NOVA GAS TRANSMISSION LTD.

Chinchaga Lateral Loop No.3

Final Offset Measures Plan for Residual Projects Effects to Caribou Habitat

February 2016

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Table of Contents

Figures

Photos

Tables

Appendices

Acronyms and Abbreviations

Terms	Definitions
AGS	Alberta Geological Survey
AEP	Alberta Environment and Parks (formerly AESRD)
AlPac	Alberta-Pacific Forest Industries Inc.
BBOP	Business and Biodiversity Offsets Programme
BC MOE	British Columbia Ministry of Environment
CBFA	Canadian Boreal Forest Agreements
CHROMMP	Caribou Habitat Restoration and Offset Measures Monitoring Program
Final CHRP	Final Caribou Habitat Restoration Plan
CLMA and FPAC	Caribou Landscape Management Association and the Forest Products Association of Canada
COSIA	Canada's Oil Sands Innovation Alliance
DC	Department of Conservation
DEFRA	Department for Environment, Food and Rural Affairs
DFO	Fisheries and Oceans Canada
EC	Environment Canada
EIA	Environmental Impact Assessment
ENGO	Environmental Non-Government Organization
EPA	Environmental Protection Agency
EPI	Department of Environment and Primary Industries
ESAR	East Side Athabasca River
NEB	National Energy Board
NGTL	NOVA Gas Transmission Ltd.
NNL	No-Net-Loss
NSW	New South Wales
Final OMP	Final Offset Measures Plan
Project	Chinchaga Lateral Loop No. 3
ROW	Right-of-Way
SEACOP	Southeast Alberta Conservation Offset Pilot
TEK	Traditional Environmental Knowledge
TLU	Traditional Land Use
TWS	Temporary Workspace
WA	Western Australia

Units of Measure

Unit	Definitions
%	percent
>	greater than
ha	hectare
km	kilometre
m	metre
mm	millimetre

Terms and Definitions

Term	Definition
Action Plans	Provincial, territorial or federal plans that identify priority conservation needs for woodland caribou.
A priori	An assumption that is true without further proof or need to prove it
Conservation Allowances	Final step in the mitigation hierarchy of Environment Canada's operational framework under which offset measures are applied; generally in the form of habitat rehabilitation or securement.
Conservation Offsets	Measurable conservation outcomes of actions designed to compensate for residual adverse impacts arising from project development after appropriate prevention and mitigation measures have been taken
Delay Factors (Time Lags)	Estimated proportion to credit an offset measure after considering how long it will take to accomplish its effect or whether the effect has a limited lifespan after implementation. Higher credit means lower delay factor (*i.e.,*1.0 = no delay factor)
Direct Offset Measures	Available measures considered as relevant habitat restoration or functional treatments to address fine and broad-scale project-related residual effects.
Indirect Offset Measures	Available measures that are considered priority conservation needs of caribou and caribou habitat, but do not qualify as "direct" measures (*i.e.,* financial mechanisms).
Mitigation Hierarchy	A framework that emphasises best-practice of avoiding, minimizing and then restoring any negative project effects, before finally considering offsets for remaining residual effects.
New Alignment	Area directly disturbed by the project footprint that is not parallel to existing anthropogenic features.
Offset Design Elements	Offset selection and design factors chosen in consideration of the potential environmental effects of the project, as well as the unique conservation needs; including some or all of equivalency, additionality, location, timing, duration, and accountability.
Offset Effectiveness	Relative proportion of a fully realized effect ascribed to an individual offset measure (Full effectiveness = 1.0)
Offset Multiplier	Minimum area (ha) necessary to offset the project residual effect (ha)
Parallel Alignment	Area directly disturbed by the project footprint that is parallel to existing anthropogenic features.
Physical Barrier	Physical obstacle to reduce ease of movement and/or visibility aspects of range utility, where the mitigated grounds becomes as challenging as the surroundings, constructed of logs, slash, earth, solid rock or other suitable materials.
Project Effects	Adverse environmental effects of the project after route selection and project design refinements, but before generic project mitigation measures are applied.
Project Footprint	Area directly disturbed by the construction and cleanup activities associated with the project, including associated physical works and activities.
Range Intactness	The frequency and size of mature habitat patches not affected by disturbance, within a defined area.

Term	Definition
Range Plan	Provincial strategy for landscape condition to address caribou conservation for one or a number of caribou herds.
Range Utility	The result of ecological mechanisms associated with the range habitat condition (presumed altered by some function of anthropogenic disturbance and fire), includes: ease of movement, speed of travel, direct traverse of habitat, increased line-of-sight, frequency of encounter (predator/prey and prey/forage), larger actualized range area (predator/prey), and increased insolation at ground level. In this report, primarily considers the effects on predators and primary prey.
Residual Effects	Project-related effects remaining after mitigation measures are applied.
Vegetation Barrier	Tree or shrub planting strategies to reduce ease of movement and visibility aspects of range utility in the long-term, where the mitigated ground becomes as challenging as the surroundings.

1.0 INTRODUCTION

NOVA Gas Transmission Ltd. (NGTL), a wholly owned subsidiary of TransCanada Pipelines Limited, received approval of Certificate GC-121 by Governor in Council in May 2013 for the Chinchaga Lateral Loop No. 3 Project (the Project). The Project consists of 33 kilometres (km) of NPS 48 inch (1,219 millimetre [mm]) outside diameter buried pipeline expanding NGTL's Alberta System to transport sweet natural gas between interconnections adjacent to the Chinchaga Meter Station located at NE 13-96-5 W6M and Meikle River Compressor Station located at NE 26-94-2 W6M in Alberta. The Project footprint consists of a 32 metre (m) wide construction right-of-way (ROW) and temporary workspace (TWS) at road, foreign pipeline, utility and drainage feature crossings, as well as at sharp sidebends and tie-ins. The Project is located within the Chinchaga caribou range. Approximately 31.1 km (94 percent [%]) of the Project is parallel and contiguous with existing linear corridors. Of the contiguous section, 29.2 km (88%) is parallel to one or two transmission lines (see Figure 1).

This Final Offset Measures Plan (OMP) was prepared in accordance with GC-121 Condition 20(b), 20(c), and 20(d) (Table 1). The Final OMP demonstrates NGTL's commitment to offset residual Project effects on Woodland caribou and their habitat. The habitat restoration measures identified in this OMP, outline the toolbox of measures available to NGTL. This OMP was developed in consideration of peer-reviewed scientific articles, guidance documents from expert individuals/agencies, as well as established offset policies and emerging offset policies from provincial, state and federal agencies in Canada and from the international community. Current policies specific to caribou: *the Alberta Woodland Caribou Recovery Plan, 2004/05 to 2013/14*; *A Woodland Caribou Policy for Alberta; and the federal Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou), Boreal Population, in Canada* were also considered in the development of this OMP.

1.1 Offset Strategy and Framework

Although the Project minimized disturbance wherever possible, there was a residual Project effect on caribou and caribou habitat (see Section 3.0). The purpose of the OMP is to describe the measures implemented to offset the Project residual effects and contribution to total cumulative effects on boreal caribou in a manner that aligned with provincial and federal policies, management plans, and priorities.

After review of the literature, NGTL developed this OMP following a strategy consistent with conservation offsets, which focused on the specific conservation needs of boreal caribou. This OMP followed a like-for-like habitat restoration framework where offsets were directed to physical habitat restoration measures rather than indirect measures such contributions to research programs or other financial mechanisms. Indirect offset measures were not contemplated for this OMP because NGTL preferred to invest in more direct measures that are considered highest priority in the federal *Recovery Strategy for Woodland Caribou* (EC 2012b).

Primary literature on the effectiveness of habitat enhancement and restoration measures of caribou habitat is still emerging (Section 7.0). NGTL consulted subject matter experts within industry, government, and expert agencies through a questionnaire to evaluate the effectiveness and acceptance of current caribou habitat restoration practices (Appendix 2). The questionnaire guided the development of other NGTL offset plans and has also been applied in this Final OMP.

To address uncertainty and time lags associated with habitat restoration measures, NGTL has applied the discrepancy risk approach suggested by DEFRA (2011). The underlying principles of the discrepancy approach were developed in consideration of the risk factors associated with habitat restoration. The following risk factors associated with the habitat restoration measures employed in this Final OMP include:

- Delivery risks associated with each measures effectiveness and achievability (*i.e.,* challenges and uncertainty of the restoration technique);
- Spatial risks associated with the proximity of measures to caribou and caribou habitat (*i.e.,* spatial relevance within caribou range); and,
- Temporal risks associated with each measures ability to achieve full effectiveness (*i.e.,* short or long-term time lags).

Multipliers reflect the degree of risk associated with each habitat restoration measure. Multipliers address the effectiveness and uncertainty of habitat restoration measures (*i.e.,* achievability, spatial relevance and time lags). After applying multipliers to each habitat restoration measure, the effectiveness of the measure was quantified for both direct and indirect residual Project effects. Within this OMP, multipliers range from 1.0 through 5.0, aligning with the majority of offset literature (Section 7.0).

To ensure a consistent approach between this Final OMP and other NEB approved NGTL offset programs, the habitat restoration measures implemented in this Final OMP are the same in terms of measure design, degree of intensity and functionality. The process involved the:

- Quantification of the area (ha) directly and indirectly disturbed by the Project footprint, including the restored area where habitat restoration measures were implemented (Section 2.0);
- Assessment of the effectiveness of habitat restoration measures implemented on the Project footprint), inconsideration of the mitigation hierarchy (Section 3.0);
- Calculation of the area (ha) of residual Project effects after avoidance, minimization and rehabilitation/restoration measures were implemented on the Project footprint (Section 3.0); and
- Quantification of the final offset area (ha) required to counterbalance the area (ha) of the remaining residual Project effect to caribou and caribou habitat (Section 5.0).

Habitat restoration activities were completed on the Project footprint as described within the Final Caribou Habitat Restoration Plan[1] (Final CHRP) and on existing disturbances within the Dillon River Wildland Park in northeastern Alberta in summer 2015. The Dillon River Wildland Park is provincial crown land located within the Bohn caribou range. NGTL has restored 54.5 hectares of caribou habitat, in addition to the 94.3 hectares previously completed under other NGTL offset programs that directly benefit the declining Bohn herd. NGTL recognizes the residual Project effect occurred within the Chinchaga caribou range and applied a spatial risk multiplier to account for this spatial separation (DEFRA 2011) (Section 5.0).

[1] NEB Filing ID A64196

Restoration investments in the Dillon River Wildland Park optimize and leverage collaboration between government, academia, industry and Aboriginal communities to undertake additive restoration efforts, restore ecological connectivity and movement. There are also learnings from coordinated monitoring and applied research, and promotion of local stewardship capacity through active stakeholder participation at the landscape scale where the immediate threats to local caribou populations may be imminent. For the Chinchaga Lateral Loop No. 3 Project, detailed alignment sheets showing offset measure locations within the Dillon River Wildland Park are presented in Section 5.0 and Appendix 3.

KP 33.29
KP 30
KP 25
KP 20
KP 15
KP 10
KP 5
KP 0
ESA 548
Dugout #4
Dugout #3
Dugout #2
Dugout #1
Muskwa River
Kechika River
Rainbow Lake
High Level
British Columbia
Alberta
Chinchaga Section
Manning
Fort St. John
Grimshaw
Fairview
Peace River
Dawson Creek
Spirit River
Falher
McLennan

> 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

12351 0572 -01 05

NT
Area of Interest
BC
SK
AB
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. 1-1

Last Modified: 3/18/2013 By: arocha

1.2 Organization of the Final OMP

This Final Offset Measures Plan (OMP) was prepared in accordance with GC-121 Condition 20(b), 20(c), and 20(d). Table 1 presents concordance.

Table 1 Concordance Table

CERTIFICATE GC-121 CONDITION 20	DETAILS AND LOCATION IN THIS REPORT
20. NGTL shall file with the Board for approval, a plan to offset all residual effects related to the Chinchaga Section resulting from directly and indirectly disturbed caribou habitat, after taking into account the implementation of the Environmental Protection Plan and CHRP measures. NGTL shall provide a copy of the filings to Environment Canada and the appropriate provincial authorities. The OMP for the Chinchaga Section shall include:	
b) a final version, to be filed for approval on or before 1 February after the second complete growing season following the commencement of operation, with:	
• the contents of the preliminary version, with any updates identified in a revision log that includes the rationale for any changes to decision making criteria;	• Preliminary OMP (NEB Filing ID: A56197).
• a complete table listing the offset measures and offset ratios to be implemented or already underway, including site-specific details and map locations, and how they meet criteria in the literature for offsets;	• Table 3 provides the list of offset measures (i.e., habitat restoration measures) considered in this OMP along with their multipliers. • Section 3.0, 4.0 and 7.0 discuss how offset measures meet the criteria in the literature for offsets. • Section 5.0 provides the offset measures selected for implementation and their multipliers (Table 5). • Section 4.0, 5.0 and Figure 8 provide the site-specific details and map locations of offset measures.
• a schedule indicating when offset measures will be initiated and the estimated date when implementation will be complete; and,	• Section 5.1 and Table 6 provide the schedule of when offsets were implemented and completed.
• an assessment of the effectiveness of the measures, including a discussion of uncertainty, and a quantitative compilation showing how the offset measures have offset the previously calculated residual effects.	• Section 7.9 provides an assessment of measure effectiveness based on results from the questionnaire survey. • Table 3 provides a quantitative compilation of measure effectiveness and their respective multipliers. • Section 5.0 (Table 5) demonstrate how measures offset previously calculated residual Project effects (Table 4).
Both preliminary and final versions of the plan shall include:	
c) a description of NGTL's consultations with potentially affected Aboriginal groups regarding the plan, including any concerns that were raised and how these have been addressed; and,	• A summary of NGTL's consultation with potentially affected Aboriginal groups on the OMP is provided in Section 6.0
d) evidence and summary of consultation with EC and provincial authorities regarding the plan.	• A summary of NGTL's consultation with EC and AEP is provided in Section 6.0.

NGTL - NOVA Gas Transmission Ltd.; Final CHRP – Final Caribou Habitat Restoration Plan; OMP - Offset Measures Plan; EC - Environment Canada; AEP – Alberta Environment and Parks; NEB - National Energy Board.

2.0 QUANTIFICATION OF AREA DISTURBED

This section provides the final quantification of caribou habitat directly and indirectly disturbed including a summary of the area of the Project footprint restored. The rationale and methodology used to calculate residual direct and indirect disturbance are also discussed.

Post-construction as-builts of the Project footprint informed the final quantification of the area directly and indirectly disturbed by the Project footprint and provided the baseline metrics from which the Residual Project Effect and Required Offset Area were calculated including:

- **Direct Project Disturbance:** the total area of the Project footprint (ha) including the ROW, temporary workspace and log deck locations within caribou range (see Figure 2).
- **Restored Project Footprint**: the total area along the Project footprint where Final CHRP measures have been applied in the form of planting, mounding or coarse woody debris (see Figure 3) and assumes restoration measures will be effective on the portion of the footprint available for restoration (i.e., excluding Residual Direct Project Disturbance).
- **Residual Direct Project Disturbance**: the 10 m area over the pipeline, which must remain visible for aerial integrity inspections, as required by CSA Z662-15 safety standards. NGTL has modified its Operating Procedures to allow planting of line of sight breaks across the pipeline. Areas planted across the ROW and at third party crossings are not included in the final calculation of total area (ha) of residual direct project disturbance (see Figure 4).
- **Incremental Indirect Disturbance**: calculated following methods provided by Environment Canada (2012a), and includes the additional disturbance associated with buffering the Project footprint by 500 m. The buffered area is calculated from the outer edge of the Project footprint and includes temporary workspace (see Figure 5).

Table 2 Quantification of Direct and Indirect Project Disturbance of Caribou Habitat

	Area (ha)			
	Direct Project Disturbance	Restored Project Footprint	Residual Direct Project Disturbance	Incremental Indirect Disturbance
Pipeline Segment within Caribou Range	121.0	87.8	33.2	1.3

Note: Restored project footprint, residual direct project disturbance and incremental project disturbance are used as the baseline metrics for determining the remaining residual Project effect and calculating the required offset area (Section 5.0).
ha = hectare.

Figure 2 Example of Direct Project Disturbance

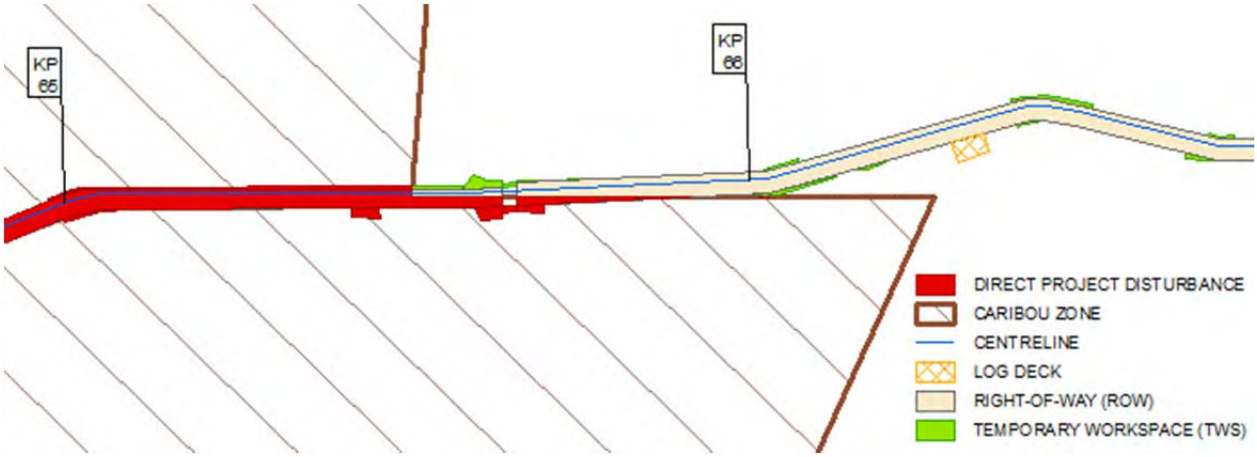


Figure 3 Example of Restored Project Footprint

Figure 4 Example of Residual Direct Project Disturbance

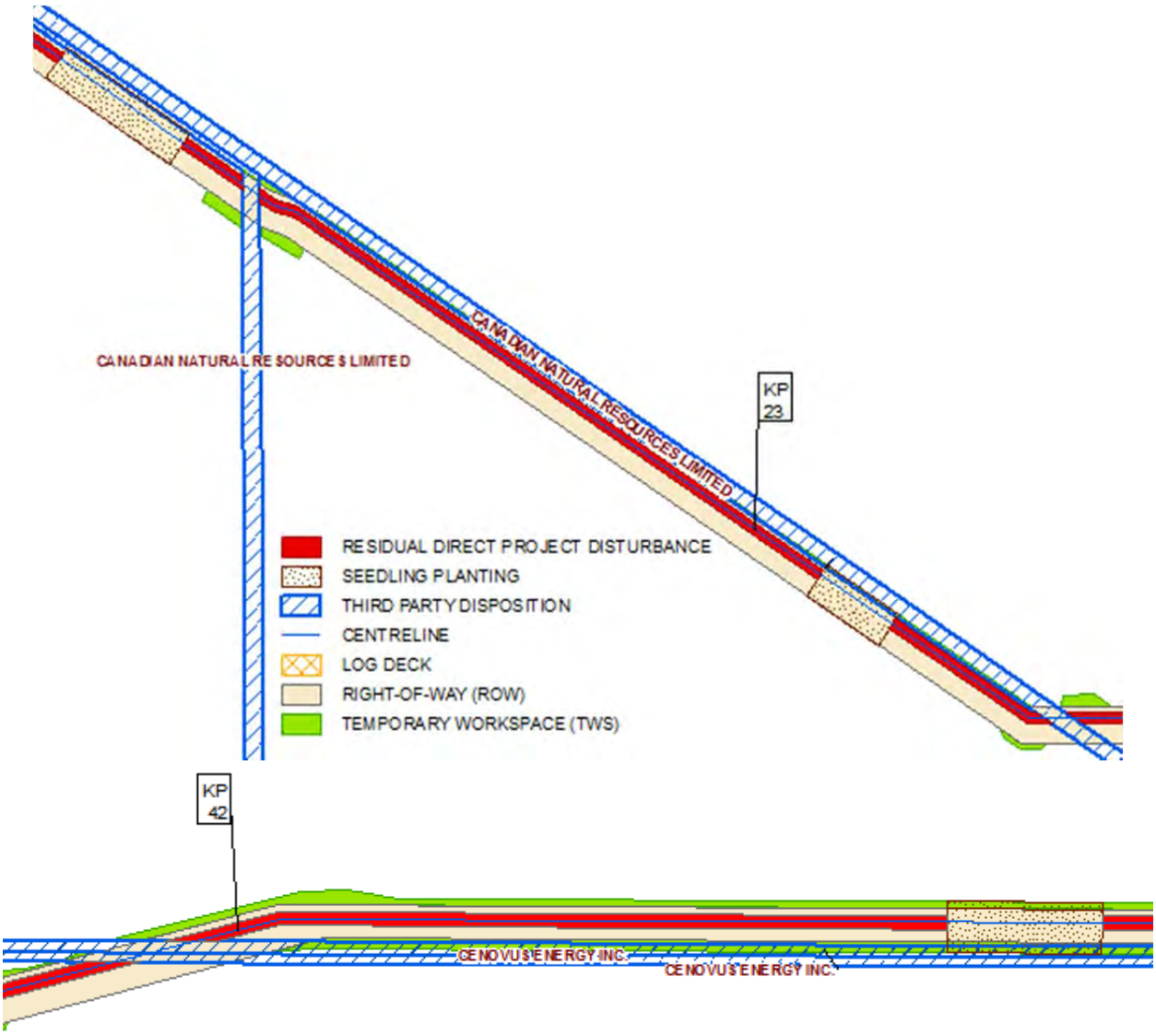
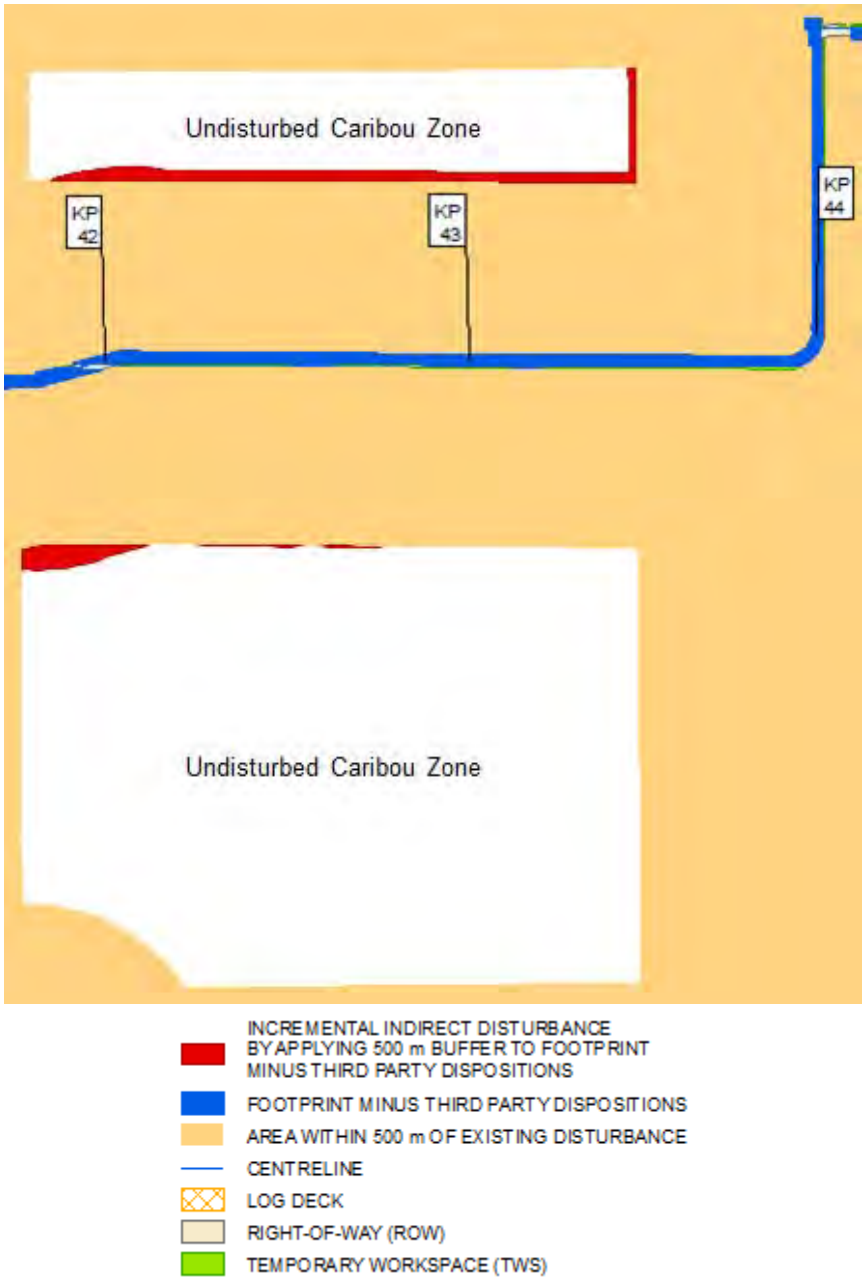


Figure 5 Example of Incremental Indirect Disturbance



3.0 ASSESSMENT OF RESIDUAL PROJECT EFFECTS

This section discusses the methodology used to quantify the effectiveness of habitat restoration measures, in consideration of the mitigation hierarchy (Section 7.4).

3.1 Mitigation Hierarchy Effectiveness

Following the methodology provided by Business and Biodiversity Offsets Programme [BBOP] (2012a), residual project effects are calculated using the mitigation hierarchy. The mitigation hierarchy evaluates each project phase including; pre-construction planning (*i.e.,* avoidance), construction activities (*i.e.,* minimization) and post-construction activities (*i.e.,* rehabilitation/restoration). For calculating the Residual Project Effect on caribou habitat, the following mitigation hierarchy measures was considered:

- **Avoidance**: measures[2] taken during Project planning stages to avoid potential effects (i.e., route selection with preference for parallel alignment to other industrial features).
- **Minimization**: measures taken to reduce the intensity, extent and/or duration of potential effects (including direct, indirect and cumulative effects) that cannot be completely avoided, but are reduced as far as is practically feasible (i.e., reduction of footprint size, minimum ground disturbance construction methods, activity scheduling, using existing access, and minimizing vegetation clearing).
- **Rehabilitation/Restoration**: measures[3] taken to rehabilitate or restore equivalent habitat and ecological mechanisms following construction.

3.1.1 Avoidance

Avoidance measures applied during the planning stages included route selection measures, with preference for parallel alignment to other industrial features. These measures were used to reduce the amount of direct (*i.e.,* vegetation clearing) and indirect disturbance (*i.e.,* encroachment into undisturbed habitat as defined by EC 2012a) within caribou range. The following steps demonstrate the process involved in calculating the area of Residual Project Effect considering the avoidance measures applied to the Project:

- The Direct Project Disturbance (ha) is proportional to the Project Footprint (ha) and was the initial starting point for calculating the Residual Project Effect.
- The Residual Direct Project Disturbance (ha) was subtracted from the Direct Project Disturbance (ha), to provide the area of Restored Project Footprint.
- The Restored Project Footprint (ha) was categorized into new alignment (ha) or parallel alignment (ha), where avoidance measures used to reduce disturbance to caribou habitat are credited (i.e., preference for parallel alignment see Section 7.9).
- Segments of new alignment (ha) and parallel alignment (ha) were then categorized into restoration units (see Final CHRP). This process step accounted for avoidance measures implemented during planning stages and a delay factor multiplier was applied to the restoration unit (i.e., time lag).

[2] As outlined in the Project's Environmental and Socio-Economic Assessment, including the Environmental Protection Plan and the Caribou Protection Plan.
[3] As outlined in the Project's Caribou Habitat Restoration Plans (Preliminary and Final).

3.1.2 Minimization

Minimization measures applied during the planning and construction stages reduced the intensity, extent and/or duration of residual project effects (including direct, indirect and cumulative effects) that could not be completely avoided, but were reduced as far as is practically feasible. These measures included reduction of footprint size, minimum surface disturbance, activity scheduling, using existing access, and minimizing vegetation clearing within caribou range. The following steps demonstrate the process involved in calculating the area of Residual Project Effect considering the minimization measures applied to the Project:

- The area of minimum surface disturbance (ha) construction methods that were implemented on the Project footprint was calculated.
- Segments of new alignment (ha) and parallel alignment (ha) were then categorized into restoration units (see Final CHRP). This process step accounted for minimization measures implemented during construction and a delay factor multiplier was applied to the restoration unit (*i.e.,* time lag).

3.1.3 Rehabilitation/Restoration

Although there is some uncertainty in the effectiveness of measures implemented to restore habitat (see Final CHRP), and the functional response of caribou, predators and primary prey species (*i.e.,* moose and deer) to restored disturbances in the short term, the assumption is that habitat restoration will be effective in the long-term.

The habitat restoration measures identified in this OMP, outline the toolbox of measures available to NGTL (Table 3). Habitat restoration measures were developed in consideration of the ecological mechanisms believed to be associated with the effect of linear features on caribou population decline (Section 7.8). The degree to which each habitat restoration measure reduce the Residual Project Effect was derived from published guidance documents concerning offset design elements and delivery risk; scientific literature regarding caribou management and results of the questionnaire (Section 7.9).

Habitat restoration measures were applied at the post-construction stages of the Project (see Final CHRP). These measures were aimed at restoring the equivalent ecological mechanisms associated with caribou habitat in the long-term. The following steps demonstrate the process involved in calculating the area of Residual Project Effect considering the rehabilitation/restoration measures applied to the Project:

- The area of individual habitat restoration measures (ha) were implemented on the Project footprint were calculated for segments of new alignment (ha) and parallel alignment (ha) within each restoration unit (see Final CHRP).
- Individual habitat restoration measures (including minimum surface disturbance) were assigned multipliers for measure effectiveness and delay factors (*i.e.,* time lags). This process step accounted for the rehabilitation/restoration measures implemented during post-construction phases in order to calculate the Residual Project Effect.
- The Residual Project Effect was calculated following the methodology presented in Section 3.2 (Table 4). The above steps account for all habitat restoration measures implemented on the Project footprint following the mitigation hierarchy (BBOP 2012a).

3.1.4 Summary

Following the mitigation hierarchy presented by BBOP (2012a), the Residual Project Effect was calculated by accounting for all pre-planning, construction and post-construction activities implemented on the Project footprint to reduce the direct and indirect disturbance to caribou and caribou habitat. The Residual Direct Project Disturbance associated with the 10 m area over the pipeline was included in the calculation of Residual Project Effect using the same methodology applied to avoidance measures, where credit is given to segments of parallel alignment. Indirect Incremental Disturbance to caribou and caribou habitat, as described in EC (2012a), present challenges to the mitigation hierarchy process as the area of influence extends beyond the boundaries of the Project footprint. NGTL acknowledges the potential for the Project to create indirect disturbances to caribou and caribou habitat and have added the area of Incremental Indirect Disturbance to the Residual Project Effect (Table 4).

Habitat restoration measures were categorized as either discontinuous or continuous based on whether there are future operational access requirements. Measures that can be applied continuously across lines are considered more effective than discontinuous applications. The average effectiveness of habitat restoration measures, including their respective multipliers was derived from the questionnaire (Section 7.9 and Appendix 2). For example, the average effectiveness of discontinuous barrier segments relying on coarse woody debris at high intensity is equal to 0.3 (or expressed as 1 / 0.3 = 3.3 multiplier) from Q32 of the questionnaire. Likewise, for continuous barrier segments relying on coarse woody debris at high intensity, the average effectiveness is equal to 0.6 (or expressed as 1 / 0.6 = 1.6 multiplier) from Q34 of the questionnaire. For continuous and discontinuous planting strategies to accelerate reforestation, the average effectiveness and multipliers were derived from Q39 and Q40 respectively. In general, most respondents considered continuous planting strategies to be more effective than discontinuous planting.

Recommendations from the Final CHRP, suggest that short-term restoration objectives and measurable targets will be achieved within a five year period for upland areas. Specifically, the restoration objectives were based on sustained growth (*i.e.,* tree height and stem density criteria) across 80% of restoration locations following commencement of operation. Treed lowlands and shrub/graminoid lowlands are less predictable as time lags associated with their restoration likely exceed 20 years. For these reasons, a short-term delay factor (*i.e.,* 1.2 multiplier) was applied to upland areas and a long-term delay factor (*i.e.,* 2.8 multiplier) was applied to treed lowlands and shrub/graminoid lowlands following DEFRA (2011). Physical mitigation measures such as coarse woody debris, fences or berms that do not rely on vegetation regeneration were assumed to have full effect once established (*i.e.,* 1.0 multiplier). Delay factors associated with habitat restoration measures of the Project footprint and at offset locations were applied once the measures were implemented within caribou range.

Table 3 presents the habitat restoration measure effectiveness, delay factors and multipliers. For ease of calculation of the Residual Project Effect, habitat restoration measures and delay factors are expressed as proportions (Table 4). For calculation of the required offset area, habitat restoration measures and delay factors are expressed as multipliers (Section 5.0).

Table 3 Habitat Restoration Measure Effectiveness, Delay Factors and Multipliers

Habitat Restoration Measure	Application	Degree of Intensity	Measure Effectiveness (Multiplier)	Delay Factor (Multiplier)
Discrete Barriers (Fences/Berms)	Discontinuous	250 m Intervals (High Intensity)	0.3 (3.3)	1.0
		500 m Intervals (Low Intensity)	0.3 (3.3)	1.0
	Continuous	250 m Intervals (High Intensity)	0.5 (2.0)	1.0
		500 m Intervals (Low Intensity)	0.4 (2.5)	1.0
Barrier Segments (Coarse Woody Debris / Mounding)	Discontinuous	50 m Segments / 250 m Intervals (High Intensity)	0.3 (3.3)	1.0
		100m Segments / 500 m Intervals (Low Intensity)	0.3 (3.3)	1.0
	Continuous	50 m Segments / 250 m Intervals (High Intensity)	0.6 (1.6)	1.0
		100 m Segments / 500 m Intervals (Low Intensity)	0.5 (2.0)	1.0
Planting for Future Barrier	Discontinuous	250 m Intervals (High Intensity)	0.4 (2.5)	0.83 (Short-Term Delay = 1.2) 0.36 (Long-Term Delay = 2.8)
		500 m Intervals (Low Intensity)	0.4 (2.5)	0.83 (Short-Term Delay = 1.2) 0.36 (Long-Term Delay = 2.8)
Planting for Future Barrier	Continuous	250 m Intervals (High Intensity)	0.8 (1.25)	0.83 (Short-Term Delay = 1.2) 0.36 (Long-Term Delay = 2.8)
		500 m Intervals (Low Intensity)	0.8 (1.25)	0.83 (Short-Term Delay = 1.2) 0.36 (Long-Term Delay = 2.8)
Planting to Accelerate Reforestation	Continuous	Where Appropriate (Includes Minimum Surface Disturbance)	0.8 (1.25)	0.83 (Short-Term Delay = 1.2) 0.36 (Long-Term Delay = 2.8)

Note:

(1) Habitat restoration measure effectiveness and delay factor multipliers were derived from the questionnaire; a high effectiveness values has a lower multiplier (Section 7.9).
(2) Multipliers associated with delay factors are derived from DEFRA 2011 (Section 7.7). A delay factor of 1.0 implies no penalty as the measure is assumed effective upon implementation. Where delays are incremental through years (i.e., planting and minimum surface disturbance) short and long-term multipliers are used.

3.2 Residual Project Effect

The Residual Project Effect is the area required to be offset after habitat restoration measures are implemented on the Restored Project Footprint (*i.e.,* Final CHRP measures), and include the area of Residual Direct Project Disturbance and Incremental Indirect Disturbance (Table 4). Some measures were assumed more effective than others, and their suitability to surrounding habitat condition, available materials and feasibility to implement were also important considerations. As discussed above, effectiveness values for each measure were derived from the questionnaire (section 7.9, Appendix 2) and delay factors associated with time lags were addressed using multipliers suggested by DEFRA (2011).

In Table 4 (working from left to right), the Residual Project Effect was calculated through the following process steps:

- The restored Project footprint (87.8 hectares) was categorized into new alignment or parallel alignment. New alignment was assumed to have full effect (5.4 ha x 100% = 5.4 ha) on range utility, whereas segments parallel to adjacent pre-existing disturbances have less effect on range utility (82.4 ha x 20% = 16.5 ha), refer to Section 7.9.
- New alignment and parallel alignment segments were categorized into their respective restoration units in order to apply measure effectiveness and delay factor multipliers (*i.e.,* time lags).
- Determined the area (ha) each habitat restoration measure was implemented within each restoration unit for new alignment and parallel alignment segments (see Final CHRP).
- Calculated the Restored Project Footprint Residual Effect for individual habitat restoration measure implemented on the Project footprint, accounting for segments of new and parallel alignment within each restoration unit using the following equation:

$$\text{Residual Project Effect (ha)} = \text{Project Effect (ha)} \times \{1 - (\text{Measure Effectiveness} \times \text{Delay Factor})\}$$

- Sum the total area of Restored Project Footprint Residual Effect (Table 4), Residual Indirect Project Disturbance (Table 2) and Incremental Indirect Disturbance (Table 2) to calculate the Residual Project Effect (Table 4).

For areas where multiple habitat restoration measures were implemented on the Project footprint, their combined effectiveness was additive within the equation. From Table 4, the Restored Project Footprint Residual Effect is equal to 16.5 ha, the Residual Direct Project Disturbance associated for new alignment and parallel alignment is equal to 1.9 ha and 6.3 ha respectively (*i.e.,* total = 8.2 ha), the Incremental Indirect Disturbance is 1.3 ha. The Residual Project Effect required for offset was 26 ha, and included both the area associated with Residual Direct Project Disturbance and Incremental Indirect Disturbance (Table 4).

Table 4 Quantification of Residual Project Effects for the Chinchaga Lateral Loop No.3

Restored Project Footprint (ha)	Inherent Project Effect% (ha)[1]	Restoration Unit (ha)	Habitat Restoration Measure (ha)	Measure Effectiveness	Delay Factor	Restored Project Footprint Residual Effect (ha)	Residual Project Effect (ha)[2]
New Alignment 5.4 (ha)	5.4 (ha) (100%)	Upland Mixedwood Coniferous Transitional (1.1 ha)	Discontinuous Planting to Accelerate Reforest State (1.1 ha)	0.4	0.83	1.1 (ha) x {1 -(0.4*0.83)} = 0.77 (ha)	16.5 ha (Restored Project Footprint Residual Effect) + 8.2 ha (Residual Direct Project Disturbance) + 1.3 ha (Incremental Indirect Disturbance) = 26 ha (Residual Project Effect)
		Treed Lowland Wetland (4.3 ha)	Discontinuous Minimum Surface Disturbance to Accelerate Reforest State (4.3 ha)	0.4	0.36	4.3 (ha) x {1 - (0.4*0.36)} = 3.87 (ha)	
Parallel Alignment 82.4 (ha)	16.5 (ha) (20%)	Upland Mixedwood Coniferous Transitional (12.9 ha)	Discontinuous Barrier Segments (Planting for Future Barrier) (0.04 ha)	0.4	0.83	0.04 (ha) x {1 - (0.4*0.83)} = 0.03 (ha)	
			Discontinuous Barrier Segments (Discrete Barriers/Screens) (0.02 ha)	0.3	0.83	0.02 (ha) x {1 - (0.3*0.83)} = 0.01 (ha)	
			Discontinuous Barrier Segments (Coarse Woody Debris and Planting) (0.7 ha)	0.3 + 0.4 = 0.7	1.0	0.7 (ha) x {1 - (0.7*1.0)} = 0.21 (ha)	
			Discontinuous Planting to Accelerate Reforest State (12.1 ha)	0.4	0.83	12.1 (ha) x {1 - (0.4*0.83)} = 8.47 (ha)	
		Treed Lowland Wetland (3.6 ha)	Discontinuous Barrier Segments (Mounding and Planting) (0.2 ha)	0.3 + 0.4 = 0.7	1.0	0.2 (ha) x {1 - (0.7*1.0)} = 0.06 (ha)	
			Discontinuous Planting to Accelerate Reforest State (1.2 ha)	0.4	0.36	1.2 (ha) x {1-(0.4*0.36)} = 1.08 (ha)	
			Discontinuous Minimum Surface Disturbance to Accelerate Reforest State (2.2 ha)	0.4	0.36	2.2 (ha) {1 - (0.4*0.36)} = 1.98 (ha)	

Notes:

(1) Inherent project effect assumes new alignment has a greater effect on range utility (i.e., 100% = 5.4 ha) than parallel alignment (20% = 16.5 ha), see Appendix 1.

(2) Calculations incorporate the inherent Project effect associated with the residual direct Project disturbance for parallel alignment (1.91 ha x 1.0 [i.e., 100% inherent effect of new alignment]) + (31.3 ha x 0.2 [i.e., 20% inherent effect of parallel alignment]) = 8.2 ha; and the incremental indirect disturbance of 1.3ha. Area calculations (ha) were derived from as-builts presented in Table 2.

4.0 OFFSET MEASURE DECISION-MAKING CRITERIA

This section provides the criteria used to select offset locations and measures and outlines the challenges faced by NGTL to identify feasible offset opportunities. Finally, this section identifies the Project locations and measures selected for offsets, the Required Offset Area and outlines the schedule for when measures were implemented.

4.1 Challenges

NGTL followed the offset selection criteria outlined in BBOP (2012a), where the preferred approach to implementing offsets first considers the regulatory policies and frameworks under which offsets may be structured; however, for this project, several challenges to using that approach were identified:

- The absence of an established offset policy or other regulatory mechanisms for developing offsets for caribou and caribou habitat;
- The absence of provincial range plans, directives or preliminary guidance for priority caribou management/conservation areas in Alberta; and,
- The limited availability of suitable offset locations within caribou range that offer long-term protection through disposition holder agreements, preferably formalized through regulatory permits or other agreements.

Literature suggests these items form the necessary foundations for developing and sustaining successful offset plans with objectives that range from biodiversity conservation through to threatened species conservation. However, in context of the design elements proposed by expert agencies and regulatory authorities, NGTL has largely aligned with BBOP criteria[4]. In light of these challenges, NGTL took guidance from the Recovery Strategy (EC 2012b), which identified range intactness, reducing total disturbance and improving habitat condition as priorities. As these priorities relate to the listed woodland caribou ranges defined in EC (2012b), NGTL considered offset opportunities within all caribou ranges in Alberta.

4.1.1 Aboriginal Community, Industry and Regulatory Considerations

NGTL conducted consultation with regulatory authorities and engaged potentially affected Aboriginal communities to inform offset measures planning and to identify potential opportunities for suitable offset locations (Section 6.0). The main considerations identified for choosing offset locations were:

- Provincial and federal agencies have requested direct “like-for-like” measures (Table 8), thus, indirect offset options were not contemplated for the OMP.
- Discussions with local provincial authorities indicated that current regulatory mechanisms would not provide adequate protection for offsets unless implemented on NGTL dispositions or on dispositions where NGTL has standing agreements with the disposition holder.

[4] with the exception of “Timing”, which would require offsets to be implemented prior to the development occurring. Timing is a design element, which is implemented through indirect offsets in the form of financial contributions to established conservation banks or other financial mechanisms (see Appendix 1).

  - As suggested in EC (2012b), linear anthropogenic disturbances were considered ideal locations for applying offsets; however, provincial authorities discouraged the location of offset measures on seismic lines, as there is the risk that the lines may be re-entered later and thus the offset measures destroyed.
  - Provincial authorities also discouraged the placement of offset measures on third party logging roads and oil and gas roads as those third parties would have a reclamation condition on their surface disposition. Thus, implementation of offsets on areas with historical disturbance, where the area could be disturbed in the future was not the best choice.
  - While preference remains to implement offset measures within the affected range, provincial authorities favoured siting offsets more strategically within permanently protected Wildland Parks in the East Side Athabasca Range (ESAR) and West Side Athabasca Range (WSAR) that fall under established regulatory and integrated resource management mechanisms of the Lower Athabasca Regional Plan and where the immediate threats to local caribou populations may be imminent.

- NGTL engaged with potentially affected Aboriginal communities to discuss the offset approach in general and identify potential offset locations. Several communities expressed the need for continued access into caribou range (*e.g.,* existing roads, pipelines and seismic lines) for hunting and trapping and other traditional activities.
- NGTL approached industry proponents developing or currently conducting habitat restoration projects to identify potential opportunities for suitable offset locations. The Canada's Oil Sands Innovation Alliance (COSIA) and its members have implemented long-term habitat restoration programs and associated research within caribou ranges in northeast Alberta.
  - NGTL approached COSIA and several individual member companies and engaged in discussions to establish a framework to participate, collaborate and conduct future work as part of broader management initiatives. Although positive relationships were developed with industry partners concerning future land management priorities for caribou, these discussions did not result in the securement of offset locations required for this OMP.
- NGTL approached AlPac a holder of a large surface disposition (Forest Management Area) within caribou range. Through discussions, an offset opportunity was identified and is described further in Section 4.2.1.

4.2 Offset Locations

Where possible, preferred offset locations were chosen to reduce aspects of range utility as they relate to total range disturbance. For the OMP, offset location selection criteria included:

- Range planning specific to boreal caribou recovery and management from discussions and consultation with provincial and federal authorities (Section 6.0) and available caribou location data;
- Areas with no or minimal traditional use needs (*i.e.,* hunting, trapping, seasonal access requirements) as identified through engagement with potentially affected Aboriginal communities (Section 6.0);

- Areas of lower potential for future bitumen or hydrocarbon extraction, including existing infrastructure, pipeline and transmission corridors (AGS 2013);
- Areas adjacent, or in close proximity to monitoring programs or other wildlife/landscape management objectives (*e.g.,* Algar Restoration Project and LiDea Project [COSIA 2014]);
- Areas with minimal or no further industrial access requirement, including known recreational access where feasible (*i.e.,* linear features or other available footprint); and
- NGTL has been working collaboratively with Alberta Environment and Parks (AEP) to identify, prioritize and select candidate caribou habitat restoration areas in priority caribou ranges for this Project and other ongoing projects within caribou ranges in Alberta.
    - Selection criteria considered AEP's priority caribou restoration areas, degree of existing disturbance, opportunities for collaborative partnerships and ease of access.
    - Candidate sites were identified in established Wildland Parks in northeastern Alberta that overlap with priority caribou habitat restoration areas identified by the province to enable permanence of caribou habitat restoration and contribute to Recovery Strategy goals and objectives. NGTL will continue to work with AEP, and its partners (e.g., Forest Management Agreement holders) and stakeholders to select specific locations to meet shared objectives.

4.2.1 Dillon River Wildland Park

Dillon River Wildland Park, where NGTL implemented offsets measures for the Project, is located within the Bohn caribou area. The Park is approximately 191,544 ha in size and is located in northeastern Alberta within the Regional Municipality of Wood Buffalo. The Government of Alberta announced the Park's creation through its approval of the Lower Athabasca Regional Plan in August 2012, with boundary revisions completed in 2014 (Figure 8).

The lands within the Dillon River Wildland Park were formerly within AlPac's Forest Management Area, but were surrendered to the province for the creation of the Park. AlPac has not logged in the recent past, however the lands have existing seismic lines. Access to the area is limited, with only a few roads; of which, the majority are winter access only. In a Wildlands Park, the Government of Alberta allows hunting, trapping and fishing, as well as all-terrain vehicle use (on designated trails only) but new industrial development is not permitted.

Offset measures implemented in Dillon River Wildland Park increase the potential for beneficial synergistic effects by enhancing transitional habitats between intact habitat units (i.e., reducing habitat fragmentation effects) This affords protection of offset locations from future development and contributes additional hectares of restored habitat in the Dillon River Wildland Park, where other NGTL offset projects have been previously completed.

NGTL has been working with AlPac and the Government of Alberta to implement offset measures within the Dillon River Wildland Park and are evaluating other park areas. Collaboration among these organizations demonstrates the efficiency of joint participation to achieve common goals and provides synergies and opportunities beyond those realized by working in isolation. The contributions and benefits of each organization are as follows:

Organization	Contributions	Benefits
Government of Alberta	• Government of Alberta provided access to lands within the Dillon River Wildland Park, where future industrial development will not be permitted. Protection from future development is vital for offset measures to achieve success.	• Within the Lower Athabasca Regional Plan, Dillon River Wildland Park was proposed to conserve and protect wildlife and wildlife habitat. • Parks received habitat restoration without cost to the Government of Alberta. Restoration supports the Woodland Caribou Policy for Alberta.
AlPac	• AlPac Integrated Land Management (ILM) team (biologists and silviculturalists) developed, in consultation with TransCanada Pipeline Limited (TCPL), a restoration plan for offset measures within Dillon River Wildland Park. • AlPac implemented the offset measures.	• Implementation of ILM s a key aspect of forest sustainability and cumulative effects management for AlPac. • Contribute to strategies related to the conservation of Species at Risk, in particular caribou habitat restoration, as outlined in *Recovery Strategy for Woodland Caribou* (EC 2012a). • Alignment with Canadian Boreal Forest Agreement goals under Caribou Action Planning and requirements for compliance with forest certification standards (Forest Stewardship Council, Sustainable Forestry Initiative).
TCPL	• TCPL prepared the Final OMP based on the NEB-approved Preliminary OMP including the restoration measures jointly developed with AlPac. • TCPL provided funding for implementation of the offset measures. • TCPL developed and will implement a monitoring program, with an adaptive management component, to monitor the effectiveness of the offset measures.	• Compliance with NEB GC-121 Condition 20. • Restore disturbed caribou habitat within the Bohn caribou area. • Align with directives for caribou habitat restoration as outlined in the Woodland Caribou Policy for Alberta

4.3 Offset Measures

Offset measure selection criteria were derived from recent scientific literature about caribou biology (Appendix 1), the Final CHRP and logistical and feasibility considerations (*i.e.,* equipment access requirements and availability of on-site physical materials). The selection of specific offset measures considered the following criteria:

- upland or transitional habitat types generally provide favorable conditions for habitat restoration and are presumed to facilitate predator and primary prey mobility within the range;
- leverage off existing biophysical conditions such as terrain complexity, line-of-sight and available materials (*i.e.,* coarse woody debris) to maximize offset effectiveness;
- leverage off existing linear feature/footprint condition (*i.e.,* successional state, line-of-sight, terrain complexity) to facilitate, enhance and accelerate offset effectiveness;
- leverage off adjacent habitat condition (*i.e.,* successional state, line-of-sight, terrain complexity) to facilitate, enhance and accelerate equivalent ecological mechanisms of the location; and,
- leverage off transition habitats between intact habitat units to reduce fragmentation effects and increase connectivity between smaller and more diverse habitat units.

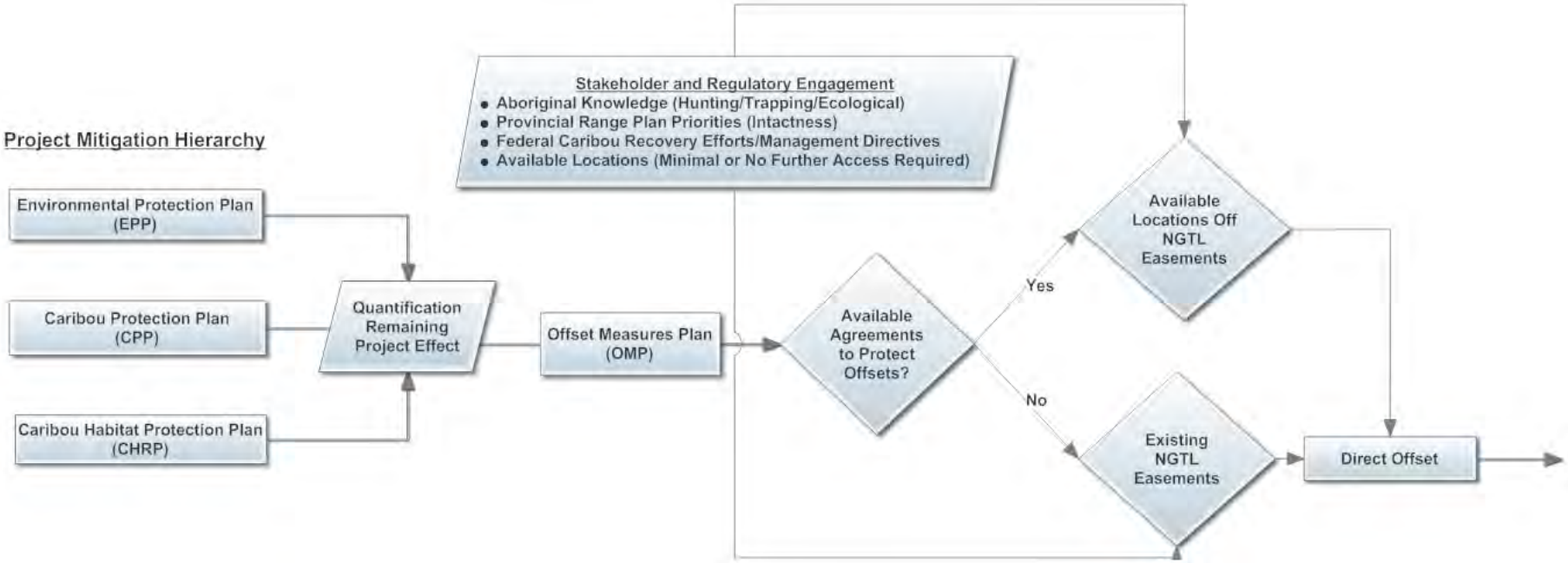
4.3.1 Site-Specific Measures

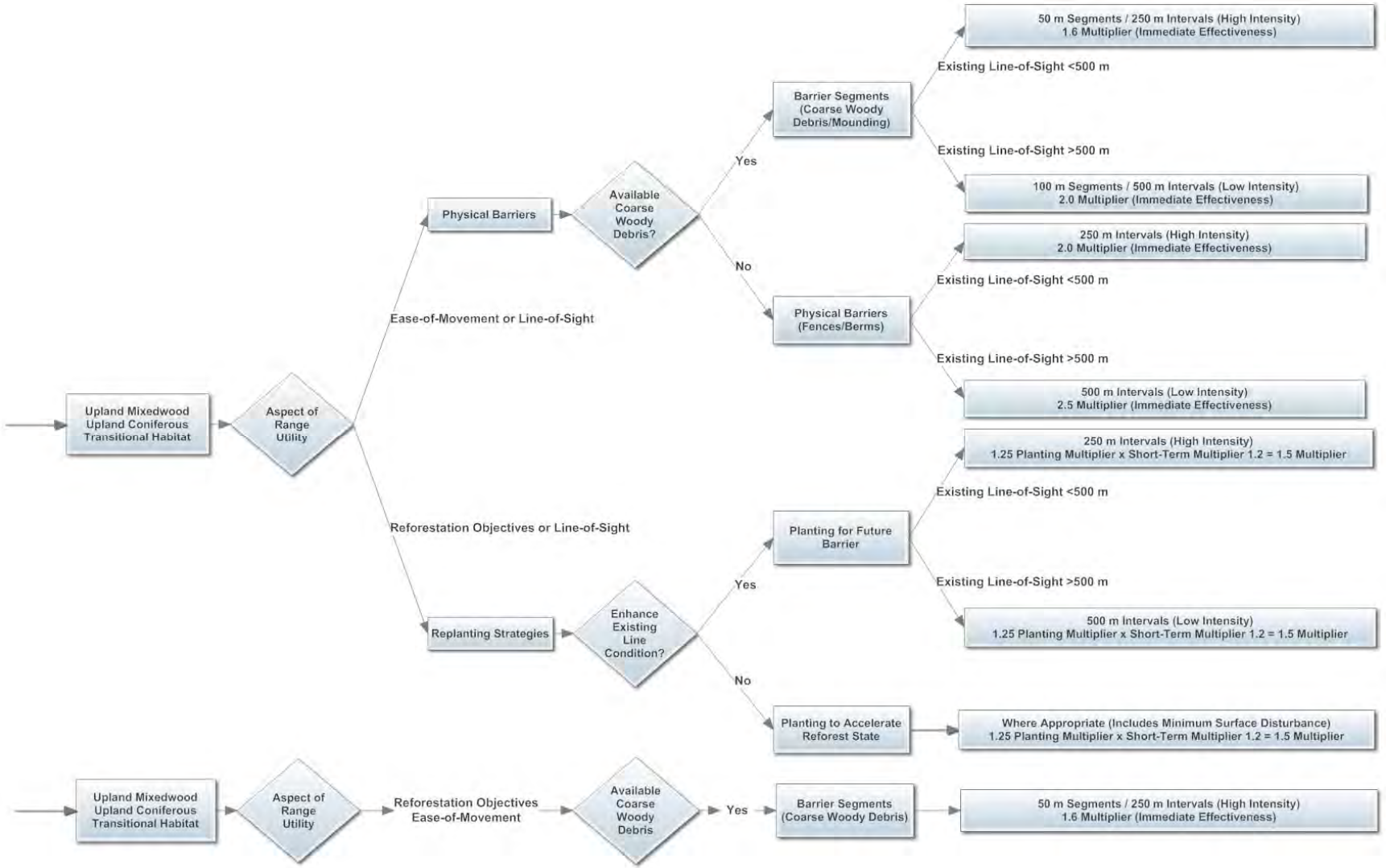
A restoration plan was developed by AlPac Integrated Land Management silviculture specialists for this Final OMP, which included the identification of preferred locations for seedling plantings and coarse woody debris treatments. Habitat restoration measures used for the implementation of this Final OMP included:

- planting to accelerate reforestation along seismic lines and abandoned forestry roads within the Dillon River Wildland Park (Photo 1).
- coarse woody debris in combination with planting to accelerate reforestation along seismic lines and abandoned forestry roads within the Dillon River Wildland Park (Photo 2); and
- coarse woody debris as a standalone measure for access control at strategic locations within the Dillon River Wildland Park (Photo 3).

Where coarse woody debris treatments were applied in combination with planting strategies, the intent was to reduce predator mobility along seismic lines and promote vegetation re-establishment through the creation of localized micro-sites (Vinge, T. February 27, 2014, Pers. Comm.). Coarse woody debris treatments utilized existing materials at offset locations. The site-specific selection criteria for offset measures are represented in a decision flow chart in Figure 6.

Figure 6 Offset Measure Selection Criteria





Notes:

Selection criteria for individual offset measures with multipliers (Table 3).

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Figure 7

PROJECT FEATURES
- Chinchaga Project Area

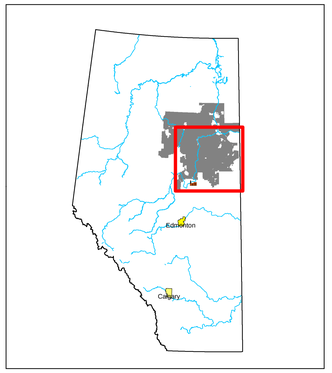
TRANSPORTATION FEATURES
- Railway
- Industry Roads
- Paved Raod
- Gravel Road
- Improved Road
- Unimproved Road

WATER FEATURES
- Streams
- Lakes and Rivers

CADASTRAL FEATURES
- Township Grid
- Al-Pac's Forest Management Agreement Area

MUNICIPAL FEATURES
- Village Hamlet
- Cities, Towns, and Urban Service Areas

PARKS AND PROTECTED AREAS
- Dillon River Wildland Park
- Métis Settlements
- Indian Reserve
- Ecological Benchmark
- Protected Areas
- Millitary Reserves



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Modified: January 22, 2015 by BUTSONRO
Printed: January 22, 2015 by BUTSONRO

1:250,000 Base Map purchased from Spatial Data Warehouse (c) 1:2,000,000 Base Map, Government of Canada (Natural Resources Canada) (c) 1999

FOCUS ON EXCELLENCE

Photo 1 Planting to Accelerate Reforestation

Photo 2 Coarse Woody Debris in combination with Planting to Accelerate Reforestation

Photo 3 Coarse Woody Debris for Access Control

5.0 REQUIRED OFFSET AREA

The methods used to derive the Required Offset Area followed the same methods used to calculate the Residual Project Effect described in Section 3.2.

In Table 5 (working from left to right), calculating the Required Offset Area was achieved through the following process steps:

- Partitioning the total area of Residual Project Effect into the respective offset measure. The Residual Project Effect is 26 ha (Table 4).
    - 14.3 ha of the Residual Project Effect was offset by planting to accelerate reforestation in combination with coarse woody debris
    - 7.1 ha of the Residual Project Effect was offset by planting to accelerate reforestation as a standalone measure; and,
    - 4.6 ha of the Residual Project Effect was offset withcoarse woody debris placement as a standalone measure for access control.
- Effectiveness and delay factor multipliers were applied to the portion of Residual Project Effect to be offset:
    - Where multiple measures were implemented, effectiveness values and delay factors became additive. The implementation of multiple measures was assumed to have short and long term benefits with regard to reducing the spatial and temporal aspects of range utility. For example, 14.3 ha of planting to accelerate reforest state in combination with coarse woody debris are assumed to have maximum measure effectiveness with regard to range utility (*i.e.,* effectiveness value = 1.0).
    - As discussed above, the Residual Project Effect occurred in the Chinchaga caribou range while the offset was placed in the Bohn caribou range within Dillon River Wildland Park. For this reason, a 1.5 spatial risk multiplier was applied to each offset measure following DEFRA (2011).
- the Required Offset Area was calculated by multiplying the portion of Residual Project Effect for each offset measure by the measure effectiveness, delay factor and spatial risk multiplier using the following equation:

$$\text{Required Offset (ha)} = \{\text{Residual Project Effect (ha)} \times (\text{Measure Effectiveness} \times \text{Delay Factor} \times \text{Spatial Risk})\}$$

The Required Offset Area for the Project was calculated as 48.5 ha (Table 5). The offset measures addressed the total area associated with direct and indirect disturbances associated with the restored anthropogenic disturbances within the Dillon River Wildland Park. Offset locations within Dillon River Wildland Park are shown in Figure 8; measures and general descriptions are presented in Appendix 3.

Table 5 Required Offset Area for the Chinchaga Lateral Loop No. 3

Residual Project Effect (ha)	Proportion of Residual Project Effect (ha)	Offset Measure[1]	Measure Effectiveness Multiplier[2]	Delay Factor Multiplier[3]	Spatial Risk Multiplier[4]	Required Offset Area Calculation (ha)[5]	Required Offset Area (ha)[6]
26 ha	14.3 ha	Continuous Planting to Accelerate Reforest State & Coarse Woody Debris High Intensity	1.0	1.0	1.5	1.0 x 1.0 x 1.5 14.3ha = 21.5 ha	21.5 ha + 15.9 ha + 11.1 ha = 48.5 ha
	7.1 ha	Continuous Planting to Accelerate Reforest State	1.25	1.2	1.5	1.25 x 1.2 x 1.5 x 7.1ha = 15.9 ha	
	4.6 ha	Continuous Coarse Woody Debris High Intensity	1.6	1.0	1.5	1.6 x 1.0 x 1.5 4.6 ha = 11.1 ha	

Notes:

(1) Offset measure(s), effectiveness values and delay factors employed to offset the Remaining Project Effect (see Table 5). Where multiple measures are employed their effectiveness values becomes additive in the calculation of the required offset area.

(2) Offset measure effectiveness value is converted to a multiplier for ease of calculation as presented in Table 3 (*i.e.,* 1 / measure effectiveness = multiplier).

(3) Delay factor associated with the time required for the measures to achieve full effectiveness is converted to a multiplier for ease of calculation (*i.e.,* 1 / delay factor = multiplier).

(4) Final offset multiplier required to offset the remaining Project effect (ha) employing specific offset measure(s) and associated delay factors.

(5) Required offset area (ha) using the selected offset measure(s) and associated delay factor.

(6) Required Offset Area is the total amount of lands necessary to offset the Residual Project Effect. For Chinchaga Lateral Loop No. 3, offsets will be implemented on 48.5 ha. During the implementation of offset measures in the Dillon River Wildland Park, NGTL added an additional 4.0 ha of continuous planting to accelerate reforest state in combination with coarse woody debris as a contingency to supplement potential unsuccessful offset areas.

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Figure 8: Dillon River Wildlands Caribou Habitat Restoration Project

Chinchaga Project - 2015

Tree Species Planted

Cadastral Feature Boundaries
- Township / Range
- Section
- Quarter Section

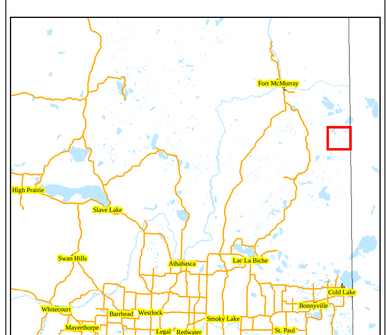
Drainage and Related Features
- River/ Stream - Perennial
- Lakes/ Rivers

Tree Species Planted
- Black Spruce
- Black Spruce - Jack Pine
- Jack Pine
- White Spruce

Other Features
- Linear Features

Chinchega Project Summary

Treatment	Area (ha)
Coarse Woody Debris and Plant Seedlings	27.5
Black Spruce	10.4
Black Spruce - Jack Pine	13.4
White Spruce	3.7
Plant Seedlings Only	15.9
Black Spruce	6.9
Black Spruce - Jack Pine	6.9
Pine	1.6
White Spruce	0.5
Coarse Woody Debris Only	11.1
Total	54.5



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Meters

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5.1 Implementation Schedule

Identification of offset locations and associated planning activities for this OMP included desktop mapping, restoration suitability analysis and planning exercises, which included:

- compiling an anthropogenic disturbance layer to identify linear features;
- building a development restoration unit layer (associating Alberta Vegetation Inventory and Enhanced Wetland Classification data and caribou location data, where available);
- developing a canopy height model from LiDAR imagery, in order to assess current regeneration on lines to identify preferred offset locations;
- develop planting prescriptions for preferred offset locations including a restoration matrix using the aforementioned disturbance layer, restoration unit layer, planting prescriptions and physical barriers; and,
- developing the restoration plan using the restoration matrix, imagery, silviculture expertise and offset measures knowledge.

The implementation schedule for offsets is presented in Table 7. Habitat restoration activities were completed on the Project footprint (Final CHRP measures) and at offset locations on anthropogenic disturbances within the Dillon River Wildland Park in northeastern Alberta. Detailed alignment sheets showing offset measure locations within the Dillon River Wildland Park are presented in Figure 8 and Appendix 3.

Table 6 Implementation Schedule

Activity	2015		
	Q2	Q3	Q4
Detailed lineal inventory	May 1 through June 15		
Aerial reconnaissance[5]	June		
Finalize planning	June		
Implementation		July 15 through December 1	

[5] To mitigate potential effects of the aircraft on caribou, a minimum altitude of 300 m was maintained.

5.2 Adaptive Management and Monitoring

NGTL has filed a Caribou Habitat Restoration and Offset Measures Monitoring Program (CHROMMP) as required under Certificate GC-121 Condition 21 for the Chinchaga Lateral Loop No.3 Project. The CHROMMP provides further details concerning the monitoring methodology and adaptive management procedures to ensure the long-term success of habitat restoration measures implemented on the Project footprint and at offset locations. The following provides a brief summary of adaptive management procedures described within the CHROMMP.

Adaptive management procedures for the monitoring program were developed following guidance provided by the *Operational Policy Statement for Follow-Up Programs* under CEAA (CEA Agency 2011). The goal of adaptive management in this context is to provide a systematic approach for evaluating program outcomes and addressing unsuccessful restoration measures. This requires an assessment and understanding of the underlying cause(s) that might lead to unsuccessful restoration as well as site conditions and other factors that might be affecting recovery.

Evaluation criteria and measurable targets have been developed as part of the CHROMMP to identify the unsuccessful restoration sites during the monitoring timeframe. Measures that do not successfully achieve their respective targets will require adaptive management. Adaptive management will:

- validate assumptions regarding offset locations, performance and effectiveness;
- identify unsuccessful measures (i.e., microsite conditions that are either not conducive or suitable for establishment of vegetation); and,
- address unforeseen spatial or temporal uncertainties.

Additional considerations for adaptive management will incorporate new information and research as it evolves across the monitoring timeframe. For example, provincial range plans and action plans are expected within the next few years. These documents will provide guidance for the implementation of measures to address threats to caribou in order to achieve population and distribution objectives, including an approach to monitoring and reporting (Government of Alberta 2014).
Adaptive management will also incorporate a component of lessons learned from NGTL habitat restoration measures implemented on the Project footprint. For example, measures that have limited to low applicability to pipeline ROWs; such as berms; will be only used where adequate soil materials are available. These will be further expanded upon in the CHROMMP and subsequent monitoring reports. NGTL is currently working to further refine the adaptive management processes to include more detail and decision frameworks so the criteria for implementation and the targets can be well understood and communicated

6.0 CONSULTATION AND ENGAGEMENT

The following sections summarize NGTL's consultation with regulatory agencies and engagement with potentially affected Aboriginal groups during the development of the Final OMP. This summary complements the detailed bi-monthly updates on Aboriginal engagement activities, as previously filed with the NEB. For issues or concerns communicated by regulators, see Table 7, and for issues or concerns communicated by Aboriginal communities, see Table 8.

6.1 Regulatory Consultation

In consultation with both provincial and federal regulatory authorities (Table 7), NGTL understands that ecological mechanisms associated with range intactness, habitat restoration, predator mobility and human access are the priority concerns. For these reasons, offset measures developed for this Final OMP focus on like-for-like measures that are equivalent to, and appropriate for, the level of disturbance, environmental values and residual effects associated with the Project. Population management measures and financial measures were not considered befitting or feasible for this Final OMP given regulatory agency requests for like-for-like measures to be applied within caribou range.

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
Federal					
EC	Paul Gregoire, Wildlife Biologist Edmonton, AB	December 20, 2013 Email (Received)	Environment Canada's comments on the Preliminary Chinchaga OMP are as follows. Commentary: 1) In Page 2-6 and 6-9 of the report the proponent discusses indirect offsets in the form of Research and Monitoring Programs or other Financial Mechanisms. The estimated population size for the Chinchaga population is 250 animals and is declining and deemed not self-sustaining (Boreal Caribou Recovery Strategy). Only 24 percent of the habitat is undisturbed. For all populations with less than 65 percent undisturbed habitat all remaining habitat is considered potential critical habitat unless otherwise identified in a range plan or equivalent evidence. The predicament for the Chinchaga caribou is time sensitive. Although research and monitoring, and other means are important they should not be considered as part of any offset measures for this population. Offsets should be habitat offsets. Critical habitat is habitat necessary for the survival or recovery of the species and should not be destroyed. The final determination on whether critical habitat was destroyed will be made in a Provincial Range Plan, which has yet to be released. It is imperative that all development adhere to the Recovery Strategy goals and objectives. Project review documentation needs to be clear on how boreal caribou critical habitat is being protected and demonstrate, with the support of necessary provincial evidence, that the project will not: • compromise the ability of a range to be maintained at 65% undisturbed habitat; • compromise the ability of a range to be restored to 65% undisturbed habitat; • reduce connectivity within a range; • increase predator and/or alternate prey access to undisturbed areas; or • remove or alter biophysical attributes necessary for	Indirect offsets in the form of financial mechanisms or population management measures are not considered in the Final OMP. Like-for-like measures in the form of direct habitat restoration or other physical measures that reduce the effects of range utility are considered viable offset measures (Comment 1). The model used to quantify the effectiveness of measures applied to the Project ROW (Final CHRP) is necessary to estimate the required offset, and address uncertainty and time lags associated with GC-121 Condition 20. Although new, the model was developed from results of the questionnaire that consider the Project effect in terms of range utility as it relates to total range disturbance (EC 2012b). The ecological mechanisms are the same as they relate to assumptions concerning predator/primary prey response to range disturbance and habitat condition. A revised quantification of the direct and indirect disturbance including restored footprint and area required for operational access is provided in the Final OMP (Section 4.0). EC (2012a) propose that multiplier ratios range from 1:1 through 4:1. The ecological mechanisms associated with the Project effect vary given the degree of disturbance it creates (i.e., parallel alignment to adjacent existing disturbances >15 m in contrast to new alignment). Multipliers for offsets range from 1.0 through 5.0 depending upon the effectiveness of the offset measure, its delay factor and the location implemented (*i.e.,* applied on linear disturbances with no further access needs that are not parallel to adjacent disturbances are more beneficial than a scenario where the opposite would apply). Literature suggests that multipliers need to be based on scientific knowledge. NGTL has collected	In consideration of comments received by provincial and federal regulatory agencies, like-for-like measures in the form of direct habitat restoration or other physical measures as discussed in Section 3.0 and Section 4.0. Refer to Section 7.0 which provides a discussion of literature associated with offsets in general and multipliers. Multipliers for specific measures including their effectiveness are provided in Section 3.0. Offset locations and selection criteria are provided in Section 4.0 and Section 5.0. Adaptive management is discussed in Section 5.0, The CHROMMP provides more specific details for how adaptive management and monitoring will be applied to areas where measures do meet their measurable targets.

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
			boreal caribou. 2) EC notes that the proponent has created a model to assess the effects to caribou and to calculate an offset number in hectares. The model is new and, in spite of the survey, the criteria for inherent residual effect, effectiveness, delay penalty, residual calculation, etc., have not been adopted by wildlife management agencies (Tables 8-10). Therefore EC does not endorse the use of this model. 3) EC notes that the estimated direct disturbance is 169.8 ha. EC requests the proponent provide the hectares that will be restored on the right-of-way, the hectares on the ROW that will be left to natural regeneration, and the hectares of direct (non-modeled) residual habitat disturbance (e.g. including but not limited to the 6-10 m ROW that must be maintained). EC maintains that a 4:1 offset ratio for residual habitat disturbance/loss is the minimum appropriate for this population to address effectiveness, delay and the threatened status of this population. 4) EC acknowledges in the proponent's Preliminary Caribou Habitat Restoration Plan, where it is determined after 5 years following commencement of operation that habitat restoration is underperforming and will not reach predetermined goals/trajectory in a timely fashion, that this additional residual disturbance will be added to the total residual habitat disturbance for the purposes of the offsets plan. 5) The approach for the Offset Selection Criteria, Section 6.5, appears reasonable, save for the above noted concern with indirect offsets. EC looks forward to reviewing the Final Offset Measures Plan.	data from expert individuals and agencies (i.e., questionnaire) concerning caribou mitigation to develop hypotheses regarding their effectiveness, which will be monitored at minimum for5 years with the implementation of adaptive management in the CHROMMP (Comment 2 and 3). The CHROMMP addresses monitoring requirements and adaptive management for measures that do not achieve goals with respect their unique evaluation criteria (Comment 4).	

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
EC	Paul Gregoire, Wildlife Biologist Edmonton, AB	November 18, 2015 Email (Received)	Environment Canada's comments on the Final Chinchaga Final OMP are as follows. Commentary: 1) Offset Location The likelihood that critical habitat will be destroyed is increased if any one of the following activities, or combination thereof, were to occur in such a manner, place and time, that after appropriate mitigation techniques any one of the following were to occur (Federal Recovery for Woodland Caribou 2012): • compromise the ability of a range to be maintained at 65% undisturbed habitat; • compromise the ability of a range to be restored to 65% undisturbed habitat; • reduce connectivity within a range; • increase predator and/or alternate prey access to undisturbed areas; or • remove or alter biophysical attributes necessary for boreal caribou. Because offset measures are proposed for the Eastside Athabasca Range (Bohn) and not in the range where the pipeline project effects occur, there is a high likelihood that critical habitat will be destroyed in the Chinchaga range. EC recommends that offsetting measures be located within the project affected Chinchaga caribou range. 2) Offset Ratios The total direct project disturbance is 121 ha of which 87.8 ha will be restored, 33.2 ha will be Residual Direct Project Disturbance (1.91 ha new alignment + 31.3 ha parallel existing alignment) and 1.3 ha will be incremental Indirect Disturbance. The proposed offset for the project is 48.5 ha. The proposed offset is only 1.5 times that of the residual effects, including consideration for effectiveness and delay (lag) associated with the restored and offset habitat, and is deemed insufficient by EC.	NGTL Response to Environment Canada's comments on the Final Chinchaga OMP (Sherry Nugent / Email Sent, January 26, 2016). 1) NGTL's first priority is to locate offset measures within the same caribou range where the project effects occured; however, for the Chinchaga Lateral Loop No. 3 Project there were several logistical challenges. It would have been NGTL's preference to implement offset measures within the Chinchaga range, but this was not possible. In particular, NGTL worked with stakeholders but was unable to secure offset locations within the Chinchaga caribou range that offer permanent protection from future industrial development disturbances. At the site-specific scale, permanence considerations related to traditional access needs and operational access requirements. Lease holder or disposition agreements that permit application of offset measures and restrictions on further access were also considerations affecting the permanence of offsets. NGTL has implemented restoration of linear features in relatively intact areas of caribou range; reducing both direct and indirect habitat (i.e., buffered area) disturbances to contribute to the Recovery Strategy goal of 65% undisturbed habitat. NGTL has previously implemented offset measures on its own easements for other NEB approved offset projects (i.e., Northwest Mainline Sloat Creek and Cranberry Pipelines) in the same caribou range where the Project disturbance occurred (i.e., Chinchaga caribou range). However, due to offset location proximity to adjacent habitat disturbances (i.e., seismic lines, pipelines,	In consideration of comments received by Environment Canada regarding offset measure locations are discussed in Section 4.0, 5.0 and Section 7.0. Section 4.0 provides the rational and decision-making criteria for offset measure locations and the selection process. Section 7.0 provides a discussion of literature associated current offset policies and practices, design elements and implementation considerations, including applicable multipliers (i.e., offset ratios). Multipliers for specific measures including their effectiveness are provided in Table 3, Section 3.0. Section 4.0 provides the project-specific details regarding the Required Offset.

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
			Through a series of calculations the report has reduced the inherent effect on range utility of the 31.3 ha residual parallel disturbance to a 6.3 ha effect (31.3 ha x 0.2 [i.e., 20% inherent effect of parallel alignment]) = 6.3 ha), because it parallels an existing right of way. Similar calculations were undertaken for the restored habitat. Given that this habitat is likely critical habitat for the Chinchaga range, it may not be appropriate to reduce the project effects in this manner. The Federal Recovery Strategy has identified the Chinchaga caribou range as only 24 percent undisturbed and not self-sustaining. Sixty-five percent is the minimum amount of undisturbed habitat required in order for the population to be deemed self-sustaining. The Chinchaga range is considerably below this threshold. For all populations with less than 65 percent undisturbed habitat all remaining habitat is considered critical habitat until otherwise identified in a range plan or equivalent evidence. Until a range plan is released, it is imperative that activities that have the potential to destroy critical habitat, such as this pipeline project, ensure that the effects are effectively mitigated. Because restoration and offsetting activities are limited by their effectiveness and delay (lag), and that the Chinchaga population continues to decline, offsets ratios must be aggressive to ensure that critical habitat is effectively protected. If the Minister is of the opinion that the laws of the province do not effectively protect critical habitat, an Order may be made. EC recommends that offsets must be aggressive and functionally additive in order to mitigate for project effects and ensure that projects do not result in the destruction of critical habitat (for example, EC has recommended offsets of 4:1 for this and other pipeline projects).	transmission lines, cut blocks, facilities), the effectiveness of these offsets to reduce indirect habitat disturbances within caribou range is highly reduced. Currently there is limited availability of suitable offset locations within the Chinchaga caribou range that offer long-term protection through disposition holder agreements, preferably formalized through regulatory permits or other agreements. However, NGTL confirms the proposed offset location decision-criteria considered the Recovery Strategy prioritization guidance, Traditional Knowledge and Aboriginal community interests, and is the direct result of collaboration with provincial resource managers over the past two years. The factors considered: • regional ecological factors (landscape (range) scale, site specific (feature) scale) • risks and limiting factors relative to representative habitat / population condition • regulatory mechanisms (worked with provincial resource managers to find appropriate and available locations) • contributing to Provincial conservation and recovery priorities (Lower Athabasca Regional Plan) • opportunity for coordinated, collaborative and participatory restoration efforts For securement of offset locations, NGTL worked with both Alberta Environment and Parks (AEP) to identify candidate public lands sites across Alberta that affords permanent protection to offset measures. These areas also overlap high priority caribou habitat restoration areas and are proximal	

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
				to NGTL pipeline projects. While preference remains to implement offset measures within the caribou range where the pipeline project effects occurred, all factors considered, the selection process favoured siting offsets more strategically within Wildland Parks in the East Side Athabasca Range (ESAR) and West Side Athabasca Range (WSAR). These fall under established regulatory and integrated resource management mechanisms of the Lower Athabasca Regional Plan. Offset investments in the ESAR and WSAR are able to optimize and leverage collaboration between government, academia, industry and Aboriginal communities to undertake additive connectivity restoration efforts, learn from coordinated monitoring and applied research, and promote local stewardship capacity through active stakeholder participation at the landscape scale where the immediate threats to local caribou populations may be more imminent. The offsets for the Chinchaga Lateral Loop No. 3 Project were implemented in the Dillon River Wildland Park, which is located within one of the provincial priority areas. In keeping with NGTL's caribou objectives, goals and commitments, restoration and offset investments planned and undertaken in both ranges reduce and offset the residual predicted Project effects and Project contribution to cumulative effects. The Required Offset for the Project was calculated to be 48.5 ha. NGTL actual completed 52.5ha in the summer of 2015; which when added to the offsets implemented by NGTL for other Projects in 2014; there is over 140 ha of contiguous restored habitat in the Dillon River Wildland Park.	

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
				2) Multipliers are applied to account for and address the effectiveness and uncertainty risks of habitat restoration measures (i.e., achievability, spatial relevance and time lags). After applying the appropriate multipliers to each habitat restoration measure, the effectiveness of the measure is quantified for both direct and indirect residual Project effects. Multipliers were developed from results of the questionnaire-based survey and literature provided by DEFRA 2011 (original research conducted by Moilanen 2009). EC (2012a) proposes that offset ratios should range from 1:1 (i.e., 1.0 expressed as multiplier) through 4:1 (i.e., 4.0 expressed as multiplier). Multipliers contributing to an overall offset ratio in this Final OMP range between 1.0 through 5.0 and are dependent upon uncertainty factors related to their overall effectiveness (i.e., implementation on linear disturbances with no further access needs that are not parallel to adjacent disturbances are more effective than a scenario where the opposite would apply) including associated delay factors (i.e., time lags). NGTL recognizes that for the Final Chinchaga OMP, offset measures were placed in the ESAR caribou range rather than the Chinchaga caribou range where the project disturbance occurred. NGTL assigned an additional 1.5 multiplier to the required offset calculation to account for the spatial difference (i.e., spatial risk) between caribou ranges, which is consistent with DEFRA 2011. The Residual Project Effect of the Chinchaga Lateral Loop No. 3 on caribou habitat is 26 ha and the Required Offset is 48.5. During the implementation of offset measures in Dillon River Wildland Park in summer 2016, NGTL added an	

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
				additional 4 ha of measures bringing the total Project offset to 52.5 ha. This represents a total of 52.5 ha of Required Offset for a final general offset ratio of approximately 2.0. NGTL recognizes EC recommends a 4:1 ratio for pipeline projects like the Chinchaga Lateral Loop No. 3. The application of multipliers to address delivery, temporal and spatial risks is also augmented by a long term monitoring program (15 years) to validate residual effect predictions and risk assumptions, and to apply adaptive management mechanisms to ensure caribou restoration and offset objectives are being met. The Caribou Habitat Restoration and Offset Measures Monitoring Program (CHROMMP) for this Project commits NGTL to evaluate program outcomes, adjust, and supplement restoration or offset measures that are unsuccessful. Measures that do not meet their respective targets will be subject to site-specific adaptive management to ensure success of the program. NGTL believes that although the offsets for this Project are less than a 4:1 ratio, the DEFRA discrepancy risk model, current multiplier calculations, combined with long term monitoring and adaptive management commitments, is defensible and ensures success of the restoration offsets. NGTL will continue to evaluate, refine, and apply the DEFRA model for its approach to caribou restoration and offsetting until such time as EC or the provincial Resource Manager releases an equivalent (or better) conservation offset framework to be applied equally across all industrial sectors operating in caribou range.	

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
Provincial					
AESRD (now AEP)	Tim Vinge Provincial Landscape Ecology Specialist , Major Industrial Applications and Reclamation Section	January 22, 2014 Meeting	Mr Vinge outlined a possible process for `selecting the right lines' while planning a restoration project. Appropriate data, potential sources and analysis were discussed including use of LiDAR imagery to detect current condition of linear features in terms of regenerating vegetation that may be present as well as light levels. The importance of microsite creation and site treatment was emphasized, particularly in legacy sites that have not be recently disturbed. These sites are particularly challenging. It is important to determine the reason(s) that vegetation may not be re-established and determine what silvicultural or other tools are available to ameliorate the site condition and create a hospitable site for planting or natural regeneration. Emphasized that this is more than a tree planting exercise and several, varied methods of restoration and access management are needed to enhance potential for success.	Silviculture specialists with AlPac developed the restoration plan and planting prescriptions based on education and professional knowledge of practises. Restoration plans consider the most suitable species for a specific location, which include mixed coniferous species and deciduous species. NGTL is working with provincial and industry partners to find appropriate locations within caribou range to implement offset measures. These locations are chosen in collaboration with provincial authorities in order to meet their planning priorities	Refer to 4.0and 5.0 for offset selection criteria and locations.
AESRD (now AEP)	Tim Vinge Provincial Landscape Ecology Specialist , Major Industrial Applications and Reclamation Section	February 27, 2014 Meeting	Continued the discussion with Mr Vinge in terms of challenges and opportunities for effective restoration activities along linear features in caribou habitat. Several documents, a slide presentation, treatment matrix and alternative approaches were provided/discussed. The importance of assisting sites that were not currently regenerating was emphasized. For wetter soils, lowland situations where mounding is prohibitive due to access constraints and costs, Tim suggests an application of coarse woody debris to create microsites and promote the development of the `hump and hollow' topography in lowland sites. This would be a possible method of assisting to create microsites and variability in these lowland sites while not using mechanical site prep methods. The utility of a linear inventory (e.g., Greenlink forestry methodology used for CEMA project) would by high for the Dillon area due to the length of time since disturbance and the variable regeneration response throughout the area. The linear inventory will provide info on% cover and height classes of vegetation along the linear feature as well as provide info on ecosite and other site characteristics.	Silviculture specialists with AlPac developed the restoration plan and planting prescriptions. Restoration plans consider the most suitable species for a specific location, which include mixed coniferous species and deciduous species. Offsets focus on upland areas, some coarse woody debris treatments will be applied at strategic locations for access control in lowland areas.	Refer to 4.0and 5.0 for offset selection criteria and locations.

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
AESRD (now AEP)	Dave Moyles Senior Wildlife Biologist, Peace Region, Operations Division	December 15, 2016 Email (Received)	Mr Moyles commented on applying offsets associated with residual effects of Project disturbances in the Chinchaga caribou to the ESAR caribou range. Caribou populations in these two ranges may have localized pressures associated with differing amounts of footprint which may affect how they utilize the range.	NGTL's first priority is to locate offset measures within the same caribou range where the project effects occurred; however, for the Chinchaga Lateral Loop No. 3 Project there were several logistical challenges. It would have been NGTL's preference to implement offset measures within the Chinchaga range, but this was not possible. In particular, NGTL worked with stakeholders but was unable to secure offset locations within the Chinchaga caribou range that offer permanent protection from future industrial development disturbances. At the site-specific scale, permanence considerations related to traditional access needs and operational access requirements. Lease holder or disposition agreements that permit application of offset measures and restrictions on further access were also considerations affecting the permanence of offsets. NGTL has implemented restoration of linear features in relatively intact areas of caribou range; reducing both direct and indirect habitat (i.e., buffered area) disturbances to contribute to the Recovery Strategy goal of 65% undisturbed habitat. NGTL has previously implemented offset measures on its own easements for other NEB approved offset projects (i.e., Northwest Mainline Sloat Creek and Cranberry Pipelines) in the same caribou range where the Project disturbance occurred (i.e., Chinchaga caribou range). However, due to offset location proximity to adjacent habitat disturbances (i.e., seismic lines, pipelines, transmission lines, cut blocks, facilities), the effectiveness of these offsets to reduce indirect habitat disturbances within caribou range is highly reduced. Currently there is limited availability of suitable offset locations within the Chinchaga caribou range that offer long-term protection through disposition holder agreements, preferably formalized through regulatory	Section 4.0 provides the rational and decision-making criteria for offset measure locations and the selection process.

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
				permits or other agreements. However, NGTL confirms the proposed offset location decision-criteria considered the Recovery Strategy prioritization guidance, Traditional Knowledge and Aboriginal community interests, and is the direct result of collaboration with provincial resource managers over the past two years. The factors considered: • regional ecological factors (landscape (range) scale, site specific (feature) scale) • risks and limiting factors relative to representative habitat / population condition • regulatory mechanisms (worked with provincial resource managers to find appropriate and available locations) • contributing to Provincial conservation and recovery priorities (Lower Athabasca Regional Plan) • opportunity for coordinated, collaborative and participatory restoration efforts For securement of offset locations, NGTL worked with both Alberta Environment and Parks (AEP) to identify candidate public lands sites across Alberta that affords permanent protection to offset measures. These areas also overlap high priority caribou habitat restoration areas and are proximal to NGTL pipeline projects. While preference remains to implement offset measures within the caribou range where the pipeline project effects occurred, all factors considered, the selection process favoured siting offsets more strategically within Wildland Parks in the East Side Athabasca Range (ESAR) and West Side Athabasca Range (WSAR). These fall under established regulatory and integrated resource management mechanisms of the Lower Athabasca Regional Plan.	

Table 7 Regulatory Consultation and Concordance Tracking for the Final OMP

Agency	Name and Title	Date and Method	Details	Concordance Comments and Rationale	Section in the Final OMP
				Offset investments in the ESAR and WSAR are able to optimize and leverage collaboration between government, academia, industry and Aboriginal communities to undertake additive connectivity restoration efforts, learn from coordinated monitoring and applied research, and promote local stewardship capacity through active stakeholder participation at the landscape scale where the immediate threats to local caribou populations may be more imminent. The offsets for the Chinchaga Lateral Loop No. 3 Project were implemented in the Dillon River Wildland Park, which is located within one of the provincial priority areas. In keeping with NGTL's caribou objectives, goals and commitments, restoration and offset investments planned and undertaken in both ranges reduce and offset the residual predicted Project effects and Project contribution to cumulative effects. The Required Offset for the Project was calculated to be 48.5 ha. NGTL actual completed 52.5ha in the summer of 2015; which when added to the offsets implemented by NGTL for other Projects in 2014; there is over 140 ha of contiguous restored habitat in the Dillon River Wildland Park.	

6.2 Aboriginal Engagement

NGTL constructs and operates facilities near many Aboriginal communities across Canada and believes in developing positive relationships with the Aboriginal communities affected by its activities, to try to achieve respective business and community interests.

6.2.1 Guiding Principles for Aboriginal Engagement Activities

Principles guiding Aboriginal engagement activities are that NGTL:

- respects the diversity of Aboriginal cultures, recognizes the importance of the land and cultivates relationships based on trust and respect;
- works together with Aboriginal communities to identify impacts of company activities on the community's values and needs in order to find mutually acceptable solutions and benefits;
- strives to create short and long-term employment opportunities for Aboriginal people affected by its activities;
- supports learning opportunities for Aboriginal people to provide a well-trained source of Aboriginal employees and to build capacity within Aboriginal communities; and,
- respects the legal and Constitutional rights of Aboriginal peoples and recognizes that its relationships with Aboriginal peoples are separate and different from that of the Crown.

6.2.2 Strategic Plan

As part of its commitment to build and maintain positive relationships, NGTL has obtained direct input and traditional knowledge from potentially affected Aboriginal communities in order to focus efforts and investments in areas that provide greatest benefit for the Final OMP.

6.2.3 Consultation Goals

In engaging with potentially affected Aboriginal communities, NGTL had goals to:

- increase awareness and understanding of the Final OMP, NGTL's commitments to caribou habitat protection, and priorities for caribou habitat restoration;
- gain insight of community priorities for traditional ecological knowledge integration into the Final OMP;
- receive community insight (geospatial) about how caribou move and utilize habitat throughout their range for all stages of their lifecycle; and,
- receive recommendations from community members on future opportunities to follow-up with the community to review the Final OMP and lessons learned.

6.2.4 Communities Engaged

The following Aboriginal communities were engaged to provide comments and traditional knowledge concerning the development of this Final OMP:

- Beaver River First Nation
- Dene Tha First Nation
- Doig River First Nation
- Duncan's First Nation
- Ft Vermillion Metis Society
- Horse Lake First Nation
- Metis Nation of Alberta Region 6
- Metis Nation of BC
- Paddle Prairie Metis Settlement
- Prophet River First Nation

6.2.5 Past Activities with Aboriginal Communities

NGTL has existing relationships with many of the communities consulted during the development of the Final OMP. Much of NGTL's previous work with these Aboriginal communities has focused on project-specific issues, or other issues of a general nature.

Aboriginal engagement conducted as part of this Final OMP has informed NGTL of the importance of caribou to many of the communities in the region. It has also allowed NGTL to have a greater understanding of the Aboriginal Communities' preferred consultation processes, including certain capacity and timing issues that were considered throughout the consultation process. As NGTL has long-standing relationships with many of these communities, it is important that NGTL respects the amount of effort and time that has gone into establishing these relationships, and to respect the effort that communities put towards engaging on the projects.

Although NGTL does have previous working relationships with many of the communities, it was critical for NGTL to treat the information and the engagement efforts as new. NGTL's existing relationship with the communities on the Project also meant there were some issues related to earlier stages of the Project raised, but could not be addressed in the Final OMP as the Project had already been constructed.

6.2.6 Action Plan

NGTL identified an Aboriginal Engagement Action Plan at the outset of the Preliminary and Final OMP engagement efforts. However, based on the unique circumstances of each community, NGTL was also flexible to meet the requests of communities in an attempt to have them better understand the process.

NGTL's Aboriginal engagement activities were guided by the following action plan:

1. Initial OMP Project Engagement
    a. Expression of interest to engage community sent to community contacts
    b. Follow-up call to confirm depth of engagement interests on the OMP
        i. Community Open House
        ii. Field-based program
        iii. Technical workshop
        iv. Knowledge Holder meetings

2. Offset Measures Plan Engagement: Map-based Review Process
    a. Written request for participation in OMP planning / map mail out
        i. Past engagement activity
        ii. Plans and Priorities
        iii. Timelines
    b. Follow-up call to confirm participation preferences
        i. Mail-in TEK map review session
        ii. Face-to-face Knowledge Holder map review
    c. Individual community map review meetings, as requested
        i. Finalize plans, priorities and timelines

3. Integration of Traditional Knowledge and Community Feedback
    a. Copy and return marked up maps
    b. Written overview of decisions and actions
    c. Notification of Final OMP filing

NGTL also employed other measures to facilitate a better understanding. During this time, NGTL provided the option of capacity funding to communities, made in-house experts available at meetings to provide detailed responses to community questions, and provided a fly-over of the caribou range based on a community's request. Ultimately, NGTL's goal was to collect, consider, and look to incorporate input that the community found to be important to the overall goal of restoring critical caribou range, and find ways to ensure that NGTL reflected the importance of the information in the same manner it was provided by the Aboriginal communities.

6.2.7 Reflecting Community Input

NGTL asked Aboriginal communities to help identify priority areas for offset measures within caribou ranges based on their traditional knowledge. NGTL also asked the communities to provide their insight on the most effective types of offset measures. Where feasible, and in accordance with community protocols on confidentiality, NGTL incorporated this information into the Final OMP, as part of the Offset Selection Criteria for the types of offsets that will be applied, and for the priority areas where they will be implemented.

Many of the communities provided similar input throughout the engagement process. Some of the comments that NGTL received related to general support for increasing caribou populations, decreasing wolf predation, and ensuring effective monitoring programs are in place to ensure success of our offset measures. There was also concern that NGTL was not establishing habitat where caribou have been known to be located. Additionally, communities expressed concern with participating in the process, as

there was concern that community member's knowledge would be disrespected by not being used in the Final OMP. NGTL has attempted to show through the engagement process, and as summarized in Table 8, where either community members input was considered and/or incorporated into the Final OMP. Input from Aboriginal communities has resulted in changes to the Final OMP.

Communities also made suggestions regarding the process that NGTL used to develop the Final OMP. Some suggestions included working with other companies and government in the area to develop an effective Final OMP. Concerns regarding economic development opportunities were relayed to Supply Chain contacts within TransCanada.

There were some issues raised by communities that were outside of NGTL's mandate. Many communities expressed concerns that NGTL was not doing enough to solve the caribou issue; recovering caribou populations is the challenge that currently faces the provincial government as the responsible authority. There were also concerns regarding the use of Final OMP measures to allow additional development within critical caribou habitat.

NGTL will maintain strict confidentiality over traditional knowledge information provided by Aboriginal communities and will not share that information with any other individuals or organizations, unless the owner specifically grants permission to do so. Any detailed information used in the Final OMP planning process will not be printed on any final maps or reports unless the owner of the information specifically grants permission to do so. The owner of the information has the right to grant or deny access to all information to NGTL. NGTL also excluded any discussion related to hunter/trapper access in specific areas from the Final OMP document, but has incorporated this feedback into overall selection criteria.

Table 8 Aboriginal Consultation and Concordance for the Final OMP

Community	Date and Method	Special Issues and Concerns	Concordance Comments and Rationale	Section in the Final OMP
Metis Nation British Columbia	June 20, 2013 Meeting	NGTL met with administrative and technical staff from Metis Nation British Columbia. NGTL used an agenda and PowerPoint presentation, modifying content to reflect learnings from other workshops held for the Preliminary OMP. NGTL noted in the PowerPoint presentation that caribou-related information had been gathered from the traditional use study that Metis Nation British Columbia had completed as part of the Project.		
		• Metis Nation British Columbia asked whether big game: moose, deer (whitetail and mule), elk, caribou, bison, goat, sheep and bear (black and grizzly) are affected and considered within the OMP area.	NGTL described how the Preliminary OMP was to the benefit of caribou as they are a Threatened species and would likely have no effect on populations of other species within the area.	Section 7.8 discusses the ecological mechanisms associated with caribou and how the OMP is specific for caribou and caribou habitat.
Dene Tha' First Nation	October 9, 2013 Workshop	Dene Tha' First Nation indicated that they would like to be involved in providing input into the Preliminary and Final OMP. NGTL provided the links to the NEB website for filings of the Preliminary OMP, correspondence from the NEB on Preliminary OMP and provided a map showing other existing NGTL lines within the caribou range.		
		• Concern regarding the amount of roads and well sites that have upstream impacts on caribou.	The Preliminary OMP focus is on habitat restoration of caribou habitat, active roads and well sites are not considered in the OMP. Abandoned easements or leases would be considered where they can be protected.	Section 4.0 and 5.0 describe the types of offset measures implemented and their respective locations.
		• Preference for "like-for-like" offsets. Population management measures are too tough. Predators tangible but problematic. Trapping alpha males and sterilizing would need to be continuous.	NGTL is implementing direct "like for like" offset measures within the Preliminary OMP	Section 4.0 and 5.0 describe the types of offset measures implemented and their respective locations.
		• Dene Tha' believe research and monitoring programs is a great gap. Currently working with the University of Alberta collecting baseline environmental data including caribou collaring and tracking.	Research and monitoring programs are considered indirect measures within the Preliminary OMP. Direction from provincial and federal regulatory agencies have indicated that direct measures be applied within the landscape.	Section 4.0 and 5.0 describe the types of offset measures implemented and their respective locations.

Table 8 Aboriginal Consultation and Concordance for the Final OMP

Community	Date and Method	Special Issues and Concerns	Concordance Comments and Rationale	Section in the Final OMP
Metis Nation of Alberta - Region 6	October 10, 2013 Meeting	NGTL met with Metis Nation of Alberta - Region 6 regarding the Preliminary OMP. Comments from Metis Nation of Alberta - Region 6 workshop participants included as follows: Need to confirm TLU studies with Metis Nation of Alberta - Region 6 for the Project..		
		• Grizzly bears, not just wolves are a big issue. Also cougars. More grizzlies around Hines Creek and the south end of the Chinchaga caribou range. Alberta Sustainable Resource Development is trans-locating these predators and it was not known whether they were being monitored for population and range expansion growth. Impact on caribou not reported.	NGTL described how offset measures were developed to the benefit caribou as they are a Threatened species and would likely have no effect on populations of other species within the area.	Section 7.8 discusses the ecological mechanisms associated with caribou and how the Final OMP is specific for caribou and caribou habitat.
		• Signage to keep people and quads off of restored areas and offset areas.	NGTL will be applying access controls in the form of coarse woody debris for offset locations where suitable materials are available and judged to be effective.	Section 4.0 and 5.0 describe the types of offset measures implemented and their respective locations
		• Monitoring is very important. Need to monitor the caribou to understand more. What kind of monitoring and technology will be used?	Monitoring of offset measures will be conducted via aerial and ground-based programs and are defined within the CHROMMP.	NGTL's filing for Condition 21 will address monitoring and adaptive management (Section 5.0)

Table 8 Aboriginal Consultation and Concordance for the Final OMP

Community	Date and Method	Special Issues and Concerns	Concordance Comments and Rationale	Section in the Final OMP
• Beaver River First Nation • Dene Tha First Nation • Doig River First Nation • Duncan's First Nation • Ft Vermillion Metis Society • Horse Lake First Nation • Metis Nation of Alberta Region 6 • Metis Nation of BC • Paddle Prairie Metis Settlement • Prophet River First Nation	November 9, 2015 Letter attached to email and sent to all community contacts	Communities that replied or wished to discuss the Final OMP further were the Dene Tha First Nation and the Beaver First Nation.	A letter was mailed out to the communities listed. The letter requested that if the communities would like to provide feedback and input into the proposed Final OMP, that they can provide written feedback or request to have a meeting with NGTL prior to December 15th, 2015. The need for NGTL to have a Final OMP submitted by February 1st, 2016 was also communicated to the communities in this letter.	Section 6.2 describes NGTL's Aboriginal Engagement Activities for this Final OMP.

Table 8 Aboriginal Consultation and Concordance for the Final OMP

Community	Date and Method	Special Issues and Concerns	Concordance Comments and Rationale	Section in the Final OMP
Dene Tha First Nation	November 30th, 2015 Meeting at Chateh with Dene Tha First Nation Lands Dept. Officer, Baptiste Metchooyeah	NGTL met with Dene Tha First Nation Lands department to discuss the Final Caribou Offset Measures Plan for Residual Effects to Caribou Habitat. Dene Tha First Nation had no specific issues with the current Chinchaga Final OMP. Dene Tha First Nation provided comments in regards to future OMPs. Dene Tha First Nation made general industry related comments, not specific to pipelines. Dene Tha First Nation also suggested that there may be an opportunity to provide workshops to provide the community with more information on pipelines in general.	NGTL described how the Final OMP was developed to benefit caribou as they are a Threatened species and would likely have no effect on populations of other species within the area. The Final OMP focus is on habitat restoration of caribou habitat, active roads and well sites are not considered in the Final OMP. Abandoned easements or leases would be considered where they can be protected. NGTL will continue to engage Aboriginal Communities in the progression of this Final OMP and future OMPs, including feedback and traditional knowledge. Potential economic development opportunities to participate in the implementation and monitoring phases of the Final OMP have been relayed to Supply Chain at NGTL.	Section 7.8 discusses the ecological mechanisms associated with caribou and how the Final OMP is specific for caribou and caribou habitat. Section 4.0 describe the types of offset measures implemented and their respective locations Section 6.2 describes NGTL's Aboriginal Engagement Activities for this Final OMP
Beaver River First Nation	December 9th meeting in High Level with Beaver First Nation Consultation Representative, Kieran Broderick	NGTL met with Beaver River First Nation to discuss the Final Caribou Offset Measures Plan for Residual Effects to Caribou Habit. Beaver River First Nation had no specific issues with the current Chinchaga OMP. Beaver River First Nation would like to be involved in any opportunities that are presented through further OMPs in their Traditional Territory. Beaver River First Nation would be favorable to having other First Nations in the North Peace area working collectively on caribou OMPs.	NGTL described how the Final OMP was to the benefit of caribou as they are a Threatened species and would likely have no effect of populations of other species within the area. The Final OMP focus is on habitat restoration of caribou habitat, active roads and well sites are not considered in the Final OMP. Abandoned easements or leases would be considered where they can be protected. NGTL will continue to engage Aboriginal Communities in the progression of this Final OMP and future OMPs, including feedback and traditional knowledge. Potential economic development opportunities to participate in the implementation and monitoring phases of the Final OMP have been relayed to Supply Chain at NGTL.	Section 7.8 discusses the ecological mechanisms associated with caribou and how the OMP is specific for caribou and caribou habitat. Section 4.0 describe the types of offset measures implemented and their respective locations Section 6.2 describes NGTL's Aboriginal Engagement Activities for this Final OMP

7.0 LITERATURE REVIEW

7.1 Summary and Conclusions

After review of the literature, NGTL developed this OMP following an approach consistent with the development of conservation offsets, which recognize the environmental values of concern that are specific to the threats and unique conservation needs of boreal caribou. Literature reviewed suggests a strong preference for equivalency between the nature of the residual effects arising from the development and the value added by an offset measure to counterbalance the residual effects (*e.g.,* like-for-like habitat restoration) (Bull *et al.* 2013a; Habib *et al.* 2013; Poulton 2013). NGTL adopted the principle of like-for-like habitat restoration in this OMP.

In order to address uncertainty and time lags for each offset measure, NGTL has applied the discrepancy risk approach suggested by DEFRA (2011). The DEFRA approach was derived from original research conducted Moilanen et al. (2009; as cited in DEFRA 2011). The underlying principles of the discrepancy approach were developed in consideration of the risk factors associated with habitat restoration which provide direct relevance to this OMP. For example, risk factors associated with each offset measure employed in this OMP are considered in terms of:

- delivery risks associated with each measures effectiveness and achievability (*i.e.,* challenges and uncertainty of the restoration technique);
- spatial risks associated with the proximity of measures to caribou and caribou habitat (*i.e.,* spatial relevance within caribou range); and,
- temporal risks associated with each measures ability to achieve full effectiveness (*i.e.,* short or long-term time lags).

The discrepancy approach provides a quantitative methodology from which formal hypothesis tests can be constructed to assess offset measure effectiveness and ability to achieve a No-Net-Loss or net gain outcome (Moilanen *et al.* 2009).

Multipliers reflect the degree of risk related to the ecological mechanisms associated with the effects of linear features on caribou population decline. Multipliers help to address the effectiveness and uncertainty of offset measures (*i.e.,* achievability, spatial relevance and time lags). After applying multipliers to each offset measure the effectiveness of the measure is quantified for both direct and indirect residual effects associated with the remaining residual effect of the Project. For this OMP, multipliers range from 1.0 through 5.0, which is consistent with the majority of offset literature discussed below.

7.2 Background and Search Criteria

NGTL's Preliminary OMP provided reference to primary literature and guidance documents considered in the development of the plan to offset residual effects of the Project to caribou habitat (Appendix 1). The following presents further information on the approach used to conduct the literature review to inform NGTL's offset measures planning decisions including scientific methodology, mitigation hierarchy, design elements, offset measures and multipliers.

The literature reviewed included peer-reviewed scientific articles, guidance documents from expert individuals/agencies, as well as established offset policies and emerging offset policies from provincial,

state and federal agencies in Canada and from the international community. Literature was reviewed and collected from the following sources from July 2013 through October 2015:

- ScienceDirect (sciencedirect.com), JSTOR (jstor.org) and ELSEVIER (elsevier.com) for biological and environmental science journal databases, including other related research fields and disciplines;
- provincial, state and federal government agency websites for established or emerging offset policies and frameworks (countries included: Australia, Brazil, Canada, New Zealand, United Kingdom, and the United States);
- expert agency websites that provide scientific review and best-practice guidance and frameworks for established and emerging offset programs (organizations included: Alberta Biodiversity Monitoring Institute, Alberta Conservation Association, Business Biodiversity Offset Programme, Commonwealth Scientific and Industrial Research Organization, International Union for Conservation of Nature, Pembina Institute, and the United Nations Convention on Biological Diversity); and,
- expert individual websites (author-specific, where available) for published articles and associated links or documents related to the aforementioned sources, including presentations from the 15th North American Caribou Workshop held in Whitehorse, Yukon from May 12 – 16, 2014.

Key words used in search engines included environmental, conservation, biodiversity, allowance, compensatory, mitigation, bio-banking, direct, indirect, in-kind, out-of-kind, like-for-like, multiplier and offset. For the purpose of this OMP, literature collected for review and citation focused on, but was not limited to, “Conservation Offsets” and “Biodiversity Offsets”.

Within the literature reviewed, the term “offsets” encompasses a broad range of definitions and applications specific to the context in which they are applied. Parameters and selection processes for relevant literature reviewed for this OMP focused on the application of offsets addressing residual effects arising from industrial, agricultural and urban developments (both in theory and in applied examples).

7.3 Offset Definitions and Principles

Conservation and biodiversity offsets are defined as measurable conservation outcomes or environmental values resulting from actions designed to compensate for residual adverse effects arising from a development after appropriate mitigation measures are applied.

Biodiversity offsets are discussed primarily in the context of ensuring either No-Net-Loss (NNL) or a net gain of biodiversity value (BBOP 2012a; DC 2010; EPI 2013; McKenney and Kiesecker 2010). Biodiversity offsets imply broader considerations of a landscape’s ability to maintain biodiversity, while still acknowledging the application might be focused on specific objectives (BBOP 2012a; DC 2010; McKenney 2005; Kiesecker *et al.* 2009; Poulton 2014).

Conservation offsets generally refers to an increased quantity, quality, or security of specific environmental values outside the project footprint to compensate for residual adverse effects arising from the development activity (Australian Government 2012a; Croft *et al.* 2011; EC 2012a; Noga and Adamowicz 2014). Conservation offsets are generally applied in circumstances where the environmental

values are specific to either individual species or plant communities under threat. Parameters can range from numbers of individuals of a threatened species or characteristics of its habitat, to the area and quality of threatened communities or ecotypes (Australian Government 2012a; Bull *et al.* 2013a; EPI 2013; Gibbons and Lindenmayer 2007). Some literature suggests the potential overlapping benefit of conservation offsets might be the indirect conservation of localized biodiversity values (Australian Government 2012a; Bull *et al*. 2013b; Croft *et al*. 2011).

In order to meet requirements outlined in GC-121, Condition 20 (Table 1), this OMP follows the internationally accepted model for conservation offsets as the measures developed in this OMP are specifically focused on caribou habitat restoration. This offset approach recognizes the environmental values of concern specific to the unique conservation needs of caribou and will directly focus on the threats considered highest priority to boreal caribou as defined in the federal Recovery Strategy for Woodland Caribou (EC 2012b).

Literature reviewed suggests a strong preference for equivalency between the nature of the residual effects arising from the project and the value added by an offset measure to counterbalance the residual effects (*e.g.,* like-for-like habitat restoration) (Bull *et al.* 2013a; Habib *et al.* 2013; Poulton 2013). This is particularly relevant when offsets target specific environmental values rather than pursue a program with a more general mandate that might suit higher-level biodiversity management objectives (Bull *et al.* 2013b; Gibbons and Lindenmayer 2007). According to Business and Biodiversity Offsets Programme (BBOP 2012a), as well as the Australian Government (2012a), British Columbia Ministry of Environment (BC MOE 2014a), Croft *et al.* (2011), Environment Canada (EC 2012a), McKenney (2005), Schneider (2011), SENES Consulting Ltd.. (2013), ten Kate *et al.* (2004),and Weber (2011), offset measures can be further categorized as:

<u>Direct Offsets</u>

- Like-for-Like habitat restoration or various methods of land securement (*e.g.,* land acquisition, provincial protective notations, rezoning and transfer of development rights);
- Population Management Measures (*e.g.,* fish restocking programs as defined by Fisheries and Oceans Canada (DFO 2013), or other programs that provide benefit to species conservation and management);

<u>Indirect Offsets</u>

- Financial Offset Mechanisms (*e.g.,* bio-banking systems, trust funds or other trading programs where contributions are made in advance of the project development proceeding); and
- Research and Monitoring Programs (*e.g.,* financial contributions to develop the scientific knowledge concerning the environmental value or ecological mechanisms).

A habitat-based rationale specifies that direct offsets (*i.e.,* equivalent like-for-like measures) are distinct from indirect offsets based on whether habitat is, or will be, directly modified (Bull *et al.* 2013a; BBOP 2012b). For example, direct offsets in the form of land securement have been utilized recently by proponents of other industrial projects, including; the Joslyn North Mine Project (Total E&P Canada Ltd.), the Roman Coal Mine (Peace River Coal Inc.), the True North Forest (Shell Canada), and two recent Canadian Boreal Forest Agreements (CBFA 2012a,b).

Indirect offsets are defined as measures that contribute to research programs and financial compensatory mechanisms through established banking trusts (Australian Government 2012a; BBOP 2012a; Croft *et al.* 2011; Schneider 2011; ten Kate *et al.* 2004).

7.3.1 Canadian Examples

In Canada, compensating for lost fish habitat was first introduced by DFO as a policy objective to achieve "net gain of habitat" within its Policy for the Management of Fish Habitat (DFO 1986). In 2013, DFO amended the *Fisheries Act* embedding a modernized approach to offsetting into regulation. *Fisheries Productivity Investment Policy: A Proponent's Guide to Offsetting*, requires proponents of projects that cause serious harm to fish and fish habitat to offset that harm to maintain and enhance the ongoing productivity of important fisheries serving the public interest. Offset measures include habitat restoration and enhancement, habitat creation, chemical or biological manipulations (stocking of fish or control of aquatic invasive species), complementary measures (contributions to scientific research to maintain or enhance productivity of fisheries) and habitat banking in advance of the project's impact.

Provincial requirements for compensation of the permanent loss of wetlands are discussed in Alberta's Wetland Policy (Government of Alberta 2013). Where permanent losses occur, the policy employs "restorative and non-restorative replacement" objectives where multiplier ratios consider the value of wetland lost versus the value of wetland replaced. Wetland evaluation criteria include biodiversity, water quality improvement, flood reduction, human value and relative abundance (current versus historical). Offsets for wetlands in Alberta are reviewed on a case-by-case basis and follow guidance documents and frameworks for other wetland compensation programs in Canada (Cox and Grose 2000). Another example, although voluntary, includes the Southeast Alberta Conservation Offset Pilot (SEACOP) program which focuses on net habitat conservation of native grasslands. Under this program, industrial development that disturbs native grassland can be offset by creating native grassland elsewhere within the region (SEACOP 2014).

The BC MOE *Policy for Mitigating Impacts on Environmental Values* consider offset principles in terms of "environmental value" and "ecological equivalency" (BC MOE 2014b). The *Procedures for Mitigating Impacts on Environmental Values* recognize the importance of the best available data and information to be used for developing procedures for specific environmental values, associated components and risks (BC MOE 2014a). Environmental values and risks are reviewed in the context of the mitigation hierarchy; offsets are judged on a case-by-case basis in consideration of the residual effects. BC MOE (2014a) introduce the concept of environmental indicators as the metrics to trend and report on the processes affecting environmental components. Environmental risks are considered in terms of probability of occurrence and consequence to the environmental value and graded using a qualitative matrix (BC MOE 2014a).

7.3.2 International Examples

In the United States, early examples of offsets include wetlands (*Clean Water Act* 1972) and endangered species through compensatory "habitat mitigation" (*Endangered Species Act* 1973). Compensatory mechanisms under these legislative acts (as they evolved) consider the type, degree and scale of habitat disturbance, where compensation ranges from habitat restoration activities through financial contributions to trusts or other conservation programs. Conservation banks for wetlands, stream mitigations and threatened species management have seen modest increases at both state and federal jurisdictions in the Unites States within the last five years. The United States wetland and stream mitigation policies are

well-established offset programs. Some of these programs follow NNL principles within environmental impact assessment criteria, while others provide indirect contributions to specific conservation programs. Similar offset models are observed in Africa, the European Union and South America, which are either emerging policies or voluntary contributions (Madsen *et al.* 2011).

Madsen *et al.* (2011) documented at least 45 existing compensatory mitigation programs (including offsets), ranging from banking of biodiversity credits through allocation of development fees, to policies that drive one-time offsets. At time of publication, there were another 27 programs in various stages of development. Countries with offsets policies enabled through legislation include Australia, Brazil, Canada, New Zealand, Sweden and the United States (Australian Government 2012a; Brovarnick *et al.* 2010; DEFRA 2013; Madsen *et al.* 2011; NSW Government 2013; Queensland Government 2008; WA Government 2011).

Offset policies in Australia and New Zealand generally follow the mitigation hierarchy with NNL objectives (Australian Government 2012a; DC 2010; NSW Government 2013; Queensland Government 2008; WA Government 2011). With established policies dating back nearly 20 years, offset programs are relatively diversified with established bio-banking trust funds (or conservation banks) and other offset mechanisms under the *Environmental Protection and Biodiversity Conservation Act* (Australia) and The *Conservation Act* (New Zealand). Bio-banking trust funds have provided flexibility to align offsets toward the priority conservation objectives. A prominent example is the “The Reef Trust” with the strategic objective of improving water quality, habitat, managing invasive species and protecting threatened species in *The Great Barrier Reef World Heritage Area* (Australian Government 2013).

7.4 Mitigation Hierarchy

The sequence of actions to identify the need, availability and suitability of offsets is outlined in the Standard on Biodiversity Offsets (BBOP 2012a, p8). Under this accepted standard, potential effects of a proposed development activity are assessed in context of a mitigation hierarchy presented below. The mitigation hierarchy includes four steps in the assessment process and reflects the preference for residual effects of the project to be avoided, minimized and restored within the project footprint before considering offsets (BBOP 2012a).

Maximizing the implementation of each step before continuing to the next is the recommended practice to reduce residual effects and the potential need for offsets (Australian Government 2012a; BBOP 2012a; EC 2012a). Offsets are considered a measure of last resort within the mitigation hierarchy, as their ability to counterbalance ecological losses outside the project footprint is less certain and of greater risk than mitigation measures applied to the project footprint (Bull *et al.* 2013a; Gibbons and Lindenmayer 2007; Morris *et al.* 2006).

In the context of caribou mitigation measures, the mitigation hierarchy can be described as:

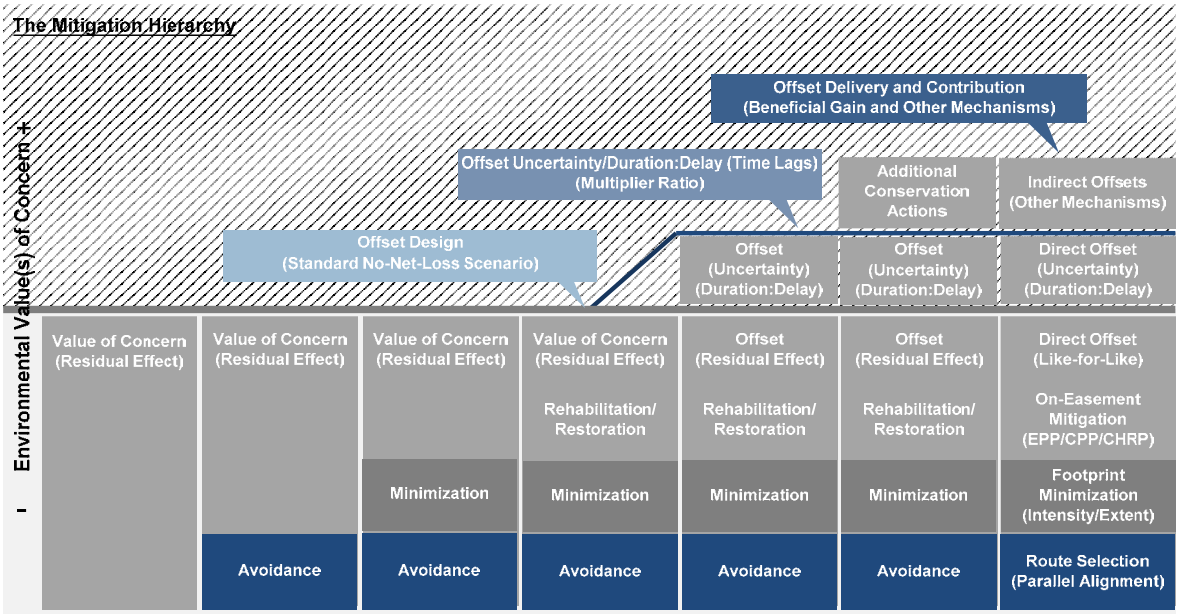
- **Avoidance**: measures[6] taken during Project planning stages to avoid potential effects (*i.e.,* route selection).
- **Minimization**: measures[1] taken to reduce the intensity, extent and/or duration of potential effects (including direct, indirect and cumulative effects, as appropriate) that cannot be completely

[6] As outlined in the Project’s Environmental and Socio-Economic Assessment, including the Environmental Protection Plan and the Caribou Protection Plan.

avoided, but are reduced as far as is practically feasible (*i.e.,* reduction of footprint size, minimum ground disturbance construction methods, activity scheduling, using existing access, and minimizing vegetation clearing).

- **Rehabilitation/Restoration**: measures[7] taken to rehabilitate or restore equivalent ecological mechanisms following construction.

In the context of the Mitigation Hierarchy, this OMP reflects the final measures taken to address the residual Project effects on caribou habitat.



Note: Adapted from Rio Tinto (2008), Australian Government (2012a) and BBOP (2012a).

7.5 Offset Measure Frameworks

In referenced literature, including EC (2012a) guidance, existing offset programs commonly utilize the principles and frameworks recommended by BBOP (2012a) as the standard best practice, and therefore, applied to this OMP. Under BBOP, initial planning stages first consider the legal framework and/or policy requirement for an offset. Currently, there is minimal guidance or policy specific to caribou recovery or offsets in general in Alberta (Poulton 2014, Seiferling 2015). Notwithstanding, offset guidelines and frameworks referenced in the development of this OMP considered examples and applications presented in primary literature, current scientific knowledge, and emerging science to address the conservation needs of caribou and their habitat.

NGTL evaluated preference for like-for-like habitat restoration against pipeline integrity operational requirements, offset design elements, delivery mechanisms, and the National Energy Board (NEB) condition for direct offset measures. Indirect offset measures were not employed in the final OMP

[7] As outlined in the Project's Caribou Habitat Restoration Plans (Preliminary and Final).

because NGTL preferred to invest in more direct measures to address the threats considered highest priority as referenced in the federal *Recovery Strategy for Woodland Caribou* (EC 2012b).

7.5.1 Challenges

Where offsets policies are established, some have been acknowledged as imperfect, uncertain and ineffective in maintaining environmental values (Bull *et al.* 2013a; DEFRA 2013; Gibbons and Lindenmayer 2007; Madsen *et al.* 2011; Morris *et al.* 2006). Offsets are perceived as more remote and uncertain than actions directly applied to prevent, reduce or repair a development's effects. Offsets cannot make "unacceptable" development "acceptable"; they simply provide an additional tool that can be used during the environmental impact assessment process (Australian Government 2012a; BBOP 2012a; DC 2010; DEFRA 2013).

Bull *et al.* (2013a) provides a more recent review of the theoretical and practical challenges of offset guidelines, frameworks and policy. Bull *et al.* (2013a) identify the importance of an established policy or legal framework to direct, protect and sustain offsets programs. Additional recommendations for offset criteria, objectives (*i.e.,* equivalency, permanency and uncertainty) and the degree of financial investment necessary to achieve gains (*i.e.,* multipliers) be based on scientific research, rather than *a priori* assumptions of offset effectiveness (Bull *et al.* 2013a).

Despite the complex and inter-relating challenges associated with offset design, objectives and implementation, they are not considered sufficiently flawed to be dismissed as a policy instrument. In the absence of conclusive scientific research to provide guidance, adaptive management is suggested to provide an opportunity to reduce uncertainty risk for specific circumstances where offset response cannot be adequately predicted or does not achieve NNL (Gibbons and Lindenmayer 2007).

7.6 Design Elements

Design elements consider the potential environmental effects of the project, environmental values of concern, available offset measures, including their effectiveness and objectives (Australian Government 2012b; BBOP 2012a; Bull *et al.* 2013a; McKenney 2005; McKenney and Kiesecker 2010).

Proponents of offsets advocate their use as an effective and operationally efficient mechanism for enhancing environmental values and achieving important conservation objectives (BBOP 2013; Brovarnick *et al.* 2010; Croft *et al.* 2011; Dyer *et al.* 2008; McKenney 2005; McKenney and Kiesecker 2010). Offsets, in their various forms (e.g., like-for-like mitigation, banking or trading programs, and land securement), provide flexibility for stakeholders, industry and regulatory authorities to exercise a number of measures where legislative policy and frameworks exist. Voluntary offsets, although not formally reviewed within scientific literature, are acknowledged for their influence in advancing offset policies (Madsen *et al.* 2011; McKenney and Kiesecker 2010; Rio Tinto 2008; ten Kate *et al.* 2004).

International best practices suggest that offset design elements should be considered on a case-by-case basis and reflective of the legislative framework governing the offset requirement. Furthermore, offset design elements should address residual effects of the development and provide benefit to environmental values or equivalent ecological mechanisms affected (Australian Government 2012a; BBOP 2012a, 2013; DEFRA 2013; EC 2012a; ten Kate *et al.* 2004).

Environment Canada (2012a) identifies the following design elements as an initial starting point for the development conservation allowances (or conservation offsets):

- **Equivalency**: Conservation allowance projects should compensate for adverse impacts by protecting, enhancing or restoring equivalent ecological mechanisms at another site;
- **Additionality**: Conservation allowances should provide ecological protection beyond what would be provided under a business-as-usual scenario;
- **Location**: The location of a conservation allowance should have comparable ecosystem values, such as species composition and habitat structure, and should be determined based on an assessment of the relevant species and habitat/ecosystem context;
- **Timing**: The preference is for conservation allowances that can be implemented before the adverse impacts of proposed development occur;
- **Duration**: The positive effects of the conservation allowance should last an appropriate amount of time to compensate for the duration of the ecological loss resulting from the project; and,
- **Accountability**: Conservation allowances should be formalized through written documentation, or; where possible; through permitting or other conditions.

The offset design elements described by EC (2012a):

- provide an operational framework relevant to the jurisdiction within which the project is located;
- are specific to “conservation offsets” (as discussed in Section 2.1) although termed “conservation allowances” (for clarity sake “offsets”);
- adhere to the mitigation hierarchy and international best practice suggested by BBOP (2012a, 2013) and other offset policies (Australian Government 2012a; DC 2010; NSW Government 2013; WA Government 2011);
- align environmental values with the unique conservation needs of caribou and federal recovery strategy objectives (*i.e., Recovery Strategy* [EC 2012b]) and provincial guidelines (Government of Alberta 2011); and,
- provide consistency with current federal and provincial position statements and expert agency recommendations concerning offsets as they develop and mature (Croft *et al.* 2011; DEFRA 2011; Dyer *et al.* 2008; Schneider 2011; Weber 2011; Poulton 2014).

As previously noted, a conservation offset policy is very much in the early stages of development in Alberta. However, the Government of Alberta has committed to interested stakeholders to examine a number of regulatory instrument options, including a regulation-based biodiversity offset policy, available under the *Alberta Land Stewardship Act* (Ogilvie, K. October 7, 2013, Pers. Comm.). NGTL will continue its participation in this and other stakeholder consultation opportunities provided by the Government of Alberta into the future.

7.7 Managing Risk and Uncertainty

Risks associated with the effectiveness of offset measures, intensity of application and duration or delay in influence are addressed using multipliers (Australian Government 2012a; BBOP 2012a; Burrows 2013; Croft *et al*. 2011; DEFRA 2011; McKenney and Kiesecker 2010; Moilanen *et al.* 2009). Within the literature, multipliers vary considerably between regulatory jurisdictions and agencies, including the methods used to calculate an appropriate multiplier (Australian Government 2012a; BBOP 2012c; Government of Alberta 2013; Cole 2010; Croft *et al*. 2011; Moilanen *et al.* 2009; Queensland Government 2007).

Established offset policies or other regulatory criteria requiring compensatory actions often employ multipliers on a scale of 1.0 through 4.0. Multipliers equal to or greater than 3.0 are, for the majority, judged on a case-by-case basis. Offset measures and multipliers based on scientific knowledge or proven techniques reduce the need for higher multipliers as uncertainty and risk concerning offset effectiveness are more predictable (Australian Government 2012a; BBOP 2013; Cox and Grose 2000; Croft *et al*. 2011; Moilanen *et al.* 2009).

Where uncertainty and time lags exist, the Department for Environment, Food and Rural Affairs (DEFRA 2011) propose multipliers to account for discrepancies or risks based on original research conducted by Moilanen *et al.* (2009). DEFRA (2011) define these risks as:

- **Delivery Risks**: associated with the actual delivery of the offset due to uncertainty in the effectiveness of restoration, habitat creation or management techniques.
- **Spatial Risks**: reflect ecological risks derived from the change in location of the habitat or resource, where recreating a habitat in a new location may reduce its environmental value. Location parameters consider offsets in terms of proximity to the species/ecosystem affected.
- **Temporal Risks**: reflect time lags of offset measures to achieve full effectiveness, intent or condition.

DEFRA (2011) suggests that the risk reduction strategies include the selection of successful offset measures (*i.e.,* proven habitat restoration techniques) and locations that are more likely to achieve the long-term objectives of the offset (*i.e.,* protected or secured areas). Multipliers for offset discrepancy and risk, as defined by DEFRA (2011) are summarized below.

Delivery Risk – Difficulty of Restoration/Recreation	Multiplier
Low	1.0
Medium	1.5
High	3.0
Very High	10.0

Spatial Risk – Location Parameters	Multiplier
Offset is located so that it is accessible to the species population affected.	1.0
Offset is directly contributing to a spatially identified area, corridor or stepping-stone or restoration area where accessibility by a population is not required.	1.5
Offset buffering, linking, restoring or expanding a habitat outside an area outside of the offset area in question.	2.0
Offset does not contribute to any of the above.	3.0
Temporal Risk – Years to Target Condition	**Multiplier**
5	1.2
10	1.4
15	1.7
20	2.0
25	2.4
30	2.8

Source: DEFRA (2011).

7.7.1 Delivery Risks

Offset uncertainty to achieve full effectiveness generally require higher multipliers to accommodate potential loss or portion of failure of measures. Bailey (2000) as cited within Cox and Grose (2000 p. 57-80) suggests (p.70) that multipliers for wetland compensation may vary from 1.5 for restoration, to 2.0 for recreation and 3.0 and higher on a case-by-case basis.

Moilanen *et al.* (2009) introduce a theoretical analysis of offset multiplier requirements using a probabilistic modelling approach concerning offset delivery, ability to achieve NNL and uncertainty risks associated habitat restoration. Moilanen *et al.* (2009) demonstrate that multipliers rapidly move from 2.0 through to greater than 100.0 where the predicted probability of restoration failure exceeds 0.5 (*i.e.,* greater than 50%) and the information gap concerning uncertainty of habitat restoration is moderate to high (*i.e.,* α >0.4). Moilanen *et al.* (2009) suggest that if improvements to the conservation value through habitat restoration is slow (*i.e.,* 150 year planning horizon), it is questionable whether the habitat should be considered restorable at all.

Despite these theoretical challenges, recommendations to reduce risk and uncertainty involve a strategy that considers several restoration treatments applied to multiple locations, in contrast to a single restoration treatment applied to a single, large area (Moilanen *et al.* 2009).

7.7.2 Spatial Risks

Higher multipliers are employed to discourage development activities where the permanent loss of environmental values or ecological mechanisms may occur (Australian Government 2012a; Cox and

Grose 2000; Government of Alberta 2013; Moilanen *et al.* 2009). Indirect offsets (*e.g*., research programs) generally incur higher multipliers where equivalency to the environmental values or ecological mechanisms cannot be achieved. A minimum multiplier of 1.0 has been proposed for direct offsets (*i.e.,* like-for-like measures) to achieve NNL for equivalent environmental values or ecological mechanisms (Australian Government 2012a; Croft *et al.* 2011: DEFRA 2011).

In the United States, a multiplier of close to 1.0 is typically used for direct compensation and higher multipliers for indirect compensation. Ohio's wetland restoration program uses a multiplier of 1.0 for direct replacement, and 2.0 for enhancement and preservation actions; New Jersey's restoration multiplier for both direct and indirect measures is 2.0, while Michigan's multiplier of 1.0 for direct replacement increases to 10.0 for preservation (indirect) measures (Environmental Law Institute 2002). Brown and Lant (1999) completed a review of 68 indirect offsets programs for wetlands in the United States; where mitigation banking schemes were used, the average multiplier was 1.36; where mitigation was based on trading schemes of spatial wetland area, the average multiplier increased to 1.41.

The Alberta Wetland Policy utilizes incremental multipliers that consider "restorative and non-restorative replacement" objectives for the permanent loss of wetlands. Multipliers vary from 1.0 through 8.0, based on the value of wetland lost versus the value of wetland replaced (The Wetland Replacement Matrix). Wetland evaluation criteria include biodiversity, water quality improvement, flood reduction, human value and spatial distribution (*i.e.,* current versus historical, where data exists). A mid-point multiplier of 3.0 is the suggested multiplier necessary to achieve the goals of the policy, and is broadly recognized throughout North America where permanent loss of wetlands occur (Government of Alberta 2013). Cox and Grose (2000) provide examples of wetland mitigation and compensation projects where permanent loss of wetlands and adjacent habitats have occurred elsewhere in Canada. Multipliers varied from 1.0 through 4.5 for wetland compensation.

The Alberta Conservation Association (Croft *et al*. 2011) explore a like-for-like model for offset multipliers that range from 1.0 through 4.0, when considering ecosite rarity through detailed analysis of vegetation, soil, site and forest productivity parameters at the ecosite level. If offsets are required outside of the natural subregion where the residual effects occurred, proposed multipliers increase to 6.0 through 10.0. Successional stage was not considered when determining equivalency; as it is assumed that if two locations (*i.e.,* project footprint and offset location) are classified as the same ecosite then the characteristics unique to the ecosite (*e.g.,* species composition) will be the same at some point in time (Croft *et al.* 2011, p.9). The SEACOP propose a system of varying multipliers that consider the environmental significance of the site disturbed where multipliers are determined by consensus of industry stakeholders and government and can range from 3.0 to 5.0 (Noga and Adamowicz 2014).

The *Queensland Government Policy for Vegetation Management Offsets* outlines multipliers from 1.0 through 4.0 (Queensland Government 2007), where spatial factors such as condition of offset area, proximity to area of impact, and ecological equivalence are considered.

7.7.3 Temporal Risks

The Australian Government's Offset Policy places higher value on "advanced" offsets that incorporate multipliers to address temporal risks (*i.e.,* time lags). Advanced offsets are intended to minimize the time lag between the project impact occurring and the offset providing benefit to the environmental value, following the "Timing" design element principle. Advanced offsets are generally indirect financial contributions to established conservation trusts or bio-banking systems, which may or may not focus on

the specific needs of the environmental value and are judged on a case-by-case basis (Australian Government 2012a).

Quétier and Lavorel (2011) have also suggested that multipliers are appropriate for offset measures that need to account for temporal risks. Where lengthy delays are incurred, higher multipliers are proposed through a financial systems approach that calculates gains and losses on an annual basis. DEFRA (2011) propose a model that considers temporal risk in terms of habitat restoration time lags, where multipliers range from 1.2 through 2.8 for 5 year to 30 year time periods, based off theoretical modelling conducted by Moilanen *et al.* (2009).

7.8 Ecological Mechanisms

This section of the literature review discusses the ecological mechanisms believed to be associated with caribou population decline and explains the methodology of the questionnaire survey provided to various researchers, government, non-government, and industry experts to inform the quantification of measure effectiveness for the Final CHRP and OMP. The questionnaire formed the basis of evaluating caribou habitat restoration measures for other NGTL offset projects, which have been approved by the NEB. By using the same foundation for its offset projects, NGTL will collectively evaluate the effectiveness for all offset projects as part of a continual improvement process and add to the emerging data surrounding caribou habitat restoration techniques.

Boreal caribou occur at low densities within their herd ranges, do not appear to be forage-limited, and are experiencing elevated mortality rates due to increasing predator densities believed to be associated with increases in primary prey (*i.e.,* moose and deer populations) (EC 2012b). Landscape change and a trend of mild winters are suspected factors contributing to these processes (Bergerud and Elliot 1986; Bergerud 1996; James and Stuart-Smith 2000; Courtois *et al*. 2007; Seip and Cichowski 1996). Environment Canada's *Recovery Strategy for the Woodland Caribou (Rangifer tarandus caribou) Boreal Population, in Canada* (EC 2012b) has identified likely ecological mechanisms, which can be categorized as fine-scale effects of the project footprint (*i.e.,* those affecting animal behaviour) and potentially include:

- attraction of primary prey due to increasing forage availability and ease of movement;
- subsequent attraction of predators (including human use) in search of prey, improved hunting efficiency mediated by extended line-of-sight, and overall ease of occupying and traversing the landscape; and,
- reduced use of habitat by caribou near disturbed areas, though this may be neutral or beneficial for predation avoidance.

Research have identified a correlation between caribou population decline rates and the overall amounts of clearing or young forest within caribou range, including recent burns, harvest blocks and linear clearings represented by an assumed area-of-influence (Boutin and Arienti 2008; Dyer *et al.* 2001; Hervieux *et al*. 2013; Sorensen *et al.* 2008; Whittington *et al.* 2011; Vors *et al.* 2007). However, there is little in the way of scientific literature or guidance documents (based on formal hypothesis tests) that have evaluated the effectiveness of measures employed to alter predator or primary prey behavioral response and distribution within caribou range.

Literature identify scale-dependent relationships where caribou avoidance of forestry harvest blocks at broad-scales of resource selection (*i.e.,* population and individual home range) must first be achieved before avoidance of linear features at fine-scales of resource selection (*i.e.,* individual telemetry locations) become predictive of spatial distribution (DeCesare *et al.* 2012). This suggests that forestry disturbances (and potentially recently burned areas) may be of greater limitation to caribou spatial distribution than linear disturbances (DeCesare *et al.* 2012; Latham *et al.* 2011a). DeCesare *et al.* (2012) identify fine-scale avoidance of linear features at 70 m, which varies from other studies that suggest no avoidance of seismic lines (Oberg 2001), to 250 m avoidance (Dyer *et al.* 2001, Sorensen *et al.* 2008) to 500 m (EC 2011), differences in methodology and the exclusion of roads are acknowledged.

Studies of wildlife population response, in particular predator response, to linear features where restoration treatments are applied is emerging. Black bears have been observed to use seismic lines >2 m in width more than forest interior, suggesting they may use linear features to increase their ability to capture prey, including caribou (Tigner *et al.* 2014). Wolves have been observed to use linear features 1.25 to 2 times more than expected and move 1.3 to 3.3 times faster on linear features than non-linear habitats in the oil sands region of Alberta (Dickie *et al.* 2014). Similarly, wolves in northeastern BC were found to be 1.5 and 3 times more likely to use seismic lines and roads, than other habitats, and travelled 4.2 times faster on roads than other habitats (DeMars *et al.* 2014).

Although the link between predator movement and caribou mortality has not been mechanistically determined, these results support the theory that linear features are likley contribute to increased caribou mortality risk by increasing landscape permeability to these species. Preliminary results of intensive linear feature blocking suggest that this type of measure can be effective at reducing wildlife use of linear features. Application of high densities of salvage logs (i.e., rollback) at linear feature intersections reduces human use of linear features by 100%, wolf use of linear features by 90%, and deer use of linear features by 50% (Keim *et al.* 2014).

The broader influence on caribou range condition and wildlife population response as a whole is the cumulative increment of fine-scale effects operating at varying spatial scales (DeCesare *et al.* 2012; EC 2012b; Gustine and Parker 2008; James *et al.* 2004; Keim *et al.* 2014; Nagy 2011; Latham *et al*. 2011a). The accumulation of the fine-scale effects contributes to increased primary prey and predator numbers, with an associated increase in caribou mortality risk (Boutin *et al*. 2012; Courtois *et al*. 2007; EC 2012b; Gustine *et al.* 2006; Latham *et al.* 2011a,b; Nagy 2011; Polfus *et al.* 2011; Whittington *et al.* 2011). The fine-scale effects contributed by the Project are the focus of measures developed for this OMP.

7.8.1 Range Utility

Recognizing that caribou mortality rate is correlated to total range disturbance buffered by 500 m (EC 2012b), this OMP focuses on the ecological mechanisms associated with predator and primary prey response to range condition. Range utility is used to define the ecological mechanisms and animal behavioural responses associated with range habitat condition (presumed altered by some function of anthropogenic disturbance and fire), and includes:

- ease of movement (i.e., predators and primary prey);
- speed of travel (i.e., predators);
- direct traverse of habitat (i.e., predators and primary prey);

- increased line-of-sight (i.e., predators and primary prey);
- frequency of encounter (i.e., predators/primary prey and primary prey/forage);
- larger actualized range area (i.e., predators and primary prey), and,
- increased insolation at ground level (i.e., forage availability).

7.9 Questionnaire Survey

Questionnaire surveys are commonly used tools used to collect specific information from target audiences that otherwise may not be published or attainable. There are several examples within the literature that demonstrate the benefit of conducting questionnaires for offsets in general, frameworks and other related criteria.

Hayes and Morrison-Saunders (2007) provide perspectives of offset effectiveness in Environmental Impact Assessment (EIA) in Western Australia. A survey was designed to determine the degree of support for offsets, and included questions on NNL and net environmental gain, achievability of the like-for-like principle, and time lags associated with offset measures. Concern regarding offset design, implementation and monitoring were noted in the context of theoretical objectives versus achieved objectives (Hayes and Morrison-Saunders 2007).

Another example that draws relevance to developing offset policy design is the British Columbia Ministry of Environment Mitigation and Offsetting Policy (BC MOE 2014b) that initially made use of an online questionnaire and other engagement tools. Participants included representatives from mining, forestry, clean energy, oil and gas, urban development, agriculture, aquaculture and tourism industries, environmental non-government organizations (ENGOs), Aboriginal groups and leaders, chairs of all species at risk teams in British Columbia, federal and provincial natural resource management agencies, organizations representing local government, natural resource sector organizations, technical advisory groups and Senior Policy Official Groups. Participants responded to categorized questions with more emphasis placed on comments and discussion.

For this OMP, estimates concerning the effectiveness of caribou restoration measures applied prior to construction, during construction and post-construction were derived using a questionnaire. Results from the questionnaire were used to derive quantitative methods for calculating the required offset area. More specifically, the questionnaire provided quantifiable information on:

- fundamental ecological mechanisms associated with caribou habitat disturbance;
- consideration for range utility as the primary factor for evaluating Project effects from which the required offset was calculated;
- relative efficacy and effectiveness of mitigation/offset measures applied at both high and low intensity (*e.g.,* barrier segments, discrete barriers, planting strategies);
- influence of surrounding habitat conditions on mitigation/offset effectiveness;
- penalty factors associated with the delay of mitigation/offset measures to achieve full effectiveness (*i.e.,* planting to accelerate reforest state); and,

- degree of uncertainty associated with mitigation/offset treatments to achieve full effectiveness (*i.e.,* long-term variability).

A similar questionnaire regarding the effectiveness of caribou restoration measures to minimize the effects of linear features on caribou was conducted by CLMA and FPAC (2007). Results and similarities between the CLMA and FPAC (2007) and the questionnaire conducted during the development of this OMP are discussed further below.

7.9.1 Methodology

The questionnaire was provided to 36 individuals, using a web-based survey tool, between October 1, 2013 and April 15, 2014 (Appendix 2). On the closing date (April 15, 2014), a total of 28 respondents completed the questionnaire. The questionnaire was designed to provide anonymity to respondents, their responses and professional affiliation. Respondents were categorized into four groups: government (n = 4), industry (n = 12, representing both oil and gas, and forestry sectors), academic/research (n = 2) or other (n = 6, consultants). Four respondents chose not to provide their professional affiliation (hence n ≤ 28 for some responses). Respondent backgrounds included wildlife biology, cumulative effects assessment, environmental planning, silviculture; reclamation and restoration. Respondent qualifications included registered professionals; PhD students; or, other environmental practitioners with typically more than 10 years' experience in caribou management, planning or research.

The first section of the questionnaire (Q1 – Q 7) addressed caribou population response, primary prey/predator population response at the range scale (*i.e.,* cumulative or broad-scale effects) and introduced the definition of range utility with regard to primary prey and predator population response to range condition.

The second section of the questionnaire (Q8 – Q12) addressed caribou and primary prey forage supply at the site scale (*i.e.,* fine-scale effects), and whether range utility should be considered a factor to address project effects.

The third section of the questionnaire (Q13 – Q26) addressed questions concerning the effect of linear disturbance with regard to different aspects of range utility. This section provided clarity with regard to the project effect to caribou habitat in consideration of line width, new linear disturbance, parallel linear disturbance and existing line condition.

The fourth section of the questionnaire (Q27 – Q45) addressed questions concerning the effectiveness of different types of mitigation measures (*i.e.,* restoration mitigation measures or offset measures) employed to reduce aspects of range utility, including uncertainty and time lags associated with reforestation strategies.

Where questions required agreement or disagreement, a simple yes, no or unsure response was provided. Where questions asked the respondent for additional input or considerations concerning a concept or approach, open-ended questions in the form of comments were provided. For questions related to the effectiveness of treatments or effects of linear features with regard to specific aspects of range utility, multiple-choice questions in the form of percentile categories were provided. All questions included a comments section for respondents to provide additional information or written responses. Respondents were asked to only provide answers they felt they were qualified to answer and a skip function was included for each question.

7.9.2 Results

Results are summarized with respect to each section of the questionnaire, where relevant, similarities with CLMA and FPAC (2007) are also discussed, although differences in survey methods and criteria used to grade the effectiveness of measures are acknowledged.

Section 1 – Population Response at the Range Scale (Q1 – Q7)

Caribou forage supply (*i.e.,* lichen) was not considered a limiting factor within the range and the project effect on caribou forage supply was minor or negligible (89% of respondents). Increases in primary prey forage supply contributed by the project was considered minor or negligible (60% of respondents); and replanting strategies on the project footprint was seen to address long-term cumulative effects associated with forage supply risks at the range scale (85% of respondents). Caribou avoidance of linear features was considered neither beneficial (46%) nor detrimental (17%), with several respondents remaining neutral (35%). There was general agreement that the ecological mechanisms associated with current range habitat condition have increased primary prey and predator populations at the range scale (78% of respondents).

Section 2 – Forage Supply, Range Utility and Habitat Condition at the Site Scale (Q8 – Q12)

Project mitigation to address lichen distribution and quantity was considered to be minor or very minor (82% of respondents). However, project mitigation to address primary prey forage was considered important (63% of respondents). Range utility was considered suitable as the primary factor for evaluation of project effects (92% of respondents); management of future habitat condition (*i.e.,* accelerate closure of forest canopy) was also considered a factor for evaluation of project effects (85%). The majority agreed with mitigating residual project effects in consideration of range utility as the primary focus, including future habitat state (85% of respondents).

Section 3 – Linear Disturbance and Line Width Project Effects (Q13 – Q26)

All types of linear disturbances were not considered to be equal (89% of respondents) and it was felt the project effect could be discounted by width of cut (66% of respondents) or when paralleling an existing linear feature (70% of respondents). However, the condition of the existing linear feature (*i.e.,* minimal vegetation in contrast to established vegetation on a successional trajectory) was considered important (88% of respondents). The full manifestation (*i.e.,* maximum effect) of improved visibility for predators and possibly primary prey is seen to be achieved when line width is greater than 15 m (82% of respondents). Therefore, the project effect associated with new linear disturbance where the project ROW is greater than 15 m improve aspects of range utility for predators and primary prey by 100%. Likewise, where the project ROW is parallel to existing linear disturbances (with minimal vegetation regeneration) greater than 15 m in width, respondents felt aspects of range utility were already present and the additional contribution added by the project is 20% (*i.e.,* 100% full effect - 80% average respondent effect = 20% inherent project effect, see Q19).

Section 4 – Mitigation Effectiveness, Time Lags and Uncertainty (Q27 – Q45)

Discontinuous measures in the form of fences, windrows, berms, coarse woody debris or mounding are of less value than continuous mitigation measures applied to lines with no further operational access requirement. Continuous coarse woody debris measures received the highest discount for reducing project effects (60% of respondents). Tree or shrub plantings in combination with coarse woody debris were seen to address the duration of effectiveness in the long-term (66% of respondents). Continuous

tree or shrub planting strategies in areas where no further operational access is required were considered to be beneficial (95% of respondents), with a half discount or higher for reducing project effects completely (72% of respondents). Time lags associated with tree or shrub planting strategies received a quarter credit or higher for continuous applications where the present value of planting today was considered to be worth more than planting in the future (80% of respondents).

7.9.3 Discussion

Project effects on range utility varied in consideration of whether the alignment is a new linear disturbance or parallel to existing linear disturbances. Results from the questionnaire suggest that new linear disturbances and width of cut (*i.e.,* greater than 15 m) alter aspects of range utility. Therefore, new linear disturbance created by the project receives zero discount as it directly alters aspects of range utility (*i.e.,* 100% project effect). Where the project ROW is parallel to existing linear disturbances greater than 15 m in width (with minimal vegetation regeneration), the aspects of range utility are considered already present and the additional contribution added by the project is 20% (*i.e.,* 100% full effect - 80% average respondent effect = 20% inherent project effect, see Q19).

Utilizing existing linear disturbances and minimizing the amount of new cut reduced the projects effect, and are also considered high value measures by CLMA and FPAC (2007). Other similarities between CLMA and FPAC (2007) and this questionnaire with regard to high value measures (*i.e.,* high effectiveness) include planting strategies to accelerate reforestation objectives, minimum ground disturbance techniques and implementation of line-of-sight breaks (*i.e.,* physical measures and vegetative screens).

Physical measures that are more effective at reducing aspects of range utility were considered to have an immediate effect but may be more challenging to implement with respect to site feasibility and available materials (*i.e.,* coarse woody debris). Measures with time lags (*i.e.,* planting strategies) were identified to be of more value too long-term reforestation objectives. Based on these results, where possible, combinations of measures will implemented at locations determined to have greater influence in reducing aspects of range utility in the short and long-term. There are limitations of physical measures, including locations where their effectiveness is lessened by adjacent linear disturbances or they are located along lines with operational access requirements.

8.0 REFERENCES

AGS (Alberta Geological Survey). 2013. Location of the Athabasca, Cold Lake and Peace River oil sands in Alberta. http://www.ags.gov.ab.ca/graphics/CBM/oil_sands/alberta-oil-sands-map2.jpg.

ASRD (Alberta Sustainable Resource Development) and ACA (Alberta Conservation Association). 2010. Status of the Woodland Caribou (*Rangifer tarandus caribou*) in Alberta: Update 2010. Alberta Sustainable Resource Development. Wildlife Status Report No. 30 (Update 2010). Edmonton, AB. 88pp. http://esrd.alberta.ca/fish-wildlife/species-at-risk/species-at-risk-publications-web-resources/mammals/documents/SAR-StatusWoodlandCaribouAlberta-Jul2010.pdf.

Australian Government. 2012a. Environmental Protection and Biodiversity Conservation Act Environmental Offset Policy. Department of Sustainability, Environment, Water, Population and Communities, Public Affairs, GPO Box 787 Canberra ACT 2601. http://www.environment.gov.au/resource/epbc-act-environmental-offsets-policy

Australian Government. 2012b. How to Use the Offsets Assessment Guide. Department of Sustainability, Environment, Water, Population and Communities, Public Affairs, GPO Box 787 Canberra ACT 2601. http://www.environment.gov.au/resource/epbc-act-environmental-offsets-policy.

Australian Government. 2013. Great Barrier Reef Long-term Sustainability Plan. Department of the Environment, Public Affairs, GPO Box 787, Canberra ACT 2601. http://www.environment.gov.au/system/files/pages/e166e5b7-bd7f-4bc5-9807-ba263e248632/files/gbr-ltsp-info-sheet_0.pdf

BBOP (Business and Biodiversity Offsets Programme). 2012a. Standard on Biodiversity Offsets. BBOP, Washington, D.C. Available from: http://bbop.forest-trends.org/guidelines/Standard.pdf

BBOP. 2012b. Glossary. BBOP, Washington, D.C. Available from: http://www.forest-trends.org/documents/files/doc_3100.pdf.

BBOP. 2012c. Resource Paper: No Net Loss and Loss-Gain Calculations in Biodiversity Offsets. http://bbop.forest-trends.org/guidelines/Resource_Paper_NNL.pdf.

BBOP. 2013. To No Net Loss and Beyond: A Review of the Business and Biodiversity Offset Programme. http://www.forest-trends.org/documents/files/doc_3319.pdf

BC MOE (British Columbia Ministry of Environment). 2014a. Procedures for Mitigating Impacts on Environmental Values (Environmental Mitigation Procedures), January 9, 2014. Environmental Mitigation Procedures – Working Document. http://www.env.gov.bc.ca/emop/.

BC MOE. 2014b. Policy for Mitigating Impacts on Environmental Values (Environmental Mitigation Policy), January 9, 2014. Environmental Mitigation Policy – Working Document. http://www.env.gov.bc.ca/emop/.

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer, Special Issue* 4: 85 -116.

Bergerud, A.T., and J.P. Elliott. 1986. Dynamics of caribou and wolves in Northern British Columbia. *Canadian Journal of Zoology* 64:1515–1529.

Boutin, S. and C. Arienti. 2008. BCC Equation Reanalysis, Final Report – November 26, 2008. Unpublished Report Prepared for the Alberta Caribou Committee Research and Monitoring Subcommittee by University of Alberta Integrated Land Management Laboratory.

Boutin, S., M.S. Boyce, M. Hebblewhite, D. Hervieux, K.H. Knopff, M.C. Latham, A.D.M Latham, J. Nagy, D. Siep, and R. Serrouya. 2012. Why are caribou declining in the oil sands? *Frontier in Ecology and the Environment*. 10:65-67.

Brovarnick, A., F. Alpizar and C. Schnell. 2010. The Importance of Biodiversity and Ecosystems in Economic Growth and Equity in Latin America and the Caribbean: An economic valuation of ecosystems, United Nations Development Programme.

Brown, P.H. and C.L. Lant. 1999. The effect of wetland mitigation banking on the achievement of no-net-loss. Environmental Management 23:333–45.

Bull, J.W., K.B. Suttle, A. Gordon., N.J. Singh. and E.J. Milner-Gulland. 2013a. Biodiversity offsets in theory and practice. Fauna and Flora International, *Oryx*: 0(0), pp1–12*Clean Water Act*. 1972. US Environmental Protection Agency. http://www.epa.gov/oecaagct/lcwa.html

Bull, J.W., A. Suttle., N.J. Singh and E.J. Milner-Gulland. 2013b. Conservation where nothing stands still: moving targets and biodiversity offsets. *Frontiers in Ecology and the Environment*: 11(4): 203–210

Burrows, L. 2013. Somerset Biodiversity Offsetting Strategy and Methodology. Strategic Planning, Environment Department, Somerset County Council.

CBFA (Canadian Boreal Forest Agreement). 2012a. CBFA Caribou Action Planning in Northeastern Alberta: Inputs and Ideas. PowerPoint Presentation.

CBFA. 2012b. Recommendations for, and Voluntary Contributions, towards a Kesagami Range Caribou Action Plan. http://canadianborealforestagreement.com/media-kit/CBFA_NE_Ontario_Recommendations_FullDoc_FINAL.pdf.

Cole, S. 2010. How much is enough? Determining adequate levels of environmental compensation for wind power impacts using equivalency analysis. An illustrated and hypothetical case study of sea eagle impacts at the Smola Wind Farm, Norway. Department of Forest Economics, Umea, Sweden.

COSIA (Canada's Oil Sands Innovation Alliance). 2014. Project Summary for the Caribou Restoration program and LiDEA Project. http://www.cosia.ca/caribou-habitat-restoration.

CLMA and FPAC (Caribou Landscape Management Association [CLMA] and the Forest Products Association of Canada [FPAC]). 2007. Audit of Operating Practices and Mitigation Measures Employed within Woodland Caribou Ranges. Prepared for: CLMA and FPAC. Prepared by: P. Bentham, Golder Associates, Edmonton, AB. 135pp + appendices.

Courtois, R., J.P. Ouellet, L. Breton, A. Gingras and C. Dussault. 2007. Effects of forest disturbance on density, space use, and mortality of woodland caribou. *Ecoscience* 14(4):491-498. doi:10.2980/1195-6860(2007)14[491:EOFDOD]2.0.CO;2.

Cox, K. W., and A. Grose. 2000. Wetland mitigation in Canada: A framework for application. North America Wetland Conservation Council (Canada) Issues Paper 2000-1.

Croft, C.D., T. Zimmerling and K. Zimmer. 2011. Conservation Offsets: A Working Framework for Alberta. Alberta Conservation Association. http://www.ab-conservation.com/go/default/assets/File/Publications/ACA%20Conservation%20Offsets%20Framework%20Aug%202011.pdf

DC (Department of Conservation - *Te Papa Atawhai*). 2010. Biodiversity Offsets Programme: A CDRP Funded Research Program: 2009-2012.

DeCesare, N.J., M. Hebblewhite, F. Schmigelow, D. Hervieux, G.J. McDermid, L. Neufeld, M. Bradley, J. Whittington, K.G. Smith, L. Morgantini, M. Wheatley and M. Musiani. 2012. Transcending scale dependence in identifying habitat with resource selection functions. *Ecological Applications* 22(4): 1068-1083.

DEFRA (Department for Environment, Food and Rural Affairs) 2011. Biodiversity Offsetting. Technical paper: proposed metric for the biodiversity pilot in England. London: Department for Environment, Food and Rural Affairs.

DEFRA. 2013. Biodiversity Offsetting in England: Green Paper. London: Department for Environment, Food and Rural Affairs. https://consult.defra.gov.uk/biodiversity/biodiversity_offsetting.

DeMars, C. G. Breed, J. Potts and S. Boutin. 2014. The effectiveness of dispersion by boreal caribou calving in a human-modified multi-predator landscape. 15th North American Caribou Workshop, Whitehorse Yukon, 12-16 May 2014.

DFO (Fisheries and Oceans Canada). 1986. The Department of Fisheries and Oceans Policy for the Management of Fish Habitat. http://www.dfo-mpo.gc.ca/habitat/role/141/1415/14155/fhm-policy/pdf/policy-eng.pdf.

DFO. 2013. Fisheries Protection Policy and Operational Approach. http://www.dfo-mpo.gc.ca/habitat/cg2/pol/index-eng.html.

Dickie, M., F. Blanchard, R. Serrouya and S. Boutin. 2014. The impact of linear features on wolf (Canis lupus) movement. 15th North American Caribou Workshop, Whitehorse Yukon, 12-16 May 2014.

Dyer, S.J., J.P. O'Neill, S.M. Wasel and S. Boutin. 2001. Avoidance of industrial development by woodland caribou. *Journal of Wildlife Management* 65:531-542.

Dyer, S., J. Grant, T. Lesack and W. Weber. 2008. Catching Up: Conservation and Biodiversity Offsets in Alberta's Boreal Forest. Canadian Boreal Initiative. http://www.pembina.org/pub/1650

EC (Environment Canada). 2011. Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada: 2011 Update. Ottawa, Ontario, Canada. 102 pp. plus appendices.

EC. 2012a. Operational Framework for Use of Conservation Allowances. ISSN 978-1-100-21427-6.

EC. 2012b. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. xi + 138pp.

Environmental Law Institute. 2002. Banks and fees: the status of offsite wetland mitigation in the United States. Washington, DC, 202 pp

EPA (Environmental Protection Agency). 2006. Environmental Offsets Position Statement No. 9. Government of Western Australia. http://www.epa.wa.gov.au/docs/1863_PS9.pdf

EPI (Department of Environment and Primary Industries). 2013. Native Vegetation Offsets. http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/native-vegetation/native-vegetation-permitted-clearing-regulations/native-vegetation-offsets.

Gibbons, P. and D.B., Lindenmayer. 2007. Offsets for land clearing: no net loss or the tail wagging the dog. *Ecological Management and Restoration* 8(1): 26-31.

Government of Alberta. 2011. A Woodland Caribou Policy for Alberta. ISBN No. 978-0-7785-9478-9. Pub No.
I/524. http://www.srd.alberta.ca/FishWildlife/WildlifeManagement/CaribouManagement/documents/WoodlandCaribouPolicy-Alberta-Jun2011.pdf.

Government of Alberta. 2013. Alberta Wetland Policy.
Ahttp://www.waterforlife.alberta.ca/documents/Alberta_Wetland_Policy.pdf

Government of Alberta. 2014. Caribou Action and Range Planning FAQs.
http://esrd.alberta.ca/fish-wildlife/wildlife-management/caribou-management/caribou-action-range-planning/caribou-action-range-planning-faqs.aspx

Gustine, D.D. and K.L. Parker. 2008. Variation in seasonal selection of resources by woodland caribou in Northern British Columbia. *Canadian Journal of Zoology* 86: 812-825.

Habib, T.J., D.R. Farr, R.R. Schneider and S. Boutin. 2013. Economic and ecological outcomes of flexible biodiversity offset systems. Conservation Biology 27(6): 1313–1323.

Hayes, N. and A. Morrison-Saunders. 2007. Effectiveness of environmental offsets in environmental impact assessment: practitioner perspectives from Western Australia*. Impact Assessment and Project Appraisal* 25(3): 209-218.

Hervieux, D., M. Hebblewhite, N.J. DeCesare, M. Russell, K. Smith, S. Robertson and S. Boutin. 2013. Widespread declines in woodland caribou (*Rangifer tarandus caribou*) continue in Alberta. Canadian Journal of Zoology. 91: 872-882.

James, A.R.C. and A.K. Stuart-Smith. 2000. Distribution of caribou and wolves in relation to linear corridors. *Journal of Wildlife Management* 64:154-159.

James, A.R.C., S. Boutin, D.M. Hebert, A.B. Rippin and J. White. 2004. Spatial separation of caribou from moose and its relation to predation by wolves. *Journal of Wildlife Management 68*(4):799-809.

Keim, J.L., P.D. DeWitt, T. Shopik, J. Fitzpatrick and S.R. Lele. 2014. Understanding and mitigating the effects of linear features and snow condition on caribou predator-prey overlap in the Alberta oil sands. 15th North American Caribou Workshop, Whitehorse Yukon, 12-16 May 2014.

Kiesecker, J.M., H. Copeland, A. Pocewicz, N. Nibblink, B. McKenney, J. Dahlke, M. Holloran and D. Stroug. 2009. A framework for implementing biodiversity offsets: selecting sites and determining scale. *Bioscience* 1: 77-84.

Latham, A.D.M., M.C. Latham, N.A. McCutchen and S. Boutin. 2011a. Invading white-tailed deer change wolf-caribou dynamics in northeastern Alberta. *Journal of Wildlife Management* 75: 204–212.

Latham, A.D.M., M.C Latham, M.S. Boyce and S. Boutin. 2011b. The Role of Predation in Woodland Caribou Population Declines in Northeastern Alberta – Coyotes: Report prepared for the Alberta Upstream Petroleum Research Fund, Petroleum Technology Alliance of Canada, June 2011.

Madsen, B., N. Carroll, D. Kandy and G. Bennet. 2011. State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide. Forest Trends, Washington, DC, USA. http://www.thegef.org/gef/sites/thegef.org/files/publication/Bio-Markets-2011.pdf

McKenney, B. 2005. Environmental Offset Policies, Principles, and Methods: A Review of Selected Legislative Frameworks. Amherst (NH): Biodiversity Neutral Initiative. http://www.slu.se/Documents/externwebben/ltj-fak-dok/Landskapsarkitektur,%20planering%20och%20f%C3%B6rvaltning/Personal/CV/Jesper%20Persson/Projekt/Litteraturtips/McKenny_Environmental%20Offset.pdf

McKenney, B.A. and J.A. Kiesecker.2010. Policy development for biodiversity offsets: A review of offset frameworks. *Environmental Management* 45:165-176.

Moilanen A, A. van Teeffelen, Y. Ben-Haim and S. Ferrier. 2009. How much compensation is enough? A framework for incorporating uncertainty and time discounting when calculating offset ratios for impacted habitat. Restoration Ecology 17:470–478

Morris, R.K.A., I. Alonso, R.G. Jefferson and K.J. Kirby. 2006. The creation of compensatory habitat—can it secure sustainable development? *Journal for Nature Conservation* 14:106–116.

Nagy, J. 2011. Use of Space by Caribou in Northern Canada. PhD. Thesis. University of Alberta, Edmonton, Alberta. 164p.

Neufeld, L.M. 2006. Spatial Dynamics of Wolves and Woodland Caribou in an Industrial Forest Landscape in West-central Alberta. M.Sc. Thesis. University of Alberta, Edmonton, Alberta.

Noga, W. and W.C. (Vic) Adamowicz. 2014. A study of Canadian Conservation Offset Programs: Lessons Learned viewed from a Review of Programs, Analysis of Stakeholder Perceptions, and Investigation of Transaction Costs. Sustainable Prosperity Research Paper. Department of Resource Economics and Environmental Sociology. University of Alberta, Edmonton AB, Canada.

NSW (New South Wales) Government. 2013. New South Wales Offset Principles for Major Projects (State Significant Development and State Significant Infrastructure). http://www.environment.nsw.gov.au/biocertification/offsets.htm.

Oberg, P.R. 2001. Responses of mountain caribou to linear features in a west-central Alberta landscape. M.Sc. Thesis, University of Alberta, Edmonton, AB.

Ogilvie, K. (TransCanada Pipelines Ltd). 2013. Manager Canadian Planning and Permitting, *Personal Communication*: Conservation Offsetting Workshop - Government of Alberta and Multi-Stakeholders. October 7, 2013.

Polfus, J.L., M. Hebblewhite and K. Heinemeyer. 2011. Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain caribou. *Biological Conservation*: 144: 2637-2646.

Poulton, D. 2013. Alberta's New Wetland Policy as a Conservation Offset System. http://ablawg.ca/wp-content/uploads/2013/09/Blog_DP_Alberta_Wetlands_Policy_September-2013.pdf

Poulton, D. 2014. Biodiversity Offsets a Primer for Canada. Prepared for Sustainable and the Institute of the Environment. Background Paper – February 2014. pp. 60.

Queensland Government 2007. Policy for Vegetation Management Offsets. Queensland Government Natural Resources and Water. 22 pp.

Queensland Government. 2008. Environmental Offsets Policy. http://www.ehp.qld.gov.au/management/planning-guidelines/policies/environmental-offsets/

Quétier, F. and S. Lavorel. 2011. Assessing ecological equivalence in biodiversity offset schemes: key issues and solutions. *Biological Conservation*. (doi:10.1016/j.biocon.2011.09.002.

Rio Tinto. 2008. Rio Tinto's Biodiversity Strategy: Achieving Results on the Ground. Melbourne, Australia, 26 pp. http://www.Rio Tinto.com/documents/ReportsPublications/RTBidoversitystrategyfinal.pdf

Schneider, R. R. 2011. An Integrated Planning Approach for Selecting Conservation Offsets in Northern Alberta. NSERC Chair in Integrated Landscape Management, University of Alberta 8pp.

Seiferling, M. 2015. Opportunities to Move Forward with Conservation Offsets in Alberta. Prepared for the Alberta Biodiversity Monitoring Institute. http://ecosystemservices.abmi.ca/resources/publications.

Seip, D.R. and D.B. Cichowski. 1996. Population ecology of caribou in British Columbia. *Rangifer, Special Issue* 9:73-80.

SEACOP (Southeast Alberta Conservation Offset Pilot). 2014. Conservation Offset Pilot Program for Native Grasslands. http://www1.agric.gov.ab.ca/$Department/deptdocs.nsf/all/sag14846/$FILE/seacop-overview-may2014.pdf

SENES Consulting Ltd. 2013. Best Practices for Advancing the Application of Habitat Conservation Banking in Canada. http://www.prasinogroup.com/pdfs/Best%20Practices%20for%20Advancing%20the%20Application%20of%20Habitat%20Conservation%20Banking%20in%20Canada.pdf

Sorensen, T., P.D. McLoughlin, D. Hervieux, E. Dzus, J. Nolan, B. Wynes and S. Boutin. 2008. Determining sustainable levels of cumulative effects for boreal caribou. *Journal of Wildlife Management* 72(4): 900-905.

ten Kate, K., J. Bishop and R. Bayon. 2004. Biodiversity Offsets: Views, Experience, and the Business Case. Gland (Switzerland): IUCN and Insight Investment. http://www.epa.gov/owow/wetlands/pdf/Biodiversity_Offsets_Report.pdf.

TCPL (TransCanada Pipelines). 2014. Final Caribou Habitat Restoration Plan (Final CHRP) for the Chinchaga Lateral Loop No.3 (Chinchaga Section). November 7, 2014.

Tigner, J., Bayne, E. M. and Boutin, S. (2014), Black bear use of seismic lines in Northern Canada. The Journal of Wildlife Management, 78: 282–292.

Vinge, T. (Government of Alberta). 2014. Boreal Forest Reclamation Specialist, *Personal Communication*: March 2, 2014.

Vors, L.S., J.A. Schaefer, B.A. Pomd, A.R. Rodgers and B.R. Patterson. 2007. Woodland caribou extirpation and anthropogenic landscape disturbance in Ontario. *Journal of Wildlife Management* 71(4): 8 pp

WA (Western Australia) Government. 2011. Western Australian Government's Environmental Offsets Policy. http://www.epa.wa.gov.au/EPADocLib/WAEnvOffsetsPolicy-270911.pdf

Weber, M. 2011. Experimental Economic Evaluation of Offset Design Options for Alberta: A Summary of Results and Policy Recommendations. Prepared for the Alberta Land Use Secretariat.

Whittington, J., M. Hebblewhite., N.J. DeCesare, L. Neufeld, M. Bradley, J. Wilmshurst and M. Musiani. 2011. Caribou encounters with wolves increase near roads and trails: a time-to-event approach. *Journal of Applied Ecology*, no-no. doi:10.1111/j.1365-2664.2011.02043.

Appendix 1 Preliminary Offset Measures Plan

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December 23, 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)
Condition 20, Certificate GC-121
Preliminary Offset Measures Plan
NEB File: OF-Fac-Gas-N081-2011-05 02

In accordance with Conditions 20(a), (c), and (d) of Certificate GC-121, NGTL encloses for filing with the Board its Preliminary Offset Measures Plan for Residual Impacts to Caribou Habitat for the Chinchaga Lateral Loop No. 3 (Chinchaga Section).

The Preliminary Offset Measures Plan (OMP) has been developed to offset all residual effects related to the Chinchaga Section resulting from directly and indirectly disturbed caribou habitat, after taking into account the implementation of the Environmental Protection Plan and the Caribou Habitat Restoration Plan. The Preliminary OMP also provides a description of NGTL's consultations with potentially affected Aboriginal groups, Environment Canada, and provincial authorities regarding the plan.

Should the Board require additional information with respect to this filing, please contact the undersigned at (403) 920-7732 or by email at steph_brown@transcanada.com.

Yours truly,
NOVA Gas Transmission Ltd.

Original signed by

Stephanie Brown
Regulatory Project Manager

Attachment
cc: Mr. Dan Barghshoon, NEB Operations Manager

NOVA GAS TRANSMISSION LTD.

Chinchaga Lateral Loop No. 3

Preliminary Offset Measures Plan for Residual Effects on Caribou Habitat

December 2013

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

Prepared by:
Northern Resource Analysts Ltd.
Calgary, Alberta
and
TransCanada Corporation
Calgary, Alberta

Project Number: 20136004-1019

EXECUTIVE SUMMARY

Offset measures are the final step of a mitigation hierarchy - a framework that, in its basic form, has four steps:

- Avoid potential effects; then, if necessary;
- Minimize potential effects; then, if necessary;
- Rehabilitate/Restore; then, if necessary;
- Address any residual environmental effects that cannot be avoided or sufficiently minimized.

Offset measures address the residual effects that remain after mitigation measures to avoid or minimize effects are adopted. The goal of offset measures is to counterbalance unavoidable residual effects and to sustain productivity of ecosystem mechanisms that would otherwise be lost because of proposed land or resource use activities. It is anticipated that all unavoidable residual effects within the Chinchaga caribou range will be offset using this multi-stage process.

This Preliminary Offset Measures Plan has been developed in consideration of peer-reviewed scientific literature, guidance documents from expert individual(s)/agencies, established offset policies and emerging offset policies in both Canada and Internationally. Current regulatory policies specific to caribou include: A Woodland Caribou Policy for Alberta (Government of Alberta 2011) and Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada (Environment Canada [EC] 2012a). The provincial policy identifies efforts to stabilize, recover and sustain woodland caribou populations, including the maintenance and restoration of caribou habitat, land-management planning, management of other wildlife populations (predators and primary prey), conservation offsets, and designated areas or deferrals of development activities. The federal Recovery Strategy identifies habitat alteration and predation resulting from human land-use activities as a threat that directly and/or indirectly affects caribou and their habitat (EC 2012a).

In consultation with provincial and federal agencies, a current framework for offset design elements unique to the conservation needs of boreal caribou is not available. Restoration of habitat and ecological mechanism are the priorities, with focus on like-for-like offset measures that are applicable to, and appropriate for, the level of disturbance, as well as the significance of residual and cumulative effects associated with the Project. Where knowledge gaps exist concerning uncertainty of like-for-like offsets, research and monitoring offset measures are considered.

Potential ecological mechanisms contributing to caribou population decline are discussed, and the most important are considered for use in quantifying effects, rating mitigation and selecting offset measures. Individual offset measures, their expected effectiveness and valuation in terms of restoring ecological mechanisms were derived from applicable literature, industry guidelines and questionnaire-based surveys of environmental specialists, academic researchers, industry and government representatives. These results have been used to quantify the effectiveness of on-easement mitigation (i.e., Caribou Habitat Restoration Plan) in order to estimate remaining residual effects, required offset and proposed ratios using a quantitative model presented in this document.

Table of Contents

Figures

Tables

Appendices

Acronyms and Abbreviations

Terms	Definitions
BBOP	Business and Biodiversity Offsets
BC MOE	British Columbia Ministry of Environment
CBFA	Canadian Boreal Forest Agreements
CHROMMP	Caribou Habitat Restoration and Offset Measures Monitoring Program
CHRP	Caribou Habitat Restoration Plan
CWA	Canadian Wildlife Act
DC	Department of Conservation
DEFRA	Department for Environment, Food and Rural Affairs
DFO	Department of Fisheries and Oceans Canada
EC	Environment Canada
EIA	Environmental Impact Assessment
ENGO	environmental non-government organizations
EPA	Environmental Protection Agency
EPI	Department of Environment and Primary Industries
EPP	Environmental Protection Plan
ESA	Environmental and Socio-Economic Assessment
ESRD	Environment and Sustainable Resource Development
MBCA	*Migratory Birds Convention Act*
NE	Northeast
NEB	National Energy Board
NGTL	NOVA Gas Transmission Ltd.
NNL	No Net Loss
NSW	New South Wales
OMP	Offset Measures Plan
Q1	Quarter 1
Q4	Quarter 4
ROW	Right-of-Way
SARA	*Species at Risk Act*
TCC	TransCanada Corporation
US	United States
W6M	West of the 6th Meridian
WA	Western Australia Government

Terms and Definitions

Term	Definition
Action Plan	Provincial, Territorial or Federal plans that identify priority conservation needs for woodland caribou.
Broad-Scale Effects	A form of Residual Effect, beyond the Project Footprint, related to the contribution to range-scale habitat condition influencing primary prey and predator use and population response.
Conservation Allowances	Final step in the mitigation hierarchy of Environment Canada's operational framework under which offset measures are applied; generally in the form of habitat rehabilitation or securement.
Conservation Offsets	Measures intended to assist caribou survival in both the short and long term; that may include habitat or animal population management
Duration and Delay Penalty Factors (Time Lags)	Estimated proportion to credit an offset measure after considering how long it will take to accomplish its effect or whether the effect has a limited lifespan after implementation. Higher credit means lower penalty (i.e.,1.0 = no penalty)
Design Minimum Needs	Minimum disturbance mitigation measures to promote natural habitat revegetation (especially reduced grading or grubbing)
Direct Offset Measures	Available measures considered as relevant habitat restoration or modification treatments to address fine and broad-scale Project-related residual effects.
Energetic Costs	Inherent constraints for species to sustain life within their occupied habitat (i.e., traverse landscape, access adequate food resources seek shelter and avoid predation).
Fine-Scale Effects	A form of Residual Effect, within the boundaries of the Project Footprint. Viewed primarily as issues of animal use of the footprint as it differs from previous use.
Forage Minimization	Revegetation prescription to planting low palatable tree/shrub/forb species along the ROW to reduce its attractiveness to primary prey.
Ecological Mechanisms	Associated with predator and primary prey interaction; in the context of this report refers to how they respond to landscape alteration.
Highly Permeable Areas	Habitats characterized by greater ease of movement for predators and primary prey to access caribou range (natural habitat openness, anthropogenic disturbance and fire disturbance)
Indirect Offset Measures	Available measures that are considered priority conservation needs of caribou and caribou habitat, but do not qualify as “direct” measures.
Line-of-Sight	Distances that objects are visible when viewed along a linear feature
Low Palatable Species	Tree and shrub species considered less desirable to primary prey as a food source.
New Alignment	Area directly disturbed by the Project footprint that is not parallel to existing anthropogenic features.
Offset Design Elements	Offset selection and design factors chosen in consideration of the potential environmental effects of the project, as well as the unique conservation needs; including some or all of equivalency, additionality, location, timing, duration, and accountability.
Offset Effectiveness	Relative proportion of a fully realized effect ascribed to an individual offset measure (Full effectiveness = 1.0)
Offset Intensity	Degree of application of an offset measure. Full intensity is required to achieve its maximum realized effect. Lesser intensity requires more length/area to accomplish same offset value. (May be contingent on the surrounding habitat and available materials).
Offset Ratio or Multiplier	Minimum area (ha) necessary to offset the Project residual effect (ha)
Parallel Alignment	Area directly disturbed by the Project footprint that is parallel to existing anthropogenic features.
Physical Barrier	Physical obstacle to reduce ease of movement and/or visibility aspects of Range Utility, where the mitigated grounds become as challenging as the surroundings, constructed of logs, slash, earth, solid rock or other suitable materials.
Project Effects	Adverse environmental effects of the Project after route selection and project design refinements, but before generic Project mitigations are applied.

Term	Definition
Project Footprint	Area directly disturbed by the construction and clean-up activities associated with the Project, including associated physical works and activities.
Range Intactness	Consideration of the relative frequency and size of mature habitat patches not affected by disturbance.
Range Plan	Land Manager's strategy for landscape condition to address caribou conservation for one or a number of caribou herds.
Range Utility	The result of ecological mechanisms associated with the Range habitat condition (presumed altered by some function of anthropogenic disturbance and fire), includes: ease of movement, speed of travel, direct traverse of habitat, increased line-of-sight, frequency of encounter (predator/prey and prey/forage), larger actualized range area (predator/prey), and increased insolation at ground level. In this report, primarily considers the effects on Predators and Primary Prey.
Reforestation Prescription	Planting plan for suitable tree or shrub species to accelerate achievement of long-term forest goals (>50 years).
Residual Effects	Project-related effects remaining after mitigations are applied. In principle, offsets are not preferred where mitigations are feasible.
Revegetation Prescription	Revegetation strategies conducted on the ROW to reduce utility to primary prey and predator species, but maintain adequate soil erosion control.
Vegetation Barrier	Tree or shrub planting strategies to reduce ease of movement and visibility aspects of Range Utility in the long-term, where the mitigated grounds become as challenging as the surroundings.

1.0 INTRODUCTION

NOVA Gas Transmission Ltd. (NGTL), a wholly owned subsidiary of TransCanada Corporation (TCC), received approval of Certificate GC-121 by Governor in Council on May 6, 2013, for the Chinchaga Lateral Loop No. 3 Project (the Project).

The Project is located within the Chinchaga caribou range. Approximately 31.1 kilometres (km) (94 percent [%]) of the Project is parallel and contiguous with existing linear corridors. Of the contiguous section, 29.2 km (88%) is parallel to one or two transmission lines (see Figure 1).

The Project consists of 33 kilometres (km) of NPS 48 inch (1,219 mm) outside diameter buried pipeline expanding NGTL's Alberta System to transport sweet natural gas between interconnections adjacent to the Chinchaga Meter Station located at NE 13-96-5 W6M and Meikle River Compressor Station located at NE 26-94-2 W6M in Alberta.

The Project footprint consists of a 32 metre (m) wide construction right-of-way (ROW) and temporary workspace (TWS) at road, foreign pipeline, utility and drainage feature crossings, as well as at sharp sidebends and tie-ins. Construction is schedule for Q4 2013 through Q1 2014.

This document provides information required to satisfy Condition 20(a), (c) and (d) of Certificate GC-121 (Table 1). It includes a Preliminary Offset Measures Plan (OMP) to address residual impacts to caribou habitat, summarizes the consultation to-date with federal and provincial authorities and describes the NGTL plan to engage potentially affected Aboriginal groups. It will be followed by the preparation of a Final OMP, in accordance with Condition 20(b) of GC-121.

Table 1 Certificate GC-121 – Condition 20: Offset Measures Plan

20. NGTL shall file with the Board for approval, a plan to offset all residual effects related to the Chinchaga Section resulting from directly and indirectly disturbed caribou habitat, after taking into account the implementation of the EPP and CHRP measures. NGTL shall provide a copy of the filings to Environment Canada and the appropriate provincial authorities. The Offset Measures Plan for the Chinchaga Section shall include:

a) a preliminary version, to be filed for approval at least 60 days prior to requesting Leave to Open for the Chinchaga Section including, but not limited to, a discussion of:
   i. an initial quantification of the area of caribou habitat directly and indirectly disturbed based on the components of critical habitat identified in the *Recovery Strategy;*
   ii. the proposed offset ratios for each potential measure, based on consultation with expert agencies and on a review of the literature on conservation offsets;
   iii. a list of the potential offset measures available, the expected effectiveness of each, and how they align with criteria specified in the scientific literature specific to conservation offsets;
   iv. the relative quantitative and qualitative value of each measure towards achieving the offset; and,
   v. a decision tree(s) that will be used to select which specific offset measures and accompanying offset ratios would be used under what circumstances.

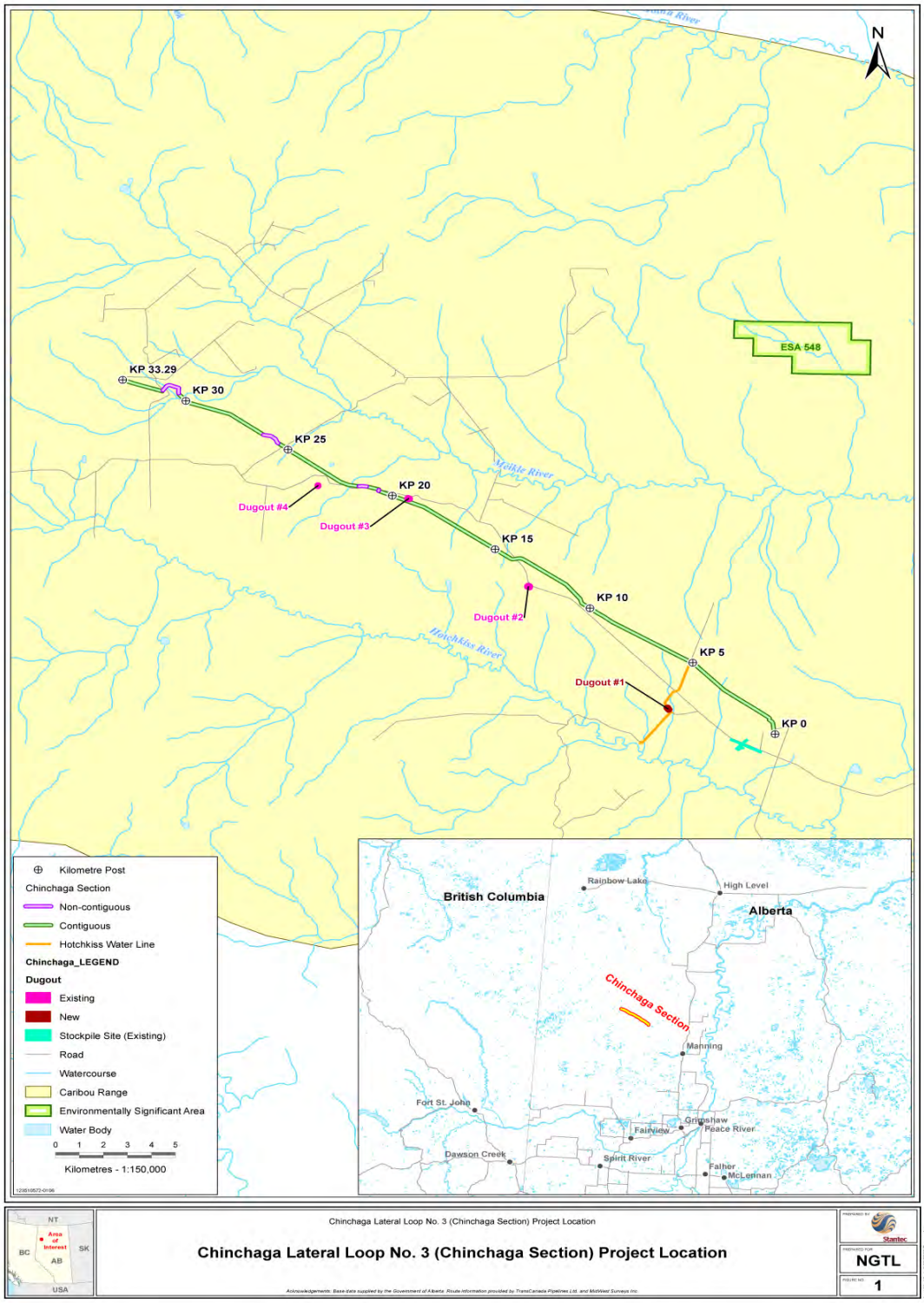
b) a final version, to be filed for approval on or before 1 February after the second complete growing season following the commencement of operation, with:
   i. the contents of the preliminary version, with any updates identified in a revision log that includes the rationale for any changes to decision making criteria*;*
   ii. a complete table listing the offset measures and offset ratios to be implemented or already underway, including site-specific details and map locations, and how they meet criteria in the literature for offsets;
   iii. a schedule indicating when offset measures will be initiated and the estimated date when implementation will be complete; and,
   iv. an assessment of the effectiveness of the measures, including a discussion of uncertainty, and a quantitative compilation showing how the offset measures have offset the previously calculated residual effects.

Both preliminary and final versions of the plan shall include:

c) a description of NGTL's consultations with potentially affected Aboriginal groups regarding the plan, including any concerns that were raised and how these have been addressed; and,

d) evidence and summary of consultation with Environment Canada and provincial authorities regarding the plan.

Figure 1: Project Location within the Chinchaga Caribou Range



1.1 Organization of the Preliminary Offset Measures Plan

This document has been prepared to satisfy Condition 20(a)(i to v), (c) and (d) of Certificate GC-121:

- **Section 2.0:**
  - introduces the concept of offsets, policy frameworks and design elements including precedent from previous offset initiatives in Canada and Internationally; and,
  - provides a literature review discussing the ecological mechanisms believed to be associated with boreal caribou population decline and context for offsets to address these mechanisms.
- **Section 3.0:**
  - summarizes the common approach taken on NGTL projects to caribou habitat mitigation.
- **Section 4.0:**
  - describes an initial quantification of direct and indirect residual effects [Condition 20a(i)].
- **Section 5.0:**
  - describes the fine and broad-scale residual effects of the Project on caribou habitat.
- **Section 6.0:**
  - defines the proposed offset ratios for each potential measure based on consultation with expert agencies and scientific literature specific to conservation offsets [Condition 20a(ii)];
  - lists potential offset measures available, their expected effectiveness and alignment with criteria specific to conservation offsets [Condition 20a(iii)];
  - identifies the relative quantitative and qualitative value of each measure [Condition 20a(iv)]; and,
  - provides decision trees used to select specific offset measures and accompanying offset ratios used under certain circumstances [Condition 20a(v)].
- **Section 7.0:**
  - provides a summary of NGTL's engagement plan and consultations held with potentially affected Aboriginal groups regarding the plan [Condition 20c]; and,
  - provides evidence and summary of consultation with Environment Canada and provincial authorities regarding the plan [Condition 20d].

2.0 OFFSETS

Numerous literature specific to offsets were reviewed to assist the development of this Preliminary OMP. Literature sources included; peer-reviewed scientific articles, guidance documents from expert individual(s)/agencies, established offset policies and emerging offset policies from provincial, state and federal agencies in Canada and Internationally.

Within the literature, the term “offsets” encompasses a broad range of definitions and applications specific to the context in which they are applied. Key word(s) used within search engines included; environmental, conservation, biodiversity, allowance, compensatory, mitigation, bio-banking, direct, indirect, in-kind, out-of-kind, like-for-like, dynamic, static, terrestrial, aquatic, multiplier, ratio, and offset. Literature collected for review and citation within this document focused on, but was not limited to, “Conservation Offsets” and “Biodiversity Offsets”.

Conservation offsets provide an increased amount, quality or security of specific environmental value outside the project footprint to compensate for significant residual adverse effects arising from the development activity (Australian Government 2012a; Government of Alberta 2008, 2009; Environment Canada [EC] 2012a; Hayes and Morrison-Saunders 2007; Poulton 2013). Biodiversity offsets are discussed primarily in the context of assuring either no net loss (NNL) or net gain of biodiversity value (Business and Biodiversity Offsets Program [BBOP] 2012a; Department of Conservation [DC] 2010; Department of Environment and Primary Industries [EPI] 2013; McKenney 2005; McKenney and Kiesecker 2010). Environmental “value(s) of concern” refer to the environmental components that could trigger compensation (Government of Alberta 2008; Australian Government 2012a; BBOP 2012b; Environmental Protection Agency [EPA] 2006. Gibbons and Lindenmayer 2007; New South Wales [NSW] Government 2013; Western Australia [WA] Government 2011).

Conservation offsets better reflect circumstances where the environmental values are very specific to either individual species or plant communities. Parameters can range from numbers of individuals of a threatened species or characteristics of its habitat, to the area and quality of threatened communities or ecotypes (Government of Alberta 2008; Australian Government 2012a; Bull *et al*. 2013a; EPI 2013; Gibbons and Lindenmayer 2007; NSW Government 2013; WA Government 2011; Weber 2011). Biodiversity offsets imply broader considerations of a landscape’s ability to maintain biodiversity, while still acknowledging the application may be focused on finer scale objectives (BBOP 2012a; DC 2010; McKenney 2005; Kiesecker *et al.* 2009; Quétier and Lavorel 2011).

Recent literature suggests a strong preference for equivalency between the nature of the residual effects and the value added by an offset (Bull *et al.* 2013a; Habib *et al.,* 2013; Poulton 2013; Quétier and Lavorel. 2011). This is particularly relevant when offsets target specific values, rather than a program with a more general mandate that might suit higher-level biodiversity management objectives (Bull *et al.* 2013b; Gibbons and Lindenmayer 2007; Kiesecker *et al.* 2009). For this Preliminary Offset Measures Plan, rationale and decision-making criteria have adopted principles for the development of “conservation offsets”, herein referred to as “offsets”, to address residual effects to caribou habitat associated with the Project.

2.1 Guidelines and Principles

Early examples of offsets include wetlands (*Clean Water Act* 1972) and endangered species through compensatory "habitat mitigation" (*Endangered Species Act* 1973) in the United States. In Canada, federal offset initiatives through "habitat replacement" were first introduced under the *Fisheries Act* (1985); followed by the Fisheries and Oceans Canada (DFO) 1986 policy for "no-net-loss of fish habitat" (and DFO 2013); and more recently EC's Operational Framework for Use of Conservation Allowances (EC 2012a). Provincial examples include; Alberta's Wetland Policy (Government of Alberta 2013) which have adopted "restorative and non-restorative replacement" objectives; and the British Columbia Ministry of Environment (BC MOE) Environmental Mitigation Policy (Final Working Draft) which consider offset principles in terms of "environmental value" and "ecological equivalency" (BC MOE 2012).

Internationally, Madsen *et al.* (2011) documented at least 45 existing compensatory mitigation programs (including offsets), ranging from banking of biodiversity credits through allocation of development fees to policies that drive one-time offsets. At time of publication, there were another 27 programs in various stages of development. Countries with offsets policies enabled through legislative *Acts* include; Australia, Brazil, Canada, New Zealand; Sweden and the US (Government of Alberta 2013; Australian Government 2012a; Brovarnick *et al.* 2010; Department for Environment, Food and Rural Affairs [DEFRA] 2013; Madsen *et al.* 2011; NSW Government 2013; Queensland Government 2008; WA Government 2011).

The anticipated sequence of actions required to identify the need, availability and suitability of offsets generally follow the Standard on Biodiversity Offsets (BBOP 2012a, p8), with focus on NNL and biodiversity as a whole. Initial planning stages first consider the legal framework and/or policy for an offset. Potential effects of the proposed development activity are assessed in context of the mitigation hierarchy from which the offset (if required) is designed. Design elements consider the environmental value(s) of concern, available offset measures, their effectiveness and achievability of objectives (Australian Government 2012b; BBOP 2012a; Bull *et al.* 2013a; McKenney 2005; McKenney and Kiesecker.2010).

Proponents of offsets advocate their use as an effective and operationally efficient mechanism for enhancing environmental values and achieving important conservation objectives (BBOP 2013; Brovarnick *et al.* 2010; Croft *et al.* 2011; Dyer *et al.* 2008; McKenney 2005; McKenney and Kiesecker 2010). Offsets, in their various forms (e.g., in-kind mitigation or out-of-kind credit, banking, trading and securement programs), provide flexibility for stakeholders, industry and regulatory agencies to exercise a number of measures where legislative frameworks and policy exist. Voluntary offsets, although not formally reviewed within scientific literature, are acknowledged for their cumulative influence in advancing policies (Madsen *et al.* 2011; McKenney and Kiesecker 2010; Rio Tinto 2008; ten Kate 2004).

However, where offsets policies are established, some have been acknowledged as imperfect, uncertain and ineffective in maintaining environmental values of concern (Bull *et al.* 2013b; DEFRA 2013; Gibbons and Lindenmayer 2007; Madsen *et al.* 2011; Morris *et al.* 2006; Quétier and Lavorel 2011). Offsets are perceived as more remote and uncertain than actions directly applied to prevent, reduce or repair a development's effects, and considered unsuitable for replacement when those preceding efforts can be reasonably accomplished. Offsets cannot make "unacceptable" development "acceptable" they simply provide an additional tool that can be used during the environmental impact assessment process (Australian Government 2012a; BBOP 2012a; DC 2010; DEFRA 2013; EPA 2006; NSW 2013; WA 2011).

2.1.1 Mitigation Hierarchy

Although offsets are to a certain degree controversial within the literature; as they may encourage continued development through compensatory programs despite specific environmental value(s) of concern being unacceptably threatened (Australian Government 2012a; BBOP 2012a; DC 2010; DEFRA 2013; DFO 2013; EPA 2006; Gibbons and Lindenmayer 2007; Morris *et al.* 2006; NSW 2013; Quétier and Lavorel 2011; WA 2011). Offsets are more often intended as a final step following the rigorous application of the mitigation hierarchy, where all reasonable measures are taken to minimize effects of the project footprint on-easement (BBOP 2012a; DC 2010; DEFRA 2011, 2013; NSW 2013; Queensland Government 2008; Quétier and Lavorel 2011; WA 2011).

Recent revisions to the mitigation hierarchy now include four steps within the assessment process and better reflect the preference for residual effects of the project footprint to be addressed on-easement (BBOP 2012a). The mitigation hierarchy defined below is presented in context to standard caribou habitat mitigation measures applied to the Project footprint (Figure 2), discussed further in Section 3.

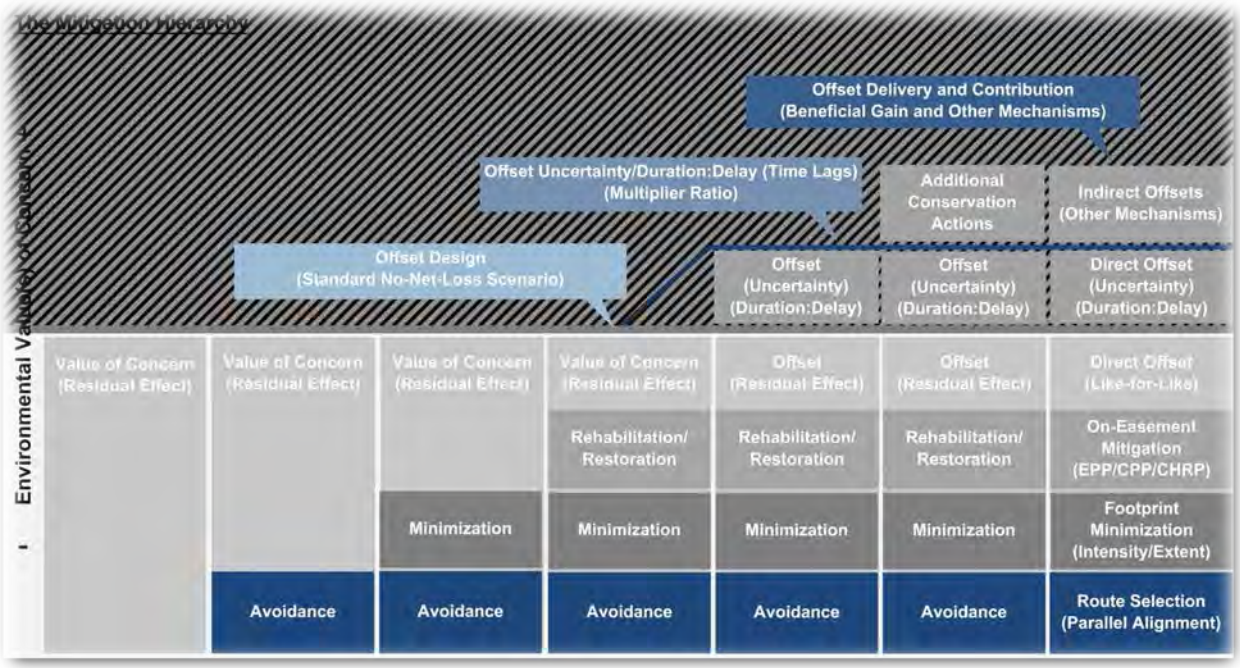
- **Avoidance**: measures taken to avoid creating impacts to the value(s) of concern during pre-Project planning stages: spatial and temporal placement of infrastructure, parallel site or route selection, consideration for natural Line-of-Sight breaks (i.e., utilize topography, highly permeable areas, recently burned areas), engineered Line-of-Sight breaks (i.e., dog-legs, Horizontal Directional Drills).
- **Minimization**: measures taken to reduce the intensity, extent and/or duration of impacts to the value(s) of concern (including direct, indirect and cumulative effects, as appropriate) that cannot be completely avoided, as far as is practically feasible: reduction of footprint size, minimum disturbance construction methods, activity scheduling, utilize existing access, minimize vegetation clearing.
- **Rehabilitation/Restoration**: measures taken to rehabilitate or restore equivalent ecological mechanisms to the value(s) of concern following exposure to impacts that cannot be completely avoided or minimized; Project footprint habitat restoration (e.g., Caribou Habitat Restoration Plan [CHRP]), other mitigations and access management (e.g., mounding, coarse woody debris, physical barriers).

“Residual effects” are any net negative impacts to the value(s) of concern that remain after the above are considered. Where these actions cannot reduce significant, adverse residual project effects to an acceptable level, development of:

- **Offsets**: measures taken off-easement to compensate for any residual significant, adverse impacts that cannot be avoided, minimized and/or rehabilitated or restored, in order achieve a net neutral or beneficial outcome to the value(s) of concern by replacing equivalent ecological mechanisms.

The rigorous application of the mitigation hierarchy and the degree to which each step should be pursued before continuing to the next is a key issue for offset design elements. There are no guarantees or certainties; careful consideration of the environmental value(s) of concern, equivalent ecological mechanisms and context for offsets play important roles in the rationale and decision making process (Australian Government 2012a; BBOP 2012a; Bull *et al.* 2013b; Gibbons and Lindenmayer 2007; Madsen *et al.* 2011; Morris *et al.* 2006; Quétier and Lavorel 2011; ten Kate 2004).

Figure 2 Project Mitigation Hierarchy



Note: Figure 2 adapted from Australian Government (2012a), BBOP (2012a) and Rio Tinto (2008).

2.1.2 Design Elements

The starting point in designing an offset measures plan is the consideration of offset design elements. Design elements should be considered on a case-by-case basis, based on the legislative framework under which the offset is required (if applicable), the potential residual effects of the project, and environmental value(s) of concern (Australian Government 2012a; BBOP 2012a, 2013; DC 2010; DEFRA 2013; EPA 2006; NSW 2013; RioTinto 2008; ten Kate 2004; WA 2011).

Regulatory frameworks in Canada which require the implementation of offsets, such as EC's policy mechanisms under the *Migratory Birds Convention Act, 1994*, the *Species at Risk Act*, the *Canadian Wildlife Act* and *Canadian Environmental Assessment Act, 2012*; however, none of these mechanisms are triggers or provide specific guidance for this Preliminary OMP.

Offset design elements described by EC (2012a) have been adopted for this Preliminary Offset Measures Plan as they;

- provide an operational framework relevant to the jurisdiction within which the Environmental and Socio-Economic Assessment (Stantec 2011) for the Project was conducted;
- are specific to "conservation offsets" in both definition and objective (as defined in Section 2.0) although termed "conservation allowances" (for clarity sake "offsets");

- adhere to the mitigation hierarchy and best practice standards suggested by BBOP (2012a, 2013) and other offset policies (Australian Government 2012a; DC 2010; NSW 2013; WA 2011);
- align environmental values(s) of concern for the unique conservation needs of boreal caribou with federal objectives (i.e., *Recovery Strategy* [EC 2012b]) and provincial guidelines (Government of Alberta 2011); and,
- provide consistency with current federal and provincial position statements, guidance documents and expert agency recommendations concerning offsets as they develop and mature (Croft *et al.* 2011; DEFRA 2011; Dyer *et al.* 2008; Schneider 2011; Weber 2011).

The design elements defined by EC (2012a) below are in context to offset considerations for this Preliminary Offset Measure Plan, these considerations are discussed further in Sections 2.3 and 4.0.

- **Equivalency:** offsets should compensate for adverse residual effects by protecting, enhancing or restoring value(s) of concern and equivalent ecological mechanisms at another location off-easement.
- **Additionality:** offsets should provide ecological protection beyond what would be provided under a business-as-usual scenario.
- **Location:** The location of offsets should have comparable ecosystem values, such as species composition and habitat structure, and should be determined based on an assessment of the relevant species and habitat/ecosystem context.
- **Timing:** The preference is for offsets that can be implemented before the adverse residual effects of proposed development occur.
- **Duration:** The positive effects of offsets should last an appropriate amount of time to compensate for the duration of ecological loss resulting from the project.
- **Accountability:** offsets should be formalized through written documentation, such as an agreement between EC and the proponent (and, where appropriate, other partners, such as provincial or Aboriginal governments), or, where possible, formalized through permitting or other conditions.
- **Other Design Considerations:** Some jurisdictions have established conservation areas, called banks, from which developers can purchase credits representing a particular species or ecosystem type.

2.1.3 Offset Measures

Offset measures in the form of land securement have been utilized recently by proponents of other industrial projects, including; the Joslyn North Mine Project (Total E&P Canada Ltd.), the Roman Coal Mine (Peace River Coal Inc.), the True North Forest (Shell Canada), and two recent Canadian Boreal Forest Agreements (CBFA 2012a and 2012b).

With regard to caribou management, provincial and federal boreal caribou recovery strategies anticipate the creation of action plans that will identify the priority conservation needs of caribou and provide context for mitigation planning and offset determination. Action plans are expected to identify research, monitoring and wildlife management needs. Range plans are expected to provide guidance for preferred locations and methods of habitat modification, and determine the relative priorities of each of these components (EC 2012b).

Offset measures can be categorized as (Australian Government 2012a; BBOP 2012a; BC MOE 2012; Croft *et al*. 2011; Dyer *et al*. 2008; McKenney 2005; Schneider 2011; ten Kate 2004; Weber 2011):

- "Like-for-Like" habitat restoration or various methods of land securement (e.g., land acquisition, provincial protective notations, rezoning and transfer of development rights)
- Population Management Measures
- Financial Offset Mechanisms
- Research and Monitoring Programs

Consultation with provincial regulators identified that restoration of habitat and ecological mechanisms are priority environmental values of concern (Appendix 1). Therefore, proposed offsets include:

- Like-for-Like measures that are equivalent to, and appropriate for, the level of disturbance, values of concern and significance of residual effects associated with the Project.
- Research and Monitoring Program measures that focus on industry-specific knowledge gaps and uncertainties associated with habitat restoration and ecological mechanism within caribou range.

A habitat-based rationale specify that direct (i.e., like-for-like or in-kind) offsets are distinct from indirect (out-of-kind) offsets based on whether habitat is being modified (Bull *et al.* 2013a; BBOP 2012b; Poulton 2013; Quétier and Lavorel. 2011).

Direct offsets include habitat restoration or modification methods that can be only partly accomplished on the Project footprint due to the continued need for access on operational pipelines and roads, but may be more effectively accomplished at other locations without such need. They are like-for-like in terms of ecological mechanisms of concern.

Conservation measures that deal with immediate caribou mortality risk (i.e., wildlife management, financial mechanisms, research and monitoring programs) are indirect offsets. Indirect offsets are considered viable measures that contribute to industry-specific knowledge gaps or uncertainties associated with ecological mechanisms within caribou range, or other financial compensatory mechanisms (Australian Government 2012a; BBOP 2012a; Croft *et al*. 2011; McKenney 2005; Schneider 2011; ten Kate 2004; Weber 2011).

Rationale and decision-making criteria for the proposed offsets including; the specific measures available, their expected effectiveness, and relative value, are discussed in Section 6.0. Population Management Measures and Financial Offsets are also considered viable measures should the necessary mechanisms become available for their application.

2.1.4 Offset Ratios

Offset measures are preferably constructed to address residual project effects, environmental value(s) of concern, equivalent ecological mechanisms, effectiveness, and achievability (McKenney and Kiesecker 2010). Multiplier ratios (multiplier) have been suggested for measures where uncertainty of effectiveness, time lags or correlation with successful measures at different locations are not available (Burrows 2013; McKenney and Kiesecker 2010; Moilanen *et al.* 2008).

A standard multiplier of 1:1 is generally proposed for direct (like-for-like) offsets to achieve NNL regarding the value(s) of concern (Australian Government 2012a; BBOP 2012a; Croft *et al.* 2011: DEFRA 2011). Offset uncertainty and time lags to effectiveness generally require higher multipliers to accommodate potential loss or portion of failure of measures. In-direct offsets generally incur higher multipliers where equivalency to the value(s) of concern could not be achieved. Within the literature, direct and indirect offset multipliers vary considerably between regulatory jurisdictions and agencies. (BBOP 2012a; Government of Alberta 2013; Australian Government 2012a; Cole 2010; Croft *et al*. 2011; Queensland Government 2007; Senes 2013).

In the United States, a standard multiplier of 1:1 (or close too) for direct compensation and replacement of wetlands and higher multipliers for indirect offsets generally apply. Ohio's wetland restoration program uses a multiplier of 1:1 for direct replacement, and 2:1 for enhancement and preservation actions; New Jersey's restoration multiplier for both direct and indirect measures is 2:1, while Michigan's multiplier of 1:1 for direct replacement and increases to 10:1 for preservation (indirect) measures (Environmental Law Institute 2002). Brown and Lant (1999) completed a review of 68 indirect offsets for wetlands; where mitigation banking schemes were used the average multiplier was 1.36:1, where mitigation was based on trading schemes of spatial wetland area the average multiplier increased to 1.41:1.

The Alberta Wetland Policy utilize incremental multipliers, beginning at 1:1 through 8:1, based on equivalency of lost wetland vs. replacement in consideration of biodiversity, water quality improvement, flood reduction and human value indices categorize wetland value (i.e., The Wetland Replacement Matrix) (Government of Alberta 2013).

Some countries have created offsets solely for vegetation management. The *Queensland Government Policy for Vegetation Management Offsets* outlines a standard multiplier of 1:1 through 4:1 (Queensland Government 2007), where additional factors such as condition of offset area, proximity to area of impact, and ecological equivalence are considered. Brazil has taken a similar approach for forestry offsets, establishing a standard multiplier of 1:1 with incremental increases that consider biodiversity losses of forestry practices on a project-by-project basis (McKenney *et al.* 2009).

The Alberta Conservation Association explores a like-for-like model for offset multipliers that range from 1:1 through 4:1, when considering ecosite rarity through detailed analysis of vegetation, soil, site and forest productivity parameters at the ecosite level as unit of measurement. If offsets are required outside of the natural subregion the residual effects occurred, proposed multipliers increase to 6:1 through 10:1 (Croft *et al*. 2011).

Where uncertainty and time lags exists, multipliers are proposed to correct for discrepancies or risk (DEFRA 2011). DEFRA 2011 define these risks as:

- **Delivery Risks**: associated with the actual delivery of the offset due to uncertainty in the effectiveness of restoration or habitat creation or management techniques.
- **Spatial Risks**: reflect ecological risks derived from the change in location of the habitat or resource, where recreating a habitat in a new location may reduce its environmental value. Location parameters consider offsets in terms of proximity to the species/ecosystem affected.
- **Temporal Risks**: reflect time lags of offset measures to achieve full effectiveness, intent or condition.

Table 2 summarizes proposed multipliers for offset discrepancy and risk as defined by DEFRA (2011).

The Australian Government's *Environmental Protection and Biodiversity Conservation Act 1999* Environmental Offsets Policy place higher value on "advanced" offsets that incorporate multipliers to address temporal risks (i.e., time lags) on a project-by-project basis (Australian Government 2012a).

Quétier and Lavorel (2011) have also suggested that multipliers are appropriate for offset measures that need to account for temporal risks, where lengthy delays incur higher multipliers using a financial systems approach that calculates gains and losses on an annual basis (i.e., per-year).

Table 2 Proposed Multiplier Ratio's for Offset Discrepancy and Risk

Delivery Risk – Difficulty of Recreation/Restoration	Multiplier Ratio
Very High	10:1
High	3:1
Medium	1.5:1
Low	1:1
Spatial Risk – Location Parameters	**Multiplier Ratio**
Offset in located so that it is accessible to the species population affected	1:1
Offset is directly contributing to a spatially identified area, corridor or stepping-stone or restoration area where accessibility by a population is not required.	1:1
Offset buffering, linking, restoring or expanding a habitat outside an area outside of the offset area in question.	1:2
Offset does not contribute to any of the above	1:3
Temporal Risk – Years to Target Condition	**Multiplier Ratio**
5	1.2
10	1.4
15	1.7
20	2.0
25	2.4
30	2.8

Source: DEFRA 2011

2.2 Ecological Mechanisms

Boreal caribou occur at low densities within their herd ranges, do not appear to be forage-limited (EC 2012b), and are experiencing elevated mortality rates due to increasing predator densities believed to be associated with increases in primary prey populations (i.e., moose, deer). Landscape change and a recent trend of mild winters are suspected factors contributing to these processes (Bergerud and Elliot 1986; Bergerud 1996; James and Stuart-Smith 2000; Courtois *et al*. 2007; Seip and Cichowski. 1996).

Correlations have been observed between caribou population response and landscape condition as it varies from continuous mature forest. The amount of young forest and the presence of anthropogenic features are both implicated (Boutin and Arienti 2008; DeCesare *et al.* 2012; Dyer *et al.* 2001 and 2002; EC 2011; Gustine *et al.* 2006a; James and Stuart-Smith 2000; McLoughlin *et al.* 2003; Smith *et al.* 2000; Sorensen *et al.* 2008; Whittington *et al.* 2011; Vors *et al.* 2007).

Environment Canada's final *Recovery Strategy for Woodland Boreal Caribou* (EC 2012b) and current discussion amongst experts (Appendix 1) regarding boreal caribou population decline have identified likely ecological mechanisms which can be categorized as fine-scale effects of the Project footprint (i.e., those affecting animal behaviour) and potentially include:

- attraction of primary prey due to forage availability and ease of movement;
- subsequent attraction of predators (including human use) in search of prey, improved hunting efficiency mediated by extended lines of sight, and overall ease of occupying and traversing the landscape; and
- reduced use of habitat by caribou near disturbed areas, though this may be neutral or beneficial for predation avoidance.

The notion of a broader "disturbed" area described by buffering physical footprint (EC 2012b – 500 m buffer) does not provide information about the specific ecological mechanisms in action, rather adopting broader *a prior* assumptions of predator-prey dynamics (Sorensen *et al.* 2008 – 250 m buffer). In contrast, Boutin and Arienti (2008) suggest that a buffering concept is not necessary to demonstrate the correlation between physical footprint and caribou population response. Environment Canada (2011, p. 243) identify the need for future studies to directly link the ecological mechanisms associated with anthropogenic disturbance to predation risk to improve best management practices and reduce caribou predation risk. Preliminary studies, although inconclusive (small sample sizes and short study periods), of these direct ecological linkages are provided by Neufeld (2006) and Bentham (2007).

Recent literature identify scale-dependent relationships where caribou avoidance of forestry cut-blocks at broad-scales of resource selection (i.e., population and individual home range) must first be achieved before avoidance of linear features at fine-scales of resource selection (i.e., individual telemetry locations) become predictive of caribou distribution (DeCesare *et al.* 2012). This suggests that forestry disturbances (and potentially recently burned areas) may be of greater limitation to caribou spatial distribution than linear disturbances within the range area (DeCesare *et al.* 2012; Latham *et al.* 2011a). DeCesare *et al.* (2012) identify fine-scale avoidance of linear features at 70 m radii (individual telemetry locations), which varies from 250 m (Dyer *et al.* 2001, Sorensen *et al.* 2008) and 500 m (EC 2011), but acknowledge

differences in methodology and the exclusion of roads from the analysis (i.e., seismic lines and maintained trails only).

Demars *et al.* (2011) provide some insight from ongoing research used to evaluate spatial selection factors that may influence caribou calving habitat, neonate calf survival and predation risk. Where female caribou use avoidance strategies in the selection of both calving habitat and sites. Strategies include large-scale rapid movement from winter locations to preferred calving areas and fine-scale spatial separation within calving areas (i.e., interior locations) to adjacent transitional and upland habitat. Female caribou selection of high linear density areas during calving was not consistent with avoidance of anthropogenic disturbance at the range scale, but observed at finer spatial scales within seismic grids. Suggesting that fine-scale effects potentially influence female caribou selection and movement at the individual level (Demars, C. October 22, 2013, Pers. Comm.)

Current literature suggest that the broader influence is the cumulative increment of the fine-scale effects and their expression on the herd range condition and animal population responses as a whole (Demars *et al.* 2011, DeCesare *et al.* 2012; EC 2012b; Gustine *et al.* 2006a, 2006b; Gustine and Parker 2008; James *et al.* 2004; Nagy 2011; Latham *et al*. 2011a). The accumulation of the fine-scale effects at the range scale contribute to a shift towards increased primary prey and predator numbers, with an incidental increase in caribou mortality risk (Courtois *et al*. 2007; Demars *et al.* 2011; EC 2012b; Gustine *et al.* 2006a; Latham *et al.* 2011a,b; Nagy 2011; Polfus *et al.* 2011; Whittington *et al.* 2011).

2.2.1 Context for Offsets

Alberta has developed a woodland caribou policy for Alberta (Government of Alberta 2011). However, in consultation with provincial regulators, action and range plans are not currently in place (Appendix 1), but these forthcoming documents may direct industrial proponents to focus on mitigation strategies and similar offsets conducted on other footprints within caribou range to address residual effects (Hervieux, D. December 12, 2012, Pers. Comm.; Moyles, D. June 26, 2013, Pers. Comm.).

This Preliminary OMP has adapted terminology and approach of the Project's Environmental and Socio-Economic Assessment (ESA) (Stantec 2011, 2012) and from the National Energy Board's (NEB) Environmental Screening Report, to develop evaluation criteria that enable offset calculation. Reducing the Projects fine-scale effects is more involved than simple reforestation, though a goal of reforestation is believed necessary to achieve more self-sustaining, longer-term conditions, so contributions are also recognized. Mitigation measures and offsets that address the Projects fine-scale effects will also serve to protect and enhance conditions for natural regeneration and replanting to accelerate reforestation goals. Mitigation and offset measures are selected and judged on that basis.

Ecological mechanisms and fine-scale residual effects attributed by the Project and defined within the Project ESA (Stantec 2011, 2012) have been incorporated into ecological categories that address a more integrated concept of "Range Utility" for both predators and primary prey. Range Utility is defined as the "Ecological mechanisms associated with the range habitat condition (presumed altered by some function of anthropogenic disturbance and fire) including: ease of movement, speed of travel, direct traverse of habitat, increased line-of-sight, frequency of encounter (predator/prey and prey/forage), larger actualized range area (predator/prey), and increased insolation at ground level".

3.0 CARIBOU HABITAT MITIGATION MEASURES

Through the development of the Preliminary CHRP, NGTL identified generic mitigation measures that will be implemented on a site-specific basis within the Project footprint to reduce project effects on caribou habitat. These generic measures are now common for NGTL's projects in caribou range in Alberta and British Columbia and have been incorporated into the Environmental Protection Plan (EPP), Caribou Protection Plan (Annex of the EPP) and the Preliminary CHRP that the Board has approved for this Project. These measures are described in Table 3.

Table 3 Caribou Habitat Mitigation Measures Common to NGTL Projects in Caribou Range in Alberta and British Columbia

Mitigation Measure	Key Points	Reduced Effect
Seasonal Avoidance	Activity Guidance Scheduling Activities	• Caribou displacement from preferred habitat
Utilize Existing Disturbance	Routing Selection for Highly Permeable Areas	• Range utility (both prey and predators)
Habitat Revegetation (including minimum disturbance to promote natural regeneration, excavator mounding, bioengineering)	Design Minimum Needs	• Soil loss and degradation (managed for complication that forage minimization conflicts with soils concerns)
Vegetation Prescription (tree/shrub seeding, excavator mounding, bioengineering)	Species Selection and Placement	• Productivity for prey (low palatable species/lichen reestablishment) • Range utility (line-of-sight blocking/vegetation barriers)
Reforestation Prescription (tree/shrub seeding, excavator mounding, bioengineering)	Species Selection and Placement	• Productivity for prey (low palatable species/lichen substrate) • Range utility (line-of-sight blocking/vegetation barriers) • Long-term forest state
Strategic Line-of-Sight Management (Berms, tree/shrub seeding, excavator mounding, bioengineering)	Physical Barriers	• Range utility (both prey and predators)
Access/Predator Barriers (Berms, coarse woody debris, excavator mounding)	Locked Gates Physical Barriers	• Range utility (line-of-sight blocking/physical barriers) • Human access (include locked gate)

4.0 INITIAL QUANTIFICATION OF AREA DISTURBED

Environment Canada (2012b) acknowledge that habitat disturbance promotes early seral growth that favour higher primary prey densities (i.e., moose, deer), resulting in increased predator populations (i.e., wolf, bear), which have resulted in higher predation risk to caribou. Modelling exercises identified a significant correlation between caribou population sustainability (i.e., population lambda) and total disturbance (i.e., anthropogenic disturbance buffered by 500 m and area burned within the last 40 years) (EC 2011. 2012b).

As filed in Responses to NEB Round 4 and Intervenor Information Requests (NEB Filing ID A41530) by Stantec on May 15, 2012 a quantification of directly and indirectly disturbed habitat to supplement the ESA. Results demonstrate (Table 4) that the Project footprint will result in a direct disturbance of 169.8 ha (159.6 ha parallel alignment and 10.2 ha of new alignment) and indirect disturbance of 0 ha as defined by the Recovery Strategy (i.e., no increase to total disturbance in caribou range EC 2011, 2012b).

Table 4 Project Contribution to Total Disturbance in the Chinchaga Caribou Range (AB1)

Direct Disturbance Attributable to the Project[1]	Mapped Disturbance in AB1 (EC 2012b)		Increase in Total Disturbance within AB1 Attributable to Project
ha	Total ha Disturbed	% of Total Disturbance	%
169.8	2,403,585	76	0

Note: Environment Canada's source of existing anthropogenic disturbance (EC 2012b) (i.e., defined as existing anthropogenic disturbance as disturbance visible on Landsat at a scale of 1:50,000), differs from that used in the analysis conducted within Stantec 2012, the results are considered comparable for this discussion.
(1) Direct disturbance (ha) may be subject to change after construction and upon filing of the Final OMP.

5.0 RESIDUAL EFFECTS

Characterization of residual Project effects is developed from, and is consistent in nature with, that reported in the ESA and the NEB's Environmental Screening Report. Additional consideration and language (e.g., fine and broad-scale effects) has been added to inform this Preliminary Offset Measures Plan with respect to:

- Environment Canada's Recovery Strategy for Woodland Boreal Caribou (EC 2012b) and Alberta's Woodland Caribou Policy (Government of Alberta 2011);
- recent scientific literature identifying ecological mechanisms (Demars *et al.* 2011, DeCesare *et al.* 2012; Gustine *et al.* 2006a; Gustine and Parker 2008; James *et al.* 2004; Nagy 2011; Latham *et al.* 2011a); and,
- quantitatively characterize environmental value(s) of concern, residual Project effects and offset requirements.

Residual effects are those remaining after mitigation is applied and can be categorized as fine-scale or broad-scale. In principle, offsets are not supposed to be used where mitigation is feasible and valuable.

5.1 Fine-Scale Effects

Fine-scale effects consider individual animal behavioural responses attributable by the Project (Table 5).

Table 5 Fine-Scale Effects on the Project Footprint

Fine-Scale Effects	Related Residual Effect from Project ESA	Key Points
Fine-Scale Effects (i.e., related to the actual area of physical disturbance)		
Loss of Caribou Forage (i.e., lichen) (New and Parallel Alignment)	Loss or alteration of wildlife habitat (general effect for all wildlife species)	• Considered a minor issue. • Minimum herbaceous revegetation prescription will enhance lichen regeneration/recolonization.
Improved Productivity for Prey (i.e., forage type and quantity) (New and Parallel Alignment)	Related to increased risk of mortality as a result of increased predator access due to creation of new linear corridors	• Only minor cumulative increment at prey population scale (see broad-scale effects) • Habitat revegetation and reclamation strategies for non/low-palatable vegetation species establishment. • Vegetation reestablishment success: CHRP measurable objectives need to align with potential offset measures.

Table 5 Fine-Scale Effects on the Project Footprint

Fine-Scale Effects	Related Residual Effect from Project ESA	Key Points
Increased Range Utility (i.e., line of sight, ease of travel) (Primarily New Alignment)	Related to increased risk of mortality as a result of increased predator access due to creation of new linear corridors	• Only partial increment where paralleling existing linear disturbance. • Some limited mitigation available where operational access required • Strategic placement of access-limiting barriers within New Alignment areas is challenged to achieve full restriction • Effective offsets available for historic footprint; immediate and long term barriers • Offset measure based on a length metric and scaled to the Project Footprint.
Future Habitat State (detraction of long-term forest goal) (New and Parallel Alignment)	Related to increased risk of mortality as a result of increased predator access due to creation of new linear corridors, as well as reduction in habitat availability and effectiveness	• Only partial increment where paralleling existing linear disturbance. • Long-term Provincial habitat condition objectives for caribou range areas. • Early initiation or enhancement of reforestation within caribou range areas.
Caribou Displacement (re: preferred habitat) (New and Parallel Alignment)	Displacement of caribou due to sensory disturbance	• Construction activity and noise associated with project, access and associated facilities considered short-term and effects minimal across the general range. • Little current evidence of seasonally-selected, fine-scale, High Caribou Potential Areas. • Potential to adjust activity schedules.

5.2 Broad-Scale Effects

Broad-scale effects consider the cumulative effects within the caribou range area (Table 6).

Table 6 Broad-Scale Effects within the Caribou Range Area

Broad-Scale Effects	Related Residual Effect from Project ESA	Key Points
Broad-scale effects (i.e., contribution to home-range and/or herd-range scale, prey and predator population response and subsequent increase in caribou mortality risk)		
Increased Range Utility (i.e., improved energetic cost/ benefits for primary prey/predators). (Primarily New Alignment)	Related to increased risk of mortality as a result of increased predator access due to creation of new linear corridors	• Occurs in relatively small cumulative increments (except fire) to range-scale metric. • Increased utility for predator and primary prey species at the Range scale. Define what the increase is in unit area given the establishment of the CHRP. • Explore whether offsets can be developed in other locations that could increase energetic costs and decrease efficiency of predators and primary prey. Applicable to strategic placing of all mitigation measures, including human access and ongoing maintenance requirements. • More influence in more intact areas. Offsets potentially more effective in relatively intact areas. • Offsets (access inhibition and enhanced restoration) may occur anywhere on the range; preferably part of a provincial range plan.

6.0 OFFSET MEASURES PLAN

Assumptions about the nature of ecological mechanisms of relevant wildlife to anthropogenic disturbance (Demars *et al*. 2011, DeCesare *et al.* 2012; EC 2012b; Gustine *et al.* 2006a; Gustine and Parker 2008; James *et al.* 2004; Nagy 2011; Latham *et al.* 2011a) of the landscape are made to support the estimation of residual effects (Table 7). The same rationale used to evaluate mitigation is used to evaluate offsets within this Preliminary OMP. Limits to the potential effectiveness of offset measures, intensity of application and duration or delay in influence, as well as associated uncertainty, suggest multiplier ratios for offset measures (Australian Government 2012a; BBOP 2012a; Croft *et al*. 2011; DEFRA 2011; Quétier and Lavorel 2011)

Where the objective can be accomplished, offset measures that are implemented on other pre-existing linear disturbances (i.e., seismic or other lines with no access needs are preferred), or on adjacent footprint (i.e., NGTL easement) where the Project has parallel alignment, qualify as direct offsets of both fine and broad-scale effects. Where direct offsets cannot be accomplished, indirect offsets that focus on knowledge gaps and uncertainty of habitat restoration, physical mitigations and ecological mechanism are considered. The quantitative methodology used to estimate the remaining residual effect (hectare) of the Project and the required offset to residual effect (hectare equivalent) and are subject to change by the time of the Final Offset Measures Plan.

6.1 Residual Effects

Route selection and on-easement mitigation are applied to reduce or eliminate a Project's residual effects with regard to ecological mechanisms of concern. Utilization of existing disturbance and linear features serve to reduce the incremental effect of total disturbance within caribou range (see Section 6.4, Table 8 for the distinction and Table 9 for estimate of reduction).

Consideration is then given to the degree to which mitigation measures on-easement reduce this inherent Project effect, recognizing operational limitations, temporal considerations and uncertainty (DEFRA 2011). On-easement mitigation measures and their average effectiveness score (i.e., questionnaire base survey) are described in Table 8. Residual effects are those that remain following the application of mitigation measures. The model developed for this Preliminary OMP, to quantify residual effects is represented by the following equation:

$$\text{Residual Effect (Ha)} = \text{Project Effect (Ha)} \times \{1-(\text{Mitigation Effectiveness} \times \text{Duration:Delay Penalty})\}$$

Table 7 Generalized Mitigation and Offset Measure Categories

Residual Effect (Post-Mitigation)		Residual Effect Rating	Ecological Mechanism	Mitigation/Offset Categories	Feasibility	Effectiveness
Fine-Scale Effects (i.e., related to the actual area of physical disturbance)						
Loss of Caribou Forage (i.e., lichen)	All Alignment	Minor	Forage	Vegetation Management	Achievable/Duration:Delay	Moderate
Improved Productivity for Prey - Forage	All Alignment	Minor	Forage	Vegetation Management	Achievable/Duration:Delay	Moderate
Increased Range Utility - Predator/Prey Response	Parallel Alignment	Minor-Moderate	Line-of-Sight Ease of Movement	Vegetation Barriers	Achievable/Duration:Delay	Moderate-High
	New Alignment	Minor-Moderate	Line-of-Sight Ease of Movement	Vegetation Barriers	Achievable/Duration:Delay	Moderate-High
Increased Range Utility - Predator/Prey Response	Parallel Alignment	Minor-Moderate	Line-of-Sight Ease of Movement	Physical Barriers	Achievable	Moderate-High (Degree of Effort)
	New Alignment	Minor-Moderate	Line-of-Sight Ease of Movement	Physical Barriers	Achievable	Moderate-High (Degree of Effort)
Future Habitat State Detraction of Long-Term Forest Goal	Parallel Alignment	Minor-Moderate	Duration to Future State	Replanting	Achievable/Duration:Delay	Moderate-High
	New Alignment	Minor-Moderate	Duration to Future State	Replanting	Achievable/Duration:Delay	Moderate-High
Caribou Displacement (re: Preferred Habitat)	Parallel Alignment	Consideration for Indirect Offsets Reference Need for Range Plan Guidance				
	New Alignment					
Broad-scale effects (i.e., contribution to home-range and/or herd-range scale, prey and predator population response and subsequent increase in caribou mortality risk)						
Increased Range Utility – Predator/Prey Response	New Alignment	Accommodated by Offsets for Fine-Scale Effects. Illustrates that Off-Easement Offsets Qualify as “Direct” Reference Need for Range Plan Guidance				

6.2 Mitigation and Offset Categories

For the purposes of this Preliminary OMP, ecological mechanisms described within the ESA (Stantec 2011, 2012) have been incorporated into ecological component categories that address the integrated effect of Range Utility as it interrelates directly to available mitigation and offset measures that are consistent with pipeline development projects in woodland boreal caribou range. Offset categories focus on fine-scale effects on other pre-existing linear disturbance (i.e., seismic or other lines with no access needs is preferred), or on adjacent NGTL footprint in segments with parallel alignment.

Broad-scale residual effects are viewed as the cumulative contribution of fine-scale effects to the entire range condition and resulting animal population response, thus justifying the selection of direct offsets elsewhere in the range, preferably as a contribution to a restoration strategy described in a range plan likely to target more intact areas as a priority. This is supported by consultations with provincial regulators (Appendix 1). New alignment in currently more intact areas creates a larger increment in broad-scale residual effect; in the same way offset measures applied to relatively more isolated disturbances have a greater benefit than those in highly disturbed areas.

6.3 Offset Valuation

The result of the considerations outlined in Section 5.0 would be determination of a residual effect valuation (in hectares). This valuation would include fine-scale and also broad-scale effects. The following discussion deals with direct offsets of the residual effect valuation results. Quantitative scoring of the effectiveness and relative value of both on-easement mitigation and offsets is challenged by limited scientific literature relevant to linear development projects (Golder 2012).

For the purpose of this Preliminary OMP, a questionnaire-based survey was provided to environmental specialists to obtain their professional opinion and judgment. The objectives of the questionnaire included:

- clarification of the fundamental ecological mechanisms of concern associated with caribou habitat disturbance;
- the conceptual use of Range Utility as the primary ecological mechanism from which residual effects and required offsets are calculated;
- comments regarding available mitigation/offset measures on pipeline ROWs with boreal caribou herd ranges (i.e., from initial routing considerations through restoration of footprint);
- relative effectiveness and value of mitigation/offset measures applied at both high and low intensity (e.g., barrier segments, discrete barriers, planting strategies);
- the influence of surrounding habitat conditions on mitigation/offset effectiveness;
- penalty factor considerations associated with the delay of mitigation/offset measures to full effectiveness (i.e., replanting);
- degree of uncertainty associated with mitigation/offset treatments to achieve full effectiveness (i.e., long-term variability);

Results of the questionnaire-based survey provide a basis for estimating the effectiveness of on-easement mitigation and offset measures to calculate remaining residual effects and required offset area.

6.3.1 Rationale for Questionnaire

Questionnaire-based surveys are commonly used tools used to collect specific information from target audiences that otherwise may not be published or attainable. For the purpose of this Preliminary OMP and other Offset Plans currently in development, a questionnaire "Estimating Residual Effects of Boreal Caribou Habitat" was provided to environmental specialists, academics, industry and government representatives who have participated in caribou recovery effort/research in western Canada. The questionnaire was provided via a web link in order to effectively track responses of participants.

There are several examples within the literature that demonstrate the benefit of conducting questionnaires for offsets in general, frameworks and policies, effectiveness and other related criteria.

The effectiveness of environmental offsets in an Environmental Impact Assessment (EIA) in Western Australia was examined in Hayes *et al.* (2007). A survey was conducted to determine what the support was the use of environmental offsets in an EIA. The survey was sent to 26 Western Australia EIA practitioners representing regulators (n = 6), consultants (n = 6), government agencies (n = 6), and industry proponents (n = 8). Participants were selected on the basis of having offset experience.

Participants responded to seven-point graded scale (i.e., 1 = to no extent; 7 = to a large extent) or open-ended questions that provided areas for comments. If the participant lacked knowledge of the question or subject matter, no response was provided. The response was from "neutral" to "a large extent" in favour of offsets as a tool within an EIA's. Concern regarding the offset design, implementation and monitoring were noted in the context of theoretical objectives vs. achieved objectives Hayes *et al.* (2007).

Another example that draws relevance to developing offset policy design in include the British Columbia Ministry of Environment Mitigation and Offsetting Policy (BC MOE 2011) that initially made use of an online questionnaire and other engagement tools. Participants included representatives from: mining, forestry, clean energy, oil and gas, urban development, agriculture, aquaculture and tourism industries; environmental non-government organizations (ENGOs); aboriginal groups and leaders; chairs of all species at risk teams in British Columbia; federal and provincial natural resource management agencies; organizations representing local government; natural resource sector organizations, technical advisory groups and Senior Policy Official Groups. Participants responded to categorized questions with more emphasis placed comments and discussion.

With regard to caribou recovery efforts, the Caribou Protection and Recovery Program Technical Guidance Document (Antoniuk *et al*. 2012), which included expert workshop attendees (government personnel, consultants, researchers and industry representatives) participated in a questionnaire gathering views on three key criteria regarding predator exclosure/caribou enclosure fencing and anticipated benefits and challenges.

Questionnaires concerning the effectiveness of mitigations applied to project footprint to minimize residual project effects on caribou and caribou have been conducted (Golder 2012). The aim of the questionnaire for this Preliminary OMP and other Offset Measure Plans currently in development, is to build to this information to assist the development of effective offset for linear development projects.

6.4 Offset Calculation

Direct offsets include habitat restoration or modification methods that can be only partly accomplished on the Project footprint due to the continued need for access on operational pipelines and roads, but may be more effectively accomplished at other locations without such need. They are like-for-like in terms of ecological mechanisms of concern.

The required offset is the proportion of remaining residual effect multiplied by the measure effectiveness and multiplier ratio associated with delays (i.e., time lags). It may differ for segments of line that are new or parallel alignment, or have different habitat importance or response effect values. The model developed for this Preliminary Offset Measures Plan, to quantify the required offset is represented by the following equation:

Required Offset (Ha) = Residual Effect (Ha) x (Offset Measure Effectiveness Ratio × Delay Multiplier Ratio)

Offset measures their expected effectiveness and delay factors are outlined in Table 8. Effectiveness scores were derived from the questionnaire based survey (n=19 to-date), which include estimates of uncertainty in regard to reduction of range utility. While offset mitigations will be conducted on off-easement locations, the Project easement itself will be restored following construction and following abandonment, with a presumption of full effectiveness over the longer term.

6.4.1 Multiplier Ratio

Offset measures are preferably constructed to address residual project effects, environmental value(s) of concern, equivalent ecological mechanisms, effectiveness, and achievability (McKenney 2005; McKenney and Kiesecker 2010). Multiplier ratios (multiplier) have been suggested for measures where uncertainty of effectiveness, time lags or correlation with successful measures at different locations are not available (Australian Government 2012a; DEFRA 2011; McKenney and Kiesecker 2010; Quétier and Lavorel 2011)

Temporal challenges for on-easement mitigation measures to achieve full effectiveness are discussed in the Project CHRP (i.e., habitat-specific planting and minimum surface disturbance construction). The multiplier ratio for individual offset measures varies with the degree of intensity at which a measure(s) is applied and the delay (i.e., time lag) to achieve full effectiveness with regard to reduction in range utility.

Delay penalty factors and associated multiplier ratio's have been categorized into incremental year periods for calculation purposes following DEFRA 2011. The multiplier ratio is specific to the habitat type (upland and lowland) and offset measure applied with regard to reduction of range utility. Required offset for the Project are presented in Table 9 and 10, respectively.

Table 8 On-Easement Mitigation and Offset Measure Effectiveness and Delay Penalty

Offset Category	Mitigation/Offset Measure	Mitigation Offset Application	Aspect of Range Utility	Degree of Intensity	Reduction Range Utility (Effectiveness) (*Standard Ratio*)[1]	Delay Penalty (Factor) (*Multiplier Ratio*)[2]
Physical Barriers	Discrete Barriers (Fences/Berms)	Discontinuous	Line of Sight	250m Intervals (High Intensity)	0.3 (*3.3:1*)	1.0 (*Immediate Effect Multiplier = 1:1*)
				500m Intervals (Low Intensity)	0.1 (*6.6:1*)	1.0 (*Immediate Effect Multiplier = 1:1*)
		Continuous	Line of Sight Ease of Movement	250m Intervals (High Intensity)	0.5 (2:1)	1.0 (*Immediate Effect Multiplier = 1:1*)
				500m Intervals (Low Intensity)	0.4 (*2.5:1*)	1.0 (*Immediate Effect Multiplier = 1:1*)
Physical Barriers	Barrier Segments (Coarse Woody Debris & Mounding)	Discontinuous	Line of Sight	50m Segments Spaced By 200 m Intervals (High Intensity)	0.4 (*2.5:1*)	1.0 (*Immediate Effect Multiplier = 1:1*)
				100m Segments Spaced By 400 m Intervals (Low Intensity)	0.3 (*3.3:1*)	1.0 (*Immediate Effect Multiplier = 1:1*)
		Continuous	Line of Sight Ease of Movement	50m Segments Spaced By 200 m Intervals (High Intensity)	0.8 (*1.3:1*)	1.0 (*Immediate Effect Multiplier = 1:1*)
				100m Segments Spaced By 400 m Intervals (Low Intensity)	0.6 (*1.6:1*)	1.0 (*Immediate Effect Multiplier = 1:1*)
Vegetation Barriers	Planting for Future Barrier	Discontinuous	Line of Sight	250 m Intervals (High Intensity)	0.3 (*3.3:1*)	0.83 (*5 Year Delay Multiplier Uplands = 1.2:1*) 0.36 (*30 Year Delay Multiplier Lowlands = 2.8:1*)
				500 m Intervals (Low Intensity)	0.2 (*4:1*)	0.83 (*5 Year Delay Multiplier Uplands = 1.2:1*) 0.36 (*30 Year Delay Multiplier Lowlands = 2.8:1*)
Vegetation Barriers	Planting for Future Barrier	Continuous	Line of Sight Ease of Movement	250 m Intervals (High Intensity)	0.6 (*1.6:1*)	0.83 (*5 Year Delay Multiplier Uplands = 1.2:1*) 0.36 (*30 Year Delay Multiplier Lowlands = 2.8:1*)
				500 m Intervals (Low Intensity)	0.4 (*2.5:1*)	0.83 (*5 Year Delay Multiplier Uplands = 1.2:1*) 0.36 (*30 Year Delay Multiplier Lowlands = 2.8:1*)
Replanting	Planting to Accelerate Reforest State	Discontinuous Continuous	Line of Sight Ease of Movement	Where Appropriate (Includes Minimum Surface Disturbance)	0.6 (*1.6:1*)	0.83 (*5 Year Delay Multiplier Uplands = 1.2:1*) 0.36 (*30 Year Delay Multiplier Lowlands = 2.8:1*)

Note:

(1) On-Easement Mitigation and Offset Effectiveness scores are taken from the questionnaire and presented in the form of proportions to evaluate the reduction of range utility for specific individual measures (Maximum Effectiveness = 1.0).

(2) Multiplier Ratio's are adopted from DEFRA 2011 (Table 2) where a Delay Penalty Factor of 1.0 = no penalty as the measure is effective immediately; where delays are incremental through years (i.e., planting for barriers, minimum surface disturbance or planting to accelerate reforest state) multipliers are used. Effectiveness and Penalty Factor scores can be converted into Ratio's using the formula 1 / Measure Effectiveness or Penalty Factor (e.g., 1 / 0.6 for Planting to Accelerate Reforest State = 1.6:1 Standard Ratio).

Table 9 Remaining Residual Effects - Chinchaga Lateral Loop No. 3 Project

Project Footprint	Area (ha)	Inherent Residual Effect (%) (ha)[1]	Habitat Type (% of ha)[2]	On-Easement Mitigation Measure	On-Easement Mitigation (Effectiveness)[3]	Delay Penalty (Factor)[4]	Effectiveness Calculation	Residual Effect Calculation (ha)[5]	Total Remaining Residual Effect (ha)[6]
New Alignment	10.2 ha	100% (10.2 ha)	Upland Mixedwood Upland Coniferous Transitional (100% of 10.2 ha = 10.2 ha)	Barrier Segments (Discontinuous/High Intensity)	0.4	1.0	(0.4*1.0) = 0.4	Choosing max implementation of barriers segments and replanting 1-(0.4+0.50) = 0.10	(0.1 x 10.2 ha) + (0.50 x 19.1 ha) + (0.78 x 12.8 ha) = 20.6 ha
				Planting to Accelerate Reforest State & Minimal Surface Disturbance	0.6	0.83	(0.6*0.83) = 0.50		
			Treed Lowland Wetland (0% of 10.2 ha)	NA	NA	NA	NA		
Parallel Alignment	159.6 ha	20% (31.9 ha)	Upland Mixedwood Upland Coniferous Transitional (60% of 31.9 ha = 19.1 ha)	Planting to Accelerate Reforest State & Minimal Surface Disturbance	0.6	0.83	(0.6*0.83) = 0.50	Choosing max implementation of discrete barriers and replanting) 1-(0.50) = 0.50 + 1-(0.22) = 0.78	
			Treed Lowland Wetland (40% of 31.9 ha = 12.8 ha)	Planting to Accelerate Reforest State & Minimal Surface Disturbance	0.6	0.36	(0.6*0.37) = 0.22		

Notes:

(1) The Inherent Residual Effect is the incremental effect of the project with reference to range utility derived from questionnaire (e.g., new alignment has a maximum effect on range utility (i.e., 100% = 10.2 ha); parallel alignment has a smaller effect on range utility (20% = 31.9 ha).

(2) Categorized by Habitat Type as defined by the Project CHRP

(3) On-Easement Mitigation Effectiveness and

(4) Delay Penalty Factors are derived from the results of the questionnaire-based survey and DEFRA 2011, respectively (Table 8).

(5) If multiple On-Easement Mitigation are applied these treatments become additive for calculation of Remaining Residual Effect (ha).

(5) Remaining Residual Effect calculations are derived using the equation presented in Section 6.1 and represent the proportional Area (ha) remaining after project mitigation. Bolded text indicates on-easement mitigation measures selected. Area calculations (ha) assume a 32 m wide ROW.

Table 10 Required Offset to Residual Effect (ha Equivalent) - Chinchaga Lateral Loop No. 3 Project

Total Remaining Residual Effect (ha)	Offset Measure Example[1]	Standard Offset Ratio[2]	Delay Penalty Multiplier Ratio[3]	Final Offset Ratio[4]	Total Required Offset Area (ha)[5]
20.6 ha	Upland Mixedwood/Upland Coniferous/Transitional Planting to Accelerate Reforest State (Effectiveness = 0.6) & Delay Penalty of 5 Years (Factor = 0.83)	1 / 0.6 = 1.66	1 / 0.83 = 1.2	1.66 x 1.2 = 2.0	2.0 x 20.6 = 41.2 ha

Notes:

(1) The selection of an example Offset Measure used to offset the Total Remaining Residual Effect of the Project (e.g., Planting to Accelerate Reforest State in Upland Mixedwood/Upland Coniferous/Transitional Areas).

(2) Offset Measure Effectiveness converted to the Standard Ratio for the specific measure (i.e., 1 / Measure Effectiveness = Standard Ratio).

(3) Delay Penalty Factor converted to the Multiplier Ratio for the timeframe till full effectiveness with regard to Range Utility (i.e., 1 / Delay Penalty Factor = Multiplier Ratio).

(4) Final Offset Ratio required to offset the Total Remaining Residual Effect (ha) using the selected Offset Measure and associated Delay Penalty Factor.

(5) Total Required Offset Area to offset the Total Remaining Residual Effect (ha) using the selected Offset Measure and associated Delay Penalty Factor. If multiple Offset Measures are applied these treatments become additive (as with Residual Effects) for calculation of Total Required Offset Area (ha).

6.5 Offset Selection Criteria

The selection of individual offset measures and implementation within the range follow a similar framework to that of the Preliminary CHRP and are presented in Figure 3.

6.5.1 Offset Measures

Strategic placement of offset measures within the range need first consider proposed or current provincial range planning priorities (i.e., landscape intactness) in addition to local/aboriginal knowledge or guidance. Unless otherwise directed, it is anticipated that areas of highest range intactness will be the primary focus for offset measure application. In the event that regulatory mechanisms are unavailable to protect off-easement locations, additional considerations for offset locations include:

- Direct offsets on existing TCC/NGTL easements with minimal (i.e., aerial inspection only) or no further access requirements or easements where lease holder agreements permit the application offset measures; and,
- Indirect offsets in the form of Research and Monitoring Programs or other Financial Mechanisms, where the financial contribution will be the hectare equivalent to the total required offset area under a scenario of planting for future reforest state (i.e., high delay penalty factor).

6.5.2 Offset Selection Criteria

Locations that contribute most to range utility (i.e., predator/primary prey ease of movement) will be the primary focus in association to range intactness. Modelling exercises conducted by Environment Canada (2012b) demonstrate that caribou population decline (i.e., population lambda) is correlated to total range disturbance. Consideration for priority locations that have greater potential to reduce total range disturbance or other ecological mechanisms include:

- Provincial authorities or range planning directives specific to boreal caribou recovery efforts and management, if available upon filing of the Final OMP;
- Minimal (i.e., aerial inspection only) or no further access current access requirements in areas of higher range intactness;
- High habitat quality (where habitat data available), transitional zones between upland and lowland areas and riparian corridors;
- High caribou use areas (where data available), transitional zones between upland and lowland areas and riparian corridors adjacent to specific areas of importance (i.e., calving habitat); and
- Traditional trapping, hunting or access on existing easements will also be a consideration when selecting lines for offset measure application.

Selection criteria considerations, where possible, will align with current or developing research associated with the ecological mechanisms of concern. Additional planning considerations include surrounding habitat and condition, terrain complexity and available materials to maximize offset effectiveness at the site scale. The intensity of application will be contingent upon the required offset (ha) estimate and range planning priorities (if available). Unless otherwise directed, it is assumed that line of sight and ease of movement aspects of range utility will be the priority.

For example, treed lowland areas comprising naturally open habitat and line of sight greater than 500m may not be the primary focus of offset measure selection criteria. In contrast, upland or transitional areas with naturally dense habitat and line of sight less than 500m may require the application of both line of sight and ease of movement offset measures of varying degree, particularly in areas of higher range intactness. Other considerations will include terrain complexity (i.e., naturally hilly areas) and its influence on line of sight and ease of movement given surrounding habitat and condition.

Offset measures focused on replanting strategies for either future barriers or reforestation priorities, will make use of recommendations from the Project CHRP with respect the most effective restoration method for specific habitat types or locations.

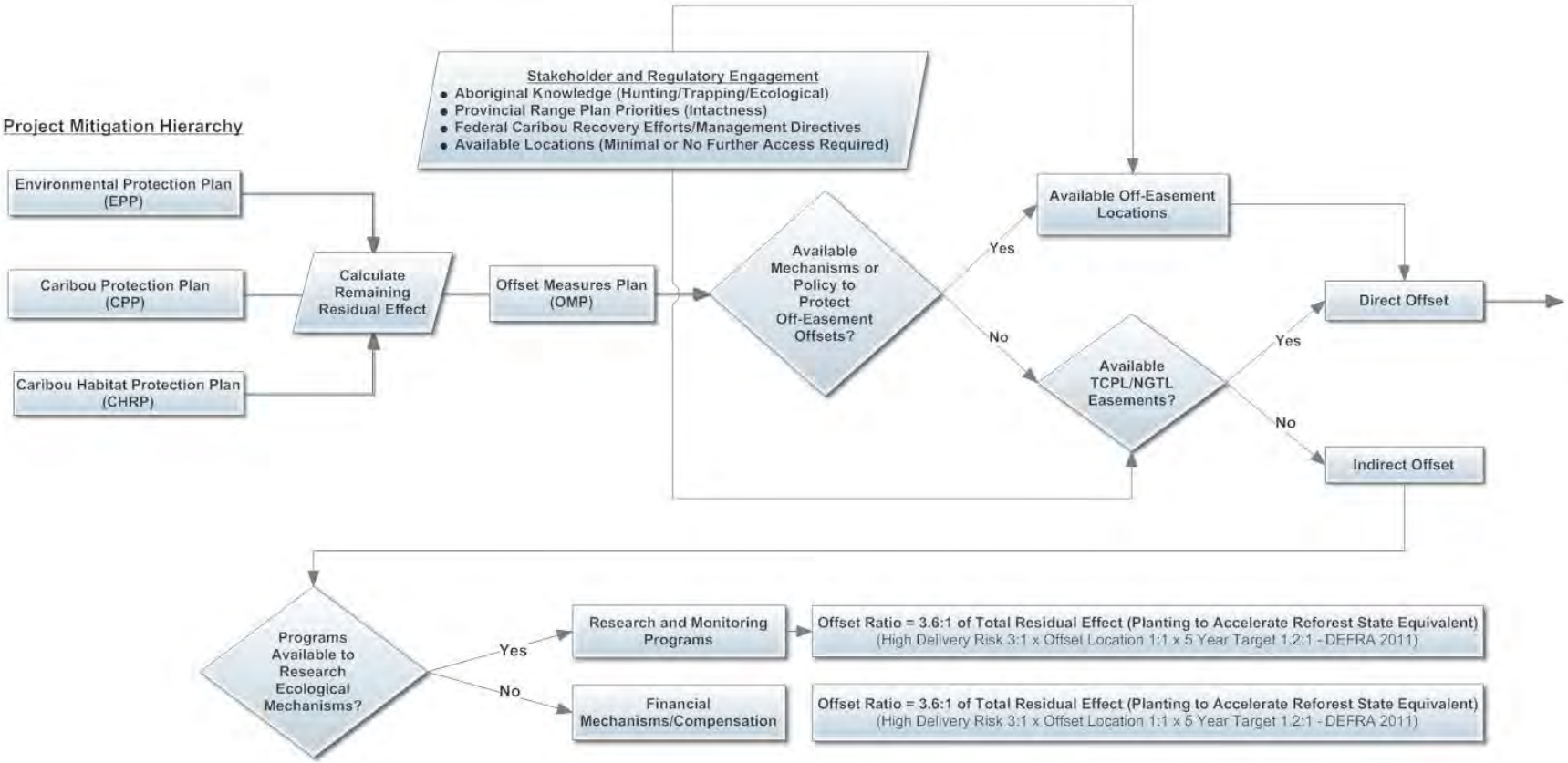
6.6 Adaptive Management Program

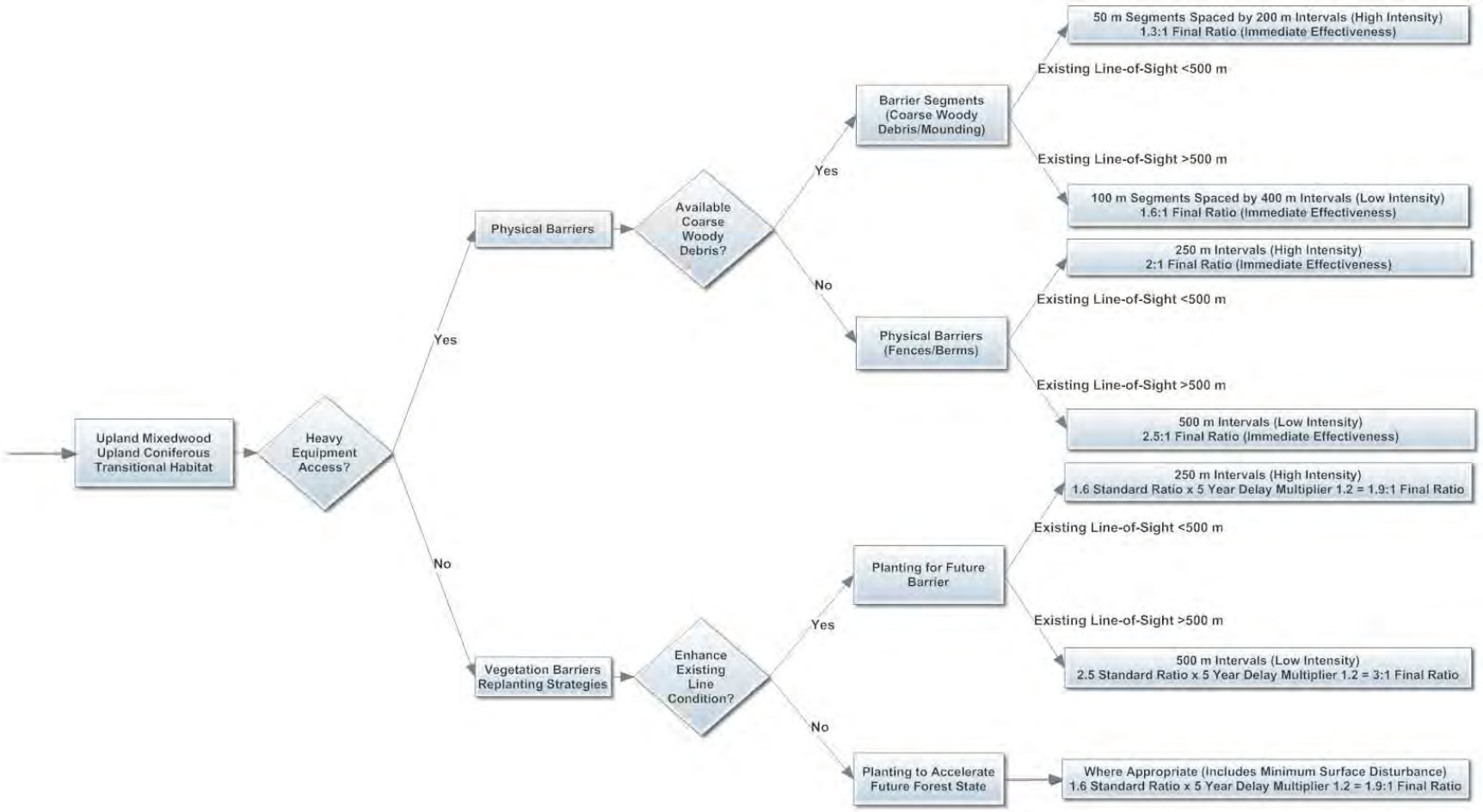
Given the inherent uncertainty associated with caribou habitat restoration, mitigation, and offset measures, assumptions are made in the development of evaluation criteria. The ability to successfully achieve the offset is uncertain. Offsets are intended as a final step following the rigorous application of the mitigation hierarchy, where all reasonable measures are taken to minimize effects of the project footprint on-easement (BBOP 2012a; DC 2010; DEFRA 2011, 2013; NSW 2013; Queensland Government 2008; Quétier and Lavorel. 2011; WA 2011).

Adaptive management provide the means by which this uncertainty can be addressed within the OMP. The aim of the adaptive management will be to validate assumptions made regarding ecological mechanisms of concern, effectiveness and other unforeseen spatial or temporal uncertainties associated with measures. The adaptive management program is subject to change given the identification of unsuccessful offset treatments, 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 offset.

It is anticipated that where offset measures do not achieve full effectiveness or defined goals (with the exception of events attributable to natural processes) they will be reviewed and supplemented, where required, with treatments that correct or enhance the offset measure. The Caribou Habitat Restoration and Offset Measures Monitoring Program (CHROMMP) as required in Certificate Condition 20 will provide further detail on the criteria, methodology and protocols by which the effectiveness of the CHRP and OMP measures will be evaluated.

Figure 3 Offset Measure Selection Criteria in Caribou Range





Notes: Selection criteria for offset measures and suggested ratio's. If multiple offset measures are applied these mitigations (standard ratios) become additive in the calculation of total required offset area. Offset effectiveness scores were derived from the questionnaire and subject to change upon filing of the Final Offset Measures Plan.

7.0 CONSULTATION AND ENGAGEMENT

The following sections summarize NGTL's consultation with regulatory agencies and plans for engagement with potentially affected Aboriginal groups on the Preliminary OMP. This summary will be augmented with an update on Aboriginal engagement activities, which will be filed with the Board before Leave to Open is requested.

7.1 Regulatory Consultation

NGTL has consulted with provincial and federal regulatory agencies, including ESRD and EC, regarding the Preliminary OMP. A record of consultation including summaries of discussions and meetings is provided in Appendix 1.

NGTL developed a draft discussion document regarding potential offset measures and strategies pertaining to proposed pipeline projects in woodland caribou range in Alberta and British Columbia; the purpose of the discussion document was to facilitate discussions with regulatory agencies. Input received from these regulatory agencies informed this Preliminary OMP.

Given the implications for provincial range planning as per EC's Final Recovery Strategy for Woodland Boreal Caribou, NGTL's Preliminary OMP will require input and advice from provincial regulators, particularly regarding their specific range priorities and proposed mechanisms for achieving compliance with the Species at Risk Act (Appendix 1). NGTL has committed to continuing consultations and expects that development of the Final OMP will be a dynamic and iterative process.

7.2 Aboriginal Engagement

NGTL constructs and operates facilities near many Aboriginal communities across Canada. NGTL believes that by developing positive relationships with the Aboriginal communities affected by our activities, we can achieve our respective business and community interests.

7.2.1 Guiding Principles for Aboriginal Engagement Activities

- NGTL respects the diversity of Aboriginal cultures, recognizes the importance of the land and cultivates relationships based on trust and respect;
- NGTL works together with Aboriginal communities to identify impacts of company activities on the community's values and needs in order to find mutually acceptable solutions and benefits;
- NGTL strives to create short and long-term employment opportunities for Aboriginal people affected by our activities;
- NGTL supports learning opportunities for Aboriginal people to provide a well-trained source of Aboriginal employees and to build capacity within Aboriginal communities; and
- NGTL respects the legal and Constitutional rights of Aboriginal peoples and recognizes that its relationships with Aboriginal peoples are separate and different from that of the Crown.

7.2.2 Strategic Plan

As part of its commitment to build and maintain positive relationships, NGTL shall seek direct input and traditional ecological knowledge from potentially affected aboriginal communities in the development of its Offset Measures Plan in order to focus efforts and investments in areas that provide greatest ecological and social benefits.

Offset measures address the residual effects that remain after mitigation measures to avoid or minimize potential effects. The goal of offset measures is to achieve a NNL of productivity by replacing ecosystem functions that would be lost as a result of proposed land or resource use activities.

7.2.3 Consultation Goals

- Increase awareness and understanding of the Project, NGTL's commitments to caribou habitat protection, and priorities for caribou habitat restoration;
- Gain insight of community priorities for traditional ecological knowledge integration into the offset measures planning;
- Receive community insight (geospatial) about how caribou move and utilize habitat throughout their range for all stages of their lifecycle; and
- Receive recommendations from community members on future opportunities for follow-up.

7.2.4 Communities Engaged

The following Aboriginal communities were engaged to provide comments and traditional knowledge concerning the development of this plan.

- Beaver First Nation ('BFN')
- Dene Tha' First Nation ('DTFN')
- Doig River First Nation ('DRFN')
- Duncan's First Nation ('DFN')
- Fort Vermillion Metis Society ('FVMS')
- Horse Lake First Nation ('HLFN')
- Métis Nation of Alberta-Region 6 ('MNA-6')
- Paddle Prairie Métis Settlement ('PPMS')
- Prophet River First Nation ('PRFN')

Dene Tha' First Nation, Duncan First Nation, Doig River First Nation and Metis Nation Region 6 are the only communities that have thus far confirmed an interest in participating in the OMP process (Appendix 2).

7.2.5 Past Activities

NGTL has a long-established relationship with several of the potentially affected communities formalized through community agreements. However, extensive economic development activity draw on already limited capacity, consultation overload, competing priorities, and lack of dedicated resources challenge most Aboriginal communities to meaningfully engage in several aspects of project planning and execution. NGTL has implemented the following action plan with preference for interpersonal interaction (meetings, workshops, field activities) hosted by NGTL and facilitated by external consultants. A summary of Aboriginal consultation activities for the Project is provided in Table 11.

NGTL will maintain strict confidentiality and does not share the information with any other individuals or organizations, unless the owner specifically grants permission to do so. Any detailed information used in the OMP planning process will not be printed on any final maps or reports unless the owner of the information specifically grants permission to do so. The owner of the information has the right to grant or deny access to all information to NGTL.

7.2.6 Action Plan

1. Initial Project Engagement
    a. Expression of interest to engage community
    b. Follow-up call to confirm depth of engagement interests on Project
        i. Community Open House
        ii. Field-based program to observe scientific study methodolgy
        iii. Technical workshop
        iv. Knowledge Holder meetings

2. Offset Measures Plan Engagement: Map-based Review Process
    a. Written request for participation in OMP planning / map mail out
        i. Past engagement activity
        ii. Plans and Priorities
        iii. Timelines
    b. Follow-up call to confirm participation preferences
        i. Mail-in
        ii. Face-to-face Knowledge Holder map review
    c. Individual community map review meetings, as requested
        i. Finalize plans, priorities and timelines

3. Integration of Traditional Knowledge / Community Feedback
    a. Copy and return marked up maps
    b. Written overview of decisions and actions
    c. Notification of concluded engagement

Table 11 Summary of Aboriginal Consultation Activities

Deliverable	Timeline	Status
OMP introduction mail out	June 2013	Complete
Verbal Follow-up	June/July 2013	Complete
Field-based Meetings	July 2013	Complete
OMP Participation request	November 2013	Complete
NEB Filing (Preliminary OMP)	December 2013	Complete
Verbal Follow-up	January 2014	
Knowledge Holder Meetings	December 2013 to March 2014	
Integration into OMP	2014 & 2015	
Written Follow-up Report	2015	
Notification of Conclusion	2015	
NEB Filing (Final OMP)	February 1, 2016	

8.0 REFERENCES

Antoniuk, T., McNeil, L., Nishi, J., and K. Manuel. 2012. Caribou Protection and Recovery Program Technical Guidance. Oil Sands leadership Initiative Land Stewardship Working Group. 84pp.

Australian Government. 2012a. Environmental Protection and Biodiversity Conservation Act Environmental Offset Policy. Department of Sustainability, Environment, Water, Population and Communities, Public Affairs, GPO Box 787 Canberra ACT 2601. http://www.environment.gov.au/resource/epbc-act-environmental-offsets-policy

Australian Government. 2012b. How to Use the Offsets Assessment Guide. Department of Sustainability, Environment, Water, Population and Communities, Public Affairs, GPO Box 787 Canberra ACT 2601. http://www.environment.gov.au/resource/epbc-act-environmental-offsets-policy

BBOP (Business and Biodiversity Offsets Programme). 2012a. Standard on Biodiversity Offsets. BBOP, Washington, D.C. Available from: http://bbop.forest-trends.org/guidelines/Standard.pdf

BBOP. 2012b. Glossary. BBOP, Washington, D.C. Available from: http://www.forest-trends.org/documents/files/doc_3100.pdf

BBOP. 2013. To No Net Loss and Beyond: A Review of the Business and Biodiversity Offset Programme. http://www.forest-trends.org/documents/files/doc_3319.pdf

BC MOE (British Columbia Ministry of Environment). 2011. Implementation plan for the ongoing management of Boreal Caribou (*Rangifer tarandus caribou* pop. 14) in British Columbia. Fort St. John, BC.

BC MOE. 2012. Procedures for Mitigating Impacts on Environmental Values (Environmental Mitigation Procedures), June 11, 2012. Environmental Mitigation Procedures – Final Working Draft. http://www.env.gov.bc.ca/emop/docs/EMProceduresFinalWorkingDraft.pdf

Bentham, P. 2007. Audit of operating practices and mitigation measures employed within caribou ranges. Final report to the Caribou Landscape Management Association (Peace River, Alberta) and Forest Products Association of Canada. Golder Associates. 162 pp.

Bergerud, A.T. 1996. Evolving perspectives on caribou population dynamics, have we got it right yet? *Rangifer, Special Issue* 4: 85 -116.

Bergerud, A.T., and J.P. Elliott. 1986. Dynamics of caribou and wolves in Northern British Columbia. *Canadian Journal of Zoology* 64:1515–1529.

Boutin, S. and C. Arienti. 2008. BCC Equation Reanalysis, Final Report – November 26, 2008. Unpublished Report Prepared for the Alberta Caribou Committee Research and Monitoring Subcommittee by University of Alberta Integrated Land Management Laboratory.

Brovarnick, A., F. Alpizar and C. Schnell. 2010. The Importance of Biodiversity and Ecosystems in Economic Growth and Equity in Latin America and the Caribbean: An economic valuation of ecosystems, United Nations Development Programme.

Brown, P.H. and C.L. Lant. 1999. The effect of wetland mitigation banking on the achievement of no-net-loss. Environmental Management 23:333–45.

Bull, J.W., K.B. Suttle, A. Gordon., N.J. Singh. and E.J. Milner-Gulland. 2013a. Biodiversity offsets in theory and practice. Fauna and Flora International, *Oryx*: 0(0), pp1–12*Clean Water Act*. 1972. US Environmental Protection Agency. http://www.epa.gov/oecaagct/lcwa.html

Bull, J.W., A. Suttle., N.J. Singh and E.J. Milner-Gulland. 2013b. Conservation where nothing stands still: moving targets and biodiversity offsets. *Frontiers in Ecology and the Environment*: 11(4): 203–210

Burrows, L. 2013. Somerset Biodiversity Offsetting Strategy and Methodology. Strategic Planning, Environment Department, Somerset County Council

CBFA (Canadian Boreal Forest Agreement). 2012a. CBFA Caribou Action Planning in Northeastern Alberta: Inputs and Ideas. PowerPoint Presentation.

CBFA. 2012b. Recommendations for, and Voluntary Contributions, towards a Kesagami Range Caribou Action Plan. http://canadianborealforestagreement.com/media-kit/CBFA_NE_Ontario_Recommendations_FullDoc_FINAL.pdf.

Cole, S. 2011. How much is enough? Determining adequate levels of environmental compensation for wind power impacts using equivalency analysis. An illustrated and hypothetical case study of sea eagle impacts at the Smola Wind Farm, Norway. Department of Forest Economics, Umea, Sweden.

Courtois, R., J.P. Ouellet, L. Breton, A. Gingras and C. Dussault. 2007. Effects of forest disturbance on density, space use, and mortality of woodland caribou. *Ecoscience* 14(4):491-498. doi:10.2980/1195-6860(2007)14[491:EOFDOD]2.0.CO;2

Croft, C.D., T. Zimmerling and K. Zimmer. 2011. Conservation Offsets: A Working Framework for Alberta. Alberta Conservation Association. http://www.ab-conservation.com/go/default/assets/File/Publications/ACA%20Conservation%20Offsets%20Framework%20Aug%202011.pdf

DC (Department of Conservation - *Te Papa Atawhai*). 2010. Biodiversity Offsets Programme: A CDRP Funded Research Program: 2009-2012.

DeCesare, N.J., M. Hebblewhite, F. Schmigelow, D. Hervieux, G.J. McDermid, L. Neufeld, M. Bradley, J. Whittington, K.G. Smith, L. Morgantini, M. Wheatley and M. Musiani. 2012. Transcending scale dependence in identifying habitat with resource selection functions. *Ecological Applications* 22(4): 1068-1083.

DEFRA (Department for Environment, Food and Rural Affairs) 2011. Biodiversity Offsetting. Technical paper: proposed metric for the biodiversity pilot in England. London: Department for Environment, Food and Rural Affairs.

DEFRA. 2013. Biodiversity Offsetting in England: Green Paper. London: Department for Environment, Food and Rural Affairs. https://consult.defra.gov.uk/biodiversity/biodiversity_offsetting

Demars, C. (University of Alberta). PhD Student Caribou Biologist, *Personal Communication*: October 22, 2013

Demars, C., C. Theissen and S. Boutin. 2011. Assessing Spatial Factors Affecting Predation Risk to Boreal Caribou Calves: Implications for Management. http://www.scek.ca/sites/default/files/documents/RA-2011-01-Assessing-Spatial-Factors-Affecting-Predation-Risk-Boreal-Caribou-Calves-Dec-1-11.pdf

DFO (Fisheries and Oceans Canada). 1986. The Department of Fisheries and Oceans Policy for the Management of Fish Habitat. http://www.dfo-mpo.gc.ca/habitat/role/141/1415/14155/fhm-policy/pdf/policy-eng.pdf

DFO (Fisheries and Oceans Canada). 2013. Fisheries Protection Policy and Operational Approach. http://www.dfo-mpo.gc.ca/habitat/cg2/pol/index-eng.html

Dyer, S.J., J.P. O'Neill, S.M. Wasel and S. Boutin. 2001. Avoidance of industrial development by woodland caribou. *Journal of Wildlife Management* 65:531-542.

Dyer, S.J., J.P. O'Neill, S. M. Wasel and S. Boutin. 2002. Quantifying barrier effects of roads and seismic lines on movements of female woodland caribou in Northeastern Alberta. Canadian *Journal of Zoology* 80:839-845.

Dyer, S., J. Grant, T. Lesack and W. Weber. 2008. Catching Up: Conservation and Biodiversity Offsets in Alberta's Boreal Forest. Canadian Boreal Initiative. http://www.pembina.org/pub/1650

EC (Environment Canada). 2011. Scientific Assessment to Inform the Identification of Critical Habitat for Woodland Caribou (*Rangifer tarandus caribou*), Boreal Population, in Canada: 2011 Update. Ottawa, Ontario, Canada. 102 pp. plus appendices.

EC. 2012a. Operational Framework for Use of Conservation Allowances. ISSN 978-1-100-21427-6.

EC. 2012b. Recovery Strategy for the Woodland Caribou (*Rangifer tarandus caribou*), Boreal population, in Canada. Species at Risk Act Recovery Strategy Series. Environment Canada, Ottawa. xi + 138pp.

Environmental Law Institute. 2002. Banks and fees: the status of offsite wetland mitigation in the United States. Washington, DC, 202 pp

EPA (Environmental Protection Agency). 2006. Environmental Offsets Position Statement No. 9. Government of Western Australia. http://www.epa.wa.gov.au/docs/1863_PS9.pdf

EPI (Department of Environment and Primary Industries). 2013. Native Vegetation Offsets. http://www.depi.vic.gov.au/environment-and-wildlife/biodiversity/native-vegetation/native-vegetation-permitted-clearing-regulations/native-vegetation-offsets

Gibbons, P. and D.B., Lindenmayer. 2007. Offsets for land clearing: no net losss or the tail wagging the dog. *Ecological Management and Restoration* 8(1): 26-31.

Golder (Golder Associates Ltd.). 2012. Woodland Caribou CAPP State of Science Backgrounder. Presentation January 13, 2012. FRI Caribou Workshop: http://issuu.com/landusekn/docs/bentham?mode=window&viewMode=singlePage

Government of Alberta. 2008. *Alberta Land-Use Framework*. ISBN No. 978-0-7785-7714-0. https://landuse.alberta.ca/LandUse%20Documents/Land-use%20Framework%20-%202008-12.pdf

Government of Alberta. 2009. *Alberta Land Stewardship Act*. Chapter A-26.8, Part 3: Division 4: http://www.qp.alberta.ca/1266.cfm?page=A26P8.cfm&leg_type=Acts&isbncln=9780779773596&display=html

Government of Alberta. 2011. A Woodland Caribou Policy for Alberta. ISBN No. 978-0-7785-9478-9. Pub No. I/524. http://www.srd.alberta.ca/FishWildlife/WildlifeManagement/CaribouManagement/documents/WoodlandCaribouPolicy-Alberta-Jun2011.pdf.

Government of Alberta. 2013. Alberta Wetland Policy. Ahttp://www.waterforlife.alberta.ca/documents/Alberta_Wetland_Policy.pdf

Gustine, D.D., K.L. Parker, R.J. Lay, M.P. Gillingham and D.C. Heard. 2006a. Interpreting resource selection at different scales for woodland caribou in winter. *Journal of Wildlife Management* 70(6):1601-1614.

Gustine, D.D., K.L. Parker, R.J. Lay and M.P. Gillingham. Calf survival of woodland caribou in a multipredator ecosystem. *Wildlife Monographs* 165:1-32.

Gustine, D.D. and K.L. Parker. 2008. Variation in seasonal selection of resources by woodland caribou in Northern British Columbia. Canadian *Journal of Zoology* 86: 812-825.

Habib, T.J., D.R. Farr, R.R. Schneider and S. Boutin. 2013. Economic and ecological outcomes of flexible biodiversity offset systems. Conservation Biology

Hayes, N. and A. Morrison-Saunders. 2007. Effectiveness of environmental offsets in environmental impact assessment: practitioner perspectives from Western Australia*. Impact Assessment and Project Appraisal* 25(3): 209-218.

Hervieux, D. ESRD (Alberta Environment and Sustainable Resource Development). Fisheries and Wildlife Program Manager, *Personal Communication*: December 12, 2012.

James, A.R.C. and A.K. Stuart-Smith. 2000. Distribution of caribou and wolves in relation to linear corridors. *Journal of Wildlife Management* 64:154-159.

James, A.R.C., S. Boutin, D.M. Hebert, A.B. Rippin and J. White. 2004. Spatial separation of caribou from moose and its relation to predation by wolves. *Journal of Wildlife Management 68*(4):799-809.

Kiesecker, J.M., H. Copeland, A. Pocewicz, N. Nibblink, B. McKenney, J. Dahlke, M. Holloran and D. Stroug. 2009. A framework for implementing biodiversity offsets: selecting sites and determining scale. *Bioscience* 1: 77-84.

Latham, A.D.M., M.C. Latham, N.A. McCutchen and S. Boutin. 2011a. Invading white-tailed deer change wolf-caribou dynamics in northeastern Alberta. *Journal of Wildlife Management* 75: 204–212.

Latham, A.D.M., M.C Latham, M.S. Boyce and S. Boutin. 2011b. The Role of Predation in Woodland Caribou Population Declines in Northeastern Alberta – Coyotes: Report prepared for the Alberta Upstream Petroleum Research Fund, Petroleum Technology Alliance of Canada, June 2011.

Madsen, B., N. Carroll, D. Kandy and G. Bennet. 2011. State of Biodiversity Markets Report: Offset and Compensation Programs Worldwide. Forest Trends, Washington, DC, USA. http://www.thegef.org/gef/sites/thegef.org/files/publication/Bio-Markets-2011.pdf

McKenney, B. 2005. Environmental Offset Policies, Principles, and Methods: A Review of Selected Legislative Frameworks. Amherst (NH): Biodiversity Neutral Initiative. http://www.slu.se/Documents/externwebben/ltj-fak-dok/Landskapsarkitektur,%20planering%20och%20f%C3%B6rvaltning/Personal/CV/Jesper%20Persson/Projekt/Litteraturtips/McKenny_Environmental%20Offset.pdf

McKenney, B.A. and J.A. Kiesecker.2010. Policy development for biodiversity offsets: A review of offset frameworks. *Environmental Management* 45:165-176.

McLoughlin, P.D., E. Dzus, B. Wynes and S. Boutin. 2003. Declines in populations of woodland caribou. *Journal of Wildlife Management* 67(4): 755-761.

Moilanen A, A. van Teeffelen, Y. Ben-Haim and S. Ferrier. 2008. How much compensation is enough? A framework for incorporating uncertainty and time discounting when calculating offset ratios for impacted habitat. Restoration Ecology 17:470–478

Morris, R.K.A., I. Alonso, R.G. Jefferson and K.J. Kirby. 2006. The creation of compensatory habitat—can it secure sustainable development? *Journal for Nature Conservation* 14:106–116.

Moyles, D. ESRD (Alberta Environment and Sustainable Resource Development). Fisheries and Wildlife Regional Officer, *Personal Communication*: June 26, 2012.

Nagy, J. 2011. Use of Space by Caribou in Northern Canada. PhD. Thesis. University of Alberta, Edmonton, Alberta. 164p.

Neufeld, L.M. 2006. Spatial Dynamics of Wolves and Woodland Caribou in an Industrial Forest Landscape in West-central Alberta. M.Sc. Thesis. University of Alberta, Edmonton, Alberta.

NSW (New South Wales) Government. 2013. New South Wales Offset Principles for Major Projects (State Significant Development and State Significant Infrastructure). http://www.environment.nsw.gov.au/biocertification/offsets.htm

Polfus, J.L., M. Hebblewhite and K. Heinemeyer. 2011. Identifying indirect habitat loss and avoidance of human infrastructure by northern mountain caribou. *Biological Conservation*: 144: 2637-2646.

Poulton, D. 2013. Alberta's New Wetland Policy as a Conservation Offset System. http://ablawg.ca/wp-content/uploads/2013/09/Blog_DP_Alberta_Wetlands_Policy_September-2013.pdf

Queensland Government 2007. Policy for Vegetation Management Offsets. Queensland Government Natural Resources and Water. 22 pp.

Queensland Government. 2008. Environmental Offsets Policy. http://www.ehp.qld.gov.au/management/planning-guidelines/policies/environmental-offsets/

Quétier, F. and S. Lavorel. 2011. Assessing ecological equivalence in biodiversity offset schemes: key issues and solutions. *Biological Conservation*. (doi:10.1016/j.biocon.2011.09.002.

Rio Tinto. 2008. Rio Tinto's Biodiversity Strategy: Achieving Results on the Ground. Melbourne, Australia, 26 pp. http://www.riotinto.com/documents/ReportsPublications/RTBidoversitystrategyfinal.pdf

Schneider, R. R. 2011. An Integrated Planning Approach for Selecting Conservation Offsets in Northern Alberta. NSERC Chair in Integrated Landscape Management, University of Alberta 8pp.

Seip, D.R. and D.B. Cichowski. 1996. Population ecology of caribou in British Columbia. *Rangifer, Special Issue* 9:73-80.

Smith, K.G., E.J. Ficht, D. Hobson, T.C. Sorensen and D. Hervieux.2000. Winter distribution of woodland caribou in relation to clear-cut logging in West-central Alberta. *Canadian Journal of Zoology* 78:1493-1440.

Sorensen, T., P.D. McLoughlin, D. Hervieux, E. Dzus, J. Nolan, B. Wynes and S. Boutin. 2008. Determining sustainable levels of cumulative effects for boreal caribou. *Journal of Wildlife Management* 72(4): 900-905.

Stantec Inc. (Stantec). 2011. Chinchaga Lateral Loop No. 3 Project: Environmental and Socio-Economic Assessment. Submitted to NOVA Gas Transmission Limited.

Stantec Inc. (Stantec). 2012. Northwest Mainline Komie North Extension Project: Supplement Report on Potential Project Effects on Boreal Caribou. Report Number 123210533, 12351072.

ten Kate, K., J. Bishop and R. Bayon. 2004. Biodiversity Offsets: Views, Experience, and the Business Case. Gland (Switzerland): IUCN and Insight Investment. http://www.epa.gov/owow/wetlands/pdf/Biodiversity_Offsets_Report.pdf

Vors, L.S., J.A. Schaefer, B.A. Pomd, A.R. Rodgers and B.R. Patterson. 2007. Woodland caribou extirpation and anthropogenic landscape disturbance in Ontario. *Journal of Wildlife Management* 71(4): 8 pp

WA (Western Australia) Government. 2011. Western Australian Government's Environmental Offsets Policy. http://www.epa.wa.gov.au/EPADocLib/WAEnvOffsetsPolicy-270911.pdf

Weber, M. 2011. Experimental Economic Evaluation of Offset Design Options for Alberta: A Summary of Results and Policy Recommendations. Prepared for the Alberta Land Use Secretariat.

Whittington, J., M. Hebblewhite., N.J. DeCesare, L. Neufeld, M. Bradley, J. Wilmshurst and M. Musiani. 2011. Caribou encounters with wolves increase near roads and trails: a time-to-event approach. *Journal of Applied Ecology*, no-no. doi:10.1111/j.1365-2664.2011.02043.

Appendix 1 Regulatory Consultation

Community	Date	Communication Method	Community Contacts	Team Members	Communication Summary	Requirement / Change Request	Section in OMP or Other
Environment Canada (EC); Alberta Environment Sustainable Resource Development (ESRD)	4/9/2013 1:00 PM	E-mail (Sent)	Andrew Robinson, Paul Gregoire	Dana Charlton (TransCanada)	Dana Charlton of NGTL emailed to Paul Gregoire and Andrew Robinson of Environment Canada, and Dave Hervieux of Alberta Environment and Sustainable Resource Development, an update, indicating that the National Energy Board has approved (with conditions) NGTL's revised Preliminary Offset Measures Plan (OMP) for Leismer. • Charlton provided a link to the plan on the NEB's website. Charlton indicated NGTL would like to discuss these plans with the agencies and requested an indication of availability to meet.	Update provided.	Final OMP and CHROMMP will be submitted for regulatory review and feedback.
Alberta Environment Sustainable Resource Development (ESRD)	6/10/2013 12:00 AM	Telephone (Made)	Dave Hervieux (ESRD), Fisheries and Wildlife Program Manager, Caribou)	Rebekah Janzen (TransCanada)	Rebekah Janzen of NGTL contacted Dave Hervieux of ESRD regarding NGTL's continued work on developing the Final OMP. 1) Hervieux indicated he is not entirely supportive of the concept of range utility, and is much more focused on replanting; however, he did mention a suite of other items such as access management (coarse woody debris, tree felling, mounding) that he thinks are effective, which are included as options in NGTL's current plan. 2) Hervieux also is supportive of habitat restoration work and access management work on existing/active pipeline ROWs. Janzen mentioned the June 7, 2013 phone call between NGTL's Christine Nicholls and ESRD's Bob Yowney, wherein Yowney indicated seismic lines and old roads were off the table. Hervieux's response was that this issue needed further discussion. 3) There was discussion specifically about looking for candidate sites, and Hervieux suggested that NGTL roughly circle an area within the range,	NGTL has incorporated both replanting strategies and access management strategies that address ecological mechanisms associated with spatial and temporal considerations of range utility (i.e., replanting for future forest state is a long term temporal goal of range utility) (Comment 1 and 2). NGTL is working with Provincial Authorities and Aboriginal Communities to identity preferred offset locations. Preferred offset locations will be identified in the Final OMP and CHROMMP (Comment 3 and 4).	Refer to Section 2.2 6.5 (Figure 3) regarding ecological mechanisms of concern and offset selection criteria respectively. Refer to Final OMP and CHROMMP for offset locations and proposed monitoring.

Community	Date	Communication Method	Community Contacts	Team Members	Communication Summary	Requirement / Change Request	Section in OMP or Other
					include what NGTL proposes to do for habitat restoration, and also the nature of features NGTL are hoping to treat. This would initiate a discussion between himself, NGTL, and the managers of the project areas. 4) Hervieux also mentioned that a few companies are doing work on old ice roads, dry weather roads, active pipelines, and seismic lines, Hervieux he did indicate that NGTL would get a provincial disposition for the work. Hervieux stated that in order to get a disposition, NGTL would need approval for the proposed works.		
Alberta Environment Sustainable Resource Development (ESRD)	6/26/2013 11:00 AM	Meeting	Dave Moyles (ESRD Biologist), Don Williams (Forest Officer)	Lisa May (TransCanada), Tony Epp (TransCanada), Alex Creagh, (Consultant)	Lisa May (NGTL), Tony Epp (NGTL) and Alex Creagh (Consultant) met with Dave Moyles (ESRD Biologist) and Don Williams (ESRD Forest Officer) (Austin Babb and Chase Davies, Forest Officers were on the phone) in Peace River ESRD office to introduce and discuss the NGTL Caribou Habitat Restoration Plan (CHRP) and Offset Measures Plan (OMP). • The concept of "like for like" restoration as well as other potential restoration techniques such as line of sight and mounding were introduced as components of the CHRP and OMP. NGTL introduced the preliminary strategy for the OMP and lands off the project ROW that may be candidate sites. • NGTL asked Dave Moyles and Don Williams if there were priority areas within the Chinchaga caribou range that they would like to see NGTL target for restoration activities. • NGTL also asked Don Williams about the process of looking for offset opportunities on other companies dispositions and if there could be some type of protective notation for areas that were planted for offsets. • NGTL also asked Dave Moyles if there was a	NGTL has incorporated like-for-like habitat restoration as the primary offset focus including human access and predator movement mitigations (Comment 1). NGTL is working with Provincial Authorities to identity preferred offset locations. Refer to Final OMP and CHROMMP for offset locations and proposed monitoring (Comment 2).	Refer to Section 2.2 and 6.5 (Figure 3) regarding ecological mechanisms of concern and offset selection criteria respectively. Refer to Final OMP and CHROMMP for offset locations and proposed monitoring.

Community	Date	Communication Method	Community Contacts	Team Members	Communication Summary	Requirement / Change Request	Section in OMP or Other
					range plan being developed for the Chinchaga herd and if he knew of areas the caribou liked to go to or move through. 1) Dave Moyles like the "like for like" restoration approach for the CHRP and OMP. He would like to see projects erase the footprints as much as possible in caribou range. He would also like to see a reduction in access and the ease of access for human and predator movement. Range plans haven't been started for the Chinchaga caribou herd and as such there were no identified priority areas to date. 2) Don Williams stated there may be issues with trying to plant trees or increase line of sight barriers on other dispositions. It was his understanding that the Public Lands department in Edmonton was aware of the NGTL proposal to conduct offsets on other dispositions and was going to wait until he heard more back before he would provide recommendations.		
Alberta Environment Sustainable Resource Development (ESRD)	7/17/2013 4:00 PM	E-mail (Sent)	David Hervieux	Rebekah Janzen (TransCanada)	NGTL's Rebekah Janzen contacted ESRD's Dave Hervieux. As per Hervieux's request in a previous phone call, Janzen attached maps of three NGTL projects, with a 20 km circle drawn around them, which is the focus of NGTL's search for candidate sites for placement of offset measures. Janzen's two requests to Hervieux were outlined: • Assistance in identifying candidate sites for placement of offset measures. • Review and provide comments on the Preliminary OMPs, particularly Section 4 regarding the calculations and rationale for the development of the ratios, and the discount and delay factors for mitigation measures. • Janzen elaborated that NGTL is asking for Hervieux's assistance in identifying existing areas	Update to ESRD, no response provided by ESRD. NGTL is working with Provincial Authorities and Aboriginal Communities to identity preferred offset locations. Preferred offset locations will be identified in the Final OMP and CHROMMP.	Refer to Final OMP and CHROMMP for offset locations and proposed monitoring.

Community	Date	Communication Method	Community Contacts	Team Members	Communication Summary	Requirement / Change Request	Section in OMP or Other
					adjacent to NGTL's projects that would be suitable for this purpose. TransCanada's preference is to make use of old ice roads, dry weather roads, active pipelines, seismic lines, and other anthropogenic disturbances, in the region of our projects preferably, to conduct offset measures similar to the caribou habitat restoration measures, access control measures, and line-of-sight blocking measures proposed for the Project ROWs. Some measures such as rollback would be a less available option on an existing disturbance, and therefore berms, mounding or tree-felling may be considered for access management. • NGTL's preference would be to identify areas within the circled portion of the maps (approximately 20 kms from the pipeline footprints) for offset measures implementation, however NGTL is open to conducting offset measures elsewhere to ensure we align with the province's priorities for caribou.		
Environment Canada (EC)	8/1/2013 8:00 AM	E-mail (Sent)	Andrew Robinson, Paul Gregoire	Rebekah Janzen (TransCanada)	NGTL's Mike Wilfley emailed Paul Gregoire and Andrew Robinson to provide an update on the development of the OMP and an invitation to complete a questionnaire on offset measures. • Wilfley provided maps of the projects, with a 20 km radial ellipse drawn around them, which indicates the area of focus regarding candidate sites search area for offset measure implementation. A request was recently made to ESRD to provide assistance in determining suitable offset locations for NGTL to utilize for off-set measures. • In addition, a request was made to ESRD to provide comments and feedback regarding the Preliminary OMPs. Along with the request for optimum off-set measure locations, ESRD has been asked to provide comments regarding the off-	Update to EC provided. NGTL is working with Provincial Authorities and Aboriginal Communities to identity preferred offset locations. Preferred offset locations will be identified in the Final OMP and CHROMMP.	Refer to Final OMP and CHROMMP for offset locations and proposed monitoring.

Community	Date	Communication Method	Community Contacts	Team Members	Communication Summary	Requirement / Change Request	Section in OMP or Other
					set multiplier (or ratio) conceptual model that NGTL has introduced as a way of establishing the project residual effect area (i.e., the size of the area that requires off-set measures). • Environment Canada's views regarding NGTL's off-set multiplier model are also requested. EC was asked to provide feedback on the off-set multiplier model (or any other aspect of the attached OMPs).		
National Energy Board (NEB)	9/11/13 11:00 AM	NEB feedback "Review of Chinchaga Lateral Loop No. 3 Preliminary CHRP (Condition 10(a)) - filed with NEB on 18 July 2013	NEB	NGTL	Items to be Addressed Elsewhere (OMP, CHROMMP) 1) How will uncertainty in restoration success over time (in the CHRP) be accounted for in the OMP and CHROMMP? 2) How will adaptive management be built in? For example, when would additional measures be put into place (e.g., after one year of not meeting a restoration target? two years?) 3) How long would a restoration target remain unmet before it is offset in the OMP? 4) Where restoration targets are conservative, how will the unrestored portion be offset and monitored? 5) Provide a clear, detailed reproducible methodology for future literature reviews, particularly for the OMP (i.e., identifying search engines, search terms [key words], etc.). 6) Provide concordance table or similar mechanism for tracking how each comment made by a regulator (including the NEB) regarding a particular document (i.e., OMP, CHROMMP) has been addressed in future versions of the document or an explanation/justification for those that were not included.	Offset uncertainty will be addressed through the application of spatial and/or temporal multiplier ratios and adaptive management. Additional measures may be required for not meeting restoration targets. Monitoring timeframes and unsuccessful restoration portions will be discussed in the Final OMP and CHROMMP (Comment 1, 2, 3 and 4). Rational and methodology for literature reviews concerning offsets are discussed in Section 2.0 of this document (Comment 5). Concordance tables have been developed as part of both regulatory and aboriginal engagement summaries in Appendix 1 and 2 (Comment 6).	Spatial and temporal multiplier ratios are presented in Section 2.1 and Section 6.5. Refer to Final OMP and the CHROMMP for monitoring timeframes and unsuccessful restoration mitigations. Literature reviews and keyword(s) and search engines are discussed in Section 2.0. Concordance tables for both regulatory and aboriginal engagement in Appendix 1 and 2.
Environment Canada (EC)	12/12/13	Email (sent)	Paul Gregoire (EC), Dave	Lisa May (TransCanada)	Draft Final Offset Measures Plan was sent to EC and ESRD for review and comment.		

Community	Date	Communication Method	Community Contacts	Team Members	Communication Summary	Requirement / Change Request	Section in OMP or Other
and Alberta Environment Sustainable Resource Development (ESRD)			Moyles (ESRD Biologist), David Hervieux (ESRD)				
Environment Canada (EC)	16/12/13	Telephone (made)	Paul Gregoire	Lisa May (TransCanada)	Called Mr. Gregoire to inquire whether he had any questions or comments regarding the draft OMP. Mr. Gregoire stated he had not read the document but would communicate any comments or questions at a later date.		
Alberta Environment Sustainable Resource Development (ESRD)	16/12/13	Telephone (made)	Dave Moyles	Lisa May (TransCanada)	Left a message with Dave Moyles to inquire whether he had any questions or comments regarding the draft OMP.		
Environment Canada (EC)	17/12/13	Email (received)	Paul Gregoire	Lisa May (TransCanada)	Mr. Gregoire requested further information regarding the direct habitat disturbance, the amount of the ROW that will be restored or left for natural regeneration and how much of the ROW could not be restored for integrity reasons.		
Environment Canada (EC)	17/12/13	Email (received)	Paul Gregoire	Lisa May (TransCanada)	Mr. Gregoire requested confirmation that Mr. Dave Moyles comments regarding the Preliminary CHRP provided in April 2013 had been addressed by TransCanada.		
Environment Canada (EC)	18/12/13	Telephone (received)	Paul Gregoire	Lisa May (TransCanada)	Mr. Gregoire inquired about the schedule of the Chinchaga project.		
Environment Canada (EC)	18/12/13	Email (sent)	Paul Gregoire	Lisa May (TransCanada)	Lisa May sent Mr. Gregoire an email response as addressing his requests for further information. Details of the email were as follows: • The Chinchaga project is currently being constructed. • Many of the reclamation/restoration decisions for		

Community	Date	Communication Method	Community Contacts	Team Members	Communication Summary	Requirement / Change Request	Section in OMP or Other
					caribou habitat mitigation will be assessed this summer and physical measures will be implemented in the winter of 2014 during final clean-up and planting will follow in the summer of 2015. TransCanada delays committing to site specific restoration plans until after construction so we can assess the landscape following clearing, grading and rough clean-up. • Representatives from TransCanada have had the opportunity to discuss many of the Caribou Habitat Restoration measures with Dave Moyles in response to his comments to the preliminary CHRP forwarded this spring. Mr. Moyles was not aware of the extent of the pre filing assessments and TransCanada was able to provide him with the information and links to the reports that were prepared as part of the NEB application. TransCanada and Mr. Moyles also discussed some of the restoration options and expressed interest in consulting Mr. Moyles with respect to our plans when the time comes. TransCanada is aware of the access management challenges presented for this project due to the adjacent pipelines and powerline but believes that there is an opportunity to develop meaningful options. TransCanada's construction team has been able to retain a substantial amount of wood for rollback and are actively looking for opportunities in the field to save and snow mound existing vegetation along road crossings. Below are the responses to the direct questions regarding the preliminary OMP. 1. The total project habitat disturbance is 169		

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					Ha from project surveys. After construction, TCPL will qualify the total disturbance for the ROW, TWS, ect through as-builts. This will be updated in the Final OMP (Offset Measures Plan) for the required offset as discussed within the Preliminary CHRP/OMP. 2. The Final CHRP (Caribou Habitat Restoration Project) will provide details on the site specific type and portion of footprint restored, including prescriptive planting, minimum disturbance construction and natural regeneration. Reclamation specialists will be assessing this after construction and during the development of the Final CHRP. 3. Very recent developments (December 2013) by TCPL have included proposed revisions to TransCanada Operating Practices in Caribou Range. We are proposing to be able to plant designed vegetative barriers over operating pipelines to close in the 6-10 m area in approved areas which have previously been required to be left open for inspection and access purposes. We are still developing this TransCanada Operating Practice (TOPs) and need it to be approved before we can adopt for calculations of remaining residual effects. We have qualified this in the Preliminary CHRP/OMP in that remaining residual effect hectares are subject to change for the Final CHRP/OMP to accommodate potential changes to TOPs as a continuous improvement initiative – we haven't had this approved to date but hope that it will be early next year. 4. We need to review the as-built post-construction to provide a more accurate assessment of the hectares (area), particularly for portions of vegetation prescriptions, physical mitigations (coarse woody debris), minimum disturbance construction practices and natural regeneration (as defined in comments above).		

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Environment Canada (EC)	20/12/13	Email (received)	Paul Gregoire	Lisa May (TransCanada)	Environment Canada's comments on the Preliminary OMP are as follows. Commentary: 1. In Page 2-6 and 6-9 of the report the proponent discusses indirect offsets in the form of Research and Monitoring Programs or other Financial Mechanisms. The estimated population size for the Chinchaga population is 250 animals and is declining and deemed not self-sustaining (Boreal Caribou Recovery Strategy). Only 24 percent of the habitat is undisturbed. For all populations with less than 65 percent undisturbed habitat all remaining habitat is considered potential critical habitat unless otherwise identified in a range plan or equivalent evidence. The predicament for the Chinchaga caribou is time sensitive. Although research and monitoring, and other means are important they should not be considered as part of any offset measures for this population. Offsets should be habitat offsets. Critical habitat is habitat necessary for the survival or recovery of the species and should not be destroyed. The final determination on whether critical habitat was destroyed will be made in a Provincial Range Plan, which has yet to be released. It is imperative that all development adhere to the Recovery Strategy goals and objectives. Project review documentation needs to be clear on how boreal caribou critical habitat is being protected and demonstrate, with the support of necessary provincial evidence, that the project will not: • compromise the ability of a range to be maintained at 65% undisturbed habitat; • compromise the ability of a range to be restored to 65% undisturbed habitat;		

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					• reduce connectivity within a range; • increase predator and/or alternate prey access to undisturbed areas; • or remove or alter biophysical attributes necessary for boreal caribou. 2. EC notes that the proponent has created a model to assess the effects to caribou and to calculate an offset number in hectares. The model is new and, in spite of the survey, the criteria for inherent residual effect, effectiveness, delay penalty, residual calculation, etc., have not been adopted by wildlife management agencies (Tables 8-10). Therefore EC does not endorse the use of this model. EC notes that the estimated direct disturbance is 169.8 ha. EC requests the proponent provide the hectares that will be restored on the right-of-way, the hectares on the ROW that will be left to natural regeneration, and the hectares of direct (non-modeled) residual habitat disturbance (e.g. including but not limited to the 6-10m ROW that must be maintained). EC maintains that a 4:1 offset ratio for residual habitat disturbance/loss is the minimum appropriate for this population to address effectiveness, delay and the threatened status of this population. 3. EC acknowledges in the proponent's Preliminary Caribou Habitat Restoration Plan, where it is determined after 5 years following commencement of operation that habitat restoration is underperforming and will not reach predetermined goals/trajectory in a timely fashion, that this additional residual disturbance will be added to the total residual habitat disturbance for the purposes of the offsets plan.		

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					4. The approach for the Offset Selection Criteria, Section 6.5, appears reasonable, save for the above noted concern with indirect offsets. EC looks forward to reviewing the final Offset Measures Plan.		

Appendix 2 Aboriginal Engagement

Aboriginal Community	Engagement Activity to Date	Community Feedback	Requirement / Change Request	Section in OMP or Other
BFN	• Letter sent on June 13, 2013 providing an explanation of the OMP condition and expressing interest in community participation and comment on the development of the plan and an invitation to participate in a site visit. • A registered letter was sent on November 28, 2013 with a summary of the Offset Measures concept and the strategy for the OMP, including proposed timelines and milestone dates for the preliminary and final OMP. An invitation to participate in a detailed map review process or the option to provide mark ups to a map and return in to NGTL for incorporation into the Project OMP. Included in the mail out package was two poster sized maps outlining the Chinchaga caribou range with return postage.	• BFN has expressed they do not have a key land representative to coordinate OMP workshops with NGTL. NGTL will continue to provide OMP updates and opportunities to provide input. BFN did not respond to the invitation to participate in the site visit.	Updates will be provided upon filing the Preliminary OMP.	Updates will be provided upon filing the Preliminary OMP
DTFN	• Letter sent on June 13, 2013 providing an explanation of the OMP condition and expressing interest in community participation and comment on the development of the plan and an invitation to participate in a site visit. • NGTL organized a field visit for July 15, 2013. As part of NGTL's planning activities for the OMP there was an opportunity for the DTFN participants to observe wildlife biologist during the Caribou Habitat field survey. The field visit was an opportunity for an interactive discussion for participants to ask questions or comment on the caribou habitat assessment and OMP planning. • NGTL contacted DTFN to confirm that their proposal for a third part review had been accepted and proposed various dates for further discussion regarding the OMP. NGTL organized a workshop to discuss OMP development was help on Oct. 9, 2013 in High Level. • A registered letter was sent on November 28, 2013 with a summary of the Offset Measures concept and the strategy for the OMP, including proposed timelines and milestone	DTFN sent a participant to the site visit. Participant input included • Focusing restoration efforts on lands disturbed by Project construction, including temporary workspaces, the Project right-of-way (approximately 32 m wide) as well as the existing, adjacent right-of-way to the Project (NGTL ROW approximately 10-20 m wide) rather than offsite restoration at locations such as abandoned wellsites or seismic clearings. • If seismic lines were open, they were likely used by trappers and should remain open. 1) DTFN participant feedback during the OMP workshop included monitoring of offsets and restoration efforts, agreement with the "like for like" offset concept and requested further information about financial offset mechanisms.	NGTL is working with Provincial Authorities and Aboriginal Communities to identity preferred offset locations. Preferred offset locations will be identified in the Final OMP and CHROMMP. Offset measures are primarily focused on like-for-like ecological mechanisms. Updates will be provided upon filing the Preliminary OMP (Comment 1).	Refer to Section 2.0 for selection of like-for-like offset measures. Refer to Final OMP and CHROMMP for offset locations and proposed monitoring.

Aboriginal Community	Engagement Activity to Date	Community Feedback	Requirement / Change Request	Section in OMP or Other
	dates for the preliminary and final OMP. An invitation to participated in a detailed map review process or the option to provide mark ups to a map and return in to NGTL for incorporation into the Project OMP. Included in the mail out package was two poster sized maps outlining the Chinchaga caribou range with return postage.			
DFRN	• Letter sent on June 13, 2013 providing an explanation of the OMP condition and expressing interest in community participation and comment on the development of the plan and an invitation to participate in a site visit. • NGTL organized a field visit for July 15, 2013. As part of NGTL's planning activities for the Offset Measures Plan (OMP) there was an opportunity for the DFRN participants to observe wildlife biologist during the Caribou Habitat field survey. The field visit was an opportunity for an interactive discussion for participants to ask questions or comment on the caribou habitat assessment and OMP planning. • NGTL will schedule an OMP meeting to meet the interest DFRN expressed.	DRFN was unable to attend the July 15, 2013 field site visit. However, they have agreed to participate in caribou habitat planning activities in the near future. • NGTL received an email from DRFN on Oct. 31, 2013 confirming that the community would like to discuss the OMP at the end of 2013 or in the New Year.	Updates will be provided upon filing the Preliminary OMP and follow-up for meetings concerning offsets and the Final OMP in 2014.	Refer to Final OMP and CHROMMP for offset locations and proposed monitoring.

Aboriginal Community	Engagement Activity to Date	Community Feedback	Requirement / Change Request	Section in OMP or Other
DFN	• Letter sent on June 13, 2013 providing an explanation of the OMP condition and expressing interest in community participation and comment on the development of the plan and an invitation to participate in a site visit. • NGTL organized a field visit for July 15, 2013. As part of NGTL's planning activities for the Offset Measures Plan (OMP) there was an opportunity for the DFN participants to observe wildlife biologist during the Caribou Habitat field survey. The field visit was an opportunity for an interactive discussion for participants to ask questions or comment on the caribou habitat assessment and OMP planning. • A registered letter was sent on November 28, 2013 with a summary of the Offset Measures concept and the strategy for the OMP, including proposed timelines and milestone dates for the preliminary and final OMP. An invitation to participated in a detailed map review process or the option to provide mark ups to a map and return in to NGTL for incorporation into the Project OMP. Included in the mail out package was two poster sized maps outlining the Chinchaga caribou range with return postage.	DFN sent a participant to the site visit. Participant input included • Focusing restoration efforts on lands disturbed by Project construction, including temporary workspaces, the Project right-of-way (approximately 32 m wide) as well as the existing, adjacent right-of-way to the Project (NGTL ROW approximately 10-20 m wide) rather than offsite restoration at locations such as abandoned wellsites or seismic clearings. • If seismic lines were open, they were likely used by trappers and should remain open.	NGTL is working with Provincial Authorities and Aboriginal Communities to identity preferred offset locations. Preferred offset locations will be identified in the Final OMP and CHROMMP.	Refer to Final OMP and CHROMMP for offset locations and proposed monitoring.
MNA-Region 6 Local 74	• Letter sent on June 13, 2013 providing an explanation of the OMP condition and expressing interest in community participation and comment on the development of the plan and an invitation to participate in a site visit. • NGTL organized a field visit for July 15, 2013. As part of NGTL's planning activities for the OMP there was an opportunity for the DFN participants to observe wildlife biologist during the Caribou Habitat field survey. The field visit was an opportunity for an interactive discussion for participants to ask questions or comment on the caribou habitat assessment and OMP planning. • NGTL and a MNA-Region 6 technical advisor worked together to coordinate an OMP meeting for locals and members in early October. A registered letter was sent on November 28, 2013 with a summary of the Offset Measures concept and the strategy for the OMP, including	MNA-Region 6 sent a participant to the site visit. . Participant input included • Focusing restoration efforts on lands disturbed by Project construction, including temporary workspaces, the Project right-of-way (approximately 32 m wide) as well as the existing, adjacent right-of-way to the Project (NGTL ROW approximately 10-20 m wide) rather than offsite restoration at locations such as abandoned wellsites or seismic clearings. • If seismic lines were open, they were likely used by trappers and should remain open.. MNA-Region 6 participated in an OMP workshop on Oct. 10, 2013. The participant feedback included: • Caribou awareness sessions for locals to	NGTL is working with Provincial Authorities and Aboriginal Communities to identity preferred offset locations. Preferred offset locations will be identified in the Final OMP and CHROMMP. Offset measures are primarily focused on like-for-like ecological mechanisms. Updates will be provided upon filing the Preliminary OMP.	Refer to Section 2.0 for selection of like-for-like offset measures. Refer to Final OMP and CHROMMP for offset locations and proposed monitoring.

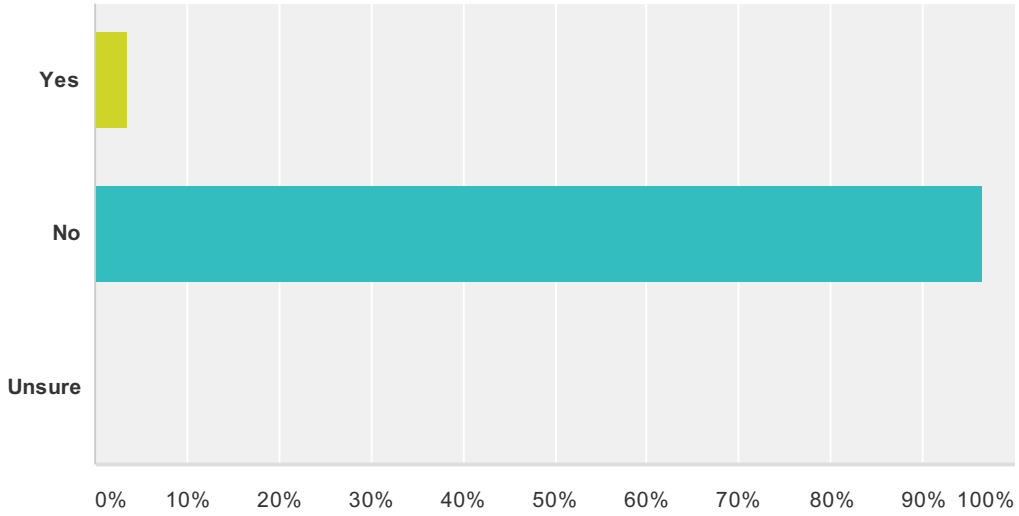
Aboriginal Community	Engagement Activity to Date	Community Feedback	Requirement / Change Request	Section in OMP or Other
	proposed timelines and milestone dates for the preliminary and final OMP. An invitation to participated in a detailed map review process or the option to provide mark ups to a map and return in to NGTL for incorporation into the Project OMP. Included in the mail out package was two poster sized maps outlining the Chinchaga caribou range with return postage.	enable them to help track location of caribou; • Identified areas of caribou sightings on a map; • Expressed concern with predation of wolves and grizzly bears; • Suggested control of access for quads; • Expressed concern with the level of consultation from the province on caribou range planning; and • Suggested NGTL consider reviewing BC tools The MNA-Region 6 technical advisor submitted a proposed OMP workplan and budget that NGTL subsequently approved.		
HLFN	• Letter sent on June 13, 2013 providing an explanation of the OMP condition and expressing interest in community participation and comment on the development of the plan and an invitation to participate in a site visit. • A registered letter was sent on November 28, 2013 with a summary of the Offset Measures concept and the strategy for the OMP, including proposed timelines and milestone dates for the preliminary and final OMP. An invitation to participated in a detailed map review process or the option to provide mark ups to a map and return in to NGTL for incorporation into the Project OMP. Included in the mail out package was two poster sized maps outlining the Chinchaga caribou range with return postage.			
PPMS	• Letter sent on June 13, 2013 providing an explanation of the OMP condition and expressing interest in community participation and comment on the development of the plan and an invitation to participate in a site visit. • A registered letter was sent on November 28, 2013 with a summary of the Offset Measures concept and the strategy for the OMP, including proposed timelines and milestone dates for the preliminary and final OMP. An invitation to participated in a detailed map review process or the option			

Aboriginal Community	Engagement Activity to Date	Community Feedback	Requirement / Change Request	Section in OMP or Other
	to provide mark ups to a map and return in to NGTL for incorporation into the Project OMP. Included in the mail out package was two poster sized maps outlining the Chinchaga caribou range with return postage.			
FVMS	• Letter sent on June 13, 2013 providing an explanation of the OMP condition and expressing interest in community participation and comment on the development of the plan and an invitation to participate in a site visit. • A registered letter was sent on November 28, 2013 with a summary of the Offset Measures concept and the strategy for the OMP, including proposed timelines and milestone dates for the preliminary and final OMP. An invitation to participated in a detailed map review process or the option to provide mark ups to a map and return in to NGTL for incorporation into the Project OMP. Included in the mail out package was two poster sized maps outlining the Chinchaga caribou range with return postage.			
PFRN	• Due to the proximity to the project PFRN haven't expressed interest in participating in the engagement activities for the Project to date.			

Appendix 2 Questionnaire Survey

Q1 Caribou Population Response - Forage Supply Is forage supply (i.e., lichen) generally considered a limiting factor to woodland caribou at the Range Scale?

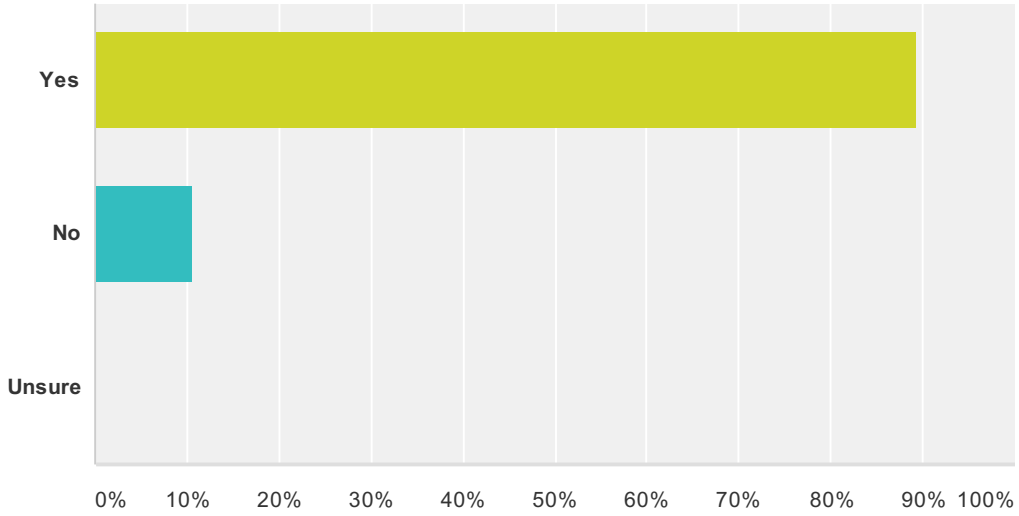
Answered: 28 Skipped: 0



Answer Choices	Responses	
Yes	**3.57%**	1
No	**96.43%**	27
Unsure	**0.00%**	0
Total		**28**

Q2 Caribou Population Response - Forage Supply Is the Project Effect on forage supply (i.e., lichen) generally considered minor or negligible at the Range Scale?

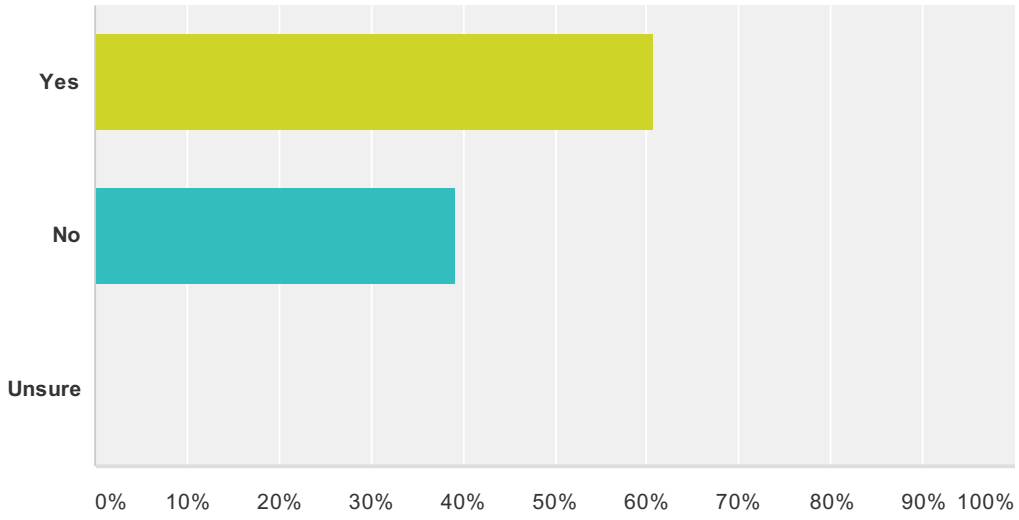
Answered: 28 Skipped: 0



Answer Choices	Responses	
Yes	**89.29%**	25
No	**10.71%**	3
Unsure	**0.00%**	0
Total		**28**

Q3 Primary Prey Population Response - Forage Supply Is the increase in primary prey forage supply contributed by the Project generally considered minor or negligible at the Range Scale?

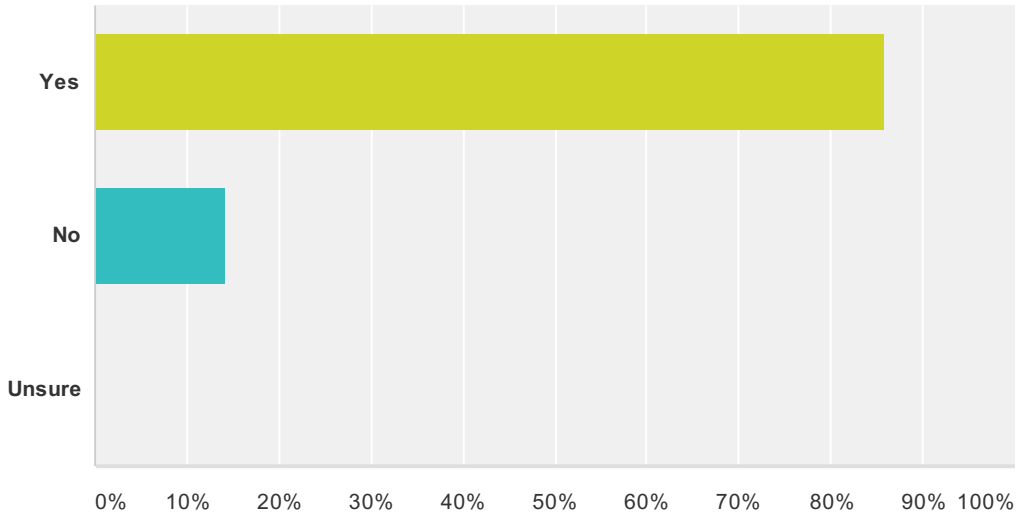
Answered: 28 Skipped: 0



Answer Choices	Responses	
Yes	**60.71%**	17
No	**39.29%**	11
Unsure	**0.00%**	0
Total		**28**

Q4 Future Habitat State - Forage Supply Can attention to site preparation or replanting strategies address long-term cumulative effects associated with forage supply risk at the Range Scale?

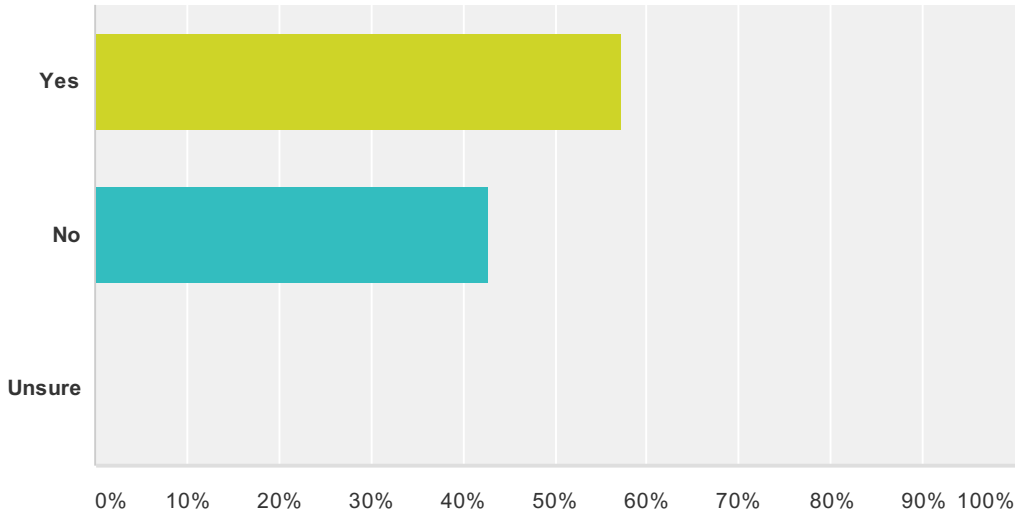
Answered: 28 Skipped: 0



Answer Choices	Responses	
Yes	**85.71%**	24
No	**14.29%**	4
Unsure	**0.00%**	0
Total		**28**

Q5 Caribou Population Response - Avoidance Caribou avoid linear disturbance at varying degrees, but do not appear to abandon their range. Is there a mechanism by which cumulative avoidance directly results in higher mortality rates or reduced fecundity at the Range Scale?

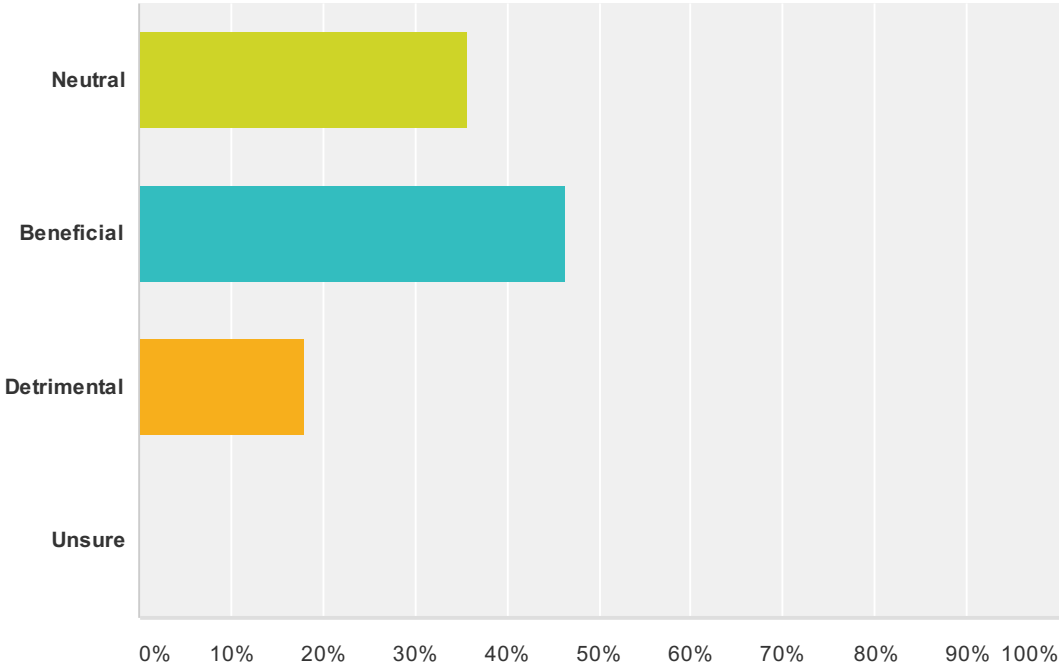
Answered: 28 Skipped: 0



Answer Choices	Responses	
Yes	**57.14%**	16
No	**42.86%**	12
Unsure	**0.00%**	0
Total		**28**

Q6 Caribou Population Response - Avoidance Caribou avoid linear disturbance to varying degrees. Is this beneficial or detrimental given current predator densities at the Range Scale?

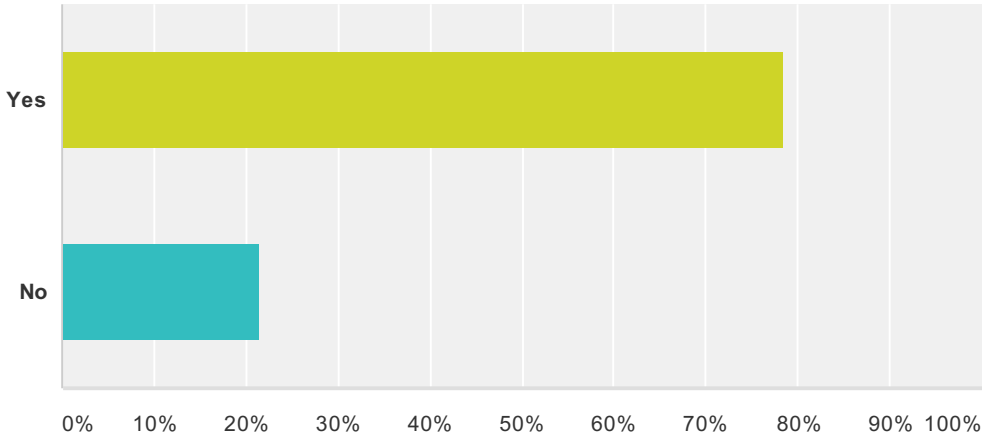
Answered: 28 Skipped: 0



Answer Choices	Responses	
Neutral	**35.71%**	10
Beneficial	**46.43%**	13
Detrimental	**17.86%**	5
Unsure	**0.00%**	0
Total		**28**

Q7 Primary Prey/Predator Population Response The ecological mechanisms associated with the range habitat condition (presumed altered by some function of anthropogenic disturbance and fire) include: ease of movement, speed of travel, direct traverse of habitat, increased line-of-sight, frequency of encounter (predator/prey and prey/forage), larger actualized range area (predator/prey), and increased insolation at ground level. These ultimately result in higher primary prey and predator populations at the Range Scale. Is this your current understanding of primary prey and predator population response to range condition?

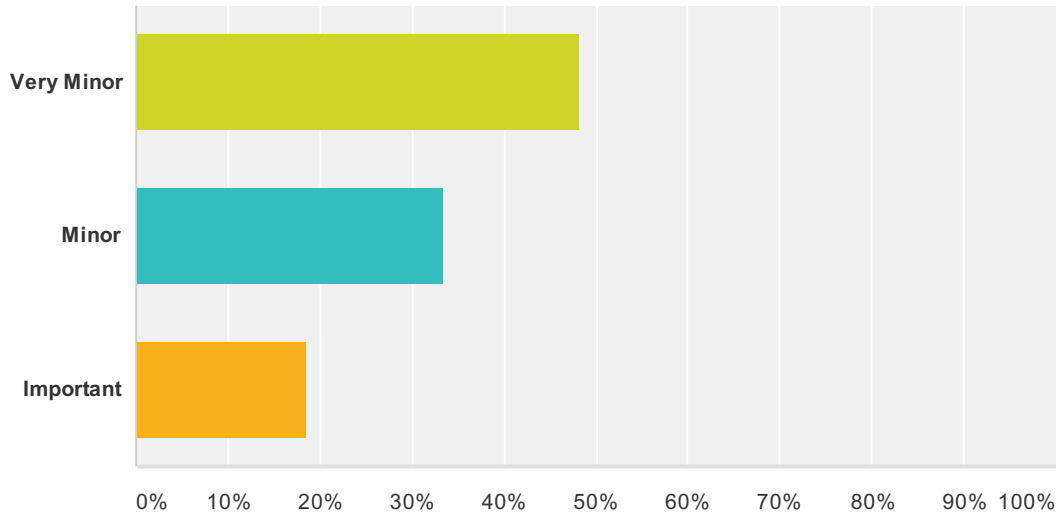
Answered: 28 Skipped: 0



Answer Choices	Responses	
Yes	**78.57%**	22
No	**21.43%**	6
Total		**28**

Q8 Forage Supply How important is Project mitigation to address lichen distribution and quantity at the Site Scale? (i.e., on-easement)

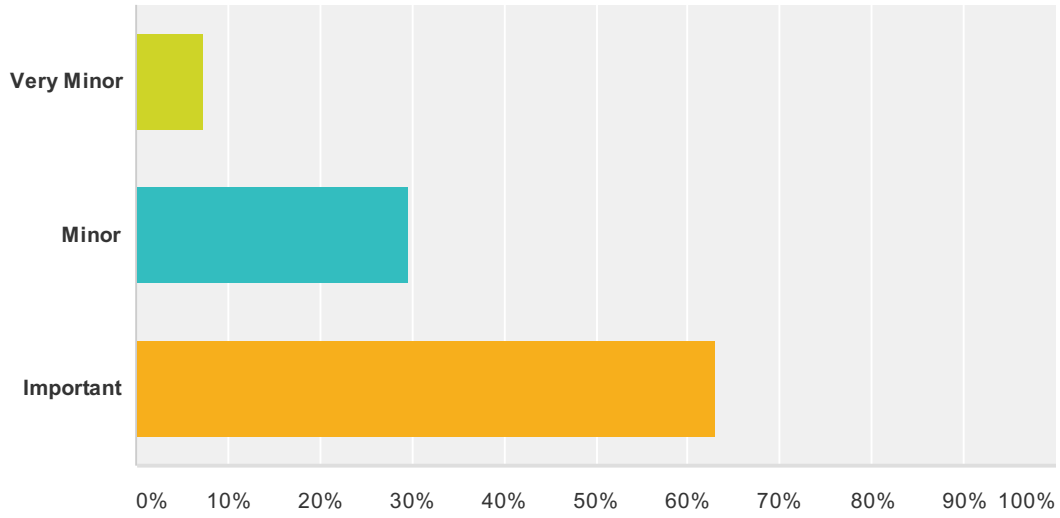
Answered: 27 Skipped: 1



Answer Choices	Responses	
Very Minor	**48.15%**	13
Minor	**33.33%**	9
Important	**18.52%**	5
Total		**27**

Q9 Forage Supply How important is Project mitigation to address primary prey forage at the Site Scale? (i.e., on-easement)

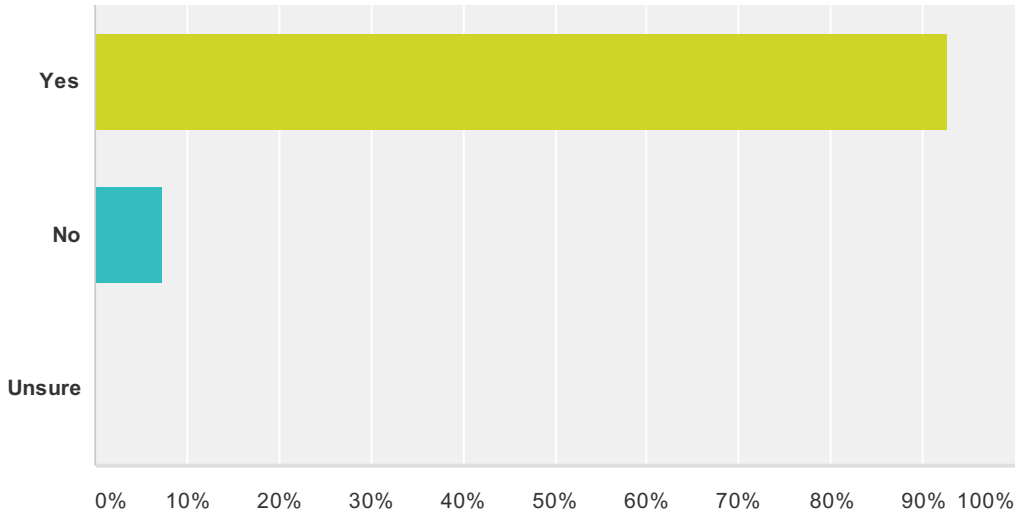
Answered: 27 Skipped: 1



Answer Choices	Responses	
Very Minor	**7.41%**	2
Minor	**29.63%**	8
Important	**62.96%**	17
Total		**27**

Q10 Range Utility Is Range Utility (defined above) suitable as the primary factor for consideration of Project Effects?

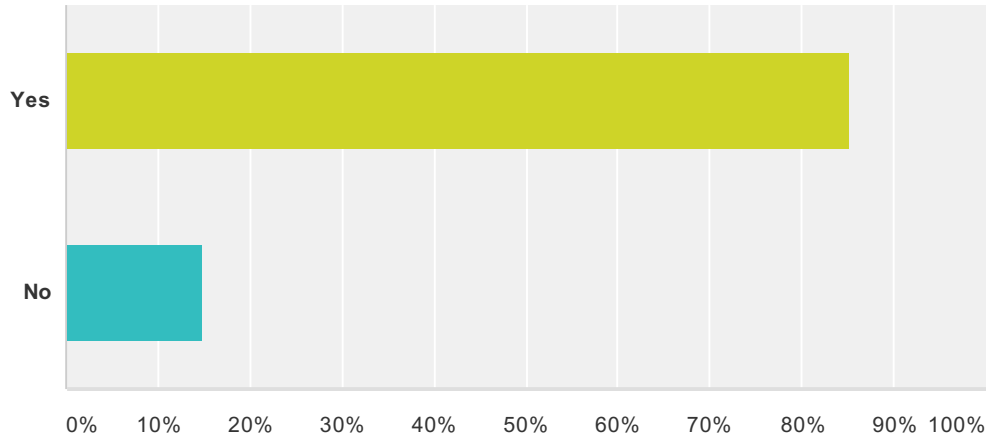
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**92.59%**	25
No	**7.41%**	2
Unsure	**0.00%**	0
Total		**27**

Q11 Future Habitat State Current regulatory considerations include management toward future habitat condition (i.e., reforestation). Is Future Habitat State (i.e., accelerate closure of forest canopy) a suitable alternate factor for consideration of Project Effects?

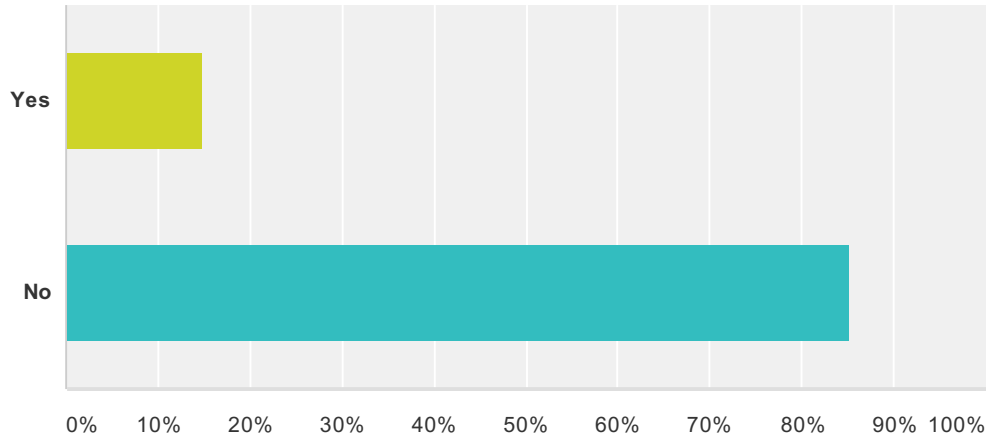
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**85.19%**	23
No	**14.81%**	4
Total		**27**

Q12 The balance of the questionnaire deals with the effects of linear disturbance and the effectiveness of mitigation to address the primary factor of Range Utility as well as the alternate factor of Future Habitat State. Are there any significant concerns with proposed approach stated above?

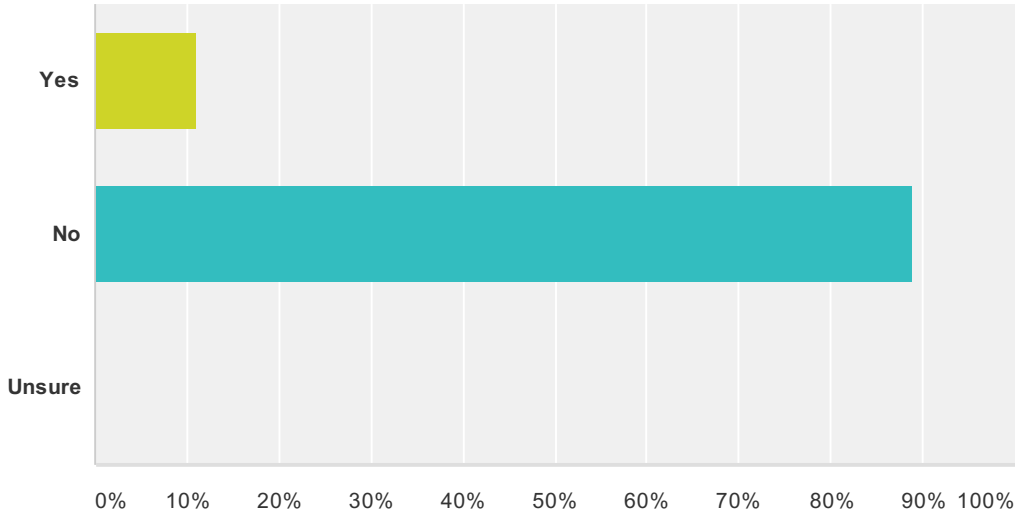
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**14.81%**	4
No	**85.19%**	23
Total		**27**

Q13 Linear Disturbance With regard to Range Utility are all 'lines' equal?

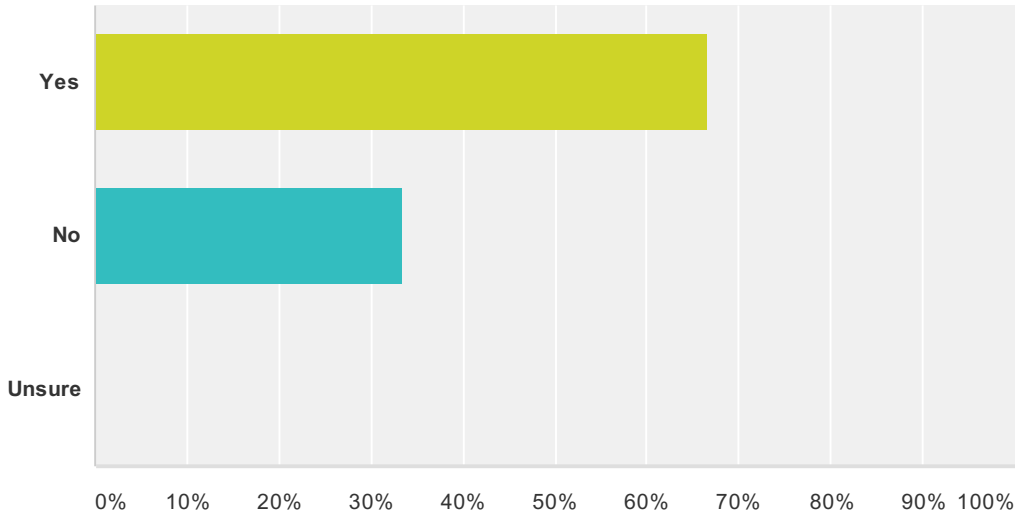
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**11.11%**	3
No	**88.89%**	24
Unsure	**0.00%**	0
Total		**27**

Q14 Linear Disturbance Should we discount the Project Effect based on the width of cut (i.e., does line width matter)? (Please note more detailed questions regarding line width follow)

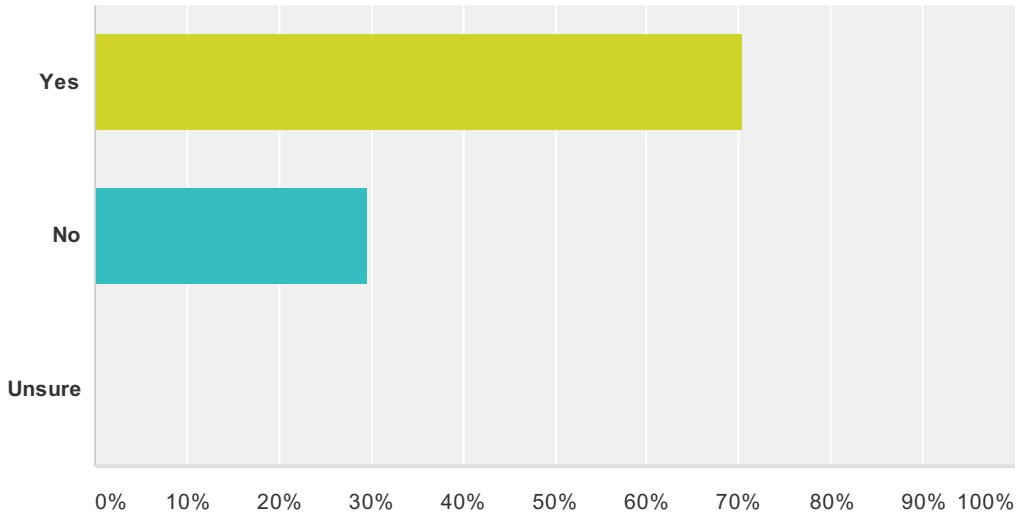
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**66.67%**	18
No	**33.33%**	9
Unsure	**0.00%**	0
Total		**27**

Q15 Linear Disturbance Should we discount the Project Effect when paralleling an existing line? (Please note more detailed questions regarding parallel lines follow)

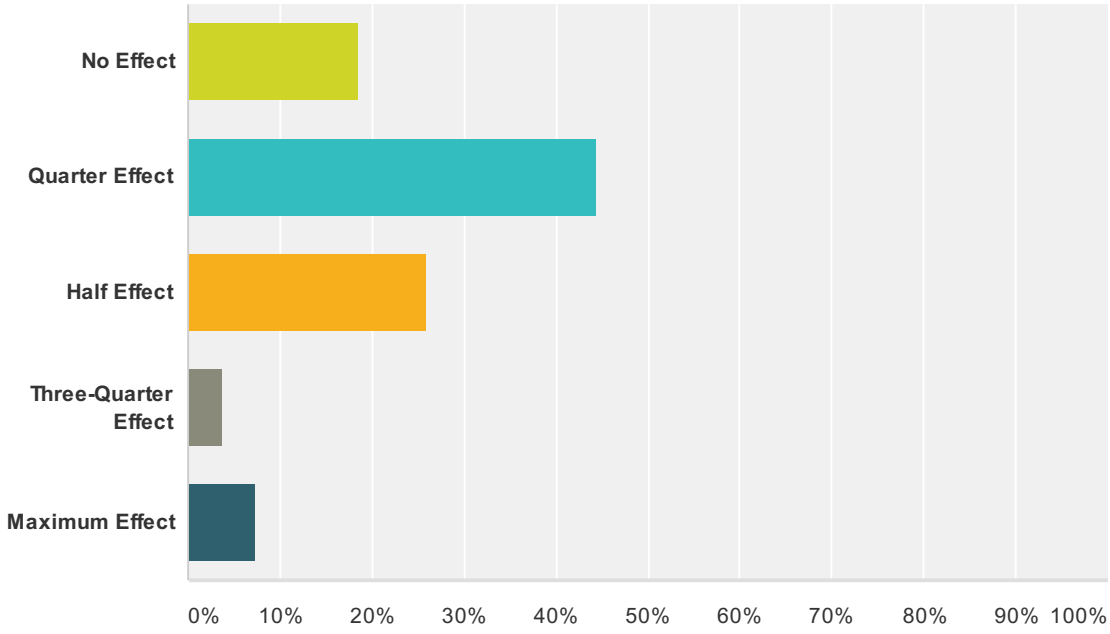
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**70.37%**	19
No	**29.63%**	8
Unsure	**0.00%**	0
Total		**27**

Q16 Line Width - New Linear Disturbance Assume the base case: that surrounding vegetation is moderately treed and terrain is simple. View the width of line primarily from the stand-point of its contribution to the visibility aspect of Range Utility. Note: Line ground condition has influence on both visibility and ease of movement but will be addressed in a different category. Note: Maximum Effect = the full manifestation of improved visibility for predators and possibly primary prey. What is the effect of lines <2.5 m (i.e., low impact seismic) in width with regard to their contribution to the visibility aspect of Range Utility?

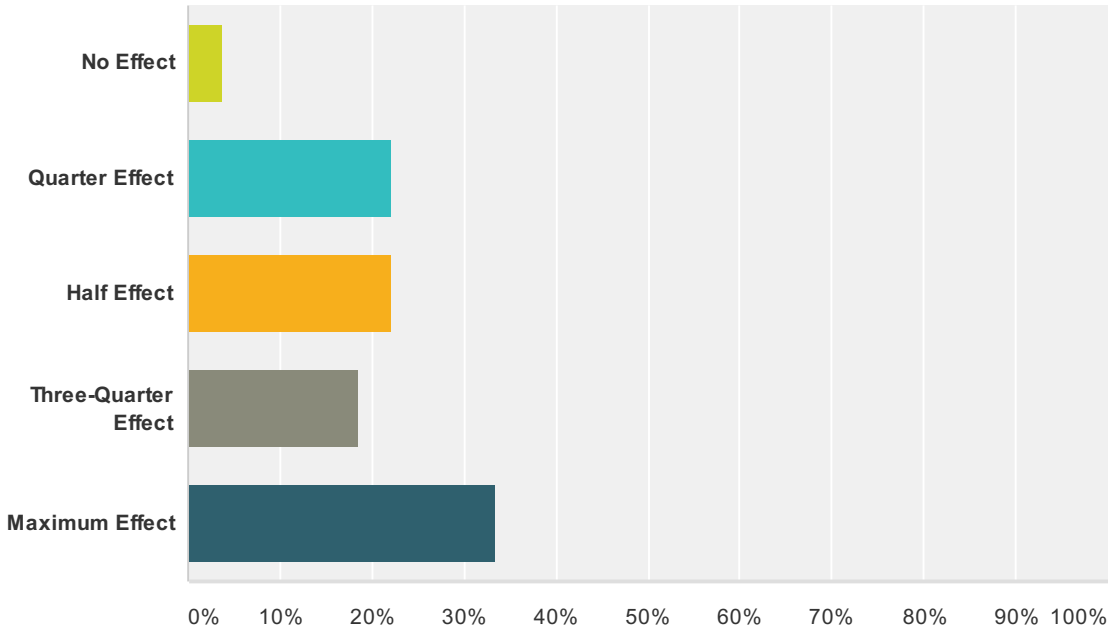
Answered: 27 Skipped: 1



Answer Choices	Responses	
No Effect	18.52%	5
Quarter Effect	44.44%	12
Half Effect	25.93%	7
Three-Quarter Effect	3.70%	1
Maximum Effect	7.41%	2
Total		27

Q17 Line Width - New Linear Disturbance What is the effect of lines with 3 m to 8 m width (i.e., conventional seismic) with regard to their contribution to the visibility aspect of Range Utility?

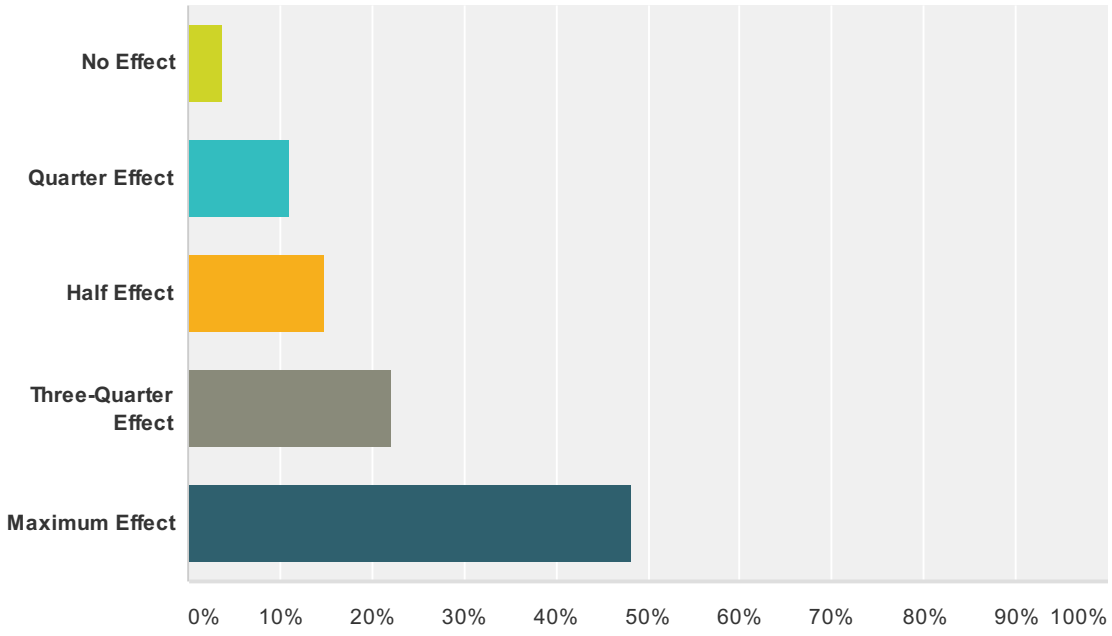
Answered: 27 Skipped: 1



Answer Choices	Responses	
No Effect	3.70%	1
Quarter Effect	22.22%	6
Half Effect	22.22%	6
Three-Quarter Effect	18.52%	5
Maximum Effect	33.33%	9
Total		27

Q18 Line Width - New Linear Disturbance What is the effect of lines with 9 m to 15 m width (i.e., trails/pipelines) with regard to their contribution to the visibility aspect of Range Utility?

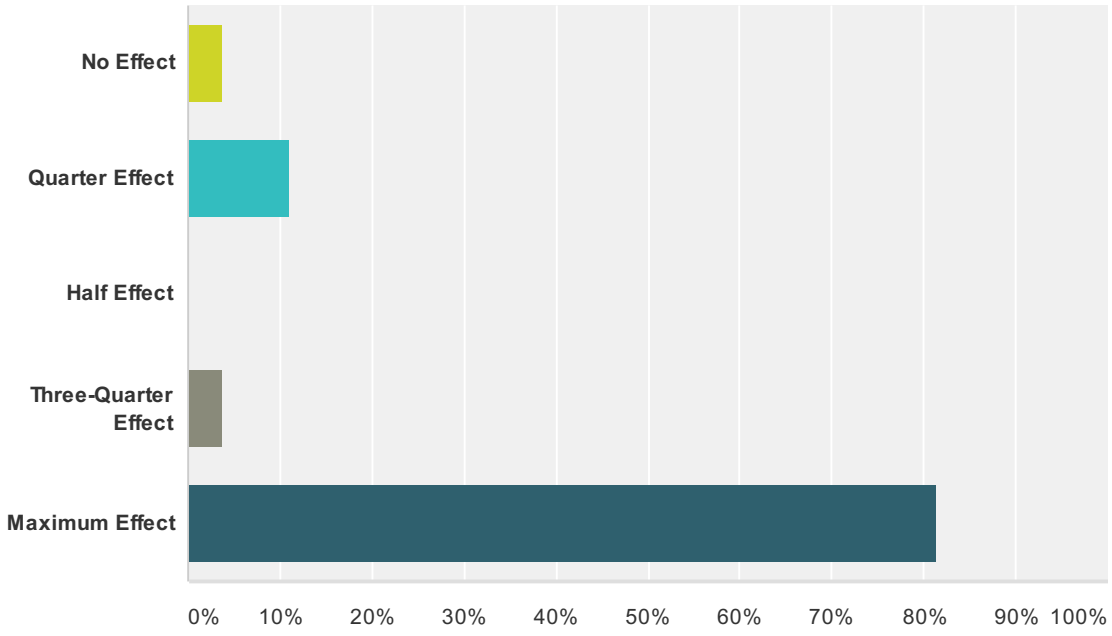
Answered: 27 Skipped: 1



Answer Choices	Responses	
No Effect	**3.70%**	1
Quarter Effect	**11.11%**	3
Half Effect	**14.81%**	4
Three-Quarter Effect	**22.22%**	6
Maximum Effect	**48.15%**	13
Total		**27**

Q19 Line Width - New Linear Disturbance What is the effect of lines with 16 m to 30 m width (i.e., trails/pipelines) with regard to their contribution to the visibility aspect of Range Utility?

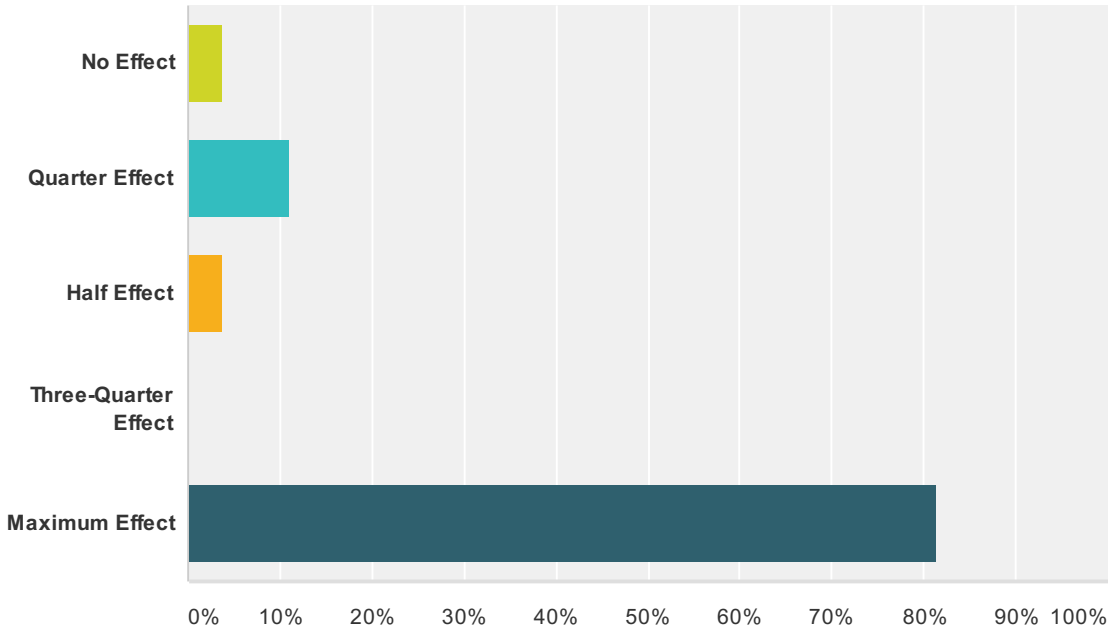
Answered: 27 Skipped: 1



Answer Choices	Responses	
No Effect	**3.70%**	1
Quarter Effect	**11.11%**	3
Half Effect	**0.00%**	0
Three-Quarter Effect	**3.70%**	1
Maximum Effect	**81.48%**	22
Total		**27**

Q20 Line Width - New Linear Disturbance What is the effect of lines with 31 m to 45 m width (i.e., roads/pipelines) with regard to their contribution to the visibility aspect of Range Utility?

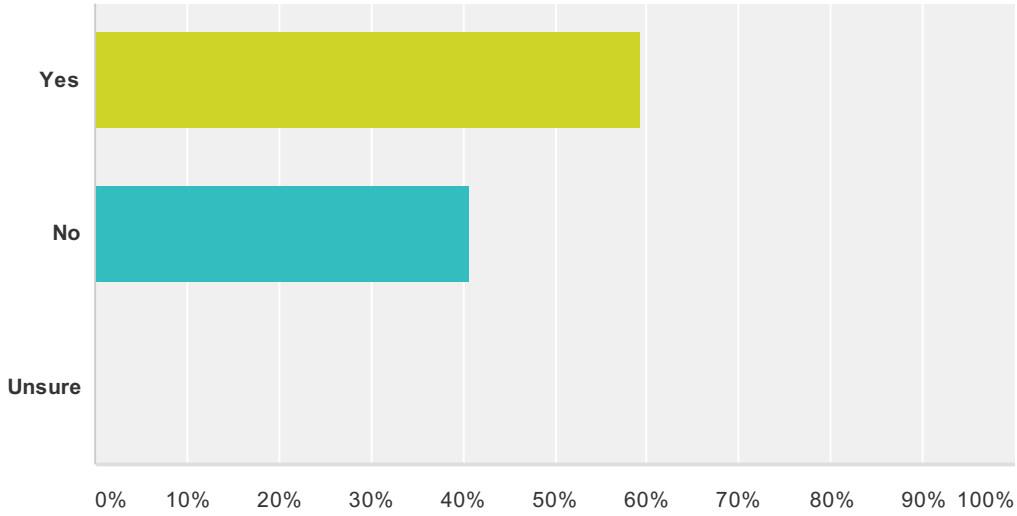
Answered: 27 Skipped: 1



Answer Choices	Responses	
No Effect	**3.70%**	1
Quarter Effect	**11.11%**	3
Half Effect	**3.70%**	1
Three-Quarter Effect	**0.00%**	0
Maximum Effect	**81.48%**	22
Total		**27**

Q21 Line Width - New Linear Disturbance Would you modify your responses above if the surrounding vegetation was more open?

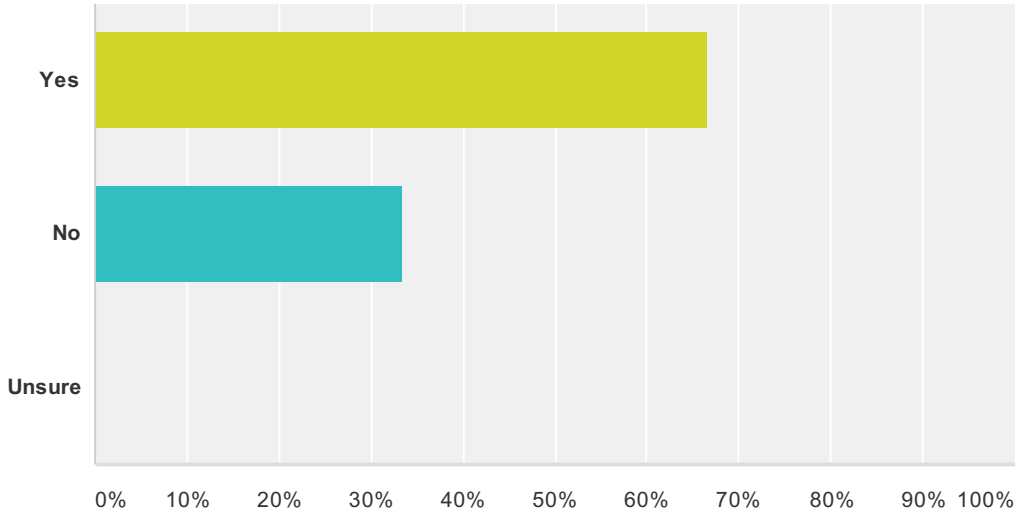
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**59.26%**	16
No	**40.74%**	11
Unsure	**0.00%**	0
Total		**27**

Q22 Linear Width - New Linear Disturbance Would you modify your responses above if the surrounding terrain was more complex?

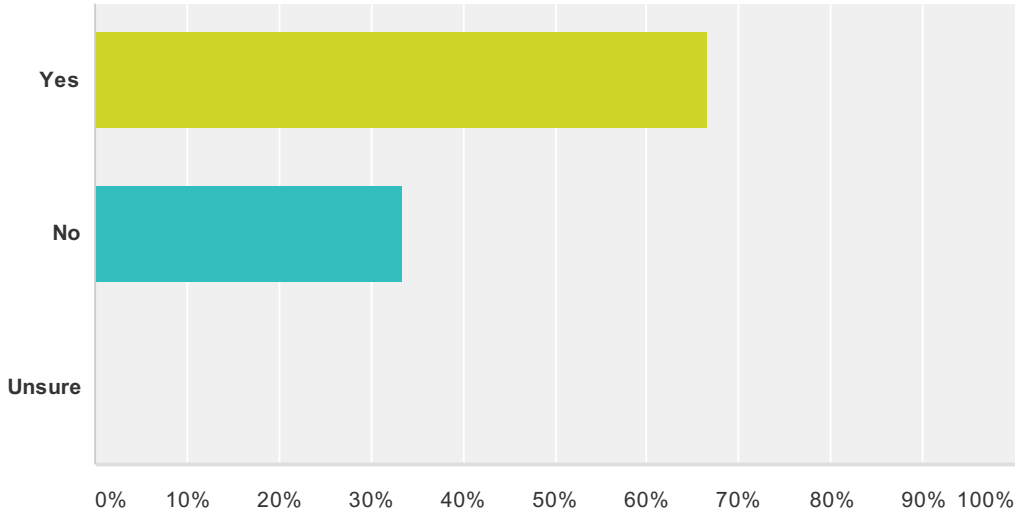
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**66.67%**	18
No	**33.33%**	9
Unsure	**0.00%**	0
Total		**27**

Q23 Line Width - New Linear Disturbance Is there benefit for varying line width (e.g., varying typical 25 m cut to frequent 15 m cut)?

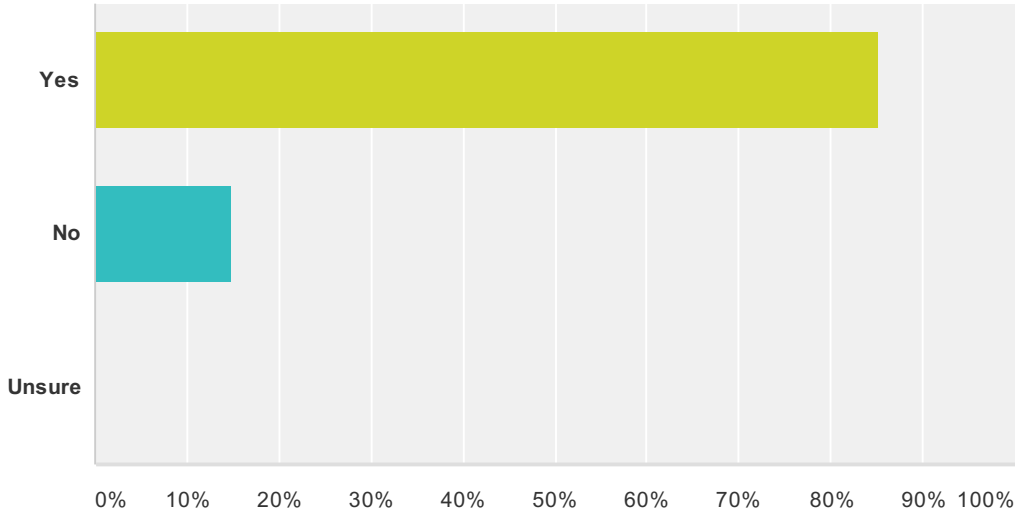
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**66.67%**	18
No	**33.33%**	9
Unsure	**0.00%**	0
Total		**27**

Q24 Line Width - New Linear Disturbance Is there benefit to winding the alignment to reduce the visibility aspects of Range Utility?

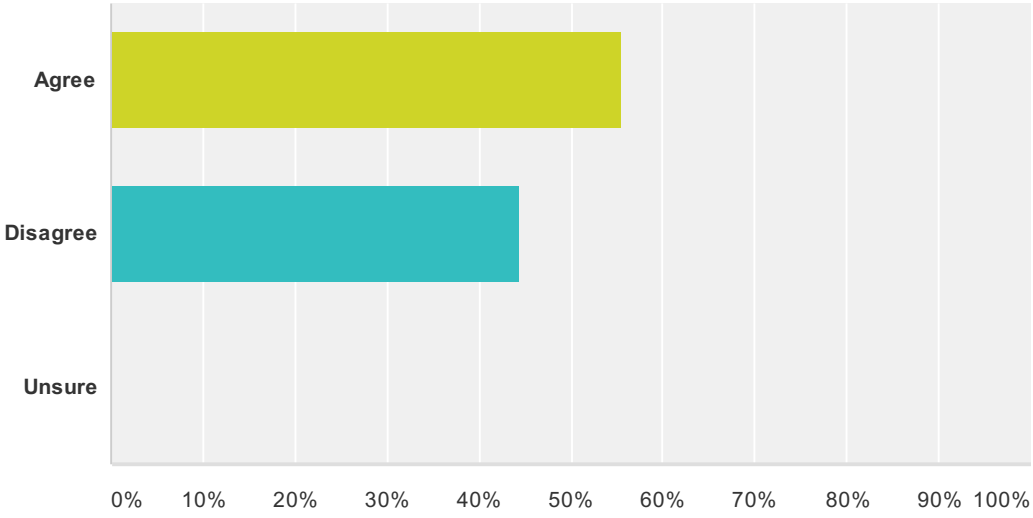
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**85.19%**	23
No	**14.81%**	4
Unsure	**0.00%**	0
Total		**27**

Q25 Line Width - Parallel Linear Disturbance Assuming there is benefit to utilizing or paralleling existing linear features: Is the Project effect the net increment in width category as listed and rated above? For example, if a 8 m seismic line was rated above as Half Effect, and incorporated into a new 30 m RoW rated Maximum Effect; incremental effect of the new line is Half Effect.

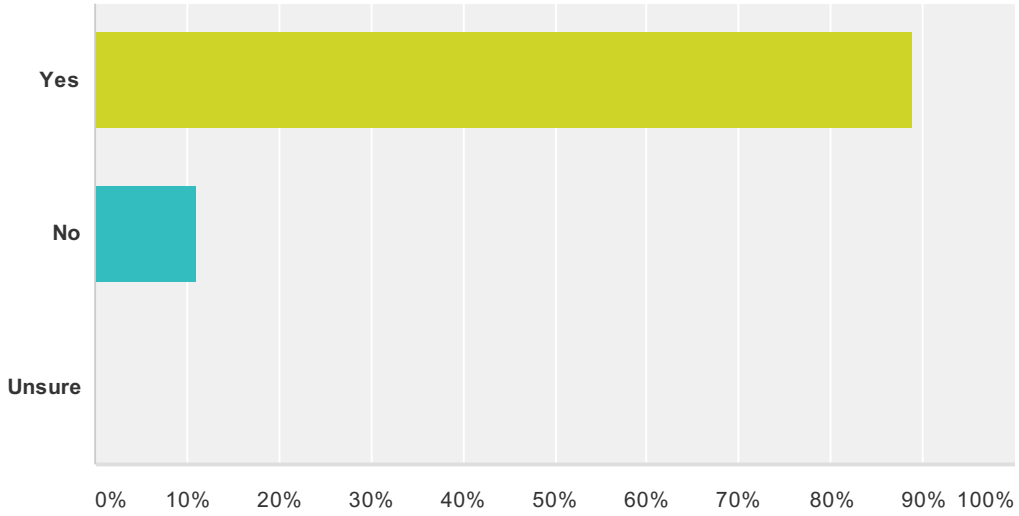
Answered: 27 Skipped: 1



Answer Choices	Responses	
Agree	**55.56%**	15
Disagree	**44.44%**	12
Unsure	**0.00%**	0
Total		**27**

Q26 Line Width - Parallel Linear Disturbance Would you modify the effect estimate based on current conditions of existing lines?

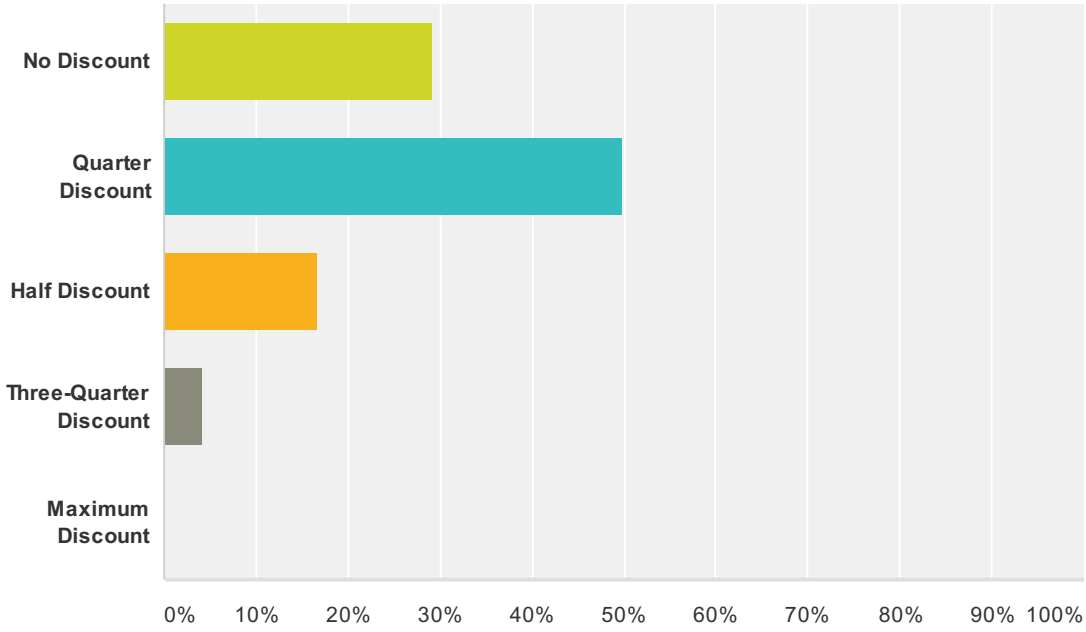
Answered: 27 Skipped: 1



Answer Choices	Responses	
Yes	**88.89%**	24
No	**11.11%**	3
Unsure	**0.00%**	0
Total		**27**

Q27 Barriers - Discrete Fences/Windrows/Berms What discount to the Project's Effect would you apply for segments that have strategically placed barriers, where barrier's are discontinuous across a line, placed at typical 500 m spacing intervals? (i.e., discontinuous as provision for operational access 5-10 m width is required) Note: Consider the barriers' effectiveness in the short term and assume it is managed or maintained as necessary for the long-term. Note: Maximum Discount = complete reduction of Project Effect.

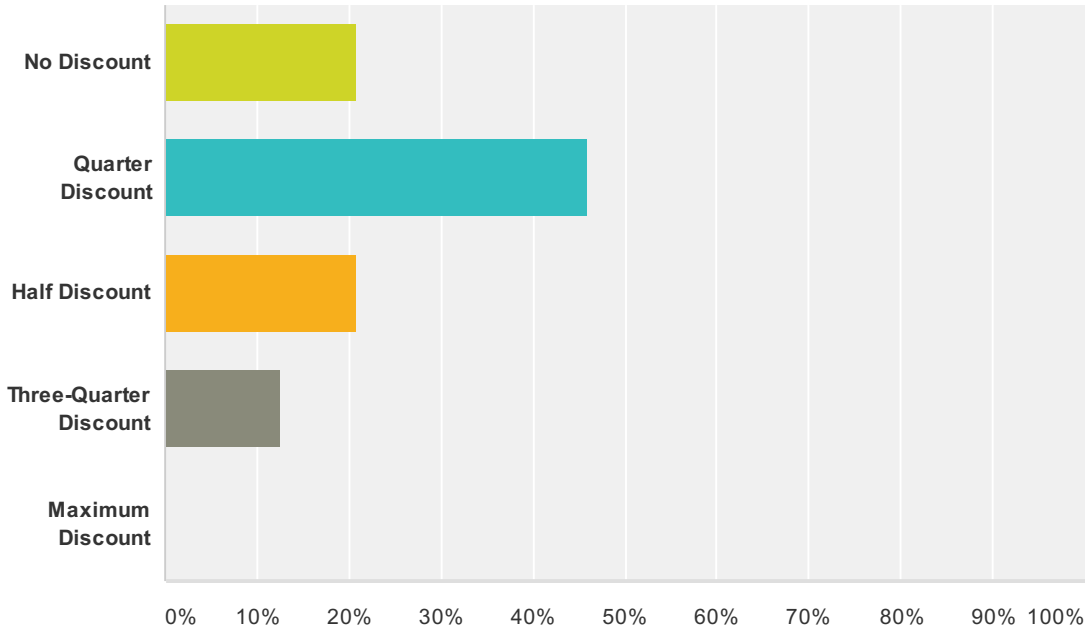
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Discount	**29.17%**	7
Quarter Discount	**50.00%**	12
Half Discount	**16.67%**	4
Three-Quarter Discount	**4.17%**	1
Maximum Discount	**0.00%**	0
Total		**24**

Q28 Barriers - Discrete Fences/Windrows/Berms For discontinuous barriers what discount would you apply to a higher intensity spacing interval of 250 m? (i.e., discontinuous as provision for operational access 5-10 m width is required) Note: Consider the barriers' effectiveness in the short term and assume it is managed or maintained as necessary for the long-term. Note: Maximum Discount = complete reduction of Project Effect.

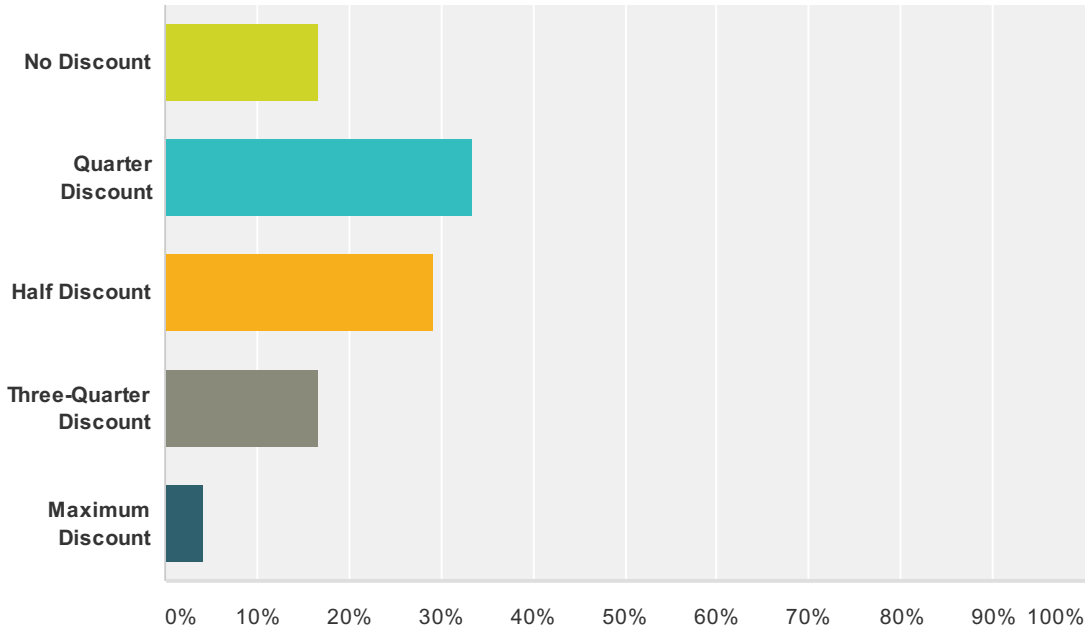
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Discount	**20.83%**	5
Quarter Discount	**45.83%**	11
Half Discount	**20.83%**	5
Three-Quarter Discount	**12.50%**	3
Maximum Discount	**0.00%**	0
Total		**24**

Q29 Barriers - Discrete Fences/Windrows/Berms What discount to the Project's Effect would you apply for segments that have strategically placed barriers, where barrier's are continuous across a line, placed at typical 500 m spacing intervals? (i.e., continuous as no operational access required) Note: Consider the barriers' effectiveness in the short term and assume it is managed or maintained as necessary for the long-term. Note: Maximum Discount = complete reduction of Project Effect.

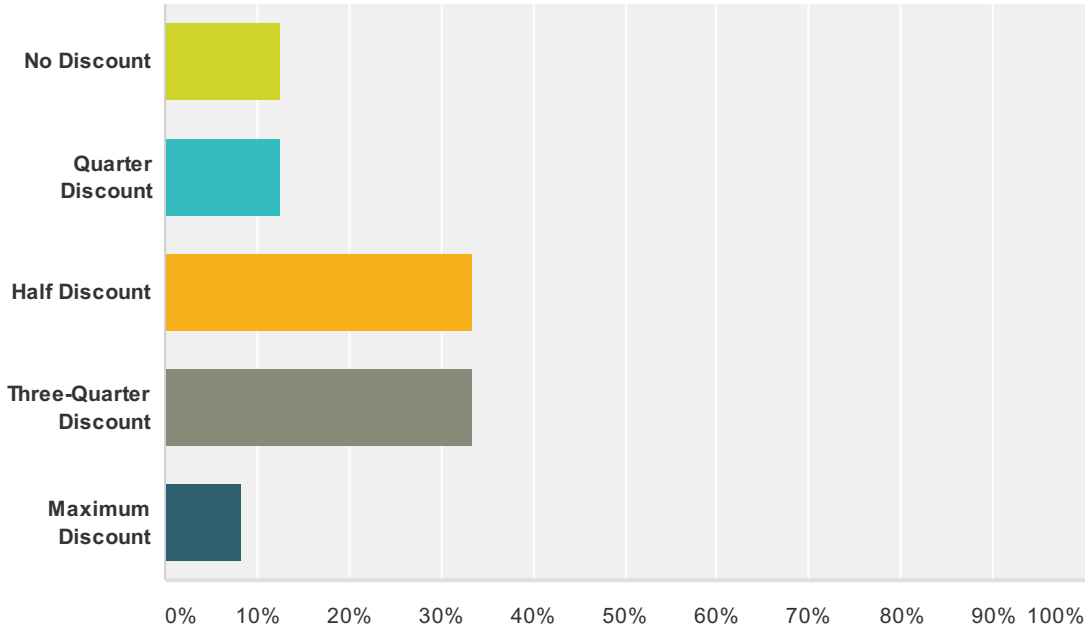
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Discount	**16.67%**	4
Quarter Discount	**33.33%**	8
Half Discount	**29.17%**	7
Three-Quarter Discount	**16.67%**	4
Maximum Discount	**4.17%**	1
Total		**24**

Q30 Barriers - Discrete Fences/Windrows/Berms For continuous barriers what discount would you apply to a higher intensity spacing interval of 250 m? (i.e., continuous as no operational access required) Note: Consider the barriers' effectiveness in the short term and assume it is managed or maintained as necessary for the long-term. Note: Maximum Discount = complete reduction of Project Effect.

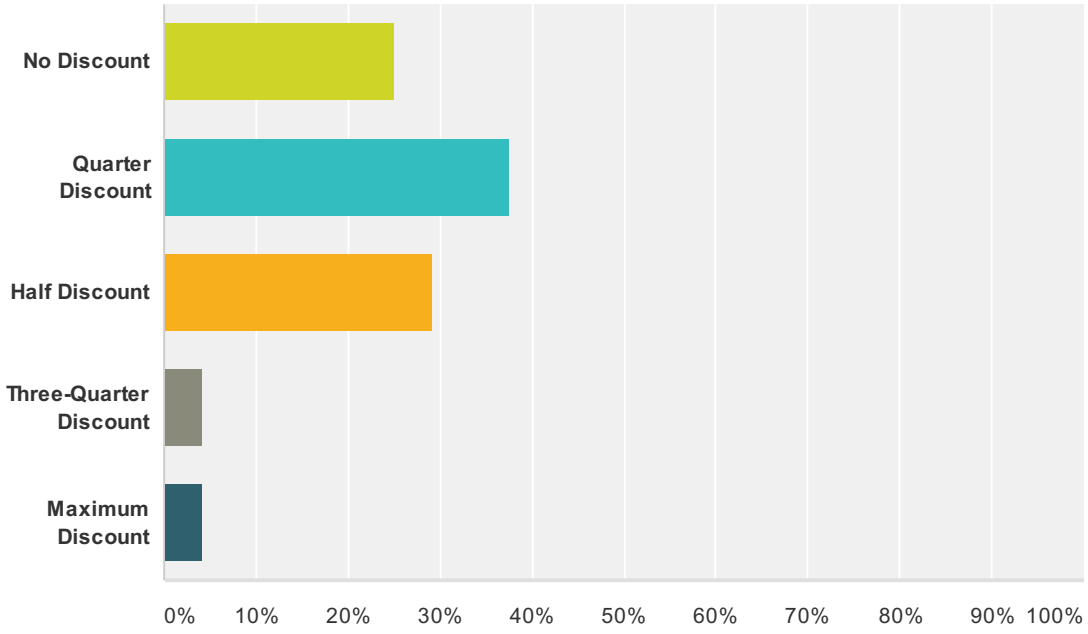
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Discount	12.50%	3
Quarter Discount	12.50%	3
Half Discount	33.33%	8
Three-Quarter Discount	33.33%	8
Maximum Discount	8.33%	2
Total		24

Q31 Barriers - Coarse Woody Debris/Mounding What discount to the Project's Effect would you apply for segments that have strategically placed aggressive, coarse woody debris or mounding, where barrier's are discontinuous across a line, with 100 m treated segments separated by 400 m spacing intervals? (i.e., discontinuous as provision for operational access 5-10 m width is required) Note: Consider the barriers' effectiveness in the short term and assume it is managed or maintained as necessary for the long-term. Note: Maximum Discount = complete reduction of Project Effect.

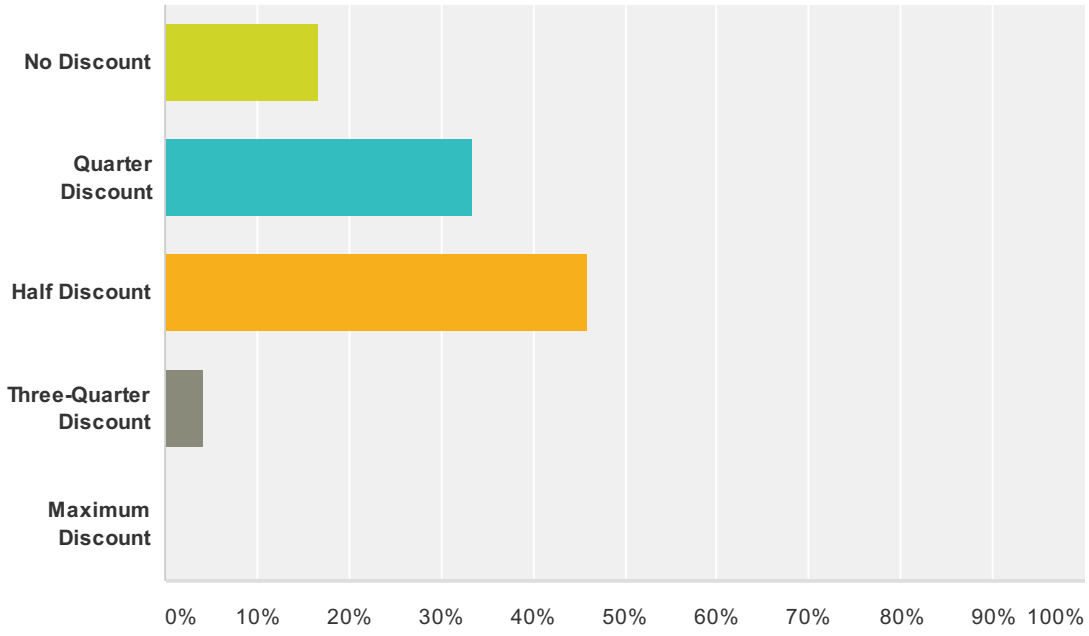
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Discount	25.00%	6
Quarter Discount	37.50%	9
Half Discount	29.17%	7
Three-Quarter Discount	4.17%	1
Maximum Discount	4.17%	1
Total		24

Q32 Barriers - Coarse Woody Debris/Mounding For discontinuous barriers what discount would you apply to a higher intensity application of 50 m treated segments separated by 200 m spacing intervals? (i.e., discontinuous as provision for operational access 5-10 m width is required) Note: Consider the barriers' effectiveness in the short term and assume it is managed or maintained as necessary for the long-term. Note: Maximum Discount = complete reduction of Project Effect.

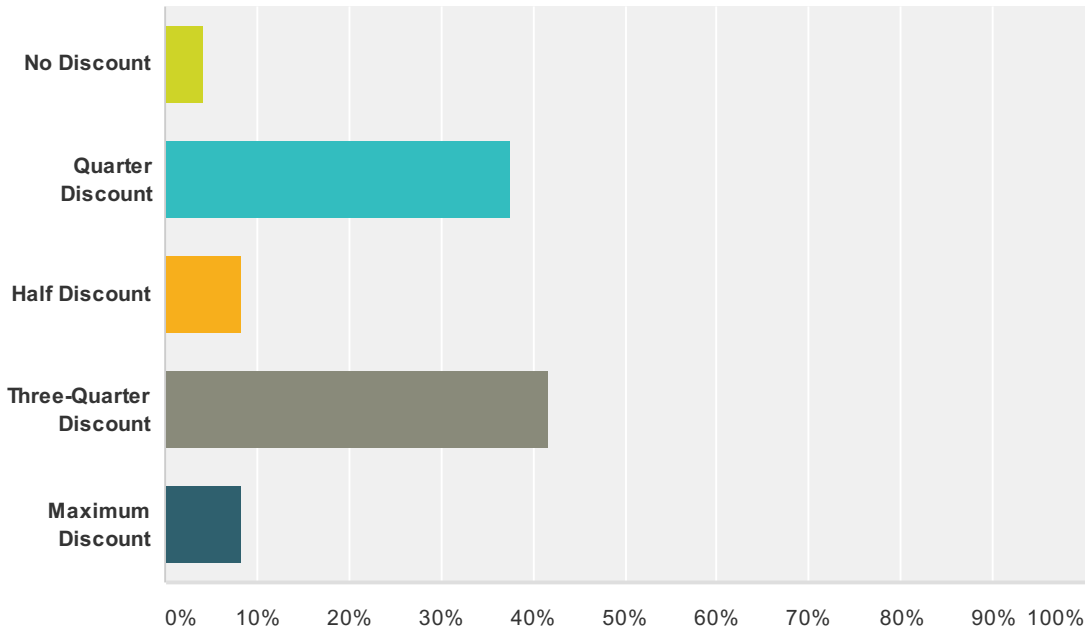
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Discount	**16.67%**	4
Quarter Discount	**33.33%**	8
Half Discount	**45.83%**	11
Three-Quarter Discount	**4.17%**	1
Maximum Discount	**0.00%**	0
Total		**24**

Q33 Barriers - Coarse Woody Debris/Mounding What discount to the Project's Effect would you apply for segments that have strategically placed aggressive, coarse woody debris or mounding, where barrier's are continuous across a line, with 100 m treated segments separated by 400 m spacing intervals? (i.e., continuous as no operational access required) Note: Consider the barriers' effectiveness in the short term and assume it is managed or maintained as necessary for the long-term. Note: Maximum Discount = complete reduction of Project Effect.

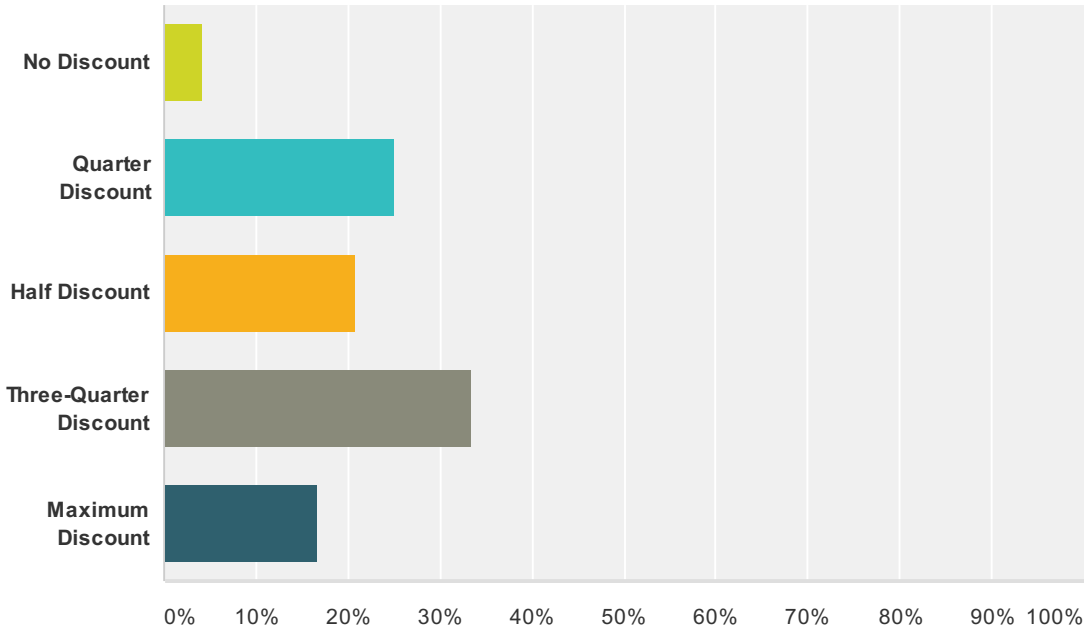
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Discount	4.17%	1
Quarter Discount	37.50%	9
Half Discount	8.33%	2
Three-Quarter Discount	41.67%	10
Maximum Discount	8.33%	2
Total		24

Q34 Barriers - Coarse Woody Debris/Mounding For continuous barriers what discount would you apply to a higher intensity application of 50 m treated segments separated by 200 m spacing intervals? (i.e., continuous as no operational access required) Note: Consider the barriers' effectiveness in the short term and assume it is managed or maintained as necessary for the long-term. Note: Maximum Discount = complete reduction of Project Effect.

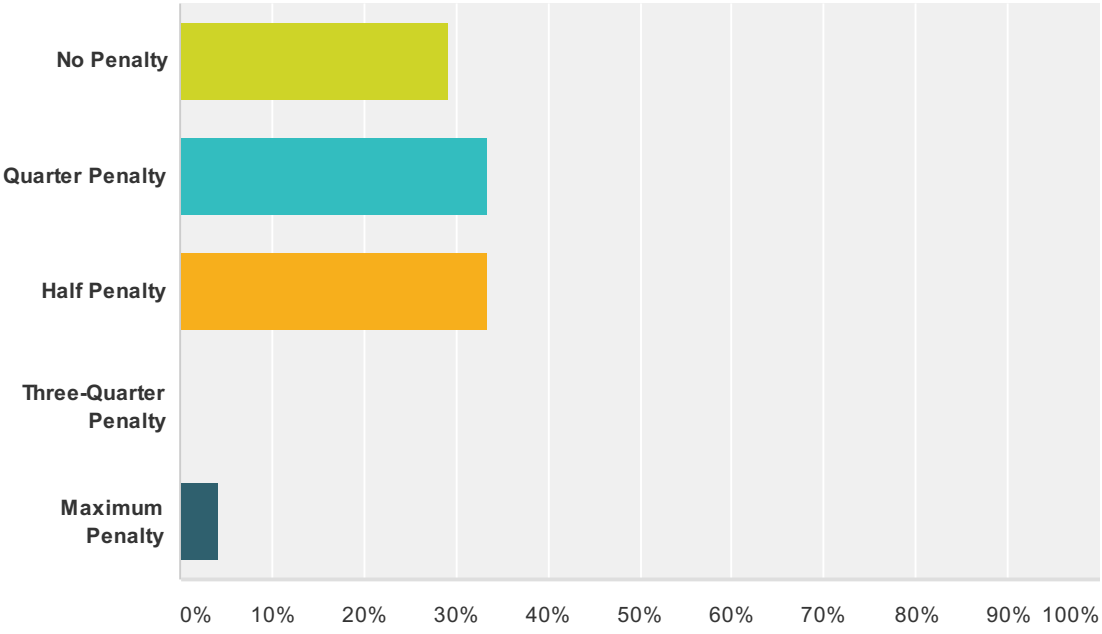
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Discount	4.17%	1
Quarter Discount	25.00%	6
Half Discount	20.83%	5
Three-Quarter Discount	33.33%	8
Maximum Discount	16.67%	4
Total		24

Q35 Duration of Barrier Effectiveness Barriers relying on coarse woody debris may have limited lifespan (i.e., duration of effectiveness) if not maintained. How much penalty (as reduction in coarse woody debris effectiveness) would you apply to account for this limited duration? Note: Half Penalty = effectiveness of measures relying on coarse woody debris reduced by half.

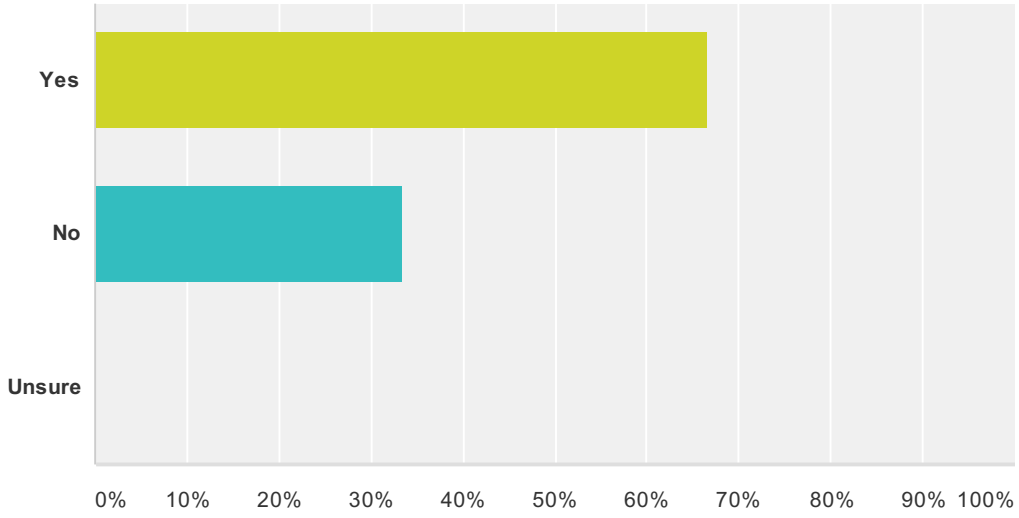
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Penalty	**29.17%**	7
Quarter Penalty	**33.33%**	8
Half Penalty	**33.33%**	8
Three-Quarter Penalty	**0.00%**	0
Maximum Penalty	**4.17%**	1
Total		**24**

Q36 Would tree or shrub planting within barriers relying on coarse woody debris address the duration of effectiveness issue completely?

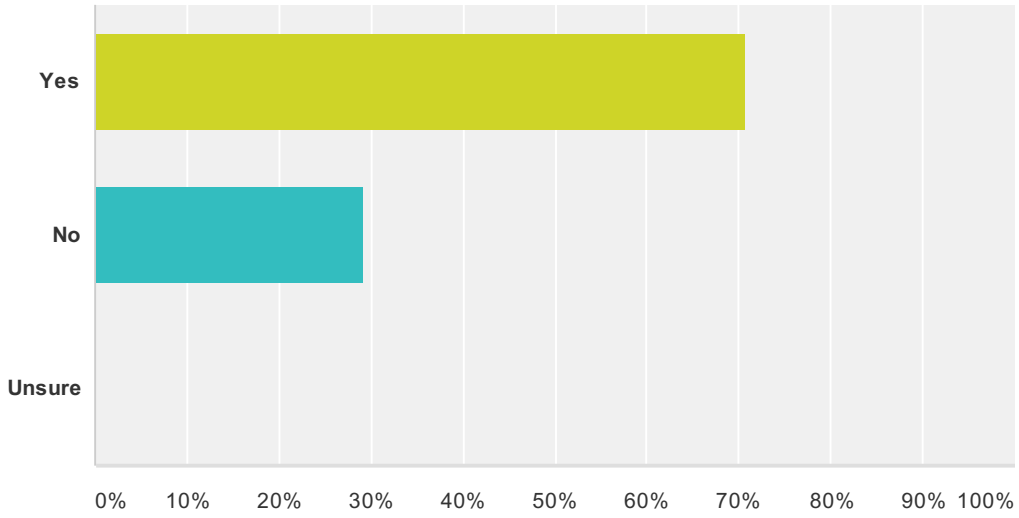
Answered: 24 Skipped: 4



Answer Choices	Responses	
Yes	**66.67%**	16
No	**33.33%**	8
Unsure	**0.00%**	0
Total		**24**

Q37 Would barriers relying on coarse woody debris last long enough for natural regeneration to occur?

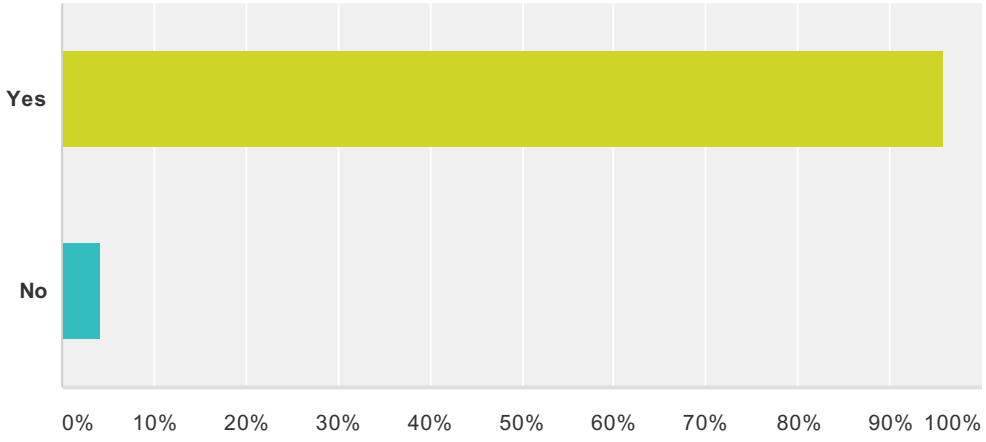
Answered: 24 Skipped: 4



Answer Choices	Responses	
Yes	**70.83%**	17
No	**29.17%**	7
Unsure	**0.00%**	0
Total		**24**

Q38 Tree or Shrub Planting Assume tree or shrub planting strategies have a long-term goal of future reduction of Range Utility and contribution to Future Forest State. In general, does tree or shrub planting strategies that are continuous across a line and target eventual reforestation to surrounding characteristics provide benefit? (i.e., continuous as no operational access required)

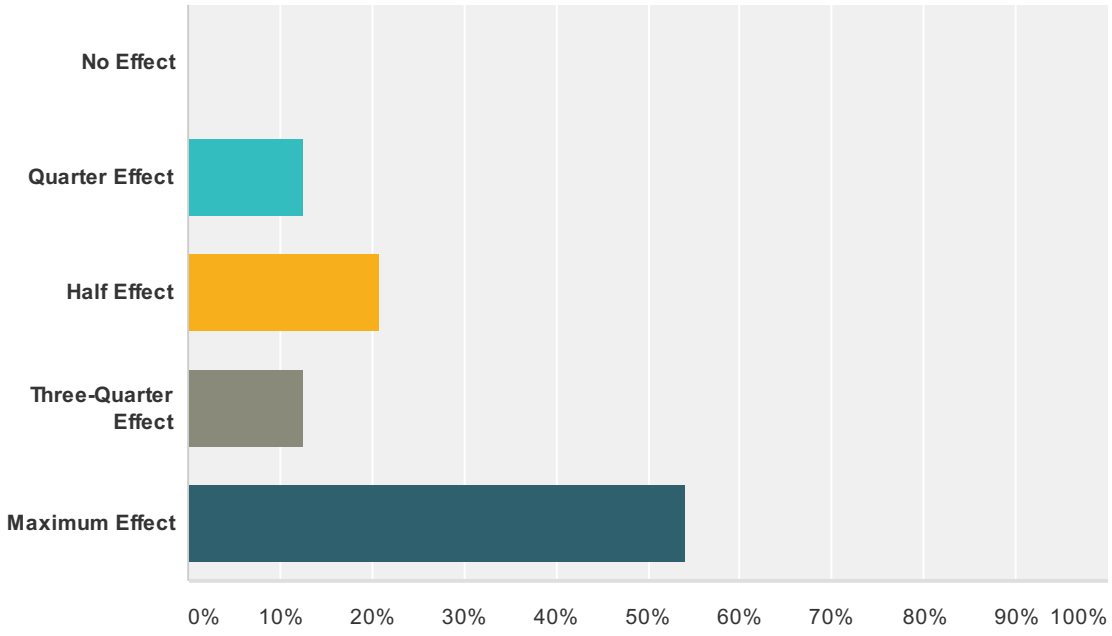
Answered: 24 Skipped: 4



Answer Choices	Responses	
Yes	**95.83%**	23
No	**4.17%**	1
Total		**24**

Q39 How effective do you believe tree or shrub planting, continuous across a line, will be in the long-term for future reduction of Range Utility and contribution to Future Forest State? (i.e., continuous as no operational access required) Note: Maximum Effect = complete reduction of Project Effect.

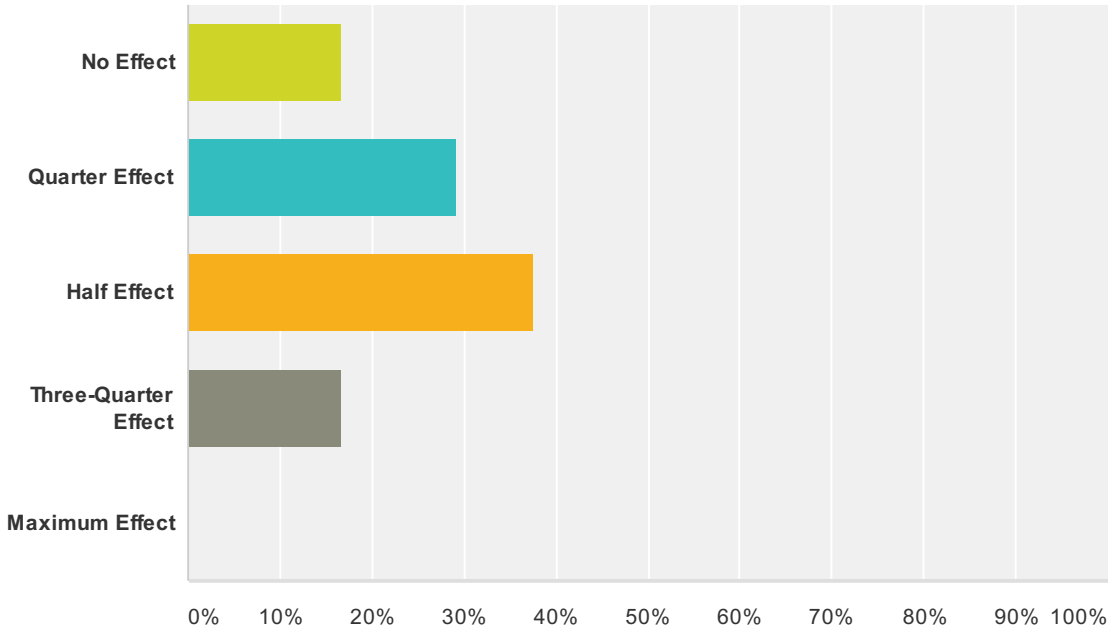
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Effect	**0.00%**	0
Quarter Effect	**12.50%**	3
Half Effect	**20.83%**	5
Three-Quarter Effect	**12.50%**	3
Maximum Effect	**54.17%**	13
Total		**24**

Q40 How effective do you believe tree or shrub planting, discontinuous across a line, will be in the long-term for future reduction of Range Utility and contribution to Future Forest State? (i.e., discontinuous as provision for operational access 5-10 m width is required) Note: Maximum Effect = complete reduction of Project Effect.

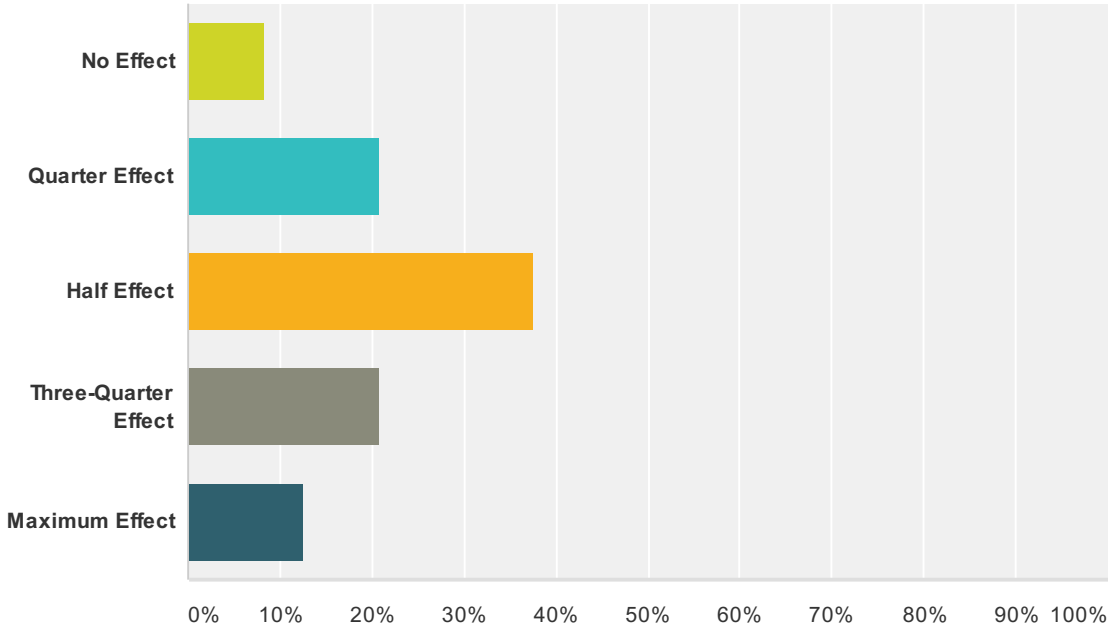
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Effect	**16.67%**	4
Quarter Effect	**29.17%**	7
Half Effect	**37.50%**	9
Three-Quarter Effect	**16.67%**	4
Maximum Effect	**0.00%**	0
Total		**24**

Q41 Duration/Delay: Recognizing that tree or shrub planting effects on future reduction of Range Utility and contribution to Future Forest State are not immediate but accelerate eventual accomplishment of those effects. What credit would you give immediate tree or shrub planting that is continuous across a line as a present value for future effectiveness? (i.e., continuous as no operational access required) Present Value: is the concept that planting today is worth more than planting in the future, or no planting at all. Note: Maximum Effect = complete reduction of Project Effect.

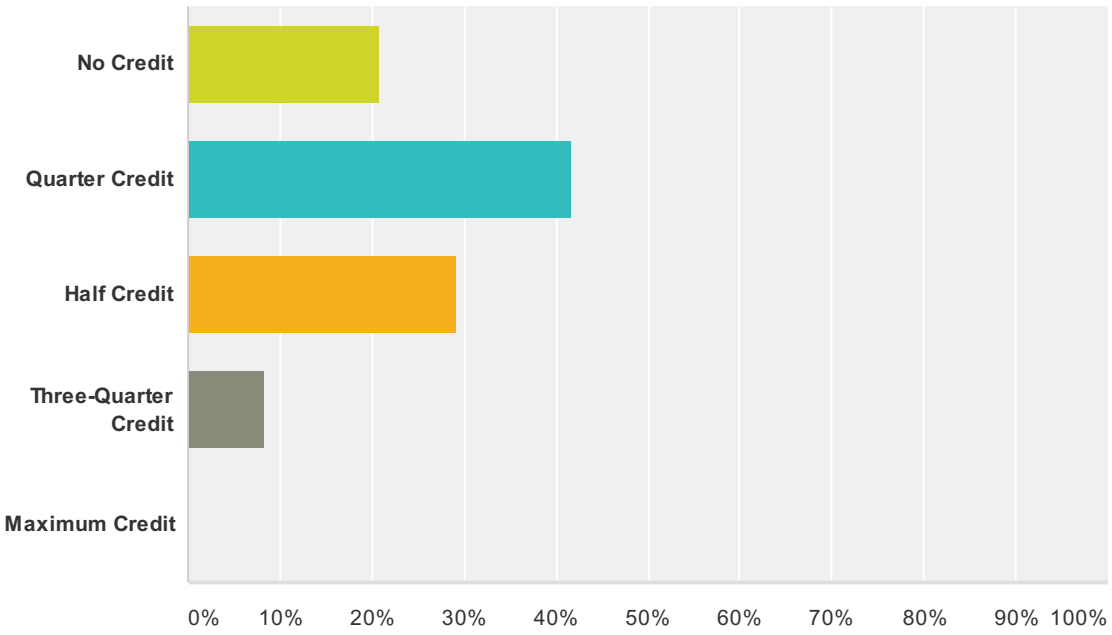
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Effect	8.33%	2
Quarter Effect	20.83%	5
Half Effect	37.50%	9
Three-Quarter Effect	20.83%	5
Maximum Effect	12.50%	3
Total		24

Q42 Duration/Delay: Recognizing that tree or shrub planting effects on future reduction of Range Utility and contribution to Future Forest State are not immediate but accelerate eventual accomplishment of those effects. What credit would you give immediate tree or shrub planting that is discontinuous across a line as a present value for future effectiveness? (i.e., discontinuous as provision for operational access 5-10 m width is required) Present Value: is the concept that planting today is worth more than planting in the future, or no planting at all. Note: Maximum Credit = complete reduction of Project Effect.

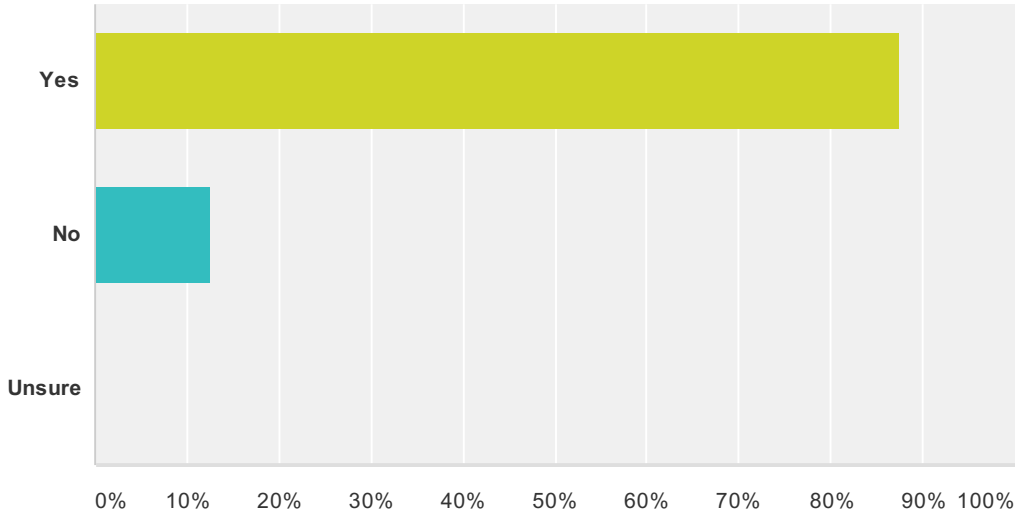
Answered: 24 Skipped: 4



Answer Choices	Responses	
No Credit	**20.83%**	5
Quarter Credit	**41.67%**	10
Half Credit	**29.17%**	7
Three-Quarter Credit	**8.33%**	2
Maximum Credit	**0.00%**	0
Total		**24**

Q43 Uncertainty Estimates of the effectiveness of mitigation efforts currently rely on informed opinion. Until research can demonstrate actual levels of effectiveness, precautionary added efforts may be warranted. This relates to the Site Scale effects on Range Utility as defined above, not on any animal population response or caribou avoidance. Did you already accommodate this by being conservative in your estimates?

Answered: 24 Skipped: 4



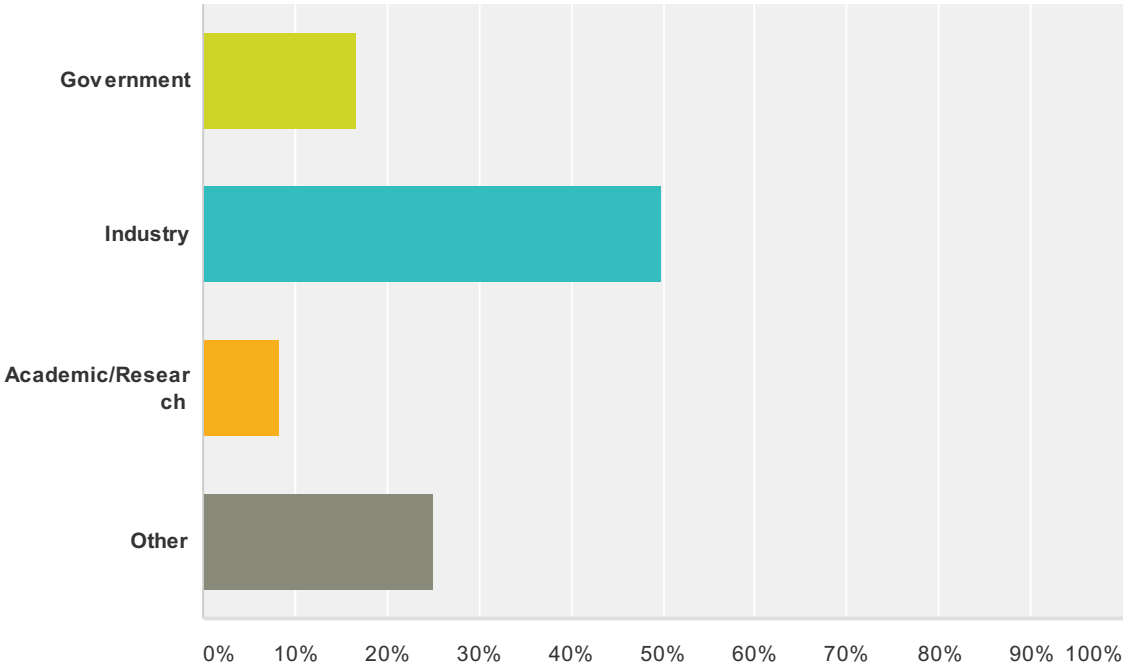
Answer Choices	Responses	
Yes	**87.50%**	21
No	**12.50%**	3
Unsure	**0.00%**	0
Total		**24**

Q44 Uncertainty If you answered "no" to the above question, or feel the need to qualify your "yes", what do you believe is the likely range of error accumulated in your Project Effects and Mitigation Effectiveness estimates (e.g., plus or minus what %)

Answered: 5 Skipped: 23

Q45 Please select your professional affiliation.

Answered: 24 Skipped: 4



Answer Choices	Responses	
Government	**16.67%**	4
Industry	**50.00%**	12
Academic/Research	**8.33%**	2
Other	**25.00%**	6
Total		**24**

Appendix 3 Offset Locations Dillon River Wildland Park

Offset Locations, Measures and Description – Dillon River Wildland Park

Offset Measure	Planted Species	Location	Area (ha)
COARSE WOODY DEBRIS	None	76 - 1 WM4	0.044756
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.009335
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.033506
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.016401
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.021098
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.123227
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.804511
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.366587
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.122786
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.201304
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.156215
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.463739
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.205858
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.07987
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.050128
COARSE WOODY DEBRIS	None	76 - 2 WM4	0.02434
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.172993
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.127774
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.033746
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.009211
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.173858
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.068291
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.850842
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.164168
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.038327
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.014002
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.234413
COARSE WOODY DEBRIS	None	77 - 1 WM4	0.016442
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.197844
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.060236
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.037933
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.179317
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.034243
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.048508
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.040763
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.043173
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.028658
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.034141
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.014072
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.020919
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.033507
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.014338
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.032275
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.162138
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.156209

Offset Locations, Measures and Description – Dillon River Wildland Park

Offset Measure	Planted Species	Location	Area (ha)
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.327837
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.13963
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.288304
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.076963
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.134472
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.064665
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.06194
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.097052
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.196484
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.143158
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.263243
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.075189
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.108287
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.520292
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.031052
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.224685
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.35289
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.036011
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.076578
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.036791
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.273029
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.010359
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.077106
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.025364
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.03892
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.029328
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.012166
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.022854
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.028824
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.109911
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.024436
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.055413
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.225837
COARSE WOODY DEBRIS	None	77 - 2 WM4	0.018279
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.038434
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.077305
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.032827
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.03577
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.007504
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.028461
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.012446
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.005479
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.025202
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.039232
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.024972

Offset Locations, Measures and Description – Dillon River Wildland Park

Offset Measure	Planted Species	Location	Area (ha)
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.056674
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.154205
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.058367
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.065369
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.190955
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.225158
COARSE WOODY DEBRIS	None	78 - 2 WM4	0.011817
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.081671
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.218687
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.215372
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.271782
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.111037
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.163723
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.040801
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.130896
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.123634
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.749346
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.135291
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.241305
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.621036
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.123103
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.038293
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.019426
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.040748
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.070532
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.278088
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.215926
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.356987
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.264451
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.088684
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.115173
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.102889
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.144253
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.036048
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.066917
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.100389
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.23843
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.037435
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.128033
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.282865
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.068466
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.22233
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.232928
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.357212
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.070407

Offset Locations, Measures and Description – Dillon River Wildland Park

Offset Measure	Planted Species	Location	Area (ha)
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.197061
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.490222
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.13778
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.038748
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.374816
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.206866
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.132378
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	1.016551
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.226419
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.07896
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.106517
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.210664
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.098832
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.03877
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.12995
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.135571
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 1 WM4	0.030865
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 1 WM4	0.392185
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 1 WM4	0.058178
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 1 WM4	0.122437
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 1 WM4	0.288835
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 2 WM4	0.142911
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 2 WM4	0.233857
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 2 WM4	0.158371
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 2 WM4	0.121135
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 2 WM4	0.266936
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 2 WM4	0.128989
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.121165
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.226011
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.100064
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.176277
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.430548
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.378262
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.273773
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.114745
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.18771
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.017649
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.295494
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.166356
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.154369
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.374993
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.354314
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.097842
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.173393
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.411194

Offset Locations, Measures and Description – Dillon River Wildland Park

Offset Measure	Planted Species	Location	Area (ha)
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.05269
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.049078
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.190352
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.071824
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.263089
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.186476
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.224282
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.098825
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.205407
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.081434
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	1.019915
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.26048
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.199786
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.041981
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.328551
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.321166
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.129533
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.061167
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.071023
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.368968
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.096614
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.405512
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.193676
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.225166
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.134019
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.089837
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.267619
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.360324
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.151219
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.311068
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.108842
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.072385
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.157665
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.191288
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.288393
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.110885
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	76 - 1 WM4	0.088775
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	76 - 2 WM4	0.11473
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	76 - 2 WM4	0.242559
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 1 WM4	0.046561
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 1 WM4	0.202772
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 1 WM4	0.259312
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.204178
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.122748
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.225166

Offset Locations, Measures and Description – Dillon River Wildland Park

Offset Measure	Planted Species	Location	Area (ha)
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.063063
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.043189
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.040117
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.213058
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.173104
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.055998
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.117226
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.097011
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.203011
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.273319
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.056158
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.335219
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.021446
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.24257
COARSE WOODY DEBRIS AND PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.271871
PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.236868
PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.078108
PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.173646
PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.06584
PLANT SEEDLINGS	Black Spruce	76 - 1 WM4	0.634514
PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.024434
PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.070269
PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.153215
PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.110804
PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.317374
PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.304021
PLANT SEEDLINGS	Black Spruce	76 - 2 WM4	0.270833
PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.234638
PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.226439
PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.038689
PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.033685
PLANT SEEDLINGS	Black Spruce	77 - 1 WM4	0.097331
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.085003
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.027946
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.039431
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.071668
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.25336
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.047266
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.211614
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.045724
PLANT SEEDLINGS	Black Spruce	77 - 2 WM4	0.07622
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.016876
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.268394
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.325605
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.15138

Offset Locations, Measures and Description – Dillon River Wildland Park

Offset Measure	Planted Species	Location	Area (ha)
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.521176
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.067535
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.088522
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.527794
PLANT SEEDLINGS	Black Spruce	78 - 1 WM4	0.045905
PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.121811
PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.524459
PLANT SEEDLINGS	Black Spruce	78 - 2 WM4	0.274244
PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 1 WM4	0.175629
PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 2 WM4	0.064226
PLANT SEEDLINGS	Black Spruce - Jack Pine	76 - 2 WM4	0.169179
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.046058
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.524204
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.049006
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.089932
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	1.554584
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.154209
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.275106
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.442839
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.24264
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 1 WM4	0.10574
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.014641
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.023255
PLANT SEEDLINGS	Black Spruce - Jack Pine	77 - 2 WM4	0.377019
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.143172
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.177056
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.334217
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.150818
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.101022
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.483371
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.111571
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.251843
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 1 WM4	0.072964
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.169844
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.508629
PLANT SEEDLINGS	Black Spruce - Jack Pine	78 - 2 WM4	0.037996
PLANT SEEDLINGS	Pine	78 - 1 WM4	0.628745
PLANT SEEDLINGS	Pine	78 - 1 WM4	1.005766
PLANT SEEDLINGS	White Spruce	76 - 2 WM4	0.293333
PLANT SEEDLINGS	White Spruce	77 - 2 WM4	0.084414
PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.027164
PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.007454
PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.07366
PLANT SEEDLINGS	White Spruce	78 - 2 WM4	0.052413