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July 17, 2013

Filed Electronically

National Energy Board
444 Seventh Avenue S.W.
Calgary, Alberta T2P 0X8

Attention: Ms. Sheri Young, Secretary of the Board

Dear Ms. Young:

Re: NOVA Gas Transmission Ltd. (NGTL)
Chinchaga Lateral Loop No. 3 (Chinchaga Section) (Project)
Certificate GC-121 (Certificate)
Compliance Condition 10(a) – Revised Preliminary
Caribou Habitat Restoration Plan (CHRP)
NEB File: OF-Fac-Gas-N081-2011-05 02

To satisfy the requirements of Condition 10(a) of Certificate GC-121 for Board approval, NGTL filed a preliminary Caribou Habitat Restoration Plan (CHRP) for the Project footprint within the Chinchaga caribou range on May 7, 2013 (NEB Filing ID A3H5J8).

On July 2, 2013, Board staff provided feedback on NGTL's preliminary CHRP filing. NGTL has since incorporated this information into the preliminary CHRP and encloses for Board approval a revised version of the plan.

Should the Board require additional information with respect to this filing, please contact the undersigned at (403) 920-7163 or at linda_angus@transcanada.com.

Yours truly,
NOVA Gas Transmission Ltd.

Original signed by

Linda Angus
Regulatory Project Manager

Attachment

cc:
Mr. Dan Barghshoon, National Energy Board, Project Operations Manager
Mr. Paul Gregoire, Environment Canada (paul.gregoire@ec.gc.ca)
Mr. Dave Hervieux, Fisheries and Wildlife Management – Grand Prairie, ESRD (dave.hervieux@gov.ab.ca)
Mr. Dave Moyles, Fisheries and Wildlife Management – Peace River, ESRD (dave.moyles@gov.ab.ca

Preliminary Caribou Habitat Restoration Plan for the Chinchaga Lateral Loop No. 3 (Chinchaga Section)

July 2013

Prepared for:
NOVA Gas Transmission Ltd.
A Wholly Owned Subsidiary of
TransCanada PipeLines Limited
Calgary, Alberta

Prepared by:
Stantec Consulting Ltd.
Calgary, Alberta
and
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Calgary, Alberta

Project Number: 123510572

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Abbreviations

AESRD ..... Alberta Environment and Sustainable Resource Development
CHRP ..... Caribou Habitat Restoration Plan
CHROMMP ..... Caribou Habitat Restoration and Offset Measures Monitoring Program
CPP ..... Caribou Protection Plan
EAS ..... Environmental Alignment Sheets
EPP ..... Environmental Protection Plan
NEB ..... National Energy Board
NGTL ..... NOVA Gas Transmission Ltd
OMP ..... Offset Measures Plan
ROW ..... right-of-way

1 INTRODUCTION

NOVA Gas Transmission Ltd. (NGTL), a wholly owned subsidiary of TransCanada PipeLines Limited, has applied to the National Energy Board (NEB) under Section 52 of the *NEB Act* for authorization to construct and operate the Chinchaga Lateral Loop No. 3 (the Project) (see Figure 1). The Project is 33 km long, and is parallel and contiguous with 31 km (94%) of existing ROW. Of this contiguous section, 29.2 km is parallel to one or two transmission lines. This report has been prepared in accordance with Certificate Condition 10a of Certificate GC-121 (Table 1).

Table 1 Certificate Condition 10 – Caribou Habitat Restoration Plan

Caribou Habitat Restoration Plan Certificate Condition
10. Caribou Habitat Restoration Plan NGTL shall file with the Board for approval, in accordance with the timelines below, preliminary and final versions of a CHRP for the Chinchaga Section. NGTL shall provide a copy of the filings to Environment Canada and the appropriate provincial authorities.
a. Preliminary CHRP –to be submitted at least 180 days prior to commencement of construction for the Chinchaga Section. This version of the CHRP shall include, but not be limited to: i. the objectives of the CHRP; ii. a decision tree(s) that will be used to (1) prioritize potential caribou habitat restoration sites and (2) prioritize mitigation to be used at different types of sites. The decision tree(s) should be based on a literature review identifying temporal and spatial caribou habitat restoration methodologies and their relative effectiveness, as well as based on typical site factors that may constrain implementation; iii. the quantifiable targets and performance measures that will be used to evaluate: (1) the extent of predicted, residual effects, (2) the extent to which the objectives have been met and the need for consequent compensation offsets; iv. a schedule indicating when mitigation measures will start and the estimated completion date; and v. evidence and a summary of consultation with Environment Canada and provincial authorities regarding the CHRP.
b. Final CHRP – to be submitted on or before 1 November after the first complete growing season following the commencement of operation for the Chinchaga Section. This updated version of the CHRP shall include, but not be limited to: i. the preliminary CHRP, with any updates identified in a revision log that includes the rationale for any changes to decision making criteria; ii. a complete table of caribou habitat restoration sites, including but not limited to location, spatial area, description of habitat quality, site-specific restoration activities and challenges; iii. maps or Environmental Alignment Sheets showing the locations of the sites; iv. evidence and summary of consultation with Environment Canada and provincial authorities regarding the Final CHRP; and v. a quantitative and qualitative assessment of the total area of direct disturbance to caribou habitat that will be restored, the duration of spatial disturbance, and the aerial extent of the resulting residual effects to be offset, which also includes indirect disturbance.

This Preliminary CHRP will be followed by a Final CHRP, which will address Certificate Condition 10b. The Final CHRP will expand on the Preliminary CHRP to provide specific information on the location of restoration sites and specific restoration measures selected, as well as an assessment of residual project effects on caribou habitat. An Offset Measures Plan (OMP; Preliminary and Final as per Certificate Condition 20) and a Caribou Habitat Restoration and Offset Measures Monitoring Program (CHROMMP; as per Certificate Condition 21) will be prepared and filed separately in accordance with the timelines outlined in the Certificate Conditions.

1.1 Guidelines for Boreal Caribou

The CHRP has been developed in consideration of the current regulatory policies specific to caribou. The Woodland Caribou Policy for Alberta (Government of Alberta 2011) identifies recovery strategies that include maintenance and restoration of caribou habitat, establishment of range-specific habitat objectives, management of other wildlife populations (predators and primary prey), adaptive management, and legislative and social considerations. A key strategy adopted by the Woodland Caribou Policy for Alberta is the development of range-specific assessments and objectives, which builds on the work of previous recovery strategies, such as the Alberta Woodland Caribou Recovery Plan 2004/05 – 2013/14 (Alberta Woodland Caribou Recovery Team 2005). A range-specific assessment or recovery plan for the Chinchaga caribou herd range has not yet been developed.

Similar to the provincial policy, the final Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada (Environment Canada 2012) stresses the importance of landscape level planning, such as planning development activities at appropriate temporal and spatial scales, incorporating caribou habitat requirements into fire management plans, establishing key protected areas and incorporating adaptive management. One of the management approaches suggested in the federal recovery strategy to address effects of habitat alteration on boreal caribou is to undertake coordinated actions to reclaim boreal caribou habitat through restoration efforts. This might include restoration of industrial features such as roads, seismic lines, pipelines, cut lines and clearings (Environment Canada 2012).

NGTL is continuing to work with Alberta Environment and Sustainable Resource Development (AESRD) to ensure caribou habitat restoration plans undertaken for this Project align with the provincial caribou policy and the future provincial Caribou Action Plan for the Chinchaga caribou herd. Herd-specific Caribou Action Plans, as part of the province's commitment to the federal Recovery Strategy, are required.

N

ESA 548

KP 33.29

KP 30

KP 25

KP 20

KP 15

KP 10

KP 5

KP 0

Dugout #4

Dugout #3

Dugout #2

Dugout #1

Meikle River

Hotchkiss River

Kilometre Post

Chinchaga Section

Non-contiguous

Contiguous

Hotchkiss Water Line

Chinchaga_LEGEND

Dugout

Existing

New

Stockpile Site (Existing)

Road

Watercourse

Caribou Range

Environmentally Significant Area

Water Body

0 1 2 3 4 5

Kilometres - 1:150,000

123510572-0106

British Columbia

Alberta

Rainbow Lake

High Level

Chinchaga Section

Manning

Fort St. John

Grimshaw

Peace River

Fairview

Dawson Creek

Spirit River

Falher

McLennan

NT

Area of Interest

BC

AB

SK

USA

Chinchaga Lateral Loop No. 3 (Chinchaga Section) Project Location

Chinchaga Lateral Loop No. 3 (Chinchaga Section) Project Location

Acknowledgements: Base data supplied by the Government of Alberta. Route information provided by TransCanada Pipelines Ltd. and MidWest Surveys Inc.

PREPARED BY Stantec

PREPARED FOR NGTL

FIGURE NO. 1

Last Modified: 3/18/2013 By: arocha

1.2 Organization of the Preliminary CHRP

Consistent with the requirements of Certificate Condition 10(a), this preliminary CHRP is organized into the following Sections:

- **Objectives** - Section 2.0 (Certificate Condition 10(a)(i)): introduces the primary objectives of the preliminary CHRP including: (i) restore as much caribou habitat as possible and (ii) provide a means to assess the extent of habitat loss that will require compensatory efforts. This section also outlines NGTL's commitment to develop a study design that will help to evaluate the extent to which the CHRPs objectives have been met.
- **Literature Review** - Section 3.0 (Certificate Condition 10(a)(ii)): focuses on a literature review of current and historical habitat restoration initiatives and techniques, and their reported successes and failures. The literature review provides a basis for understanding general decision-making criteria with regard to prioritization of restoration sites and mitigation measures. The literature review provides key results and measures suited for caribou range, but the application of those restoration measures will be specific to the Project and dependent on site conditions. Therefore, not all restoration measures discussed in Section 3.0 may be appropriate or necessary for the Project, but are nonetheless provided for completeness and consideration.
- **Prioritization of Caribou Habitat Restoration Sites and Mitigation** - Section 4.0 (Certificate Condition 10(a)(ii)): General decision-making criteria derived from the literature review was used to develop habitat-specific decisions trees for the Project. The decision trees aid in the process of identifying and prioritizing the selection of caribou habitat restoration locations and proposed mitigation.
- **Evaluation of Residual Effects and Restoration Objectives** - Section 5.0 (Certificate Condition 10(a)(iii)): provides the quantifiable targets and performance measure criteria by which the effectiveness of the proposed habitat restoration objectives will be evaluated. Limitations and assumptions specific to the Project are included in this section.
- **Schedule** – Section 6.0 (Certificate Condition 10(a)(iv)): provides a schedule of activities indicating when mitigation measures will begin and the estimated completion date.
- **Consultation with Environment Canada (EC) and Alberta Environment and Sustainable Resource Development (AESRD)** - Section 7 (Certificate Condition 10(a)(v)): summarizes the consultation and dialogue that has taken place with EC and AESRD regarding the Preliminary CHRP.

The Preliminary and Final CHRPs are intended to supplement the measures provided in the Project Environmental Protection Plan (EPP) (ESA Section 20A), Caribou Protection Plan (CPP) (ESA Section 20A Appendix H) and the Environmental Alignment Sheets (EAS) ESA Section 20B). The EPP, CPP and EAS were developed in consideration of the Project location within caribou range, and therefore incorporate standard best practices for working in this particular caribou range. The Preliminary CHRP builds on those caribou protection measures to provide detail on NGTL's commitment to restore the

Project footprint in the Chinchaga caribou range and provides potential measures, objectives and criteria for evaluation.

2 OBJECTIVES

The Project will potentially affect caribou in the Chinchaga caribou range as a result of direct loss of habitat and an indirect change in habitat suitability; a small increase in mortality risk may occur as a result of small changes in access and associated travel efficiency by humans and predators. The intent of the Preliminary CHRP is to provide decision-making criteria and decision trees for evaluation of habitat restoration treatments to reduce Project residual effects on caribou and caribou habitat. The objectives of the Preliminary CHRP are:

- Habitat Restoration: promote habitat restoration (*i.e.*, native vegetation re-establishment) within the Project footprint in a manner that will achieve re-establishment of natural ecosystem types adjacent to the Project footprint, where feasible.
- Access Control: implement access control to discourage human use, and possibly predator travel, along or into the Project right of way (ROW).
- Line-of-Sight Blocking: establish line-of-sight blocks, where feasible (*i.e*., new alignment, or locations along parallel alignment that have existing line-of-sight blocks), to reduce caribou mortality risk along the Project ROW.
- Monitoring Program: evaluate predicted residual effects and restoration treatment effectiveness using a quantitative design in order to modify or implement new restoration treatments, if required.
- Adaptive Management: identify unsuccessful restoration treatments, microsite conditions that are either not conducive or suitable for establishment of vegetation, and need to be adjusted or supplemented to achieve the objectives of the CHRP.

Project effects on caribou, resulting either from direct or indirect change in habitat suitability or a change in mortality risk, are key metrics for determining habitat restoration targets, measureable objectives and final determination of residual effects that might require offsetting. As reported in the Supplemental Report on Potential Effects on Caribou (Stantec 2012), the Project was not predicted to result in any incremental increase in indirect effects on habitat. Direct effects were estimated to range from 119.19 to 127.01 ha, depending on the method of calculation (Stantec 2012). The estimated incremental increase in linear density resulting from the Project was less than 0.01 km/km^2. Final determination of direct effects (i.e., loss of habitat) cannot be known until Project construction is complete, as Project specific mitigation might result in lower total disturbance. Furthermore, quantification of effects on habitat and line-of-sight is part of an ongoing ground-based caribou habitat assessment under Condition 7, and linkages between the habitat assessment, caribou critical habitat attributes, and actual direct Project effects will be forthcoming.

Restoration through accelerated revegetation will address habitat directly disturbed by the Project ROW, with the exception of a 6-10 m wide area along the pipeline centreline required for maintenance practices and CSA standards. By addressing direct habitat loss through revegetation, indirect effects on habitat

effectiveness in surrounding habitats will be minimized as a direct proportion of restoration implemented within the Project ROW. Time lags and uncertainties associated with restoration treatment effectiveness and other areas on the Project ROW that are not addressed by the CHRP (i.e., centreline) will be compensated for by the OMP, but elsewhere within caribou range. A final assessment of whether the quantifiable targets and performance measures were achieved for each restoration unit (e.g., Upland Deciduous/Mixedwood; see Appendix B) along the Project ROW will be conducted upon completion of the CHRP monitoring program (i.e., for 5 years following commencement of operation). The total area of habitat-specific restoration units that underperform and are statistically significant from their respective target or performance measure will also be addressed by the OMP.

Restoration will be achieved through a variety of measures, including construction mitigation measures, natural regeneration, site preparation, seeding with woody vegetation species, bio-engineering, and seed or seedling planting of native species. Pursuant to Condition 7, a pre-construction habitat assessment will aid in understanding the quality, quantity, variability, and areal extent of caribou critical habitat along the Project ROW, and provide a basis for setting quantifiable targets for restoration.

Objectives provide a means by which the effectiveness of the CHRP can be evaluated through monitoring. Section 5.0 provides detail on the rationale and assumptions of quantifiable targets and performance measures used to evaluate predicted residual effects and restoration objectives, and the quantitative design of the monitoring program.

While not an explicit goal of this Preliminary CHRP, the measures implemented through this plan will have the added advantage of benefiting a number of other species and environmental values. For example, habitat restoration and access control will reduce the potential for negative human-wildlife interactions. In Alberta, controlling access to reduce human-caused grizzly bear mortality is a key recommendation in Alberta's grizzly bear recovery plan (Alberta Grizzly Bear Recovery Team 2008). Bayne *et al.* (2011) also demonstrated positive effects of habitat restoration along linear features (notably seismic lines) for black bear, marten and several bird species.

3 LITERATURE REVIEW

Restoration of disturbed habitat has become one of the key components for caribou conservation, and has been identified in the federal recovery strategy (Environment Canada 2012) and in provincial boreal caribou recovery planning efforts (Government of Alberta 2011). The purpose of this literature review is to provide an understanding of the current state of knowledge of the value and purpose of habitat restoration in caribou range, to provide a review of historical and ongoing habitat restoration initiatives, and to summarize the various techniques that have been implemented and along with their associated effectiveness. The results of the literature review have been used to develop decision trees that will aid in the prioritization of caribou habitat restoration sites as well as mitigation measures at different types of sites (see Section 4). The literature review was conducted using a systematic approach and standard research techniques including the use of in-house reference material and querying scholarly databases using keywords and phrases. Literature cited in peer-reviewed scientific papers was also consulted where appropriate.

3.1 Current Information on Woodland Caribou, Habitat and Human Use

Boreal woodland caribou use a strategy of spatial separation from primary prey to limit predation risk (Bergerud *et al.* 1984, Bergerud 1988, Holt and Lawton 1994, Johnson *et al.* 2001, James *et al.* 2004, Environment Canada 2008, Environment Canada 2011). Evidence shows that caribou resource selection at the population and individual seasonal home range scale is affected by forestry cutblocks (DeCesare *et al.* 2012), which are linked to increased predator densities (Latham *et al.* 2011). Individual caribou resource selection at the location level, however, is shown to be affected by linear features (DeCesare *et al.* 2012). Linear features (*e.g.*, roads, pipeline and transmission ROWs, seismic and cut lines) have been associated with increased predator mobility, potentially putting caribou at greater risk of predation when near or on these features (James 1999, James and Stuart-Smith 2000, Whittington *et al.* 2011). However, McCutchen (2006) modeled dynamic use of the landscape by wolves, primary prey (moose) and caribou, and concluded that wolves experience no additional advantage accessing caribou from linear features, although they do benefit in accessing primary prey species (*i.e.*, moose). Latham *et al.* (2011) supports this by finding that kill sites were no closer to linear features than random. Reduced habitat effectiveness adjacent to linear features may occur as caribou may partially avoid habitats near access ROWs (Dyer 1999, Oberg 2001). DeCesare *et al.* (2012) reported a scale-dependent trade-off such that the ultimate costs to caribou habitat suitability appear relatively less for linear feature-induced changes to the predator functional response (predator kill rate) than forestry-induced changes to the predator numerical responses (predator density). This supports work by Latham (2009) where forest harvest leading to early seral stage regeneration was suggested as one factor leading to increased primary prey abundance (moose and deer), with numerical responses in wolf populations, increased forays into caribou range and subsequent higher predation risk to caribou.

Rehabilitation of existing anthropogenic disturbances not currently in use within caribou range is expected to reduce the degradation of functional habitat over the long-term, because caribou will no longer exhibit reduced use on or near (*i.e.*, within a zone of influence) a land-use feature (*e.g.*, Oberg 2001). Restoration of disturbances also assumes that caribou will return to being spatially separated from primary prey (moose, deer) and predators, and hence return to natural levels of mortality risk (Athabasca Landscape Team 2009).

Management of boreal caribou habitat to maintain viable populations over time will require both minimizing the impact of future development and recovery of the existing industrial footprint.

3.2 Recovery and Restoration of Habitat

Mitigating the effects of industrial development (*e.g.*, forestry, seismic, oil and gas, and mining) in the boreal forest has a common challenge: reclamation/restoration of a development footprint that is either a linear feature (*e.g.*, pipeline) or a polygon (*e.g.*, cutblock, mine). A common approach in reclamation of forested land is the application of provincial standards developed to achieve equivalent land capability to support target end land uses, often with a focus on merchantable forest stands (e.g., AENV 2010, AENV 2011). In relation to oil sands mining in northeastern Alberta, Straker and Donald (2011) and Hawks (2011) have suggested that current reclamation standards may not be suitable where there is a broader set of management objectives such as maintenance of biodiversity, creating functional forest ecosystems, or restoration of species-specific wildlife habitat.

Although restoration ecology specific to caribou habitat is a relatively new science, some key initiatives have identified important learning's related to oil and gas development in caribou range. Initiatives have generally focused on revegetation and access control, as well as limiting growth and establishment of plant species favourable to primary prey (*e.g.*, Caribou Range Restoration Project [CRRP] 2007a,b, Golder Associates [Golder] 2010, Osko and Glasgow 2010). These included tree planting initiatives, coarse woody debris management best practices, habitat enhancement programs and habitat restoration trials in caribou range (CRRP 2007a, b, Enbridge 2010, Golder 2010, 2011, Oil Sands Leadership Initiative [OSLI] 2012). Blocking line-of-sight has been implemented through land use guidelines as a tool aimed at mitigating increased risk of predation in the short-term, while longer term goals of revegetation of lines are achieved. Inoculation of reclaimed landscapes with lichen fragments has been effective in re-establishing lichen forage over the long term (17-45 years) in disturbed areas (Stokes et al.2009). While lichen establishment is valuable to long-term habitat restoration as an important caribou habitat attribute, the long time frame associated with lichen growth is not expected to be a short-term attractant to caribou while efforts to reduce predator presence are also undertaken.

Common among many of these initiatives are learning's on: which plant species to use, and when and where to replant; development of effective techniques to promote natural revegetation; and a better understanding of methods to control access. Lessons learned from these initiatives have been incorporated into large-scale habitat restoration projects near Grande Prairie, Cold Lake and Fort McMurray, Alberta. Table 2 provides a summary of habitat restoration initiatives and the accomplishments

and lessons learned. The summary is based on publicly-available information that NGTL considers to be the most recent, relevant, and comprehensive with regard to caribou habitat restoration initiatives for the Chinchaga range.

3.2.1 Key Results

Recent research has shown positive results for establishing native vegetation on seismic lines and other linear features using techniques such as planting tree and shrub seedlings, and creating microsite conditions (*i.e.*, mounding) that are conducive to seedling growth and natural vegetation encroachment (CRRP 2007b, OSLI 2012). Measures such as rollback can address site condition issues including competition from non-target or undesired plant species, erosion, frost, and heat or moisture deficiencies (CRRP 2007b). Natural revegetation and successful planting initiatives have also benefited from construction practices that minimize disturbance during development of the footprint. Minimal disturbance pipeline construction techniques that avoid grubbing and grading are effective at facilitating rapid regeneration of native vegetation within the ROW, in particular in deciduous habitats (TERA 2011a, 2012). A trial natural revegetation response inventory program in west central Alberta reported that 85% of disturbed sites did not require artificial recovery, since a natural recovery projection was observed on previously disturbed sites (CRRP 2007c). Although regenerating conifers provide a better visual barrier, the faster growth rates of deciduous species provides for effective results more quickly (DES 2004). Recent research suggests that planting shrubs along with trees allows trees to grow healthier, faster and with less competition for nutrients and water from fast-growing grasses (OSLI 2012). It may also provide important habitat benefits for wildlife, compared to only planting tree seedlings, by providing hiding cover (Bayne *et al.* 2011).

Salvage and transplanting of native vegetation is a means of introducing small scale island mat transplants containing native flora and soil fauna important to regeneration. Transplanting native materials can be difficult to implement on a large scale as part of a habitat restoration program for the following reasons (Golder 2012b):

- inconsistent availability of vegetation suitable for transplant;
- potential for degradation of neighbouring vegetation communities if transplants are sourced from adjacent stands;
- transplanting programs often require storage of plant materials under less-than-ideal conditions due to uncontrollable factors (*i.e.*, weather); and
- other treatments, such as seeding and seedling planting, have been shown to be more successful in comparison.

Table 2 Historic and Current Habitat Restoration Initiatives

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
AXYS Environmental	Recommended Peatland Restoration Techniques for Oil and Gas in Boreal Forest	• AXYS conducted a literature review of successfully used peatland reclamation techniques within wildlife habitats in the boreal forest	• A mean water table level higher than 40 cm and preferably within 20 cm promotes peatland growth[1]. • Removing drainage ditches following decommissioning will help restore peatlands[2]. • Water table management is essential to ensure successful re-vegetation of peatlands and to guide the direction of re-vegetation. Soil chemistry adjustment may be required for problem soils[3]. • To achieve improved black spruce seedling growth and environmental quality, use selected mycorrhizal fungi when reclaiming dense black spruce bogs[4]. • Re-establish site hydrology, site topography, and appropriate bog vegetation to reclaim raised bogs. • Patches of discontinuous permafrost (*e.g.*, in northeastern Alberta) are not yet possible to reclaim[5].	AXYS 2003 [1] Tedder and Turchenek 1996 [2] Girard *et al*. 2002 [3] Naeth*et al*. 1991 [4] Khasa*et al*. 2001 [5] Robinson and Moore 2000 [5] Turetksy*et al*. 2000 [5] Camill 1999
Canadian Natural Resources Limited (CNRL), Diversified Environmental Services	Ladyfern Pipeline Re-vegetation Program (natural gas pipeline running from northeast BC into northwest Alberta)	• Pipeline construction occurred in 2002 • Promoted revegetation on a pipeline development by: minimizing root disturbance during construction; mechanical seeding of the ROW on areas of erosion concern only; promoting the growth of native species from seed; planting of tree seedlings; and transplanting of existing trees • Goal was to create line-of-sight breaks as introduced trees grow over time • Upland habitat: tree seedlings were planted primarily with white spruce and lodgepole pine • Lowland habitat: planted larger, locally collected and transplanted black spruce	• Annual monitoring of species composition and percent vegetation ground cover was conducted for two growing seasons. • Survival rates were higher in upland sites than lowland sites (focus on lowland sites was black spruce transplants). • Poor survival of locally collected transplanted black spruce. • Coniferous tree seedling (nursery stock white spruce and lodgepole pine) survival and growth appeared to be more successful than using locally collected transplants.	Diversified Environmental Services (DES) 2004

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
Canadian Natural Resources Limited (CNRL), Diversified Environmental Services (cont'd)			• Natural regeneration in both upland and lowland sites was noted in areas that had minimized root disturbance during construction of the pipeline and where there was no mechanical seeding of grass seed. • Re-colonization of coniferous species provided the best visual barrier; deciduous species effective more quickly. • Recommended that transplants should be conducted in the fall when trees are dormant, but still have sufficient time to establish roots. • Recommended that the most effective method for establishing a line-of-sight break is to concentrate efforts on productive uplands. • Recommended that smaller trees (20-30 cm) be selected for further transplants.	
Suncor Energy	Accelerated Seismic Line Restoration	• Program initiated in 2000 • Objective was to promote revegetation of seismic lines through the use of tree seedling planting, bioengineering (willow staking) and transplanting existing vegetation • Techniques tried on upland, transitional wetlands and wetland ecosites • No follow-up monitoring beyond this program	• Four years post-treatment: • upland black spruce transplants survived but showed signs of stress; • black spruce and willow plugs worked better than transplants; • poor results for lines with mulch on them; • transitional wetland black spruce transplanting showed high survival but low growth or vigour rate; and • wetland black spruce and willow transplants and plugs had poor survival, but slightly better survival when planted in elevated microsites.	Golder 2005

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports

Consortium composed of oil/gas companies, Environment Canada, Alberta Conservation Association, the Alberta Caribou Committee, and Alberta Environment and Sustainable Resource Development [AESRD]) (previously referred to as Alberta Sustainable Resource Development[ASRD])	CRRP	• Program active from 2001 to the end of 2007
		• Mandate was to use an adaptive management approach to restoring caribou habitat while testing methods to speed recovery of man-made linear disturbance
		• Involved trials to increase the recovery path of seismic and other linear corridors to treed cover, studying the effect of access management techniques on wildlife and humans, performing a cost/benefit analysis, and drafting recommended operating practices and planning strategies from the construction through to the reclamation phases of oil and gas developments
		• Field treatments included: transplanting trees and shrubs, seeding, tree seedling planting, using planting enhancements, soil decompaction, mounding, rollback, and installation of wooden fences for line-of-site breaks
		• Planning strategies included the use of aerial imagery for collecting vegetation inventories, and developing logistical best practices for tree seedling planting in wetland areas during the summer
			• Tested site preparation techniques as they pertain to promoting revegetation and limiting human use of linear corridors, including excavator mounding, decompaction and rollback.
			• Researched and tested the use of aerial imagery and LiDAR for collecting vegetation inventories on linear disturbances, of which aerial imagery was proven to be successful and adopted for other habitat restoration programs.
			• Managed the macro-scale Suncor/ConocoPhillips Caribou Habitat Restoration Pilot implemented within the Little Smoky caribou range in 2006:
			  • over 100 km of linear corridors treated, encompassing several townships;
			  • included site preparation techniques (excavator mounding and rollback);
			  • included planting of tree seedlings on a variety of different ecosites, treatment types and disturbances;
			  • included the installation of wooden fences at the beginning of linear corridors to serve as line-of-sight breaks;
			  • focused on access management by using excavator mounding at the beginning of linear corridors; and
			  • installation of signs at treatment sites.
			• Produced an unpublished draft document on recommended practices for implementing a habitat restoration program, from the planning through to the treatment and monitoring phases.
			• Produced an unpublished monitoring manual for collecting revegetation data on linear corridors.
				Suncor 2007
				CRRP 2007a,b
				Neufeld 2006

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
Consortium composed of oil/gas companies, Environment Canada, Alberta Conservation Association, the Alberta Caribou Committee, and Alberta Environment and Sustainable Resource Development [AESRD]) (previously referred to as Alberta Sustainable Resource Development[ASRD]) (cont'd)			• Conducted trials of transplanting existing trees under winter and summer conditions. • Sponsored trials of frozen tree seedling planting. • Sponsored trials for the use of encapsulated seed products for reclamation purposes. • Sponsored a line-blocking study, as part of L. Neufeld's Master's Thesis on wolf/caribou dynamics in the Little Smoky caribou range.	
ConocoPhillips, Canadian Association of Petroleum Producers and Suncor Energy	Caribou Habitat Restoration Pilot Study	• Remote camera study (summer 2008) initiated within the Little Smoky caribou range in Alberta. Objectives included comparing wildlife (caribou, deer, moose, bear, wolf, coyote, cougar and lynx) presence and use between naturally restored seismic lines and open cutlines.	• Pooled prey species (caribou, deer, moose) preferentially select restored seismic lines (>1.5 m vegetation heights, average age of trees 23 years) over non-vegetated sites. • Deer had the strongest preference for restored sites, with the preference attributed to the increased forage within the restored sites, as well as reduced line-of-site and potentially predator avoidance. • Caribou were shown to have a slight preference for re-vegetated seismic line sites over non-vegetated sites, but with limited data there was no statistical difference. However, caribou on control sites were observed to be running much more frequently than on re-vegetated sites and engaged in standing related behaviours only while on re-vegetated sites. Data indicate that caribou are more likely to travel quickly through open seismic lines, which may be a response to the minimal vegetation cover.	Golder 2009

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports

CNRL	Habitat Enhancement Program	• Program is part of the Terms and Conditions of the *Environmental Protection and Enhancement Act* (*EPEA*) approval for the construction, operation and reclamation of the Canadian Natural Primrose and Wolf Lake (PAW) Project
		• Program targeted the restoration of seismic lines, old lease roads, and abandoned well and core hole sites through re-vegetation and access control to improve wildlife habitat on a caribou range within the CLAWR
		• Focused on restoration of historic (pre-oil sands development) features on the landscape that are recovering poorly, either due to environmental conditions (cold, wet soils), historical clearing and reclamation practices, or recent clearing for winter access
		• Focused on areas outside of 10 year development plan to avoid re-entry into areas where restoration treatments are placed
			• Used aerial imagery to conduct linear corridor vegetation inventories on all of CNRL's CLAWR operations, encompassing approximately nine townships.
			• Detailed restoration plan developed.
			• Ground-truthed sites that appeared on aerial imagery as having little to no woody plant regeneration.
			• Focused on access control and micro-site creation for introduced tree seedlings, using the following three treatments:
			  • mounding;
			  • tree seedling planting; and
			  • rollback.
			• Planting sites are subject to monitoring over a five year period.
			• To date, only monitored black spruce seedlings planted in the summer on sites treated in the winter with excavator mounding in treed bog and fen sites.
			• Excellent survival and vigour of seedlings after one growing season at all monitored sites.
			• Additional site preparation and seedling planting scheduled for 2013.
				Golder 2010

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports

University of Alberta led project, supported by a number of oil/gas companies, Canadian Association of Petroleum Producers (CAPP), Forest Resource Improvement Association (FRIA), and Alberta-Pacific Forest Industries Inc. (ALPAC)	Integrated Land Management	• Ongoing study began in 2004 and focused on contributing to best practices for wellsite construction and reclamation on forested lands in the Green Area of northeastern Alberta. Techniques to enable appropriate revegetation and accelerate recovery of ecological processes after disturbance were studied
		• Old wellsites component involved monitoring soils and vegetation
		• New wellsites component researched methods to use during well-site construction that will promote the prompt revegetation of the site during the reclamation phase
			• Report produced in 2010, "Recommended Practices for Construction and Reclamation of Wellsites on Upland Forests in Boreal Alberta", that evaluated soil and vegetation responses to different winter construction and reclamation techniques.
			• Recommendations included:
			  • maximizing low disturbance construction practices;
			  • use of snow/water to level sites as opposed to stripping;
			  • retain root zone when stripping and store soil layers in separate piles;
			  • plant seedlings promptly after reclamation to lessen impact of native vegetation competition;
			  • rollback is preferable to mulching;
			  • mulch layers need to be less than 10 cm thick when present;
			  • avoid planting tree and shrub species that may impact predator/prey dynamics and do not occur naturally in the area. For example, planting of species palatable to moose in caribou areas should be avoided; and
			  • pre-disturbance assessments and prescription planning can pay dividends at the reclamation stage.	

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
Enbridge Pipelines (Athabasca)	Waupisoo Pipeline Habitat Restoration	• Pipeline construction occurred in the winter of 2007/08 • Promoted revegetation on a pipeline development within critical moose and caribou habitat by: mechanical seeding of the ROW on areas of erosion concern only; promoting the growth of native species from seed; planting tree and shrub seedlings; transplanting existing shrubs; and using rollback for access control and micro-site creation for seedling and seed establishment • Goal was to use growth of planted trees to create line-of-sight breaks, directly restore habitat and control access	• Approximately 250,000 seedlings were planted at strategic locations over 3 summers. Locations included intersections with other linear corridors, upland sites to create line-of-sight breaks, and riparian areas. • Rollback was applied on some steeper slopes and at some intersections with all-season and winter roads. • Shrub species (alder and willow) transplanted successfully on the banks of the Christina River during the winter. • Planting sites are currently subject to monitoring over a five year period. • Good survival of seedlings was observed on upland sites; lowland site seedling survival to be evaluated during monitoring in the fall of 2012 (an update report was not available for review). • Vegetation ingress of clover and native grasses has had a negative impact on seedling survival in some areas. • Where no access control measures were applied, human use of the ROW by ATV damaged many seedlings. • Seedlings planted in conjunction with rollback were not damaged.	Enbridge 2010 Golder 2011

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports

Canadian Natural Resources Limited, Wolf Lake	Interconnect Pipeline	• Pipeline construction occurred during the winter of 2007/08
		• Promoted revegetation on a pipeline development adjacent to the Cold Lake Air Weapons Range (CLAWR) by planting of tree and shrub seedlings
		• Goal was to use growth of planted tree species to create line-of-sight breaks, limit the overall width of the developed corridor that the pipeline parallels, directly restore habitat and control access
			• Planting sites are currently subject to monitoring over a five year period
			• Approximately 60,250 seedlings planted at strategic locations over 2 summers. Locations included:
			  • intersections with other linear corridors;
			  • upland sites to create line-of-sight breaks; and
			  • riparian areas.
			• Planting sites are currently subject to monitoring over a five year period (an update report was not available for review).
			• Good survival of seedlings where mechanical seeding was avoided.
			• Areas mechanically seeded to native grass mixtures had lower survival and vigour of planted seedlings, possibly due to increased competition for sunlight, water and nutrients, and graminoid vegetation falling over and smothering the seedlings when snowfall occurs.
			• Damage to seedlings from ATV use in many monitoring plots.
			• Other environmental factors such as frost and wetland encroachment possibly contributing to seedling mortality.
				Golder 2012a

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
OSLI	Faster Forests	• Ongoing since 2007, planting trees to increase the pace of reclamation	• Planting shrubs along with trees allows for trees to grow healthier, faster and with less competition for nutrients and water from fast-growing grasses. • Planted 143,850 seedlings on 113 sites in 2009. • Planted 238,632 seedlings on 120 sites in 2010. • Planted >600,000 seedlings in 2011 on 200 sites (included 4 tree species, 7 shrub species).	OSLI 2012
	Winter Wetland Planting Trial	• Wetlands re-vegetation trials consisting of winter planting of black spruce seedlings to address challenges involved with planting disturbed wetland sites during the summer months • Goal is to improve reclamation performance	• Planted 900 trees in winter 2011. • >90% survival rate in spring 2011. • Findings were used to help develop a larger scale frozen seedling program for the on-going Algar Reclamation Program.	

	Algar Reclamation Program	• Program targeting the restoration of seismic lines through re-vegetation and access control to improve wildlife habitat in a caribou area with historic seismic disturbance
		• The Algar area of northeastern Alberta covers approximately six townships (each township is 6 miles by 6 miles)
			• Inventory of linear disturbance completed using remote sensing methods.
			• Detailed restoration plan developed.
			• Stakeholder consultation led by AESRD on the closure of selected seismic lines to the general public (*i.e.*, to provide some level of protection to areas with restoration treatments).
			• Macro-scale restoration activities began in winter 2011/2012 and include:
			  • excavator mounding;
			  • rollback; and
			  • frozen tree seedling planting.	

Table 2 Historic and Current Habitat Restoration Initiatives (cont'd)

Company or Group	Initiative Name or Goal	Description	Accomplishments and/or Learnings	Key Reports
Alberta School of Forest Science and Management / OSLI	Coarse woody debris management - best practices	• Goal is to come up with consistent standards that industry users can implement when spreading woody debris on reclaimed sites	• Developed a guide for improved management of coarse woody debris materials as a reclamation resource. • Best practices manual was prepared through consultation with resource managers and operators, consideration of economic and ecologic requirements, and synthesis of the most relevant and current scientific knowledge. • Wood mulch depths exceeding 3-4 cm form an insulating layer over the soil surface limiting plant growth. • Use of whole logs enhances forest recovery by creating microsites, which creates improved conditions for vegetation to establish and grow. • Total rollback of material along the entire length of exploration and access features is the most effective way to discourage recreational use of linear features. • Well-designed scientific monitoring of wildlife use is needed to provide managers with an understanding of treatment effectiveness.	OSLI 2012

NOTE:
Table modified from Golder 2012b.

A standard alternative to salvage and transplanting is to source seeds and/or seedlings from a nursery. Typically, trees and shrubs are sourced about one year prior to planting, either as seeds or seedlings from a source in the same geographic region as the Project. Seed mixes for plants and agronomic grasses can be sourced on a shorter timeframe, often in the range of three to four months. Consideration of the species mix, and the ratio of each species in the mix, will be provided in the Final CHRP.

Seismic lines have been reported to have very slow reforestation rates (Revel *et al.* 1984, Osko and MacFarlane 2000), and recovery is strongly influenced by the characteristics of the adjacent forests (*e.g.*, site productivity, tree and shrub species and heights) (Bayne *et al.* 2011). Conventional seismic lines cleared by bulldozer may take as long as 112 years to reach 95% recovery to woody vegetation in the absence of restoration efforts (Lee and Boutin 2006). Slow tree regeneration has been attributed to root damage from the original disturbance, compaction of the soil in tire ruts, insufficient light reaching the forest floor, maintenance of apical dominance from surrounding stands, introduction of competitive species (*i.e.*, planted seed mixes), drainage of sites (*i.e.*, regeneration slowest on poorly-drained sites with low nutrient availability such as bogs) and repeated disturbances (*e.g.*, all-terrain vehicles [ATVs], animal browsing, repeated exploration) on seismic lines (Revel *et al.* 1984, MacFarlane 1999, 2003, Sherrington 2003, Lee and Boutin 2006). However, tree regeneration on seismic lines is a key determinant of recovery success (MacFarlane 2003) and, therefore, factors that hinder revegetation efforts should be mitigated.

The ability of linear features to recover to a natural forested state is affected considerably by human use. Oberg (2001) identified that recovery of conventional seismic lines to functioning mountain caribou habitat occurs within 20 years following disturbance in west-central Alberta. Golder (2009) reports that in the Little Smoky caribou range, seismic lines that were allowed to revegetate naturally achieved an average height of 2 m, across all ecosite types, within 20 to 25 years, when they had not been recently disturbed by human activity (*e.g.*, re-cleared to ground level for winter access or seismic program use). The average age of trees on the control lines was only 10 years, suggesting sites that are continually disturbed or re-cleared by human activity take longer to regenerate. Restoration efforts have also failed when ATVs destroyed seedlings after planting (Enbridge 2010, Golder 2011, 2012a). The federal recovery strategy for boreal caribou indicates that forested stands less than 40-50 years of age, depending on stand type, do not meet critical habitat requirements for the Chinchaga range (Environment Canada 2012).

Subjective expert ratings suggest that effectiveness of most physical access control measures (*e.g.*, gates, berms, excavations, rollback, visual screening) vary considerably between negligible and high effectiveness in controlling human access (Caribou Landscape Management Association [CLMA] and the Forest Products Association of Canada [FPAC] 2007). Effectiveness, or ability to reduce variability, of access control measures is likely dependent on suitable placement (*e.g.*, placed to prevent detouring around access control point), enforcement, and public education on the intent of the access control, which facilitates respect of the control measures (AXYS 1995). Mounding has been found to discourage human access (*i.e.*, truck and ATV) during snow-free periods and also creates microsites that improve vegetation establishment (review in CLMA and FPAC 2007). Excavator mounding is a well-researched and popular

site preparation technique in the silviculture industry (Macadam and Bedford 1998, Roy *et al.* 1999, MacIsaac*et al.* 2004). Target density of mounding for access control and/or microsite creation purposes can vary from 1,400 to 2,000 mounds/ha (AENV 2011). Switalski and Nelson (2011) monitored human access on open and closed (*i.e.*, gated, barriered and recontoured) roads using remote cameras, and found that the frequency of detection of humans on closed roads was significantly lower than on open roads, but not significantly different among road closure types. Results of that study also indicated significantly higher levels of hiding cover and lower line-of-sight distances on barriered and recontoured roads compared to open roads (Switalski and Nelson 2011). Physical access control measures provide short-term solutions to manage access and allow for natural regeneration (Golder 2009). Once linear features have regenerated to a pole sapling or young forest structural stage, Sherrington (2003) suggested that ATV access is no longer facilitated. However, when a pipeline must be operated free of trees in the range of 6-10m wide above the ditch line, other means of access control at key access points would be required (e.g., use of berms, boulders or gates). Where the Project RoW is contiguous with another operator, as is the case for 29.2 km of transmission line that is parallel to the Project, the challenge of effective access control is greater.

The above techniques to block human access also contribute to initiatives to block line-of-sight. Short-term management for access and line-of-sight blocking should ultimately lead to long-term access control by way of revegetation of disturbed areas (CLMA and FPAC 2007). Expediting growth of visual barriers along linear features can be achieved by concentrating restoration efforts on productive upland habitats, since conifer and shrub (*e.g.*, alder) species grow more quickly on these sites compared to lowland sites. Although regeneration of conifer species provides the best year-round visual barrier, their growth can be slow. Therefore, encouraging deciduous woody species growth is important to quickly establish visual barriers in the short-term.

While there has been some effort to assess wildlife use of regenerating seismic lines (*e.g.*, Bayne *et al.* 2011) and reclaimed areas in the Athabasca Oil Sands Region (*e.g.*, Hawkes 2011), few researchers have assessed natural habitat recovery and wildlife responses to recovery with respect to caribou. A pilot study was conducted in the Little Smoky caribou range to measure the effects of revegetating linear disturbances on wildlife use and mobility (Golder 2009). Data were collected for a group of predators (*i.e.*, cougar, wolf, coyote, lynx, grizzly and black bears) and prey (*i.e.*, moose, deer and caribou). Results of the pilot study indicated that revegetated seismic lines (*i.e.*, minimum 1.5 m vegetation regrowth) were preferred by both predator and prey species compared to control lines (*i.e.*, vegetation regrowth of 0.5 m or less), and in general, control lines were used primarily for travel (*i.e.*, both predators and prey species were constantly moving as opposed to standing, foraging, etc.). In addition, human use was almost exclusively limited to the control lines. The line-of-sight measured on the revegetating lines was typically less than 50 m. Golder (2009) suggested that moose and deer may have been attracted to the revegetated lines for forage availability and perceived cover protection. The preference for regenerating seismic lines by wolves may be explained as a response to increased prey use of these lines (Golder 2009). The study also showed that caribou travelled more quickly (running more frequently) and did not

engage in standing-related behaviours on control lines, whereas on revegetating lines running was rare and standing-related behaviours occurred more often.

Line-blocking is another potential measure that may have benefits for controlling access and reducing wolf use. Neufeld (2006) conducted a preliminary assessment of tree-felling along seismic lines to block access in the Little Smoky herd range in Alberta during the summer and fall of 2004. While she did not observe statistical significance between wolf use of blocked versus non-blocked seismic lines, there was an indication that wolves tended to use areas with unblocked seismic lines more often than areas with blocked seismic lines (Neufeld 2006). Neufeld (2006) concludes that if tree-felling is to be used as a line-blocking measure, it should be investigated more thoroughly, and not relied upon solely as a mitigation tool. Preferably, line-blocking should be used in combination with other management actions such as habitat restoration (Neufeld 2006), and continue to be evaluated for effectiveness using an adaptive management approach.

To date, vegetation recovery in the medium and long-term following the creation of pipeline ROWs or other industrial activity has been poorly documented. Lack of time sequence recording for regenerating seismic lines and other developments reduces the ability to estimate natural rates and types of vegetation recovery. The focus of most initiatives has been on establishing vegetation along pipelines or seismic lines, with goals of creating line-of-sight breaks, directly restoring habitat with transplanted vegetation, planting shrub and tree seedlings, sowing native shrub and tree seed, and controlling human access to reclaimed areas to allow undisturbed vegetation growth. Due to the lack of monitoring and the time lag that exists to restore caribou habitat, there is currently no direct link to indicate that implemented restoration techniques are having a positive effect on caribou populations. However, based on modeling scenarios of management options for caribou, restoration of habitat should have benefits in the long-term by contributing to the restoration of large contiguous habitat patches that are preferred by caribou.

3.2.2 Best Suited Restoration Methods and Knowledge Gaps

Based on the review of industry initiatives in habitat restoration, a suite of habitat restoration measures that are considered best suited for caribou areas have been identified and provided in Table 3. Transplanting of native vegetation has not been included since it has been shown to be a difficult technique to implement on a large scale, and has marginal results.

The literature review also provided the opportunity to identify knowledge gaps. These have been identified as:

- restoration criteria (*e.g.,* defined guidelines or measurable objectives) for restoration of boreal ecosystems for wildlife habitat values, in particular habitats that do not support merchantable timber (*e.g.,* treed bogs and fens);
- functional responses of caribou, wolves and primary prey (*e.g.*, moose, deer) to reclaimed habitats in various stages of successional progression, as well as to access control and line-of-sight management; and

- long-term monitoring of vegetation recovery on linear disturbances and of predator response to access control.

Table 3 Habitat Restoration Methods Best Suited for Caribou Areas

Type of Mitigation Prescription	Objective(s)	Specifications	Comments	References
Minimum disturbance construction	• erosion control • reduce line-of-sight • facilitate rapid revegetation of native vegetation • maintain natural drainage	Grubbing on the ROW is restricted to the trench width, allowing the integrity of the root layer to be maintained on the majority of the ROW, and allowing rapid recovery of herbaceous and deciduous woody vegetation species. Snow padding or matting on work areas of the ROW can be used to avoid the need for grubbing, and protect shrubs and small trees.	Construction during winter conditions reduces the need for soil salvage and grading, and the width of grubbing is limited to the trench area. Reduced disturbance to vegetation and root systems by cutting, mowing or walking down and mulching shrubs and small diameter trees at ground level facilitates rapid regeneration of vegetation. Use of snow padding or matting in select locations limits the need for cutting or mowing shrubs and small trees, and facilitates regeneration of native vegetation.	Results of preliminary field evaluation one growing season following construction on the Horn River Pipeline Project (TERA 2012).
Excavator mounding	• create microsites in areas where it is deemed to be effective for enhanced survival and growth of planted seed and seedlings, and natural regrowth of woody species • access control	For access control purposes, mounds should be created using an excavator. Mounds should be approx. 0.75 m deep, if feasible. The excavated material is dumped right beside the hole. Target density of mounding for access control and/or microsite creation purposes can vary from 1,400 to 2,000 mounds/ha.	For the purposes of enhancing microsites for planted seedlings, mounding is a well-researched and popular site preparation technique in the silviculture industry. It is commonly used in wetter, low-lying areas to create higher, better-drained microsites for seedlings. Mounding treed fen and bog areas can enhance a site to promote natural revegetation over time, as higher, drier spots are created that seed can eventually settle into and germinate. Mounding has been used as an access control measure on old roads and seismic lines to discourage off-road vehicle activity. It is effective immediately following implementation.	Macadam and Bedford 1998 Roy *et al.* 1999 MacIsaac*et al.*2004 Golder 2010 OSLI 2012

Table 3 Habitat Restoration Methods Best Suited for Caribou Areas (cont'd)

Type of Mitigation Prescription	Objective(s)	Specifications	Comments	References
Bio-engineering	• access control • erosion control • reduce line-of-sight • restore habitat	Species and densities utilized are site dependent.	Bio-engineering is the use of existing live vegetation to revegetate a site (*e.g.*, transplants; installing cuttings). Vegetation used is either found at the site to be treated, or collected nearby in the form of cuttings. Willows and poplar can be used as cuttings. Both species are fast growing, which establishes line-of-sight breaks quickly and works well for riparian restoration. Bio-engineering is considered a medium to long-term restoration treatment.	DES 2004 Golder 2005, 2011 Polster 2008
Tree/shrub seeding	• access control • erosion control • reduce line-of-sight • restore habitat	Species and application rates required are site dependent.	Seeding is considered a long-term restoration treatment. Application rates and preferred sites for seeding require further investigation.	CRRP 2007a Golder 2012a
Tree/shrub seedling planting	• access control • erosion control • reduce line-of-sight • restore habitat	Determination of which species to plant is determined at the planning stage of a restoration program. Species are determined based on the adjacent forest stand and restoration objectives (*e.g.*, low palatability for ungulates). Appendix A summarizes reclamation considerations specific to a selection of potentially suitable tree and shrub species. Shrub and tree seedlings are often planted together, depending on site conditions and anticipated natural revegetation of both species.	Seedling planting is considered a long-term restoration treatment due to the length of time it takes to establish effective line-of-sight breaks, hiding cover and access deterrents.	AENV 2010, 2011 CRRP 2007a DES 2004 Golder 2005, 2010, 2011, 2012a OSLI 2012

Table 3 Habitat Restoration Methods Best Suited for Caribou Areas (cont'd)

Type of Mitigation Prescription	Objective(s)	Specifications	Comments	References
Berms	• access control • reduce line-of-sight • create microsites and protection for natural seed ingress and vegetation growth	Berms may be constructed of slash and timbers, or a combination of slash and earth. Supported berms are constructed using timber cleared from the ROW. Construct berms to an approximate height of 2 m. Promote rapid shrub/tree regeneration at ends of berms (*e.g.*, bio-engineering, seedling planting) to increase effectiveness as access control.	Feasibility of slash/timber berms is dependent on approval from provincial authorities to retain and pile slash onsite, and retention of sufficient quantities of slash onsite during construction. Availability of source material is unlikely sufficient for earth berm construction in areas where minimal disturbance construction techniques are employed. Earth berms should not be located in peatlands to avoid potential for settling and alteration of surface hydrology. Berms are effective immediately following implementation.	TERA 2011b Westland Resource Group 2011

Table 3 Habitat Restoration Methods Best Suited for Caribou Areas (cont'd)

Type of Mitigation Prescription	Objective(s)	Specifications	Comments	References
Rollback	• control of human access during snow free periods • erosion control, particularly along steep slopes • protect planted seedlings from extreme weather, wildlife trampling, and damage from off-road vehicles (human access) • provide nutrients to introduced planted seedlings as the rollback decomposes over time • provide microsites for natural seed ingress	Spread rollback evenly across the entire ROW width. Ensure coarse woody debris is consistently dense enough on the ground to discourage ATV use along a ROW. Osko and Glasgow (2010) recommend rollback loads do not exceed 400 tonnes/ha. Locations where rollback are considered effective include the following: • on each side of an intersection with a linear feature that is not an all season road; • for 100 - 200 m or more on each side of roads and permanent watercourses crossed by the ROW, depending on site suitability; • on segments of the ROW that deviate from paralleling existing linear features (*i.e.*, new cut) to discourage new access trails from developing; • on slopes > 10%; and • on temporary access (*i.e.*, shoo-flies) and false rights-of-way created for vehicle crossings of watercourses Implement along segments left for natural recovery (*e.g.*, areas that are not graded, have low erosion potential, are located within wetlands), as well as segments that are seeded and/or planted with seedlings (*e.g.*, upland areas that are graded, upland and lowland areas where adjacent vegetation is characterized by a treed component).	The use and length of a rollback segment is dependent on sufficient quantities of rollback during clearing of new disturbance and the trade-off between its use and the ability/space to store it during construction. Longer segments are a more effective treatment at controlling human access since ATV riders will be less inclined to try to ride through the rollback or traverse around the rollback in adjacent forest stands if rollback continues for an extended distance. Rollback can also conserve soil moisture, moderate soil temperatures and provide nutrients as rollback decomposes, prevent soil erosion, provide a source of seed for natural revegetation, provide microsites for seed germination and protection for introduced tree seedlings, and protect seedlings from wildlife trampling and browsing. Rollback is effective immediately following implementation.	CRRP 2007b Enbridge 2010 Osko and Glasgow 2010 Golder 2010, 2011 Government of Alberta 2012 OSLI 2012

4 PRIORITIZATION OF RESTORATION SITES AND MITIGATION

4.1 Habitat Restoration Measures and Site Selection

Based on the literature review, and on specific Project knowledge, general decision-making criteria were used to develop habitat-specific decision trees for the Chinchaga Section. The decision trees were developed to guide the process of identifying areas for habitat restoration, access control and line-of-sight measures in caribou range, and determining which kinds of measures are expected to be most applicable and effective. The general decision-making criteria and habitat-specific decision trees include consideration of best management practices, Project design and construction techniques, industry standards (*i.e.*, Canadian Standards Association [CSA] Z-662-11 (CSA 2011) and preliminary habitat information. The decision trees also allow for consideration of habitat information being collected as part of the detailed caribou habitat assessment specified in Condition 7.

Habitat-specific Decision Trees: initial restoration units and associated suitable restoration measures were identified using information from the general decision-making criteria that would be applicable to the Chinchaga caribou range. The purpose was to identify Project-specific habitat types, construction factors and habitat restoration measures that may be applied based on general decision-making criteria. Details on the restoration units identified for the Project within the Chinchaga caribou range are provided in Appendix B, and decision trees for determining which restorative measures could be used for each restoration unit or objective under different scenarios are provided in Figures 2a-b. A decision tree for access control and line-of-sight blocks has also been developed using general decision-making criteria and consideration of Project-specific factors to improve effectiveness (Figure 2c). This information was used as the basis for developing quantifiable targets and performance measures for restoration of the Project footprint for the Preliminary CHRP. In addition, pursuant to Condition 7, the Pre-construction Caribou Habitat Assessment will identify, describe and quantify critical habitat types, including their biophysical attributes and areal extent within the Chinchaga Section ROW. This information may be used to adjust quantifiable targets and performance measures consistent with Condition 10 (CHRP), and the general decision-making framework and Appendix B will be revised so as to directly relate to caribou critical habitat attributes as requested in Condition 7 and described in the final federal recovery strategy. Monitoring and adaptive management will facilitate identification of unsuccessful restoration techniques, microsite conditions that are either not conducive or suitable for establishment of vegetation, and measures that need to be adjusted or supplemented to achieve the objectives of the CHRP. Section 5.4 provides additional details on Monitoring and Adaptive Management. Where restoration and other mitigation measures are applied on contiguous NGTL lines, these measures will qualify as offsets.

4.1.1 Project Considerations

Certain opportunities and constraints exist for applying site-specific restoration measures for the Project. Site-specific factors that may constrain or restrict restoration measures include:

- locations necessary for access during operations and maintenance;
- locations that are recognized by other resource users for future developments (*i.e.*, publicly disclosed, applied for and/or approved but not yet completed projects) and would require habitat disturbance within or adjacent to the Project footprint;
- locations that are considered traditional access;

In contrast, site-specific factors that will provide suitable conditions to apply restoration treatments include:

- other linear features (except roads) that intersect the Project footprint. Results from the pre-construction assessment of line-of-site at intersecting linear features as part of Condition 7 will be used as a basis for determining target sites and determining the extent to which line-of-site blocking and access control is needed;
- locations adjacent to watercourse crossings, where extending riparian construction methods and restoration efforts beyond the riparian area is feasible;
- areas rated as having moderate to high habitat capability as caribou habitat (*e.g.*, suitable forage, adequate cover/security, located away from human disturbance);
- areas that are accessible to restoration crews and equipment. Some restoration techniques may be limited by ground conditions (e.g., placement of rollback during frozen ground conditions) or by season (e.g., planting occurs in summer) when certain areas such as muskeg or wetlands may be difficult to access;
- availability of suitable material and provincial regulatory approval for rollback and berms. This will include consideration of potential hazards (e.g., fire) associated with using large volumes of timber for rollback and berms;
- on each side of an intersection with a linear feature that is not an all season road;
- at least 100 m of space required on each side of roads and permanent watercourses crossed by the ROW;
- on segments of the ROW that deviate from paralleling existing linear features (i.e., new cut) to discourage new access trails from developing;
- on slopes > 10%, and;
- on temporary access (i.e., shoo-flies) and false rights-of-way created for vehicle crossings of watercourses.

Final site selection for the habitat restoration measures will require as-built construction information to allow for validation of site-specific conditions, and input from the NGTL construction and operation/maintenance staff, Project biologists and reclamation specialists, as well as AESRD

representatives. A thorough review of site characteristics will facilitate determination of the suitability of particular sites for restoration, and selection of appropriate restoration treatments. Results from the pre-construction critical habitat assessment obtained as part of Condition 7 will also be used to identify final site selection. Information pertaining to as-built construction will also be considered, including proactive mitigation such as drilling/boring under vegetation buffers, narrowing the ROW, reducing temporary workspace, and avoiding improvement of access and line-of-sight. Experience from implementing the CHRP for the NGTL Horn River Mainline Project (TERA 2011a, 2012) will be incorporated in the decision process.

4.2 Access Control and Line-of-Sight Management

Techniques that reduce human access and possibly predator travel and hunting efficiency also need consideration when restoring habitat in caribou range. These are discussed below and are part of the decision trees in Figure 2c. Where access control and line-of-sight management is applied on the contiguous NGTL line that is adjacent to, but not part of, the Chinchaga Section, these measures will qualify as offsets.

ACCESS CONTROL

Access control measures will include rollback, vegetation planting, mounding or installation of berms (Figure 2c). Locations for access management measures will focus on intersections of the Project with other linear features, such as roads, utility rights-of-way, seismic lines or watercourses. No existing access control measures were noted during wildlife surveys or overflight surveys. Since public awareness of the reasons for access restrictions may influence the effectiveness of access control measures, signs will be installed in appropriate locations to facilitate understanding and respect for access closures.

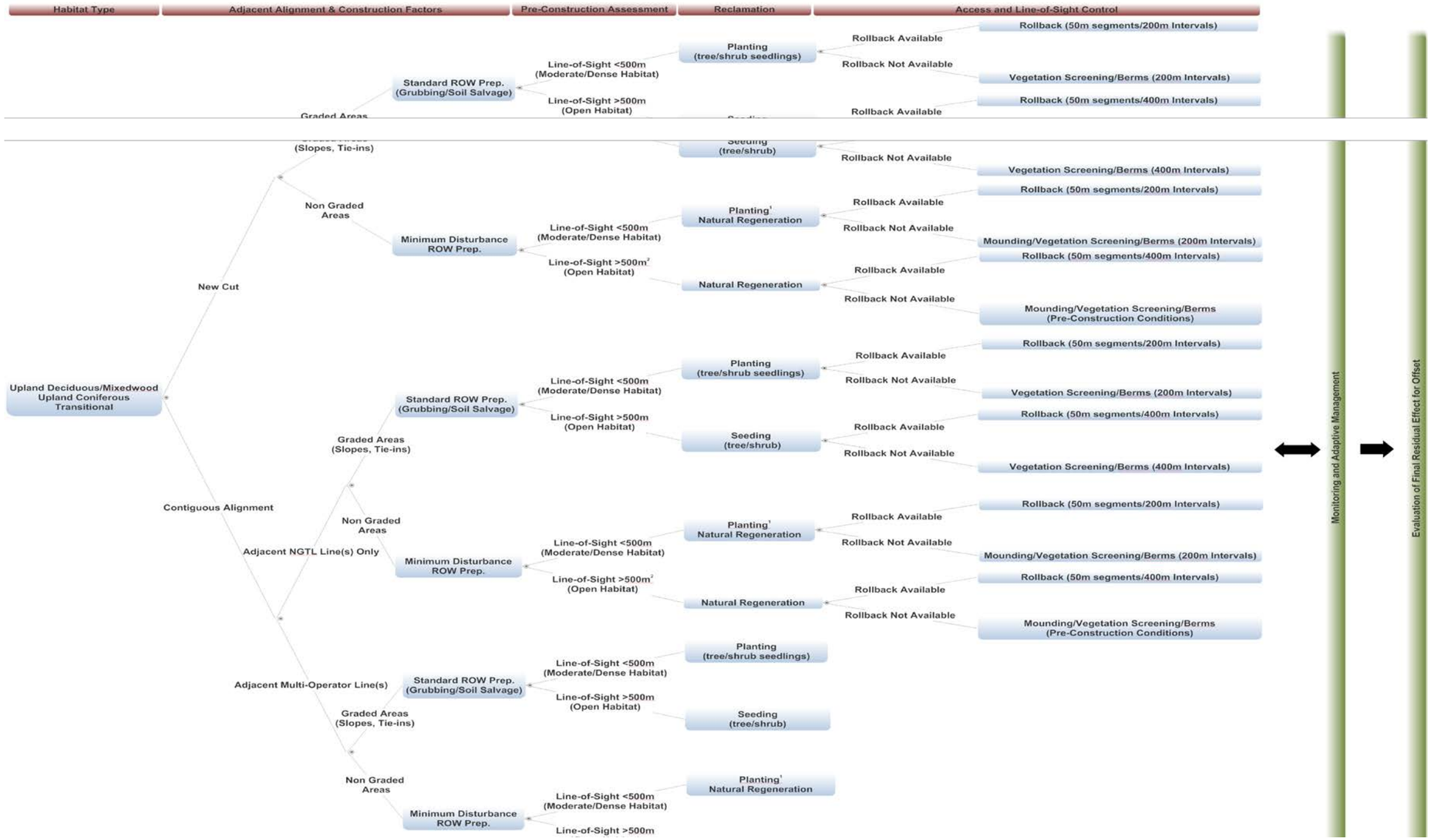
Planning considerations during the preconstruction phase include limiting the creation of new access for construction activity and identifying existing intersecting linear features. Preliminary locations for retention of rollback will be reviewed and refined in the field prior to construction by the Environmental Inspector and construction manager, based on factors such as availability of material and storage space. Implementation will occur along segments left for natural recovery (e.g., areas that are not graded, have low erosion potential, are located within wetlands), as well as segments that are seeded or planted with tree or shrub seedlings (e.g., upland areas that are graded, upland and lowland areas where adjacent vegetation is characterized by a treed component).

LINE-OF-SIGHT MANAGEMENT

Measures to reduce sight-lines may discourage human use and may also decrease predator efficiency. Appropriate locations for line-of-sight blocks include transition zones between upland forest and muskeg/black spruce forest, areas with level terrain that have long sight-lines, and where the pipeline loop intersects an existing road or other linear feature. Bends in the ROW (*e.g.*, dog-legs) are an effective method of limiting line-of-sight distances, but limited opportunities for dog-legs exist where the Project is

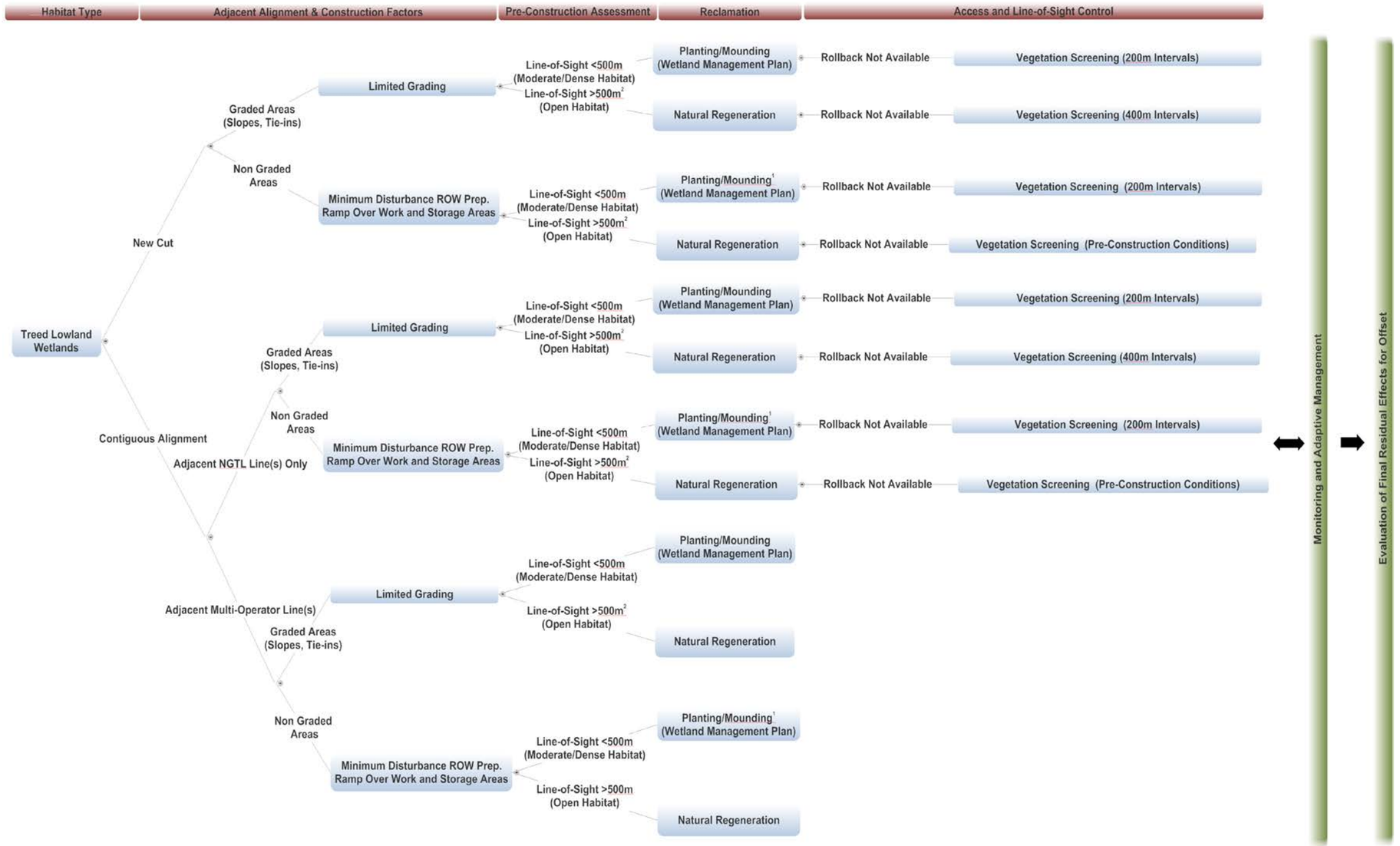
adjacent to an existing ROW. Line-of-sight can also be reduced through the use of short-term measures (*e.g.*, rollback or earth berms constructed to an approximate height of 2 m; fences) and/or long-term measures (*e.g.*, vegetation screening). Although berms and fences can be an effective measure to create immediate breaks in lines-of-sight (TERA 2011b, Westland Resource Group 2011), the feasibility of their use is limited by increased fire hazard and pest outbreak risks. Berms and fencing may not be feasible in some situations such as lowland (*e.g.*, muskeg) areas where surface drainage may be affected and/or the peat substrate does not support fencing material. Earth berms may also be impractical if sufficient source material is not available, which is often the case in locations where minimal disturbance construction is employed (*i.e.*, reduced surface disturbance and grading). Spreading of weed seeds is also a concern associated with earth berms that are constructed using imported material. In consideration of these factors, the installation of earth berms is not a practical approach in many cases. Vegetation screening, combined with bends in the ROW, are better suited for reducing line-of-sight in caribou range. In addition to natural regeneration, vegetation screens that avoid forage species (*e.g.*, willows, legumes) attractive to ungulates can be planted across the ROW.

Planning considerations during the pre-construction phase for the Project include identifying potential candidate sites for short-term (*e.g.*, rollback, fences or berms) and/or long-term measures (*e.g.*, vegetation screening) for line-of-sight blocks. In addition, as part of Condition 7, a pre-construction assessment of line-of-sight at all linear features intersecting the Project ROW will be completed and used to aid in determining baseline targets for line-of-sight restoration. Based on previous experience (*i.e.*, NGTL Horn River Project), the final locations for rollback, berms or vegetation screening are most effectively determined post-construction when final clearing is complete, when the as-built construction footprint is known, and following discussions with provincial regulators.



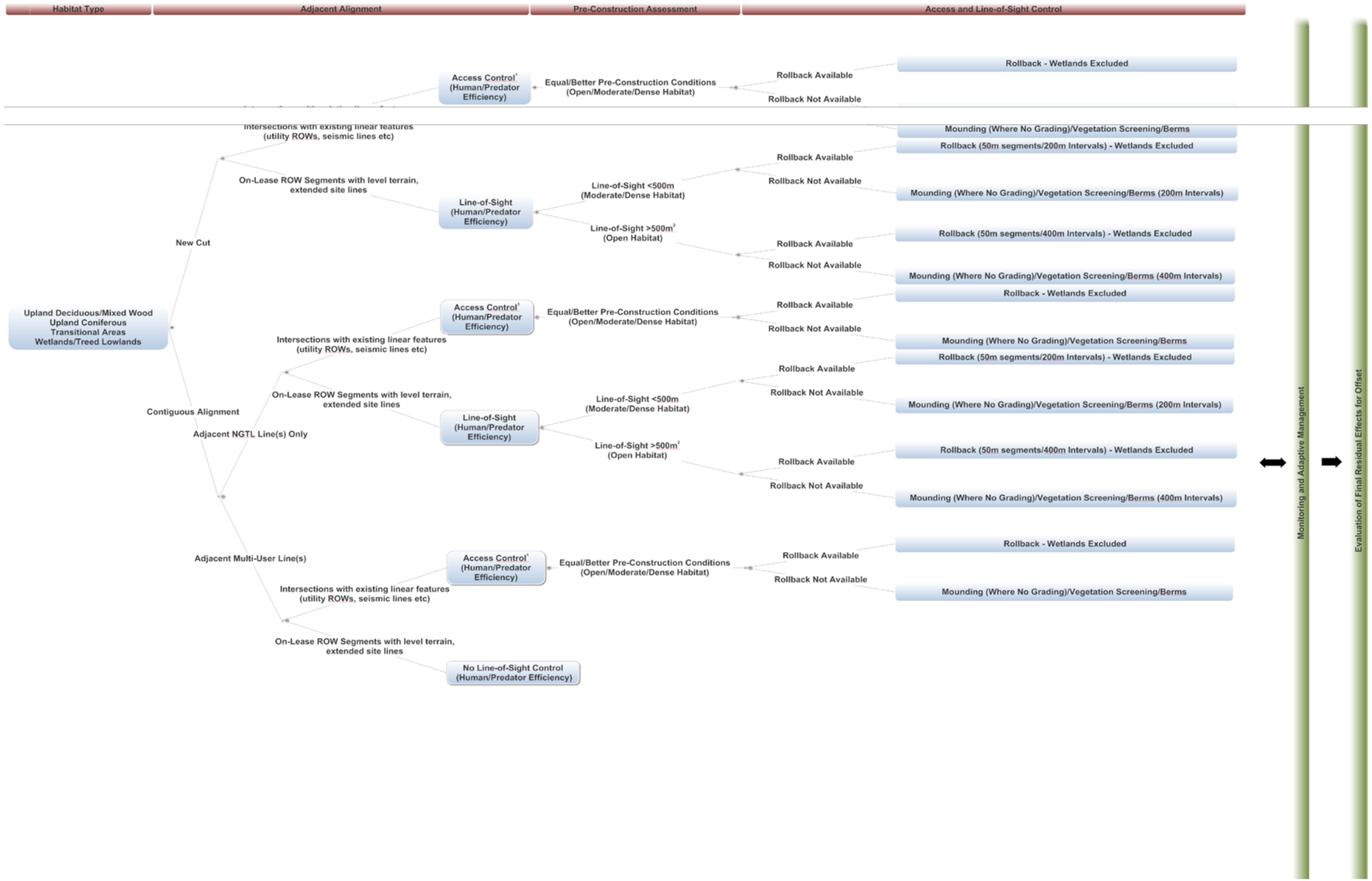
NOTE: (1) Habitat-specific planting to accelerate natural regeneration in areas of minimal disturbance ROW preparation with line-of-sight < 500 m will be obtained from detailed habitat information as part of Condition 7 of Certificate GC-121 (Pre-construction Caribou Habitat Assessment).

Figure 2a Chinchaga Lateral Loop No.3 – Caribou Habitat Restoration Site Selection and Mitigation Prioritization Decision Tree (Upland Mixedwood/Upland Coniferous/Transitional Habitat)



NOTE: (1) Habitat-specific planting to accelerate natural regeneration in areas of minimal disturbance ROW preparation with line-of-sight < 500 m will be obtained from detailed habitat information as part of Condition 7 of Certificate GC-121 (Pre-construction Caribou Habitat Assessment).

Figure 2b Chinchaga Lateral Loop No.3 – Caribou Habitat Restoration Site Selection and Mitigation Prioritization Decision Tree (Treed Lowlands and Wetlands)



NOTE: (1) Access control at intersecting existing linear features (i.e., roads, utility ROW, seismic lines etc.) will not be implemented in areas identified through consultation as traditional use.

Figure 2c Chinchaga Lateral Loop No.3 – Caribou Habitat Restoration Site Selection and Mitigation Prioritization Decision Tree (Line-of-Sight and Access Control)

5 EVALUATION OF RESIDUAL EFFECTS AND RESTORATION OBJECTIVES

This section provides additional detail on the quantifiable targets and performance measures, including methods for evaluating predicted residual effects and restoration objectives, and a discussion of the rationale associated with uncertainty. A summary of the quantifiable targets and performance measures identified for the Project and evaluation criteria are provided in Table 4. In the event that provincial guidelines related to restoration objectives are updated, Table 4 will be re-evaluated for the Final CHRP in consideration of any updates.

5.1 Habitat Restoration

NGTL's commitments to caribou habitat restoration for the Chinchaga Section within caribou range are summarized in Table 4. The preliminary restoration units used to derive the initial restoration targets in Table 4 are provided in Appendix B. These units will be re-evaluated, and potentially adjusted, following a review of results from the pre-construction caribou habitat assessment (see Condition 7).

The Reclamation Assessment Criteria for Pipelines (AENV 2001, AENV 2010) recommends that Equivalent Land Capability should take into account natural variability, which considers the range of landscape attributes that are encountered and influenced by slope, drainage, vegetation composition and organic matter. Evaluation criteria have been identified (Table 4), and are expected to vary depending on the site conditions. For example, the target stem density will vary for different sites, depending on the characteristics of the location and adjacent habitat (*e.g.*, lower stem density naturally occurs in some lowland forests).

Based on the literature review (Section 3.0), previous project experience and NGTL's commitment to implement minimal surface disturbance construction techniques, the Project footprint is expected to revegetate naturally in areas of upland deciduous and mixedwood forests, and in graminoid and shrub-dominated wetland communities. Additional restoration measures such as site preparation (*e.g.*, mounding) and/or planting trees/shrubs will be implemented in transitional and treed lowlands, and potentially in graded areas, to accelerate revegetation and achieve the performance measures of habitat restoration. The actual proportions will be defined in the Final CHRP.

The measurable objectives in Table 4 specifically related to habitat restoration should be considered preliminary and subject to change. Restoration and variables such as the extent of grading, the potential need for clearing of access over the centreline of pipe during the operations phase of the Project (*i.e.*, evaluation criteria are affected by 6 to 10 m wide area centered over the pipeline) and shared workspace on adjacent existing linear corridors. Assumptions are made in order to address uncertainty. Additional variables that may be encountered over the course of this process and identified through consultation with AESRD and Environment Canada will be addressed in the Final CHRP.

Table 4 Evaluation Criteria for Measurable Objectives

Objective/Project Implementation[1]	Rationale / Limitations / Assumptions	Evaluation Criteria	Performance Measures / Targets

Habitat Restoration:
• Based on a review of the restoration units (Appendix B), pre-construction survey drawings, and NGTL's commitment to minimum disturbance construction, NGTL estimates the following proportion of restoration measures will be undertaken on the Project footprint:
  • ~47% of the available[2] footprint = natural regeneration (upland deciduous and mixedwood areas);
  • ~1% of the available[2] footprint = combination of natural encroachment/revegetation from the existing adjacent seed bank and strategic seeding/planting of coniferous species (upland coniferous areas);
  • ~41% of the available[2] footprint = combination of treatments including natural regeneration, site preparation techniques (*e.g.*, mounding and rollback to create microsites) and strategic seeding/planting of tree/shrub species (treed lowlands and poorly drained transitional areas (11%) and previously disturbed land (30%)); and
  • ~11% of the available[2] footprint = natural regeneration (wetlands including open water wetlands and graminoid or shrub-dominated lowlands).
	• Successful native vegetation re-establishment through the set of habitat restoration measures proposed will achieve trajectories toward natural ecosystem types, which will eventually re-establish native wildlife habitat.
	• The Project footprint in caribou range is the proposed clearing of new area (i.e., excludes overlapping/shared areas with existing disturbances).
	• NGTL's operation and maintenance practice includes vegetation control over the pipe centreline (approximately 6-10 m wide area centred over the pipeline) (TCPL 2011) as a corporate mechanism to meet compliance with CSA-Z662-11. This Standard requires that vegetation shall be controlled along rights-of-way to maintain clear visibility from the air and provide ready access for maintenance crews (CSA 2011). Although there is flexibility in NGTL's vegetation control practice to allow for wildlife habitat objectives yet remain in compliance with CSA-Z662-11, NGTL acknowledges limitations for sustained revegetation success along the pipe centreline while the pipeline is in operation. NGTL understands its obligations for achieving equivalent land capability at the end-of-life of the pipeline.
		• Quantitative measures of success will include comparisons of regeneration parameters (e.g., vigour, height, percent cover, species composition) between years 1, 3 and 5 following commencement of operation with the objective of ensuring the establishment of each habitat type and a trend towards achieving equivalent land capability. Regeneration success will also be compared to pre-construction habitat assessments (see Condition 7) to determine whether caribou critical habitat attributes are successfully being restored.
		• GPS location, number and type of restoration treatments and the frequency of monitoring sessions will be defined and mapped in the final CHRP.
			Upland Deciduous/Mixed Wood/Transitional
			• Achieve 70% or higher survival rate for planted seedlings within 5 years following commencement of operation.
			• Demonstrate sustained growth trends across 70% of restoration locations within 5 years following commencement of operation.
			
			Upland Coniferous
			• Achieve 70% or higher survival rate for planted seedlings within 5 years following commencement of operation.
			• Demonstrate sustained vegetation growth trends across 70% of restoration locations within 5 years following commencement of operation.

Table 4 Evaluation Criteria for Measurable Objectives (cont'd)

Objective/Project Implementation[1]	Rationale / Limitations / Assumptions	Evaluation Criteria	Performance Measures / Targets
Habitat Restoration (cont'd):	• Although restoration measures will be undertaken across the entire Project footprint, expectations for intermittent maintenance on the pipeline centreline (discussed above), approximately 70% of the Project footprint will be available for sustained revegetation during the operational life of the pipeline. • The length of ROW requiring grading cannot be accurately determined prior to clearing; however, the extent of grading is anticipated to be limited given the low-grade nature of the terrain. Therefore, the proportion of the ROW requiring grading is excluded from the estimated restoration for the purposes of this Preliminary CHRP. • Areas of the Project footprint that parallel existing footprints with grass cover may have limited successful survival of planted species, due to competition from species ingress from adjacent disturbance. • Overlapping dispositions such as a gravel roads or facilities may limit long-term restoration prior to end-of-life.	• Where revegetation success is inadequate, NGTL will use adaptive management to determine an appropriate course of action. For example, if seedling mortality is unexpectedly high, NGTL may choose to do additional planting, improve site conditions for seedling success, or improve restoration efforts at other sites.	Wetlands/Treed Lowlands • Achieve 50% or higher survival rate for planted seedlings/transplants within 5 years following commencement of operation. • Demonstrate sustained growth trends across 50% of restoration locations within 5 years following commencement of operation.

Table 4 Evaluation Criteria for Measurable Objectives (cont'd)

Objective/Project Implementation[1]	Rationale / Limitations / Assumptions	Evaluation Criteria	Performance Measures / Targets

Access Control:
• Access control measures will include rollback, vegetation planting, mounding or installation of berms (Figure 2). Refer to Section 4.2 for additional information.
	• The Chinchaga Section of the route is located in a relatively remote area. Observations from field studies conducted for the project and anecdotal observations from AESRD indicate there are low levels of human use on the adjacent existing pipeline ROW.
	• Access control measures are most effective when implemented at intersections of the Project ROW with existing perpendicular linear features (*e.g.*, roads, utility corridors, seismic lines, etc.).
	• Access by NGTL staff and contractors, including operation personnel as well as reclamation and monitoring crews, will be recorded and monitored. Access by Project personnel within the footprint in caribou range will be limited to the extent practical.
		• Evidence and level of vehicular (ATV, truck) use along the Project ROW using subjective criteria ratings such as:
		  • access evident: yes/no;
		  • access type: ATV/ truck/ snowmobile/ other;.
		• access level: low (*e.g.*, tracks/ trail evident but difficult to discern or appear to be infrequently used)/ high (tracks/trails appear to be well used; vegetation is trampled down, bare ground may be visible from frequent use)
		An evaluation of whether the objective for access control is achieved will consider all of the criteria ratings
			Access Control:
			• Where existing linear features intersect the Project ROW (i.e., seismic and other utility ROWs), use access control measures in the form of rollback/berms/mounding to achieve and maintain their functionality as a barrier within 5 years following commencement of operation.
			• In areas where vegetation screening has been used to control access, achieve 70% or higher survival rate for planted seedlings within 5 years following commencement of operation.

Table 4 Evaluation Criteria for Measurable Objectives (cont'd)

Objective/Project Implementation[1]	Rationale / Limitations / Assumptions	Evaluation Criteria	Performance Measures / Targets
Line-of-Sight • Appropriate locations for line-of-sight blocks will be identified post-construction when final clearing is complete. • A combination of measures including vegetation screening, rollback and mounding will be applied. Feasibility of installing berms or fencing will be investigated further.	• There are no provincial guidelines in Alberta for line-of-sight management for linear features. Reclamation programs for previous developments in Alberta have targeted maximum sight lines of 400 m (Golder 2007, DES 2004). Operating practices for energy development in sensitive caribou range in BC (BC Ministry of Environment 2011) suggest implementing line-of-sight management every 500 m on linear features that do not share a ROW boundary with a road. • Bends in the pipeline (doglegs) can reduce line-of-sight, but there are limited opportunities to do this for the Chinchaga Section because it is adjacent to another ROW for most of its length. • Wetlands and some treed lowlands encountered by the Project footprint naturally have low and/or open vegetation structure. The line-of-sight distance in these areas is naturally long and, therefore, sight-line management techniques are not practical for these locations. • Limitations associated with construction of slash and earth berms or fencing to reduce sight lines in the short-term include concern from provincial regulators regarding fire hazard and forest health (pathogen spread), availability of material, suitability of substrate to support structures (*i.e.*, peat does not support fencing), introduction of weeds from imported material, and potential for alteration in surface hydrology (particularly from earth berms).	• Establish line-of-sight blocks in forested areas of the footprint within caribou range that will achieve a sight-line distance of 500 m or less in areas of new cut or in sections contiguous with, and adjacent to, NGTL lines only.	Line-of-Sight: • Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, achieve sight line distances of < 500m within 5 years following commencement of operation. • Along the Project ROW, in areas of new cut or contiguous Project ROW with NGTL lines only, where planting for future vegetation screens in combination with or without rollback have been installed, achieve 70% or higher survival rate for planted seedlings that are intended as line-of-sight blocks within 5 years following commencement of operation. • Where existing linear features intersect the Project ROW (i.e., seismic and other utility ROWs), achieve line-of-sight distances equal to or less than pre-construction distances

Table 4 Evaluation Criteria for Measurable Objectives (cont'd)

Objective/Project Implementation[1]	Rationale / Limitations / Assumptions	Evaluation Criteria	Performance Measures / Targets
Line-of-Sight (cont'd)	• Fewer limitations are associated with using vegetation screening to reduce line-of-sight. However, this method is a long-term solution (refer to Table 3). • Paralleling an existing linear corridor presents challenges for line-of-sight where the adjacent line is owned by a different company. Application of sight-line management techniques should extend across the width of the Project footprint and adjacent disturbance to be effective.		

NOTES:
[1] Restoration objectives will continue to be evaluated for the Final CHRP to consider any updated consultation with ESRD or other information that becomes available
[2] Available footprint is the area of the Project footprint that is not anticipated to be disturbed by future operation and maintenance activities during the life of the Project

Some grading is expected to facilitate Project construction. The extent of grading is influenced by a number of factors such as terrain variability and weather conditions. A detailed grade plan cannot be completed until clearing of the ROW is completed. The grade plan will be prepared by the contractor and approved by NGTL. The implementation of measures outlined in the EPP (ESA Section 20A) is designed to limit grading to the maximum extent feasible. Areas of grading will be delineated in the grade plan and considered in the siting of restoration measures for the Final CHRP.

5.2 Access Control

Access control measures are most effective when implemented at intersections of the Project ROW with existing perpendicular linear features (*e.g.*, roads, utility corridors, seismic lines, etc.). Given that the Chinchaga Section parallels an existing ROW (including two transmission lines for much of its length), the issues associated with the creation of new access opportunities are largely avoided. Reducing access potential into the ROW from existing linear features will be completed. Determining where access control (e.g., rollback) will occur in part depends on results from the pre-construction caribou habitat assessment (see Condition 7). However, where seasonal or all-weather roads cross the ROW, access control will be implemented at these junctions. Subjective criteria ratings (Table 4) were developed to evaluate the effectiveness of access control measures.

Observations from field studies conducted for the Project and anecdotal observations from AESRD indicate there are relatively low levels of human use on the adjacent existing pipeline rights-of-way paralleled by the Chinchaga Section. Relating changes in access to the Project can be difficult, given the potential for increased access associated with other developments and activities in the Project area. However, the success of access control measures within the Project ROW can be evaluated using the subjective criteria developed for the CHRP (Table 4). Although the importance of access control in establishment and growth of vegetation on reclaimed sites is well understood (refer to Section 3.0), there is uncertainty related to the functional response of caribou, predator and primary prey populations to access control measures, given the lack of empirical studies and published literature on this topic.

5.3 Line-of-Sight

In forested areas of the Project footprint that are new cut or are adjacent to and contiguous with NGTL lines only, line-of-sight blocks and rollback will be established to reduce human use and possibly predator travel and hunting efficiency. Because lines-of-sight are often naturally longer in more open habitats, such as lowland muskeg communities compared to upland forest communities, line-of-sight distances will vary, depending on the location and structure of the adjacent vegetation community. Determining where line-of-sight restoration will occur in part depends on results from the pre-construction caribou habitat assessment (see Condition 7). However, at locations where linear features intersect the Project ROW (i.e., seismic or other utility ROWS), pre-construction estimates of line-of-sight as determined from the caribou habitat assessment (see Condition 7) will be used as a basis for establishing restoration targets.

Similar to access control, evaluating the success of line-of-sight reduction is challenging. Paralleling an existing linear corridor presents challenges for line-of-sight management. The evaluation criteria (Table 4) will allow determination of whether sight-line management objectives within the Project are achieved, although there is uncertainty related to the functional response of caribou, predator and primary prey populations to reduced lines-of-sight given the lack of empirical studies and published literature on this topic.

5.4 Monitoring Program

NGTL has initiated the development of a monitoring program to evaluate the extent of predicted residual effects and restoration objectives of the Preliminary CHRP. Quantifiable targets and performance measures have been developed to provide overlapping benefits for the assessment of both residual effects and restoration objectives. Restoration targets and performance measures (Table 4) will evaluate the success of vegetation restoration in addition to line-of-sight blocking. Access control and line-of-sight barriers constructed at strategic locations within the Project ROW will be evaluated using measures associated with their ongoing function as a sufficient barrier/deterrent.

5.4.1 Methodology

The Project ROW traverses several ecosite phases within the Chinchaga caribou range. Restoration units have been developed to promote native vegetation re-establishment for each ecosite phase (Appendix B). Additional restoration units may be developed at strategic locations to reduce line-of-sight or mitigate areas requiring grading during construction.

Coarse and fine-scale monitoring of vegetation re-establishment will be conducted across varying spatial and temporal gradients. Monitoring will be conducted across the entire Project ROW prior to construction and during years 1, 3 and 5 following Project completion. A repeated measures design will be employed to evaluate the effectiveness of restoration units. The repeated measures design for coarse and fine-scale monitoring will conform to the following model:

$$y_{ijk} = \mu + \alpha_i + \tau_{ik} + \beta_j + (\alpha\beta)_{ij} + \varepsilon_{ijk}$$

Where y_{ijk} is the predicted response of the restoration target or performance measure, α_i is the effect of restoration unit, τ_{ik} is the random variation attributed to sample plots within restoration unit, β_j is the effect year, $(\alpha\beta)_{ij}$ is the interaction between restoration unit and year, and ε_{ijk} is the natural variation attributed to the repeated measure on each sample plot for each respective year (Kuehl 2000). The model term τ_{ik} defines the repeated measure component associated with natural variation between sample plots for each restoration unit and provides a more accurate estimate of the restoration target or performance measure (Kuehl 2000; Montgomery 2001)

5.4.2 Coarse-Scale Monitoring

Coarse-scale monitoring will be conducted across the entire Project ROW via aerial surveys using a high resolution geo-referenced 360 degree camera. Targets and performance measures used to evaluate vegetation re-establishment will be used as baseline estimates to test restoration units re-establishment effectiveness. The specific observations and selected coarse-scale measures (i.e., aerially visible characteristics relevant to the fine-scale monitoring) will be judged to stratify restoration units by performance. This stratification becomes the basis for the fine-scale subsampling. The objectives of coarse-scale monitoring include:

- provide a baseline estimate of vegetation re-establishment performance and define within-restoration unit condition.
- identification of site-specific areas and/or line segments that require restoration unit adjustment or additional mitigation (*i.e.*, erosion, stability)
- assess localized biophysical features that may affect vegetation re-establishment and performance (*i.e*., slope, aspect).
- provide an efficient methodology for the spatial evaluation of quantifiable targets and performance measures for each restoration unit.
- estimate restoration effectiveness against quantifiable targets and performance measures, and test for positive growth trends across a temporal scale.

5.4.3 Fine-Scale Monitoring

Fine-scale monitoring will provide the primary mechanism for evaluating predicted residual effects and restoration unit effectiveness of the CHRP. Each restoration unit will comprise a representative number of sample plots to efficiently represent the Project Footprint. Fine-scale monitoring will also be conducted where line-of-sight and/or site-specific restoration treatments are applied (*i.e*., grading). The objectives of fine-scale sampling include:

- provide detailed raw estimates of vegetation re-establishment for evaluation of restoration targets and performance measures
- spatial and temporal representation of restoration targets and performance measure estimates for each restoration unit.
- ground truth coarse-scale monitoring estimates obtained aerial surveys using high resolution geo-referenced 360 degree camera.
- evaluate line-of-sight blocking treatments applied at site-specific locations.
- estimate restoration effectiveness against quantifiable targets and performance measures, and test for positive growth trends across a temporal scale.

5.4.4 Access Control

Monitoring effectiveness of access control measures will be conducted through an assessment of:

- ATV/snowmobile use (e.g., track presence/absence, U-turn evidence at rollback locations, reduced seedling mortality due to crushing)
- wolf, moose, and deer use of blocked and unblocked linear features (e.g., track or scat/pellet surveys)
- monitoring cameras installed at access control locations where the Project intersects existing linear features (i.e., utility ROW and seismic lines)

Monitoring changes in pre- and-post restoration conditions, including line-of-sight, will be documented in order to evaluate the need for adaptive management within the 5-year period following commencement of operation.

5.5 Adaptive Management

Given the inherent uncertainty associated with caribou habitat restoration, assumptions are made in the development of quantifiable targets and performance measures. The ability to successfully achieve the CHRP objectives is uncertain. Monitoring and adaptive management provide the means by which this uncertainty can be addressed.

The CHROMMP, as required in Certificate Condition 21 (see Section 1), will provide further detail on the criteria and protocols by which the effectiveness of the CHRP and OMP will be evaluated.

The adaptive management component of the monitoring program will facilitate identification of unsuccessful restoration techniques, microsite conditions that are either not conducive or suitable for establishment of vegetation, and measures that need to be adjusted or supplemented to achieve the objectives of the CHRP.

6 SCHEDULE

Scheduling and logistical coordination prior to restoration field work will consider seasonal access constraints, sensitive periods for caribou and other wildlife, lead time needed for collection of seed and production of nursery seedlings, and appropriate timing for restoration efforts. Commencement of clean-up and reclamation activities are expected to begin immediately following construction (*i.e.*, winter 2013/2014). Final site selection for caribou habitat restoration treatments and seed collection, if required, will be completed during the first summer following construction (July/August 2014). Scheduling of caribou habitat restoration measures will be coordinated with completion of clean-up and reclamation of the Project footprint (winter 2014/2015 and summer 2015). Effectiveness monitoring and adaptive management will be ongoing from construction to 5 years following commencement of operation. At the end of this 5-year period, , final restoration success will be evaluated (i.e., targets and objectives are being met) and a review of potential residual effects will be completed in consideration of the OMP (see Condition 20).

The following is a summary of key scheduling and logistical

1. July to September 2013: Completion of pre-construction habitat assessment and filing of report.
2. September to November 2013: Review results of Condition 7 and determine whether additional mitigation measures can be accommodated to reduce potential Project effects on caribou critical habitat. Information from the completion of Condition 7 is also expected to aid in the identification and refinement of restoration sites. Baseline targets for restoration will be updated in the Final CHRP and will be include information from the results of Condition 7.
3. October 2013: Provide updated construction schedule 14 days prior to commencement of construction of the Chinchaga Section. Additional modifications to the schedule will be filed with the NEB as they are identified.
4. April to June 2014: Tree and shrub seeds or seedlings to be locally sourced by a nursery for planting in 2015.
5. November 2014: File with the NEB the Final CHRP. Include in the Final CHRP a list of proactive mitigation measures that were applied during construction.
6. Summer 2015: Habitat restoration activities which include active planting commence.
7. Ongoing (1-5 years following commencement of operation): Evaluation of mitigation, restoration and adaptive management activities. First report to be produced on or before January 31 after each of the first, third and fifth growing seasons following the commencement of operation of the Chinchaga Section (in accordance with Condition 18) .
8. Ongoing (1-5 years following commencement of operation): Performance and effectiveness monitoring. First report to be produced one year after the first complete growing season following

construction, and subsequent reports at 3 and 5 years after the first complete growing season following construction.

Effectiveness monitoring and adaptive management will be ongoing from construction to 5 years following commencement of operation , as part of the Post-Construction Monitoring Program (see Condition 13). This program will take into consideration the performance measures and quantifiable targets set out in this document. For example, supplemental plantings may occur in treatment areas if survival rates are lower than expected, and locations of natural regeneration may be considered for supplemental plantings if regeneration does not appear to be meeting established targets. At the end of 5 years following commencement of operation, final restoration success will be evaluated (i.e., targets and objectives are being met) and a review of potential residual effects will be completed in consideration of the OMP (see Condition 20).

7 CONSULTATION

Table 5 provides a summary of consultation related to the CHRP for the Project. Consultation for the Project will continue with Environment Canada and AESRD during the development and implementation of the CHRP.

Table 5 Summary of Consultation with Federal and Provincial Authorities

Agency	Name	Date and Method	Details
Federal Agencies			
Environment Canada Department of Fisheries and Oceans Department of Transportation		April 2, 2012 Meeting and teleconference	Discussion on alignment of environmental assessment with the current recovery strategy for caribou. NGTL committed to prepare CHRP and offset measures plan (OMP) for the Project. Environment Canada indicated that they would be interested in participating in future discussions relating to how Project effects on caribou will be mitigated, and specifically are interested in reviewing and offering advice on reclamation, restoration, and offsetting plans. Environment Canada is bound to uphold the Federal Caribou Recovery Strategy.
Environment Canada	June Yoo Rifkin Andrew Robinson Paul Gregoire Stephen Virc Victoria Snable Hugo Gherbavaz Francois Blouin-Maurice Melissa Vance Cheryl Ann Johnson	October 9, 2012 Meeting and teleconference	Discussion on the final federal recovery strategy for boreal caribou, including implications for the Project. NGTL discussed the status of the preliminary CHRP and provided an updated draft to Environment Canada for comment. Environment Canada also requested that NGTL work with them in the development of the OMP.
Environment Canada		January 17, 2013	Discussion on the CPP, CHRP and OMP. NGTL provided a history of the development of the caribou documents, from pre-construction through operations. The documents will be the toolbox for what will be done. Preliminary CHRP explains how measures were arrived at and what could be done; Final CHRP allows for evaluation of detailed construction activities and quantification of measureable parameters to refine objectives (i.e., where, what, when, how). Conduct a preliminary caribou habitat assessment that is robust, defensible and quantitative; Preliminary CHRP will not have the quantitative results, but they will be in the Final CHRP and in a separate report under Condition 7 EC informed NGTL of its Conservation Allowances policy; also, that the recovery strategy lays out advice and approach for recovery. EC wants NGTL to focus on critical habitat, and on the guidance from the Province.

Table 5 Summary of Consultation with Federal and Provincial Authorities (cont'd)

Agency	Name	Date and Method	Details
Federal Agencies (cont'd)			
Environment Canada (cont'd)			EC informed NGTL that they are not in a position to decide or inform whether critical habitat is/will be restored/offset. EC cannot support destruction of critical habitat, wants to know what is going on, and wants NGTL to consult with the Province. NGTL (via Rob Staniland) provided an overview of the OMP, including initial thoughts on calculation of residual effects, measures to reduce residual effects, and ways to gauge effectiveness of mitigation CHRP will focus on planting and restoration, but also on access and line-of-sight blocking. NGTL indicated they were expecting feedback on NWML and Leismer from the NEB on the CHRPs for those projects.
Environment Canada	Paul Gregoire	April 12, 2013 Email sent to EC April 26, 2013 Email sent to EC	Stantec emailed Mr. Gregoire on April 12 and provided a copy of the draft protocols for the ground based caribou habitat assessment to satisfy Condition 7 of Certificate GC-121. A follow-up email was sent by Stantec to Mr. Gregoire on April 26 to ask whether Environment Canada would be providing feedback and if a date for this could be anticipated. No feedback was received
Environment Canada	Paul Gregoire	April 17, 2013 Email sent to EC	NGTL emailed Mr. Gregoire on April 2 and provided a copy of the draft Preliminary CHRP. Mr. Gregoire indicated he found the report comprehensive, but wanted to hear from AESRD, especially with respect to Table 4 (Measureable Objective / Project Implementation).

Table 5 Summary of Consultation with Federal and Provincial Authorities (cont'd)

Agency	Name	Date and Method	Details
Provincial Agencies			
AESRD	Don Williams Dave Moyles Norm Van Vliet Gerry Matthews Marcus Ruehl Ryan Minchau	December 8, 2011 Meeting and teleconference	Discussion regarding use and limitations of rollback for access management.
AESRD	Dave Moyles	June 13, 2012 Telephone	Discussion between Mr. Moyles (AESRD) and Albert Lees (Stantec) regarding boreal caribou along the Chinchaga section. Mr. Moyles suggested that NGTL seek a coordinated approach to caribou protection planning across projects. Mr. Moyles also indicated that he could provide telemetry data for the Chinchaga herd.
AESRD	Dave Hervieux	November 16, 2012 Telephone	A telephone discussion was held between Dana Charlton (NGTL) and Mr. Hervieux on November 16 regarding CHRP and offset measures.
AESRD	Don Williams	February 25, 2013 Telephone	Discussion between Jim Cochrane (NGTL) and Mr. Williams regarding use of timber for rollback.
AESRD	Dave Moyles	April 2, 2013 Email sent to AESRD April 15, 2013 Email sent to AESRD April 29, 2013 Email received by NGTL	Christine Nicholls (NGTL) emailed Mr. Moyles on April 2 and provided a copy of the draft Preliminary CHRP. Ms. Nicholls followed up on April 15. Mr. Moyles emailed Ms. Nicholls (NGTL) on April 29 with comments on the preliminary CHRP. Mr. Moyles main concern was the use of natural regeneration on the Project ROW and the lack of access management outlined in the plan.

Table 5 Summary of Consultation with Federal and Provincial Authorities (cont'd)

Agency	Name	Date and Method	Details
Provincial Agencies			
AESRD	Dave Hervieux	April 2, 2013 Email sent to AESRD April 15, 2013 Email sent to AESRD	Ms. Nicholls emailed Mr. Hervieux on April 2 and provided a copy of the draft Preliminary CHRP. Ms. Nicholls followed up on April 15. NGTL will continue dialogue to seek input from Mr. Hervieux during the preparation of the final CHRP.
AESRD	Dave Moyles Don Williams	April 12, 2013 Email sent to AESRD April 26, 2013 Email received by Stantec June 6, 2013 Email sent to AESRD	Michael Preston (Stantec) emailed Mr. Moyles on April 12 and provided a copy of the draft protocols for the pre-construction caribou habitat assessment to satisfy Condition 7 of Certificate GC-121. Mr. Moyles emailed Mr. Preston on April 26. His main comments are below: 1) Mr. Moyles indicated that description of critical attributes of caribou habitat should be expanded based AESRD knowledge of the Chinchaga herd range. A description of habitat types important to caribou was provided based on AESRD knowledge of the range. 2) Mr. Moyles stated that the construction and operation of the Chinchaga Section would have impacts extending further than 30 m from the ROW and that habitat data could be collected 500 to 1000m outside the Project footprint. 3) Mr. Moyles asked if the proposed effort of 60 to 80 survey sites was finalized and if the sites had been chosen. On June 6 Lisa May (NGTL) emailed a letter from Mr. Preston to Mr. Moyles responding to Mr. Moyles comments of the draft protocols. Mr. Preston's key response points are below: 1) All of the habitats described by Mr. Moyles would be considered as part of the ecosite identification component of the habitat assessment. Mr. Preston agreed that these habitats are important to caribou, and that they are a component of Table 1 of the federal recovery strategy.

Table 5 Summary of Consultation with Federal and Provincial Authorities (cont'd)

Agency	Name	Date and Method	Details
Provincial Agencies (cont'd)			
AESRD (cont'd)			2) Mr. Preston indicated that an assessment of Project effects had been completed at both local and regional scales and that the pre-construction caribou habitat assessment was designed to help develop the final CHRP and OMP specific to the ROW. 3) The final number and location of sites was yet to be determined. Plots would be established in appropriate locations subject to habitat variability and replication.
AESRD	Dave Moyles Don Williams Austin Babb	June 26, 2013 Meeting	Mr. Moyles confirmed he agreed with the "like for like" restoration approach of planning restoration to match the existing landscape of upland and lowland/wetland vegetation. Mr. Moyles confirmed he like the mounding approach for line of sight barriers especially in lowland/black spruce areas. Range plans haven't been started for the Chinchaga Herd. He doesn't want to commit to any "special areas" of concern or priority for Offset Measures because of shifts in behavior that may not be reflected in the development of the plan as well as yearly weather and snow conditions. Mr. Moyles would like to be consulted and possibly work with TCPL to explore more site specific locations for Offsets. Mr. Williams wasn't sure how the Offsets Measures strategy and the existing land disposition system will work together but he would open the conversation when TCPL has more specific locations in mind.

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APPENDIX A

Restoration Considerations for Select Revegetation Species

Table A-1 Restoration Considerations for Select Revegetation Species

Species	Restoration Considerations
Black Spruce	Black spruce appears to grow well when there is sufficient sunlight and on well-drained upland sites, particularly in mixedwood forests, and on wider corridors where greater exposure to the sun may warm soils, and where enhanced microsites are created by mounding or rollback (CRRP 2007b). Black spruce seedling growth may be limited by nutrient deficiency common in treed muskegs. The OSLI has reported positive results with planting frozen nursery-grown black spruce seedlings during winter in wetland areas of northeastern Alberta (OSLI 2012), although longer term monitoring is required to attain conclusive results.
White Spruce	White spruce requires well-drained and nutrient rich soils to grow, such as some upland mixedwood forests. Disturbance or reduction of surface organic soils as a result of construction affects success of restoration using white spruce on disturbed areas (CRRP 2007b).
Lodgepole Pine	Pine grows well in a variety of site types, despite limitations such as low light and lack of nutrient rich soils (CRRP 2007b). Soils must be relatively well drained.
Alder	Many shrub species (*e.g.*, willow) are not considered suitable for planting to restore caribou habitat due to their high palatability for primary prey (CRRP 2007b). Alder generally has low browse value for ungulates such as moose and deer. Sites that are difficult to treat using mechanical site preparation methods (*e.g.*, mounding) can benefit from inter-planting alder with conifers. When alder is interspersed with conifer plantings, human access on linear features can be reduced over the medium-term (*i.e.*, alder's faster growth compared to conifers helps to reduce visibility and make travel difficult), and the nitrogen-fixing characteristics of alder will provide soil enhancement (Sanborn *et al*. 2001, Sweeney 2005), potentially promoting improved conifer growth over the long-term (Simard and Heineman 1996, BC Forest Service 2001). Additional benefits of planting alder include: its ability to increase soil porosity by reducing soil compaction; quick growth (relative to conifers), which can assist with soil stabilization where erosion may be a problem; and leaf litter, which helps re-establish the forest floor where extensive disturbance to surface soils is a problem (Robb 2001, CRRP 2007b). However, the fast growth of alder may reduce growth rates of conifer plantings due to competition when alder densities are high (Simard and Heineman 1996, CRRP 2007b).
Hardwood Trees (*e.g.*, aspen, poplar, cottonwood)	Similar to shrubs, hardwood trees have relatively fast growth rates. Since their growth is less dense than shrubs such as alder, hardwood trees are less likely to out-compete conifers. The fast root growth of hardwood trees can effectively reduce soil compaction, which provides a natural alternative to costly and highly disruptive mechanical site preparation. They are also better adapted to unfavourable site conditions (*e.g.*, wet or compacted areas) than conifers. Deciduous trees provide leaf litter to enhance surface soil properties. They may also improve conifer growth in mixed plantings by deflecting browse and moderating temperatures, although their fast growth can out-compete or slow conifer growth. Seed and nursery stock for hardwood trees is not as readily available as for conifers, and less information on site characteristics, propagation and planting requirements are available for some hardwood species compared to conifers (CRRP 2007b).

APPENDIX B

Restoration Units for the Chinchaga Section in the Chinchaga Caribou Range

Table B-1 Chinchaga Section Area of Restoration Units in Chinchaga Caribou Range

Restoration Unit[1]	Ecosite Phase	Caribou Range	
		Area (ha)	Percent (%)
Upland Deciduous/Mixedwood	B1 – blueberry / jack pine – aspen (white birch)	1.5	1.2
	D1 – low-bush cranberry / aspen	10.5	8.6
	D2 – low-bush cranberry / aspen – white spruce – black spruce	36.2	29.6
	D3 – low-bush cranberry / white spruce	8.5	7.0
	E1 – Dogwood balsam poplar - aspen	0.9	0.7
Upland Deciduous/Mixedwood Total		*57.6*	*47.1*
Upland Coniferous	C1 – common Labrador tea / mesic jack pine – black spruce	1.2	1.0
Upland Coniferous Total		*1.2*	*1.0*
Transitional	G1 – common Labrador tea / moist black spruce – jack pine	10.7	8.7
Treed Lowlands	Treed fen	1.6	1.3
	Treed bog	1.3	1.1
Transitional and Treed Lowlands Total		*13.6*	*11.1*
Open water wetlands, graminoid and shrub-dominated lowlands	Shrubby bog	2.1	1.7
	Shrubby fen	10.8	8.8
	Shallow open water	0.0	0.0
Wetland/Lowland Total		*12.9*	*10.5*
	Previously disturbed lands	37.1	30.4
Riparian	Riparian areas are not quantified separately. They are classified based on vegetation community (*e.g.*, ecosite phase and site characteristics).		

NOTES:
[1] Restoration Treatment Units correspond to the Habitat Types in Figure 2: Conceptual Guide for Habitat Restoration Measures in Caribou Range. Treed lowlands, open water wetlands, graminoid and shrub-dominated lowlands correspond to the Wetland habitat type in Figure 2. Transitional areas are variable; site characteristics may tend to be more like upland coniferous sites, or treed lowlands and, therefore, restoration methods will vary accordingly.