa, and other projects associated with transmission development or maintenance projects such as the Kelsey upgrading, were not considered in this CEA as there was no spatial and temporal overlap with the effects of the Wuskwatim Project. In addition, impacts of two current projects, the CRD and INCO smelter at Thompson, were not included in the CEA as the residual effects of these projects were not expected to change the assessment of significance of residual effects of the Wuskwatim Project. The effect of CRD is incorporated into the description of the existing environment, which is believed to have adjusted to CRD and be relatively stable; in addition, any residual effects that are still changing (e.g., erosion) are expected to become smaller, rather than larger, over time. Aerial emissions from the INCO smelter may be contributing to on-going metal enrichment in the aquatic environment (in particular sediments); however, this impact was not assessed as the study area is in the secondary area of deposition, as the quality of smelter emissions will likely improve over time, and as there is no recent information available (Volume 10).

6.12.1 Construction

During the construction phase, measurable impacts at the construction site and extending downstream are expected for:

(i) Water Quality – short-term elevations in TSS in the Burntwood River during activities such as coffer dam construction and removal and at stream crossings during road construction, and increases in nutrients, ammonia and other parameters in the backwater inlet 4 during sewage lagoon discharge.

(ii) VEC fish species – may observe a negligible, short-term decrease in fish abundance due to the combined effects of short-term inputs of TSS (e.g., in plumes), excavation, blasting, and degradation of habitat in backwater inlet 4 during sewage lagoon discharge. Harvesting during construction could have an effect on fish populations (depends on management).

Construction of the Wuskwatim transmission line is the only major activity identified during this phase (though limited forestry may occur in 2009). The transmission line extending from the Wuskwatim site to Thompson would cross the Burntwood River and several tributaries on the south side. However, no impacts to water quality or fish and fish habitat are expected due to environmental protection measures during construction (Wuskwatim Transmission Project EIS 2003). Therefore, no cumulative effects are expected. The second line, which connects Wuskwatim GS to the Herblet Lake Transmission station, after crossing the Burntwood River, does not pass through aquatic areas affected by construction of the GS.

6.12.2 Transition

Following construction of the Project, conditions both upstream and downstream are expected to evolve quite rapidly over the first several years, and then more slowly thereafter. A twenty-five year period has been designated as the transition phase.

During this period, the following measurable impacts to the aquatic VECs are expected:

(i) water quality - local effects as discussed in Section 6.11, including increases in suspended sediment and some metals off of banks experiencing a marked increase in the rate of erosion in Wuskwatim Lake; slight nutrient enrichment and exacerbation of existing low oxygen levels in off-current areas of off-system waters (e.g., Wuskwatim Brook, Sesep Lake); and potentially some depletion of oxygen adjacent to peatlands in backwater inlets and the north shore of Opegano Lake;

(ii) walleye and northern pike – increased production upstream of the GS due to more food and increased access to spawning and feeding habitat on Wuskwatim Lake; a decline in production downstream of the GS up to and including Opegano Lake due to: (i) a general decrease in productivity in this reach, and (ii) a reduction in the downstream movement of fish from Wuskwatim Lake. Overall, a not significant positive increase in the abundance of these species is predicted in the long term for the study area;

(iii) lake whitefish and lake cisco – increased production upstream of the GS due to more food and increased access to spawning and feeding habitat on Wuskwatim Lake counteracted in first years of transition phase by increased sedimentation affecting a portion of the spawning habitat. As with walleye and northern pike, a decline in the abundance of these species is expected in the Burntwood River between the GS up to and including Opegano Lake. Overall, a not significant positive increase in the abundance of these species is predicted in the long term;

(iv) increased mercury levels in northern pike, walleye and, to a lesser extent, lake whitefish and lake cisco; and

(v) increased domestic, commercial, and recreational harvest is predicted. Manitoba Conservation is responsible for the management of fisheries, including avoiding potential adverse effects associated with over-harvest.

The following activities/developments were evaluated for this phase:

Wuskwatim transmission facilities – no impact on aquatic environment.

Forestry – areas to the south of Wuskwatim Lake and the Burntwood River upstream and throughout the reach could be harvested. It should be noted that this is a hypothetical scenario and actual harvesting would be contingent on receiving approvals from Manitoba Conservation. Based on the Environmental Impact Statement for the Repap Manitoba Inc. 1997-2009 Forest Management Plan (assessed harvest in the areas under consideration), timber harvest and the associated development of roads can result in impacts to water quality and fish and fish habitat (e.g. impediment of fish passage at stream crossings, degradation of habitat due to sedimentation), but these impacts can be minimized through the implementation of appropriate measures.

The cumulative impacts to water quality in Wuskwatim Lake and adjoining waters from forestry are expected to be minimal for the following reasons:

- during timber harvest, maintenance of a buffer along Wuskwatim Lake would minimize the inputs of sediments from harvested areas to the nearshore environment, where suspended sediments and sedimentation are increased as a result of the Wuskwatim Project;

- timber harvest and the construction of roads in the upper sections of Wuskwatim Brook could cause minor downstream increases in suspended sediments and nutrients. If these effects occur in the first years after the Wuskwatim Project is built, there would be a cumulative effect to water quality in this area; and,

- no major upstream movements of fish into Wuskwatim Brook or other tributaries where upstream reaches could be impacted by forestry were identified. Therefore, alterations to fish habitat in these tributaries is not expected to affect fish populations in Wuskwatim Lake.

Increased number of cabins and TLE from NCN - the increased number of cabins could lead to localized effects to water quality (e.g., seepage from pit privies, oil and gas from boat motors) and an incremental increase in harvesting of fish.

With respect to the TLE, no plans have been developed, but an increase in human usage of Wuskwatim Lake, in conjunction with possible development of infrastructure (e.g., cabins) would likely occur. Impacts would be similar to increased development of cabins.

Effects of the Project on Wuskwatim Lake would impose few limitations in usage. The primary effect would be to the suitability of surface waters at local sites as a drinking water source: for example, there will be an increase in suspended sediments off of eroding shorelines (e.g., peninsula at south end of lake selected as a TLE is in a high erosion area). Likewise, isolated bays on Wuskwatim Brook and Sesep Lake may experience a greater amount of oxygen depletion during winter, making the water less suitable for drinking. With respect to cabin and other development along the lakeshore, it is recommended that activities not be undertaken which would exacerbate the existing erosion along the shoreline, to avoid incremental effects on whitefish and cisco spawning habitat.

6.12.3 Stabilized Phase

Prediction of potential developments and impacts during the stabilized phase is associated with a high degree of uncertainty due to the interaction of many variables. By 2034, the aquatic environment in the area affected by the Wuskwatim Project is expected to have achieved a new steady state, and the residual effects of the Project would be related to permanent changes in the water regime:

(i) Wuskwatim Lake levels would be generally steady, with a resulting small increase in lake productivity compared to the existing condition;

(ii) daily fluctuation of water levels downstream of the GS up to and including Opegano Lake would have resulted in a generally less productive environment; and

(iii) fewer fish would be moving downstream from Wuskwatim Lake to Opegano Lake than under pre-Project conditions due to the presence of the GS.

During this phase, several activities considered in the transition phase (e.g., transmission facilities, timber harvest within the immediate watershed, NCN activities at Wuskwatim Lake) would continue; however, after the transition phase, cumulative impacts with the Wuskwatim Project would no longer be expected to occur.

In this phase, climate change could also affect the environment. Due to the high level of uncertainty, expected impacts to the aquatic environment are difficult to describe, however an increase in overall temperature is expected (Volume 4. Indirect effects to the aquatic environment, related to the melting of permafrost and an increase in the frequency of fires, may also occur (Volume 10).

The residual impacts of the Project during the stabilized state are not expected to act in a cumulative manner with the impacts of climate change. Although climate change may affect water quality, operation of the Project is not expected to affect water quality during this phase. Likewise, an increase in water temperature could reduce the suitability of the environment for coldwater species such as lake whitefish and lake cisco; however, during this period the station is not expected to cause a measurable impact to these species (population-related effects due to turbine mortality are expected to be negligible).

It should be noted that, in the long term, additional hydroelectric stations may be constructed at sites on the Burntwood River within the Wuskwatim study area; however, plans for these stations have not been developed and, as they would be subject to an environmental review process, are not included in this CEA.

6.13 ENVIRONMENTAL MONITORING AND FOLLOW-UP

This section provides an overview of the aquatic ecosystem environmental monitoring and follow-up activities that will be undertaken during construction and operation of the Project. Detailed descriptions of the programs are presented in Volume 5 of the Project EIS.

The aquatic monitoring and follow-up program is intended to document conditions over time for identified VECs and other parameters to:

- confirm impact predictions;
- identify unexpected effects and impacts;
- monitor effectiveness of mitigation measures;
- identify other mitigation or remedial actions that may be implemented;
- confirm compliance with regulatory requirements including Project approvals; and
- provide baseline data and information for other users.

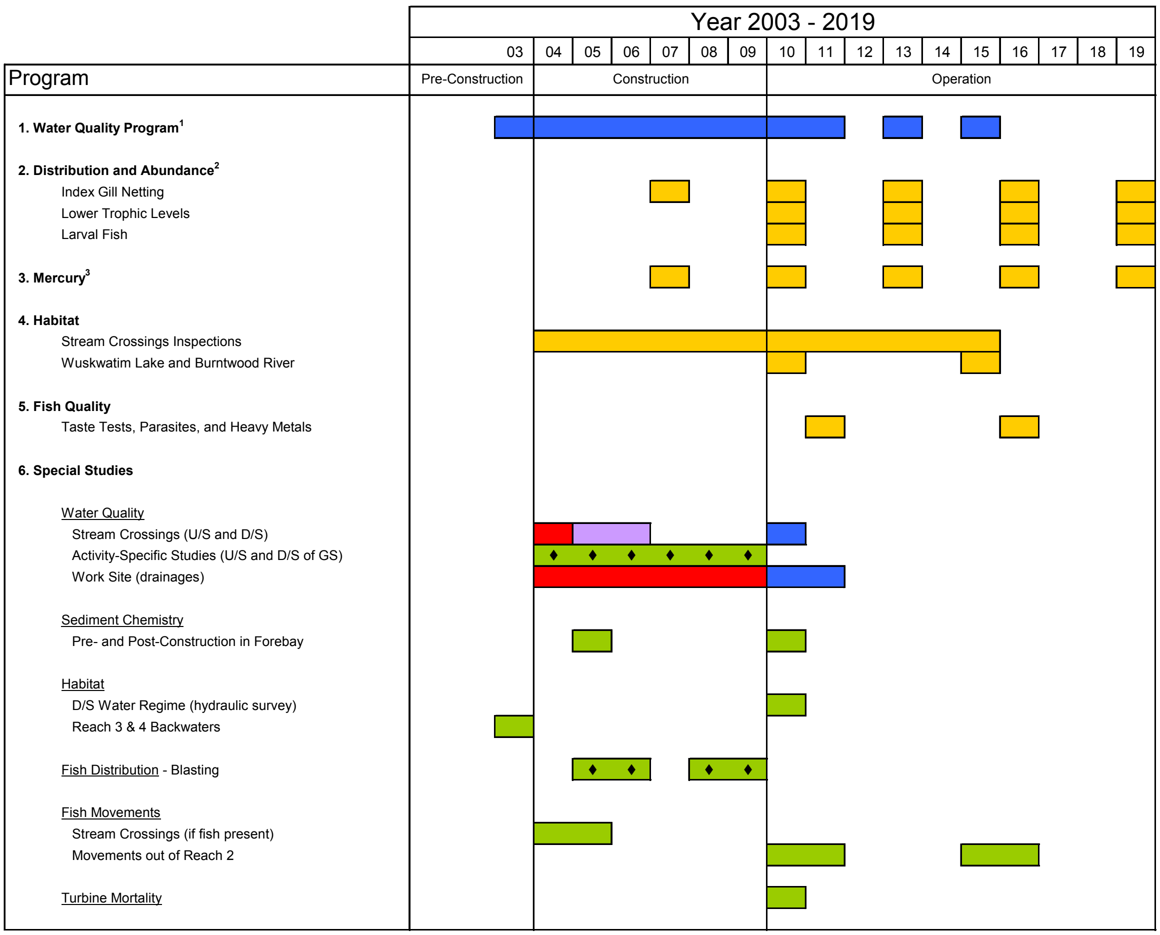
As many aquatic ecosystem components experience wide ranges of seasonal and year-to-year variation, and as some effects of the Project may only be detectable after a period of several years, the monitoring program must be long-term and designed to document the key characteristics of each component. Some monitoring activities will be scheduled within an ongoing program, while others will be conducted on an "as required" basis; some activities will be confined to a specific site, whereas some will be regional in scope. The assessment studies conducted for the EIS have established monitoring sites and sampling protocols that will be maintained through the construction and operation of the Project. Each monitoring program and activity will be described in a work plan supporting the Environmental Protection Plan

As the field studies for the EIS were primarily conducted in the 1998 – 2002 period, and as in many instances only one or two rounds of samples or measurements were taken, and as environmental components often have a wide range of year-to-year natural variability, and as the Project will not cause major changes to water regimes for several years, there is opportunity to carry out additional pre-construction monitoring to strengthen the data base for key aquatic components, such as water quality.

Monitoring activities will be conducted by competent professionals and technicians using accepted methods and appropriate equipment to produce scientifically credible results. Traditional Knowledge will be a major component of the monitoring record and NCN resource users will participate in implementing the monitoring program. Monitoring activities will be reviewed with resource managers and resource users prior to program implementation and results will be made available to all interested parties.

The following outlines the proposed aquatic monitoring activities that are summarized in Table 6.13-1.

Table 6.13-1. Aquatic Monitoring Program Activity Schedule.



[1] Water quality sampling at permanent sites on the Burntwood River, including sites upstream and downstream of the GS.
[2] Distribution and abundance as per pre-Project programs.
[3] Standardized sampling as per established protocols.

Legend:
- Once per year
- Monthly (open-water period)
- Bi-monthly (open-water period)
- Four times per year
- Special studies
- ♦ Subject to construction schedule

6.13.1 Pre-Construction

Prior to flooding of the forebay and changes to the upstream and downstream water regimes the following aquatic monitoring will be conducted:

- collection of water samples at permanent water quality monitoring sites to strengthen the existing data base (including quarterly water quality sampling from sites immediately upstream and downstream of the generating station site) (2003); and
- collection of additional information on aquatic habitat and vegetation communities in backwaters of reaches 3 & 4 (2003).

6.13.2 Construction

Construction activities, environmental parameters and environmental effects will be closely monitored during the construction period. The Environmental Protection Plan for the Project outlines monitoring requirements and responsibilities arising from the commitments made in the EIS, as well as the Terms and Conditions of Environment Act License, Fisheries Act Authorizations, Work Permits and other approvals granted for the work. This monitoring will include, but not necessarily be limited to:

Access Road Stream Crossings

- water quality sampling upstream and downstream of each crossing will be conducted before and after road construction to assess those parameters most likely to be affected by construction. Monthly water quality analysis during the 2004 open-water season and bi-monthly sampling during the 2005 and 2006 open-water seasons will be conducted. The need for additional sampling will be determined on the basis of the results from the 2004 to 2006 sampling programs; and
- annual visual inspection of aquatic habitat and fish passage conditions upstream and downstream of road crossings (spring of 2004 to 2009) and assessment of fish passage in spring of 2004 and 2005.

Construction Camp and Work Areas

- monthly observations and sampling of basic water quality parameters in drainages from active work sites at the site boundary and at their discharge into the Burntwood River (2004 to 2009). (Discharges from the sewage plant and other operating site facilities will be monitored as required by approvals for those facilities).

Generating Station Site

- site- and activity-specific water quality monitoring as appropriate to assess only those parameters most likely to be affected during construction activities such as coffer dam construction and removal, rock excavation, and flooding of the forebay (2004 to 2009);
- monitoring of fish presence in reaches 1-3 within 1 km of the site pre- and post-blasting (2005 and 2006);
- monitoring of fish mortality following single blasts for removal of rock plugs (2008 and 2009);
- standard gang index gill net survey in reaches 1 – 4 to determine fish distribution and abundance (2007); and
- documentation of sediment chemistry immediately upstream of the station and dam prior to inundation (2005).

Reaches 1- 4

- four times a year water quality monitoring at permanent sites (2004 to 2009); and
- mercury sampling in fish from Wuskwatim Lake and Opegano Lake to strengthen mercury database (2007).

6.13.3 Operation

Access Road Stream Crossings

- four times a year water quality sampling upstream and downstream of each road crossing in 2010 to assess only those parameters most likely to have been affected by construction; and
- annual visual inspection of aquatic habitat and fish passage conditions upstream and downstream of each road crossing (2010 to 2015).

Construction Camp and Work Areas

- four times a year observation and sampling of basic water quality parameters at the drainage site discharging into the Burntwood River for two years after site rehabilitation (2010 and 2011).

Generating Station Site

- fish tagging and recapture study to document fish movements upstream and downstream from the generating station forebay in 2010/11 and 2015/16;

- turbine mortality study in 2010; and
- documentation of post-construction forebay sediment chemistry following construction of the GS (2010).

Reaches 1 - 4

- four times a year water quality monitoring at permanent sites in 2010, 2011, 2013, and 2015;
- hydraulic survey of downstream water regime in 2010;
- standard gang index gill net surveys of reaches 1 – 4 to define fish distribution and abundance in 2010, 2013, 2016, and 2019;
- sampling of fish for mercury content in Wuskwatim and Opegano lakes in 2010, 2013, 2016, and 2019;
- surveys for lower trophic levels and larval fish at all established sampling sites in 2010, 2013, 2016, and 2019;
- survey of lake and river habitat in reaches 1 – 4 in 2010 and 2015; and
- fish quality tests in 2011 and 2016 (taste tests, parasites, and heavy metals).

6.13.4 Reporting

Annual reports presenting monitoring activities and results for all parameters will be issued. These reports will be distributed to Manitoba Hydro, NCN Chief and Council, and NCN resource users, federal/provincial regulatory authorities, and resource managers. Presentation of the results will also be provided to NCN community members at meetings in Nelson House. Changes to the monitoring programs will be based on results and only be made with the concurrence of all the involved parties. A meeting between all involved parties is proposed for years 2, 5 and 10 following completion of construction to review monitoring results, environmental changes resulting from the Project and revisions to the monitoring program.

7.0 TERRESTRIAL ENVIRONMENT

7.1 INTRODUCTION

This section of the Environmental Impact Statement describes the existing terrestrial environment and assesses the anticipated impacts of the construction and operation of the Project on the components of the terrestrial ecosystem: terrestrial habitat (i.e., soils, groundwater, surface water, permafrost, vegetation/ plants, vegetation age and main type of disturbance), insects, amphibians, reptiles, birds and mammals.

As it is not feasible to investigate and assess every component of the terrestrial ecosystem, species having high ecological importance, species important to NCN and/or species recognized as being good indicators of each ecosystem component were identified as Valued Ecosystem Components or VECs and are discussed in detail in this EIS. The VECs documented in the terrestrial environment Section are listed in Table 7.1-1.

The effects of the Project on the VECs, on key ecosystem linkages, and key components of **ecosystem health** were measured in terms of predicted changes in:

- areas and locations of **land type**s;
- areas and locations of **habitat type**s;
- amount and quality of VEC habitat;
- areas and locations of white spruce (a surrogate for the balsam fir VEC); and
- road density in the study area as an indicator of habitat fragmentation effects (road length is expressed as km/ km^2).

Summary discussions of each terrestrial ecosystem component are presented in Sections 7.5 to 7.9. Utilization of these resources is described in Section 6.4. Study Areas for the terrestrial environment studies are defined, linkages between ecosystem components and the Project activities and operations are described and the methods used in collecting and assessing information are outlined in Section 5.3.1. Cumulative effects of the varied development activities within the region are discussed in Section 8, while the proposed monitoring and follow-up program for the terrestrial disciplines is outlined in Section 10. The agencies and individuals who conducted and reported the terrestrial investigations are identified in Appendix 1.

Table 7.1-1. Valued Ecosystem Components – Terrestrial Environment.

Common Name	Scientific Name	Cree Name
HABITAT and PLANTS		
Dry jack pine Forest	Dry *Pinus banksiana* forest	Oskahtik
Balsam fir	*Abies balsamea*	Napakasiht
Dry ground cranberry	*Vaccinium vitis-idaea*	Wesakemina
Velvet-leaf blueberry	*Vaccinium myrtilloides*	Ethinimina
Bog cranberry	*Oxycoccus microcarpus*	Wesakemina
Sweet flag or rat root	*Acorus americanus*	Wikhees
Wild mint	*Mentha arvensis*	Wikaskwah
Sensitive plants (i.e., plants species that are endangered, threatened, rare, near the limit of their range or with low reproductive potential)		
BIRDS		
Canada Goose	*Branta canadensis*	
Mallard	*Anas platyrhynchos*	
Bufflehead	*Bucephala albeola*	
Common Goldeneye	*Bucephala clangula*	
Common Loon	*Gavia immer*	
Bald Eagle	*Haliaeetus leucocephalus*	
Red-winged Blackbird	*Agelaius phoeniceus*	
Palm Warbler	*Dendroica palmarum*	
Belted Kingfisher	*Ceryle alcyon*	
Common Snipe	*Gallinago gallinago*	
MAMMALS		
Beaver	*Castor canadensis*	Amisk
Muskrat	*Ondatra zibethicus*	Wuchusk
Woodland Caribou	*Rangifer tarandus caribou*	Ethinutwatehk
Moose	*Alces alces*	Mooswa

7.2 STUDY AREAS

Five superimposed Study Areas were adopted for the terrestrial environment disciplines using the habitat and life activity requirements (e.g., migration ranges, reproductive areas) of the VECs and the extent of Project effects. These areas are shown on Figure 7.2-1 and described as follows.

- Region (i.e., an ecological region encompassing the southern three-quarters of the Nelson House Resource Management Area and all of the proposed development site);
- Sub-Region (i.e., a block of approximately 340,000 ha centering on the proposed development site);
- Affected Aquatic Area (i.e., encompasses all the shoreline, peat island and mineral island habitat in the affected waterway from Early Morning Rapids to the Opegano Lake outlet);
- Aquatic Buffer (i.e., a 1 km band around the Affected Aquatic Area encompassing all anticipated mainland habitats to be directly and indirectly affected by the generating station features and Project related erosion); and
- Upland Buffer (i.e., a 1 km band around the access road and borrow pits encompassing all anticipated mainland habitats to be directly and indirectly affected by these Project features).

The level of detail is generally greater for the specific areas where direct Project impacts will occur.

7.3 LINKAGES

This section provides an overview of the major impacts from the construction and operation of the Project that were considered in the assessment of effects to the terrestrial environment. Additional information and a complete list of impacts are provided in Volume 6.

7.3.1 Construction-Related Impacts

Effects to the terrestrial environment related to impacts such as clearing, sensory disturbances by construction activity (including 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

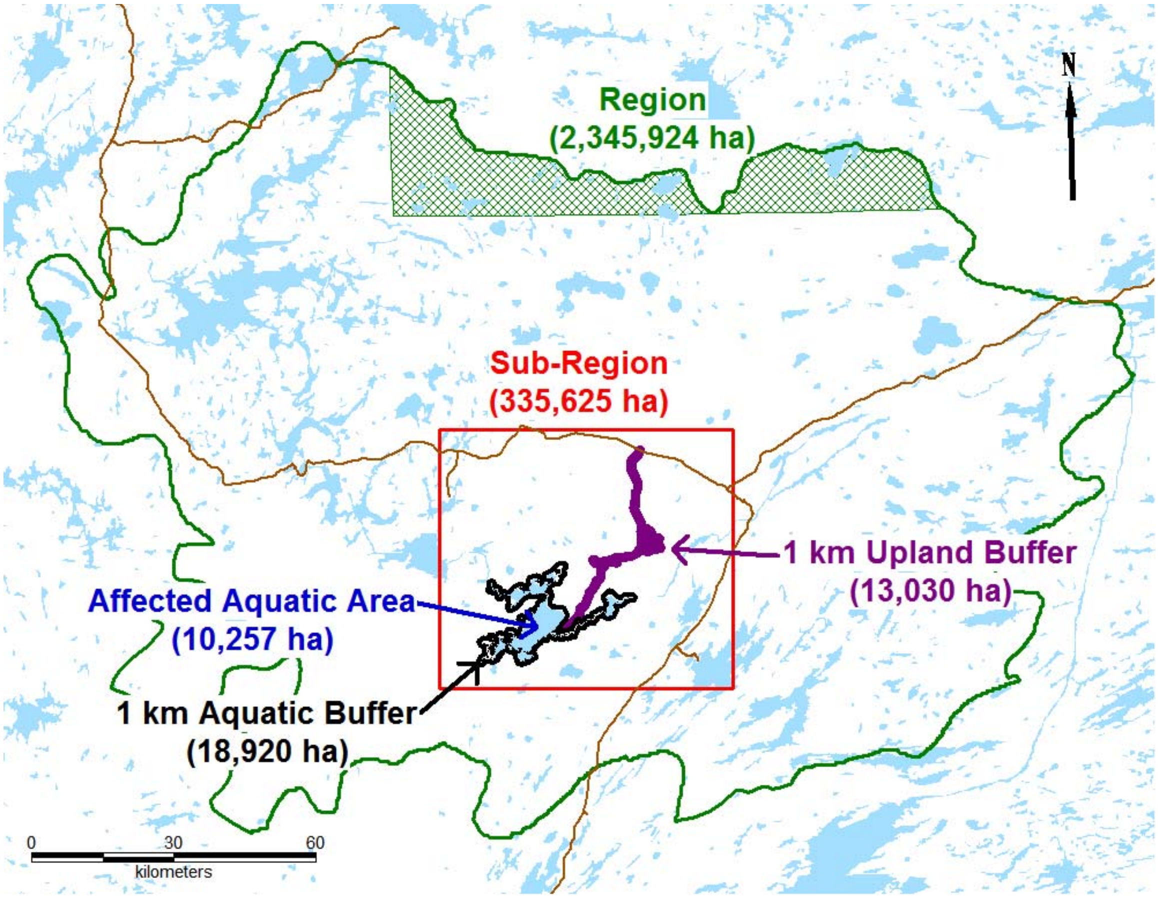


Figure 7.2-1. Terrestrial habitat assessment study areas. Cross-hatched area shows the portion of the Region that has inconsistent habitat information. (Note: Maps in this volume are for general reference purposes only. Volume 6, Section 5 contains larger maps plotted at a common scale.)

Hydro (this assessment also applied to the operating period); in certain instances there are differences in the aerial extent of impacts described in this section and in sections 4.5 and 5.2 due to differences in the map bases and definition of impacted areas.

As described in Section 4.5, measures employed during construction will reduce impacts and thereby reduce potential effects to terrestrial biota. It should be noted that, based on handling procedures for hazardous materials and emergency response measures (Section 4.5), the potential for significant contamination of the terrestrial environment as a result of a spill is considered negligible.

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.

7.3.2 Operation-Related Impacts

Section 6.3 provides an overview of impacts to water regime, which also affects the riparian terrestrial environment.

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. It should be noted that NCN resource harvesters feel that some debris will be mobilized as a result of the Project (Section 5.8).

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.

7.4 METHODS

The terrestrial environment studies were developed and implemented to respond to information requirements identified in the federal/provincial guidelines for the Project and to meet NCN's and Manitoba Hydro's needs for project planning/design purposes. These studies were conducted by discipline professionals assisted by competent technical staff and informed NCN members using proven techniques and procedures. Over the course of conducting the studies, adjustments were made to the scope of work in response to findings and expressed concerns.

All technical specialists employed the following common general methods to carry out their work:

- consultation with NCN leadership and members regarding traditional knowledge;
- collection of resource use information from NCN resource harvesters;
- consultation with NCN members to gain an understanding of their concerns about and expectations from the Project;
- collection and review of published information relevant to the Study Area;
- consultation with regulatory authorities and local resource managers;
- review of information and consultation with Manitoba Hydro about the proposed development, including locations of potential disturbance, construction schedule and activities, temporary and permanent facilities, planned operations, environmental protection practices, and mitigation programs;
- field investigations and monitoring;
- review of information and data regarding previous hydroelectric developments in the region and in other similar situations; and
- study team meetings and discussions.

An ecosystem approach was used throughout the study to describe terrestrial habitat and the terrestrial ecosystem components, to predict the effects of the proposed Project and to assess the ecological significance of those effects. The general concepts of the ecosystem approach to effects assessment include the following:

- all things (physical, biological and spiritual) are interconnected within and between scales of space, time and biological organization;
- effects of the Project must be considered in both short and long time frames;
- people who value the local environment can identify issues of concern;
- people who know the local environment can provide important information;
- ecosystem health includes maintaining native biological diversity (ecosystems, species, genes), ecosystem condition and productivity, soil and water quantity and quality and continuation of global ecological cycles; and
- the principles of Sustainable Development and Environmental Stewardship are to be practiced. Project activities and impacts are to be managed so that the terrestrial ecosystem can recover from the stresses placed on it.

To the extent possible, study information and data were recorded and presented using Geographic Information System techniques with mapping at the appropriate scale, supporting text and tabular presentations. Discipline-specific methods are summarized below.

7.4.1 Habitat

Descriptions of habitat and the associations between plants, soils, groundwater, surface water, permafrost and disturbance were based on NCN Traditional Knowledge, field studies, existing GIS databases, and studies conducted specifically for the Wuskwatim EIA. Field studies were conducted in 2000, 2001 and 2002 using ground, boat, and aerial field surveys.

A hierarchical approach was used to map ecological units. The hierarchy was Region - Sub-Region - landscape (the 1 km buffers) - landscape elements (broad habitat type) - habitat (fine habitat type) - and site (see Figure 7.2-1 for the three largest scales). Most study and Project impact area descriptions use the broad habitat types. The fine and broad habitat types were used the basis of habitat modeling for the VECs. Fine habitat types were also used to identify rare and uncommon types. A habitat type or tree species was classified as rare if its mapped coverage was less than 0.06% of Sub-Region or Region area and uncommon if it covered less than 2.1% of the area.

Land and habitat type maps for the areas outside of the Affected Aquatic Area were developed in two stages. First, preliminary maps were prepared from existing surface material maps, National Topographic Survey maps and the Manitoba Forest Resource Inventory (FRI) map. Second, preliminary maps were enhanced and ground-truthed with information obtained from photo-interpretation and field studies. Univariate and multivariate statistics were used to describe the ecological relationships between habitat components using field and GIS map data. In the Affected Aquatic Area, habitat and environment type maps for the Shore Zone, Peat Islands and Mineral Islands were developed from aerial photos and field studies that included ground, boat and aerial data collection. The water duration zone approach (Hellsten 2000; Keddy 2000) was applied to GIS maps to explain and predict the locations of different types of plants at different beach elevations and habitats along the shoreline.

An effects assessment should consider species that are either endangered, threatened, rare, uncommon, near the limit of their range or have low reproductive potential (FEARO 1996). The habitat effects assessment refers to this group of species as sensitive species. Sensitive species occurrence was noted during all types of field sampling. Reconnaissance searches for these species were conducted in potential habitats and in the impact areas. Plants were classified as provincially very rare, rare or uncommon based on the rankings produced by the Manitoba Conservation Data Centre (CDC). Plants were classified as regionally rare or uncommon based on field observations, herbaria records and CDC information.

7.4.2 Insects

Insects are important indicators of ecosystem health, function and stability. Although no insects are identified as VECs, they are used to describe ecosystem components and linkages. Three sources of information were considered - TK, field studies and scientific literature. TK and field studies relating to terrestrial insects are limited to the Aquatic Buffer area and to major forest pests. As there are few surveys assessing the insect fauna of this region, the primary scientific reference is Danks and Foottit (1989), a paper which discusses insects relative to the entire boreal zone of Canada, unless otherwise noted.

The discussions in this section contain summary information about some terrestrial insects that require aquatic habitat early in their life cycles such as midges and mayflies. Detailed descriptions of **terrestrial** and some **riparian insect** environments, including a general description of the insect community, ecological associations, abundance and distribution of habitats in the 1 km Upland and Aquatic Buffers, rare species, and predicted impacts are found in Volume 6 Section 6. Other information relating to insects, invertebrates and lower trophic levels of the aquatic environment are found in Volume 5 Section 7.

7.4.3 Reptiles and Amphibians

Information regarding the presence, abundance, and distribution of amphibians and reptiles in the study area was obtained from:

- Traditional Knowledge of the local NCN people from the following sources:
  - comments from NCN representatives at project meetings and workshops; and
  - conversations with NCN people, including those assisting with scientific studies.
- EIS studies conducted during the spring, summer and fall of 2000 and 2001 in the study area (Figure 7.4-1), included:
  - terrestrial amphibian surveys;
  - boat-based surveys; and
  - general reconnaissance.

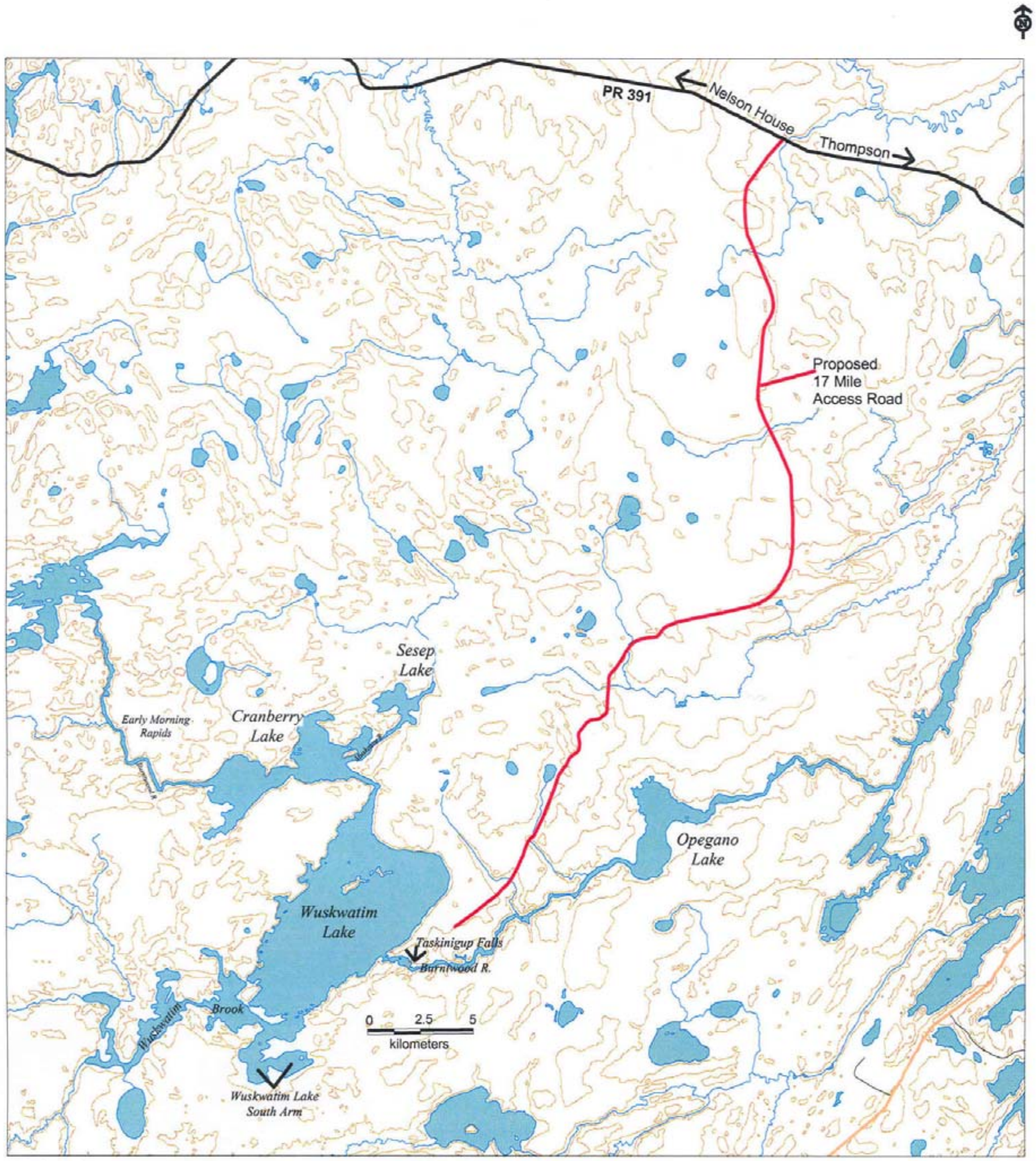


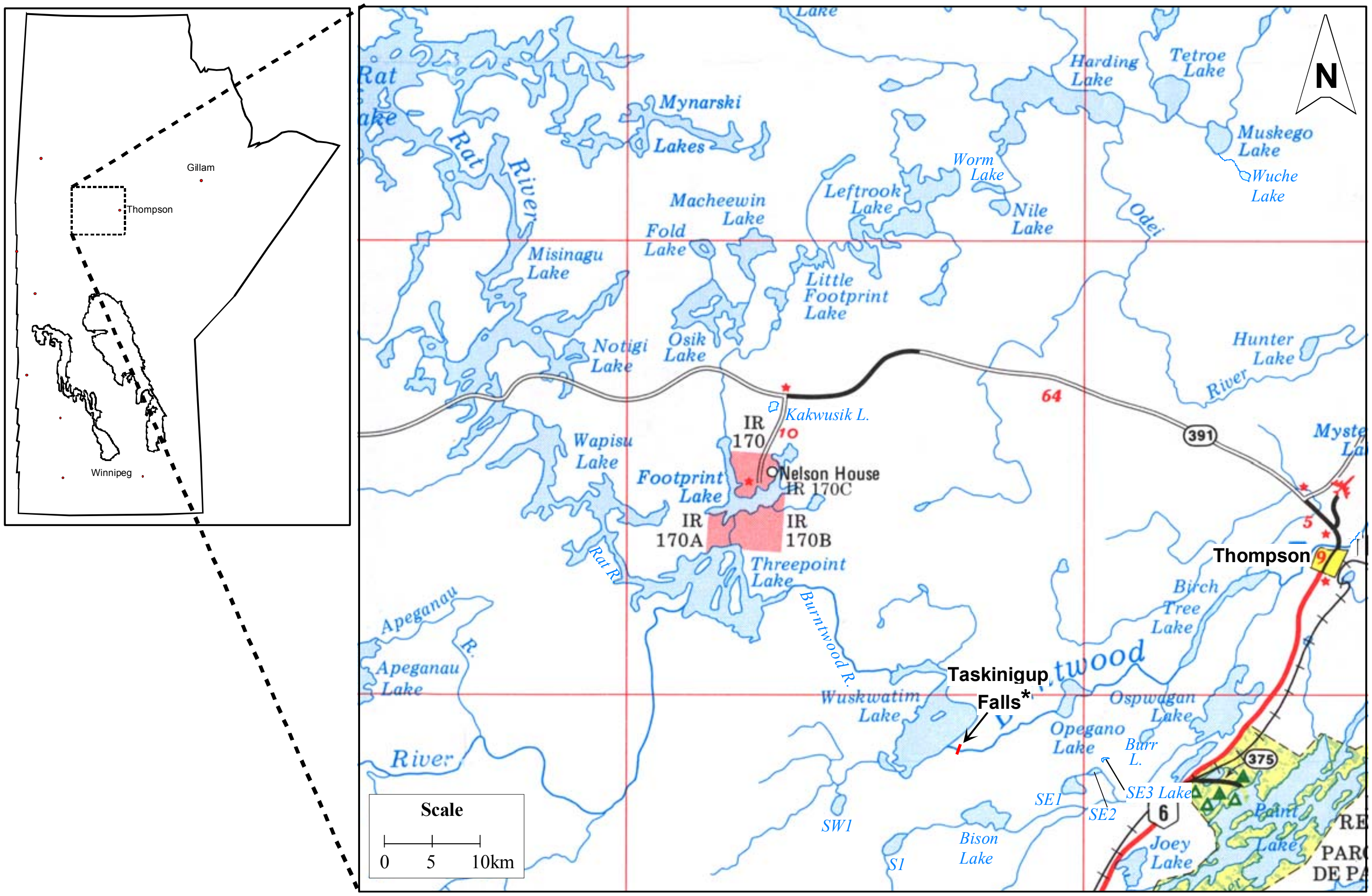
Figure 7.4-1. Study area for amphibians and reptiles.

7.4.4 Birds

The TK information regarding bird abundance, distribution and habitat use within the study area from was obtained from local NCN members including those assisting with studies and from interviews with NCN resource harvesters. In addition, bird harvest information was obtained from a Harvest Calendar survey that was conducted from Aug. to Nov. 2001 and Jan. to March 2002 and country foods distribution records. Previous scientific studies regarding birds within the study area were obtained from Canadian Wildlife Service (CWS), Manitoba Conservation; and the U.S. Fish and Wildlife Service reports. To provide detailed Project-specific information on bird abundance, distribution and habitat use, field studies were conducted during the spring, summer and fall of 2000 and 2001 (Figure 7.4-2) and included: helicopter and boat-based surveys; terrestrial breeding bird surveys; and reconnaissance.

Approximately 432 km^2 and 704 km^2 of shoreline were surveyed by helicopter in 2000 and 2001, respectively. Waterbodies along the Rat-Burntwood River system, including Wuskwatim Lake, were surveyed in addition to waterbodies adjacent to the Rat-Burntwood River system for regional comparison purposes. Boat-based surveys were conducted along approximately 757 km^2 and 733 km^2 of shoreline in 2000 and 2001, respectively, along potentially affected waterbodies in the Wuskwatim Lake area.

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, Opegano Lake, and access road areas in 2001. Surveys were conducted at 93 stops along 16 line transects in 2000 and at 239 stops along 47 transects in 2001 within representative bird habitat types. Details of bird survey methods provided in Volume 6, Sections 8.2.4.1 to 8.2.4.3.



* - Proposed Wuskwatim Generating Station Site

Figure 7.4-2. Bird study area.

7.4.5 Mammals

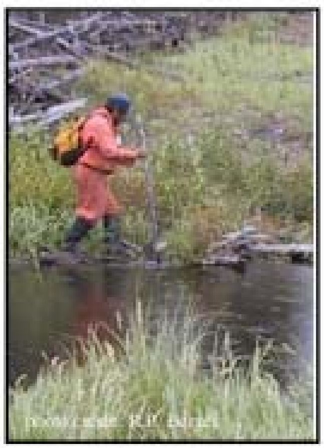
Mammal habitats used to predict Project-related impacts were derived from terrestrial habitat estimates (Volume 6 Section 5). Habitat models for each VEC used available data and expert opinion to express the species-habitat relationship. **Primary** and **secondary habitats** were used to express habitat quality and availability for each VEC. Habitat maps and Project-related effects for mammal VECs were linked to the hierarchy of study areas described previously; as required to reflect the differences between mammal species movements, distribution, relative abundance and habitat use.

Traditional Knowledge provided by NCN field assistants, interviews with resource harvesters at Project meetings and workshops, was supplemented with data from the harvest calendar survey, the TK pilot project with NCN's Community Consultants (Volume 1, Section 3), and Nelson House woodland caribou TK project (Manitoba Conservation, 2002, Unpubl. Report).

Field surveys of major wildlife habitats by walking, boat, snowmobile, ATV and aircraft; extending over several thousand kilometres; were conducted from 2000 to 2002. 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 study team that conducted the mammal component of the assessment included NCN members who were responsible for sampling and identifying mammal sign by species, and animal attributes such as sex, age, habitats, and habitat features (Volume 6 Section 9).

Transect-based sampling in all major terrestrial habitat types was the primary method used to estimate the relative abundance, habitat use and distribution of terrestrial and riparian mammals. Specialized methods (e.g., radio-collaring) were used to measure components of a mammal's life cycle, such as important movements and seasonal use of caribou habitats.

Limited pre-CRD (Slaney & Company 1974) and post-CRD (Wardrop Engineering et al. (1990), Elliott and Hedman (2001), data from Manitoba Conservation, and unpublished reports) mammal population information exists for the Project Area.



NCN Members conducting shoreline, habitat and aerial surveys in the Project Area.

7.5 HABITAT

The key attributes of terrestrial habitat that collectively determine the presence, survival and abundance of plants and animals at any site are soils, hydrology, permafrost, vegetation/plants, vegetation age and disturbance regime. A habitat type is defined as an area with a particular combination of these attributes. Aquatic, upland/mainland, shore zone, lake peatland and mineral island are the major habitat types found in the region (Figure 7.5-1). All of these major types except for aquatic are considered to be terrestrial habitat.

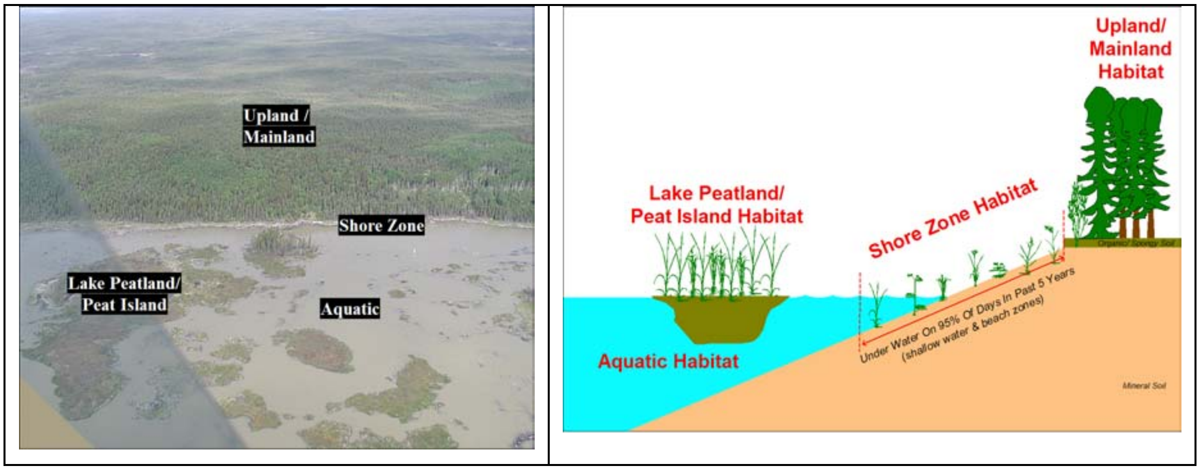


Figure 7.5-1. Major habitat types. Note: In the major habitat types, upland/ mainland habitat includes wetlands outside of the Affected Aquatic Area.

The remainder of the habitat section provides an overview of existing terrestrial habitat and the expected impacts of the proposed Project on habitat, VECs and indicators of ecosystem health. Informative details including qualifications on generalizations are found in Volume 6, Section 5.

7.5.1 Existing Environment

7.5.1.1 Upland/ Mainland Habitat

Large disturbances, particularly wildfire, play an important role in creating the patchwork of upland/mainland habitat types in the Study Area. Fire history maps indicate that approximately 25% of the Sub-Region area has been affected by large wildfires in the past 30 years. Insect and disease outbreaks and human activities other than fires have played a minor role in converting mature plant communities into younger ones and/or different types. Most of the human developments are highways, industry and communities concentrated along the northern and eastern edges of the Sub-Region.

Terrestrial land cover in the Region and Sub-Region is dominated by conifer forest on various types of soils and very open vegetation on peatlands (48% and 29% of land area, respectively). Water covers about 10% of the Sub-Region and Region. Analysis of field data and GIS maps led to the use of 14 land types, 113 fine habitat types and 37 broad habitat types for the habitat effects assessment (Table 7.4-1).

Table 7.4-1. Land and broad habitat types used in the habitat effects assessment.

Land Types
Exposed bedrock
Dry mineral soil
Mineral soil
Peaty mineral soil
Peatland
Frozen peat
Wet bog
Wetland - other
Fen with patches of water
Fluctuating water
Water
Human- Agriculture
Human- Other

Broad Habitat Types
Open vegetation on Exposed bedrock
Open forest on Dry mineral soil- 3 age classes[1]
Jack pine forest on Mineral soil- 3 age classes
Other conifer forest on Mineral soil- 3 age classes
Other conifer mixedwood forest on Mineral soil- 3 age classes
Black spruce forest[2] on Peaty mineral soil- 3 age classes
Black spruce/ conifer mixedwood forest on Peaty mineral soil- 3 age classes
Hardwood mixedwood forest on Mineral soil- 3 age classes
Hardwood forest on Mineral soil- 3 age classes
Black spruce forest[2] on Peatland- 3 age classes
Black spruce[2] mixedwood forest on Peatland- 3 age classes
Sparsely treed wetland
Tall shrub wetland
Low shrub, graminoid and/ or emergent wetland
Small islands (< 2 ha)
Human
Human- Linear

[1] Age classes were young (0 – 30 years), immature (30 - 70) and mature (70+). Age ranges are estimates from the FRI for the best site conditions for the species. [2] Up to 0.5% of Sub-Region area in the category includes forest where tamarack is the dominant species.

Land type composition in the Region and Sub-Region is a mosaic of peatland, mineral soil and peaty mineral soil. Peatlands are found throughout the Sub-Region but are more abundant in a southwest to northeast band (Figure 7.5-2). Permafrost is common in the bog peatlands. Exposed bedrock, dry mineral soil and fen with patches of water are uncommon. Other land types are very uncommon or rare. Most dry mineral soils in the Sub-Region are in three ridges along the proposed access road route and one ridge near the western edge of the Sub-Region.

Sparsely treed peatland is the most abundant broad habitat type in the Sub-Region followed by black spruce forest on peaty mineral soil (29% and 15% of land area, respectively; Figure 7.5-3). Black spruce forest on peatland, other conifer forest on mineral soil, jack pine forest on mineral soil and wetlands with low shrub, graminoid and/or emergent vegetation each covers about 10% of land area. Open forest on dry mineral soil, hardwood forest on mineral soil, tall shrub wetland, conifer mixedwood forest on mineral soil, and black spruce and other mixedwood forest on peatland each cover less than or equal 2% of land area. It is estimated that over 80% of the forests are between 20 and 90 years old. Within the Sub-Region:

- black spruce is the most widespread and abundant tree species;
- most of the trees on the sparsely treed peatland are black spruce;
- most of the trees in the open forest on dry mineral soil are jack pine;
- forests dominated by balsam fir, white spruce, tamarack, aspen and white birch mixtures, white birch and other hardwood mixtures and balsam poplar are rare; and
- willow/alder wetland, alder wetland, ericaceous low shrub/ Sphagnum bog and bare exposed bedrock are also rare.

Most balsam fir and white spruce in the Region and Sub-Region are found on mineral soils within 300 m of a large lake or river. Jack pine forest is scattered throughout the Sub-Region; several large concentrations are located in the northeast portion along the proposed access road route and potential borrow pits.

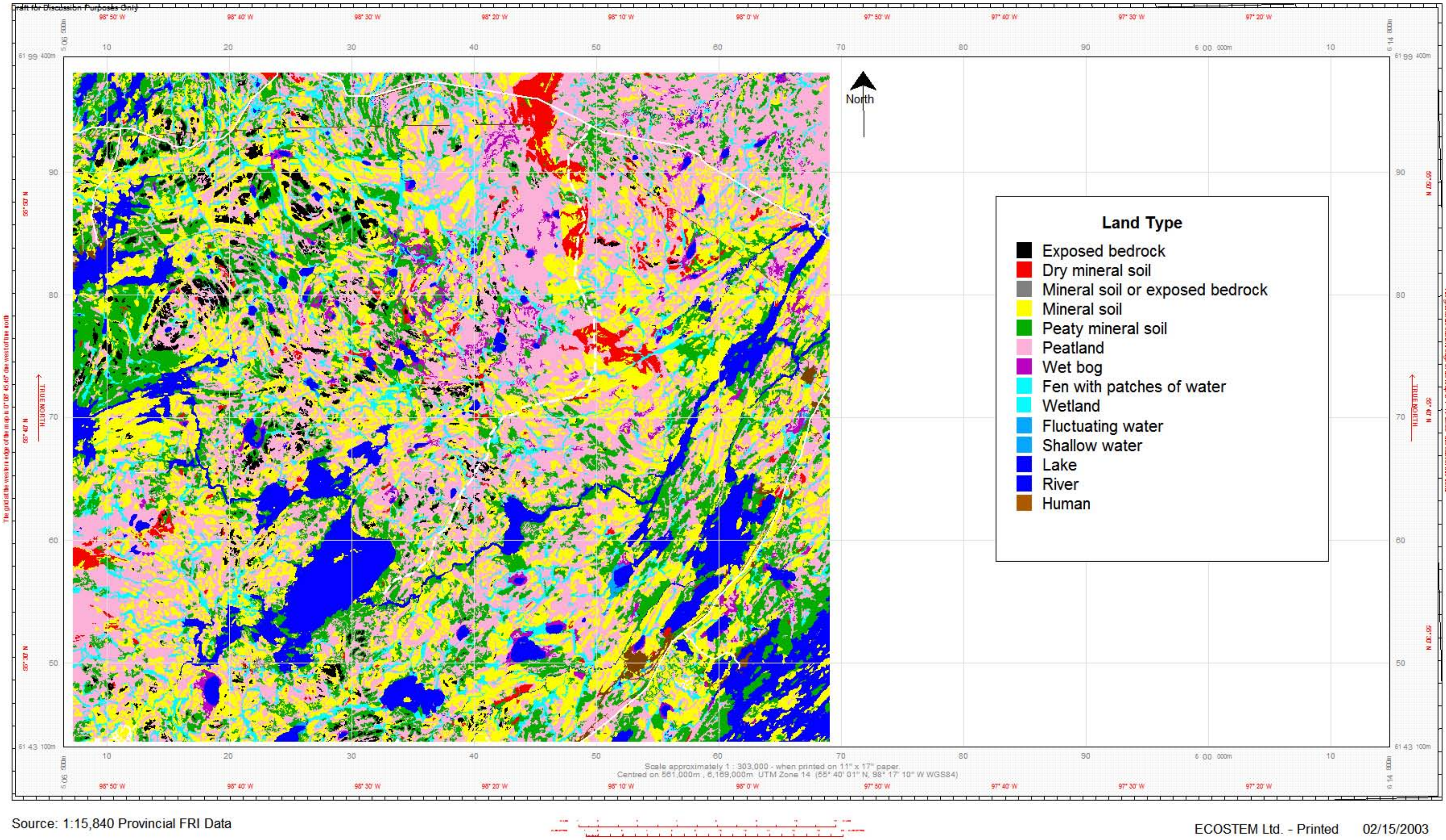


Figure 7.5-2. Land types in the Sub-Region. Proposed access road shown as white dashed line.

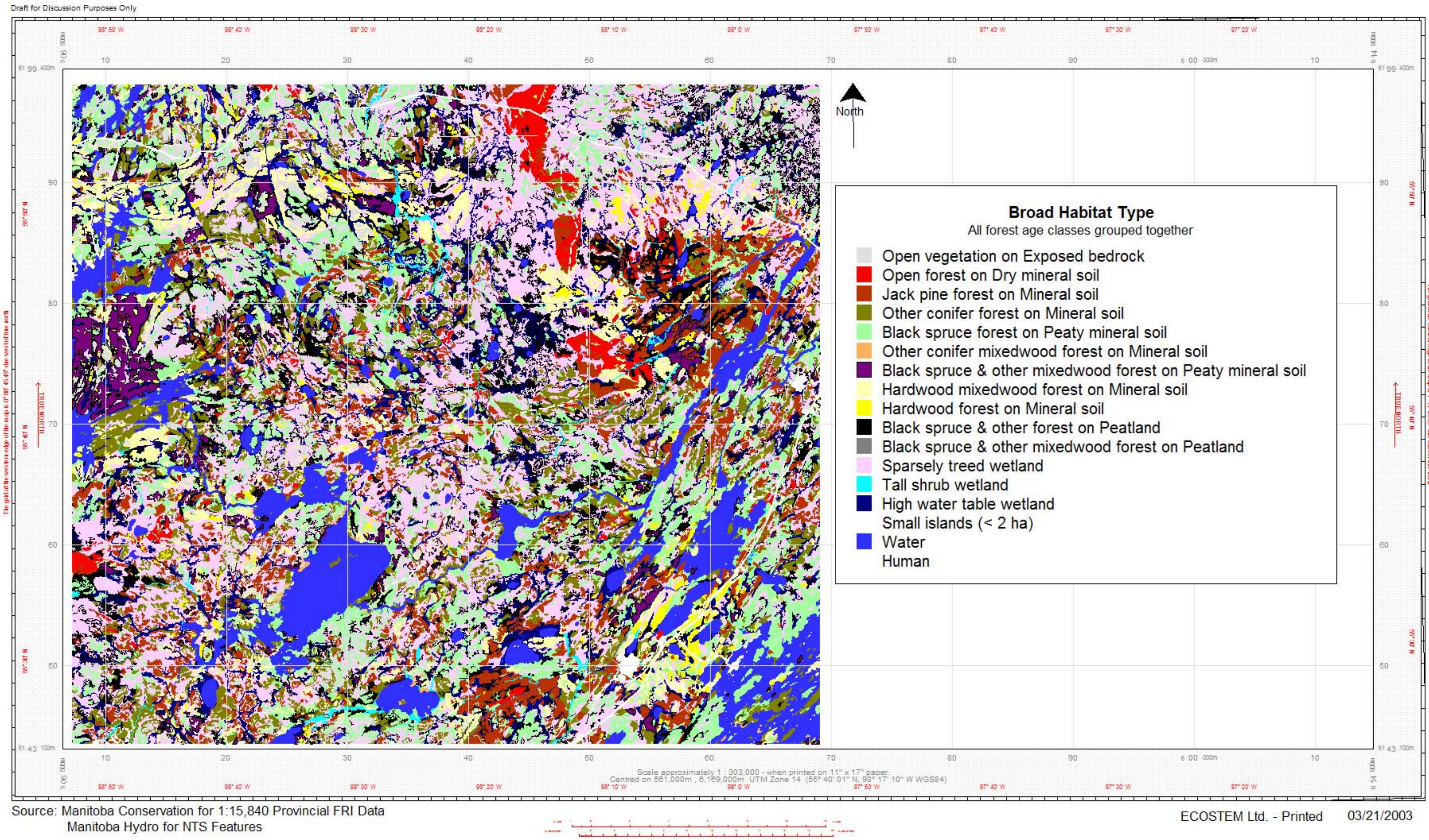


Figure 7.5-3. Habitat types in the Sub-Region. All age classes for the forest types were grouped together to simplify the map. Proposed access road shown as white dashed line.

The land type and habitat composition of the 1 km Upland and Aquatic Buffers (Figures 7.5-2 and 7.5-3) are similar to that of the Sub-Region with a few exceptions. 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 CRD. Black spruce forest on peatland and wetlands with low shrub, graminoid and/ or emergent vegetation are less abundant in the 1 km Aquatic Buffer than in the Sub-Region while black spruce forest on peaty mineral soil is more abundant. Land type differences and the sheltering effect of Wuskwatim Lake against fires probably account for the occurrence of a small amount of white spruce forest and scattered balsam fir saplings and trees along the shoreline. White spruce and balsam fir forest are rare in the Region and Sub-Region.

Peaty mineral soils and black spruce forest on peatland or peaty mineral are less abundant in the 1 km Upland Buffer than elsewhere in the Sub-Region while dry mineral soils and jack pine forest on dry mineral soils are much more abundant. The Upland Buffer contains approximately 26% of the Sub-Region's jack pine forest on dry mineral soil.

7.5.1.2 Affected Aquatic Area Habitat

Shore zone, lake peatland/ peat island and mineral island are the major terrestrial habitat types found in the Affected Aquatic Area (Figure 7.5-1). Fluctuating water levels is the dominant disturbance in the Affected Aquatic Area.

Most wetlands occur in the sheltered bays peripheral to the main body of Wuskwatim Lake and are a mixture of marsh, shoreline bog, shoreline fen and Peat Islands. The current configuration of wetland types is relatively recent. Prior to the CRD, there were extensive lake peatlands in sheltered bays while marshes were virtually absent (Figure 7.5-4). Since the CRD, 84% of the lake peatlands have disappeared and the remainder have become Peat Islands that are separated from the adjacent uplands by an organic or clayey beach.

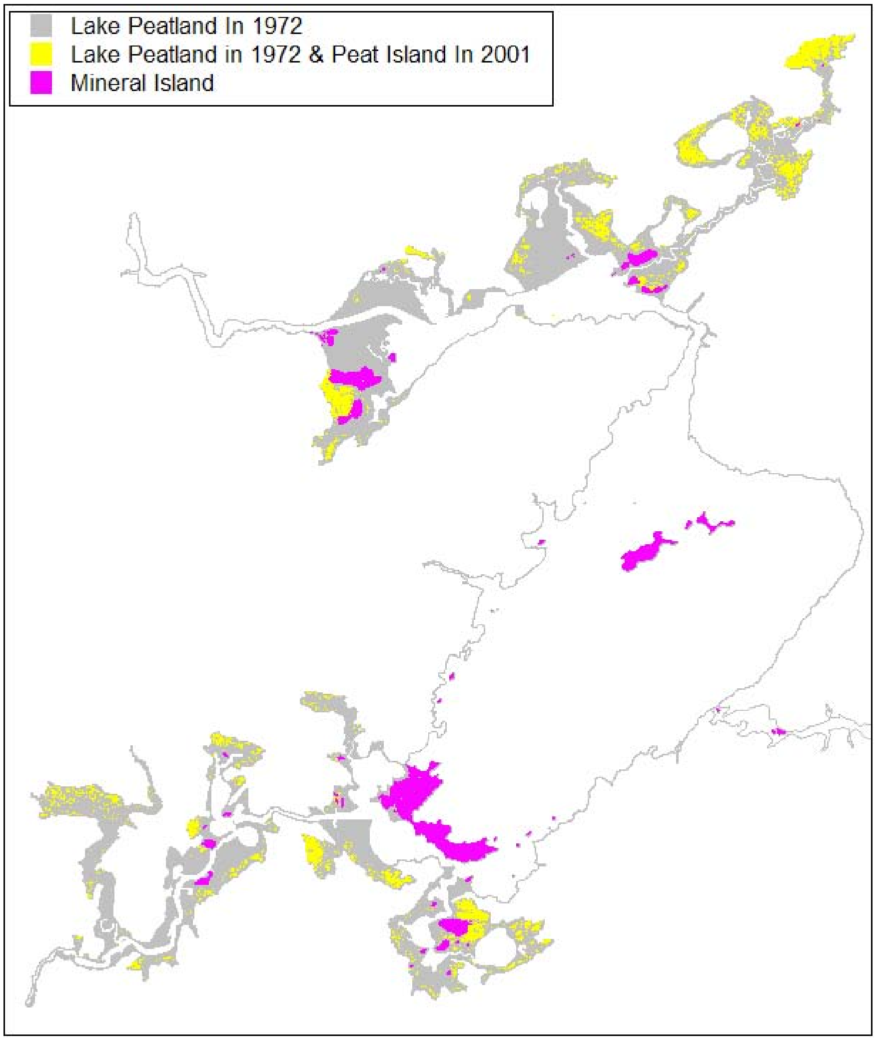


Figure 7.5-4. Locations of Peat Islands, pre-CRD lake peatlands and mineral islands in Affected Aquatic Area. (Note: Maps in this volume are for general reference purposes only. Volume 6, Section 5 contains larger maps plotted at a common scale.)

The current distribution of shore zone vegetation generally reflects differences in wave energy and water current. Most of the shoreline vegetation is in the sheltered bays peripheral to the main body of Wuskwatim Lake where the low slope organic or clayey beaches occur (Figure 7.5-5). The vast majority of the organic and clayey beach vegetation is dominated by sedges, grasses and herbs that grow well on newly exposed wet organic or mineral soil.

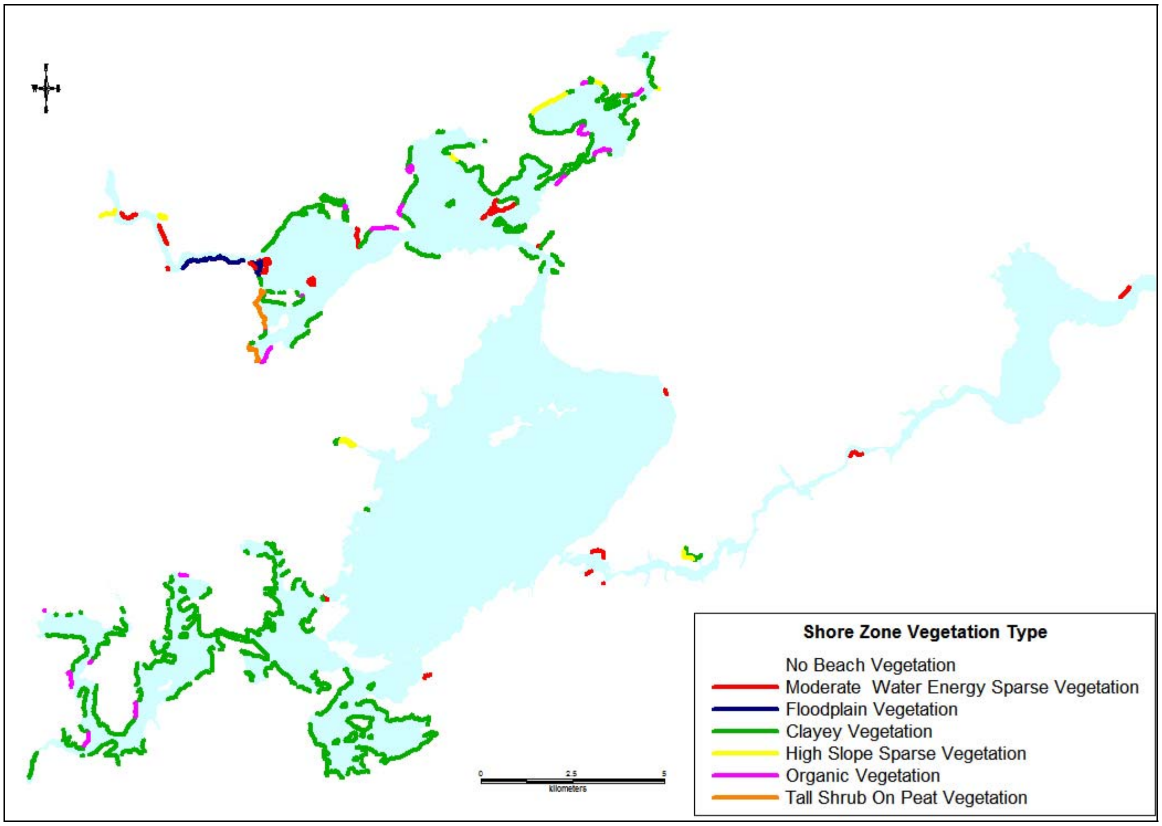


Figure 7.5-5. Locations of shore zone vegetation by habitat type.

Transects from the upland edge across the beach and into the shallow water show bands of different vegetation types. There is a gradual transition from shore zone plants that die when their roots are submerged under water for a long time to plants that cannot survive out of the water for more than a few days. These shore zone bands of different vegetation types are created by the day to day water level fluctuations.

Peat Islands provide a large amount of habitat in the Affected Aquatic Area. In 2001, there were more than 8,700 individual Peat Islands with a combined area of 411 ha in areas outside of the main body of Wuskwatim Lake (Figure 7.5-4). Cattails or sedges were the most common plants on the majority of the Peat Islands. Ericaceous bog and treed bog vegetation types covered most of the remaining areas of the Peat Islands.

The Affected Aquatic Area has 119 Mineral Islands with a combined area of 314 ha. The largest islands are in the main body of Wuskwatim Lake (Figure 7.5-4). Black spruce forest on clayey mineral soil accounts for 90% of the habitat on these islands. The largest island, located in the north part of Wuskwatim Lake, supports a 25 ha balsam fir forest.

This is the largest balsam fir forest community in the Sub-Region and accounts for 30% of Regional balsam fir forest.

7.5.1.3 Sensitive Plants

In the Sub-Region, no endangered, threatened or provincially very rare plant species were previously recorded or found during field investigations. Field studies in the Sub-Region found three plant species listed by CDC as provincially rare (*Vaccinium caespitosum* Michx./dwarf bilberry, *Torreyochloa pallida* (Torr.) Church/grass with no common name, *Nymphaea tetragona* Georgi/pygmy water-lily), two species listed as uncommon (*Bidens beckii* Torr. ex Spreng./water marigold, *Astragalus americanus* (Hook.) Jones/ American milk-vetch) and one species listed as rare to uncommon (*Thalictrum sparsiflorum* Turcz./few-flowered meadow rue).

Dwarf bilberry was found in four of the field plots. The other two provincially rare plants were observed in only one location each; neither location was in an area that would be affected by the proposed Project. Of the provincially uncommon plants, water marigold and American milk-vetch were found in some of the aquatic areas that would be affected by the Project (see Volume 6). The CDC ranks the rarity of a species based on the number of reported sightings. It is possible that some of the listed plants are not as rare as their current ranking indicates simply because there has been little sampling in the northern part of the province. Dwarf bilberry and water marigold are probably examples.

Information on the range limits of plants is limited for the Region since there has been little previous fieldwork in the area. It is estimated that 19 species approach a range limit in the Region.

7.5.2 Impacts And Mitigation

7.5.2.1 Construction

Impacts

Project construction will change as much as 1,605 ha of terrestrial habitat (Figure 7.5-6) through clearing, excavation, grading, infilling and erection of structures. This disturbance area includes all nine major potential borrow pits; it is anticipated that only three of these borrow areas, yet to be identified, will be utilized. As a result, the total area actually cleared may be reduced by as much as 35%.

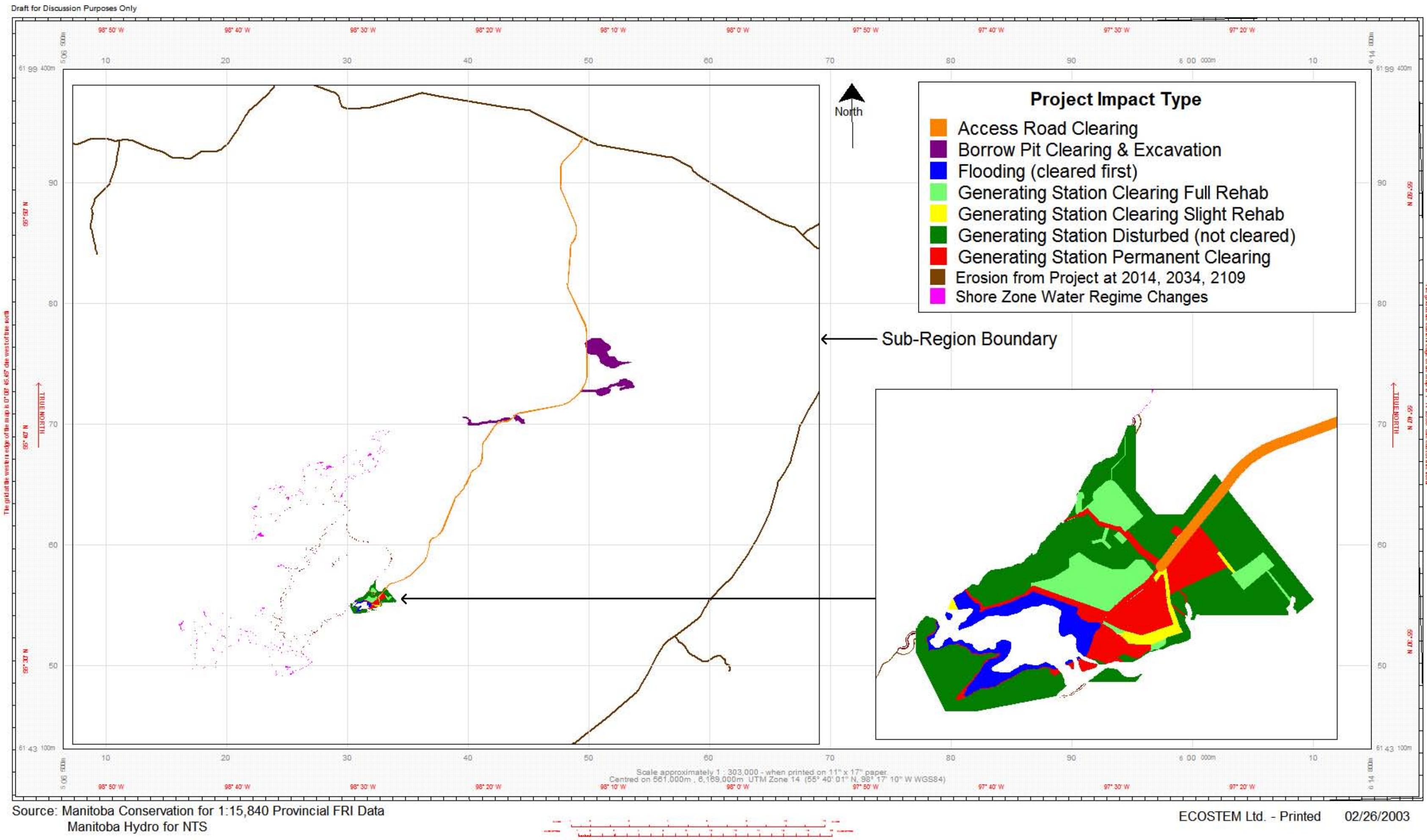


Figure 7.5-6. Areas cleared or physically altered during construction and/ or operation. Note: Shore Zone and incremental project erosion impact areas appear spotty because the areas affected are small.

Construction activities or facilities also may result in indirect effects to adjacent upland, shoreline and island habitat through one or more of the pathways listed below:

- 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 airborne emissions from vehicles and construction equipment;
- Accidental spills of contaminants;
- Accidental disturbance of plants;
- Effluent discharge and waste disposal from the construction camp and activities;
- Introduction of invasive species on incoming people, vehicles and equipment; and
- Change in forest fire frequency and/or severity due to better access to and more people in the area.

Upon completion of construction, all Project structures and features not required for operation will be removed. Rehabilitation of these areas will be assisted by removal of gravel pads, loosening compacted soils and spreading available organic material on exposed mineral soil.

The water regime in the Burntwood River will be unchanged during construction.

Habitat In The Upland/ Mainland Impact Areas

The upland/ mainland habitat directly impacted by the Project is contained within the 1 km Upland and Aquatic Buffers. Habitat composition at the generating station site is primarily dominated by land and vegetation types that are common in the Sub-Region. Peaty mineral soil covers more than half of the site and habitat is dominated by black spruce forest with small patches of white spruce forest (Figure 7.5-6). Balsam fir occurs in the understorey. White spruce and balsam fir forest are rare in the Region and Sub-Region (i.e., each covers less than 0.06% of land area).

The access road right-of-way (RoW) and potential borrow pits capture a disproportionately high percentage of jack pine forest on dry mineral soil. Jack pine forest on dry mineral and mineral soil dominates the borrow pit areas and the northern half of the access road RoW. Jack pine forest on dry mineral soil is an uncommon habitat type in the Sub-Region (i.e., covers less than 2.1% of land area). The 1 km Upland Buffer, which includes the borrow pits and access road, contains 26% of the dry jack pine forest in the Sub-Region. An accidental fire along the access road right-of-way has the potential to affect a large proportion of the Sub-Region's dry jack pine forest. Fire protection measures and fire watch equipment in the camp and the entrance to the access road are expected to mitigate these effects.

Short-term effects on water levels during construction of coffer dams, etc. are not expected to create downstream water level fluctuations that are outside the current range. Therefore, construction effects on shore zone, peat island or mineral island habitat are not expected.

7.5.2.2 Operation

Accidental events, vehicle traffic, maintenance of some cleared areas and increased access into the area should be the only ongoing sources of indirect operational effects on the terrestrial environment. The risk of accidental events such as fires and the deposition of airborne dust and emissions will be reduced by the considerably lower traffic volumes on the access road during operation.

The upstream and downstream water regimes will change once the generating station is in operation. Upstream of the generating station, water levels will be stabilized within a narrow range slightly below post-CRD high water levels; the new regime will affect the shore zone, lake peatlands and mineral islands. The average width of the Shore Zone beach habitat will be substantially reduced by stable water levels and a small band of incremental upland/ mainland habitat loss will occur in susceptible areas due to Project related erosion (Figure 7.5-6).

Downstream of the generating station, median water levels may be slightly higher but will remain within the post-CRD maximum. Daily variations in water levels will increase substantially when Burntwood River flows are below the median. The Project is not expected to increase downstream erosion.

All of the upland/ mainland impact area habitat is in the 1 km Buffers (described above).

7.5.2.3 Effects On Habitat, VECs and Indicators

The following sections summarize how Project impacts are expected to affect terrestrial habitat, VECs and indicators of ecosystem health. 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 each of the study areas (Figure 7.2-1). Secondly, in most instances, the effects are very small in terms of the percentage of the habitat affected. 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 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 7.2-1), Sub-Region scale for effects contained within the Sub-Region and Region scale for all other effects. In all cases, the ecological magnitude of an effect (i.e., small, moderate or large) was assessed using the Sub-Region as the comparison area.

Upland/ Mainland Habitat, VECs And Other Indicators

Upland/ Mainland Habitat

Potential construction and operational effects on upland/ mainland 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 upland/ mainland habitat except accidental forest fires and potentially invasive plant species are expected to be limited to less than 2,500 ha or 1% of the Sub-Region land area. Construction will not substantially alter habitat composition. Removal of structures and termination of activities not required for operation will reduce construction effects. Project-related erosion is the only upland/ mainland 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. Direct and indirect habitat effects from construction and operation will be reduced 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.

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.

Balsam Fir (Napakasiht) and White Spruce (Wapiskimnahtik))

Potential construction and operational effects on balsam fir and white spruce are expected to be 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. 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. High quality balsam fir and white spruce habitat was mineral soil within 300 m of large lakes and rivers and mineral islands in large lakes.

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. 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. 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 also affects 10 to 15 ha of white spruce forest. 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 7.5-6) 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.

Dry Jack Pine Forest (Oskahtik)

Potential construction and operational effects on dry jack pine forest are expected to be 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.

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.

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. Indirect Project effects (i.e., effects related to soil, groundwater and microclimate changes adjacent to cleared areas) may reduce the quality of a further 0.4% of Sub-Region high and moderate quality habitat. 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.

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% of moderate to high quality velvet-leaf blueberry habitat in the Sub-Region. 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.

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.

Road density (length of roads in the study area expressed as km/km^2) can be a good indicator of the extent to which plant and animal populations are affected by 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. Although the Project would increase Sub-Region road density by 40% to 0.058 km/km^2, this is still expected to be below the level needed to affect sensitive plants and animal populations.

Although road density will increase as a result of the Project, 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 harvesting and disturbance will be mitigated by restricting access at Highway 391.

Affected Aquatic Area Habitat And VECs

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 will 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 will 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 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 will 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 will 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 upland/ mainland areas. The shoreline plant species which are disadvantaged by stable water regimes on upstream shorelines will become more widespread and abundant on the newly created downstream shoreline with the fluctuating water levels.

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.

Mineral Island Habitat

Potential construction and operational effects on Mineral Island habitat are expected to be negative, extend throughout the Affected Aquatic Area, be small in magnitude and continue for at least 26 years.

The Project will permanently submerge 18 ha of low, very sparsely vegetated 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.

Wild Mint (Wikaskwah)

Potential construction and operational effects on wild mint are expected to be positive and significant (extend throughout the Affected Aquatic Area, moderate magnitude and continue for at least 26 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 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 biodiversity effect because it helps to restore mint distribution and abundance towards pre-CRD levels. Certainty in the predicted effects is moderate.

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.

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 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 0.5% of mainland high and moderate quality bog cranberry habitat and indirectly affect a further 0.3% of high quality mainland 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.

Sensitive Plants

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 the potential effects is moderate.

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 offincianilis*} or other herbs)

7.6 INSECTS

7.6.1 Existing Environment

Insects (**Nunicos**) are **invertebrates** and organisms of the class **Insecta**. They include a large variety of organisms such as bees, beetles, dragonflies, grasshoppers and butterflies. Insects play an important role in soil decomposition and plant pollination. They are also an important part of the food web, and are eaten by a variety of fish, amphibians, reptiles, mammals, and birds.

In terms of both biomass and diversity, invertebrates are the largest animal group, of which insects are a large part. Approximately 22,000 insect species are estimated to occur within the boreal zone, and many of these species likely occur within the Project Region. Over 4,000 species of insects are reported from Canadian boreal forest bogs, fens and marshes.

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. 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*). Most of these species also occur in similar habitats further south.

Major groupings of terrestrial insect habitats expected to 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. Some families or genera of insects are characteristically boreal, living in habitats that are particularly abundant in the study area. 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 (Ives and Wong 1988). Lepidoptera (moths, butterflies, skippers) and their larvae are well-represented on forest trees (Klassen et al. 1989).

Other forest species are most conspicuous in their adult stages. Mosquitoes such as *Aedes punctor* inhabit the northern woods but are less abundant in extensive open areas. Conversely, groups such as bees, wasps, and ants prefer open disturbed areas. Some true bugs are better represented on shrubs and herbs, especially in clearings than they are on forest trees. Such plants, together with deciduous trees, also harbour diverse species of leaf miners, gall makers, as well as their predators and parasites. Dead wood and habitats under bark are colonized by many species, including beetles. Soil and litter layers contain large numbers of mites and the larvae of many species of flies.

Many insect species are also found in the Project Area's lake, stream, pond or marsh-type environments, including many orders of water mites, mayflies, caddisflies, dragonflies, water bugs, water beetles, biting flies and non-biting flies. Midges were the most common taxa found in the Burntwood River habitat below Taskginigup Falls (Volume 5 Section 7).

Rare Insects

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. The most recent listing includes no Threatened or Endangered butterflies expected to occur within the Project Region.

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) refers to Columbine Dusky Wing, Western Pine Elfin, Yukon Blue and *Chryxus Arctic* as such species.

Critical, limiting or unique insect habitats are not expected in the Project Area. Uncommon insect habitat types may occur in some situations e.g., mature white spruce, balsam fir, open forest on dry soil, on other rare plants (Volume 6 Section 5) and at uncommon water features such as springs.

7.6.2 Impact Assessment and Mitigation

The potential effects of Project construction and operation on insects are expected to 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 1 km Upland and Aquatic Buffers and in the Sub-region.

Small negative, long-term and site-specific to local effects to insects and insect habitat 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 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:

- decrease in forest insect abundance;
- changes in the distribution or movements of a few species (e.g., moths) associated with attraction/repulsion due to noise at construction sites and 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;
- 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 EnvPP, such as minimizing clearing, encouraging regrowth of natural vegetation, and material handling and storage procedures will reduce effects to terrestrial and riparian insects.

7.7 REPTILES AND AMPHIBIANS

7.7.1 Existing Environment

The Wuskwatim Generation Project study area is located in the **Boreal Shield Ecozone** of northern Manitoba. There are three amphibian species whose documented ranges include the study area: the leopard frog (*Rana pipiens*), wood frog (*Rana sylvatica*) and boreal chorus frog (*Pseudacris triseriata*; Preston 1982). While wood frogs and boreal chorus frogs are common throughout most of Manitoba, leopard frog populations in Manitoba are classified by Committee on the Status of Wildlife in Canada (COSEWIC 2002) as being of Special Concern.

The results of field studies suggest that boreal chorus and wood frogs occur in very low numbers in the study area (Volume 6, Section 7). No other amphibian species was observed during field surveys. The shoreline of the main body of Wuskwatim Lake has generally poor frog habitat characterized by clay-silt and bedrock shorelines which generally lack nearby marshy areas or inland ponds. Suitable frog habitat (marshy bays, wet low-lying shoreline, inland creeks and ponds) in the Wuskwatim and Opegano Lake area were found to support very few frogs. Wood frogs and boreal chorus frogs were also found to occur in very low numbers in upland sites (e.g., proposed access road and footprint of the GS site).

There are no reptile species whose documented ranges extend as far north as the Wuskwatim study area (Volume 6, Section 7). None of the reptiles that have any potential to occur in the study area (likely red-sided garter snakes, painted or snapping turtles) are listed under COSEWIC or *Manitoba Endangered Species Act* as being **endangered**, **threatened** or of **special concern** in Manitoba. No reptiles were observed during field studies conducted in 2000 and 2001. Communications with local resource users have indicated that reptiles have not been observed in the study area. Therefore, potential impacts will not be assessed for reptiles.

7.7.2 Impacts and Mitigation

7.7.2.1 Construction

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 Falls and Taskinigup Falls; and
- mortality associated with vehicles that would travel along the access road during the construction and operational periods.

The potential effects of Project construction on amphibians 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 apparent lack of any sensitive or critical habitat in the areas to be affected by the Project (Volume 6, Section 7).

7.7.2.2 Operation

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 Falls 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 areas that would be flooded and areas affected by the access road provide low quality habitat that appeared to support very small populations of amphibians (Volume 6, Section 7). Therefore, the expected effects on amphibians are expected to be small.

The effects of generating station operation on amphibian populations are expected to be small, local, long-term and not significant.

7.8 BIRDS

7.8.1 Existing Environment

Approximately 184 bird species breed or potentially breed within the Wuskwatim study area (Volume 6, Section 8, 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 7.8-1.

No threatened or endangered bird species, as listed by COSEWIC or MESA were observed within the bird study area during field studies conducted in 2000 and 2001. No nationally, regionally or locally important migratory bird habitat occurs within the Project study area as indicated by Environment Canada and the Canadian Wildlife Service (Volume 6, Section 8.3.1)

Approximately 114 bird species were observed during surveys and **reconnaissance** in the study area in 2000 and 2001. In most areas surveyed, considerable variation in bird abundance and distribution was observed seasonally and between the two survey years. The majority of birds observed each year during helicopter surveys of waterbodies along and adjacent to the Rat-Burntwood River system were waterfowl, i.e., geese, ducks and swans (87% of 6,777 birds in 2000 and 79% of 9,158 birds in 2001; Volume 6, Section 8.3.4.2). Some of the most common waterfowl species observed in the study area included Mallards, Canada Geese, Bufflehead, Ring-necked Ducks and Common Goldeneye. Results of two years of baseline studies suggest that waterbodies that will be potentially affected by the Project (i.e., the Early Morning Rapids to Birch Tree Lake reach including Wuskwatim Lake) do not appear to be regionally important areas for

Table 7.8-1. 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 Tetr*ES* 2002a,b for densities of birds observed in various habitat types in 2000 and 2001.

Refer to **Volume 6, Section 8.8, Appendix 8.8.1** for a list of bird species that potentially breed in the Wuskwatim study area.

large numbers of spring and fall migrating waterfowl or shorebirds (Volume 6, Sections 8.3.4 and 8.3.7).

The most important areas for nesting and brood-rearing waterfowl in the Wuskwatim Lake area occur in the Wuskwatim Brook area, at Sesep Lake and at the south arm of Wuskwatim Lake (Volume 6, Section 8.3.4.3). These three areas contain the majority of marsh habitat within the Wuskwatim lake area, which is often used by brood-rearing waterfowl and for nesting by some waterfowl and other waterbird species such as grebes. During summer helicopter surveys, higher densities of waterfowl broods were observed along the Rat-Burntwood River system compared to off-system waterbodies in 2000 (1.3-fold higher) and 2001 (3-fold higher; Volume 6, Section 8.3.4.2).

Within terrestrial habitats, the most common birds observed were songbird (passerine) species (Table 7.8-1). All of the terrestrial bird species observed are not unique to the study area and are common throughout the boreal region of Manitoba. Terrestrial breeding bird densities were typically higher in moist spruce-dominant forest and fen/bog habitat near shoreline areas compared to dryer upland forested habitats which occur along much of the access road route (Volume 6, Section 8.4.3).

7.8.2 Impacts and Mitigation

7.8.2.1 Construction

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; and
- noise associated with machinery, people and activities such as blasting.

Field studies revealed that sites proposed for construction did not contain rare or endangered bird species, but generally consisted of spruce-dominant forests that supported bird species common to the region (e.g., Ruby-crowned Kinglets, Chipping Sparrows, Yellow-rumped Warblers, Magnolia Warblers, Dark-eyed Juncos and Swainson's Thrush).

A summary of construction-related effects to bird VEC species is provided in Section 7.10 (Table 7.10.3). Additional detail regarding construction-related effects to birds is provided in Volume 6, Section 8.4.2. 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). Where possible, blasting schedules will be augmented to minimize potential impacts to the critical life functions of birds. **Through these mitigative measures, construction-related impacts to birds are expected to be small to moderate, site-specific, short to long-term and not significant**

7.8.2.2 Operation

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 (Volume 6, 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 (geese and ducks). However, water level stabilization is also expected to gradually degrade offshore marsh areas (Volume 6, 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). '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 (Volume 6, Section 5). 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. 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.

Considering the predicted decline of offshore marsh habitat and offshore peat islands over the long-term, and expected increase in access for hunters to the Wuskwatim Lake area, operation of the Project is expected to have an overall long-term negative effect to waterfowl in the Wuskwatim Lake area. Access-related effects, such as opportunistic hunting of waterfowl, are expected to be mitigated through the implementation of an Access Management Plan for the access road.

Operation of the generating station is not expected to significantly impact raptors (i.e., eagles, hawks, falcons, osprey and owls). The Bald Eagle is the raptor species expected to be most affected by the operation of the generating station primarily because:

- the expected increase in erosion rates (Volume 4) may remove established nest sites along erodible shorelines; and

- increased human presence in the Wuskwatim Lake area due to the access road (Volume 7) is expected to result in some limited disturbance of nesting and foraging eagles.

These negative effects are expected to be offset by:

- the limiting of human access to the Wuskwatim Lake area due to the implementation of an Access Management Plan for the access road; and

- an increase in food availability (i.e., fish) due to:

  - fish refuse piles resulting from the expected continuation of commercial fishing in the Wuskwatim Lake area due to increased access to the area (Volume 7, Section 3); and

  - occasional presence of killed and stunned fish downstream of the generating station as a result of fish passing through the generating station turbines (Volume 5, Section 8).

Other raptors such as hawks, falcons and owls, typically nest further inland rather than along shoreline areas and will likely not be affected by eroding shorelines. Osprey (fish-eating raptor) are uncommon in the Wuskwatim area and are not expected to be affected by the operation of the Project since fish populations are not expected to be significantly affected (Volume 5, Section 8).

There was an overall low number and diversity of shorebirds (e.g., plovers, sandpipers) in the study area during all seasons (breeding, young rearing and migration) due to the limited amount and low quality of shorebird habitat present. The Project is expected to result in the additional loss of a small amount of low quality shorebird habitat.

A limited amount of mainland songbird habitat (e.g., forested shoreline habitat) is expected to be affected by the operation of the Project due to increased erosion (Volume 4). The most affected songbird habitat will be associated with the long-term reduction of marsh habitat. This will result in a local, long-term reduction in the numbers of those songbirds associated with marsh habitat (e.g., Red-winged Blackbirds).

A summary of operation effects to bird VEC species is provided in Section 7.10, Table 7.10-2. Additional detail regarding operation-related effects to birds is provided in Volume 6, Section 8.4.3.

Overall, negative effects to birds associated with Project operation are expected to be small to moderate, local, long-term and not significant.

7.9 MAMMALS

7.9.1 Existing Environment

At least 39 species of mammals occur in the region representing six taxonomic orders (Volume 6 Section 9). Twenty-six species of mammals were recorded in the Study Area during 2000-2002 studies (Table 7.9-1A). All species and groups occurring within the Sub-region are found commonly in the boreal forest. All furbearing and large mammals are used by NCN domestically; some of these are harvested commercially (Volume 1 Section 5.4).

Neither MESA or COSEWIC list any mammal found in the region as 'Endangered'. However, woodland caribou and wolverine, which have been respectively designated by COSEWIC as ‘Threatened’ and of ‘Special Concern’, occur in the Study Area.

The **terrestrial mammal community** in the Sub-region is extensive. The upland habitat is composed primarily of forested areas and peatlands (Volume 1, Section 7.5). The quality of terrestrial habitats is individually and collectively influenced by soils, vegetation, landforms, topography, and drainage processes. Broad habitat types (Volume 1, Section 7.5) that influence mammal distribution and abundance the most include sparsely treed peatland and combinations of black spruce forest that dominate the landscape.

Small mammals such as red-backed voles and masked shrews are the most abundant mammal group in the Project Area.

Woodland caribou is the VEC used to assess impacts to Upland habitat.

Riparian mammal habitat in the Sub-region consists of lakeshore margins, creeks, rivers, beaver floods, swamps, peatlands (including peat islands) and other lowlands and adjacent upland boreal forests that are hydrologically linked to lakes and watercourses. Again this habitat may be influenced by soils, vegetation, landforms, topography, drainage, water levels, shore sediments, and erosion processes. Moose, muskrat and beaver are the three VEC's used to assess aquatic, shoreline, peat island, mineral island, and adjacent upland habitats.

Table 7.9-1A Mammal species recorded in the Project Area, 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

Woodland Caribou (Ethinutwatehk)

About 200 woodland caribou live in the Region (NCN Members, pers. comm.; Berger et al. 2001). During winter, the majority of animals live near Partridge Crop Hill, while moderate numbers live near Harding Lake (Figure 7.9-1.), 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 (Volume 6 Section 9).

Upland areas are primary habitat for woodland caribou, although caribou do use riparian habitats (Figure 7.9-1.). 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, (Volume 6 Section 9). 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. 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.

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 7.9-1.). Approximately 23% of the Region and 19% of the Sub-region contain secondary woodland caribou habitat (Volume 6 Section 9)

Moose (Mooswa)

Moose are widespread, abundant, and secure throughout Manitoba. In the Project Area, 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).

Moose (Mooswa) calves

The greatest moose abundance was observed at Wuskwatim Brook, on the east side of Wuskwatim Lake and along the Burntwood River (Volume 6 Section 9). 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 7.9-2.). Primary habitats in the study area likely provide moose with better availability and abundance of common food items (Slaney & Company 1974; Coady 1990) such as swamp horsetail, reed grass, pondweeds, red-osier dogwood, alders, or willows, or common tree species such as black spruce, tamarack, and jack pine (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 7.9-2., Volume 6 Section 9). 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

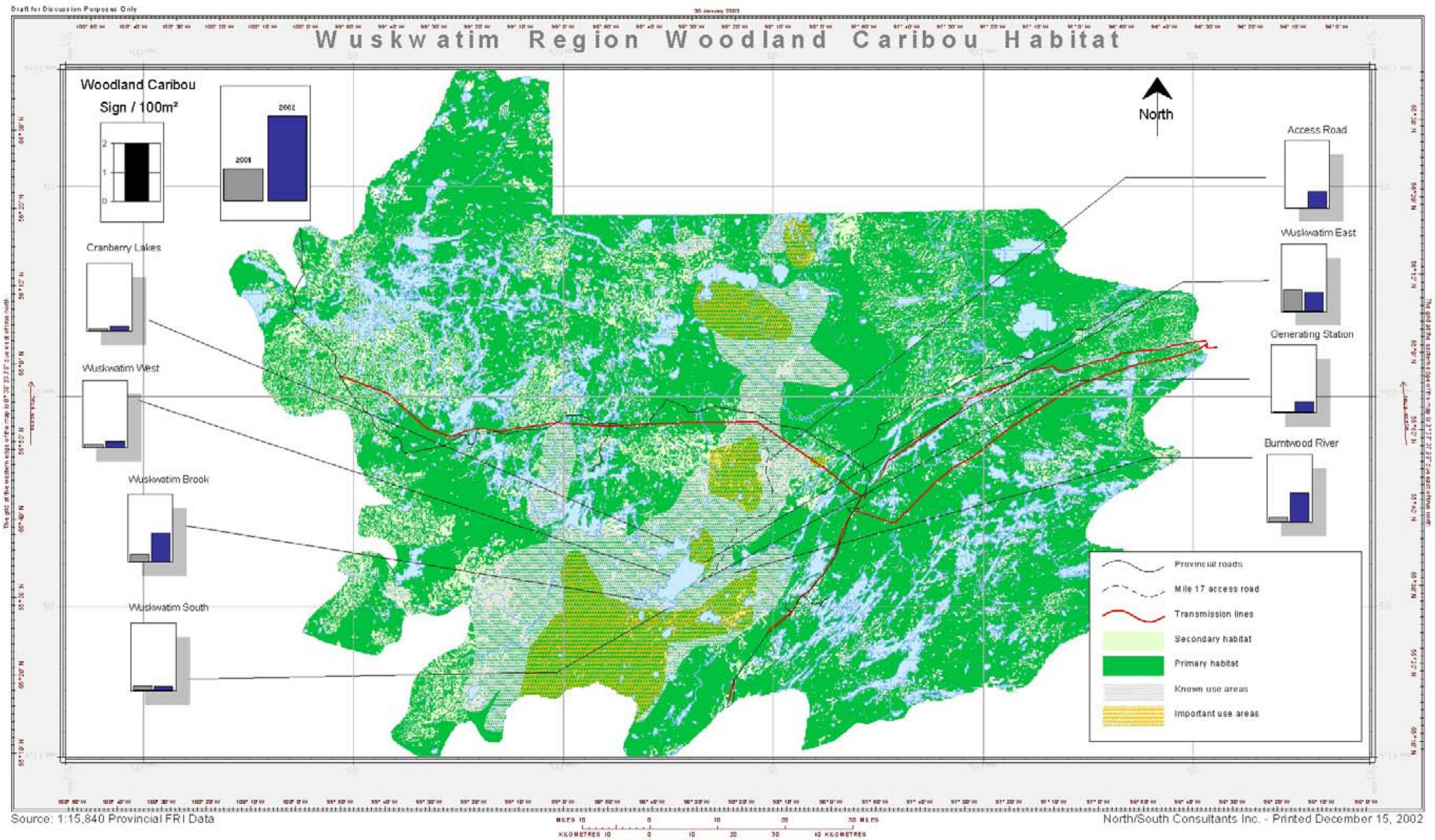


Figure 7-9-1. Woodland caribou habitat in the Region, including known use and important use areas. Movement corridors are not shown.

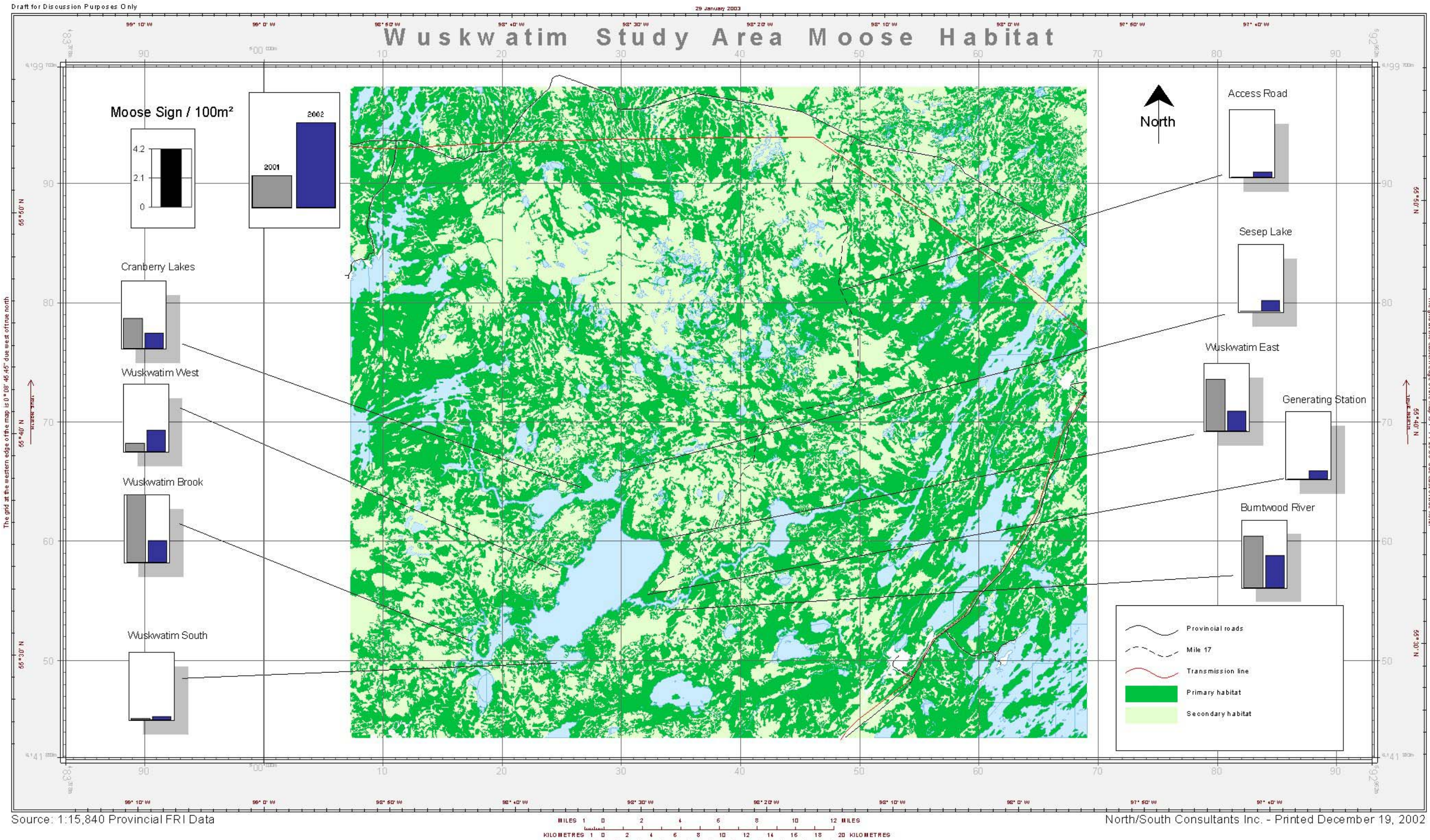


Figure 7.9-2. Moose habitat in the Sub-region.

the water" (NCN Member, pers. comm.). Approximately 49% of the Sub-region contains primary moose habitat (Volume 6 Section 9).

Secondary habitat for moose consists of those forest types located greater than 500 m from water (Volume 6 Section 9), or all other forest stands not described as primary habitat (Figure 7.9-2.), (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 contains secondary moose habitat (Volume 6 Section 9).

Muskrat (Wuchusk)

Muskrat (Wuchusk)

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.; Volume 6 Section 9).

Muskrat sign on a peat island

Primary habitat for muskrat is a combination of riparian and peat islands habitats (Figure 7.9-3.). Primary riparian environments have low exposure or low water velocity (North/South Consultants unpublished data), predominantly low slopes with no exposed bedrock, glaciolacustrine clay and silt banks, and vegetation including sedges or other beach vegetation. Primary muskrat habitat also includes certain types of peat islands, especially cattails with or without submerged fringe, or sedges and ericaceous with cattail fringe or marsh, muskeg, or beaver flood areas. 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 (Volume 6 Section 9.). Primary habitats in the Aquatic Buffer area likely provide muskrat with better availability and abundance of common food items (Slaney & Company 1974; Perry 1990) such as water arum, beaked sedge, reed grasses, manna grasses, pond weeds or cattails (Volume 6 Section 5), or shelter for dens. Approximately 12% of the area delineated by the 1 km Aquatic buffer and 6% of the 1 km Upland Buffer contain primary muskrat habitat (Volume 6 Section 9).

Secondary habitat for muskrat is similar to primary habitat, but does not contain preferred beach vegetation (Figure 7.9-3.). Approximately 3% of the 1 km Aquatic Buffer and 0% of the 1 km Upland Buffer contain secondary muskrat habitat (Volume 6 Section 9).

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 study area 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 (Volume 6 Section 9).

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 (Figure 7.9-3.). Similar movements and habitat use occur elsewhere in the region (Volume 6 Section 9). 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).

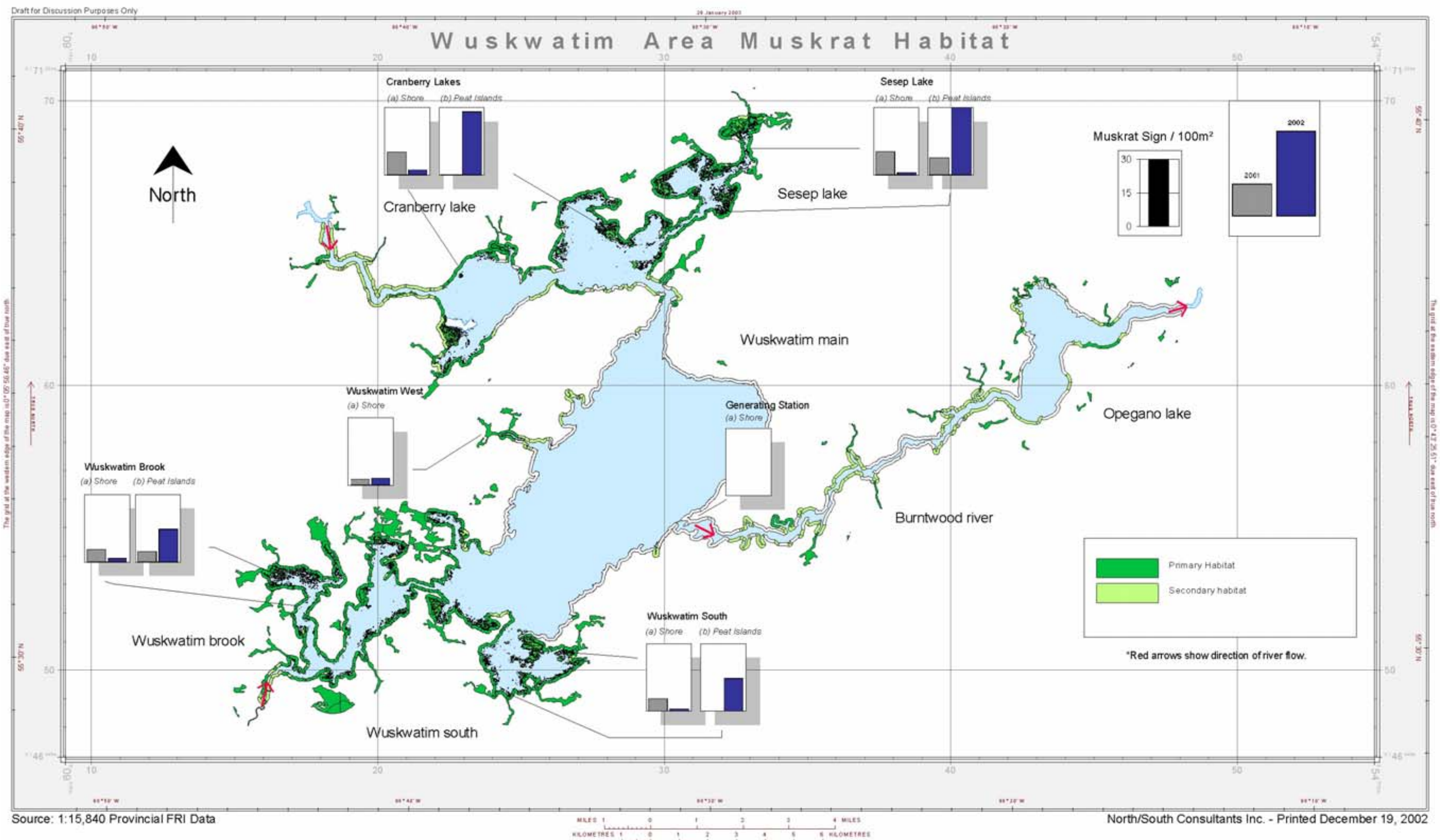
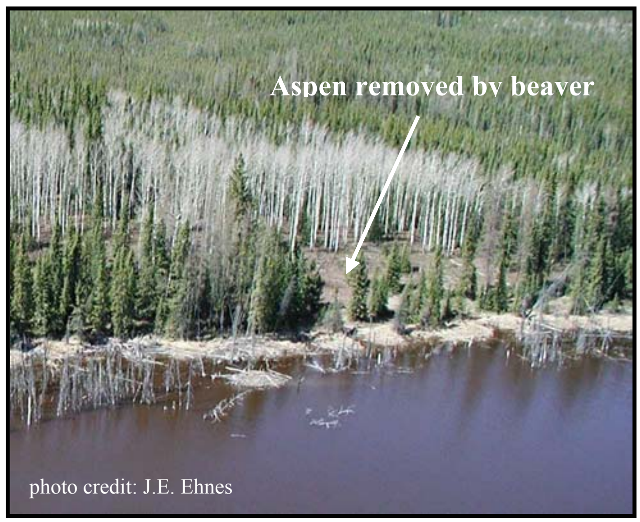


Figure 7.9-3. Muskrat habitat in the 1 km Aquatic Buffer.

Beaver (Amisk)

The beaver is widespread, abundant, and secure throughout Manitoba. In the Project area, beaver are found in most small ponds, creeks, rivers and lakes. 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 (Volume 6 Section 9).

Beaver (Amisk)



Beaver habitat

Primary habitat for beaver (Figure 7.9-4.) is near shorelines. Primary riparian environments have low exposure or low water velocity (North/South Consultants unpublished data) located near trembling aspen. Primary beaver habitat also includes tall shrub wetland, marsh, muskeg, or beaver flood. 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 (Volume 6 Section 9.). Primary habitats in the study area likely provide beaver with better availability and abundance of common food items (Slaney & Company 1974; Hill 1990) such as alder, aspen, or willows materials for lodge or dam construction or shelter for bank dens. Approximately 6% of the area delineated by the Aquatic Buffer and 4% of the Upland Buffer contain primary beaver habitat (Volume 6 Section 9).

Secondary habitat for beaver consists of peat islands and mineral islands (Figure 7.9-4.). Although not mapped, other secondary habitat in the Buffers may consist of moderate water velocity and a variety of bank conditions. Approximately 1% of the area bounded by the Aquatic Buffer and 0% of the Upland Buffer contain secondary beaver habitat (Volume 6 Section 9).

Elongated beaver lodge anchored to river shoreline; possible adaptation to water-level fluctuations

7.9.2 Impacts and Mitigation

Negative effects to mammals are expected from habitat loss (Volume 1 Section 7.5.2), 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 R-o-W, 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

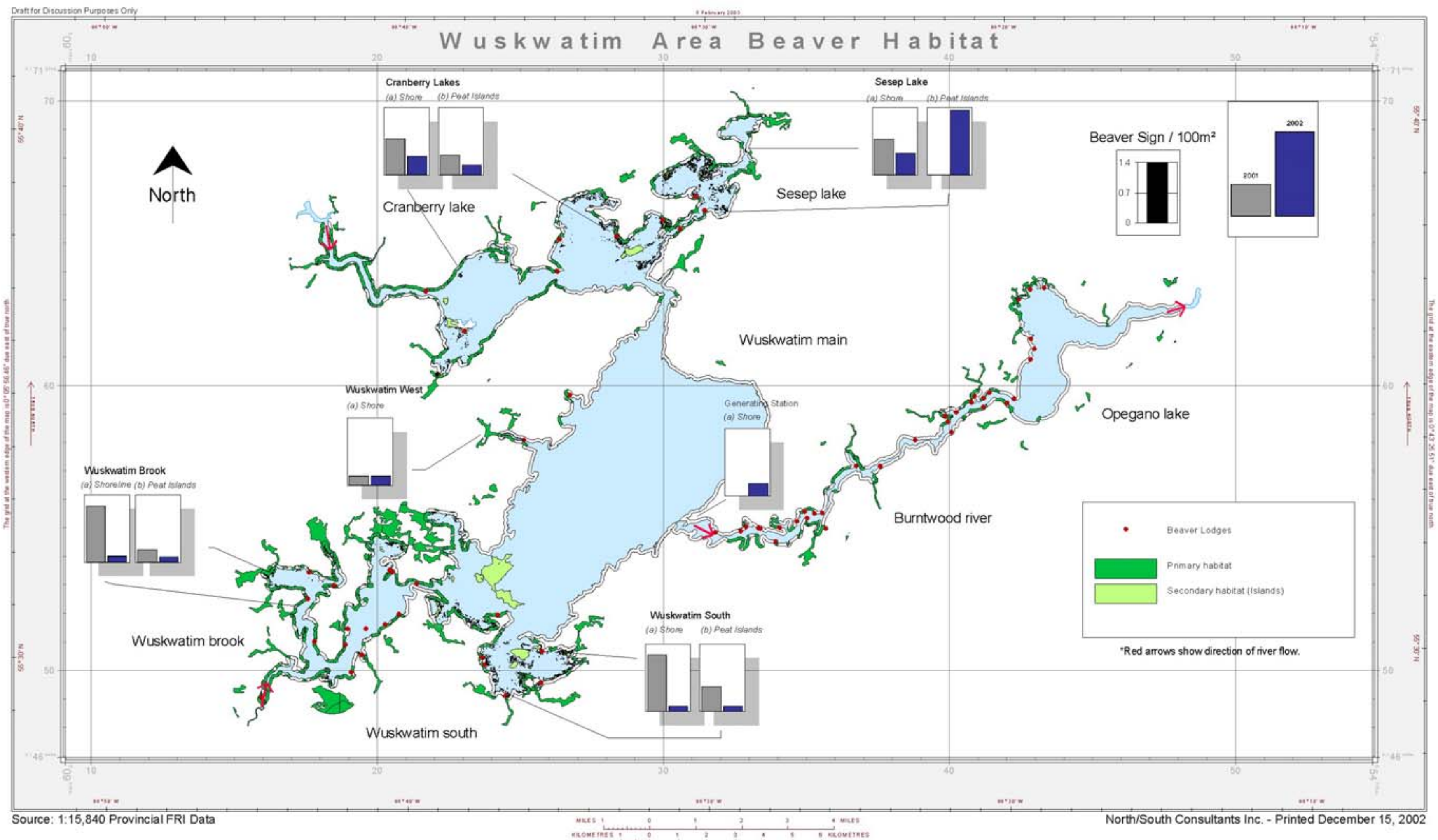


Figure 7.9-4. Beaver habitat in the 1 km Aquatic Buffer.

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.

7.9.2.1 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 1 Section 7.5.2). Direct long-term habitat losses are associated with permanently clearing or altering vegetation in the access road R-o-W, 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. One 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 7.9-1B.

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 7.9-2; shoreline habitat lengths for riparian VECs are presented in Table 7.9-3.

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 1 Section 7.5.2.) 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

Table 7-9.1B 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
	1 km Aquatic Buffer	176.1	0.93	2.12	6.5	0.03	0.02	7.3	0.04	8.05
	1 km 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
	1 km Aquatic Buffer	120.1	0.63	<0.01	69.6	0.37	<0.01	0	0	0
	1 km 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	1 km Aquatic Buffer	21.4	0.12	0.15	5.9	0.03	<0.01	153.0	0.85	11.99
	1 km 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	1 km Aquatic Buffer	9.6	0.05	0.16	0	0	0	180.3	0.95	<0.01
	1 km 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 7-9.2 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	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	
Moose	1 km 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	1 km 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	1 km 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 7-9.3 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 because discharge from, the sewage lagoon will meet Provincial standards (Volume 3).

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 (Volume 3). 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. Habitat alienation extending into the 1 km Upland and/or Aquatic Buffers may occur in the vicinity of these activities. 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.

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 7.12).

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*. 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.

7.9.2.2 Effects on VECs

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.

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.

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.

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 habitat 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.

Other Mammals

Potential construction and operational effects on other mammalsincluding 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.

7.10 RESIDUAL EFFECTS

7.10.1 Habitat

Residual effects on terrestrial habitat, 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) in order to keep the negative residual effects on dry jack pine forest insignificant.

Table 7.10-1. Residual Project effects on terrestrial habitat, VECs and selected ecosystem components during construction and operation.

	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
Upland/ Mainland 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, 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 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

	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
	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.

	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
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)
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)

	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
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
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 asmaterials 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)

	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT
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)
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. Small white water-lily (*Nymphaea tetragona*) and *Torreyochloa pallida* (grass with no common name) were the only rare plants found in the Sub-Region but they 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.

7.10.2 Insects

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**. 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 light; and
- mortality associated with accidental events (i.e., spills or fire).

7.10.3 Amphibians

Residual impacts of the Project that will persist after the implementation of mitigation measures are associated with:

- mortality associated with the long-term use of the access road (i.e., vehicle-amphibian collisions); and
- removal/degradation of a limited amount of terrestrial frog habitat through:

  - clearing and flooding of the forebay; and

  - continued erosion of erodible shorelines.

Residual impacts to amphibian populations as a result of generating station development are not expected to be significant.

7.10.4 Birds

Residual impacts to birds that will persist during Project operation, after the implementation of mitigative measures, 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.

Table 7.10-2 summarizes the expected residual effects to bird VEC species. Additional detail regarding residual effects to birds is provided in Volume 6, Section 8. **In summary, the residual negative effects of the Project to birds are expected to be local, long-term, small and not significant.**

Table 7.10-2. Summary of Project residual effects on bird Valued Ecosystem Component (VEC) species.

VEC SPECIES	SOURCE OF EFFECT	DESCRIPTION OF EFFECT	MITIGATION MEASURE	RESIDUAL EFFECT [a]
Canada Goose	**CONSTRUCTION PHASE**			
	Clearing and construction of access roads, borrow areas, generating station site area; noise associated with machinery, people and activities such as blasting	Disturbance to nesting, foraging and brood-rearing geese; loss of some foraging and nesting habitat	Restrict clearing and blasting activities outside peak nesting/brood-rearing months (i.e. May, June and July) [b] to the extent feasible	Short-term, site-specific and small negative effect and therefore **not significant**
	OPERATING PHASE			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; access road presence, use and maintenance	Decrease in nesting, cover and foraging habitat; occasional incidence of road-kill or injury; increased mortality due to increased hunting opportunity	Access restriction along access road [c]	Long-term, local and small negative effect and therefore **not significant**
Mallard	**CONSTRUCTION PHASE**			
	Clearing and construction of access roads, borrow areas, generating station site area; noise associated with machinery, people and activities such as blasting	Disturbance to nesting, foraging and brood-rearing Mallards; loss of some foraging and nesting habitat	Restrict clearing and blasting activities outside peak nesting/brood-rearing months (i.e. May, June and July) [b] to the extent feasible	Short-term, site-specific and small negative effect and therefore **not significant**
	OPERATING PHASE			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; access road presence, use and maintenance	Decrease in nesting, cover and foraging habitat; occasional incidence of road-kill or injury; increased mortality due to increased hunting opportunity	Access restriction along access road [c]	Long-term, local and small negative effect and therefore **not significant**
Bufflehead and Common Goldeneye	**CONSTRUCTION PHASE**			
	Clearing and construction of generating station site area; noise associated with machinery, people and activities such as blasting	Disturbance to nesting, foraging and brood-rearing Bufflehead and goldeneye; potential loss of some nest cavity habitat due to clearing	Restrict clearing and blasting activities outside peak nesting/brood-rearing months (i.e. May, June and July) [b] to the extent feasible	Short-term, site-specific and small negative effect and therefore **not significant**
	OPERATING PHASE			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; access road presence, use and maintenance	Increased mortality due to increased hunting opportunity	Access restriction along access road [c]	Long-term, local and small negative effect and therefore **not significant**
Common Loon	**CONSTRUCTION PHASE**			
	Noise associated with machinery, people and activities such as blasting; presence of boats related to construction activities	Disturbance of nesting, foraging and brood-rearing loons	Restrict clearing and blasting activities outside peak nesting/brood-rearing months (i.e. May, June and July) [b] to the extent feasible	Short-term, site-specific and small negative effect and therefore **not significant**

Table 7.10-2 Continued

Common Loon	**OPERATING PHASE**			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; access road presence, use and maintenance	Mortality due to entrapment in commercial fishing nests due to increased / regular commercial fishing activities; increased disturbance of nesting and brood-rearing loons due to increased human presence and boating; decrease in preferred island nesting habitat	Access restriction along access road [c]	Long-term, local and small negative effect and therefore **not significant**
Bald Eagle	**CONSTRUCTION PHASE**			
	Clearing of generating station site area; noise associated with machinery, people and activities such as blasting	Disturbance of nesting and foraging eagles	Restrict clearing and blasting activities outside peak nesting/brood-rearing months (i.e. May, June and July) [b] to the extent feasible	Short-term, site-specific and small negative effect and therefore **not significant**
	OPERATING PHASE			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; occasional fish kills and stunned fish passing through generating station turbines; access road presence, use and maintenance	Potential for increased eagle presence and nesting success due to abundant, easily accessible food supply (due to commercial fish-gut piles and presence of stunned/killed fish passing through turbines); potential for disturbance of nesting and foraging eagles due to increased human presence; erosion causing loss of established nest trees	Access restriction along access road [c]	**No net effect** on Bald Eagles
Red-winged Blackbird	**CONSTRUCTION PHASE**			
	None expected	None expected	None	**No expected effect**
	OPERATING PHASE			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; access road presence, use and maintenance	Decline of off-shore marsh habitat	None	Long-term, local and small negative effect and therefore **not significant**
Palm Warbler	**CONSTRUCTION PHASE**			
	Clearing and construction of access roads, borrow areas, generating station site area; noise associated with machinery, people and activities such as blasting	Disturbance of some nesting and foraging Palm Warblers	Restrict clearing and blasting activities outside peak nesting/brood-rearing months (i.e. May, June and July) [b] to the extent feasible	Short-term, site-specific and small negative effect and therefore **not significant**

Table 7.10-2 Continued

Palm Warbler	**OPERATING PHASE**			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; access road presence, use and maintenance	Potential increase in shrubby bog and peatland nesting habitat; potential for reduced incidence of nest flooding in lowland bog areas near shore; limited potential for increase in nesting habitat in bog areas created by pooled water adjacent to the access road	None	Long-term, local and small positive effect and therefore **not significant**
Belted Kingfisher	**CONSTRUCTION PHASE**			
	Noise associated with machinery, people and activities such as blasting; presence of boats related to construction activities	Disturbance of some foraging and possibly some nesting Belted Kingfishers	Restrict clearing and blasting activities outside peak nesting/brood-rearing months (i.e. May, June and July) [b] to the extent feasible	Short-term, site-specific and small negative effect and therefore **not significant**
Belted Kingfisher	**OPERATING PHASE**			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; access road presence, use and maintenance	Increased erosion of suitable shoreline bank nesting habitat [d]; increased turbidity [d] near some erodable shoreline areas, thus decreasing potential foraging habitat; potential for increased disturbance to nesting and foraging kingfishers due to increased human presence and boating	Access restriction along access road [c]	Long-term, local and small negative effect and therefore **not significant**
Common Snipe	**CONSTRUCTION PHASE**			
	Clearing and construction of access roads, borrow areas, generating station site area; noise associated with machinery, people and activities such as blasting	Disturbance of nesting, foraging and brood-rearing snipe	Restrict clearing and blasting activities outside peak nesting/brood-rearing months (i.e. May, June and July) [b] to the extent feasible	Short-term, site-specific and small negative effect and therefore **not significant**
	OPERATING PHASE			
	Wuskwatim Lake water level increased to 234 asl and kept relatively stable; access road presence, use and maintenance	Potential increase in peatland nesting habitat; potential for reduced incidence of nest flooding in lowland bog areas near shore; limited potential for increase in nesting habitat in bog areas created by pooled water adjacent to the access road	None	Long-term, local and small positive effect and therefore **not significant**

a = Refer to **Volume 6, Section 8.5** for more detail
b = To be described in an Environmental Protection Plan
c = To be described in an Access Management Plan (discussions in progress)
d = During first 5 years; gradually reducing back to current rates over the next 20 years

7.10.5 Mammals

Residual effects on mammal VECs are summarized in Table 7.10-3. Insignificant residual effects range from short-term to long-term, small, and site-specific to regional, for mammal VECs assessed.

7.11 CUMULATIVE EFFECTS

7.11.1 Habitat

7.11.1.1 Background

The cumulative effects assessment for terrestrial habitat and plant VECs considered the Sub-Region portions of the following projects:

- 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) (see Section 2).

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.

Table 7.10-3. 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			

The cumulative effects assessment of 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 impacts 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 7.11-1). 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 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 Burntwood River (Volume 7). For the cumulative effects assessment it was assumed that as many as twenty cabins could be built, that no new roads would be built to access cabins and that the primary effect of a cabin is the equivalent of about 1 ha of clearing (includes an allowance for firewood cutting) on average.

As noted in Section 6.12-2, although plans will be developed, an increase in human usage of Wuskwatim Lake, in conjunction with possible development of infrastructure (e.g., cabins) would likely occur. Impacts 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 could have a large positive effect on Sub-Region habitat and VECs (Figure 7.11-1). 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. 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. 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 under-storey 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. 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 types to 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.

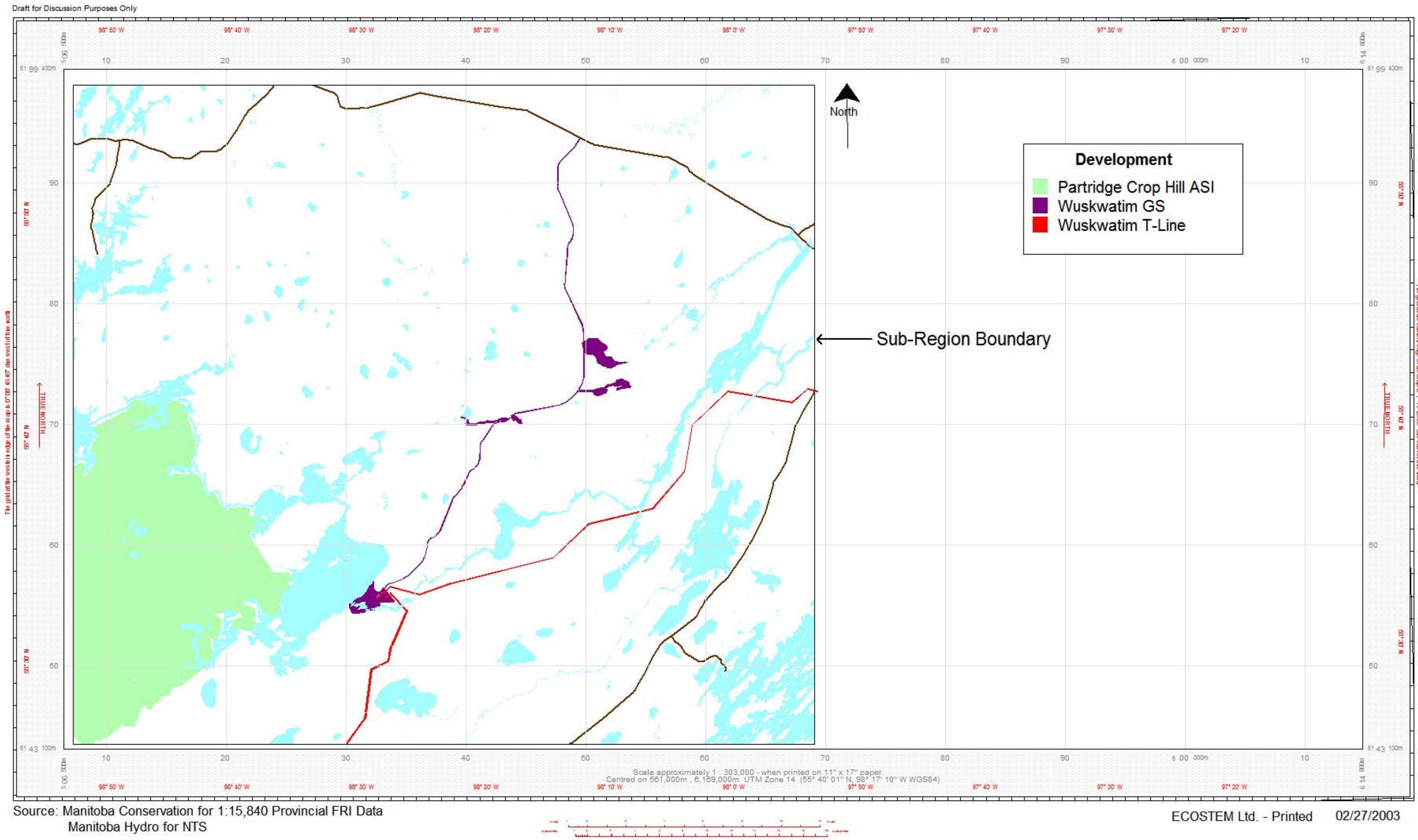


Figure 7.11-1. Potential projects in the Sub-Region.

7.11.1.2 Cumulative Effects on VECs

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.

Table 7.11-1 summarizes the maximum anticipated cumulative effects on terrestrial habitat and plant VECs if all of the potential projects proceed. 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. Mitigation, which can have a significant effect on cumulative effects, is also considered. Further details on the cumulative effects assessment are provided in Volume 6 Section 5.7.1.

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 effects of climate change. Certainty regarding this particular effect is low due to the highly uncertain effects of climate change.

Cabin development, TLE and future CRD erosion could increase effects on balsam fir. Effects will remain small and insignificant (versus significant and moderate to large) only if appropriate mitigation is undertaken by all other projects.

Effects on dry jack pine forest will remain insignificant (versus significant and moderate to large) only if appropriate measures are taken by other projects to control increased fire frequency and/or severity. 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. Mitigation may not reduce potential cumulative effects on dry jack pine forest to small because the potential effects of climate change are not mitigable by a particular other project. Certainty regarding cumulative effects on dry jack pine forest is low due to the highly uncertain effects of climate change.

Table 7.11-1. Maximum anticipated cumulative effects if all of the potential projects in the Sub-Region proceed with or without mitigation by other 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

[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.

7.11.2 Insects

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.

7.11.3 Amphibians

Cumulative effects to amphibians were assessed relative to the expected effects to amphibian habitat regarding past, present and reasonably foreseeable future projects and

* Summary of effect - = negative, small and insignificant; -- = negative, moderate and significant; --- = negative, large and significant; same conventions hold for positive effects.

activities within ecodistricts defined in Volume 6 (Section 7.8.2). The cumulative effect 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 (Volume 6, 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.

Considering the extent of knowledge regarding future projects or activities, it is expected that 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.

7.11.4 Birds

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 Volume 6 (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 (Volume 6, Section 7.8.2). Effects to bird habitat within those ecodistricts potentially affected by the Project were assessed. Approximately 0.15% of the bird habitat 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.

7.11.5 Mammals

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.

Woodland Caribou (Ethinutwatehk)

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.

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.

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.

7.12 ENVIRONMENTAL FOLLOW-UP AND MONITORING

Residual Project effects are expected to be either: (1) positive (i.e., semi-aquatic habitat and plants); or (2) negative but small 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. Monitoring will focus on:

- mitigation measures intended to eliminate or reduce significant effects to insignificant effects on VECs; and
- the major assumptions (e.g., fire regime).

7.12.1 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. The Project's 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.

7.12.2 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 5.4.2.2;
- 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 near either of the 1 km Buffers or the shoreline of the Affected Aquatic Area.

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.

7.12.3 Insects

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 7.7.).

7.12.4 Amphibians

No monitoring activities specifically related to amphibian or reptile 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 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.

7.12.5 Birds

Monitoring of Project-related impacts to birds will occur during the construction and operation phases of the Project to confirm predictions of effects and to determine whether unexpected effects are occurring.

7.12.5.1 Construction

Monitoring of birds will occur during construction years 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.

Recommended bird monitoring activities during the construction phase of the Project include terrestrial breeding bird surveys, boat-based surveys and helicopter surveys (Volume 6, Section 8.7.2).

7.12.5.2 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. Table 7.12-2 provides a list of, and rationale for, bird monitoring activities proposed to occur during the Project operation phase (also Volume 6, Section 8.7.3).

The level of effort during Project operation monitoring studies (2010 to 2014) will duplicate the baseline studies conducted in 2000, 2001 and during additional baseline studies for boat- and helicopter-based surveys, such that data can be directly compared, accurately analyzed, and sound conclusions can be derived. The level of effort with respect to terrestrial breeding bird surveys will be focused on those transects that occur within key habitat types that are expected to be most affected by the new water regime (Volume 6, Appendix 8.8.6).

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.

Recommended bird monitoring activities during the operation phase of the Project include terrestrial breeding bird surveys, boat-based surveys and helicopter surveys (Volume 6, Section 8.7.3).

7.12.6 Mammals

Woodland caribou

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

Radio-collaring a woodland caribou to monitor movements.

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.

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.

8.0 RESOURCE USE

8.1 INTRODUCTION

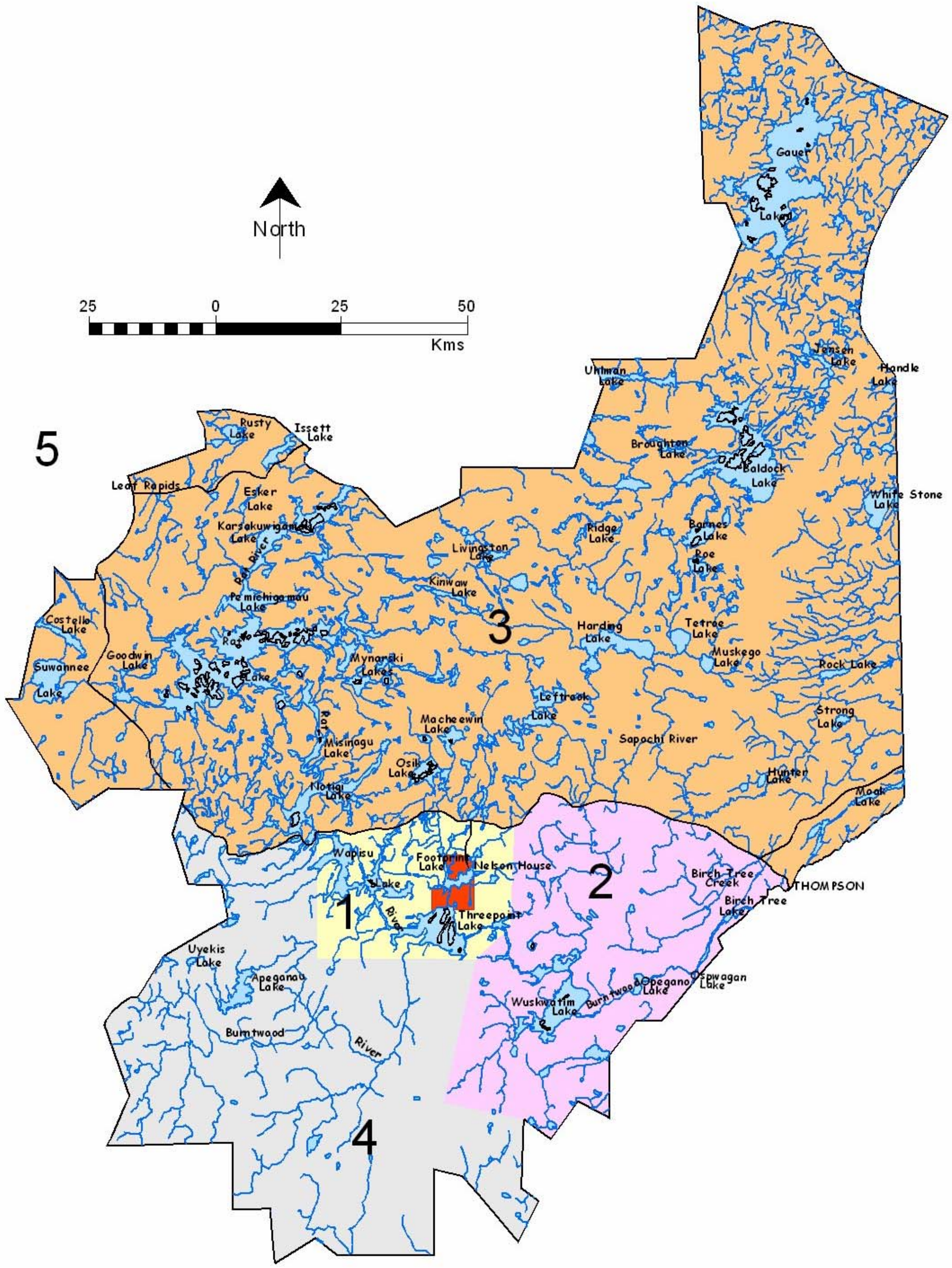
This section of the **EIS** provides an assessment of Project impacts on resource use, reflecting Section 6.3.1 of the EIS guidelines.

Councillors D'Arcy Linklater (NCN) and David Spence (NCN) emphasized the importance of resource use by NCN in their addresses to the Clean Environment Commission on February 12, 2002. Councillor Spence stated that one of the goals of NCN was:

> "to develop a socio-economic plan to maximize training, employment and business opportunities for our people, which includes forestry, mining, tourism, transportation, resource harvesting, health, education, recreation, and hydro development."

Resource use by NCN members in the Nelson House Resource Management Area (RMA, Figure 8.1-1) has a long historical record and, as noted by Councillors Linklater and Spence, will play a major role in the future of NCN. Resources harvested by NCN members provide both income and income-in-kind. NCN Elders also clearly stated that resource harvesting is not just an economic activity but is a key link to traditional lifestyles and past generations. During interviews with NCN resource harvesters it was clear that economics was often of secondary importance and that activities such as **commercial trapping** were, in some instances, conducted for cultural reasons. One NCN member stated that she continued trapping despite losing money as she could feel the presence of her ancestors when she was on the land and that it "defined what she was". It is clear that resource use must be viewed from both cultural and economic perspectives.

During scoping workshops held in early 2000, NCN members identified a number of valued ecosystem components (VECs) in relation to potential Project **impact**s on resource use. These included: traditional resource use (which consists of **subsistence/domestic** hunting, trapping, and fishing, and gathering of plants for medicinal and dietary purposes); **commercial** fishing; and commercial trapping. The impact assessment focuses on these VECs but also addresses other important resource use activities in the region including: commercial forestry, mining, recreational fishing and hunting; lodges, outfitters and other tourism; and protected areas and scientific sites.



*Zones 1-5 were used to delineate the Harvest Calendar Study results.

Figure 8.1-1. The Nelson House Resource Management Area.

Potential **effect**s to resource use activities are identified and, where possible, classified by nature (positive, negative or neutral), magnitude (size of the effect), duration (how long the effect will last), and spatial boundary (i.e., where will the effect be noticeable – Wuskwatim Lake, RMA or northern Manitoba). However, because different resource users can perceive Project effects on resource use differently, the nature and magnitude of some effects are not classified. Detailed information on the existing environment and anticipated impacts for each resource use VEC and activity are provided in Volume 7.0 of the EIS.

Changes to resources in one area will cause resource use patterns to shift, which can ultimately affect resource use in other areas. To understand the impacts of the Project on resource use, it was necessary not only to have an understanding of how resources are used in the area to be affected, but also to have an understanding of the how important the affected area is to overall resource use in the region. Consequently, existing resource use is generally described in terms of the Nelson House RMA and in terms of the area directly affected by the Project (Zone 2 in Figure 8.1-1).

The process of documenting existing resource use and potential impacts to resource use relied heavily on input from NCN members, particularly with regard to domestic/subsistence harvesting, commercial fishing, and commercial trapping. Traditional knowledge, which was provided by NCN Elders and resource harvesters, provides the foundation for a major part of each of these sections. A Harvest Calendar Study conducted with NCN resource harvesters in Nelson House from August 2001 to July 2002 provided information on the types, timing, magnitude and locations of subsistence/domestic harvests. Harvest calendar data were delineated by the harvesting zones indicated on Figure 8.1-1, with harvesting in Zone 2 representing resource use in the Project area. Data from the Nelson House Country Foods Program (a program operated by the First Nation that utilizes local resource harvesters to provide **country food** to Elders and other NCN members) provided additional information on domestic harvest quantities and locations. Government and industry data were used to describe the locations and magnitude of commercial resource harvests. Key person interviews with government and industry officials provided additional information with regard to commercial and recreational harvests. It should be noted that in some cases, the information provided in the EIS has been generalized to safeguard resources. For example, to avoid potential overexploitation, moose harvest locations are not specifically identified on a map. As an alternative, the harvests have been noted in a broad sense for consideration in the impact analyses.

Some of the factors affecting resource use, such as increased access, an increase in the wage economy, and loss/change of **habitat**, will commence during construction and continue through operation. Other factors, such as the presence of a large workforce and its effect on animal populations, occur only during construction, but continue to affect resource harvesting for a period of time after the Project is complete. For this reason, and to reduce repetition, discussions of Project impacts and the effects on traditional resource use, commercial fishing, commercial trapping, and recreational fishing and hunting have not been delineated by the construction and operation phases of the Project as has been done for other sections.

8.2 TRADITIONAL RESOURCE USE

8.2.1 Existing Environment

Prior to the arrival of Europeans, Aboriginal peoples inhabiting what is now Manitoba depended entirely on game, fish, and wild plants for their livelihood. Harvesting resources was an integral part of their daily lives and affected every aspect of their culture, including their religion (Young and Skarsfard 1983). The continued importance of traditional pursuits to NCN was noted by NCN Councillor D. Linklater (2002) who stated in his presentation to the CEC that:

> "The well-being of NCN has always been tied to the land and its resources…..we must recognize and respect traditional pursuits and ensure they are maintained."

NCN Elders stated that traditional resource use is more than just consumption of natural resources. It is a way of life that provides sustenance, medicines, building materials, a heat supply, and spiritual fulfillment. An elder interviewed for a Traditional Knowledge Project conducted by NCN stated, "All animals are important to me because that is the way of life, food, and clothing."

NCN residents often refer to traditional resource use as "living on the land" or "bush living". It includes hunting, fishing, trapping, and gathering. Treaties signed in the late 1800s and early 1900s between First Nations and Canada recognized the importance of traditional resource harvesting activities by giving Status Indians the right to hunt and fish for food during any time of the year on unoccupied Crown land and on any other land to which they had legal access. Commercial fishing and hunting have also become integral components of this traditional lifestyle.

This section focuses on the subsistence/domestic component of traditional resource use, some of which occurs in conjunction with commercial fishing and trapping activity. The commercial components of these activities are discussed in the following two sections (Sections 8.3 and 8.4). For the remainder of this section subsistence/domestic resource use will simply be referred to as domestic resource use.

During implementation of the Harvest Calendar study, NCN resource managers estimated that approximately 55% of NCN households participate in traditional harvesting activities at some time during the year. Of those households, approximately 19% were classified as intensive harvesters (spent at least one month in the bush each year), 11% as active harvesters (spent at least one week in the bush each year), 40% as occasional harvesters (spent at least a day or weekend in the bush each year), and 4% as unique harvesters (harvest a traditional resource that is not commonly harvested by most other resource harvesters, e.g., medicinal plants).

Domestic harvesting activity, as reported in the Harvest Calendar, was primarily conducted within Zone 1 near Nelson House (49%) and in the area north of PR #391 in Zone 3 (30%) (Figure 8.1-1). The remainder of harvesting activity occurred as follows: 11% in Zone 2, which encompasses the Wuskwatim study area; 2% in Zone 4 (the area south of PR #391 and southwest of **CRD**); and 3% in Zone 5 (all areas outside the Nelson House RMA). A location was not specified for 5% of the resource harvesting activity reported (Zone 0). Results of an opinion survey conducted by NCN showed that most travel occurred close to the community of Nelson House (Zone 1), corresponding to the majority of the domestic harvest locations identified in the Harvest Calendar.

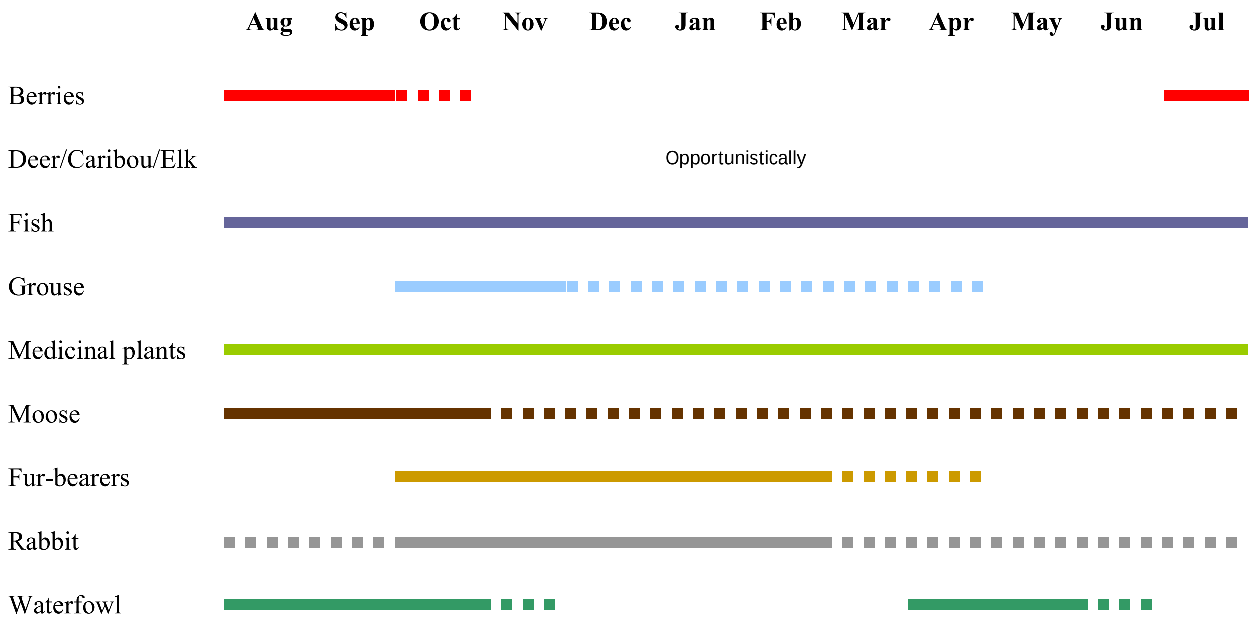
Residents of NCN use a wide array of plants and animals for traditional purposes (Table 8.2-1). Resources are harvested year round with specific resources targeted at different times of the year (Figure 8.2-1). Berry picking occurs from July through October; moose hunting occurs most frequently from August through October; **furbearer**s, rabbits, and grouse are typically harvested most often from October through April; and **waterfowl** hunting is concentrated during spring and fall. Fish and medicinal plant harvesting occur throughout the year. Harvests of barren ground caribou, deer, and elk occur outside the RMA on an irregular basis. NCN Resource Program staff report that harvests of woodland caribou are rare and generally restricted to certain Elders within the community.

Table 8.2-1. List of species harvested by NCN.

	Species Name		
Category	**English**	**Latin**	**Cree**
Berries			
	Blueberries	*Vaccinium* sp.	Ethinimina
	Cranberries	*Oxycoccus* sp.	Wesakemina
	Raspberries	*Rubus* sp.	Athoskanuk
	Saskatoons	*Amelanchier* sp.	Misaskatoomina
	Strawberries	*Fragaria* sp.	Otihemina
Medicinal Plants/Fungi			
	Balsam fir	*Abies balsamea*	Napakasiht
	Bark		Wathakisk
	Birch tree bark	*Betula* sp.	Wuskwi-wathakisk
	Blackberry roots	*Rubus* sp.	Kahkiteminahtik-Ochipihk
	Cat tails	*Typha* sp.	Wahatoya
	Choke cherry tree	*Prunus virginiana*	Pusisaweminahtek
	Devil's claw	*Haragophytum procumbent*	
	Driftwood		Akwahonehtuk
	Ginger root	*Asarum canadense*	Wihkis
	Herbs		Muskehkewahtekwa
	Juniper	*Juniperus* sp.	Kahkakeminahtek
	Labrador tea	*Rhododendron groenlandicum*	Mwakopukwahtekwu
	Mint	*Menta arvensis*	Wehkuskwa
	Mushroom		Uthekis Otakuwastehonan
	Poplar buds	*Populus* sp.	Osemiskwuk
	Red willows	*Salix* sp.	Mehkwapemukwa
	Rosehips	*Rosa* sp.	Okenyuk
	Spruce buds	*Picea* sp.	Wunuskochunuskosuk
	Spruce gum	*Picea* sp.	Misliko-pekew
	Sweet gale	*Myrica gale*	Apischisakwewuskosa
	Tamarack	*Larix laricina*	Wakinakan
	Weed tea		Muskihkiwapwi
Fish			
	Lake cisco/Tullibee	*Coregonus artedi*	Ochonipis
	Burbot/Maria	*Lota lota*	Methachos
	Sucker/Mullet	*Catostomus* sp.	Namepith
	Longnose/Red sucker	*Catostomus catostomus*	Mehkwamepith
	White/Common sucker	*Catostomus commersoni*	Namepith
	Yellow perch	*Perca flavescens*	Asawisis
	Northern pike/Jackfish	*Esox lucius*	Osawuskwapis
	Trout-perch	*Percopsis omiscomaycus*	
	Walleye/Pickerel	*Stizostedion vitreum*	Okow
	Lake whitefish	*Coregonus clupeaformis*	Atihkamek
Birds			
	Bald eagle	*Haliaeetus leucocephalus*	Mikisew
	Belted kingfisher	*Ceryle alcyon*	Okiskimanaseu
	Red-winged blackbird	*Agelaius phoeniceus*	Chakatho
Grouse			
	Grouse		
	Sharp-tailed grouse	*Tympanuchus phasianellus*	Pithew
	Ruffed grouse	*Bonasa umbellus*	Pithew
	Partridge	*Perdix perdix*	Pithew
	Ptarmigan/Willow ptarmigan	*Lagopus lagopus*	Wapethew
	Spruce Hens/Spruce grouse	*Dendragapus canadensis*	Pithew
Waterfowl			**Nepinayisuk**
	Common loon	*Gavia immer*	Makwa
	Ducks		Sesep
	Mallards	*Anas platyrhynchos*	Ethinisipuk
	Black duck/Lesser scaup	*Aytha affinis*	Kahkilisipuk
	Bufflehead	*Bucephala albeola*	Wapacipisuk
	Geese/Canada geese	*Branta canadensis*	Niskuk

Table 8.2-1. (Cont).

Category	Species Name: English	Latin	Cree
Mammals			
Fur Bearers			
	Arctic fox	*Alopex lagopus*	Wapahkisew
	Beaver	*Castor canadensis*	Amisk
	Fox	*Vulpes* sp.	Mahkisew
	Red Fox	*Vulpes vulpes*	Osawahkisew
	Cross Fox	*Vulpes vulpes*	Kamusinasot
	Silver Fox	*Vulpes vulpes*	Soneyawahkisew
	Fisher	*Martes pennanti*	Ochek
	Flying Squirrel	*Glaucomys sabrinus*	Taswikanikachas
	Lynx	*Lynx lynx*	Pisew
	Marten/American marten	*Martes americana*	Wapistan
	Mink/American mink	*Mustela vison*	Sakwesew
	Muskrat	*Ondatra zibethicus*	Wuchusk
	Otter/River otter	*Lutra canadensis*	Nikik
	Rabbit/Snowshoe hare	*Lepus americanus*	Wapos
	Tree Squirrel		Anikwachas
	Gray squirrel	*Scuirus carolinensis*	
	Red squirrel	*Tamiosciurus hudsonicus*	
	Weasel	*Mustela* sp.	Sehkos
	Wolverine	*Gulo gulo*	Omethaches
Ungulates			**Ka-owuskasechik**
	Caribou		
	Woodland caribou	*Rangifer tarandus caribou*	Ethinutwatehk
	Barrenground caribou	*Rangifer tarandus groenlandicus/granti*	Utehk
	Deer	*Odocoileus virginianus*	Apischachihkos
	Elk	*Cervus elaphus*	Wenaskisew
	Moose	*Alces alces*	Mooswa



*solid lines denote periods of relatively intense harvesting. Occasional and intermittent harvest activities are represented by dotted lines.

Figure 8.2-1. Harvesting activity by NCN, August 2001 to July 2002.

Although traditional resource harvesting is seasonal, resources are often harvested at the same time and outside of peak season. For example, a traditional resource harvester that is fishing may harvest a moose if the opportunity arises. Seven of ten commercial trappers interviewed from NCN indicated that they harvested fish while trapping. Because of this harvesting overlap, it is difficult to quantify the amount of time traditional harvesters spend harvesting one particular **species** and to delineate the time spent harvesting from time spent on other activities associated with traditional resource use.

Country Foods Program and Harvest Calendar data suggest that moose comprise the largest component of domestic harvest, by weight, followed by lake whitefish. Big game animals comprised an estimated 63% of all meat harvested by NCN residents, followed by fish at 26%. Domestic harvests provided an estimated 240,262 meals annually to NCN residents, or approximately 7% of all meals consumed (based on an annual total of 3,613,550 meals calculated from a population of 3,300 consuming three meals per day). Moose was by far the most important single animal in terms of the proportion of country foods meals consumed (Figure 8.2-2). Lake whitefish, pickerel (walleye), and northern pike (jackfish) also comprised a substantial number of meals, as did other big game animals and beaver.

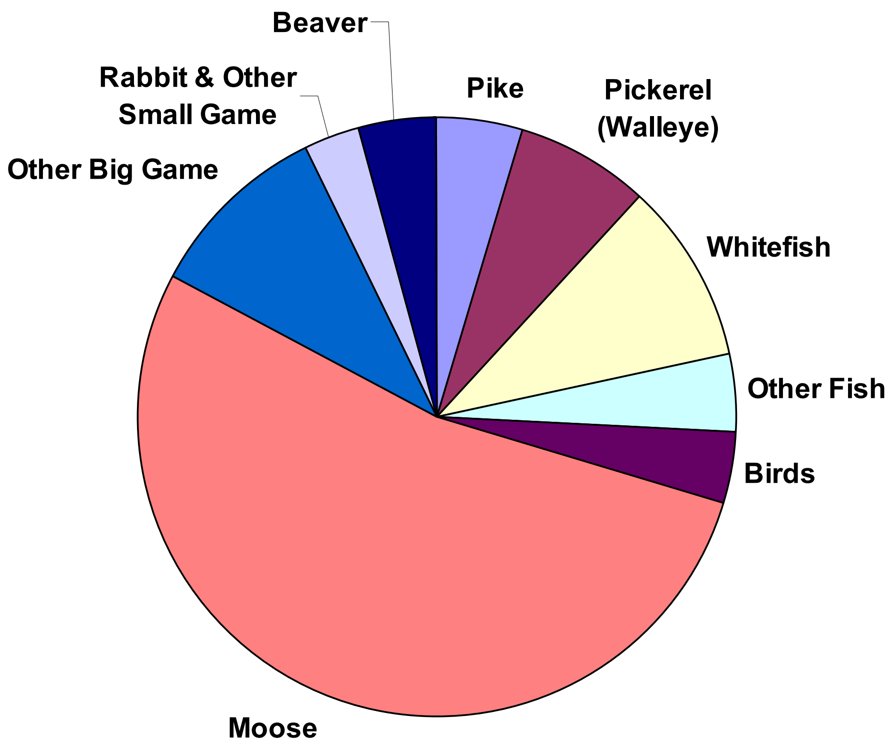


Figure 8.2-2. Proportions (%) of country foods meals obtained from animals harvested by the NCN (derived from Harvest Calendar and Country Foods Program data).

Access is an important factor limiting where traditional resource use activities occur. Resource harvesting areas are accessed by boat, car, truck, all-terrain vehicle, snowmobile, aircraft, or on foot. The majority of harvest attempts are concentrated close to Nelson House. The importance of roads is evident in the Harvest Calendar results from Zone 2 (the Project study area), where 84% of harvest activity occurred along PR 391 or on water bodies that are considered safe for navigation (e.g., Sapochi River, Birch Tree Creek). Navigational hazards on waterways were reported by Nelson House residents to be a major concern with regard to traditional resource harvesting activity in the RMA, particularly in relation to fast water and debris on the Burntwood River system. Under agreements, license arrangements and federal legislation, Manitoba Hydro is responsible for mitigating adverse effects from its operations on travel and access along affected waterways. The 1996 Comprehensive Implementation Agreement (which implements the Northern Flood Agreement for NCN) contains a number of safety provisions to be undertaken by Manitoba Hydro to ensure safe travel along affected waterways in the Nelson House RMA, as well as a comprehensive mechanism established through the NCN Trust. These safety provisions are associated with safe ice trails, navigational aids, and debris management.

There are a number of cabins located along PR 391 that can be accessed by car or truck and are generally used throughout the year. Cabins without road access are used primarily by commercial fishers and trappers and are generally used less often than those with road access. NCN resource users and harvesters identified approximately 45 cabins in the vicinity of Nelson House, PR 391 and the Burntwood River, two of which are located on Wuskwatim Lake.

Domestic Hunting/Trapping

Domestic hunting is conducted year round. Animals most actively pursued include moose, barren ground caribou, waterfowl, grouse, and furbearers. Woodland caribou are not targeted, but are taken on occasion. Based on Harvest Calendar and Country Foods Program data, hunting and trapping harvests provided an estimated 178,257 meals to NCN resident in 2001/2002 (or approximately 5% of all meals consumed).

Because of poor access, there is currently little use of the Wuskwatim Lake area for hunting. The proportion of NCN hunting activity (i.e., days spent hunting) that occurred in Zone 2 (as reported in the Harvest Calendar) ranged from approximately 13-14% of waterfowl and moose hunting, respectively, to 40% of grouse hunting. However, very little of this hunting activity occurred in the vicinity of Wuskwatim Lake, which accounted for just 3.9% of the total domestic hunting harvests from Zone 2. Reported domestic harvests from Wuskwatim Lake in 2001/2002 included three moose and three ducks. Over 50% of the domestic hunting harvests from Zone 2 were taken directly adjacent to PR 391.

Domestic Fishing

Domestic fishing occurs throughout the year and includes methods such as angling, snaring, and netting. Catches are often shared within families and the community and, based on Harvest Calendar and Country Foods Program data, provided an estimated 62,005 meals to NCN residents in 2001/2002 (or approximately 2% of all meals consumed). As with most traditional activities, fishing is often conducted while participating in other resource harvesting activities such as trapping. Commercial fishers also reported that they generally keep a portion of non-saleable fish from their catch, such as longnose (red) sucker and maria (burbot), for domestic use.

The most common fish species (based on weight) distributed annually by the NCN Country Foods Program between 1994 and 2000 were lake whitefish, pickerel, northern pike, sucker, tullibee (lake cisco), and lake trout. Longnose sucker, lake whitefish, and northern pike are commonly smoked prior to distribution.

Access is a key factor limiting the domestic fishery in the RMA. Harvest Calendar results showed that 64% of domestic fishing effort was concentrated near Nelson House in Zone 1 (including Threepoint and Footprint lakes). A considerable amount of fishing (29%) also occurred north of PR 391 in Zone 3. Very little (4%) domestic fishing was conducted in Zone 2 (the Project study area). Fishing activity for pickerel and northern pike was concentrated near Nelson House in Zone 1, whereas fishing for lake whitefish was concentrated north of PR 391 in Zone 3. During spring, the domestic fishery focuses on runs of spawning fish in creeks located along PR 391.

Some NCN resource harvesters consider lake whitefish from Wuskwatim Lake to be of higher quality than lake whitefish from Footprint or Threepoint lakes. In fish quality testing, conducted by he University of Manitoba Faculty of Food Sciences, lake whitefish from Wuskwatim Lake were classified highest in “acceptability” by NCN residents (Ryland and Watts 2002). However, it should be noted that whitefish and pickerel from all locations sampled from within the RMA were liked “moderately”, and no significant differences were found among any of the lakes for any fish species. Despite the high regard for fish in Wuskwatim Lake, poor access and unsafe travel conditions presently restrict the amount of domestic fishing that occurs on the lake to a negligible level.

Nelson House residents harvested an estimated 13,007 fish from August 2001 to July 2002 (excluding Country Foods Program harvests). The domestic harvest was comprised primarily of pickerel (43%), followed by northern pike (17%), lake whitefish (16%), tullibee (8%), suckers (5%), unidentified fish (9%), maria (1%) and perch (1%). The majority of the harvest (51%) came from Zone 3 and 47% of the harvest came from Zone 1. Due to **mercury** levels, northern pike in Rat Lake and pickerel in Notigi and Wuskwatim lakes are currently not being accepted for commercial sale by the Freshwater Fish Marketing Corporation. While these closures do not apply to the domestic harvest, such closures can discourage people from harvesting fish for domestic use. (It should be noted that recent **monitoring** conducted as part of the Joint Study Program has shown that mercury levels in pickerel from Wuskwatim Lake are below the commercial sales limit.)

Resource Gathering

In addition to animals, northern forests provide First Nations peoples with plants for food, medicines, fuel, building materials, and craft items. Arnason et al. (1981) reported at least 175 food plants and 52 beverage plants gathered by Native peoples in eastern Canada. Although not as important to the local First Nation economies as it was historically, resource gathering continues to provide a significant contribution to domestic needs within aboriginal communities and an opportunity for First Nations to remain in close contact with the land.

Berries comprised the third highest food item, in terms of weight, distributed by the Nelson House Country Foods Program from 1994 to 2000. An average of 302 kg of berries were distributed annually of which 54% were blueberries, 28% were cranberries, and 19% were raspberries/strawberries. Berry picking occurs in a relatively restricted time during summer and fall when the berries are ripe. Based on Harvest Calendar data, an estimated 2,735 litres of berries were harvested (excluding those provided to the country foods program) from August 2001 to July 2002, with the majority harvested from Zone 1 (57%), followed by Zone 2 (21%), and Zone 3 (18%). Berry picking is generally a family activity and ease of access is an important factor in determining berry-picking locations. Consequently, berry picking is focused on areas near Nelson House in Zone 1 and along PR 391 in Zone 2

Medicinal plants have been, and continue to be, particularly important to NCN members; NCN medicine men such as the late Mr. Nazar Linklater were known across Canada for their vast knowledge in this area. NCN Elders have noted that the harvesting of medicinal plants, both in regards to harvesting techniques and locations of harvests, have strong cultural and spiritual links. Elders have also noted that medicinal plants from areas affected by CRD appear to have decreased strength or potency.

Plants identified in the Harvest Calendar as being collected included: bark, devil's claw, driftwood, herbs, juniper, Labrador tea, min, poplar buds, spruce buds, tamarack, ginger root, mushrooms (actually a **fungus**), and "medicinal plants". Factors identified by resource harvesters as limiting the collection of traditional plants included knowledge of plants, access, and need. Safe access to locations where traditional plants grow was a concern noted by commercial trappers.

Harvest calendar results showed 50% of plant gathering activity occurred in Zone 1, near Nelson House, Footprint Lake, Threepoint Lake, and Wapisu Lake. Twenty-six percent of plant gathering activity occurred in Zone 2, of which 60% occurred at Wuskwatim

Lake. NCN residents identified wihkis, mint, and spruce gum as the most frequently harvested medicinal plants. Almost all commercial trappers and fishers operating in the Wuskwatim Lake study area reported collecting plants. Some plants were identified that are only found in the Wuskwatim area. Resource harvesters indicated that flooding from CRD has made harvesting of medicinal plants at Wuskwatim Lake more difficult than it was prior to 1976.

8.2.2 Impacts and Mitigation

Positive and negative effects to traditional resource use during construction and operation of the Project have the potential to occur as a result of the following:

- increased access;
- presence of a large workforce;
- **terrestrial** habitat loss;
- disturbances from Project construction;
- disturbances from Project operation;
- change in water levels and **flow**s; and
- increased wage economy.

Increased Access

The Wuskwatim road will provide access to an area that is currently only accessible by foot, boat (e.g., on the Sapochi or Burntwood rivers), snow machine, or all-terrain vehicle on relatively rough trails. Once road access is provided, NCN residents will have an interest in travelling to the Wuskwatim Lake area to undertake traditional resource harvesting activity. It is also expected that commercial and recreational resource users will have an interest in accessing the area. Because resource use in the project area is currently limited by access, the potential increase in resource harvesting due to increased access is the most significant potential effect of the Project on resource harvesting. The extent to which resource use increases in the Wuskwatim area will depend on measures implemented by NCN, Manitoba Hydro, and Manitoba Conservation. During construction, access will be controlled at PR 391 by a staffed gate and will be limited to construction crews. Access by others will be by special arrangement only. NCN and Manitoba Hydro, in consultation with the Resource Management Board, will develop an Access Management Plan for the construction period prior to the start of construction. An Access Management Plan for the operation period will be developed at the end of the construction period. Measures included in the Plan will directly influence the amount of harvesting that will occur in the Wuskwatim area during and after construction.

Domestic Hunting

The Access Management Plan will dictate who will be provided access to the Wuskwatim area during construction and operation. During construction, hunting would not be allowed near the access road or work areas due to safety concerns.

If NCN members are provided access it will likely result in an increase in domestic hunting activity in the Wuskwatim area, particularly for moose and waterfowl. It is expected that the majority of effort would be redistributed from elsewhere in the RMA. Domestic hunters from NCN will view increased access as a positive effect. However, the increased hunting pressure could have a negative effect on local animal populations (Section 7.9.2.2).

NCN has identified increased access and harvesting by non-NCN members, and subsequent effects on resource populations, as a key concern related to the Project. An increased level of recreational hunting would contribute to a reduction of animals in the area available to domestic hunters. This is not expected to be an issue during construction as gated access and restrictions on weapons will preclude recreational hunting in the Project area. The Access Management Plan will determine the level of access provided to recreational resource users during project operation. Management of harvests by recreational hunters is ultimately the responsibility of Manitoba Conservation. Use of the Nelson House RMA by First Nation members from outside of the area is not expected to increase noticeably because of increased access. According to NCN Resource Program staff, aboriginal harvesters generally respect RMA boundaries and harvest within their own areas.

Woodland caribou are known to use the Project area for migration, feeding, and calving. Increased access to the area will increase the probability of human/caribou encounters and caribou harvests. According to NCN Resources Program staff, NCN residents do not generally target caribou when hunting but will occasionally harvest the animals when encountered. Harvests are generally restricted to Elders who share the animals within the community. As a result, NCN Resource Program staff does not anticipate that additional harvests of caribou by NCN members as a result of the road will be significant. A Woodland Caribou Conservation Awareness Program stressing the vulnerability and scarcity of the species will be implemented during road construction to **mitigate** the potential for increased harvests.

Domestic Fishing

The Access Management Plan will dictate who will be provided access to the Wuskwatim area during construction and operation. If NCN members are provided access it will likely result in an increase in domestic fishing activity on Wuskwatim Lake. Much of the increased effort would probably be redirected from elsewhere in the RMA. An increase in domestic fishing effort will be moderated to some degree by the distance of Wuskwatim Lake from Nelson House (~ 50km by road). However, local resource users have indicated that lake whitefish from Wuskwatim Lake are considered to be of high quality and will be of interest to domestic fishers. It is expected that the annual domestic harvest after access is provided to Wuskwatim Lake will be similar to, or less than, the harvest from Threepoint Lake as estimated from Harvest Calendar data in 2001/2002 (n= 1,605 fish). Species composition of the domestic catch would be similar to recent experimental and commercial catches from Wuskwatim Lake as follows: 10% pickerel, 36% lake whitefish, 7% northern pike, 26% tullibee, and 21% other species. According to NCN Resource Program staff, increased access to Wuskwatim Lake would be viewed as a positive effect by NCN domestic fishers.

Commercial and recreational fishers will also have an interest in accessing Wuskwatim Lake and will compete for resources with domestic fishers. Measures outlined in the Access Management Plan will ultimately determine the level of harvest that occurs by these groups in the Wuskwatim Lake area. Increased harvests by commercial and recreational fishers would have a negative effect on the resources available to domestic fishers.

Gathering

Harvest Calendar data indicated that berry picking by NCN residents was heavily dependent on access and was primarily focused on road accessible areas. It is expected that with increased access there will be some interest in berry picking activity in the Wuskwatim area. Any increase in berry picking effort in the Wuskwatim area would likely be small and redirected from other locations within the RMA. Measures in the Access Management Plan will determine when and if berry-picking effort will increase in the Wuskwatim area.

Gathering of medicinal plants and other forest resources is expected to increase as access increases. NCN Elders indicated that some plants found in the Wuskwatim area are rare in other areas of the Nelson House RMA (i.e., saskatoons). It is expected that increased access will facilitate the harvesting of these and other plants that more common in the

Wuskwatim area. Measures in the Access Management Plan will determine the degree to which the gathering of medicinal plants increases in the Wuskwatim area.

Other Considerations

The Project will provide a safe all-season means of crossing the Burntwood River and accessing resource-harvesting areas to the south. Whether access will be provided and to whom, will be determined by the Access Management Plan. Limited existing access on the south side of the Burntwood River will moderate the potential for increased harvests once resource harvesters are on the south side of the River. Access downstream of the Wuskwatim GS will remain difficult after completion of the Project because of dangerous water conditions and a lack of trails.

NCN resource harvesters identified poaching as a key concern with regard to increased access. Measures will be undertaken as part of the Access Management Plan to reduce poaching in the Project area during construction. NCN and Manitoba Hydro will work closely with Manitoba Conservation, which is responsible for enforcing regulations with regard to the harvest of wildlife.

Increased access is also expected to increase the demand by NCN residents to construct cabins on Wuskwatim Lake and along the access road. The number of cabins built on Wuskwatim Lake is not expected to exceed the number currently on Threepoint Lake (8). Cabin construction will be regulated under existing permitting by Manitoba Conservation and reviewed jointly by the Nelson House Resource Management Board. Overall, the presence of increased numbers of people in the Wuskwatim area will increase the probability of cabin vandalism and environmental disturbances such as fuel spills, garbage, and forest fires. Manitoba Hydro and NCN will implement educational programs and signage to encourage people to respect local property and to protect against forest fires and other environmental damage.

Presence of a Large Workforce

During peak construction, there will be approximately 600 people employed by the Wuskwatim Project of which approximately half will be people from the south and approximately 150 will be Aboriginal peoples from other locations in northern Manitoba. The remainder of the workers will be NCN members. Non-NCN workers will compete for space and resources with domestic harvesters from Nelson House. The presence of the workforce will increase the probability of cabin vandalism and environmental disturbances such as fuel spills, garbage, and forest fires. The ability of the workforce to harvest resources in the Wuskwatim area will be addressed through the Access Management Plan and will be discussed with the Nelson House Resource Management Board.

Restrictions on gun possession, access constraints, and long work days (six 9-hour days per week) will likely preclude hunting and reduce fishing and gathering in the Wuskwatim area by the workforce even if it would be allowed by the Access Management Plan. However, it is expected that there will be some harvest of resources from other locations in the RMA by the workforce. To put the magnitude of the non-aboriginal workers from the south (~300) into context, it amounts to approximately 3% of the non-aboriginal adult population of Thompson (~8,700). If it is assumed the non-aboriginal workers will harvest resources in the Nelson House RMA at the same frequency as Thompson's non-aboriginal adult population, then it would be expected that non-aboriginal harvests and harvesting activity within the RMA during construction would increase by approximately 3%.

Although there are no records of resource harvests from the Nelson House RMA by non-aboriginals, provincial harvest records for big game animals from Game Hunting areas 9 and 9A (of which the Nelson House RMA comprises about 20%) provides an estimate of the potential magnitude of the additional harvesting activity. A 4% increase in one-fifth of the average resident moose harvest from these game-hunting areas from 1993/94 through 2000/2001 equates to < 1 moose per year. Such a harvest is not expected to have a noticeable effect on the availability of animals for NCN domestic hunters. Similarly, a 3% increase in fishing and waterfowl hunting by non-aboriginals within the Nelson House RMA would have little noticeable effect on the availability of fish or birds for NCN resource harvesters.

To put the magnitude of potential harvests by aboriginal workers from communities other than Nelson House into perspective, it can be assumed that approximately 50% of the 150 outside aboriginal workers during peak construction will be resource harvesters (based on Harvest Calendar results from Nelson House 2001/2002). If half of these individuals (n=35) chose to hunt for moose within the Nelson House RMA (it is probable that the proportion would be less) and had similar success as Nelson House domestic hunters and Manitoba recreational hunters (approximately 20% - from Harvest Calendar results and Manitoba Conservation 2002), there is potential for an additional harvest of seven moose annually from the Nelson House RMA during the peak construction period. This could have a short-term negative effect on local moose abundance, and therefore on NCN resource harvesters. However, because aboriginal workers will not be familiar with the area and will have limited time to harvest due to long work days, it is likely harvests will be much lower and have little noticeable affect on NCN resource harvesters. There will also be an increased potential for caribou harvests by aboriginal workers, which will be mitigated by implementation of a Woodland Caribou Conservation Awareness Program during construction stressing the vulnerability and scarcity of woodland caribou.

Terrestrial Habitat Loss

Habitat losses, resulting from **borrow pit** excavation and camp construction, are not expected to have a significant effect on regional animal populations (Section 7.9.2.2). A stand of balsam fir, which is used for medicinal purposes, will be lost in the **footprint** of the **generating station**, and other medicinal plants are expected to be lost where vegetation clearing occurs. Because the majority of habitat loss associated with construction will occur in areas where little resource harvesting has occurred in the recent past, effects to current resource use are expected to be negligible. Plants of interest to resource harvesters that will be affected by terrestrial habitat loss are commonly found elsewhere within the RMA (Section 7.5.2.3)

Disturbances From Project Construction

Disturbances related to construction of the access road and generating station, and to the presence of increased people and traffic, will have a negative effect on the environmental setting of the Wuskwatim Lake area. Commercial trappers from NCN stated that construction noises would frighten animals and cause them to avoid the areas during the construction phase. The disturbances are not expected to have a significant effect on the long-term abundance of animals in the area available to resource harvesters, however, resource harvesters may notice a small short-term decrease in the abundance of animals in the immediate area of disturbance (Section 7.9.2.2). Increased traffic on PR 391 may have a small, short-term negative effect on cabin use and berry picking areas. There are 17 cabins adjacent to PR 391, many within 100 m and in direct view of the road. A substantial amount of berry picking activity is also known to occur adjacent to the road. With the exception of noise, disturbances to existing cabin users on Wuskwatim Lake from Project construction are expected to be minimal as the cabins are located approximately 6 km from the Project site. If traditional resource harvesters are permitted into the area, Manitoba Hydro will implement educational programs in relation to construction activities and safety concerns.

In summary, disturbances to resource users as a result of construction activity are expected to be negative, moderate, short-term and localized to the Wuskwatim Lake area and PR 391.

Disturbances From Project Operation

Operation of the project will affect traditional resource users by changing the environmental setting on Wuskwatim Lake, causing safety concerns near the Generating Station, and causing a small increase in traffic on PR 391 and on the access road. Manitoba Hydro will implement educational programs and signage in relation to safety concerns for resource harvesters in the area. Because little resource use currently occurs in the area, it is expected that changes will have little effect on traditional resource use. However, the overall effect of operational disturbances will depend on perception, and be specific to each individual resource user.

Change in Water Level Regime and Flows

Changes to shoreline habitat as a result of changes to the water regime upstream of the generating station are not expected to have a significant effect on animal abundance in the Wuskwatim area (Section 7.9.2.2) and, therefore, should have no affect on the availability of animals for harvest. Changes in abundance of wihkis (sweet flag), wisayimina (mountain cranberry), ithinimina (velvet blueberry), and bog cranberry are expected to be negligible or positive as a result of higher and stable water levels. Wild mint (wehkuskwa) is the only domestic resource for which a reduction in abundance is expected as a result of the change in water level regime (Section 7.5.2.3). However, wild mint is widespread in the region, and losses are expected to have no effect on resource use. Increased and stabilized water levels are expected to have a small long-term positive impact on fish populations (Section 6.8.2.2), which should have a small, long-term, positive effect on traditional resource harvesters.

The change in water level regime upstream of the proposed generating station will increase shoreline **erosion** and woody debris and could make it **incrementall**y more difficult for resource harvesters to access shorelines and to secure boats. However, more stable water levels will facilitate shoreline access to some degree by decreasing the distance that boats will need to be pulled up on shore. Most of the additional debris entering the lake is expected to remain trapped behind the existing floating debris mat on the shorelines and should not have a noticeable effect on navigation (Section 5.8.2.2). However, NCN fishers expect that the increased levels of debris will be mobilized by ice and high water and will have a negative effect on domestic fishing efforts by causing increased levels of debris in nets. Floating debris hazards will be monitored and mitigated as required. Ice conditions are not expected to change on the lake (Section 5.4.2.2) and therefore, winter traveling conditions are not expected to change.

Increased water levels upstream are expected to cause mercury concentrations in some fish species to rise marginally after construction of the Project (Section 6.9.2.2), which could decrease the demand to harvest fish for domestic consumption. However, this is not expected to be a major deterrent to domestic fishers, as post-Project mercury levels will remain lower than current mercury levels in fish from Footprint and Threepoint lakes. The abundance of northern pike, which act as the primary host for *Triaenophorus crassus* (a tapeworm which encysts in the flesh of whitefish), is expected to increase marginally as a result of the project, but the degree to which this will affect lake whitefish infestations is uncertain (Section 6.9.2.2). Lake whitefish catches will be monitored to determine if infestation levels change as a result of the project.

Some NCN residents have stated that flooding decreases the potency of some medicinal plants. This may decrease interest in harvesting some medicinal plants along shorelines in the Wuskwatim area. Increased erosion is expected to increase levels of total suspended solids in nearshore areas (Section 6.5.2.2), which will decrease drinking water quality for those resource harvesters who take their water near shore or require harvesters to take their water further offshore.

Changes in the water level regime and flows are expected to have a small long-term negative effect on the quality of resources available to traditional resource users in the Wuskwatim area.

Water levels and flows downstream of the Project will remain highly variable and should have no effect on resource harvesting activity in the area.

Increased Wage Economy

Increased employment and increased income resulting from the Project will have counteracting effects on domestic resource use activity. Local residents that gain employment as a result of construction will have less time to use cabins and pursue traditional domestic resource gathering, hunting, and fishing activities. However, while it has been shown that there can be an inverse relationship between a community's average personal income level and domestic productivity (a study conducted in Alaska by Wolfe and Walker 1987), it has also been shown that the availability of country foods within aboriginal households can be largely dependent on a means of transportation for hunting (a study conducted near Wood Buffalo National Park by Wein and Sabry 1988). Increased incomes will provide a means to purchase resource-harvesting equipment. During construction, increases in resource harvesting activities may primarily occur during winter when a large proportion of the construction workforce will be laid off. The long-term effect of the wage economy on resource harvesting remains uncertain. It is expected that some of the shift away from traditional resource use caused by the increase in wage economy will be mitigated by promotion of traditional lifestyles by NCN.

8.3 COMMERCIAL FISHING

8.3.1 Existing Environment

Manitoba's commercial fisheries account for 25% of all freshwater fish harvested in Canada and contribute significantly to the province's economy. The commercial fishing industry is extremely important in northern Manitoba, especially within First Nations communities where other economic opportunities are often limited. Commercial fishing is one of the few sectors of the cash economy in which aboriginals can participate while maintaining their traditional subsistence lifestyle.

In northern Manitoba, lake whitefish are the most valuable species (accounting for 29% of the open-water catch value), followed by northern pike (24%), suckers (22%), and pickerel (19%) (Manitoba Conservation 2001). An average of 733 fishers were employed annually in northern Manitoba fisheries from 1990-2000, earning an average income of $6449 (2002 dollars) per fisher before expenses (Manitoba Conservation 2001). Expenses incurred by commercial fishers include the costs of boats, motors, gasoline, nets, helpers, etc.

The Nelson House RMA contains 47 lakes for which names could be found on NTS maps or in Manitoba Conservation databases, 29 of which have been fished commercially since 1976. Approximately half of the lakes that have been fished are accessible by road or boat, while the others are more remote and primarily accessed by aircraft. Twenty-six of the lakes have been assigned quotas by Manitoba Fisheries Branch (MFB). Lakes without quotas have had very little production, are remote, and/or have been fished on no more than three occasions. Leftrook and Footprint lakes are reserved for domestic fishing. Most lakes in the Nelson House RMA are open to commercial fishing year-round, with the exception of May 1 to May 31 and from October 21 to "when ice first makes after November 1". Harvesting is conducted with gillnets. Allocation of lakes is the responsibility of Manitoba Fisheries Branch. Lakes assigned to NCN are divided up among the fishers primarily based on past fishing experience. Residents of Granville Lake and South Indian Lake also fish lakes within the Nelson House RMA.

From 1976 to 2002, the average annual value of commercial fish production from the Nelson House RMA was $215,714 (2002 dollars). The most valuable catches came from

Gauer, Mynarski, Suwannee, Wuskwatim, Uhlman, Baldock, and Rat lakes. Pickerel accounted for approximately 49% of the value of the fishery during this period, with lake whitefish (32%) and northern pike (16%) generating most of the remaining revenue. Over 90% of the value of the fishery was produced during the open-water season.

Eight lakes were fished during the open-water season of 2002, producing a total of 80,758 kg of lake whitefish, pickerel, northern pike, and "other species", such as lake trout, sauger, suckers, and tullibee, worth $186,060. Suwannee (27,222 kg), Gauer (15,048 kg), Rat (14,792 kg), Uhlman (9,057 kg), and Issett (6,807 kg) lakes had the highest production. No commercial fishing was conducted during winter 2001/2002.

Commercial fish taken from lakes in the Nelson House RMA are delivered to fish processing plants in Leaf Rapids, Wabowden or Nelson House. The fish processing plant in Nelson House is owned by the Freshwater Fish Marketing Corporation and operated by the Nelson House Fishermen's Association. Fishers generally deliver fish to the closest processing plant to minimize cost. Fishers receive an initial payment from the Freshwater Fish Marketing Corporation based on the composition and weight of the catch delivered to the plant, and then receive a final payment based on the final selling price after the fish have been marketed.

Factors limiting the commercial fishery in the Nelson House RMA include: production of fish; transportation costs; sale price; mercury concentrations; and fish quality (parasitism in lake whitefish and tullibee). During summer 2002, commercial fishers received approximately $7.12/kg (including the final payment) for headless dressed medium pickerel (data from FFMC). "Jumbo" export dressed lake whitefish were worth $2.70/kg, headless dressed pike were worth $1.21/kg, and large dressed tullibee were worth $0.90/kg. Due to the higher value, fishers generally target lakes that produce the largest pickerel catches.

The **1996 NFA Implementation Agreement** allocated monies to subsidize the Nelson House commercial fishery from 1996 through 2001. Subsidy allocation to individual fishermen was decided by NCN and evolved during implementation of the agreement. Subsidies received by fishers were generally based on harvest and provided in addition to revenues generated from the sale of the fish. As of 2002, the Community Approval Process has the responsibility to decide how much trust money, if any, commercial fishing will receive in a year. Fishers operating on some of the more remote lakes in the Nelson House RMA received up to $0.90/kg from the subsidy program in 2002 (pers. comm. NCN Resource Programs staff, 2002). All commercial fishers operating out of Nelson House received some amount of subsidy regardless of the location fished.

Fish are transported to the processing plants by boat, truck, or airplane. Transportation costs are significantly higher for lakes that are only accessible by air and the additional costs can be a key factor in determining whether a fishery in a remote lake is economically viable.

Wuskwatim Lake

Wuskwatim Lake has a quota of 18,200 kg for whitefish and pickerel combined. NCN residents commercially fished the lake in all but six years from 1976 to 2002, primarily during open-water in June and September. Winter fishing was conducted in seven years during this period but has not occurred since 1993. Commercial fishers stated that winter fishing was difficult on Wuskwatim Lake because of unsafe ice conditions, slush on the ice, and poor access.

Commercial fishing on Wuskwatim Lake generally employs 4-10 individuals during the open-water season. Fishers stated that they bring their boats to the lake via the Burntwood River, portaging around at least two sets of rapids. Boats are often left at the lake from year to year to avoid traveling on the river. Access to and from the lake during the commercial fishing season is by aircraft. In recent years, the fishers have resided in a cabin at the south end of the lake while conducting the fishery.

Total annual commercial harvest by weight from Wuskwatim Lake from 1976-2002 is illustrated in Figure 8.3-1. Average harvests (based only on years when fishing occurred) of fish during the open-water and winter fisheries during this period were 12,811 kg and 4,828 kg, respectively. Since 1976, the quota has only been reached on two occasions (1976 and 1981), and less than two-thirds of the quota has been taken each year since 1988 (Figure 8.3-1). The Wuskwatim Lake harvest has comprised approximately 8.9% of the total value of the commercial harvest from the Nelson House RMA since 1976. In more recent years (1989-2002), harvests from Wuskwatim Lake have comprised an average of 4.2% of the commercial harvest value from the RMA. (It should be noted that the value of the catch from Wuskwatim Lake is proportionally much higher to Nelson House fishers than to all RMA fishers combined, as some of the RMA fishers come from other communities). Commercial fishing was not conducted on Wuskwatim Lake in 2001 and 2002 and less than 1,500 kg of fish were harvested from the lake in 2000. The low level of commercial fishing on the lake in recent years is attributable to the availability of alternative employment opportunities (pers. comm. NCN Resource Programs staff, 2002). The fishers that are usually employed to conduct commercial fishing on Wuskwatim Lake were hired to conduct Wuskwatim GS EIA studies on the lake in 2000/2001 and 2001/2002.

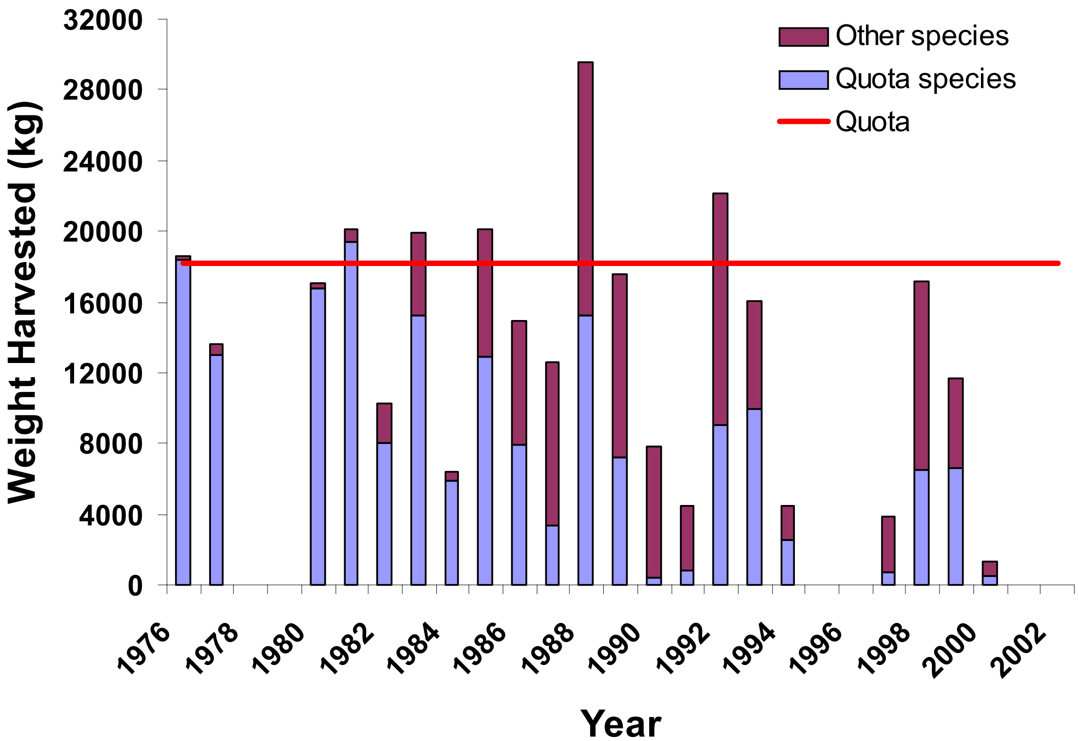


Figure 8.3-1. Commercial harvest of quota fish species (pickerel and lake whitefish) and other fish species from Wuskwatim Lake from 1976-2002.

"Other fish", including yellow perch, tullibee, suckers, and sauger, comprised less than 500 kg of the total annual catch from the Wuskwatim fishery from 1976 to 1984, but have comprised the majority of the harvest in over half the years (n=9) since 1985. Commercial fishers stated that tullibee have replaced pickerel as the most abundant fish in Wuskwatim Lake over the past 10-15 years.

The cost of transportation to and from Wuskwatim Lake is a key factor currently limiting the fishery. From 1988 to 1999, the average annual delivered value of fish harvested from Wuskwatim Lake was $1.40 (2001 dollars) per kg. The cost of flying fish out of Wuskwatim Lake to the Nelson House fish plant in 2001 was approximately $1.30/kg (pers. comm. C. Braun, 2001). Nelson House fishers stated that although there is an abundance of fish in Wuskwatim Lake, it is not economically viable to fly them out. The unreliability of air transportation (e.g., due to weather) can lead to fish spoilage, adding costs to a fishery that is already marginal. The cost of transportation becomes even more significant when the value of the harvest decreases. As of 2001, Freshwater Fish Marketing Corporation decided not to accept pickerel from Wuskwatim Lake because of mercury concentrations (However, it should be noted that sampling conducted for the EIS has indicated that mercury levels in walleye are below the limit for commercial sale [Section 6.9.1.1]. It is assumed that FFMC will review the EIS data and the status of Wuskwatim Lake walleye). Lower revenues generated by other fish species reduce the feasibility of operating a viable fishery on the lake where air transportation is presently the only option for delivering fish to the plant.

As a result of CRD, erosion and debris levels at Wuskwatim Lake have increased since 1976. Local fishers stated that eroding shorelines require that campsites and docks be relocated on a regular basis. Fishers also reported that debris affects navigation, is a safety concern, and also affects fishing efforts by becoming entangled in nets, which increases net maintenance. Fishers stated that it is often difficult to find set locations where debris can be avoided. Fishers generally avoid areas with currents and target protected areas such as behind islands. To reduce net maintenance, fishers will often set just one or two net panels (100 yards long).

Other Lakes

Opegano Lake is the only other lake within the study area that has been assigned a commercial quota by Manitoba Fisheries Branch (1500 kg of pickerel and lake whitefish). However, because it is only accessible by air and has a small quota, it has never been fished commercially. Birch Tree Lake has not been assigned a quota because there has never been interest to fish it commercially (pers. comm. D. Macdonald, 2002).

8.3.2 Impacts and Mitigation

Positive and negative effects to commercial fishing during construction and operation of the Project have the potential to occur as a result of the following:

- increased access;
- presence of a large workforce;
- disturbances from Project construction;
- disturbances from Project operation;
- change in water level regime and flows; and
- increased wage economy.

Increased Access

The Wuskwatim road will facilitate access to Wuskwatim Lake. Once the road is completed, NCN commercial fishers will have an interest using it to access the lake and to transport their catch to the Nelson House fish plant. The extent to which commercial fishers are allowed to use the access road will depend on measures implemented by NCN and Manitoba Hydro. During construction, access will be controlled at PR 391 by a staffed gate and will be limited to construction crews. Access by commercial fishers will occur by special arrangement only. NCN and Manitoba Hydro, in consultation with the Nelson House Resource Management Board, are developing an Access Management Plan. Measures included in the Plan will influence the accessibility to Wuskwatim Lake by commercial fishers and other resource users during and after construction.

The access road to the Wuskwatim GS will provide a cost effective mode of transportation for de1ivering commercial fish catches from Wuskwatim Lake to the Nelson House fish plant. Transportation by truck will result in a cost saving of approximately \$1.20/kg of fish compared to air transportation (based on road transportation costs of \$0.10/kg and air transportation costs of \$1.30/kg in 2001 dollars). Based on the average harvest from 1988-1999 (6534 kg) this would result in a net annual saving of \$7,841 (2001 dollars) annually. The value of the increased access will change annually in relation to harvests.

The average gross revenue from the Wuskwatim Lake commercial fishery, excluding subsidies, over the last ten years of significant harvests (1988-1999) was \$9,148 (2001 dollars) annually (or \$1.40/kg). However, the value of the fishery on an annual basis is highly dependent on the species of fish harvested and sold. As discussed previously, Freshwater Fish Marketing Corporation is not currently accepting walleye from Wuskwatim Lake because of mercury levels (Section 8.3.1). Without harvesting walleye, the value of each kg of fish harvested from Wuskwatim Lake decreases significantly. As discussed previously, recent sampling conducted for the EIS has indicated that mercury levels in walleye are now below the limit for commercial sale [Section 6.9.1.1]. It is assumed that FFMC will review the EIS data and the status of Wuskwatim Lake walleye.

Regardless of whether walleye are harvested, road access will make it more cost effective to harvest fish of lesser value (e.g., tullibee). Consequently, it is likely that if the commercial fishery resumes, annual total harvests of species other than walleye will increase with road access compared to recent historical values.

Overall, the cost savings associated with road access will have a large, positive, long-term effect on the Wuskwatim Lake and Nelson House commercial fisheries.

As discussed in Section 8.2.2, depending on measures in the Access Management Plan, domestic fishing effort may also increase on Wuskwatim Lake with increased access. While domestic harvests could approach those from Threepoint Lake (estimated from

Harvest Calendar data at 1,605 fish weighing approximately 1,621 kg in 2000/2001), it is probable that in the short term the actual domestic harvest will be much lower (moderated by the distance from Nelson House and the perception of high mercury levels). A domestic harvest equivalent to the harvest from Threepoint Lake would amount to approximately 13% of the average commercial catch from Wuskwatim Lake from 1988 to 2000 (1,621 kg compared to 12,389 kg). Such a harvest would have a large negative effect on the commercial fishery. The actual magnitude of the effect over the long term is uncertain, as it is difficult to predict future traditional resource use activity.

Access to Wuskwatim Lake by **recreational** fishers will be determined by measures in the Access Management Plan. It is expected that recreational fishers from outside the workforce will not be allowed to use the access road during construction. If access is provided during operation, there will be an interest by recreational fishers to travel to Wuskwatim Lake. Wuskwatim Lake has a relatively high gillnet catch-per-unit-effort compared to other road accessible lakes in the area such as Wapisu and Notigi, and it is expected that some recreational fishing effort would be re-directed to the lake after completion of the Project. Over the short-term, the effects from increased recreational fishing on the commercial fishery are expected to be small. However, levels of recreational fishing could increase in the future and have a more noticeable effect on the commercial fishery.

Although the ultimate harvest levels and magnitude of effects are uncertain, the combined effect of increased domestic and recreational fishing pressure on Wuskwatim Lake has the potential to have a long-term negative effect on the fish population and, ultimately, on the commercial fishery. This will offset to some degree, the large long-term positive effects to the commercial fishery resulting from savings associated with transportation costs.

Presence of a Large Workforce

During peak construction there will be approximately 600 workers that could potentially fish, 50% of which will be aboriginal and have treaty-fishing rights. Much of the harvesting effort on Wuskwatim Lake, if allowed, is expected to be shore-based and will not result in significant harvests. Whether or not recreational boats will be permitted to use the access road or Project facilities during construction will be determined by the Access Management Plan. If allowed, harvests by aboriginal workers could be substantial, but would be short-term and would have no effect on the commercial fishery in the RMA in the long-term. Measures in the Access Management Plan will dictate the level of recreational and domestic harvest that occurs by the workforce on Wuskwatim Lake.

Disturbances From Project Construction

Disturbances from Project construction activities (such as noise and dust) will change the environmental setting for commercial fishers working on the lake. The perceived change will be moderated to some extent by the location of the current fish camp, which is situated at least 6 km from the construction site at the south end of the lake. Construction activities will also be a safety concern for commercial fishers. Manitoba Hydro will implement an educational program with regard to construction activities and safety for all resource harvesters allowed on the access road during construction. It is also expected that boat traffic will not be permitted near the construction site. Disturbances from Project construction are expected to have a small short-term negative effect on the Wuskwatim Lake commercial fishery.

Disturbances From Project Operation

Project operation will change the environmental setting on Wuskwatim Lake for commercial fishers and may cause some safety concerns near the station. Manitoba Hydro will implement educational programs and signage in relation to safety concerns for commercial fishers in the area. It is expected that the change in environmental setting will only have a small effect on local commercial fishers. However, the actual effects will depend on perception, and be specific to each individual commercial fisher. Destruction of fish habitat in the footprint of the dam is not expected to have a measurable effect on fish populations in Wuskwatim Lake (Section 6.8.2.2) and, therefore, should have no effect on the commercial fishery

Change to Water Level Regime and Flows

NCN commercial fishers stated that fishing is generally better when water levels are more stable. Stabilized water levels are expected to have a small, positive, long-term effect on fish populations in Wuskwatim Lake (see Section 6.8.2.2) and to the commercial fishery.

Increased water levels on Wuskwatim Lake will increase erosion of shorelines and the level of debris entering the lake. The additional debris will primarily be contained near shore by existing debris mats (Section 5.8.2.2). However, NCN commercial fishers expect that some debris will be mobilized by high water levels and ice and will have a negative short-term effect on fishing conditions and navigation. Floating debris hazards will be monitored and mitigated as required.

Increased water levels in Wuskwatim Lake area expected to result in a small increase in mercury concentrations in walleye, northern pike and whitefish, but with the possible exception of northern pike, mean mercury concentrations are expected to remain below levels of concern for the commercial fishery (Section 6.9.2.2). The abundance of northern pike, which act as the primary host for *Triaenophorus crassus* (a tapeworm which encysts in the flesh of whitefish), is expected to increase marginally as a result of the project, but the degree to which this will affect lake whitefish infestations is uncertain (Section 6.9.2.2). Lake whitefish catches will be monitored to determine if infestation levels change as a result of the project.

Increased Wage Economy

An increase in the wage economy during construction may cause a short-term decrease in the number of individuals interested in commercial fishing. Fishers may be required to choose between commercial fishing and Project employment as the majority of jobs provided to Nelson House residents will occur during existing commercial fishing seasons (spring and fall). The extent to which a decrease in interest occurs will be dependent on the potential return from the fishery (i.e., whether FFMC accepts pickerel from Wuskwatim Lake). If the potential returns are high it is expected that the benefits from increased access will outweigh any wage effects, resulting in a net increase in interest in the fishery. Layoffs during winter could increase interest in a winter commercial fishery. The increased wage economy is expected to have no effect on the commercial fishery.

8.4 COMMERCIAL TRAPPING

8.4.1 Existing Environment

Commercial trapping is an integral component of the social setting and economy in the north. Similar to commercial fishing, it is one of the few sectors of the cash economy in which First Nation people can participate while maintaining their traditional subsistence lifestyle.

In the 1940's the Government of Manitoba developed the registered trapline system to address conflicts between trappers and to improve management of fur resources. The system divided most of the province into relatively large Registered Trapline Districts that were subdivided into individual registered traplines (**RTL**s). Manitoba Conservation allocates RTLs to specific trappers who maintain an individual right to trap within the designated boundary of the trapline. Where RTL Districts are operated as community trapping blocks (such as at Nelson House), a local fur council recommends to Manitoba Conservation the allocation of specific trapping areas to members of the local trapping community. Historical use of areas by individuals or families is often the basis for allocation. The RTL system makes each RTL trapper responsible for managing the harvest of all fur-bearers in his trapline area to ensure sustained production over the years.

Trapping is generally initiated when it is safe to travel after ice first forms on creeks and rivers and when furs are generally in prime condition (between December and March). The majority of trappers have cabins located within or adjacent to their respective RTL areas. Travel to and from cabins and on traplines is generally conducted by snowmobile on trails cleared by the trappers. Traps are set within walking distance of main trapline trails and are generally checked daily (weather permitting).

Costs associated with trapping include snowmobiles, traps, cabin maintenance, gas, etc. The benefits of trapping include the monetary value of the furs and meat, as well as the non-monetary value associated with living a traditional life-style. NCN Elders have stated that the value of meat produced by trapping may, in many cases, exceed the value of the income received from the sale of the furs. For example, beaver meat is an important food source for trappers and is often consumed in place of store bought food.

The cash income generated from commercial trapping is important not only for subsistence, but also to support other subsistence activities such as hunting. Cash can often be a scarce resource in a traditional way of life. Income from the sale of furs can be used to buy snowmobiles, boats, guns, traps, ammunition, gas, and oil.

The study area for this assessment lies entirely within the Nelson House RTL District, which is located within the Nelson House RMA. The Nelson House RTL District is the seventh largest in the province with an area of 22,975 km^2 and a total of 54 registered traplines (Figure 8.4-1). The Nelson House Local Fur Council assigns traplines within the RTL. Trapline 49 is retained as a community trapline for educational purposes, hobby trapping, and Elders. Trapline 53 is reserved for youth trapping.

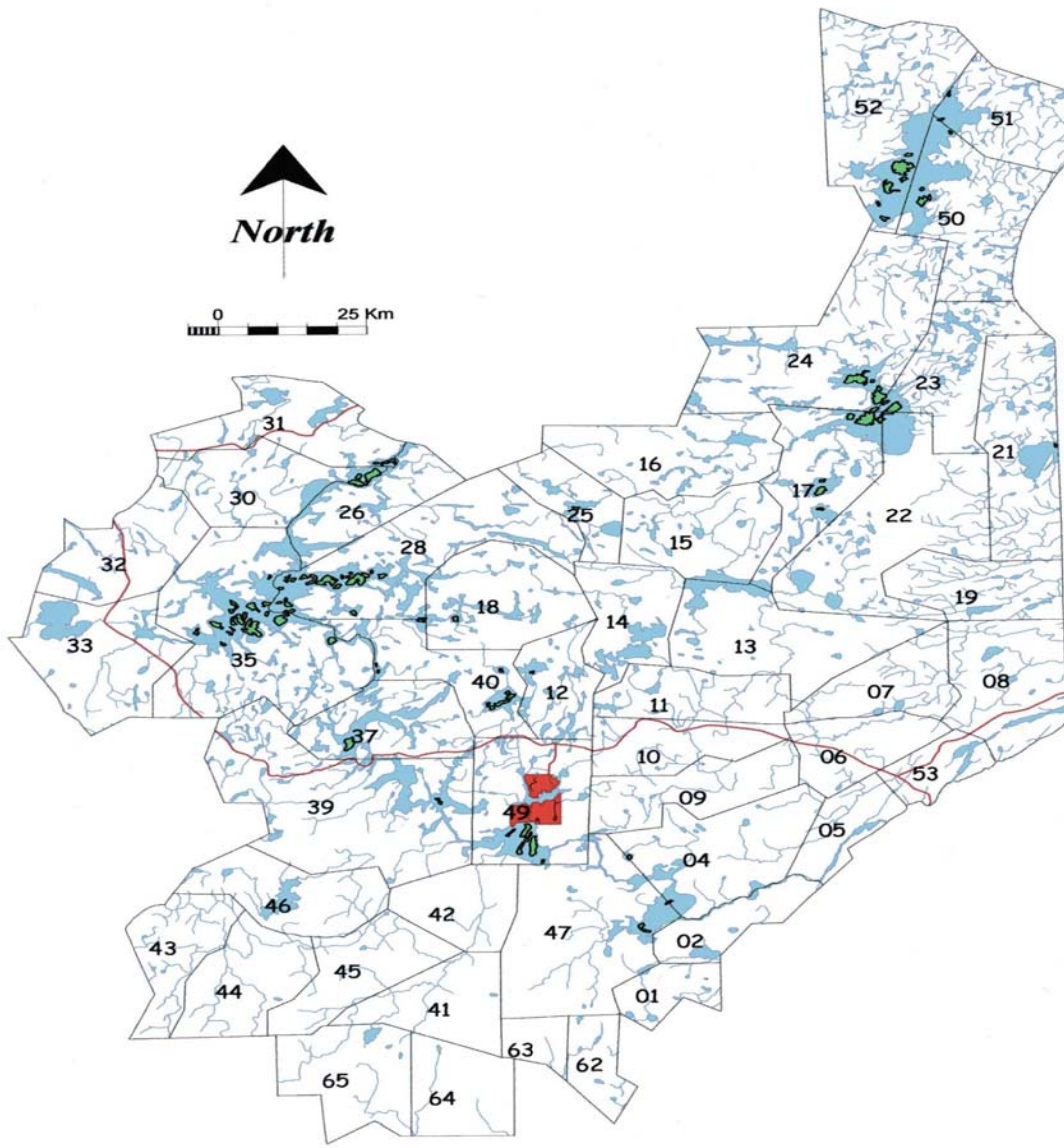


Figure 8.4-1. Registered traplines within the Nelson House Resource Management Area.

The primary species targeted by commercial trappers within the Nelson House Trapping District include: beaver, muskrat, ermine, fisher, red fox, lynx, marten, mink, otter, and squirrel. Wolf, wolverine, arctic fox, and bear are also harvested, but in lesser numbers, and coyote and raccoon are harvested infrequently. Trappers reported that wolf numbers have decreased in recent years, while lynx, beaver, and marten populations have been increasing. Trappers sell their furs to the Northern Store or to private fur buyers, who then sell the fur at auctions in the south.

Between 1976 and 1990, the number of individuals reporting harvests from RTLs in the Nelson House RTL District averaged approximately 129 annually. After 1990, the number of trappers reporting harvests from the RTL District dropped to an average of 53 annually. The number of traplines from which harvests were reported peaked in 1979/1980 at 46. Harvests were reported from 23 traplines in 2001/2002.

The value of annual harvests from the Nelson House RTL District since 1976 peaked in 1978/1979 at $1,135,140 (2002 dollars). Annual harvest value decreased to $197,196 by 1981/1982 and remained relatively stable during the remainder of the 1980s, averaging $179,378 before dropping again in 1989/1990 to $50,302 (Figure 8.4-2). The annual harvest value from 1989/1990 to 2001/2002 was $53,130, or 14% of the average reported from the previous 14 years ($370,166 annually). The value of the harvest in 2001/2002 was $30,348. Declining fur prices is the key factor that contributed to the reduction in effort and harvests during the early 1980s. Local trappers attribute some of the decrease in value to a decrease in the number of animals and quality of fur in the RMA since construction of CRD in the mid-1970s.

In terms of animal numbers, muskrat and beaver have comprised the greatest proportion of the trapping harvest since 1976, representing approximately 38% and 30% of the annual harvest, respectively. However, in six of the last nine years (1991/1992 to 2001/2002), muskrat have comprised less than 10% of the animals harvested. In contrast, the proportion of marten harvested increased from less than 5% annually from 1976/1977 to 1987/1988 to more than 48% of the annual harvest in the last three years (1999/2000-2001/2002). NCN resource harvesters noted that marten numbers have been increasing in the RMA in recent years and attribute the decrease in muskrat harvests to the effects of CRD. It is probable that fur prices have also had a significant influence on types and quantities of species harvested.

Access is an important limiting factor in the level of harvest in the NCN RTL District, particularly in the trapline areas south of the Burntwood River (pers. comm. NCN Resource Programs staff, 2002). The primary concerns are safety and travel conditions

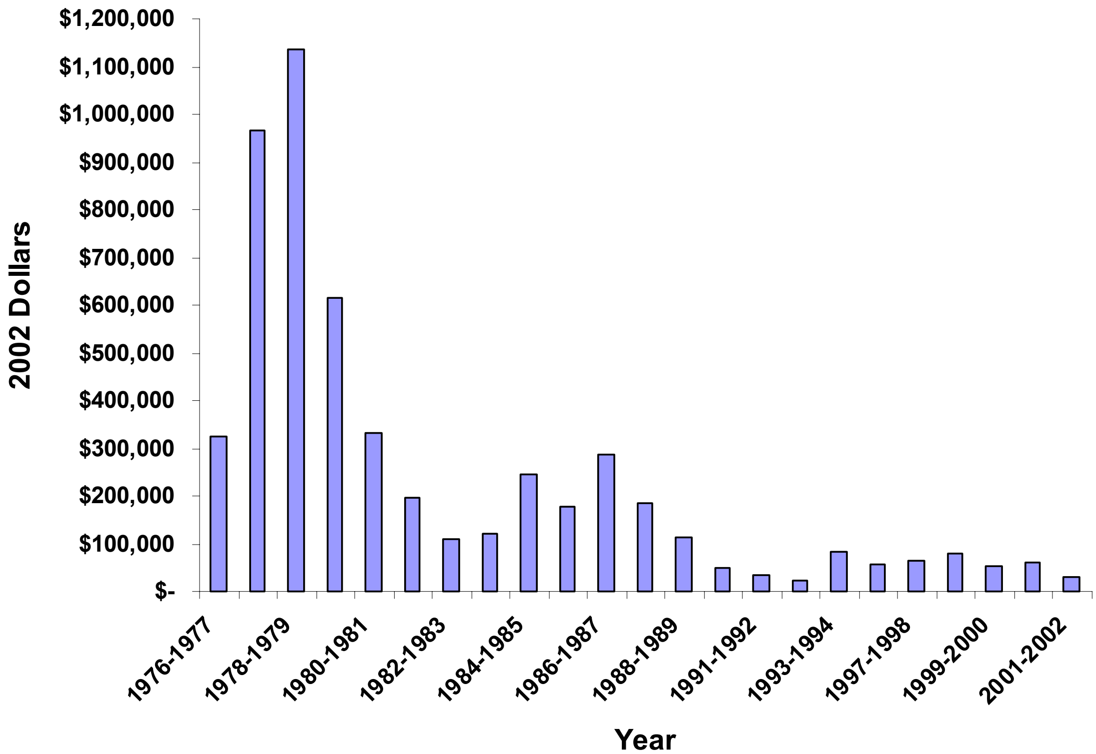


Figure 8.4-2. Annual value of commercial trapping harvests in the NCN RTL District from 1976-2002.

on waterbodies affected by CRD. Local trappers stated that slush and unstable ice prevent travel on the main waterbodies, and fluctuating water levels create unstable ice along the shorelines and in tributaries including small creeks. For example, trappers reported that the old Wabowden Bombardier trail, which runs south from the Burntwood River near Wuskwatim Lake, is difficult to traverse due to uncertain ice conditions on smaller creeks caused by the effects of CRD. Debris is also reported to hinder travel along shorelines, especially on the southeast shore of Wuskwatim Lake. Trappers stated that trails to some areas (including those to and around the Wuskwatim Lake area) have deteriorated because of a lack of maintenance and decreased use over the past generation. Manitoba Hydro is responsible for mitigating adverse effects from its operations on travel and access along affected waterways and undertakes a number of safety provisions in this regard, including safe ice trails, navigational aids, and debris management.

Of 54 traplines in the Nelson House RTL District, 16 are directly accessible by road. The average annual harvest value since 1976 from traplines with road access ($7,474) is more than double the average harvest value from traplines without road access ($2,936) (Figure 8.4-3).

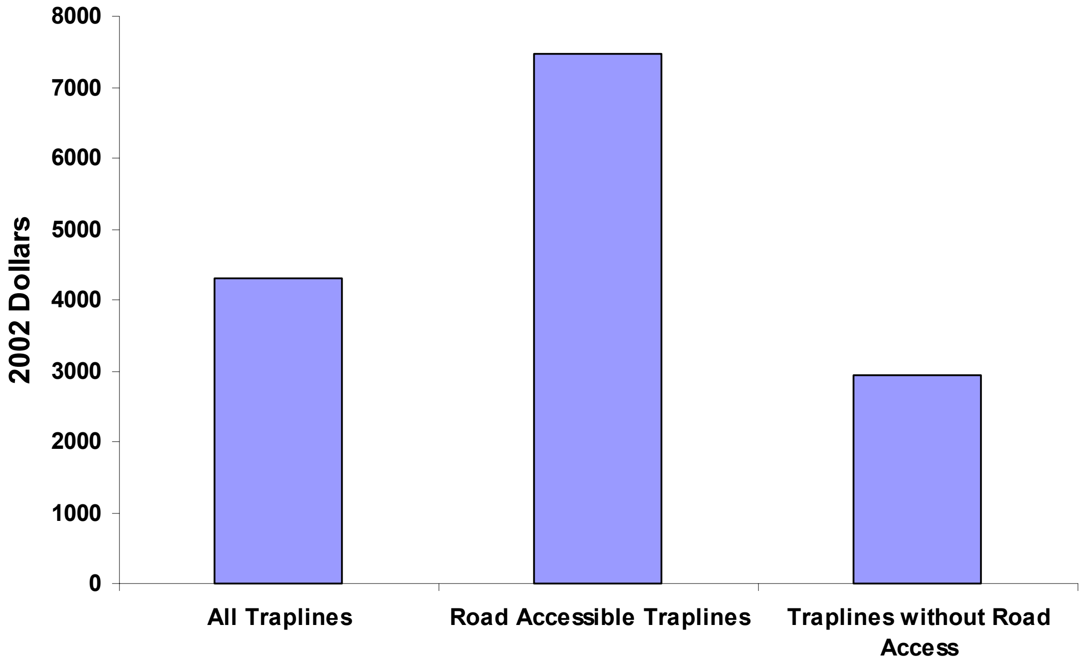


Figure 8.4-3 Average annual harvest value from Nelson House RTL District traplines with and without road access, 1976-2002.

Traplines 2, 4, 9, and 47 have the most potential to be directly affected by the Project. Since 1976, these traplines have produced from 2% to 11% (average of 8%) of the total annual value of the Nelson House RTL District harvest and rank from 9th (Trapline 4, on the north side of the Burntwood River) to 38st (Trapline 2, on the south side of the Burntwood River) in average total annual production value. During this period, the average annual production value from each of these traplines ($4,443) was similar to the average production value from all other traplines in the RTL District ($4,278).

8.4.2 Impacts and mitigation

Positive and negative effects to commercial trapping during construction and operation of the Project have the potential to occur as a result of the following:

- increased access;
- disturbances from Project construction;
- disturbances from Project operation;
- change in water level regime and flows; and
- increased wage economy.

<u>Increased Access</u>

The road to the Wuskwatim GS will provide direct access into or to the edge of four RTLs that have not previously had road access (traplines 2, 4, 9, 47, Figure 8.4.1). Commercial trappers holding the affected traplines will have an interest in using the road to access their traplines. The extent to which the trappers will be allowed to use the access road will depend on measures implemented by NCN and Manitoba Hydro. During construction, access will be controlled at PR 391 by a staffed gate and will be limited to construction crews. Access by commercial trappers will occur by special arrangement only. NCN and Manitoba Hydro, in consultation with the Nelson House Resource Management Board, are developing an Access Management Plan. Measures included in the Plan will influence how accessible the Wuskwatim Lake area will be to commercial trappers and other resource users during and after construction.

If commercial trappers are provided road access they would be able to drive directly into RTLs 4 and 9 and to Wuskwatim Lake but would still need to travel across the lake to access traplines to the south of the Burntwood River (e.g., 2, 47). Completion of the generating station will provide a means of safe passage across the Burntwood River during all seasons and would provide an additional level of safety for accessing traplines 2 and 47 and other traplines further to the south. The Access Management Plan will determine whether commercial trappers are provided access across the generating station.

During interviews, commercial trappers indicated that increased safety and reduced transportation costs associated with road access would facilitate increased harvests from affected traplines. From 1976-2002, average annual production from road accessible RTLs in the Nelson House RTL District was $7,474 (2002 dollars) compared to an average annual production value of $4,434 (2002 dollars) from traplines 2, 4, 9, and 47.

It can be expected that increased access will facilitate increased productivity from these traplines. According to NCN Resource Programs staff, production may also increase from other traplines south of the Burntwood River that have been difficult to access since completion of CRD (e.g., trapline 1, 62, 63).

If domestic and recreational resource harvesters also gain access to the area they are not expected to have any noticeable effect on the number of animals available for commercial trappers. Harvests of furbearers by domestic and recreational resource users are expected to be negligible. According to NCN Resources Program staff, domestic resource users generally do not harvest furbearers on RTLs held by other individuals.

Overall, increased access is expected to have a large, positive, long-term effect on commercial trapping in the Wuskwatim area by facilitating travel and decreasing costs.

Disturbances from Project Construction

During interviews with commercial trappers it was suggested that construction noises would frighten animals and cause them to avoid the Wuskwatim area during the construction period. Construction activity and the associated increase in number of people and traffic are expected to cause a redistribution of animals in the area, but not to have a significant effect on the overall abundance of animals (Section 7.9.2.2). Increased traffic may cause a reduction in the number of animals found near roads. The overall impact of animal redistribution on trapping is expected to be small and short-term. Loss of habitat associated with station construction, borrow pits, and the access road is expected to have a small long-term negative effect on animal populations in the area. However, the reduction in animal populations is expected to be too small to measure (see Section 7.9.2.2) and should have no detectable effect on commercial trapping production.

Safety concerns for trappers during the construction period will be addressed in the Access Management Plan.

Disturbances from Project Operation

Traffic and noise associated with access road use, operating noises, and the presence of the generating station will result in a change in the environmental setting of traplines 2, 4 and 9. Although these changes are expected to have only a small negative effect on local commercial trappers, the actual effects will depend on perception and be specific to each individual trapper. According to NCN Resource Program managers, there will likely be a desire by some trappers to construct cabins along the access road despite the potential disturbances.

Change in Water Level Regime and Flows

Alterations to water levels and flows will have direct effects on traplines 2, 4, 5, 9, and 47 (Figure 8.4.1). Changes to shorelines as a result of changes to the water regime upstream and downstream of the generating station are expected to have no effect on furbearer abundance (see Section 7.9.2.2). A small increase in near-shore debris (see Section 5.8.2.2) will make it incrementally more difficult for trappers to access shorelines from Wuskwatim Lake. Existing dangerous travel conditions on the Burntwood River downstream of the Taskinigup Falls will remain after construction of the Project. Commercial trappers have concerns that trails currently used for travel will become flooded and pose a danger for winter travel. This may occur on portions of some trails situated immediately adjacent to the Burntwood River and Wuskwatim Lake; however, no changes to winter ice conditions are expected on Wuskwatim Lake (Section 5.4.2.2).

Effects related to changes in water levels and flows are expected to be neutral in relation to commercial trapping activity

Increased Wage Economy

During Project construction, a large part of the local labour force will be laid off during winter months when most commercial trapping is conducted, and will have income available to purchase trapping equipment (e.g., snowmobiles). Consequently, the increase in wage economy during construction could result in a small short-term increase in commercial trapping activity in the Nelson House RTL District. The long-term effect of an increased wage economy on commercial trapping is uncertain.

8.5 COMMERCIAL FORESTRY

8.5.1 Existing Environment

Manitoba's commercial forest industry contributes approximately $480 million in export sales to the provincial economy (Natural Resources Canada 1999). Approximately 2.2 million m^3 of timber are harvested annually within the province (Manitoba Conservation 2001) of which approximately 770,000 m^3 are harvested north of the 53rd parallel (Hunt et al. 1997 & 1998; Ksiezopolski et al. 1999; Sullivan et al. 2000 & 2001).

8.5.1.1 Forest Management Responsibilities

The Province of Manitoba retains the responsibility to administer all resources, including forests on Crown lands. This falls within the jurisdiction of Manitoba Conservation and, for the timber resources, specifically with the Forestry Branch. The Forestry Branch is responsible for calculating the **annual allowable cut** (AAC) and allocating available timber volumes to industry and private individuals through mechanisms such as the **Forest Management License** (FML), **Timber Sale**, **Timber Permit** and **Timber Quota System**.

The principal timber allocation mechanism in the Wuskwatim study region is the FML, which is held by Tolko Industries Ltd. (Tolko). Periodic license renewals are subject to the submission of 10-Year **Forest Management Plans** and their environmental review, approval, and licensing by Manitoba Conservation.

8.5.1.2 Land Ownership and Forest Distribution

Manitoba Conservation Forestry Branch has divided the commercial forestry zone into administrative units known as **Forest Sections** and **Forest Management Units** (FMU) (Figure 3.1, Volume 6). The bulk of the Wuskwatim region and all of the Wuskwatim sub-region are contained within the **Nelson River Forest Section** (NRFS), thus study area conditions are characteristic of the Forest Section. For commercial forestry aspects, an overview of the Forest Sections and specific FMUs are provided as these are the units at which forestry resources are administered.

According to the Manitoba **Forest Resource Inventory**, only 0.3% of the NRFS is privately owned. The area is classified as 39% **productive forest land** (capable of producing **merchantable** wood) and 61% **non-productive land** (Table 8.5-1, Figure 8.5-1). From a timber volume perspective 77% of the current merchantable volume is **softwood** (conifer species).

Table 8.5-1 Nelson River Forest Section Land Cover Distribution

Status & Ownership	Total Land (ha)	Water (ha)	Total Area (ha)	% Land of Total Area	% Productive Forest land of Total Land Area	% Non-Productive Land[1] of Total Land Area
All Status & Ownerships[2]	3 897 455	601 855	4 499 310	87	39	61
Crown Land Open	3 835 919	588 722	4 424 641	87	39	61
Private	13 274	1210	14 484	92	44	56

Source: Manitoba Conservation 2001.

[1] Includes forested and non-forested lands.

[2] Note that "All Status & Ownership" includes "Crown Land Open" and "Closed"

8.5.1.3 The NRFS AAC, Timber Harvest and Wildfire

The current annual allowable cuts for the NRFS are 1,022,000 m^3 and 328,800 m^3 of softwood and **hardwood** respectively, of which only 30% of the softwood and 1% of the hardwood were harvested between 1996 and 2001 (Manitoba Conservation 2001), leaving a considerable surplus. The bulk of the harvest activities take place in FMUs 83, 84 and 85 east of PTH #6 (Figure 8.5-1, and Volume 7, Section 5.1, Figure 5.1-2, Table 5.1-5). The area currently harvested annually within these FMUs equates to approximately 2,500 hectares.

Wildfires are a dominant influence in the study area and the NRFS; however, amounts burnt are not consistent from year to year. The severity of a fire season is directly linked to local and regional climatic conditions where hot, dry summers can cause highly volatile conditions. Fires consumed an average of 28,095 hectares annually between 1976 and 2000 (51% productive forest and 49% non-productive land) (Manitoba Conservation 2001), which was more than 10 times the area harvested commercially.

8.5.1.4 Tolko Industries Ltd.

Tolko Industries Ltd. (Tolko) at The Pas owns and operates a kraft pulp and paper mill and a modern small-dimension sawmill. For the 2001 calendar year a total of 831,000 m^3 of softwood were harvested from **Forest Management License Area** (FMLA) #2 (Sullivan et al. 2002). Of this, 292,000 m^3 (35 % and approx. 2,430 ha) were harvested from the NRFS much of which overlaps the Wuskwatim study region (Figure 8.5-1 and Volume 6, Figure 6.3-1). The remaining supply was harvested from other FMUs within FMLA #2 or acquired through other mechanisms (including purchase) from outside of the FMLA.

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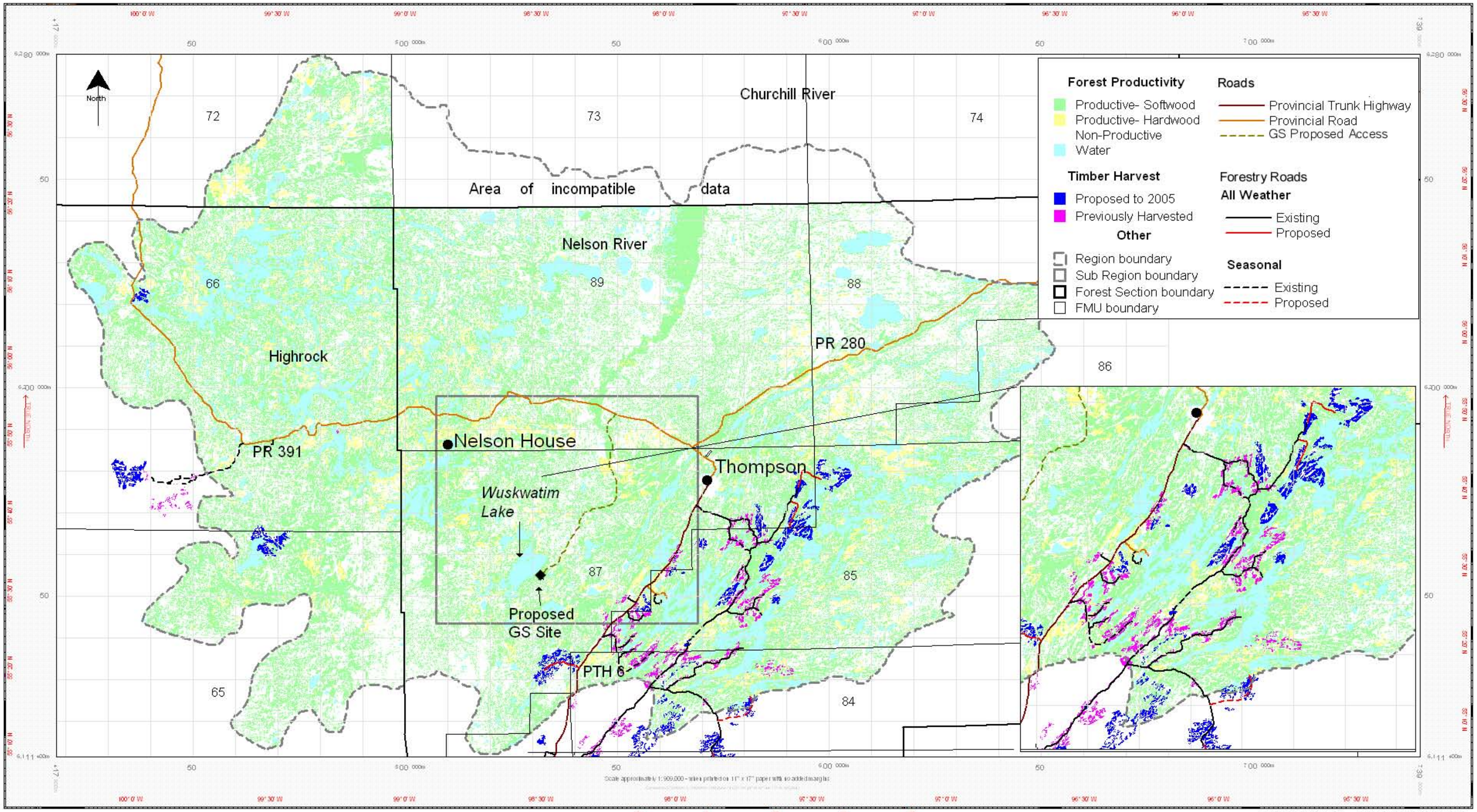

Source: Manitoba Conservation for 1:15,840 FRI Data
Manitoba Hydro for NTS Features
Tolko Industries for Harvest Data and Logging Roads
Incomplete forestry road information west of nelson house
Previous harvest data up to 2000
Data for FMU 73 and 74 not shown due to incompatible data

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Figure 8.5-1 Productive and Non-productive Lands with Historic and Proposed Timber Harvest and Access Development (to 2005).

As the FML holder, Tolko is responsible for all forest management planning, implementation, and administration for all softwood (except special allocations or salvage that are handled by Manitoba Conservation) within the license area, including **third party operations**. Responsibilities include the preparation of a 10-year (some flexibility is allowed) forest management plan and annual harvest and renewal plans. These plans respectively outline the general and specific locations of company operations including harvesting, forest renewal and road construction. Tolko's current license issued under the Manitoba Environment Act covers the 1997 – 2009 Forest Management Plan submitted in 1996 by the former FMLA #2 holder Repap Manitoba Inc.

Recent Activities

The Wuskwatim sub-region partially encompasses FMUs 87 and 89 (Figure 8.5-1). Currently, softwood AAC surpluses in these management units remain at 96% and 100% respectively. Tolko engages Nelson House Forest Industries to harvest timber on a contract basis within the region.

Roads are required to access timber; however, where possible this is limited to seasonal roads, and all-weather roads are decommissioned when planning objectives are met. A total of 67 km of roads with three culverts were constructed in the region between 1997 and 2001 (Hunt et al. 1997 & 1998; Ksiezopolski et al. 1999; Sullivan et al. 2000 & 2001). Forest renewal keeps pace with harvesting thus mitigating transitory impacts. All harvested sites must be reforested to government standards within set time lines.

Proposed Activities

Tolko plans to increase annual harvesting levels within the Wuskwatim region by approximately 52% by 2005. This is in contrast to a projected 13% decrease in harvest for the broader area. Supporting access requirements include 39 km of roads and three bridges (Figure 8.5-1 and Volume 7, Table 5.1-9, Figure 5.1-3) (Tolko 2002).

8.5.1.5 Third Party Operators/Allocation Holders

Third party operators include quota, allocation and permit holders. There are two quota holders in the Wuskwatim region with a combined volume of 13,230 m^3 of softwood. Although the International Nickel Company of Canada (INCO) maintains its softwood allocation within the region, the company does not exercise its right to harvest timber.

8.5.1.6 Forest Research/Monitoring

The Canadian Forest Service, Manitoba Conservation and Tolko are actively involved in research and monitoring activities within the region relative to forest growth and yield, health, tree improvement, ecology and forest renewal. These are summarized in Volume 1, Section 8.9 and discussed in greater detail in Volume 7, Section 5.1.3.6, and Appendix 7.5.1-3.

8.5.2 Forestry Impact Definition

Effects on forestry resources from the construction and operation of the Generation Project can occur as a result of clearing (access road, borrow pits and generating station footprint), flooding, and erosion, all of which are limited to the confines of the sub-region (Volume 6, Figure 6.3-1). All forestry impacts are contained within Management Units 87 and 89 and are best described at this level. These are summarized in Table 8.5-2.

Table 8.5-2. Summary of Project Impacts

Impact	Area (ha)
Clearing[1]	1566
Flooding	38
Erosion[2]	45
Total	**1649**

[1] Includes the GS footprint in its entirety.
[2] Incremental erosion up to 2034 (Volume 4, Section. 6).
Only the first 5 years of erosion impacts (27 ha) are included in the impact on the AAC calculations.

The project area is largely forested. Therefore, clearing, flooding, and erosion will result in the removal of forest resources (temporarily and permanently). Clearing and flooding related impacts occur during construction whereas erosion impacts are gradual over the life span (100 years) of the project. From a commercial forestry perspective, forest cover removal results in a number of impacts, which include:

- forested area loss;
- standing timber volume loss;
- reduction in the AAC; and
- area withdrawal from FMLA #2.

8.5.2.1 Area Impact

All mentioned impacts result in forest resource losses. Excluding projected erosion impacts beyond the year 2014, impacts from clearing, flooding, and erosion equate to 1,631 ha of which 1,417 (87%) are classified as productive forest lands and 214 ha (13%) are non-productive lands (Volume 7, Section 5.2.1.1.1, Table 5.2-2). All of these lands are classified within the forest resource inventory as Crown owned and **open** to commercial forest harvesting and other development. Of the affected productive forestlands, 58% are under young **cutting classes** (CC 0, 1, 2) that currently have no commercial timber value. Another 31% of the area is categorized as immature timber stands (CC 3) which may or may not be merchantable. The remaining 11% consist of mature forest stands (CC 4, 5), which are considered commercially merchantable.

8.5.2.2 Volume Impact

A total of 61,660 m^3 of softwood and 10,060 m^3 of hardwood may be affected by the Project. These numbers reflect the softwood dominant nature of the northern Boreal forest. Although CC 0, 1, and 2 represent 58% of the total productive area affected, they account for only 30% (21,560 m^3) of the volume affected. The immature (CC 3) and mature (CC 4, 5) groups account for 47% (33,610 m^3) and 23% (16,540 m^3) of the volume respectively. An impact summary on area and volume is provided below.

Table 8.5-3. Area and Volume Impact Summary

	Impact Area (ha)				Volume Impact	
FMU	**Productive Land**	**Non-productive Land**	**Total**	**% of Total Area**	**m^3**	**% of Total**
87	1352	184	1536	94	68090	95
89	65	30	95	6	3630	5
Total	**1417**	**214**	**1631**	**100**	**71720**	**100**

8.5.2.3 Effects on the AAC

As re-calculating the AAC is complex and time consuming, Manitoba Conservation suggested a simplified alternative approach for estimating the effect on the AAC. This entails calculating the effect on each major species by FMU as a percent of productive forest land affected. The applicable percentage factor is then applied to each **working group** AAC volume (pers. comm. Carlson 2001). This approach has been adopted in this analysis. Two perspectives are presented: a) Project effects on CCs 4 and 5 only; and b) Project effects on all productive forest lands (all cutting classes). Where the first scenario focuses on effects on current operational AACs and harvest levels, the second provides a perspective of Project effects on the long-term timber resource sustainability. Neither approach gives an accurate account of AAC reduction as a result of Project effects but rather estimates effects on the AAC.

Operational AAC

For purposes of this study the operational AAC considers mature forest stands (CCs 4 and 5) and Project effects on them, as these are the stands currently targeted for harvest. Cumulative area effects affecting FMUs 87 and 89 amount to 147 ha of softwood representing 0.33% of all CC 4 and 5 softwood **working groups**. Only 4 ha of CC 4 and 5 hardwood working group area are impacted affecting 0.05% of that total area (Volume 7, Section 5.2.2.1). Thus, estimated Project effects on current operational AACs for FMUs 87 and 89 are minimal (Table 8.5-4). Translated to volume, the highest estimated losses of AAC for both softwoods and hardwoods are to FMU 87. In total, AAC reductions amount to approximately 1221 m^3 (0.6%) of softwood and 25 m^3 (0.0%) of hardwood **net merchantable** volume.

Table 8.5-4 AAC Impact Summary and Balance (Net Merchantable)

	Softwood Volume (m^3)				Hardwood Volume (m^3)			
FMU	**AAC**	**Impact**	**AAC Balance**	**% Impact on AAC**	**AAC**	**Impact**	**AAC Balance**	**% Impact on AAC**
87	144550	1174	143376	**0.8**	39440	25	39415	**0.1**
89	54580	47	54533	**0.1**	20730	0	20730	**0.0**
Total	**199130**	**1221**	**197909**	**0.6**	**46740**	**25**	**46715**	**0.0**

Timber Resource Sustainability

Among other inputs, AAC values are a function of productive forest land, species, and cutting class CC distribution. Reviewing Project effects on productive forest lands and species groups (softwood/hardwood) provides a perspective on the larger picture of long-term resource sustainability.

Project effects within FMUs 87 and 89 amount to 1336 ha of softwood and 81 ha of hardwood. These represent 0.4% and 0.2% respectively of the aforementioned species groups on productive forest lands within these FMUs (Volume 7, Section 5.2.4.1.2). These effects are insignificant on the long-term timber resource sustainability.

8.5.2.4 Effects on the Forest Industry

AAC Reduction

The reductions to the AACs in FMUs 87 and 89 will have no immediate effect on current harvest levels by the FML holder or third party operators as these are well below the current AAC levels (Volume 7, Section 5.2.2.2).

Area Withdrawal

All of the area affected by the Generation Project is under FMLA #2 held by Tolko Industries Ltd. Although Manitoba reserves the right to withdraw certain areas from the FMLA for other development, limits on withdrawals are specified in the FML Agreement as 5% of the productive forest land base over a 100-year period and 0.5% over a 10-year period. These are specific to each Forest Section and equate to 5,360 ha for the NRFS for the 10-year period 1999 to 2009. The withdrawal of 1,417 ha of productive forest lands from the FMLA for Project purposes amounts to 26.4% of the 10-year allowable withdrawal, well within the period limits.

8.5.2.5 Forest Research/Monitoring

Forest research and monitoring activities and sites have been documented within the Wuskwatim region (Volume 1, Section 8.9 and Volume 7, Section 5.1.3.6). Impacts are not expected as concerns identified to date have been mitigated during project planning.

8.5.2.6 Mitigation

Clearing requirements will be well planned and carefully monitored during clearing operations to minimize the amount cleared. Where logistically and economically feasible, merchantable timber will be salvaged. Those sites not required after project construction will be rehabilitated.

Provincial **forest damage fees** and **timber dues** are generally applied to CC 1 to 5 forest stands. If applicable, they will be calculated by Manitoba Conservation at the time of impact.

8.6 COMMERCIAL MINING

8.6.1 Existing Environment

The Thompson Nickel Belt runs through the eastern edge of the Nelson House RMA, reaching the outlet of Opegano Lake along its westernmost edge. Despite this, there is relatively little mining activity in the RMA. There are a number of mining claim sites and several exploration licenses throughout the RMA; however, there are no operating mines in the Nelson House RMA, other than infrequent aggregate quarries (pers. comm. Assessment Geologist, Assessment/Exploration Section, Mineral Mines Section, Industry, Trades and Mines, Government of Manitoba, March, 2002).

8.6.1.1 Mining Claims

The RMA includes several mining claims. A mining claim is a parcel of Crown mineral land used to explore for and develop minerals. There are two areas partially within the RMA designated as Available for Claim Staking Only and the majority of mining claim sites located within the RMA are within or adjacent to these areas.

8.6.1.2 Exploration Licenses

In addition to mining claims in the RMA, there are also several exploration licenses. Under the Provincial Mines and Minerals Act, exploration licenses are used to reserve a large area of Crown land for mineral exploration (pers. comm. Executive Vice-President, Mining Association of Manitoba, March 2002)

There are currently three active exploration licenses within the Nelson House RMA – one fully within the RMA and two partially within the RMA. These exploration licenses occur along the northeast boundary of the RMA and two extend into the Split Lake RMA.

8.6.2 Effects and mitigation

Creation of the access road will be the primary source of effect from the Project on mining activities in the Nelson House RMA. The road may make it easier to access the Wuskwatim Lake area, as well as areas north and south of the Burntwood River.

8.6.2.1 During Construction

Mining activities in the Nelson House RMA are not expected to change during Project construction. During this time, use of the access road will be controlled at PR 391 with a staffed gate and access will generally be limited to those people working on the Project.

8.6.2.2 During Operations

Once the Project is in operation, effects on mining activities in the Nelson House RMA are expected to be minimal. The access road will improve access to the area and could result in increased mineral exploration activity in the Wuskwatim area; however, this access may be limited depending on the final terms of the operations portion of the Access Management Plan.

Even with the increased access created by the access road, substantial increases in mining activity are not anticipated, based on current activity and interest in the area.

8.7 RECREATIONAL FISHING AND HUNTING

8.7.1 Existing Environment

Recreational fishing and hunting as discussed in this section is restricted to non-aboriginals. Fishing and hunting by aboriginals is discussed under traditional resource use (Section 8.2).

Recreational fishing pressure in the Nelson House RMA is relatively low compared to areas southwest of Thompson (e.g., Paint Lake) and near Snow Lake (e.g., Wekusko Lake, pers. comm. D. Macdonald, 2002). The primary locations targeted by recreational fishers during the open-water season are road accessible and include Footprint, Wapisu, and Notigi lakes. The base of the Notigi Control Structure is a popular location for shore-based fishers, and RC Channel at Nelson House and Leftrook Lake are popular destinations for ice-fishers from Thompson. Tourists are known to fish in the RMA but generally focus their effort in areas to the south and north of the RMA. Some tourists are known to utilize Wapisu and Notigi lakes, and the Suwannee River to access Rat Lake. Recreational fishing at Wuskwatim Lake is limited by access and is currently negligible.

Recreational hunting within the RMA is relatively low compared to other areas northeast and southwest of Thompson. The Nelson House RMA lies within Game Hunting Areas 9 and 9a, which have a general resident rifle season for moose during September and October and in December; an archery moose season during August and September; and a non-resident rifle moose season during September and October. Harvests are generally restricted to one bull or calf moose per hunter. The Rat River system and Birch Tree Creek, as well as areas adjacent to PR 391, receive some local moose hunting effort. Resident and non-resident moose harvests from Game Hunting Areas 9 and 9a, of which the Nelson House RMA comprises approximately 20% of the area, averaged 114 animals annually from 1993/94 to 2000/01 (data from Manitoba Conservation). Based on these data it can be assumed that the recreational moose harvest from the RMA has averaged less than 23 animals annually. A small amount of bear hunting, some through outfitters based out of Thompson (see Section 8.8.1.2), also occurs in the area during spring and fall. The harvest is limited to one adult bear per hunter. The average bear harvest from GHA 9 and 9a from 1993/94 to 2000/01 was 91 animals per year. Thus, the recreational harvest of bear from the RMA likely averages less than 18 animals annually. Because of difficult access, recreational hunting effort at Wuskwatim Lake is negligible. Very little other hunting activity occurs in the RMA.

8.7.2 Impacts and Mitigation

Recreational hunting and fishing is currently limited in the Project area. The extent to which recreational resource harvesters will gain access to the Wuskwatim area will be determined by measures in the Access Management Plan. If access is granted to recreational harvesters it will facilitate increased levels of recreational hunting and fishing activity in the Wuskwatim area and it is expected that some effort will be redistributed from other areas in the vicinity. Recreational fishers and hunters accessing the Wuskwatim area will compete for resources with commercial and domestic resource harvesters from NCN.

8.8 LODGES, OUTFITTERS AND OTHER TOURISM

8.8.1 Existing Environment

One lodge and seven outfitters operate in the Nelson House RMA. There are also four businesses that offer adventure travel and eco-tourism activities in and around the Nelson House RMA.

8.8.1.1 Lodges

The Notigi Portage Lodge, the only lodge in the Nelson House RMA, is located near Notigi Lake about 100 kilometres (60 miles) west of Thompson on PR 391. Fishing and hunting outfitting services based out of the lodge have been provided since 2001.

8.8.1.2 Sport Hunting and Fishing Outfitters

There are currently seven outfitters whose allocations are fully or partially located within the Nelson House RMA. Outfitters operating in the Nelson House RMA provide both sport fishing and hunting services and most have non-resident hunting allocations (a parcel of land assigned to an outfitter to carry out their guiding services) and licenses (primarily for black bear and moose).

8.8.1.3 Adventure Travel and Eco-tourism

Adventure travel and eco-tourism (ATE) activities are characterized as non-consumptive, nature-based travel experiences that respect the integrity of the ecology, culture and economy of the local area and community. Eco-tourism differs somewhat from adventure travel in that it also explicitly incorporates educational components.

Four businesses offer ATE activities in or near the Nelson House RMA. Three of the four ATE operators also offer hunting and fishing outfitting services.

8.8.2 Effects and Mitigation

Creation of the access road will be the primary source of effect from the Project on tourism activities in the Nelson House RMA. The road may make it easier to access the Wuskwatim Lake area, as well as areas north and south of the Burntwood River. An additional source of effect will be the Project's physical infrastructure on the landscape, including the access road, construction camp and other structures associated with the generating station.

8.8.2.1 During Construction

Current tourism activities in the Nelson House RMA are not expected to be affected during Project construction. Wuskwatim Lake and the area in the vicinity of the Project construction site, work areas, camp, access road and borrow areas are not now used for tourism activities. There is one outfitter with an allocation in this area; however, as a result of access difficulties this outfitter currently focuses on areas within the allocation that are south of the Burntwood River (Trapper Mike's Outfitting, pers. comm., 2002).

During this time, use of the access road will be restricted via a staffed gate and limited to those people working on the Project with few exceptions. As such, improved access for tourism activities via this road is unlikely.

8.8.2.2 During Operations

Once in operation, the Project access road may improve access to the Wuskwatim Lake area for the outfitter whose allocation is adjacent to Wuskwatim Lake (particularly in the area north of the Burntwood River, which is currently used very little due to access difficulties) and, potentially, for other tourism operators. As well, it is possible that, with easier access into Wuskwatim Lake, local outfitters would begin to guide clients into the area for sport fishing. This is dependent on the final terms of the operations portion of the Access Management Plan, and the ability of tourism operators to use the Wuskwatim access road.

8.9 PROTECTED AREAS AND SCIENTIFIC SITES

This section provides a brief overview of the potential effects of the proposed Project on Manitoba's Protected Areas Initiative and an overview of scientific sites in the area.

8.9.1 Protected Areas

The Province of Manitoba is in the process of assembling a network of lands to protect and conserve representative examples of each of the province's 18 natural regions. Representation of each natural region requires that adequate examples of all of the characteristic landforms or enduring features within a region be set aside in protected land where, at a minimum, industrial uses such as mining (including aggregate extraction), logging, oil, petroleum, natural gas and hydro-electric development are prohibited. These protected areas still allow for activities such as hunting, trapping or fishing and also respect First Nation's rights and agreements such as the Manitoba Treaty Land Entitlement Framework Agreement. Activities such as intensive agriculture, urban or major recreational developments are avoided when establishing protected areas.

Areas of Special Interest (ASI) is the term used to describe "candidate sites" identified as having high potential to efficiently protect groupings of enduring features and associated natural and cultural values. Once ASIs have been identified, they form the starting point for protection discussions. The final boundary will depend upon consultations with various stakeholders and the levels of public support received. Candidate sites are chosen, wherever possible, to avoid resource allocation conflicts and to protect undeveloped areas of significant size. Further discussion of the Protected Areas Initiative and the consultation process is provided in the Wuskwatim Transmission Project EIS.

Sites in the Project Area

During the route selection for the access road, analysis of landform, soil, and vegetation features identified a glacial outwash plain as an uncommon feature in the area. Discussions with personnel in MC, Parks and Natural Areas (R. Schroeder and H. Hernandez) indicated that three enduring features were traversed by the proposed route alignment. The southern third of the access route traverses an enduring feature of deep basin deposits with grey brown luvisolic soils (DB/F) that is abundant in the region and ample opportunity exists elsewhere in the region to represent this feature. (See Volume 7 Section 9.0 for a more detailed description and map of the features.)

The northern two-thirds of the access route traverses a complex of two enduring features: a deep basin deposit with eutric brunisolic soils (DB/M) and a beach and near shore deposit with eutric brunisolic soils on morainal features (BN/M/M). These features extend north of PR 391 some 80 kms into the former Amisk Park Reserve and into the two associated ASIs of the Amisk North and Amisk South Addition. The BN/M/M feature would be adequately represented through the redesignation of the currently lapsed Amisk Park Reserve, an action that is likely to be taken (Volume 7 Section 9.0). An abundance of the DB/M feature stretches north and east out toward the Stephens Lake ASI where opportunity exists to protect that feature.

The association of enduring features is a consideration in the design of a protected area network. These two enduring features (DB/M and BN/M/M) occur in combination along portions of the access route and as well in isolated locations in the South Amisk Addition and North Amisk Addition ASIs. Consequently, the selection of this route for the access road highlights the importance of the redesignation of the Amisk Park Reserve and protecting the designated ASIs (Amisk South and North additions) that encompass the association of these features.

Partridge Crop Hill ASI

Partridge Crop Hill was identified as an area of cultural importance to NCN. In addition, an ASI has been identified around and including Partridge Crop Hill and extending northwards to the Burntwood River and east to Wuskwatim Lake (Figure 8.9-1). Development of the Wuskwatim GS would not directly impact this ASI (i.e., construction of permanent facilities and flooding associated with the Project are well away from this area). The Project would affect the existing water regime and rates of erosion on segments of Wuskwatim Lake and the Burntwood River, which form boundaries for the ASI; however, these waters are presently regulated for hydroelectric generation (i.e., CRD).

8.9.2 Scientific Sites

A variety of active and dormant research sites are present in the area (Figure 8.9-1). A detailed description of studies being conducted at these sites is provided in Volume 8. The sites can be classified into three broad categories:

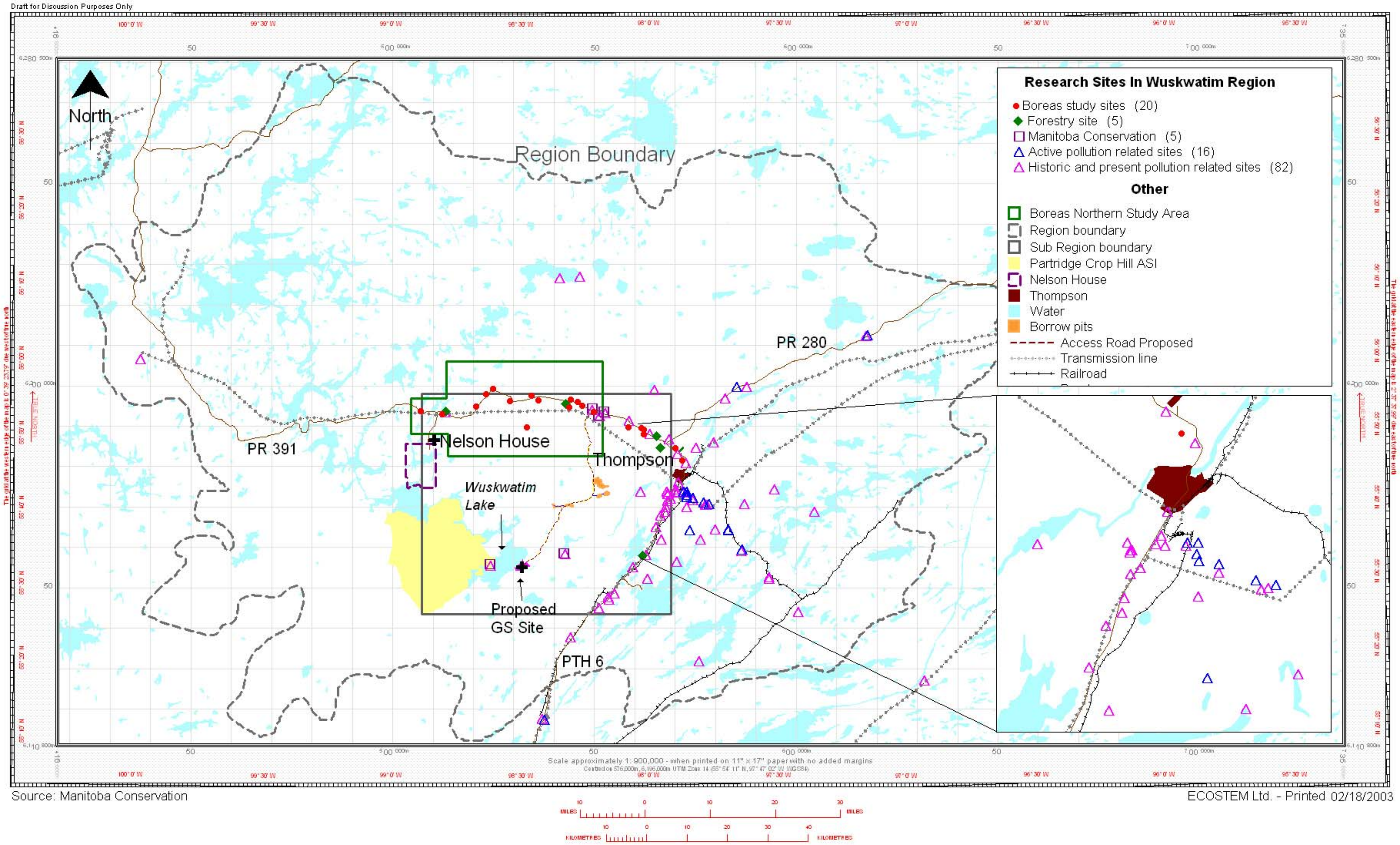


Figure 8.9-1. Active and dormant sites in the Wuskwatim study area.

- forestry research (e.g., measurement of tree growth) maintained by Manitoba Conservation and/or the Canadian Forestry service;
- pollution studies related to emissions from the INCO smelter in Thompson conducted by the Canadian Forest Service, INCO, and, most recently, Manitoba Conservation; and
- Boreal Ecosystem-Atmosphere Study (BOREAS) sites an international study.

These sites are not directly affected by the Project. The access road passes in close proximity to several of the BOREAS sites but does not directly impact them.

8.10 RESIDUAL EFFECTS

Residual effects to resource use VECs will primarily result from the increased access provided by the Project. Levels of domestic, commercial, and recreational resource harvesting activity in the Wuskwatim area are expected to increase. However, the residual level of increase remains uncertain and will depend on the Access Management Plan.

Although increased access is generally viewed as a positive long-term benefit to all three resource-user groups, each will compete against the other for available resources. It is expected that some resource harvesting activity will be redirected from other locations thereby reducing harvesting pressures elsewhere within the Nelson House RMA. However, increases in commercial fishing, commercial trapping and recreational harvesting as a result of the Project are expected to result in a net increase in resource harvesting activity in the Nelson House RMA.

Although improved access and the presence of the Project will affect the environmental setting of the area in the vicinity of Wuskwatim Lake, the change was not mentioned during resource user interviews as a significant negative effect of the Project. However, the nature and magnitude of this effect will be specific to each resource user. Decreases in animal abundance due to loss of terrestrial habitat are expected to be small and should have no noticeable effect on resource use. Similarly, positive effects on fish population due to changes to the water level regime on Wuskwatim Lake are expected to be small and will likely have no noticeable effect on the domestic, recreational or commercial fisheries. Increased access probably will result in increased utilization of the two existing cabins on the lake and construction of several more cabins on or in the vicinity of the lake and access road. Increased numbers of people utilizing the Wuskwatim area for resource use activities will increase the chances of cabin vandalism, environmental disturbances, and/or forest fires in the area

Improved access will significantly decrease operating costs for the Wuskwatim Lake commercial fishery. Decreased costs will increase the potential for higher net revenues, increasing interest in the fishery, and ultimately leading to increased commercial harvests. Similarly, increased access is expected to result in increased harvests from traplines in the vicinity of the Project (particularly RTLs 2, 4, 9, and 47). Based on average harvests from road accessible RTLs and affected RTLs, harvests could increase by as much as 68%.

Overall, NCN resource harvesters have indicated that, primarily because of the benefits of increased access, the project will result in a **significant, positive, long-term, moderate, regional effect on traditional resource use and a significant positive, long-term, large, local effect on commercial fishing and commercial trapping.**

Improved access may also result in a marginal increase in mineral exploration activity and tourism and recreational activities in the Wuskwatim Lake area and on either side of the Burntwood River.

A summary of mitigation and **residual** effects of the Project on traditional resource use, commercial fishing and trapping and recreational resource use is provided in Table 8.10-1. A summary of mitigation and residual effects on commercial forestry is provided in Table 8.10-2. For definitions of impact ratings see Vol. 7, Sec. 2.4.

8.11 CUMULATIVE EFFECTS

A scoping exercise identified four potential future development activities in the Wuskwatim region that may have a **cumulative effect** with the proposed project on resource use VECs: the Wuskwatim Transmission Project, Tolko forest harvesting activity, designation of Partridge Crop Hill Area of Special Interest as a protected area, and Treaty Land Entitlements. The Wuskwatim Transmission Project will facilitate access into the Nelson House RMA south of the Burntwood River concurrent with Project construction. Tolko has plans to initiate forest harvesting activity in the Nelson House RMA in the 2009 to 2014 time period (i.e., following the construction phase of the Project), which may include construction of access into areas to the south and east of the Threepoint Lake (Note that there is currently a legal challenge to Tolko's license. As of writing, the license is valid). The additional access provided by these developments will further increase harvesting activity and pressure on resources in the Wuskwatim region, particularly south of the Burntwood River. Future development and inhabitation of Treaty Land Entitlements near Wuskwatim Lake would cause an additional incremental increase in harvesting activity in the area. Designation of the Partridge Crop Hill Area as

Table 8.10-1 Mitigation summary for Project effects on resource use (excluding forestry).

Source of Effect	Description of Effect	Proposed Mitigation	Residual Effect
Increased Access	Road access will increase opportunities to harvest resources in Wuskwatim area by NCN residents	**Construction** -Access Management plan. -Gated access at PR 391. -Access granted by special permission only. **Operation** -Access Management plan.	**Significant** increase in resource harvesting activity in Wuskwatim area by NCN members. **Significant** cost savings associated with transportation for commercial fishing and trapping industries.
	Increased opportunity to harvest resources in Wuskwatim area by non-NCN First Nations people.	**Construction** -Access Management Plan. -Gated access at PR 391. **Operation** -Access Management plan.	Depends on Access Management Plan – Possible significant increase in resource harvesting activity in Wuskwatim area by non-NCN First Nations people.
	Increased opportunity for recreational resource harvesters to harvest resources in the Wuskwatim area.	**Construction** -Access Management Plan -Gated access at PR 391. -No access to recreational hunters will be permitted. **Operation** -Access Management plan.	Depends on Access Management Plan – Possible significant increase in resource harvesting activity by recreational resource harvesters. Small increase in opportunities for local outfitters.
	Increased poaching.	**Construction** -Access Management Plan -Gated access at PR 391. **Operation** -Access Management Plan -Work with Manitoba Conservation to ensure regulatory patrols are adequate.	Depends on Access Management Plan - An increase in poaching is likely to occur in the Wuskwatim area if access is open.

Source of Effect	Description of Effect	Proposed Mitigation	Residual Effect
	Increased resource use in Wuskwatim area may reduce animal and plant populations available for resource users.	-Addressed by mitigation for impacts to the terrestrial and aquatic environments. -Measures to be outlined in Access Management Plan. -Work with Manitoba Conservation to ensure proper regulatory measures and patrols are in place.	Will depend on results of mitigation and follow-up and the Access Management Plan. Potential for small to large reduction in animals available for harvest.
	Change in environmental setting for traditional resource users. Increased chances of vandalism on cabins and environmental disturbances (e.g., fuel spills, forest fires).	**Construction** -Access Management Plan. -No cabin construction will be permitted during construction. -Educational program to encourage resource users to respect local property and to protect against forest fires, etc. **Operation** -Access Management Plan. -Manitoba Conservation in consultation with NCN will determine number of cabins on lake by permitting process. -Educational program to encourage people to respect local property and to protect against forest fires, etc.	The environmental setting of Wuskwatim Lake will change. The level of effect will depend on perception and will be specific to individual resource users. There will be an increased possibility of environmental disturbances associated with increased access. Level of effects will depend on Access Management Plan.
Presence of a Large Workforce.	Compete for resources with NCN resource users in Wuskwatim area and elsewhere in RMA.	**Construction** -Access Management Plan. -Hunting in Wuskwatim area will be limited by on-site restriction on guns. -Work with Manitoba Conservation to ensure proper regulatory measures and patrols are in place.	No residual effects anticipated.
	Increased chances of vandalism on cabins and environmental disturbances (e.g., fuel spills, forest fires).	**Construction** -Access Management Plan. -Educational program to encourage workers to respect local property and to protect against forest fires, etc.	No residual effects are anticipated.

Source of Effect	Description of Effect	Proposed Mitigation	Residual Effect
Disturbances from Construction and Operation of Project	Safety concerns for resource harvesters in relation to construction and operation activities.	**Construction** -Access Management Plan. -Gated access at PR 391. -Access granted by special permission only. -Educational program for workers and NCN members granted access. -No fishing and hunting area near station and access road. -Signage **Operation** -Signage.	No residual effects are anticipated.
	Change in environmental setting for traditional resource users.		Level of effect will depend on perception and be specific to individual resource users.
Change in Water Regime	Increased debris causing navigational and fishing problems (debris in nets).	**Operation** If and as required: -Boat Patrols. -Debris management. -Navigational aids. -Signage -Extend safe ice trails.	No residual effects are anticipated.
	Quality of resources may change (e.g., mercury, whitefish cysts, potency of medicinal plants).	**Operation** -Communication program to educate resource users about changes in mercury levels and whitefish quality.	Long-term negative effect on opportunity to harvest medicinal plants along shoreline and near generating station. No other residual effects anticipated.
Shift to Wage Economy	Possible reduction in resource harvesting activity.	-Promotion of traditional harvesting lifestyle by NCN.	Unknown.

Table 8.10-2. Wuskwatim GS Project construction and operation forestry impact summary.

Source of Effect	Description of Effect	Proposed Mitigation	Residual Effect
Productive forest area loss during construction & operation	• Result of clearing, flooding & erosion; • Permanent & temporary losses; • Reduction in productive forest base; • Woody debris contribution to the reservoir.	• Minimize clearing; • Rehabilitate sites after construction; • Support reforestation & tree planting initiatives in other areas; • Pay forest damage fees if applicable;	Duration – short-/long-term; Magnitude – small; Geographic extent – local; **Overall – insignificant.**
Timber volume loss during construction	• Reduced standing volume; • Reduced volume contributing to the AAC.	• Minimize clearing; • Salvage timber where feasible; • Rehabilitate sites after construction; • To offset impacts support reforestation & tree planting initiatives in other areas; • Pay forest damage fees & timber dues, if applicable.	Duration – short-/long-term; Magnitude – small; Geographic extent – local; **Overall – insignificant.**
Reduced AAC during construction & operation	• Reduced industrial expansion potential.	• Minimize clearing; • Rehabilitate sites after construction; • To offset impacts support reforestation & tree planting initiatives in other areas.	Duration – long-term; Magnitude – small; Geographic extent – local; **Overall – insignificant.**
Area withdrawal from FMLA #2 during construction & operation	• Reduced management area.	• Minimize area of impact; • Rehabilitate sites after construction.	Duration – long-term; Magnitude – small; Geographic extent – local; **Overall – insignificant.**

a protected area would counteract some of the increased access and possible increase in resource harvesting activity.

Resource users generally view increased access as a positive effect. Increased access resulting from the additional projects is expected to contribute to the significant positive long-term regional effect that the project will have on resource use activity. However, as access increases further, some resource users, particularly commercial trappers and some traditional resource harvesters, may view the cumulative changes to the current environmental setting as a negative effect. Increased harvesting activity also has the potential to cause an overexploitation of resources in the area. However, cumulative effects assessments of terrestrial and aquatic resources (sections 6.12 and 7.11) have concluded that there will be no significant long-term negative effects on resource abundance in the area as a result of the potential additional projects (although there is some uncertainty with regard to woodland caribou, this species comprises a negligible proportion of current resource use). Consequently, it is expected that the cumulative effects of the projects considered would not change the significant positive, long-term regional effect on resource use VECs that will result from the Project.

The Wuskwatim Transmission Project**,** Treaty Land Entitlements, and conservation initiatives have the potential to cumulatively affect the forest industry through reductions in productive forest land available under forest management. Although such withdrawals of productive forest lands may not immediately affect current harvest levels as these are below AAC levels, the AAC is negatively affected each time productive forest land is withdrawn. The potential is there to exceed the 10-year withdrawal limit of productive forest land from FMLA #2 within the Nelson River Forest Section. Such cumulative effects may limit potential forest industry expansion opportunities in the area.

Although most future withdrawals are uncertain, the Wuskwatim Transmission Project will require a further withdrawal from the NRFS of approximately 420 ha of productive forest land. Combined with the Generation Project this amounts to a total of 1837 ha which represents 34.3 % of the allowable limit for the 10-yr period (1999-2009). While this represents a relatively large percent of the withdrawal limit, it constitutes 0.1% of the total productive forest land within the NRFS. This relatively small withdrawal represents an insignificant effect on the long-term sustainability of the timber resources.

8.12 ENVIRONMENTAL FOLLOW-UP AND MONITORING

The most significant effect to resource use resulting from the Project is increased access to the Wuskwatim Lake area, which is expected to result in increased harvesting activity.

Monitoring of harvests during and after construction will be necessary to gain an understanding of how resource use changes and additional measures that may need to be taken to prevent overexploitation.

Changes in traditional resource harvesting activity will be documented by repeating the Harvest Calendar study during and after construction. It is expected that there will also be measures specified in the Access Management Plan to monitor non-NCN harvesting activity via the access road after construction.
Manitoba Conservation is responsible for implementing **regulatory** measures to control harvests of resources. Manitoba Conservation, cooperatively with the Nelson House Resource Management Board, will be responsible for using the domestic and recreational harvest monitoring data in conjunction with annual commercial fishing and trapping data to assess resource harvesting pressures and implement suitable regulatory measures to ensure sustainable harvests and protect resources. Individual trapline holders are responsible for managing harvests on their own traplines.

Post project monitoring of fish populations in Wuskwatim Lake as discussed in Section 6.13 will address fish quality issues for resource harvesters including mercury concentrations and infestations of *Triaenophorus crassus* (a tapeworm which encysts in the flesh of whitefish).

Beyond monitoring completed as part of the Access Management Plan, no specific monitoring and follow-up measures are considered necessary for forestry, mining and tourism activities in the Nelson House RMA.

9.0 SOCIO-ECONOMIC ENVIRONMENT

9.1 INTRODUCTION

This section of the **EIS** provides a **socio-economic impact assessment (SEIA)** for the Project, reflecting Section 6.4[1] of the **EIS Guidelines**. More detail is provided in Volume 8.

Socio-economic studies consider people, their lifestyles and their communities. In so doing, they take into account the myriad of interrelated factors that contribute to social and economic welfare for different groups of people. These factors include the ways people do things to survive and develop, how they interact with the natural environment, and how they use their built environment. Culture, ways of community organization, plans for the future, heritage, beliefs, spirituality and values are also important factors.

In the case of the Project, socio-economic studies have focused on components of the socio-economic environment identified in the EIS Guidelines:

- <u>Economy</u>: Economic activities in communities and regions affected by the Project, including employment, business, resource economy (which includes resource use)[2], and, in the case of NCN, ownership participation;
- <u>Infrastructure and Services</u>: Infrastructure and services in communities and regions affected by the Project, including effects on community population; and
- <u>Personal, Family and Community Life</u>: Personal, family and community life in communities and regions affected by the Project. This environment presents a much broader picture of individual, family and community well-being and brings together many of the interrelated aspects that contribute to social and economic welfare.

The SEIA identifies and, where possible, quantifies predicted effects of the Project for each of the above socio-economic environments. To do this requires understanding of the current socio-economic environment, as well as possible future states with and without the Project. Each of these environments constitutes a "type" of effect on people – and often the same people experience effects under more than one of these topics. The SEIA topics considered here reflect stakeholder interests and can be considered to be socio-economic VECs (Section 1.6.2).

[1] The EIS Guidelines for the Project show this incorrectly as Section 6.3.
[2] Details related to Resource Use are addressed in Section 8 of the EIS (Volume 1).

How socio-economic effects are experienced differs for individuals, families and communities, and varies with the degree to which people are connected to the direct or indirect pathways of change from the Project. Socio-economic effects can also be affected by personal, family and community perspectives about their current situation, their goals and aspirations and how the Project affects their vision for the future. The SEIA addresses these considerations in part by focusing separately on distinct regional groupings of people and communities affected by the Project.

Section 9.2 provides an overview of the Approach and Methodology used to assemble the SEIA. Sections 9.3 through 9.5 each address effects on a key component of the socio-economic environment (i.e., economy, infrastructure and services and personal, family and community life) and are organized according to geographic area of effect. Depending on the sources and scope of effects, not all geographic areas are included in the assessment of each socio-economic environment. In accordance with the EIS Guidelines, the discussion of effects on each of the socio-economic environments (Sections 9.3 through 9.5) includes:

- sources of effect from the Project;
- existing environment in each region;[3]
- socio-economic effects and **mitigation**
  - during the construction phase
  - during the operations phase;
- **cumulative effects**;
- **residual effects**; and
- monitoring and follow-up, including implementation of impact management measures.

9.2 APPROACH AND METHODOLOGY

The SEIA focuses on people likely to be affected by the Project. In addition to addressing “expected effects” on such people, it also addresses planning and decision-making to mitigate **adverse effects**, enhance beneficial effects, and help those likely to be affected to be prepared (including, where relevant, to minimize the possibility of unanticipated outcomes and to address potential consequences of anticipated outcomes).

[3] In accordance with the EIS Guidelines, the existing environment in each sub-section is described in sufficient detail to predict the effect of the Project; the scoping of this description, therefore, reflects the predicted sources of effect from the Project.

Keeping this focus in mind, the SEIA in this EIS has involved several dimensions as well as interactions with different individuals, groups and communities.

- Socio-economic effects to be considered for each of the included environments, and particularly for personal, family and community life, were identified for consideration based on their direct interest to stakeholders and perceived public concern.
- Possible effects on each of the included socio-economic environments and appropriate mitigation strategies have been identified in consultation with those who may be potentially affected by the Project – most notably, NCN members (see below), as well as others resident in the **Project Region** defined for the **Public Involvement Plan (PIP)** (Section 9.2.1.2).
- Residual effects (those remaining following implementation of mitigation measures) have been assessed for their significance, taking into consideration possible cumulative effects from past, present and future projects.
- Flexible monitoring and follow-up measures have been developed to provide those most likely to be affected with the ability to respond to uncertain, as well as unexpected, effects in a way that is most likely to meet their needs and circumstances.

9.2.1 Involvement of NCN and Other Communities in the SEIA

9.2.1.1 NCN Involvement

The Nisichawayasihk Cree Nation, who live primarily in Nelson House (the closest community to the Project) and South Indian Lake, are prospective partners in the Project (Sections 1, 2.2.3 and 3.2). As a result, NCN has had the potential both to influence the way the Project is undertaken and to be significantly involved in advance planning for mitigation of negative effects and enhancement of positive effects. NCN communities, and primarily NCN members at Nelson House, also have the greatest potential to experience the main socio-economic effects stemming from the Project.

Given these important circumstances, NCN has played a key role in guiding SEIA studies undertaken for the Project, particularly in the area of personal, family and community life. The SEIA, in turn, has benefited substantially from the collaboration, cooperation and advice of NCN.

In addition to offering general advice and direction at key junctures during the study program, NCN involvement has included:

- collaborating on the development and implementation of the SEIA study program, including the identification of priority issues of concern to the NCN communities for more detailed review;
- assisting in the development and implementation of key person interview and workshop programs designed to gain a better understanding of community perspectives and concerns about life in Nelson House – current and future, with and without the Project;
- sharing their perspectives and concerns through these key person interviews and workshops, as well as through informal conversations;
- undertaking and sharing the results of NCN's own **Traditional Knowledge (TK)** study, which included interviews with resource harvesters and Elders;
- undertaking and making available the results of NCN Opinion Surveys of members living in Nelson House (2000), South Indian Lake (2001), Thompson (2001) and Winnipeg (2001); and
- reviewing, commenting on and helping to revise the SEIA so that it accurately reflects and is sensitive to NCN community concerns.

9.2.1.2 Involvement of Other Communities

A Public Involvement Plan was developed and carried out as part of the EIS study program for the Project (Section 3). The PIP defined a Project Region to include northern communities which might be perceived, prior to completion of the EIS, to be potentially affected by the Project through biophysical changes to the environment or through interests that may be affected pursuant to current agreements with Manitoba Hydro.[4]

Consultations with communities in the Project Region have provided important inputs to the SEIA with regard to the concerns, interests and local knowledge of Aboriginal and other communities beyond NCN, Nelson House and South Indian Lake (Section 3.3).

9.2.2 Linkages

Effects on people stemming from the Project accumulate as a result of an array of direct effects from the Project (such as direct employment and expenditures) and indirectly

[4] Being defined as a potentially affected community for PIP (i.e., being included in the Project Region) does not necessarily mean that significant environmental effects on the community are, in fact, predicted in the EIS.

through changes in the biophysical environment in which people live, on which they depend for income and which sustains their way of life and culture. As such, the SEIA in many instances relies upon results set out in other sections of the EIS (Figure 9.2-1 describes how the supporting SEIA Volume 8 is linked to other volumes of the EIS).

Not all socio-economic linkages to the Project will be considered by every reader. For example, it is relevant for the purpose of tests applied under *CEAA* to distinguish between two different types of socio-economic linkages to the Project (see Section 1.5 and 2.4). The Reference Guide published by the Canadian Environmental Assessment Agency, *Determining Whether a Project is Likely to Cause Significant Adverse Environmental Effects*, is helpful in understanding the *CEAA* approach to socio-economic effects.

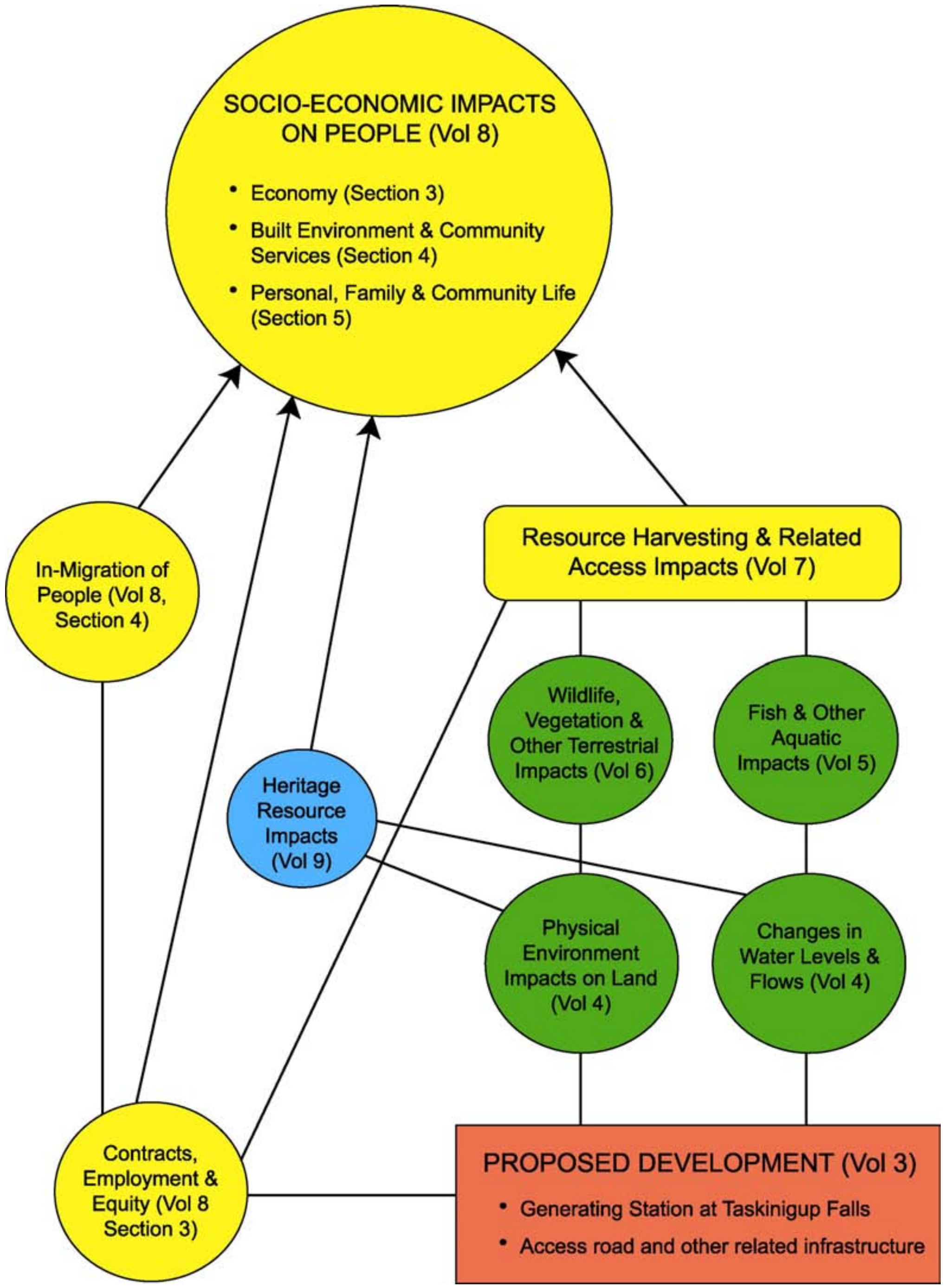
The Guide discusses each of the elements of the *CEAA* test for "significant adverse environmental effects", explaining that not all socio-economic effects of a project are "environmental effects" as defined in *CEAA*.

The two types of socio-economic effects are:

- <u>Socio-economic effects caused by a change in the biophysical environment which, in turn, are caused by the Project</u> (such as resource use or job losses caused by loss of fish habitat);
- <u>Other socio-economic effects:</u> socio-economic effects caused by something else related to the Project (such as an increase in demand on local services caused by an influx of population who have come because of increased job opportunities caused by the Project).

The Guide explains that, since only the first type of effect is an "environmental effect" as defined in *CEAA*, a socio-economic effect of the second type cannot be an "adverse environmental effect" within the meaning of *CEAA*.

Both types of socio-economic linkages to the Project are addressed in this section of the EIS.



Source: InterGroup Consultants Ltd.

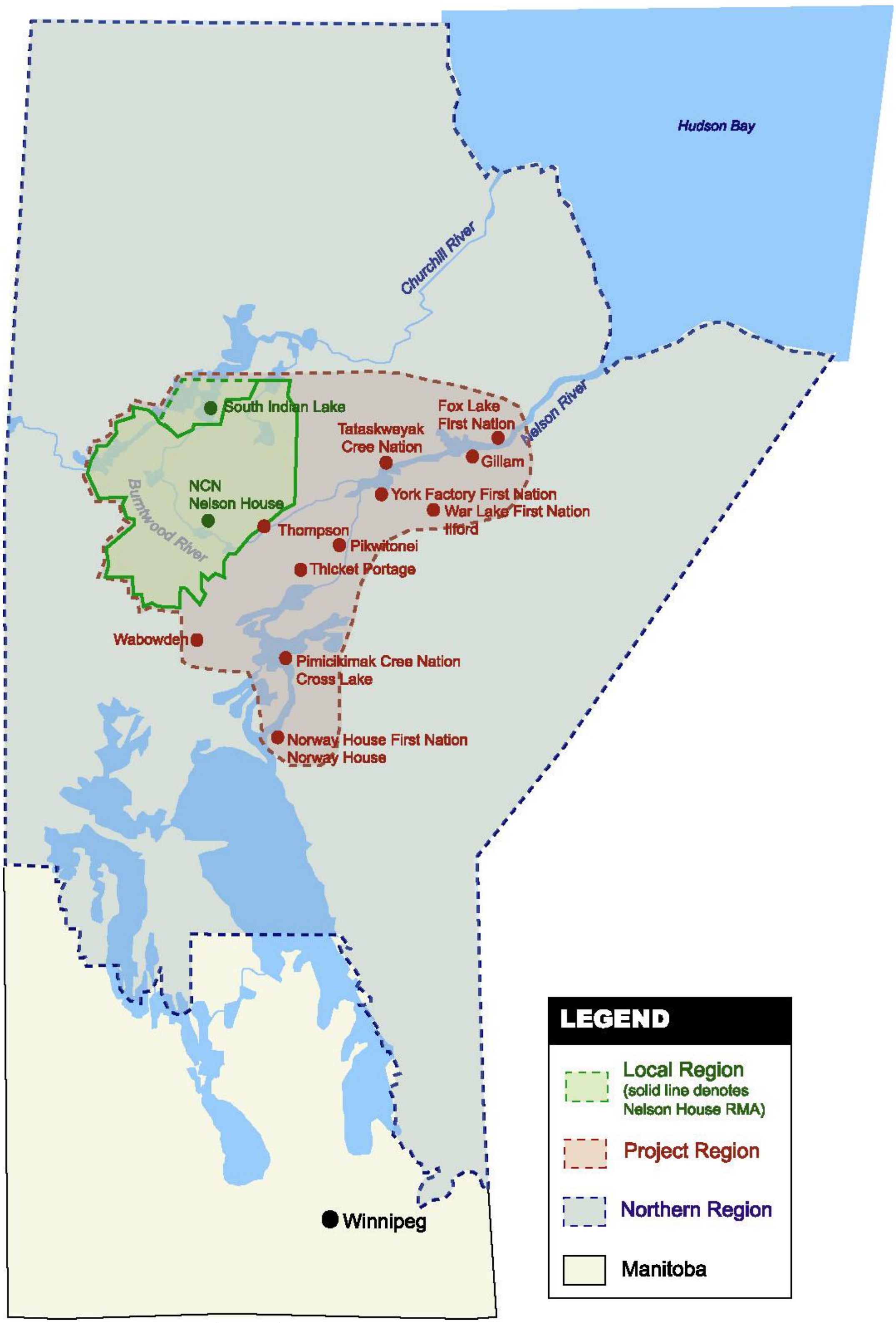
Figure 9.2-1. Socio-economic Framework: How Socio-economic Studies Relate to Other Parts of the EIS.

9.2.3 Geographic Area of Effect

The Project's effects on people depend largely on proximity to and level of involvement in the Project. These effects are also affected by the diversity of perspectives held by different communities and groups. For this reason, the analysis for each type of effect has been broken down into four geographic regions (Figure 9.2-2).

- Local Region: The Local Region is defined largely by the boundaries of the Nelson House **Resource Management Area (RMA)**. However, it includes: all members of NCN, including those members living in the First Nation community of Nelson House and the Northern Affairs community of Nelson House, referred to locally as the Métis community; and the Northern Affairs community of South Indian Lake, given its close relationship with NCN and Nelson House (80 to 90 per cent of South Indian Lake residents are NCN members). Each of these communities in the Local Region is an **Aboriginal community**;[5] overall, as of 2000, approximately 3,300 NCN members lived in these communities.
- Project Region: The Project Region is a broad region that includes, but goes beyond, the Local Region. The Project Region was identified initially for the purposes of the PIP consultation to include "potentially affected publics" (Section 3 and Section 9.2.1.2). Inclusion in this region for the PIP did not necessarily mean that significant environmental effects would in fact be expected on the basis of the conclusions set out in this EIS. The Project Region for this EIS includes communities in the vicinity of the Burntwood and Nelson Rivers, extending from South Indian Lake to Gillam and the Fox Lake First Nation community on the lower Nelson River, as well as the Cross Lake and Norway House communities on the upper Nelson River. Except for Thompson and Gillam, the communities in the Project Region are Aboriginal communities. The 1996 Census reported that 29,551 people lived in the Project Region with almost half (46 per cent) living in Aboriginal communities.
- Northern Region: The Northern Region includes, but goes beyond, the Project Region. The Northern Region is defined as the portion of northern Manitoba that extends as far south as the Northern Employment Preference Boundary under the

[5] "Aboriginal community" in this SEIA means that most of the people residing in the community are Aboriginal (i.e., Indian, Métis or Inuit), the community has a separate form of government, provides some level of service to its residents, and has clear community boundaries.



Source: InterGroup Consultants Ltd.

Figure 9.2-2. Regions Defined for the SEIA.

current **Burntwood Nelson Agreement (BNA)**.[6,7] This region includes many Aboriginal communities.

- Manitoba and Canada: The economic effect the Project may have on both Manitoba and Canada is included in the SEIA, including contributions to Gross Domestic Product (GDP) as a result of project expenditures for products, services and labour, project employment, and government revenues earned through income and sales taxes.

9.2.4 Time Period of Effect

There are two distinct time periods during which Project effects accrue.[8]

- Construction phase: This phase consists of the six years required to construct the **generating station** and associated facilities (assumed to extend from 2004 to 2009), as well as Project planning activities, which began with NCN in 1997 and still continue today. The majority of socio-economic effects stemming from the Project (excluding ownership effects) will be felt during Project construction when Project employment and purchasing are at their greatest.
- Operations phase: The operations phase of the Wuskwatim Generation Project will extend from the end of construction (assumed to occur in 2009) throughout the life of the station. Project employment and purchasing requirements during this phase will be very small and, as a result, socio-economic effects not related to ownership will be much less than during the construction phase.

9.2.5 Approach to Assessment

The approach used in this study is based on: the EIS Guidelines developed by the regulators; topics of importance to NCN and others consulted during the PIP; previous SEIAs and experience on other large-scale projects; and SEIA literature. The approach to the SEIA for the Project has been reviewed with Manitoba Hydro and NCN (who were

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[6] The BNA is a collective agreement between the Allied Hydro Council and Hydro Projects Management Association that sets out employment conditions, including hiring preference for northern Aboriginal people and northern residents. The Northern Region includes, "…that part of Manitoba encompassed by Census Division 16 and that part of Census Division 19 north of the Winnipeg River, based on the 1971 Census as prepared by Statistics Canada" (BNA 1989). Census boundaries changed in 1996, with 1971 Census Division 16 and that part of the 1971 Census Division 19 north of the Winnipeg River becoming Census Divisions 19, 21, 22 and 23.

[7] Currently, the BNA is being renegotiated and this boundary may change in the next version of the agreement. The Northern Region population in the 1996 Census was 86,134.

[8] As reviewed in Section 2.1, the SEIA does not provide any further assessment of Project decommissioning and final disposition.

involved in developing and guiding the studies) and, to a lesser extent, with participants in the PIP and regulators (Technical Advisory Committee).

Greater detail on the specific methodology used to assess effects for each topic area is provided in Volume 8. The general approach for assessing socio-economic effects is consistent with the approach set out in Section 2 and followed nine major steps.

- Identify categories of anticipated Project issues and effects.
- Determine methodology for conducting assessment (e.g., VECs selected based on EIS Guidelines).
- Identify and obtain relevant Project description information (as required to assess likely Project linkages to the socio-economic environment).
- Identify and obtain relevant baseline information and Project setting features (in order to describe the baseline environment as it is expected to be in the future without the Project).
- Review SEIA literature, previous SEIAs and experience of other relevant projects.
- Analyze and determine effects and mitigation.
- Identify cumulative effects of relevant future projects and activities (Table 9.2-1; Section 2.3).
- Identify residual effects and determine their significance (Section 2.4).
- Identify monitoring and follow-up.

The types of effects stemming from future activities and projects (for the cumulative effects assessments) are predicted based on best available information, consultation with key persons (including NCN members and PIP participants) and professional judgement. In most cases, the detail known about future projects and activities (Table 9.2-1) and their possible interaction with the Project is such that only a general description of anticipated cumulative effects is possible.[9]

Residual effects, or effects predicted to remain after implementation of mitigation measures outlined in the EIS, were determined based on the anticipated outcome of proposed mitigation measures and, where known, possible cumulative effects. In all cases, both positive and adverse residual effects are presented.

[9] In light of these considerations, and in accordance with the EIS Guidelines, Volume 8 discussion of cumulative effects includes assumptions and analyses used to develop the conclusions reached, as well as the level of confidence in the data used to develop the analyses (based on available project description information and level of commitment about when the development will proceed).

Table 9.2-1. Future Projects/Activities Included in the Cumulative Effects Assessment for the SEIA.

Future Project/Activity	Regions Affected[1]	Socio-economic Environments Affected
Wuskwatim Transmission Project	Local Region	Economy; Personal, Family and Community Life
	Project Region	Economy
Gull/Keeyask Generation Project	Local Region	Economy; Infrastructure and Services; Personal, Family and Community Life
	Project Region	Economy
Notigi Generation Project	Local Region	Economy
	Project Region	Economy
Conawapa Generation Project	Local Region	Economy; Infrastructure and Services; Personal, Family and Community Life
	Project Region	Economy; Infrastructure and Services
Bipole III Transmission Project	Project Region	Economy
Kelsey Upgrade (maintenance program)	Project Region	Economy
Tolko future forest harvesting plans[2]	Local Region	Economy; Personal, Family and Community Life

Note:
1 - CEA was confined to Local, Project and Northern Regions. Effects on the Provincial and Canadian economies were not included.
2 - There is currently a legal challenge to Tolko's licence. As of today, the licence is valid.

For residual effects stemming from other components of the EIS (e.g., Resource Use in Section 8), the determination of significance is based on the methodology and conclusions reached separately for those relevant VECs.

The SEIA significance analysis focuses on the nature of an effect (i.e., the component of the socio-economic environment that is affected and how it is affected by the Project), and its duration, magnitude and socio-economic "geographic" extent (Section 2.4). Separate assessment is assumed for each region (in particular the Local Region, Project Region, and Northern Manitoba). As noted in Section 9.2.2, many socio-economic effects are not "environmental effects" for the purpose of a *CEAA* assessment.

In accordance with the EIS Guidelines, where significant *adverse* effects are predicted, the likelihood of significance is discussed in terms of both the probability of occurrence and the degree of "scientific uncertainty". In many cases the likelihood of significance is dependent upon the outcome of mitigation strategies (e.g., retention measures at the job site). Definitions of uncertainty can be found in Volume 8 (Table 2.4).

9.3 ECONOMY

9.3.1 Introduction

This section considers effects of the Project on people's economic activities including employment, business and resource harvesting activity. It addresses the socio-economic components set out in Section 6.4.2 of the EIS Guidelines: [10]

- "a general description of the economic base of Aboriginal and other communities potentially affected by the project shall be provided including the state of the **labour force**, employment, unemployment and a profile of existing economic sectors; and
- sufficient detail regarding the existing economy of the region shall be provided in order to predict the effect of the project on the economy of Aboriginal and other affected communities."

Economic activity is important to the survival of people and contributes significantly to quality of life. The level of income, derived from both monetary (e.g., wages and government transfers) and non-monetary (e.g., country food) sources, affects the standard of living of families and households. Income affects access to basic human needs – housing, food and clothing – and is linked to human health. Where and how people make a living is intimately bound up with their way of life; work activity can shape the way of life and, ultimately, the culture of a community as a whole.

For communities as a whole, the local economy is usually a central element in planning for the future; community goals often include improvements in economic activity, employment and standard of living for residents, along with other elements of quality of life, including long-term sustainability of resources, environmental quality, social well-being and others. Economic opportunities, or lack of same, can be one reason (there can be many reasons) for adults and their families to migrate from one location to another, affecting requirements for governments to respond with public housing (in some cases) and other public facilities and services (e.g., health care, education, daycare, recreation).

[10] The EIS Guidelines for the Project show this incorrectly as Section 6.3.2.

Local and provincial public finances can be affected, including instances where declining population and economic activity shrink the tax base.

The Project has the potential to affect in a material way the economy of the Local Region and, to a lesser extent, the economies of communities located in the Project Region and Northern Region. Construction-phase effects on the provincial and national economies are also expected.

Potential direct effects of the Project are expected from participation in construction-phase employment opportunities and contract services required to build the proposed generating station and associated infrastructure, including construction camp, work area and access road. Participation is anticipated by residents of the Local Region, Project Region and Northern Region, as well as workers and firms elsewhere in Manitoba and Canada.

Much more limited direct effects, mainly for residents of the Local Region, are also possible through participation in limited employment and contracting opportunities during the operations phase. In addition, if NCN takes up the opportunity to participate in ownership of the generating station, return on that investment would be expected during the operations phase. This, in turn, is likely to have economic effects on the economy of the Local Region.

Indirectly, the Project is also expected to affect the current and future resource-based economy of the Local Region as a result of physical and biophysical changes from the Project to resources used by people (both commercially and domestically), including through new access to the Wuskwatim area and the area south of the Burntwood River. (Detailed analysis of the effects of the Project on resource use is provided in Section 8 of Volume 1 and Volume 7.)

Details of the approach and methodology, existing environment, effects and mitigation, cumulative effects, residual effects, and monitoring and follow-up for effects on the economy are found in Section 3 of Volume 8.

9.3.2 Sources of Effect

Project-related sources of change in the economy differ for each Project phase (construction versus operations) and vary by region.

- Employment, training and business opportunities will occur primarily during the construction phase and are expected to be the main source of change from the Project in all regions (Local, Project & Northern Regions, as well as Manitoba and Canada).
- Operations phase employment and business opportunities are much smaller, by comparison, and are likely to affect mainly the Local Region.
- Physical and biophysical effects, while the Project is being constructed and once it is in operation, are expected to affect the resource harvesting economy of Nelson House in the Local Region, but no other region.
- Finally, if NCN chooses to invest in the Project, that ownership participation could affect the economy of the Local Region during the operations phase.

9.3.2.1 Employment, Training and Business Opportunities

Employment effects are likely to be felt primarily during the construction phase. The Project will be constructed over six years and will occur in two main stages (Section 4 and Volume 3 for further Project Description Information).

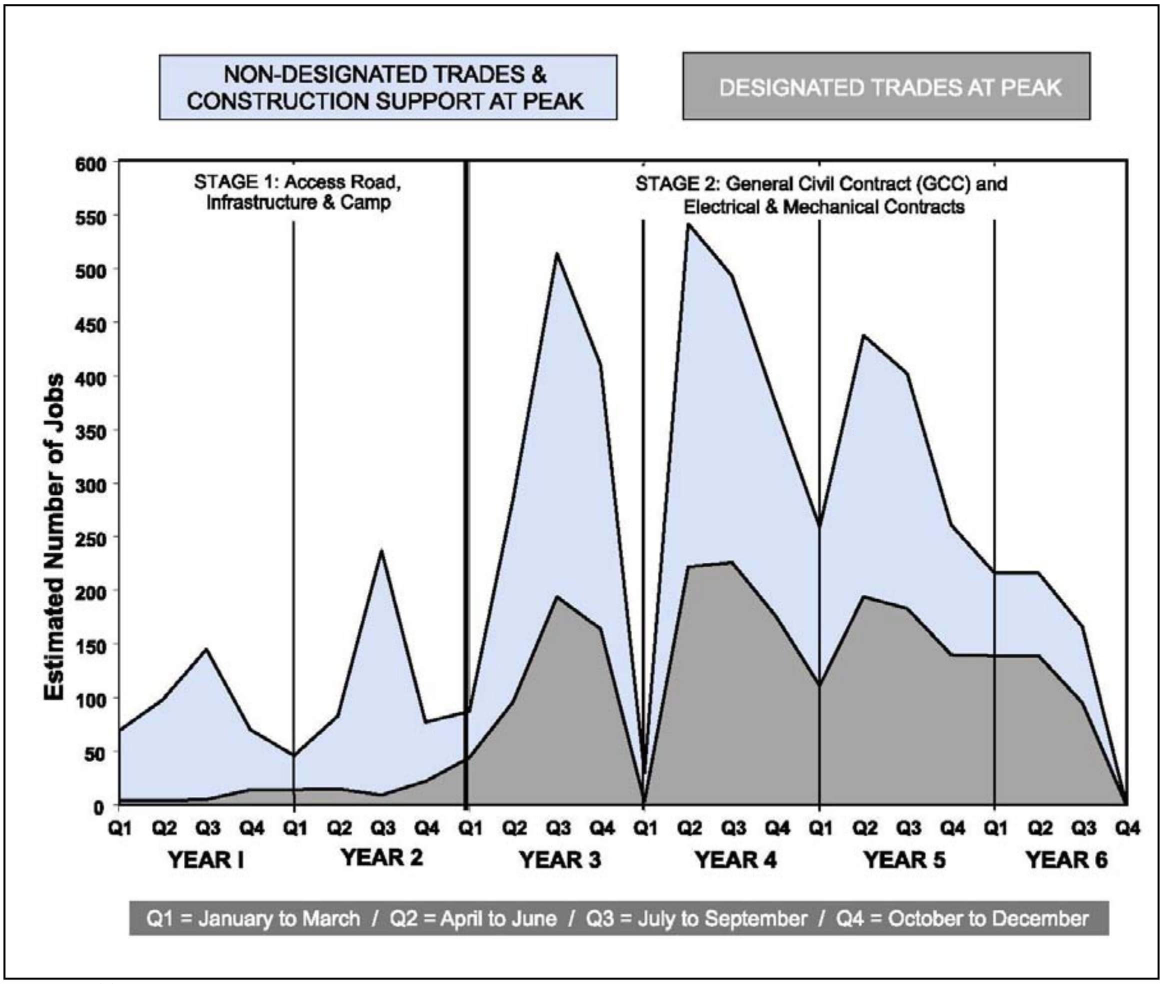
- Stage 1 – **Infrastructure Development** (Years 1-2): This stage will take place during the first two years and will involve construction of the access road, construction camp, work areas, water and sewer systems and other infrastructure. It is expected that most of the **negotiated contracts** with NCN will be carried out during this stage.
- Stage 2 – **Major Works Construction**/Installation (Years 3-6): This stage, to take place during years 3 through 6 of construction, involves construction of the major Project works, including the temporary and permanent **dams**, powerhouse, generators, turbines and gates.

The construction site for the Project will be **unionized** and operate under a renegotiated Burntwood Nelson Agreement (BNA). The BNA is currently being renegotiated between the **Hydro Projects Management Association** and the **Allied Hydro Council** of Manitoba and was not finalized at the time of the EIS submission.

Contractors engaged by Manitoba Hydro will employ over 90 per cent of the Project construction workforce. The vast majority of contractor jobs will be filled through the **job order** process, to be set out in the renegotiated BNA. A small number of supervisory/management positions will be out-of-scope of the BNA and will be hired directly by the contractor and the remaining positions will be internally hired by Manitoba Hydro staff. It is assumed that, as in the current BNA, Aboriginal contractors with negotiated contracts (assumed to be only NCN) may also be able to directly hire northern Aboriginal employees (the BNA is currently being renegotiated). Under the job order process, it is anticipated that Manitoba **Advanced Education and Training (AET)** will act as the referral agency for the Project, with sole responsibility for handling job orders from contractors. AET will establish a referral system before construction gets underway (it has not yet been established). Northern residents would be able to register in AET's applicant database for Project employment at one of their referral offices. Thompson will likely be the central referral office and a satellite referral office will be located in Nelson House. Additional satellite offices may be established in other northern communities.

Figure 9.3-1 provides a quarterly breakdown of the estimated construction workforce requirements to be filled through the job order process during each stage of construction. The figure indicates that construction jobs will vary over the six years of construction, and most jobs will be seasonal in nature. Two general types of positions will be available and the training and experience required for each varies.

- **Designated Trades Positions:** These positions have apprenticeship programs typically requiring four years of technical training and work experience leading to a journeyperson certification. Among the designated trades positions required for the Project, carpenters will be in high demand during Years 3 and 4, and by the second half of year 4 a sizable number of electricians, pipefitters, millwrights, and iron workers will be needed. Apprentices will account for about 20 per cent of the Project's designated trades positions. To qualify for an apprentice position, a person will typically require three or more years of training and work experience.
- **Non-designated Trades** and **Construction Support Positions:** These occupations, which do not have apprenticeships, account for almost all of the job order positions available during Stage 1 (Years 1-2) and continue to account for significant numbers during Stage 2 (Years 3-6), including labourers, heavy equipment operators, vehicle drivers (teamsters), rebar workers, cement masons, and catering and clerical staff. Most of these positions require less than three years of related work experience, and about 45 per cent require one year or less of related work experience.



Source: Table 4.4-5.
Notes:
1 - The above information represents an estimate only, based on current regulations, Project plans as of 2002 and past experience with similar projects. Contractors will determine specific job requirements when the Project is being built. Actual workforce requirements will vary from the estimate presented above.
2 - Excludes Manitoba Hydro staff and contractor supervisory and management positions.
3 - Designated trades are those in which individuals take apprenticeship training to become certified journeypersons.

Figure 9.3-1. Estimated Project Construction Workforce at Peak (Positions Filled Through Job Order Process).

To prepare for construction phase employment opportunities, pre-project training opportunities are being prepared for Northern Aboriginal residents. Manitoba Hydro, Canada, Manitoba and NCN are working with four Cree Nations (who are preparing for the Gull/Keeyask Project) to establish pre-project training for jobs required during construction of new generation projects. Each of these Cree Nations is undertaking its own pre-project training. In the Local Region, NCN has taken on responsibility for developing and implementing pre-Project training activities for its members. For others in the Project Region and Northern Region, pre-project training will be offered to Northern Aboriginal people through AET.

On-the-job training opportunities will be provided by Project contractors for principal occupations where there is opportunity for extended work (e.g., jobs of at least two months or more in duration); in addition, NCN and Manitoba Hydro expect to implement arrangements to enhance retention of northern Aboriginal employees who are hired on the Project.

Construction of the Project will include a range of contracting opportunities. Participation by NCN businesses in contracting opportunities is anticipated to occur via negotiated contracts with qualifying NCN businesses. Other business contracts will be let under restricted or open **tendering**.

Project construction employment effects in different areas of the Northern Region will be affected by pre-Project training (which affects local capacity to secure Project jobs), negotiated contracts with NCN contractors,[11] and job hiring preferences to be established in the BNA for construction of the Project.[12] In advance of a renegotiated BNA, employment estimates have been prepared based on the assumption that a first preference scenario would be assigned to Aboriginal residents of communities in the Project Region.[13] The actual preference has not yet been determined and will be an outcome of BNA negotiations, which at the time of this EIS were still underway.

During the operations phase, long-term job and business opportunities will be small. Normally from two to six employees will be required (including three or four technicians and two utility workers) at the modern automated facility (see Section 4.5.2.2).

9.3.2.2 Physical and Biophysical Change

The Project will cause changes to water levels and flows in the Wuskwatim area (see Section 5), and will provide increased access into the Wuskwatim area (as a result of the Project access road) and possibly to areas south of the Burntwood River (as a result of travel over the dam) (see Section 4). These, in combination with possible lifestyle changes brought on by Project employment, may lead to changes in resource harvesting levels by NCN members (see Section 8).

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[11] It is assumed for the purposes of this assessment that the renegotiated BNA would enable contractors with northern Aboriginal ownership to hire northern Aboriginal persons directly, without having to go through the job order process that otherwise applies.

[12] Hiring preference is assumed to affect jobs not covered by negotiated contracts where required pre-Project training and experience are less than 24 months.

[13] For purposes of socio-economic impact assessment, a second, third and fourth preference are also assumed (based on current BNA), affecting residents of the Northern Region (Volume 8, Section 3.1.1.1).

9.3.2.3 NCN Ownership Participation

The understandings between NCN and Manitoba Hydro set out anticipated arrangements for NCN to own up to 33 per cent of the Partnership for the Project. As a result of this investment, NCN is expected to receive annual dividends from the Project. The magnitude of any annual dividend payments will depend on NCN's level of cash investment in the Partnership, the Project's profitability and the final terms agreed upon in the **Project Development Agreement (PDA)**.

9.3.3 Existing Environment

9.3.3.1 Local Region

The economy of the Local Region is based primarily on providing goods and services to the resident population of Nelson House (the NCN reserve community and the adjacent Northern Affairs community) and South Indian Lake (which is composed primarily of NCN members). Wage employment in Nelson House is found primarily in the areas of government services, education services and health and social services. In South Indian Lake, the main sources of employment are in education, government services and commercial fishing and trapping. NCN also has a growing commercial economy, which includes investments by the First Nation and its members in businesses in both Nelson House and Thompson.

In the Nelson House Resource Management Area, commercial and domestic resource harvesting were once the mainstay of the Nelson House economy, but their relative importance to the local economy, in terms of dollar value, has diminished in recent years. Despite this, substantial numbers of NCN members continue to participate in traditional resource-based activities throughout the Nelson House RMA that provide both cash and income-in-kind for many residents. These activities continue to be important for economic, social and cultural reasons and there are efforts to encourage greater participation in them.

Employment, Participation and Unemployment Rates

In order to provide an overview of the existing labour force, characteristics of the labour force of the reserve community at Nelson House and the Northern Affairs community of South Indian Lake were compared to characteristics of the provincial labour force as a whole using 1996 Census of Canada data.[14] Comparable data for the small Northern

[14] The 2001 Census data have recently become available, and are being assessed to confirm that a complete and consistent data set can be provided for all communities and regions under review in the SEIA. If feasible, the 2001 data may be added to SEIA at a later time.

Affairs community of Nelson House, with a resident population of about 77, were not available.

Based on these data, the population of labour force age (defined by Statistics Canada as those age 15 and over) in both Nelson House and South Indian Lake can be characterized as having lower participation[15] in the labour force than the provincial population (44 per cent participation in Nelson House and 41 per cent participation in South Indian Lake, compared to 66 per cent provincially). Lower participation is, in part, due to the lack of opportunities available in the Local Region (i.e., many people typically give up looking for work when it is apparent that no opportunities are available). Unemployment rates calculated by Statistics Canada show that, overall, unemployment is up to six times higher in Nelson House (45 per cent) and South Indian Lake (31 per cent) than in the Province as a whole (8 per cent). These data tend to underestimate unemployment because rates are based on those considered to be participating in the labour force (known as the **active labour** force), which is typically under-reported, as noted above.

More recent data from Indian and Northern Affairs Canada (INAC) place the total **potential labour** force of NCN members on-reserve in 2000 at approximately 1,247 individuals (659 males and 588 females). It is projected that by 2011, the potential labour force in Nelson House will have reached between 1,800 and 2,000 individuals (about a 40 to 50 per cent increase) (Volume 8, Appendix A, Section 2.1.1.5 provides detailed population projections). This would mean an estimated active labour force at that time of between 900 and 1,100 individuals.

These same data place the potential labour force of NCN members living on Crown land (primarily South Indian Lake and the Northern Affairs community of Nelson House) at 613 individuals (318 males and 295 females) in 2000. By 2011, it is projected that this potential labour force would increase to between 893 and 1,048 individuals (about a 45 to 70 per cent increase). This would mean an estimated active labour force of NCN members living on Crown land in 2011 of between 339 and 391 individuals.

The growing labour force in both Nelson House and South Indian Lake suggests that the significant need for employment opportunities, already apparent in the current labour force (as evidenced by high unemployment rates), is expected to grow substantially over the next seven to ten years.

[15] Participation is defined as those working or actively looking for work in the week prior to the Census and those participating in the labour force are known as the active labour force.

As of 1996, the largest sources of employment in Nelson House were in the areas of government services, education services and health and social services. Together these accounted for 60 to 65 per cent of all local employment (Statistics Canada 1996). In South Indian Lake, the main sources of employment, as of 1996, were fishing and trapping, which accounted for 25 per cent of employment, as well as educational services and government services, which accounted for eight per cent of employment (Volume 8, Appendix A (Section 2.2.1.1) provides further details).

Of particular interest in estimating possible participation in construction phase employment opportunities is the extent to which those with construction skills are present in the NCN labour force. Data from the NCN Housing Authority, NCN Human Resources Department, Nelson House Forest Industries (a construction firm based in Nelson House) and an NCN Human Resources staff member in South Indian Lake indicate that there are pools of construction labour among NCN members resident at Nelson House and South Indian Lake (and to a lesser extent at Thompson). These include members working in both non-designated and designated trades (Volume 8). The availability of these construction workers varies and it is anticipated that only a subset of workers will find the opportunities for Project construction employment to be attractive enough to give up their current construction work.

Levels of Education

Education is an important factor in assessing the extent to which Project construction employment opportunities may be filled by the labour force in the Local Region. Basic education levels for NCN members on-reserve and in South Indian Lake were determined using the 1991 and 1996 Census of Canada[16] and the NCN Opinion Survey – Total Sample in Nelson House and South Indian Lake.[17] Data are presented in detail in Volume 8. Overall, general levels of education are increasing in both communities.

Construction of the generating station will require a range of skills and experience. Apprenticeable trades of various kinds will be required for the Project. Data on the presence of apprenticeable trades skills in the Nelson House labour force were available from Manitoba Apprenticeship Branch and are provided in detail in Volume 8. Similar

[16] The most recent years for which Census data were available. Data from the 2001 Census for these characteristics have not yet been released.

[17] NCN Opinion Surveys (Volume 8, Appendix 3) were undertaken by the NCN Future Development Team in the summer of 2000 in Nelson House and in the summer of 2001 in South Indian Lake. The purpose of the survey was to gain a better appreciation of the opinions and perspectives of NCN members about proposed future hydroelectric developments in the Nelson House Resource Management Area. The statistically-valid sample included questions about demographic characteristics; results can be applied to the community as a whole. Survey respondents were ages 16 and older.

data were not available for NCN members living at other locations in the province, including at South Indian Lake.

Income Levels and Sources

Income is an important indicator of the results from economic activity. Statistics on income provide an indication of what is available to sustain the standard of living (basic needs and other goods and services) of residents of Nelson House. Examining sources of income contributes to a profile of the local economy.

Annual monetary incomes in Nelson House and South Indian Lake are generally lower than those seen provincially. Detailed comparison of average income per person, employment income, household income and family income are found in Volume 8.

Commercial Resource Economy

The commercial resource economy in the Nelson House RMA consists primarily of commercial fishing and commercial trapping. Additional activities, such as forestry, contribute to the resource economy, but to a lesser degree. As well, one outfitter from Thompson, Trapper Mike's, has an outfitting license that extends along both sides of the Burntwood River from the outlet of Wuskwatim Lake to Thompson. NCN also operates a lodge and outfitting service elsewhere in the RMA - the lodge is located near Notigi Lake, 60 miles west of Thompson, and outfitting allocations are around Notigi Lake and around Baldock Lake, north of PR 391. A description of resource use activities is found in Section 8.

In general, over the past decade or more, there has been a decrease in the revenues generated by the local resource economy, particularly in terms of their relative importance to the overall NCN economy. Commercial trapping activities have decreased dramatically in the past 10 to 15 years, and commercial fishing has also declined in the past 5 years. Further detail regarding the resource economy can be found in Volume 8 and regarding resource use activities can be found in Volume 7.

Traditional Resource Use

Traditional pursuits, like hunting and fishing, play an important role in contributing to the non-monetary income of NCN members living in Nelson House. The availability and use of natural resources has, to some extent, limited local reliance on store-bought items, most notably food. Domestically-harvested foods are a significant contributor to local diets. Detailed data regarding domestic use can be found in Volumes 7 and 8.

Other bush products also contribute to income-in-kind for the local economy. These include collection of medicinal plant materials, collection and use of furs/hides for crafts (sold commercially and for personal use) and collection of firewood for personal use.

Similar to commercial resource harvesting in the RMA, the value of the harvested products and the process of obtaining them goes well beyond their nominal value. Even though the number of individuals and families who undertake traditional harvesting has declined in recent decades, the knowledge and use of the land is important to NCN as a community and is central to their culture. Efforts are underway to encourage these types of activities, particularly among youth in the community (e.g., taking youth onto the land has been an element of some programming at both the Wellness Centre and the school) (Family and Community Wellness Centre, Nelson House Education Authority, personal communication, 2002).

Nelson House Business Economy

Businesses are playing a growing role in the local economy. Some businesses are long-standing (e.g., Nelson House Forest Industries, established in the 1970s) and others have been developed recently. Expansion of the business sector in Nelson House (and elsewhere) has been an element of NCN's strategic planning to improve the local economy. The Nelson House business economy consists of on-reserve businesses in three general categories: businesses owned and operated by the Nelson House Development Corporation, businesses wholly or partially owned by NCN, and private businesses. Detailed review of local businesses can be found in Volume 8.

9.3.3.2 Project and Northern Region

In the Project Region, the City of Thompson is the next closest community to the proposed Wuskwatim Generating Station site, after Nelson House. The size and close proximity of Thompson mean that the City will play a service centre role during the construction phase, for construction workers during their leisure time, for some contractors (e.g., bulk fuel), and for the transportation of most supplies and equipment and some workers. For this reason, the economy of the City of Thompson is highlighted separately from the balance of the Project Region. (The LGD of Mystery Lake is included in the discussion about the City. The LGD, which surrounds the City of Thompson, includes mining, recreation and other activities, but has almost no population/labour force).

Elsewhere in the Project Region and Northern Region, the degree of economic effect is likely to be limited to employment opportunities for local workers. The profile of other communities focuses primarily on labour force characteristics. Included in this summary is a profile of the Northern Region, which includes the Project Region. Further detailed review of both the Project Region and Northern Region can be found in Volume 8.

Employment, Participation and Unemployment Rates

Table 9.3-1 below provides labour force characteristics for the Northern Region, as compared to the Province, based on 1996 Census data.[18] In general, service industries (e.g., retail trade services, health and social services, government service industries) accounted for the greatest proportion of the employment in the North, while commodity industries (e.g., manufacturing and construction industries) and service industries were of equal importance throughout the whole of Manitoba. Collectively, however, primary industries and service industries had a higher share of the labour force in the North in 1996 (60 per cent) than in the rest of Manitoba (52 per cent). In particular, primary industries like mining, forestry, fishing and trapping were of high importance to the Northern economy relative to the rest of Manitoba (Statistics Canada 1996).

Income Levels

The average annual personal income (from all sources) for Northern Region residents was approximately 10 per cent less than the provincial average annual personal income. Average annual family and household incomes for the Northern Region were also considerably less than the corresponding provincial figures. For further details, see Volume 8.

Education and Training

In 1996, 23 per cent of Northern Region residents 15 years of age or older had less than a Grade 9 education, which was almost 50 per cent higher than the provincial average of approximately 13 per cent. Levels of university education for Northern Region residents (14 per cent) were significantly lower than the provincial average of 23 per cent. Approximately 4 per cent of Northern Region residents had trades certificates or diplomas in 1996, which was about the same as the provincial figure (Statistics Canada 1996). For further details, see Volume 8.

[18] The 2001 Census data have recently become available, and are being assessed to confirm that a complete and consistent data set can be provided for all communities and regions under review in the SEIA. If feasible, the 2001 data may be added to the SEIA at a later time.

Table 9.3-1. Employment, Participation and Unemployment in the Northern Region and Province of Manitoba: 1996.

Characteristics[1,2]	**Northern Region**	**Manitoba**
The potential labour force[3]	55,110	855,880
The active labour force[4]	33,505	567,825
• Employed[5]	27,990	523,210
• Unemployed[6]	5,510	44,615
Persons not in the labour force	21,610	288,055
Participation rate	60.8%	66.3%
Employment rate	83.5%	92.1%
Unemployment rate	16.5%	7.9%

Source: Statistics Canada, 1996 Census of Canada.

Notes:

1 - Data incomplete: 20 per cent sample data.

2 - Totals may not add due to rounding.

3 - Statistics Canada defines the potential labour force as all persons in a given population, excluding institutional residents, age 15 years and over.

4 - The active labour force includes all persons 15 years of age and over, excluding institutional residents, who, during the week (Sunday to Saturday) prior to Census Day were either employed or unemployed.

5 - The "employed" include all persons who "worked for pay or in self-employment" in the paid labour force in the week prior to enumeration. This includes all persons working for wages or salaries, all self-employed persons (with or without paid help) working in their own business, farm or professional practice, and all persons working without pay on a family farm or business during the reference week. The “employed” also include those persons absent from their job or business for the entire week because of vacation, illness, a labour dispute at their place of work or other reasons.

6 - The classification of unemployed does not account for the underemployed, or those individuals working part time but desiring a full time position. As well, the classification does not include discouraged workers: those individuals who wish to work but have ceased looking because they do not believe they will find a job. Unemployment numbers may be understated for these reasons.

9.3.3.3 Manitoba and Canada

This section provides an overview of current labour force characteristics in Manitoba and Canada, as well as a brief profile of Manitoba Hydro.

Employment, Participation and Unemployment Rates

Based on 1996 Census data,[19] **employment rates** were slightly higher in Manitoba than they were for the country as a whole in 1996 (92.1 per cent provincially versus 89.9 per cent federally). In both the province and Canada, employment was found primarily in manufacturing industries, retail trade industries and health and social services.

[19] The 2001 Census data have recently become available, and are being assessed to confirm that a complete and consistent data set can be provided for all communities and regions under review in the SEIA. If feasible, the 2001 data may be added to the SEIA at a later time.

Income Levels, Education and Training

In general, average incomes were slightly lower in Manitoba than for Canada as a whole. In general, the Canadian population has slightly higher levels of education than the provincial population. Further details can be found in Volume 8.

Manitoba Hydro

Manitoba Hydro, a Crown Corporation owned by the Province of Manitoba, is a major energy utility headquartered in Winnipeg, Manitoba. The corporation's capital assets in service exceed $10 billion, making it the fourth largest energy utility in Canada.

In addition to serving more than 500,000 electricity and 250,000 gas customers in the province, Manitoba Hydro currently has 11 formal long-term export trade agreements with seven electric utilities and numerous short-term agreements with more than 40 electric utilities and marketers in Ontario, Saskatchewan and the Midwestern United States.

Virtually all of Manitoba Hydro's energy is produced from 14 hydroelectric generating stations. Hydroelectric stations are located on the Nelson, Winnipeg, Saskatchewan and Laurie Rivers and, combined, have the capability of approximately 5,000 megawatts of hydroelectric power. Manitoba Hydro's hydroelectric generating stations on the lower Nelson River in northern Manitoba generate almost 80 per cent of the utility's total energy production, with the three largest stations (Kettle, Long Spruce and Limestone) accounting for more than 70 per cent of the annual total. On an annual basis, Manitoba Hydro pays water rental costs to the provincial government for use of the water resources needed for hydroelectric generation. In the most recent fiscal year (2001-2002), the utility paid $107 million in water rentals to the provincial government, or $3.34 per megawatt-hour of hydroelectricity generated.

The low cost of producing hydroelectric power (compared to other forms of electricity production) combined with export revenues have allowed Manitoba Hydro to keep their average retail electricity rates among the lowest of any major utility in North America. As of 2002-2003, electricity rates for residential customers in Manitoba had remained unchanged for seven years and those for industrial customers had remained unchanged for 12 years.

Manitoba Hydro employs more than 5,400 people throughout the province. Approximately 540 employees are located in northern Manitoba, where the majority of the utility's hydroelectric energy is produced.

9.3.4 Effects and Mitigation

9.3.4.1 Local Region

Construction Phase

During construction, economic effects in the Local Region will be short-term and stem primarily from employment and business opportunities associated with the Project. The local economy will also be affected, to some extent, by training opportunities associated with the Project and changes to the local environment that affect commercial and domestic resource harvesting in the Nelson House RMA.

It is anticipated that Aboriginal residents in the Local Region (virtually all of whom are considered to be NCN members) could secure between 52 and 59 per cent of **peak positions** (about 81 to 93 local peak positions, which translates to 57.5 to 66.0 **person-years** of employment) during the first stage of construction, and between 10 and 15 per cent of peak positions (about 80 to 113 peak positions, which translates to 123.5 to 170.5 person-years of employment) during the second stage of construction. Employment estimates for the Local Region are found in Appendix 4.

It is anticipated that most of the Local Region employment during Project construction will go to NCN members who currently work on a seasonal, on-call or part-time basis or are unemployed. For these residents, Project construction employment will likely lead to an increase in personal income.

Project construction employment will have some "boom-bust" effects on the economy and labour force of this Region. Steps are being taken, or are under consideration, by NCN to reduce this effect. These steps include targeting of skill areas that will be of value during and after the construction project in other work settings. In addition, NCN is pursuing economic development opportunities that would coincide with the latter years of the construction phase. In the event that other hydro projects (e.g., Gull/Keeyask, Conawapa, Notigi) begin to be built during or immediately following Project construction, Aboriginal residents of the Local Region will have additional opportunities for construction employment. Nevertheless, some degree of "boom and bust" effect is likely to be felt.

NCN businesses are expected to participate in construction of the Project through a range of negotiated contracts during all construction years. Possible negotiated contracts are still under discussion, but could include various infrastructure contracts during Stage 1 (e.g., access road construction, clearing and grubbing, various camp-related contracts, catering, and access control and security) and specific Stage 2 work packages (e.g., catering, certain materials transportation services, and various camp-related contracts). Some NCN members may also establish various entrepreneurial opportunities associated with the Project (e.g., convenience store/snack bar at the construction camp, taxi service). It is not practical to estimate the economic potential of these opportunities.

Training effects in the Local Region related to construction stem from both pre-Project and on-the-job training opportunities. Pre-project training budgets and plans involve annual reviews and updates to reflect experience to date; furthermore, actual outcomes of training programs are not certain. Accordingly, estimates of employment effects consider possible ranges for pre-project training effects. NCN is working to develop and deliver training programs for approximately 194 members in a mix of designated trades, non-designated trades and construction support occupations. Of these, NCN anticipates that 172 trainees (or 89 per cent) will complete the training program in their chosen field by 2006-2007 (e.g., the second year of Stage 2 construction). In the case of designated trades, the 28 trainees projected to be near completion at the end of 2006-2007 are expected by NCN to have completed at least their first two levels of apprenticeship training (i.e., will be 3rd or 4th level apprentices, or journeypersons).[20]

Project specifications for the general civil and other major tendered contracts are expected to include provisions requiring the successful contractor to provide on-the-job training in the principal occupations they employ where there is opportunity for extended work (e.g., jobs of at least two months or more in duration.) Based on the existing BNA, it is assumed that, for non-designated trades, a maximum of one in five positions is expected to be on-the-job training positions. Similarly, for most designated trades, it is assumed that major contractors will generally be expected to hire one apprentice for every four journeypersons for extended work contracts. (Apprentices will likely be required to have attained 3rd or 4th level status to qualify for Project construction positions.) The actual number of trainees employed at any time will be affected by several factors, including the outcome of current BNA negotiations.

In terms of the commercial resource economy, it is anticipated that during Project construction commercial trappers and fishers will have access to the Wuskwatim area along the Project access road. Access along the new road will be controlled during construction via a staffed gate at PR 391. Under an Access Management Plan (Section 4), the **Limited Partnership** will decide who may use the road during this phase and it is expected that local resource harvesters will be among those who will be permitted to

[20] Designated trades positions require completion of a certain number of levels, typically four, before journeyperson status can be obtained. Each level includes a combination of on-the-job skill development and technical, classroom-based training.

make restricted use of the road. The cost savings associated with road access will increase net revenues from the Wuskwatim Lake commercial fishery and, in turn, production levels. This effect is expected to continue during Project operation, with annual harvest expected to exceed the average from the past fifteen years.

Improved access is also expected to increase commercial trapping production from **Registered Traplines (RTLs)** 1, 2, 4, 9 and 47. This effect will begin during Project construction and continue into Project operation. Based on average harvests from road accessible RTLs, harvests could increase by as much as 65 per cent.

Domestic harvesting is also expected to increase in the Wuskwatim area; however, the extent of this increase will depend on the final terms of the Access Management Plan. It is likely that a proportion of the domestic resource harvesting activity in the Nelson House RMA will be re-directed to the Wuskwatim area because of improved access. Increased utilization and harvests for domestic purposes may compete with commercial use in the area.

Operations Phase

During the Project's operations phase, economic effects in the Local Region are expected to result mainly from potential ownership investment in the Project by NCN. Employment, business and training opportunities during the operations phase are limited. As reviewed in Section 4.5.2.2, a very small number of employees will be required (ranging normally from two to six depending on the inspection, maintenance and monitoring requirements from time to time). Maintenance contracts for the Project buildings and infrastructure may also provide a source of direct small-scale, long-term employment opportunities.

In terms of the commercial resource economy, it is anticipated that new access for commercial trappers and fishers, begun during the construction phase, will likely continue during the operations phase as part of the Access Management Plan (to be developed). As during the construction phase, the cost savings associated with road access will increase revenues from the Wuskwatim Lake commercial fishery (compared to the period prior to the construction phase) and, in turn, production levels. Annual harvests are expected to exceed the average from the past fifteen years.

Increased commercial trapping production from RTLs 1, 2, 4, 9 and 47 (compared to the period before the construction phase) is expected to continue during the operations phase. Others RTLs south of the Burntwood River may also become more accessible (assuming access over the dam is permitted) and this may result in increased production in these areas. Based on average harvests from road accessible RTLs, harvests could increase by as much as 65 per cent.

Domestic harvesting is also expected to increase in the Wuskwatim area; however, the extent of this increase will depend on the final terms of the operations phase portion of the Access Management Plan (to be developed by the Limited Partnership before the operations phase begins). It is likely that a proportion of the domestic resource harvesting activity in the Nelson House RMA will be re-directed to the Wuskwatim area because of improved access. Increased utilization and harvests for domestic purposes may compete with commercial use in the area. Although safe access to the south side of the Burntwood River will be provided by the generating station, a lack of existing trails in the area will result in only a marginal increase in use by domestic harvesters.

Assuming that NCN invests in the Project, significant Project effects on the Local Region economy will be felt during the Project's operations phase (beginning in 2009) when NCN begins to realize the stream of revenue stemming from this ownership investment. The revenue that NCN receives would be based on the percentage of the partnership that they choose to acquire (potentially up to 33 per cent). Annual revenue for NCN would be based on the financial performance of the Generation Project; they would share in the risks associated with the Generation Project as well as the benefits.

The source of NCN funding for its cash investment (to be provided at the end of the construction period) has not yet been identified and could create effects on near-term community funding for other community priorities. Dividends paid to NCN in any year will vary depending on the level of NCN cash investment, the project's profitability and the final terms agreed upon in the PDA. The levels of investment return to NCN anticipated during the first decade or more of operations are in the order of several million dollars annually. These amounts are similar to the annual revenue that NCN now obtains from its community-based trusts. No special mitigation or impact management measures are considered to be required. In the long term (i.e., after 15 to 25 years of operation), annual dividends to NCN could provide ongoing new annual long-term sustainable community incomes well in excess of the current community-based trusts experience (i.e., tens of millions of dollars). Mitigation measures to deal with the effects of such new community incomes include planning (related to spending these levels of income) being started early in the operations phase in order to identify options, priorities and specific plans.

9.3.4.2 *Project and Northern Regions*

In the Project Region and Northern Region, economic effects in most communities will primarily be felt during the Project's construction phase. In some cases, economic effects of the Project beyond the Local Region are limited to the City of Thompson (given its proximity to the Project); these are noted in the section that follows. Few effects are anticipated in most communities outside of the Local Region during the operations phase of the Project.

Construction Phase

During construction, economic effects in the Project Region and Northern Region (beyond the Local Region) will stem primarily from employment opportunities associated with the Project. The business economy of Thompson will also be positively affected, particularly the service and retail sectors. There may also be limited effects beyond the Local Region as a result of Project-related training opportunities for Aboriginal residents.

During the first stage of construction, it is anticipated that Aboriginal residents in the Project Region, outside of the Local Region, could secure between 31 and 39 per cent of peak positions (about 49 to 61 peak positions) and between 31 to 39 per cent of the available person-years of employment (35.3 to 43.8 person-years of employment). In total, Aboriginal residents in the Project Region (including those in the Local Region) could secure up to 90 per cent of peak positions (142 peak positions) or 90 per cent (101.3 person-years) of the available person-years of employment during Stage 1 (Appendix 4).

During the second stage of construction, it is anticipated that Project Region Aboriginal residents, outside of the Local Region, could secure between 20 and 28 per cent of peak positions (about 157 to 214 peak positions) and 25 to 33 per cent of person-years of employment (245.3 to 326.5 person-years of employment). In total, during the second stage of construction, Aboriginal residents in the Project Region (including those in the Local Region) could secure between 31 and 42 per cent of peak positions or between 37 and 50 per cent of the available person-years of employment.[21] Effects will depend on the outcome of proposed mitigation measures, especially workplace retention strategies for Aboriginal employees on the construction site (Appendix 4).

Beyond the Project Region, it is anticipated that Aboriginal residents of the Northern Region could also secure construction employment. During Stage 1, it is estimated that

[21] The ranges indicate uncertain effects from pre-Project training activities, both in the Local Region and elsewhere in the Project Region.

an additional eight peak positions could be taken up by Aboriginal residents of the Northern Region (8.6 person-years of employment). During Stage 2, an additional 24 to 42 peak positions (26.1 to 46.2 person-years of employment) are anticipated to be taken up by Aboriginal residents of communities in the Northern Region, but beyond the Project Region (see Appendix 4).

Non-Aboriginal residents in the Project Region are expected to experience more limited Project-related employment effects. Those who are employed on the Project will primarily be employed during Stage 2 in highly skilled positions (i.e., when there is a high demand for skilled workers and fewer qualified northern Aboriginal people to fill the available positions).

During construction of the Project, business effects in the Project Region, beyond the Local Region, will be limited to the City of Thompson. The extent and magnitude of these benefits have not been predicted. Similarly, it is expected that residents in the Local Region (primarily in Nelson House) will take up the limited range of entrepreneurial opportunities that are likely to be associated with the construction projects (e.g., convenience store at the site). In Thompson, business effects will occur primarily as a result of indirect Project expenditures. Most notably, Thompson businesses that provide services to workers (e.g., restaurants, recreational facilities, hotels) and retail businesses are likely to benefit from the re-spending of construction worker wages. Some commercial and industrial supply services may also benefit from support to construction contractors (e.g., small engine repair shops, heavy duty equipment repair, hardware suppliers) and possibly supply of bulk fuels to the Project. Services supporting the movement of workers and contractors to and from the Wuskwatim construction site will also benefit (e.g., transportation services).

Training effects from both pre-Project and on-the-job Project training opportunities in the Project and Northern Region will almost wholly be felt by Aboriginal residents. Outside of the Local Region, some of the monies designated for training will be managed by Manitoba AET to assist northern Aboriginal residents access pre-Project training. The number of residents who may participate in training is difficult to estimate, as the level of interest among Aboriginal residents in the Project and Northern Regions to participate in Project training programs is not known; however, pre-Project training opportunities outside the Local Region are expected to be limited relative to those provided within the Local Region. Some Aboriginal residents in the Project and Northern Regions (outside of the Local Region) are also likely to secure trainee positions during Project construction.

Operations Phase

During the Project's operations phase, economic effects in the Project and Northern Regions, outside of the Local Region, are expected to be negligible.

During the operations phase, only a very small number of employees will be required (normally from two to six employees, including three or four technicians and two utility workers; Section 4.5.2.2). Maintenance contracts for the Project buildings and infrastructure could also provide a source of direct small-scale, long-term employment opportunities.

9.3.4.3 Manitoba and Canada

Construction Phase

During Project construction, Manitoba and Canada will experience moderate economic benefits. These include (constant 2002 dollars):

- contributions of over $500 million to Canada's Gross Domestic Product (GDP), of which nearly $275 million will accrue in Manitoba, with the remaining $230 million accruing in the rest of Canada;
- generation of almost 7,700 person-years of direct and indirect employment and approximately $360 million of labour income; and
- generation of sales, income and property tax revenues for Federal, Provincial and local governments of approximately $148 million, of which approximately $53 million will go to governments in Manitoba (including over $3 million to municipal governments).

Operations Phase

During Project operations, economic effects experienced at the provincial and national levels will be minor. Effects will primarily be felt at the provincial level as a result of the $5.1 million paid annually by the Project to the Province in water rentals.

For Manitoba Hydro, export revenues made possible with the Generation Project would contribute significantly to its financial performance. Financial evaluations indicate that within about five years following the start of operations, the Project will produce positive returns (even under pessimistic export price scenarios), and within 15 to 25 years, returns to Manitoba Hydro would increase to over $50 million annually.

9.3.5 Cumulative Effects Assessment

Cumulative effects of the Project are assessed in combination with effects of other known or planned projects that overlap in space and time with socio-economic effects of the Project (Section 2.3).

- Wuskwatim Transmission Project
  a) In the Local Region, will provide limited, additional seasonal construction job opportunities beginning concurrently with the Project's construction – current estimates are 25 to 30 seasonal jobs in any given year – during the winter months when most Project construction workers will be laid off. Added business opportunities are also limited (e.g., line clearing, surveying, materials transportation). The extent of NCN business participation is still being discussed internally at NCN and with Manitoba Hydro.
  b) In the Project and Northern Regions (beyond the Local Region), will provide limited, additional seasonal construction job opportunities during the winter months when most Project construction workers will be laid off. Thompson businesses that provide services to construction workers (e.g., hotels, restaurants, bars, recreation facilities) may experience some additional benefit as workers constructing the proposed Birchtree Station (just south of Thompson) are likely to stay in the community.
  c) Manitoba and Canada – some positive cumulative effects expected.
- Gull/Keeyask Generation Project and/or the Conawapa Project
  a) In the Local Region, these projects, if developed starting in 2006, would provide additional job opportunities for Local Region Project construction workers to make use of experience and skills gained while working on the Project, and to extend the opportunities available within proximity of the Local Region to complete the necessary work requirements for trades apprenticeships. Such additional jobs could help to ease the anticipated "boom-bust" effect likely to be felt from the Project in the Local Region. Employment opportunities associated with these projects could also provide employment for Local Region residents who were unable to obtain Project employment.
  b) In the Project and Northern Regions (excluding the Local Region), these projects, if developed starting in 2006 or 2007 with a similar hiring preference as assumed in this EIS for the Project, would provide major additional construction job opportunities for Project Region residents. Outside of the Project Region, in the rest of the North, employment secured by Aboriginal and other residents would likely be in positions requiring greater than 24 months of combined training and experience. These projects would provide additional job opportunities, in

particular, for residents to make use of the experience and skills gained while working on the Project. They would also extend the opportunities to complete the necessary work requirements for trades apprenticeships (i.e., apprentices from the Project and Northern Regions may be able to complete work experience requirements within the North).

c) In Manitoba and Canada**,** these projects would result in material additional economic benefits to the Manitoba and Canada regions through contributions during construction to Gross Domestic Product, project employment and revenues earned through income and sales taxes. The Provincial Government would also receive material additional revenue during the operations phase of these projects.

- Notigi Generation Project
  a) In the Local Region, if developed, the Notigi Project, which at the earliest would start construction after 2009, would provide additional employment opportunities for Local Region residents, beyond the completion of Project construction. This could also help to ease the anticipated "boom-bust" effect as Project construction comes to an end.
  b) In the Project and Northern Regions (excluding the Local Region), if developed, the Notigi Project, which at the earliest would start construction after 2009, would provide additional employment opportunities for Region residents, beyond the completion of Project construction.
  c) Manitoba and Canada – some positive cumulative effects expected.
- Tolko Forestry Activities[22]
  a) In the Local Region, there is a possibility that Tolko may begin harvesting in the Nelson House RMA in the 2009-2014 time period (i.e., following the construction phase of the Project). This could include possible construction of a winter road and timber harvesting in areas to the south and east of Threepoint Lake, between PTH 6 and the Burntwood River and including Partridge Crop Hill.[23] (Partridge Crop Hill area may be designated a protected area and not be harvested; however, it is currently in the Tolko harvesting plans so is included here.) Tolko harvesting activity in this area may overlap with increased resource harvesting activity south of the Burntwood River during Project operations, assuming access across the dam is permitted. Additionally, a winter road would provide further access into this area and could create additional access management concerns.
  b) Project, Northern and Manitoba and Canada Regions (outside Local Region) – no material cumulative effects expected.

[22] There is currently a legal challenge to Tolko's licence. As of today, the licence is valid.
[23] Partridge Crop Hill has spiritual importance to NCN. NCN has indicated that it would object to forestry operations in this area.

- Bipole III Transmission Project
  a) In the Local Region – no material cumulative effects expected.
  b) In the Project and Northern Regions (excluding Local Region), the Bipole III project will provide some additional limited seasonal (winter) construction job opportunities for residents in the eastern parts of the Project and Northern Regions. Employment opportunities associated with the Bipole III project are likely to be secured by Project Region residents in the vicinity of the **transmission line** (i.e., not by Local Region residents).
  c) Manitoba and Canada – some positive cumulative effects expected.
- Kelsey Upgrade
  a) In the Project and Northern Regions (excluding Local Region), the Kelsey upgrade (maintenance program) will provide some additional construction job opportunities, albeit limited and highly skilled, within the next five to eight years for residents in the Project and Northern Regions.

9.3.6 Residual Effects and Significance

This section presents the estimated residual effects of the Project on the economy. Residual effects incorporate, to the extent possible, cumulative effects noted in Section 9.3.5 and consider the effect of impact management measures (both mitigation and enhancement measures) that are planned. Based on socio-economic criteria outlined in Section 2.4, the significance of these effects for the community as a whole is assessed, along with the general direction of change (positive, negative or elements of both).

Table 9.3-2 presents a summary of residual effects and significance of effects (including direction of change – positive or negative) by phase and region. As reviewed in Section 2.4, the EIS examines under "residual effects" both positive and negative (or adverse) effects. The focus of concern identified in the EIS Guidelines for significance evaluation, however, is adverse effects. No significant adverse effects were found with respect to the Project's socio-economic effects on the economy of any region examined.

During the Project's construction phase, the Local Region is expected to experience moderate positive economic effects in the following topic areas considered – employment, income, business, and training. Although short term, these effects are moderate in magnitude and significant. In the areas of employment and training, where the largest number of Local Region residents is likely to be affected, the magnitude of positive residual effects will depend on the outcome of proposed mitigation measures (especially workplace retention strategies to be developed by NCN and Manitoba Hydro and training retention strategies to be developed by NCN) and is likely to be significant.

Table 9.3-2. Residual Effects and Significance of Effects on the Economy of the Local Region, Project Region and Northern Region.

Project Phase	Residual Effects	Region	Significance[1]
Construction	Increased Employment	Local Region	Moderate (+) (Significant)
		Project Region	Moderate (+) (Significant for some Aboriginal communities)
	Increased Incomes	Local Region	Moderate (+) (Significant)
		Project Region	Moderate (+) (Significant for some Aboriginal communities)
	Increased Business Opportunities	Local Region	Moderate (+) (Significant)
	Increased Capacity through Project Training	Local Region	Moderate (+) (Significant)
		Other Regions	Negligible (+)
	New access for resource harvesting	Local Region	Minor (+ and -)
Operations	Revenue from Ownership Investment	Local Region	Major (+)
	Increased Employment	Local Region	Negligible (+)
	Increased Business Opportunities	Local Region	Negligible (+)
	New access for resource harvesting	Local Region	Minor (+ and -)

Note:
1 - See Section 2.4 for definitions adopted for this assessment.

During the Project's operations phase, NCN ownership investment in the Project is expected to generate major (significant) positive economic effects in the Local Region, resulting in effects that are long-term and major in magnitude and affect the whole NCN community. Effects on Local Region employment, business and training are expected to be positive and minor (not significant), and effects on the local resource economy are expected to be positive and minor (not significant) during this phase.

During the Project's construction phase, the Project Region, outside of the Local Region, is expected to experience moderate positive employment effects, but only negligible (not significant) positive business and training effects directly related to the Project. In the area of employment, where the largest number of residents is likely to be affected, the magnitude of positive residual effects will depend on the outcome of proposed enhancement measures, especially any workplace retention strategies to be developed for Aboriginal employees on the construction site, and is likely to be significant for at least some Aboriginal communities.

During the Project's operations phase, economic effects in the Project Region and Northern Region, outside of the Local Region, are expected to be negligible.

During Project construction, Manitoba and Canada will experience moderate economic benefits. The significance of these effects could increase cumulatively if other hydroelectric developments are approved and begin construction before 2009.

During Project operations, economic effects experienced at the provincial and national levels will be minor. Effects will primarily be felt at the provincial level as a result of water rental revenue.

For Manitoba Hydro, the Wuskwatim Generation Project represents a significant positive addition to its financial position and to the reliability of power supply.

9.3.7 Monitoring and Follow-up

Monitoring and follow-up measures in the Local Region, Project Region and Northern Region will be put in place regarding training (pre-Project and on-the-job), Project employment and business participation. Monitoring and follow-up measures for the resource harvesting economy, including access management measures, are outlined in Section 4, Project Description, and Section 8, Resource Use.

Monitoring will be undertaken to measure and evaluate levels of Project employment (especially during the construction phase) and turnover rates among Project employees. Volume 8 reviews potential indicators that could be monitored. Monitoring results will help determine whether impact management measures, beyond those specified as part of an employee retention strategy, are required. An Employment Advisory Committee (made up of representatives from Manitoba Hydro, NCN, AET, the Hydro Projects Management Association and the Allied Hydro Council) will be established and, among other responsibilities, will receive and consider employment monitoring results.

Project training activities (both pre-Project and on-the-job) will be evaluated on a regular basis to determine their success and provide information to those parties managing these activities. Volume 8 presents potential indicators that could be monitored. Relevant pre-Project training results will be gathered and examined by NCN, Manitoba Hydro and potentially AET. The Employment Advisory Committee, noted above, will examine and respond to monitoring information regarding on-the-job training at the construction site.

Participation in the Project by businesses in the Local Region, Project Region and Northern Region (through negotiated contracts or other means) will be monitored by NCN and Manitoba Hydro.

No monitoring and follow-up measures are required regarding effects on the economies of Manitoba or Canada.

9.4 INFRASTRUCTURE AND SERVICES

9.4.1 Introduction

This section addresses the socio-economic component of the environment set out as follows in Section 6.4.3 Infrastructure and Services of the EIS Guidelines: [24]

- "a general description of the infrastructure and services of Aboriginal and other related communities affected by the project shall be provided in sufficient detail to predict the effect of the project on infrastructure and services of Aboriginal and other affected communities."

Infrastructure and services available to people living in Northern Manitoba and elsewhere in the province are critical to meeting a wide range of human needs. They include provision for housing, public infrastructure (to provide potable water and waste handling, roads, electricity and other needs) and public facilities to provide education, health care, recreation, social services and other government services. In many Northern communities, and particularly in First Nation communities, providing infrastructure and services is often hampered by limited financial resources coupled with, in many cases, rapid population growth. This is particularly the case for housing. Although provision of adequate housing for residents is usually a priority and has been recognized as important to human health and social well-being, in northern First Nation and some Northern Affairs communities (where housing is typically supplied to residents) demand frequently exceeds the available supply of quality homes. As a result, many community residents and families live in crowded conditions, and there is limited capacity to accept new residents into the community.

[24] The EIS Guidelines for the Project show this incorrectly as Section 6.3.3.

Providing public facilities, infrastructure and services, and in some cases, housing, for community residents involves governments and draws on public funds, to varying degrees, at the local, provincial and national levels. In planning for future demands in this area, communities usually consider as a key input projections of future population by age and other demographic characteristics. Factors affecting population growth or decline are births, deaths and migration. Of these, migration is hardest to predict because adults and their families migrate from one community to another for many reasons, including a search for job and business opportunities, better housing conditions, education, personal and other reasons.

The Project has the potential to affect in-migration to the Local Region (primarily to the Nelson House reserve community) and, to a much lesser extent, the Project Region (primarily to the City of Thompson), as a result of the draw of training and construction phase employment and business opportunities. This new population, and particularly those with limited financial resources, will generate additional demand for housing, facilities and services and, depending on current capacity, could have implications for public finances.

In the Local Region, a second potential source of change to infrastructure and services related to the Project is the revenue stream that would eventually accompany an investment by NCN in the Project. Depending upon community priorities, improvements to local infrastructure and services could result.

There is a small possibility of effects on other Aboriginal communities in the Project Region (outside of the Local Region), as a result of the Project's likely hiring preference policies and associated Northern residency requirements (the BNA is currently being renegotiated; however, based on the current BNA, it is likely that Northern residency requirements associated with employment preference will require a total of at least five years of residency in Northern Manitoba and six months Northern residency immediately prior to being hired). For this reason, a brief discussion of population, infrastructure and services in these communities is also provided.

Details of the approach and methodology, existing environment, effects and mitigation, cumulative effects, residual effects, and monitoring and follow-up regarding effects on infrastructure and services are found in Volume 8 (Section 4).

9.4.2 Sources of Effects

In the Local Region, sources of effects from the Project on population change relate primarily to the lure of a large number of well-paying construction jobs over a six-year construction period. Several factors would tend to draw NCN members who currently live in Thompson, Winnipeg, South Indian Lake and other locations back to the community and encourage those already there to stay. They include: available community-based training opportunities at Nelson House, hiring by some Nelson House-based contractors (as a result of negotiated contracts during Stage 1 of construction); residency requirements likely to be associated with employment preference (assumed to be a total of at least five years of residency in Northern Manitoba and six months Northern residency immediately prior to hire); and a general sense of optimism about associated indirect opportunities.

Additionally, it is possible that some Project workers and their families may use the additional employment income to migrate away from Nelson House (e.g., to Thompson) for housing or other reasons. This, however, is difficult to estimate.

Outside of the Local Region, Thompson could see migration as a result of the Project, including a small number of senior Hydro staff and senior contractor staff and their families; people seeking to be near the construction site for recruitment, or even commuting purposes; and, potentially, NCN members with construction jobs seeking to find housing or other services in Thompson. Also, in Thompson (located about 75 km by road from the construction site), demand for services is likely to be generated by up to 540 workers in the construction camp during the course of the six-year construction phase.

Outside of Thompson, there is a possibility that Aboriginal communities in the Project Region (excluding those in the Local Region) may see very small levels of population change – potential in-migration as a result of the hiring preference policy and associated northern residency requirement; and potential out-migration, as a result of workers' Project income.

9.4.3 Existing Environment

9.4.3.1 Local Region

Project-related in-migration is expected to occur primarily to the Nelson House reserve community. For this reason, this section focuses primarily on the current and projected future status of population, housing, infrastructure, facilities and services in this community.[25] The task of providing facilities and services to the NCN population on-reserve is a challenge for the First Nation government because the population is young and growing rapidly, with correspondingly rapid growth in needs for housing and other services.

Current and Projected NCN Population

This section presents characteristics of the current NCN population as well as projected growth in population to 2011.[26] Understanding current and potential future size population is important to realizing the incremental effect that in-migration associated with future developments, like the Project, may have on the community.

Table 9.4-1 indicates total NCN membership living on-reserve and on Crown land (primarily in the Northern Affairs communities of South Indian Lake and Nelson House) compared to those living off-reserve (in Thompson, Winnipeg, Brandon, and other locations) for the period from 1990 to 2000, based on INAC and FNIHB data. In 2000, INAC data indicate that approximately 2,258 members lived on-reserve at Nelson House and 1,083 members lived on Crown land in the Northern Affairs communities of South Indian Lake (approximately 1,000 members) and Nelson House (approximately 80 members).

[25] NCN currently provides housing, infrastructure, facilities and services to members living on-reserve at Nelson House. Some services are also provided to NCN members living off-reserve on Crown land (primarily in the Northern Affairs communities of South Indian Lake and Nelson House) and, to a much lesser degree, in other locations (Thompson, Winnipeg, Brandon and others). Also in the Local Region, the Northern Affairs communities of South Indian Lake and Nelson House, with elected Mayors and Councils, provide a range of services to their resident populations.

[26] Population data for total NCN membership were available from Indian and Northern Affairs Canada (INAC) and from Health Canada's First Nations and Inuit Health Branch (FNIHB) for the eleven-year time period from 1990 to 2000. Both sources have been cited because differences in collection methods can lead to differences in the populations reported for First Nation communities; actual population levels are expected to be within the range shown. The 2001 Census data have recently become available, and are being assessed to confirm that a complete and consistent data set can be provided for all communities and regions under review in the SEIA. If feasible, the 2001 data may be added to Volume 8 at a later time.

Table 9.4-1. NCN Members Living On-Reserve and on Crown Land Compared to Members Living Off-Reserve: 1990-2000.

YEAR	INAC[1]		FNIHB[2]	
	On-Reserve & On Crown Land	Off-Reserve	On-Reserve & On Crown Land	Off-Reserve
1990	2,110	849	2,018	824
1991	2,270	943	2,110	825
1992	2,377	992	2,298	930
1993	2,447	1,035	2,369	982
1994	2,797	868	2,484	1,021
1995	2,758	1,047	2,827	880
1996	2,956	1,036	2,915	985
1997	2,998	1,095	2,957	1,055
1998	3,079	1,127	3,063	1,071
1999	3,223	1,154	3,149	1,122
2000	3,341	1,158	3,279	1,098
Average Annual Growth Rate	4.7%	3.2%	5.0%	2.9%

Sources:

1 - Population data for 1990 to 2000 from INAC records. INAC records are based on membership data collected by the NCN Membership Clerk in Nelson House and forwarded to INAC each year.

2 - Population Totals Report for 1990 to 2000 from Health Canada, First Nations and Inuit Health Branch, Status Verification System (SVS).

Notes:

1 - Off-reserve population includes members living on another reserve. Most off-reserve members live in Thompson, Winnipeg and Brandon.

2 - South Indian Lake and Nelson House Northern Affairs populations represent the Crown land population.

When compared to the provincial population, the NCN population is very young. Table 9.4-2 below shows the proportion of NCN members that were of school age, labour force age and seniors in 2000 for on-reserve, on Crown land and off-reserve populations, based on INAC data.

Over the next decade, NCN is expected to continue experiencing relatively high population growth (between 2.4 and 4.3 per cent annually, compared to a provincial growth rate of 0.3 per cent for the same period). Total NCN membership is projected to grow from about 4,500 members in 2000 to between 5,808 and 7,150 members by 2011, excluding Bill C-31 reinstatements.[27] (Between 2001 and 2011, approximately 52 Bill C-31 reinstatements are projected for NCN – 15 on-reserve and 37 off-reserve.) Of the

[27] In June 1985, the federal government introduced legislation to end the *Indian Act's* discriminatory provisions. The legislation - Bill C-31, *An Act to Amend the Indian Act* - respected three fundamental principles: end discrimination in the *Indian Act;* restore Indian status to people who voluntarily or involuntarily lost their status because of the *Indian Act*; give First Nations the option of assuming control of their own membership. The main impact of Bill C-31 has been the elimination of gender discrimination in the *Indian Act*, and the restoration of Indian status to people who lost it under the act's previous provisions. The Bill was of particular significance to Indian women who, under the previous stipulations of the *Indian Act*, lost their status upon marrying non-Indian men (INAC 1997).

projected population, between 2,969 and 3,687 members are projected to live on-reserve, 1,469 to 1,855 members are projected to live on Crown land and 1,375 to 1,629 members are projected to live off-reserve. Detailed information about population projections can be found in Volume 8.

Rapid population growth will present economic challenges for NCN in the future, particularly on-reserve at Nelson House (where growth rates are projected to be between 2.5 and 4.6 per cent annually) and in the Northern Affairs communities of South Indian Lake and Nelson House (i.e., Crown land populations; annual population growth rates here are expected to be between 2.8 and 5.0 per cent). These will come as a result of increased numbers of young people, greater numbers of people entering the labour force, and increased rates of family formation with associated demands for housing and other services. Although birth rates are generally declining, natural increase is expected to continue at well above the provincial average for many more years into the future.

Table 9.4-2. Proportion of School-Age Children, Total Labour Force and Seniors in the NCN On-Reserve, On Crown Land and Off-Reserve Populations, Compared to the Provincial Population: 2000.

	NCN[1]			Manitoba[2] (%)
	On-Reserve (%)	On Crown Land (%)	Off-Reserve (%)	
Proportion of school age children (ages 4-18)	43	56	61	21
Proportion of labour force age (Ages 15-64)	56	41	34	65
Proportion of seniors (65 years +)	3	3	3	14

Sources:
1 - Population data for NCN from INAC. INAC records are based on membership data collected by the NCN Membership Clerk in Nelson House and forwarded to INAC each year.
2 - Population data for Manitoba from the Manitoba Health Population Report for June 1, 2000.
Notes:
1 - The school age population for Manitoba is calculated based on the population between the ages of 5 and 19 years.
2 - Totals do not add to 100% because of overlap in age between the population categories of school age children (ages 4 to 18) and total labour force (ages 15 to 64), as well as the absence of the 0 to 3 age group.

NCN Land in the Nelson House RMA

As a base for settlement, for development and for other purposes, NCN has approximately 148,900 acres (603 square kilometres) of current and potential **reserve land** within the Nelson House RMA. This land falls into three general categories.

- Indian Reserve (IR) parcels (approximately 14,468 acres (59 square kilometres), or less than 10 per cent of the total land base).
- Lands selected through the **Treaty Land Entitlement (TLE)** process (79,435 acres or 322 square kilometres) of which approximately 63,743 acres (258 square kilometres) have been selected to date. All TLE selections have yet to be approved.
- Lands selected as part of the 1996 **Northern Flood Agreement** Implementation Agreement **(1996 NFA Implementation Agreement)** signed by NCN, Manitoba Hydro and the provincial and federal governments (approximately 55,000 acres or 223 square kilometres).

Further details about these lands can be found in Volume 8.

Nelson House Northern Affairs Community Land

The Nelson House Northern Affairs community lies to the northeast of the reserve community along a bay of Footprint Lake. NCN members and others living in the community reside on Crown and private land.

On-Reserve Housing

Housing is largely provided on-reserve by NCN to the majority of its members. Limited private housing stock has also been developed in recent years.

As of 2002, there were approximately 393 accommodation units available to NCN members/residents living on-reserve (366 houses, 17 trailers, and 10 apartments). Annually, an average of 10 to 20 new residences are added (Lederman Consulting 2000). Three eight-unit multiplexes were constructed and completed in spring 2002. Further plans for 2002/2003 include construction of a six-unit multiplex, two 24-unit apartment complexes and 18 new houses (NCN Housing Authority, personal communication, 2002).

There is an average of eight to ten people per home in Nelson House and about 140 homes have more than one family living in them. These conditions reflect overcrowding in homes; there is also a backlog of residents waiting for housing. At present, there are over 100 families on the waiting list to receive a home, of which three to four per cent are members living off-reserve. Currently, priority is given to members requiring emergency housing, followed by those with medical problems (NHA, personal communication, 2001).

Further details regarding housing can be found in Volume 8.

Other Community Services

Information regarding education services, health facilities and services, social services, emergency and police services, community recreation, additional NCN government services, the Nisichawayasihk Trust Office, and the Nelson House **Future Development** Office are found in detail in Volume 8.

9.4.3.2 Project Region

Beyond the Local Region, any population changes, and associated effects from the Project on facilities or services, are expected primarily in the City of Thompson. Therefore, this section provides a profile of the current and projected future population of Thompson and a profile of key service areas.[28]

Population Characteristics – Thompson

Thompson is home to the third largest population in the Province of Manitoba (Mystery Net Project 2001). Throughout Thompson's history, total population levels have fluctuated. During the 1970s, the early years of Thompson's history, population levels increased annually. This consistent growth trend (including sometimes large annual increases) ended in the mid-1970s. Subsequently, population levels entered a period of decline until about 1981. Fluctuations have continued since 1981, but have been less dramatic than during Thompson's early years (Mystery Net Project 2001).

According to the 1996 Census of Canada, the total population of Thompson was about 14,000 people, representing 1.3 per cent of Manitoba's total population (Statistics Canada 1996).[29] More recent Manitoba Health data place the population of Thompson as of June 1, 2000 at about the same level of 14,000 people, representing 1.2 per cent of the provincial population (Manitoba Health 2000).

The Aboriginal population within the Thompson population has experienced similar fluctuations over time, following trends in the total population. In recent years, however, growth in Thompson's Aboriginal population has been more rapid than in the total population. In 1996, the total Aboriginal population of Thompson was about 4,000

[28] The LGD of Mystery Lake, which had a population of 5 people in 1996, is considered here as part of the City of Thompson. Basic population information for other communities that make up the Project Region, as well as a general overview of infrastructure and services in the Region's Aboriginal communities, is provided in Volume 8.

[29] The 2001 Census data have recently become available, and are being assessed to confirm that a complete and consistent data set can be provided for all communities and regions under review in the SEIA. If feasible, the 2001 data may be added to the SEIA at a later time.

individuals, representing 28 per cent of the community's total population. However, local residents estimate that the Aboriginal portion of the total Thompson population is higher - 40 per cent or larger (City of Thompson, personal communication, 2002).

Both the total and Aboriginal populations in Thompson can be described as relatively young when compared to the total population of the Province. In 1996, 46.0 per cent of the Thompson population was under the age of 25, with only 2 per cent over the age of 65. At that time, 60 per cent of Thompson's Aboriginal population was under the age of 25, 43 per cent was under the age of 15 and only 1 per cent of the population was over the age of 65. In comparison, 36 per cent of the 1996 Manitoba population was under the age of 25, with 14 per cent aged 65 and older (Statistics Canada 1996).

Population levels are anticipated to increase slightly to between 14,500 and 17,500 people by 2011. It is anticipated that growth in Thompson's Aboriginal population will continue at a greater rate than growth in the total population, with the Aboriginal population (based on Census data) reaching between about 5,600 and 6,000 in 2011 (or approximately 35 per cent of Thompson's total population compared with 28 per cent in 1996).[30]

Population Characteristics – All Communities in the Project Region

In addition to Thompson and the LGD of Mystery Lake, the Project Region includes First Nations, incorporated municipalities and Northern Affairs communities, including those found in the Local Region (i.e., the reserve community of Nelson House and the Northern Affairs communities of South Indian Lake and Nelson House). Population data for each of these groups of communities is presented below.

First Nation Communities

Table 9.4-3 presents available population data from three sources for First Nation communities in the Project Region. Where data were available, on- and off-reserve populations are specified (off-reserve includes Crown lands).

First Nation communities in the Project Region have young populations, with approximately 35 to 40 per cent of their residents below the age of 15 years. This was nearly double the comparable proportion of the provincial population (which was approximately 20 per cent in both 1996 and 2000). The age characteristics of First Nation communities in the Project Region correspond closely to the provincial First Nation

[30] These projections are based on INAC fertility and survival rates for Manitoba First Nations living off-reserve for 2000 to 2011. Detailed information about population projections can be found in Volume 8.

population, where 40 per cent of the population was under 15 years of age in both 1996 and 2000 (Manitoba Health 2000, Statistics Canada 1996).

Based on Manitoba Health data for 1995 to 2000, annual population growth rates in Project Region First Nation communities were higher than the provincial population: approximately 2.2 per cent annually for Project Region First Nation communities between 1995 and 2000, as compared to 0.1 per cent provincially over the same period (Manitoba Health 2000).

Incorporated Municipalities

Incorporated municipalities in the Project Region include the Town of Gillam and the City of Thompson and LGD of Mystery Lake. In 1996, the total population of these communities was 15,928 individuals – 1,543 in Gillam and 14,385 in Thompson and the LGD of Mystery Lake. More recent data from the 2000 Manitoba Health Population Report place the population of these communities at 15,566 individuals – 1,526 in Gillam and 14,040 in Thompson.

Both the Thompson and Gillam populations can be characterized as relatively youthful when compared to the total population of the Province. In 1996, 46.0 per cent of the population in these communities was under the age of 25, with only 1.7 per cent over the age of 65. In comparison, 35.8 per cent of the 1996 Manitoba population was under the age of 25, with 14.0 per cent aged 65 and older (Statistics Canada 1996).

Annual growth rates for Project Region incorporated communities are relatively low when compared to Project Region First Nation and Northern Affairs communities. Between 1995 and 2000, the annual population growth rate calculated for these communities was 0.1 per cent per year, using Manitoba Health population data. Gillam actually experienced negative annual growth during this time period of -4.2 per cent. Statistics Canada data for 1991 and 1996 indicate average annual growth over the time period from 1991 to 1996 of -1.2 per cent for Project Region incorporated communities. During this time period, both Thompson and Gillam experienced negative annual growth of -0.8 per cent per year and -4.1 per cent, respectively.

Table 9.4-3. Total Population of Project Region First Nation Communities: 1996, 2000 and 2002.

Community	Statistics Canada 1996	Manitoba Health 2000	INAC[1] January, 2002
Nisichawayasihk Cree Nation (NCN) (Also included in the Local Region)			
• On-reserve[2]	1,760	2,226	2,360
• Off-reserve[3]			2,354
Tataskweyak Cree Nation (TCN)			
• On-reserve	1,500	1,274	1,847
• Off-reserve			822
War Lake First Nation			
• On-Reserve	155	83	80
• Off-reserve			144
York Factory First Nation			
• On-reserve	300	278	412
• Off-reserve			543
Fox Lake Cree Nation			
• On-reserve	155	230	141
• Off-reserve			1,768
Pimicikamak Cree Nation (PCN)			
• On-reserve	3,495	2,977	4,085
• Off-reserve			1,682
Norway House Cree Nation[1]			
• On-reserve	3,400	3,493	4,069
• Off-reserve			1,455
Total On-Reserve	**10,765**	**10,561**	**12,994**
Total Off-Reserve			**8,768**

Sources:

1 - Census of Canada 1996.

2 - Manitoba Health Population Report, June 1, 2000. Note that First Nations members are counted according to the postal code (location) where they reside.

3 - Indian and Northern Affairs Canada (INAC), January 2002 (except for Norway House Cree Nation).

4 - Norway House Cree Nation Profile, 2000.

Notes:

1 - No INAC 2002 information was available for Norway House. The most recent INAC data presently available (December 2000) are used for Norway House. (Source: Norway House Cree Nation Profile). The data do not distinguish off-reserve populations on Crown Land.

2 - "On-Reserve" includes registered males and females on own reserve.

3 - "Off-Reserve" includes registered males and females on other reserves and off-reserve, as well as on Crown Land.

Northern Affairs Communities

The most recent population data for Northern Affairs communities in the Project Region are from the 1996 Census of Canada and are outlined in Table 9.4-4 below. The population of the Northern Affairs community of Ilford is included as part of the War Lake First Nation population in the section on First Nation Communities above.

Table 9.4-4. Total Population of Northern Affairs Communities in the Project Region: 1996.

Northern Affairs Community	1996 Total Population
Nelson House (also in Local Region)	77
South Indian Lake (also in Local Region)	887
Pikwitonei	140
Thicket Portage	204
Wabowden	563
Cross Lake	412
Norway House	575
Total	**2,858**

Source: Manitoba Northern Affairs 1998.

Growth rates for Northern Affairs communities in the Project Region were calculated over the period from 1991 to 1996 using Statistics Canada data. These data indicate that, over this six-year period, each of the six Northern Affairs communities in the Project Region experienced positive annual population growth rates. The average annual population growth rate during this time period for these communities was 2.1 per cent per year. The provincial growth rate over this same time period (1991 to 1996) was significantly lower at 0.4 per cent (Statistics Canada 1996).

Housing and Temporary Accommodation – Thompson

Although migration into the City of Thompson as a result of the Project is expected to be relatively small, those who do migrate will require some form of housing. Travel to and from the construction site by contractors and others is likely to mean some increase in use of temporary accommodation. In Thompson, temporary accommodation includes hotels, bed and breakfast facilities and hostels.

The number of dwelling units in Thompson has remained stable over the past fifteen years. As of January 2002, there were 3,336 duplexes and houses and 1,709 apartments in Thompson (City of Thompson real estate agents, personal communication, 2002). According to local real estate agents, many dwelling units are unoccupied, with approximately 100 to 150 dwelling units currently available in the Thompson area. The average price of these units ranges from $85,000 to $115,000 (City of Thompson real estate agents, personal communication, 2002). There are also several building lots available for those interested in building a home.

Few apartment units are unoccupied in Thompson. There is typically a very low vacancy rate for apartments in the City, with a slight increase in vacancy during the summer months when local schools and university programs are closed. Rent for a one-bedroom apartment is approximately $400 to $500 per month, and a two-bedroom apartment costs between $500 and $600 per month (City of Thompson real estate agents, personal communication, 2002).

Temporary accommodation in Thompson consists of seven hotels and three bed and breakfasts. Together these facilities have a total of 362 rooms. In general, the cost of a hotel room in Thompson currently ranges from $40 to $80 for a single room and $45 to $90 for a double room. Rates at bed and breakfast facilities vary from $40 to $55 for a single room and $50 to $60 for a double room (including breakfast).

There are also two hostels in Thompson: the Ma Mow We Tak Friendship Centre with 26 beds, and the YWCA Residence with 104 beds (Manitoba Intergovernmental Affairs 2001).

Housing – First Nation and Northern Affairs Communities

Much like the Local Region, the majority of the housing stock in Project Region Aboriginal communities is publicly funded. Limited financial resources mean that many of these communities experience difficulty providing sufficient levels of quality housing for their residents. As a result, housing represents one of the most critical areas of community needs in these and other Northern Aboriginal communities (Manitoba Family Services and Housing 2001).

Based on INAC's 2001/2002 First Nation Community Profiles, there are an average of four to six people living in private dwellings in Project Region First Nation communities. Interview data from Nelson House suggest that this number may actually be higher – using this same source, Nelson House homes house an average of six people, but interviews suggest an average of 8 to 10 people per home is typical and there are cases of up to 17 people living in one household (NHA, personal communication, 2001; Interview with Health Care Providers 2002). By comparison, in Manitoba there was an average of 3 people per home in 2001 (Statistics Canada 2001).

In terms of housing quality, data from the 1996 Census of Canada indicate that, on average, 36 per cent of housing in Project Region First Nation communities required major repairs. Only one First Nation community in the Project Region had no homes requiring major repairs; the remainder had between 22 and 51 per cent of homes requiring major repairs. By comparison, in 1996, only 11 per cent of homes in Manitoba required major repairs.

Although similar data were not available for Northern Affairs communities in the Project Region, the results of a recent Northern housing forum suggest that the circumstances are similar in these communities. At this forum, it was noted that the difficulties experienced with Northern housing (availability, quality and age of homes) are prevalent in both First Nation and Northern Affairs communities (Manitoba Family Services and Housing 2001).

Community Infrastructure and Services

Information regarding community infrastructure (road, rail and air transportation; water and sewer; waste disposal) and community services (education, health care, community recreation, emergency and policing services) for the City of Thompson and First Nation communities in the Project Region can be found in Volume 8.

9.4.4 Effects and Mitigation

9.4.4.1 Local Region

Construction Phase

Community-based training and Project-related construction employment opportunities may result in return migration of NCN members of working age and their families to Nelson House. Estimates of the magnitude of this migration range from 35 to about 400 individuals, reflecting the high degree of uncertainty associated with migration estimates.

Return migration to Nelson House is expected to begin as community-based training expands and to continue through the first stage of the construction phase. In-migration is likely to diminish following this first stage of construction; however, the rate or extent of decline is unclear.

Based on past experience, some out-migration may also occur by NCN members with construction-related employment income (e.g., seeking to obtain an owned dwelling or different educational opportunities for their families in Thompson).

Any level of in-migration to Nelson House, particularly by young families, that occurs due to the Project is likely to strain housing and possibly education and other services oriented to children and young families. Depending upon the extent of in-migration, new demands could be placed on budgets in key housing and service agencies. Impact management mitigation measures are possible, including putting in place bus transportation between Nelson House and Thompson, ensuring that the job order process is well understood (so that members know that they can be registered to work from a variety of locations), and targeting information for NCN members who live away from the community regarding the extent and nature of construction phase employment opportunities. Given the high degree of uncertainty related to migration estimates (evident here in the large range of in-migration estimates presented in the minimum and maximum scenarios), timely information for NCN service providers in key areas through monitoring will be an important tool for addressing this potential effect.

Operations Phase

During the operations phase and depending on community priorities, the stream of revenue stemming from NCN investment in the Project could be used to improve and develop community infrastructure and services.

9.4.4.2 Project Region

Construction Phase

In Thompson, it is anticipated that a small number of senior Manitoba Hydro staff and contractors (less than ten) and possibly some Project workers from Nelson House, along with their families, will move to the community. New workers and their families could provide a positive contribution to the mid-to-upper-range housing market and are unlikely to stretch available community services.

Thompson may also experience some speculative in-migration (predicted range of 10 to 35 NCN members and their families and potentially other Northern Aboriginal people) as people move to be closer to Project-related training and employment opportunities. Additionally, some NCN members currently residing in Thompson may relocate to Nelson House. Most of these population changes are anticipated to take place during the early part of the construction phase.

Speculative migration into Thompson has the potential to strain the City’s already limited affordable rental housing and temporary accommodation and may also strain some local social services, most notably daycare, which is one of the few programs in Thompson operating at capacity.

It is expected that a number of Project construction workers will visit Thompson on their evenings/day off (assumed to be Saturday evening and Sunday) and possibly on weekday evenings, although to a lesser degree. This effect will be greatest during Stage 2 of construction when the peak workforce reaches 540 workers, and when construction on the Gull/Keeyask Generating Station Project is set to begin. Thompson businesses that provide services to workers (e.g., restaurants, lounges, bars, movie theatres, stores) are likely to benefit from this influx. However, some businesspersons noted that they could experience difficulty in adding to their staff complement due to the current shortage of entry-level labour. As well, this possibly large influx of workers at specific times may put additional strain on policing and emergency services (e.g., roads, accidents, bar-related disturbances and sexual harassment) in the community. This effect is expected to be minimal and restricted to specific time periods (e.g., Saturday nights).

Although the Project construction camp is expected to have its own ambulance and nurse as well as fire-fighting capability, limited additional demand may be expected at the Thompson Hospital emergency room due to industrial accidents or other emergencies. As well, medical services unavailable at the camp (e.g., physician services) may see very limited additional demand due to the presence of the camp population.

Outside of Thompson and the Local Region, other Aboriginal communities in the Project Region may experience small variations in population during Project construction as a result of the Project's hiring preference policies and associated Northern residency requirement. This effect is expected to be negligible.

Operations Phase

During the operations phase, residual effects on infrastructure and services in Thompson will be negligible given the limited employment at the site (about three or four technicians and two utility workers). No Project-related effects are anticipated on infrastructure and services in Project Region Aboriginal communities (outside of the Local Region) during this phase.

9.4.5 Cumulative Effects Assessment

Cumulative effects of the Project are assessed in combination with effects of other known or planned projects that overlap in space and time with socio-economic effects of the Project on infrastructure and services (Section 2.3).

- Wuskwatim Transmission Project – This project offers only limited employment and business opportunities and is not anticipated to generate any further migration into the Local Region or the Project Region, beyond that already predicted for the Project. Thompson businesses that provide services to construction workers (e.g., hotels, restaurants, bars, recreation facilities) may experience some additional demand because workers constructing the proposed Birchtree Station (just south of Thompson) are likely to stay in the community.
- Gull/Keeyask Generation Project or the Conawapa Generation Project – If the Gull/Keeyask Generation Project or the Conawapa Generation Project is approved and begins construction during the second phase of Project construction, there is a possibility that the Local Region will be affected by an additional, small number of NCN members returning to the community to seek out employment opportunities on these projects.[31] In the Project Region, development of these projects during the second phase of Wuskwatim Project construction may result in Thompson experiencing a small amount of additional speculative in-migration, although limited by the distance to the sites (the Gull/Keeyask project site is about 200 km from Thompson and the Conawapa site is about 300 km). In addition, such development could overlap with the very small Project-related in-migration that may occur in Project Region Aboriginal communities.[32] Thompson businesses that provide services to construction workers (e.g., hotels, restaurants, bars, recreational facilities) may also see some additional demand as Gull/Keeyask construction workers, and to a lesser extent Conawapa workers, may visit the community on their days off.
- Notigi Generation Project – The Notigi Project is relatively small and, on its own, is not likely to generate additional migration into the Local Region or to Thompson and/or other Project Region communities. The Notigi Project is not expected to begin construction until after Wuskwatim Project construction has come to an end.

[31] It is likely that any added effects will be considerably less than those predicted for the Project for the following reasons:

- the distance of Nelson House from these projects (approximately 250 kilometres from the Gull/Keeyask Project and 400 kilometres from the Conawapa Project);
- the likelihood of fewer project-related training opportunities based in the community; and
- the fact that many NCN members will already have returned to the community in anticipation of Wuskwatim training and employment.

[32] It is likely that most individuals who move to the Project Region in anticipation of Gull/Keeyask employment will be members returning to one of the four First Nation communities in the vicinity of the Gull/Keeyask Generation Project - Tataskweyak Cree Nation, York Factory First Nation, War Lake First Nation and Fox Lake Cree Nation. It is likely that levels of return migration to these communities related to the Gull/Keeyawsk or Conawapa projects would be much greater than return migration to these communities as a result of the Wuskwatim Project (which is expected to be negligible).

The proximity of Notigi to Thompson and the presence of the Notigi workforce could continue to generate demand for Thompson businesses that provide retail, hospitality and recreational services for workers.

- Tolko Forestry Activities – The Tolko Forest Management Plan indicates that there may be harvesting in areas of the Nelson House RMA within the next 13 years. Although not likely to generate additional in-migration, this activity may provide some employment for Local Region residents beyond the Project's construction phase and could discourage out-migration.

9.4.6 Residual Effects and Significance

This section presents the estimated residual effects of the Project on infrastructure and services. Residual effects incorporate, to the extent possible, cumulative effects noted in Section 9.4.5 and consider the effect of impact management measures that are planned. Based on socio-economic criteria outlined in Section 9.2, the significance of these effects for the community as a whole is assessed, along with the general direction of change (positive, negative or elements of both).

Table 9.4-5 presents a summary of residual effects and significance of effects (including direction of change – positive or negative) by phase and region.

During construction, the Local Region community of Nelson House is likely to experience moderate adverse effects on infrastructure and services. Effects will accrue as a result of Project-related changes in local population (i.e., in-migration to Nelson House to seek out employment and training opportunities) and will be felt primarily in the area of community housing. The extent of in-migration is difficult to predict. For this reason, effective monitoring and a coordinated service group ready to respond with impact management plans for a range of possibilities are considered to be essential. The measures being considered by NCN to discourage in-migration (e.g., offering daily transportation services between Thompson and Nelson House for those enrolled in training) will also play an important role in managing this effect, and are likely to result in the effects on infrastructure and service not being significant.

During the operations phase, new revenue from NCN's ownership investment would mean additional resources for the community to address local priorities. Although it is difficult to predict what community priorities will be in the long term, it is possible that community infrastructure and services will benefit from at least a portion of these resources.

Table 9.4-5. Residual Effects and Significance of Effects on Infrastructure and Services of the Local Region and Project Region.

Project Phase	Residual Effect	Region	Significance[1]
Construction	Strain on infrastructure & services as a result of Project-related in-migration	Local Region	Moderate (-) (Not Significant)
		Thompson	Minor (-) (Not Significant)
		Other Project Region	Negligible (-) (Not Significant)
	Effects of workers visiting Thompson	Thompson	Minor (-) (Not Significant)
Operations	Improvements/additions to community infrastructure & services using revenue from ownership investment	Local Region	Moderate - Major (+) (Significant)

Note:
1 - See Section 2.4 for definitions adopted for this assessment.

During construction of the Project, residual effects on infrastructure and services in communities outside of the Local Region are expected to be minimal (insignificant) in Thompson and negligible (insignificant) in other Project Region Aboriginal communities. As in the Local Region, the difficulties associated with predicting migration mean that monitoring and follow-up measures will be important in the City of Thompson.

9.4.7 Monitoring and Follow-up

Appropriate monitoring and impact management measures will be established and implemented for Nelson House and for the City of Thompson during the Pre-Construction/Planning and Construction Phase.

For Nelson House, key indicators will be used to determine the extent of in-migration, out-migration and natural growth (potential indicators are presented in Volume 8). Monitoring data will be reviewed by an NCN Coordinated Response Committee (made up of NCN key service providers) who may, if necessary, implement impact management measures.

In the Project Region, monitoring and follow-up measures are only considered to be necessary for the City of Thompson. Here, Manitoba Hydro and NCN will meet, as required, with representatives of the City of Thompson and relevant agencies (e.g., social services, policing, emergency services) to provide information in advance about potential in-migration effects. Follow-up contact to the extent required will be undertaken.

9.5 PERSONAL, FAMILY AND COMMUNITY LIFE

9.5.1 Introduction

This section considers impacts on people's personal, family and community life. It addresses the socio-economic components set out in Section 6.4.4 of the EIS Guidelines:[33]

- "a general description of the personal, family and community life of Aboriginal and other communities potentially affected by the project shall be provided, including a population and demographic profile, outdoor recreation and travel, aesthetics, health status and health issues, way of life, culture and spirituality and community cohesion and organization; and
- sufficient detail on the noted items shall be provided to predict the effect of the project on personal, family and community life."

The lives of individuals, families and communities as a whole are shaped by many factors. Although there are many ways of looking at these factors,[34] there tends to be a common understanding that many things contribute to the quality of people's lives and experiences and the interplay among these factors affects human and social development, including economic well-being (e.g., income and employment to meet basic human needs for shelter, food and clothing), physical well-being (e.g., personal health and safety), social well-being (e.g., social supports, family stability) and the environment (particularly important for Aboriginal people who undertake traditional activities).

Culture and spirituality are important foundations shaping this socio-economic environment, in particular for Aboriginal communities. Perspectives of people also play a role in personal, family and community life – perspectives about current circumstances and possibilities for the future. Communities typically plan for improvements in

[33] The EIS Guidelines for the Project show this incorrectly as Section 6.3.4.

[34] Examples range from social indicators of community well-being (City of Calgary, 2000-2002) and quality of life (Northern Manitoba Economic Development Commission, 1993; Quality of Life Research Unit, University of Toronto; Mukherjee, 1989; Shookner, 1997) to a population health approach (Frankish *et al.*, 1996; Health Canada, 1999).

economic activity and standard of living, infrastructure and services, community health and the well-being of residents. Community goals and plans for the future are measures against which communities judge whether the effects of proposals are considered to be positive or negative and the significance of those effects – i.e., do proposals support or work against a community's vision for their future.

The Project is expected to have the most pronounced effect on the people of the Local Region (NCN members and others at Nelson House and the Northern Affairs community of Nelson House) by virtue of their proximity to the Project, their traditional use of the area around Wuskwatim Lake, and their participation in the Project as a potential partner (including employment and business activities). The community of South Indian Lake (made up primarily of NCN members) is also included in the Local Region, but due to its distance from the Project is not expected to experience the same degree of effects as Nelson House. South Indian Lake residents are expected to experience effects mainly through construction phase employment and business opportunities.

In the Project Region, Thompson is expected to see much more limited effects than will Nelson House. Elsewhere in the Project Region, Northern Region, Manitoba and Canada, effects are expected to be limited to participation in construction-phase employment and business opportunities, potentially distributed across many communities, so that the effect on any one community is anticipated to be small. Key person interviews indicate that use of the Local Region is limited beyond NCN members and, to a very limited extent, Thompson residents.

Potential effects of the Project on personal, family and community life in the Local Region could result during the construction phase. These primarily include participation in construction-phase employment and business opportunities, potential associated in-migration to Nelson House (and some potential out-migration), very limited new access to the Wuskwatim Lake area via the access road required for the Project, and physical/biophysical changes to Taskinigup Falls, Wuskwatim Falls, and related work and camp areas traditionally used by NCN. The effects of these changes on people resident in the Local Region are examined in this section.

The City of Thompson is the next closest community to the proposed Project. During the construction phase, effects on community life could result from the community's role as a regional service centre. These include services for workers during their days off, some construction-related road and air traffic, and services provided to construction contractors. Effects could also result from some potential in-migration associated with

Project-related economic opportunities. The effects of these changes on people resident in Thompson are examined in this section.

In other communities in the Project Region beyond Thompson and in the Northern Region and beyond, effects on personal, family and community life from the Project are expected to be typically positive and minor. Two possible links to the project are noted for these other communities.

- Economic effects from construction employment: The main source of effects from the Project for these other communities is limited to some benefits (as reviewed in Section 9.3) associated with participation in construction-phase employment (and perhaps some business) opportunities distributed across a broad range of communities; no attempt has been made to assess likely employment effects for specific communities, although it is reasonable to assume that such effects in any community will be moderate relative to effects in the Local Region.
- Concerns about possible adverse water-related effects during operations: Through the public consultation and involvement activities (Section 3 and Volume 2), concerns about possible water-related adverse effects from the Project were also expressed by some residents in Project Region communities (beyond Thompson), particularly with respect to possible biophysical effects of changes in water levels and flows at South Indian Lake or downstream of the Project on the Burntwood-Nelson River system as a result of the Project. Biophysical studies have concluded that water-related effects are not expected to extend beyond the Local Region (noticeable effects are expected to be confined to the area between Early Morning Rapids and Birch Tree Lake) (see Section 6, Aquatic Environment). Nevertheless, monitoring of potential downstream effects beyond the Local Region is planned to address these concerns. Periodic communication of monitoring results to communities where such concerns were expressed is planned to mitigate such concerns and to provide a basis for prompt action in the event that unpredicted adverse effects do occur.

During the operations phase, effects of new road access and physical/biophysical changes to resources in areas traditionally used by residents of the Local Region could result in material changes to personal, family and community life for these residents. In the long term, if NCN takes up the opportunity to participate in ownership of the generating station, use of funds returned from that investment could shape personal, family and community life for NCN in the future. Potential limited new access to the Wuskwatim Lake area may result in limited recreation benefits for Thompson residents during the operations phase. These effects are examined in this section.

Details of the approach and methodology, existing environment, effects and mitigation, cumulative effects, residual effects, and monitoring and follow-up regarding effects on personal, family and community life are found in Section 5 of Volume 8.

9.5.2 Sources of Effect

Personal, family and community life can be affected by the accumulation of a broad range of Project-related effects. Many of these effects flow indirectly through physical, biophysical, economic and population changes.

In the Local Region, sources of effects during the construction phase include:

- participation in construction employment and business opportunities by residents of the Local Region, new income associated with this employment and associated new patterns of work life, including interaction with non-local construction workers in a construction camp at the construction site;
- change in resource-based income in the Local Region;
- potential in-migration to Nelson House (and most likely some offsetting out-migration), particularly early in the construction period, and potentially prior to construction when training is made available; associated new demand for housing and services;
- construction-related traffic;
- limited new access to the Wuskwatim Lake area during the construction phase; and
- physical changes to the landscape as a result of clearing and construction of the access road, camp and work areas, dam and associated works.

In the Local Region, sources of effect during the operations phase include:

- participation in very limited operations employment and contracting opportunities by people residing in the Local Region;
- if NCN pursues ownership participation in the Project, eventual return on investment for the benefit of the community;
- change in resource-based income in the Local Region;

- changes to water levels and flows, associated debris and water quality on Wuskwatim Lake; and
- continuing, and potentially greater, new access to the Wuskwatim Lake area and to the south side of the Burntwood River (if access is permitted across the dam).

For the City of Thompson/LGD of Mystery Lake, key sources of change during the construction phase include:

- visits to Thompson by construction workers resident at the construction camp;
- potential in-migration to Thompson, particularly early in the construction period, and associated new demand for housing and services;
- construction-related traffic; and
- some new employment and business income.

For the City of Thompson/LGD of Mystery Lake, the primary source of change during the operations phase is expected to be potential new access to the Wuskwatim Lake area via the new access road.

9.5.3 Existing Environment

9.5.3.1 Local Region

Overview

In the Local Region, the primarily Aboriginal population resides at the reserve community of Nelson House (NCN members), at the small adjacent Northern Affairs community of Nelson House (mainly NCN members) and at the Northern Affairs community of South Indian Lake. The latter community primarily includes people holding NCN membership; these members have been in the process for some time of applying to create a separate Cree Nation of O-Pipon-Na-Piwin Cree Nation. NCN members continue to use the Nelson House RMA for commercial and domestic resource harvesting, cultural and other reasons.

The following sections characterize personal, family and community life in the Local Region in summary form,[35] focusing on those geographic areas and communities where change is anticipated to occur:

[35] Further detail for each section can be found in Section 5.2.2 in Volume 8.

- transportation safety in the area between Nelson House and Opegano Lake, including both water and trail-based transportation, as well as road traffic on PR 391 between Nelson House and Thompson;
- current aesthetic character of the area at and near Taskinigup Falls and Wuskwatim Falls, Wuskwatim Lake and the access road;
- community health status at Nelson House and, to the extent that data are available, at South Indian Lake;
- social well-being at Nelson House;
- NCN culture, primarily at Nelson House;
- community organization and governance of NCN at Nelson House; and
- goals and plans of NCN at Nelson House.

Transportation, Safety and Access

This section highlights existing conditions with respect to water and trail-based navigation and safety, as well as road traffic. Details regarding existing conditions can be found in Volume 8.

Water and Trail-based Navigation and Safety

Under agreements, licence arrangements and federal legislation, Manitoba Hydro is responsible for mitigating adverse effects from its operations on travel and access along affected waterways. The 1996 NFA Implementation Agreement (which implements the Northern Flood Agreement of 1977 for the NCN), contains a number of safety provisions to be undertaken by Manitoba Hydro to assure safe travel along affected waterways in the Nelson House RMA, as well as a claims mechanism established through the NCN Trust. These safety provisions are associated with safe ice trails, navigational aids, and debris management.

Open Water Navigation

Under open water conditions, there is only a very small amount of travel beyond Threepoint Lake to Wuskwatim Lake. The stretch of the Burntwood River between Threepoint Lake and Birch Tree Lake has been characterized by Nelson House residents as having strong currents, areas with high amounts of debris and generally being unsafe for travel. People travelling to Wuskwatim Lake do have access to portages maintained by Manitoba Hydro at God's Rapids and Early Morning Rapids. As a result of dangerous conditions, however, most people who travel along this waterway are accompanied by guides who have extensive knowledge and experience with this route (NCN Resource Programs staff, personal communication 2002; also see Section 5 and Volume 4).

Wuskwatim Lake itself has low to medium debris densities and is often subject to strong winds, fast currents and a lot of wave action. According to Nelson House residents, winds also tend to stir up debris and sediment making travel on the lake more dangerous. Other navigation difficulties on the lake include considerable erosion, lack of anchor stones for landing boats and setting nets, water level fluctuations and navigational hazards such as reefs and rocks (NCN commercial harvesters, personal communication, 2002; also see Section 5 and Volume 4).

Very few people travel beyond Wuskwatim Lake to Opegano Lake and Birch Tree Lake. The route is extremely dangerous and is used infrequently, principally because of the need to bypass Wuskwatim Falls and Taskinigup Falls.

Some Thompson residents use Birch Tree Lake and sections of the Burntwood River as far west as Kepuche Falls for fishing, boating and recreational purposes. Typically these residents do not attempt to pass Kepuche Falls in order to access Opegano Lake (Manitoba Hydro Mitigation Dept. – Thompson office, personal communication, 2002).

Ice Conditions Navigation

As in the summer, the waterways between Threepoint Lake and Wuskwatim Lake are not frequently used in the winter. These areas have been identified as having intermittent or weak ice cover, including areas of border ice[36] (e.g., God's Rapids), anchor ice[37] (e.g., God's Rapids), open water (e.g., downstream of Upper Caribou Rapids) and hanging ice dams[38] (e.g., Early Morning Rapids). Each of these ice conditions creates serious navigation and safety concerns in these areas. Wuskwatim Lake has solid lake ice[39] (see Section 5 and Volume 4). NCN commercial harvesters (trappers and fishers) expressed several concerns relating to navigation and access during winter ice conditions between Footprint Lake and Birch Tree Lake.

Further downstream, there is some use of Birch Tree Lake and the adjoining sections of the Burntwood River by Thompson residents for snowmobiling, ice fishing and

[36] Border ice forms along the shoreline of a river, extending out into the centre. It will grow throughout the winter and may cover the entire width of the river (depending on the river velocity and geometry).
[37] Anchor ice typically forms in areas of shallow and rapidly flowing water (i.e., rapids).
[38] Hanging ice dams are formed when river velocities are too high and ice accumulates under the ice cover. This can result in a substantial rise in water levels due to the local thickening of ice and blockage of the river.
[39] Lake ice forms on very low velocity lakes. Lake ice thickness is primarily governed by winter air temperatures and depth of snow cover.

recreational purposes (Manitoba Hydro Mitigation Dept. – Thompson office, personal communication, 2002).

Land-based Navigation and Safety

There are a number of land-based trails in the Local Region surrounding the Nelson House community. NCN members continue to use these trails for traditional resource harvesting activities (fishing, hunting, berry picking, etc.). Typically, the trails are used to gain access to lakes in the area, including Footprint Lake, Threepoint Lake, Kinosaskaw Lake, Cranberry Lakes, Wuskwatim Lake, Opanahaskoe Lake, Opegano Lake and Bison Lake. The land-based trails are also used to connect sections of ice trails located on some of these lakes. The trails are used by snowmobiles in the winter and all-terrain vehicles in the summer.

Road Traffic and Safety

Provincial Road (PR) 391 links Nelson House to Thompson (to the southeast) and Leaf Rapids/Lynn Lake (to the northwest). PR 391 is a two-lane secondary arterial road route with a posted speed limit of 90 kilometres per hour. The road is seal-coated for the 30 kilometre section located immediately west of Thompson, gravel surfaced for the next 25 kilometres, and again seal-coated for the last stretch of the road which ends at the Nelson House road turnoff (ND Lea 2002). Table 9.5-1 below highlights traffic volumes, as well as accident rates, for two sections of PR 391.

Table 9.5-1. PR 391 Traffic Volumes and Accident Rates: 2000.

Highway	Section	Average 2000 AADT[3]	AADT[4] *(Truck %)*	ASDT[5]	# of Accidents (2000)	Accidents / Million vehicle-km
PR 391 (excl. Thompson)	A[1]	775	55 *(7.0%)*	935	5	1.77
	B[2]	425	65 *(15%)*	525	12	1.21

Source: ND LEA, 2002.

Notes:

1 - Section 'A' applies to the stretch of PR 391 between the Burntwood River Bridge at the north end of Thompson and the turnoff to PR 280.

2 - Section 'B' applies to the stretch of PR 391 between the turnoff to PR 280 and the Nelson House access road.

3 - AADT = Average Annual Daily Traffic (vehicles/day).

4 - AADTT = Average Annual Daily Truck Traffic (trucks/day).

5 - ASDT = Average Summer Daily Traffic (vehicles/day).

The majority of traffic on PR 391 is comprised of passenger cars and other 2-axle, 4-tire, single-unit vehicles. Single-unit trucks and single trailer trucks with four or less axles represent 3.5 per cent of the total traffic on PR 391. Larger trucks with four or more axles represent 8.9 per cent of the total traffic.

Aesthetics

In general, Wuskwatim Lake receives very few visitors. Some residents travel from Nelson House for fishing, moose hunting and visits to culturally important areas surrounding the lake. However, as noted in the previous section, dangerous travel conditions prevent frequent visits to the Wuskwatim Lake area.

The shores of Wuskwatim Lake are mainly covered with spruce trees and varying amounts of beached and leaning debris cover most of the shoreline (see Figure 9.5-1). There is a substantial amount of woody debris on the lake.

Few people travel past Wuskwatim Lake towards Thompson. There are trees along the shorelines and numerous inlets as the Burntwood River widens after the falls and meanders before reaching the second set of nearby falls, Taskinigup Falls.

Taskinigup Falls has more whitewater rapids and a greater vertical drop than Wuskwatim Falls. There is a small covered island that separates the current as it passes through Taskinigup Falls. Figure 9.5-2 displays Taskinigup Falls in the foreground and Wuskwatim Falls in the back left corner.

Source: Manitoba Hydro, 2002.

Figure 9.5-1. Wuskwatim Lake Shoreline.

Source: Manitoba Hydro, 2002.

Figure 9.5-2. Taskinigup Falls.

Community Health

The following provides a general overview of the current status of health in Local Region communities; a detailed review of local perspectives about health and health status indicators can be found in Section 5.2.2 in Volume 8. The majority of this section focuses on the reserve community of Nelson House but, wherever possible, South Indian Lake data are also presented.

A full understanding of community health also requires consideration of a community's social, physical and economic environments (Health Canada, 2002). These aspects of community health are presented in other sections.

Local Perspectives on Community Health

In general, many of the key persons interviewed commented that the community is not as healthy as it could be, especially when compared to Manitoba as a whole. However, most also indicated that community health had improved significantly in recent years. Those interviewed cited a number of positive developments that are contributing to improved community health and wellness, including economic development, new health and wellness facilities and improved health care programming.

Despite these positive developments, health care providers and others have expressed concern about various medical conditions, including diabetes and related conditions, substance abuse, thyroid problems, hypertension, cancer, respiratory conditions, skin rashes and communicable diseases. Many of those interviewed also commented on factors that may be contributing to health concerns, including housing conditions, water quality, low income, problems with personal well-being and lack of self-esteem, road conditions and continuing concern about mercury levels in lakes and rivers along the Rat and Burntwood river systems. Concerns about mercury stem from the elevated mercury levels in fish seen along these waterways following completion of the **Churchill River Diversion (CRD)**.

Mercury testing of fish shows that there has been a gradual decline in fish mercury concentrations during the 1990s, in some cases reaching levels similar to those seen prior to the CRD (see Section 6, Aquatic Environment). In addition to testing of fish, various studies have also been undertaken to determine levels of methyl mercury in residents of Nelson House and South Indian Lake. These studies, conducted by First Nations and Inuit Health Branch, took place between 1976 and 1988 (using hair and blood samples) and more recently in 2000/2001 (using hair samples).[40] The data indicate that, in general, mercury levels in people have declined in both of these communities. In earlier studies (those between 1976 and 1988), hair methyl mercury levels exceeding the normal range (6 parts per million (ppm)) were found in Nelson House and South Indian Lake. In addition, these earlier studies showed individuals with methyl mercury levels considered "at risk" (30 ppm or over) each year between 1976 and 1988 in South Indian Lake and in 1976, 1978 and 1984 in Nelson House. In the more recent 2000/2001 studies, for 98 per cent of randomly selected participants and 96 per cent of self-selected (volunteer) participants, the highest levels of methyl mercury in hair samples were within the normal range of 6 ppm or less. In South Indian Lake, 97 per cent of randomly selected participants and 91 per cent of self-selected participants had maximum methyl mercury levels in hair samples within the normal acceptable range (Health Canada 2002). No one tested in 2000-2001 had methyl mercury levels in the "at risk" range.[41]

[40] Caution should be applied in interpreting these findings, as only a small number of individuals took part in the studies, the methodologies for collecting hair samples may have varied and the amount of fish consumed by study participants is unknown.

[41] The FNIHB study, determined from the hair samples taken in 2000-2001 that none of the participants had methylmercury levels which place them at risk for health effects (Health Canada, 2002). However, caution should be applied in interpreting these findings, as the sample size for each community was small and did not include a linked fish consumption study.

Health Status Indicators for Nelson House

A series of indicators of health was compiled, based on data from Health Canada, First Nations and Inuit Health Branch (includes Nelson House and South Indian Lake) and Manitoba Health, Department of Decision Support Services (includes Nelson House only) (detailed results are presented in Volume 8):

- Infant and Maternal Health – includes birth rate, fertility rate, birth rate of teen mothers, low birth weight rate, high birth weight rate and infant mortality rate;
- Communicable Diseases;
- Mortality – includes mortality rate, premature mortality, potential years of life lost (PYLL); and
- Medical Services and Hospital Utilization – includes utilization of medical services and hospital utilization.

Health indicators such as these can be used to monitor and report on progress towards health goals and objectives, and allow for comparisons of health status among different populations and over time. However, health data should be interpreted with caution due to the small population size at Nelson House and the level of data available (e.g., categories of illness as opposed to specific ailments; also some data are suppressed for confidentiality reasons).

In general, the data show the following with respect to the health of people living at Nelson House (in some cases, data also include NCN members living at South Indian Lake).

- There is a trend toward a slight decline in birth rates compared to the provincial First Nations population. Birth rates remain substantially higher than for the general population.
- There is a decline in infant mortality rates at Nelson House, but rates are still higher than the provincial average for First Nations populations. Leading classifications of infant mortality between 1986 and 1999 were congenital anomalies (for example, Downs Syndrome), conditions originating in the perinatal period (for example, Fetal Alcohol Syndrome), symptoms, signs and ill-defined conditions (for example, Sudden Infant Death Syndrome) and injury and poisoning.[42]

[42] Each of these classifications represents defined terms in the infant mortality statistics.

- Low and high birthweight rates are comparable to or lower than the provincial average.
- Injury and poisoning, a defined category of disease (Volume 8), leads to a heavy burden on the community in terms of physician utilization, hospitalization and deaths. The proportion of deaths in this category is higher than for the provincial First Nations populations[43] and occurs mainly before the age of 65 years. Similarly, injury and poisoning were reasons for hospitalization and physician visits more often for this population than for the Manitoba population as a whole.

Social Well-Being

The following provides an overview of current social well-being in Nelson House, particularly among NCN members. Detailed review of social well-being can be found in Section 5.2.2 in Volume 8.

Results from the 2000 NCN Opinion Survey – Total Sample indicate that, in general, community members feel good about the future of Nelson House (74 per cent of men and 66 per cent of women over 16 years of age were positive).

Results from key person interviews and workshops (with social service providers and others, including Elders from both Nelson House and South Indian Lake, youth and women) indicate that this optimism can be credited to a number of initiatives and developments that have taken place in the last five to ten years. These include the following (details can be found in Section 5.2.2 in Volume 8):

- the emergence of self-governing institutions in Nelson House, including education, health programming and child and family services;
- a sense of cultural revitalization and a renewed interest among community members in learning traditional teachings;
- increased economic development activities, including new employment opportunities; and
- the continued existence of relatively strong support networks among families and, in many cases, friends and neighbourhoods.

Despite the many positive aspects of life in Nelson House, results of the 2000 NCN Opinion Survey – Total Sample, as well as interviews and workshops with community

[43] In particular, motor vehicle accidents and accidental suffocation.

members, suggest that NCN members believe the positive future envisioned by residents will first require addressing key social challenges. Most notable among these are (further detail can be found in Section 5.2.2 of Volume 8): health of the local environment, particularly local water bodies (including water quality); home environments, including crowded and poor living conditions; personal and family well-being problems; quality of community infrastructure, including roads and drinking water facilities; and lack of employment opportunities.

Culture

Culture is a composition of values, beliefs, perceptions, principles, traditions and world views that are superimposed on one another and are perpetuated through the language and kinship system of a distinct group of people. Culture can be manifested in the way people do things and the way they think.

Nine indicators were identified as most representative of culture. To understand the status of existing culture, key person interviews were conducted, based on a set of questions developed and reviewed with NCN representatives. The four indicators considered to be vulnerable at the present time (without the Project) are presented first. More detail can be found in Section 5.2.2 of Volume 8.

- Language: The language of the Nehethow (people from the four directions) at Nelson House is called Nehethow-we-win (speaking from the four directions, also commonly known as Cree). As with loss of first languages worldwide, continuation of Nehethow-we-win as a first language of NCN is in jeopardy. Although measures are being taken to sustain language (e.g., through the Nelson House Education Authority), several factors work against its use.
- Traditional Knowledge: Over time, observations, experiences and events worked together as the foundation for a way of understanding, now referred to as Traditional Knowledge (TK). Interviewees noted that few people now venture down river to the Wuskwatim Lake area due to the difficulty in traveling the waterways since the CRD in the late 1970s. For this and other reasons people are not using the land as frequently as in the past. Therefore, the use of TK is declining and could eventually be lost. Traditional Knowledge was collected and incorporated as part of the **EIA** studies, including a TK study undertaken by NCN.
- Cultural Practices: Cultural practices, i.e., customary conventions that reinforce one's cultural identity, are reappearing among some community members, including

youth. Ceremonies such as sweats, morning and evening prayer, fasting and women's ceremonies are regularly performed. Ceremonies held in 2000 at ceremonial sites near Wuskwatim Lake were viewed as having a major positive impact on community members. Ancient legends about Taskinigup Falls and Wuskwatim Falls continue to be part of the cultural experience of NCN members.

- Health and Wellness: Interviewees identified four kinds of health – physical, mental, spiritual and emotional. There is active health and wellness programming within the community that is attempting to address all four aspects of health. Some interviewees noted that both traditional and contemporary methods are being used to heal people in the community. Many felt that physical health of community members is not as good as in the period prior to the CRD, but that the community is on a healing journey.
- World View: The abstract expression of culture is captured in world view and Nehethow philosophy (see "language" above). At Nelson House, there is a strong relationship to Mother Earth and a strong belief that all things are connected, including to the whole cosmic order. Spirituality and respect were noted as fundamental values that people strive for. While various influences have eroded Nehethow values and ideals, young people interviewed indicated that there has been a resurgence and renewed interest in upholding the Nehethow world view.
- Kinship: Kinship, the glue that binds a community together, provides the basis for certain kinds of relationships and obligations. Key persons noted that kinship patterns prior to Europeans were different than they are today. Some practices, such as grandparents raising the first-born child, continue in some cases. Family connections are considered by some to be weaker than before.
- Leisure: Leisure, defined as activities that people do in their spare time, today includes television, as well as outdoor activities such as boating and swimming (although limited by concerns about water safety) and organized recreational activities in Nelson House for people of all ages.
- Law and Order: Today, a local police force, supported by the RCMP in Thompson, maintains law and order in the community. A new justice initiative is underway. Laws pertaining to natural resources are enforced by Natural Resources Officers. Political organization consists of an elected Chief and Council who are mandated to manage the affairs of the First Nation.

- Cultural Products: Cultural products, often the expression of cultural practices, include the archaeological record of ancient cultural practices (described by NCN as "since time immemorial"; findings date back for at least 6000 years) and the ethnographic record of living cultural practices. The living culture is represented by visual and abstract expressions. Ceremonies, dancing, singing and drumming are most often the means of expressing one's culture, as well as artistic creations such as birchbark biting, beading, quilling, painting, sewing, knitting, wood and stone carving and storytelling.

Community Organization and Governance

NCN is governed by a Chief and six Councillors, elected under NCN's own Election Code which was adopted in 1998. In 2000, approximately 2,260 NCN members lived on reserve at Nelson House while approximately 80 members resided in the small adjacent Northern Affairs community of Nelson House. In addition, approximately 960 NCN members lived at South Indian Lake. While the majority of residents of both off-reserve communities are NCN members, each community is governed by a Mayor and Council under *The Northern Affairs Act (Manitoba)*. At South Indian Lake, a Headman is also elected to represent NCN members in that community (about 80 to 90 per cent of all residents). Members at South Indian Lake have for some time been actively working to establish their own reserve and Cree Nation, separate from NCN, called O-Pipon-Na-Piwin. Beyond the Local Region, NCN members live in Thompson, Winnipeg, Brandon and other locations.

NCN delivers most community-based services available to on-reserve members. Some are operated directly by the Cree Nation government (e.g., different providers include Social Assistance, Public Works, Membership Services), while others operate under the auspices of elected or appointed boards (e.g., Education Authority, Housing Authority, Economic Development Corporation, Wellness Centre, Personal Care Home) (see Section 5.2.2, Volume 8 for a description of the full range of services provided).

Particularly within the past two decades, NCN has developed considerable capacity in planning and delivering services. In addition to experience gained through delivery of government programming, NCN has built organizational and governance capacity through the process of negotiating, settling and implementing the NFA Implementation Agreement (1996). Over the past several years, NCN's Future Development Team has actively participated in the multi-faceted joint planning process with Manitoba Hydro and other organizations.

NCN Goals and Plans

NCN goals and plans will play a role in shaping the future of the Local Region, particularly for members resident in the community of Nelson House. NCN continues to develop goals and plans for the future of the community, particularly at Nelson House. NCN has developed a Vision Statement as follows:

> *"To exercise sovereignty that sustains a prosperous socio-economic future for the Nisichawayasihk Cree Nation."*

With the transfer of authority for key services to local control (i.e., housing, education, social services, water and sewer infrastructure, economic development) over the past 20 years and the building of local planning capacity, goals and plans have been developed in many individual NCN organizations.

Within the last five years in particular, substantial community-based activity has been undertaken, including the addition of several businesses (Otohowin Gas, Lucky Dollar Store, Footprint Engineering, Meetah Building Supplies), community facilities (e.g., Wellness Centre, Elders' Care Home) and housing and infrastructure (although not enough to address the housing backlog and rapidly growing population). Individual NCN organizations have developed, and continue to develop, goals and plans for services that they deliver to NCN. Many specific plans are underway. Some of these plans are focused on the community of Nelson House, while others relate to land and resources within the Nelson House RMA and beyond the RMA.

In 2001, NCN Chief and Council initiated a process of comprehensive community planning focused on creating a plan for the community by the community. A Steering Committee of NCN community members began a process of developing a new Community Plan for NCN. To date, the process has involved the completion of a work plan for a Community Development Plan and the initiation of a process to develop community goals.

9.5.3.2 Project Region

In the Project Region, the City of Thompson is home to people who have moved to the City for economic reasons, in particular to participate in the mining-based resource economy that was the basis for establishing the community in the late 1950s. In general, the population of Thompson has grown and declined along with employment opportunities associated with the mining sector. Over time, Thompson's role as a regional government and service centre for communities in central and northeast Manitoba has grown. A segment of Thompson's population has migrated to the City from the south or other locations to participate in government or private sector employment. There are also segments of the population who have migrated to Thompson in order to access services (e.g., educational services or specialized medical care such as dialysis treatment). In some cases, residents of outlying communities have moved to Thompson because of lack of opportunities for work in their home community (e.g., migration from Leaf Rapids in 2002) or lack of housing. Aboriginal people made up about 28 per cent of Thompson's population in 1996 (Statistics Canada 1996); some estimates place that proportion at 40 per cent or more. The Local Government District of Mystery Lake, which surrounds the City of Thompson, includes very limited population (five persons in 1996 according to Statistics Canada).

Transportation Safety

Within City of Thompson

Within the City, PR 391 becomes a four-lane divided street, known as Mystery Lake Road. Along Mystery Lake Road (from south to north) there are four signalized intersections at Burntwood Road, Thompson Drive South, Station Road and Thompson Drive North. Accident statistics are shown for each of these intersections in Table 9.5-2 below.

Table 9.5-2. Accidents within City of Thompson: 1995 to 2000.

Intersection	Average # of Accidents per year	Accidents per Million Vehicles Entering Intersection
PR 391/Burntwood Road	1	0.36
PR 391/Thompson Drive S.	2	0.48
PR 391/Station Road	6	1.07
PR 391/Thompson Drive N.	3	0.57

Source: ND Lea 2002.

PTH 6 South of Thompson

Thompson is connected to Winnipeg by Provincial Trunk Highway (PTH) 6, an all-weather two-lane highway. The travelling distance between Thompson and Winnipeg along PTH 6 is 756 kilometres, or approximately eight hours driving time. PTH 6 meets PR 391 at the southern limit of Thompson.

Table 9.5-3 presents highway traffic volumes and accident rates along PTH 6 (divided into four segments between Winnipeg and Thompson; see Volume 8 for further details).

Table 9.5-3. PTH 6 Highway Traffic Volume and Accidents: 2000.

Highway	Section	Average 2000 AADT[1]	AADTT[2] (Truck %)	ASDT[3]	# of Accidents (2000)	Accidents/ Million vehicle-km
PTH 6	1	2,290	220 (9.6%)	2,630	36	0.36
	2	1,035	140 (13.5%)	1,190	33	0.34
	3	410	90 (21.8%)	485	10	0.32
	4	1,025	100 (10.0%)	1,240	24	0.42

Source: ND Lea 2002.

Notes:

1 - AADT: Annual Average Daily Traffic. This statistic provides an indication of the average usage of a road at a particular traffic station. The AADT estimates the typical daily traffic on a particular road segment for all days of the week (Sunday to Saturday) over a one-year period.

2 - AADTT: Average Annual Daily Truck Traffic (trucks/day).

3 - ASDT: Average Summer Daily Traffic. The ASDT represents an estimate of typical daily traffic on a road segment for all days of the week (Sunday to Saturday) over the summer season (in Manitoba the summer season spans May 1 to September 30).

Outdoor Recreation

The importance of outdoor recreation to Thompson residents is noted in the 2001 Thompson Planning District Development Plan, which recognizes the need to enhance opportunities for recreation within and adjacent to the Planning District (Thompson Community Planning Services Office 2001). These include:

- within the City, Maclean Park, located close to City Hall on the banks of the Burntwood River, and the fifteen-kilometre Thompson Millennium Trail are popular for outdoor recreation activities;
- areas south of Thompson, are the most popular outdoor recreation sites for Thompson residents, including Paint Lake Provincial Park and Pisew Falls;
- areas to the east of Thompson, are heavily used for recreational purposes by Thompson residents, including Ore Creek, parts of the Burntwood River system and the Canadian National Railway line corridor (used for snowmobiling in the winter and all-terrain vehicle use in the summer);
- west and southwest of Thompson, there is substantial snowmobiling in winter and moose hunting in the fall by Thompson residents. Recreational snowmobiling occurs along the WL 43 transmission line corridor, which runs towards Leaf Rapids. The turn-around point is located near Mile 20 on PR 391 between Thompson and the

Nelson House road. Portions of Birch Tree Lake and the adjacent Burntwood River are also considered good for snowmobiling. Very little recreational activity occurs on Opegano Lake because it is too difficult to access from Jackpine Falls. Manasan Falls and Manasan River, as well as the Portage River, are used to a lesser degree for canoeing;

- areas to the west along PR 391, are used heavily by Americans, residents of Thompson and others interested in fishing and out-camps. Many of these activities occur on Notigi and Rat Lakes; and
- north of Thompson, McCreedy Campground (the most popular recreation destination), and four cross-country ski trails are used.

Social Well-being

The City of Thompson is a relatively young community whose character is beginning to change from a single-industry, resource-based community with a transient population (mainly from the south) to a more mature and stable community (e.g., some second-generation residents raised in the community; some people retiring in the community; people settling in the community for reasons other than mining and related employment). This transition has led to a stronger sense of community. Education and other opportunities for the growing Aboriginal population are seen to be improving to some degree, as is the understanding of Aboriginal culture, although some people felt that a degree of racism remains. Thompson's regional-centre role (including as a road, rail and air transportation hub) also means that there are many visitors to the City from outlying communities and from the south.

In key person interviews, Thompson is described as a very active community with a sports and fitness orientation. While most activities are considered to be affordable and accessible, some felt that there is a divide between the lifestyles of the poorest families (who are unable to afford these types of activities) and of others with higher incomes in the community. Key social issues facing the community were seen by those interviewed as housing and homelessness, employment-related issues and alcoholism. The community is taking steps to address these issues.

Goals and Plans

The City of Thompson and LGD of Mystery Lake, as part of the Thompson Planning District, have prepared a Development Plan (Thompson Community Planning Services Office 2001). The Plan includes overall goals in the following four areas.

- Environment: The Plan aims to "maximize the quality of the environment of the Thompson Planning District by minimizing the pollution of water, air and land through the preservation of special attributes of the area's landscape". The Plan indicates that other goals should be consistent with this goal in order to improve the quality of life of people living in the Planning District.
- Sustainable Development: The Plan states the importance of ensuring that "environmental, economic, social and developmental activities meet the needs of the present without compromising the ability of future generations to meet their needs".
- Social Development: The Plan aims to "create a desirable community that promotes well-being and safety, as well as extending options to citizens of the Planning District in meeting their basic needs and aspirations".
- Economic Development: The Plan aims to develop the most diversified economic potential possible while enhancing the general quality of life of local residents. The intent is to provide the maximum level of District-wide services at a minimum public expense in accordance with the District's financial capabilities.

9.5.4 Effects and Mitigation

9.5.4.1 Local Region

The Project is expected to have both positive and negative effects on people in the Local Region (NCN, including members living at Nelson House and the Nelson House Northern Affairs community). The Project will have the most pronounced effect on these people by virtue of their proximity to the Project, their continued traditional use of the area around Wuskwatim Lake, and their participation in the Project as a potential partner (including employment and business activities). Effects at South Indian Lake are expected to be limited to employment and business opportunities.

Personal, family and community life can be affected by the accumulated effects of physical, biophysical, economic (including return on ownership investment in the generating station) and population changes. The experience of these changes will vary for individuals, for families and for the community as a whole. For example, residents who harvest resources in the Wuskwatim Lake area will experience the Project differently than residents who take up construction jobs at the construction site.

In addition to their own experience of positive and negative changes, effects on community life would be interpreted by residents of the Local Region according to their own outlook on their current circumstance and on the future circumstance for themselves, their families and their community (i.e., how those changes fit with their world today and their goals and aspirations for improving their world tomorrow).

NCN is in a special position of full involvement with Manitoba Hydro in planning for the Project. This means that residents of the Local Region, through NCN's Future Development Team and through community involvement processes, have participated in planning many aspects of the proposed development that can affect personal, family and community life. Key aspects of involvement on issues of priority to NCN have included the following.

- <u>Choice of design for the dam</u>: A critical planning decision was the selection, by NCN and Manitoba Hydro, of a "low head" design for the dam, which will minimize flooding and effects on the environment (and as a result energy output will also be lower compared to "high head" alternatives).
- <u>Selection of alternative road and camp locations and approach to access management</u>: NCN participated in joint planning with Manitoba Hydro of locations for the access road and construction camp and jointly developed the approach to access management for the new access road.
- <u>Shaping of training, employment and business benefits</u>: NCN and Manitoba Hydro have discussed at length the scope and nature of potential training, employment and business opportunities that will be made available to residents of the Local Region if the Project proceeds. Finalizing these matters through 2003 will involve parties beyond NCN (e.g., negotiation of a new **collective agreement** for the construction project between the Hydro Projects Management Association, representing Manitoba Hydro and Project contracts, and the Allied Hydro Council, a group representing unions at the site).
- <u>Shaping of ownership investment benefit</u>: NCN and Manitoba Hydro have discussed arrangements for NCN investment in the generating station. If NCN chooses to participate, a revenue stream related to the Project's profitability would be forthcoming for the community in the long term.

Policy and other matters that affect personal, family and community life, which will not be finalized by the time of filing of the Environmental Impact Statement, introduce uncertainties to the conclusions presented in this section. These are made apparent in the individual sections that follow.

At the same time, the continuing involvement of NCN in planning processes relevant to the Project means that there will be ongoing opportunities to discuss anticipated effects on personal, family and community life with residents of the Local Region and to refine impact management measures (to enhance benefits and mitigate adverse effects) through the course of 2003. One of these processes is development of a legally binding PDA between Manitoba Hydro and NCN. As was done for the earlier Agreement-in-Principle (finalized in 2001), NCN intends to discuss the PDA at length with members and to put the agreement to a secret-ballot vote of NCN members before NCN Chief and Council decide whether to approve it. This process, specified by Manitoba Hydro and NCN as a prerequisite, must be concluded prior to commencement of the Project.

If the Project proceeds, it is anticipated that NCN will integrate management of effects of the Project (mitigation, enhancement and monitoring) with NCN's own planning for the future during 2003 and beyond. For example, planning and implementation of training programs relevant to the Project are already underway (since 2002). Volume 8 (Section 5.2.3) provides a summary of impact management categories pertinent to all socio-economic effects (economy, infrastructure and community services and personal, family and community life) that would be integrated with NCN's own community planning for its members. Impact management measures (to address both mitigation of adverse effects and enhancement of positive effects) will be required in all eight of NCN's community planning theme areas.[44]

Construction Phase

Transportation, Safety and Access

During construction, PR 391 is capable of safely accommodating all project-related traffic. Traffic volumes, which peak at 1,100 vehicles/day during years three to five, are well within the 6,000 vehicles/day that can be accommodated on this highway. Construction traffic is expect to have a minimal effect on accident rates along PR 391 (projected increase of one additional accident per year between the Split Lake Junction at PR 280 and the access road during 2007, the busiest year of construction).

The access road between PR 391 and the Wuskwatim site will improve entry to the Wuskwatim Lake area, which currently is difficult to reach. Access will be limited during the construction phase (via a staffed gate at PR 391 operated 24 hours per day and 7 days per week), to those associated with Project construction and to others deemed by the

[44] The eight theme areas are: economic development; education; health and wellness; physical infrastructure; recreation; justice; land use and resource management planning and environmental monitoring and management; cultural values and traditions.

Limited Partnership to be permitted to use the access road (e.g., this is likely to include NCN resource harvesters) (see discussion of Access Management Plan in Section 4 and in Volume 3).

During the construction phase, travel conditions on Wuskwatim Lake are expected to remain unchanged during summer (i.e., existing debris, as noted in Section 9.5.3.1, will remain) and winter (i.e., current areas of limited or no ice cover will remain). Current travel risks on Wuskwatim Lake and areas upstream and downstream of the construction site will be communicated to workers unfamiliar with the area and water-based travel will be discouraged. During construction, road access by individuals other than construction-related staff will be decided by the Limited Partnership (e.g., access is likely to include resource harvesters with traplines along the access road and south of the Burntwood River). To the extent that any of these individuals may be unfamiliar with current travel hazards (e.g., NCN members who have not visited the area in some time), this will be dealt with, if and as required, through safety measures to be discussed between NCN and Manitoba Hydro.[45] Safety measures under ice conditions will also be put in place as appropriate or required (e.g., marking areas unsafe for ice travel).

Aesthetics

For residents of the Local Region who currently use the Wuskwatim Lake area, as well as others in the Region who have an attachment to the Wuskwatim Lake area, there will be obvious negative changes in the aesthetic quality of the area with the addition of the physical structures (including loss of the Wuskwatim and Taskinigup Falls), work area, borrow areas and access road. While this effect would be of concern for many residents of the Local Region, it is unlikely to be of sufficient magnitude to cause a discernible change to community life (e.g., it has not been expressed during public involvement activities by residents as a reason not to pursue the Project).

Community Health

Water quality is not expected to change in the majority of Wuskwatim Lake; water quality in the vicinity of construction activity (mainly periodic changes in turbidity) and in the vicinity of the construction camp waste treatment outfall will be reduced (Section 6.5.2). Those who use the area will already be restricted from construction areas for safety reasons and are likely to use the main lake to obtain water; therefore, there should be no Project-related effects on human health due to water quality effects.

[45] For example, safety measures could include boat patrols to address debris concerns that constitute navigational hazards on Wuskwatim Lake and the marking of shoals on Wuskwatim Lake.

Indirect effects of Project construction have the potential to affect some "determinants" of health (factors affecting health). However, due to the broad range of confounding variables, it is difficult to comment with certainty on the magnitude of these indirect changes on health of residents of the Local Region. In addition, some effects are positive and others negative. Construction phase income, employment and training may help to improve the standard of living of construction workers and their families at Nelson House (on and off reserve) and at South Indian Lake, at least for the period of construction employment, e.g., income is an important determinant of health. If measures to support workers and their families are successful, these opportunities will be maximized; if not, then benefits may be limited. If measures by NCN are successful in extending economic opportunities beyond the Project, then the "boom and bust" effect of these opportunities will be lessened. Population returning to Nelson House may worsen already crowded housing conditions (another important determinant of health) and strain health services. With mitigation, however, this effect is considered to have a limited negative effect on health. Finally, worry among residents about the extent of environmental change from the Project should be diminished for some people through full reporting of environmental monitoring and health status monitoring to residents on a regular basis.

Social Well-being

During the construction phase, social well-being of residents of Nelson House may be affected in both positive and negative ways. New training, employment and business opportunities have the potential to generate new household income and self-esteem for workers. Measures to assist workers and their families to make this a positive force for social well-being are being planned. Returning population (numbers uncertain) would be positive for social well-being in terms of reuniting family and friends, but could add to social stress if crowded housing conditions persist for a substantial length of time. Mitigation measures were outlined in Section 9.4. Finally, beginning during the construction phase, limited new access to the Wuskwatim Lake area (the degree of access will be constrained during the construction phase) will allow some residents to begin to reconnect with important cultural features.

Culture

The construction phase of the Project has the potential to affect four indicators of culture in the Local Region that are considered to be vulnerable at the present time.

- Language: Limited effect on language is anticipated as a result of local residents working and living at the construction site; reduced opportunities to speak

Nehethow-we-win will occur mainly during seasonal periods during years three to six of construction.

- Traditional Knowledge: NCN has expressed an interest in continuing the work begun during the environmental assessment studies of collecting and preserving Traditional Knowledge.
- Cultural Practices: Few people have been able to visit the Wuskwatim and Taskinigup Falls area (until recent site ceremonies in 2000). Beginning during the construction phase, physical changes to the Wuskwatim Falls and Taskinigup Falls area could affect the opportunity to undertake cultural practices associated with this specific area. However, limited access to the area via the new access road could provide the opportunity for residents once again to undertake cultural practices associated with important ceremonial sites in the Wuskwatim Lake area. (Section 10.3 indicates that a management plan will be prepared with respect to cultural and heritage sites on the area.)
- Health and Wellness: Health and wellness may be affected in positive and negative ways by the construction phase, as noted above.

Community Organization and Governance

Prior to and during the construction phase, Local Region community organization and governance will continue to be affected by NCN's participation in joint planning for the Project, along with Manitoba Hydro and others. Particularly in 2003, senior staff involved in the Future Development Team will continue to face very heavy workloads. The Future Development Team will continue to be part of the organization. If the Project proceeds, NCN will put in place a new organization for their participation in the Limited Partnership. Beginning during 2003, NCN service providers, potentially participating in impact management if the Project proceeds, will be engaged in internal planning to prepare for community change. Once underway, NCN government and service providers will implement coordination and communication mechanisms to respond to community changes. Overall, the Project experience prior to the operations phase is expected to strengthen and extend skills and capability of NCN's community organization and governance.

NCN Goals and Plans

NCN goals and plans will play a role in shaping the future of the Local Region, particularly for members resident at the community of Nelson House. NCN's vision, goals and plans will provide a context against which members are likely to compare the benefits and drawbacks of the proposed Project for themselves, their families and the community as a whole. NCN is well-positioned to consider the question of compatibility of proposed Project effects with the Cree Nation's future vision, goals and plans for the future. Since late 1999, NCN has been engaged with Manitoba Hydro in joint planning activities, including development of an **Agreement-in-Principle (AIP)** and eventually a Project Development Agreement (PDA). Ultimately, referenda at both the AIP stage and the PDA stage will provide a clear indication of whether the Project is consistent enough with the goals and plans of NCN that it should proceed, from the perspective of residents of the Local Region. (The AIP was ratified in 2001, indicating that members wanted to continue to the next stage of the Wuskwatim planning process.) In addition, the position of NCN as potential partner provides an opportunity for the community to shape the Project, to some degree, to meet their own goals.

If the Project proceeds, the framework of current community planning is a likely vehicle through which NCN community effects of the Project would be managed. Impact management measures (mitigation and enhancement measures) associated with effects on people in the Local Region (particularly residents at Nelson House), for both construction and operations phases, would be integrated with NCN's current community planning for the future. Impact management plans, along with estimated residual effects of the proposed Project, will form part of the information considered by NCN members as they vote on the proposed PDA in 2003.

Prior to and during the construction phase of the Project, planning for and enhancing positive effects of construction opportunities and mitigating negative effects of the development will be required in all eight of NCN's community planning theme areas. In addition, initial planning for revenue from NCN's ownership investment is likely to be undertaken.

Operations Phase

Transportation, Safety and Access

No impacts on traffic safety are anticipated once the construction phase is complete. A very small workforce will operate the station, creating negligible traffic.

The access road will improve the safety of travel to the Wuskwatim Lake area, which currently is difficult to reach. If restricted access across the completed dam is permitted under the Access Management Plan (to be determined by the Limited Partnership in consultation with the Nelson House Resource Management Board), those who are granted such access will see improved safety of travel to the south side of the Burntwood River. The management of access on the access road will be governed by an Access Management Plan (Section 4); the post-construction portion of the Plan will be developed by Manitoba Hydro and NCN (via the Limited Partnership) before the operations phase begins. Whether access across the dam will be permitted will also be decided prior to the operations phase.

Travel conditions on Wuskwatim Lake are expected to remain unchanged during summer (limited additional debris is expected, but existing debris as noted in Section 9.5.3.1, will remain) and in winter (except for a small area of open water upstream of the generating station, once in operation; current areas of limited or no ice cover will remain). However, current travel risks on Wuskwatim Lake and areas upstream and downstream will need to be communicated to those unfamiliar with the area. Safety measures, if and as appropriate, will be put in place by NCN and Manitoba Hydro under open water conditions (e.g., signage for safety concerns upstream and downstream of the generating station site and, if determined by the Limited Partnership to be warranted, boat patrols, marking of shoals on Wuskwatim Lake) and under ice conditions (e.g., marking areas unsafe for ice).

Community Health

Water quality is largely expected to remain unchanged in the majority of Wuskwatim Lake and water quality in nearshore areas is expected to change only in terms of turbidity, particularly after stormy weather (Section 6.5.2). For those who draw and consume surface water from Wuskwatim Lake while camped there, no change in the practice of boiling lake water before use or bringing bottled water from other locations is warranted. Sharing of water quality monitoring results (as well as the need for continued safe water practice) will occur, focusing on resource harvesters and others who may use the area.

While there has been limited domestic use of fish from Wuskwatim Lake in recent years because the area was difficult to access, new access by Local Region residents and others could mean that fish could be harvested and used in local diets. Analysis of expected post-Project mercury levels in fish indicates that restrictions by residents on consumption of walleye (2.2 meals per week) and pike (1.6 meals per week) from Wuskwatim Lake would be prudent.[46] By comparison, these restrictions are slightly less than would apply for Footprint Lake (1.1 meals per week for walleye and 1.3 meals per week for pike) and

[46] Volume 5 (section on fish quality). The analysis shown for each lake is based on calculations of fish meals per week that can be safely consumed by a 70 kilogram male. Women of child-bearing years (15 to 39 years) should consume half as many fish meals per week.

slightly more than for Leftrook Lake (3.1 meals per week for walleye and 3.3 meals per week for pike). Both lakes are currently used for domestic harvest. Whitefish consumption should be unaffected, with calculated restrictions for safe consumption of 6.5 meals per week at Wuskwatim Lake. Any actual recommendations to local residents regarding reduced use of walleye and pike in the future should be based on actual monitoring results.

Indirect effects of Project operation have the potential to affect some determinants of health. However, due to the broad range of confounding variables, it is difficult to comment with certainty on the magnitude of these indirect changes to the health of residents of the Local Region. In addition, some effects are positive and others negative. Worry among residents about the extent of environmental change because of the Project should be diminished for some through full reporting of environmental monitoring and health status monitoring on a regular basis. In the long term, revenue to NCN from investment in the Project could potentially contribute to improving determinants of health (e.g., new housing, economic development).

Social Well-being

During the operations phase, social well-being of residents of Nelson House may be affected in both positive and negative ways. If efforts by NCN to sustain and extend economic opportunities for workers who have gained a base of training and experience during the construction phase are successful, then a positive contribution to social well-being will continue for these workers and their families. New access to the Wuskwatim Lake area will allow residents to reconnect with important cultural features. In the long term, new revenue available to NCN, as a result of their possible ownership participation in the Project, would be available to address community priorities, including the goal of improving social well-being.

Culture

The operations phase of the Project has the potential to affect three indicators of culture in the Local Region that are considered to be vulnerable at the present time. Traditional Knowledge gained through long-term observation of the landscape in the vicinity of Wuskwatim Lake will be affected by one-half square kilometre of flooding at Wuskwatim Falls and Taskinigup Falls. With monitoring and contingency plans in place, Elders’ concerns about protection of the important ceremonial sites at Wuskwatim Lake should be reduced. Renewed access to the area, including access to the south side of the Burntwood River over the dam, would allow for continued observation of the land that has been interrupted by CRD-related travel difficulties. New access to ceremonial sites could bring new opportunities for cultural practices by NCN members. Risks to the sites through visits by others will be coordinated through the Access Management Plan and a cultural and heritage resources management plan (Section 10.3). Potential effects on health and wellness are noted above. Finally, in the long term, if revenue available through NCN's potential investment in the Project is used for cultural programming, then the vulnerable indicators (including language) could be strengthened.

Community Organization and Governance

During the operations phase, community organization and governance for NCN will be affected by the need to deal with the stream of income arising from NCN's investment in the Project.

NCN Goals and Plans

Potential community effects during the operations phase will require planning for impact management by NCN during the period just prior to the operations phase and during the operations phase. Planning in all eight of NCN's theme areas will be required. Of particular note will be planning for use of the stream of revenue resulting from NCN's investment in the Project.

9.5.4.2 Project Region

Construction Phase

Within Thompson, traffic volumes are expected to increase slightly at each of the City's four main signalized intersections during construction of the Project. However, the addition of traffic is small enough to be considered within the normal fluctuations of day-to-day traffic. There will be a slight increase in traffic volumes along PTH 6 during construction of the Project (up to a maximum of 20 additional vehicles during Stage 2 of construction). As a primary arterial, PTH 6 currently experiences traffic volumes of up to 2,300 vehicles per day, but is designed to accommodate up to 5,000 vehicles per day. As such, there is sufficient capacity for the anticipated Project-related increase in traffic.

No effects on outdoor recreation are anticipated as a result of the construction project. Project construction is expected to have a limited effect on recreation opportunities for Thompson residents. The Thompson Golf Course is currently operating near capacity and is the only recreational facility that may experience difficulty in meeting additional demands from the Wuskwatim construction workforce.

Social well-being may be potentially affected by limited increased income for workers in businesses serving the construction project. Limited effects could result from in-migration of population by those seeking work who may have limited means and could strain services that are already stretched in this area (negative effect). In-migration, including new senior Manitoba Hydro and contractor staff and their families, expected to settle in Thompson for the duration of the construction phase, will to a small degree help to offset the decline in population. Workers visiting Thompson during leisure time could have a limited negative effect on social well-being.

The Project appears to be compatible with economic, environmental and sustainable development goals of the Thompson Planning District.

Operations Phase

Once in operation, there could be an increase in recreational activity (primarily sport hunting and possibly fishing) by Thompson residents in the Wuskwatim area if new access is permitted on the access road and new boat launches at the Project site. Access, however, is contingent upon the final terms of the operations portion of the Access Management Plan to be developed during Project construction.

9.5.5 Cumulative Effects Assessment

9.5.5.1 Local Region

Socio-economic effects of the Project are assessed in combination with effects of other known or planned projects that overlap in space and time (Section 2.3). In general, the Wuskwatim Transmission Project will be developed concurrently with the Project (i.e., it overlaps in time) and will also overlap in space with effects of the Project, adding limited additional access south of the Burntwood River to new access provided by the road and dam across the river. It will also add minimally to employment in the Local Region. The Gull/Keeyask and Conawapa Generation projects, if developed, will not overlap in space, but construction of these projects could overlap in time, potentially extending effects for local workers who pursue further employment opportunities as the Project construction phase is nearing completion. If Tolko winter road-building and harvesting activities are pursued south of the Burntwood River, this would overlap in space and time with new access associated with the Project. However, the likelihood of the Tolko activity in this time period is not certain.

These cumulative effects are as follows.

- Wuskwatim Transmission Project
    a) Transportation Safety – During the Project construction phase, a small construction workforce for the Wuskwatim Transmission Project will also be active in the area. While this construction activity will overlap with Project construction activity, the amount of additional road traffic created is expected to be very small. Once in operation, the cleared transmission line rights-of-way are expected to provide some additional access for NCN resource harvesters traveling to their traplines south of the Burntwood River (subject to provisions of an Access Management Plan to be developed with NCN for transmission lines in the RMA). The degree of new access will depend on local terrain conditions.
    b) Aesthetics – The Wuskwatim Transmission Project will create a linear right-of-way permanently cleared of trees (although some undergrowth may return after construction) between Birchtree Station and the Wuskwatim Station (58 metre width cleared and about 45 kilometres in length; guyed steel-lattice towers about 38 metres in height strung with three conductors). In the area between the Wuskwatim Station and the Herblet Lake Station at Snow Lake (the majority of the 138 kilometre length falls within the Local Region), two parallel transmission lines will be placed on a single right-of-way, of which about 108 metres will be cleared of trees. About twelve squares kilometers (five square miles) of land in total will be cleared within the Local Region.
    c) Community Health and Social Well-being – Indirectly, the Project could affect determinants of health by marginally adding to employment income during the construction of the transmission line, Birchtree Station and Wuskwatim Station. The Wuskwatim Transmission Project is expected to have no direct effect on the health of local residents during either construction or operations phases.
    d) Culture – By virtue of developing a new transmission line right-of-way south of the Burntwood River, the Wuskwatim Transmission Project could add new access for local residents to reach their traplines south of the Burntwood River (the new access road and dam will allow access to the south side of the Burntwood River once construction is complete). This could marginally enhance the opportunity to undertake cultural practices in this area.
    e) Community Organization and Governance – NCN staff will continue to be involved in planning for the portion of the Wuskwatim Transmission Project that

will be developed within the Local Region (e.g., detailed routing, participation in monitoring).

- Gull/Keeyask Generation Project and/or Conawapa Project
  a) Transportation Safety – A small overlap in road-based traffic could occur on PR 391 at the eastern edge of the Local Region, where road traffic will turn north on PR 280 toward Split Lake and Gillam. However, this would be at a time when construction-phase traffic for the Project will be reduced compared to the peak construction years.
  b) Community Health and Social Well-being – Indirectly, the Gull/Keeyask or Conawapa Generation project could affect determinants of health and social well-being by extending income and employment effects of the construction phase of the Project, during a period when Wuskwatim construction phase employment will be declining. The Gull/Keeyask and Conawapa projects could also extend population in-migration effects at Nelson House, to some small degree. Direct health effects from potential forestry activities during the 2009 to 2014 time frame are not expected.
  c) Culture – Those workers from the Local Region who participate in construction of the Gull/Keeyask and Conawapa Generation projects, would continue to be exposed to other languages while at those construction projects (as will be the case for local workers during years three to six of the construction for the Project). The cumulative effect of the Project, however, is likely to be marginal.
- Tolko Forestry Activities
  a) Transportation Safety – Tolko's future plans for the period 2009 to 2014 include development of a winter road and harvest areas south of the Burntwood River from PTH 6 to the area south of Wuskwatim Lake. This new access could combine with new access to the area south of the Burntwood River via the Wuskwatim access road and generation facility across the Burntwood River, as well as the Wuskwatim Transmission Project (although the degree of access will vary according to specific terrain conditions). If developed, a Tolko winter road south of the Burntwood River would be unlikely to pose additional travel safety concerns, but would elevate concerns about management of access to these areas (e.g., problems encountered in the past, such as vandalism to cabins/traplines and overharvesting of wildlife). The cumulative effect of the Project in combination with Tolko activities is likely to be marginal.

b) Culture – If new winter road access is developed by Tolko south of the Burntwood River, then concern about protection of important ceremonial sites in the Wuskwatim Lake area would increase. However, the likelihood of such a development in the 2009 to 2014 time period is not certain.

c) Community Organization and Governance – Future Tolko activities in the Local Region in the 2009 to 2014 period are likely to be discussed with NCN to some degree, but the level of involvement is not known. Response to other projects would not be onerous for the NCN organization.

9.5.5.2 Project Region

Effects of the Project on personal, family and community life of residents of Thompson in the Project Region would be expected to combine with effects of the Gull/Keeyask Generating Station Project if it is developed for in-service in 2012 (possibly beginning construction in 2007). In particular, the proximity of Thompson to the Gull/Keeyask Generation Project site would mean that it could play a regional-centre role, to some extent, for that project. Two main effects could combine with effects of the Project.

- In-migration: there is potential for some in-migration of population to Thompson in anticipation of obtaining work on the Gull/Keeyask project. This could further strain resources that are in place for people without means (e.g., affordable housing, social services).
- Worker Visits: Construction workers from the Gull/Keeyask construction project could visit Thompson for leisure activities (shopping, restaurant meals, taverns) at approximately the same time that Wuskwatim construction workers will be visiting. The combined effect would be greatest in the summer season. However, the added effect of the Gull/Keeyask project would be limited because the overlapping construction workforce would be smaller during the first two years of that construction project than peak years that follow. While Thompson may see a temporary noticeable effect (e.g., visits to taverns and recreation facilities), the scale of the community will tend to minimize the significance of any short-term changes.

9.5.6 Residual Effects and Significance

This section presents the estimated residual effects of the Project on personal, family and community life of residents in the Local Region and Project Region. Residual effects incorporate, to the extent possible, cumulative effects noted in Section 9.5.5 and consider the effect of impact management measures (both mitigation and enhancement measures) that are planned. Based on criteria outlined in Section 2.4, the significance of these effects for the community as a whole is assessed, along with the general direction of change (positive, negative or elements of both).

The Project is expected to have both positive and negative effects on people in the Local Region (NCN, including members living at Nelson House and the Nelson House Northern Affairs community). The Project will have the most pronounced effect on these people by virtue of their proximity to the Project, their ongoing traditional use of the area around Wuskwatim Lake, and their participation in the Project as a potential partner (including employment and business activities). At South Indian Lake, also discussed in the Local Region, effects are expected to be limited to employment and business opportunities.

Table 9.5-4 presents a summary of residual effects and significance of effects (including direction of change – positive or negative) by phase and region. There are no significant adverse socio-economic effects predicted from the Project with respect to personal, family and community life. Significant positive effects from the Project on the Local Region are possible with respect to the following components of personal, family and community life:

- Construction Phase
  - Goals and Plans – process for discussion and vote on the PDA

- Operations Phase
  - Transportation Safety – improved access in the Wuskwatim Lake area
  - Community Health – potential revenue effects from ownership investment
  - Culture – potential revenue effects from ownership investment
  - Social Well-being – potential revenue effects from ownership investment
  - Goals and Plans – potential revenue effects from ownership investment

It should be noted that the magnitude of positive effects that may result from the use by NCN of future revenue from their ownership investment is difficult to predict. As a community, NCN would set priorities for that revenue resource in the future.

Table 9.5-4. Residual Effects and Significance of Effects on Personal, Family and Community Life of the Local Region and Project Region.

Topic and Project Phase	Residual Effect	Significance[1]
Transportation Safety		
Construction Phase – Local Region	• Limited exposure to existing water-based travel risks on Wuskwatim Lake and downstream on the Burntwood River • Limited additional traffic and risk of accidents on PR 391	Minor (-) (not significant) Minor (-) (not significant)
Construction Phase – Thompson in Project Region	• Limited additional traffic and risk of accidents within City of Thompson and on PTH 6 south of Thompson	Minor (-) (not significant)
Operations Phase – Local Region	• Limited exposure to existing water-based travel risks on Wuskwatim Lake and downstream on the Burntwood River • Improved safety in accessing Wuskwatim Lake area (and potentially across the Burntwood River)	Minor (-) (not significant) Moderate (+) (significant)
Aesthetics		
Construction Phase – Local Region	• Negative change to aesthetic quality of construction site, access road and borrow areas • Increased exposure of residents with limited improved access	Minor (-) (not significant) Minor (-) (not significant)
Operations Phase – Local Region	• Continued negative aesthetic quality of immediate generating station area, but rehabilitation of work and borrow areas	Minor (-) (not significant)
Community Health		
Construction Phase – Local Region	• As today, continued need for boiling surface water at Wuskwatim Lake; communication of same to newcomers • Indirect effect of income, employment and training on standard of living of workers and families; if measures to support workers and families successful, positive contribution to health; cumulative effects could extend opportunities • Indirect effect of crowded housing conditions; mitigation measures to address issue • Indirect effect on concern about environmental change, reduced for some through full and frequent reporting of physical/biophysical monitoring results and health monitoring results	Negligible (-) (not significant) Minor (+) (not significant) Minor (-) (not significant) Minor (-) (not significant)

Table 9.5-4. Residual Effects and Significance of Effects on Personal, Family and Community Life of the Local Region and Project Region Cont'd.

Topic and Project Phase	Residual Effect	Significance[1]
Community Health Cont'd		
Operations Phase – Local Region	• As today, continued need for boiling surface water at Wuskwatim Lake; communication of same to newcomers • Limited effect on health of increased mercury in Wuskwatim Lake; if monitoring warrants, mitigation of recommended reduction in domestic use of fish • Indirect effect on concern about environmental change, reduced for some through full and frequent reporting of physical/biophysical monitoring results and health monitoring results • Potential for indirect contribution to factors affecting health (e.g., new housing, economic development) from revenue from ownership investment	Negligible (-) (not significant) Negligible (-) (not significant) Minor (-) (not significant) Moderate – Major (+) (significant)
Social Well-being		
Construction Phase – Local Region	• Indirect effect of income, employment and training on standard of living of workers and families; if measures to support workers and families successful, positive contribution to social well-being • Reuniting family and friends, but possible effect of crowded housing conditions, to some extent; mitigation measures in place • Opportunity to reconnect with Wuskwatim Lake area for cultural practices through improved access	Minor (+) (not significant) Minor (- and +) (not significant) Minor (+) (not significant)
Construction Phase – Thompson in Project Region	• Indirect effect of new income for workers and businesses serving construction project • Stretching of social services serving small group of speculative in-migrants; in-migration stems declining population • Workers visiting taverns during leisure time	Minor (+) (not significant) Minor (- and +) (not significant) Minor (-) (not significant)

Table 9.5-4. Residual Effects and Significance of Effects on Personal, Family and Community Life of the Local Region and Project Region Cont'd.

Topic and Project Phase	Residual Effect	Significance[1]
Social Well-being Cont'd		
Operations Phase – Local Region	• If opportunities sustained, then positive contribution to social well-being • Opportunity for members to reconnect with culturally-important area through better access • Potential for indirect contribution to factors affecting social well-being (e.g., new housing, economic development) from revenue from ownership investment	Minor to Moderate (+) (not significant) Minor (+) (not significant) Moderate – Major (+) (significant)
Culture		
Construction Phase – Local Region	• Reduced opportunities to speak Nehethow-we-win (Cree) during years 3 to 6; extended with work on other projects • NCN interest in continuing to collect and preserve TK • Loss of Taskinigup and Wuskwatim Falls for cultural practices, but new access to important ceremonial sites, once again, to undertake cultural practices • As noted under health, positive and negative health and wellness effects	Minor (-) (not significant) Minor (+) (not significant) Minor (- and +) (not significant) see health
Operations Phase – Local Region	• Loss of TK re: falls, but opportunity to observe and be part of Wuskwatim Lake area and area south of Burntwood River through improved access. Risks associated with visits by others dealt with through Access Management Plan • With contingency planning, reduced concerns about effects on important ceremonial sites • Concern about environmental changes reduced for some through full and frequent reporting of physical/biophysical monitoring • Potential for indirect contribution to factors affecting culture (e.g., investment in culture programming) from revenue from ownership investment	Minor (- and +) (not significant) Minor (-) (not significant) Minor (-) (not significant) Moderate – Major (+) (significant)

Table 9.5-4. Residual Effects and Significance of Effects on Personal, Family and Community Life of the Local Region and Project Region Cont'd.

Topic and Project Phase	Residual Effect	Significance[1]
Community Organization and Governance		
Construction Phase – Local Region	• Continued participation in joint planning process in 2003; stretching key staff and development of new staff • Development of new organization to participate in Limited Partnership • Participation by NCN service providers in community-based impact management, beginning in 2003	Minor (+ and -) (not significant) Minor (+) (not significant) Minor (+) (not significant)
Operations Phase – Local Region	• New community mechanism to deal with decision-making for stream of revenue	Minor (+) (not significant)
Goals and Plans		
Construction Phase – Local Region	• Process of discussion and vote on PDA affords opportunity for NCN membership to test Project against community vision and goals	Moderate (+) (significant)
Construction Phase – Thompson in Project Region	• Project consistent with Development Plan goals for Thompson Planning District	Minor (+) (not significant)
Operations Phase – Local Region	• Potential for indirect contribution to factors affecting quality of life for NCN members (e.g., new housing, economic development) from revenue from ownership investment	Moderate – Major (+) (significant)
Outdoor Recreation		
Construction Phase – Thompson in Project Region	• No effect on outdoor recreation in general, even with cumulative effects of Gull/Keeyask construction workforce; only Thompson Golf Course is near capacity	Negligible (-)

Note:
1 - See Section 2.4 for definitions adopted for this assessment.

9.5.7 Monitoring and Follow-up

Monitoring will be undertaken in order to provide, in a timely way, information that will be used by NCN and/or Manitoba Hydro (and potentially other relevant parties) to manage effects of the Project. Specific work plans for monitoring and following up topics in personal, family and community life will be developed between NCN and Manitoba Hydro. Monitoring for health, social well-being and culture is intended to be coordinated with efforts in the Local Region to make the most of Project benefits, i.e., purchasing, employment and training for residents of the Local Region (Section 9.3.7), and to deal with population change and its associated effects (Section 9.4.7); this is important because these factors are likely to influence personal, family and community life. Collectively, monitoring of economic change, population change and change in personal, family and community life topics, is intended to inform NCN's community planning response to the Project. No specific monitoring or follow-up is required for aesthetics, community organization and governance and goals and plans.

During the pre-construction/construction phase, monitoring in the following areas will be undertaken.

- Road traffic: Tracking of road accidents and Project-related incidents on the new access road (between PR 391 and the construction site), on PR 391 west of Thompson, within the City of Thompson and on PTH 6 south of Thompson. Monitoring results will be used by Manitoba Hydro and NCN, in conjunction with other relevant parties, to highlight any issues.
- Water-based navigation: Monitoring of the effectiveness of any safety measures put in place by NCN and Manitoba Hydro (e.g., safety signage at Wuskwatim Lake and downstream of the construction site, and other measures if and as required).
- Community health, social well-being and culture: Monitoring of community health, social well-being and culture will be undertaken at Nelson House. This will be coordinated with physical, biophysical and resource use monitoring. Results will be used to inform NCN (including key service providers), Manitoba Hydro and community residents, and as input to management of effects.
- Unanticipated effects: Unanticipated effects will be tracked through an annual workshop with community residents, at the same time that physical, biophysical and socio-economic monitoring results are being shared.

During the operations phase, monitoring in the following areas will be undertaken.

- Road traffic: No traffic monitoring on PR 391 is necessary. Monitoring of the effectiveness of the Access Management Plan (see Section 4, Project Description) is assumed.
- Water-based navigation: Monitoring any mechanisms implemented by Manitoba Hydro and NCN to address navigation on Wuskwatim Lake and the area immediately downstream of the dam will be undertaken (e.g., safety signage and other measures if and as required).

- Community health, social well-being and culture: During the operations phase for a period to be determined (e.g., five to ten years), continued monitoring of community health, social well-being and culture at Nelson House will be undertaken. Monitoring of water levels on Wuskwatim Lake will occur, as needed, in relation to important ceremonial sites and follow-up contingency action. Monitoring will be coordinated with physical, biophysical and resource use monitoring. Results will be used to inform NCN (including key service providers), Manitoba Hydro and community residents and as input to management of effects.
- Unanticipated effects: Unanticipated effects will be tracked through an annual workshop with community residents, at the same time that physical, biophysical and socio-economic monitoring results are being shared.

10.0 HERITAGE RESOURCES

10.1 INTRODUCTION

Under *The Heritage Resources Act* (1986) heritage resources in Manitoba are described as any *"…heritage site, heritage object or work or assembly of works of nature or of human endeavour that is of value for its archaeological, palaeontological, pre-historic, historic, cultural, natural, scientific or aesthetic features, and may be in the form of sites or objects or a combination thereof"* (*The Heritage Resources Act* 1986:3).

NCN has a rich archaeological record that attests to its ancient and continuous use and occupancy in the Wuskwatim Lake area. Many aspects of NCN's history have been passed down verbally from generation to generation, thus preserving important cultural and physical heritage knowledge. The archaeological record lends support to the oral history of long-term occupation by NCN and NCN's ancestors. In turn, the oral history record gives meaning to many of the archaeological sites discovered and the objects that are recovered. Together, these two techniques illustrate a continuity of land use and occupancy that extends back into the ancient past.

Data gathered from the Churchill River Diversion archaeological investigations in the 1970s and subsequent mitigation conducted by the Province of Manitoba were used to draft an area characterization of archaeological resources (Northern Lights Heritage Services Inc. 2001). These data were also used to predict the potential for archaeological site location within the footprint of the Project and to identify predicted site locations in the field (Volume 9).

Cree terms will be used to introduce various physical and cultural features pertinent to the EIS, followed by the English equivalent. However, for consistency with the other components of the EIS, the English terms will then be used for the remainder of the EIS.

10.2 EXISTING ENVIRONMENT

The Province of Manitoba Archaeological Site Inventory Register indicated that 44 archaeological sites were reported between Early Morning Rapids and Jackpine Falls on the Burntwood River, including Wuskwatim and Opegano lakes (Figure 10.2-1). Of these, the cultural affiliations of 17 archaeological sites were identifiable. The majority of these sites, originally recorded during pre-CRD investigations, were discovered between 196 and 231 m ASL and within 0 to 10 m of the original shoreline.

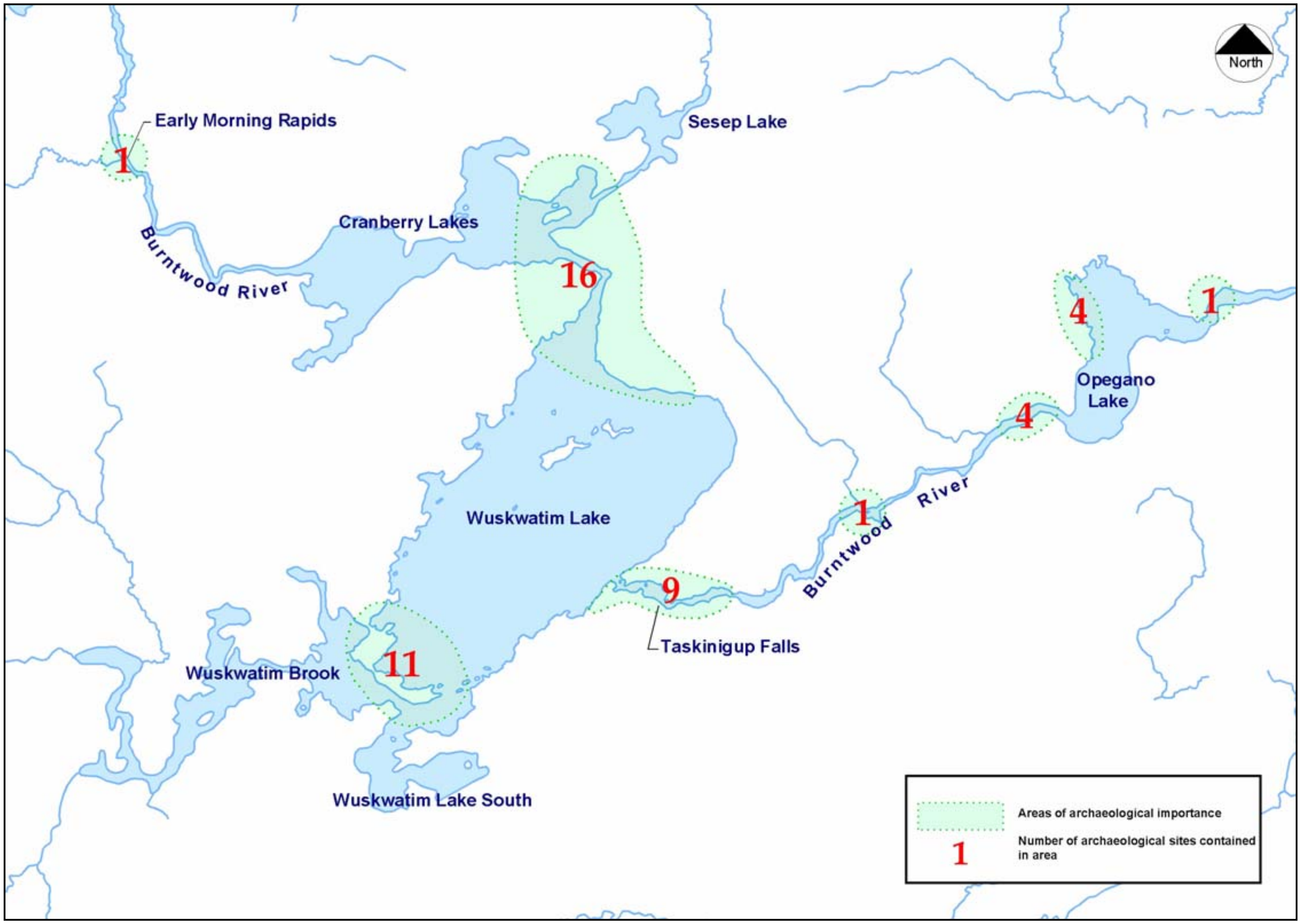

Figure 10.2-1. Archaeological sites reported between Early Morning Rapids and Jackpine Falls on the Burntwood River including Wuskwatim and Opegano lakes.

All previously recorded sites have been severely impacted by raised water levels associated with the CRD. In general, the 17 dateable sites cluster at three major locations: the outlet of the Burntwood River into Wuskwatim Lake; the southwest quarter of Wuskwatim Lake; and between Wuskwatim Falls and *Taskinikahpehk* (Taskinigup Falls). On Wuskwatim Lake, artifacts indicative of most cultural groups known to have lived in Manitoba since the retreat of glacial Lake Agassiz some 7500 years ago were found at levels corresponding to the original shoreline elevation. This suggests that in addition to site preference at strategic locations adjacent to water bodies, there has been little change in natural water levels over the past 7500 years, except that created by CRD.

Archaeologists identify Pre-Contact[1] cultural groups chronologically based on stone projectile point typology, or shape. The reason for this is because organic material rarely survives in a boreal forest setting. Forest fires and acidic soils are agents that remove much of the evidence of past lifeways.

The earliest cultural group to be identified belongs to the Early Pre-Contact Period and is referred to as the **Northern Plano** tradition *ca*. 7500 years ago (Wiersum 1973). Two sites at the north end of Wuskwatim Lake were concluded to be Northern Plano on the basis of projectile point typology (Larcombe 1997). While there is a Middle Pre-Contact Period (Archaic) component to the archaeological record, the cultures most frequently represented in the study area are the Late Pre-Contact Period or Woodland-adapted pottery makers referred to by archaeologists as the **Laurel, Blackduck, and Selkirk**.

Multi-component sites are those locations where the archaeological record shows that more than one cultural group inhabited the site over time. One such site, upstream from Wuskwatim Lake, revealed a continuity of occupation from the Early to the Late Pre-Contact period represented by **Archaic,** Laurel, Blackduck and Selkirk heritage resources. As well, historic and recent Cree occupations were noted at this site. A second multi-component site, on the Burntwood River at the mouth of the Muskoseu River, not only contained artifacts indicating that site occupation extended over a period of 6500 years, but also produced the oldest burial found in Manitoba (P. Badertscher, pers. comm. 2003). The human remains were radiocarbon dated to 6770 ± 100 years old. A third multi-component site, in the south basin of Wuskwatim Lake near Wuskwatim Brook, also contained an archaeological record indicating occupations beginning as early as 6,500 years ago and continuing until the early 1940s.

[1] Pre-Contact Period refers to that time period prior to the arrival of Europeans and their technology.

Sites containing components of the Historic Period are usually identified on the basis of metal assemblage, e.g., artifacts such as nails, jewellery, barrel hoops, etc. Structural remnants such a sill logs for cabin or cellar depressions dating to the pre-1900 era are rarely found because these architectural features have long-since decayed. One exception was recorded on a small island in the southeast corner of Wuskwatim Lake. At this site, a quantity of chimney stone, floorboards, and chinking[2] were recovered from the eroding bank (Smith and Brownlee 1999). Although dated to the 1800s, it could not be concluded with any certainty whether this site related to a Historic Cree occupation or a trade post.

Since 1990, Historic Resources Branch staff have conducted archaeological fieldwork, namely **salvage** reconnaissance, which is a part of the mitigative measures associated with the Churchill River Diversion Archaeological Program (Manitoba Hydro contributes funding for this program). The main objective of this Program is to carefully exhume eroding burials for reburial, with appropriate ceremonies, in the NCN community and recover cultural material, namely artifacts, for interpretative displays. HRB has also conducted a number of mitigative surveys on the Burntwood River and Wuskwatim Lake to document the status of previously recorded archaeological sites and to document any new sites. Manitoba Hydro, the Historic Resources Branch, and the Manitoba Museum, in concert with NCN, currently have an active public awareness program that highlights their notable achievements relative to the Churchill River Diversion Archaeological Program.

Over the ensuing 25 years, shoreline erosion has removed most evidence of the known archaeological sites on the Burntwood River and Wuskwatim Lake. Priority for mitigative measures at most sites was determined to be low or non-existent (Smith and Brownlee 1999).

One archaeological site was recorded at Early Morning Rapids. Six sites were found at the east end of the Cranberry Lakes near the entrance to Wuskwatim Lake. These are mapped in the site cluster (16) for the north end of Wuskwatim Lake (Figure 10.2-1). There is the potential for culturally significant sites to be present, particularly at Early Morning Rapids and at the bends in the river. Based on an archaeological understanding of the cultural history of Pre-Contact people, there is a moderate to high potential for ceremonial sites to occur at rapids and waterfalls. Indeed, the oral tradition for NCN relates that Early Morning Rapids, called *Wapanowaniskamanihk*, is the site where a spiritual man once prayed all night. Such a site would not likely contain any physical

[2] Chinking is a mortar, usually composed of clay which is used as a wall plaster or filler between gaps in log walls , bricks or stones.

evidence, but as part of the oral tradition identifies cultural activity at a specific location. These sites are characterized by a specific place name which acts as a **mnemonic device** for remembering past events. They are an integral part of the **collective identity** of NCN. In addition, elevated locations overlooking water bodies, frequently on the convex banks of rivers, are often preferred burial sites because of their aesthetic setting.

Twenty-one archaeological sites have been identified on Wuskwatim Lake; 10 at the north end of the lake are included in the cluster shared with the Cranberry Lake (16), 11 sites are located at the south end of the lake. (Figure 10.2-1). Most of these sites have been lost to active erosion. Nine archaeological sites are located between Wuskwatim Falls and the area just below Taskinigup Falls (Figure 10.2-1). All have been impacted by erosion as a result of higher water levels between the two falls. *Taskinikahpehk,* signifies "split portage" in Cree and, while this has been used to name the fall, it does not actually refer to the falls but to the portage (NCN Elder, pers. comm. 2002). According to several NCN members, the legend of ***Misipisew***, the water lynx, is associated with Taskinigup Falls. It should be noted that there are other legends associated with Wuskwatim Falls and Taskinigup Falls (NCN Elder, pers. comm. 2002).

Ten archaeological sites representing Pre-Contact campsites and workshops have been identified between Taskinigup Falls and Jackpine Rapids (Figure 10.2-1). All have been impacted by flooding and extensive erosion. This river section is called ***Barbara Ka-pahpit*** or "the place where Barbara was laughing", so named because of a woman from Nelson House who was always happy and laughing (NCN Elder, pers. comm. 2002).

The ***Nimihitowananis*****,** (Wuskwatim) Dancing Circle, which is located in the vicinity of Wuskwatim Lake, is a culturally significant site to NCN Elders and community members.

No previously recorded archaeological sites were recorded within the proposed route of the access road from its junction on PR391 to the proposed Generation Project. One of the options originally considered for the access road started at Mile 20 on PR391. However, ***Thithikope Wachi***, or Misty Hill (also known to the general public as Eagle Hill) was identified as a culturally significant area by members of NCN, as was the ridge between Eagle Hill and Wuskwatim Lake. The ridge was identified as the overland route used by NCN ancestors travelling from Eagle Hill to *Pethew Wachi* (Partridge Crop Hill) (NCN member, pers. comm. 2002). In addition, the land between two small lakes just west of the access road, called *Ka-peyetuwikamisik*, may be a waymarker for this ancient travel route. The presence of these cultural sites was taken into consideration, along with other factors, during selection of the access road (Mile 17 on PR391 was selected as the preferred option).

10.3 IMPACTS AND MITIGATION

Impacts to heritage resources as a result of construction and operation of the Generation Project and associated facilities will primarily be confined to the area between Wuskwatim Falls and Taskinigup Falls. Shorelines on the south basin of Wuskwatim Lake also will be affected as a result of increased erosion. Components of the development (Section 4, Volume 1) that have the potential to impact heritage resources include:

- the channel improvement at Wuskwatim Falls;
- portions of the Taskinigup Falls spillway;
- the north bank of the Burntwood River within the area designated as the reservoir (234.0 m contour);
- level areas along the south bank of the Burntwood River within the reservoir (234.0 m contour);
- the area of the switchyard;
- the area of the construction camp;
- portions of the Wuskwatim Lake shoreline;
- borrow locations; and
- the Mile 17 Access Road.

A Cultural and Heritage Resources Committee will be struck prior to the start of construction to manage potential effects on cultural and heritage resources. The Committee will consist of NCN members, a Manitoba Hydro representative (sitting on the Committee to assist in the implementation of management plans developed by the Committee), and other expertise as required.

10.3.1 Early Morning Rapids to Cranberry Lakes

Several areas in the vicinity of Early Morning Rapids have the potential to be impacted through erosion. It is anticipated that these impacts will be mitigated by ongoing Historic Resources Branch mitigation surveys through the Churchill River Diversion Archaeological Program.

10.3.2 Wuskwatim Lake

Archaeological sites at the south end of the lake are in immediate risk of projected accelerated erosional destruction. It is expected that these sites will continue to be salvaged and/or mitigated according to Historic Resources Branch's management plan for Wuskwatim Lake.

Although the Dancing Circle is not located in an area that will be directly impacted by the Project, concerns have been expressed by NCN that the Wuskwatim Dancing Circle may be vulnerable because of changes in soil stability as a result of an increased water table. In addition, increased access to the Wuskwatim Dancing Circle by NCN and non-NCN members has the potential to impact the physical integrity of this sacred site and/or cause loss of cultural significance. These concerns will be managed by the Cultural and Heritage Resources Committee.

10.3.3 Wuskwatim to Taskinigup Falls

Between 2000 and 2002, all areas with the exception of Wuskwatim Lake were subjected to a field assessment as part of a heritage resources impact assessment (HRIA) as identified in Section 12 (2) of *The Heritage Resources Act*.

Testing conducted at on the north side of the Burntwood River at Wuskwatim Falls exposed a rock feature, possibly a waymarker along the former portage. A waste flake deposited at an unknown date by an Aboriginal craftsperson was also found. There is potential for additional heritage resources to be present at this location. Monitoring activities at this site will be conducted during construction, and any artifacts that are found will be appropriately mitigated.

Two sites were recorded northwest of Taskinigup Falls. One was a shoreline scatter of lithic reduction flakes that were deposited during stone tool manufacture or retouch. These artifacts were probably part of a larger site, which has since eroded into the river. **Remote sensing** and excavation conducted at the second site in 2001 revealed the remains of a log structure with saddle-notched corners. This is consistent with post-1900 construction techniques. On Wuskwatim Lake, historical burials have been associated with former settlements similar to the site northwest of Taskinigup Falls. However, an intensive pedestrian survey adjacent to the cabin revealed no evidence of burials in this area.

In addition to the work conducted to date, additional archaeological surveys will be conducted at sites directly affected by the Project to further manage potential risks to heritage resources and to reduce the potential for work stoppages. Cultural mitigation of Taskinigup Falls is planned for the summer of 2003 prior to the start of construction in 2004.

The waymarker and portions of the portage trail will be impacted as a result of the channel improvement at Wuskwatim Falls. The waymarker, in particular, is of cultural significance as it can be viewed as a mnemonic device for remembering traditional knowledge regarding past events. Waymarkers can be functional and spiritual at the same time (Hallendy 2000). Removal of the waymarker by the EMT archaeologists prior to construction and monitoring can mitigate these impacts. Based on assessments conducted between 2000 and 2002, it is evident that any intact heritage resources **diagnostic** of the Pre-Contact Period are located below the **A horizon** and above the **B clay horizon**. Mitigation, therefore, would consist of removing the A horizon so that any artifacts, hearths or additional waymarkers can be recorded and collected.

The legend of the water lynx, *Misipisew*, an important cultural link between NCN and Taskinigup Falls requires mitigation. Consultation with NCN Elders and spiritual leaders to determine the cultural significance of the falls and to formulate an acceptable form of cultural mitigation through traditional methods is necessary prior to development. It is expected that the Cultural and Heritage Resources Committee will look at ways to mitigate the loss of this culturally important feature.

Monitoring is required at any construction activities requiring subsurface disturbance in the vicinity of Taskinigup Falls and in the vicinity of the historic cabin.

10.3.4 Taskinigup Falls to Jackpine Rapids

Depending on erosional study rates, there is the potential for impacts to burial sites, campsite locations, and cultural areas. It is anticipated that any mitigation of this section of the Burntwood River will be conducted by Historic Resources Branch as part of the Churchill River Diversion Archaeological Program in consultation with NCN Elders.

10.3.5 Access Road and Borrow Locations

An elevated area away from the Burntwood River and Wuskwatim Lake could have served as natural pedestrian routes for humans as well as migratory routes for wildlife. These elevated areas may also have been used as a source for lithic material for tools during the Pre-Contact Period. Assessment of two proposed borrow locations were examined through a pedestrian survey of cut lines and shovel testing. No heritage resources were recovered.

The route of the Mile 17 Access Road was assessed following clearing of the corridor and before construction of the road. No heritage resources were located.

10.4 RESIDUAL EFFECTS AND MONITORING

The water level of Wuskwatim Lake will not be higher than the historic high water level of the CRD after construction of the Wuskwatim Generation Project. However, depending on erosion rates, sites that have been affected by CRD may be at a higher risk of impact. Furthermore, an increased rate of erosion may destroy those archaeological sites which are as yet undiscovered. Of particular importance would be sites that were occupied during the post-1900 period which appear to be located further back from the present Wuskwatim Lake shoreline and the banks of the Burntwood River.

Historic Resources Branch currently has a multi-year program in place with NCN and Manitoba Hydro (who provide the required funding) whereby sites that have eroded as a result of CRD are mitigated. It is anticipated that this government agency will continue to address residual effects on Wuskwatim Lake once the Generation Project is in place.

A Management Plan will be developed by the Cultural and Heritage Resources Committee and all cultural and heritage sites will be subject to ongoing mitigation, as required. Therefore, no residual effects are expected because all heritage resources sites that are at risk will be properly mitigated.

It should be noted that the absence of archaeological material does not mean that the land is culturally insignificant. Cultural values cannot be measured by the number of artifacts that are collected. Furthermore, because of the nature of archaeological and other heritage sites, the physical objects related to former cultural groups are most often found below the surface of the ground and are not visible until the top soil layers are removed. For this reason, additional monitoring will be conducted during construction of the Project.

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12.0 GLOSSARY OF TERMS AND LIST OF ACRONYMS

12.1 GLOSSARY 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.

1996 NFA Implementation Agreement - the agreement signed by NCN, Manitoba Hydro, Canada and Manitoba to implement the 1977 Northern Flood Agreement (NFA) and resolve most, although not all, outstanding claims stemming from the Churchill River Diversion (CRD) Project.

Aboriginal community - a community where most of the residents are Aboriginal (i.e., Indian, Métis or Inuit) and that has a separate form of government, provides some level of service to its residents, and has clear community boundaries.

Above Sea Level (ASL) - elevations are referenced to Geodetic Survey of Canada, Canadian Geodetic Vertical Datum 1928, 1971 Local Adjustment.

active labour force - all persons 15 years of age and over, excluding institutional residents, who are either employed or unemployed.

adult - sexually mature.

Advanced Education and Training (AET) - refers to Manitoba Advanced Education and Training, a department of the Government of Manitoba. It is anticipated that AET will act as the referral agent for job-order hiring of workers for the Project construction workforce. AET, Employment and Training Services may also be the lead agency to assist northern Aboriginal residents that are not NCN members to develop career plans and access pre-project training programs.

adverse effects - negative effects on the environment and people that may result from a proposed project.

Affected Aquatic Area - encompasses all the aquatic, shoreline, peat island and mineral island habitat in the affected waterway from Early Morning Rapids to the Opegano Lake outlet.

Agreement-in-Principle (AIP) - in 2001, NCN and Manitoba Hydro ratified an Agreement-in-Principle (AIP) regarding possible future development of the Wuskwatim (Generation and Transmission) and Notigi projects, including the opportunity for NCN to invest in the ownership of the Wuskwatim Generation Project. The AIP is not legally binding, but sets out a series of topics to be discussed between the parties to develop a binding Project Development Agreement (PDA) and related agreements. NCN members approved the AIP through a secret ballot ratification vote. The AIP was also approved by the Manitoba Hydro Board and the Minister Responsible for Manitoba Hydro. Manitoba Hydro and NCN are now working to develop a binding Project Development Agreement (PDA), based on the topics identified in the AIP.

A-horizon - the uppermost, often dark-coloured natural level in a soil profile characterized by roots, humus, and a lack of clay, iron, carbonates and soluble salts which have leached to lower levels. Often written as A^h.

algae - a group of simple plant-like aquatic organisms possessing chlorophyll and capable of photosynthesis; they may be attached to surfaces or free-floating; most freshwater species are small or microscopic in size.

alkaline (basic) - a pH value of greater than 7.0 (pH is a way to measure the acidity or alkalinity of a solution).

Allied Hydro Council (AHC) - a group of representatives from the International and Local Unions whose members work on the Project. The AHC is the exclusive labour bargaining agent for negotiating and administering the Burntwood Nelson Agreement.

Alternating Current (AC) - is the oscillating (back and forth) flow of electrical current, whereas the DC (Direct Current) is the unidirectional continuous flow of electrical current. AC is the common household form of electricity and DC is the form provided by a battery.

amphibian - cold-blooded animal of the Class Amphibia that typically lives on land but breeds in water (e.g., frogs, toads, salamanders).

anchor ice - ice which sometimes forms about stones and other objects at the bottom of running or other water, and is thus attached or anchored to the ground; typically forms on the river bed at locations that are shallow and flowing rapidly, such as at the “brink” of a set of rapids or a waterfall - at these locations, the turbulent, high velocity flow causes mixing of the newly formed frazil ice, which comes into contact with the river bed and attaches to the material on the river bottom; as this ice mass slowly grows, it begins to constrict or block the river channel, and can result in a substantial rise in upstream water levels.

annual allowable cut (AAC) - the volume of wood that may be harvested from a given area each year on a sustained yield basis.

Archaic - a term used in Manitoba archaeology which refers to a specific cultural period (ca. 7000 B.P). The main technological marker that is left in the archaeological record is the atlatl, or spear-thrower.

Augmented Flow Program - an annual amendment to the Churchill River Diversion 1973 Interim Water License which provides additional flexibility in the operation of the CRD.

backflooding - intentionally flooding the work area behind a cofferdam to minimize erosion during cofferdam removal.

backpack electrofisher - a unit equipped with a power source which makes use of electrical currents to capture fish in shallow tributaries.

bank-recession rates - the quantity, amount, or degree of the shore or bank retreat by progressive erosion.

basal pterygiophores - form the base of support for the dorsal and anal fin rays.

bedrock - the solid rock that underlies soil and the regolith that is exposed at the surface.

benthic invertebrates - small animals (without backbones) that live on or in the bottom of water bodies (e.g., insect larvae, clams).

best gate - the wicket gate setting at which a hydraulic turbine operates most efficiently. The wicket gates are the main flow control to the turbine.

B-horizon - that natural level within a soil profile which directly underlies the surficial A-horizon and which contains the clay, iron oxides and carbonates which have leached down from it. Often written as B^h.

biodiversity - the existence of a wide range of different species in a given area or during a specific period of time.

biomagnified - the process by which a substance is passed up the food chain resulting in higher levels of that substance at upper levels of the food chain.

Blackduck - a term used in Manitoba archaeology, which refers both to a specific cultural period (ca. A.D 1000-1750) and to a distinctive ceramic ware. The cultural group is considered to be the ancestors of the Ojibwa.

bog - wetland ecosystem characterized by an accumulation of peat, acid conditions and a plant community dominated by *Sphagnum* moss.

border ice - forms along the shoreline of a river, where velocities are low; formation similar to that of lake ice; reduces the area of open water; in particularly low velocity locations, the border ice forming along each shore may eventually grow together, creating an ice bridge and hence an ice front against which drifting ice sheets can begin to accumulate; extent of border ice formation governed by flow velocity, river geometry, and winter temperatures.

boreal forest - needle-leafed evergreen or coniferous forest bordering sub-polar regions.

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 kilometres from Newfoundland, west to Alberta.

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.

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.

Brunisols - soils of the Brunisolic order have sufficient development to exclude the soils from the Regosolic order, but lack the degrees or kinds of horizon development specified for soils of the other orders. The central concept of the order is that of soils formed under forest and having brownish coloured Bm horizons and/or various colours with both Ae horizons and B horizons having slight accumulations of either clay, or amorphous aluminum and iron compounds, or both.

buffer - an area of land separating two distinct land uses that acts to soften or mitigate the effects of one land use on the other.

Burntwood Nelson Agreement (BNA) - the collective bargaining agreement between the Hydro Project Management Association (HPMA), representing Manitoba Hydro management, and the unions of the Allied Hydro Council (AHC), representing workers, that will be in effect during the construction of the Project. (See above for definition of collective bargaining agreement.) The BNA was under renegotiation at the time of writing. It is expected that the renegotiated BNA will be completed and in effect for construction of the Project.

calcareous - composed of, containing or resembling calcium carbonate, calcite or chalk.

capacity factor - the ratio of average load on a plant or machine, to its maximum capacity rating.

catch-per-unit-effort - the number or weight of fish caught in a given unit of effort within a given time period (e.g., #fish/100m of net/24hrs).

Celsius (C) - a scale for measuring temperature. To convert Celsius to Fahrenheit: multiply degrees in C by 9/5 and add 32.

channel-forming flow - flow that defines the characteristics of the channel; typically it is the flood flow that has a return period of once every two years.

chlorophyll - a group of green pigments present in plants cells that are essential in the trapping of light energy during photosynthesis.

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.

Clean Environment Commission (CEC) - provincial body created by *The Environment Act (Manitoba).* At the request of the Minister of Conservation, the CEC, amongst other related responsibilities, conducts public hearings concerning major projects that may affect the environment. The CEC writes a report about their findings and makes recommendations to the provincial government about the subject they have been asked to review. The final decision with respect to licensing a development is the responsibility of the Minister of Conservation. The CEC will hold public hearings on the Wuskwatim Projects and these are expected to take place in fall, 2003.

Climate Models - a quantitative way of representing the interactions of the atmosphere, oceans, land surface and ice. Models can range from relatively simple to very complex. Global Climate Models model the entire globe, while regional models model a sub-set of the globe.

cofferdam - a temporary barrier, usually an earthen dyke, constructed around a work site in a river, so the work site can be de-watered or the water level controlled. See dam.

collective agreement - a contract between a union and an employer. It covers all of the working conditions (salary, vacation, etc.) for all the union members employed by the employer. These employees no longer sign individual employment contracts with the employer because they are all covered by the same contract – the collective agreement.

collective identity - this refers to those cultural beliefs, values, customs and ways that are held in common by members of a cultural group and which make the group unique.

colour - the colour of water is the result of backscattering of light upward from a water body after it is selectively absorbed at various depths. True colour is used as an indicator of dissolved and suspended materials in water.

commercial fishery/trapping - where the catch is sold.

commissioned - with reference to the hydro generating station: testing of generating equipment and upon satisfactory completion, releasing for commercial service.

concrete aggregate - crushed rock or gravel of varying size used in the production of concrete. Aggregate is mixed with sand, cement, and water and other additives to produce concrete.

conductivity - a measure of the ability of water to carry an electrical current; is used as an indicator of the total dissolved solids content of water.

conifer - any of numerous cone-bearing trees of the order Pinales, including the pine, fir and spruce; having simple, needle-like leaves.

coniferous - typically bearing cones and needle-like leaves (often evergreen).

conservation - any various efforts to preserve or restore the earth's natural resources, including such measures as: the protection of wildlife; the maintenance of forest or wilderness areas; the control of air and water pollution and the prudent use of farmland; mineral deposits; and energy supplies.

Construction Support Positions - jobs that are needed during the Project construction, but do not involve actually building the Project. Catering and clerical staff are examples of construction support positions. Training and work experience requirements can range from on-the-job training for entry level positions to more than 3 years of formal training and professional experience for the most highly-skilled positions.

contaminant - any physical, chemical, biological, or radiological substance or matter in the environment.

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.

control structure - a type of structure designed to control the outflow from a lake (e.g., Missi Falls control structure, Notigi control structure).

country foods - foods harvested by hunting, trapping, fishing or gathering (i.e., not bought in a store).

cover - **1)** vegetation such as trees or undergrowth that provides shelter for wildlife; **2)** 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; and **3)** 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.

critical habitat - (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.

Cryosols - soils of the Crysolic order are formed in either mineral or organic materials that have permafrost either within 1 m of the surface or within 2 m if the pedon has been strongly crysturbated laterally within the active layer, as indicated by disrupted, mixed or broken horizons. They have a mean annual temperature of less than or equal to 0 degrees Celsius.

Cryptosporidium - a protozoan parasite found in intestinal tracts of various vertebrates; it has been implicated in human intestinal disease (Cryptosporidiosis).

crystalline - consisting of or containing or of the nature of crystals; general term applied to metamorphic or igneous rocks formed by the process of crystallization from solid or liquid precursors.

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.

dam - a structure holding back water, usually in a river. It may be designed to control the flow and release of water. It may also be designed to generate electricity.

dampened - to reduce amplitude (of oscillations or waves).

debouchment - the mouth or outlet of a river.

decommission - to take out of active use (typically involves the dismantling and removal of the original structure(s) and associated facilities).

density - the number of individuals in relation to the space in which they occur.

Designated Trades Positions - occupations that have formal apprenticeship programs that provide supervised training leading to certification as a fully-qualified journeyperson in the trade. Apprenticeships in the designated trades typically entail four or more years of in-class technical training and on-the-job work experience. Carpenters and electricians are examples of occupations in the designated trades.

diagnostic - a significant trait pertaining to an artifact that provides useful information, usually age or function of the specimen.

diversity - related to the number of different species or different features in a given location.

domestic harvest - the harvest of natural resources for personal use or consumption (i.e., not sold).

drawdown - the act, process, or result of lowering the surface level of water.

duration curve - a cumulative distribution function based on a sample of data, to indicate frequency of exceedance. A curve that shows how often an event is expected to be exceeded.

dyke - an embankment, usually constructed to prevent flooding of low lying areas and thus limit the extent of flooding.

dynamic equilibrium - when two (or more) processes occur at the same rate so that no net change occurs.

Dystric Brunisols - acid Brunisols (see definition for Brunisol above) that lack a well-developed mineral organic surface horizon; occur widely, usually on parent materials of low base status and typically under forest vegetation.

ecosystem - a functional unit consisting of all living organisms (plants, animals, microbes, etc.) in a given 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.

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.

egg incubation - the period of time and conditions required for the successful hatching of eggs.

EIS Guidelines - the April 29, 2002 *Guidelines for the Preparation of an Environmental Impact Statement for the Wuskwatim Generation Project* issued by Manitoba Conservation. Draft Guidelines prepared by federal/provincial officials were made available in December 2001 and comments were invited until March 2002. Public review included meetings held by the Clean Environment Commission (CEC) in Thompson, Nelson House, Winnipeg and The Pas. In April 2002, the CEC issued a report on these public meetings, and provided recommendations on the Draft Guidelines.

employment rate - the proportion of individuals in the active labour force that have a job. This includes all persons working for wages or salaries, all self-employed persons (with or without paid help) working in their own business, farm or professional practice, and all persons working without pay on a family farm or business during the reference week.

endangered - as defined by COSEWIC, a species facing imminent extirpation (no longer existing in the wild in Canada, but occurring elsewhere) or extinction (no longer exists).

entrainment - fish (larval or adult) that are drawn into a current and cannot escape.

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 Management Team (EMT) - a team of consultants jointly selected by Manitoba Hydro and NCN to manage the environmental planning and assessment studies for the Wuskwatim Generation and Transmission Projects. The EMT reports to both NCN and Manitoba Hydro.

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.

euphotic zone - area of the water column in which there is adequate light to support photosynthesis. It is generally defined as the depth within a minimum of 1% of radiation remains.

eutrophic - a body of water with high concentrations of nutrients, particularly nitrogen and phosphorus, and high productivity.

existing flows - refers to flows (or water levels) that have occurred since the final commissioning of the Churchill River Diversion (CRD), see post-CRD. Flow record used in study September 1977 to June 2001.

fecal coliform bacteria - include genera such as *Escherichia* and *Klebsiella*, are indicators of organisms from the intestinal tracts of humans and other animals, used to represent the potential presence of pathogens.

fen - low-lying wet land with grassy vegetation; usually is a transition zone between land and water.

Fibrisols - organic soils that are composed largely of relatively undecomposed fibric organic material. They occur extensively in peat deposits dominated by *Sphagnum* mosses.

fill - natural soils that are manually or mechanically placed. Soil or loose rock used to raise a grade.

first-order stream - a small stream that has no larger tributaries.

fish passage facilities - structures to provide upstream or downstream fish passage over an obstruction in the stream (e.g., fish ladders).

floating drift trap - a modified trap which suspends in the water column used for collecting drifting organisms such as larvae and invertebrates.

floating ice pan - agglomeration of frazil ice, or slush ice, into frazil pans and larger ice sheets. Slush ice, if on the surface long enough, will form a continuous ice sheet over a porous mass of frazil sheets. This ice sheet is known as a frazil pan. As these pans move, they bump and grind, and become somewhat circular in shape. These pans may then freeze together to produce larger ice sheets, typically in slow moving reaches where the contacting pans have had time to freeze together.

flow - motion characteristic of fluids (liquids or gases); any uninterrupted stream or discharge.

Floy-tagged - a fish that has been marked with a spaghetti-like tag, possessing an identifying series and number, which is attached between the basal pterygiophores of the dorsal fin.

footprint - the surface area occupied by a structure or activity.

forage - food.

forage fish - small fish species such as cyprinids, sculpins, sticklebacks, and trout-perch that are consumed by larger, predatory species.

forebay - the portion of a reservoir immediately upstream of a hydroelectric facility.

forest damage fees - fees assessed by Manitoba Conservation where non-merchantable forest resources are damaged or removed. They normally include forest renewal and forest protection fees and are determined using the Forest Damage Appraisal Procedures as outlined by Manitoba Conservation.

Forest Management License (FML) - is a license issued under the Manitoba Forest Act to a forest industry company providing that company the authority to carry out sustainable timber harvesting, renewal, and management activities on a designated forest area of Manitoba.

Forest Management License Area (FMLA) #2 - is area allocated to Tolko Industries Ltd. under Forest Management License Area #2 and described in the Forest Management License agreement between the Province of Manitoba and Tolko Industries Ltd.

Forest Management Plan - is a long-term plan of forest management activities covering the Forest Management License Area for a period of 10 or 20 years. It is prepared by Forest Management License holders as part of their obligations under the FML agreement and is subject to governmental approval.

Forest Management Unit (FMU) - a forest resource based administrative unit within a Forest Section.

Forest Resource Inventory - a classification system and inventory derived from aerial photo interpretation of the provinces forest resources. It is the base information that is used to calculate growth and yield and the annual allowable cut.

Forest Section - a term applied to designated areas of the Province of Manitoba by Manitoba Conservation for the administration of the forest resources. The Forest Section is subdivided into Forest Management Units.

frazil ice - fine spicular or ground ice (slush), derived from the French word for cinders, which this variety of ice most resembles. When first formed, frazil is colloidal and is not visible in the water. Frazil crystals are discoid in shape, with diameters that are typically smaller than 1 mm. Frazil crystals tend to stick to objects and each other. After forming, frazil crystals continue to grow and agglomerate, initially into small clusters, and then into larger flocs.

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].

full gate - a fully open wicket gate setting at which the hydraulic turbine produces maximum power.

fungus - a simple, nonphotosynthetic organism which lives instead off living or decomposing organisms.

furbearer - referring to those mammal species that are trapped (e.g., marten, fox, etc.) for the useful or economic value of their fur.

Future Development - defined in the 1996 NFA Implementation Agreement, Future Development means any new development by Manitoba Hydro arising from the CRD which has a reasonable likelihood of having a material and continuing physical, chemical or biological impact on a water body within the Nelson House Resource Management Area, including the Wuskwatim Generation Project. Article 8 of the 1996 NFA Implementation Agreement sets out a process for NCN and Manitoba Hydro to discuss potential Future Developments that could affect the Nelson House Resource Management Area and NCN members.

Future Projects - projects and activities included in a cumulative effects assessment for a proposed development. Future Projects have effects that overlap with those of the proposed development. Only projects and activities that are likely to proceed in the foreseeable future are considered to be future projects. Typically, these include projects and activities that have been approved, have been officially announced by the proponent, are in a government approvals process, or are directly associated with the Project. Uncertain or hypothetical projects are not usually included.

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.

***Giardia* sp.**- a protozoan parasite living in the intestines of mammals that causes the disease giardiasis (i.e., beaver fever) in humans.

Gigawatt (GW) - one billion watts (1,000,000,000 watts) of electricity.

glaciolacustrine sediments - sediments pertaining to, derived from, or deposited in glacial lakes; especially said of landforms and deposits such as varved sediments.

Gleysols - an order of soils developed under wet conditions and permanent or periodic reduction. They occur under a wide range of climatic conditions; Gleysolic soils may or may not have a thin Ah horizon over mottled gray or brownish gleyed material. They may have up to 40 cm of mixed peat or 60 cm of fibric moss peat on the surface.

gneiss(es) - coarse-grained, banded rocks that formed during high-grade regional metamorphism; the banding is a result of the separation of dark- and light-coloured minerals.

granular fill - fill material including sand and gravel.

Gray Luvisol - these Luvisolic (see Luvisol definition below) soils usually have L, F, and H horizons (duff layer) and may or may not have a degraded, organic enriched A horizon. They typically occur under boreal or mixed forest vegetation and in forest-grassland transition zones under a wide range of climatic conditions.

Greenhouse Gas (GHG) - gases e.g., methane, carbon dioxide, chlorofluorocarbons emitted from a variety of sources and processes, said to contribute to global warming by trapping heat between the earth and the atmosphere.

groin - a rock fill structure extending out into a river or lake from the bank or shore. Used to protect the bank from erosion.

groundwater - the portion of sub-surface water that is below the water table, in the zone of saturation.

habitat - the place where a plant, animal or microorganism lives; often related to a function such as breeding, feeding, etc.

habitat alienation - occurs when wildlife habitat is used by people in ways that prevent animals from using it.

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 type - an area (i.e., a patch) that has similar soils, hydrology, vegetation, vegetation age and disturbance regime (e.g., highly variable water fluctuations, frequent large fires).

hardwood(s) - deciduous, broad leaved tree species belonging to the botanical group Angiospermae that shed their leaves annually, such as trembling aspen, white birch, balsam poplar, ash, oak, elm, Manitoba maple, basswood, etc. Also refers to stands of such trees and the wood produced by them.

hectares (ha) - a metric unit of square measure equal to 10,000 square metres or 2.471 acres.

heterogeneous - consisting of dissimilar components.

High Boreal Ecoclimatic Region - subdivision in the Canadian Ecological Land Classification System hierarchy, which divides Canada’s natural landscapes into 15 terrestrial Ecozones, which are then subdivided into 45 Ecoprovinces, 177 Ecoregions and 5,428 Ecodistricts.

high-head - a generating station design that has a high forebay elevation compared to other options.

Humic - partly or wholly decomposed vegetable matter; Humic Gleysol soils have a dark-coloured (organic enriched) A horizon. They may have up to 40 cm of mixed peat or 60 cm of fibric moss peat on the surface.

hydraulic - of, involving, moved by, or operated by a fluid, especially water, under pressure.

Hydro Projects Management Association (HPMA) - an association of representatives of the owners and contractors for new hydroelectric generation projects and converter station projects involving Manitoba Hydro. The HPMA serves as the exclusive management bargaining agent for negotiating and administering the Burntwood Nelson Agreement.

hydrocarbon - an organic compound that contains only carbon and hydrogen, and no other elements; derived mostly from crude petroleum and also from coal tar and plant sources. Excessive levels may be toxic.

hydroelectric - electricity produced by converting the energy of falling water into electrical energy (i.e., at a hydro generating station).

hypoxic - deficiency of oxygen.

ice dam - a partial blockage formed on a water body by the buildup or deposition of ice.

ice-scouring - ice-induced erosion.

impact - a positive or negative effect of a disturbance on the environment or a component of the environment.

impervious fill - fill that has low permeability (usually clay) and used in an embankment structure to reduce leakage through the dam. It can also be used as a liner of a pond or lagoon to prevent leakage into the surrounding area.

impingement - the process whereby a fish (larval or adult) comes into contact with an object (i.e., a screen) and is unable to free itself.

impoundment - a body of water confined by a dam or other structure. See forebay.

in-service date - the date the Wuskwatim Generation Project starts to produce electricity. The earliest in-service date for the Project is 2009.

in situ - in place; undisturbed.

incremental - a small addition or increase.

infrastructure - the basic features needed for the operation or construction of a system (e.g., access road, construction camp, construction power, batch plant, etc.).

Infrastructure Development (Stage 1 of Project construction) - refers to the construction of the infrastructure required for Project construction, including the access road, water and sewer lines and buildings for the construction camp, and contractor work areas. Infrastructure development would take place during the first two years of Project construction.

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.

interlobate ridge - long raised strip of sand or gravel formed along the general line of contact or zone of overlap between two former glaciers or ice lobes.

intrusive - applied to a body of rock, usually igneous, that has emplaced within pre-existing rocks.

inundated - land covered by water which is not normally covered by water.

invertebrates - animals without a spinal column.

job order process - the process followed by contractors to hire employees to fill positions in the construction workforce for the Project. During construction of the Project, the vast majority of contractor-hired positions will be filled through a job order process where contractors have to submit their job requests, or job orders, to Manitoba Advanced Education and Training, which will act as the referral agency for the Project. AET will refer qualified job candidates from its database of applicants to contractors in a timely and unbiased manner, and according to the terms of any employment preference(s) set out in the Burntwood Nelson Agreement.

juvenile - individual not yet achieving sexual maturity.

kick nets – a hand-held dip net with fine mesh used to collect benthic invertebrates, fish eggs, and larvae. Samples are collected either by moving the net through the water or placing the net on the substrate and "kicking" the substrate immediately upstream of the net.

labour force (participation) - individuals in the potential labour force who are working or actively looking for work.

lacustrine - of, pertaining to, or inhabiting lakes.

Lake Winnipeg Regulation (LWR) - allows the regulation of Lake Winnipeg water levels to enhance power production on the lower Nelson River. Constructed in the early 70's by Manitoba Hydro the project involved three main components:

- channel excavations that included: 2-mile channel, 8-mile channel and Ominawin Channel to increase winter outflows from Lake Winnipeg;
- Jenpeg Generating Station and control structure to control flows from Lake Winnipeg into the Upper Nelson River; and
- a dam at the outlet of Kiskitto Lake to prevent water from backing up into the lake.

land type - an area (i.e., a patch) that has similar soils, surface water and ground water.

larvae - the period of life immediately after hatching lasting until the yolk-sac has been absorbed.

larval - the stage of being a larvae.

larval drift traps – modified traps placed in the water column (either fixed near the substrate or suspended) which collect organisms drifting downstream.

Laurel - a term used in Manitoba archaeology which refers to the cultural period in which the first ceramics were manufactured (ca. 200 B.C. - A.D. 1000). The cultural group is considered to be the ancestors of Algonkian people.

length-stratified - sub-sample selected for analysis which is chosen from the sample based on length (i.e., a given number of individuals from a given length class).

lentic - pertaining to very slow moving or standing water, as in lakes or ponds.

life histories - the timeline of an organism's life; including development, maturation, and reproduction.

Limited Partnership - a special form of partnership – it involves a "general partner" (usually a corporation) and a "limited partner". The limited partner has limited liability and is only liable for its partnership interest (a fixed amount of money that is agreed to in advance). The general partner is liable for all of the partnership's debts and makes all of the management decisions for the partnership.

Local Region - a study region identified as part of the socio-economic impact assessment (SEIA) for the Wuskwatim Generation Project. The Local Region is defined largely by the boundaries of the Nelson House Resource Management Area (RMA). It includes all members of the Nisichawayasihk Cree Nation (NCN), including those members living in the First Nation community of Nelson House, and the Northern Affairs community of Nelson House. The Northern Affairs community of South Indian Lake has also been included in the Local Region, given their close relationship with NCN and Nelson House (80 to 90 per cent of South Indian Lake residents are NCN members).

lotic - pertaining to moving water.

lower trophic level - a level in the movement of matter and energy along a food chain or through a food web.

low-head - a generating station design that has a low forebay elevation compared to other options.

Luvisols - soils of the Luvisolic order generally have light-coloured, eluvial horizons and have illuvial B horizons in which silicate clay has been accumulated. These soils develop characteristically in well to imperfectly drained sites, in sandy loam to clay, base saturated parent material under forest vegetation in subhumid to humid, mild to very cold climates.

Major Works Construction (Stage 2 of Project construction) - refers to the construction of the actual dam, powerhouse, turbines, gates, generators and associated structures that make up the generating station. Major works construction takes place once the infrastructure development is largely completed, primarily in years three to six of Project construction.

megawatts (MW) - a unit of power equal to one million watts. One megawatt is enough to power 50 average homes.

meiofauna - microscopic animals often defined as organisms that are retained by a 63 µm mesh. Meiofauna live in the water column, on the surfaces of plants, and in the sediments.

merchantable - a tree or a stand of trees that has reached maturity (rotation age and/or size) and is suitable and/or ready for harvest.

mercury (Hg) - a natural metallic element that occurs in soils and minerals of the earth's crust.

Mesisols - these are Organic soils (see Organic definition below) that are at a stage of decomposition intermediate between Fibrisols and Humisols. They occur on all types of peatland but are especially widespread in fens.

meso-eutrophic - moderately eutrophic (see eutrophic).

methyl mercury - an organic form of mercury that is able to concentrate in animal tissue.

microbial - the activity of microorganisms such as bacteria, algae, diatoms, plankton, and fungi.

migrants - individuals that have moved from one area to another.

mineral island habitat - mineral or bedrock islands in lakes or rivers (organic layer on top of the mineral soil < 20 cm thick).

mitigation - actions taken during the planning, design, construction and operation of works to reduce or avoid potential adverse effects.

mnemonic device - a technique used for remembering specific details. On the land, certain features may remind people of specific events that took place at that location in the past.

mode of operation - the method of operating a generating station for meeting electrical demands. The operation method, or mode, will determine the pattern of the outflows from the powerhouse.

model - a tool used to help visualize something that cannot be directly observed.

moderate timeframe - period of time that is less than 20 years; adopted for the purpose of defining physical effects that adjust over time (e.g., erosion, sedimentation).

modified neuston sampler - instrumentation used for collecting larval fish from the neuston (surface) layer of water.

modified run-of-river - a mode of operation that is based on modest flow changes that-allows efficient generation, but is restricted so that the outflow pattern does not cause excessive downstream water level fluctuations. Generally the daily average outflow will be equal to the daily average inflow, therefore also limiting the forebay water level changes.

monitoring - any on-going process or program for measuring the actual effects of constructing or operating a development.

nearshore downcutting - vertical erosion of the shallow underwater nearshore slope by wave action.

negligible - minimal.

negotiated contracts - contracts for work that are negotiated directly with a qualifying company. These types of contracts do not go through the tendering process.

Nelson River Forest Section (NRFS)- a specific Forest Section located in northern Manitoba encompassing a large portion of the Nelson River.

net merchantable - is the volume of all species with a diameter of 9.1 centimetres at diameter breast height (1.3 m) and larger, less the respective cull factors.

non-designated trades - jobs that are directly involved with the construction of the Project, but do not have formal apprenticeship programs leading to a journeyperson certification. Examples of non-designated trades are labourers, heavy equipment operators, vehicle drivers (teamsters), rebar workers and cement masons. Training and work experience requirements can range from basic on-the-job training for entry-level positions to more than three years of formal training and professional experience to be fully qualified for the most highly-skilled positions.

non-productive forest land - a classification within the Manitoba Forest Resource Inventory. It includes all forest land not capable of producing timber of merchantable size.

Northern Flood Agreement (NFA) - a 1977 adverse effects agreement between Canada, Manitoba, Manitoba Hydro, and the Northern Flood Committee (representing five First Nations, including NCN). Among other things, the NFA allowed the participating First Nations and their members to claim compensation for the adverse effects of the CRD and the Lake Winnipeg Regulation projects and any future developments by Manitoba Hydro arising from these projects.

Northern Plano - this is a general term that refers to the time period and culture of the late Early Prehistoric period (ca. 8000 B.C.). Some archaeologists believe that the Algonkian people originated from Northern Plano.

Northern Region - a study region identified as part of the socio-economic impact assessment (SEIA) for the Wuskwatim Generation Project. The Northern Region has been defined as the portion of northern Manitoba that extends as far south as the Northern Employment Preference Boundary under the current Burntwood Nelson Agreement (BNA).

nursery habitat - areas suitable for the maturation of larval or juvenile animals.

off-system - a reference (e.g., a body of water that has not been affected by a particular disturbance.

Open [Zone] - a classification within the Manitoba Forest Resource Inventory. Crown land open to harvest.

Organic - soils of the Organic order are composed largely of organic materials. They include most of the soils commonly known as peat, muck, or bog and fen soils. Most organic soils are saturated with water for prolonged periods. These soils occur widely in poorly and very poorly drained depressions and level areas in regions of subhumid to perhumid climate and are derived from vegetation that grows in such sites.

organic carbon - measure of organic matter (in dissolved or particulate forms in water or in sediments).

Organic Cryosol - these Cryosols (see Cryosols definition above) have developed primarily from organic material and are underlain by permafrost within 1 m of the surface.

organic nitrogen - nitrogen which is bound to carbon-containing compounds (i.e., organic matter). Organic nitrogen is converted to ammonia via anaerobic bacteria.

overburden - the soil (including organic material) or loose material that overlies bedrock.

overwinter - to remain through the ice-covered period.

palatability - a substance (e.g., water or fish flesh) that is free from objectionable tastes, odours, and colours.

palsa bog - mounds of perennially peat and mineral soil, up to 5-m high, with a maximum diametre of 100 m. The surface is convex in shape and highly uneven. Collapse scar bogs may be found in association with palsa bogs. Fens commonly occur around palsa bogs.

parameters - any set of physical, chemical or biological properties whose values determine the characteristics or behaviour of a system.

parasite - an organism that lives in association with, and at the expense of, another organism, the host, from which it obtains organic nutrition.

Participant Assistance Program - The Participant Assistance Program for the Wuskwatim Projects was announced by the Minister of Conservation in spring, 2002. The Program provides financial assistance to groups or individuals participating in the environmental hearing process for the Projects. Further details about the Program are available on the Manitoba Conservation Web site at: http://www.gov.mb.ca/conservation/

peak positions - a measure of the maximum number of positions required for the construction workforce during a specified time period. In the EIS, the maximum numbers of peak positions are estimated separately for the Infrastructure and Major Works Construction stages. The estimated peak for each construction stage consists of the maximum number of positions that could be available for all the occupations required during that stage of construction. The peaks for the different occupations would not occur simultaneously and would not last for the entire construction stage. As a result, the actual peak workforce requirement at any given time would be lower than the maximum peak number estimated for the construction stage.

peaking - a mode of operation that is based on large flow changes that maximize on-peak generation, unrestricted outflow pattern may cause large downstream water level fluctuations.

Peat Island habitat - lake peatlands 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 peatlands have broken down into islands.

peat plateau bog - composed of perennially frozen peat and are sharply defined. The surface sits about 1m higher than unfrozen fen that surrounds it. The surface is relatively flat, even and covers large areas. Peat plateau bogs appear to have developed under non-permafrost conditions and which subsequently became elevated and permanently frozen. Collapse scars are commonly found with peat plateau bogs. These bogs are common in areas of discontinuous permafrost.

peatland - a type of ecosystem in which organic matter is produced faster than it is decomposed, resulting in the accumulation of partially decomposed vegetative material called peat; most extensive in northern regions, developing where drainage of water is blocked, precipitation is retained, and decomposition of organic matter is slowed.

permafrost - permanently frozen ground.

person-years - a measure of the amount of work that could be available during a specific time period or for a specific type of work. One person-year approximates the amount of work that one worker could complete during twelve months of full-time employment.

pH - method of expressing acidity or basicity of a solution. pH is the logarithm of the reciprocal of the hydrogen ion concentration, with pH 7.0 indicating neutral conditions.

phytoplankton - microscopic floating plants (primarily algae) that live suspended in water bodies.

planform - shape of plan view.

pocket - cavity in the earth containing a deposit of material that is different than the surrounding material.

polycyclic aromatic hydrocarbons (PAHs) - class of highly stable organic molecules comprised of only carbon and hydrogen, found in coal tar, crude oil, creosote, roofing tar, dyes, plastics, and pesticides and may be present in the aquatic environment in association with heavy boat traffic. They are formed from incomplete combustion of coal, oil and gas, garbage and other organic substances (e.g., tobacco).

ponding - formation of a reservoir due to the damming of a river or creek; retention of water to replenish an existing reservoir.

post-CRD - see existing flows.

potable - water which meets drinking quality standards.

potential labour force - all persons in a given population, excluding institutional residents, age 15 years and over.

powerhouse - the building that encloses the generating equipment at a generating station.

Precambrian bedrock - bedrock formed in the Precambrian era, which began with the consolidation of the earth's crust and ended approximately 4,000 million years ago.

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.

productive forest land - a classification within the Manitoba Forest Resource Inventory. It includes all forest land capable of producing timber of merchantable size.

Project Administration Team (PAT) - set up to oversee the joint federal and provincial review of the Wuskwatim Projects. The PAT is made up of senior representatives from the Canadian Environmental Assessment Agency and the Manitoba Department of Conservation that have an environmental assessment responsibility with respect to the Project.

Project Development Agreement (PDA) - a legally binding agreement between NCN and Manitoba Hydro that outlines the obligations of signatory parties should the Wuskwatim Generation Project proceed. NCN and Manitoba Hydro are currently negotiating a binding PDA based on topics set out in the Agreement in Principle. The PDA will cover many issues, including the partnership arrangements between NCN and Manitoba Hydro, training, employment and business opportunities, the water regime for the Project and compensation for adverse effects.

Project inflows - a simulated record of Wuskwatim Lake monthly inflows created from historical monthly system inflows (1912 to 1997) and current system operating rules. Assumed to represent future inflows for the Project.

Project Manager - person who oversees the construction and all related aspects of the project.

Project Region - a study region identified as part of the socio-economic impact assessment (SEIA) for the Wuskwatim Generation Project. The Project Region is a broad region identified initially for the purposes of the Public Involvement Plan (PIP). For the PIP, it included "potentially affected publics", defined (prior to completing the EIS) as those who potentially might see themselves as being affected by project-induced biophysical changes (e.g., by upstream or downstream water-based effects, by effects on land or air, or by related biophysical or resource effects) from any component of project construction or operation. The Project Region for the Project includes the Local Region as well as other communities in the vicinity of the Burntwood and Nelson rivers, extending from South Indian Lake to Gillam and the Fox Lake Cree Nation community on the lower Nelson River, and including the Cross Lake and Norway House communities on the upper Nelson River.

Public Involvement Plan (PIP) - a plan developed by Manitoba Hydro and NCN outlining their approach to public involvement for the Wuskwatim Generation and Transmission Projects. The purpose of the PIP is to provide the public, particularly those who may potentially be affected by the projects, with early and ongoing opportunities to review information on, and provide their views about, the projects. The PIP was submitted to federal and provincial regulators in August, 2002.

Public Registry - both the federal and provincial governments maintain a Public Registry system. The Public Registry is a collection of development proposals filed, in Manitoba, under *The Environment Act (Manitoba)* and, in the case of the federal government, under the *The Canadian Environmental Assessment Act.* Through the Public Registry system, information concerning proposed developments is collected and made available to the public. For the Wuskwatim Projects, the Province maintains public registries at various locations throughout the province, including at the Conservation and Environment Library (123 Main Street in Winnipeg), and the federal government maintains a public registry at the Freshwater Institute (501 University Crescent in Winnipeg).

radioactivity - energy released when certain radioactive elements (radionuclides) decay or break down. For example, uranium and thorium are two radioactive elements found naturally in the earth's crust. Over billions of years, these two elements slowly change form and produce "decay products" such as radium and radon. During this change process, energy is released. Two forms of this energy alpha and beta radiation.

radio-tagged - a fish that has been marked with a radio-transmitter.

radio-transmitters - a small electronic device that is attached to a fish and emits a radio signal at a specific frequency so that its movements can be tracked.

raptor - any bird of prey (for this study, includes eagles, hawks, falcons, owls and osprey).

rated discharge capacity - the maximum power that a generator is designed to deliver without exceeding mechanical safety factors or allowable temperatures.

reach - term used to describe sections of a river.

reconnaissance - a preliminary survey or inspection.

recreational - where the primary intent is enjoyment.

region - an ecological region encompassing the southern three-quarters of the NCN Resource Management Area and all of the proposed development site.

Registered Trapline (RTL) - in the 1940s, the Province of Manitoba developed the registered trapline system which divides most of the province into RTL Districts that are subdivided into individual registered traplines. Manitoba Conservation allocates registered traplines to specific trappers who maintain an individual right to trap within the designated boundary of the trapline. Where Registered Trapline Districts are operated as community trapping blocks (such as at Nelson House), a local fur council recommends to Manitoba Conservation the allocation of specific trapping areas to members of the local trapping community. The RTL system makes each RTL trapper responsible for managing the harvest of all fur-bearers in the trapper's trapline area, with the objective of sustained production over the years.

regulatory - pertaining to requirements.

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.

remote sensing - a scientific technique used to detect sub-surface soil disturbances associated with human burials. This is a non-intrusive method of identifying burial locations because no digging in the soil is required. The machine measures the electrical conductivity of the ground and produces maps that show the areas of ground disturbance.

reptiles - cold-blooded animal of the Class Reptilia that includes tortoises, turtles, snakes, lizards, alligators and crocodiles.

Reserve Land - land that has been set aside by the federal government for the use and occupancy of a specific First Nation.

residual effects - effects of a project that are expected to remain after mitigation or enhancement measures have been implemented.

Resource Management Area (RMA) - an area to be jointly managed by a Resource Management Board established by agreement between Manitoba and a First Nation or a local Aboriginal Community. The Resource Management Area for Nelson House means the area described and shown in Schedule 6.1 of the 1996 NFA Implementation Agreement; the Resource Management Board for the Nelson House RMA was established pursuant to Article 6 of the 1996 NFA Implementation Agreement.

Right-of-Way (RoW) - area or strip of land cleared to accommodate a road or transmission line

riparian insect - association of insects that prefer to occupy habitats adjacent to water-dominated ecosystems.

riparian mammal habitat - the place where animals live either continuously or seasonally, and rely on water and shorelines for food, shelter and reproduction. Aquatic, shore zone, lake peatland, mineral island and the near portions of upland, are the major riparian habitat types found in the region.

riprap - a layer of large stones, broken rock, boulders, or other suitable material generally placed in random fashion on the upstream and downstream faces of embankments, or other land surfaces to protect them from erosion or scour caused by current, waves, and/or ice action.

rock fill - fill material typically consisting excavated and crushed rock that is used to provide mass to a structure while protecting it from erosion.

run-of-river - a mode of operation that passes the inflow as outflow with no flow changes as a result of the generating station operation. This operation does not cause any short-term fluctuation in upstream or downstream water levels, and a constant power generation.

salvage - this is the same as rescue archaeology where sites are in imminent danger of destruction. Standard archaeological control methods are used as much as possible so that the site can be reconstructed in the laboratory.

Secchi disc - circular black and white disc used to measure the transparency/clarity of a water body.

Secchi disc depth - measure of the turbidity/clarity of water. Depth at which it is no longer visible from the water surface.

secondary habitat - specific, but less important environmental conditions than primary habitats in which organisms may need to thrive in the wild.

second-order stream - when two first-order streams join they become a single second-order stream.

sediment balance - the application of the principle of the conservation of matter to sediment processes.

Selkirk - this term is used to refer to a specific cultural period (ca. A.D. 850 – 1750) and the ancestors of the Cree. The ceramic ware is the distinctive identifier of the cultural group.

service bay - an open area of the powerhouse where turbine and generator components are assembled during construction, and later, where maintenance and repairs are performed to major generating equipment.

shaping - see modified run-of-river.

shear strength - a measure of the resistance of earth materials to be moved.

shore - the narrow strip of land in immediate contact with the sea, lake or river.

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.

significance - 1) significant negative impacts are those effects that are predicted to cause unacceptable environmental change and, therefore, require efforts to avoid, minimize, and/or remediate those effects; (e.g., long-term measurable reductions in population size and viability); 2) significant positive impacts are those effects that would cause a beneficial environmental change that is measurable or obvious.

simulated flow - flow values that have been artificially created through modeling; see project inflows.

Socio-Economic Impact Assessment (SEIA) - provides detailed information about effects, both positive and negative, that a proposed project may have on people, their lifestyles and their communities. In particular, effects that flow from biophysical effects are included. Often, effects that flow from other aspects of a project (e.g., employment and business opportunities) are also discussed. An SEIA also provides ways to address effects that are likely to be adverse, from the point of view of an affected population, and to enhance those effects perceived to be positive. Residual effects, cumulative effects and monitoring are also included. An SEIA is often part of the environmental impact assessment (EIA) for a proposed project.

softwood(s) - cone-bearing trees with needle or scale-like leaves belonging to the botanical group Gymnospermae. It includes such tree species as jack pine, black spruce white spruce, balsam fir, etc. Also refers to stands of such trees and/or the wood produced by them.

spawning habitat - areas suitable for the deposition of eggs and their incubation.

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.

spillway - a structure that allows normal and/or flood flows to bypass the powerhouse in a manner that protects the structural integrity of the dam.

spillway channel - the channel around or over a dam through which excess water is diverted.

standard-gang index gill nets - a gill net comprised of adjoining different sized panels (often six panels consisting of 1.5, 2, 3, 3.75, 4.25, and 5 in stretch mesh) used to assess fish abundance.

sub-region - a block of approximately 340,000 ha centring on the proposed development site.

subsistence harvest - where the harvest is for personal consumption, dog food, or bait for trapping; the catch is not sold.

surficial geology - the geology of surficial deposits, including soils; the term is sometimes applied to the study of bedrock at or near the earth's surface.

sustained swimming speeds - those speeds which a fish is capable of maintaining for an indefinite period of time.

switching station - a facility used to terminate transmission lines operating at the same voltage, and enable individual lines to be taken out of service or connected to other lines to redirect or control the flow of power.

synthetic flow - flow values that have been artificially created through modeling or simulation.

synthetic flow - see project inflows.

tailrace - a channel or raceway that directs the water away from a turbine into the river channel.

tailwater - the water in the tailrace, or the level of this water.

Technical Advisory Committee (TAC) - developed to review and provide advice on the Wuskwatim Projects to the Provincial Administration Team (PAT). The TAC is made up of representatives from federal and provincial departments that have an interest in the Project.

temporal - pertaining to time.

tendering - providing different groups and companies with an opportunity to bid on a job. The general principle is that the qualified bidder with the lowest price gets the job. “Open tendering” means that anyone can bid. “Restricted tendering” means that only some types of companies can bid.

terrestrial - living on or in the ground, or related to the ground.

terrestrial insect - association of insects that prefer to occupy upland habitats in forest-based ecosystems.

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.

Terric - unconsolidated mineral substratum underlying organic soil material; prefix in the soil classification; denotes a condition where a mineral contact occurs within the control section of organic soils or organic cryosols - thus is only used with organic soils. It is used at the subgroup level of the soil classification.

thermal plant - a generating station that uses coal or natural gas to create steam to drive a generator. Thermal plants are used at both Brandon and Selkirk, as well as a natural gas-fired simple-cycle combustion turbine at Brandon.

third party operation - an operation that is run by a timber operator(s) that harvests timber within the Forest Management License area under the authority of a timber permit, timber sale agreement, or special timber sale allocation.

threatened - as defined by COSEWIC: a species that is likely to become endangered if limiting factors are not reversed.

Threepoint Lake Ecodistrict - subdivision in the Canadian Ecological Land Classification System hierarchy, which divides Canada's natural landscapes into 15 terrestrial Ecozones, which are then subdivided into 45 Ecoprovinces, 177 Ecoregions and 5,428 Ecodistricts. The Threepoint Lake Ecodistrict is 7,930 km^2; located in north-central Manitoba; lies within the glacial Lake Agassiz Basin; and the whole Ecodistrict is part of the Nelson River drainage system.

timber dues - fees assessed by Manitoba Conservation on merchantable timber. Also known as stumpage fees. They normally include forest renewal and forest protection fees.

Timber Permit - cutting authority issued under the Forest Act and generally the Timber Quota System for small volumes of timber (usually 300 cubic metres or less).

Timber Quota System - the timber allocation system instituted in 1965 that provided timber permit and/or timber sale agreement holders the right to cut a volume of softwood and/or hardwood timber on Crown land in perpetuity. It was based on the average annual harvest of timber in the years 1962 to 1964 inclusive.

Timber Sale - cutting authority issued under the Forest Act and generally the Timber Quota System for large volumes of timber (usually in excess of 300 cubic metres).

total dissolved solids (TDS) - measure of the amount of material dissolved in water (primarily inorganic salts).

total kjeldahl nitrogen (TKN) - total concentration of nitrogen in the form of ammonia and organic nitrogen.

total suspended solids (TSS) - solids present in water that can be removed by filtration, consisting of suspended sediments, phytoplankton, and zooplankton.

tracked - relocated.

transect - a long, continuous sample area.

transmission - the electrical system used to transmit power from the generating station to customers.

transmission line - carry the power produced at a generating station to other parts of Manitoba Hydro's existing power system.

Traditional Knowledge (TK) - NCN considers Traditional Knowledge to be:

- the observation and experience of the land;
- Aboriginal law regarding how the environment works;
- the understanding of NCN's place in the world – how things are connected, including spirituality; the relationship to the land;
- the goals and aspirations of NCN;
- the outlook on the proposed projects – concerns; acceptability;
- NCN's identity and culture;
- the stewardship of the land; and
- a base for natural resource management.

NCN feels that Traditional Knowledge comes from Elders and others, both traditional and modern.

Treaty Land Entitlement (TLE) - refers to land owed to certain First Nations under the terms of the Treaties signed by the First Nations and Canada between 1871 and 1910. Each Treaty provided that Canada would provide reserve land to First Nations based on population size; however, not all First Nations received their full allocation of land. In 1997, the Manitoba Treaty Land Entitlement Agreement was signed by the TLE Committee of Manitoba Inc. (representing 20 First Nations), Canada and Manitoba. This Framework Agreement is intended to fulfill Canada's outstanding debt of lands owed to the 20 TLE Committee member First Nations.

Triaenophorus crassus - a parasite that encysts in the flesh of lake whitefish and lake cisco.

turbid - (1) having the lees or sediment disturbed; roiled; cloudy (2) Not clear or translucent; clouded, muddy.

turbine - a machine in a hydroelectric generating station which converts the energy of flowing water into rotary mechanical energy. This rotational energy is then transferred to the generator for conversion to electrical energy.

turbine mortality - mortality of an individual(s) due the passing through the turbines of a generating station.

turbulence - disturbed or agitated flow.

ubiquitous - present everywhere, omnipresent.

unemployment rate - the proportion of individuals in the active labour force that do not have a job. The Statistics Canada definition of unemployed does not account for the underemployed, or those individuals working part-time but desiring a full-time position. As well, the definition does not include discouraged workers: those individuals who wish to work but have ceased looking because they do not believe they will find a job.

union - an organization of workers. When a group of workers (a bargaining unit) decides that it wants a union to represent it, it goes to a labour board. If a majority of workers in the bargaining unit wants the union, the board certifies the union as the representative for that bargaining unit. That means that the union represents 100 per cent of the workers in that bargaining unit. It negotiates a collective agreement for all of these workers.

upland habitat - all areas that are on the mainland side of the shore zone (includes peatlands).

veneer - thin layer or cover.

water hardness - the presence of dissolved minerals, generally expressed as calcium carbonate.

water regime - a description of water body (i.e., lake or river) with respect to elevation, flow rate, velocity, daily fluctuations, seasonal variations, etc.

waterbird - a bird commonly associated with water, e.g., waterfowl, terns and gulls.

waterfowl - ducks, geese and swans (game birds that frequent water).

water-washed - refers to narrow river and downstream lake shoreline areas that are largely non to sparsely vegetated and that are periodically subjected to flooding, stream flow, wave action and/or ice-scouring under temporary high water level conditions. No eroded bank is observed and relatively minor nearshore erosion is inferred. This shoreline classification applies to upstream and downstream river reaches and downstream lakes mapped using low level video coverage. The term applies to clay shorelines as well as non-eroding bedrock shorelines.

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.

wind-rose - diagram showing yearly wind strengths for a locality.

working group(s) - refers to the grouping within the Forest Resource Inventory of all sub-types having the same dominant species e.g., the "Jack Pine Working group".

YSI meter - a brand name of a meter used to measure water quality parameters including dissolved oxygen, temperature, conductivity and salinity.

zooplankton - floating or weakly swimming animals that live in the water column.

12.2 LIST OF ACRONYMS

AAC - Annual Allowable Cut

AC - Alternating Current

AET - Advanced Education and Training

AIP - Agreement-in-Principle

AHC - Allied Hydro Council

ASI - Area of Special Interest

ASL - Above Sea Level

BNA - Burntwood Nelson Agreement

C - Celsius

CC - Cutting Class

CCME - Canadian Council of Ministers of the Environment

CDC - Manitoba Conservation Data Centre

COSEWIC - Committee on the Status of Endangered Wildlife in Canada

CRD - Churchill River Diversion

CWQI - Canadian Water Quality Index

DO - dissolved oxygen

EIA - Environmental Impact Assessment

EIS - Environmental Impact Statement

EMT - Environmental Management Team

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

GW - gigawatt

GW.h - gigawatt hours

ha - hectares

HPMA - Hydro Projects Management Association

km - kilometres

LOEL - Lowest Effect Level

LWR - Lake Winnipeg Regulation

m - metres

MESA - *Manitoba Endangered Species Act*

MSQG - Manitoba Sediment Quality Guideline

MW - megawatts

MWQSOG - Manitoba Water Quality Standards, Objectives, and Guidelines

NFA - Northern Flood Agreement

NRFS - Nelson River Forest Section

NTU - Nephelometric Turbidity Units

OMOE - Ontario Ministry of the Environment

PAH - polynuclear aromatic hydrocarbons

PDA - Project Development Agreement

PEL - Probable Effects Level

PIP - Public Involvement Plan

RMA - Resource Management Area

RoW - Right-of-Way

RTL - Registered Trapline

SEIA - Socio-Economic Impact Assessment

SEL - Severe Effects Level

TDS - total dissolved solids

TK - Traditional Knowledge

TKN - total Kjeldahl nitrogen

TLE - Treaty Land Entitlement

TN - total nitrogen

TSS - total suspended solids

VEC - Valued Ecosystem Component

WQ - water quality

WQI - Water Quality Index

APPENDIX 1

EIS STUDY TEAM

EIS PARTICIPANTS: CONSULTANTS

The following provides a list of the consultants that were involved in the conduct of the environmental assessment and/or the preparation of the Environmental Impact Statement for the Wuskwatim Generation Project.

The Environmental Management Team

The EMT (Tetr*ES* Consultants Inc., North/South Consultants Inc., ND LEA Engineers and Planners Inc., and InterGroup Consultants Ltd.) was jointly selected by the Nisichawayasihk Cree Nation and Manitoba Hydro to conduct the environmental assessment studies and prepare the EIS for the Wuskwatim Generation Project. The key individuals from the EMT firms, as well as individuals from specialist firms retained by the EMT, are listed below.

Tetr*ES* Consultants Inc.

G. Rempel, M.Sc., P. Eng.	Study Coordinator: EMT
B. McMahon, M.Sc.	Senior Wildlife Biologist: Birds, Reptiles and Amphibians
G. Mohr, B.Sc., P. Eng.	Senior Water Resource Specialist: Physical Environment
M. Gifford, M.Sc.	Terrestrial Biologist: Birds
D. Harron, B.Sc.	Biologist: Physical Environment
K. Mathers, M.Sc., P. Geo.	Geologist: Physical Environment
M. Sweet, B.Sc.	Environmental Scientist: Birds

North/South Consultants Inc.

S. Davies, B.Sc.	Project Leader: Generation
F. Schneider-Vieira, Ph.D.	Project Manager/Senior Scientist
R. Remnant, MNRM	Senior Fisheries Biologist
M. Cooley, M.Sc.	Senior Water Quality Specialist
L. Zrum, M.Sc.	Senior Lower Trophic Levels Specialist
D. MacDonell, MNRM	Resource Use
W. Jansen, Ph.D.	Mercury and Fish Movements
M. Lawrence, B. Sc. A.	Alternatives Assessment and Access Mgmt.

ND LEA

D.C. Hicks, MCIP, P. Eng.	Study Leader: Transmission
E. Hicks, M.A.	Study Coordinator
B. Krawchuk, MNRM	Environmental Assessment Specialist
R. Tebinka, M.A.Sc., P. Eng.	Transportation Planning Specialist
G. LeMoal, M.Sc., P. Eng.	Road Design Specialist

InterGroup Consultants Ltd.

C. Osler, M.A.	Study Leader: Socio-economic Assessment and Public Involvement
J. Kinley, M.A., MCIP	Study Coordinator: Socio-economic Assessment
D. DePape, M.A.	Senior Advisor: Socio-economic Assessment
V. Cole, MNRM	Research Consultant: Socio-Economic Assessment
M. Reed, MES	Research Consultant: Economic Impact Analysis
J. Osler, MBA	Coordinator: Public Involvement
L McKay, MNRM	Research Analyst: Public Involvement

Calyx Consultants

J.A. Krindle, B.Sc.	Terrestrial Vegetation

ECOSTEM Ltd.

J. Ehnes, M. Phil. Ph.D.	Terrestrial ecologist

Plus4 Consulting Inc.

J. Dyck, Forester	Forestry

Northern Lights Heritage Services Inc.

V. Petch, M.A., Ph.D.	Anthropologist/Archaeologist: Cultural and Heritage Resources

K.D. McLeod, M.A.	Archaeologist: Cultural and Heritage Resources

Resource Ecosystem Services

D. Rannard, BSc. F, MS	Forestry

R.K. Schmidt Environmental

R. Schmidt, M.Sc.	Senior Wildlife Biologist: Mammals

SRK Consulting

S. Day, M.Sc., P. Geo.	Geologist: Leachate Specialist

Wildlife Resource Consulting Services MB Inc.

R. Berger, M.N.R.M.	Wildlife Biologist: Mammals
A. Patenaude, B.Sc.	Environmental Scientist

Other Consultants and Specialists Retained by Manitoba Hydro

Acres International

J. Smith, P.Eng.	Project Management/Geotechnical
R. Dewar, P.Eng.	Project Services
E. Sikora, P.Eng.	Geotechnical Engineer
R. Zhou, Ph.D., P.Eng.	Hydraulics: Sediment Processes
J.L. Groeneveld, P. Eng.	Hydraulics: Ice Processes
B. Harding, P. Eng.	Hydraulics: Ice Processes

J.D. Mollard and Associates

J.D. Mollard, O.C., Ph.D., LL.D., P.Eng., P.Geo.	Terrain Specialist: Access Road
L. Penner, M.Sc., P. Eng, P. Geo.	Geomorphologist: Lake Erosion Processes

Northwest Hydraulics

C. Neil, P. Eng.	River Erosion Processes

Other Consultants and Specialists Retained by NCN

The following Community Consultants were retained by NCN:

D. Linklater	Community Consultant: Office Manager
T. Linklater	Community Consultant: Elders Consultant
C. James Hart	Community Consultant: Nelson House
C. Joe Hart	Community Consultant: Nelson House
E. Hart	Community Consultant: Nelson House
D. Moore-Linklater	Community Consultant: Nelson House
M. Linklater	Community Consultant: Nelson House
C. Moore	Community Consultant: Nelson House
R. Spence	Community Consultant: Nelson House
H. Wood	Community Consultant: Nelson House
M. Dumas	Community Consultant: South Indian Lake
V. Dysart	Community Consultant: South Indian Lake
C. Wood	Community Consultant: Liaison Officer
J. D. Spence	Community Consultant: Translator

Footprint Engineering Inc.

T. Nykoluk, B.Sc., P.Eng.	Engineering: Project Management

UNIES Ltd.

C. MacInnes, Ph.D., P.Eng.	Water Resources Management

APPENDIX 2

GUIDELINES FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT FOR THE WUSKWATIM GENERATION PROJECT

April 29, 2002

GUIDELINES FOR THE PREPARATION OF AN ENVIRONMENTAL IMPACT STATEMENT FOR THE WUSKWATIM GENERATION PROJECT

April 29 2002

1. PURPOSE:

The purpose of this document is to identify for Manitoba Hydro, Nisichawayasihk Cree Nation and the public the information required by government agencies for consideration in an environmental impact statement for the Wuskwatim Generation Project.

2. INTRODUCTION

2.1 BACKGROUND

Manitoba Hydro and the Nisichawayasihk Cree Nation (NCN) are currently considering the development of the Wuskwatim hydroelectric generating station and associated infrastructure in the Nelson House Resource Management Area (RMA). The Wuskwatim Generating Station, to be located at Taskinigup Falls, would provide approximately 200 MW of new electrical generating capacity to Manitoba Hydro's system. The general purpose of the proposed development is to take advantage of export opportunities over the 2009 to 2018 time frame. A schematic showing the location of the proposed project is provided as Schedule 1. to these guidelines.

Discussions between Manitoba Hydro and NCN regarding the future Wuskwatim Generation Project (as well as a potential development at the Notigi Control Structure) have been ongoing for several years. Article 8 of the 1996 *Agreemen*t (signed by NCN, Manitoba Hydro, Manitoba, and Canada) sets out a process for NCN and Manitoba Hydro to discuss potential future developments that could affect the Nelson House Resource Management Area and NCN members. In 1997, NCN and Manitoba Hydro established a working group to facilitate ongoing consultation regarding the proposed developments. NCN and Manitoba Hydro are currently considering potential partnership arrangements for the development of the Wuskwatim Generation Project, should it proceed. An Agreement in Principle, which describes the partnership arrangement, was jointly prepared by NCN and Manitoba Hydro and was signed on September 25, 2001.

Among other things, Article 8 of the 1996 *Agreement* requires that Manitoba Hydro consult with NCN to identify issues of concern to the First Nation and to provide detailed information on the expected positive and negative effects of any project in the Nelson House Resource Management Area. To address these obligations, NCN and Manitoba Hydro jointly selected a study team in late 1999 to conduct the biophysical and socio-economic studies required to provide sufficient information to conduct an environmental assessment of the proposed development.

Following a series of scoping meetings held with NCN and Manitoba Hydro officials in early 2000, the study team designed and implemented a preliminary study plan, which is referred to as the Joint Study Program (NCN Manitoba Hydro: Joint Study Program, updated August 2001). The overall objectives of the Joint Study Program are reported as follows:

- to address the concerns and issues raised by NCN and Manitoba Hydro;
- to provide environmental and socio-economic information that can be used in the project planning phase to avoid or minimize impacts and, where those impacts cannot be avoided or minimized, to address compensatory issues;
- to provide sufficient information to conduct an environmental assessment of the proposed project and prepare an Environmental Impact Statement; and
- to provide information on the existing environment in sufficient detail to allow for post-project monitoring.

In September 2001, NCN and Manitoba Hydro, with the assistance of the study team, drafted a scoping document that provided useful background to the Project Administration Team (PAT)* in the development of these Guidelines for the Preparation of an Environmental Impact Statement for the Wuskwatim Generation Project.

* The Canada – Manitoba Agreement on Environmental Assessment Cooperation provides that the Lead Party in a cooperative environmental assessment process will establish and chair a Project Administration Team with membership representing the federal responsible authority(ies) and Manitoba Conservation. The Project Administration Team would then be responsible for managing the cooperative environmental assessment.

2.2 ENVIRONMENTAL ASSESSMENT REQUIREMENTS AND PROCESS

The Wuskwatim Generation Project will require a comprehensive-study level environmental assessment under *The Canadian Environmental Assessment Act.* As well, the project is a Class 3 development as defined in the *Classes of Development Regulation* under Manitoba's *The Environment Act.*

Under the provisions of the *Canada-Manitoba Agreement on Environmental Assessment Cooperation*, the Parties have agreed that, where both governments have an environmental assessment responsibility for a proposed project, a cooperative environmental assessment will be undertaken. Accordingly, these Guidelines for the Preparation of an Environmental Impact Statement for the Wuskwatim Generation Project have been developed to address specific issues and identify necessary information that Manitoba and Canada require to be considered in the environmental assessment of the project. The Project Administration Team has finalized the draft guidelines after consideration of public comments, the Clean Environment Commission's report on the Draft Guidelines and input received from the Federal/Provincial Technical Advisory Committee (TAC).

The Manitoba Minister of Conservation has determined that there will be public hearings conducted by the Clean Environment Commission in accordance with section 6(5) of *The Environment Act* for the Wuskwatim projects. The hearings will be conducted in order for the Commission to review, based on the public's input and the environmental impact statement, the issues raised in the environmental assessment process and provide advice and recommendations on those issues to the Minister in a report to be prepared subsequent to the hearings. The Clean Environment Commission hearings will incorporate consideration of the issues associated with both the Wuskwatim Generation Project and the Wuskwatim Transmission Project concurrently.

On January 29, 2002 the Government of Manitoba announced that it would establish a review process through the Public Utilities Board (PUB) that will provide for a public examination of the *need for* the project and *alternatives to* developing the proposed Manitoba Hydro projects. Based on this review process information, the PAT, in consultation with Manitoba Hydro and their study team, has developed a draft review schedule, which is provided as Schedule 2. to these Guidelines.

2.3 INTENT AND SCOPE OF THE ENVIRONMENTAL ASSESSMENT

2.3.1 INTENT:

The intent of preparing these Guidelines is to identify for NCN, Manitoba Hydro and the public the information required by government agencies to be considered in an environmental impact statement being prepared for the project.

The intent of preparing the environmental impact statement (EIS) will be to:

- describe the Wuskwatim Generation Project and identify and characterize the environment in which the project is to exist;
- provide a description of the regulatory framework within which the Wuskwatim Generation Project will be planned, built and operated;
- identify potential bio-physical, socio-economic and cultural effects related to the Wuskwatim Generation Project;

- describe the scientific analysis of ecosystem effects, Traditional Ecological Knowledge (TEK), local knowledge, and the experience of aboriginals and other sectors of the public that was used by the study team in the assessment of environmental effects;

- describe how the use of TEK and the analysis of potential effects to valued ecosystem components (VEC's) contributed to judging the significance of the effects on the well being of the environment and the communities within the area affected by the project;

- provide a description of the anticipated environmental effects associated with a decommissioning and an environmental rehabilitation scheme for the Wuskwatim Generation Project;

- provide a summary of the regional, provincial or national objectives, standards, guidelines and relevant land and resource related agreements which have been used in the evaluation of the significance of the environmental effects;

- describe the consideration given to comments received from the public during the environmental assessment; and

- propose mechanisms for follow-up to identify and manage the effects of the project and to confirm the effectiveness of mitigation strategies employed.

It is intended that the Environmental Impact Statement for the Wuskwatim Generation Project shall incorporate and reflect the ***Principles of Sustainable Development*** as contained in ***Towards a Sustainable Development Strategy for Manitobans*** and the policies under ***The Land and Water Strategy.***

2.3.2 SCOPE:

The Project:

The environmental assessment for the Wuskwatim Generation Project shall include consideration of the environmental effects of all undertakings associated with the site preparation, construction, operation and the final disposition of all components of the proposed Wuskwatim hydro-electric generating station, including any required infrastructure development. The assessment must consider the purpose of the project and alternative means of carrying out the project that are technically and economically feasible.

The Assessment:

The scope of the environmental assessment shall include examination of:

- potential changes to the environment that may result from the Wuskwatim Generation Project, including consideration of effects to:
  - land, water and air – including all layers of the atmosphere;
  - the biological environment, including terrestrial and aquatic ecosystems – all organic and inorganic matter and living organisms;
  - present and planned resource use, including land and water; and
  - human health, socio-economic and cultural conditions, physical and cultural heritage, the current use of lands and resources for traditional purposes by aboriginal persons, or any structure, site or thing that is of historical, archaeological, paleontological or architectural significance that will be affected by any changes to the environment caused by the project;
- the significance of the environmental effects;
- the implications of the Wuskwatim Generation Project in terms of land and resource-related agreements;
- the environmental effects of potential malfunctions or accidents that may occur in connection with the project;
- the environmental effects of any alternative means of carrying out the project that will be considered as part of the assessment;
- cumulative environmental effects of the Wuskwatim Generation Project that are likely to result from the project in combination with other projects or activities that have been or will be carried out;
- the effects of the influx of workers, equipment and materials on residents, land and resources of the region;
- the technically and economically feasible measures that would mitigate any significant adverse environmental effects of the project;
- the adequacy of measures proposed to mitigate adverse environmental effects of the project and to compensate for residual adverse effects, where appropriate;
- any change to the project that may be caused by the environment;

- the need for, and requirements of, any follow-up program in respect of the project; and

- the capacity of renewable resources, if any, that are likely to be significantly affected by the project.

The study area, i.e. the geographic scope of the investigations, shall include those local areas directly impacted by the undertakings associated with Wuskwatim Generation Project and also the zones within which there may be environmental effects that are regional or global in their nature.

The assessment for the transmission lines related to the Wuskwatim Generation Project and their ancillary components will be addressed separately in an associated EIS document.

3. REGULATORY FRAMEWORK

The environmental impact statement shall identify the legislation, policies, necessary approvals, land and resource related agreements and current planning initiatives applicable to the review of the Wuskwatim Generation Project. The report shall discuss the primary focus of each regulatory or policy requirement, such as resource allocation, environmental protection, land-use designation or development control.

4. PUBLIC CONSULTATION AND INVOLVEMENT PLAN

Details of the overall public consultation process for the environmental assessment shall be described at the outset in a public involvement plan. The plan will recognize all interested members of the public and describe the various means to provide for their participation in the assessment process. Generally, the public shall include, but is not limited to: Aboriginal peoples; other local residents; community groups; environmental groups; the private sector; municipal governments; and other interested parties. The public involvement plan shall be included in the environmental impact statement (EIS) and the results of the public's input reported and evaluated.

The EIS shall describe the proponents' community consultation program that will have been undertaken with respect to the project, including the following:

- the role of community contacts in the consultation program;

- the use of any communication tools employed to provide information to NCN members and those of other communities, including newsletters, television broadcasts, and briefing documents;

- the frequency and outcome of open houses, community meetings, school presentations, and other meetings, that were employed to provide information to, and collect information from the community(ies) consulted; and

- plans for ongoing consultation with the affected publics following completion of the environmental assessment.

The environmental impact statement shall describe how concerns and issues raised by the public were incorporated into the development of the project including its design, impact mitigation and monitoring. Any unresolved issues that were raised by Manitoba Hydro or stakeholders during the assessment process shall be discussed. In addition, efforts made to involve organizations and persons residing beyond the project area in issue identification and problem resolution shall be documented and evaluated in the EIS.

5. PROJECT DESCRIPTION

5.1 OVERVIEW OF MANITOBA HYDRO'S SYSTEM COMPOSITION

The environmental impact statement shall provide an overall description of Manitoba Hydro's generation system. Emphasis in the description shall be on the hydro-generation components and especially on those components that relate to the selection of the Wuskwatim Generation Project and the selected site.

5.2 PROJECT ALTERNATIVE AND SITE SELECTION

The environmental impact statement shall include a discussion of the alternative means of carrying out the project that were considered technically and economically feasible. A discussion of the potential environmental effects that were considered relative to any such alternative means shall also be included. Consideration of alternative means for achieving the goals of the project, for the purpose of the environmental impact statement, will include discussion of other processes that could have been implemented or locations that could have been chosen to achieve a similar end result. The purpose of and the rational for selection of the Wuskwatim Generation Project shall be presented.

As well, the site selection process for all significant components of the project shall be discussed in the EIS. The information presented will include the rational for selection of the proposed sites (routes) along with how the technical, geotechnical and environmental criteria were considered in the decision making.

5.3 OVERVIEW OF THE WUSKWATIM GENERATION PROJECT

The environmental impact statement shall provide an overview of the Wuskwatim Generation Project, including a general description of the site selection process, construction, operation and maintenance of the facilities, and the final disposition of all components of the project. Included in this overview shall be the designed capacities of the project, location of all its components on a site-development plan, phasing and sequencing of the various undertakings associated with the components, a description of activities relating to the project that have been undertaken to date, and a description of how Manitoba Hydro has incorporated consideration of traditional ecological knowledge in the project's design.

5.3.1 SITE PREPARATION

The environmental impact statement shall describe all undertakings associated with preparing for construction at the site. Detailed descriptions of timing and the methods associated with the various undertakings that were and are required including surveying, clearing, test drilling, establishing dump and borrow areas, setting up camps and work areas, and the development of the infrastructure requirements to access and service the site. This will include providing:

- topographical maps and aerial mosaics of suitable scale showing the location of the proposed generating station, related access road, work camp, borrow and disposal sites, power source and utility corridors with inclusion of the local topography, watercourses, wetlands and lakes; and

- a description of the extent of clearing, excavation, quarrying and earthworks required to prepare for construction of the powerhouse, identification of borrow sites for construction materials such as sand, gravel, clay and stone, and the proposal for removal of waste materials including transportation methods.

5.3.2 CONSTRUCTION

The environmental impact statement shall describe all elements of the construction of the proposed Wuskwatim project. Detailed descriptions of timing and the methods proposed for the various undertakings related to the construction of the generating station and related facilities shall be required including the following:

- plans and descriptions of any existing works, temporary works including work areas, cofferdams, dewatering and control facilities, and the proposed permanent facilities including the dam, dikes, spillway, power facilities, buildings and infrastructure, intake and discharge channels and structures;

- maps of the existing and proposed reservoir area, an indication of the anticipated changes in reservoir area as a result of the construction project, the boundaries of the reservoir area at both high and low water levels on the Wuskwatim Lake;

- a description of the proposed construction methods that could have an effect on the environment such as those required for placement and removal of cofferdams, underwater or near-water blasting (if required), large scale clearing, grading or earth removal and disposal, including a discussion of possible alternative construction methods;
- an estimate of the size and composition of the workforce required during different times of construction;

- a description of measures that will be taken to protect the health and safety of workers and the general public in and around the construction areas;

- a description of the living accommodations and servicing required for camps provided for the construction workers, including potable water supply (location of source and intake), and waste disposal;

- an analysis of the need for a construction-phase waste disposal ground, and the specific site requirements, including access;

- a description of the character and volumes of waste streams generated during the construction phase of the project and how each waste stream would be managed, consistent with best industry practices, with specific references to waste oil and other potentially hazardous or recyclable material;

- a description of the proposed environmental surveillance and monitoring proposed during construction along with proposed contingency plans that consider the effects associated with serious malfunctions or accidents;

- a description of the proposed construction schedule including sequencing of the various undertakings; and.

- subsequent removal of camp facilities and clean up of construction infrastructure.

5.3.3 OPERATION AND MAINTENANCE

The environmental impact statement shall describe how the Wuskwatim project would be operated and maintained in the context of the Churchill River Diversion. A discussion of river flows and levels with and without the Wuskwatim project in place shall be provided. The description will include:

- planned, average hourly discharges at the generating site;

- average hourly forebay water level elevation under a range of flow and station operating conditions;

- average hourly tailrace water-level elevation under a range of flow and station operating conditions; and

- average hourly water level elevation under a range of flow and station operating conditions at several downstream locations where water level effects are expected to occur.

The environmental impact statement shall:

- describe how the proposed operation of the generating station would affect the existing operating regime along the river and its relationship to existing regulatory licences/approvals and agreements;

- describe waste disposal practices and long-term facility recycling practices in-place during the operation of the project along with the operation of any waste disposal facilities planned to accommodate the project;

- provide a description of the progressive decommissioning practices that will occur during the operation of the project, with specific reference to infrastructure that would no longer be required after the construction phase; and

- describe the size and composition of the proposed labour force involved in the operation and maintenance of the generating station, along with a description of measures that will be taken to protect the health and safety of workers and the general public in and around the various facilities including spill prevention and contingency planning.

5.3.4 FINAL DISPOSITION

The environmental impact statement shall provide a general description of plans for decommissioning the proposed generating station project at the end of its operational life, including any plans for rehabilitating the sites of the project facilities.

6. DESCRIPTION OF THE EXISTING ENVIRONMENT

The environmental impact statement shall describe the existing environmental setting for the proposed project. This will include a broad overview of the local area and the zones within which there may be environmental effects that are regional or global in their nature. This description is intended to provide a context for a detailed understanding of the potential effects of the project. A description of any deficiencies or limitations in the existing environmental database shall be reported.

The environmental impact statement shall provide a discussion of the rationale for the determinations taken regarding the spatial and temporal boundaries chosen for the study areas used for the assessment.

6.1 PHYSICAL ENVIRONMENT

The environmental impact statement shall describe:

- general climate conditions with sufficient data provided to predict the effect of the project on climate and the potential effects of climate on the project;
- local air quality potentially affected by the project;
- local and regional land and geology;
- existing range of flows and water levels in the context of the operation of the Churchill River Diversion (CRD), the Augmented Flow Program and associated water level and flow constraints;
- ice conditions, including changes during the winter and variability from year to year;
- existing shoreline environment and the rate of shoreline erosion and recession based on long term monitoring programs; and
- nature and extent of existing sediment deposition and shoreline debris.

6.2 AQUATIC ENVIRONMENT

The environmental impact statement shall describe the existing aquatic biological resources and associated habitat in watercourses, wetlands and other water-bodies. The Environmental Impact Statement should establish a suite of biotic and abiotic indicators for the area including a discussion of the rational for their selection. The environmental impact statement shall describe:

6.2.1 WATER QUALITY:

- sufficient detail regarding the pre-project water quality and temperature parameters to predict the effect of the project on water quality and how it would relate to human consumption and to compare post-project water quality conditions shall be provided.

6.2.2 LOWER TROPHIC LEVELS:

- sufficient detail regarding existing primary producers and decomposers shall be included to provide a basis to predict the potential effect(s) of the project on energy (food) production.

6.2.3 AQUATIC INVERTEBRATES:

- sufficient detail respecting the existing species composition and abundance of aquatic invertebrates shall be provided in order to assess the overall productivity of the aquatic eco-system, biodiversity, and potential effects on fish populations and their range.

6.2.4 FISH HABITAT:

- sufficient data on bathymetric mapping, habitat classification and quantification within the study area shall be required to provide a basis for predicting project effects and to quantify the actual effects of the project on fish habitat.

6.2.5 Fish Populations:

- sufficient data regarding species composition and relative abundance, critical life stages and requirements of key fish species, movements and migration patterns, habitat use and fish quality (mercury and heavy metal levels/fish health/palatability) shall be provided to predict the effect of the project on fish populations within the study area.

6.3 TERRESTRIAL ENVIRONMENT

The environmental impact statement shall describe:

6.3.1 VEGETATION:

- information on plant communities, "Species at Risk", and "Rare Species" that may be affected by the project, including; medicinal plants, riparian and wetland vegetation and type(s) of vegetation to be flooded and/or cleared shall be provided in sufficient detail to predict the effect of the project on vegetation in the study area. Additionally, information shall be collected on the location and extent of forest stands potentially affected by the project and a description of those stands in sufficient detail to evaluate the potential impact the project may have on the forests, including potential effects to the wood volumes available for harvest within FML No.2.

6.3.2 WILDLIFE AND WILDLIFE HABITAT:

- animal species (birds, including waterfowl and non-waterfowl species, mammals, plus available data for microorganisms, insects, reptiles and amphibians), populations, habitat and seasonal use patterns shall be provided;
- threatened and endangered animal species common to the study area shall be identified;
- important ecological communities representative of the study area by key species shall be provided;
- a description of the seasonal use of wetlands by waterbirds for breeding and molting and spring and fall staging shall be included;
- migratory populations including migratory birds common to the study area shall be identified;
- known habitat and critical areas for woodland caribou and moose, including wintering calving areas;
- any animal species common to the study area that is listed in Manitoba's *Endangered Species Act* or by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) shall be identified; and
- sufficient information on wildlife populations and wildlife habitat in the study area to predict, avoid and mitigate, to the extent practicable, the effects of the project on wildlife habitat and populations in the study area shall be provided.

6.3 SOCIO-ECONOMIC ENVIRONMENT

The environmental impact statement shall describe:

6.3.1 RESOURCE USE:

- domestic harvesting of resources including fishing, hunting, trapping, and gathering medicinal and other plants and berries and fuel wood by Aboriginal groups shall be described;

- commercial use of resources by Aboriginal and other groups, including commercial fishing, sport fishing and hunting, outfitting, mining, forestry, and accommodating tourism and eco-tourism shall be identified; and

- sufficient detail regarding domestic harvesting, human consumption patterns and commercial use of resources, including fish, wildlife and vegetation shall be provided to predict project related effects.

6.3.2 ECONOMY:

- a general description of the economic base of Aboriginal and other communities potentially affected by the project shall be provided including the state of the labour force, employment, unemployment, and a profile of existing economic sectors; and

- sufficient detail regarding the existing economy of the region shall be provided in order to predict the effect of the project on the economy of Aboriginal and other affected communities.

6.3.3 INFRASTRUCTURE AND SERVICES:

- a general description of the infrastructure and services of Aboriginal and other related communities affected by the project shall be provided in sufficient detail to predict the effect of the project on infrastructure and services of Aboriginal and other affected communities.

6.3.4 PERSONAL, FAMILY AND COMMUNITY LIFE:

- a general description of the personal, family and community life of Aboriginal and other communities potentially affected by the project shall be provided, including a population and demographic profile, outdoor recreation and travel, aesthetics, health status and health issues, way of life, culture and spirituality and community cohesion and organization; and

- sufficient detail on the noted items shall be provided to predict the effect of the project on personal, family and community life.

6.4 HERITAGE RESOURCES

The environmental impact statement shall describe:

- historic land use and occupancy in the study area;

- archaeological sites and culturally important sites in the study area, including shoreline sites that could potentially be affected by erosion;
- location of potential burial sites in the study area (if any);
- archaeological sites and culturally important sites located on or near shoreline areas in the study area that could potentially be affected by erosion. Identification of these sites shall be provided using the work of Historic Resources Branch as the basis for this description;
- any structure, site or thing that is of historical, archaeological, paleontological or architectural significance in the study area that will be affected by any changes to the environment caused by the project; and
- a ranking of any archaeological sites identified in order of importance.

7. ENVIRONMENTAL AND SOCIO-ECONOMIC EFFECTS AND MITIGATION

The environmental impact statement shall provide information on all environmental effects associated with the Wuskwatim Generation Project. Both positive and adverse environmental effects shall be described. The following criteria will be used to evaluate the significance of adverse effects:

- nature of the effect;
- magnitude of the impact;
- duration of the impact;
- frequency of the impact;
- reversibility of the impact;
- temporal boundaries (short or long term);
- spatial boundaries (project site, local area or regional); and
- ecological context {(sensitivity of valued ecosystem components (VEC) to environmental disturbance)}.

The following criteria will be used to determine the likelihood of significance of the effects:

- probability of occurrence; and
- scientific uncertainty.

The environmental and socio-economic effects and associated mitigation shall relate to each phase of the project including site preparation, construction and post construction, operation, maintenance and eventual decommissioning and shall assess all components of the environment in the context of section 6. DESCRIPTION OF THE EXISTING ENVIRONMENT of this document. The assessment shall consider scientific analysis of ecosystem effects, along with TEK, local knowledge and available experience in determining the significance of potential effects. Mitigation and habitat enhancement measures to manage or avoid adverse effects shall be described for these components and for each undertaking in relation to the project.

An assessment of the project's effect to the carbon inventory for the area affected must be included in the EIS. As well, an exhaustive list of potential contaminants that could result from the project in vegetation and wildlife that would be consumed by humans shall be provided in the environmental impact statement. Specific and detailed reference shall be made in the environmental impact statement to evaluating the effects of the project on Manitoba's Protected Areas Initiative.

Cumulative effects assessment (CEA) shall form an integral part of the environmental and socio-economic assessment. The cumulative effects assessment shall look at all effects that are likely to result from the project when they are anticipated to occur in combination with other projects or activities that have been, or will be carried out. The environmental impact statement shall explain the approach and methods used to identify and assess the cumulative effects and provide a record of all assumptions and analysis that support the conclusions, including the level of confidence in the data used in the analysis.

All assessment conclusions shall be supported by technical information based on experience in Manitoba and elsewhere as well as traditional ecological and local knowledge. Any deficiencies in the information about potential effects shall be clearly noted and addressed as stated in section 9. ENVIRONMENTAL MONITORING of this document.

8. RESIDUAL EFFECTS

The environmental impact statement shall describe the nature and extent of any residual environmental effects of the project, and include a characterization as to whether residual environmental effects are significant or insignificant, and the rationale for such characterization. It shall provide a detailed plan for responding to any known or predicted residual effects, and provide a procedure for identifying and responding to effects that were not predicted or foreseen.

9. ENVIRONMENTAL MONITORING

The environmental impact statement shall provide a detailed description of the proposed monitoring activities of effects of the project on the physical, aquatic, terrestrial and socio-economic environments arising from the site preparation, construction, operation, and eventual decommissioning of the Wuskwatim Generation Project. It shall describe the equipment to be used, the parameters to be measured, the methodology and frequency of measurement and the mechanism for reporting results of proposed monitoring of the environmental conditions affected by the Wuskwatim Generation Project. The design of the environmental monitoring proposal and its implementation shall incorporate traditional ecological and local knowledge.

The environmental impact statement shall describe how the proposed monitoring activities will help to verify and manage environmental effects and confirm the performance of mitigation and habitat enhancement measures to be employed.

If regulatory approval for the project is provided, and prior to construction, a project-specific Environmental Protection Plan (EPP) shall be developed. The EPP will be designed to commit the proponent to a long term monitoring program, including accountability and reporting requirements, that would encompass both the construction and operational phases of the project in order to confirm predictions of effects and to determine whether unexpected effects are occurring. The EPP shall be developed to accomplish the following goals:

- to facilitate the mitigation of environmental effects throughout the full-life cycle of the project by providing field construction and operating personnel with clear instructions on the mitigation measures to be implemented and on the appropriate lines of communication and means of reporting to be followed;

- to incorporate issues and concerns identified by NCN, including protocols put in place by the First Nation;

- to identify modifications to construction methods or schedules, summarize environmental sensitivities and mitigation actions, list emergency response plans and reporting protocols, describe a closure plan for aggregate quarries, including mitigation of potential hazards to public safety and mitigation to address land reclamation concerns;

- to provide specific information on waste management practices to be utilized during the construction phase of the project, including consideration of all liquid and solid wastes generated; and

- to monitor construction practices to ensure that the work proceeds in accordance with the EPP.

10. SOURCES OF INFORMATION

All assessment conclusions shall be backed up by credible technical information and traditional ecological and local knowledge. The environmental impact statement shall describe the primary sources of information used to conduct the environmental assessment of the proposed project. This information shall include:

- technical studies of similar facilities and processes which are operating elsewhere;
- original studies performed by qualified engineers or scientists commissioned by the proponent specific to the Wuskwatim Generation Project;
- identification of facility design documents prepared by qualified engineers as they become available;
- scientific reports and papers on topics relevant to the Wuskwatim Generation Project; and
- traditional ecological and local knowledge.

Credible analysis and documentation shall support all conclusions of 'no or insignificant effect".

11. REPORT FORMAT

The Environmental Impact Statement for the Wuskwatim Generation Project shall include an executive summary to be written with a minimum of technical terminology and to include a glossary of terms used throughout the document. Deficiencies in scientific evidence shall be identified, including areas where there is no evidence specific to Manitoba.

The information in the environmental impact statement shall maximize the use of maps, charts, diagrams and photographs for presentation. To the extent possible, maps and diagrams shall be presented at a common scale, appropriate to represent the level of detail considered, and where possible, allowing for direct overlay for ease of reference. Specifically, maps indicating zones of effect on land and water use and habitat areas shall be on maps of a common scale.

For clarification of these Guidelines please contact PAT through Mr. Bryan Blunt at:

Telephone: 204-945-7085
Toll Free: 1-800-282-8069
E-mail: bblunt@gov.mb.ca

APPENDIX 3

REGULATORY FRAMEWORK

3.0 REGULATORY FRAMEWORK

3.1 INTRODUCTION

This appendix outlines and describes provincial and federal legislation that is applicable to the Wuskwatim Generating Station Project. It also includes a listing of current TAC representatives (Table A.3-1).

TABLE A.3-1

CURRENT TECHNICAL ADVISORY COMMITTEE (TAC) REPRESENTATIVES

TAC REPRESENTATIVE	GOVERNMENT DEPARTMENT
Trent Hreno	Manitoba Conservation, Environmental Approvals Branch (TAC Chair)
Brian Blunt	Manitoba Conservation, Environmental Approvals Branch
Jim Popplow	Manitoba Health
Juliane Schaible	Manitoba Energy, Science and Technology
Joe Romeo	Manitoba Transportation and Highway
Ken Agar	Manitoba Aboriginal and Northern Affairs
Dennis Peristry	Manitoba Aboriginal and Northern Affairs
Kevin Brownlee	Historic Resources Branch
Luke Peloquin	Manitoba Conservation, Sustainable Resource Management Branch
Larry Strachan	Manitoba Conservation, Environmental Approvals Branch
Shelly Matkowski	Manitoba Conservation, Fisheries Branch
Angela Bidinosti	Indian Affairs & Northern Development
Dan McNaughton	Canadian Environmental Assessment Agency
Jim Gibson	Department of Fisheries and Oceans
Richard Janusz	Department of Fisheries and Oceans
Bev Ross	Department of Fisheries and Oceans
Terry Youmans	Environment Canada
James Cummine	Environment Canada
Kelly Lehman	Health Canada
Rolly Wickstrom	Environment Canada (Canadian Wildlife Service)

3.2 PROVINCIAL STATUTES, REGULATIONS AND GUIDELINES

The Manitoba Acts and Regulations that are applicable to the Wuskwatim Generation Project include the following:

- *The Environment Act*

- Storage and Handling of Gasoline and Associated Products Regulation (MR 97/88R);
- Waste Disposal Grounds Regulation (MR 150/91);
- Litter Regulation (MR 92/88R);
- Environmental Assessment Hearing Cost Recovery Regulation (MR 210/92);
- Joint Environmental Assessment Regulation (MR 126/91);
- Participant Assistance Regulation (MR 215/91);
- Licencing Procedures Regulation (MR 163/88);

- *The Wildlife Act;*
- *Forest Act;*
- *Crown lands Act;*
- *Mines and Minerals Act;*
- *Water Power Act;*
- *Water Rights Act;* and
- *Sustainable Development Act*.

Other provincial Acts potentially applicable to the project includes the following:

- *Endangered Species Act;*
- *Ecological Reserves Act;*
- *Heritage Resources Act;* and
- *Provincial Parklands Act.*

3.2.1.1 The Environment Act

The "Guidelines for the Preparation of an Environmental Impact Statement for the Wuskwatim Generating Project – April 29, 2002" define the project as a Class 3 development as defined by the *Classes of Development Regulation* under Manitoba's *The Environment Act*. The project therefore falls under Section 12 of *The Environment Act* regarding the assessment which outlines the general procedures of the projects regulatory review requirements.

Other potentially applicable regulations under *The Environment Act* include the following:

- Storage and Handling of Gasoline and Associated Products Regulation (MR 97/88R);
- Waste Disposal Grounds Regulation (MR 150/91);
- Litter Regulation (MR 92/88R);
- Environmental Assessment Hearing Cost Recovery Regulation (MR 210/92);

- Joint Environmental Assessment Regulation (MR 126/91);
- Participant Assistance Regulation (MR 215/91); and
- Licencing Procedures Regulation (MR 163/88).

Manitoba has also participated in the federal government's, "A Canada-wide Accord in Environmental Harmonization" including the "Canada-Manitoba Agreement for Environmental Assessment Cooperation".

3.2.1.2 The Wildlife Act

The *Wildlife Act* under Section 50(1) states that:

> *"No person shall destroy or damage habitat on Crown land, except pursuant to a license, permit or other authorization issued or given under this or any other Act of the legislature."*

Prohibited activities specific to Wildlife Management Areas are listed in Section 2(1) of the "Uses and Activities in Wildlife Management Areas Regulation" as follows:

2(1) "*Except as otherwise provided in this regulation, no person shall, in a wildlife management area:*

a) grade, level or clear a road or trail
b install or modify a stream crossing
c) drain, dike or block a man-made or natural waterway or wetland
d) engage in haying, grazing, clearing, bulldozing, burning, fencing, logging, cultivation, mineral exploration or extracting
e) apply pesticides
f) construct, place, occupy or use a building structure or tent."

3.2.1.3 Forest Act

The *Forest Act* requires under Section 28 that a person:

> "*Unless he holds a license or permit therefore, no person shall enter upon forest land owned by the Crown for the purpose of cutting or removing timber or shall cut, or remove, timer thereon or there from*".

The "Forest Use and Management Regulation" of the *Forest Act* classifies as restricted zones (Section 4[b]):

> "*all Crown lands on a strip up to 150 metres in width depending on land topography along both sides of provincial trunk highways, provincial*

> *roads, railway, right-of-way, hiking trails, riding trails, portages, streams, rivers and lakeshores*."

Within a restricted zone, Section 6(1) states:

> "*No timber shall be cut within a closed zone or restricted zone without the approval of the Department of Natural Resources*".

3.2.1.4 Endangered Species Act

The Manitoba *Endangered Species Act* defines endangered, threatened, extinct and extirpated species in Canada. Section 10(1) of the *Act* states that:

> "*no person shall*
> *(a) kill, injure, possess, disturb or interfere with an endangered species, a threatened species, or an extirpated species that has been reintroduced;*
> *(b) destroy, disturb or interfere with the habitat of an endangered species, a threatened species or an extirpated species that has been reintroduced; or*
> *(c) damage, destroy, obstruct or remove a natural resource on which an endangered species, a threatened species or an extirpated species that has been reintroduced depends for its life and propagation.*"

3.2.1.5 Mines and Minerals Act

A Quarry Permit will need to be obtained, as per Section 1278(1) of the Manitoba *Mines and Minerals Act*, before the excavation of material is initiated.

3.2.1.6 The Water Rights Act

Section 3(1) of The Water Rights Act requires:

- "*no person shall…divert water, unless he holds a valid and subsisting license to do so*".
- "*the definition of "divert" includes block, dam, impound, obstruct, interfere with, remove, dispose of, alter or change the course of position of, or disturb, whether wholly or partially, any water whether flowing or at rest*".

3.2.1.7 Water Power Act

The Water Power Act administers the development or "*undertaking" relating to "the storage, pondage, penning back, regulation, augmentation, carriage, diversion and use,* *of water or of the flow thereof*", including "*the generation of energy at any plant that is used as an auxiliary to the water power plant*".

3.2.1.8 Other

Other *Acts* and Regulations that are potentially relevant to the Wuskwatim Generation Project are the:

- *Ecological Reserves Act;*
- *Heritage Resources Act;*
- *Provincial Parklands Act;*
- *Sustainable Development Act;*
- *Crown Lands Act;* and
- *The Provincial Lands Act.*

Associated with the legislature requirements are a group of forestry, wildlife, and stream crossing guidelines, primarily designed for the forestry industry. The Draft Manitoba Surface Water Quality Standards, Objectives and Guidelines may also be relevant to components of this project.

3.2.2 Federal Statutes, Regulations and Guidelines

Canadian federal governments *Acts* and Regulations applicable to the Wuskwatim Generation Project include the following:

- *Canadian Environmental Assessment Act;*
- *Fisheries Act;*
- *Navigable Waters Protection Act;* and
- *The Constitution Act.*

Federal *Acts* and Regulations potentially applicable to the project include the following:

- *Species at Risk Act;* and
- *Migratory Bird Convention Act.*

3.2.2.1 Canadian Environmental Assessment Act

Section 16(1a) of the *Canadian Environmental Assessment Act (CEAA)* states:

- Section 16.(1) "*Every screening or comprehensive study of a project and every mediation or assessment by a review panel shall include a consideration of the following factors:*

> *(a) the environmental effects of the project, including the environmental affects of malfunctions or accidents that may occur in connection with the project and any cumulative environmental effects that are likely to result from the project in combination with other projects or activities that have been or will be carried out*"

The first step in the CEAA is to define the "project" as a starting point of the assessment. The *Canadian Environmental Assessment Act* defines a "*project*" to mean the following:

- "*(a) in relation to a physical work, any proposed construction, operation, modification, decommissioning, abandonment or other undertaking in relation to that physical work, or*
- *(b) any proposed physical activity not relating to a physical work that is prescribed or is within a class of physical activities that is prescribed pursuant to regulations*"

The Wuskwatim Generation Project will potentially impact fish habitat and navigation, and trigger the CEAA process. Since the project will involve "*a hydroelectric generation station with a productive capacity of 200 MW or more"* (from Section 4(b) of CEAA's Comprehensive Study List Regulation), a comprehensive study will be required, as confirmed by the Guidelines.

It is anticipated that those project components which are interdependent on the principal project will fall under CEAA's definition of a "project" and are part of the environmental assessment of the project. CEAA Section 15 (3) requires that:

- "*where a project is in relation to a physical work, an environmental assessment shall be conducted in respect of every construction, operation, modification, decommissioning, abandonment or other undertaking in relation to that physical work that is proposed by the proponent or that is, in the opinion of*

  (a) the responsible authority

  (b) where the project is referred to a mediator or a review panel, the Minister, after consulting with the responsible authority likely to be carried out in relation to that physical work."

"Physical activities" are defined by CEAA in the Inclusion List Regulations and include the following activities potentially applicable to the proposed projects:

- Section 39.1 - "*Physical activities ... relating to the establishment or relocation of a temporary road for use in winter*",

- Section 46 - "*The harmful alteration, disruption or destruction of fish habitat by means of the removal of vegetation in or adjacent to a water body that requires the authorization of the Minister of Fisheries and Oceans*",
- Section 46.1 - "*The harmful alteration, disruption or destruction of fish habitat by means of physical activities intended to establish or modify more than 500 m of continuous natural shoreline and that require the authorization of the Minister of Fisheries and Oceans*",
- Section 48.1 - "*Physical activities … intended to threaten the continued existence of a biological population in an ecodistrict, either directly or through the alteration of its habitat*",
- Section 77 - "*Physical activities relating to the establishment or use of a temporary field camp if the camp is to be used for 200 person-days or more*", and
- Section 80 - "*Outdoor recreational activities to be carried on in rural areas of Canada, …, relating to the operation of rafting, boat touring and horseback riding enterprises having 10 full-time employees at any one time*".

The "Guidelines for the Preparation of an Environment Impact Statement for the Wuskwatim Transmission Line Project April 26, 2002" state that "*the Wuskwatim Generation Project…may require a screening or possibly be part of a comprehensive study level environmental assessment under the Canadian Environmental Assessment Act".* The Guidelines note that they "*have been developed to address specific issues and identify necessary information that Manitoba and Canada require to be considered in the environmental assessment of the project*". To this effect, the requirements of the *Canadian Environmental Assessment Act* have been used to assist in defining the impact assessment.

3.2.2.2 Fisheries Act

The project occurs on "*Canadian Fisheries waters*" which the *Fisheries Act* defines as including "*all internal waters of Canada*". Provisions potentially related to the construction and operation of the Wuskwatim Generating Station include the following:

- Section 26(1) of the Act notes that "*one-third of the width of any river…shall always be left open", while Section 26(3) notes that "the Minister may authorize…other obstructions in streams…that the Minister deems in the public interest*";
- The Minister may direct, under Section 20(1), that "*every obstruction across or in a stream where the Minister determines it to be necessary for the public interest that a fish pass should exist shall be provided by the owner*";
- Section 21(4) also notes that "*the Minister may require the owner or occupier of any obstruction to install and maintain…fish stops or diverters…adequate to prevent the*

destruction of fish or to assist in providing for their ascent". Section 22(1) notes that "*a sufficient flow of water over the spillway…to permit the safe and unimpeded descent of fish*" and Section 22(3) requires the "*escape into the river-bed below the obstruction of such quantity of water, as will, in the opinion of the Minister, be sufficient for the safety of fish and for the flooding of the spawning grounds to such depth as will, in the opinion of the Minister, be necessary for the safety of the ova deposited thereon*"; and

- Section 30(1) notes that "*every water intake…constructed… for conducting water from any Canadian fisheries waters for…power generation…shall, if the Minister deems it necessary in the public interest, be provided at its entrance or intake with a fish guard or screen*".

General provisions of the *Act* include the following:

- Section 32 - "*No person shall destroy fish by any means other than fishing except as authorized by the Minister*";
- Section 35(1) - "*No person shall carry on work or undertaking that results in the harmful alteration, disruption or destruction of fish habitat*" unless, as discussed in Section 35(2), "*authorized by the Minister*"; and
- Section 36(3) - "*no person shall deposit or permit the deposit of a deleterious substance of any type in water frequented by fish*" unless, as discussed in Section 36(4) "*authorized by regulations*".

Section 37(1) states that "*any work or undertaking that results or is likely to result in the alteration, disruption or destruction of fish habitat, or in the deposit of a deleterious substance in water frequented by fish…the person shall on the request of the Minister…provide…such plans, specifications, studies, procedures, schedules, analyses, samples, or other information relating to the work or undertaking*". Under Section 37(2a), after reviewing the information it may "*require such modifications or additions to the work or undertaking…necessary in the circumstances*" or "*restrict the operation of the work or undertaking*".

3.2.2.3 Navigable Waters Protection Act

Section 5(1) of the *Navigable Waters Protection Act* requires that:

- "*no work shall be built or placed in, on, over, under, through or across any navigable water unless*
  - *(a) the work and the site and plans thereof have been approved by the Minister".*

The provisions of the Navigable Water Works Regulation respecting operation of a dam will also need to be addressed.

3.2.2.4 Species at Risk Act

On June 11, 2002 the House of Commons passed the "*Species at Risk Act*" (SARA). The *Act* was restored in October 2002 with respect to the 40th sitting of parliament and received royal assent on December 12, 2002. SARA generally utilizes the COSEWIC defined lists of endangered and threatened species and provides a measure of protection to them as follows:

- listed species on federal lands in Canada;
- migratory birds as protected by the *Migratory Birds Convention Act*; and
- all aquatic species as described by the *Fisheries Act*.

Provincial and territorial jurisdictions must provide an equivalent degree of protection or "*the Minister must recommend (to the Governor in Council) that the order (to apply in lands in a province that are not federal lands*) *be made if the Minister is of the opinion that the laws of the province do not effectively protect the species or the residences of its individuals*" (clauses 34(2) and 34(3) of SARA).
SARA provides the following degree of protection:

- Clause 32(1) – "*No person shall kill, harm, harass, capture or take an individual of wildlife species that is listed, as an extirpated species, an endangered species or a threatened species*"; and
- Clause 33 – "*No person shall damage or destroy the residence of one or more individuals of a wildlife species that is listed*".

3.2.2.5 Migratory Bird Convention Act

The *Migratory Bird Convention Act* provides the status to the 1916 Migratory Bird Convention Treaty between Canada and the United States. The "*Protocol Between the Government of Canada and the Government of the United States of America Amending the 1916 Convention Between the United Kingdom and the Unites States of America for the Protection of Migratory Birds in Canada and the United States*", under Article IV requires that the parties:

- "*seek means to prevent damage to such birds and their environments*"; and
- "*pursue co-operative arrangements to conserve habitat essential to migratory bird populations*".

Clause 12(1) (ii) allows for regulations to be established with respect to when "*nests may be damaged, destroyed, removed or disturbed*". The Act's Migratory Birds Regulations (CR.C.c1035) notes that no person shall:

- "*disturb, destroy or take a nest, egg, nest shelter, eider duck shelter or duck box of a migratory bird*"; and
- Clause 35(1) – "*deposit or permit to be deposited oil, oil waste or any substance harmful to migratory birds in any waters or area frequented by migratory birds*".

APPENDIX 4

ESTIMATED CONSTRUCTION EMPLOYMENT IN THE LOCAL REGION, PROJECT REGION AND NORTHERN REGION (PEAK POSITIONS AND PERSON-YEARS OF EMPLOYMENT)

APPENDIX 4

Table A4-1. Estimated Maximum Peak Positions Employment in the Local Region during Project Construction.

Trade & Experience Group	Estimated Maximum Peak Positions Employment[1]	
	Total Number of Positions Available[2]	Estimated Positions Held by Local Region Aboriginal Residents[3]
Stage 1 (Years 1-2) Infrastructure Development[4]		
Trainees and Positions with 0 – 24 months experience	130	78-90[6]
Construction Support & Non-designated Trades, 3 – 4 and >4 yrs. Experience	10	0
Designated Trades Positions	17	3[7]
Stage 2 (Years 3-6) Major Works Construction Installation[5]		
Trainees and Positions with 0 – 24 months experience	265	64-83[6]
Construction Support & Non-designated Trades, 3 – 4 and >4 yrs. Experience	124	2
Designated Trades Positions	385	14-28[7]

Notes:

1 - This information represents an estimate only, based on current regulations, Project plans as of 2002, and past experience with similar projects. Contractors will determine specific job requirements when the Project is being built. Actual employment requirements will vary from the estimate presented above.

2 - The number of positions refers to the maximum during the stated construction stage. These positions will not be concurrent. Actual number of positions at a given time will be less than the estimated maximum. The positions identified are those potentially filled by job orders. Excludes Manitoba Hydro staff and contractor supervisory and management positions.

3 - The Local Region includes Aboriginal residents of Nelson House and the Northern Affairs communities of Nelson House and South Indian Lake.

4 - During Stage 1, the majority of this work is expected to be performed by NCN contractors engaged in negotiated contracts with Manitoba Hydro. Analysis is based on the provisions of Article 2.9 in the existing BNA, which enables northern Aboriginal contractors with negotiated contracts to directly hire northern Aboriginal residents without having to go through the job order process to which the northern employment preference applies. The BNA is currently being renegotiated.

5 - Catering and security work are expected to be negotiated contracts with NCN contractor(s) during the Major Construction in Y3-Y6. Analysis is based on the provisions of Article 2.9 in the existing BNA, which would allow these contractors to directly hire northern Aboriginal residents, e.g., NCN members. This results in some positions that would otherwise be accessible to other northern Aboriginal residents in the employment preference region going to NCN members. The BNA is currently being renegotiated.

6 - The low end of the range reflects existing capacity of NCN members and about 50 per cent of NCN pre-Project training targets. The upper end of the range reflects employment effects that would occur if NCN pre-Project training targets are fully achieved.

7 - NCN apprentices will compete with other pre-project training participants, particularly pre-project training participants on the Gull/Keeyask Project, and this may constrain achievement at the upper end of the range.

Table A4-2. Estimated Maximum Person-years Employment in the Local Region during Project Construction.

Trade & Experience Group	Estimated Person-years of Employment[1]	
	Total Number of Person-years Available[2]	Estimated Person-years Secured by Local Region Aboriginal Residents[3]
Stage 1 (Years 1-2) Infrastructure Development[4]		
Trainees and Positions requiring 0 – 24 months experience	92.0	55.2-63.7[6]
Construction Support & Non-designated Trades, 3 – 4 and >4 yrs. Experience	8.3	0
Designated Trades Positions	12.8	2.3[7]
Total	113.2	57.5-66.0
Stage 2 (Years 3-6) Major Works Construction Installation[5]		
Trainees and Positions with 0 – 24 months experience	437.9	105.8-137.2
Construction Support & Non-designated Trades, 3 – 4 and >4 yrs. Experience	127.5	2.1
Designated Trades Positions	430.5	15.7-31.3 [7]
Total	995.9	123.5-170.5

Notes:

1 - This information represents an estimate only, based on current regulations, Project plans as of 2002, and past experience with similar projects. Contractors will determine specific job requirements when the Project is being built. Actual employment requirements will vary from the estimate presented above.

2 - The number of person-years refers to the total for the stated construction stage. The person-years of employment are for positions potentially filled by job orders. Excludes Manitoba Hydro staff and contractor supervisory and management positions.

3 - The Local Region includes Aboriginal residents of Nelson House and the Northern Affairs communities of Nelson House and South Indian Lake.

4 - During Stage 1, the majority of this work is expected to be performed by NCN contractors engaged in negotiated contracts with Manitoba Hydro. Analysis is based on the provisions of Article 2.9 in the existing BNA, which enables northern Aboriginal contractors with negotiated contracts to directly hire northern Aboriginal residents without having to go through the job order process to which the northern employment preference applies. The BNA is currently being renegotiated.

5 - Catering and security work are expected to be negotiated contracts with NCN contractor(s) during the Major Construction in Y3-Y6. Analysis is based on the provisions of Article 2.9 in the existing BNA, which would allow these contractors to directly hire northern Aboriginal residents, e.g., NCN members. This results in some positions that would otherwise be accessible to other northern Aboriginal residents in the employment preference region going to NCN members. The BNA is currently being renegotiated.

6 - The low end of the range reflects existing capacity of NCN members and about 50 per cent of NCN pre-project training targets. The upper end of the range reflects employment effects that would occur if NCN pre-project training targets are fully achieved.

7 - NCN apprentices will compete with other pre-project training participants, particularly pre-project training participants on the Gull/Keeyask Project, and this may constrain achievement at the upper end of the range.

Table A4-3. Estimated Maximum Peak Positions Employment for Project Region and Northern Region Aboriginal Residents during Project Construction.

Trade & Experience Group	Estimated Maximum Peak Positions Employment[1]				
		Project Region		Northern Region	
	Total Number of Positions Available[2]	*(Excluding the Local Region)* Estimated Positions Held by Project Region[3]	*(Including the Local Region)* Aboriginal Residents[3] Total Estimated Positions Held by Project Region Aboriginal Residents[3]	*(Excluding the Project Region)* Estimated Positions Held by Northern Region Aboriginal Residents[3]	*(Including the Project Region)* Total Estimated Positions Held by Northern Region Aboriginal Residents[3]
Stage 1 (Years 1-2) Infrastructure Development[4]					
Trainees and Positions with 0 – 24 months experience[4]	130	40 -52[5]	130[6]	0[7]	130[7]
Construction Support & Non-designated Trades, 3 – 4 and >4 yrs. Experience	10	3	3	4	7
Designated Trades Positions	17	6	9	4	13
Stage 2 (Years 3-6) Major Works Construction Installation[5]					
Trainees and Positions with 0 – 24 months experience[4]	265	134-173[5]	198-256 [5,6]	0[8]	198-256[8]
Construction Support & Non-designated Trades, 3 – 4 and >4 yrs. Experience	124	8	10	8	18
Designated Trades Positions	385	15-33[5]	29-61[5,6]	16-34[8]	45-95[8]

Notes:

1 - This information represents an estimate only, based on current regulations, Project plans as of 2002, and past experience with similar projects. Contractors will determine specific job requirements when the Project is being built. Actual employment requirements will vary from the estimate presented above.

2 - The number of positions refers to the maximum during the stated construction stage. These positions will not be concurrent. Actual number of positions at a given time will be less than the estimated maximum. The positions identified are those potentially filled by job orders. Excludes Manitoba Hydro staff and contractor supervisory and management positions.

3 - Project Region is defined in Section 3.1.1.2, and includes communities defined by the Burntwood River and Nelson River areas.

4 - The effects of the assumed employment preference are observed in the positions for trainees and workers with 0 to 24 months combined training and experience, as there are more workers in northern Manitoba available for these types of positions than are required for the construction workforce.

5 - The high end of the range reflects the number of positions that could be taken by Project Region Aboriginal residents assuming existing capacity of NCN members, NCN training targets fully achieved and other Aboriginal residents in the Project Region receive pre-Project training for up to 15 designated trades positions. The low end of the range reflects the number of positions that could go to Project Region Aboriginal residents assuming approximately 50 per cent achievement of NCN training targets and the existing capacity of other Aboriginal residents in the Project Region.

6 - When Aboriginal residents from the Local Region are included, all the non-designated trades and construction support occupations requiring less than 24 months of combined training and experience could go to Aboriginal residents in the Project Region (maximum combined peak of 130 positions during Stage 1 and 198-256 positions during Stage 2).

7 - All of the positions for trainees and workers with 0-24 months of training & experience could be taken up by Aboriginal residents in the Project Region alone (including those in the Local Region). There are enough Aboriginal residents with 0-24 months training & experience in this Region to fill the number of available positions for occupations where there are the relevant skills and interest in northern Manitoba (maximum combined peak of 130 positions during Stage 1, and 198-256 positions during Stage 2).

8 - For the major construction works, the high end of the range reflects the number of positions that could be taken by Aboriginal residents in the entire Northern Region, assuming the existing capacity of NCN members as well as full achievement of NCN training targets. The low end of the ranges represents that number of positions that could be secured assuming the existing capacity of NCN members and about 50 per cent of NCN pre-project training targets.

Table A4-4. Estimated Maximum Person-years Employment for Project Region and Northern Region Aboriginal Residents during Project Construction.

Trade & Experience Group	Estimated Maximum Person-years Employment[1]				
	Total Number of Person-years Available[2]	Project Region		Northern Region	
		(Excluding the Local Region) Estimated Person-years Secured by Project Region Aboriginal Residents[3]	*(Including the Local Region)* Total Estimated Person-years Secured by Project Region Aboriginal Residents[3]	*(Excluding the Project Region)* Estimated Person-Years by Northern Region Aboriginal Residents[3]	*(Including the Project Region)* Total Estimated Person-Years by Northern Region Aboriginal Residents[3]
Stage 1 (Years 1-2) Infrastructure Development[4]					
Trainees and Positions with 0 – 24 months experience[4]	92.0	28.3-36.8[5]	92.0	0[8]	92.0[8]
Construction Support & Non-designated Trades, 3 – 4 and >4 yrs. Experience	8.3	2.5	2.5	3.3	5.8
Designated Trades Positions	12.8	4.5	6.8	5.3	12.1
Total	113.2	35.3-43.8	101.3[6]	8.6	109.9
Stage 2 (Years 3-6) Major Works Construction Installation[5]					
Trainees and Positions with 0 – 24 months experience[4]	437.9	221.4-285.9[5]	327.2-423.0[5,6]	0[8]	327.2-423.0[7]
Construction Support & Non-designated Trades, 3 – 4 and >4 yrs. Experience	127.5	8.2	10.3	8.2	18.5
Designated Trades Positions	430.5	15.7-32.4[5]	32.4-68.2[5,6]	17.9-38.0[7]	50.3-106.2 [7]
Total	995.9	245.3-326.5	369.9-501.5	26.1-46.2	396.0-547.8

Notes:

1 - This information represents an estimate only, based on current regulations, Project plans as of 2002, and past experience with similar projects. Contractors will determine specific job requirements when the Project is being built. Actual employment requirements will vary from the estimate presented above.

2 - The number of person-years refers to the total for the stated construction stage. The person-years of employment are for positions potentially filled by job orders. Excludes Manitoba Hydro staff and contractor supervisory and management positions.

3 - Project Region is defined in Section 3.1.1.2, and includes communities defined by the Burntwood River and Nelson River areas.

4 - The effects of the assumed employment preference are observed in the positions for trainees and workers with 0 to 24 months combined training and experience, as there are more workers in northern Manitoba available for these types of positions than are required for the construction workforce.

5 - The high end of the range reflects the number of positions that could be taken by Project Region Aboriginal residents assuming existing capacity of NCN members, NCN training targets fully achieved and other Aboriginal residents in the Project Region receive pre-Project training for up to 15 designated trades positions. The low end of the range reflects the number of positions that could go to Project Region Aboriginal residents assuming approximately 50 per cent achievement of NCN training targets and the existing capacity of other Aboriginal residents in the Project Region.

6 - When Aboriginal residents from the Local Region are included, all the non-designated trades and construction support occupations requiring less than 24 months of combined training and experience could go to Aboriginal residents in the Project Region (maximum of 92.0 person-years during Stage 1 and 327.2-423.0 person-years during Stage 2).

7 - For the major construction works, the high end of the range reflects the number of positions that could be taken by Aboriginal residents in the entire Northern Region, assuming the existing capacity of NCN members as well as full achievement of NCN training targets. The low end of the ranges represents that number of positions that could be secured assuming the existing capacity of NCN members and about 50 per cent of NCN pre-project training targets.

8 - All of the positions for trainees and workers with 0-24 months of training & experience could be taken up by Aboriginal residents in the Project Region alone (including those in the Local Region). There are enough Aboriginal residents with 0-24 months training & experience in this Region to fill the number of available positions for occupations where there are the relevant skills and interest in northern Manitoba (maximum of 92.0 person-years during Stage 1 and 327.2-423.0 person-years during Stage 2).