KEEYASK TRANSMISSION PROJECT

TERRESTRIAL HABITAT, ECOSYSTEMS AND PLANTS TECHNICAL REPORT

Prepared For Manitoba Hydro

By ECOSTEM Ltd.

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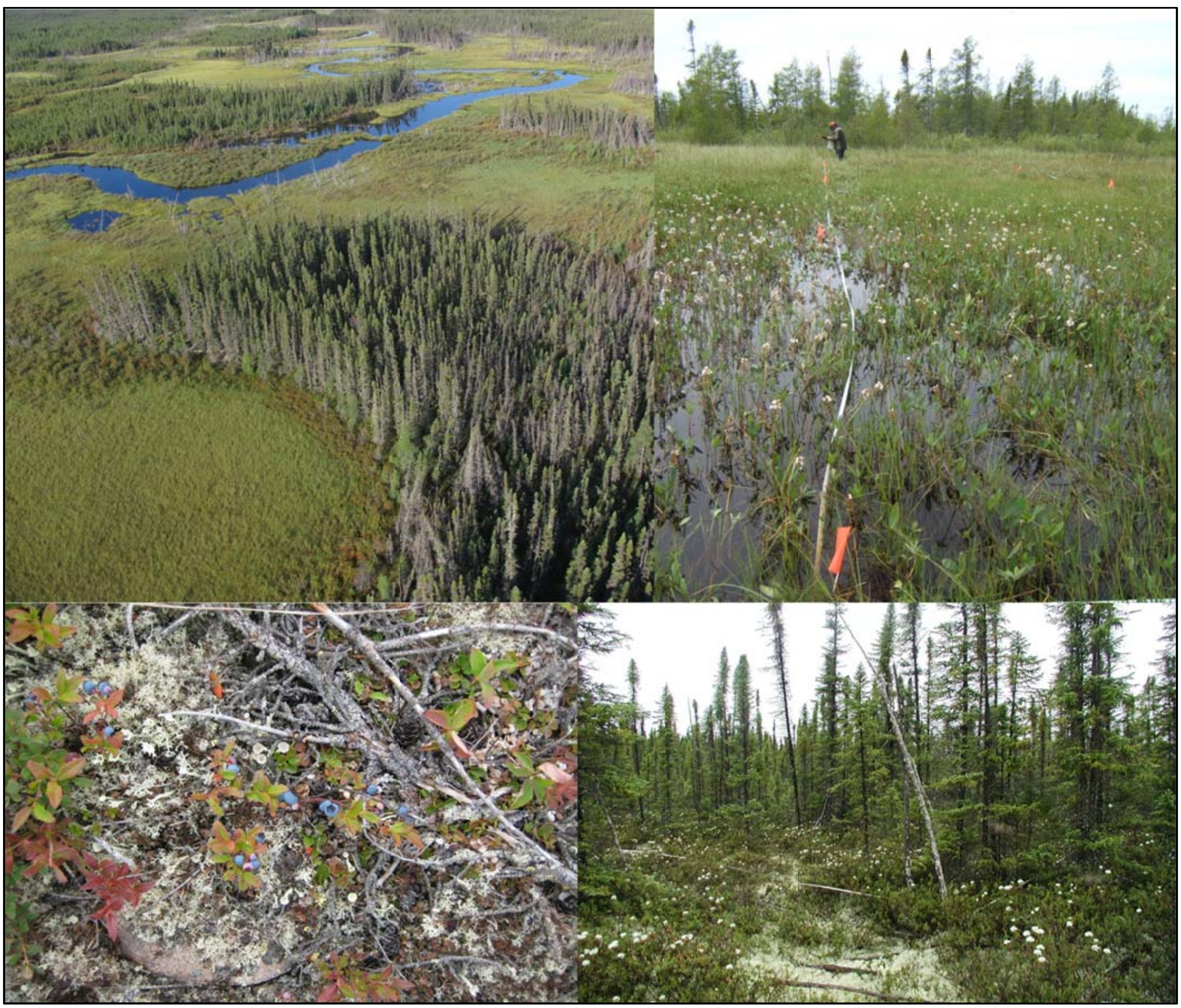

PREFACE

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.

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EXECUTIVE SUMMARY

Keeyask HydroPower Limited Partnership is currently proposing to develop a generation station, the Keeyask Generation Project, on the Nelson River at Gull Rapids. As a related component of this potential project, Manitoba Hydro, “the Proponent,” is proposing construction of the Keeyask Transmission Project (the Project) to transport electrical energy from: a) the existing transmission system to the Keeyask generating station site for construction purposes; and b) from the proposed Keeyask Generation Project into the Manitoba Hydro northern collector system and existing transmission system. The proposed Project includes the development of a Construction Power Transmission Line (138 kV) and Station that would convey power between an existing transmission line (KN36) and the site where the Keeyask Generation Station would be built, four Unit Transmission Lines originating at the Keeyask Generation Project generating station and terminating at the Keeyask Switching Station, the Keeyask Switching Station, three Generation Outlet Transmission lines that would link the Keeyask Switching Station to the Radisson Converter Station and upgrades to the Radisson Converter Station. The width of the right-of-way for the Construction Power line will be 60 m. A 200-m width will be required for the three Generation Outlet Transmission lines proposed between the Keeyask Switching Station and Radisson Converter Station. The proposed Keeyask SS will require 52 ha of potential land for Project development, with an additional 35 ha reserved for future developments.

Preliminary planning identified two alternative transmission line routes for the Construction Power Transmission lines and four alternative routes for the Generation Outlet Transmission lines. Manitoba Hydro conducted a site evaluation and selection process for the transmission line routes, which included recommendations on a preferred route from the biological, socio-economic, local community, cost and engineering perspectives.

This report evaluated the Construction Power Transmission and Generation Outlet Transmission alternative routes in terms of their potential effects on terrestrial habitat, ecosystems and plants as a component of the overall site selection process for the Keeyask Transmission Project. The alternative routes evaluation was focussed by selecting three valued environmental components to represent terrestrial habitat, ecosystems and plants, which included fragmentation, ecosystem diversity and priority plants.

There were no major concerns with any of the Construction Power Transmission or Generation Outlet Transmission alternative routes. The slightly preferred route for the Construction Power Transmission line was Alternative Route 1 because it was expected to create less fragmentation and have lower effects on ecosystem diversity. Alternative Route C was the preferred route for the Generation Outlet Transmission lines because it was expected to minimize effects on fragmentation, ecosystem diversity and priority plants, largely because more of this route was near existing human features. Alternatives A and D created the highest fragmentation effects and Alternative D had the highest ecosystem diversity effects.

Manitoba Hydro selected overall preferred routes for the Construction Power Transmission and Generation Outlet Transmission lines after considering the preferred route recommendations from the perspectives of biological effects, socio-economic effects, community concerns, cost and engineering limitations. Construction Power Transmission Alternative 1 and a combination of segments from Generation Outlet Transmission Alternatives B and C (with one minor modification) were the selected routes. By combining segments from Alternatives B and C, the preferred Generation Outlet Transmission route had slightly lower effects on ecosystem diversity.

This report also assessed the effects of the proposed Keeyask Transmission Project on terrestrial habitat, ecosystems and plants effects assessment based on the selected locations for the transmission line rights-of-way and the station sites. This effects assessment included an analysis of potential Project effects, recommendations for mitigation measures and predicted residual Project effects after recommended mitigation. Interactions of residual Project effects with other potential reasonably foreseeable future projects were considered. The assessment was focussed using the same VECs that were used for the Construction Power Transmission and Generation Outlet Transmission alternative route evaluations.

Based on the selected locations for the transmission line rights-of-way and the station sites, the Project was not expected to substantially affect terrestrial habitat, ecosystems and plants. Predicted residual effects on fragmentation, ecosystem diversity and priority plants were expected to be adverse and long-term but regionally acceptable given their limited magnitude and geographic extent. This largely occurred because the degree of past and current development in the Regional Study Area was limited and because substantial portions of the proposed Project were located near existing or planned human infrastructure. Some key mitigation measures included to reduce residual Project effects included ensuring that the final right-of-way routing avoids priority habitat sites to the extent practicable and conducting pre-construction rare plant surveys in portions of the transmission line rights-of-way that were not previously surveyed and have the highest potential for supporting provincially very rare to rare plant species. A limited program to monitor Project effects on fragmentation, ecosystem diversity and priority plants was recommended.

STUDY TEAM

James Ehnes was the project manager and study designer. Fieldwork was conducted by Brock Epp, Alanna Sutton, Jackie Krindle (Calyx Consulting), Alex Snitowski, Pierre-Hughes Tremblay, Karine Grotte and Chris Higgs. Data analysis, GIS analysis and report writing was completed by James Ehnes, Brock Epp and Alanna Sutton. Jackie Krindle provided the plant nomenclature and reviewed the plant results. Alex Snitowski completed GIS analysis and cartography.

1.0 INTRODUCTION

1.1 OVERVIEW

Keeyask HydroPower Limited Partnership is currently proposing to develop a generation station, the Keeyask Generation Project, on the Nelson River at Gull Rapids. As a related component of this potential project, Manitoba Hydro, "the Proponent," is proposing construction of the Keeyask Transmission Project (the Project) to transport electrical energy from: a) the existing transmission system to the Keeyask generation station site for construction purposes; and b) from the proposed Keeyask Generation Project into the Manitoba Hydro northern collector system and existing transmission system. The Project includes the development of a Construction Power Transmission Line (138 kV) and Station that would convey power between an existing transmission line (KN36) and the site where the Keeyask Generation Station would be built, four Unit Transmission Lines originating at the Keeyask Generation Project generation station terminating at the Keeyask Switching Station, the Keeyask Switching Station, three Generation Outlet Transmission lines that would link the Keeyask Switching Station to the Radisson Converter Station and upgrades to the Radisson Converter Station (Map 1-1).

Once the Keeyask Generation Project is commissioned, the Construction Power Transmission Line and a portion of the proposed Keeyask Construction Power Station will remain in place to provide emergency power for black starting the Keeyask Generation Project. A portion of the land (2 ha) on which the Construction Power Station occurs will be salvaged. Two overhead 12.47 kV service lines will be constructed from the proposed Keeyask Switching Station to the Keeyask Generation Project to provide operational power supply to the Keeyask Generation Project.

The proposed Keeyask Switching Station will require 52 ha of potential land for Project development, with an additional 35 ha reserved for future developments. A 60 m wide right-of-way (ROW) is proposed for the Construction Power line. A 200-m wide ROW will be required for the three Generation Outlet Transmission lines proposed between the Keeyask Switching Station and Radisson Converter Station. Preliminary planning identified two alternative transmission line routes for the Construction Power Transmission lines and four alternative routes for the Generation Outlet Transmission lines (Map 1-1).

This report evaluates the Construction Power Transmission and Generation Outlet Transmission alternative routes in terms of their potential effects on terrestrial **habitat**, **ecosystem**s and plants as a component of Manitoba Hydro's overall site selection and environmental assessment (SSEA) process for the Project. The alternative route evaluations culminate in a preferred route recommendations for Construction Power Transmission and Generation Outlet Transmission.

During the SSEA process for the Project transmission line routes, Manitoba Hydro considered the Construction Power Transmission and Generation Outlet Transmission preferred route recommendations in this report in combination with other biological, socio-economic, local community, cost and engineering perspectives. Manitoba Hydro selected an overall preferred route for the Construction Power Transmission and Generation Outlet Transmission lines using this process. Chapter 3 of the Project Environmental Assessment Report (Manitoba Hydro 2012) describes the site selection and environmental assessment process in detail.

This report also describes and assesses the effects of the proposed Project on terrestrial habitat, ecosystems and plants effects assessment based on the locations for the transmission line rights-of-way and the station sites selected through the SSEA process. The effects assessment includes an analysis of potential Project effects, mitigation measures and predicted residual Project effects after mitigation. Interactions of residual Project effects with other potential reasonably foreseeable future projects are then considered. Monitoring recommendations are also provided.

An ecosystem-based approach was used to evaluate and assess the potential effects of the alternative routes and of the proposed Project on terrestrial habitat, ecosystems and plants. The ecosystem-based approach recognized that the terrestrial ecosystem is a complex, hierarchically organized system in which changes to one component directly and/or indirectly affect other components. A key element of the ecosystem-based approach was identifying the ecosystem components (i.e., elements, patterns, linkages, processes and functions) that are particularly important for maintaining terrestrial ecosystem health and could potentially be substantially affected by the Project. These ecosystem components, along with topics of particular social interest, became the **valued environmental component**s (VECs) that were used to focus the alternative route evaluation and the Project effects assessment. Where relevant, other important ecosystem components or influences were also considered.

The alternative route evaluations and the Project effects assessment were built on environmental assessments recently completed for the Keeyask Infrastructure Project (Manitoba Hydro 2009) and the Keeyask Generation Project (Keeyask HydroPower Partnership 2012a). Much of the existing environment information was either summarized or copied from the terrestrial sections of the Keeyask Generation Project Environmental Impact Statement. Details regarding methodology, methods and procedures can be found in Sections 1 to 3 of the Keeyask Generation Project Environmental Impact Statement Terrestrial Supporting Volume (Keeyask HydroPower Partnership 2012b).

1.2 PROJECT COMPONENT OVERVIEW

1.2.1 Construction Power Transmission Line and Station

A new Construction Power Transmission Line (138-kV and approximately 22 km long) from the existing 138-kV KN36 transmission line to a new 138-kV to 12.47-kV Construction Power Station to be located north of the proposed Keeyask Generation Station.

The purpose of the Construction Power Transmission Line and Station is to provide power for the construction activities of the Generation Station. After operation, the Construction Power Station will be left in place, as will a portion of the Construction Power Transmission Line, to provide a contingency function for a “black start”[1] emergency backup to diesel generation units at the Generation Station (Figure 1-1).

1.2.2 Unit Transmission Lines

Four 138-kV AC Unit Transmission lines (KE1 to 4) will transmit power from the seven generators located at the Keeyask Generation Station to the new Keeyask Switching Station. Three lines will be double circuit and one line single circuit to accept power from the seven Generation Station turbines. The four lines, each approximately 4 km long, will be located in a single corridor.

1.2.3 Keeyask Switching Station

A new Keeyask Switching Station will accept power from Generation Station via the four Unit Transmission lines from the Generation Station transformers and transfer that power to three Generation Outlet Transmission lines. The Switching Station will be located on the south side of the Nelson River. The purpose of the Switching Station is to provide the terminal facilities for the electrical connection to the Generation Station, and to provide flexibility for accommodating power transmission from the Generation Station to the Radisson Converter Station (Figure 1-2).

1.2.4 Generation Outlet Transmission Lines

Three 138-kV AC Generation Outlet Transmission (GOT) lines will transmit power from the Keeyask Switching Station to the existing Radisson Converter Station 138-kV AC switchyard. The three lines, each approximately 38 km long, will be located in a single corridor. Manitoba Hydro plans to build one of these Generation Outlet Transmission lines to serve as a backup construction power line during construction and the line will be partially

[1] Black start is the process of restoring a power station to operation without relying on the external electric power transmission network or grid.

salvaged back to the Keeyask Switching Station and utilized as a Generation Outlet Transmission Line.

1.2.5 Radisson Converter Station Upgrades

The existing Radisson Converter Station will be upgraded in two stages, as follows:

1. Stage I: Radisson Converter Station will require the addition of a 138-kV breaker to accommodate the initial new 138-kV transmission line KR1 from Keeyask Switching Station.

2. Stage II: Station equipment will include the addition of a 138-kV bay (Bay 1) complete with four 138-kV breakers and associated equipment for the termination of two additional lines (KR2 and KR3) from Keeyask Switching Station. KR2 and KR3 will enter the west side of the station utilizing dead-ended steel structure with line switches. The KR2 and KR3 lines will proceed underground around the station and finally terminate to Bay 1. This is done to avoid complex line crossings into the station. Thirty-one 138-kV AC breakers will also need to be replaced due to fault levels exceeding existing breaker ratings.

1.3 POTENTIAL PROJECT EFFECTS

Since habitat is the key pathway for most Project effects on terrestrial ecosystems, this introductory section includes a description of anticipated Project effects on terrestrial habitat and how those effects were incorporated into the alternative route evaluations and the Project effects assessment.

Potential direct Project effects on terrestrial habitat will include the loss, alteration and disturbance of habitat in the ROW, borrow areas used for tower construction and any associated access roads and trails. **Habitat loss** refers to the conversion of terrestrial habitat into human features or an aquatic area, either temporarily or permanently. **Habitat alteration** refers to changes in one or more habitat attributes that are large enough to convert a habitat patch to a different fine habitat type. Lesser changes in one or more habitat attributes are classified as **habitat disturbance**. An example of habitat disturbance is a habitat patch adjacent to the ROW that has had trees or debris pushed into it.

Direct Project effects will create indirect effects, both within the **Project Footprint** and in some surrounding areas. That is, a Project impact will have a zone of influence surrounding its physical footprint. For example, clearing trees on permafrost soils will generally lead to higher soil temperatures, both within the cleared area and in adjacent areas. A particular indirect effect may be several stages removed from the direct Project effect. Vegetation clearing that creates large openings on treed peatlands with thick ground ice will generally lead to permafrost melting, followed by collapse of the soil surface to form craters, and then by the development of very wet peatland habitat and/or open water in the craters.

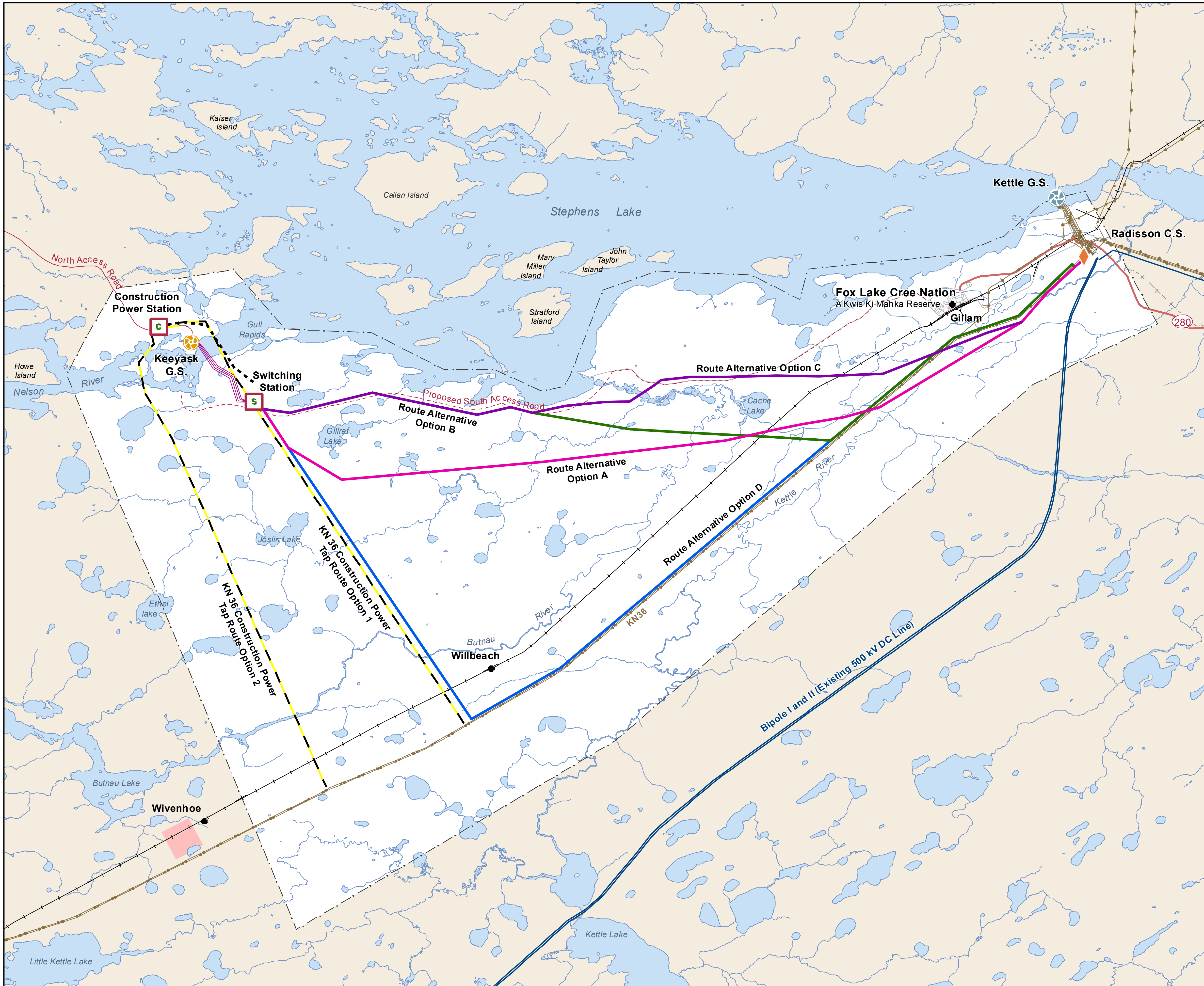
The size and nature of the indirect zone of influence will be determined by how the particular Project feature interacts with the ecosystem component of interest and local conditions. For example, tree clearing in dense, mature forest on permafrost soils will have a much larger zone of influence on terrestrial habitat than clearing sparsely distributed trees on a bedrock outcrop. The nature and spatial extent of indirect habitat effects can range from not measurable to conversion to aquatic or human infrastructure areas. It should be noted that the term **habitat zone of influence** refers either to the concept of indirect effects on terrestrial habitat or to the expected (*i.e.*, most likely) spatial extent of indirect effects on terrestrial habitat.

Indirect Project effects on vegetation, soils and other terrestrial habitat were expected to generally diminish below measurable levels within 10 m from the transmission line ROWs. Studies of vegetation clearing in forests have documented **edge effect**s that range from 15 m to 50 m, depending on the ecosystem component of interest, the type of human disturbance and local conditions (Euskirchen *et al.* 2001; Harper and Macdonald 2002; Rheault *et al.* 2003; Gignac and Dale 2005, 2007). However, none of these studies were conducted in an ecological region that is highly comparable to the Regional Study Area. An edge effects study conducted along more than 900 km of transmission line rights-of-way in north-western Manitoba (the study area overlapped the Regional Study Area) found that effects on overstorey vegetation extended less than 10 m from the cleared opening (Ehnes and ECOSTEM 2006). Compared with studies conducted in other ecological regions, the narrower zone of overstorey edge effects observed in north-western Manitoba was attributed to the very low proportion of area that is dense forest so that habitat attributes are more strongly influenced by factors other than those related to canopy closure. Only approximately 21% of the total area of the treed stands more than 50 years old in the detailed habitat mapping area had canopy closure greater than 60%.

Improved access is another potentially important pathway for indirect Project effects since this will bring more equipment, material and/or people into an area, which could lead to increased resource harvesting, invasive plant spread and/or human-caused fires, among other things.

A 50 m buffer of the transmission line ROWs was created to account for indirect Project effects on terrestrial habitat (*i.e.*, the terrestrial habitat zone of influence). This was a cautious overestimate of the anticipated total size of the terrestrial habitat zone of influence. Indirect Project effects on habitat could extend further than 10 m from the transmission line ROWs in localized areas along the routes. These localized exceptions could occur in wetlands, areas physically disturbed by construction equipment, for by-pass trails are needed in difficult terrain and/or areas affected by a low probability event (*e.g.*, a human caused fire). To the extent these effects occur, they were expected to alter only a small portion of the total area in the peripheral 40 m of the 50 m buffer so that the 50 m ROW buffer was likely a substantial overestimate of the total area of transmission line ROW indirect effects.

A larger buffer of 150 m was used for station sites to account for the higher degree of impact associated with soil removal and permanent infrastructure construction as well as the higher potential for unplanned Project activities outside of the station footprint such as equipment moving outside of the designated Project Footprint or additional clearing.



Project Infrastructure
Alternative Transmission Line Routes

Map 1-1

2.0 METHODS AND PROCEDURES

This section briefly describes the methodology, methods and procedures used for the Construction Power Transmission and Generation Outlet Transmission alternative route evaluations and the Project effects assessment, which were generally the same as those used for the Keeyask Generation Project environmental impact statement except where noted. Details regarding methodology, methods and procedures can be found in Sections 1 to 3 of the Keeyask Generation Project Environmental Impact Statement Terrestrial Supporting Volume (Keeyask HydroPower Partnership 2012b).

2.1 STUDY AREA DEFINITION

Local and **regional study area**s were used for the alternative route evaluations and preferred route effects assessments. The **local study area** captured potential Project effects on individual organisms or individual ecosystem elements while the Regional Study Area provided the comparison area for evaluating the potential significance of effects on individual organisms or individual ecosystem elements. Local and regional study areas are typically selected for each VEC since their spatial and temporal requirements differ.

An important consideration when delineating a regional study area is that it be large enough to capture the populations and the regional ecosystem attributes of interest but not so large that it is virtually impossible for most projects to have significant effects. Another important consideration is that the regional study area size and boundaries are ecologically relevant for the topics being examined.

The regional study area used for the Keeyask Generation Project environmental assessment was delineated using the above methodology. Because the Project is located near the center of the regional study area most commonly used for the Keeyask Generation Project assessment, and for compatibility with the other recently completed environmental impact assessments, the Project Regional Study Area was the same one that was used for most VECs in the Keeyask Generation Project Environmental Impact Statement (Section 1 of Keeyask HydroPower Partnership 2012b).

The 1,420,000 hectare Regional Study Area (Map 2-1) was an area surrounding the Project that was large enough to capture a region level ecosystem. A region level ecosystem is a relatively homogenous area in terms of its ecological context (e.g., climate, surface materials) that is large enough to capture the populations of most of the resident wildlife species and the key ecological processes operating at the regional ecosystem level (such as the **fire regime**). In practical terms, the Regional Study Area size was determined such that it was large enough to maintain a relatively stable habitat composition in response to the natural fire regime. In other words, one large fire was unlikely to substantially change the proportion of any **habitat type**, thereby providing alternative habitat for species to move to when large fires occur. All of the topics examined in this report used the same Regional Study Area. The Keeyask Generation Project Environmental Impact Statement further explains how the Regional Study Area was delineated (Sections 1 and 2 of Keeyask HydroPower Partnership 2012b).

The approach to delineating local study areas differed for the alternative route evaluations and preferred route effects assessments. Since multiple routes were evaluated for the alternative route evaluation, an overall Alternative Routes Local Study Area was identified using fragmentation because it was the VEC expected to have the largest Project zone of influence (see Section 2.3.1.1 for details). On this basis, the Alternative Routes Local Study Area was delineated as a 1,150 m buffer of the proposed alternative routes. Map 2-1 shows the 29,310 hectare Alternative Routes Local Study Area.

As described in Section 2.4, alternative route evaluation corridors were used for the detailed comparison of the Construction Power and Generation Outlet alternative routes.

For the Project effects assessment, a Local Study Area was identified independently for each VEC based on the potential Project zone of influence on that VEC using the approach described in Section 2.5.1.3.

A Project Study Area was also defined for the Project (Map 2-1) that generally captured the local study areas used by the various disciplines when completing their alternative route evaluations and Project effects assessments.

2.2 DATA COLLECTION AND ANALYSIS

2.2.1 Overview of Information Sources and Data

The information used for the alternative route evaluations and Project effects assessment was largely obtained from data and other information developed for the Keeyask Generation Project effects assessment (Sections 1 to 3 of Keeyask HydroPower Partnership 2012b). As noted above, the Project Regional Study Areas was the same as the most commonly used regional study area in the Keeyask Generation Project effects assessment. Additionally, most of the alternative Generation Outlet Transmission line ROWs and over half of the Construction Power Transmission route ROWs overlap the areas that were intensively studied for the Keeyask Generation Project effects assessment. Some additional field data were collected within the proposed alternative route evaluation corridors to supplement the data already collected for the Keeyask Generation Project assessment. Habitat and terrain mapping was completed for the portion of the overall Alternative Routes Local Study Area that was outside of the Keeyask Generation Project detailed mapping area.

A description of the information used for terrestrial habitat, ecosystem and plant alternative route evaluations and Project effects assessment is provided below. Further details are provided in Sections 1 to 3 of the Keeyask Generation Project environmental impact statement terrestrial supporting volume (Sections 1 to 3 of Keeyask HydroPower Partnership 2012b).

2.2.2 Terrestrial Habitat

Habitat is the place where an organism or a population lives. Because all natural areas are habitat for something, this report uses “habitat” to refer to terrestrial habitat for all species. Habitat for a particular species is identified with a species prefix (e.g., moose habitat, jack pine habitat).

Documenting the condition of and trends in terrestrial habitat and understanding the relationships between habitat components and the drivers for habitat change are the foundation for understanding and predicting potential Project effects on terrestrial ecosystems. As examples, plants and animals use habitat for survival and reproduction while most terrestrial environment effects predictions use qualitative and/or quantitative **model**s that require habitat maps as an input.

Reliable predictions of potential Project effects on habitat and ecosystems depend upon a detailed terrestrial habitat map for the existing environment and on an adequate understanding of local relationships between each of the major habitat components (e.g., vegetation, soils, permafrost, groundwater) and the factors that could have a substantial influence on ecosystem composition, structure and dynamics (e.g., water regime). Additionally, as described below, habitat types and habitat mapping are often used as proxies for ecosystem types and ecosystem mapping.

A stand level, 1:15,000 scale habitat and terrain map was completed for the central 221,500 ha of the Regional Study Area. Map 2-2 shows the detailed habitat mapping area, including the areas for which additional 1:15,000 stand level mapping was completed to provide coverage for the overall Alternative Routes Local Study Area.

Generation Outlet Alternative Route D was added late in the evaluation process. Consequently, ecosite mapping was completed for the entire Alternative D evaluation corridor while vegetation mapping was only available for approximately half of the route length. Vegetation information for the portion of the route lacking habitat mapping was obtained from helicopter-based oblique aerial photography taken on August 22, 2012. Older Forest Resource Inventory (FRI) data derived from 1991 stereo photography was also available for 7 of the 17 km lacking habitat mapping.

The habitat mapping methods are described in detail in Section 2 of Keeyask HydroPower Partnership (2012b). in summary, a hierarchical ecological habitat, ecosystem and land classification was developed for the alternative route evaluations and the Project effects assessment to reflect local conditions in the Regional Study Area and to provide a framework for characterizing terrestrial ecosystems and their components at multiple ecosystem levels (Section 2 of Keeyask HydroPower Partnership 2012b). From largest to smallest, the ecosystem levels relevant for the terrestrial habitat and ecosystems assessment were region, subregion, landscape, landscape element, stand and site. The region ecosystem level corresponds with the Regional Study Area in this report.

A nested habitat classification was applied to each of the ecosystem levels. From most general to most detailed, the nested levels in the habitat classification were **land cover**, **coarse habitat**, **broad habitat** and **fine habitat**. The categories within each classification level were combinations of vegetation type and **ecosite type** (Table 2-1). **Wetland** habitat classes were obtained from the Canadian Wetland Classification System (National Wetlands Working Group 1997), with enhancements to reflect dramatic differences in marsh water regimes along the Nelson River and between the Nelson River and off-system waterbodies. The attributes used to classify and map terrestrial habitat attributes were vegetation type, vegetation age class (where this could be determined), ecosite type, topographic position and either recent disturbance type (*e.g.*, large fires, ice scouring) or water depth duration zone. Ecosite type is a classification of soil, surficial material, surface water, groundwater and permafrost conditions that are associated with substantial differences in vegetation composition and/or structure.

Regionally relevant vegetation and ecosite types were developed through multivariate analysis of field data from the Regional Study Area (see Section 2 of Keeyask HydroPower Partnership 2012b for a description of methods). Table 2-2 provides the number of classes within each habitat classification level, an example of a habitat type and an example of how the classification level was used in this report. Appendix A provides a list of the land cover, coarse habitat and broad habitat types developed for the Regional Study Area. Each of the coarse ecosite and habitat types are described in Section 2 of Keeyask Generation Project environmental impact statement terrestrial supporting volume (Keeyask HydroPower Partnership 2012b).

The characteristics of each habitat type, as well as relationships between habitat components (*e.g.,* soils and vegetation) and drivers such as wildfire or permafrost melting, were derived from vegetation, soil and environmental data collected at over 500 habitat plots, along over 540 km of habitat transects and at over 4,000 soil profile sample points. Map 2-3 shows the locations of the 98 habitat plots sampled in the preliminary alternative route evaluation corridors during the summer of 2009.

Table 2-1: Coarse and Broad Ecosite Classes and Criteria

Broad Ecosite	Coarse Ecosite	Coarse Ecosite Code	Criteria*
Mineral land types			
Mineral Soil	Mineral Soil	1	Surface organic layer < 20 cm thick.
Thin peatland land types			
Thin Peatland	Thin Peatland	15	Surface organic layer >= 20cm and < 100 cm. Occurs on ridges and crests or sloped topography.
Peatland land types			
Shallow Peatland	Shallow Peatland	20	Surface organic layer > 20 cm and ≤ 200 cm thick.
Ground Ice Peatland	Ground Ice Peatland	30	Surface organic layer ≥ 20 cm; excess ice continuous. Level surface.
Wet Peatland	Other Permafrost Peatland	40	Surface organic layer ≥ 20 cm; evidence of excess ice actively forming or melting (e.g., collapse scar peatlands). Hummocky surface due to patchy excess ice.
	Deep Peatland	50	Surface organic layer > 200 cm; surface level and featureless. Excess ice usually absent and not confined by bedrock or mineral terrain.
	Wet Deep Peatland	60	Surface organic layer > 200 cm; surface level and featureless. Evidence of very high water table. Excess ice usually absent and not confined by bedrock or mineral terrain.
Shore zone peatland land types			
Riparian Peatland	Riparian Peatland	66	Surface organic layer ≥ 20 cm, floating. Open water present.
Shore zone- regulated land types			
Ice Scoured Upland	Ice Scoured Upland	70	Along Nelson River banks, disturbed by ice movement. Usually a terrace or steeply sloped mineral/ bedrock area.
Upper beach-regulated	Shoreline Wetland-regulated	75	Wet meadow, sloped transition between open water and upland. Herbaceous and/or tall shrub vegetation.
Sunken peat-regulated			
Lower beach-regulated			
Shore zone marsh land types			
Upper beach	Shoreline Wetland	75	Wet meadow, sloped transition between open water and upland or along fringes of floating peat. Emergent, Herbaceous and/or tall shrub vegetation.
Lower beach			
Littoral			

* Criteria refer to dominant conditions throughout the polygon.

Source: Section 2 of Keeyask HydroPower Partnership (2012b).

Table 2-2: Hierarchical Habitat Classification and Examples of its Uses in this Report

Classification Level (number of classes)	Example of a Habitat Type	Examples of Uses in Environmental Assessment	
		Habitat and Ecosystems	Plants and Animals
Land Cover Type (11)	Needleleaf treed on peatlands	Very general description of the study areas	Very general description of habitat use by a species
Coarse Habitat Type (23)	Black spruce treed on **shallow peatland**	Overview description of the study areas	Characterize the habitat preferences for a **generalist** species. Develop mixture types to relate to mammal 500m field transects.
Broad Habitat Type (65)	Black spruce mixture on ground ice peatland	Identify the regionally rare and **uncommon habitat type**s	Characterize the general habitat preferences for a species
Fine Habitat Type (114)	Black spruce mixture/ Tall shrub on ground ice peatland	Distinguish the nature and degree of effects for different Project linkages (*e.g.*, groundwater versus vegetation clearing)	Identify patches satisfying specialized needs for some wildlife species (*e.g.*, feeding habitat)

Source: Section 2 of Keeyask HydroPower Partnership (2012b)

2.2.3 Terrestrial Ecosystems

The terrestrial ecosystems component of this report addresses terrestrial ecosystem components except for wildlife and plants, focusing on VECs and other key topics relevant for a transmission line assessment. The methods used for terrestrial ecosystems are described in Section 2.3.

2.2.4 Plants

Including fieldwork conducted for the Keeyask Generation Project Environmental Impact Statement (Section 3 of Keeyask HydroPower Partnership 2012b), plant data was collected at over 500 habitat plots, along over 540 km of habitat transects and along over 507 km of rare and invasive plant transects during the summers of 2003 to 2011 and on August 22, 2012. Map 2-4 shows the locations of the 17 priority and invasive plant transects sampled in the alternative route evaluation corridors during the summers of 2009 and 2012.

Extensive rare plant surveys in the Regional Study Area did not detect rare plant species in certain habitat types (Section 3 of Keeyask HydroPower Partnership 2012b). On this basis, these habitat types were not surveyed further for the Project. The length of transect surveyed in each corridor was roughly proportional to the amount of habitat with relatively high potential to support rare plants rather than to total evaluation corridor area.

2.3 VALUED ENVIRONMENTAL COMPONENT SELECTION

Valued Environmental Components (VEC) are components of the biological or socio-economic environment that may be affected by the Project. VECs are species and/or environmental components that are used to highlight or focus an environmental assessment. VECs are defined as elements of the environment having scientific, social, cultural, economic, historical, archaeological or aesthetic importance and are proposed and identified and described under each environmental component. VECs are typically selected on the basis of their importance or relevance to stakeholders (e.g., species such as moose that are hunted) and/or as indicators of environmental effects to a broader range of animals. VECs are typically determined with the input from regulators and stakeholders, Aboriginal people and discipline experts, as well as literature reviews and experience with other projects. Environmental indicators and measurable parameters or variables are identified and described for each VEC. The same indicators and parameters/variables are used to describe environmental effects and residual environmental effects, and to monitor changes or trends over time during the Project construction and operation/maintenance phases.

The Keeyask Transmission Project selected VECs that were identified as being important or valued by members of the study team (e.g., species that are protected) and/or by the public and by other elements of the SSEA process. The identified VECs facilitated assessment of the interactions between the Project components and specific valued components of the environment.

2.3.1 Terrestrial Habitat Ecosystem and Plants

A stepwise screening process that focused on Project-related ecosystem health issues that were of relatively high ecological and/or social concern was used to select the key topics (Figure 2-1), from which the valued environmental components (VECs) were selected. In short, the key terrestrial environment issues of concern related to the Project were identified using the land use sustainability framework developed by the Canadian Council of Forest Ministers (CCFM), industry and others (CCFM 1995) as a component of an international process that culminated in the Santiago Declaration (Anonymous 1995). In brief, the overall goal of the CCFM framework is to maintain long-term ecosystem health for present and future generations while conducting human activities and development. Ecosystem health is maintained when biodiversity, ecosystem condition and productivity, soil and water quantity and quality and contributions to global ecological cycles are all maintained within their ranges of natural variability (after CCFM 1995). The CCFM framework is applicable to regional ecosystems that have not already been dramatically altered by human activities. This framework is consistent with many environmental assessment regulations, policies and guidelines (*e.g.*, Canadian Environmental Assessment Agency 1996; *Federal Sustainable Development Act*) because it is a scientific approach developed by governments in partnership with stakeholder groups following extensive international, national and local consultation.

There were many potential pathways for Project impacts to lead to effects on terrestrial ecosystem health. The first step in the screening process was identifying generic issues of particular concern that could have Project linkages. These linkages were identified using a number of tools such as conceptual diagrams, pathway diagrams and network linkage diagrams. Key Project specific issues of concern were identified from the generic list of concerns. VECs and other supporting topics were selected from this list using the following criteria:

- Key for ecosystem function;
- Umbrella indicator;
- Indicator species;
- Overall importance/value to people;
- Regulatory requirements;
- Potential for substantial Project effects; and,
- Amenable to scientific study in terms of the analysis of existing and post-construction conditions.

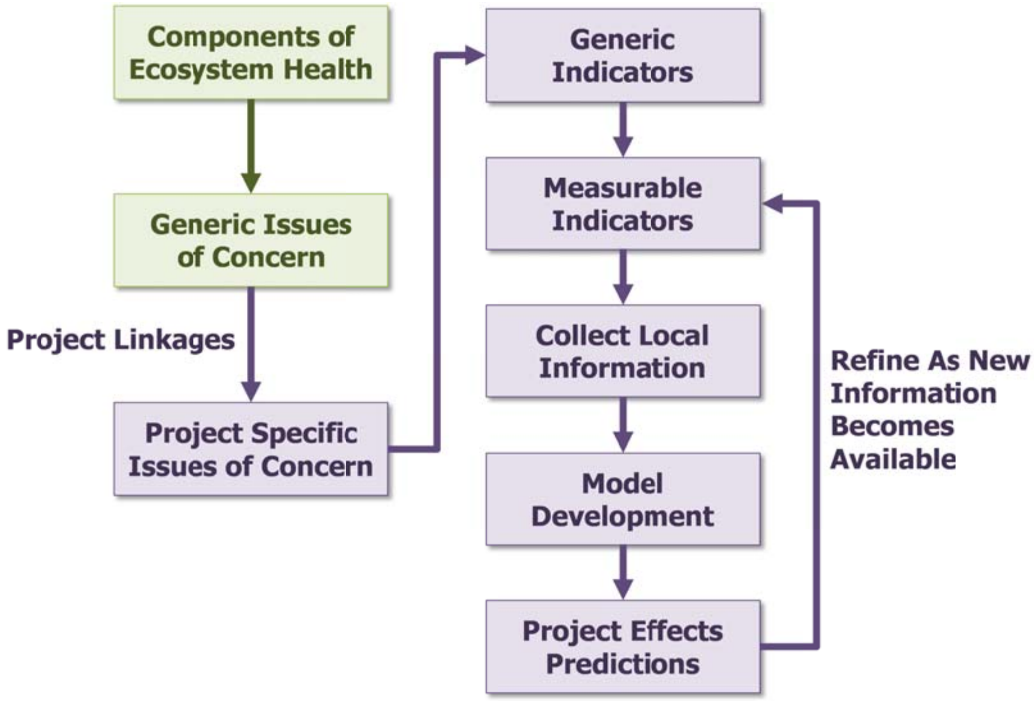


Figure 2-1: Steps to select Valued Environmental Components and Supporting Topics

Generic indicators and then measurable parameters were then identified to represent each VEC and supporting topics. These measurable parameters guided the data collection that was used to characterize the Project area and to improve understanding of local cause-effect relationships to the degree needed to predict Project effects with a reasonable level of uncertainty.

Based on the anticipated potential direct and indirect Project effects, the stepwise screening process described above led to the selection of **fragmentation**, **ecosystem diversity** and **priority plants** as the VECs for the alternative route evaluations and the Project effects assessment. Other important topics considered when evaluating and assessing potential Project effects on terrestrial ecosystems (*i.e.*, the supporting topics) were fire **regime** and **invasive plant**s. An explanation of what the VECs represent and why they were selected is provided in the following sections.

2.3.1.1 Fragmentation

Fragmentation is the degree to which an ecosystem has been altered by human development and activities that remove habitat and increase fragmentation (McGarigal and Cushman 2002). Fragmentation is a landscape-level process in which human features progressively subdivide habitat blocks into smaller and more isolated fragments.

Fragmentation affects ecosystem processes as well as species (Saunders *et al.* 1991; Soulé *et al.* 2004; McGarigal and Cushman 2002; Lindenmayer and Fischer 2006; Fischer and Lindenmayer 2007). Among other things, fragmentation reduces the size of interior areas, isolates habitat and creates edges. In the context of fragmentation, edges are the peripheral areas of intact habitat blocks where the adjacent human features create conditions (e.g., noise) that cause some animals to either partially or completely avoid areas that would otherwise be habitat for them (i.e., reduced habitat effectiveness). A **core area** is the interior area of an undisturbed habitat patch that remains after removing the edge area (e.g., the area of reduced habitat effectiveness for animals). Some wildlife species are sensitive to human disturbance and require large core areas (e.g., caribou) while other species can move between smaller habitat patches.

Human linear features such as roads, railway lines, transmission lines, cutlines and trails can have additional ecological effects compared with patch-like human features. For example, linear features can function as corridors for animal movement and plant dispersal while road traffic can cause wildlife injuries and mortality. FLCN noted that trappers are concerned about hunters that will use the transmission corridor to access areas (Keeyask Transmission Project Workshop 2012a).

A transmission line and its ROW could increase fragmentation by adding linear features, reducing the total amount of core area and subdividing core areas. Newly constructed transmission lines and associated access trails and roads add to linear feature density.

The fragmentation VEC provides an overall evaluation of fragmentation for species and ecosystems. Effects on wildlife species that are highly sensitive to fragmentation are not addressed by this VEC. It was recognized that intactness rather than fragmentation is what is valued as an environmental component. Because the word fragmentation is more widely recognized than intactness, this was used as the name for the VEC.

Road density (*i.e.*, km of roads per km^2 of study area) is often used as a single, synthetic indicator of fragmentation effects on plant and animal populations (Forman 1995). Among other things, higher road density improves access, which can lead to increased resource harvesting, collision mortality, habitat disturbance and fire frequency. Trails, cutlines and other linear features can also contribute to fragmentation but to a lesser degree (Mattson 1993 cited in AXYS 2001). Although some authors have recommended that each type of human linear feature be included and assigned a weight that reflects a qualitative degree of effects (Mattson 1993 cited in AXYS 2001), a literature review revealed no examples of a weighted linear feature density being applied in an environmental assessment or for management purposes. However, some authors implicitly weight the effects of different types of linear features when delineating core areas by using buffer widths that vary with the linear feature type (Mace *et al.* 1996; Anderson *et al.* 2002; Salmo Consulting Inc. *et al.* 2003; Strittholt *et al.* 2006).

Recent approaches to evaluating intactness have used linear feature density and core area abundance as indicators for intactness (*e.g.*, Salmo Consulting Inc. *et al.* 2003). Core area abundance is used as a complementary indicator because linear feature density ignores the spatial distribution of linear features. For example, are most of the linear features concentrated in a single corridor or are they dispersed throughout a study area? These two situations have very different implications for intactness and regional ecosystem health as demonstrated by the single large or several small (SLOSS) debate.

Linear feature density and core area percentage were the indicators used to evaluate fragmentation. Consideration of the spatial locations and size distribution of linear features and core areas (*i.e.*, the number of large core areas and the sizes of the large core areas) were also a component of the fragmentation evaluation.

Linear feature density was measured as the number of kilometres of linear features per square kilometre of land area in the Regional Study Area. All highways, roads outside of settlements, winter roads, rail lines, transmission lines, dykes and cutlines were included in the total linear feature length calculations. Total linear feature density in kilometres per square kilometre was measured as the total length of all linear features divided by the total land area in the Regional Study Area. Transportation density was the combined density of roads and rail lines.

Linear features in the Regional Study Area were mapped from a combination of digital ortho-rectified imagery produced from 1:60,000 stereo air photos acquired in 1999, Landsat 7 panchromatic imagery acquired circa 2000, large scale stereo air photos acquired over several years in the 1990s and infrastructure mapping from NTS and other sources. Large scale (1:15,000) stereo air photos acquired in 2003 and 2006 were available for the detailed habitat mapping area (Map 2-2). Portions of the linear feature mapping were validated during helicopter surveys.

Some of the cutlines mapped from the older remote sensing were regenerating back to shrubland or woodland. It is also possible for cutlines to revegetate within a forest landscape and become non-existent from the perspective of predators or prey. The point at which a cutline becomes sufficiently overgrown to no longer function as a predator travel corridor is not well understood. Following Salmo Consulting Inc. *et al.* (2003), cutlines with woody vegetation that was at least 1.5 m tall and having total canopy closure of either at least 75% or between 25% and 75% with no game trails or evidence of human use were assumed to no longer function as corridors. Vegetation regeneration was evaluated in 883 km of the mapped cutlines using low level oblique helicopter-based photography acquired during summer 2011.

Core areas were the residual areas left after buffering linear features and other human footprints. Linear features typically experiencing relatively low human use (transmission lines, trails, dykes and cutlines) were buffered 200 m (Mace *et al.* 1996) while high use linear features (railways and all types of roads) and settlements were buffered 500 m (Salmo Consulting Inc. *et al.* 2003). The non-linear human features relevant for the core area analysis were identified by selecting the human land cover class from the terrestrial habitat mapping completed for the detailed habitat mapping area and from air photos and satellite imagery for the remainder of the Regional Study Area.

2.3.1.2 Ecosystem Diversity

Maintaining native biodiversity is fundamental to maintaining overall **ecosystem function** and ecosystem health (CCFM 1995). Ecosystem diversity, species diversity and genetic diversity are the three generally recognized components of biodiversity (Noss 1990). Ecosystem diversity refers to the number of different ecosystem types and the distribution of area amongst them at various ecosystem levels. Maintaining the ecosystem types that are particularly important in the regional context (e.g., types that are species rich, structurally complex or rare for the Regional Study Area) is key to maintaining regional ecosystem health.

Terrestrial habitat mapping is often used as a proxy for terrestrial ecosystem mapping (Leitão et al. 2006; Noss et al. 2009).

Potential direct and indirect Project effects on ecosystem diversity through the pathways described in Section 2.5 include reducing the number of native ecosystem types, altering the distribution of area amongst the ecosystem types, reducing the total number of stands representing an ecosystem type and/or reducing the total area of a priority ecosystem type. The KCNs have noted that transmission lines reduce forest habitat (Split Lake Cree 1996).

Ecosystem diversity was selected as a VEC to provide information on ecosystem diversity, partial information on plant species diversity and serve as a proxy for other ecosystem components and functions. Given the nature of the ecosystem diversity measures (see below), they serve as proxies for potential Project effects on wetland function and soil quantity and quality. For example, since ecosite type is a component of habitat type and soil types can be grouped into ecosite types, Project effects on habitat provide information on how soil quantity and quality are affected. Likewise, the habitat types include wetland classes so that Project effects on wetland habitat types provide information on how wetland function is affected.

Numerous metrics have been developed to measure stand and landscape level ecosystem diversity. Leitão *et al.* (2006) review potential patch and landscape diversity metrics and reduce them to a core set that they expect will meet the typical needs of land use planning. The core set includes two composition metrics (patch richness and class area proportion) and eight configuration metrics (*e.g.*, patch number). The patch richness, class area proportion and patch number metrics can be alternative names for the number of broad habitat types, proportions of each habitat type and number of stands, depending on how these are measured.

Habitat mapping was used as a proxy for ecosystem mapping, as is often done (*e.g.*, Leitão *et al.* 2006; Noss *et al*. 2009). The mapped habitat attributes represent most of the major stand level ecosystem components, biomass and controlling factors.

The indicators used for the ecosystem diversity VEC were stand level habitat composition and **priority habitat type**s. Habitat composition addressed the number of different ecosystem types and the distribution of area amongst them. Priority habitat types were those native habitat types that were particularly important for ecological reasons and/or of particular social interest. Specifically, priority habitat types were the native broad habitat types that were regionally rare or uncommon, highly diverse (*i.e.*, species rich and/or structurally complex), highly sensitive to disturbance, had a high potential to support rare plants and/or were highly valued by people. Habitat types that are especially important to wildlife are not directly addressed.

Site level ecosystem diversity was also partially captured by the ecosystem diversity indicators in the sense that high species richness (*i.e.*, **alpha diversity**) and structural complexity were among the criteria for identifying priority habitat types.

Attributes measured for the habitat composition indicator were the number of native broad habitat types, the distribution of area amongst the native broad habitat types and the number of stands representing each native habitat type (ecosystem types represented by only a few stands in the Regional Study Area are more vulnerable to disappearing).

The attribute measured for the priority habitat indicator was the area of each priority habitat type. To evaluate cumulative historical effects, the estimated current area of a priority habitat type was compared with its estimated historical area prior to the development of infrastructure and the Nelson River for hydroelectric power generation. Table 2-3 lists the priority habitat types and the selection criteria they satisfied. The methods used for each of the priority habitat selection criteria were as follows. A broad habitat type was classified as being regionally rare if it comprised less than 1% of Regional Study Area land area and regionally uncommon if it covered between 1% and 10% of land area (note that the ground ice broad habitat types were not included as a priority habitat type because they are expected to disappear over time). Site level terrestrial habitat plot data were used to estimate the mean number of plant species, the occurrence of rare plant species and the typical number of distinct vegetation layers in each broad habitat type. Broad habitat types that had a mean number of plant species within the top 25th percentile for all of the inland broad habitat types were classified as having relatively high plant species density. Structurally diverse habitat types were those that typically had at least three distinct vegetation layers in most of the inland habitat plots. Broad habitat types that had high potential to support rare plant species were those in which the mean number of rare plant species per inland habitat plot was in the top 25th percentile of all of the inland broad habitat types. The Keeyask Cree Nations (KCNs), which includes Tataskweyak Cree Nation, War Lake First Nation, Fox Lake First Nation and York Factory First Nation, indicated that all terrestrial habitat types are important and did not identify any inland terrestrial habitat types that were of particular interest beyond the uses of these habitat types for other reasons such as habitat for favoured wildlife species (*e.g.* the importance of shrubby shoreline habitat for moose and other wildlife.

Existing and historical ecosystem diversity values were obtained from the Keeyask Generation Project Environmental Impact Statement (Section 2 of Keeyask HydroPower Partnership 2012b).

Table 2-3: Priority Habitat Types With Their Reasons for Inclusion and Their Historical and Current Areas in the Regional Study Area

Priority Habitat Type	Priority Criteria*	Estimated Historical Area (ha)**	Estimated Current Area (ha)
Balsam poplar dominant on all ecosites	RD	21	20
Trembling aspen dominant on all ecosites	RD	7,073	6,843
White birch dominant on all ecosites	RD	553	535
Balsam poplar mixedwood on all ecosites	RDS	12	11
Trembling aspen mixedwood on all ecosites	RDS	5,872	5,681
White birch mixedwood on all ecosites	R	446	432
Black spruce mixedwood on mineral	R	3,099	2,998
Black spruce mixedwood on thin peatland	RDS	885	856
Jack pine mixedwood on mineral	RD	2,166	2,095
Jack pine mixedwood on thin peatland	RDS	1,415	1,369
Jack pine dominant on mineral	UDS	15,584	15,077
Jack pine dominant on thin peatland	RDS	1,323	1,280
Jack pine mixture on thin peatland	R	5,255	5,084
Tamarack dominant on mineral	RDS	307	297
Tamarack mixture on mineral	RDS	1,067	1,033
Black spruce dominant on mineral	U	97,857	94,673
Black spruce mixture on mineral	RD	9,797	9,478
Black spruce mixture on thin peatland	R	8,132	7,868
Tamarack dominant on thin peatland	RDS	241	233
Tamarack mixture on thin peatland	RDS	3,029	2,930

Table 2-3: Priority Habitat Types With Their Reasons for Inclusion and Their Historical and Current Areas in the Regional Study Area

Priority Habitat Type	Priority Criteria*	Estimated Historical Area (ha)**	Estimated Current Area (ha)
Tall shrub on mineral	RD	490	474
Tall shrub on thin peatland	RDS	1,978	1,913
Low Vegetation on thin peatland	U	53,247	51,514
Jack pine dominant on shallow peatland	RS	137	132
Jack pine mixture on shallow peatland	RDS	526	509
Black spruce mixedwood on shallow peatland	RD	292	282
Jack pine mixedwood on shallow peatland	RS	103	100
Black spruce mixture on shallow peatland	RD	5,757	5,570
Black spruce dominant on wet peatland	UD	26,802	25,930
Black spruce mixture on wet peatland	R	1,759	1,702
Tamarack mixture on wet peatland	RD	9,648	9,334
Tamarack dominant on shallow peatland	R	440	426
Tamarack mixture on shallow peatland	RD	3,494	3,381
Tamarack dominant on wet peatland	R	2,048	1,982
Black spruce dominant on riparian peatland	RDS	8,522	8,245
Tamarack- black spruce mixture on riparian peatland	RD	435	421
Tamarack dominant on riparian peatland	R	82	79
Tall shrub on shallow peatland	RDS	3,351	3,242
Tall shrub on wet peatland	R	1,661	1,607
Low vegetation on shallow peatland	U	41,754	40,395
Low vegetation on wet peatland	U	20,026	19,374
Tall shrub on riparian peatland	R	7,606	7,358
Low vegetation on riparian peatland	U	23,495	22,731
Area of all types		*377,788*	*365,494*

*R = Rare, U = Uncommon, D = Diverse, S = Relatively high potential to support rare plant species.
**Historical areas estimated by multiplying the total Regional Study Area land area by the fraction of total native habitat area for each broad habitat type.
Source: Section 2 of Keeyask HydroPower Partnership (2012b).

2.3.1.3 Priority Plants

Plants perform key functions in terrestrial ecosystems. Among other things, they provide food and shelter for wildlife, contribute to soil development, store carbon, release oxygen and ultimately are the source for most life because they convert solar energy to biomass.

Priority plants are the native plant species that are especially important for ecological (*e.g.*, they are rare species) and/or social (e.g., food or cultural importance to the KCNs) reasons.

Direct Project effects on terrestrial plants will include loss, alteration and disturbance of plants and their habitats in the cleared ROW, borrow areas used for tower construction and any associated access roads and trails. These direct effects will lead to indirect effects on terrestrial plants, primarily through edge and access-related effects. The spatial extent of indirect Project effects on terrestrial plants in areas surrounding the Project Footprint (i.e., the terrestrial plants zone of influence) was expected to be the same as the terrestrial habitat zone of influence.

Priority plants was the VEC for terrestrial plants. Priority plants were native species that met one or more of the following criteria: highly sensitive to human features, thought to make high contributions to ecosystem function and/or were of particular interest to local people. A plant species was considered to be highly sensitive to human features if it was globally, provincially or regionally rare, near a range limit, had low reproductive capacity, depended on rare environmental conditions and/or depended on the natural **disturbance regime**.

The list of priority plants was selected from the list of species potentially occurring in the Regional Study Area. Globally, nationally and provincially rare species were identified from The *Manitoba Endangered Species Act* (MESA), *Schedule 1* of the *Species at Risk Act* (SARA), the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) and Manitoba Conservation Data Centre conservation concern rankings. Regionally rare and range limit species were identified from field data, floras (*e.g.*, FNA 1993+), herbarium records (MBCDC *pers. comm.*; Manitoba Museum *pers. comm.*) and terrestrial habitat mapping. A list of plant species of particular interest to the KCNs was developed from documents produced by the KCNs and notes from Keeyask Generation Project working group meetings.

Plant species potentially occurring in the Regional Study Area were identified from field data, MBCDC information (*pers. comm.* 2011), herbarium records, floras and relevant literature. Plant nomenclature followed Flora of North America (FNA 1993+) where volumes currently exist for the genus and the Manitoba Conservation Data Centre elsewhere.

Invasive plants were also considered for the Project effects assessment. Invasive plants are considered a threat to other plant species and to ecosystems. Invasive plants are plant species that are growing outside of their country or region of origin and are able to out-compete or replace native plants (ISCM 2012). Highly invasive plants can crowd out other plant species and, in extreme cases, extirpate species and alter vegetation composition, ecosystem diversity and other ecosystem attributes.

Invasive plants potentially occurring in the Regional Study Area were identified from Scoggan (1978), FNA (1993+), White *et al.* (1993), Royer and Dickinson (1999), Riley (2003) and ISCM (2012).

The distribution and abundance of each plant species recorded during field studies was classified. Distribution classes were very widespread, widespread, scattered, localized or absent (Table 2-4) based on frequency of occurrence across the sample locations using the ranges shown in Table 2-5. Species abundance was classified as being very abundant, abundant, sporadic, scarce or absent (Table 2-4) based on mean percentage of presences in the sub-samples (*e.g.*, percentage of quadrats in plots) across the locations using the ranges shown in Table 2-5.

Table 2-4: Distribution, Abundance and Regional Rarity Classes Used in the Terrestrial Plants Assessment

Distribution (D)	Abundance (A)	Rarity (R)
Very Widespread	Very Abundant	Very Common
Widespread	Abundant	Common
Scattered	Sporadic	Uncommon
Localized	Scarce	Regionally rare
Absent	Absent	n/a

Table 2-5: Distribution and Abundance Class Names and Ranges

Distribution (D)*		Generalized Distribution	Abundance (A)**	
Very Widespread	90% ≤ D ≤ 100%	Widely	Very Abundant	80% ≤ A ≤ 100%
Widespread	75% ≤ D < 90%		Abundant	53% ≤ A < 80%
Scattered	25% ≤ D < 75%	Narrowly	Sporadic	33% ≤ A < 53%
Localized	0% < D < 25%		Scarce	0% < A < 33%
Absent	0%	Absent	Absent	0%

Notes:
*. Distribution measured as percentage of sample locations where the species occurred (*i.e.*, percentage of plots or percentage of paired transect locations).
**. Abundance was measured as the mean subsample frequency across all sample locations. For Inland plots this was mean quadrat frequency out of a maximum 15; for shoreline wetlands this was mean percentage of total transect length.

The probability of detecting a species increases with the density of sample locations in the study area sampled. The sample density in the Terrestrial Plants Local Study Area was approximately 11 times higher than in the rest of the Regional Study Area as a whole because sampling was more intensive in areas with potential Project effects. The sample density in the Terrestrial Plants Local Study Area was 1.03 sample locations per km^2 while in the rest of the Regional Study Area it was 0.09 sample locations per km^2, which was approximately 11 times higher sampling density (1.03/0.09).

To provide a crude correction so that the number of known locations in the Terrestrial Plants Local Study Area could be converted into an estimated percentage of Regional Study Area locations, the estimated number of locations in the Regional Study Area was obtained from calculations completed for the Keeyask Generation Project environmental impact assessment (Section 3 of Keeyask HydroPower Partnership 2012b) since this analysis included all of the Project and the Keeyask Generation Project sample locations. Since this was a crude method to adjust for differences in sampling intensity, the resulting number of Regional Study Area locations was treated as being an approximation with a wide range around the true value (which is considered adequate where the number of locations in the Terrestrial Plants Local Study Area is clearly a small proportion of the estimated number of known locations).

2.4 EVALUATION OF ALTERNATIVE ROUTES AND OTHER INFRASTRUCTURE

The alternative routes assessed for Construction Power Transmission and Generation Outlet Transmission were those provided by Manitoba Hydro in a Shape file (downloaded from Orientis April 20, 2012).

When the first iteration of the alternative route evaluation was completed, there was some uncertainty regarding the ROW widths and whether all of the Generation Outlet Transmission lines would be located within a single ROW. Consequently, a 400 m wide evaluation corridor was generated for each alternative route as a 200 m buffer of the route. A 400 m wide corridor was wide enough to capture the ROW width as well as the most likely extent of indirect Project effects on terrestrial habitat, to ensure that any sensitivities in the immediate vicinity were captured and to provide some flexibility for refining routing should the particular route be selected. These 400 m wide corridors are referred to as the **alternative route evaluation corridor**s. The alternative route evaluation corridors were used for the ecosystem diversity and priority plant evaluations.

2.4.1.1 Fragmentation

The potential fragmentation effects of the alternative routes were compared using total route length, the total amount of core area removed and how the largest core areas would be affected. Since the Regional Study Area is the same for all of the alternative routes, comparisons based on total route length and total core area are proportional to the changes in total linear feature density and total core area percentage.

2.4.1.2 Ecosystem Diversity

As described in Section 2.3.1.2, terrestrial habitat mapping was used as a proxy for ecosystem mapping.

Using the 400 m wide corridors to identify affected terrestrial habitat, the potential effects of the alternative routes on ecosystem diversity were compared based on the number of stand level habitat types that would be completely removed, changes in stand level habitat composition and area losses for each of the priority habitat types.

2.4.1.3 Priority Plants

Since the terrestrial plants and terrestrial habitat zones of influence were the same, the potential effects of the alternative routes on priority plants were compared based on the number of priority plant locations found in the 400 m wide alternative route evaluation corridors, with special emphasis on the species of highest conservation concern. To the extent that the rare priority plants were associated with particular habitat types, the priority habitat indicator of the ecosystem diversity VEC provided a comparison of the effects on priority plant habitats. Additionally, relatively high potential to support rare plant species was one of the criteria used to select the priority habitat types.

2.5 PROJECT EFFECTS ASSESSMENT

2.5.1 General Approach

2.5.1.1 Introduction

The assessment of Project effects was based on the existing environment, as described in in this report (Section 3). This existing environment incorporates the effects of past and current projects and activities. The Project effects assessment also considered interactions with reasonably foreseeable potential future projects. Monitoring recommendations were provided.

The technical analysis determined Project effects on the terrestrial environment by considering the linkages between the terrestrial environment and changes caused by the Project, both directly and indirectly. The Terrestrial Environment Supporting Volume of the Keeyask Generation Project Environmental Impact Statement (Keeyask HydroPower Partnership 2012b) details the potential pathways of Project effects and the expected changes to various terrestrial ecosystem components.

Several approaches were used in the technical assessment. Generally, potential effects were identified based on a combination of scientific knowledge of causal relationships (*e.g.*, how vegetation and soils are affected by elevated soil temperatures due to vegetation clearing), results from Project studies and information from other existing transmission projects that provided relevant examples of how the Project could affect ecosystem components and relationships between these components.

Although the terrestrial habitat, ecosystems and plants effects assessment considered a wide range of terrestrial ecosystem components, the assessment focussed on the VECs and supporting topics. As described above, the VECs were fragmentation, ecosystem diversity and priority plants while the supporting topics were fire regime and invasive plants. The rationale used to select the VECs was provided in Section 2.3.

The main steps used to complete the terrestrial habitat, ecosystems and plants assessment were as follows:

1. Scope the Project;
2. Scope the environmental assessment in terms of VECs (see Section 2.3) and supporting topics, spatial scope and temporal scope;
3. Describe the existing environment;
4. For each VEC:
    - 4.1. Describe existing environment conditions;
    - 4.2. Predict and assess potential Project effects in combination with other past and current projects before considering potential mitigation;
    - 4.3. Identify credible mitigation measures where potential effects are expected to be greater than desired;
    - 4.4. Assess residual Project effects after mitigation;
    - 4.5. Assess Project interactions with reasonably foreseeable future developments and activities; and,
    - 4.6. Recommend monitoring.

2.5.1.2 Project Scope

The Project components relevant for the terrestrial environment assessment included:

- Physical components that could directly remove or alter terrestrial habitat and/or ecosystems, including effects on wildlife and/or their habitat;
- Components that could indirectly remove or alter terrestrial habitat and/or ecosystems, including effects on wildlife and/or their habitat;

- Components that could disturb animals and/or cause them to avoid habitat they would otherwise use;
- Improved access since it could increase disturbance, mortality or resource harvesting;
- Conditions that could increase the risk that diseases or invasive species are introduced or further spread; and,
- Conditions that increase fragmentation or otherwise reduce regional intactness.

Section 1.2 provides details regarding Project components during construction and operation that are relevant for the terrestrial environment scoping. The locations and boundaries for the Project components used to define the Project Footprint and for the Project effects assessment were those provided by Manitoba Hydro (Shape file provided by Stantec on September 18, 2012).

2.5.1.3 Spatial Scope

Local and Regional Study Areas were selected separately for each VEC and supporting topic using a nested, cause-effect approach (FEARO 1994; CEAA 1996; Milko 1998a, 1998b; Hegmann 1999; Manitoba Hydro 2003). The scoping approach considered the hierarchical structuring of ecosystems and the potential pathways of Project effects on the VEC or supporting topic.

The rationale for the nested cause-effect approach was as follows. Project **impact**s such as vegetation clearing would have direct **effect**s on the VEC or supporting topic being assessed. These Project impacts could also have indirect effects on the topic in question through linkages such as those shown in Figure 2-2 (*e.g.*, Project-related clearing leads to higher soil temperatures which eventually alters soils and vegetation). For each VEC and supporting topic, the spatial extent of potential direct and indirect effects defined a potential **zone of influence** on individuals (*i.e.*, the local zone of influence), which became the Local Study Area for the topic in question. In the case of a wildlife topic, individuals were the individual animals that would be affected (*e.g.*, five moose are displaced). In the case of a non-species topic, individuals were the relevant ecosystem elements (*e.g.*, 10 jack pine stands will be cleared; two core areas will be fragmented).

Although effects on individuals are of interest, the question of ultimate concern for the Project effects assessment was how effects on individual animals would translate into long-term effects on population viability or how effects on individual ecosystem elements would translate into long-term effects on components of regional ecosystem health (which is a synthetic measure of ecosystem functions). For example, how would removing the habitat that supports five moose affect the long-term viability of the moose population, or, how would removing ten jack pine stands affect regional ecosystem diversity? On this basis, an area that was large enough to capture the local "population" (*i.e.*, the regional zone of influence) was used to assess the potential significance of Project effects (Miller and Ehnes 2000). The spatial extent of the regional zone of influence became the Regional Study Area for the key topic. Figure 2-3 illustrates the conceptual approach using the potential effects of a hypothetical project on moose. Section 1 of the Keeyask Generation Project environmental impact statement terrestrial supporting volume (Keeyask HydroPower Partnership 2012b) provides further details on the methodology.

In summary, the Local Study Area represented the potential Project zone of influence on "individuals" while the Regional Study Area provided the comparison area for evaluating the potential significance of those individual effects on populations or the relevant regional ecosystem health attribute.

Map 2-5 shows the Local Study Areas used for the VECs and the other study areas used for the Project effects assessment. The same Regional Study Area was used for all of the VECs.

2.5.1.4 Temporal Scope

Temporal scope was determined separately for each VEC based on potential pathways of Project effects, including where these interactions could overlap with other past, current and reasonably foreseeable future projects. An important consideration for temporal scoping was the time required for the regional or population measures relating to the VEC to stabilize. This was closely related to life cycle length for priority plants and the length of the natural post-disturbance recovery cycle for habitat and ecosystem key topics.

2.5.1.5 Effects Benchmarks

Currently there are no regulatory or generally accepted scientific **threshold**s or **benchmark**s for any of the selected VECs or supporting topics. Regulatory thresholds or benchmarks may be developed in the future for plants that are listed as endangered or threatened by the federal *Species At Risk Act*.

Given the lack of regulatory thresholds and generally accepted scientific standards, the benchmarks used to assess Project effects varied depending on the key topic and included one or more of the following:

- Principles or recommendations from federal or Provincial policies and guidelines;
- Quantitative values or qualitative conditions proposed in the scientific literature;
- Conditions in areas relatively unaffected by human development;
- The range of natural variability;

- Comparison to conditions that existed in the past (*i.e.*, has the key topic already experienced major stress or declines from events that occurred in the past?);
- Relative degree of change from current conditions; and/or
- Relative degree of change from relatively natural conditions.

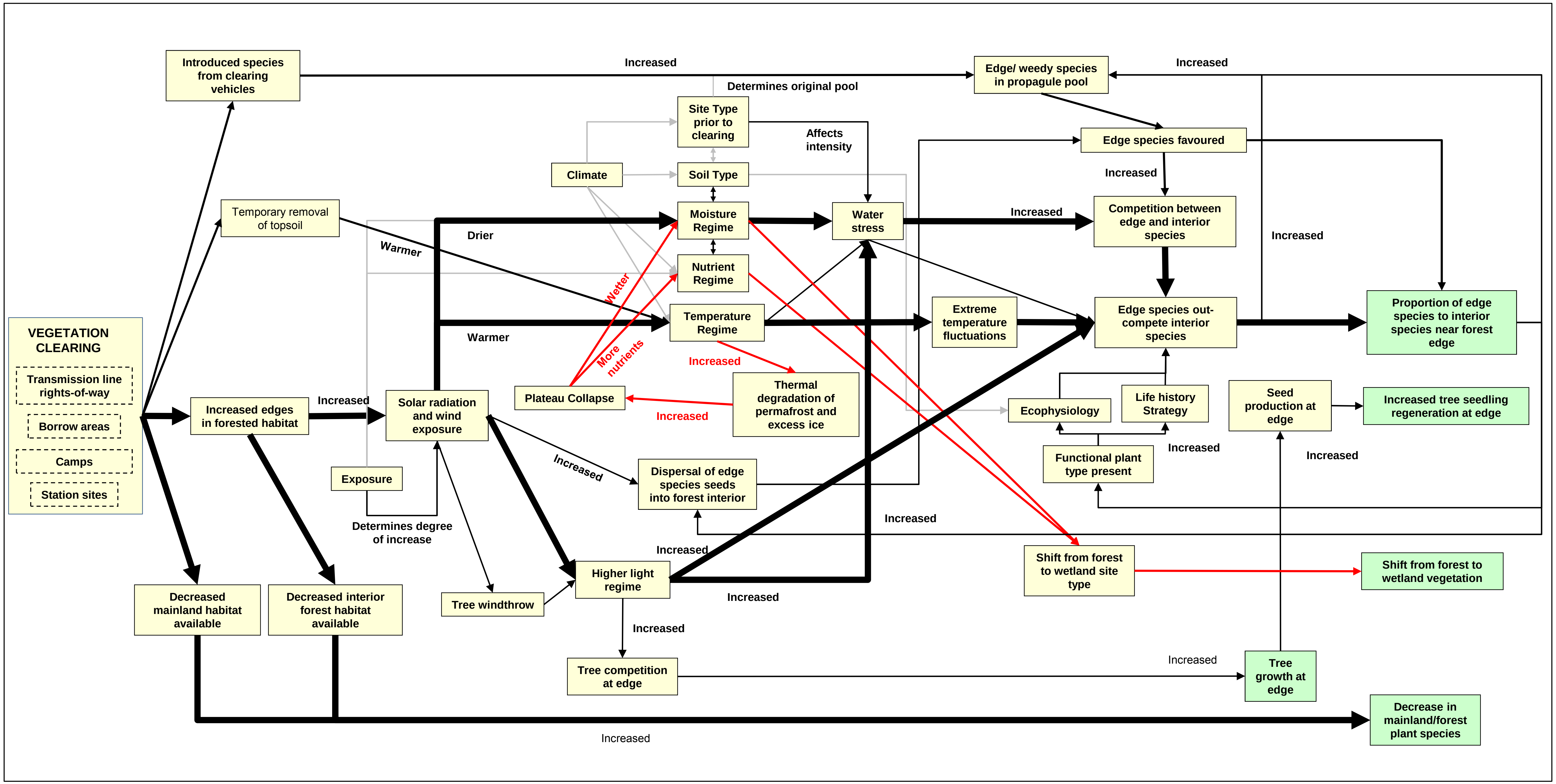


Figure 2-2: Network Linkage Diagram for Terrestrial Vegetation Changes Caused by Project Clearing

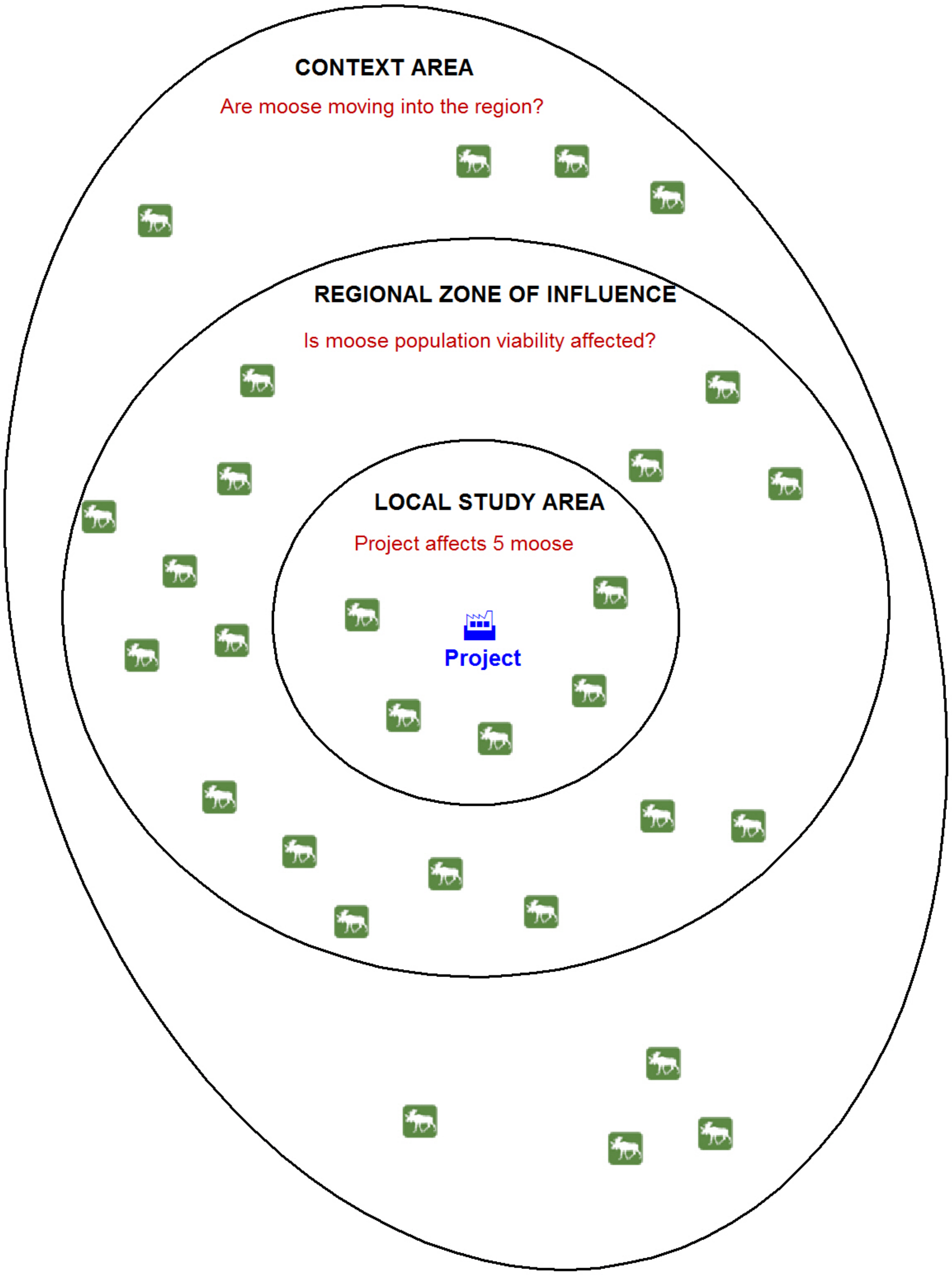


Figure 2-3: Nested Study Area Methodology for a Hypothetical Project

2.5.1.6 Evaluation of Residual Effects

Potential Project effects on the VEC were assessed using the selected benchmark. Potential mitigation measures that could avoid or reduce potential adverse Project effects were evaluated to determine which would be incorporated into the Project. The anticipated **residual effect**s of the Project, in combination with past and current existing developments and activities, were then assessed for each of the key topics in terms of nature, geographic extent, magnitude, duration, frequency and reversibility. Definitions for each of these criteria are provided in Table 2-6.

A two-step process was used to evaluate effects. Each VEC was first assessed for magnitude, geographic extent and duration. VECs with residual Project effects meeting the following criteria were further examined in step 2:

- Small in geographic extent, large in magnitude and long term in duration;
- Medium in geographic extent and either large in magnitude (regardless of duration) or moderate in magnitude and long-term in duration; or
- Large in geographic extent and either moderate or large in magnitude (regardless of duration).

In step 2, frequency, reversibility and ecological context were evaluated.

Ecological context refers to VEC's sensitivity to disturbance, capacity to adapt to change and past and future trends for the VEC. For example, if a VEC is known to be highly resilient (i.e., adaptable and recovers well from disturbance), effects that could otherwise be considered significant for the purposes of regulatory determination of significance, may be determined as insignificant. Conversely, where the loss of even a few individuals may affect the long-term viability of a population, the effect on a VEC may be significant, even where the residual effect is moderate magnitude and medium geographic extent.

Table 2-6: Criteria Used to Assess Residual Project Effects

Factor	Level	Definition
Step 1 - Each VEC is initially evaluated using the following criteria:		
Direction or Nature	Positive	• Beneficial or desirable on the environment
	Neutral or negligible	• No measurable change in the environment
	Adverse	• An undesirable effect on the environment
Magnitude	Small	• No definable, detectable or measurable effect • Below established benchmarks of acceptable change • Within range of natural variability • Minimum impairment of ecosystem component's function

Table 2-6: Criteria Used to Assess Residual Project Effects

Factor	Level	Definition
	Moderate	• Effects that could be measured and could be determined within a normal range of variation of a well designed monitoring program • Generally below or only marginally beyond guidelines or other established benchmarks of acceptable change • Marginally beyond the range of natural variability • Marginally beyond minimal impairment of ecosystem component's function
	Large	• Effects that are easily observable, measured and described • Well beyond guidelines or other established benchmarks of acceptable change • Well beyond the range of natural variability • Well beyond minimal impairment of ecosystem component's functions
Geographic Extent	Small	• Effects that are confined to a small portion of one or more areas where direct and indirect effects can occur (e.g., rights-of-way or component sites)
	Medium	• Effects that extend into local surrounding areas where direct and indirect effects can occur
	Large	• Effects that extend into the wider regional area where indirect and cumulative effects may occur
Duration	Short term	• Effects that generally occur within the construction period or initial period of impoundment • Occur within only one generation or recovery cycle of the VEC
	Medium term	• Effects extend through a transition period during the operations phase • Occur within one or two generations or recovery cycles for the VEC
	Long-term	• Effects extend for a long-term during the operations phase or are permanent • Extend for two or more generations or recovery cycles for a VEC
Frequency	Infrequent	• Effects that occur only once or seldom during life of the Project
	Sporadic/ Intermittent	• Effects that occur only occasionally and without predictable pattern during life of the Project •
	Regular/ Continuous	• Effects that occur continuously or at regular periodic intervals during life of Project •
Reversibility	Reversible	• Effect that is reversible during the life of the Project
	Irreversible	• A long-term effect that is permanent

Table 2-6: Criteria Used to Assess Residual Project Effects

Factor	Level	Definition
Ecological context	Low	• The VEC is not rare or unique, resilient to imposed change, or of minor ecosystem importance
	Moderate	• The VEC has some capacity to adapt to imposed change • The VEC is moderately/seasonally fragile • The VEC is somewhat important to ecosystem functions or relationship
	High	• The VEC is a protected/designated species • The VEC is fragile with low resilience to imposed change or a very fragile ecosystem

2.5.2 Valued Environmental Components (VECs)

The following subsections describe the Project effects assessment methods used for each VEC.

2.5.2.1 Fragmentation

Potential Project effects on fragmentation included increased fragmentation from linear features, lower total core area and fewer large core areas. Newly constructed transmission lines and access trails added to linear feature density. Core area was reduced by Project features that either remove existing core area or occur within 500 m of an existing core area.

The Fragmentation Local Study Area was a 1,150 m buffer of the Project Footprint as shown in Map 2-5. The Local Study Area was the area where Project features could directly or indirectly create linear disturbance and/or affect individual core areas. The Regional Study Area was large enough to represent a region level ecosystem in the Keeyask area (see Section 2.1).

Project effects on fragmentation were predicted by adding all Project features to the cumulative linear feature and cumulative human footprint maps developed for the Keeyask Generation Project environmental impact statement (Section 2 of Keeyask HydroPower Partnership 2012b).

The acceptability of residual Project effects on fragmentation was evaluated based on total linear feature density (especially outside of the Thompson portion of the Regional Study Area), core area percentage and the number of very large core areas. The complete removal of one or more very large core areas from the Regional Study Area was an unacceptable effect. For the linear feature density and core area percentage indicators, effects that were small to moderate in magnitude were generally be acceptable regardless of their duration or geographic extent because this degree of change was expected to fall within the range of natural variability. Exceptions could occur for a moderate magnitude residual effect if there was a substantial ongoing adverse trend in either of these indicators.

The benchmark values used to evaluate the magnitude of residual effects for the fragmentation indicators were as follows. For total linear feature density, adverse effects on fragmentation are: small magnitude for regional values below 0.40 km/km^2; moderate magnitude for regional values between 0.40 km/km^2 and 0.60 km/km^2; and, high magnitude for regional values greater than 0.60 km/km^2 (Salmo Consulting Inc. *et al.* 2003). For total core area as a percentage of land area, adverse effects on fragmentation are: small magnitude for regional values greater than 65%; moderate magnitude for regional values between 40% and 65%; and, high magnitude for regional values lower than 40% land area (Salmo Consulting Inc. *et al*. 2003; Athabasca Landscape Team 2009; and Dzus *et al.* 2010).

2.5.2.2 Ecosystem Diversity

Potential Project effects on ecosystem diversity include reducing the number of native ecosystem types, altering the distribution of area amongst the ecosystem types, reducing the total number of stands representing an ecosystem type and/or reducing the total area of a priority ecosystem type.

The Ecosystem Diversity Local Study Area was the area where Project features could directly or indirectly affect ecosystem diversity. Based on the anticipated maximum potential effects on terrestrial habitat described in Section 1.3, the Local Study Area was the area encompassed by a 50 m buffer of the transmission line ROWs and a 150 m buffer of the station sites (Map 2-5).

Project effects on ecosystem diversity during construction were predicted by converting all areas inside of the Ecosystem Diversity Local Study Area to the “human infrastructure” habitat type. This was a cautious approach in the sense that it was a substantial overestimate of the spatial extent of anticipated Project effects. In the case of transmission line ROWs, Project effects on terrestrial habitat were generally expected to extend approximately 10 m from the ROW edge (Section 1.3).

The acceptability of residual Project effects on ecosystem diversity was evaluated based on the number of stand level habitat types that would be completely removed, changes in stand level habitat composition (Noss *et al*. 2009) and cumulative historical area losses for each of the priority habitat types. The complete removal of one or more stand level habitat types from the Regional Study Area was an unacceptable effect. For the habitat composition and priority habitat type indicators, effects that were small to moderate in magnitude were generally acceptable regardless of their duration or geographic extent because this degree of change was expected to fall within the range of natural variability. Exceptions could occur for a moderate magnitude residual effect if there was a substantial ongoing adverse trend in the amount of a habitat type being considered.

The benchmark values used to evaluate the magnitude of residual effects on the priority habitat types were derived from two sources. Hegmann *et al.* (1999) cite rules of thumb for measurable indicator attributes for which accepted thresholds or benchmarks do not exist. The 10% value they cite as the transition from moderate to high magnitude effects was also used as the critical cutoff to evaluate cumulative effects risks to rare and unique physical and vegetation features for the Deh Cho Plan area (Salmo *et al.* 2004). The benchmark values for evaluating adverse residual effects of the Project in combination with past and current projects and human activities on priority habitat types were as follows: small magnitude for area losses below 1% of regional historical area; moderate magnitude for area losses between 1% and 10% of regional historical area; and, high magnitude for area losses greater than 10% of regional historical area.

2.5.2.3 Priority Plants

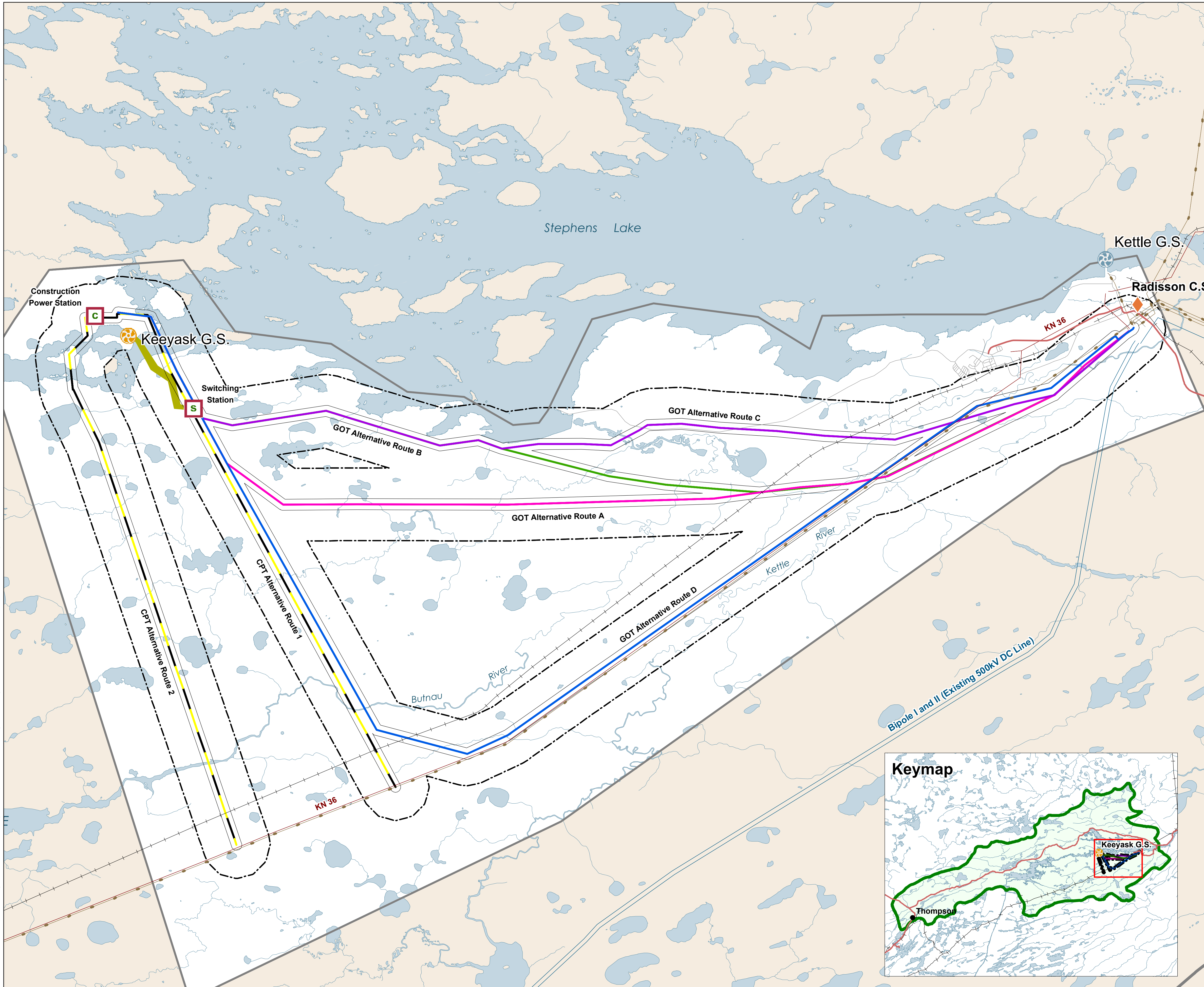
Potential Project effects on priority plants include removing and disturbing individual plants and plant populations as well as removing, altering or disturbing their habitats.

The Priority Plants Local Study Area was the area encompassed by a 50 m buffer of the Project Footprint as shown in Map 2-5. The Local Study Area is the area where Project features could directly or indirectly affect priority plants or their habitats.

The acceptability of residual Project effects on priority plants was evaluated based on the number of plant locations and/or the available priority plant habitat that could be affected by the Project. For both of these indicators, effects that were small to moderate in magnitude would generally be acceptable regardless of their duration or geographic extent because this degree of change was expected to fall within the range of natural variability. Exceptions could occur for a moderate magnitude residual effect on a species if there was a substantial ongoing adverse trend in either its population level or amount of available habitat.

The magnitude of residual Project effects on plant locations was measured as the predicted percentage of affected locations. Magnitude for residual effects on available habitat was measured as the cumulative percentage of habitat affected within the Regional Study Area. For the endangered, threatened, globally rare, provincially very rare species and provincially rare species, the percentage benchmarks for both indicators were as follows: small magnitude for percentage changes below 1%; moderate magnitude for percentage changes between 1% and 5%; and, high magnitude for percentage changes greater than 5% (Hegmann *et al*. 1999; Wagner 1991). For the remaining priority plants, the percentage benchmarks for both indicators were as follows:

small magnitude for percentage changes below 1%; moderate magnitude for percentage changes between 1% and 10%; and, high magnitude for percentage changes greater than 10% (Hegmann *et al*. 1999).



Manitoba Hydro

Keeyask Transmission Project

Project Infrastructure

- Generation Outlet Transmission (GOT) Alternative Route A
- Generation Outlet Transmission (GOT) Alternative Route B
- Generation Outlet Transmission (GOT) Alternative Route C
- Generation Outlet Transmission (GOT) Alternative Route D
- Construction Power Transmission (CPT) Alternative Route 1 and 2
- Unit Transmission Line Right-of-Way
- C Construction Power Station
- S Switching Station

Study Areas

- Project Study Area
- Regional Study Area
- Local Study Area for Alternative Routes Evaluation
- Detailed Analysis Corridor

Infrastructure

- Converter Station
- Generating Station (Proposed)
- Generating Station
- Transmission Line KN36
- Bipole I and II (Existing 500 kV DC Line)
- Other Existing Transmission Line

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Cons, MB Hydro, NTS.
Date Created: September 27, 2012

N

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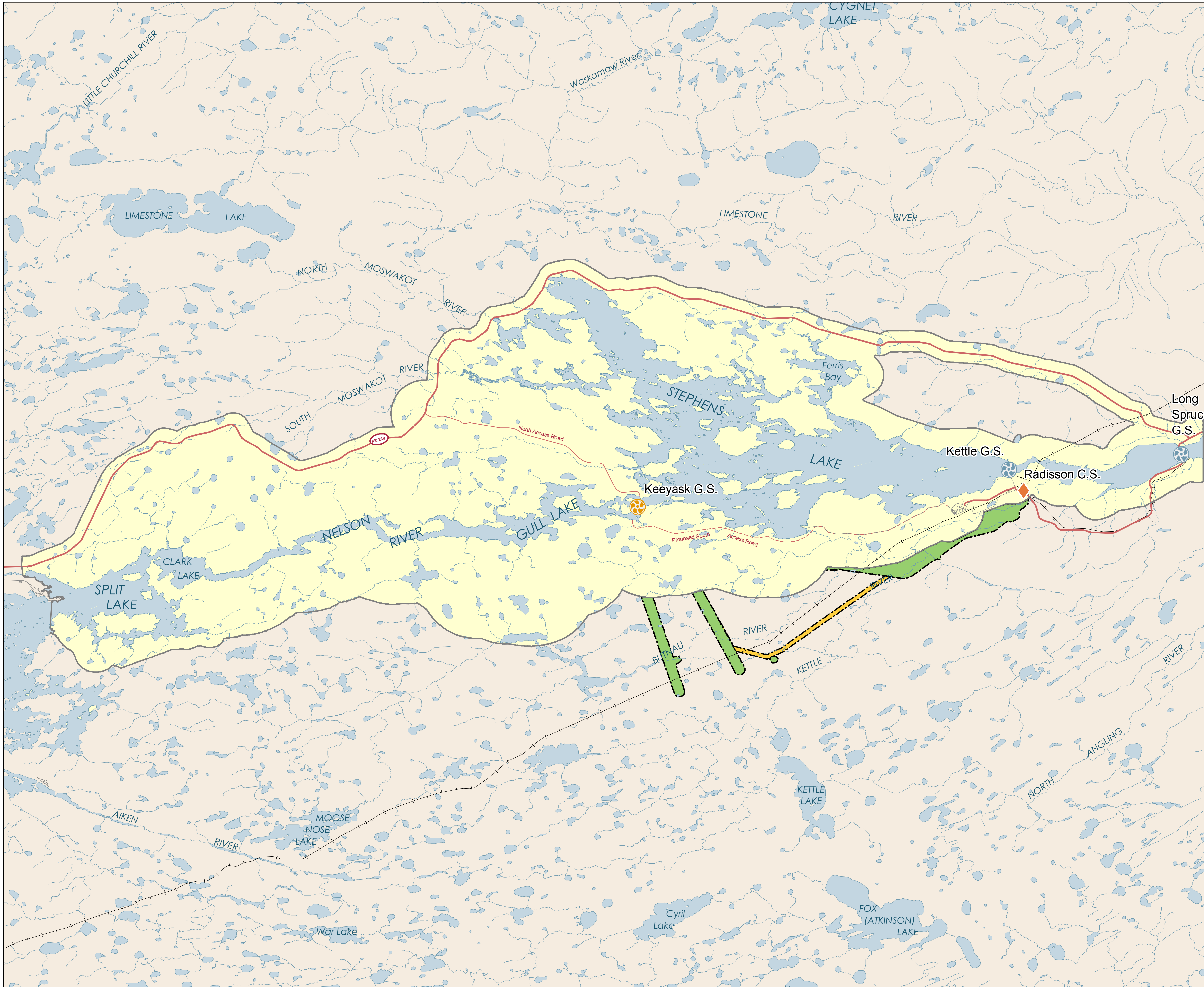
Local and Regional Study Area Used for the Alternative Routes Evaluation

Map 2-1

File Location: Z:\Workspaces\Keeyask Transmission\Figures\Map 2-1 Local and Regional Study Areas Used for the Terrestrial Habitat, Ecosystems and Plants Evaluation V8.wor



Manitoba Hydro

Keeyask Transmission Project

Mapping Areas

- Keeyask Transmission Detailed Mapping Area
- Ecosite and Priority Habitat Only Mapping Area
- Keeyask G.S. Detailed Mapping Area

Infrastructure

- Converter Station
- Generating Station (Proposed)
- Generating Station
- Keeyask G.S. North Access Road
- Proposed Access Road

Landbase

- Provincial Road
- Municipal Road
- Active Railway

Coordinate System:UTM Zone 15N NAD83
Data Source: MB Hydro, MB Cons, ECOSTEM Ltd., NTS.
Date Created: September 27, 2012

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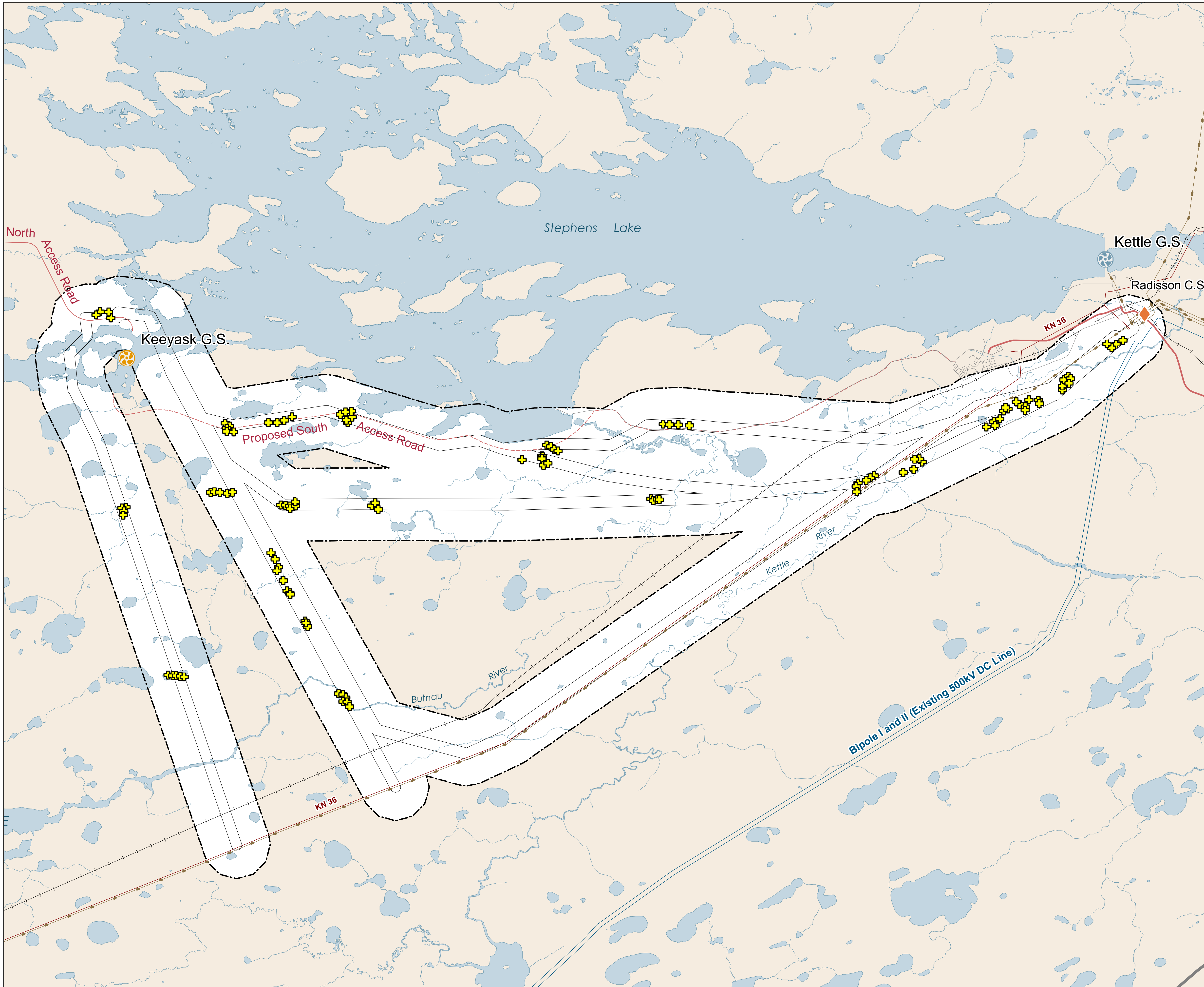
Detailed Terrestrial Habitat Mapping Area

Map 2-2

File Location: Z:\Workspaces\Keeyask Transmission\Keeyask Transmission\Figures\Map 2-2 Keeyask Transmission Detailed Habitat Mapping Area V5.wor



Manitoba Hydro

Keeyask Transmission Project

Upland and Peatland Sample Locations

- Sample Plot

Study Areas

- Local Study Area for Alternative Routes Evaluation
- Detailed Analysis Corridors

Infrastructure

- Converter Station
- Generating Station (Proposed)
- Generating Station
- Keeyask G.S. North Access Road
- Proposed Access Road
- Bipole I and II (Existing 500 kV DC Line)
- Other Existing Transmission Line
- Transmission Line KN36

Landbase

- Provincial Road
- Municipal Road
- Active Railway

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Hydro, MB Cons, NTS
Date Created: September 27, 2012

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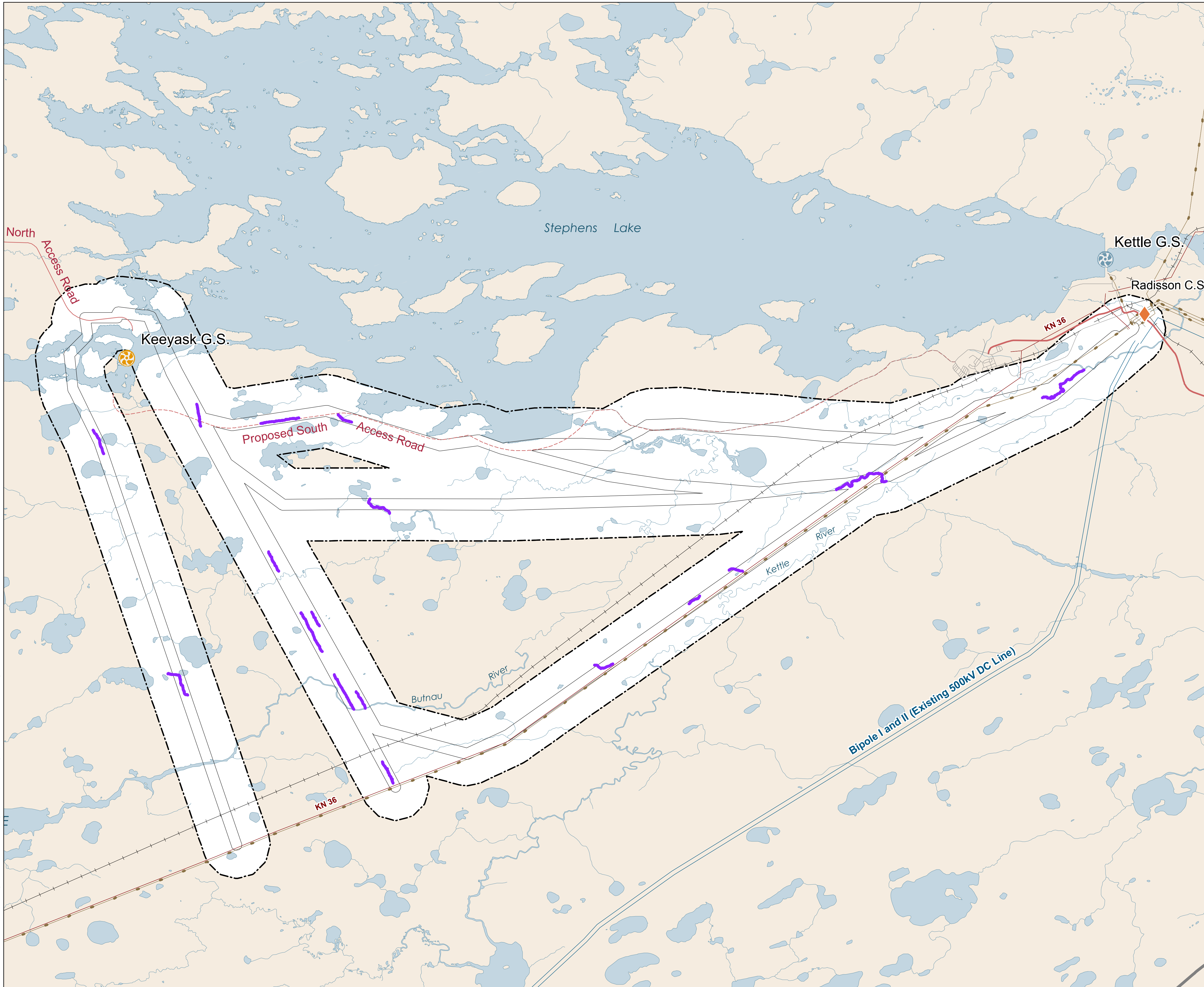
Habitat Sample Locations

Map 2-3

File Location: Z:\Workspaces\Keeyask Transmission\Keeyask Transmission\Figures\Map 2-3 Keeyask Transmission Priority Habitat Sample Locations V6.wor



Manitoba Hydro

Keeyask Transmission Project

Priority Plant Sample Locations

- Sample Transect

Study Areas

- Local Study Area for Alternative Routes Evaluation
- Detailed Analysis Corridors

Infrastructure

- Converter Station
- Generating Station (Proposed)
- Generating Station
- Keeyask G.S. North Access Road
- Proposed Access Road
- Bipole I and II (Existing 500 kV DC Line)
- Other Existing Transmission Line
- Transmission Line KN36

Landbase

- Provincial Road
- Municipal Road
- Active Railway

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Hydro, MB Cons, NTS
Date Created: September 27, 2012

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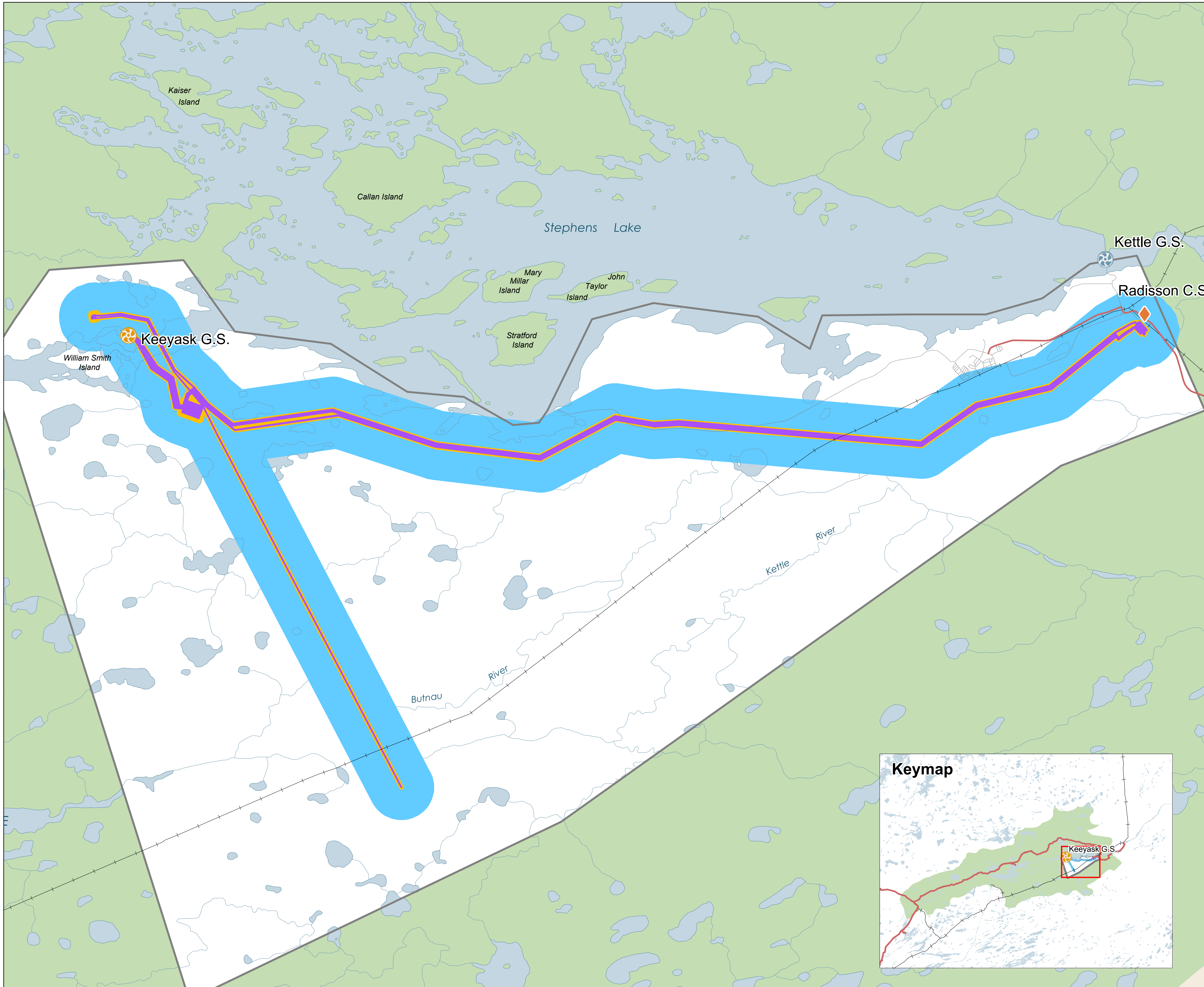
Priority and Invasive Plant Transect Locations

Map 2-4

File Location: Z:\Workspaces\Keeyask Transmission\Figures\Map 2-4 Keeyask Transmission Priority and Invasive Plant Sample Locations V6.wor



Manitoba Hydro

Keeyask Transmission Project

Study Areas
- Project Footprint
- Ecosystem Diversity and Terrestrial Plants Local Study Area
- Fragmentation Local Study Area
- Regional Study Area
- Project Study Area

Infrastructure
- Converter Station
- Generating Station (Proposed)
- Generating Station

Landbase
- Provincial Road
- Municipal Road
- Active Railway

Note: Each study area includes all of the study areas nested within it

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Conservation, NTS.
Date Created: September 27, 2012

N

0 2 4 Kilometres
0 1 2 Miles

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Local Study Areas Used for the Project Effects Assessment

Map 2-5

File Location: Z:\Workspaces\Keeyask Transmission\Figures\Map 2-5 Local Study Areas for Project Effects Assessment V6.wor

3.0 STUDY AREA CHARACTERIZATION

3.1 STUDY AREA OVERVIEW

Most of the Regional Study Area (Map 2-1) is located within the Boreal Shield **Ecozone** and the Hayes River Upland Ecoregion (Ecological Stratification Working Group 1996). There is some overlap with the Taiga Shield Ecozone and the Selwyn Lake Upland Ecoregion in the northeast and with the Churchill River Upland Ecoregion in the northwest. The Regional Study Area overlaps seven Ecodistricts. Most of the Local Study Area is within the 2,300,000 ha Knee Lake Ecodistrict.

Land accounted for approximately 87% of the 1,420,000 ha Regional Study Area in 2010 (Table 3-1). The percentage of land area was higher for the Alternative Routes Local Study Area due to the lesser influence of the Nelson River.

Table 3-1: Total Land and Water Areas and Percentages of Total Area for the Study Areas and Alternative Route Evaluation Corridors

Study Area*	Total Area (ha)	Land Area (ha)**	Water Area (ha)**
Regional Study Area	1,420,000	1,240,000 (*87*)	180,000 (*13*)
Project Study Area[1]	34,145	29,010 (*85*)	5,140 (*15*)
Alternative Routes Local Study Area	22,170	26,841 (*95*)	2,469 (*5*)
Alternative Route Evaluation Corridors	9,171	8,816 (*96*)	355 (*4*)

* Each study area includes all of the study areas nested within it.
** Percentage of total area shown in brackets. Land and water areas and percentages were estimated by extrapolating detailed terrestrial habitat mapping for the sub-region (identified as study zone 4 in the Keeyask Generation Project environmental impact statement (Section 2 of Keeyask HydroPower Partnership 2012b). Water area for portion of Local Study Area with missing habitat data was obtained from the National Hydrography Network data (GeoBase Secretariat 2007).
[1] This table only includes the portion of the Project Study Area for which detailed terrestrial habitat mapping exists (Map 2-2).

3.2 ENVIRONMENTAL SETTING

3.2.1 Physiography

The terrain is broadly similar throughout the Regional Study Area, having been shaped by glaciation and subsequent inundation by glacial Lake Agassiz. Undulating **morain**al plains are punctuated by ridges and hills (Smith *et al.* 1998). Much of this morainal terrain is overlain by clayey **glaciolacustrine** deposits, which are more prominent and extensive in lower-laying areas and more continuous toward the south in the basin of former Lake Agassiz. **Glaciofluvial** and morainal deposits form ridges and hills throughout the area. Extensive areas of shallow to deep organic soils have developed on the glaciolacustrine deposits.

Peatlands dominate the Project Study Area. According to Soil Landscapes of Canada (Agriculture and Agri-Food Canada 1996), which is 1:1,000,000 scale mapping, surficial materials in and around the Project Study Area consist of approximately two-thirds organic deposits and one-third lacustrine mineral deposits. Large scale (1:15,000 scale) mapping indicates that organic and mineral deposits account for approximately 92% and 8% of the detailed habitat mapping area (Map 2-2), respectively. Veneer bogs and blanket bogs are the most common peatland types covering approximately 62% of the land area. Veneer bogs are thin peats (i.e., less than 1.5 m thick) that primarily occur on slopes in the detailed habitat mapping area. Blanket peatlands are thicker than veneer bogs and occur on lower slopes, valleys and level areas. Peat plateau bogs are ice-cored bogs with a relatively flat surface that is elevated from the surroundings, and has distinct banks. Peat plateau bogs and associated peatland types, which cover about 16% of the land area, primarily occur in the western two-thirds of the detailed habitat mapping area. The remaining peatland types are horizontal peatlands, aquatic peatlands and thin wet peatlands. These peatlands are generally found in lower slope and depression locations; aquatic peatlands occur along the shorelines of waterbodies. Mineral deposits are more common in the eastern one-third of the area. Human infrastructure accounts for approximately 3% of the detailed habitat mapping area.

Large scale mapping indicates that discontinuous surface permafrost is widespread, occurring as cold soil temperatures, ice crystals, ice lenses and thick ground ice. Consequently, Cryosols (organic) are the dominant soil order type in the detailed habitat mapping area, followed in descending order by Organics, Brunisols, Gleysols, Luvisols and Regosols.

Climate parameters vary across the Regional Study Area with mean annual temperatures and total annual precipitation generally decreasing toward the northeast. Mean annual temperatures across the Regional Study Area range from about -2.4°C to -4.9°C, with growing seasons ranging from 124 days in the northeast extent, to 149 days in the southwest extent (Smith *et al.* 1998).

The weather station at Gillam, which is at the eastern end of the Alternative Routes Local Study Area, was used to characterize climate for the Alternative Routes Local Study Area. Mean annual temperature at Gillam is approximately -4.2°C while mean daily temperatures in the coldest and warmest months are -25.8°C in January and 15.3°C in July. The total accumulated growing degree days are 969.6 with a 5°C threshold base temperature, and 428.6 using a 10°C threshold base temperature. The average number of frost-free days is 91.9.

Total annual precipitation is approximately 499.4 mm on average. Rainfall accounts for approximately 63% of the total annual precipitation. Annual precipitation is highly variable throughout the Regional Study Area. The highest mean annual precipitation is 530 mm in the northwestern extent of the Regional Study Area in the Pikwitonei Lake, Orr Lake and Waskaiowaka Lake Ecodistricts, (Smith *et al.* 1998). Mean annual precipitation decreases to approximately 480 mm at the northeastern extent. At Gillam, mean annual precipitation ranges from approximately 500 – 530 mm, most of which falls during the summer months.

3.2.2 Terrestrial Habitat

Land cover in 2010 was dominated by sparsely to densely treed needleleaf vegetation on thin or shallow peatlands (about 80% of the land in the Regional Study Area; Section 2 of Keeyask HydroPower Partnership 2012b). Broadleaf treed land cover accounted for approximately 1% of the land area, typically occurring on upland mineral soils, in richer riparian areas and near the Nelson River (Map 3-1). Tall shrub and low vegetation on mineral or peatland ecosites covered 16% of land area, primarily occurring along streams and rivers, other wet areas and in poorly regenerating burned areas (a substantial proportion of the low vegetation on mineral, thin peatland and shallow peatland was treed vegetation prior to burning in wildfires during the 1980s and 1990s). Shoreline wetlands other than shallow water wetlands accounted for less than 1% of land area. Human infrastructure comprised approximately 2% of the existing land area.

Black spruce (*Picea mariana*) on thin peatlands and black spruce on shallow peatlands were the two most abundant coarse habitat types by far, with each covering approximately one-third of land area (Table 3-2). The other needleleaf coarse habitat types were jack pine (*Pinus banksiana*) and tamarack (*Larix laricina*) types. The overstorey species included in the broadleaf treed and mixedwood coarse habitat types were trembling aspen (*Populus tremuloides*), balsam poplar (*Populus balsamifera*) and white birch (*Betula papyrifera*). Black spruce and jack pine typically were the needleleaf species in the mixedwood types.

Because of frequent large fires, approximately one-quarter of inland terrestrial habitat in the Regional Study Area was less than 50 years old in 2010 (Section 2 of Keeyask HydroPower Partnership 2012b).

Shoreline wetland coarse habitat types comprised less than 1% of land area (shallow water wetland class not included in land area or as a type since bathymetry data were not available to separate shallow from deep water throughout the Regional Study Area). Shrub and/or low vegetation on upper beach on the Nelson River was the most abundant of these types (0.6% of the land area).

Land cover in the Alternative Routes Local Study Area was similar to that in the Regional Study Area. There was a lower proportion of needleleaf vegetation on mineral, thin or shallow peatlands (71% vs. 80%), and a higher proportion of tall shrub and low vegetation cover (24% vs. 16%). Much of this difference is due to slowly regenerating burned areas occurring throughout a large portion of the Alternative Routes Local Study Area. The overall habitat composition with respect to overstorey species was very similar to that of the regional study area, with black spruce on thin peatlands and black spruce on shallow peatlands being the most abundant habitat types.

Table 3-2: Land cover and Coarse Habitat Composition of the Regional, Project and Alternative Routes Local Study Areas, as a Percentage of Total Land Area

Land Cover	Coarse Habitat Type	Regional Study Area	Project Study Area	Alternative Routes Local Study Area
Mineral and Thin Peatland Types				
Broadleaf Treed on All Ecosites	Broadleaf treed on all ecosites	0.6	0.3	0.3
	Broadleaf mixedwood on all ecosites	0.5	0.3	0.3
Needleleaf Treed on Mineral or Thin Peatland	Black spruce mixedwood on mineral or thin peatland	0.3	0.3	0.3
	Jack pine mixedwood on mineral or thin peatland	0.3	0.2	0.3
	Jack pine treed on mineral or thin peatland	1.8	2.1	2.1
	Black spruce treed on mineral soil	8.4	4.6	4.4
	Black spruce treed on thin peatland	33.2	28.6	28.7
Tall Shrub on Mineral or Thin Peatland	Tall Shrub on Mineral or Thin Peatland	0.2	0.2	0.3
Low Vegetation on Mineral or Thin Peatland	Low Vegetation on Mineral or Thin Peatland	4.6	7.2	8.0
Other Peatland Types				
Needleleaf Treed on Other Peatlands	Jack pine treed on shallow peatland	0.1	0.0	0.0
	Black spruce mixedwood on shallow peatland	0.0	0.0	0.0
	Black spruce treed on shallow peatland	32.8	28.8	28.3
	Black spruce treed on wet peatland	2.1	2.7	3.1
	Tamarack- black spruce mixture on wet peatland	0.9	0.7	0.8
	Tamarack treed on shallow peatland	0.4	1.2	1.2
	Tamarack treed on wet peatland	0.2	0.3	0.4
	Black spruce treed on riparian peatland	0.7	0.8	0.9
	Tamarack- black spruce mixture on riparian peatland	0.0	0.1	0.1
	Tamarack treed on riparian peatland	0.0	0.0	0.0

Table 3-2: Land cover and Coarse Habitat Composition of the Regional, Project and Alternative Routes Local Study Areas, as a Percentage of Total Land Area

Land Cover	Coarse Habitat Type	Regional Study Area	Project Study Area	Alternative Routes Local Study Area
Tall Shrub on Other Peatlands	Tall Shrub on Shallow Peatland	0.3	0.1	0.2
	Tall Shrub on Wet Peatland	0.1	0.1	0.1
Low Vegetation on Other Peatlands	Low Vegetation on Shallow Peatland	7.0	10.2	10.1
	Low Vegetation on Wet Peatland	1.6	2.2	2.3
Shrub/Low Vegetation on Riparian Peatland	Tall shrub on riparian peatland	0.6	0.5	0.5
	Low vegetation on riparian peatland	1.8	2.2	2.0
Shore Zone Types				
Nelson River Shore Zone	Nelson River shrub and/or low vegetation on ice scoured upland	0.0	0.2	0.2
	Nelson River shrub and/or low vegetation on upper beach	0.1	0.2	0.1
	Nelson River shrub and/or low vegetation on sunken peat	0.0	0.8	0.5
	Nelson River marsh	0.0	0.0	-
Off-system Shore Zone	Off-system marsh	0.0	0.1	0.1
Other Land Cover Types				
Human Infrastructure		0.9	4.8	4.3
Unclassified		0.5	0.1	0.0
All		100.0	100.0	100.0
Total Land Area (ha)		*1,239,328*	*29,010*	*20,024*

Note: Cells with 0 values are values that round to 0, while "-" cells indicate a value of 0. Reported areas are land area only.

3.2.3 Terrestrial Ecosystems

3.2.3.1 Fragmentation

Linear Feature Density

The Regional Study Area included 5,628 km, or 0.45 km/km^2, of mapped linear features in 2010 (Section 2 of Keeyask HydroPower Partnership 2012b). Per lineal kilometre, roads are the linear feature type that have the highest adverse effects on ecosystems and species, especially those linear features that are passable all year. The 738 km of existing roads created a road density of 0.06 km/km^2 in the Regional Study Area, with PR 280 making the largest contribution. The remaining roads occurred around small communities, such as York Landing and Ilford, with about half of these being winter roads.

Roads and rail lines combined to create a regional transportation density of 0.13 km/km^2 (Section 2 of Keeyask HydroPower Partnership 2012b). Transmission line density in 2010 was 0.06 km/km^2.

At 0.30 km/km^2, cutlines made the highest contribution to total linear feature density in the Regional Study Area (Section 2 of Keeyask HydroPower Partnership 2012b). The ecological effects of cutlines are expected to be lower than those of other linear features for a variety of reasons (*e.g.*, narrower footprint, lower habitat disturbance). Regarding the access function of linear features, it is likely that portions of the mapped cutlines and transmission line rights-of-way were not being used as human or wildlife corridors because they were partially overgrown, distant from any current human uses and/or were accessible only in winter due to natural barriers. For example, approximately 35% of the 883 km of cutlines surveyed for vegetation regeneration and game trails in 2011 had regenerated to the degree that they were no longer expected to function as travel corridors (Section 2 of Keeyask HydroPower Partnership 2012b). To illustrate the effect of cutlines on linear density, total linear feature density declined from 0.45 km/km^2 to 0.15 km/km^2 when cutlines were not considered.

There was a very high concentration of linear features near Thompson, which skewed the linear feature densities for the rest of the Regional Study Area (Section 2 of Keeyask HydroPower Partnership 2012b). Whereas the Thompson area comprised only 15% of the Regional Study Area, it included 38% of the linear features. Total linear feature density in the Thompson area was 1.27 km/km^2 compared with only 0.32 km/km^2 in the rest of the Regional Study Area.

Core Areas

Core areas larger than 200 ha accounted for 84% of Regional Study Area land area in 2010 (Section 2 of Keeyask HydroPower Partnership 2012b). When the minimum size for a core area was increased to 1,000 ha, then core area percentage only dropped to 83% because almost 98% of total core area occurred in core areas that were larger than 1,000 ha.

The three largest core areas contributed over half of the total core area (Section 2 of Keeyask HydroPower Partnership 2012b). The largest core area (270,769 ha) was located north of PR 280 between Split Lake and Long Spruce Generating Station. The second largest core area (181,147 ha) was located north of PR 280 between Split Lake and Thompson.

3.2.3.2 Ecosystem Diversity

The Regional Study Area included 56 native broad habitat types (Appendix A).

The distribution of area amongst the native broad habitat types was very uneven (Section 2 of Keeyask HydroPower Partnership 2012b). Three black spruce habitat types (black spruce dominant on thin peatland, black spruce dominant on shallow peatland, and black spruce dominant on ground ice peatland) accounted for nearly 65% of the total land area. In contrast, the 44 least abundant broad habitat types covered less than 9% of land area.

The four broad habitat types represented by less than ten stands included balsam poplar dominant on all ecosites, balsam poplar mixedwood on all ecosites, jack pine dominant on shallow peatland, and jack pine mixedwood on shallow peatland (Section 2 of Keeyask HydroPower Partnership 2012b). It was likely that there were additional stands representing each of these habitat types in the portion of the Regional Study Area that was outside of the detailed habitat mapping area. A simple area based extrapolation to provide a very crude estimate would increase the total number of stands for each type by approximately 7.5 times.

Due to the highly uneven distribution of area amongst the broad habitat types, 46 broad habitat types met the regional rarity criterion for priority habitat types. Of this total, 28 habitat types satisfied at least two priority habitat criteria. The two rarest habitat types in the Regional Study Area were balsam poplar mixedwood on all ecosites and balsam poplar dominant on all ecosites. The abundances of regionally rare and uncommon habitat types in the Alternative Routes Local Study Area was similar to that in the rest of the Regional Study Area. These types were generally located on an esker and along the Nelson River (Map 3-1).

The most structurally and/or plant species diverse priority habitat types were tall shrub on shallow peatland, tall shrub on thin peatland, balsam poplar mixedwood on all ecosites, trembling aspen mixedwood on all ecosites, black spruce mixedwood on thin peatland, jack pine dominant on mineral, jack pine dominant on thin peatland, jack pine mixedwood on thin peatland, jack pine mixture on shallow peatland, tamarack dominant on mineral, tamarack mixture on mineral, tamarack dominant on thin peatland and tamarack mixture on thin peatland.

Priority habitat types with the highest potential to support rare plant species were jack pine, trembling aspen mixedwood on all ecosites, balsam poplar mixedwood on all ecosites, tamarack on mineral or thin peatland ecosites, black spruce mixture and mixedwood on thin peatland, and tall shrub types.

3.2.4 Terrestrial Plants

3.2.4.1 Plant Communities

The plant species occurring in the Regional Study Area are typical of the central Canadian boreal forest, consisting primarily of species that are tolerant of the cold, harsh climate and can grow in wetlands. Available information indicated that over 750 terrestrial **vascular plant** species could potentially occur in the Regional Study Area (Section 2 of Keeyask HydroPower Partnership 2012b). Of this total, 120 species and 12 additional species groups (e.g., species only identified to the genus level) were detected by field studies conducted in the alternative routes evaluation corridors (Map 2-1). Based on field data and ground layer samples collected at the terrestrial habitat plots, 88 mosses, six lichens and two liverworts were identified to either a species or a broader taxon (field studies only attempted to identify the most common and abundant ground mosses and lichens in the field).

In descending order, the most widespread and abundant inland plant species recorded to the species level during field studies were black spruce, green alder (*Alnus viridis*), Bebb's willow (*Salix bebbiana*), myrtle-leaved willow (*S. myrtillifolia*), flat-leaved willow (*S. planifolia*), bog willow (*S. pedicellaris*), swamp birch (*Betula pumila*) Labrador tea (*Rhododendron groenlandicum*) and rock cranberry (*Vaccinium vitis-idaea*). Of the plants that were only identified into species groups, peat mosses (*Sphagnum* spp.) were the only group that was widespread and abundant. The most widespread shoreline wetland plants found on the Nelson River and off-system waterbodies were marsh reed-grass (*Calamagrostis canadensis*), common horsetail (*Equisetum arvense*) and water sedge (*Carex aquatilis*). More beach and sub-littoral zone species occurred in off-system waterbodies. Species only found in off-system waterbodies included bitter-cress (*Cardamine pensylvanica*), wooly sedge (*Carex pellita*), thread rush (*Juncus filiformis*), small yellow pond-lily (*Nuphar lutea* ssp. *variegata*) and several pondweed species. Of the shoreline plants that were only identified into groups, none of the groups were widespread and abundant.

3.2.4.2 Priority Plants

The priority plant list for the Regional Study Area consisted of 101 vascular plants. Appendix B provides the species list, their MBCDC conservation concern ranking (G-Rank and S-Rank), their reasons for inclusion as a priority plant species, the number of sample locations where the species was found at in the Regional Study Area, and very general habitat associations.

Species listed as endangered or threatened under MESA, SARA or COSEWIC were not expected to occur in the Regional Study Area. All of these except for flooded jellyskin lichen (*Leptogium rivulare*) are prairie species. Flooded jellyskin lichen was not expected to occur in the area, primarily because its required microhabitat was not found in the study area.

None of the 13 provincially very rare species that could potentially occur in the Regional Study Area were found during field studies. One species with an uncertain rare or very rare conservation concern ranking, elegant hawk's-beard (*Crepis elegans*), was found at nine roadside locations.

Field studies recorded seven of the 45 provincially rare (Map 3-2) to uncommon (Map 3-3) upland and wetland plant species that could potentially occur in the Regional Study Area, including small pondweed (*Potamogeton pusillus* ssp. *tenuissimus*), Robbin's pondweed (*Potamogeton robbinsii*), shrubby willow (*Salix arbusculoides*), rock willow (*Salix vestita*), horned pondweed (*Zannichellia palustris*), oblong-leaved sundew (*Drosera anglica*), muskeg-lousewort (*Pedicularis macrodonta*) and American milk-vetch (*Astragalus americanus*). All species except for American milk-vetch were more regionally common than suggested by their provincial conservation concern rank, being found at more than 25% of locations sampled in appropriate habitat. American milk-vetch, which was recorded in a few locations at the eastern end of the Regional Study Area, was found at a larger number of locations to the northeast of the Regional Study Area.

Of the remaining 42 priority plants, 27 were regionally rare and/or near a range limit. Map 3-4 shows the locations of the regionally rare species found in the Alternative Routes Local Study Area during field studies. Range limit species included jack pine (*Pinus banksiana*), shrubby willow, rock willow, northern Labrador tea (*Rhododendron tomentosum*), wolf-willow (*Elaeagnus commutata*), elegant hawk's-beard, hairy goldenrod (*Solidago hispida*), arctic wintergreen (*Pyrola grandiflora*) and small yellow pond-lily. Map 3-4 shows the locations of the range limit species found in the Alternative Routes Local Study Area during field studies.

Plants of particular interest to the KCNs were sweet flag (*Acorus americanus*; locally known as ginger root in English; *wekes*, *wekas* or *wihkis* in Cree), white birch (*Betula papyrifera* and *B. neoalaskana*; *asatee* in Cree), strawberries (*Fragaria virginiana*; *odahihminah* in Cree), northern Labrador tea, currants and gooseberries (*Ribes triste or R. lacustre*; *ekomina* or *anikimina* in Cree), cloudberries (*Rubus chamaemorus*; *ostikonihminah* in Cree), red raspberry (*Rubus ideaus*; *anouskanuk* in Cree), dewberry (*Rubus pubescens*; *ooskeesihikoominh* in Cree), blueberries (*Vaccinium uliginosum*; *niskeminah* in Cree) and cranberries (*Vaccinium vitis-idaea*; *wesahkeminah* in Cree). Most of these species were common in their preferred habitats. Exceptions were ginger root and northern Labrador tea. Ginger root was not found during field studies. Northern Labrador tea was recorded at seven locations in the Regional Study Area.

None of the provincially very rare species that could potentially occur in the Alternative Routes Local Study Area were found during field studies. Shrubby willow, rock willow and muskeg-lousewort were the provincially rare to uncommon species recorded in the Alternative Routes Local Study Area (Table 4-5 and Table 4-18). One regionally rare species and six range limit species were recorded in the Alternative Routes Local Study Area. Seven of the plants of particular interest to the KCNs were also recorded in the Alternative Routes Local Study Area (Table 4-5 and Table 4-18).

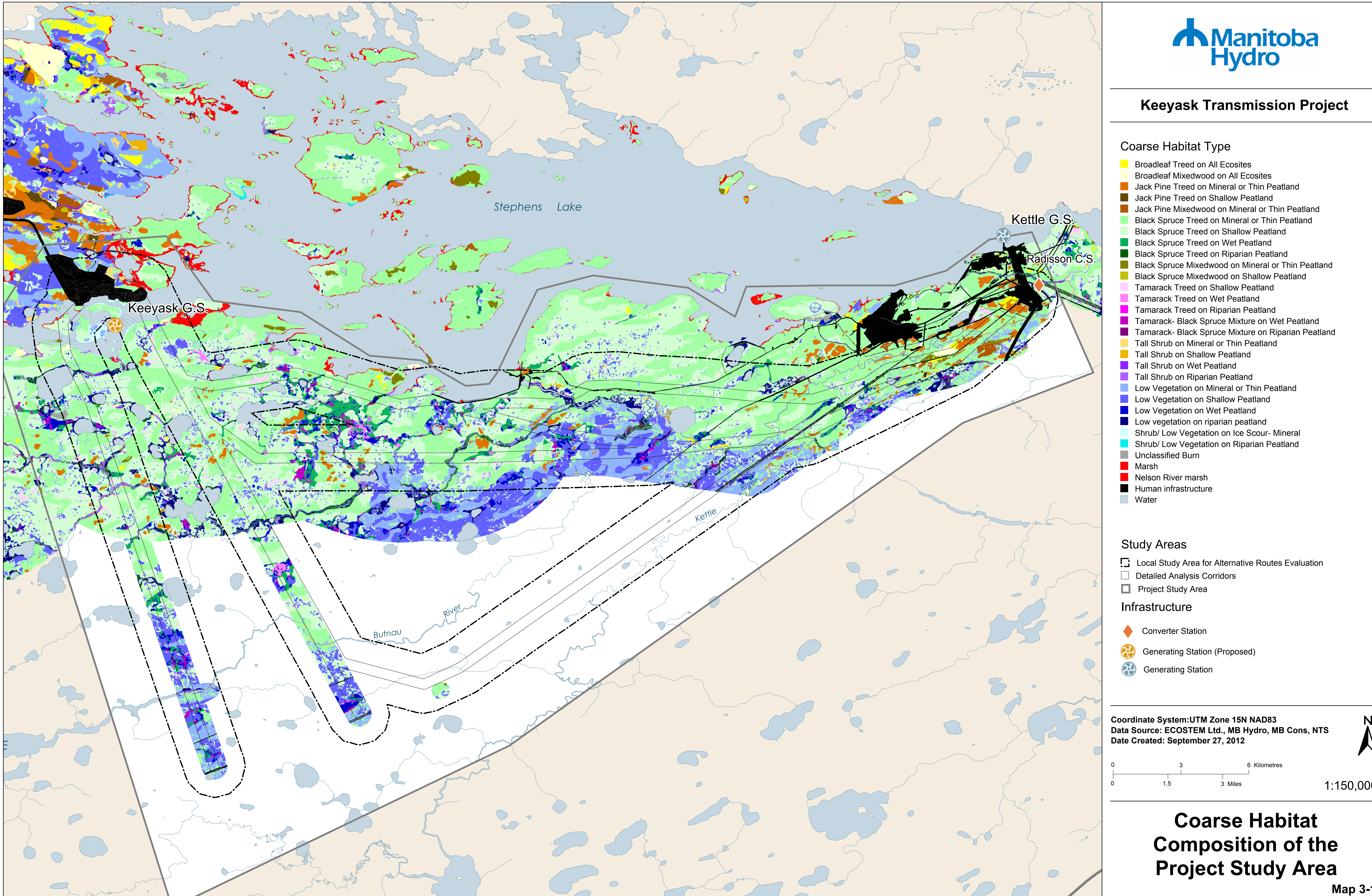
3.2.4.3 Invasive Plants

Invasive plants are widely considered to be a threat to species and ecosystems. Invasive plants are introduced and spread by human activities and natural dispersal mechanisms. Invasive plants are spreading in Manitoba (ISCM 2012).

Field studies detected all of the 19 invasive plants known to occur in the Regional Study Area (Section 2 of Keeyask HydroPower Partnership 2012b). Two of these species occurred within the alternative route evaluation corridors (Map 3-6). The majority of invasive plant locations were in disturbed areas, such as along PR 280 or in borrow pits, or along Nelson River shorelines having substrates similar to those in human-disturbed inland areas.

Reed-canary grass (*Phalaris arundinacea*), the only detected plant species that is currently classified as highly invasive, was found at 27 locations in the Regional Study Area (primarily along Nelson River shorelines), but was not found in the Alternative Routes Local Study Area. Moderately invasive species included smooth brome grass (*Bromus inermis*) and white sweet-clover (*Melilotus albus*). These species were not found in the Alternative Routes Local Study Area. Common dandelion (*Taraxacum officinale*) was recorded at 5 locations in the Construction Power Alternative Route 1 evaluation corridor while wild barley (*Hordeum jubatum*) was recorded at one location in the Construction Power Alternative Route 2 evaluation corridor. No invasive non-native species were recorded along the Generation Outlet Alternative Route evaluation corridors.

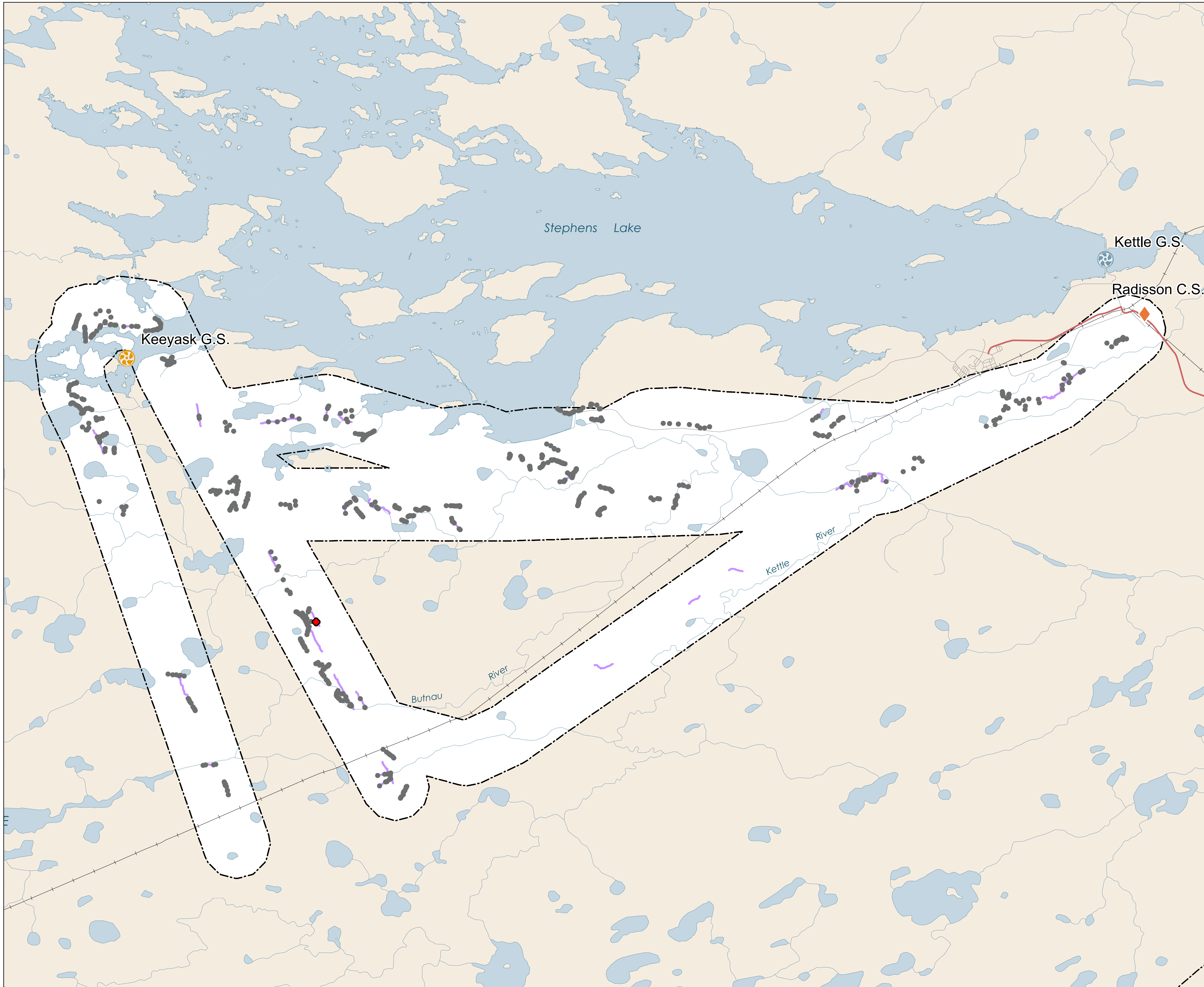
Purple loosestrife (*Lythrum salicaria*) and leafy spurge (*Euphorbia esula*), other species classified as being highly invasive, have not been recorded in the Regional Study Area to date. Purple loosestrife has been extending its range northward in Manitoba.



Coarse Habitat Composition of the Project Study Area

Map 3-1

File Location: Z:\Workspaces\Keeyask Transmission\Figures\Map 3-1 Habitat Composition of the Project Study Area V2.wor



Manitoba Hydro

Keeyask Transmission Project

Sample Locations
- S-2 Ranked Species
- Sample Plot
- Sample Transect

Study Areas
- Local Study Area

Infrastructure
- Converter Station
- Generating Station (Proposed)
- Generating Station

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Cons, NTS
Date Created: September 27, 2012

N

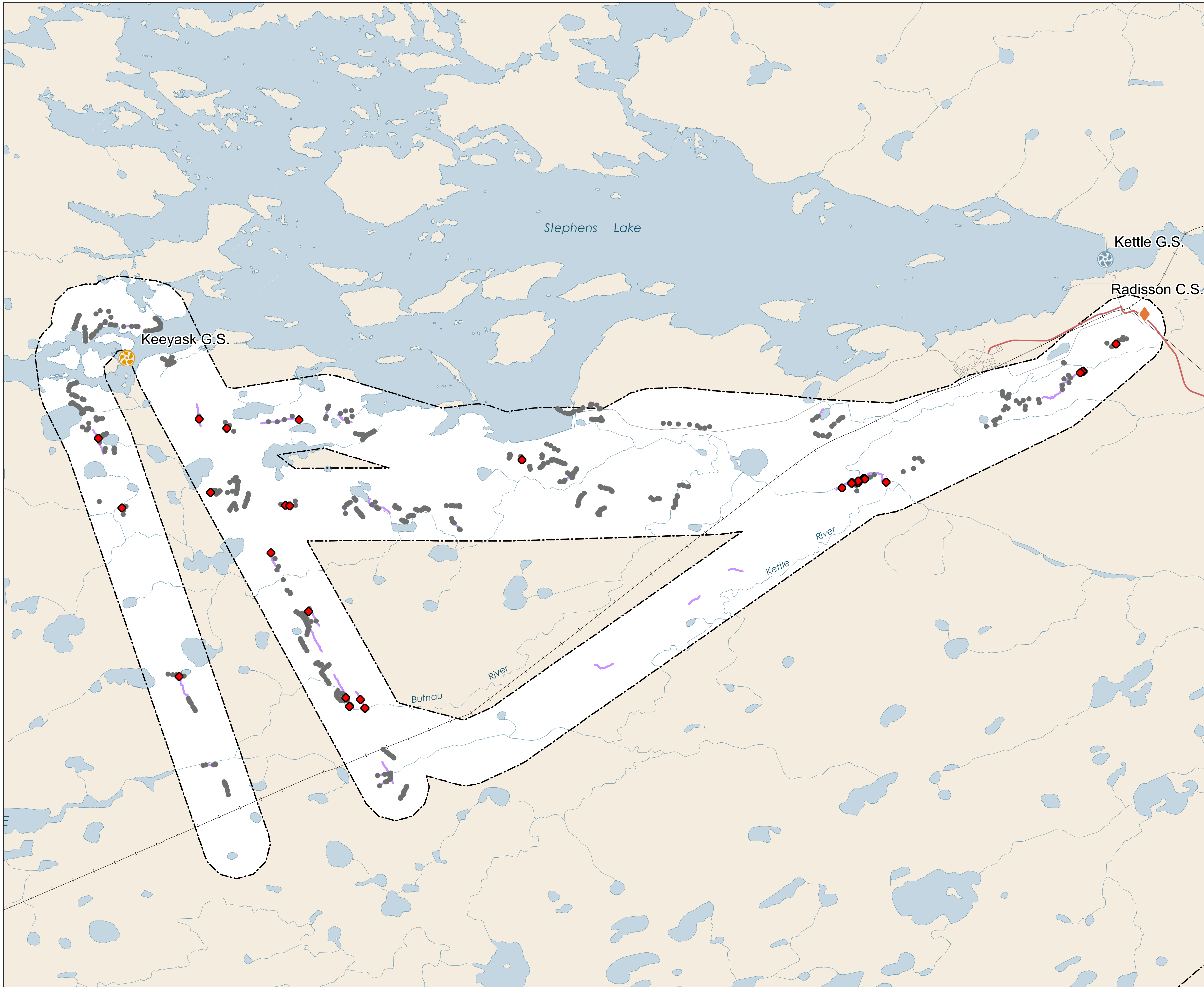
0 3 6 Kilometres
0 1.5 3 Miles

1:150,000

Locations of S-2 Ranked Species Found During Project Field Studies

Map 3-2

File Location: Z:\Workspaces\Keeyask Transmission\Outlet Power\Priority Plants\KTL S-2 Ranked plant species observations V5.wor



Manitoba Hydro

Keeyask Transmission Project

Sample Locations
- S-3 Ranked Species
- Sample Plot
- Sample Transect

Study Areas
- Local Study Area

Infrastructure
- Converter Station
- Generating Station (Proposed)
- Generating Station

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Cons, NTS
Date Created: September 27, 2012

N

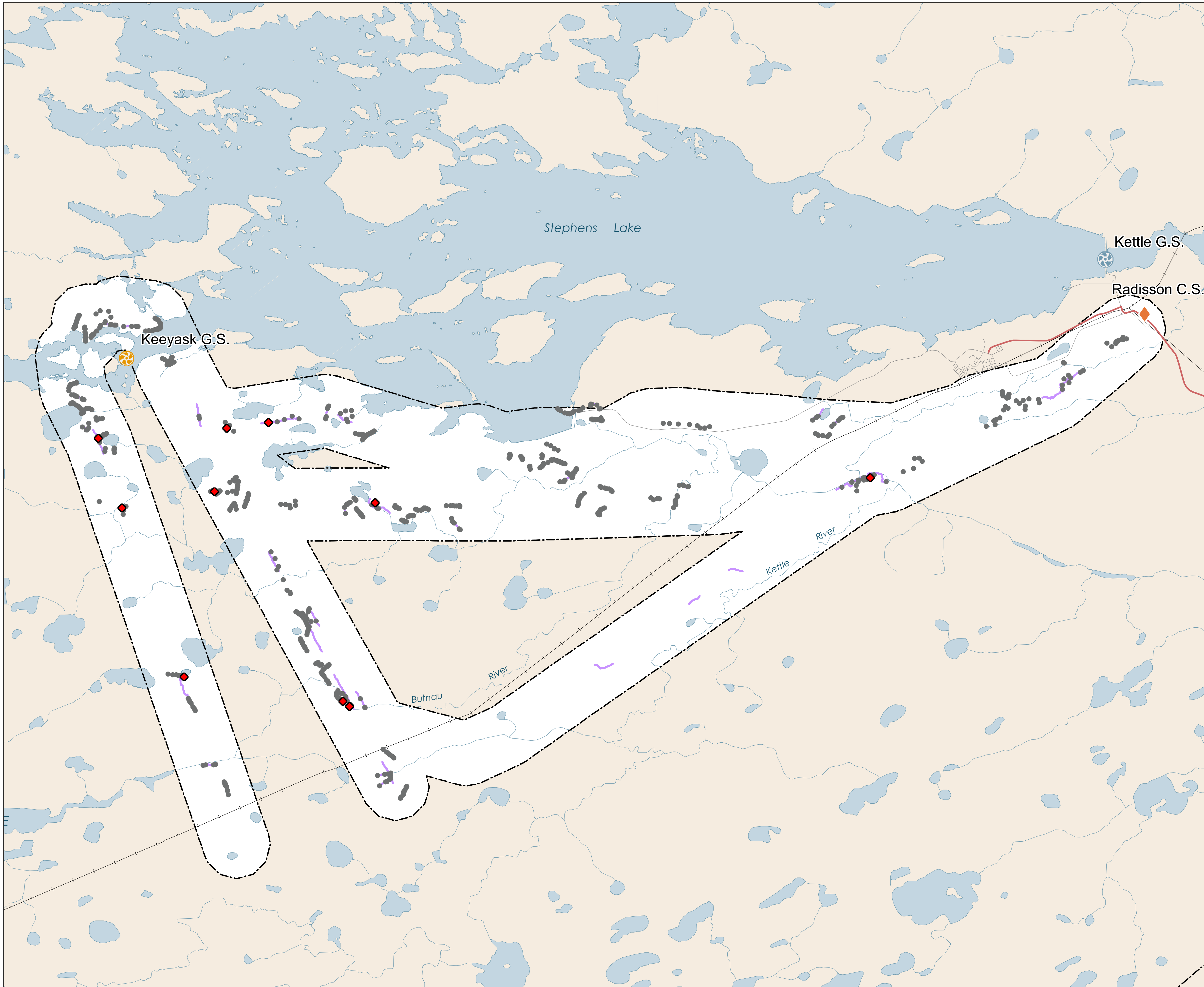
0 3 6 Kilometres
0 1.5 3 Miles

1:150,000

Locations of S-3 Ranked Species Found During Project Field Studies

Map 3-3

File Location: Z:\Workspaces\Keeyask Transmission\Outlet Power\Priority Plants\KTL S-3 Ranked plant species observations V5.wor



Manitoba Hydro

Keeyask Transmission Project

Sample Locations
- Regionally Rare Species
- Sample Plot
- Sample Transect

Study Areas
- Local Study Area

Infrastructure
- Converter Station
- Generating Station (Proposed)
- Generating Station

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Cons, NTS
Date Created: September 27, 2012

N

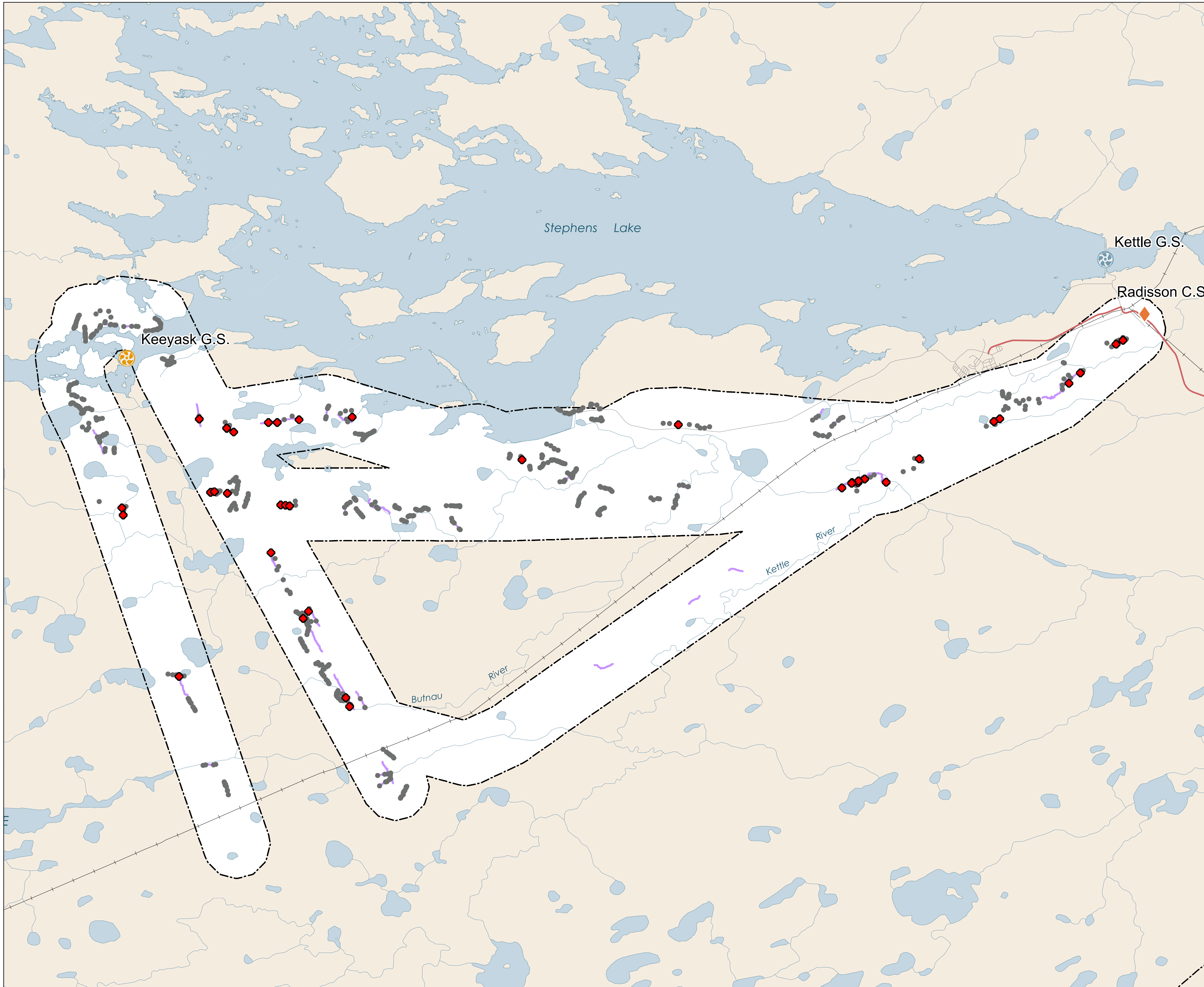
0 3 6 Kilometres
0 1.5 3 Miles

1:150,000

Locations of Regionally Rare Species Found During Project Field Studies

Map 3-4

File Location: Z:\Workspaces\Keeyask Transmission\Outlet Power\Priority Plants\KTL Range Limit plant species observations V5.wor



Manitoba Hydro

Keeyask Transmission Project

Sample Locations
- Range Limit Species
- Sample Plot
- Sample Transect

Study Areas
- Local Study Area

Infrastructure
- Converter Station
- Generating Station (Proposed)
- Generating Station

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Cons, NTS
Date Created: September 27, 2012

N

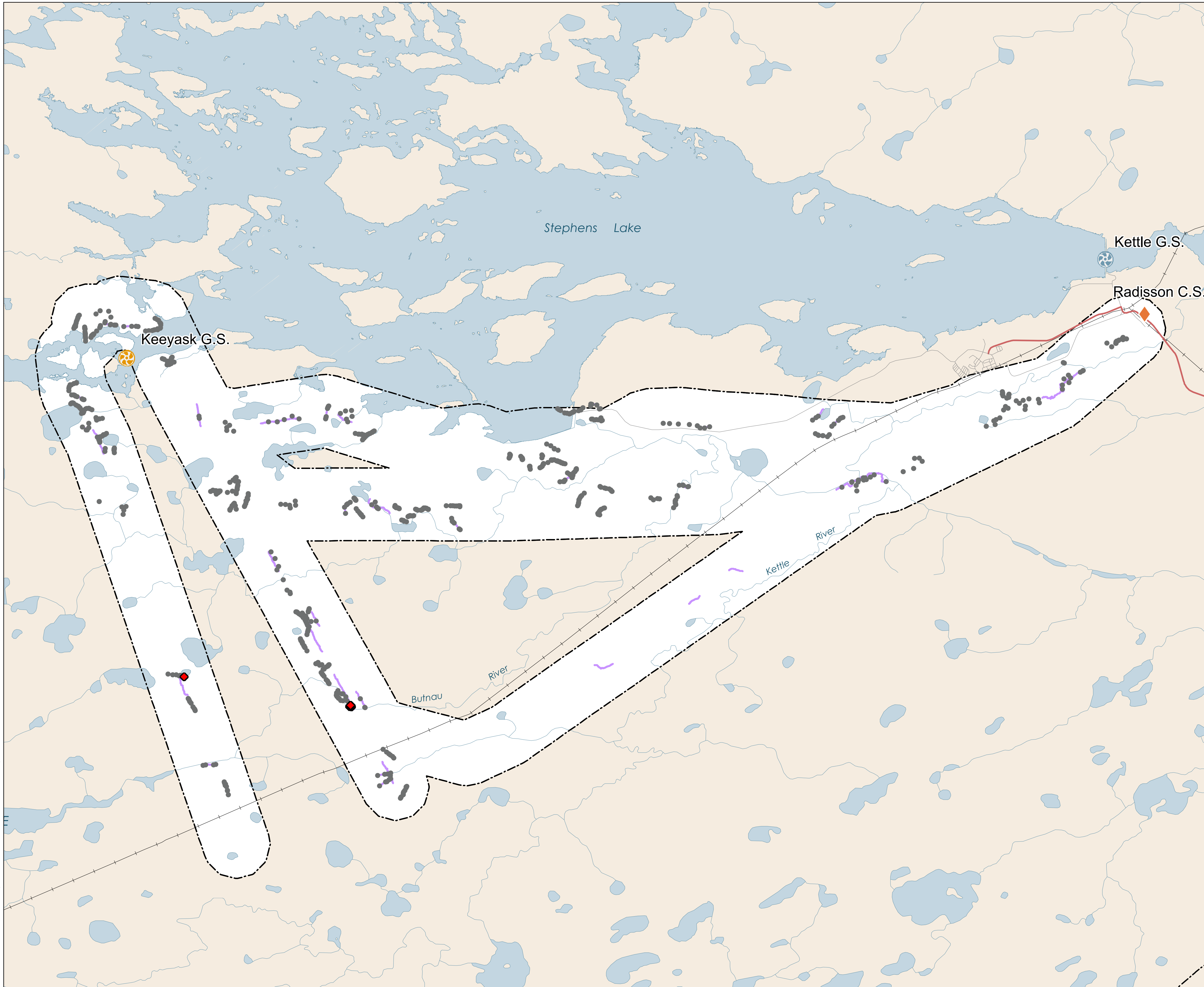
0 3 6 Kilometres
0 1.5 3 Miles

1:150,000

Locations of Range Limit Species Found During Project Field Studies

Map 3-5

File Location: Z:\Workspaces\Keeyask Transmission\Outlet Power\Priority Plants\KTL Range Limit plant species observations V5.wor



Manitoba Hydro

Keeyask Transmission Project

Sample Locations
- Invasive Species
- Sample Plot
- Sample Transect

Study Areas
- Local Study Area

Infrastructure
- Converter Station
- Generating Station (Proposed)
- Generating Station

Coordinate System:UTM Zone 15N NAD83
Data Source: ECOSTEM Ltd., MB Cons, NTS
Date Created: September 27, 2012

N

0 3 6 Kilometres
0 1.5 3 Miles

1:150,000

Locations of Invasive Plant Species Observed During Project Field Studies

Map 3-6

File Location: Z:\Workspaces\Keeyask Transmission\Outlet Power\Priority Plants\KTL Invasive and non-native plant species observations V5.wor

4.0 EVALUATION OF ALTERNATIVE ROUTES AND OTHER INFRASTRUCTURE

This section describes the Construction Power Transmission and Generation Outlet Transmission alternative routes and the other Project infrastructure. Additionally, it compares the alternatives using the valued environmental components (VECs).

4.1 CONSTRUCTION POWER TRANSMISSION LINE

4.1.1 Alternative Route Descriptions

4.1.1.1 Size

The approximate lengths of the alternative routes were 20.5 km for Alternative 1 and 21.5 km for Alternative 2. There was no overlap in the routes (Map 2-1).

The total land area encompassed by the two alternative route evaluation corridors was similar, with Alternative 1 including the smaller area (755 ha) compared with Alternative 2 (778 ha).

4.1.1.2 Terrestrial Habitat

The ecosite composition of the Construction Power Transmission alternative route evaluation corridors was generally similar. The evaluation corridor for Alternative 2 had a somewhat higher proportion of wet and riparian peatlands compared with Alternative 1, particularly horizontal fen and riparian fen, as well as a slightly higher proportion of thin peatland. The latter three ecosite types were more likely to support priority habitat types that are of higher ecological concern (Section 2 of Keeyask HydroPower Partnership 2012b).

The ecosite composition of the Alternative 1 evaluation corridor included thin peatland and other peatland types for 91% of the land area. These peatlands were predominantly comprised of blanket bog (32%), veneer bog on slope (29%) and peat plateau bog/ collapse scar peatland mosaics (17%; Table 4-1). Most of the remaining area was wet peatlands, primarily horizontal fen, and deep dry mineral (7% and 6%, respectively). Riparian peatlands accounted for a small proportion of Alternative 1 evaluation corridor area.

Land cover in Alternative 1 evaluation corridor (Map 3-1) was dominated by needleleaf treed vegetation on mineral or thin peatland and on other peatlands (75% combined; Table 4-2). Most of this area was comprised of the black spruce treed on shallow peatland (41%) and black spruce treed on thin peatland (24%) coarse habitat types, which were each common in the region (Section 2 of Keeyask HydroPower Partnership 2012b). Low vegetation on shallow peatland comprised most of the remaining habitat.

The ecosite composition of the Alternative 2 evaluation corridor was dominated by thin peatlands and other peatlands (89% of the area; Table 4-1. Thin peatlands (veneer bog on slope) comprised the highest proportion (32%), followed by blanket bog and peat plateau bog/ collapse scar peatland ecosite types. Horizontal fens (14%), deep dry mineral and riparian fens (5% each) made up most of the remaining area.

More than half of the land cover (59%) in Alternative 2 was needleleaf treed on mineral or thin peatland, and other peatlands (Table 4-2). Black spruce treed on shallow peatland was the most abundant coarse habitat type (28%), followed by black spruce treed on thin peatland (20%), both of which were common habitat types in the region. Most of the remaining area was low vegetation cover (29%), mostly on shallow peatland, and mineral or thin peatland.

4.1.1.3 Plants

A total of 101 plant species were recorded in the Alternative 1 evaluation corridor and 88 species in the Alternative 2 evaluation corridor. Labrador tea was the only widespread vascular plant species, being abundant in Alternative 2 and sporadic in Alternative 1. The other moss species group was also widespread and at least sporadic in both of the alternative route evaluation corridors.

Two of 19 invasive plants known to occur in the Regional Study Area occurred within the Construction Power Transmission alternative route evaluation corridors (Map 3-6). Common dandelion was recorded at five locations along Alternative 1 corridor, and wild barley was recorded at one location along Alternative 2.

Table 4-1: Land Type, Coarse Ecosite and Fine Ecosite Composition of the Construction Power Alternative Route Evaluation Corridors

Land Type	Coarse Ecosite Type	Fine Ecosite Type	Alternative 1		Alternative 2	
			Area (ha)	%	Area (ha)	%
Mineral	Mineral	Deep dry mineral	46	6.0	40	5.2
		Shallow/ thin mineral			1	0.1
Thin peatland	Thin peatland	Veneer bog on slope	221	29.2	253	32.5
Peatland	Shallow peatland	Blanket bog	245	32.5	210	27.0
		Slope bog	10	1.3	3	0.4
		Slope fen	3	0.4	1	0.1
		Veneer bog	3	0.5	0	0.0
	Ground ice peatland	Blanket bog/ collapse scar peatland mosaic				
		Peat plateau bog			5	0.7
		Peat plateau bog transitional stage	20	2.6	20	2.5
		Peat plateau bog/ collapse scar peatland mosaic	132	17.4	110	14.1
	Permafrost peatland- other	Collapse scar bog	0	0.0	1	0.1
		Horizontal fen/ blanket bog mosaic				
	Deep peatland	Flat bog				
		Horizontal fen	53	7.1	90	11.6
Shore Zone Peatland	Riparian Peatland	Riparian bog				
		Riparian fen	12	1.5	41	5.3
Shore Zone- Regulated	Ice Scoured Upland	Ice scour on mineral above wet meadow zone	0	0.0	2	0.3
	Shoreline Wetland- regulated	Upper beach on sunken, disintegrated peatland	11	1.4		
		Upper beach- regulated			2	0.2
Shore Zone	Shoreline Wetland	Upper beach on sunken peat	0	0.0		
		Lower beach			0	0.0
Total land area			*755*		*778*	

Table 4-2: Land cover and Coarse Habitat Type Composition of the Construction Power Alternative Route Evaluation Corridors

Land Cover Type	Coarse Habitat Type	Corridor Alternative 1		Corridor Alternative 2	
		Area (ha)	%	Area (ha)	%
Broadleaf treed on all ecosites	Broadleaf mixedwood on all ecosites			7	0.9
	Broadleaf treed on all ecosites	0	0.0		
Needleleaf treed on mineral or thin peatland	Black spruce mixedwood on mineral or thin peatland			1	0.1
	Black spruce treed on mineral soil	19	2.5	17	2.2
	Black spruce treed on thin peatland	181	24.0	159	20.5
	Jack pine mixedwood on mineral or thin peatland				
	Jack pine treed on mineral or thin peatland	6	0.8	1	0.1
Tall shrub on mineral or thin peatland	Tall shrub on mineral or thin peatland	1	0.1	1	0.1
Low vegetation on mineral or thin peatland	Low vegetation on mineral or thin peatland	19	2.5	52	6.7
Needleleaf treed on other peatlands	Black spruce treed on riparian peatland	2	0.2	7	0.9
	Black spruce treed on shallow peatland	311	41.2	216	27.8
	Black spruce treed on wet peatland	17	2.2	41	5.2
	Jack pine treed on shallow peatland				
	Tamarack- black spruce mixture on riparian peatland	0	0.0	0	0.0
	Tamarack- black spruce mixture on wet peatland	3	0.4	14	1.8
	Tamarack treed on riparian peatland				
	Tamarack treed on shallow peatland	11	1.5	4	0.5
	Tamarack treed on wet peatland	14	1.9		
Tall shrub on other peatlands	Tall shrub on shallow peatland	0	0.0	0	0.0
	Tall shrub on wet peatland	5	0.7		
Low vegetation on other peatlands	Low vegetation on shallow peatland	85	11.3	112	14.4
	Low vegetation on wet peatland	15	1.9	35	4.5

Table 4-2: Land cover and Coarse Habitat Type Composition of the Construction Power Alternative Route Evaluation Corridors

Land Cover Type	Coarse Habitat Type	Corridor Alternative 1		Corridor Alternative 2	
		Area (ha)	%	Area (ha)	%
Shrub/ low vegetation on riparian peatland	Low vegetation on riparian peatland	8	1.1	24	3.1
	Tall shrub on riparian peatland	0	0.0	6	0.7
Nelson River shore zone	Nelson River shrub and/or low vegetation on ice scoured mineral			2	0.3
	Nelson River shrub and/or low vegetation on sunken	9	1.2	2	0.2
	Nelson River shrub and/or low vegetation on upper				
Off-system shore zone	Off-system marsh	0	0.0	0	0.0
Human infrastructure		49	6.4	77	10.0
Total land cover		*755*		*778*	

Notes: See Section 2 of Keeyask HydroPower Partnership (2012b) for a description of the land cover and coarse habitat types.

Table 4-3: Broad Habitat Type and Priority Habitat Type Composition of the Construction Power Alternative Route Evaluation Corridors

Broad Habitat Type	Priority Habitat Criteria Met*	Cumulative % of Historical Area Already Affected**	Alternative 1			Alternative 2		
			Total Area (ha)	% total area	% total priority area	Total Area (ha)	% total area	% total priority area
Balsam poplar mixedwood on all ecosites	RDS							
Black spruce dominant on ground ice peatland	None	5.5	102	13.6		64	8.2	
Black spruce dominant on mineral	U	5.7	19	2.5	11.9	17	2.2	7.1
Black spruce dominant on riparian peatland	RDS	5.4	2	0.2	1.1	7	0.9	2.9
Black spruce dominant on shallow peatland	C	5.6	193	25.5		141	18.1	

Table 4-3: Broad Habitat Type and Priority Habitat Type Composition of the Construction Power Alternative Route Evaluation Corridors

Broad Habitat Type	Priority Habitat Criteria Met*	Cumulative % of Historical Area Already Affected**	Alternative 1			Alternative 2		
			Total Area (ha)	% total area	% total priority area	Total Area (ha)	% total area	% total priority area
Black spruce dominant on thin peatland	C	5.6	175	23.2		140	18.0	
Black spruce dominant on wet peatland	UD	5.3	17	2.2	10.5	41	5.2	16.6
Black spruce mixedwood on mineral	R	5.5				1	0.1	0.2
Black spruce mixedwood on thin peatland	RDS	5.4						
Black spruce mixture on ground ice peatland	None	5.8	4	0.5		2	0.2	
Black spruce mixture on mineral	RD	8.8						
Black spruce mixture on shallow peatland	RD	6.2	12	1.6	7.6	10	1.3	4.0
Black spruce mixture on thin peatland	R	7.2	1	0.1	0.5	10	1.3	4.1
Black spruce mixture on wet peatland	R	5.2	1	0.1	0.7	2	0.3	0.9
Emergent on lower beach	R							
Emergent on upper beach	R	2.8	0	0.0	0.0	0	0.0	0.0
Jack pine dominant on mineral	UDS	5.6						
Jack pine dominant on shallow peatland	RS	5.0						
Jack pine dominant on thin peatland	RDS	5.9						
Jack pine mixedwood on mineral	RD	5.9						
Jack pine mixedwood on thin peatland	RDS	6.6						
Jack pine mixture on thin peatland	R	7.0						
Low vegetation on ground ice peatland	None	5.7	41	5.4		52	6.7	
Low vegetation on mineral soil	None	5.9	1	0.1		0	0.1	
Low vegetation on riparian peatland	U	5.8	8	1.1	5.2	24	3.1	10.0
Low vegetation on shallow peatland	U	5.4	44	5.8	27.4	60	7.7	24.5
Low vegetation on thin peatland	U	5.5	18	2.4		52	6.6	
Low vegetation on wet peatland	U	5.6	15	1.9	9.1	35	4.5	14.2
Tall shrub on ground ice peatland	None	5.3						

Table 4-3: Broad Habitat Type and Priority Habitat Type Composition of the Construction Power Alternative Route Evaluation Corridors

Broad Habitat Type	Priority Habitat Criteria Met*	Cumulative % of Historical Area Already Affected**	Alternative 1			Alternative 2		
			Total Area (ha)	% total area	% total priority area	Total Area (ha)	% total area	% total priority area
Tall shrub on mineral	RD	8.1						
Tall shrub on riparian peatland	R	8.0	0	0.0	0.0	6	0.7	2.3
Tall shrub on shallow peatland	RDS	5.6	0	0.0	0.0	0	0.0	0.0
Tall shrub on thin peatland	RDS	7.3	1	0.1	0.4	1	0.1	0.3
Tall shrub on wet peatland	R	6.9	5	0.7	3.1			
Tamarack- black spruce mixture on riparian peatland	RD	6.4	0	0.0	0.0	0	0.0	0.1
Tamarack dominant on ground ice peatland	None	5.3						
Tamarack dominant on mineral	RDS	6.3						
Tamarack dominant on riparian peatland	R							
Tamarack dominant on shallow peatland	R		0	0.0	0.0			
Tamarack dominant on thin peatland	RDS	5.8						
Tamarack dominant on wet peatland	R	5.1	14	1.9	8.7			
Tamarack mixture on ground ice peatland	None	6.1	2	0.3		1	0.2	
Tamarack mixture on mineral	RDS	7.6	6	0.8	3.5	1	0.1	0.2
Tamarack mixture on shallow peatland	RD	6.5	9	1.2	5.8	2	0.3	0.9
Tamarack mixture on thin peatland	RDS	7.5	5	0.7	3.1	9	1.2	3.9
Tamarack mixture on wet peatland	RD	5.2	2	0.2	1.0	12	1.5	4.9
Trembling aspen dominant on all ecosites	RD	6.7	0	0.0	0.2			
Trembling aspen mixedwood on all ecosites	RDS	6.1				7	0.9	2.7
Total area (ha)			*755*			*778*		
Total priority habitat area (ha)			*161*			*244*		

* Priority habitat criteria: R=regionally rare; U= regionally uncommon; D= structurally diverse; and S= relatively high potential to support rare plant species.
** See Section 2 of Keeyask HydroPower Partnership (2012b) for the method used to determined cumulative percentage of historical area already affected.

4.1.2 Fragmentation

Alternative 1 was the slightly preferred Construction Power Transmission route in terms of potential fragmentation effects because it created lower increases to linear feature densities and smaller reductions to core area measures.

Since Alternative 1 was the shorter route by approximately 1 km, it produced a smaller increase to total linear feature densities (i.e., total and non-transportation densities). However, the difference in length was very small relative to the existing total length of linear features in the Regional Study Area.

Alternative 1 created a lower reduction in total core area than Alternative 2 but the difference was only 112 ha, which is quite small relative to the amount of core area in the Regional Study Area.

The same three core areas were affected by both alternative routes (Map 4-1). The sizes of these core areas ranged from 2,074 ha to 69,156 ha (Table 4-4). One of the fragmented core areas was a long, narrow block located between the railway and a transmission line ROW. Both Construction Power Transmission alternative routes split each of these three core areas into two blocks, creating six smaller core areas (Table 4-4). On this attribute, Alternative 1 was preferred because it left a larger habitat block from the largest of the three existing core areas. Alternative 1 also paralleled an existing trail for approximately 3.5 km thereby lessening the reduction in size for the largest core area.

Table 4-4: Sizes of Core Areas Remaining for Each of the Construction Power Alternative Route Evaluation Corridors

Core Area ID*	Existing Environment (ha)	Area (ha)	
		Alternative 1	Alternative 2
4	69,156	68,725	68,607
37	2,360	2,305	2,296
40	2,074	2,034	2,048
Total	**73,590**	**73,063**	**72,951**

* See Map 4-1 for core area IDs.

4.1.3 Ecosystem Diversity

Alternative 1 was the preferred Construction Power Transmission route in terms of potential ecosystem diversity effects because it included the lowest area in priority habitat types and the lowest total habitat loss.

Neither alternative route evaluation corridor completely removed a stand level habitat type from the Regional Study Area. Additionally, neither alternative substantially altered the regional proportions of the common or uncommon habitat types.

Both alternative route evaluation corridors included one broad habitat type that was represented by less than 20 stands (i.e., tamarack- black spruce mixture on riparian peatland). The total area affected was less than 0.15 ha in both cases.

Although priority habitat types made up just over 21% (161 ha) of land area in Alternative 1 evaluation corridor (Table 4-3), nearly two-thirds of this area was comprised of six uncommon habitat types that were of lesser concern. Of the habitat types that met several priority criteria (regionally rare, diverse and/or higher rare species potential) and were of higher concern, tamarack mixtures on mineral, on shallow peatlands and on thin peatlands comprised a total of 12% of the priority habitat area affected, and black spruce mixture on shallow peatland made up an additional 8%.

For the Alternative 2 evaluation corridor, priority habitat accounted for more than 31% (244 ha) of the land area, but most of that area (73%) was in regionally uncommon rather than regionally rare types (Table 4-3). Low vegetation on shallow peatland, on wet peatland and on riparian peatland made up 49% of the priority habitat combined, followed by black spruce dominant on wet peatland (17%) and black spruce dominant on mineral (7%), all of which are regionally uncommon. As with Alternative 1, higher concern priority habitat types (multiple priority criteria met) with the largest proportion of area in Alternative 2 evaluation corridor included tamarack mixture on thin and wet peatland, but also black spruce dominant on riparian peatland (12%).

Each of the alternative route evaluation corridors included a very small amount of the shoreline wetland priority habitat types. Approximately 800 square meters of emergent on upper beach habitat occurred within each corridor (Table 4-3).

For the priority habitat types that were of higher concern, Alternative 1 evaluation corridor had less of these types in percentage of corridor area (1.7% vs. 3.1%) and absolute area (13 ha vs. 24 ha) than Alternative 2 (Table 4-3).

4.1.4 Priority Plants

Neither of the Construction Power Transmission alternative route evaluation corridors was preferred for priority plants. Both alternatives had a similar number of regionally rare and range limit species. Alternative 1 had more species of particular interest to KCNs because it had higher proportions of the common and uncommon habitat types, which is where most of these species were found (Section 3 of Keeyask HydroPower Partnership 2012b).

Species listed as endangered or threatened under MESA, SARA or COSEWIC were not expected to occur in either the alternative route evaluation corridors since none were anticipated to occur in the Regional Study Area (see Section 3.2.4.2).

As described in Section 3.2.4.2, extensive field studies did not detect any of the 13 provincially very rare species that could potentially occur in the Regional Study Area. Elegant hawk’s-beard, the only species with an uncertain conservation concern rank of provincially rare or provincially very rare that was found in the Regional Study Area during field studies, was not recorded in either of the alternative route evaluation corridors.

Field studies found three of the 45 provincially rare to uncommon upland and wetland plant species that could potentially occur in the Regional Study Area, including shrubby willow (*Salix arbusculoides*), rock willow (*Salix vestita*) and oblong-leaved sundew (*Drosera anglica*) in the Construction Power Transmission alternative corridors (Table 4-5). Field studies in the Regional Study Area demonstrated that all of these species probably more regionally common than indicated by the provincial conservation concern ranks (Section 3 of Keeyask HydroPower Partnership 2012b).

Two of the remaining 15 priority plants, as well as one of the provincially rare species, encountered in the Construction Power Transmission alternative route evaluation corridors were regionally rare (Table 4-5), including wild daisy (*Erigeron hyssopifolius*), balsam poplar (*Populus balsamifera*) and oblong-leaved sundew.

Four range limit species were observed in the Alternative Route 1 evaluation corridor, and two were observed in corridor 2. Range limit species observed included shrubby willow, rock willow, jack pine (*Pinus banksiana*), northern Labrador tea (*Rhododendron tomentosum*) and hairy goldenrod (*Solidago hispida*). Plants of particular interest to KCNs that were observed in the Construction Power Transmission evaluation corridors were white birch, northern Labrador tea, bog bilberry, smooth wild strawberry, red currant, red raspberry, cloudberries and rock cranberry.

Table 4-5: Number of Locations in the Construction Power Transmission Alternative Route Evaluation Corridors Where Priority Plant Species Were Found During Field Studies

Species	MBCDC S-Rank	Reason for inclusion	Alternative	
			1	2
Oblong-leaved sundew	S3	Provincially uncommon/Regionally rare	0	1
Shrubby willow	S3	Provincially uncommon/Range limit	3	0
Rock willow	S3	Provincially uncommon/Range limit	1	2
Wild daisy	S4	Regionally rare	0	1
Balsam poplar	S5	Regionally rare	2	1
Jack pine	S5	Range limit	1	0
Hairy goldenrod	S5	Range limit	0	1
Northern Labrador-tea	S4	Range limit/KCN importance	1	0
White birch	S5	KCN importance	4	10
Smooth wild strawberry	S5	KCN importance	4	1
Red currant	S5	KCN importance	0	1
Cloudberry	S5	KCN importance	9	4
Red raspberry	S5	KCN importance	0	5
Bog bilberry	S5	KCN importance	12	6
Rock cranberry	S5	KCN importance	14	7
Total			*51*	*40*
Provincially Uncommon Sub-total			*4*	*3*
Regionally Rare Sub-total			*2*	*3*
Range Limit Sub-total			*6*	*3*
KCN Importance Sub-total			*44*	*34*

4.1.5 Conclusions

From a terrestrial ecosystems, habitat and plants perspective, there were no major concerns with either of the two construction power alternative routes. Alternative Route 1 was the slightly preferred route since it was expected to create less fragmentation and have lower effects on ecosystem diversity.

Alternative 1 was the slightly preferred option in terms of potential fragmentation effects. It was the shorter route, which produced a smaller increase to total linear feature density. Both alternatives had similar core area effects since they both fragmented three core areas into six core areas with neither alternative producing a clearly preferable core area configuration. However, Alternative 1 followed an existing trail for approximately 3.5 km, which may create less potential for increased access than Alternative 2.

Alternative 1 was the preferred option in terms of potential ecosystem diversity effects because it affected a lower total area of terrestrial habitat, included a higher proportion of common habitat types and had the smallest area in priority habitat types.

Neither alternative was preferred for priority plants. Endangered, threatened or provincially rare plants were not expected to occur along either of the routes. Elegant hawk’s-beard and swamp lousewort, the only provincially rare to very rare terrestrial plants found during field studies in the region, were not observed along either route. Although swamp lousewort was observed near Alternative 1, potential mitigation measures exist if this alternative is selected and this species is subsequently found in the preferred ROW. The number of locations where the remaining regionally rare or range limit plants were found during field studies was low and sufficiently similar given the sampling effort so that neither alternative was preferred. Alternative 1 had more species of particular interest to KCNs because it had higher proportions of the common and uncommon habitat types, which is where most of these species are found.

4.2 CONSTRUCTION POWER STATION

4.2.1 Site Description

The entire Construction Power Station footprint and potential terrestrial habitat zone of influence occurred on pre-existing human infrastructure and clearing associated with construction of the north access road (Map 3-1). More than half (51%) of this land area was thin peatland, with most of the remaining area comprised of peat plateau bog/ collapse scar peatland mosaics (37%). Fen was present in the habitat zone of influence.

Table 4-6: Coarse and Fine Ecosite Types of the Construction Power Station

Coarse Ecosite Type	Fine Ecosite Type	Project Footprint	Habitat Zone of Influence	Total
Thin peatland	Veneer bog on slope	58.7	49.2	50.9
Ground ice peatland	Peat plateau bog/ collapse scar peatland mosaic	34.9	37.9	37.4
	Peat plateau bog transitional stage	0.7	0.3	0.3
	Peat plateau bog	5.7		1.1
Deep peatland	Horizontal fen		8.3	6.8
Riparian peatland	Riparian fen		4.4	3.6
All types		100	100	100
Total land area (ha)		*4*	*16*	*19*

4.2.2 Valued Environmental Components

There were no major concerns with the construction power station site from the terrestrial ecosystems, habitat and plants perspectives. This site did not include any sensitive habitat types or plant species of high conservation concern. Because the site was within an existing human infrastructure area, there would be no effects on fragmentation.

Details regarding the evaluation of construction power station site effects on the VECs is deferred to the Project effects assessment section since only one location was considered.

4.3 UNIT TRANSMISSION LINES

4.3.1 Site Description

Land comprised 74% of the Unit Transmission Line ROW area, with most of the water area associated with the Nelson River (Map 3-1).

Nearly all of the land area was peatland, dominated by shallow peatland (37%), thin peatland (26%) and ground ice peatland (31% combined). Mineral ecosites comprised less than 1% of the Unit Transmission Line ROW land area.

Table 4-7: Coarse and Fine Ecosite Types in the Unit Transmission Lines right-of-way

Coarse Ecosite Type	Fine Ecosite Type	Project Footprint	Habitat Zone of Influence	Total
Mineral	Deep dry mineral	0.0	2.0	0.5
Thin peatland	Veneer bog on slope	24.3	30.4	25.9
Shallow peatland	Blanket bog	42.1	21.7	36.7
Ground ice peatland	Peat plateau bog/ collapse scar peatland mosaic	21.2	17.0	20.1
	Peat plateau bog transitional stage	7.5	20.1	10.8
Riparian peatland	Riparian fen	2.1	1.9	2.0
Ice scoured upland	Ice scour on mineral above wet meadow zone	2.9	7.0	4.0
All types		100.0	100.0	100.0
Total Land Area (ha)		*63*	*23*	*86*

Land cover in the ROW was dominated by common needleleaf treed vegetation, primarily black spruce treed on shallow peatland and on thin peatland (54% and 24%, respectively). An additional 9% of the needleleaf cover was tamarack treed on shallow peatland habitat. Low vegetation made up most of the remaining area.

Table 4-8: Land Cover and Coarse Habitat in the Unit Transmission Lines Right-Of-Way

Land Cover Type	Coarse Habitat Type	Project Footprint	Habitat Zone of Influence	Total
Needleleaf treed on mineral or thin peatland	Black spruce treed on mineral soil		1.7	0.4
	Black spruce treed on thin peatland	22.9	29.0	24.5
Low vegetation on mineral or thin peatland	Low vegetation on mineral or thin peatland	1.4	1.7	1.5
Needleleaf treed on other peatlands	Black spruce treed on riparian peatland		0.1	0.0
	Black spruce treed on shallow peatland	55.3	48.5	53.5
	Tamarack treed on shallow peatland	10.1	5.5	8.9
Tall shrub on other peatlands	Tall shrub on shallow peatland	0.2		0.1
Low vegetation on other peatlands	Low vegetation on shallow peatland	5.2	4.9	5.1
Shrub/ low vegetation on riparian peatland	Tall shrub on riparian peatland	0.9	0.8	0.9
	Low vegetation on riparian peatland	1.2	1.0	1.1
Nelson River shore zone	Nelson River shrub and/or low vegetation on ice scoured upla	2.9	7.0	4.0
All types		100	100	100
Total land area (ha)		*63*	*23*	*86*

4.3.2 Valued Environmental Components

There were no major concerns with the Unit Transmission Line ROW from the terrestrial ecosystems, habitat and plants perspectives. This site did not include any particularly sensitive habitat types or plant species of high conservation concern. Because the site was small and crossed two existing cutlines, fragmentation effects would be very limited.

Details regarding the evaluation of Unit Transmission Lines effects on the VECs is deferred to the Project effects assessment section since only one route was considered.

4.4 KEEYASK SWITCHING STATION

4.4.1 Site Description

Land comprised 100% of the Keeyask Switching Station area (Map 3-1).

Shallow peatlands (blanket bog) made up 55% of the ecosite cover in the Keeyask Switching Station area, with thin peatland and mineral ecosites comprising 32% and 13% of the total area, respectively. All most all of the mineral ecosites occurred in the habitat zone of influence.

Table 4-9: Coarse and Fine Ecosite Types of the Keeyask Switching Station

Coarse Ecosite Type	Fine Ecosite Type	Project Footprint	Habitat Zone of Influence	Total
Mineral	Deep dry mineral	0.2	24.1	13.3
Thin peatland	Veneer bog on slope	40.5	24.7	31.8
Shallow peatland	Blanket bog	59.3	51.2	54.8
All types		100	100	100
Total land area (ha)		*31*	*38*	*68*

Most of the land cover was needleleaf treed, almost entirely black spruce. The dominant habitat types were black spruce treed on shallow peatland (52%) and on thin peatland (32%). Black spruce treed on mineral made up an additional 13% of the area, almost entirely within the habitat zone of influence, with low vegetation on shallow peatland making up most of the remaining area.

Table 4-10: Land Cover and Coarse Habitat of the Keeyask Switching Station

Land Cover	Coarse Habitat	Project Footprint	Habitat Zone of Influence	Total
Needleleaf treed on mineral or thin peatland	Black spruce treed on mineral soil	0.2	24.1	13.3
	Black spruce treed on thin peatland	40.5	24.5	31.7
Low vegetation on mineral or thin peatland	Low vegetation on mineral or thin peatland		0.2	0.1
Needleleaf treed on other peatlands	Black spruce treed on shallow peatland	58.2	46.8	51.9

Table 4-10: Land Cover and Coarse Habitat of the Keeyask Switching Station

Land Cover	Coarse Habitat	Project Footprint	Habitat Zone of Influence	Total
	Tamarack treed on shallow peatland		0.8	0.4
Low vegetation on other peatlands	Low vegetation on shallow peatland	1.1	3.6	2.5
Needleleaf treed on mineral or thin peatland	Black spruce treed on mineral soil	0.2	24.1	13.3
All types		100	100	100
Total land area (ha)		*31*	*38*	*68*

4.4.2 Valued Environmental Components

There were no major concerns with the Keeyask Switching Station site from the terrestrial ecosystems, habitat and plants perspectives. This site did not include any particularly sensitive habitat types or plant species of high conservation concern. Because the site was very small and adjacent to existing cutlines, fragmentation effects would be very limited.

FLCN expressed concern that the switching station is on or near a jack pine ridge, which is a rare vegetation type, and would prefer not to see a tower there (Keeyask Transmission Project Workshop. 2012). It was determined that the jack pine ridge is southeast of the final switching station location.

Details regarding the evaluation of Keeyask Switching Station effects on the VECs is deferred to the Project effects assessment section since was only one location was considered.

4.5 GENERATION OUTLET TRANSMISSION LINES

4.5.1 Alternative Route Descriptions

4.5.1.1 Size

The approximate lengths of the Generation Outlet Transmission alternative routes ranged from approximately 40.3 km for Alternative C to 50.8 km for Alternative D (note that at the time this analysis was completed the routes included the temporary construction line route from the Keeyask Switching Station to the Construction Power Station, which adds an identical length for all four alternatives).

Table 4-11: Total Lengths of the Generation Outlet Transmission Alternative Routes

Alternative	Length (km)
A	41.7
B	40.7
C	40.3
D	50.8

The key differences between the four alternative Generation Outlet Transmission routes were their proximity to the Nelson River and existing human infrastructure (Map 2-1). Alternative C had the highest proportion of its route along existing human infrastructure and the Nelson River while Alternative A had the lowest proportion of its route along these features. Most of Alternative D followed existing human infrastructure if Alternative 1 was selected as the Construction Power Transmission preferred route. Alternative D was approximately 25% longer than the other alternative routes.

Alternative A had the highest proportion of its length to the south while Alternative C had the highest proportion of its length to the north (Map 2-1). Starting from the east, all of the alternatives initially followed an existing transmission line ROW. Alternative C branched to the north, following adjacent to the existing Butnau Road and the proposed Keeyask Generation Project south access road for most of its length. Alternatives A and B continued along an existing transmission line ROW for a short distance. Alternative B branched to the north where the existing transmission line ROW deflects to the north, traversing through approximately 7.5 km of area lacking existing human infrastructure before joining the Alternative C route. Alternative A continued in a southwesterly and then westerly direction through an area without existing human infrastructure before turning northwards to the Keeyask Generation Project dam site.

The total land area encompassed by each of the four alternative route evaluation corridors was not greatly different, with Alternative D including the largest area (1,972 ha) and Alternative C the smallest area (1,564 ha).

4.5.1.2 Terrestrial Habitat

The terrestrial habitat composition of the alternative route evaluation corridors (Map 3-1), particularly A, B and D, was generally similar (note that this is based on partial mapping for Alternative D as described in Section 2.2.2). The corridor for Alternative C had considerably more black spruce treed on thin peatlands (a common habitat type), both in proportional and absolute terms, as well as considerably more black spruce treed on mineral soil (an uncommon habitat type). Alternative A had somewhat more black spruce treed on shallow peatlands (also a common habitat type), both in proportional and absolute terms. Both Alternatives A and B had higher proportions of wet and riparian peatlands than Alternatives C and D. Alternative D had a higher proportion of broadleaf treed, broadleaf mixedwood and jack pine treed habitat than the other alternatives. Ecosite mapping for the 17 km vegetation mapping gap indicated that there was a substantially lower proportion of mineral ecosites, and a higher proportion of ground ice peatland compared to the portion with detailed mapping. Helicopter-based oblique aerial photography and old Forest Resource Inventory data indicated that the southernmost portion of the Alternative D corridor was predominantly black spruce treed on thin, shallow and ground ice peatlands, which are regionally common habitat types.

In the Alternative A evaluation corridor, thin peatland and other peatland ecosites accounted for 84% of the land area, predominantly veneer bog on slope (38%) and blanket bog (29%). Deep dry mineral ecosites made up most of the remaining area. Wet and riparian peatlands were relatively scarce in the Alternative A corridor, with horizontal fen being the most abundant at 5%.

Land cover in the Alternative A evaluation corridor (Map 3-1) was dominated by a relatively even mixture of needleleaf treed on mineral or thin peatland and needleleaf treed on other peatlands (72% combined). Black spruce treed on thin peatland (29%) and black spruce treed on shallow peatland (27%), which are regionally common, were the most abundant coarse habitat types. In combination, low vegetation on mineral, thin and shallow peatland accounted for 18% of the land area. Wet and riparian peatland habitat types were relatively scarce in the Alternative A evaluation corridor, comprising 7% of the area combined.

Table 4-12: Land Type, Coarse Ecosite and Fine Ecosite Composition of the Generation Outlet Alternative Route Evaluation Corridors

Land Type	Coarse Ecosite Type	Fine Ecosite Type	Alternative A		Alternative B		Alternative C		Alternative D*	
			Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Mineral	Mineral	Deep dry mineral	230	14.1	208	13.1	273	17.4	264	13.4
		Shallow/ thin mineral								
Thin peatland	Thin peatland	Veneer bog on slope	628	38.5	669	42.3	768	49.1	552	28.0
Peatland	Shallow peatland	Blanket bog	470	28.8	376	23.7	315	20.1	574	29.1
		Slope bog	7	0.4	12	0.8	12	0.8	12	0.6
		Slope fen	0	0.0	2	0.1	1	0.1	8	0.4
		Veneer bog	43	2.6	39	2.5	8	0.5	125	6.3
	Ground ice peatland	Blanket bog/ collapse scar peatland mosaic								
		Peat plateau bog	0	0.0	2	0.1			1	0.0
		Peat plateau bog transitional stage	14	0.8	4	0.2	9	0.6	47	2.4
		Peat plateau bog/ collapse scar peatland mosaic	110	6.8	104	6.6	67	4.3	264	13.4
	Permafrost peatland-other	Collapse scar bog	1	0.0	0	0.0	1	0.1		
		Horizontal fen/ blanket bog mosaic	0	0.0	0	0.0				
	Deep peatland	Flat bog	7	0.4	14	0.9	5	0.3		
		Horizontal fen	84	5.1	107	6.8	65	4.1	79	4.0
Shore Zone Peatland	Riparian Peatland	Riparian bog			1	0.1	3	0.2	0	0.0
		Riparian fen	21	1.3	30	1.9	21	1.4	15	0.8
Shore Zone-Regulated	Ice Scoured Upland	Ice scour on mineral above wet meadow zone	0	0.0	0	0.0	0	0.0		
	Shoreline Wetland-regulated	Upper beach on sunken, disintegrated peatland	15	0.9	15	0.9	15	1.0		
		Upper beach- regulated					0	0.0	30	1.5
Shore Zone	Shoreline Wetland	Lower beach			0	0.0	0	0.0		
		Upper beach on sunken peat	0	0.0	0	0.0	0	0.0	0	0.0
Total land area			*1,631*		*1,583*		*1,564*		*1,972*	

Table 4-13: Land Cover and Coarse Habitat Type Composition of the Generation Outlet Alternative Route Evaluation Corridors

Land Cover Type	Coarse Habitat Type	Alternative A		Alternative B		Alternative C		Alternative D	
		Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
Broadleaf treed on all ecosites	Broadleaf mixedwood on all ecosites	3	0.2	4	0.2	3	0.2	13	1.2
	Broadleaf treed on all ecosites	11	0.7	11	0.7	6	0.4	11	1.1
Needleleaf treed on mineral or thin peatland	Black spruce mixedwood on mineral or thin peatland	8	0.5	10	0.6	13	0.8	16	1.5
	Black spruce treed on mineral soil	114	7.0	102	6.5	150	9.6	66	6.3
	Black spruce treed on thin peatland	467	28.6	501	31.7	682	43.6	315	30.1
	Jack pine mixedwood on mineral or thin peatland	8	0.5	8	0.5	13	0.8	8	0.8
	Jack pine treed on mineral or thin peatland	55	3.3	41	2.6	42	2.7	62	5.9
Tall shrub on mineral or thin peatland	Tall shrub on mineral or thin peatland	5	0.3	6	0.4	3	0.2	3	0.3
Low vegetation on mineral or thin peatland	Low vegetation on mineral or thin peatland	120	7.4	126	7.9	36	2.3	24	2.3
Needleleaf treed on other peatlands	Black spruce treed on riparian peatland	7	0.4	11	0.7	5	0.3	1	0.1
	Black spruce treed on shallow peatland	444	27.2	339	21.4	324	20.7	283	27.0
	Black spruce treed on wet peatland	34	2.1	52	3.3	32	2.0	11	1.0
	Jack pine treed on shallow peatland	0	0.0	0	0.0				
	Tamarack- black spruce mixture on riparian peatland	3	0.2	3	0.2	0	0.0	0	0.0
	Tamarack- black spruce mixture on wet peatland	16	1.0	15	1.0	7	0.5	2	0.2
	Tamarack treed on riparian peatland					1	0.0		
	Tamarack treed on shallow peatland	17	1.0	24	1.5	27	1.7	7	0.7
	Tamarack treed on wet peatland	3	0.2	2	0.1	0	0.0	4	0.4
Tall shrub on other peatlands	Tall shrub on shallow peatland	2	0.1	1	0.1	0	0.0	0	0.0
	Tall shrub on wet peatland	3	0.2	3	0.2	3	0.2	3	0.3
Low vegetation on other peatlands	Low vegetation on shallow peatland	173	10.6	164	10.4	51	3.3	63	6.1
	Low vegetation on wet peatland	35	2.2	47	2.9	25	1.6	14	1.4
Shrub/ low vegetation on riparian peatland	Low vegetation on riparian peatland	8	0.5	15	1.0	16	1.0	6	0.6
	Tall shrub on riparian peatland	2	0.1	2	0.1	1	0.1		
Nelson River shore zone	Nelson River shrub and/or low vegetation on ice								

Table 4-13: Land Cover and Coarse Habitat Type Composition of the Generation Outlet Alternative Route Evaluation Corridors

Land Cover Type	Coarse Habitat Type	Alternative A		Alternative B		Alternative C		Alternative D	
		Area (ha)	%	Area (ha)	%	Area (ha)	%	Area (ha)	%
	scoured mineral								
	Nelson River shrub and/or low vegetation on sunken	10	0.6	10	0.7	11	0.7	10	1.0
	Nelson River shrub and/or low vegetation on upper								
Off-system shore zone	Off-system marsh	0	0.0	0	0.0	0	0.0		
Human infrastructure		81	5.0	86	5.5	114	7.3	124	11.9
Total land cover		*1,631*		*1,583*		*1,564*		*1,047*[1]	

[1] Based on terrestrial habitat mapping for 52% of the area in corridor for Alternative D.

Table 4-14: Broad Habitat Type and Priority Habitat Type Composition of the Generation Outlet Alternative Route Evaluation Corridors

Broad Habitat Type*	Priority Criteria Met**	Cumulative % Historical Area Affected***	Alternative A			Alternative B			Alternative C			Alternative D****		
			Total Area	% total area	% total priority area	Total Area	% total area	% total priority area	Total Area	% total area	% total priority area	Total Area	% total area	% total priority area
Balsam poplar mixedwood on all ecosites	RDS		0	0.0	0.1	0	0.0	0.1						
Black spruce dominant on ground ice peatland	None	5.5	54	3.3		57	3.6		62	3.9		65	6.2	
Black spruce dominant on mineral	U	5.7	101	6.2	20.3	84	5.3	15.8	123	7.9	28.0	62	5.8	19.5
Black spruce dominant on riparian peatland	RDS	5.4	7	0.4	1.4	11	0.7	2.0	5	0.3	1.0	1	0.1	0.4
Black spruce dominant on shallow peatland	C	5.6	375	23.0		275	17.4		252	16.1		201	19.0	
Black spruce dominant on thin peatland	C	5.6	424	26.0		444	28.0		636	40.7		294	27.8	
Black spruce dominant on wet peatland	UD	5.3	34	2.1	6.9	52	3.3	9.7	32	2.0	7.2	11	1.0	3.4
Black spruce mixedwood on mineral	R	5.5	8	0.5	1.6	9	0.6	1.7	12	0.8	2.8	16	1.5	4.9
Black spruce mixedwood on thin peatland	RDS	5.4				1	0.0	0.1	1	0.0	0.1			
Black spruce mixture on ground ice peatland	None	5.8	4	0.3		1	0.1		2	0.1		2	0.2	
Black spruce mixture on mineral	RD	8.8	13	0.8	2.6	18	1.1	3.4	26	1.7	6.0	4	0.4	1.2
Black spruce mixture on shallow peatland	RD	6.2	10	0.6	2.1	5	0.3	1.0	8	0.5	1.9	15	1.5	4.8
Black spruce mixture on thin peatland	R	7.2	10	0.6	2.0	21	1.4	4.0	27	1.7	6.0	10	0.9	3.0
Black spruce mixture on wet peatland	R	5.2	2	0.2	0.5	1	0.1	0.3	1	0.0	0.1	2	0.2	0.6
Emergent on lower beach	R					0	0.0	0.0	0	0.0	0.0			
Emergent on upper beach	R	2.8	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0			
Jack pine dominant on mineral	UDS	5.6	39	2.4	7.8	31	1.9	5.7	34	2.2	7.7	55	5.2	17.3
Jack pine dominant on shallow peatland	RS	5.0	0	0.0	0.0	0	0.0	0.0						

Table 4-14: Broad Habitat Type and Priority Habitat Type Composition of the Generation Outlet Alternative Route Evaluation Corridors

Broad Habitat Type*	Priority Criteria Met**	Cumulative % Historical Area Affected***	Alternative A			Alternative B			Alternative C			Alternative D****		
			Total Area	% total area	% total priority area	Total Area	% total area	% total priority area	Total Area	% total area	% total priority area	Total Area	% total area	% total priority area
Jack pine dominant on thin peatland	RDS	5.9	3	0.2	0.6	3	0.2	0.5	1	0.1	0.2	1	0.1	0.2
Jack pine mixedwood on mineral	RD	5.9	8	0.5	1.5	8	0.5	1.5	12	0.8	2.7	7	0.7	2.4
Jack pine mixedwood on thin peatland	RDS	6.6	1	0.0	0.1	1	0.0	0.1	1	0.0	0.2	0	0.0	0.1
Jack pine mixture on thin peatland	R	7.0	8	0.5	1.6	3	0.2	0.5	2	0.1	0.5	2	0.2	0.7
Low vegetation on ground ice peatland	None	5.7	63	3.8		49	3.1		10	0.6		20	1.9	
Low vegetation on mineral soil	None	5.9	13	0.8		9	0.6		5	0.4		4	0.4	
Low vegetation on riparian peatland	U	5.8	8	0.5	1.6	15	1.0	2.9	16	1.0	3.6	6	0.5	1.8
Low vegetation on shallow peatland	U	5.4	110	6.8	22.2	115	7.2	21.5	42	2.7	9.5	43	4.1	13.6
Low vegetation on thin peatland	U	5.5	107	6.6		117	7.4		31	2.0		20	1.9	
Low vegetation on wet peatland	U	5.6	35	2.2	7.1	47	2.9	8.7	25	1.6	5.8	14	1.4	4.5
Tall shrub on ground ice peatland	None	5.3	0	0.0		0	0.0							
Tall shrub on mineral	RD	8.1							0	0.0	0.1	0	0.0	0.0
Tall shrub on riparian peatland	R	8.0	2	0.1	0.5	2	0.1	0.3	1	0.1	0.3			
Tall shrub on shallow peatland	RDS	5.6	2	0.1	0.3	1	0.1	0.2	0	0.0	0.0	0	0.0	0.0
Tall shrub on thin peatland	RDS	7.3	5	0.3	1.0	6	0.4	1.1	3	0.2	0.6	3	0.2	0.8
Tall shrub on wet peatland	R	6.9	3	0.2	0.6	3	0.2	0.6	3	0.2	0.7	3	0.3	0.9
Tamarack- black spruce mixture on riparian peatland	RD	6.4	3	0.2	0.6	3	0.2	0.5	0	0.0	0.0	0	0.0	0.0
Tamarack dominant on ground ice peatland	None	5.3							0	0.0		0	0.0	
Tamarack dominant on mineral	RDS	6.3				1	0.1	0.3	2	0.1	0.3			
Tamarack dominant on riparian peatland	R								1	0.0	0.2			
Tamarack dominant on shallow peatland	R		0	0.0	0.0	0	0.0	0.0	0	0.0	0.1	0	0.0	0.1

Table 4-14: Broad Habitat Type and Priority Habitat Type Composition of the Generation Outlet Alternative Route Evaluation Corridors

Broad Habitat Type*	Priority Criteria Met**	Cumulative % Historical Area Affected***	Alternative A			Alternative B			Alternative C			Alternative D****		
			Total Area	% total area	% total priority area	Total Area	% total area	% total priority area	Total Area	% total area	% total priority area	Total Area	% total area	% total priority area
Tamarack dominant on thin peatland	RDS	5.8	7	0.5	1.5	9	0.6	1.6	1	0.0	0.1	1	0.1	0.4
Tamarack dominant on wet peatland	R	5.1	3	0.2	0.6	2	0.1	0.4	0	0.0	0.0	4	0.4	1.4
Tamarack mixture on ground ice peatland	None	6.1	2	0.1		0	0.0		1	0.1		0	0.0	
Tamarack mixture on mineral	RDS	7.6	5	0.3	0.9	4	0.2	0.7	3	0.2	0.8	14	1.3	4.3
Tamarack mixture on shallow peatland	RD	6.5	15	0.9	3.0	23	1.5	4.3	25	1.6	5.7	7	0.7	2.2
Tamarack mixture on thin peatland	RDS	7.5	26	1.6	5.2	27	1.7	5.1	18	1.2	4.2	12	1.1	3.7
Tamarack mixture on wet peatland	RD	5.2	14	0.8	2.7	14	0.9	2.6	7	0.4	1.5	0	0.0	0.0
Trembling aspen dominant on all ecosites	RD	6.7	11	0.7	2.3	11	0.7	2.0	6	0.4	1.4	11	1.1	3.6
Trembling aspen mixedwood on all ecosites	RDS	6.1	2	0.1	0.5	3	0.2	0.6	3	0.2	0.7	13	1.2	4.0
Total area (ha)			*1,631*			*1,583*			*1,564*			*1,057**		
Total priority habitat area (ha)			*496*			*533*			*440*			*317**		

* See Section 2 of Keeyask HydroPower Partnership (2012b) for a description of the land cover and coarse habitat types.
** Priority habitat criteria: R=regionally rare; U= regionally uncommon; D= structurally diverse; and S= relatively high potential to support rare plant species.
*** See Section 2 of Keeyask HydroPower Partnership (2012b) for the methods used to determined cumulative percentage of historical area already affected.
***** Based on terrestrial habitat mapping for 52% of the area in corridor for Alternative D, plus 11 ha of priority habitat identified in the unmapped areas.

In the Alternative B evaluation corridor, the land type composition was an even mixture of thin peatlands and other peatlands, at 42% each. Other peatlands were predominantly comprised of the shallow peatland ecosite type, primarily blanket bog (24%), with most of the remaining area divided between peat plateau bog/ collapse scar mosaic and horizontal fen (7% each). Deep dry mineral made up most of the remaining area.

Land cover in the Alternative B evaluation corridor was predominantly needleleaf treed on mineral or thin peatland (42%), and needleleaf treed on other peatlands (28%). The regionally common habitat types, black spruce treed on thin peatland and black spruce treed on shallow peatland made up most of these two land cover types. Low vegetation on mineral or thin peatland and on shallow peatland made up an additional 18% of the habitat. Black spruce treed on mineral soil was the habitat type most commonly found on mineral ecosites. Wet and riparian peatlands made up 9% of the habitat, most of which supported black spruce treed or low vegetation types.

In the Alternative C evaluation corridor, 80% of the land area was thin peatland (49%) and other peatlands, with the blanket bog ecosite type making up most of the latter at 20% of the total land area. The peat plateau bog/ collapse scar peatland mosaic and horizontal fen ecosite types made up an additional 4% of the land area each. Deep dry mineral comprised 17% of the land area in this corridor.

Land cover in Alternative C evaluation corridor was predominantly needleleaf treed on mineral or thin peatland (57%), and needleleaf treed on other peatlands (25%). The common habitat types, black spruce treed on thin peatland and black spruce treed on shallow peatland made up most of these two land cover types (44% and 21%, respectively). Black spruce treed on mineral soil was the habitat type most commonly found on mineral ecosites, making up an additional 10% of the coarse habitat area. Wet and riparian peatlands made up 6% of the habitat combined.

In Alternative D evaluation corridor, over 84% of the land area was on thin peatland (28%) and other peatlands which were mostly comprised of blanket bog and peat plateau bog/ collapse scar mosaic (29% and 13% of the total land area, respectively). Alternative D had a higher proportion of the latter ecosite type than any of the other options. Deep dry mineral ecosites made up an additional 13% of the mapped area, with most of the remaining area in veneer bogs and horizontal fens.

Based on the available information, land cover composition in Alternative D evaluation corridor was very similar to that of Alternative A. Most of the area was needleleaf treed on mineral or thin peatland (45%), and needleleaf treed on other peatlands (29%). The two regionally common habitat types, black spruce treed on thin peatland and black spruce treed on shallow peatland comprised most of these land cover types (30% and 27%, respectively). On mineral ecosites, black spruce treed and jack pine treed habitat made up most of the cover (6% of the total area, each). In combination, tall shrub and low vegetation habitat on peatlands accounted for 8% of the mapped corridor area. Data from the FRI mapping and helicopter photography indicated that there could be an additional 23 ha of shrub/ low vegetation occurring on riparian peatland ecosites, with tall shrub on riparian peatland being the most abundant habitat.

4.5.1.3 Plants

The total number of plant species recorded in each of the alternative route evaluation corridors ranged from 100 species in Alternative D to 141 species in Alternative B (note that plant occurrences were underrepresented in Alternative D for the reasons described in Section 4.5.4). The widespread and abundant species in the alternative route evaluation corridors were similar with a few exceptions. Labrador tea and rock cranberry were the most widespread and abundant vascular plant species in all four alternative route evaluation corridors. Big red stem (*Pleurozium schreberi*) and the other moss species group were also widespread and at least sporadic in each of the corridors. One lichen species, green reindeer lichen (*Cladina rangiferina*), and one lichen group identified to genus only (the cup lichens; *Cladonia* spp.) were widespread, but less abundant in all four alternative route evaluation corridors.

Invasive plant species were not found in the Generation Outlet Transmission alternative route evaluation corridors during field studies.

4.5.2 Fragmentation

The KCNs have expressed concern regarding cumulative effects of the Project on Local Study Area intactness. It was perceived that linear features such as transmission lines reduce forest habitat for wildlife (Split Lake Cree – Manitoba Hydro Joint Study Group, 1996).

Alternative C was the clearly preferred Generation Outlet Transmission alternative route in terms of fragmentation effects essentially because more of its length was near existing human infrastructure. Alternatives A and D were the least preferred.

Alternative C created the lowest increase to linear feature densities (i.e., total and non-transportation densities) since it was the shortest route (approximately 40.3 km long). As longest route, Alternative D was approximately 26% longer than Alternative C, which created the largest increase to linear feature densities.

Six core areas were crossed by at least one of the alternative routes, with the largest being 69,165 ha and 25,308 ha in size (Table 4-15). Compared with the other alternatives, Alternative C created the smallest reduction in total core area (355 ha) because more of its length was near existing human infrastructure (Table 4-15). Alternative A created the largest reduction total core area (1,151 ha), followed by Alternative D and then B.

By following the edge of the largest core area, Alternative C had the smallest effect on the size and spatial configuration of large core areas (Map 4-1). Alternative C the size of the largest core area by only 222 ha compared with a 1,004 ha reduction for Alternative A (Table 4-15). Alternative C also left the largest core area as a single large block whereas Alternative A fragmented this core area into four blocks. Additionally, Alternative C did not affect the second largest of the three core areas. Alternative B fragmented the largest core area into three blocks and reduced its size by 618 ha. While Alternatives B and A affected the second largest core area, this occurred at near its edge and Gillam.

Starting from Gillam, the first 28.8 km of the Alternative D route was situated between two existing transmission line ROWs and a railway line. Alternative D route is adjacent to the existing ROWs and approximately 1 km from the railway line. In general the preference would be to locate a human linear feature next to another linear feature to minimize the fragmentation of core areas. However, in this situation four linear features were located in close proximity, which could be a substantial deterrent for movements across this area. For the remainder of the route, the potential effects of Alternative D on the largest core areas depended on which of the Construction Power Transmission alternatives was selected as the preferred route. If Construction Power Transmission Alternative 2 was selected then Alternative D would fragment a larger core area into two core areas. If Construction Power Transmission Alternative 1 was selected then Alternative D would follow an existing linear feature, leaving the larger core area as a slightly smaller but single core area.

Table 4-15: Sizes of Affected Core Areas in 2010 and With Each of the Generation Outlet Alternative Transmission Line Routes

Core Area ID*	Existing Environment (ha)	Generation Outlet Transmission Alternative (ha)			
		A	B	C	D
4	69,165	68,161	68,690	68,943	68,593
9	25,308	25,163	25,167	25,307	25,308
37	2,360	2,360	2,360	2,360	2,293
40	2,074	2,074	2,074	2,074	1,844
92	322	319	319	189	267
94	315	315	315	315	253
All	**99,544**	**98,393**	**98,926**	**99,189**	**98,559**
Reduction from existing environment		**-1,151**	**-618**	**-355**	**-985**

* See Map 4-1 for core area IDs.

Given the number of attributes considered for the fragmentation evaluation and that there was no clear ranking of the four alternative routes, a rank-based scoring of the alternatives was completed. On this basis, Alternative C was the preferred alternative route as it had the lowest total rank-based score, followed by Alternative B (Table 4-16). Alternatives A and D were least preferred, being tied with the highest score. It should be noted that the total scores should be interpreted in a qualitative manner and that the size of the differences in the total scores for the alternatives did not represent the magnitude of difference in effects.

Table 4-16: Rank-based Scoring of Fragmentation Attributes for the Generation Outlet Alternative Transmission Line Routes

Fragmentation Attribute	**Alternative Route Rank**			
	A	B	C	D
Length	2	3	1	4
Total core area loss	4	3	1	2
Large core areas	4	2	1	3
Total linear feature width	0	0	0	1
Total score	10	8	3	10

Notes: Alternative routes are ranked relative to each other. The lowest value indicates the lowest effects.

4.5.3 Ecosystem Diversity

Alternative Route C was the preferred Generation Outlet Transmission route in terms of potential ecosystem diversity effects because it had the smallest area in priority habitat types.

None of the four alternative route evaluation corridors completely removed a stand level habitat type from the Regional Study Area. Additionally, none of the alternatives substantially altered the regional proportions of the common or uncommon habitat types.

Nine broad habitat types represented by less than 20 stands were affected by at least one of the alternative route evaluation corridors. Alternative C affected the highest number of these types (8 types) followed by Alternative B (7 types) and then by Alternative A (4 types). Alternative D could not be evaluated because habitat mapping was not available for approximately 47% of the corridor area. Alternatives A and B each affected a relatively high amount of tamarack dominant on thin peatland (up to 9 ha). Eight of these nine broad habitat types are represented by less than 10 stands. When only considering these types, the order of ranking remains the same for all alternatives, reducing the number of habitat types affected by one, except for Alternative A. For all of these broad habitat types, all of the affected stands are less than one hectare in size, with the exception of tamarack dominant on thin peatland. Alternative route evaluation corridors A and B each affect a tamarack dominant on thin peatland stand that is nearly 3 hectares in size. Considering the size of the stands and total area affected, the three evaluated alternatives appeared to have similar stand effects.

None of the alternative route evaluation corridor included a substantial amount of priority shoreline wetland habitat (Map 3-1). Alternatives B and C affected the largest areas, but each area only encompassed just over 200 square meters of these habitat types (Table 4-14).

Priority habitat accounted for approximately 30% (496 ha) of the total land area in the Alternative A evaluation corridor (Table 4-14). Uncommon habitat types accounted for most of this area (58%), mostly consisting of low vegetation on shallow peatland (22%) and black spruce dominant on mineral (20%). Habitat types that were of higher concern because they met several priority habitat criteria covered 97 ha, or 5.9%, of the land area in the corridor. Jack pine dominant on mineral and tamarack mixture on thin peatland comprised nearly 8% and 5%, respectively, of the priority habitat area.

In the Alternative B evaluation corridor, priority habitat accounted for approximately 34% (533 ha) of the total land area (Table 4-14). Uncommon habitat types comprised most of this area (59%), being mostly low vegetation on shallow peatland (21%), black spruce dominant on mineral (16%) and black spruce dominant on wet peatland (10%). Habitat types of higher concern covered 97 ha, or 6.1%, of corridor land area. Jack pine dominant on mineral and tamarack mixture on thin peatland each made up approximately 6% of the priority habitat area.

Priority habitat covered approximately 28% (440 ha) of the total land area in the Alternative C evaluation corridor (Table 4-14). Uncommon habitat types accounted for most of this area (62%), with black spruce dominant on mineral (28%) making up the largest proportion by far. Habitat types of higher concern covered 70 ha, or 4.5%, of corridor land area. Jack pine dominant on mineral and tamarack mixture on thin peatland made up approximately 8% and 4%, respectively, of the priority habitat area.

For Alternative D, vegetation mapping was not available for 47% of evaluation corridor area. Only ecosite type and priority habitat types of higher concern were mapped for the entire corridor. Priority habitat covered at least 30% (317 ha) of the total mapped land area in the Alternative D corridor (Table 4-14). Uncommon habitat types made up 60% of the priority habitat area, with black spruce dominant on mineral making up the largest proportion at over 19%. Habitat types of higher concern covered at least 99 ha, or 5%, of the total land area in the corridor. Jack pine dominant on mineral comprised over 17% of the priority habitat area. An additional 12% of the area was divided between tamarack mixture on mineral, tamarack mixture on thin peatland, and trembling aspen mixedwood on all ecosites, each of which meet all three priority habitat criteria.

To facilitate and overall comparison based on the ecosystem diversity attributes, a rank-based scoring of the alternatives was completed. The number of habitat types represented by less than 20 stands was not included in the scoring because Alternative D could not be evaluated (see above). Based on the total rank-based score, Alternative C was preferred over Alternatives A and B followed by Alternative D (Table 4-17). It should be noted that the total scores should be interpreted in a qualitative manner and that the size of the differences in the total scores for the alternatives did not represent the magnitude of difference in effects.

Table 4-17: Rank-based Scoring of Ecosystem Diversity Attributes for the Generation Outlet Alternative Transmission Line Routes

Ecosystem Diversity Attribute	Alternative Route Rank			
	A	B	C	D
Total priority habitat area	2	3	1	4
Highest concern priority habitat area	2	2	1	4
Total score	4	5	2	8

Notes: Alternative route evaluation corridors are ranked relative to each other. The lowest value indicates the lowest effects.

4.5.4 Priority Plants

Alternative C was the preferred route amongst Alternative routes A, B and C in terms of potential priority plant effects because much lower numbers of rare and uncommon plant locations were found within this alternative route evaluation corridor. Alternative D could not be evaluated against the other alternatives in a completely consistent manner.

Endangered and threatened were not expected to occur in any of the alternative route evaluation corridors for the same reasons provided in Section 4.1.4.

Provincially very rare species were not found in any of the evaluation corridors during field studies. In the unlikely event that any provincially rare species are found during pre-construction field studies along the final selected route corridor, it is likely that the ROW can be routed to avoid these species where appropriate given engineering and other environmental considerations.

A total of 4 rare to uncommon plant species were found in the Alternative B and C evaluation corridors, compared with 3 species in the Alternative A evaluation corridor. In total, 10 individuals were observed in corridor C, compared to 18 and 26 observed in corridor A and B, respectively (Table 4-18).

Field studies found four of the 45 provincially rare to uncommon upland and wetland plant species that could potentially occur in the Regional Study Area, including Robbin's pondweed (*Potamogeton robbinsii*), shrubby willow (*Salix arbusculoides*), rock willow (*Salix vestita*) and American milk-vetch (*Astragalus americanus*) in the Generation Outlet Transmission alternative route evaluation corridors (Table 4-18). Of the three alternative route evaluation corridors, Alternative C included the lowest number of locations for provincially rare to uncommon species by far (Table 4-18). Effects on Robbin's pondweed were not expected regardless of which alternative was selected since this is a submergent wetland species and ROW construction and operation typically do not affect the littoral zone of waterbodies. All of the remaining species except for American milk-vetch were probably more regionally common than indicated by the provincial conservation concern ranks. All eight occurrences of American milk-vetch were along roadsides at two general locations in the Regional Study Area.

Since Alternative D was identified late in the evaluation process, only one of the sampling protocols used to measure plant species presence/absence was conducted in the evaluation corridor for this route. Consequently, the numerical comparisons provided above do not include this alternative. It can be stated that no provincially very rare species were found in this evaluation corridor and that one provincially rare species, muskeg lousewort (*Pedicularis macrodonta*), was found at one location in the corridor.

Table 4-18: Number of Locations Where Priority Species were Found Within the Generation Outlet Alternative Route Evaluation Corridors During Field Studies

Species	MBCDC S-Rank	Reason for inclusion	Alternative			
			A	B	C	D*
Robbin's pondweed	S2	Provincially rare	0	1	1	
Shrubby willow	S3	Provincially uncommon/ Range limit	1	3	2	
Rock willow	S3	Provincially uncommon/ Range limit	12	13	5	
American milk-vetch	S3	Provincially uncommon	5	9	2	
Blue columbine	S4	Regionally rare	1	1	0	
Balsam poplar	S5	Regionally rare	1	4	4	
Jack pine	S5	Range limit	23	16	13	
Goldthread	S5	Range limit	0	0	1	
Northern Labrador-tea	S4	Range limit/ KCN importance	2	2	1	
Hairy goldenrod	S5	Range limit	5	8	6	
White birch	S5	KCN importance	16	22	25	
Smooth wild strawberry	S5	KCN importance	5	4	1	
Red currant	S5	KCN importance	0	2	2	
Cloudberry	S5	KCN importance	14	15	14	
Red raspberry	S5	KCN importance	1	2	2	
Bog bilberry	S5	KCN importance	26	25	19	
Rock cranberry	S5	KCN importance	38	42	37	
Total			*150*	*169*	*135*	
Provincially Rare/Uncommon Sub-total			*18*	*26*	*10*	
Regionally Rare Sub-total			*2*	*5*	*4*	
Range Limit Sub-total			*43*	*42*	*28*	
KCN Importance Sub-total			*102*	*114*	*101*	

* Values could not be calculated in a consistent manner with the other alternatives because the sampling approach differed for Alternative D.

4.5.5 Conclusions

In terms of potential Project effects on terrestrial habitat, ecosystem and plant VECs, there were no major concerns with any of the four Generation Outlet Transmission alternative routes. Alternative C was the preferred route because it was expected to minimize effects on fragmentation, ecosystem diversity and priority plants, largely because more of this alternative route was near existing human features. Alternatives A and D created the highest fragmentation effects and Alternative D had the highest ecosystem diversity effects.

Alternative C was the preferred option in terms of fragmentation effects. Alternative C produced the smallest increase to total linear feature density (since it was the shortest route) and the lowest reduction to total core area (because more of its length was near existing human infrastructure). Alternatives B had the second lowest effect on total core area because it was near existing human features for much of its length. Alternatives A and D were clearly the worst options in terms of fragmentation effects. Alternative A created the largest reduction in total core area, passed near the central portion of a large core area (approximately 70 km^2), and subdivided this large core area into three smaller blocks. Although Alternative D was routed near existing or proposed human features, it still created the second highest reduction in total core area. Additionally, the first 28.8 km of the Alternative D route was situated between two existing transmission line rights-of-way and a railway line. While the general preference would be to locate a human linear feature next to another linear feature to minimize the fragmentation of core areas, four linear features located in close proximity could be a substantial deterrent for movements across this area.

Alternative C was the preferred option in terms of potential ecosystem diversity effects because it affected a lower total area of terrestrial habitat, included the highest proportion of common habitat types and had the smallest area in priority habitat types. Alternative D affected substantially more terrestrial habitat than the other alternative route evaluation corridors as well as the highest amount of the priority habitat types that were of highest concern. Alternatives A and B had similar overall ecosystem diversity effects.

Alternative Route C was also the preferred option in terms of potential priority plant effects because much lower numbers of rare and uncommon plant locations were found within this alternative route evaluation corridor. Endangered, threatened or provincially very rare plants were not expected to occur along any of the alternative routes. Elegant hawk's-beard (*Crepis elegans*), the only provincially rare to very rare terrestrial plant found during field studies in the region, was not observed along either route. For the remaining priority plant species, Alternative C had considerably fewer priority plant species locations than the other two routes. Although the amount of rare plant survey work was lower along Alternative D, one provincially rare species was found at one location along this route. To the extent that rare plants are associated with the regionally rare habitat types, Alternative D could have the highest priority plant effects.

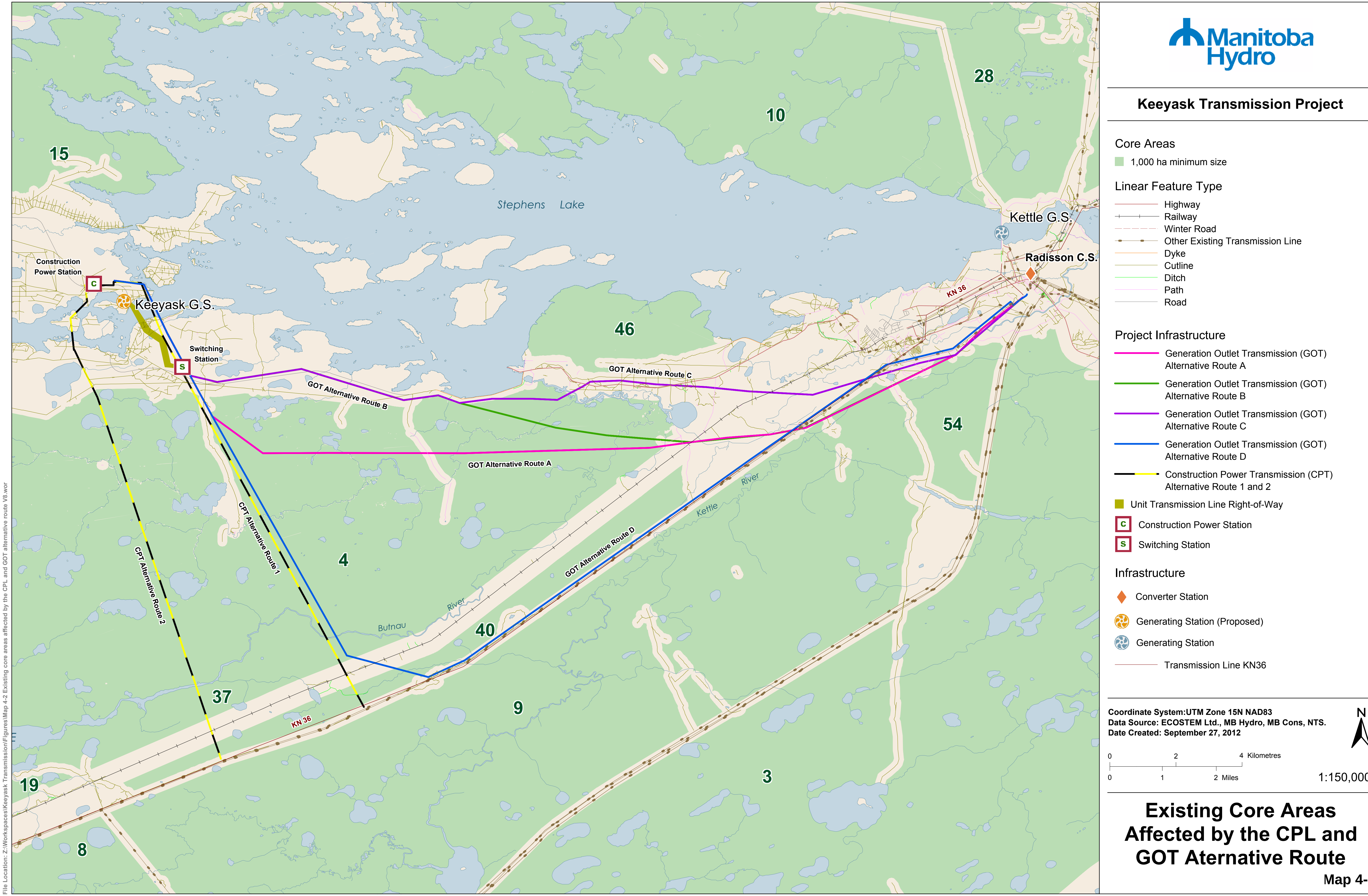
While Alternative C was the preferred route overall and Alternative D had the highest adverse effects relative to the other routes, the overall differences between the four Generation Outlet Transmission alternatives were not large. Regardless of which route is selected, final routing could likely avoid sites of relatively high concern.

Table 4-19 summarizes the results for the Generation Outlet Transmission alternative routes evaluation. For each VEC, the potential Project effects for the alternative are ranked relative to the alternative route with the lowest anticipated adverse effects. Note that the total scores should be interpreted in a qualitative manner and that the size of the differences in the total scores for the alternatives did not represent the magnitude of difference in effects.

Table 4-19: Rank-based Scoring of Potential Effects on Valued Environmental Components for the Generation Outlet Transmission Line Alternative Routes

Valued Environmental Component	Alternative Route Rank			
	A	B	C	D
Fragmentation	3	2	1	3
Ecosystem diversity	2	2	1	3
Priority plants	2	3	1	4

Notes: Alternative routes are ranked relative to each other. The lowest value indicates the lowest effects.



Existing Core Areas Affected by the CPL and GOT Aternative Route

Map 4-1

5.0 EFFECTS AND MITIGATION

Manitoba Hydro conducted a process to select the final preferred transmission line routes and station sites, which is described in Chapter 6 of the Environmental Assessment Report (Manitoba Hydro 2012). As a result of the site selection and evaluation process, Construction Power Transmission Alternative 1 and a combination of segments from Generation Outlet Transmission Alternatives B and C (with one minor modification) were the selected routes. The Project Footprint components are shown in Map 5-1.

This section describes and assesses Project effects on terrestrial habitat, ecosystems and plants based on the final selected locations for each Project component, including predicted potential Project effects, mitigation measures designed to minimize effects to the extent practicable, and the expected residual effects with mitigation measures in place. Monitoring is outlined for situations where a prediction has substantial uncertainty or a difference between predicted and actual residual effects could substantially alter the effects assessment.

5.1 OVERVIEW

The potential pathways for Project effects on terrestrial habitat, ecosystems and plants were described in Sections 1.3 and 2.5.

5.1.1 Terrestrial Habitat Affected

5.1.1.1 Construction

During construction, the Project Footprint could directly affect approximately 958 ha of terrestrial habitat (Table 5-1), assuming all of the borrow areas and construction camps are in pre-existing sites and/or within the transmission line ROWs.

The Project was predicted to indirectly affect an additional 628 ha of terrestrial habitat (Table 5-1) based on overestimates of the anticipated width of the terrestrial habitat zone of influence. It was assumed that all terrestrial habitat within 50 m of the transmission line ROWs and within 150 m of the station sites would be indirectly affected whereas the expected distances of effects were 10 m and 50 m, respectively. Two of the Project Footprint components affect no terrestrial habitat area because they are contained within areas where habitat was already altered and/or cleared by previous projects.

Table 5-1: Estimated Maximum Potential Amount (ha) of Terrestrial Habitat Affected During Construction by Source

Project Footprint Component	Area (ha)		
	Project Footprint	Habitat Zone of Influence	Total
Construction Power Station	0	0	0
Construction Power Line	111	173	285
Construction Power Temporary Line	23	17	39
Unit Transmission Lines	81	35	116
Keeyask Switching Station	35	30	64
Generation Outlet Transmission Lines	708	373	1,081
Radisson Converter Station	0	0	0
All	958	628	1,586

Needleleaf treed vegetation on mineral or thin peatland, and on other peatlands made up 85% of the native terrestrial habitat in the Project Footprint (Table 5-2). Most of this land cover was comprised of the black spruce treed on thin peatland (43%) and black spruce treed on shallow peatland (28%) coarse habitat types. Most of the remaining habitat in the Project Footprint was comprised of low vegetation on shallow peatland and low vegetation on mineral or thin peatland (7% combined). Broadleaf treed on all ecosites made up less than 2% of the total land cover in the project footprint. The terrestrial habitat composition of the terrestrial habitat zone of influence was virtually identical to that of the Project Footprint (Table 5-2).

Table 5-2: Composition (percentage) of Terrestrial Habitat Affected During Construction by Habitat Type as a Percentage of Terrestrial Habitat Area

Land Cover Type	Coarse Habitat Type	Project Footprint	Habitat Zone of Influence	Total
Broadleaf treed on all ecosites	Broadleaf mixedwood on all ecosites	1.1	0.8	1.0
	Broadleaf treed on all ecosites	0.5	1.0	0.7
Needleleaf treed on mineral or thin peatland	Black spruce mixedwood on mineral or thin peatland	1.1	0.3	0.8
	Black spruce treed on mineral soil	4.9	5.8	5.3
	Black spruce treed on thin peatland	42.5	39.8	41.5
	Jack pine mixedwood on mineral or thin peatland	0.2	0.3	0.2
	Jack pine treed on mineral or thin peatland	3.1	2.4	2.8
Tall shrub on mineral or thin peatland	Tall shrub on mineral or thin peatland	0.2	0.2	0.2
Low vegetation on mineral or thin peatland	Low vegetation on mineral or thin peatland	1.7	2.1	1.9
Needleleaf treed on other peatlands	Black spruce treed on shallow peatland	28.0	29.1	28.4
	Black spruce treed on wet peatland	2.4	2.4	2.4
	Tamarack treed on shallow peatland	1.9	1.6	1.8
	Tamarack- black spruce mixture on wet peatland	0.3	0.4	0.3
	Tamarack treed on wet peatland	0.1	0.3	0.2
	Black spruce treed on riparian peatland	0.2	0.3	0.2
	Tamarack- black spruce mixture on riparian peatland		0.0	0.0
Tall shrub on other peatlands	Tall shrub on shallow peatland	0.1	0.1	0.1
	Tall shrub on wet peatland	0.2	0.3	0.2
Low vegetation on other peatlands	Low vegetation on shallow peatland	4.9	6.9	5.7
	Low vegetation on wet peatland	2.5	2.0	2.3
Shrub/ low vegetation on riparian peatland	Tall shrub on riparian peatland	0.1	0.1	0.1
	Low vegetation on riparian peatland	0.6	0.8	0.7
Nelson River shore zone	Nelson River shrub and/or low vegetation on ice scoured uplands	0.2	0.2	0.2
	Nelson River shrub and/or low vegetation on sunken peat	3.2	2.9	3.1
All types		100	100	100
Total habitat area (ha)		*958*	*628*	*1,586*

5.1.1.2 Operation

Components of the Project not required for the operation phase include the Construction Power Transmission temporary line and 2 ha of the land on which the Construction Power Station occurs.

The portion of the construction power line ROW allocated for the temporary power line will be left to regenerate to a natural condition after removal of the temporary infrastructure. The extent of native habitat recovery in this ROW will vary depending on a number of factors such as degree of vegetation removal, degree of soil compaction, soil type and topography. Additionally, portions of the decommissioned ROW would become the terrestrial habitat zone of influence for the permanent backup power line. For the Project effects assessment it was cautiously assumed that approximately one half of the area would recover to habitat types. On this basis, the amount of affected terrestrial habitat in the Project Footprint could decline during operation by about 8 ha in the Construction Power Transmission temporary line ROW and by 2 ha in the Construction Power Station site.

Taking a cautious approach, the sizes of the terrestrial habitat zone of influence along the remainder of the Construction Power transmission line ROW and along the Generation Outlet transmission line ROW were assumed to remain unchanged during operation. On this basis, the assumed extent of edge effects during construction and operation were the same.

5.2 VALUED ENVIRONMENTAL COMPONENTS

5.2.1 Fragmentation

Potential Project effects on fragmentation include increased linear feature density, lower total core area and fewer large core areas. Newly constructed roads, transmission lines, trails and cutlines add to linear feature density. Core area is reduced by Project features that either remove existing core area or are near an existing core area. FLCN noted that trappers are concerned about hunters that will use the transmission corridor to access areas (Keeyask Transmission Project Workshop 2012).

5.2.1.1 Construction

Potential Project Effects

Linear Disturbance

The combined total length of the various Project linear features is approximately 147 km, which includes approximately 20.5 km for the construction power line, approximately 112.5

km for the three Generation Outlet Transmission lines and 14 km for the four Unit Transmission Lines.

The Project was predicted to increase total linear feature density from 0.45 km/km^2 to 0.47 km/km^2 for the entire Regional Study Area and from 0.32 km/km^2 to 0.34 km/km^2 in the portion of the Regional Study Area that is outside of the Thompson area. Total linear feature density for the entire Regional Study Area was expected to remain at the low end of the moderate magnitude effects range (between 0.40 km/km^2 and 0.60 km/km^2) and well within the small magnitude range for the Regional Study Area outside of the Thompson area.

Locating the

Core Areas

Project construction would reduce total core area by approximately 1,835 ha (Table 5-3). Since the reduction was relatively small in the regional context, the percentage of the Regional Study Area in core areas larger than 1,000 ha would remain at approximately 82%, which was still well within the small magnitude range of 66% to 100%. The percentage of the Regional Study Area in core areas larger than 1,000 ha would remain at approximately 84%.

Project construction would affect five core areas. Three cores larger than 1,000 ha would be reduced in size and fragmented (Table 5-3). The fifth largest core area in the Regional Study Area would become 1,194 ha smaller and be fragmented into four core areas. The remaining affected core areas are all less than 2,400 in size. One 315 ha core area would be removed.

Table 5-3: Core areas in Existing Environment and During Construction

Core Area ID*	Number of Fragments Post-Project**	Area (ha)		
		Existing Environment	With Project	Change
4	4	69,165	97,972	-1,194
37	1	2,360	2,162	-198
40	2	2,074	2,020	-54
92	1	322	248	-74
94	0	315	0	-315
All		74,236	72,401	-1,835

* See Map 4-1 for core area IDs.
** If the number of fragments equals one then the core area is not subdivided by the Project. If number of fragments equals zero then the core area is either completely lost or subdivide into fragments smaller than 200 ha.

Mitigation

Some of the potential fragmentation effects of the Project were already mitigated through the site selection process for the transmission line routes. Locating the Generation Outlet Transmission line route near existing human features minimized the risk that the ROW would provide hunters with better access to the area. Mitigation beyond that already incorporated through the preferred route selection process was not proposed.

Residual Project Effects

After considering mitigation and the effects of other past and existing human projects and activities, residual Project effects on fragmentation during construction were expected to include a small increase to linear feature density and a very slight reduction to total core area percentage. Total linear feature density for the entire Regional Study Area was expected to remain at the low end of the moderate magnitude effects range (between 0.40 km/km^2 and 0.60 km/km^2) and well within the small magnitude range for the Regional Study Area outside of the Thompson area. The predicted total core area percentage during construction would be reduced from 82.5% to 82.4%, which was considerably above the 65% value for the transition from small to moderate magnitude effects.

Using the criteria established to determine the significance of Project effects for regulatory purposes (Section 2.5.1.6), the likely residual effects of Project construction on fragmentation were expected to be adverse, medium in geographic extent, long-term in duration and small in magnitude.

5.2.1.2 Operation

Potential Project Effects

Removal of the temporary construction power line would reduce the total length of linear features in the Regional Study Area by approximately 5 km. Total linear feature density would remain at 0.47 km/km^2 for the entire Regional Study Area and at 0.34 km/km^2 in the portion of the Regional Study Area outside of the Thompson area.

To the extent that native habitat recovers in the temporary construction line ROW, total core area may increase very slightly over time. It was cautiously assumed that approximately 8 ha of native terrestrial habitat could recover and contribute to core area during operation. On this basis, total core area percentage would remain at 82% for core areas larger than 1,000 ha and at 84% for all core areas.

Mitigation

Mitigation beyond that already incorporated through the preferred route selection was not proposed.

Residual Project Effects

After considering mitigation and the effects of other past and existing human projects and activities, residual Project effects on regional fragmentation were not expected to measurably change during operation.

Using the criteria established to determine the significance of Project effects for regulatory purposes (Section 2.5.1.6), the likely residual effects of Project operation on fragmentation were expected to be adverse, medium in geographic extent, long-term in duration and small in magnitude.

5.2.2 Ecosystem Diversity

The potential pathways of Project effects on terrestrial habitat (Sections 1.3 and 2.5.1.6) also apply to ecosystem diversity because ecosystem diversity indicators were measured using the terrestrial habitat mapping. Potential Project effects on ecosystem diversity include reducing the number of native ecosystem types, altering the distribution of area amongst the ecosystem types, reducing the total number of stands representing an ecosystem type and/or reducing the total area of a priority ecosystem type.

Better access brings more equipment, material and/or people into an area, which could lead to increased resource harvesting, invasive plant spread and human-caused fires, among other things. In extreme cases, a single accidental fire that is severe could alter ecosystem diversity, either by extirpating a habitat type or substantially reducing its abundance (by degrading site conditions and/or decimating the propagule bank). Invasive plants have the potential to crowd out native plant species and, in extreme cases, alter ecosystem diversity through changes to broad habitat composition.

5.2.2.1 Construction

Potential Project Effects

The risk that a Project-related fire would substantially affect native terrestrial habitat composition and priority habitat was anticipated to be low. Transmission line ROW clearing, brush burning and infrastructure construction occurs in the winter. The Environmental Protection Plan (EnvPPs) can include measures to minimize the risk that invasive plants, accidental fires and accidental spills will affect terrestrial habitat.

Habitat Composition Measures

The 1,586 ha of terrestrial habitat directly and indirectly affected by Project construction (Section 5.1.1.1) would have some consequences for the habitat composition and priority habitat measures used to assess ecosystem diversity.

Project construction will not change the total number of native broad habitat types in the Regional Study Area.

Project construction was not expected substantially change the regional proportions of any of the regionally common or uncommon native habitat types. All of the predicted changes are less than 0.01% of existing habitat area (Table 5-4). Changes to the regionally rare habitat types are evaluated below.

Project construction was expected to reduce the total number of stands for four out of the 12 native habitat types with less than 10 stands in the detailed habitat mapping area. Although black spruce mixedwood on thin peatland and tamarack-black spruce mixture on riparian peatland were the most affected, in both cases the removed stands were very small and represented far less than 1% of the total stand area. In addition, it was likely that there were additional stands representing each of these habitat types in the portion of the Regional Study Area that was outside of the detailed habitat mapping area. A simple area based extrapolation to provide a very crude estimate increased the total number of stands for each type by approximately 7.5 times.

Table 5-4: Estimated Broad Habitat Composition (percentage) of the Regional Study Area in the Existing Environment and With the Project

Broad Habitat Type	Existing Environment	With Project
Black spruce dominant on shallow peatland	20.5	20.5
Black spruce dominant on thin peatland	32.6	32.6
Low vegetation on mineral soil	0.4	0.4
Black spruce dominant on ground ice peatland	12.0	12.0
Black spruce mixture on ground ice peatland	0.1	0.1
Jack pine mixture on ground ice peatland	0.0	0.0
Low vegetation on ground ice peatland	3.7	3.7
Tall shrub on ground ice peatland	0.1	0.1
Tamarack dominant on ground ice peatland	0.0	0.0
Tamarack mixture on ground ice peatland	0.1	0.1
Balsam poplar dominant on all ecosites	0.0	0.0
Balsam poplar mixedwood on all ecosites	0.0	0.0

Table 5-4: Estimated Broad Habitat Composition (percentage) of the Regional Study Area in the Existing Environment and With the Project

Broad Habitat Type	Existing Environment	With Project
Black spruce dominant on mineral	7.7	7.7
Black spruce dominant on riparian peatland	0.7	0.7
Black spruce dominant on wet peatland	2.1	2.1
Black spruce mixedwood on mineral	0.2	0.2
Black spruce mixedwood on shallow peatland	0.0	0.0
Black spruce mixedwood on thin peatland	0.1	0.1
Black spruce mixture on mineral	0.8	0.8
Black spruce mixture on shallow peatland	0.5	0.5
Black spruce mixture on thin peatland	0.6	0.6
Black spruce mixture on wet peatland	0.1	0.1
Jack pine dominant on mineral	1.2	1.2
Jack pine dominant on shallow peatland	0.0	0.0
Jack pine dominant on thin peatland	0.1	0.1
Jack pine mixedwood on mineral	0.2	0.2
Jack pine mixedwood on shallow peatland	0.0	0.0
Jack pine mixedwood on thin peatland	0.1	0.1
Jack pine mixture on shallow peatland	0.0	0.0
Jack pine mixture on thin peatland	0.4	0.4
Low vegetation on riparian peatland	1.9	1.9
Low vegetation on shallow peatland	3.3	3.3
Low vegetation on thin peatland	4.2	4.2
Low vegetation on wet peatland	1.6	1.6
Tall shrub on mineral	0.0	0.0
Tall shrub on riparian peatland	0.6	0.6
Tall shrub on shallow peatland	0.3	0.3
Tall shrub on thin peatland	0.2	0.2
Tall shrub on wet peatland	0.1	0.1
Tamarack- black spruce mixture on riparian peatland	0.0	0.0
Tamarack dominant on mineral	0.0	0.0
Tamarack dominant on riparian peatland	0.0	0.0
Tamarack dominant on shallow peatland	0.0	0.0
Tamarack dominant on thin peatland	0.0	0.0
Tamarack dominant on wet peatland	0.2	0.2
Tamarack mixture on mineral	0.1	0.1
Tamarack mixture on shallow peatland	0.3	0.3

Table 5-4: Estimated Broad Habitat Composition (percentage) of the Regional Study Area in the Existing Environment and With the Project

Broad Habitat Type	Existing Environment	With Project
Tamarack mixture on thin peatland	0.2	0.2
Tamarack mixture on wet peatland	0.8	0.8
Trembling aspen dominant on all ecosites	0.6	0.6
Trembling aspen mixedwood on all ecosites	0.5	0.5
White birch dominant on all ecosites	0.0	0.0
White birch mixedwood on all ecosites	0.0	0.0
Emergent on upper beach	0.0	0.0
Emergent on lower beach	0.0	0.0
Emergent island in littoral	0.0	0.0

Priority Habitat Types

Before considering additional mitigation measures, the Project is not expected to affect 14 of the 46 priority habitat types. The Project could affect up to 0.8% of the area of the remaining priority habitat types (Table 5-5). Past and current projects have already affected many priority habitat types to the extent that moderate magnitude effects already exist. After considering the effects of the Project in combination with these projects, the Project was not expected to increase effects to 10% of historical area for any of the priority habitat types (Table 5-5). For all of the affected priority habitat types, estimated Project effects in combination with past and current projects accounted for less than 6% of historical area, which was substantially lower than the 10% benchmark used to identify high magnitude effects.

In descending order, the priority habitat types that were most affected before mitigation were tamarack mixture on shallow peatland, tamarack mixture on mineral, tamarack mixture on thin peatland, black spruce mixedwood on mineral and tamarack dominant on mineral (Table 5-5).

FLCN expressed concern that the switching station is on or near a jack pine ridge, which is a rare vegetation type, and would prefer not to see a tower there (Keeyask Transmission Project Workshop. 2012). It was determined that the jack pine ridge is southeast of the final switching station location.

Table 5-5: Estimated Amounts of Priority Habitat Affected by the Project as a Percentage of Regional Study Area land area, and in Combination with Historical Effects

Priority Habitat Type	Rarity (R, U, D, S)*	Project Footprint	Project Footprint and Zone of Influence	In Combination With Historical Effects
Balsam poplar dominant on all ecosites	RD	-	-	5.0
Balsam poplar mixedwood on all ecosites	RDS	-	-	-
Black spruce dominant on mineral	U	0.0	0.1	5.0
Black spruce dominant on riparian peatland	RDS	0.0	0.0	5.0
Black spruce dominant on wet peatland	UD	0.1	0.1	5.1
Black spruce mixedwood on mineral	R	0.3	0.4	5.3
Black spruce mixedwood on shallow peatland	RD	-	-	5.0
Black spruce mixedwood on thin peatland	RDS	0.1	0.1	5.0
Black spruce mixture on mineral	RD	0.0	0.1	5.0
Black spruce mixture on shallow peatland	RD	0.2	0.2	5.2
Black spruce mixture on thin peatland	R	0.2	0.3	5.3
Black spruce mixture on wet peatland	R	0.0	0.1	5.0
Jack pine dominant on mineral	UDS	0.2	0.2	5.2
Jack pine dominant on shallow peatland	RS	-	-	5.0
Jack pine dominant on thin peatland	RDS	0.0	0.0	5.0
Jack pine mixedwood on mineral	RD	0.1	0.2	5.1
Jack pine mixedwood on shallow peatland	RS	-	-	5.0
Jack pine mixedwood on thin peatland	RDS	-	0.0	5.0
Jack pine mixture on shallow peatland	RDS	-	-	5.0
Jack pine mixture on thin peatland	R	0.1	0.1	5.0
Low vegetation on riparian peatland	U	0.0	0.0	5.0
Low vegetation on shallow peatland	U	0.1	0.1	5.1
Low vegetation on thin peatland	U	0.0	0.1	5.0
Low vegetation on wet peatland	U	0.1	0.2	5.1
Tall shrub on mineral	RD	-	-	5.0
Tall shrub on riparian peatland	R	0.0	0.0	5.0
Tall shrub on shallow peatland	RDS	0.0	0.1	5.0
Tall shrub on thin peatland	RDS	0.1	0.2	5.1
Tall shrub on wet peatland	R	0.1	0.2	5.1
Tamarack- black spruce mixture on riparian peatland	RD	-	0.0	5.0
Tamarack dominant on mineral	RDS	0.1	0.4	5.3
Tamarack dominant on riparian peatland	R	-	-	-
Tamarack dominant on shallow peatland	R	-	-	-

Table 5-5: Estimated Amounts of Priority Habitat Affected by the Project as a Percentage of Regional Study Area land area, and in Combination with Historical Effects

Priority Habitat Type	Rarity (R, U, D, S)*	Project Footprint	Project Footprint and Zone of Influence	In Combination With Historical Effects
Tamarack dominant on thin peatland	RDS	-	0.0	5.0
Tamarack dominant on wet peatland	R	0.0	0.1	5.1
Tamarack mixture on mineral	RDS	0.2	0.5	5.4
Tamarack mixture on shallow peatland	RD	0.5	0.8	5.7
Tamarack mixture on thin peatland	RDS	0.2	0.4	5.4
Tamarack mixture on wet peatland	RD	0.0	0.0	5.0
Trembling aspen dominant on all ecosites	RD	0.1	0.2	5.1
Trembling aspen mixedwood on all ecosites	RDS	0.2	0.3	5.2
White birch dominant on all ecosites	RD	-	-	5.0
White birch mixedwood on all ecosites	R	-	-	5.0
Emergent on upper beach	R	-	-	1.7
Emergent on lower beach	R	-	-	1.7
Emergent island in littoral	R	-	-	1.7

Notes: R = Rare, U = Uncommon, D = Diverse, S = Relatively high potential to support rare plant species.

Mitigation

Since ecosystem diversity effects from past and current projects and activities were already in the moderate magnitude range for all of the affected priority habitat types, all of these types will be avoided to the extent practicable during final routing of the transmission lines for the EnvPPs. Additionally, since this Project will not proceed without the Keeyask Generation Project, consideration was given to interactions with the Keeyask Generation Project as described in Section 5.4. Those priority habitat types identified by the Keeyask Generation Project Environmental Impact Statement as being of particular concern will be given special consideration for avoidance during the final transmission line routing.

The EnvPPs will include measures to minimize the risk that accidental fires and accidental spills will affect terrestrial habitat. The EnvPPs will also include measures to minimize the risk that invasive plants will affect terrestrial habitat. Control and eradication measures will be implemented in the event that invasive plants become a problem.

Residual Project Effects

After considering mitigation and the effects of other past and existing human projects and activities, Project construction was not expected to create additional effects on 14 priority habitat types and was expected to affect between 0.1% and 0.8% of the estimated area for the 32 remaining priority habitat types. After considering these remaining Project effects in combination with other past and current projects and activities, it was predicted that the residual effects of Project construction on ecosystem diversity would include affecting between 5.0% and 5.8% of estimated historical area for 32 priority habitat types, which was well within the range for moderate magnitude effects.

Using the criteria established to determine the significance of Project effects for regulatory purposes (Section 2.5.1.6), the likely residual effects of Project construction on ecosystem diversity were expected to be adverse, medium in geographic extent, long term in duration and, depending on the ecosystem diversity indicator either nil or moderate in magnitude. The moderate magnitude residual effects were expected to be irreversible, continuous in frequency, and low in ecological context.

5.2.2.2 Operation

Potential Project Effects

As described in Section 5.1.1.2, the decline in habitat affected during operation when compared to construction was expected to be very small in regional terms. Since the ecosystem diversity indicators were measured using habitat composition, Project effects on ecosystem diversity were not expected to substantially change from construction to operation.

Mitigation

Mitigation during operation, in addition to that already incorporated during construction, was not proposed.

Residual Project Effects

After considering mitigation and the effects of other past and existing human projects and activities, Project operation was not expected to create additional effects on 14 priority habitat types and was expected to affect between 0.1% and 0.8% of the estimated area for the 32 remaining priority habitat types. After considering these remaining Project effects in combination with other past and current projects and activities, it was predicted that the residual effects of Project operation on ecosystem diversity would include affecting between 5.0% and 5.8% of estimated historical area for 32 priority habitat types, which were moderate magnitude effects.

Using the criteria established to determine the significance of Project effects for regulatory purposes (Section 2.5.1.6), the likely residual effects of Project operation on ecosystem diversity were expected to be adverse, medium in geographic extent, long term in duration and, depending on the ecosystem diversity indicator either nil or moderate in magnitude. The moderate magnitude residual effects were expected to be irreversible, continuous in frequency, and low in ecological context.

5.2.3 Priority Plants

Direct Project effects on terrestrial plants will include loss and disturbance of plants and plant populations as well as loss, alteration and disturbance of their habitats in the Project Footprint and any Project activities that may ultimately occur outside of the Project Footprint, if any. These direct effects will lead to indirect effects on terrestrial plants, both within the Project Footprint and in some adjacent areas surrounding the physical footprint, through pathways such as edge effects and altered groundwater levels. That is, a Project impact creates indirect effects on plants, which are referred to as the terrestrial plants zone of influence. A particular indirect effect can be several stages removed from the direct Project effect. For example, clearing trees on permafrost soils often leads to higher soil temperatures within and adjacent to the cleared area. Many of the potential pathways for Project effects on plants are demonstrated in Figure 2-2.

The size and nature of an impact's zone of influence will be a function of how the impact interacts with the plant species of interest and local conditions. For example, vegetation clearing in dense, mature forest on permafrost soils will have a much larger zone of influence than vegetation clearing on a bedrock outcrop. The nature and spatial extent of indirect effects on plants and their habitat will range from not measurable to conversion to aquatic vegetation.

In general, Project effects on plants were expected to decline with distance from the Project Footprint and be confined to the terrestrial habitat zone of influence that is described in Section 1.3. The spatial extent of the Project zone of influence on terrestrial plants (*i.e.*, the terrestrial plants zone of influence) was expected to be the same as the terrestrial habitat zone of influence, which was generally less than 10 m adjacent to transmission line ROWs and less than 50 m around the stations. For the effects assessment, it was cautiously assumed that all plants within 50 m of the transmission line ROWs and within 150 m of the stations would be affected by the Project. That is, it was assumed that all terrestrial plants in the Terrestrial Plants Local Study Area (Map 2-5) would be affected.

Improved access is another potentially important pathway for indirect Project effects on terrestrial plants since this will bring more equipment, material and/or people into an area, which could lead to increased resource harvesting, invasive plant spreading and/or human-caused fires, among other things. The Generation Outlet Transmission ROW was not expected to substantially increase plant harvesting since it will largely follow roads. Access along the Construction Power Transmission ROW will be difficult in the summer due to its remoteness and the number of waterways and very wet wetlands that cross the route.

Due past projects, berry patches were lost through hydro development related infrastructure including converter stations, transmission lines, camps, borrow areas, and roads (FLCN. SV. 2012)

Past and current projects and activities, as well as natural dispersal processes, have introduced and will continue to introduce and spread invasive plants into the Terrestrial Plants Local Study Area. The Project was not expected to substantially increase the rate at which invasive plants are introduced and/or spread in the Terrestrial Plants Local Study Area. Project environmental protection plans can include measures that minimize the risk that equipment transported to the area will spread seeds in the area. Additionally, weed control on the rights-of-way is required for regulatory (i.e., *The Noxious Weed Act*), operational and safety reasons.

5.2.3.1 Construction

Potential Project Effects

Endangered and Threatened Plant Species

Project effects on endangered or threatened plant species during construction are not expected since none of these species are either known to occur or expected to occur within the terrestrial plants zone of influence (see Section 3.2.4.2).

Provincially Very Rare to Uncommon Plant Species

Project effects on provincially very rare plant species were not expected since none were found during extensive field studies in the Regional Study Area and, to the extent that these species were associated with regionally rare habitat types, Project effects on their anticipated habitats were expected to be nil or low, depending on the species (see Section 5.2.2).

Elegant hawk's-beard was the only species found during field studies with an uncertain rank of provincially very rare or rare. The likelihood that it occurred in the terrestrial plants zone of influence Terrestrial Plants Local Study Area was considered to be low because it was not found there during extensive field studies in the Local Study Area and its recorded local habitat was roadsides.

The three provincially rare to uncommon plant species recorded in the Terrestrial Plants Local Study Area during field studies were swamp lousewort, rock willow and shrubby willow.

Project effects on swamp lousewort were not expected. The only recorded location for this species in the Project Study Area was within the Terrestrial Plants Local Study Area outside of the Construction Power Transmission ROW in a horizontal fen. Since this fen extends into the ROW, it is possible that additional swamp lousewort locations occur in the Project Footprint at this location. ROW clearing was not expected to have overstorey removal or edge effects on swamp lousewort at this location because clearing is not required where the ROW crosses this fen since the vegetation is already low. Once pre-construction rare plant surveys are completed, access trails can be routed to avoid any potential effects on unobserved plants. Towers can be located outside of the area where the ROW crosses this fen. Indirect effects on hydrology were not expected since there is no vegetation clearing and construction occurs in the winter.

Project effects on rock willow were expected to be low. After correcting for differences in sampling intensity (Section 2.2.4), the estimated percentage of locations in the Regional Study Area falling within the Terrestrial Plants Local Study Area was approximately 0.8 % (Table 5-6). Rock willow was found at an additional 399 locations northeast of the Regional Study Area.

Project effects on shrubby willow were expected to be low. Approximately 0.8% of the estimated number of shrubby willow locations in the Regional Study Area were within the Terrestrial Plants Local Study Area (Table 5-6). Shrubby willow was found at an additional 745 locations northeast of the Regional Study Area. Shrubby willow was often recorded on veneer bogs on slopes, which was a common habitat type in the Regional Study Area.

Section 3.3.2.4 identified an additional 50 species ranked as being of provincial conservation concern that were not found but could potentially occur in the Terrestrial Plants Local Study Area. Of these, the 42 species ranked S1 to S2 were of highest concern. None of these species were found in the Terrestrial Plants Local Study Area despite extensive surveys in these areas. To the extent that the distributions of the provincially very rare to uncommon plant species were related to broad habitat type, Project-related effects on all of the native broad habitat types were expected to be nil to moderate in magnitude (Section 5.2.2).

Regionally Rare and Range Limit Plant Species

Seven regionally rare and/or range limit plant species were observed within the Terrestrial Plants Local Study Area. Of these, balsam poplar, goldthread, jack pine, northern Labrador-tea and hairy goldenrod were the species not already discussed in the previous section.

After correcting for differences in sampling intensity (Section 2.5.2.3), the estimated percentage of known locations in the Regional Study Area falling within the Terrestrial Plants Local Study Area was less than 1% for all five species except for goldthread (Table 5-6). The Project could affect approximately 3% of goldthread locations before considering mitigation.

An additional 28 regionally rare and 4 range limit species were not encountered but could potentially occur in the Terrestrial Plants Local Study Area. To the extent that the distributions of these species were related to the broad habitat types, the Project was predicted to affect less than 1% of their habitat.

Plant Species of Particular Interest to the KCNs

Seven of the eleven species identified as being of particular interest to the KCNs were recorded in the Terrestrial Plants Local Study Area. These species were white birch (16 locations), northern Labrador-tea (1 location), red currant (1 location), cloudberry (12 locations), red raspberry (3 locations), bog bilberry (14 locations) and rock cranberry (26 locations). Substantial Project effects on the species of particular interest to the KCNs were not expected. Most of these species were either generally widespread or widespread in their preferred habitat. After correcting for differences in sampling intensity, the percentage of locations within the Terrestrial Plants Local Study Area was less than 1% for all species. Additionally, to the extent that the distributions of these species was related to broad habitat type, the Project was predicted to affect less than 1% of their habitat (Table 5-6).

Mitigation

Because it is possible that existing locations of swamp lousewort and other provincially very rare to rare species were not found, mitigation for these species will include:

- In the segment of the Construction Power Transmission line ROW that is near the swamp lousewort location, access trails will be located to avoid swamp lousewort locations and towers will be sited outside of the area where the ROW crosses this fen;
- Pre-construction rare plant surveys will be conducted in portions of the Terrestrial Plants Local Study Area that were not previously surveyed and have the highest potential for supporting provincially very rare to rare species; and,
- In the unlikely event that a provincially very rare to rare species is discovered in the Project Footprint, the plants will be transplanted outside of the Terrestrial Plants Local Study Area.

Table 5-6: Number of Observations of Provincially Rare Plant Species in the Project Footprint and Other Study Areas

S-Rank	Species: Scientific Name*	Species: Common Name	Number of Locations Recorded During Field Studies**: Project Footprint	Construction Zone of Influence	Operation Zone of Influence	Regional Study Area	Areas to the Northeast	Estimated Percentage of Total Locations***
Provincially Rare								
S2	*Pedicularis macrodonta*	swamp lousewort	0	1	1	7	12	0.5
S3	*Salix arbusculoides*	shrubby willow	2	1	1	38	745	0.3
S3	*Salix vestita*	rock willow	1	1	1	26	399	0.3
Regionally rare								
S5	*Populus balsamifera*	balsam-poplar	3	0	0	62	947	0.2
Range Limit								
S5	*Coptis trifolia*	goldthread	1	0	0	2	3	3.0
S5	*Pinus banksiana*	jack pine	4	0	0	104	56	0.2
S4	*Rhododendron tomentosum*	northern Labrador-tea	1	0	0	7	221	0.5
S5	*Solidago hispida*	hairy goldenrod	1	2	2	30	36	0.5
KCN importance								
S5	*Betula papyrifera*	white birch	12	4	4	197	181	0.4
S5	*Ribes triste*	red currant	1	0	0	66	285	0.1
S5	*Rubus chamaemorus*	cloudberry	11	1	1	178	304	0.3
S5	*Rubus ideaus*	red raspberry	2	1	1	30	123	0.5
S5	*Vaccinium uliginosum*	Bog bilberry	11	3	3	309	986	0.2
S5	*Vaccinium vitis-idaea*	rock cranberry	20	6	6	392	844	0.3

* *Salix arbusculoides* and *Salix vestita* are also range limit species. *Rhododendron tomentosum* is also a KCN importance species.
** Number of locations is the total within the area only except for Regional Study Area which includes all of the nested areas within it.
*** Estimated percentage of Regional Study Area locations is after correcting for the much lower sampling density in the Regional Study Area compared with the Project Footprint and terrestrial plants zone of influence using the method described in Section 2.5.2.3.

Additional mitigation during construction to minimize the risk of introducing and spreading invasive plants will include:

- Equipment and machinery that was recently used more than 150 km from the Project area will be washed prior to transport to the Project area;
- Containment, eradication, and/or control programs will be implemented if monitoring identifies problems with invasive plants; and,
- Personnel working on the Project will be educated about the importance of cleaning their vehicles, equipment and footwear before travelling to the area.

Mitigation for habitat effects provided by the mitigation for priority habitats could benefit priority plants to the extent that a species is associated with these habitat types.

The EnvPPs will include measures to minimize the risk that accidental fires and accidental spills will affect priority plants.

The risks that there would be adverse Project effects on priority plants due to Project-related spreading of invasive plants, increased harvesting and fire regime changes should be low assuming that the EnvPP measures are effective.

Residual Project Effects

After considering mitigation and the effects of other past and existing human features, substantial residual Project effects on priority plants during construction were not expected. None of the species of highest conservation concern are either known or expected to occur in the Terrestrial Plants Local Study Area. For the remaining species, the Project was expected to affect low percentages of their known locations and/or available habitat.

Using the criteria established to determine the significance of Project effects for regulatory purposes (Section 2.5.1.6), the likely residual effects of Project construction on priority plants were expected to be adverse, medium in geographic extent, long-term in duration and, depending on the species, nil to moderate in magnitude.

5.2.3.2 Operation

Potential Project Effects

As described in Section 5.1.1.2, the decline in habitat area affected during operation when compared to construction was expected to be very small in regional terms. Consequently, Project effects on priority plants during operation were expected to remain similar to those described for Project construction. The potential for maintenance activities to affect priority plant locations or further spread invasive plants was not expected to change substantially when compared with the construction phase.

Herbicides may be used to control the growth of trees in the ROW. Since these herbicides are formulated to target broad-leafed plants, they may affect species of conservation concern.

Mitigation

Mitigation during operation to minimize the risk of introducing and spreading invasive plants will include:

- Equipment and machinery that was recently used more than 150 km from the Project area will be washed prior to transport to the Project area;
- Containment, eradication, and/or control programs will be implemented if monitoring identifies problems with invasive plants;
- Personnel working on the Project will be educated about the importance of cleaning their vehicles, equipment and footwear before travelling to the area; and,
- The locations of any provincially very rare or rare species in the transmission line rights-of-way will be clearly and permanently marked. Herbicides will not be applied within 100 m of these locations.

Residual Project Effects

After considering mitigation and the effects of other past and existing human features, substantial residual Project effects on priority plants during operation were not expected. None of the species of highest conservation concern were expected to occur in the Terrestrial Plants Local Study Area. For the remaining species, the Project was expected to affect low percentages of their known locations and/or available habitat.

Using the criteria established to determine the significance of Project effects for regulatory purposes (Section 2.5.1.6), the likely residual effects of Project operation on priority plants were expected to be adverse, medium in geographic extent, long-term in duration and, depending on the species, nil to moderate in magnitude.

5.3 RESIDUAL EFFECTS

This section summarizes the residual effects conclusions for the VECs used for the terrestrial habitat, ecosystems and plants assessment.

5.3.1 Fragmentation

Overall, the likely residual Project effects on regional fragmentation were expected to be adverse but regionally acceptable because the increase to total linear feature density was small, no very large core areas were lost and core area percentage was expected to remain over 80%, which was well within the small magnitude range. In part this occurred because the Project was located in a portion of the Regional Study Area where fragmentation already exists due to past and current human development.

Using the criteria established to determine the significance of Project effects for regulatory purposes, the likely residual effects of Project operation on fragmentation were expected to be adverse, medium in geographic extent, long-term in duration and small in magnitude.

5.3.2 Ecosystem Diversity

Overall, the likely Project residual effects on ecosystem diversity were expected to be adverse but regionally acceptable because no stand level habitat types were lost, the distribution of area amongst the stand level habitat types was not expected to change substantially and the cumulative area losses for all of the priority habitat types remained well below 10%.

Using the criteria established to determine the significance of Project effects for regulatory purposes, the likely residual effects of Project operation on ecosystem diversity were expected to be adverse, medium in geographic extent, long term in duration and, depending on the ecosystem diversity indicator either nil or moderate in magnitude. The moderate magnitude residual effects were expected to be irreversible, continuous in frequency, and low in ecological context.

5.3.3 Priority Plants

Overall, the likely Project residual effects on priority plants were expected to be adverse but regionally acceptable. Project effects on endangered or threatened plant species were not expected since none of these species were either known to occur or were expected to occur in areas affected by the Project. Effects on the species of particular interest to the KCNs were expected to be low because most of these species were widespread in appropriate habitats and the percentages of known locations and/or available habitat affected by the Project were low. While the Project would affect the locations and/or habitat for some of the remaining priority plant species, the magnitude of these effects was anticipated to range from small to moderate, depending on the species, based on the percentage of known locations affected and/or the cumulative percentage area losses for the native habitat types. Regarding ecological context for species with moderate magnitude effects, although population trend information for these species in the Regional Study Area was not available, there were no substantial ongoing adverse trends in the amounts of native habitat types (Section 2 of Keeyask HydroPower

Partnership 2012b). Additional pre-construction mitigation was included for the species of highest conservation concern to address the unlikely event that patches of these species exist but were not discovered to date due to the rarity of the species.

5.3.4 Summary

Table 5-7 summarizes the predicted residual effects and assessment conclusions for the VECs.

Table 5-7: Residual Environmental Effects summary – Terrestrial Habitat, Ecosystems and Plants

VEC	Project Component	Phase	Residual Effects	Assessment
Fragmentation	Construction Power, Generation Outlet and Unit Transmission Lines	Construction & Operation	Small increase to linear feature density.	Direction: Adverse Magnitude: Small Geographic Extent: Medium Duration: Long-term **Overall – Not Significant**
	All Project components	Construction & Operation	Very slight reduction to total percentage of Regional Study Area in core areas.	Direction: Adverse Magnitude: Small Geographic Extent: Medium Duration: Long-term **Overall – Not Significant**
Ecosystem Diversity	All Project components	Construction & Operation	Remove or alter priority habitat.	Direction: Adverse Magnitude: Nil or moderate depending on the priority habitat type Geographic Extent: Small to medium depending on the priority habitat type Duration: Long-term **Overall – Not Significant**
Priority Plants	All Project components	Construction & Operation	Remove or alter priority plants.	Direction: Adverse Magnitude: Nil or moderate depending on the priority plant species Geographic Extent: Medium Duration: Long-term **Overall – Not Significant**

Table 5-7: Residual Environmental Effects summary – Terrestrial Habitat, Ecosystems and Plants

VEC	Project Component	Phase	Residual Effects	Assessment
	All Project components	Construction & Operation	Remove or alter priority plant habitat.	Direction: Adverse Magnitude: Nil or moderate depending on the priority plant species Geographic Extent: Medium Duration: Long-term **Overall – Not Significant**

Notes: See Table 2-6 for definition of criteria used to assess residual Project effects.

5.4 INTERACTIONS WITH FUTURE PROJECTS

5.4.1 Introduction

For all of the VECs, adverse residual effects were evaluated for interactions with reasonably foreseeable future projects and human activities. The effects past and current projects and activities was described in the preceding sections as a component of the residual effects assessment for each VEC. The reasonably foreseeable future projects and activities considered for the cumulative effects assessment were Bipole III Transmission Project, Gillam Redevelopment, Conawapa Generation Project and the Keeyask Generation Project. The information provided below was largely based on the analysis presented in Sections 2 and 3 of the Keeyask Generation Project environmental impact statement terrestrial supporting volume (Sections 2 and 3 of Keeyask HydroPower Partnership 2012b).

5.4.2 Fragmentation

Effects from Gillam Redevelopment, Bipole III Transmission Project and the Keeyask Generation Project would overlap spatially and temporally with residual Project effects on fragmentation.

Based on the anticipated locations of the reasonably foreseeable overlapping future projects, total linear feature density could increase from 0.47 km/km^2 to approximately 0.48 km/km^2 in the Regional Study Area, and from 0.34 km/km^2 to approximately 0.36 km/km^2 in the portion of the Regional Study Area outside of the Thompson area, which is still in the lower half of the moderate magnitude effects range (between 0.40 km/km^2 and 0.60 km/km^2) for the entire Regional Study Area and within the small magnitude range for the Regional Study Area outside of the Thompson area. The Bipole III contribution to higher linear feature is somewhat offset by linear features removed by the Keeyask Generation Project project footprint.

The reasonably foreseeable future projects would increase core area effects. Based on their anticipated locations, total core area could decline to 83% or to 81% for core areas larger than 1,000 ha. Both of these percentages are still well within the range for small magnitude core area effects (*i.e.*, 66% to 100% of land area). These core area reductions could be partially offset by natural regeneration on portions of existing, disused cutlines would increase core area over time.

5.4.3 Ecosystem Diversity

Effects from Gillam Redevelopment, Bipole III and the Keeyask Generation Project would overlap spatially and temporally with residual Project effects on ecosystem diversity.

Based on the anticipated location of Gillam Redevelopment, this project could affect an approximately 50 ha of terrestrial habitat in addition to that already affected by the Project [*DN: Confirm area.*]. Based on its anticipated location, the Bipole III Transmission Project could affect approximately 3,700 of terrestrial habitat (effects analysis included the preferred route ROW plus a 50 m buffer of it). Since detailed habitat mapping was not available for the Bipole III footprint, the composition of the affected habitat was assumed to be similar to that of detailed habitat mapping area. On this basis, approximately 70% of the affected habitat is not priority habitat. Although the increased amounts of additional habitat affected would be relatively high for some of the priority habitat types using this assumption, the increases in the percentage of affected habitat area could remain below 10% of historical area for all priority habitat types, depending on the final location of the ROW.

A detailed assessment of the combined effects of all projects considered in this section on ecosystem diversity is provided in Section 2 of Keeyask HydroPower Partnership (2012b). Based on these predictions and the anticipated locations of the future projects, the residual effects of the Project in combination with the reasonably foreseeable future projects could remain at the low end of the moderate range for total habitat area affected and the common habitat types and within the small to moderate range for all of the priority habitat types.

5.4.4 Priority Plants

Effects from all of the future projects would overlap spatially and temporally with residual Project effects on priority plants. All of these future projects, except for the Conawapa Generation Project, are expected to remove individual plants and their habitat and alter plant populations. Transportation and increased activity along PR 280 for the Conawapa Generation Project could spread invasive plants and increase the risk of access-related effects.

A detailed assessment of the combined effects of all projects considered in this section on priority plants is provided in Section 2 of Keeyask HydroPower Partnership (2012b). Additional locations of swamp lousewort were not discovered in during Keeyask Generation Project field studies. Although a number of additional rock and shrubby willow locations would be affected by the Keeyask Generation Project, it has already been noted that these species are more regionally common than indicated by their provincial conservation concern ranking. Based on the Keeyask Generation Project predictions, the residual effects of the Project in combination with the Keeyask Generation Project were not expected to increase effects on priority plants to the high magnitude degree.

5.5 MONITORING

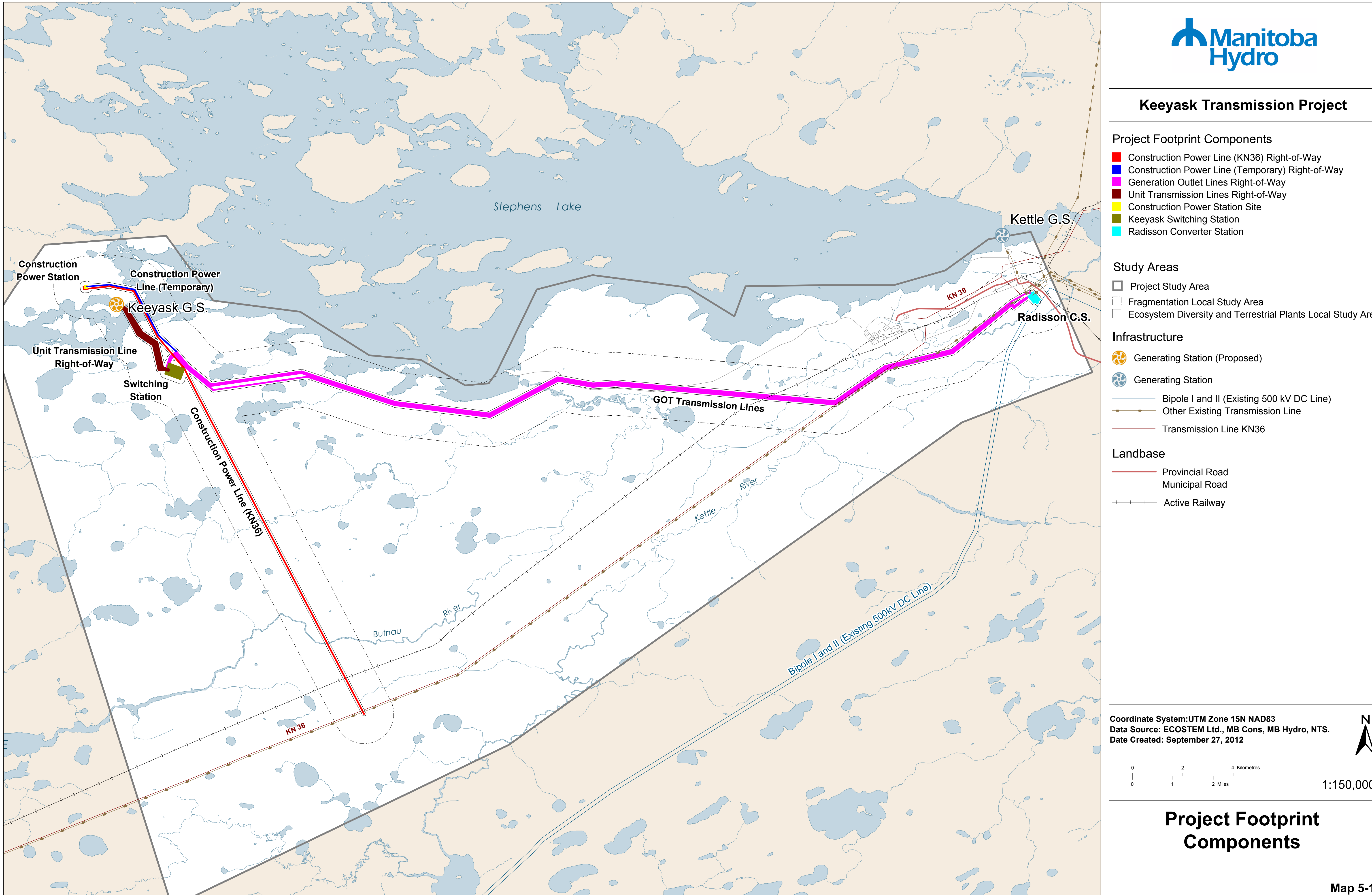
Monitoring to verify the short and long-term effects of the Project on terrestrial habitat, ecosystems and plants is outlined in Table 5-8. The monitoring focuses on the VECs. Monitoring is recommended for situations where a difference between predicted and actual residual effects could substantially alter the effects assessment or where a prediction can easily be verified using data collected for another purpose (*e.g.*, Project effects on fragmentation can be measured from data collected for ecosystem diversity monitoring).

Table 5-8: Monitoring for terrestrial Habitat, Ecosystems And Plants

Supporting Topic/ VEC	Issue/Rationale	Monitoring	Timelines
Terrestrial Habitat and Ecosystems			
Ecosystem Diversity (VEC)	• To verify the predicted amounts and composition of direct and indirect habitat loss, alteration and disturbance during construction and operation.	• Measure direct habitat loss and disturbance, by habitat type, in the Project Footprint. • Measure indirect habitat loss and change, by habitat type, in areas where indirect effects are predicted to occur.	Once at start of operation. Periodically thereafter as needed depending on the degree of indirect effects.
	• To verify that priority habitat patches marked for avoidance in the environmental protection plans are not disturbed.	• Monitor to confirm avoidance of priority habitat patches.	Regularly during clearing activities.
Fragmentation (VEC)	• To verify Project effects on linear feature density and core area abundance.	• Measure Project linear features and the Project Footprint relative to core areas.	Once at start of operation.

Table 5-8: Monitoring for terrestrial Habitat, Ecosystems And Plants

Supporting Topic/ VEC	Issue/Rationale	Monitoring	Timelines
TERRESTRIAL PLANTS			
Priority plants (VEC)	• To verify that recommendations from pre-construction rare plant surveys are implemented.	• Monitor to confirm avoidance of priority plant patches.	Regularly during clearing activities.
Invasive plants (Supporting Topic)	• To verify that the environmental protection plan measures limit the further introduction and spreading of invasive non-native plants.	• Conduct invasive plant surveys within and near to the Project Footprint.	Once during construction and periodically thereafter depending on the extent and nature of invasive plant spread.



File Location: Z:\Workspaces\Keeyask Transmission\Figures\Map 5-1 Project Footprint Components V5.wor

6.0 CONCLUSIONS

Alternative routes for the Construction Power and Generation Outlet transmission lines were evaluated from the terrestrial habitat, ecosystems and plants perspectives as part of the overall site selection process for the Keeyask Transmission Project. The evaluations were focused using VECs that represented each of these ecosystem components.

There were no major concerns with any of the alternative routes. The slightly preferred route for the Construction Power Transmission line was Alternative 1 because it created less fragmentation and had lower predicted effects on ecosystem diversity. Alternative C was the preferred route for the Generation Outlet Transmission line because it was expected to minimize effects on fragmentation, ecosystem diversity and priority plants, largely because more of this alternative route was near existing human features. Alternatives A and D created the highest fragmentation effects and Alternative D had the highest ecosystem diversity effects.

Construction Power Transmission Alternative 1 and a combination of segments from Generation Outlet Transmission Alternatives B and C (with one minor modification) were the routes selected by Manitoba Hydro based on the overall site selection process, which gave consideration to biological effects, socio-economic effects, community concerns, cost and engineering limitations. By combining segments from Alternatives B and C, the preferred Generation Outlet Transmission route had slightly lower effects on ecosystem diversity than Alternatives B or C.

Based on the selected locations for the transmission line ROWs and the station sites, the Project was not expected to substantially affect terrestrial habitat, ecosystems and plants. Predicted residual effects on the VECs, which included fragmentation, ecosystem diversity and priority plants, were expected to be adverse and long-term but regionally acceptable given the limited magnitude and geographic extent. This largely occurred because the degree of past and current development in the Regional Study Area was limited and because portions of the Project were located near existing or planned human infrastructure.

7.0 GLOSSARY

Alpha diversity: The diversity within a particular area or ecosystem, and is usually expressed by the number of species (*i.e.*, species richness) in that ecosystem.

Alternative route evaluation corridor: A 400 m corridor centered on an alternative transmission line route and used to evaluate the potential direct and indirect effects on terrestrial habitat, ecosystems and plants. The corridor is wider than the anticipated extent of effects to identify nearby potential issues of high concern and to provide some flexibility in routing should the alternative be selected.

Benchmark: A reference value or range that is used to identify increasing degrees of concern regarding a potential effect on a VEC.

Broad habitat type: The third coarsest level in the **hierarchical habitat classification** used for the terrestrial assessment. From coarsest to finest, the levels in the habitat classification system are land cover, coarse habitat type, broad habitat type and fine habitat type.

Cause-effect linkage: The relationship between an event (the cause) and a second event (the effect) or subsequent event (an indirect effect), where the second event or subsequent event is a consequence of the first.

Coarse habitat type: The second coarsest level in the hierarchical habitat classification used for the terrestrial assessment. From coarsest to finest, the levels in the habitat classification system are land cover, coarse habitat type, broad habitat type and fine habitat type used for the terrestrial assessment.

Core area: A natural area that meets a minimum size criteria after applying an edge buffer on human features. Two minimum sizes (200 ha, 1,000 ha) after applying a 500 m buffer on human features were used in the fragmentation effects assessment.

Danger trees: Trees located outside a cleared transmission line right-of-way but which may pose a risk of contact or short circuit with the line or structures.

Deposit type: Mode of surface material deposition. Refers to the dominant form of development in the case of organic deposits developed in situ.

Disturbance regime: The frequency, size, intensity, severity, patchiness, seasonality and sub-type of a particular type of disturbance or continual fluctuation.

Ecological land classification: A process of delineating and classifying ecologically distinctive areas of the earth's surface based on surficial geology, landforms, soils, vegetation, climate, wildlife, water and human features. The dominance of any one or more of these factors varies with the given ecological land unit. This holistic approach to land classification can be applied incrementally on a scale-related basis from site-specific ecosystems to very broad ecosystems.

Ecosite type: A classification of site conditions that have important influences on ecosystem patterns and processes. Site attributes that were directly or indirectly used for terrestrial habitat classification included moisture regime, drainage regime, nutrient regime, surface organic layer thickness, organic **deposit type**, mineral soil conditions and permafrost conditions.

Ecosystem: A functional unit comprised of the living and the non-living things in a geographic area, as well as the relationships between all of these things (Aber and Melillo 1991). An ecosystem has patterns (e.g., a habitat mosaic), structures (e.g., food web, trophic structure), dynamics (e.g., cycling of energy, nutrients and matter) and performs functions (e.g., converts carbon dioxide into plant material, creates soil, provides wildlife habitat). Ecosystems occur at various levels (e.g., a log, a forest stand, a region, the biosphere), with boundaries being defined by substantial differences in the rates or frequencies of change in the key ecosystem drivers.

Ecosystem diversity: The number of different ecosystem types and the distribution of area amongst them, at various ecosystem levels.

Ecosystem function: The outcomes of ecosystem patterns and processes viewed in terms of ecosystem services or benefits. Examples include producing oxygen to breathe, habitat for animals, purifying water and storing carbon.

Ecozone: A classification system that defines different parts of the environment with similar land features (geology and geography), climate (precipitation, temperature, and latitude), and organisms.

Edge effect: The effect of an abrupt transition between two different adjoining ecological communities on the numbers and kinds of organisms in the transition between communities as well as the effects on organisms and environmental conditions adjacent to the abrupt transition.

Effect: Any change that the Project may cause in the environment. More specifically, a direct or indirect consequence of a particular Project impact [ref]. The impact-effect terminology is a statement of a cause-effect relationship (see **Cause-effect linkage**). A terrestrial habitat example would be 10 ha of vegetation clearing (*i.e.*, the impact) leads to habitat loss, permafrost melting, soil conversion, edge effects*, etc*. (*i.e.*, the direct and indirect effects).

Fine habitat type: The most detailed level in the hierarchical habitat classification used for the terrestrial assessment. From coarsest to finest, the levels in the habitat classification system are land cover, coarse habitat type, broad habitat type and fine habitat type.

Fire regime: The frequency, size, intensity, severity, patchiness, seasonality and type (*e.g.*, ground versus canopy) of fires in the Regional Study Area.

Fragmentation: Refers to the extent to which an area is broken up into smaller areas by human features and how easy it is for animals, plant propagules and other ecological flows such as surface water to move from one area to another. Fragmentation can isolate habitat and create edges, which reduces habitat for interior species and may reduce habitat effectiveness for other species. *OR* The breaking up of contiguous blocks of habitat into increasingly smaller blocks as a result of direct loss and/or sensory disturbance (*i.e.*, habitat alienation). Eventually, remaining blocks may be too small to provide usable or effective habitat for a species.

Generalist: A species that is able to thrive in a wide variety of environmental conditions and can make use of a variety of different resources.

Glaciofluvial: Pertaining to streams fed by melting glaciers, or to the deposits and landforms produced by such streams.

Glaciolacustrine: Pertaining to lakes fed by melting glaciers, or to the deposits forming therein

Habitat: The place where an organism or a population lives. Because all natural areas are habitat for something, the term "habitat" is used to refer to terrestrial habitat for all species. Habitat for a particular species is identified with a species prefix, such as moose habitat.

Habitat alteration: Regarding terrestrial habitat, occurs when changes in one or more habitat attributes are large enough to convert a habitat patch to a different fine habitat type.

Habitat disturbance: Regarding terrestrial habitat, changes to a habitat patch that are not so large that they convert the patch to a different fine habitat type.

Habitat effect: Regarding terrestrial habitat, any change in a habitat attribute that results from the Project.

Habitat loss: Conversion of terrestrial habitat into human features or aquatic areas.

Habitat type: A classification of terrestrial habitats into ecologically meaningful categories. The habitat classes used in this report are combinations of vegetation type and ecosite type.

Habitat zone of influence: Spatial extent of direct and indirect Project effects on terrestrial habitat outside of the Project Footprint.

Hierarchical habitat classification: A habitat classification in which the categories at each level are subdivisions of the categories at the next more general level.

Impact: Essentially, a statement of what the Project is in terms of the ecosystem component of interest while a project effect is a direct or indirect consequence of that impact (i.e., a statement of the cause-effect relationship). A terrestrial habitat example would be 10 ha of vegetation clearing (i.e., the impact) leads to habitat loss, permafrost melting, soil conversion, edge effects, etc. (i.e., the direct and indirect effects). Note that while Canadian Environmental Assessment Act requires the proponent to assess project effects, Manitoba legislation uses the terms impact and effect interchangeably. See also Effect.

Invasive plant: A plant species that is growing outside of its country or region of origin and is out-competing or even replacing native organisms.

Land cover type: The most general level in the hierarchical habitat classification used for the terrestrial assessment. From coarsest to finest, the levels in the habitat classification system are land cover, coarse habitat type, broad habitat type and fine habitat type.

Landscape level: The level in the mappable ecosystem hierarchy that is between the stand and the sub-region.

Local study area: The spatial area within which potential Project effects on individual organisms, or individual elements in the case of ecosystem attributes, may occur. Effects on the populations to which the individual organisms belong to, or the broader entity in the case of ecosystem attributes, were assessed using a larger regional study area; the spatial area in which local effects are assessed (i.e., within close proximity to the action where direct effects are anticipated.

Mitigation: A means of reducing adverse Project effects. Under the *Canadian Environmental Assessment Act*, and in relation to a project, mitigation is "the elimination, reduction or control of the adverse environmental effects of the project, and includes restitution for any damage to the environment caused by such effects through replacement, restoration, compensation or any other means."

Model: A description or analogy used to help visualize something that cannot be directly observed. Model types range from a simple set of linkage statements or a conceptual diagram to complex mathematical and/or computer model.

Moraine: An accumulation of boulders, stones, or other debris carried and deposited by the toe of a glacier.

Peatland: A type of wetland where organic material has accumulated at the surface.

Priority habitat type: A native broad habitat type that is regionally rare or uncommon, highly diverse (*i.e.*, species rich and/or structurally complex), highly sensitive to disturbance, highly valued by people and/or has high potential to support rare plant species.

Priority plants: Native plant species that is rare, plays a highly disproportionate role in ecosystem function, is highly sensitive to Project features, or is highly valued by people.

Project footprint: The maximum potential spatial extent of clearing, flooding and physical disturbances due to construction activities and operation of the Project, including areas unlikely to be used.

Rare habitat type: A broad habitat type that covers less than 1% of land area in the regional study area. See also **uncommon habitat type**.

Regime: The frequency, size, intensity, severity, patchiness, seasonality and sub-type of a periodic event or continual fluctuation.

Regional study area: The regional comparison area used for a particular key topic. Alternatively, the spatial area within which cumulative effects are assessed (*i.e.* extending a distance from the project footprint in which both direct and indirect effects are anticipated to occur).

Residual effect: An actual or anticipated Project effect that remains after considering mitigation and the combined effects of other past and existing developments and activities.

Shallow peatland: A broad ecosite type which includes peatlands that typically have peat that is at least 100 cm thick, lack continuous or extensive discontinuous ground ice and have a water table that is typically more than 20 cm below the surface.

Site type: A plot or smaller area classification of site conditions that have important influences on ecosystem patterns and processes. Site attributes that were directly or indirectly used for habitat classification included moisture regime, drainage regime, nutrient regime, surface organic layer thickness, organic deposit type, mineral soil conditions and permafrost conditions.

Threshold: A limit or level which if exceeded likely results in a noticeable, detectable or measurable change or environmental effect that may be significant. Example thresholds include water-quality guidelines, acute toxicity levels, critical population levels and wilderness criteria. See also benchmark.

Uncommon habitat type: A broad habitat type that covers between 1% and 10% of land area in the regional study area. See also rare habitat type.

Upland: A land ecosystem where water saturation at or near the soil surface is not sufficiently prolonged to promote the development of wetland soils and vegetation.

Valued environmental component: Any part of the environment that is considered important by the proponent, public, scientists and government involved in the assessment process. Importance may be determined on the basis of cultural values or scientific concern.

Vascular plant: Any plant which has specialized tissues for transporting sugar, water and minerals within the plant.

Wetland: A land ecosystem where periodic or prolonged water saturation at or near the soil surface is the dominant driving factor shaping soil attributes and vegetation composition and distribution. **Peatland**s are a type of wetland.

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APPENDICES

Appendix A – Land cover, Coarse Habitat and Broad Habitat Types Used to Map terrestrial Habitat

Land Cover Type	Coarse Habitat Type	Broad Habitat Type
Broadleaf treed on all ecosites	Broadleaf treed on all ecosites	Balsam poplar dominant on all ecosites
		Trembling aspen dominant on all ecosites
		White birch dominant on all ecosites
	Broadleaf mixedwood on all ecosites	Balsam poplar mixedwood on all ecosites
		Trembling aspen mixedwood on all ecosites
		White birch mixedwood on all ecosites
Needleleaf treed on mineral or thin peatland	Black spruce mixedwood on mineral or thin peatland	Black spruce mixedwood on mineral
		Black spruce mixedwood on thin peatland
	Jack pine mixedwood on mineral or thin peatland	Jack pine mixedwood on mineral
		Jack pine mixedwood on thin peatland
	Jack pine treed on mineral or thin peatland	Jack pine dominant on mineral
		Jack pine dominant on thin peatland
		Jack pine mixture on thin peatland
		Tamarack dominant on mineral
		Tamarack mixture on mineral
	Black spruce treed on mineral soil	Black spruce dominant on mineral
		Black spruce mixture on mineral
	Black spruce treed on thin peatland	Black spruce dominant on thin peatland
		Black spruce mixture on thin peatland
		Tamarack dominant on thin peatland
		Tamarack mixture on thin peatland
Tall shrub on mineral or thin peatland	Tall shrub on mineral or thin peatland	Tall shrub on mineral
		Tall shrub on thin peatland
Low vegetation on mineral or thin peatland	Low vegetation on mineral or thin peatland	Low vegetation on mineral
		Low Vegetation on thin peatland
Needleleaf treed on other peatlands	Jack pine treed on shallow peatland	Jack pine dominant on shallow peatland
		Jack pine mixture on ground ice peatland
		Jack pine mixture on shallow peatland

Land Cover Type	Coarse Habitat Type	Broad Habitat Type
	Black spruce mixedwood on shallow peatland	Black spruce mixedwood on shallow peatland
		Jack pine mixedwood on shallow peatland
	Black spruce treed on shallow peatland	Black spruce dominant on ground ice peatland
		Black spruce dominant on shallow peatland
		Black spruce mixture on ground ice peatland
		Black spruce mixture on shallow peatland
	Black spruce treed on wet peatland	Black spruce dominant on wet peatland
	Tamarack- black spruce mixture on wet peatland	Black spruce mixture on wet peatland
		Tamarack mixture on wet peatland
	Tamarack treed on shallow peatland	Tamarack dominant on ground ice peatland
		Tamarack dominant on shallow peatland
		Tamarack mixture on ground ice peatland
		Tamarack mixture on shallow peatland
	Tamarack treed on wet peatland	Tamarack dominant on wet peatland
	Black spruce treed on riparian peatland	Black spruce dominant on riparian peatland
	Tamarack- black spruce mixture on riparian peatland	Tamarack- black spruce mixture on riparian peatland
	Tamarack treed on riparian peatland	Tamarack dominant on riparian peatland
Tall shrub on other peatlands	Tall shrub on shallow peatland	Tall shrub on ground ice peatland
		Tall shrub on shallow peatland
	Tall shrub on wet peatland	Tall shrub on wet peatland
Low vegetation on other peatlands	Low vegetation on shallow peatland	Low vegetation on ground ice peatland
		Low vegetation on shallow peatland
	Low vegetation on wet peatland	Low vegetation on wet peatland
Shrub/ low vegetation on riparian peatland	Tall shrub on riparian peatland	Tall shrub on riparian peatland
	Low vegetation on riparian peatland	Low vegetation on riparian peatland
Nelson River shore zone	Nelson River shrub and/or low vegetation on ice scoured upland	Shrub/Low veg mixture on ice scoured upland
	Nelson River shrub and/or low vegetation on upper beach	Tall Shrub on upper beach- regulated
		Low vegetation on upper beach- regulated
		Shrub/Low Veg Mixture on Upper beach-

Land Cover Type	Coarse Habitat Type	Broad Habitat Type
		regulated
	Nelson River shrub and/or low vegetation on sunken peat	Shrub/Low Veg Mixture on Sunken Peat-regulated
		Low vegetation on sunken peat- regulated
	Nelson River marsh	Emergent on lower beach- regulated
		Emergent on sunken peat- regulated
Off-system shore zone	Off-system marsh	Emergent on upper beach
		Emergent on lower beach
		Emergent island in littoral
Human infrastructure	Human infrastructure	Human infrastructure

Appendix B – Priority Plant Species and Their Reason For Inclusion

Scientific Name	Common Name	MBCDC S-Rank**	Reasons for Inclusion*					Number in Local Study Area***	Number in Regional Study Area	Habitats	Habitat from Literature****
			Endangered or Threatened	Provincially Very Rare to Uncommon	Regionally Rare	Range Limit	KCN importance				
Acorus americanus	sweet flag	S5					1	0	0	S, A	swamps, marshes and quiet streams
Anemone parviflora	Northern anemone	S4			1			0	2	F, S	open woods and river flats
Antennaria pulcherrima	showy pussytoes	S4			1			0	1	U, S	moist river flats and meadows
Anthoxanthum alpina	holy grass	S2		1				0	0		
Anthoxanthum alpina spp. alpina	holy grass	S2		1				0	0		
Aquilegia brevistyla	blue columbine	S4			1			0	3	U, F	open woods, meadows and rocky slopes
Artemisia tilesii	Herriot's sage	S2		1				0	0		
Artemisia tilesii spp. elatior	Herriot's sage	S2		1				0	0		
Astragalus americanus	American milk-vetch	S3		1				0	9		
Astragalus bodinii	milkvetch	S1		1				0	0		
Betula papyrifera/neoalaskana	white birch/Alaskan birch	S5					1	16	197	S, W	marshes, ditches, shallow water and shores
Botrychium minganense	mingan moonwort	S1S2		1				0	0		
Braya humilis	low braya	S2		1				0	0		

Scientific Name	Common Name	MBCDC S-Rank**	Reasons for Inclusion*					Number in Local Study Area***	Number in Regional Study Area	Habitats	Habitat from Literature****
			Endangered or Threatened	Provincially Very Rare to Uncommon	Regionally Rare	Range Limit	KCN importance				
Calamagrostis lapponica	reed grass	S2?		1				0	0		
Calamagrostis purpurascens	purple reed grass	S2		1				0	0		
Calypso bulbosa	Venus'-slipper	S4			1			0	3	F	coniferous forest
Carex arcta	narrow sedge	S1		1				0	0		
Carex buxbaumii	brown sedge	S4S5			1			0	5	W, S	swamps, bogs, meadows and river banks
Carex cryptolepis	northeastern sedge	S1		1				0	0		
Carex garberi	elk sedge	S1?		1				0	0		
Carex heleonastes	Hudson Bay sedge	S2		1				0	0		
Carex heleonastes spp. heleonastes	Hudson Bay sedge	S2		1				0	0		
Carex loliacea	rye-grass sedge	S2		1				0	0		
Carex maritima	curved sedge	S2		1				0	0		
Carex michauxiana	long-fruited sedge	S2		1				0	0		
Carex microglochin	short-awned sedge	S2		1				0	0		
Carex pauciflora	fewflower sedge	S3		1				0	0		
Carex sychnocephala	long-beaked sedge	S4?			1			0	4		
Cicuta virosa	Mackenzie's water-hemlock	S4			1			0	1	S, W	lakeshores, wetlands and shallow water
Coptis trifolia	goldthread	S5				1		1	2	U, F	damp woods

Scientific Name	Common Name	MBCDC S-Rank**	Reasons for Inclusion*: Endangered or Threatened	Reasons for Inclusion*: Provincially Very Rare to Uncommon	Reasons for Inclusion*: Regionally Rare	Reasons for Inclusion*: Range Limit	Reasons for Inclusion*: KCN importance	Number in Local Study Area***	Number in Regional Study Area	Habitats	Habitat from Literature****
Crepis elegans	elegant hawk's-beard	S1S2		1		1		0	9	S, D	sandy floodplains, gravel flats and shore zones
Descurainia sophioides	northern flixweed	S2		1				0	0		
Drosera anglica	oblong-leaved sundew	S3		1	1			0	10	W, S	poor fens, bogs and shore zones
Elaeagnus commutata	wolf-willow	S4				1		0	10	S, U	streambanks, lakeshores, floodplains
Eleocharis quinqueflora	few-flowered spike-rush	S4			1			0	1	W	wetlands
Epilobium davuricum	willowherb	S2S3		1				0	0		
Equisetum palustre	marsh horsetail	S4S5			1			0	1	S, W	lakeshores, meadows, fens and marshes
Equisetum pratense	meadow horsetail	S4S5			1			0	3	U, F	moist open woodlands
Erigeron elatus	tall fleabane	S4			1			0	1	U, F, S	woodlands, clearings and lakeshores
Erigeron hyssopifolius	wild daisy	S4			1			0	2	U, W, F	clearings, bogs and open woods
Eriophorum callitrix	beautiful cotton-grass	S2		1				0	0		
Eriophorum scheuchzeri	one-spike cotton-grass	S2?		1				0	0		
Eriophorum viridicarinatum	thin-leaved cotton-grass	S4			1			0	1	W	fens

Scientific Name	Common Name	MBCDC S-Rank**	Reasons for Inclusion*					Number in Local Study Area***	Number in Regional Study Area	Habitats	Habitat from Literature****
			Endangered or Threatened	Provincially Very Rare to Uncommon	Regionally Rare	Range Limit	KCN importance				
Euphrasia arctica	northern eyebright	S4S5			1			0	1	U, D	open, disturbed areas
Festuca richardsonii	Richardson's fescue	S1		1				0	0		
Fragaria vesca	woodland strawberry	S4S5			1			0	1	U, S	open woods, streambanks
Fragaria virginiana	smooth wild strawberry	S5					1	0	34	U, F	rock outcrops, clearings and open woodlands
Glaux maritima	sea-milkwort	S4S5			1			0	2	S, W	salt flats and saline wetlands
Glyceria pulchella	graceful manna grass	S2		1				0	0		
Gymnocarpium robertianum	limestone oak fern	S1		1				0	0		
Huperzia selago	mountain club-moss	S2S3		1				0	0		
Juncus stygius spp. americanus	moor rush	S1?		1				0	0		
Leymus mollis	sea lyme-grass	S2?		1				0	0		
Limosella aquatica	mudwort	S4S5			1			0	5	S, A	shores, mud flats and shallow water
Luzula wahlenbergii	Wahlenberg's woodrush	S2?		1				0	0		
Lycopodium sitchense	ground-fir	S1		1				0	0		
Moehringia macrophylla	large-leaved sandwort	S1S2		1				0	0		
Muhlenbergia glomerata	bog muhly	S4			1			0	1	W, U, S	fens, meadows and shores

Scientific Name	Common Name	MBCDC S-Rank**	Reasons for Inclusion*					Number in Local Study Area***	Number in Regional Study Area	Habitats	Habitat from Literature****
			Endangered or Threatened	Provincially Very Rare to Uncommon	Regionally Rare	Range Limit	KCN importance				
Myriophyllum alterniflorum	water-milfoil	S2?		1				0	0		
Najas flexilis	slender naiad	S4			1			0	2	A	lakes, ponds and rivers
Nuphar variegata	small yellow pond-lily	S5				1		0	67	A	ponds, lakes and quiet streams
Nymphaea tetragona	small water-lily	S2		1				0	0		
Parnassia kotzebuei	small grass-of-parnassus	S4			1			0	1	S, U	shores and wet meadows
Parnassia palustris var. *parviflora*	small grass-of-parnassus	S1		1				0	0		
Pedicularis lapponica	Lapland lousewort	S2S3		1				0	0		
Pedicularis macrodonta	muskeg lousewort	S2		1				1	7		
Pellaea glabella	purple cliff-brake	S2		1				0	0		
Pellaea glabella spp. *occidentalis*	purple cliff-brake	S2		1				0	0		
Pinus banksiana	jack pine	S5				1		4	104	U, F	rock outcrops, sandy substrates and poor quality sites
Platanthera hookeri	Hooker's orchid	S2		1				0	0		
Platanthera orbiculata	round-leaved bog-orchid	S3		1				0	0		
Populus balsamifera	Balsam-poplar	S5			1			3	62	U, F, S	moist depressions and shores

Scientific Name	Common Name	MBCDC S-Rank**	Reasons for Inclusion*					Number in Local Study Area***	Number in Regional Study Area	Habitats	Habitat from Literature****
			Endangered or Threatened	Provincially Very Rare to Uncommon	Regionally Rare	Range Limit	KCN importance				
Potamogeton amplifolius	large-leaved pondweed	S2?		1				0	0		
Potamogeton pusillus spp. *tenuissimus*	small pondweed	S2		1				0	27	A	shallow lakes, ponds and streams
Potamogeton robbinsii	Robbin's pondweed	S2		1				0	20	A	lakes, ponds and rivers
Potamogeton strictifolius	narrowleaf pondweed	S3		1				0	0		
Potentilla pensylvanica var. *litoralis*	prairie cinquefoil	S2S3		1				0	0		
Pyrola grandiflora	Arctic wintergreen	S4				1		0	3	U, F	open woodlands
Rhododendron tomentosum	northern labrador tea	S4				1	1	1	7	U, W, F	muskeg, bogs, wet woodlands and rocky areas
Ribes lacustre	bristly black currant	S4			1		1	0	3	U, W, F	clearings, swamps and woodlands
Ribes triste	red currant	S5					1	1	66	U, W, F	clearings, swamps and woodlands
Rubus chamaemorus	cloudberry	S5					1	12	178	W	bogs
Rubus idaeus	red raspberry	S5					1	3	30	U, F	clearings and open woods
Rubus pubescens	dewberry	S5					1	0	55	F, U	open woods and clearings
Sagina caespitosa	tufted pearlwort	S2		1				0	0		
Sagina nodosa	knotted pearlwort	S4			1			0	1	U, D	bare ground

Scientific Name	Common Name	MBCDC S-Rank**	Reasons for Inclusion*					Number in Local Study Area***	Number in Regional Study Area	Habitats	Habitat from Literature****
			Endangered or Threatened	Provincially Very Rare to Uncommon	Regionally Rare	Range Limit	KCN importance				
Salix arbusculoides	shrubby willow	S3		1		1		3	38	U, W, S, F	swamps, muskeg, shore zone and woodlands
Salix serissima	autumn willow	S4			1			0	4	S, W	bogs, marshes and shore zones
Salix vestita	rock willow	S3		1		1		2	28	U, F, S	ridges, shaded shore zones and woodlands
Selaginella selaginoides	northern spike-moss	S2		1				0	0		
Solidago hispida	hairy goldenrod	S5				1		3	30	U, F	rocky substrates and open woodland
Thalictrum sparsiflorum	few-flowered meadow-rue	S2S3		1				0	0		
Tofieldia pusilla	Scotch false asphodel	S4			1			0	1	W, F	bogs and forests
Trichophorum caespitosum	tufted bulrush	S4			1			0	4	W	bogs and marshes
Vaccinium caespitosum	dwarf bilberry	S2		1				0	0		
Vaccinium uliginosum	bog bilberry	S5					1	14	309	U, F	open woods
Vaccinium vitis-idaea	rock cranberry	S5					1	26	392	W, F, U	bogs, forests and bare ground
Viola palustris	marsh violet	S4S5			1			0	3	W, S, F	swamps, fens and streambanks
Woodsia alpina	northern woodsia	S1		1				0	0		
Woodsia glabella	smooth woodsia	S2		1				0	0		

Scientific Name	Common Name	MBCDC S-Rank**	Reasons for Inclusion*					Number in Local Study Area***	Number in Regional Study Area	Habitats	Habitat from Literature****
			Endangered or Threatened	Provincially Very Rare to Uncommon	Regionally Rare	Range Limit	KCN importance				
Zannichellia palustris	horned pondweed	S3?		1	1			0	3	A	saline ponds or streams

* Reasons for inclusion: An "X" in a column indicates that the species met this criterion. Endangered (bolded letters)/threatened species are listed according to which list they appear on (SARA (S), COSEWIC (C) or MESA (M)). Habitats include upland (U), wetland (W), shore zone (S), physically disturbed (D), forest (F) or aquatic (A) and are listed from most to least common).

**MBCDC S-Ranks: The term "species of conservation concern" includes species that are rare, disjunct, or at risk throughout their range or in Manitoba and in need of further research. The term also encompasses species that are listed under the Manitoba Endangered Species Act (MESA), or that have a special designation by the Committee On the Status of Endangered Wildlife In Canada (COSEWIC) (MBCDC website 2010). S1 - Very rare throughout its range or in the Province (5 or fewer occurrences, or very few remaining individuals). May be especially vulnerable to extirpation; S2 - Rare throughout its range or in the Province (6 to 20 occurrences). May be vulnerable to extirpation. S3 - Uncommon throughout its range or in the Province (21 to 100 occurrences). S4 - Widespread, abundant, and apparently secure throughout its range or in the Province, with many occurrences, but the element is of long-term concern (> 100 occurrences). S5 - Demonstrably widespread, abundant, and secure throughout its range or in the Province, and essentially impossible to eradicate under present conditions.

***Number of sample locations the species was found at. Species with zero values for the Regional Study Area were identified as having the potential to occur there.

****Sources: Soper and heimburger 1982, FNA 1993+, Johnson *et al*. 1995, Lahring 2003

Appendix C – Plant Species Lists

Vascular Plants

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regional Study Area	Comment
Achillea millefolium L. var. *borealis* (Bong.) Farw.	Common yarrow	S5	2	26	
Actaea rubra (Ait.) Willd.	Baneberry	S5	1	5	
Agrostis scabra Willd.	Rough hair-grass	S5	0	55	
Agrostis stolonifera L.	Redtop	SNA	0	1	
Alnus incana (L.) Moench. ssp. *rugosa*	Speckled alder	S5	7	203	
Alnus viridis (Vill.) de Candolle ssp. *crispa*	Green or mountain alder	S5	12	208	
Alopecurus aequalis Sobol.	Short-awned foxtail	S5	0	8	
Amerorchis rotundifolia (Banks *ex* Pursh) Hulten	Small round-leaved orchis	S5	0	5	
Andromeda polifolia L.	Bog Rosemary	S5	2	62	
Anemone canadensis L.	Canada anemone	S5	0	8	
Anemone multifida Poir.	Cut-leaved anemone	S5	0	6	
Anemone parviflora Michx.	Northern anemone	S4	0	2	Near range limit
Antennaria pulcherrima (Hook.) Greene	Showy pussytoes	S4	0	1	
Aquilegia brevistyla Hook.	Blue columbine	S4	0	3	
Aralia nudicaulis L.	Wild sarsaparilla	S5	0	3	Near range limit
Arctostaphylos uva-ursi (L.) Spreng.	Common bearberry	S5	3	49	
Arctuous alpina (L.) Niedenzu	Alpine Bearberry	S5	5	69	
Argentina anserina (L.) Rydb.	Silverweed	S5	0	66	
Artemisia biennis Willd.	Biennial wormwood	S5	0	4	
Astragalus americanus (Hook.) M. E. Jones	American milk-vetch	S3	0	11	
Beckmannia syzigachne (Steud.) Fern	Slough grass	S5	0	14	
Betula neoalaskana Sarg.	Alaskan birch	S5	0	1	Included with *Betula papyrifera*, not differentiated in field due to difficulty in doing so
Betula papyrifera Marsh.	White birch	S5	16	197	

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regional Study Area	Comment
Betula pumila L.	Swamp Birch	S5	14	236	
Bidens cernua L.	Smooth beggar-ticks	S5	0	17	
Bromus inermis Leyss.	Smooth brome grass	SNA	0	6	Introduced species
Calamagrostis canadensis (Michx.) Nutt.	Marsh reed-grass	S5	6	342	
Calamagrostis stricta (Timm) Koeler ssp. *stricta*	Narrow reed-grass	S5	0	45	
Calamagrostis stricta ssp. *inexpansa* (Gray) C. W. Greene	Northern reed-grass	S5	0	2	
Calla palustris L.	Wild calla	S5	2	25	
Callitriche hermaphroditica L.	Northern water-starwort	S5	0	2	
Callitriche palustris L.	Vernal water-starwort	S5	0	3	
Caltha palustris L.	Marsh-marigold	S5	2	18	
Calypso bulbosa (L.) Oakes	Venus'-slipper	S4	0	3	Near range limit
Campanula rotundifolia L.	Harebell	S5	0	2	
Cardamine pensylvanica Muhl. *ex* Willd.	Bitter-cress	S5	0	8	
Carex aquatilis Wahl.	Water sedge	S5	16	331	
Carex atherodes Spreng.	Awned sedge	S5	0	2	
Carex aurea Nutt.	Golden sedge	S5	0	1	
Carex bebbii Olney *ex* Fern.	Bebb's sedge	S5	0	4	
Carex brunnescens (Pers.) Poir.	Brownish sedge	S5	0	3	
Carex buxbaumii Wahlenb.	Brown sedge	S4S5	0	5	
Carex canescens L.	Hoary sedge	S5	0	37	
Carex capillaris L.	Hair-like sedge	S5	1	10	
Carex chordorrhiza Ehrh. *ex* L.	Prostrate sedge	S5	3	53	
Carex concinna R. Br.	Beautiful sedge	S4S5	6	42	
Carex deflexa Hornem.	Bent sedge	S5	0	2	
Carex diandra Schrank	Two-stamened sedge	S5	1	25	
Carex disperma Dewey	Two-seeded sedge	S5	1	13	
Carex foenea Willd.	Silvery-flowered sedge	S5	0	4	

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regiona l Study Area	Comment
Carex gynocrates Wormsk. *ex* Drej.	Northern bog sedge	S5	1	27	
Carex houghtoniana Torr.	Sand sedge	S5	0	1	
Carex lacustris Willd.	Lakeshore sedge	S5	0	2	
Carex lenticularis Michx.	Lens-fruited sedge	S5	0	3	
Carex leptalea Wahlenb.	Bristle-stalked sedge	S5	0	10	
Carex magellanica Lam.	Bog Sedge	S5	5	94	
Carex pellita Muhl. *ex* Willd.	Wooly sedge	S5	0	14	
Carex sartwellii Dewey	Sartwell's sedge	S4	0	6	
Carex scirpoidea Michx.	Rush-like sedge	S5	0	13	
Carex sychnocephala Carey	Long-beaked sedge	S4?	0	4	
Carex tenuiflora Wahlenb.	Thin-flowered sedge	S5	0	1	
Carex trisperma Dew.	Three-seeded sedge	S5	0	1	
Carex utriculata Boott	Bottle sedge	S5	0	101	
Carex vaginata Tausch	Sheathed sedge	S5	5	65	
Ceratophyllum demersum L.	Coontail	S5	0	3	
Chamaedaphne calyculata (L.) Moench	Leather-leaf	S5	9	268	
Chamerion angustifolium (L.) Holub	Fireweed	S5	11	223	
Chenopodium album L.	Lamb's-quarters	SNA	0	2	Introduced species
Chenopodium capitatum (L.) Ambrosi var. *capitatum*	Strawberry-blite	S5	0	2	
Chenopodium glaucum L. var. *salinum* (Standl.) Boivin	Oakleaf goosefoot	SNA	0	11	Introduced species
Cicuta bulbifera L.	Bulb-bearing water-hemlock	S5	0	33	
Cicuta maculata L.	Spotted cowbane	S5	0	7	
Cicuta virosa L.	Mackenzie's water-hemlock	S4	0	1	
Cirsium arvense (L.) Scop.	Canada thistle	SNA	0	1	Introduced species
Comarum palustre L.	Marsh-five-finger	S5	4	146	
Coptis trifolia (L.) Salisb.	Goldthread	S5	1	2	
Corallorhiza trifida Chat.	Early coral-root	S5	0	6	

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regiona l Study Area	Comment
Cornus canadensis L.	Bunchberry	S5	9	216	
Cornus sericea L.	Red osier dogwood	S5	0	46	
Corydalis sempervirens (L.) Pers.	Pink corydalis	S5	0	4	
Crepis elegans Hook.	Elegant hawk's-beard	S1S2	0	9	Near range limit
Crepis tectorum L.	Narrow-leaved hawk's-beard	SNA	0	6	Introduced species
Cypripedium parviflorum Salisb. var. *pubescesns* (Willd.) Knight	Yellow lady's-slipper	S5?	0	1	
Danthonia spicata (L.) Beauv. Ex Roemer & J. A. Schultes	Poverty oat-grass	S5	0	3	
Dasiphora fruticosa (L.) Rydb. ssp. *floribunda* (Pursh) Kartesz	Shrubby cinquefoil	S5	0	5	
Diphasiastrum complanatum (L.) Holub	Ground-cedar	S5	1	24	
Dracocephalum parviflorum Nutt.	American dragonhead	S5	0	1	
Drosera anglica Huds.	Oblong-leaved sundew	S3	0	10	
Drosera rotundifolia L.	Round-leaved sundew	S5	8	89	
Elaeagnus commutata Bernh. ex Rydb.	Wolf-willow	S4	0	10	
Eleocharis acicularis (L.) Roemer & J. A. Schultes	Needle spike-rush	S5	0	87	
Eleocharis palustris (L.) Roemer & J. A. Schultes	Creeping spike-rush	S5	0	79	
Eleocharis quinqueflora (F.X. Hartmann) Schwarz	Few-flowered spike-rush	S4	0	1	
Elodea canadensis Michx.	Canada waterweed	S5	0	2	
Elymus repens (L.) Gould	Quack grass	SNA	0	2	Introduced species
Elymus trachycaulus (Link) Gould *ex* Shinners ssp. *trachycaulus*	Slender wheat-grass	S5	0	12	
Empetrum nigrum L.	Black crowberry	S5	8	65	
Epilobium ciliatum Raf.	Northern willowherb	S5	0	8	
Epilobium ciliatum Raf. ssp. *glandulosum* (Lehm.) Dorn	Northern willowherb	S5	0	48	
Epilobium leptophyllum Raf.	Marsh willow-herb	S5	0	1	
Epilobium palustre L.	Marsh willow-herb	S5	0	30	

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regiona l Study Area	Comment
Equisetum arvense L.	Common or Field horsetail	S5	10	260	
Equisetum fluviatile L.	Water horsetail	S5	8	166	
Equisetum palustre L.	Marsh horsetail	S4S5	0	1	
Equisetum pratense Ehrh.	Meadow horsetail	S4S5	0	3	
Equisetum scirpoides Michx.	Dwarf scouring rush	S5	13	154	
Equisetum sylvaticum L.	Wood horsetail	S5	18	175	
Equisetum variegatum Schleich. *ex* F. Weber & D. M. H. Mohr	Variegated scouring-rush	S5	0	9	
Erigeron elatus (Hook.) Greene	Tall fleabane	S4	0	1	
Erigeron hyssopifolius Michx.	Wild daisy	S4	0	2	
Eriophorum angustifolium Honckeny	Tall cotton-grass	S5	0	1	
Eriophorum chamissonis C. A. Mey.	Russet cotton-grass	S5	0	2	
Eriophorum gracile W.D.J Koch	Slender cotton-grass	S5	0	2	
Eriophorum vaginatum L.	Sheathed cotton-grass	S5	1	14	
Eriophorum viridicarinatum (Engelm.) Fern	Thin-leaved cotton-grass	S4	0	1	
Euphrasia arctica Lange *ex* Rostrup	Northern eyebright	SU	0	1	
Festuca rubra L.	Red-fescue	S5	0	2	
Festuca saximontana Rydb.	Rocky mountain fescue	S5	0	2	
Fragaria vesca L.	Woodland strawberry	S4S5	0	1	
Fragaria virginiana Dcne.	Smooth wild strawberry	S5	0	44	
Galium boreale L.	Northern bedstraw	S5	0	3	
Galium labradoricum (Wieg.) Wieg.	Ladies' bedstraw	S5	0	22	
Galium palustre L.	Common marsh bedstraw	SU	0	1	
Galium trifidum L.	Small bedstraw	S5	1	96	
Galium triflorum Michx.	Sweet-scented bedstraw	S5	0	1	
Gentianella amarella (L.) Boerner	Northern gentian	S5	0	5	
Geocaulon lividum (Richards.) Fern.	Northern comandra	S5	6	111	
Geranium bicknellii Britt.	Bicknell's geranium	S5	0	1	

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regiona l Study Area	Comment
Glaux maritima L.	Sea-milkwort	S4S5	0	2	
Glyceria borealis (Nash) Batchelder	Small floating manna-grass	S5	0	26	
Glyceria grandis S. Wats.	Tall manna-grass	S5	0	3	
Glyceria striata (Lam.) A. S. Hitchc.	Fowl manna grass	S5	0	3	
Goodyera repens (L.) R. Br. *ex* Ait.	Lesser rattlesnake-plantain	S5	0	1	
Hippuris vulgaris L.	Mare's-tail	S5	0	24	
Hordeum jubatum L.	Wild barley	S5	0	28	Invasive species
Isoetes echinospora Durieu	Quillwort	S4?	0	7	
Juncus alpinoarticulatus Chaix	Alpine rush	S5	0	2	
Juncus arcticus Willd. var. *balticus* (Willd.) Traut.	Wire rush	S5	0	13	
Juncus bufonius L.	Toad rush	S5	0	12	
Juncus dudleyi Wieg.	Dudley's rush	S5	0	14	
Juncus filiformis L.	Thread rush	S5?	0	2	
Juncus nodosus L.	Knotted rush	S5	0	14	
Juniperus communis L.	Common juniper	S5	0	39	
Juniperus horizontalis Moench	Creeping juniper	S5	0	7	
Kalmia polifolia Wang.	Bog-laurel	S5	4	143	
Larix laricina (Du Roi) Koch	Tamarack	S5	20	220	
Lathyrus palustris L.	Marsh vetchling	S5	0	15	
Lathyrus venosus Muhl. *ex* Willd.	Wild peavine	S5	0	3	
Lemna minor L.	Duckweed	SNA	0	2	
Lemna trisulca L.	Star-duckweed	S5	0	4	
Leucanthemum vulgare Lam.	Ox-eye Daisy	SNA	0	1	Introduced species
Limosella aquatica L.	Mudwort	S4S5	0	5	
Linnaea borealis L.	Twinflower	S5	9	140	
Listera cordata (L.) R. Br. var. *cordata*	Heart-leaved twayblade	S4?	0	2	
Lobelia kalmii L.	Kalm's lobelia	S5	0	2	
Lonicera dioica L.	Twining honeysuckle	S5	0	2	Near range limit

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regiona l Study Area	Comment
Lonicera villosa (Michx.) J. A. Schultes	Fly honeysuckle	S5	3	23	
Luzula parviflora (Ehrh.) Desv.	Small-flowered wood-rush	S5	0	1	
Lycopodium annotinum L.	Stiff club-moss	S5	3	31	
Lycopodium clavatum L.	Running club-moss	S4	0	12	
Lycopodium dendroideum Michx.	Ground-pine	S5	0	1	Near range limit
Lycopus americanus Muhl. *ex* W. Bart.	Water-hore-hound	S5	0	37	
Lycopus uniflorus Michx.	Water-hore-hound	S5	0	27	
Lysimachia thyrsiflora L.	Tufted loosestrife	S5	0	18	
Maianthemum stellatum (L.) Link	Star-flowered Solomon's-seal	S5	0	1	
Maianthemum trifolium (L.) Sloboda	Three-leaved Solomon's-seal	S5	9	162	
Matricaria discoidea DC.	Pineappleweed	SNA	0	1	Introduced species
Melilotus albus Medik.	White sweet clover	SNA	0	30	Introduced species
Melilotus officinalis (L.) Lam.	Yellow sweet clover	SNA	0	4	Introduced species
Mentha arvensis L.	Common mint	S5	0	40	
Menyanthes trifoliata L.	Bogbean	S5	4	49	
Mertensia paniculata (Ait.) Don	Tall lungwort	S5	2	45	
Mitella nuda L.	Bishop's-cap	S5	1	77	
Moehringia lateriflora (L.) Fenzl	Grove-sandwort	S5	0	3	
Muhlenbergia glomerata (Willd.) Trin.	Bog muhly	S4	0	1	Near range limit
Myrica gale L.	Sweet gale	S5	0	78	
Myriophyllum sibiricum Komarov	Spiked water-milfoil	S5	0	92	
Najas flexilis (Willd.) Rostk. & Schmidt	Slender naiad	S4	0	2	
Nuphar variegata Dur.	small yellow pond-lily	S5	0	67	Near range limit
Orthilia secunda (L.) House	One-sided pyrola	S5	3	74	
Oryzopsis asperifolia Michx.	White-grained mountain-rice grass	S5	0	6	
Oxytropis campestris (L.) DC. var. *varians* (Rydb.)	Field locoweed	SU	0	5	
Packera paupercula (Michx.) A. & D. Love	Balsam groundsel	S5	0	3	

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regional Study Area	Comment
Parnassia kotzebuei Cham. *ex* Spreng.	Small grass-of-parnassus	S4	0	1	
Parnassia palustris L. var. *tenuis* Wahlenb.	Grass-of-Parnassus	S4	0	26	
Pedicularis macrodonta Richards.	Swamp lousewort	S2	1	7	
Persicaria amphibia (L.) Gray	Water smartweed	S5	0	69	
Persicaria lapathifolia (L.) S. F. Gray	Pale persicaria	S5	0	36	
Petasites frigidus (L.) Fries var. *palmatus* (Ait.) Cronq.	Palmate-leaved colt's-foot	S5	9	106	
Petasites frigidus (L.) Fries var. *sagittatus* (Banks *ex* Pursh) Cherniawsky	Arrow-leaved colt's-foot	S5	1	11	
Phalaris arundinacea L.	Reed-canary-grass	S5	0	27	Introduced species
Picea glauca (Moench.) Voss	White spruce	S5	3	16	
Picea mariana (Mill.) BSP	Black spruce	S5	38	638	
Pinguicula villosa L.	Hairy butterwort	S3S4	4	41	
Pinguicula vulgaris L.	Common butterwort	S5	0	1	
Pinus banksiana Lamb.	Jack pine	S5	4	104	
Piptatherum pungens (Torr. *ex* Spreng.) Dorn	Northern rice grass	S5	1	17	
Plantago major L.	Common plantain	SNA	0	24	Introduced species
Platanthera aquilonis Sheviak	Northern green bog-orchid	SNA	0	5	
Poa palustris L.	Fowl bluegrass	S5	0	17	
Polygonum aviculare L. ssp. *depressum* (Meisner) Arcangeli	Common knotweed	SNA	0	8	Introduced species
Populus balsamifera L.	Balsam-poplar	S5	3	62	
Populus tremuloides Michx.	Trembling aspen	S5	2	58	
Potamogeton gramineus L.	Various-leaved pondweed	S5	0	78	
Potamogeton praelongus Wulfen	White-stemmed pondweed	S5	0	1	
Potamogeton pusillus L. ssp. *tenuissimus* (Mert. & W.D.J. Koch) Haynes & C. B. Hellquist	small pondweed	S2	0	27	
Potamogeton richardsonii (Benn.) Rydb.	Richardson's pondweed	S5	0	81	
Potamogeton robbinsii Oakes	Robbin's pondweed	S2	0	20	

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Potamogeton zosteriformis Fernald	Flatstem pondweed	S5	0	24	
Potentilla norvegica L.	Rough cinquefoil	S5	0	26	
Primula mistassinica Michx.	Bird's-eye primrose	S5	0	7	
Prunus pensylvanica L.	Pin-cherry	S5	0	4	
Puccinellia nuttalliana (Schultes) Hitchc.	Nuttall's alkali grass	S5	0	1	
Pyrola asarifolia Michx.	Pink pyrola	S5	1	41	
Pyrola chlorantha Sw.	Greenish-flowered wintergreen	S5	0	6	
Pyrola grandiflora Radius	Arctic wintergreen	S4	0	3	Near range limit
Ranunculus aquatilis L.	Large-leaved white water-crowfoot	S5	0	46	
Ranunculus cymbalaria Pursh	Seaside buttercup	S5	0	5	
Ranunculus flammula L.	Creeping spearwort	S5	0	23	
Ranunculus gmelinii DC.	Yellow water-crowfoot	S5	0	2	
Ranunculus lapponicus L.	Lapland buttercup	S5	0	7	
Ranunculus pensylvanicus L.	Bristly crowfoot	S5	0	5	
Ranunculus sceleratus L.	Cursed crowfoot	S5	0	6	
Rhamnus alnifolia L'Her.	Alder-leaved buckthorn	S5	1	20	
Rhododendron groenlandicum (Oeder) Kron & Judd	Labrador-tea	S5	36	627	
Rhododendron tomentosum (Harmaja) G. Wallace	Northern labrador-tea	S4	1	7	Near range limit
Ribes glandulosum Grauer	Skunk currant	S5	0	15	
Ribes hudsonianum Richards.	Northern black currant	S5	0	31	
Ribes lacustre (Pers.) Poir.	Bristly black currant	S4	0	3	
Ribes oxyacanthoides L.	Northern gooseberry	S5	0	11	
Ribes triste Pall.	Red currant	S5	1	66	
Rorippa palustris (L.) Besser	Bog yellowcress	S5	0	46	
Rosa acicularis Lindl.	Prickly rose	S5	11	199	
Rubus arcticus L.	Stemless raspberry	S5	2	121	
Rubus chamaemorus L.	Cloudberry	S5	12	178	

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Rubus idaeus L.	Red raspberry	S5	3	30	
Rubus pubescens Raf.	Dewberry	S5	0	55	
Rumex crispus L.	Curly-leaf dock	SNA	0	1	Introduced species
Rumex fueginus Phil.	Golden dock	S5	0	14	
Sagina nodosa (L.) Fenzl	Knotted pearlwort	S4	0	1	
Sagittaria cuneata Sheldon	Arum-leaved arrowhead	S5	0	34	
Salix arbusculoides Anderss.	Shrubby willow	S3	3	39	Near range limit
Salix bebbiana Sarg.	Bebb's willow	S5	15	213	
Salix candida Fluegge ex Willd.	Hoary willow	S5	0	14	
Salix glauca L.	Grey-leaved willow	S4?	4	34	
Salix myrtillifolia Anderss.	Myrtle-leaved willow	S5	7	150	
Salix pedicellaris Pursh	Bog willow	S5	4	63	
Salix pellita Anderss.	Satin willow	S4	1	73	
Salix planifolia Pursh.	Flat-leaved willow	S5	9	241	Includes *S. discolor* and hybrids of *S. planifolia* and *S. discolor*.
Salix pseudomonticola Ball	False Mountain Willow	S4S5	0	6	
Salix pseudomyrsinites Anderss.	Tall blueberry willow	S5	4	26	
Salix serissima (Bailey) Fern.	Autumn willow	S4	0	4	
Salix vestita Pursh.	Rock willow	S3	2	28	Near range limit
Sarracenia purpurea L.	Pitcher-plant	S5	0	1	
Scheuchzeria palustris L.	Podgrass	S4?	1	16	
Schoenoplectus tabernaemontani K. C. Gmel.	Viscid great-bulrush	S5	0	73	
Scutellaria galericulata L.	Common skullcap	S5	0	22	
Shepherdia canadensis (L.) Nutt.	Canada buffalo-berry	S5	0	48	
Sibbaldiopsis tridentata (Ait.) Rydb.	Three-toothed cinquefoil	S5	0	2	
Silene csereii Baumg.	Smooth catchfly	SNA	0	4	
Sium suave Walt.	Water-parsnip	S5	0	74	
Solidago hispida Muhl.	Hairy goldenrod	S5	3	30	Near range limit

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Solidago multiradiata Ait.	Northern goldenrod	S5	3	9	
Solidago simplex Kunth	Mt. Albert goldenrod	SU	0	2	
Sonchus arvensis L.	Perennial sow thistle	SNA	0	8	
Sparganium angustifolium Michx.	Narrow-leaved bur-reed	S5	0	71	
Sparganium natans L.	Small bur-reed	S5	0	1	
Spiranthes romanzoffiana Cham.	Hooded ladies'-tresses	S5	0	8	
Stachys palustris L.	Marsh hedge-nettle	S5	0	10	
Stellaria crassifolia Ehrh.	Fleshy stitchwort	S4	0	19	
Stellaria longifolia Muhl. *ex* Willd.	Long-leaved stitchwort	S5	0	14	
Stellaria longipes Goldie ssp. *longipes*	Long-stalked stitchwort	S5	1	5	
Stuckenia pectinata (L.) Boerner	Sago pondweed	?	0	1	
Stuckenia vaginata (Turcz.) Holub	Sheathed pondweed	?	0	1	
Symphoricarpos albus (L.) Blake	Snowberry	S5	0	1	
Symphyotrichum boreale (Torr. & Gray) A. & D. Love	Rush aster	S5	0	3	
Symphyotrichum ciliatum (Ledeb.) G.L.Nesom	Rayless aster	SU	0	6	
Symphyotrichum ciliolatum (Lindl.) A. & D. Love	Lindley's aster	S5	1	32	
Symphyotrichum puniceum (L.) A. & D. Love var. *puniceum*	Purple-stemmed aster	S5	0	6	
Taraxacum officinale Weber.	Common dandelion	S5	0	32	Introduced species
Thalictrum venulosum Trel.	Veiny meadow-rue	S5	0	15	
Tofieldia pusilla (Michx.) Pers.	Scotch false asphodel	S4	0	1	
Trichophorum alpinum (L.) Pers.	Alpine cotton-grass	S5	0	30	
Trichophorum cespitosum (L.) Hartman	Tufted bulrush	S4	0	4	
Trifolium hybridum L.	Alsike clover	SNA	0	5	
Triglochin maritima L.	Sea-side arrow-grass	S5	1	14	
Typha latifolia L.	Common cat-tail	S5	0	9	
Utricularia intermedia Hayne	Flat-leaved bladderwort	S5	0	25	
Utricularia macrorhiza Le Conte	Common bladderwort	S5	0	43	

Scientific Name	Common Name	MBCDC S-Rank*	Number in Local Study Area**	Number in Regiona l Study Area	Comment
Vaccinium myrtilloides Michx.	Velvet-leaf blueberry	S5	6	98	
Vaccinium oxycoccos L.	Small bog cranberry	S5	13	202	
Vaccinium uliginosum L.	Bog bilberry	S5	14	309	
Vaccinium vitis-idaea L.	Rock cranberry	S5	26	392	
Veronica peregrina (L.)	Neckweed	S5	0	19	
Viburnum edule (Michx.) Raf.	Low bush-cranberry	S5	4	90	
Viola adunca Sm.	Early blue violet	S5	0	1	
Viola palustris L.	Marsh violet	S4S5	0	3	
Viola renifolia Gray	Kidney-shaped white violet	S5	1	16	
Zannichellia palustris L.	Horned pondweed	S3?	0	3	

Moss Species Identified in the Field

Scientific Name	Common Name	Number in Local Study Area*	Number in Regional Study Area	Comment
Cladina mitis (Sandst.) Hustich	green reindeer lichen	24	350	
Cladina rangiferina (L.) Nyl.	grey reindeer lichen	15	189	
Cladina stellaris (Opiz) Brodo	northern reindeer lichen	6	128	
Hylocomium splendens (Hedw.) Schimp.	stair-step moss	33	347	
Marchantia polymorpha L.	green-tongue liverwort	0	6	
Pleurozium schreberi (Brid.) Mitt.	big red stem	48	494	
Ptilium crista-castrensis (Hedw.) De Not.	Knight's plume	2	47	
Sphagnum spp.	peat mosses	23	379	
Moss spp.	other mosses	33	584	
Cladonia spp.	cup lichens	23	282	
Peltigera spp.	leaf lichens	0	150	

*Number of sample locations where the species was found.

Moss Species Identified in the Laboratory

Scientific Name	Common Name	Number in LSA*	Number in RSA	Comment
Aulacomnium palustre (Hedw.) Schwagr.	tufted moss	5	52	
Brachythecium spp.	brachythecium mosses	0	6	
Bryum pseudotriquetrum (Hedw.) G. Gaertn., B. Mey. & Scherb.	common green gryum moss	0	1	
Bryum spp.	bryum mosses	0	1	
Callicladium haldanianum (Grev.) H.A. Crum	callicladium moss	0	1	
Calliergon giganteum (Schimp.) Kindb.	giant water moss	1	5	
Calliergon stramineum (Brid.) Kindb.	straw-coloured water moss	1	2	
Campylium stellatum (Hedw.) C.E.O. Jensen	yellow star moss	0	10	
Ceratodon purpureus (Hedw.) Brid.	purple horn-toothed moss	1	2	
Chara spp.		0	44	
Dicranum polysetum Sw.	electric eels	1	8	
Dicranum scoparium Hedw.	dicranum moss	0	1	
Dicranum spp.	dicranum mosses	7	94	
Dicranum undulatum Brid.	wavy dicranum	0	4	
Ditrichum flexicaule (Schwagr.) Hampe	ditrichum moss	0	1	
Ditrichum spp.	ditrichum mosses	0	4	
Drepanocladus aduncus (Hedw.) Warnst.	common hook moss	0	1	
Drepanocladus spp.	hook mosses	0	2	
Drepanocldus revolvens (Sw.) Warnst.	limprichtia moss	1	9	
Funaria hygrometrica Hedw.	funaria moss	0	3	
Hamatocaulis vernicosus (Mitt.) Hedenas	hamatocaulis moss	0	3	
Helodium blandowii (F. Weber & D. Mohr) Warnst.	Blandow's feather moss	0	2	
Hypnum lindbergii Mitt.	Lindberg's hypnum moss	0	1	

Scientific Name	Common Name	Number in LSA*	Number in RSA	Comment
Hypnum spp.	hypnum mosses	0	1	
Leskea spp.	leskea mosses	1	1	
Liverwort spp.	liverworts	0	2	
Paludella squarrosa (Hedw.) Brid.	angled paludella moss	0	4	
Peltigera spp.	peltigera lichens	17	150	
Plagiomnium cuspidatum (Hedw.) T. Kop.	toothed plagiomnium moss	1	1	
Pohlia nutans (Hedw.) Lindb.	copper wire moss	0	3	
Pohlia spp.	pohlia mosses	0	5	
Polytrichum juniperinum Hedw.	juniper hair-cap	1	12	
Polytrichum spp.	polytrichum mosses	0	9	
Polytrichum strictum Brid.	slender hair-cap	2	11	
Pseudobryum cinclidioides (Hub.) T. Kop.	pseudobryum moss	1	1	
Sanionia uncinata (Hedw.) Loeske	sanionia moss	2	12	
Sarmentypnum exannulatum (Schimp.) Hedenas	ringless hook-moss	0	1	
Scorpidium scorpioides (Hedw.) Limpr.	sausage moss	0	3	
Sphagnum angustifolium (C.E.O. Jensen ex Russow) C.E.O. Jensen	poor fen peat moss	1	33	
Sphagnum capillifolium (Ehrh.) Hedw.	acute-leaved peat moss	7	82	
Sphagnum cuspidatum Ehrh. ex Hoffm.	toothed peat moss	0	2	
Sphagnum fallax (Klinggr.) Klinggr.	peat moss	0	1	
Sphagnum fimbriatum Wilson	peat moss	1	1	
Sphagnum fuscum (Schimp.) Klinggr.	rusty peat moss	7	111	
Sphagnum lindbergii Schimp.	Lindberg's peat moss	0	1	
Sphagnum magellanicum Brid.	midway peat moss	0	6	
Sphagnum majus (Russow) C.E.O. Jensen	greater peat moss	0	1	
Sphagnum riparium Angstr.	shore-growing peat moss	0	8	

Scientific Name	Common Name	Number in LSA*	Number in RSA	Comment
Sphagnum rubellum Wilson	peat moss	0	2	
Sphagnum russowii Warnst.	wide-tongued peat moss	0	6	
Sphagnum subsecundum Nees	peat moss	0	2	
Sphagnum warnstorfii Russow	Warnstorf's peat moss	3	25	
Tomenthypnum nitens (Hedw.) Loeske	golden fuzzy fen moss	3	38	
Tortella fragilis (Hook. & Wilson) Limpr.	fragile tortella moss	0	1	
Warnstorfia fluitans (Hedw.) Loeske	warnstorfia moss	0	1	

* Number of sample locations where the species was found.