

MANITOBA HYDRO KEYYASK TRANSMISSION PROJECT



FORESTRY TECHNICAL REPORT

PREPARED BY

PLUS4 CONSULTING INC.

WINNIPEG, MANITOBA



OCTOBER 2012

PREFACE

The following is one of several technical reports for Manitoba Hydro's application for environmental licensing of the Keeyask Transmission Project. This technical report has been prepared by an independent technical discipline specialist who is a member of the Environmental Assessment Study Team retained to assist in the environmental assessment of the Project. This report provides detailed information and analyses on the related area of study. The key findings outlined in this technical report are integrated into the Keeyask Transmission Environmental Assessment Report.

Each technical report focuses on a particular biophysical or socio-economic subject area and does not attempt to incorporate information or perspectives from other subject areas with the exception of Aboriginal Traditional Knowledge (ATK). Applicable ATK is incorporated where available at time of submission. Most potentially significant issues identified in the various technical reports are generally avoided through the Site Selection and Environmental Assessment (SSEA) process. Any potentially significant effects not avoided in this process are identified in the Environmental Assessment Report along with various mitigation options that would address those potential effects.

While the format of the technical reports varies between each discipline, the reports generally contain the following:

- Methods and procedures.
- Study Area characterization.
- Description and evaluation of alternative routes and infrastructure sites.
- Review of potential effects associated with the preferred transmission routes and station sites.

Following receipt of the required environmental approvals, an Environmental Protection Plan (EnvPP) will be completed and will outline specific mitigation measures to be applied during construction, operation and maintenance of the proposed Keeyask Transmission Project. An EnvPP is typically developed from a balance of each specialist's recommendations and external input.

Each of the technical reports is based on fieldwork and analysis undertaken throughout the various stages of the SSEA process for the Project. The technical reports are as follows:

- Technical Report 1: Aquatics Environment
- Technical Report 2: Terrestrial Habitat, Ecosystems and Plants
- Technical Report 3: Amphibians
- Technical Report 4: Avian

- Technical Report 5: Mammals
- Technical Report 6: Forestry
- Technical Report 7: Socio-economic Environment
- Technical Report 8: Heritage Resources
- Technical Report 9: Tataskweyak Cree Nation Report on Keeyask Transmission Project

The technical reports contain more detail on individual subject areas than is provided in the Environmental Assessment Report. The technical reports have been reviewed by Manitoba Hydro, but the content reflects the opinions of the author. They have not been edited for consistency in format, style and wording with either the Environmental Assessment Report or other technical reports.

TABLE OF CONTENTS

1.0	INTRODUCTION	1-1
1.1	PROJECT OVERVIEW.....	1-1
2.0	METHODS AND PROCEDURES	2-1
2.1	STUDY AREA DEFINITION	2-1
2.2	DATA COLLECTION AND ANALYSIS.....	2-1
2.2.1	The Non-Commercial Forest Zone	2-1
2.2.2	The Commercial Forest Zone.....	2-2
2.2.2.1	Productive Forestlands	2-3
2.2.2.2	Forest Damage Appraisal and Valuation	2-3
2.3	EVALUATION OF ALTERNATIVE ROUTES AND INFRASTRUCTURE.....	2-6
3.0	STUDY AREA CHARACTERIZATION.....	3-1
4.0	EFFECTS AND MITIGATION.....	4-1
4.1	OVERVIEW	4-1
4.2	THE NON-COMMERCIAL FOREST ZONE	4-1
4.2.1	Mitigation	4-2
4.3	THE COMMERCIAL FOREST ZONE.....	4-3
4.3.1	Productive Forestland	4-3
4.3.2	Standing Timber.....	4-4
4.3.3	Mitigation	4-4
4.3.3.1	Forest Damage Appraisal and Valuation	4-5
4.4	RESIDUAL EFFECTS	4-6
4.5	INTERACTIONS WITH OTHER PROJECTS	4-8
4.5.1	Scoping.....	4-8
4.5.2	Analysis	4-9
4.5.2.1	Deforestation Projects/Actions	4-9
4.5.2.2	Temporal Forest Status	4-11
4.5.2.3	Land Use Reclassification	4-11
4.5.3	Mitigation	4-12

4.5.4	Follow-up.....	4-12
4.6	MONITORING	4-12
5.0	CONCLUSIONS	5-1
6.0	GLOSSARY	6-1
7.0	ACRONYMS.....	7-1
8.0	REFERENCES	8-1
8.1	CITATIONS	8-1
8.2	PERSONAL COMMUNICATIONS	8-2
8.3	WEBSITES	8-2

APPENDICES

APPENDIX A	COMPOSITE TIMBER DUES TABLE
APPENDIX B	FOREST DAMAGE APPRAISAL AND VALUATION DETERMINATION
APPENDIX C	POTENTIAL SALVAGEABLE STANDS WITHIN THE PROJECT FOOTPRINT

LIST OF TABLES

Table 4-1	Potential Salvageable Forest Area in the NCFZ within the Project Footprint
Table 4-2	Potentially Salvageable Timber in the NCFZ of the Project Footprint
Table 4-3	Project Effects on Productive Forestland in FMU 86 (CFZ)
Table 4-4	Project Effect on Standing Timber within FMU 86 (CFZ)
Table 4-5	Project Forest Damage Appraisal & Valuation Summary (\$)
Table 4-6	Forestry Residual Effects Summary
Table 4-7	Summary of Residual Effects on Forestry Measureable Parameters
Table 4-8	Regional Interactions with Other Projects/Actions

LIST OF MAPS

Map 1-1	Study Areas
Map 2-1	Potential Salvage Timber Areas within the Project Footprint

EXECUTIVE SUMMARY

The Keeyask Transmission Project Study Area straddles portions of the Commercial and Non-Commercial Forest Zones south of Gull and Stephens lakes and falls entirely within the Split Lake Resource Management Area. The Project will require clearing of forest resources in both zones affecting a total of 146.5 ha and approximately 5395 m³ of timber volume.

Some of the affected timber within the Project Footprint may be of suitable size and concentrations to warrant salvaging where demand exists and it is economically feasible to do so. Potential volume within the Non-Commercial Forest Zone is estimated at 3121 m³ of softwood and 554 m³ of hardwood. A further 1008 m³ of softwood in cutting classes 3 and 4 are located in the Commercial Forest Zone (FMU 86).

The Project will affect 62.9 ha of productive forestland with 1601 m³ of standing timber (all cutting classes) within FMU 86 (Commercial Forest Zone). Compensation to Manitoba Conservation and Water Stewardship has been estimated by application of the Forest Damage Appraisal and Valuation policy at \$11,535.04.

The above residual effects will not have any effect on existing demand on, or availability of, forest resources within the Regional Study Area.

1.0 INTRODUCTION

1.1 PROJECT OVERVIEW

This Forestry Technical Report, **Environmental Assessment** (EA) has been developed for the Manitoba Hydro Keeyask Transmission Project (the Project). The Project is designed to support the proposed Keeyask Generating Station (GS) development at Gull Rapids on the Nelson River and includes the following proposed components:

- A 138 kV construction power transmission line from the existing KN-36 to the Keeyask GS site situated on a 60 metre right-of-way (ROW);
- The Keeyask construction power station requiring 2.25 ha of land;
- The Keeyask GS switching station, including an expansion area will require 35 ha of land;
- Four 138 kV generator lines between Keeyask GS and the Keeyask switching station located on a 265 metre wide ROW;
- Three 138 kV generation outlet transmission lines from the Keeyask GS switching station to the Radisson Converter Station near Gillam located on a 200 meter wide ROW;
- Access routes/trails required for project construction and maintenance; and
- **Borrow areas** and storage/marshalling yards required for project construction purposes.

The Keeyask Transmission Project is encompassed within a triangular shaped geographic area in the Split Lake Resource Management Area that includes Gull Rapids and the major components of the proposed Keeyask GS, and extends along the southern shore of Stephens Lake to Kettle GS and the Radisson Converter Station. The southern boundary of the Project Study Area runs northeast to southwest paralleling the existing KN-36 and R-26K transmission lines to a point east of little Kettle Lake where the western boundary extends north-northwest to Gull Lake (Map 1-1).

This Forestry technical report describes the environmental assessment conducted on the commercial aspect of the forestry resources, domestic timber use and values relative to the Project area. The assessment of the ecological aspects of the forest resources are addressed in the *Keeyask Transmission Project Alternative Routes Evaluation and Preferred Route Assessment, Terrestrial Habitat, Ecosystems and Plants* (ECOSTEM Ltd. 2012).

As a result of clearing requirements for infrastructure purposes, the proposed Keeyask Transmission Project will directly affect forestry resources during the construction phase of development. Project effects are quantified according to the Manitoba Conservation and Water

Stewardship, Forestry Branch administrative zones straddling the Project Footprint and the Regional Study Area (Map 1-1).

Keeyask Transmission Project

Project Infrastructure

- Project Study Area
- Regional Study Area

Infrastructure

- Converter Station
- Generating Station (Proposed)
- Generating Station
- Bipole I and II (Existing 500 kV DC Line)
- Transmission Line

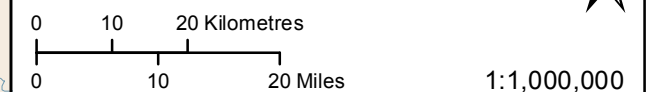
Forestry

- Forest Management Units

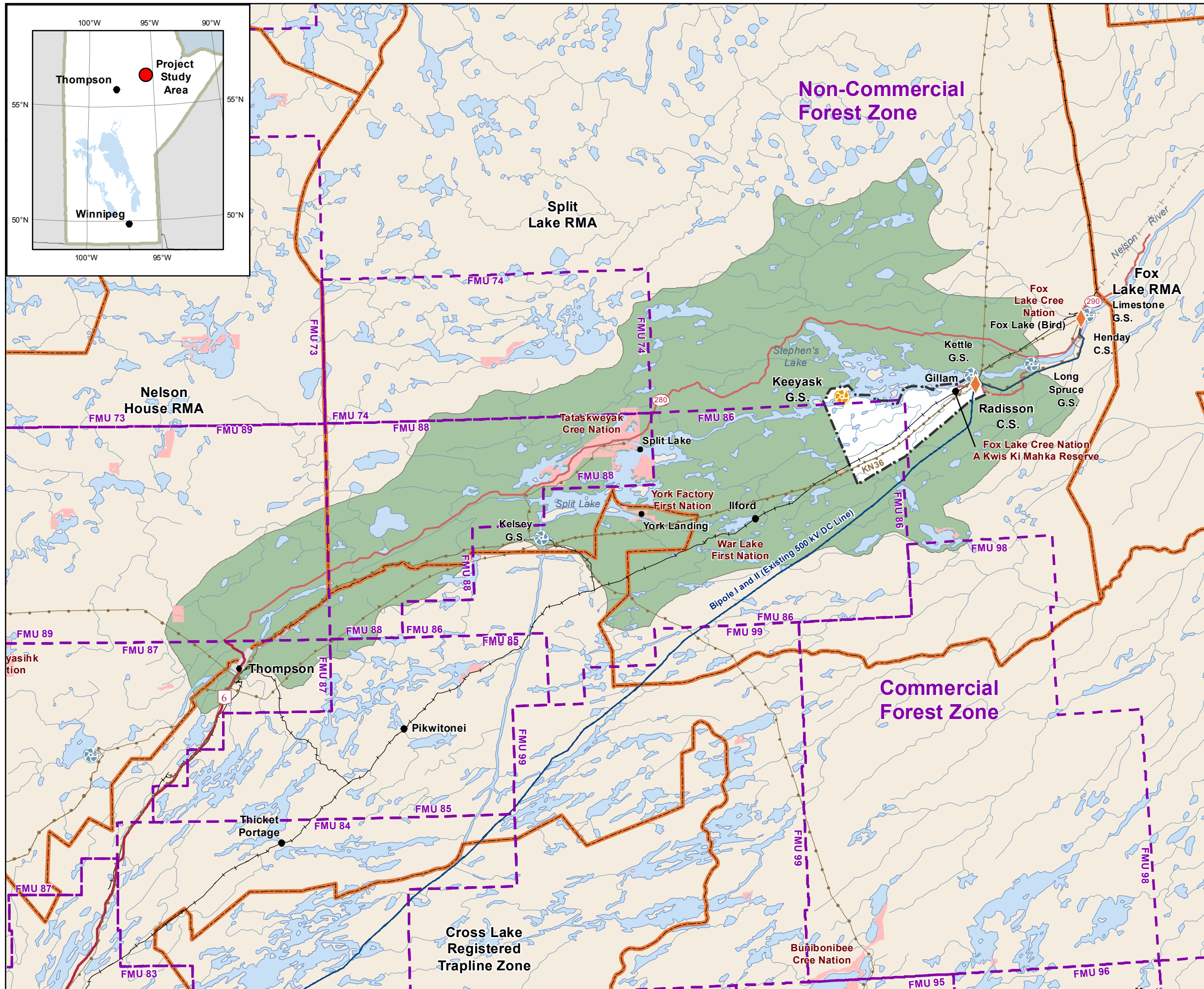
Landbase

- Community
- Provincial Highway
- Provincial Road
- Active Railway
- Abandoned Railway
- Resource Management Area
- First Nation
- Watercourse
- Waterbody

Coordinate System: UTM Zone 15N NAD83
 Data Source: MBHydro, Stantec, ProvMB, NRCAN
 Date Created: September 26, 2012



Study Areas



2.0 METHODS AND PROCEDURES

2.1 STUDY AREA DEFINITION

As part of the Project effects assessment, discussions of various study areas are considered. These areas are included on Map 1-1:

- Right-of-way (ROW) – refers to linear feature Project component footprints such as the cleared corridors required for the transmission lines and roads, where required;
- Project Footprint – describes the areas directly affected by all project components, including all transmission ROWs, station sites, borrow areas, storage/marshalling yards and access routes/trails, etc. required for Project construction purposes;
- Project Study Area – includes a large enough area that facilitates and enables the identification of alternative project routes/sites and forms the basis for the establishment of regional baseline conditions and Project effects assessment; and
- Regional Study Area – includes a large enough regional area to encompass all Project components as well as other projects, activities and actions (human and natural) to facilitate the assessment of cumulative effects.

The above areas straddle both the Manitoba Forestry Branch designated **Non-Commercial Forest Zone** (NCFZ) and the **Commercial Forest Zone** (CFZ) (Map 1-1). Given that the two forest zones have different administrative requirements, two different and independent approaches to the effects assessment were required.

2.2 DATA COLLECTION AND ANALYSIS

The potential for commercial and domestic use of forest resources was examined for the entire Regional Study Area. Information regarding potential demand and markets was obtained through discussions with members from Tataskweyak Cree Nation (TCN) during early field studies surrounding the Keeyask Generation Project, and Manitoba Conservation and Water Stewardship staff in Thompson and Gillam (Holmes, Walkoski. *pers.comm.*, 2012). Data collection, preparation and analysis were specific to the two affected forest zones, as described below.

2.2.1 The Non-Commercial Forest Zone

The assessment within the NCFZ is limited to the identification and quantification of useable timber resources. Useable timber resources are defined as forest stands of sufficient age to have produced trees of sufficient size (stem diameter and length) and in concentrations to make

it logistically and economically practical to salvage. The measurable parameters are area (ha) and timber volume (m³).

As there is no forest inventory data for the NCFZ, the description and assessment of the forest resources in the Project area started with a preliminary review of the immediately adjacent, existing Manitoba forest resource inventory (FRI) data available from Manitoba Conservation and Water Stewardship for the Commercial Forest Zone (CFZ), specifically FMU 86. This assisted in attaining an early appreciation of forest types and distribution. This was followed by forest sampling in 2001 and 2003 within the Keeyask Generation Project Study Area. Field activities and data collected were documented in Environmental Studies Program Technical Reports 01-16 and 03-07 (Plus4 et al. 2004 & Plus4. 2005). All field data was eventually incorporated into the ecosystems and habitat classification database facilitating spatial description and analysis (ECOSTEM Ltd., 2012)

To facilitate the potential effects assessment on timber within the NCFZ, the vegetation structure classifications “forest” and “woodland” on mineral soil were correlated to the FRI and **type aggregates** assigned. Applicable type aggregate codes were assigned including **subtype**, **site index**, cutting class and **crown closure**. This facilitates the application of the provincial **stand stock volume tables** (SSVT) applicable to the immediately adjacent Nelson River Forest Section. The SSVTs are a product of Manitoba Forestry Branch and the result of stand level sampling (Manitoba Government, 1991). They are developed on a Forest Section (FS) basis and provide average volume by species for stand type aggregates sampled within the forest section (date of inventory specific). Volume estimates of potentially salvageable timber are hence based on these tables. Potential salvage of timber is limited to the construction phase of the Project.

The extent of Project effects was determined by overlaying the Project Footprint shape file with the habitat land cover classification and soils data in a **Geographic Information System** (GIS) environment. The resultant data was summarized and the SSVTs applied to stands of cutting class 3 and higher to determine potential volume. The effects assessment is conducted on habitat land cover data updated to 2010.

2.2.2 The Commercial Forest Zone

The Project Footprint partially overlaps FMU 86 within the Nelson River FS which forms part of the CFZ (Map 1-1). Manitoba Conservation and Water Stewardship, Forestry Branch manages the CFZ on a sustained yield basis, expressed as Annual Allowable Cut (AAC) and administered at the FMU level. Sustainability is in part, calculated based on the amount of **productive forestland** available and the rate of growth, expressed as **mean annual increment** (MAI), on those lands. When productive forestlands are converted to other land uses (e.g., transmission ROW, station sites, roads), these lands are removed from the land base under forest management thereby reducing the theoretical sustainable volume of timber within the

FMU. A measurable parameter therefore, to determine Project effects within the CFZ, is productive forestland measured in hectares.

Given the limited Project Footprint within FMU 86, the age of the applicable FRI (origin 1991), the dated associated AAC values and the fact that Manitoba has no timber commitments within the FMU, an estimation of effect on AAC would have limited value. Manitoba Conservation and Water Stewardship, Forestry Branch advised to limit the assessment to the appraisal and valuation as specified in the Forest Damage Appraisal and Valuation (FDA&V) policy (Manitoba Government, 2002) (Epp and Holmes *pers. comm.*, 2012). The important measurable parameter required to conduct the FDA&V is standing volume of timber, measured in cubic meters, on productive forestlands.

2.2.2.1 Productive Forestlands

Manitoba Conservation and Water Stewardship, Forestry Branch, maintains a forest inventory for the CFZ in Manitoba and specifically, FMU 86 that overlaps a portion of the Project Footprint (Map 2-1). The Forest Resource Inventory (FRI) covering this area was re-interpreted from 1991 photography and has most recently been updated in 2011 to reflect depletions and fires (Boyd *pers. comm.*, 2011). Wild fires are a common occurrence in this northern region. The original SSVTs, developed from volume sampling data throughout the province in the 1980's, remain valid and form the basis for volume estimation for the FMU.

The affected lands are all classed as Crown lands within the FRI. Non-productive lands, as related to forestry, include FRI classification codes 700-900 series. These codes include all non-forest types, wetlands and water. The productive forestland codes 1–699 series have been grouped into two broad classifications; softwood leading **cover types** (codes 1-77), and hardwood leading cover types (codes 80-98) (Manitoba Government, 2007).

Project effects were determined by overlaying the Project Footprint shape file with the FRI data in a GIS environment. The resultant data were filtered for non-productive and productive forestlands and summarized. Finally, the area of productive forestlands affected was compared to the total productive forestlands within FMU 86. The FRI data was updated to 2011 for determination of project effects (see Section 2.2.2.2).

2.2.2.2 Forest Damage Appraisal and Valuation

Manitoba Conservation and Water Stewardship, Forestry Branch applies the Forest Damage Appraisal and Valuation (FDA&V) Policy (Manitoba Government, 2002) whenever productive forestland is removed from the land base. It is a compensatory form of mitigation that the province levies on the project proponent. It accounts for the volume of timber in cutting class 3, 4 and 5 stands within the Project Footprint as well as the loss in growth potential of timber within immature cutting classes (1 and 2) at the time of clearing. It also accounts for the investments in

forest management such as forest renewal, forest protection, and research and monitoring sites, where applicable. The FDA&V relies on the FRI to determine the area of productive forestland affected, the type and age of forest stands on those lands and the associated volume of timber. To perform a reliable damage appraisal and valuation estimate on the forest resources that will be affected, the FRI required updating.

Forest Resource Inventory Update

Although the FRI was updated for disturbances (fire, harvest, development) to 2011 by the Forestry Branch, these changes were limited to the year of these changes but no adjustments had been made for natural stand development over time. For untreated areas, a subtype reflective of the activity and/or expected forest transition, was assigned and the cutting class and crown closure component of the type aggregate was updated to 2011. For all other productive forested polygons, unaffected by depletion or renewal, the cutting class and crown closure components of the type aggregate were updated from year of photography (interpretation) to 2011.

The methodology employed to update cutting class required the determination of cutting class midpoint age from the cutting class age range tables provided in the FDA&V guideline document (Manitoba Government, 2002). The year 2011 was then used to calculate the number of years each forest stand has aged since initial interpretation or disturbance. This value was added to the original cutting class midpoint age, thereby arriving at a 2011 age. The cutting class age range tables were again used to update the cutting class attribute of the type aggregate to reflect its age at 2011. Crown closure was then updated to reflect the change in age or cutting class. The update to crown closure estimates the probable change in **stand density** over time. For type aggregates whose cutting class movement was greater than +/- 1 class, the crown closure class was increased or decreased accordingly by +/- 1 class. A movement of 3 cutting classes, for example, resulted in a movement of 2 crown closure classes to a minimum value of 0 and a maximum value of 4. For the purpose of this exercise, the subtype and site index of a type aggregate remain unchanged from the year of photography/interpretation. The results of this update process are reflected in the attribute data of the FRI for FMU 86 and used in all further assessment of effects within the CFZ.

Appraisal

In undertaking the forest damage appraisal, the area of productive forestlands falling within the Project Footprint were identified and summarized by updated type aggregate (subtype, site, cutting class and crown closure).

Within a type aggregate there are 6 cutting classes (0-5). Type aggregates within cutting class 3, 4 and 5 were assigned the softwood and hardwood gross **merchantable** volumes (m³/ha), presented in the SSVT, appropriate to the FS/FMU. The total softwood and hardwood

volumes/ha within these type aggregates were then multiplied by their respective areas to derive the total hardwood and softwood volumes, which are subject to the forest damage appraisal fee calculation. For cutting class 3, 4 and 5 type aggregates not represented in the SSVT (due to limited forest stand sampling), the volumes were calculated in a manner similar to the procedure for cutting class 1 and 2 type aggregates, described in the following paragraph.

Type aggregates, within immature cutting classes (1 and 2), are not reflected in the SSVT. Therefore, for type aggregates within these cutting classes, MAI was used to determine the volume of standing timber on these sites. In accordance with the procedures outlined in the FDA&V guidelines (Manitoba Government, 2002), the MAI value appropriate to the subtype, site and FS within which the type aggregate is located, was assigned. The total gross merchantable softwood and hardwood volumes for a type aggregate are then calculated by multiplying the MAI value with its mid-age of the cutting class and area. The derived volumes are subject to the forest damage appraisal fee calculation.

Type aggregates within cutting class 0 are considered recently disturbed sites (harvest, fire, etc.) and while considered to be potentially productive they have no associated standing timber volume and are therefore not subject to the forest damage appraisal.

The FDA&V has been conducted on the proposed Project Footprint using a worst-case scenario. It assumes that all footprint features identified will be cleared to their maximum extent. Changes in actual footprint development may be realized (e.g., borrow area requirements) that may ultimately affect the total amount of productive forestland affected and therefore the results of the FDA&V. A new FDA&V assessment may be required following construction to determine the exact effect on the productive forestland base.

The results of this FDA&V are summarized in Section 4.3.3.

Valuation

Effective January 1, 2008, the application of crown **timber dues** moved from a strictly volume based timber pricing system to a more comprehensive system (Manitoba Government website, 2012A). The valuation system accounts for the intended end product, current market value of that product and distance to the mill or processing facility. Timber dues are set monthly, based on the previous months average commodity reference price. The new system determines dues for hardwood and softwood timber and an associated forest product class. There are four main product classes (Kraft, Lumber, Oriented Strand Board and Newsprint) and personal use classes, such as fuelwood, posts and rails. Charges, in addition to the Crown timber dues, include a forest renewal charge (FRC) and fire protection charge (FP). The FRC is collected to offset the cost of forest renewal throughout the province and the FP charge is collected to offset the firefighting/prevention costs the province undertakes to protect forests. Both of these additional charges are volume based. The FRC charge for softwood is \$5.75/m³ and \$0.50/m³

for hardwood. The FP charge is \$0.17/m³ for softwood and hardwood. Forest plantations or high value forestry sites such as **seed orchards** and research plots are subject to an additional charge by the Province. The Province establishes a charge that reflects the value or investment into these sites. Presently the provincial average establishment cost for plantations is \$882.35/ha. However, no high value forestry sites were encountered within the Project Footprint.

In order to undertake the calculations needed to arrive at a valuation of the standing timber affected by the Project Footprint, a determination of market destination for the timber was required as well as an estimate of a fluctuating market value (commodity price index) of an as yet to be determined timber product. The uncertainty that would be associated with such determinations prompted the need for a composite dues table more suited for this valuation. The timber dues table needed to be re-structured in such a way as to provide a reasonable presumption of product end use and market index price. This involved considerable consultation with Manitoba Forestry Branch staff (Epp. *pers. comm.*, 2011) and Branch regional staff (Thorpe and Swanson. *pers. comm.*, 2011) along with an extensive examination of historical and present market pricing indices, mill demand and area specific historical trends for forest products and future market opportunities.

A composite timber dues table was prepared and structured to provide an estimate of timber dues likely to be incurred on softwood and hardwood volumes cleared within the Project Footprint at the time of construction. The composite timber dues table is provided in Appendix A.

The FDA&V has been completed for productive forestlands that will be cleared from the Project Footprint. The work sheets for the FDA&V determination are contained in Appendix B, while the results are summarized in Section 4.4 and Appendix C.

2.3 EVALUATION OF ALTERNATIVE ROUTES AND INFRASTRUCTURE

When considered purely from a commercial and domestic resource use perspective, the difference of effects between alternative routes/sites on forest resources was considered very small and insignificant to the process of selecting preferred routes/sites. The selection process was therefore referred to the biophysical (e.g. ecology, vegetation, wildlife, birds, aquatics, fisheries, amphibians and reptiles) and socio-economic (e.g. community and resource user input, heritage resources) study disciplines. For details of the preferred routes/sites selection process please refer to the following Keeyask Transmission Project technical reports: *Aquatic Environment* (North/South Consultants, 2012) *Terrestrial Habitats, Ecosystems and Plants* (ECOSTEM Ltd., 2012), *Amphibian* (Stantec, 2012A), *Avian* (Stantec, 2012B), *Mammals*

(Wildlife Resource Consulting Services, 2012), *Socio-Economic* (InterGroup Consultants Ltd., 2012), and *Heritage Resources* (Northern Light Heritage Resources, 2012).

Keeyask Transmission Project

Project Infrastructure

- Generation Outlet Transmission Lines (200m ROW)
- Construction Power Line (KN36) (60m ROW)
- Construction Power Line (Temporary) (60m ROW)
- Unit Lines (265m ROW)
- Construction Power Station
- Switching Station
- Project Study Area
- Regional Study Area

Infrastructure

- Converter Station
- Generating Station (Proposed)
- Generating Station
- Bipole I and II (Existing 500 kV DC Line)
- Transmission Line
- Access Road
- Proposed Access Road

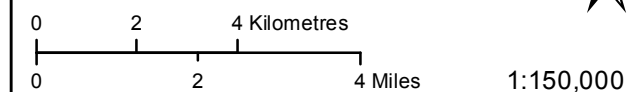
Forestry

- Forest Management Units
- Cut Class 0, 1, 2
- Cut Class 3, 4, 5
- Potential Salvage Timber in the NCFZ

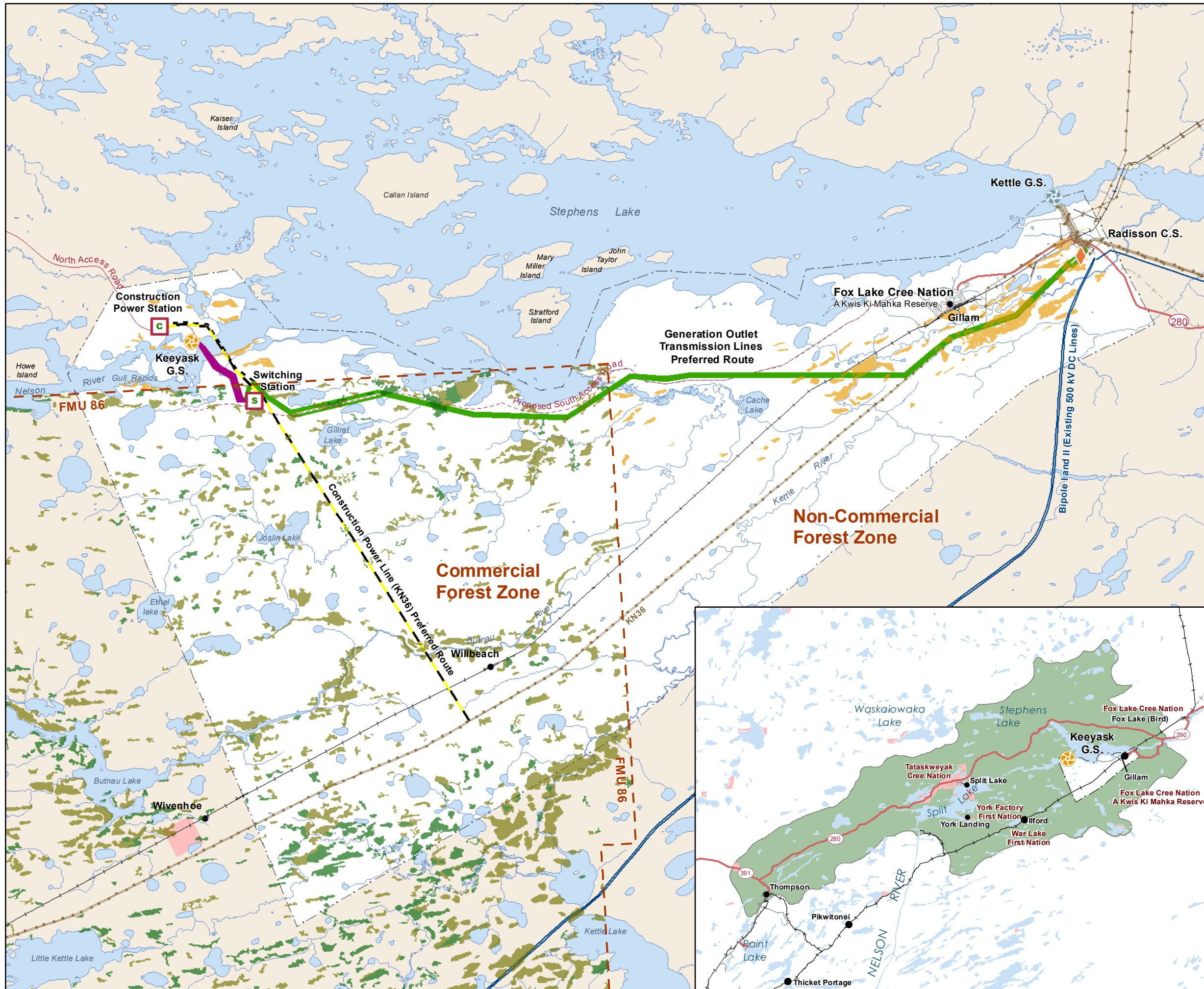
Landbase

- Community
- Provincial Road
- Municipal Road
- Active Railway
- Abandoned Railway
- Watercourse
- Waterbody

Coordinate System: UTM Zone 15N NAD83
 Data Source: MBHydro, ProvMB, NRCAN
 Date Created: Friday, October 05, 2012



Potential Salvage Timber Areas within the Project Footprint



3.0 STUDY AREA CHARACTERIZATION

The proposed Keeyask Transmission Project Footprint encompasses a range of ecosites with soil types ranging from mineral to organic (ECOSTEM Ltd., 2012). The vast majority of the Project Study Area is comprised of peatlands and water while productive forestlands (a minor component) are associated with mineral soils. Forest and woodland stands on mineral soils, comprised primarily of black spruce and jack pine in pure and mixed wood stands, populate the area. Also present are trembling aspen and white birch however, these are found primarily as minor admixtures to the conifer dominant stands. White spruce is not commonly found within this northern region.

Wildfires govern the stage of development of vegetation communities in the Regional Study Area. Much of the Project Footprint area was affected by the 1999 and 2005, as well as earlier, wildfires (ECOSTEM Ltd., 2012). These burnt areas now host young regenerating forest stands and shrub communities. Any trees killed at the time of these fires are now past the point of salvage. Although few, most remaining older forest and woodland stands that are potentially salvageable within the Project Footprint, originated during the 1930s and 1940s.

As previously indicated, the Project Footprint straddles both of the Manitoba Forestry Branch designated Non-Commercial Forest and Commercial Forest Zones (Map 1-1). The NCFZ in northern Manitoba is so designated due to its limited timber production potential (due to climatic conditions), distance to mills and markets, and lack of infrastructure (i.e., roads, railroads). Although so classified, specific ecosite types within the Regional Study Area have the potential to grow forests to useable size. Growth rates however, are generally less than in more southern latitudes and this is typified in the Project area. Although nearing their theoretical rotation age (maturity), tree stems are small in diameter and short in length resulting in low volumes per hectare.

The western portion of the Project Footprint is located on open Crown land within the CFZ albeit on the furthest northeast extremity of Forest Management Unit (FMU) 86 within the Nelson FS (Map 1-1). Of note is that much of the Project Footprint within the CFZ has been burnt by recent wildfires (ECOSTEM Ltd., 2012), most notably in 2005, and is therefore in the early stages of regeneration or immature in forest stand development.

At present, there is no commercial scale demand and therefore no commercial harvest of timber within the Regional Study Area (Holmes. *pers. comm.*, 2012). In part, this condition is created by a supply of wood fibre that exceeds the demand in closer proximity to mills and markets. Small-scale timber harvest for personal use, primarily firewood, does exist in proximity to the Project Footprint, most notably in the vicinity of Gillam. This community is however also the beneficiary of the Waterways Management Program that collects and

disposes of floating wooden debris on the Nelson River system and washed up on shorelines. Some of this material is piled near Gillam for local use (Walkoski. *pers. comm.*, 2012).

Although commercial timber harvesting may not be economically viable within or in proximity to the Project Study Area, it does not necessarily preclude timber salvage where an end use/market is available. The difference between typical timber harvesting and salvage operations is that the former is entirely reliant for economic viability based on the market price of the timber while salvage operations are partly funded by the clearing contract price. Where the clearing contractor can envision economic gain by salvaging timber then he/she may be motivated to do so, providing all other clearing contract conditions are met. Timber salvage does incur additional equipment, time, logistics and costs. Timber demand and prices are subject to market conditions and will have to be assessed at the time of clearing.

Minor quantities of timber of useable size are present on portions of the Project Footprint, specifically those sites classified as “forest” and “woodland” on mineral soil (productive forestland). Primary species are black spruce and jack pine with minor quantities of trembling aspen and white birch also present.

For a more detailed ecological description of the Project Study Area please refer to the *Terrestrial Habitat, Ecosystems and Plants Technical Report* (ECOSTEM Ltd., 2012).

4.0 EFFECTS AND MITIGATION

4.1 OVERVIEW

This section considers potential effects of the project based on the final preferred sites for each project component. The selection process that resulted in the final preferred site is described in Chapter 6 of the Keeyask Transmission Project Environmental Assessment Report.

The results of the Project effects assessment and mitigation are provided independently below for the NCFZ and CFZ followed by the identification of residual effects, a discussion of cumulative effects, monitoring and follow-up.

4.2 THE NON-COMMERCIAL FOREST ZONE

The forestry specific important measurable parameters identified for determining the effects of the Project within the NCFZ are:

- Area (ha) of potentially useable timber; and
- Volume of potentially salvageable timber.

The effects assessment assumes the worst-case scenario that all areas shown as impact areas (Project Footprint) in Map 1-1 will be cleared (e.g. all ROWs, the full extent of all borrow areas, all station sites, etc.). This implies that a total of 83.6 hectares of potentially salvageable forest and woodland will be cleared of which 87% and 13% are softwood and hardwood dominant respectively (Table 4-1). This equates to 0.35 % of the land base within the NCFZ portion of the Project Study Area. The relatively small effect on forest resources is a reflection of the terrain (non-forest/woodland types) within the Project Study Area and the frequent occurrence of wildfires in the area.

Given the climatic constraints in the Regional Study Area, commercially useable tree species develop at reduced growth rates than in more southern areas of Manitoba. Although at or near rotation age (maturity), potentially salvageable timber stands exhibit small diameter stem sizes and trees are short. Stem densities are also lower in stands due to mortality within the stands from ground fires and disease. These factors contribute to many of the stands identified as being potentially salvageable as having low volume content on a per hectare basis (Appendix C). Volume estimates rely on the SSVT for the immediately adjacent Nelson River FS. Net merchantable volume for identified stands is calculated for all trees with a diameter at breast height of 9.1 centimetres and greater. Typically in softwood timber harvest operations stands should have a minimum of 55 m³ of merchantable timber to make the operation economically feasible. Local conditions and markets may affect this.

Table 4-1: Potential Salvageable Forest Area in the NCFZ within the Project Footprint

Working Group	Major Species	Area (ha)	Percent of
			Project Study Area
Softwood	Black Spruce	48.6	n/a
	Jack Pine	23.9	n/a
Subtotal Softwood		72.5	n/a
Hardwood	Aspen/Poplar	11.1	n/a
Subtotal Hardwood		11.1	n/a
Total		83.6	0.35

An estimated 3676 m³ of timber may be salvageable in the Project Footprint area (Table 4-2). Of this, approximately 85% consists of softwood and 15% of hardwoods. The ultimate utilization options available for the timber and field logistics at the time of clearing/salvage may also influence the amount that can be practically and feasibly salvaged.

Table 4-2: Potentially Salvageable Timber in the NCFZ of the Project Footprint

Working Group	Major Species	Volume (m ³)		
		Softwood	Hardwood	Total
Softwood	Black Spruce	2235.9	164.9	2400.8
	Jack Pine	885.7	0.0	885.7
Hardwood	Aspen/Poplar	0.0	389.2	389.2
Total		3121.6	554.0	3675.6

Notes: Volumes are estimates only; based on habitat cover type correlation to FRI and application of Manitoba Conservation and Water Stewardship, Forestry Branch Stand Stock Volume Tables.

4.2.1 Mitigation

Opportunities for timber utilization should be examined locally and provincially in advance of clearing. Where timber demand exists and salvage is feasible from logistical and economical perspectives, all efforts should be made to salvage the timber. Salvage operations should then proceed, using timber-harvesting equipment, in advance of clearing operations to minimize damage and maximize value. All salvageable areas should be harvested at the same time to maximize efficiencies. Salvaged timber should be piled well clear of work areas for logistical reasons and to avoid damage from equipment. All salvaged timber should be promptly hauled off the project site and delivered to its intended end market.

In all cases clearing of forest and woodland types should be kept to the minimum area required for the project and in accordance with the provincial Forest Practices Guidelines (Manitoba Government website, 2012D). The clearing boundaries should be marked so that they are clearly visible to the equipment operators. All clearing and construction equipment is to remain within the bounds of the project area identified. Debris from harvesting and clearing is not to be pushed into standing timber. Where timber and clearing debris is to be disposed of by burning, piles are to be made well clear of adjacent forest stands to avoid scorching them during burning.

The above mitigation measures do not lessen the environmental effects of clearing required for the Project. However, these may be reduced where on-site clearing requirements are less than identified in Map 2-1 (e.g., entire borrow site areas are not needed).

The assessment of the NCFZ (Appendix C) identified small areas of standing timber with potential salvage value (Map 2-1). These areas are deemed to have minimal to no commercial value due to the very small area overlain by the Project Footprint, the broad geographic distribution of these areas, the marginal forest stand condition (stem diameter, length and density) and the long distance from any manufacturing facility. Salvage opportunities within the NCFZ, for fuelwood, may exist if a demand from the local community is identified.

4.3 THE COMMERCIAL FOREST ZONE

The forestry specific important measurable parameters identified for determining the effects of the Project within the CFZ are:

- Productive forestland; and
- Standing timber.

4.3.1 Productive Forestland

Productive forestlands form the basis for all forest management planning for Manitoba Conservation and Water Stewardship, Forestry Branch. It is the basis from which the Forestry Branch determines sustainable harvest levels for all Crown lands. A summary of the amount of productive forestland within FMU 86 and area affected by the Project Footprint is provided in Table 4-3. Project effects on productive forestland are measured in area (hectares).

Effects on productive forestland will occur during the construction phase of the Project and are primarily the result of clearing activities (Map 2-1). A total area of 467.2 ha fall within the project footprint, the majority of which are classified as non-productive lands (395 ha). A

total of 62.9 ha of productive forestland will be affected by the Project, representing 0.06 % of the total productive forestland within FMU 86.

Table 4-3: Project Effects on Productive Forestland in FMU 86 (CFZ)

Pre-Project Productive Forestland (ha)	Project Effects (ha)	Project Effects (%)
106,542	62.9	0.06

Source: Manitoba Government. 2011.

4.3.2 Standing Timber

The Project Footprint will be cleared of all trees. The volume of standing timber in all age classes on productive forestland within FMU 86 is considered under standing timber volume. The total volume of standing timber found on productive, crown-owned forestland and intersected by the Project Footprint is taken into account in the FDA&V (Section 2.2.2.2).

Effects on standing timber in FMU 86, as a result of the Project Footprint, are shown in Table 4-4. A total of 1,601 m³ (0.025%) of softwood and 119 m³ (0.012%) of hardwood will be affected by the Project for a combined total of 1720 m³ or 0.023% of the total volume of productive timber within FMU 86. Some of this wood volume (1008 m³ in cutting classes 3 and 4) may be of sufficient size and concentration to make it practical to salvage (Appendix C).

Table 4-4: Project Effect on Standing Timber within FMU 86 (CFZ)

Pre-Project Standing Timber Gross Merchantable ¹ in FMU 86 (m ³)			Project Effect on Standing Timber Gross Merchantable (m ³)			Project Effect (%)		
Soft wood	Hard wood	Total	Soft wood	Hard wood	Total	Soft wood	Hard wood	Total
6,450,518	975,391	7,425,909	1,601	119	1,720	0.025	0.012	0.023

¹ Gross Merchantable Volume does not consider operational constraints or cull factors. Gross Merchantable volume was used in the FDA&V.

4.3.3 Mitigation

Opportunities for timber utilization should be examined locally and provincially in advance of clearing. Where the opportunities exist and are feasible from logistical and economical perspectives, efforts should be made to salvage the timber. Salvage operations should then proceed, using timber harvesting equipment, in advance of clearing operations to minimize

damage and maximize value. All salvageable areas should be harvested at the same time to maximize efficiencies. Salvaged timber should be piled well clear of work areas for logistical reasons and to avoid damage from equipment. All salvaged timber should be promptly hauled off the project site and delivered to its intended end market.

All clearing activities should be conducted during the winter on frozen ground conditions. In all cases clearing of forest and woodland types should be kept to the minimum area required for the project and in accordance with the provincial Forest Practices Guidelines (Manitoba Government website 2012D). The clearing boundaries should be marked so that they are clearly visible to the equipment operators. All clearing and construction equipment is to remain within the bounds of the Project Footprint identified. Debris from harvesting and clearing is not to be pushed into standing timber. Where timber and clearing debris is to be disposed of by burning, piles are to be made well clear of adjacent forest stands to avoid scorching them during burning. All fires must be fully extinguished prior to spring break-up.

The above mitigation measures do not lessen the environmental effects of clearing required for the Project. However, these effects may be reduced where on-site clearing requirements are less than identified in the Project description (e.g., entire borrow site areas may not be needed, etc.).

4.3.3.1 Forest Damage Appraisal and Valuation

The Manitoba Conservation and Water Stewardship Forest Damage Appraisal and Valuation (FDA&V) policy stipulates financial compensation for timber values and investments on crown productive forestlands within the CFZ (Government of Manitoba 2002). Manitoba Hydro will compensate Manitoba Conservation and Water Stewardship for the effects of the Project as specified in the policy or as negotiated between the two parties. The FDA&V was applied to the Project Footprint area in order to quantify the effect on Crown forest resources. Table 4-5 summarizes the damage appraisal conducted and estimates the value of compensation payable to Manitoba Conservation and Water Stewardship. The assessment of softwood and hardwood dues is based on the volume of standing timber affected (Table 4-4). No plantations or other high value forest sites are affected. The resultant FDA&V indicates the estimated compensation payable to Manitoba Conservation and Water Stewardship to be \$11,535.04 (Table 4-5).

The composite timber dues applied in the FDA&V and the supporting documentation required to calculate the compensation are provided in Appendix B. As with the effects assessment within the NCFZ, this assessment considers a worst-case scenario where the entire Project Footprint that has been identified would be cleared.

Table 4-5: Project Forest Damage Appraisal & Valuation Summary (\$)

Plantation Cost	Softwood Dues	Hardwood Dues	Forest Renewal Charge	Fire Protection Charge	Total Valuation
0.00	1,841.17	136.39	9,265.15	292.33	11,535.04

Plantation establishment cost \$882.35/ha; FRC = forest renewal charge (softwood = \$5.75/m³, hardwood = \$0.50/m³); FP = forest protection charge (\$0.17/m³); Considers Gross Merchantable Volume which does not consider operational constraints or cull factors (Government of Manitoba 2002).

It should be noted that this evaluation is an estimate only and that recalculations should occur at the time of clearing to ensure that the FDA&V is reflective of the actual Project Footprint effects and timber dues applicable at that time.

4.4 RESIDUAL EFFECTS

The aerial extent of effects on forestry values within the Non-Commercial and Commercial Forest Zones is shown in Table 4-6. A total of 83.6 ha (3675.7 m³) of potentially salvageable timber will be affected in the NCFZ (Map 2-1). In addition, a total of 62.9 ha (1,720 m³) of productive forestlands are projected to be affected within the CFZ (Map 2-1) which represents 0.023% of the total within FMU 86.

Table 4-6: Forestry Residual Effects Summary

Non-Commercial Forest Zone (Forest & Woodland on Mineral Soil)		Commercial Forest Zone (Productive Forestland)		Total Effect	
Area (ha)	Vol. (m ³)	Area (ha)	Vol. (m ³)	Area (ha)	Vol. (m ³)
83.6	3675.7	62.9	1,720	146.5	5395.7

Residual effects are further identified and characterized relative to the forestry measurable parameters identified for this assessment (Section 4.2 and 4.3) in Table 4-7.

Table 4-7: Summary of Residual Effects on Forestry Measurable Parameters

Potential Effect	Project Phase	Mitigation	Residual Effects	Assessment Characterizations
Loss of useable timber resources in the NCFZ	Construction	<ul style="list-style-type: none"> • Limit clearing to project footprint; • Salvage timber where demand exists & it is economically & logistically feasible; • All clearing to be conducted on frozen ground conditions to minimize damage to adjacent forest stands; • Burn piles must be placed well clear of adjacent forest stands to avoid scorching them during burning; • All fires must be fully extinguished prior to spring breakup. 	<ul style="list-style-type: none"> • Loss of useable timber resources. 	Direction: adverse Magnitude: small Geographic Extent: small Duration: long-term
Loss of productive forestland in the CFZ	Construction	<ul style="list-style-type: none"> • Limit clearing to the project footprint; • Compensate MCWS as per FDA&V guideline. 	<ul style="list-style-type: none"> • Loss of productive forestland. 	Direction: adverse Magnitude: small Geographic Extent: small Duration: long-term
Loss of standing timber	Construction	<ul style="list-style-type: none"> • Limit clearing to project footprint; • Salvage timber where demand exists & it is economically & logistically feasible; • All clearing to be conducted on frozen ground conditions to minimize damage to adjacent forest stands; • Burn piles must be placed well clear of adjacent forest stands to avoid scorching them during burning; • All fires must be fully extinguished prior to spring breakup. 	<ul style="list-style-type: none"> • Loss of standing timber. 	Direction: adverse Magnitude: small Geographic Extent: small Duration: long-term

NCFZ = Non-Commercial Forest Zone, CFZ = Commercial Forest Zone.

4.5 INTERACTIONS WITH OTHER PROJECTS

Interactions with other projects are considered when the environmental effects of a project combine with the effects of other past, present and future projects or activities. Such effects typically occur over a large area that may cross spatial and temporal boundaries, and can act, at least additively and at most synergistically. A series of seemingly insignificant environmental effects over space and time, for example, may ultimately result in a significant effect when an ecological or legal threshold is exceeded.

Potential interactions with other projects are presented in the following sequence after Canadian Environmental Assessment Act (CEAA 1994) and Hegmann *et al.*, (1999):

- Scoping;
- Analysis of effects;
- Identification of mitigation ;
- Identification of follow-up; and
- Evaluation of significance.

4.5.1 Scoping

In regards to the resource based forestry values, issues of concern focus on the removal of timber supplies within the NCFZ and conversion of productive forestlands within the CFZ to something other than forest management, thereby effectively removing it from the forest land base under management. Ecological, natural events (e.g. weather) and climate change are considered in detail in the Keeyask Transmission Project *Terrestrial Habitat, Ecosystems and Plants Technical Report* (ECOSTEM *et al.*, 2012).

The project interactions review is carried out considering residual environmental effects of this and other projects or activities within the Keeyask Transmission Project Regional Study Area using the same indicators and measurable parameters as used for the Keeyask Transmission Project (Section 4.2, 4.3). For the NCFZ, these include the area and volume of potentially salvageable timber while for the CFZ they include productive forestland and standing timber.

The spatial boundary for the projects potential interaction review is the Regional Study Area (Map 1-1) that is large enough to provide a regional perspective and encompass other projects, activities and actions. Consistent with typical forest management planning horizons in Manitoba (e.g. Forest Management Plans) (Manitoba Government website, 2012B), the temporal boundary is set at 20 years into the past and future centered on the FRI updated to 2011 (i.e. 1991 to 2031). This temporal window is realistic from the perspective of historic data and information reliability and the ability to predict future actions and developments within the Regional Study Area.

The residual effects of the Keeyask Transmission Project are quantified in Section 4.4 and are considered insignificant in scale both within the Non-Commercial and Commercial Forest zones. Other projects and actions within the Regional Study Area are identified by action category in Table 4-8.

4.5.2 Analysis

Other projects, activities and actions with potential effects, within the same temporal and spatial boundaries, on the same indicators and measurable parameters as the Keeyask Transmission Project can be classed by action category as indicated in Table 4-8. Some projects/developments result in permanent deforestation that precludes forest growth on the sites affected. Other actions and events result in temporary effects to forest sites that impede or set back the development of a forest stand on a site but not on a permanent basis (e.g. fire). The third type of action category results in a change in land use status that precludes forest management activities on forested lands. Examples of this include the setting aside of lands for protection, settling of outstanding treaty land entitlements (TLE), etc.

4.5.2.1 Deforestation Projects/Actions

The Keeyask Transmission Project Footprint straddles the Non-Commercial and Commercial forest zones affecting a very small amount of land with useable timber, productive forestland and associated standing timber (Section 4.4). The effects are minimal and do not affect the domestic timber supply within the Regional Study Area or the commercial timber supply within FMU 86 (CFZ) (Section 4.4). The interaction between projects in both the Non-Commercial and Commercial forest zones is therefore negligible.

Although the Keeyask Infrastructure Project affects some lands with useable timber, the effect is entirely within the NCFZ. The effect is limited to some potentially useable timber stands along the north access road, on borrow areas and on camp, work and station sites (Keeyask Hydropower Limited Partnership, 2009). The effect is minimal and does not affect the domestic timber supply within the Regional Study Area.

The Keeyask Generation Project Footprint straddles the Non-Commercial and Commercial forest zones affecting a very small amount of land with useable timber, productive forestland and associated standing timber. The effects are minimal and do not affect the domestic timber supply within the Regional Study Area or the commercial timber supply within FMU 86 (CFZ) (Keeyask Hydropower Limited Partnership, 2012). The interactions with other projects in both the Non-Commercial and Commercial forest zones are therefore negligible.

Table 4-8: Regional Interactions with Other Projects/Actions

Action Category	Project/Action Description	Residual Environmental Effects / Measurable Parameter			
		Non-Commercial Forest Zone		Commercial Forest Zone	
		Useable timber area	Useable timber volume	Productive forestland area	Standing timber volume
Deforestation	Keyyask Transmission Project	1	1	1	1
	Keyyask Infrastructure Project	1	1	n/a	n/a
	Keyyask Generation Project	1	1	1	1
	Road infrastructure (PR 280)	1	1	n/a	n/a
	Gillam Redevelopment	1	1	n/a	n/a
Temporal Forest Status	Keyyask Transmission Project	0	0	0	0
	Mineral exploration trails and drill sites	0	0	1	0
	Borrow areas	0	0	1	0
	Domestic timber use	0	1	0	0
	Natural events (fires, floods, wind, insect/disease)	4	4	0	4
Land Use Reclassification	Keyyask Transmission Project	1	1	1	1
	Protected Area establishment, including parks	0	0	0	0
	Treaty Land Entitlement selections	0	0	0	0

Magnitude ranking: + = positive; 0 = no effect; 1 = negligible; 2 = low; 3 = low to moderate; 4 = moderate; 5 = moderate to high; 6 = high.

The highway linking Thompson, the Keyyask GS development site and Gillam (PR 280) is currently undergoing spot improvement work between PR 391 and the Keyyask North Access Road (Lausman. *pers. comm.*, 2012). These include curve and grade flattening, gravelling, intersection improvements and expansion/development of borrow areas. The

effects are entirely limited to the NCFZ. The effect to lands with useable timber are minimal and do not affect the domestic timber supply within the Regional Study Area.

The community of Gillam has been relatively static over the last 20 years but may double in size and population over the next 10 to 20 years with the proposed northern hydro-electric developments (Keewatinoow Converter Station, Keeyask and Conawapa Generating Stations) (McGurk. *pers. comm.*, 2012). Future expansion is likely to occur in very close proximity to the existing town site to take advantage of town services. Estimated expansion may involve 200 ha of land, of which only a small portion may contain useable timber. The affected areas are entirely within the NCFZ. The interactions with the Keeyask Transmission Project is negligible.

4.5.2.2 Temporal Forest Status

The action category, Temporal Forest Status, encompasses those actions and events that have a temporary effect on the forested land base. Projects and actions that require some sites to be cleared but allow the forest to re-grow following activity completion include some aspects of the Keeyask Transmission Project (e.g. borrow areas, marshaling yards, access trails), mineral exploration trails and drill sites, borrow areas and domestic timber use.

Natural events such as fires, temporary floods, wind storms, insect infestations and disease may cause damage and mortality to forest stands but the productive capacity of forest sites is usually not affected. Being natural events, these effects are not limited or influenced by administrative boundaries. They therefore affect both the Non-Commercial and Commercial forest zones. The occurrence, frequency and extent of these effects are closely related to climatic conditions and weather (e.g. lightning). Of the events considered, wildfires are the most common and have the greatest effect within the Regional Study Area, as is evidenced by the young forest age class distribution.

Although influential, these events are not anticipated to have a limiting effect to the domestic timber supply within the Regional Study Area. Such events have no negative effect on productive forestland within the CFZ (FMU 86) but can temporarily negatively affect standing timber. The overall interaction with projects and other actions is considered moderate.

4.5.2.3 Land Use Reclassification

The reclassification of productive forestlands from forest management to industrial development within FMU 86 (CFZ) for purposes of the Keeyask Transmission Project is minimal (62.9 ha). No such action is required in the NCFZ. No lands have been identified for protection within the Keeyask Transmission Project Regional Study Area (Manitoba Government website, 2012C) or for TLE selection. The interactions with the Keeyask Transmission Project is limited to the CFZ, is very small and therefore negligible.

4.5.3 Mitigation

All project interaction effects to domestic and commercial forestry values are insignificant within the Keeyask Transmission Project Regional Study Area within the period 1991 to 2031 and therefore require no mitigation at this time.

4.5.4 Follow-up

The responsibility for managing the forestry resources rests with Manitoba Conservation and Water Stewardship, Forestry Branch. Forestry Branch must continue to monitor and document the level of land use change that affects the forest land base under management, particularly in FMU 86.

4.6 MONITORING

The above assessment has identified Project effects to forestry values. It prescribes mitigation measures to minimize effects to the degree possible and quantifies residual effects. It is Manitoba Hydro's responsibility to fully implement all mitigation measures. This is best achieved through advance planning and ensuring that the required information is clearly conveyed to Manitoba Hydro construction supervisors, all crews and contractors. This can be achieved by developing a very detailed, easy to read, environmental protection plan (EnvPP) for construction purposes. The EnvPP will show all environmental sensitivities and clearly state site specific mitigation measures. All spatial information will be geo-referenced.

The construction supervisor(s) and environmental inspectors must be on site regularly to direct construction crews/contractors, flag sensitive sites and clearing boundaries, and inspect work done to ensure mitigation measures are implemented as directed. In addition, they must assess the effectiveness of the mitigation measures implemented. Where they are not as effective as anticipated, adaptive management strategies will be required to address short-comings, inadequacies and unforeseen negative effects. It will be essential for Manitoba Hydro to have adequate numbers of well-trained environmental inspectors on the job site at all times.

Monitoring is required to document the proper implementation of mitigation measures, to assess their effectiveness and to verify effect predictions (i.e., residual effects) made in this environmental assessment (see Section 4.4). It is Manitoba Hydro's responsibility to implement a monitoring program designed to capture, document and report on the implementation and effectiveness of mitigation measures and to assess the accuracy of effect predictions made in this report. The following aspects are to be included in the construction phase monitoring program:

- At the end of the construction phase, define the actual Project Footprint within the Non-Commercial and Commercial Forest Zones;
- Document the volume of timber salvaged;
- Quantify the actual Project Footprint on productive forestland within FMU 86; and
- Perform a final FDA&V based on the actual Project Footprint.

As very limited effects are predicted to forestry resources during the operation phase of the project, no monitoring undertakings are proposed for this discipline specifically. The extent of effects will be captured by ecological monitoring activities as proposed in the *Terrestrial Habitat, Ecosystems and Plants Technical Report* (ECOSTEM Ltd., 2012).

5.0 CONCLUSIONS

The effects assessment of the Keeyask Transmission Project on forestry values was conducted independently for the Non-Commercial and Commercial Forest zones. Within the Non-Commercial Forest Zone (NCFZ) the assessment was limited to the identification and quantification of potentially salvageable/useable timber within the Project Footprint, that being the limit of effects. The feasibility of salvaging approximately 83.6 ha of potentially salvageable timber (approximately 3675 m³) depends on economics and market demand for timber at the time of clearing, as well as logistics for accessing and removing the timber.

The assessment of effects for the Commercial Forest Zone (CFZ) follows the outlined approach in the provincial *Forest Damage Appraisal and Valuation* (Manitoba Government, 2002) guideline. It requires the quantification of productive forestland and standing timber affected, followed by the appraisal and valuation of damages. Productive forestlands in FMU 86 amount to 106,543.26 ha representing 17% of the total land base (627,329 ha) within the FMU. Within the 467 ha Project Footprint, 63 ha (13.6%) are productive forestland. This represents 0.06% of the productive forestlands within the FMU. The Standing timber volume within the project footprint is minimal (1,720 m³) relative to 63 hectares of productive forestland; supporting the fact that the affected stands are for the most part young with low average volume per hectare. As no high value forest sites are encountered within the Project Footprint, the total FDA&V payable by Manitoba Hydro to Manitoba Conservation and Water Stewardship is approximately \$11,535.04.

All effects are limited to the Project Footprint. Mitigation is limited to ensuring effects are contained to the Footprint, salvaging of useable timber where feasible and paying damages to Manitoba Conservation and Water Stewardship as per the conducted FDA&V. The overall effects on forestry resource values as a result of the Keeyask Transmission Project are very small with no effects to the local domestic timber supply and a very minor reduction of productive forestland within FMU 86 (CFZ) where commercial timber demand is currently non-existent.

Interactions with future projects with similar effects on the domestic timber supply within the NCFZ, productive forestland and standing timber in the CFZ include the Keeyask Infrastructure Project, the proposed Keeyask Generation Project, on-going PR 280 improvements and expected redevelopment related to Gillam.

6.0 GLOSSARY

Glossary terms appear in bold print in the report at their first occurrence.

Borrow area – A small quarry or excavation beyond the limits of road or dam construction, which provide material for use in the construction project (Dunster et al, 1996).

Commercial Forest Zone – The geographic area, defined by Manitoba Conservation and Water Stewardship, Forestry Branch, that is capable of producing trees large enough for commercial harvesting. The Commercial Forest Zone includes most of the Prairie, Boreal Plains and Boreal Shield ecozones. It is also referred to as the Productive Forest Zone.

Covertypes – Four broad cover types are recognized – Softwood ‘S’, Softwood-Hardwood ‘M’, Hardwood-Softwood ‘N’, Hardwood ‘H’. The first number of the sup-type code indicates the type aggregate (0 to 3 - Softwood; 4 to 7 – Softwood/Hardwood Mixed ; 8 – Hardwood/Softwood Mixed; 9 – Hardwood) (Manitoba, Government of, 2007A).

Crown closure – Crown closure is estimated from the photographs by the photo-interpreter. Four classes are recognized and entered onto the stand description sheet as part of the photo-interpreted type aggregate. Changes of this estimate can be made only under exceptional circumstances (0 - 0 % - 20 % crown closure; 2 - 21 % - 50 % crown closure; 3 - 51 % - 70 % crown closure; 4 - 71 % and over) (Manitoba, Government of, 2007B).

Cutting class – Cutting class is based on size, vigour, state of development and maturity of a stand for harvesting purposes (Manitoba, Government of, 2007B).

Environmental assessment – The actual technical assessment work that leads to the production of an environmental impact statement. The technical methodologies used must be scientifically sound, and explainable and defensible in a court of law. The scope of the assessment is typically outlined at the start of the project so that the project has some well-defined boundaries (Dunster et al, 1996).

Geographic Information System – A computer system used to overlay large volumes of spatial data of differing attributes. The data are referred to a set of geographical coordinates and encoded in computer (digital) format so they can be sorted, selectively retrieved, statically and spatially analyzed (Dunster et al, 1996).

Mean annual increment – or mean annual growth refers to the average growth per year a tree or stand of trees has exhibited/experienced to a specified age.

Merchantable – A tree or stand of trees is considered to be merchantable once it has reached a size, quality, volume or a combination of these that makes it suitable for harvesting and processing. Merchantability is independent of economic factors, such as road accessibility or logging feasibility (Dunster et al, 1996).

Non-Commercial Forest Zone – The geographic area, defined by Manitoba Conservation, Forestry Branch, that is predominately not capable of producing trees large enough for commercial harvesting. The Non-Commercial Forest Zone lies north of the Provincially

designated forest management administrative boundary areas (Forest Sections and Forest Management Units).

Productive forestland – Includes all forest land capable of producing merchantable wood regardless of its existing stage of productivity (Manitoba, Gov. of, 2007A).

Seed orchard – A plantation of trees either proven by analysis to be genetically superior, or a plantation of plus trees that are being tested for superior genetic traits. The seed orchard is isolated to reduce cross-pollination from potentially inferior, outside sources, and is intensively managed to improve the geno-type and produce frequent, abundant, and easily harvestable seed crops (Dunster et al, 1996).

Site index – is a term used in forestry to describe the potential for forest trees to grow at a particular location or "site." Site index is used to measure/describe the productivity of the site. It is typically defined as a function of age and height.

Stand density – A quantitative measure of the number and size of trees on a forest site. Can be expressed as number of trees per hectare, basal area (m²/hectare), stand density index, or weight. Unless specified, stand density would include all trees regardless of age (Dunster et al, 1996).

Stand Stock Volume Tables – Compiled from provincial volume sampling data, the table is comprised of forest stand volume estimates by type aggregate, diameter at breast height (DBH) class and species for specific areas throughout the Province. Volumes are provided at various utilization levels for cutting classes 3, 4 and 5 stands.

Subtype – This term indicates the species composition in broad groups within the cover type. Subtype is determined by the proportion of basal area of two or three main species in the stand as found on sample plots to the total basal area of all species. To determine the subtype, the basal area of individual species must be computed and rounded off to the nearest ten percent.

The percentage range marked after the species symbol indicates the proportion of the basal area of this particular species in comparison to the total basal area of all species in the type. The second number of the type aggregate code identifies the subtype. Subtype will include non-productive forested land and non-forested land codes. Subtype will also include the Non-Productive Forested Land and Non Forested Land codes (Manitoba, Government of, 2007A).

Timber Dues – Crown Timber harvested in Manitoba is measured in cubic metres (m³). For each cubic metre of timber harvested, specific dues and charges must be paid. Commercial users must pay three specific charges as per The Forest Act, which include Crown Timber Dues, Forest Renewal Charge and Forest Protection Charge (Manitoba, Government of website, 2011).

Type aggregate – This term is used in reference to all productive stands or potentially productive areas in a Forest Management Unit or Forest Section which have common characteristics as to cover type, subtype, site, cutting class and crown closure (Manitoba, Government of, 2007A).

Working group – This term indicates the grouping of subtypes, where the dominant or leading species in the species composition forms the working group (i.e., the jack pine working group

contains all the subtypes where jack pine is the leading species in the subtype species composition) (Manitoba, Government of, 2007A).

7.0 ACRONYMS

AAC	Annual Allowable Cut
CEAA	Canadian Environmental Assessment Act
CFZ	Commercial Forest Zone
EA	Environmental Assessment
EnvPP	Environmental Protection Plan
FDA&V	Forest Damage Appraisal and Valuation
FMU	Forest Management Unit
FP	Fire Protection
FRC	Forest Renewal Charge
FRI	Forest Resource Inventory
FS	Forest Section
GIS	Geographic Information System
GS	Generating station
Ha	Hectares
m ³	Cubic meters
MAI	Mean annual increment
NCFZ	Non-Commercial Forest Zone
PR	Provincial Road
ROW	Right-of-Way
SSVT	Stand Stock Volume Table
TCN	Tataskweyak Cree Nation
TLE	Treaty Land Entitlement

8.0 REFERENCES

8.1 CITATIONS

ECOSTEM Ltd. 2012. Keeyask Transmission Project Alternative Routes Evaluation and Preferred Route Assessment, Terrestrial Habitat, Ecosystems and Plants. Prepared for Manitoba Hydro. Winnipeg, MB.

Government of Canada. (1994). Addressing Cumulative Environmental Effects: A reference guide for the Canadian Environmental Assessment Act. Prepared by the Federal Environmental Assessment Review Office. November 1994.

Hegmann, G., C. Cocklin, R. Creasey, S. Dupuis, A. Kennedy, L. Kingsley, W. Ross, H. Spalding and D. Stalker. 1999. Cumulative Effects Assessment Practitioners Guide. Prepared by AXYS Environmental Consulting Ltd. and the CEA Working Group for the Canadian Environmental Assessment Agency, Hull, Quebec.

InterGroup Consultants Ltd. (2012). Keeyask Transmission Project. Socio-Economic Technical Report. Prepared for Manitoba Hydro. Winnipeg, MB.

Keeyask Hydropower Limited Partnership. (2009). Keeyask Infrastructure Project. Environmental Assessment Report. Winnipeg, MB.

Keeyask Hydropower Limited Partnership. (2012). Keeyask Generation Project, Environmental Impact Statement, Supporting Volume Socio-Economic Environment, Resource Use and Heritage Resources. Winnipeg, Manitoba.

Manitoba Government. (1991). Stand Stock Volume Table for the Nelson River Forest Section. Forest Inventory and Resource Analysis, Manitoba Conservation and Water Stewardship, Forestry Branch. Wpg. MB.

Manitoba Government. (2002). Forest Damage Appraisal and Valuation Guideline. Manitoba Conservation and Water Stewardship, Forestry Branch. Forest Management Section. Winnipeg, Manitoba.

Manitoba Government. (2007). Forestry Inventory Manual 1.3, 1996 - 1997. Manitoba Conservation and Water Stewardship, Forestry Branch. Forest Inventory Section. Winnipeg, Manitoba.

Manitoba Government. (2011). Forest Resource Inventory (FMU 86). Manitoba Conservation and Water Stewardship, Forestry Branch. Forest Inventory Section. Winnipeg, Manitoba.

Northern Light Heritage Resources. (2012). Keeyask Transmission Project, Heritage Resources Technical Report. Prepared for Manitoba Hydro, Winnipeg, MB.

North/South Consultants Inc. (2012). Keeyask Transmission Project, Aquatic Environment Technical Report. Prepared for Manitoba Hydro, Winnipeg, MB.

Plus4 Consulting Inc., Resource Ecosystem Services. (2004). Gull (Keeyask) Project Environmental Studies Program, Report #01-16. Forestry Activities 2001, prepared for North/South Consultants Inc., Winnipeg, Manitoba. October 2004.

Plus4 Consulting Inc. (2005). Keeyask Project Generating Station Environmental Studies Program, Report #03-07. Forestry Activities 2003. Prepared for North/South Consultants Inc., Winnipeg, Manitoba. December 2005.

Stantec. (2012A). Keeyask Transmisison Project. Amphibian Technical Report. Prepared for Manitoba Hydro. Winnipeg, MB.

Stantec. (2012B). Keeyask Transmisison Project. Avian Technical Report. Prepared for Manitoba Hydro. Winnipeg, MB.

Wildlife Resource Consulting Services. (2012). Keeyask Transmission Project. Mammals Technical Report. Prepared for Manitoba Hydro. Winnipeg, MB.

8.2 PERSONAL COMMUNICATIONS

Boyd, J. (2011). Forester, Forest Inventory & Resource Analysis. Manitoba Conservation and Water Stewardship, Forestry Branch. Winnipeg, MB.

Epp, B. (2011, 2012). Forester, Forest Inventory & Resource Analysis. Manitoba Conservation and Water Stewardship, Forestry Branch. Winnipeg, MB.

Holmes, B. (2012). Regional Forester, Northeast Region. Manitoba Conservation and Water Stewardship, Forestry Branch. Winnipeg, MB.

Lausman, H. (2012). Senior Highway Planning Engineer, Manitoba Infrastructure and Transportation. Winnipeg, MB.

McGurk, B. (2012). Senior Environmental Officer, Licensing & Environmental Assessment Department, Transmission Planning & Design, Manitoba Hydro. Winnipeg, MB.

Swanson, T. (2011). Regional Forester, Eastern Region. Manitoba Conservation and Water Stewardship, Forestry Branch. Winnipeg, MB.

Thorpe, J. (2011). Regional Forester, Western Region. Manitoba Conservation and Water Stewardship, Forestry Branch. Winnipeg, MB.

Walkoski, K. (2012). Natural Resource Officer, Gillam District Office, Northeast Region. Manitoba Conservation and Water Stewardship. Gillam, MB.

8.3 WEBSITES

Manitoba Government. (2012A). Manitoba Conservation and Water Stewardship. "Timber Pricing" <http://www.gov.mb.ca/conservation/forestry/timber-admin/index.html>. Accessed on February 20, 2011.

Manitoba Government. (2012B). Manitoba Conservation and Water Stewardship, Forestry Branch, Forest Management. On-line at: <http://www.gov.mb.ca/conservation/forestry/manage/fmp.html>. Accessed March 16, 2012.

Manitoba Government. (2012C). Manitoba Conservation and Water Stewardship, Protected Areas Initiative. On-line at:
http://www.gov.mb.ca/conservation/pai/pdf/protected_areas_2011_wall.pdf. Accessed on March 15, 2012.

Manitoba Government. (2012D). Forest Practices Guidelines. Manitoba Conservation and Water Stewardship, Forestry Branch. On-line at:
<http://www.gov.mb.ca/conservation/forestry/practices/guidelines.html> Accessed on September 20, 2012.

APPENDIX A

COMPOSITE TIMBER DUES TABLES

Table A-1: Manitoba Crown Timber Dues for FMU 86 For February 2012

Commodity	Short Distance Dues Rate (\$/m³)	Medium Distance Dues Rate (\$/m³)	Long Distance Dues Rate (\$/m³)
Softwood Lumber	\$1.75	\$1.40	\$1.15
Kraft	\$2.92	\$2.12	\$1.34
Newsprint	\$1.75	\$1.40	\$1.15
OSB	\$1.75	\$1.40	\$1.15

Source: Manitoba Government, 2012A

Table A-2: Other Commodities and Species (April 1, 2010 - March 31, 2011)

Other Commodities and Species	Short Distance Dues Rate (\$/m³)	Medium Distance Dues Rate (\$/m³)	Long Distance Dues Rate (\$/m³)
Post and Rails (any species)	\$1.40	N/A	N/A
Hardwood lumber	\$1.75	\$1.40	\$1.15
Tamarack used for any commodity or product	\$1.75	\$1.40	\$1.15
Fuelwood	\$1.75	N/A	N/A
Bio-product	\$1.75	N/A	N/A

Source: Manitoba Government, 2012A

The Crown timber dues listed in the above tables have been extracted from the Manitoba Conservation and Water Stewardship website (Manitoba Government website, 2012A) and reflect the February 2011 timber dues rates applied to forest products. The rates reflect the influence of the markets' product price index.

Dues rates may change monthly as they are based on commodity prices. Since the commodity value cannot be predicted for the time of clearing nor the product or facility that may process the wood (i.e. kraft mill or private lumber mill) the base rate of \$1.15/m³ is used in this valuation process. This was done in consultation with Manitoba Conservation and Water Stewardship, Forestry Branch (*pers. comm.* Epp. 2011).

The composite dues rates presented in Table 1.1-3 have been developed for the application of the Forest Damage Appraisal and Valuation Policy for crown standing timber estimated within the Project Footprint (Manitoba Government, 2002).

Table A-3: FDA&V Composite Dues Rates for FMU 86

MU	Softwood Lumber Base Rate	Kraft Base Rate	OSB Base Rate	Hardwood Lumber Base Rate	Larch Cedar Base Rate	Softwood Composite Rate	Hardwood Composite Rate
86	\$1.15	\$1.15	\$1.15	\$1.15	\$1.75	\$1.15	\$1.15

Source: Manitoba Government website. (2011) "2010-2011 Timber Dues Tables-Base Rate".

The rationale for developing the composite dues rates for all softwood and hardwood products, presented in Table A-3, lies in the current timber pricing methodology, the uncertainty of predicting the end use of the timber harvested and the influence of a product's timber price index on the dues rate at any point in time in the future. The timber price index is reviewed monthly and timber dues rates are adjusted to reflect market conditions. The distance of the Project from commercial timber processing facilities renders the possibility of salvaging timber, on an economic basis from the Project site, a remote possibility. In addition, the depressed economic conditions within the forest industry since 2007 are projected to remain soft well into the future. However, the demand for softwood timber by the Kraft Mill in The Pas has remained stable.

The composite dues rates, presented in Table A-3 for softwood and hardwood, was not developed to reflect the influence of mill demand, distance from mills and market price index on viable market alternatives of the timber harvested. The rates have been developed, in consultation with Manitoba Conservation and Water Stewardship (Epp, Thorpe and Swanson. *pers. comm.*, 2011), and along with the estimates of volume, are only approximations. Final dues valuation will occur after the entire Project Footprint has been cleared when volume, product and current market price index can be accurately assessed.

APPENDIX B

**FOREST DAMAGE APPRAISAL AND
VALUATION DETERMINATION**

Table B-1: Project Footprint Productive Forestland within the CFZ by Covertypes

Covertypes (Ha)				Total
S	H	M	N	(ha)
62.86	0.0	0.0	0.0	62.86

Columns may not sum to total due to rounding; S- Softwood, H – Hardwood, M – Softwood mixedwood, N – Hardwood mixedwood.

Table B-2: Project Footprint Gross Merchantable Volume (m³) within the CFZ subject to Valuation

Softwood	Hardwood	Total
1,601	118.60	1719.62

Columns may not sum to total due to rounding; Project footprint falls entirely within open crown land (ownership code = 1).

Table B-3: Project Footprint Gross Merchantable Volume Valuation (\$)

Softwood	Hardwood	Total
1,841.17	136.39	1,977.56

Columns may not sum to total due to rounding; Based on timber dues as per Table A-3, Appendix A.

Table B-4: Project Footprint within CFZ Forest Renewal Charge Valuation (\$)

Softwood	Hardwood	Total
9,205.85	59.30	9,265.15

Columns may not sum up due to rounding; Based on 2009 Softwood forest renewal charge of \$5.75/m3.

Table B-5: Project Footprint within the CFZ Fire Protection Cost Valuation (\$)

Softwood (\$)	Hardwood (\$)	Total (\$)
272.17	20.16	292.33

Columns may not sum to total due to rounding errors; Based on Forest Protection Charge of \$0.17/m3.

Table B-6: Crown Land Forest Damage Appraisal and Valuation Summary

Total Area (ha)	Total Softwood (m3)	Total Hardwood (m3)	Softwood Dues (\$)	Hardwood Dues (\$)	FRC Charge (\$)	FP Charge (\$)	Total Valuation (\$)
62.86	1,601.02	118.60	1841.17	136.39	9,265.15	292.33	11,535.04

FRC = Forest Renewal Charge; FP = Forest Protection Charge.

APPENDIX C

**POTENTIAL SALVAGEABLE STANDS
WITHIN THE PROJECT FOOTPRINT**

Table C-1: Potentially Salvageable Timber within the Project Footprint in the Non-Commercial Forest Zone (Construction Phase)

FRI_Type Aggregate*	Volume /ha (m ³)		Area (ha)	Total Volume (m ³)	
	Softwood	Hardwood		Softwood	Hardwood
53233	33.9	17.6	9.4	317.4	164.9
13233	48.9	0.0	39.2	1918.5	0.0
81233	0.0	35.2	11.1	0.0	389.2
04233	37.1	0.0	23.9	885.7	0.0
Total			83.6	3121.6	554.0

*FRI approximation based on habitat type description.

Table C-2: Standing Timber Volume Affected in the Commercial Forest Zone (Construction Phase)

Cutting Class	Working Group	Cover Type			Total (m ³)
		M	N	S	
0	Softwood	0.0	0.0	0.0	0.0
0	Hardwood	0.0	0.0	0.0	0.0
1	Softwood	0.0	0.0	0.0	0.0
1	Hardwood	0.0	0.0	0.0	0.0
2	Softwood	0.0	0.0	593.3	593.3
2	Hardwood	0.0	0.0	47.0	47.0
3	Softwood	0.0	0.0	885.1	885.1
3	Hardwood	0.0	0.0	66.0	66.0
4	Softwood	0.0	0.0	122.7	122.7
4	Hardwood	0.0	0.0	5.7	5.7
5	Softwood	0.0	0.0	0.0	0.0
5	Hardwood	0.0	0.0	0.0	0.0
Softwood Total		0.0	0.0	1601.0	1601.0
Hardwood Total		0.0	0.0	118.6	118.6
Grand Total		0.0	0.0	1719.6	1719.6

Notes:

M= softwood mixedwood; N= hardwood mixedwood; S= softwood; Note that there are no pure hardwood stands in the Project Study Area. Note there are no Mixedwood or pure hardwood stands in the Project Footprint Area.