



**CCE Award Submission**

**Species Recovery in Action:  
Boreal Caribou Habitat  
Restoration at the  
Landscape Scale**



**GOLDER**

## Introduction

*Populations of woodland boreal caribou (Rangifer tarandus caribou) in Canada have declined substantially in recent decades, leading to a 'Threatened' status under Canada's Species At Risk Act. The loss and fragmentation of boreal caribou habitat resulting from anthropogenic disturbances, and the subsequent increase in predator and primary prey populations in early seral habitats, and increased predation rates on caribou, has been identified as the main limiting factor to caribou populations by both the BC provincial government and the federal government (BC MoE 2011, EC 2012). The draft BC Boreal Caribou Recovery Implementation Plan will rely upon aggressively restoring anthropogenically disturbed habitat to improve caribou population projections. Restoration of linear disturbances, using methods that reduce wildlife and human use and promote late seral stage vegetation establishment, will create larger contiguous patches of preferred caribou habitat, with natural predation risk levels.*

In recent years there have been ongoing discussions within various jurisdictions in regards to what and where habitat restoration activities should be undertaken, how to sequence restoration plans and who should ultimately be responsible for delivering and covering the costs of landscape level restoration. To date, caribou habitat restoration field programs have been limited in scope primarily to a project scale level (e.g., a pipeline). During a one day workshop held in December 2014, 85 representatives from federal and provincial government regulatory agencies, oil and gas, oil sands, pipeline, power, transportation and mining sectors from western Canada participated in a workshop to identify the key steps and actions required for implementation of landscape level restoration plans that achieve 'net positive habitat gain' in boreal caribou ranges. Ultimately, workshop participants came to the conclusion that collaboration is essential, to strategically restore large tracts of caribou habitat in priority areas to have an impact on caribou population numbers (Golder 2015a).

The Boreal Caribou (Parker Range) Habitat Restoration Pilot Program Plan (the Program Plan) was initiated in April 2015 by the Research and Effectiveness Monitoring Board (REMB) with funding provided by the BC Oil and Gas Research and Innovation Society (BC OGRIS). The Program Plan provided a study design to inform science and guidance regarding the need for landscape level restoration for caribou recovery. Although modelling and analysis has indicated that habitat restoration is linked to improving caribou population projections, the feasibility and predicted outcomes of restoration activities are highly uncertain (Wilson et al. 2010). The Program Plan is the first plan to propose application of habitat restoration treatments over an entire boreal caribou range in Canada. The Program Plan was designed to identify potential barriers, solutions, and costs that will help guide future landscape level habitat restoration programs for boreal caribou in BC, and in Canada (Golder 2016).

The Parker boreal caribou range was chosen as the study area as forestry and oil and gas activities are expected to be low over the coming decade, and the range is small enough to provide the opportunity to apply and test the effectiveness of habitat restoration techniques over a landscape caribou range scale in relation to caribou population metrics. The Program Plan was designed to incorporate lessons learned from Alberta, to help guide restoration efforts in each implementation year, and in other ranges and jurisdictions.

Golder's expertise, garnered from numerous years of working on habitat restoration projects in Alberta's oil and gas sector, was recognized by the BC OGRIS by awarding habitat restoration projects in boreal caribou range from 2014 to 2018. The BC OGRIS is an industry-sponsored fund overseen by the BC Oil and Gas Commission, the Canadian Association of Petroleum Producers (CAPP), and the Explorers and Producers Association of Canada. The Fund is administered by the Oil and Gas Commission and serves to enable relevant applied research to inform environmental and social matters related to oil and gas exploration and development in BC. The Fund is results-based and generates improvements in conducting efficient, effective and transparent regulation of oil and

gas activities in BC. The Golder team for these projects was led by Paula Bentham, Principal and Senior Wildlife Ecologist and included biologists, archeologists, First Nation contracting specialists, GIS specialists, and Project Management staff from five offices across Golder's BC and Alberta operations. Implementation of the Zone 1 Restoration area would not have been possible without the support of the Fort Nelson First Nation, Eh Cho Dene contracting, the Fort Nelson Snowmobile Club and staff from the BC Ministry of Forests Lands Natural Resource Operations and Rural Development (MFLNRORD).

## Project Summary

Culminating from the BC OGRIS funded restoration projects, Golder planned and implemented the first restoration plan for caribou in Canada to propose application of habitat restoration techniques over an entire caribou range to support caribou population recovery. The Boreal Caribou (Parker Range) Habitat Restoration Pilot Program Plan (the Program Plan; Golder 2016) is significant, given the weighting of habitat restoration to caribou population recovery within the species' federal recovery plan under the Species At Risk Act (Environment Canada 2012), and associated Provincial and Territorial range planning recovery levers.

The overall Project objective is to transition low quality caribou habitat on legacy rights-of-way into higher quality habitat by reducing the benefits predators and their primary prey gain through linear corridor use and establish access management and a vegetation trajectory on these corridors that will in the long term increase habitat intactness. The plan has been designed to be implemented over a multi-year period with a focus on working with local Indigenous communities through an Aboriginal Inclusion Plan to build local capacity and support local businesses in northern BC. The Program Plan included completing desktop disturbance mapping, a determination of the authorization process and assessments required to conduct restoration activities within BC, a tactical multi-year restoration implementation plan (Golder 2015b) as well as a summary of restoration and wildlife monitoring. Implementation planning occurred from 2015-2016, with implementing restoration treatments within a Zone 1 Restoration area in conjunction with both pre and post-treatment wildlife (Keim et al. 2019) and vegetation response monitoring (2017-2018).

Linear disturbance inventory mapping was completed for the Parker Range to determine the extent of linear disturbances that may require implementation of habitat restoration techniques to restore caribou habitat. The mapping was gathered through public government sources, available public reference aerial imagery, and Ladybug® 360 imagery collected by air in June 2015. A total of 1,040 km (2,473 line segments) of linear disturbances were captured within Ladybug® 360 imagery. The linear disturbance inventory imagery was interpreted for the attributes of site type, dominant tree species, vegetation height, vegetation cover, line width, presence or absence of a game trail and spatially mapped and then verified in the field for quality control (87% accuracy for vegetation height, 84% accuracy for vegetation cover). Linear disturbance segments were then classified as no-treatment, leave for natural revegetation or restoration treatment candidate.

No-Treatment linear disturbances (76 km, 7%) constituted any linear disturbance that may have an active disposition or protective notation, such as a pipeline, lease road, designated recreational trail, or ecological reserve. Where the locations of these access corridors were certain, they were excluded from the linear disturbance inventory treatment areas. Leave for natural revegetation was recommended when percent cover and height classification of vegetation along a linear disturbance are above the threshold for recommending tree seedling planting, and there is no game trail. A recommendation of leave for natural was determined if a wetland had > 10% vegetation cover, consistently equal to or over 50 cm in height, and no game trail was present, or an upland site with over 30% vegetation cover, consistently equal to or over 50 cm in height with no game trail present. A total of 394 km (38%) of linear disturbances within the Parker Range are considered Leave for Natural Revegetation and will not be treated due to the current height and consistent cover of vegetation. A total of 569 km (55%) of linear disturbances within the Parker Range will be considered for treatment.



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Restoration treatment types were selected following the BC OGRIS Restoration Toolkit for practitioners (Golder 2015d), using a decision support framework incorporating existing scientific research on predator movements and vegetation recovery. In addition, an Archeological Impact Assessment and associated mitigation were incorporated to minimize impacts from restoration treatments to archaeological resources. Lastly, a Before-After-Impact-Control (BACI) monitoring design was incorporated by Matrix to monitor wildlife response to the treatments (Keim et al. 2019) and post-treatment vegetation response monitoring plots were established following the BC OGRIS Restoration Monitoring Framework (Golder 2015c).

As the Program Plan was developed to guide a multi-year, range scale, a high-level tactical plan was prepared based on zones of treatment within the Parker Range, numbered one to four, which were created and prioritized based on ecological and logistical considerations. Zone 1 became the highest priority to treat based on overlap with caribou locations, predicted caribou calving areas, overlap with wolf locations and proximity to Fort Nelson from a logistics and capacity building perspective. Implementation within the Restoration Zone 1 occurred from January to March, 2017.

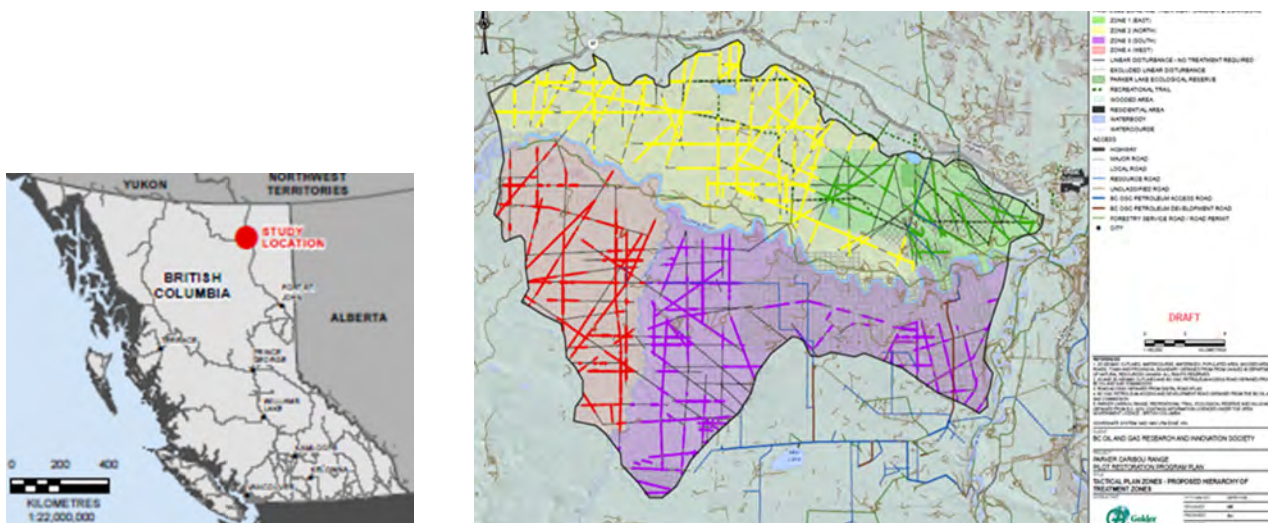


Figure 1: Landscape Scale Restoration Pilot Program Study Location within the Parker Boreal Caribou Range, west of Fort Nelson, BC. Within the Program Plan, the Parker Range was prioritized into four zones for habitat restoration based on Logistical and Ecological considerations (Zone 1 Green).

With the support of Fort Nelson First Nation’s environmental monitors, environmental technicians, a locally owned Aboriginal contractor (Eh Cho Dene), and local service providers; restoration treatments including combinations of leave for natural recovery, tree-felling, use of coarse woody debris, scarification/hoe rip, and mounding with winter seedling planting resulted in a 165 km of legacy linear disturbance within Zone 1 of the Program Plan to be set on a habitat recovery trajectory.

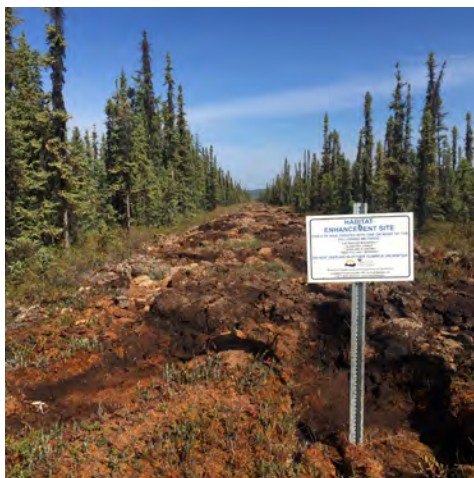


Photo 1: Woodland Caribou captured during wildlife remote camera monitoring utilizing legacy right-of-way with natural revegetation

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Photos 2 and 3: Implementing habitat restoration treatments with Local Indigenous Community and Contractors to build local capacity for future habitat restoration programs (Fort Nelson First Nation)



Photos 4, 5 and 6: Habitat restoration sites using mounding for site preparation, treeplanting and tree felling for human and predator access controls. Over 165 km of linear rights-of-way were either mapped for natural revegetation recovery or treated with 23,220 seedlings planted using winter seedling planting techniques.

## Innovation

Golder prepared a proposal to BC Oil and Gas Research and Innovation Society (BC OGRIS) for a Habitat Restoration Pilot Program to offer the first opportunity to apply restoration over an entire boreal caribou range in Canada to test if a population response occurs. Golder also focused the proposal to capture an Aboriginal Inclusion Plan to build local capacity in implementing restoration. The Pilot Program was designed to identify barriers, costs, and solutions to guide future range level restoration programs. Range level restoration for caribou has not been undertaken within any other jurisdiction in Canada, even though it is relied upon within the federal recovery strategy for the species. Key achievements:

- 1,040 km of linear disturbance has been mapped using a novel remote sensing approach, with lineal segments classified for restoration potential using attributes including vegetation status, natural revegetation potential, current access and disposition status. The range was split into 4 zones for a multi-year implementation plan and prioritized using ecological and logistical considerations. To address concerns of high archeological potential, treatment plans were modified to non-intrusive measures.



## SPECIES RECOVERY IN ACTION: BOREAL CARIBOU HABITAT RESTORATION AT THE LANDSCAPE SCALE

- Within Zone 1, 61 km of linear disturbance was physically treated winter 2017, and 104 km of disturbance was left to natural recovery to meet objectives of blocking human/predator access and to accelerate rate of vegetation recovery. Winter tree planting of 23,220 seedlings, at a mean density of 612 seedlings per hectare occurred on modified mounds.
- Local businesses were used for all aspects of the implementation program to benefit the local community. An Aboriginally owned contractor, field technicians and Indigenous observers were trained in the restoration treatments to build local capacity for habitat restoration work. Of the implementation contract budget (approximately \$725,000), 44% went directly to Fort Nelson First Nation and local businesses in Fort Nelson. Since the program, this community outreach has resulted in Fort Nelson First Nation and local contractors having successfully received funding for, and led, habitat restoration field programs.
- Golder developed an adaptive management procedure with the BC Ministry of Forests Lands Natural Resource Operations and Rural Development (FLNRORD) to capture Indigenous communities consultation within an efficient timeframe to account for field modifications. Weekly Indigenous observers and consultation in the field supported timely field modifications. Having local Indigenous communities as a team member in the planning and implementation of restoration programs was a key learning and identified as a critical step to future programs in Canada.

## Technical Excellence

Key outcomes of the pilot project included local capacity building and learning opportunities, but highlighted the high desire of Aboriginal communities for early and ongoing engagement and collaboration within larger landscapes on where and how to focus habitat restoration programs. This pilot restoration project has built connections between local stakeholders and Indigenous community groups, informing the development of a restoration framework in BC.

## Management of Risk Effort and Complexity

This Project was the first caribou range scale habitat restoration program in Canada with local capacity building with an Indigenous community. This project has informed a Provincial strategic restoration framework.

The following challenges and commitments were incorporated:

1. A Project Team Charter was established by Golder with BC OGRIS, representatives from Oil and Gas Commission, CAPP, and FLNRORD for regular communication. Building Indigenous community relationships and economic opportunities, as well as determining appropriate permits for restoration work in BC was a direct result of the Project Team working collaboratively.
2. Golder proposed and implemented an Aboriginal Inclusion Plan. Impacted First Nations were met in person to discuss the plan and determine capacity to support. Statements of Interest were provided to identify contractors, technicians and resources. Golder ensured contractors met technical and safety standards who could meet project schedule and budget, in a safe manner.
3. The treatment area is a Provincially designated recreational area. Controls were placed including communication with snowmobile club, to ensure work did not create safety risk to local users or create implications to land designation. Permanent signs were erected to communicate hazards.
4. Heavy equipment to complete site preparations required frozen access within peatlands. Field implementation was delayed due to ground conditions. Techniques for restoration were advanced to account for deep frost conditions. A modified mounding method to keep organic soils intact was introduced. Field crews confirmed method met project objectives.

## SPECIES RECOVERY IN ACTION: BOREAL CARIBOU HABITAT RESTORATION AT THE LANDSCAPE SCALE

Given the inherent risks of implementing an aggressive winter restoration program in a remote area, with new contractors from the local community and under an unknown authorization process; the program offered a high degree of difficulty. The primary challenge was executing the program while training contractors and technicians on the objectives and techniques under a research set budget. Golder implemented strategies to address inherent risks and degree of difficulty and met the project budget and schedule. Contracts were negotiated to manage. Signed daily field reports by field crews were used to track costs on daily basis. Weekly financial reports were prepared.

As restoration had not been implemented before, the community questioned the techniques. Through Open Houses and communication, Indigenous field monitors; feedback from experts was provided to the community. Recreational users became important allies for knowledge and plans were adjusted to avoid conflicts. Despite weather, access and human elements of the program, no health and safety lost time injuries or reportable incidents occurred.

### Advancement of Technology

Techniques for habitat restoration were also advanced during the project. Over 13 km of linear segments were treated with mounding and frozen seedling planting. Sites treated with mounding and frozen seedling planting were completed with 2 Caterpillar 325 excavators with a 1.5 m wide bucket with frost breaking teeth attached. The mounds targeted 1200 microsites/ha suitable for seedling planting, using a traditional (forestry style) mounding style of leaving undisturbed space between mounds (Photo 7). However, given deep frost conditions which were encountered, many of the treated sites were completed using a modified mounding method to keep organic soils intact, by creating a trench across the line, compared to the traditional mounding style (Photo 8). For the trench style mounds, the number of suitable microsites was estimated by measuring how many microsites were within a 3.99 m radial plot circle used to determine mound density to ensure that at least 1200 suitable microsites/ha was achieved. The field crews determined that this modified mounding method not only met the objective of microsite creation, but also was more effective at discouraging human and wildlife use than the traditional style of mounding. Quality Assurance/Quality Control (QA/QC) density checks were completed randomly on each line, several times per day, to ensure the target number of suitable microsites was being achieved.



Photo 7: Traditional silviculture style mounding



Photo 8: Modified Mounding Method Using a Berm and Trench Style

## Environmental Value

Woodland caribou are a species at risk across Canada and time is running out to keep them in the boreal forest. Pushing the limits on how to implement habitat restoration over landscape areas, in an effort to create large intact habitat patches to benefit the recovery of caribou populations is critical for all of Canada, in particular for the Indigenous communities who live in a holistic environment with caribou. This project created an opportunity for piloting an approach to effectively restore habitat for the benefit of a caribou population, while engaging and building opportunities for Fort Nelson First Nation to be intimately involved in a caribou recovery solution. This pilot project can be used as an example across Canada for other boreal caribou herds and Indigenous Communities.

## Added Value

The Zone 1 Implementation successfully utilized local operators and equipment. Time and budget was taken on the front end of the field implementation to train local operators and build local capacity in the treatment types and methods. As a result, the funding focused on Indigenous Community owned business and local businesses for all contractor and equipment requirements. In addition, community monitors provided opportunities for the local communities to visit the field treatments and ask questions about the objectives and anticipated outcomes. Use of the local community is believed to have built support for the restoration program. This approach has been recommended to the Ministry within a provincial habitat restoration framework for future restoration implementation programs in BC (Golder 2018, 2019).

## Benefit to Society

In addition, Fort Nelson is struggling from the downturn in logging and oil and gas activities. Broadening the skills of local workers allows for further job opportunities in future habitat restoration projects. Spending locally amounted to 44% of the contract award to Aboriginally and locally owned businesses. These restoration projects are building connections between local stakeholders and Indigenous community groups, informing restoration and mitigation policies in BC, Canada and ensuring consistent practices are being applied to maximize restoration effectiveness benefits for caribou along legacy rights-of-way.



## Conclusion

Caribou habitat restoration implementation comes at a relatively high cost economically. Current caribou population modeling exercises predict that habitat restoration will lead to an increase in caribou population numbers. The Program Plan, a multi-year program to spread out costs over multiple years, provides an opportunity to assess the mitigation efficacy of implementing restoration strategies on a defined caribou population. This will provide an opportunity to assess value of restoration treatments to a caribou population, identify challenges to implementation (e.g., Indigenous involvement and capacity building, seasonal conditions, terrain, regulatory procedures) and thereby inform considerations and costs of habitat restoration within other boreal caribou ranges in BC and elsewhere in Canada.

During an 8 week field program in the winter of 2017, implementation of the Program Plan within Zone 1 was completed. With the support of Fort Nelson First Nation's environmental monitors, environmental technicians, a locally owned Aboriginal contractor, and local service providers; restoration treatments including natural vegetation recovery, tree-felling and mounding/seedling planting were applied to 165 km of legacy linear disturbances within the Parker boreal caribou range. Key outcomes of the implementation program included local capacity building and learning opportunities for the Fort Nelson First Nation, regulatory guidance for future restoration programs within BC, feedback into a BC caribou habitat restoration framework, establishment of a program level long term restoration monitoring program, as well as a highlighted acknowledgement of the high desire of Indigenous communities for early and ongoing engagement and collaboration within larger landscapes on where and how to focus habitat restoration programs. This project is informing restoration and mitigation policies and practices in BC, as well as across Canada, to maximize restoration effectiveness benefits for caribou, federally listed species at risk.

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