PNG Legacy Site Restoration Program

Blueberry River First Nations Pink Mountain Reciprocal Restoration Program

Linear Seismic Restoration

December 2, 2022

Blueberry River First Nations
Keefer Ecological Services
Royal Roads University
WSP Golder Associates Ltd. (WSP Canada Inc)

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Executive Summary

Blueberry River First Nations (BRFN) legacy seismic restoration project at Pink Mountain aimed to restore legacy lines within our Treaty Land Entitlement (TLE) selection area, or priority area 1 (PA1), an area of high cultural significance for the Nation. This restoration project focused on caribou restoration as it took place within two caribou herd boundaries: Graham and Pink Mountain, both of which are in danger of extirpation. There was a large training component for members in this project with three different week-long training sessions on the landscape learning through a hands-on approach about seed collection and processing, restoration techniques, and earth sciences. BRFN received funding from the PNG legacy site restoration program through the BC Oil and Gas Research and Innovation Society (BCOGRIS). This project was completed with the support of WSP Golder, Keefer Ecological Services, and Royal Roads University.

It was initially determined there was 65 km of linear features within PA1 based on the desktop review; this number dropped to 30.9 km that were candidates for restoration potential after reconnaissance flights and stakeholder engagement. There were limited places to land via helicopter for ground plots and a large portion of the lines had to be assessed from the ground during training sessions or implementation. As a result, the final number treated for this restoration project was 16.04 linear kilometers over the course of 40 days. Access management proved to be difficult in some locations from the ground for a fall implementation program. The different restoration treatments on the ground included planting tree and shrub seedlings, building brush fences, sowing seed balls, earth mounding, tree felling, and screefing. BRFN is monitoring results of the brush fences to determine efficacy in blocking access as a restoration technique on the landscape.

This project took place largely over the course of one year with a GIS review and field reconnaissance occurring in September 2021 and restoration implementation occurring in September 2022. Within this project, there were 17 BRFN members, 1 Prophet River First Nations member, and 1 Doig River First Nation member trained in various facets of restoration throughout this project lifespan. We set up 12 paired monitoring plots on different lines for BRFN members to monitor at years 1, 3, 5, 10, and 15. When the lines were completed, we collected drone footage on 13 different lines flying up to 1 km down the line at different heights for long-term monitoring at years 5, 15, and 25. There are 18 wildlife cameras across the PA1 area on treated and untreated lines for monitoring wildlife movement and response on the lines.

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Table of Revisions

Revision No.	Date	Reason/Type of Revision

Acronyms & Definitions

Blueberry River First Nations	BRFN
British Columbia	BC
Keefer Ecological Services	KES
Royal Roads University	RRU
Treaty Land Entitlement	TLE
Priority area 1	PA1
British Columbia Oil and Gas Research and Innovation Society	BCOGRIS
Traditional Ecological Knowledge	TEK
Regional Strategic Environmental Assessment	RSEA
Committee on the Status of Endangered Wildlife in Canada	COSEWIC
Species at Risk Act	SARA
Hectares	ha
Alberta	AB

1 Introduction

Blueberry River First Nations (BRFN) are a Beaver and Cree First Nation occupying a traditional territory that extends over 3.8 million hectares of the Peace River region of northeastern British Columbia. We are a self-governing Treaty 8 Nation, with an elected Chief and Council. In 1900, the ancestors of the present day members of BRFN entered into Treaty No. 8 with the Crown, by which they consented to the settlement of the area in exchange for solemn promises made to them by the Crown. Foremost among those was the promise that Treaty No. 8 would not lead to forced interference with the BRFN way of life, including hunting, trapping, and fishing on the lands and waters. Today BRFN territory is one of the most impacted rural landscapes in Canada. The territory has seen decades of land alienation and degradation from logging, agriculture, hydroelectricity, and oil and gas development.

We are in a cumulative effects crisis from the impacts of industrial development, which has accelerated in recent years. Approximately 73% of BRFN territory is now within 250 m of an industrial development (MacDonald, 2016). Given the extensive level of development in our territory to date, our Nation has an urgent mandate to halt the impacts of unsustainable development in our territory, and to close the gap between the extent and scale of the lands disturbed, and those restored and reclaimed to support healthy ecosystems. Closing the gap requires concentrated efforts for conservation on the landscape as well as actively restoring with ecological restoration.

Ecological restoration aims to rehabilitate degraded sites to restore ecosystem structure and function to their pre-disturbance levels. This involves setting nature on a positive trajectory to return to reference conditions to improve ecosystem structure and function. Ecological restoration consists of planting a diverse array of species as well as considering structural and cultural components. Including cultural restoration can return biocultural uses of the land base to our community. Biological and cultural systems have been linked for generations, and reciprocal restoration aims to increase the ecological integrity and resilience of restoration practices by promoting long term stewardship and management.

Many areas of the boreal forest are fragmented and have legacy seismic lines crossing the landscape. Caribou, once numerous and a primary food source for BRFN, are now listed as a species at risk both federally and provincially, and many other species, such as moose, have lost connectivity to historic ranges and habitats or are suffering depleted numbers because of landscape changes. These changes also impact culturally important plants since they cannot easily compete with invasive or non-native plants on areas of disturbance, and cannot easily survive when there are such drastic changes to the environment such as altered light, nutrients, substrate, or water inputs. The path forward relies on ecological restoration, conservation, and land protection. BRFN's Treaty Land Entitlement (TLE) parcel in Pink Mountain is one area where these actions can be fully implemented to help ensure BRFN treaty rights can be meaningfully practiced in future generations.

BRFN's reciprocal restoration program is focused on caribou restoration through restoring linear seismic disturbances on the landscape. This project had a large training component to ensure BRFN members are trained in different methods of landscape restoration and can provide input, as active users on the land base, to how the restoration is designed and focused.

2 Background Information

2.1 Project Location and Legacy Status

Pink Mountain, BC is critical to BRFN from a traditional use, cultural transmission, and treaty rights perspective. The greater Pink Mountain area is approximately 42,000 hectares (ha) in size, and includes 526 ha of legacy geophysical disturbance of various ages, widths, and states of natural regeneration stages.

BRFN chose an initial priority area (PA1) of 3950 ha for restoration within the broader mountain valley. This small parcel of land is the BRFN TLE selection parcel south-west of Pink Mountain and along the Halfway River (Figure 1). While the TLE selection parcel is small in comparison to the larger mountain landscape that BRFN members use, it provides an immediate, long-term legislative protection greater than Section 16 or 17 withdrawals under the Land Act. Restoration in BRFN's Pink Mountain TLE will also function as a core protected area to restore out from as we continue restoration work in the surrounding matrix. Pink Mountain is sacred for the Nation, and the original disturbances on the mountain and surrounding area were done without consultation or recognition of the importance of the place. Within PA1, there are approximately 65 km of legacy seismic disturbances based on the Regional Strategic Environmental Assessment (RSEA) disturbance dataset.

PA1 is located within the woodland caribou ranges of the Graham and Pink Mountain herd boundaries, both are classified federally as 'Special Concern' in COSEWIC (2017) and SARA (2005) (BC CDC, 2022). Provincially in BC they are on the Blue list (BC CDC, 2022). Both caribou herd populations are in a historic downward trend of their populations (BC MOE 2022). The BC government has completed predator reduction programs in these two caribou ranges from 2018-2021 for Pink Mountain herd, and 2020-2021 for the Graham herd.

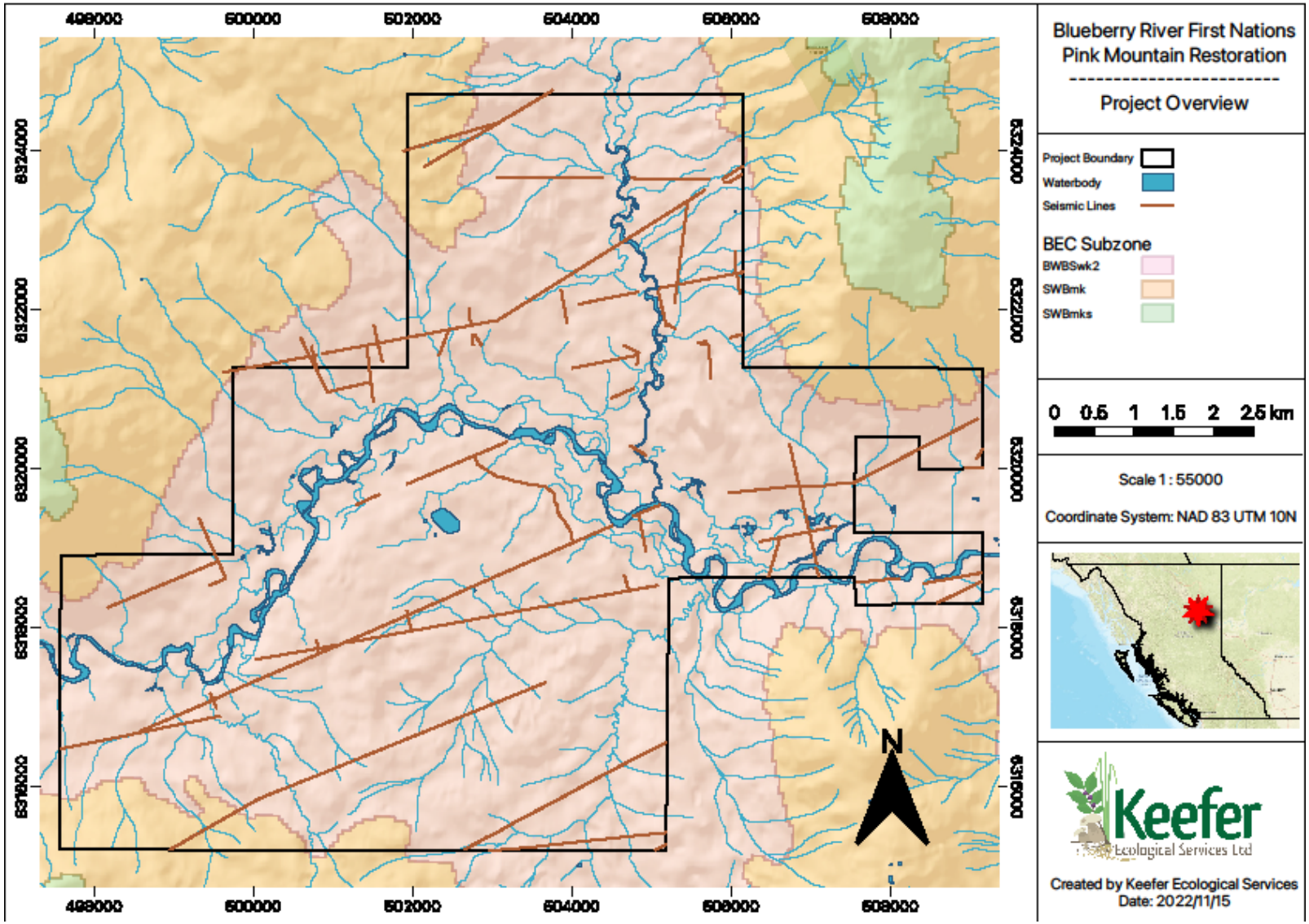

Figure 1. Biogeoclimatic Units, Seismic Lines and Water Features within the PA1 boundary

2.2 Biophysical Landscape

The TLE selection parcel is located on either side of the Halfway River and partly up Pink Mountain in the Halfway River watershed. The area encompasses both Graham Boreal White and Black Spruce wet cool - (BWBSwk2) biogeoclimatic variant and Spruce-Willow-Birch moist cool and moist cool scrub (SWBmk and SWBmks) biogeoclimatic subzones in the large valley. The SWB is located in the sub-alpine above the BWBS and typically includes white spruce and sub-alpine fir but can also include, to some extent, black spruce, aspen, and pine. The trees found in the BWBS are predominantly white spruce, black spruce, trembling aspen, lodgepole pine, and balsam poplar (in roughly that order of dominance). The bulk of the treatment area is covered by mature upland forest, with poorly productive, Black Spruce – Huckleberry – Lingonberry (BWBSwk2/104) (DeLong et al. 2011) site series predominating. Soils are predominantly fine-textured, with no coarse fragments.

The adjacent mountainside and summit are home to at least 11 species at risk, including red-listed species as well as endemic species. The Pink Mountain area also includes alpine tundra habitat. These critical and unique ecosystems have inherent value, aesthetic value, ecological value, and cultural value.

2.3 Project Scope

The Pink Mountain Reciprocal Restoration Plan planned to restore up to 33 km of linear seismic disturbance with the support of WSP Golder Associates Ltd. (WSP Canada Inc), Keefer Ecological Services (KES), and Royal Roads University (RRU) in Autumn 2022. The priority of this project was training for community members in caribou restoration techniques on the landscape leading up to and during the construction phase of this project. This training helped build capacity for BRFN Lands and Restoration Departments. Restoring for caribou as a focal species also meant other species would benefit from reduced disturbance and increased plant diversity. This project was largely completed in the span of 1 year with field reconnaissance and stakeholder engagement commencing September 2021.

2.4 Restoration Goals and Objectives for PA1

Goal 1: To restore up to 33[1] km of legacy seismic lines to maintain meaningful cultural practices on the landscape as well as maintaining wildlife and plant diversity

Objective 1.1: Accelerate passive restoration succession with well-spaced, dynamic tree growth > 1 m within five years (structure: line of sight barrier; function: thermoregulation and snow interception)

Objective 1.2: Achieve 75% of site series species composition within 5 years (structure: microsites; function: ecosystem resilience, pollinator plant diversity)

Objective 1.3: Ensure 75% of reference system's coarse woody debris (CWD) volume present throughout disturbed area once activities are complete (structure: microhabitats and shelter; function: increased fungal activity, reduce motorized access)

[1] Original proposal stated up to 40 km of legacy seismic. This was reduced to 33 km after stakeholder engagement and helicopter overview flights. The number was anticipated to be lower once ground truthing started during implementation.

Objective 1.4: Maintain line of sight < 250 m across all legacy seismic lines within 5 years (structure: vegetation strata, multi-story canopy; line-of-sight barrier; function: predator-prey dynamic regulation; prevention: limiting additional disturbance)[2]

Goal 2: To restore and maintain BRFN cultural continuity, intergenerational knowledge transfer, and mutual land relationships through biocultural (reciprocal) restoration

Objective 2.1: Train at least 20 people, from both BRFN and other communities[3], in technical restoration and land stewardship techniques by 2022

Objective 2.2: Staff record or otherwise preserve Elders' TEK and place-based knowledge during planning and implementation phases where possible as a legacy piece for the community

Objective 2.3: Create community cultural wild gardens with enhanced densities of culturally important species at key loci within project footprint by October 31, 2022

Objective 2.4: Showcase project at BRFN Culture Days in 2022 and 2023, including site visits with Elders and youth as practicable; at minimum bring plant samples to demonstration booth

Objective 2.5: Lands staff to create poster as legacy internal communication piece for display in BRFN Administration building and new Restoration building by March, 2023[4]

2.5 Restoration Priorities

We determined the restoration priorities based on the connections among BRFN community, the land, and wildlife on it. Restoring linear features in a culturally and spiritually significant place where the community reconvenes multiple times a year means members can see the restoration results throughout their lives and monitor the growth of the trees, showing generations of family members one way to heal the land. This is especially important after the land transfer of TLE from the government and ensuring the land is on a positive trajectory to returning to a cultural forest where members can practice their treaty rights.

Since PA1 is within two caribou herd boundaries and both herds have decreasing populations (Government of BC, 2021; BRFN local knowledge), prioritizing caribou as a species can help long term population goals on the landscape. As caribou are a keystone species, restoring seismic lines can push predators to the forest game trails and reduce pressures on ungulate and herbivory species. Restoring the forest helps with natural processes, e.g., water retention, plant diversity, and carbon storage.

[2] Original proposal had an objective about soil compaction, however soil compaction was not tested in the monitoring plots and thus removed from objectives.
[3] Original proposal stated 20 BRFN community members; the training was extended to other First Nations and reflects the changes.
[4] Original proposal stated October 31, 2022. Due to time constraints and the purchase of a new Restoration building since July 2021 the timeline was extended.

2.6 Summary of Activities

While this project was initiated in July 2021 with a funding proposal sent for the BCOGRIS grant, the distribution of funds and agreement was not completed until October 2021. Community and stakeholder engagement has been ongoing for this project since July 2021 given the short timelines between start of project and restoration implementation.

The activities over the past year have taken a phased approach (Table 1), starting in late September 2021 with reconnaissance flights over all the linear disturbances in PA1 and classifying them based on their regeneration, ATV/UTV presence, and perceived presence of wildlife use.

Table 1. Project Activities and Timelines

Activity	Timeline
Phase 1: Pretreatment Inventory and Planning	*July 2021-February 2022*
• Activity 1: GIS analysis	September 2021
• Activity 2: Field work: flights and ground	September-October 2021
• Activity 3: Seed collection and community training	October 2021
• Activity 4: Community engagement	July 2021 - October 2021
• Activity 5: Stakeholder engagement	July 2021 - October 2022
• Activity 6: Preliminary site prescriptions	November 2021
• Activity 7: Seedling procurement	November 2021
• Activity 8: Finalized site prescriptions	December 2022
• Activity 9: Permit applications	November 2021 - February 2022
Phase 2: Treatment Implementation	*June 2022 - October 2022*
• Activity 10: Community training	June 2022
• Activity 11: Community engagement	July 2022
• Activity 12: Community Training	August 2022
• Activity 13: Restoration Implementation and establishing monitoring plots	September-October 2022
Phase 3: Reporting	*November 2022*
• Activity 14: Final reporting	November 2022

3 First Nations Participation

Blueberry River First Nations is a Treaty 8 signatory that led this project to completion. The BRFN Lands Department managed the project for the Nation, with both Elders and members involved in many different aspects of the work, including: field work, training, seed collection, line prescriptions, and restoration implementation. Training was done in a way that emphasized practical skills delivered via an experiential approach to learning. The positive feedback received from learners supported this delivery approach.

Both Doig River and Prophet River First Nations elected to send a member representative from their Nations to participate in the training and restoration at Pink Mountain with BRFN. Over the course of the project, 17 BRFN members, one Prophet River First Nations member, and one Doig River First Nation member participated in the training program. During stakeholder engagement, all other Treaty 8 Nations were notified of the work and invited to meet to discuss the project.

Community engagement was ongoing with BRFN members throughout this project to ensure that legacy lines that are actively used would not be restored. Member engagement was also a priority for finalizing restoration treatments, determining what propagules will be collected, and what plants will be used in the creation of a cultural garden - a site within the restored area footprint where plants of critical importance to the community will be emphasized in restoration implementation.

4 Methods

The project is broken into two distinct phases:

- Phase 1 prescription development, and
- Phase 2 project implementation.

Prescription development (Phase 1) is reported in detail in the Blueberry River First Nations Pink Mountain Reciprocal Restoration Plan (Golder, 2022). Phase 1 will only be described in brief in this document to focus on presenting Phase 2 activities.

4.1 Phase 1: Prescription Development

Prescription development was achieved through a multistage process consisting of the following:

- Assessment of digital data, including an inventory of linear features (i.e., seismic lines), relevant landscape features (i.e., water and wetland features, biogeoclimatic units, existing road and recreational trails, and land tenure).
- Aerial assessment of candidate seismic line to assess the amount and stature of vegetation, presence of off-road vehicle tracks, water crossings, and potential access.
- Blueberry River First Nation community outreach consisted of in-person and virtual community meetings to solicit input.

- Indigenous Engagement: Information packets were sent to six other Indigenous communities whose traditional territory overlaps with the project.
- Stakeholder engagement: parties with tenure or other interests in the project area were contacted to identify conflicts with potential restoration treatments.
- Final prescription development: The above data and input were then synthesized into a plan for treating the seismic lines within the project area.

The prescription development process identified permits and regulatory approvals that were required for the implementation of the project to proceed. This included:

- Special Use Permit (SUP)
- A notification of proposed work under the BC Water Sustainability Act.
- An Authorization to Cut under Section 52 of the BC Forests and Range Practice Act (FRPA).
- Road Use Agreements
- Archaeological Overview Assessment
- Chance Find Procedure development
- Motor vehicle exemption for the portion of the project area overlapping the Muskwa-Kechika Management Area.
- An assessment of potential species at risk.

4.1.1 Third party engagement

After prescription development, BRFN reached out to stakeholders within the area to encourage comments, support, or align priorities within the project to ensure the success of the program (Table 2). BRFN received numerous letters of support for the project and also adjusted the restoration program as needed to accommodate other users on the landscape.

Government	Scott Schilds, Wildlife Biologist, FOR Nadia Skokun, Land and Resource Specialist, FOR Denise Booy, District Recreation Office, FOR Tara Forest, Sr. Resource Coordination, IRR
First Nations	Doig River First Nations Halfway River First Nations Prophet River First Nations Dene Tha First Nations Horse Lake First Nations West Moberly First Nations
Trapline Holders	3 traplines overlapping PA1
Recreation	Northland Trailblazers Moose ATV club FSJ North Peace Rod and Gun Club
Wind, Water, Energy	Aeolis Wind Power Corporation Canadian Natural Resources Limited Tangle Ridge Custom Crushing Canfor

4.2 Phase 2: Project Implementation

Project implementation required obtaining resources to implement the prescriptions and adjust them according to conditions found in the field. Resources that were required for implementation included:

- Tree and shrub seedlings for out-planting
- Seeds collected during training sessions
- Site preparation contractor to implement mechanical screefing and mounding treatments
- Tree planters
- Tree fallers to create tree barriers along the seismic line and create bridge crossings over water courses and wetlands.

These various facets of implementation were coordinated to ensure that the project would be implemented in late summer and early fall of 2022.

4.2.1 Tree and shrubs

Conifer tree seedlings appropriate to local conditions were purchased using the provincial Seed Planning and Registry Application (SPAR). This seed was then forwarded to Woodmere Nursery in Fairview, AB for propagation. Two species of native alder were obtained from Twin Sisters Nursery in Moberly Lake, BC, a native plant nursery in the region.

4.2.2 Site preparation contractor

A general contractor and BRFN service provider experienced with restoration implementation who had equipment appropriate to complete the required treatments was contracted for this restoration project. The prescribed ground preparation treatments were screefing and mounding. Screefing consisted of mechanical scarification to remove dense vegetation to facilitate tree planting. Mounding was prescribed for areas with a water table near the soil surface. Mounding provided a better drained and warmer planting substrate as well as creating terrain obstacles for both humans and predators.

4.2.3 Tree planters

The tree planters employed in the project were all Blueberry River First Nations members or neighbouring First Nations. All tree planters had participated in the training program associated with this project.

4.2.4 Tree fallers

A crew of certified tree fallers large enough to match the anticipated production of the tree planters was sub-contracted. The bulk of the fallers were Blueberry River First Nations members.

4.2.5 Monitoring plots

Monitoring plots were established to evaluate the efficacy of the various treatments. These monitoring plots followed the BC OGRIS Restoration Monitoring Framework methodology (Golder 2015). Monitoring plots were replicated within each treatment type in adjacent treated seismic lines, untreated seismic lines, and undisturbed forests. In addition to rehabilitation treatment monitoring plots, remote cameras to monitor wildlife and human use before and after treatments were planned to be installed. A total of 30 cameras were in the initial camera monitoring design. Locations for the cameras considered the following factors:

- A variety of treatment types (i.e., planting, falling, machine screefing, mounding)
- Natural forested areas for reference (i.e., no treatment)
- High-traffic areas (i.e., human access, game trails, tree rubs)
- Brush fences

4.2.6 Quality Assurance

In addition to daily ongoing supervision of the planting and site preparation, a quality assessment (QA) of the Phase 2 implementation activities was conducted over a two-day period by Jack Yurko of WSP Golder. The QA report is found in Appendix A.

5 Results

Project implementation began on August 29, 2022. Project photos are found in Appendix B. Detailed treatment data is found in Appendix C.

5.1 Stakeholder Engagement

The prescription document (Golder 2022: Appendix E) lists stakeholder engagement activities. Stakeholder engagement was ongoing throughout project. The first few stakeholders were engaged during proposal development in July 2021. BRFN received letters of support from both Doig River First Nations and Halfway River First Nations at this time. All other stakeholders were engaged after prescription development in October 2021 and again in January 2022 to provide progress updates with maps and allow time for review and feedback. BRFN also received a letter of support from the BC Caribou Recovery Team. Delays in government processes prevented BRFN from obtaining the necessary Section 16 permit to bring mini-excavators on the Halfway River Trail north of the river to complete restoration on lines stemming off the trail. There were still engagement discussions occurring during implementation, which forced BRFN to change prescriptions.

5.2 Permits and Regulatory Approvals

Almost all the required permits and regulatory approvals were obtained before the commencement of implementation in autumn 2022. The permitting process began in November 2021 and was completed in February 2022. Permit approvals from the BC government were received in June 2022.

5.3 Trees and shrubs

The calculation of the number of trees and shrubs required to meet the project's objectives were based on the restoration prescription by linear segment, which was informed by the aerial reconnaissance and on remotely assessed data (i.e., available ecosystem mapping to inform what species to plant where treatment areas were identified from the aerial overflight) with very limited ground-based verification. The seedling order totalled 27,000 conifer seedlings and 6,500 alder seedlings. The conifer seedlings were raised as 412A plugs by Woodmere Nursery in Fairview, Alberta, and the alder seedlings were raised as similar-sized plugs at Twin Sisters Native Plant Nursery in Moberly Lake, BC. These numbers were based

on a linear distance of 30.9 km of planting treatment, an average width of a seismic line of 8 m, and a target stocking density of 1,400 stems/ha.

A variety of species were planted to accommodate the variability in site conditions. Site conditions were predicted using the available predictive ecosystem map (PEM). The PEM used the local area's biogeoclimatic ecosystem classification (BEC) system (DeLong et al. 2011) to describe ecosystems. Four species of conifer, white spruce (*Picea glauca*), lodgepole pine (*Pinus contorta*), tamarack (*Larix larcina*), and black spruce (*Picea mariana*), were planted in descending order of abundance (Table 3). Two species of alder were planted Sitka or green alder (*Alnus viridis*) and grey or mountain alder (*Alnus incana*) (Table 3).

During the helicopter overflight for the prescription development and subsequent road-accessed ground-truthing, numerous ground checks were to be completed. Ground checks verified ecosystem conditions, appropriate tree species proportions, and width of required treatment on lines slated for treatment. Due to issues with helicopter landing spots, very poor road access, snowfall, and wet conditions, almost no ground checks were possible before the seedling orders were placed. When access improved and off-road vehicles were utilized to assess ground conditions, it was discovered that some assumptions in the prescriptions were inaccurate. Lines identified for treatment in most cases required treatment only for the portion of the line that had all-terrain vehicle (ATV) tracks. This generally meant that only four or fewer meters of line width (i.e., half or less of the total line width) required planting.

Additionally, some areas identified as treatable were sufficiently vegetated that no treatment was needed, and conversely, some areas suggested for no treatment were identified as benefitting from treatment. This adjustment of treatment location resulted in very little net change in the overall treatment area. A more significant effect was realized by areas being found inaccessible due to extremely wet conditions or overgrown roads. The combined effect of the reduced treatment area due to the above factors was that only 43% of the ordered seedlings could be planted (Table 3). The excess seedlings that could be salvaged (i.e., not affected by fungus) were sorted and used on other BRFN restoration projects. A total of 16.04 km of the line was planted (Figure 2), which is 52% of the prescribed 30.9 km of planting suggested in the prescription. Planting density was increased approximately two-fold to compensate for the reduced width of treatment lines and access issues.

Table 3. Tree and shrub species ordered and target ecosystems for planting.

Tree/shrub Species	Number of seedlings delivered	Number of seedlings planted	Target ecosystem*
White Spruce	14,000	4,950	Dry (BWBSwk2/103), mesic (BWBSwk2/101), productive forested wet (BWBSwk2/110, 111)
Lodgepole Pine	6,000	2,500	Dry, mesic, poorly productive forested (BWBSwk2/104)
Tamarack	4,000	1,900	Productive forested wet, bog and fen
Black Spruce	3,000	3,000	Poorly productive forested, bog and fen
Sitka alder	4,500	1,250	Mesic, dry
Grey alder	2,000	1,350	Productive forested wet, bogs and fen
Total	33,500	14,950	

*The site series referred to (e.g., BWBSwk2/101) are as described in DeLong et al. (2011)

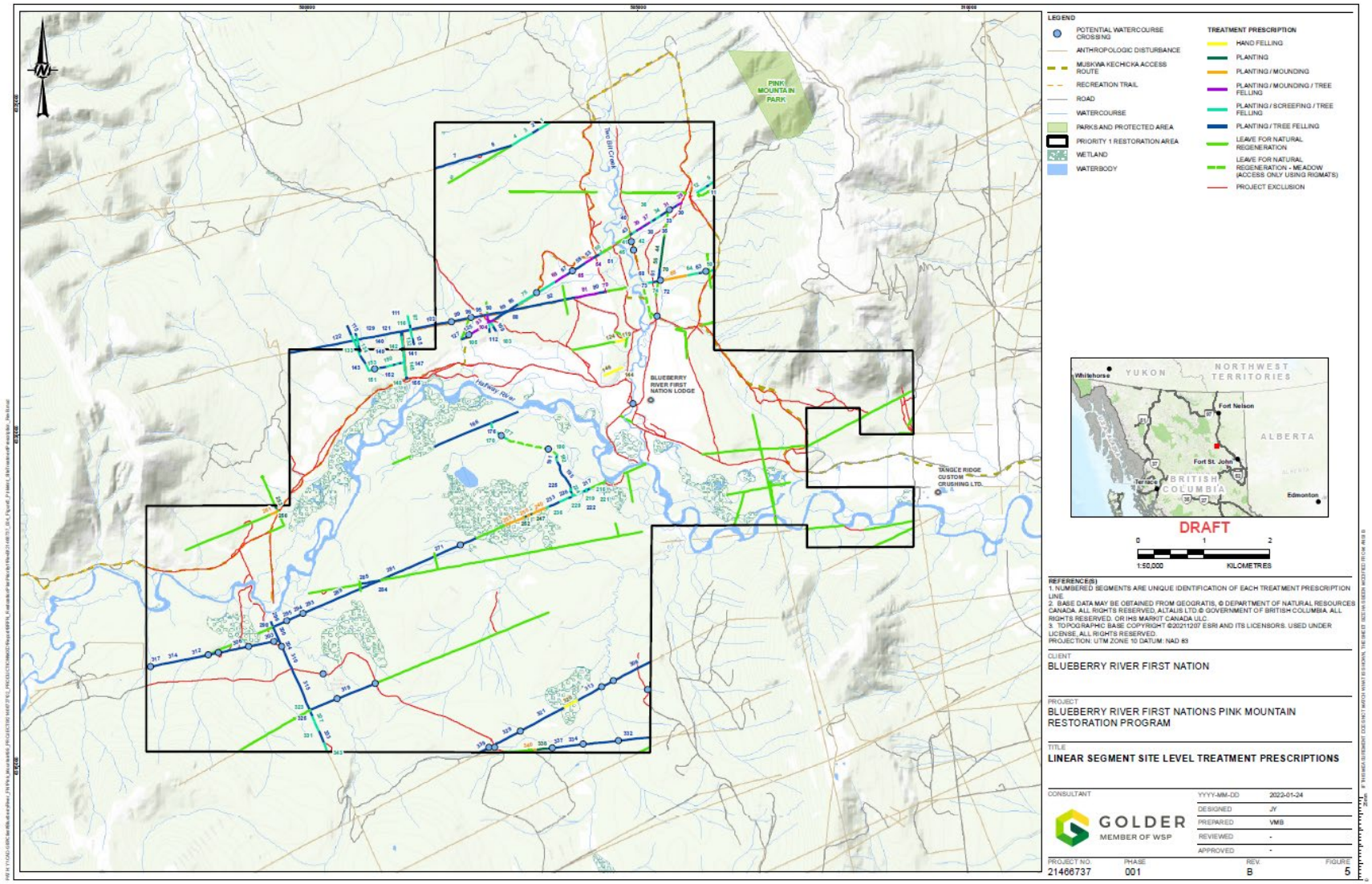

Figure 2. Map showing restoration treatment type by linear segment

5.4 Site preparation

Golden Base Contracting Ltd. carried out mechanical site preparation using a Bobcat 323 tracked mini-excavator. The excavator completed 1.84 km of mechanical screefing (Figure 3) and 2.22 km of mounding (Figure 4). There are variances in predicted vs. actuals as a large portion of the restoration was difficult to access and in-field decisions were made to change the prescriptions. BRFN elected to reduce the amount of prescriptions on the north side of Halfway River because of ongoing discussions with Recreation Sites and Trails BC. The excavator utilized large timbers to span watercourses and wet areas to reach treatment areas and avoid damaging bed or bank or sensitive sites.

Figure 3. Mechanical Screefing

Figure 4. Mechanical mounding

5.5 Tree falling

Tree felling occurred in conjunction with tree planting on 11.46 km of the treatment lines. Tree felling took the form of felling trees across the width of the seismic lines to create a visual and movement barrier about 1.5m in height and 5m wide every 30 to 50m along the lines (Figure 5). The smallest trees that would span the lines were chosen where possible. Tree fellers also cleared access routes of danger trees and constructed corduroy crossings of wet spots to aid access and protect sensitive soils.

Figure 5. Tree barriers

5.6 Monitoring plots

A total of 14 vegetation monitoring plot locations were established and measured (Figure 6). At each location, a paired treatment and undisturbed forest plot was measured within the same forest type. Two plots were established on mesic sites (BWBSwk2/101) hand-screefed and planted, 8 plots on poor productivity sites (BWBSwk2/104) hand-screefed and planted, two plots on subhygric (BWBSwk2/110), hand-screefed and planted, one plot on a fen site (BWBSwk2/Wf02) that was mounded and planted, and one plot on hygric (BWBSwk2/111) hand-screefed and planted. There were three remote cameras installed in July 2021 and the remaining 15 installed during implementation in September 2022 (Figure 6). These cameras will be used to assess wildlife movement on the lines in response to the treatments. Cameras that are on untreated lines will be used as a control to compare between the treatment types. Batteries and SD cards will be changed twice a year.

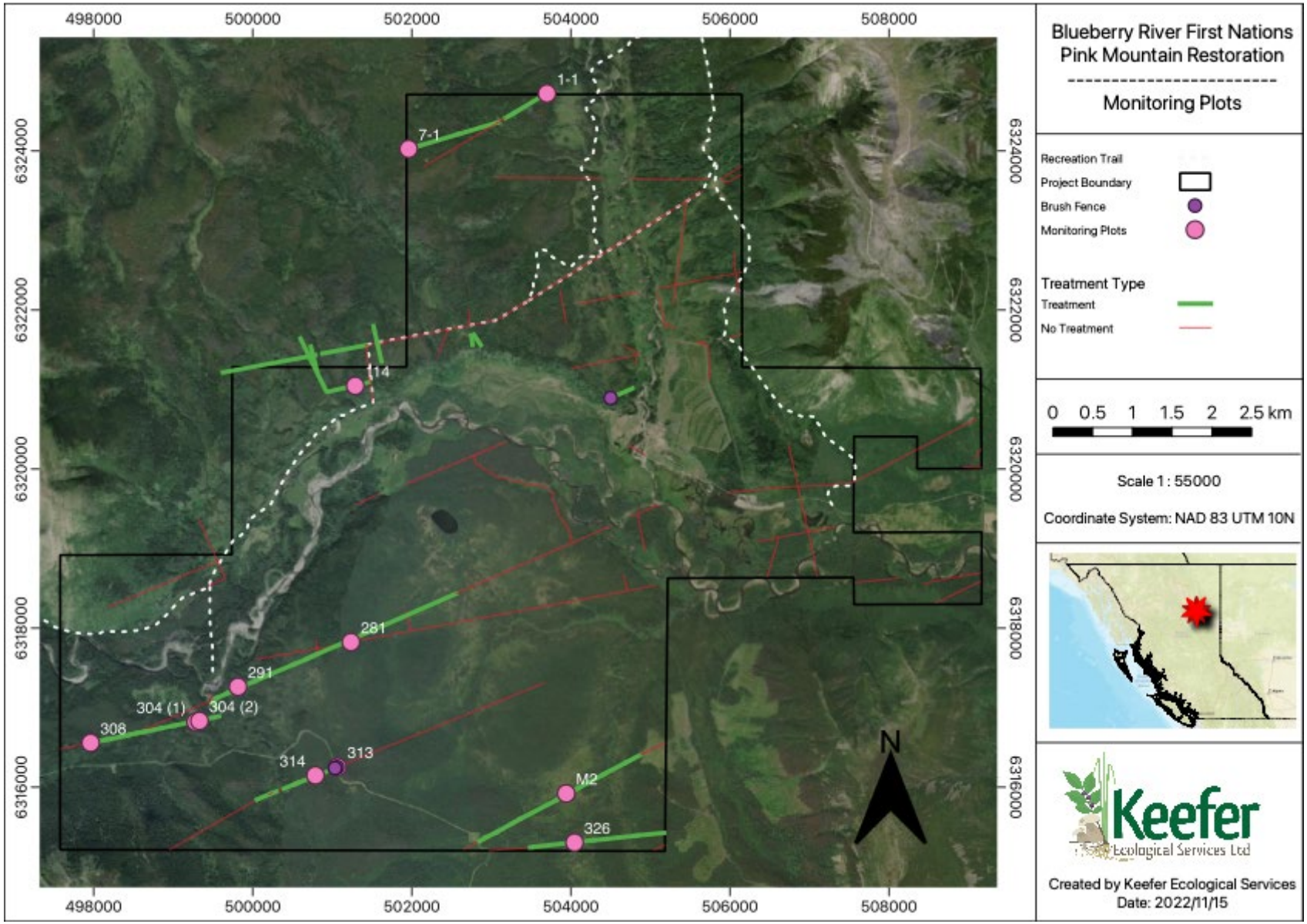

Figure 6. Map showing the locations of restoration treatment monitoring plots

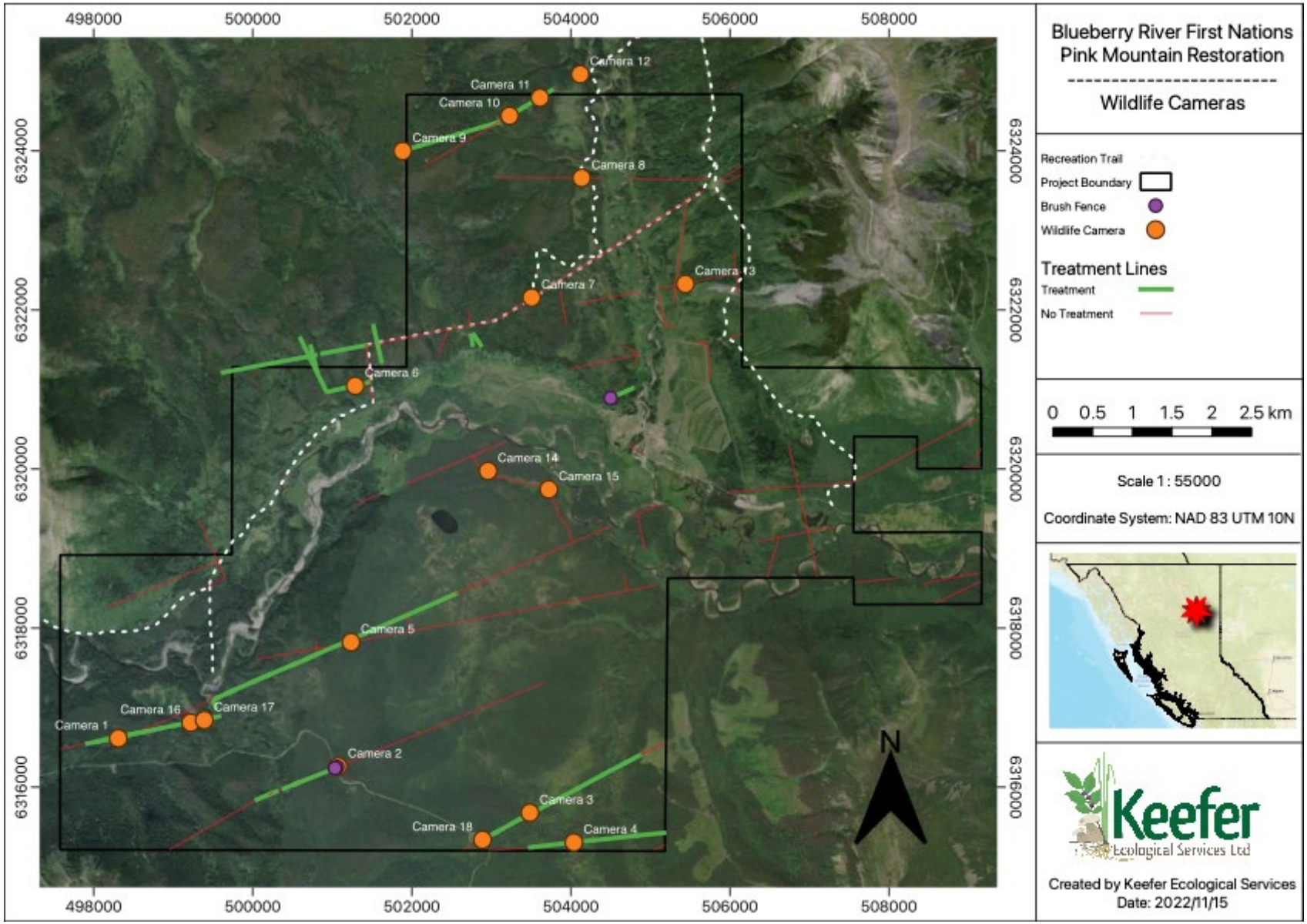

Figure 7. Map showing the locations of wildlife remote camera monitoring locations and brush fences

6 Location & Timing of the Completed Activities

6.1 Phase 1: Pre-treatment Inventory and Planning

Prescription development is detailed in WSP Golder (2022). Prescription development occurred over PA1 outlined in the proposal (referred to as project boundary on Figure 2). Phase 1 followed largely as outlined in the proposal.

One difficulty was obtaining ground data before implementation. The timeline for the field survey was condensed due to the delay in receiving the funding and occurred in late autumn. As well, there was difficult ground access, i.e., ground access to large portions of the project area is only possible using ATVs during the driest portion of the year and limited landing spots for a helicopter during overview site assessments. The prescription and subsequent seedling order were reliant on remote mapping and the helicopter overflight.

Seed collection had a large training component. Members collected, processed, and stored seeds of cultural plants within the project area. Initially, BRFN hoped to use this locally sourced seed to propagate seedlings, however with the tight timelines of the project, it was logistically simpler and more member-inclusive to create seed balls using locally sourced clay and seed (Mueller et al., 2021). These seed balls were subsequently out-planted along select treatment lines.

6.2 Phase 2: Treatment Implementation

Table 2.Site Restoration Summary for the Reporting Period

Treatment Method(s)	General Site Location	Total Length Restored (km)	Total Area Restored (ha)
Planting		**0.53**	**0.424**
	North	0.13	0.104
	Northwest	0.23	0.184
	Southwest	0.17	0.136
Falling + Planting		**11.45**	**9.161**
	North	1.78	1.424
	Northwest	3.56	2.848
	Central	0.56	0.448
	Southwest	3.01	2.408
	South	2.54	2.033
Mounding + Falling + Planting		**1.96**	**1.57**
	Southwest	1.35	1.08
	South	0.61	0.488
Screefing + Falling + Planting		**1.58**	**1.264**
	Southwest	1.10	0.880
	South	0.48	0.384
Screefing + Mounding + Falling + Planting		**0.52**	**0.416**
	Southwest	0.29	0.232
	South	0.23	0.184
TOTAL		**16.04**	**12.86**

*Note. See Appendix C for the detailed treatment data.

6.3 Phase 3: Restoration Activity Performance Monitoring

During restoration implementation, 12 paired restoration treatment monitoring plots were set up. The distribution of the monitoring plots reflected the abundance of ecosystems found in the project area. As this is the plot establishment phase, no conclusions can be drawn as yet. The wildlife cameras are useful for performance monitoring for short term influence on human and predator access. Due to the decreased restoration in PA1, 18 cameras were installed instead of the anticipated 30.

6.4 Project Training Initiatives

Training and capacity building within the BRFN community (and adjacent communities) are important components and objectives of the project. The training program was led by Professional and Continuing Studies at Royal Roads University (RRU), in partnership with Lands staff from BRFN and staff from Keefer Ecological Services (KES). The majority of the 17 students who participated in some or all of the training program were members of Blueberry River First Nations, with the training extended to one student from Doig River First Nation and one student from Prophet River First Nation. Students who successfully complete the training program receive three undergraduate credits from RRU.

The approach to the training program designed in collaboration between RRU, Lands Department staff, and Keefer Ecological Services, was to focus on practical land management and restoration skills delivered in an engaging way, and on the land as much as possible. Three training sessions of one week each were delivered at different times during the project term:

- Session 1: October 4 – 8, 2021;
- Session 2: June 6-10, 2022; and
- Session 3: August 22-26, 2022.

The training was focused on ensuring students were ready and able to fully participate in the implementation of the reciprocal restoration project, and to gain skills they would be able to apply in future. Given the scope of restoration needs across the territory, it is anticipated that members receiving this training will have the opportunity to apply the skills acquired much more broadly in future.

The three training sessions covered a range of topics as outlined in Table 3 below. *Session 1* (October, 2021) focused on orienting the students to the restoration project (what is reciprocal restoration? What are the goals for BRFN in undertaking this project?). The week of training also included an introduction to BC's biogeoclimatic ecosystem classification (BEC) methodology and its importance in restoration planning, plant identification to support restoration planning and seed harvest for propagule production, and establishing and completing vegetation and monitoring plots. We ended up harvesting rose hips in the snow after it snowed on the third day of the training week. We also completed a bioengineering exercise to demonstrate the use of wattle fencing using willow and cottonwood stakes for erosion control. *Session 2* (June 2022) included a reorientation to the restoration project, an in-depth refresher on applying the BEC system for restoration planning, and an introduction to the restoration techniques that would be applied in the project. *Session 3* (August 2022) focused on seedling care and planting procedures as we prepared for project implementation.

Table 3: Training Summary for the BRFN Pink Mountain Reciprocal Restoration Program

Training Received	Total Number of Members/Staff Trained	Issued Certifications (if applicable)
Plant identification	17	Undergraduate credits from Royal Roads University
Understanding the Biogeoclimatic Ecosystem Classification methodology	17	"
Seed collection methods	17	"
Vegetation and Monitoring Plots	17	"
Treatment methods for seismic line restoration (e.g., brush fencing, site mounding, etc.)	17	"
Seedling care	17	"
Proper site selection and planting techniques	17	"

6.5 Employment Information

Table 4: Employment Summary for the [Project Name]

Category	Actuals
Number of Team Staff Employed in Project Execution and total hours (including any personnel who received an honorarium for participation or whose work was provided in-kind).	For BRFN Lands staff, 6 existing staff were utilized throughout the lifespan of this project. Phase 1: 5 staff with 570 hours budgeted and 229 ($15,000) hours in-kind. Phases 2 and 3: 6 staff with 799 hours budgeted and 462 ($45,000) hours in-kind. Total hours for the project: 2,062 hours
	For trainees, 17 BRFN members and 2 (PRFN, DRFN) guests were trained throughout this project. Fall training 2021: 390 hours Spring training 2022: 690 hours Fall training 2022: 1300 hours Total training hours: 2,380 hours During implementation, the 19 trainees worked a cumulative 1370 hours to build brush fences, plant trees, and set up long term monitoring plots.
Number of Contractors Employed in Project Execution and total hours (including any personnel who received	For WSP Golder, 10 employees were utilized throughout the lifespan of this project for a total of 990 cumulative hours. WSP Golder staff worked side

an honorarium for participation or whose work was provided in-kind)	by side BRFN Lands and GIS staff sharing expertise to support BRFN's future permitting and planning efforts.
	For KES, 4 employees were utilized throughout the lifespan of this project for a total of 852 cumulative hours.
	For RRU, 2 employees were utilized throughout the lifespan of this project for a total of 355 cumulative hours.
	Golden Base Supervisor: 243 Hours Golden Base Operators: 218 Hours Golden Base Labour: 158 Hours Golden Base Lowbed Driver: 22 Hours Blueberry Fallers: 2160 Hours Blueberry Medic: 432 Hours Total Hours for the project: 3233 Hours

7 Discussion & Conclusion

As the restoration of PA1 was BRFN's first linear seismic restoration program there were some lessons learned throughout the year that will help improve future linear seismic restoration programs. The program was overall a success with 17 restoration-trained members and just over 16 linear kilometers treated on the landscape. There is a large amount of interest from other BRFN members to complete restoration training after this restoration program and to complete restoration on the landscape in other important cultural areas. The restoration of linear features on the landscape will continue in Pink Mountain and Graham caribou herds over the next few years to continue on the momentum from this project.

There were limitations on ground assessments of site conditions before restoration implementation. Having a good grasp of access limitations to collect ground information and subsequently apply treatments, along with an accurate assessment of ecological conditions is critical to having an accurate estimate of area and type of treatment required. If we had planned more field scouting days on lines, it would have led to a more accurate number of seedlings ordered, proportion of species ordered, amount of site preparation desired, and logistics of getting equipment to treatment areas. Due to the remote nature of some of the areas, landing helicopters was not possible on the seismic lines, especially as there was growth on the edges. The lack of on the ground observations resulted in an over-estimate of area that could accessed easily. Having to rely on the PEM rather than ground observations resulted in an under-estimate of the need for black spruce over the lines.

The accessibility of the lines in the autumn months proved to be difficult for the machines. Fens and muskeg were difficult to traverse without bringing in heavier machinery and swamp mats. We completed autumn implementation because of the timeline limitations of our external funding, instead of the more common winter programs for restoration of seismic lines. The benefits of autumn implementation were the mild weather while completing a first project and teaching members how to restore seismic lines. The last fall training session coincided directly before implementation, allowing members to get experience on the job immediately after learning the skills. The accessibility learnings of this project will help BRFN develop a winter implementation program for future phases of our seismic programs.

While BRFN engaged with stakeholder groups early to ensure the success of the program, there were permit delays during implementation that should have never occurred. These delays are something that should have been addressed earlier in the permitting process instead of during active implementation on the landscape as the government needs to prioritize restoration for Indigenous healing and species at risk.

We confirmed that a highly experiential approach to learning is the best way to build capacity in community. Experiential, hands-on learning methods are one of the best way for learners to develop new skills and knowledge, and it is certainly true with adult learners in community settings. Being flexible and adaptive to changing conditions, learner interests, and needs is also critical for success. At times we struggled to find ways for all learners to participate in all of the training components, but in the end, we realized that was not feasible given the conditions on the ground. Fortunately, our training delivery team (RRU, KES, Lands Department) was of a size that we could split up and work with different groups of students as required. One area of improvement may have been with the delivery of seedling planting training. In hindsight (and for next time), more time spent honing planting skills with one on one training

would have been better done in an open area near to the classroom location rather than in the field. This was a minor issue. Based on student feedback, the training was well received, and students enjoyed the learning process and were able to demonstrate the skills learned during the implementation of the project that followed the training.

The coordination of the many different factions on the line at the same time has helped improve our coordination and communication of each team as they work. We have learned how to efficiently coordinate tree fallers and planters and have a better sense of productivity rates for both teams. It is important in future projects to have site preparation equipment and tree fellers out early in the project due to time taken to get equipment to treatment locations and set up safe access along seismic lines. The few days delay can increase efficiency before tree planters arrive on the site. Largely, there will be more learnings in the years to come as we start the monitoring program in the next years to see the results of our restoration efforts. Until monitoring results come in subsequent years, we are unsure about the utility of planting wet sites without mechanical mounding. The cost per kilometer of this program is higher than normal considering the large training component for BRFN members and our contractors at $72,000/km.[5]

The members have demonstrated their commitment to healing the nation's territory. As an initial project of this type in the territory, BRFN has learned many valuable lessons and are ready to apply this knowledge to the many other areas in need of restoration.

[5] Cost calculated from all incurred expenses from summer training to completion of restoration actions on the landscape (August – October 2022).

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APPENDIX A

QAQC

TECHNICAL MEMORANDUM

DATE	17 November 2022	**Reference No.**	21466737-005-TM-Rev0
TO	Darian Weber Blueberry River First Nations		
CC	Paula Bentham, WSP Golder, Beth Thompson, WSP Golder		
FROM	Jack Yurko	**EMAIL**	**jack.yurko@wsp.com**

QUALITY ASSURANCE REPORT OF FIELD WORK AT PINK MOUNTAIN PRIORITY AREA 1

1.0 INTRODUCTION

Blueberry River First Nation (BRFN) had WSP-Golder develop a restoration plan and monitoring plan that BRFN would implement beginning in late August 2022. As part of the program WSP-Golder would provide a field visit during implementation to ensure compliance with the aforementioned documents. A WSP-Golder representative visited site on 5-9 September 2022.

Specific items that were considered during the field visit include the following:

- Installation of mounds and screefing site preparation;
- Number of planting spots;
- Number of planted trees;
- Number of unsatisfactorily planted trees, and reasons why they were not satisfactory;
- Vegetation monitoring plots; and
- Wildlife camera set up.

Results and observations of the field visit are presented below.

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2.0 OBSERVATIONS

2.1 Ground Preparation

On 5 September 22 an auditor from WSP-Golder began his assessment by visiting a seismic line where mounding was being performed for ground preparation. Mounds were smaller and further spaced than practical for the purposes of the program (Figure 1). The pits were also being refilled with the organic moss layer. WSP-Golder instructed the crew to refrain from filling the pits in with the organic layer of moss and forbs as it contradicted the intent of pits, which is to reduce the ability of animals and humans to travel down the seismic lines. The organic materials also did not fill the pits fully but made them appear to be level with the ground surface. This made them a hazard to walk down as they formed a tripping hazard. WSP-Golder spoke with the operator and construction foreman and operator to explain the process and the intent of the activity as outlined in the restoration plan (the Plan).

Figure 1: *The mounds being excavated when WSP-Golder arrived. Mounds were too small and too far apart to achieve the goals of hindering movement of animals and humans down the seismic line. The red circles shows where the moss layer was being put back into the pits forming a tripping hazard.*

The operator was using a small machine (Bobcat 323) to enable easier movement across the different landscapes, but the smaller machine required more effort to dig the size of pits and mounds required (Figure 2). Once the crew was redirected to not fill the pits back in, and to create larger deeper holes they were able to be less technical in moving the earth and speed up the process. Pits and mounds were created across the width of line adjusting for tree and shrub growth along the edges (Figure 3).

Figure 2: *The operator practicing different techniques to dig the appropriate size and number of pits and mounds using the smaller machine.*

Figure 3 : *Mounding on a seismic line after the crew was informed and practiced in the technique. Mounds are across the line with some variation to accommodate for tree and shrub growth along the edges of the seismic line*

Figure 4: An example of screefing on a seismic line.

When the crew arrived at a section where screefing was required a few different methods were tried out to determine what worked best for the machine on the substrate. The machine was not able to drag the bucket across the line in a perpendicular fashion and ended up using a technique of pulling back the organic layer in rows and patches to expose the mineral soil (*Figure 4*).

The crew lead for Keefer Ecological Services (Keefer) asked if they could forgo the row across and instead install multiple patches that are slightly askew to maximize planting opportunities that were less symmetrical. WSP-Golder agreed that they can experiment with the exact layout of the screefed patches so long as sufficient planting opportunities were maintained.

2.2 Tree Falling and Brush Fences

On 6 September 2022 WSP-Golder made his first visit to a tree felling crew. It was observed that the tree fellers were falling the trees in quantities that were not sufficient to provide a satisfactory barrier sufficient to impede a predator and provide coarse woody debris to support seedling establishment (*Figure 5*). WSP-Golder discussed with the tree fellers how to determine which sections of seismic line should have tree felling focussing on areas that have trees large enough to cross the seismic line and enough trees to build a pile that impedes an animal's ability to move through the area. Sections that have sparse tree cover on either side of the seismic line can be left and space between tree felling increased as appropriate to achieve the purpose of felling trees. Discussions also included felling trees in such a way that they didn't just cross the seismic line, but also push slightly into the forest, which would cause an animal to enter the forest deeper to get around the brush pile. When WSP-Golder returned to the tree felling crews on subsequent days the brush piles were generally of an adequate height and width and made getting around them very difficult forcing WSP-Golder into the forest (*Figure 6*).

One brush fence was installed at the time of WSP-Golder's visit (*Figure 7*). The fence was approximately 1.7 m high and went across the width of the seismic line. The fence was dense enough that one could not see through it. It appeared to be stable in construction and it used standing trees to help stabilize it. The fence appeared as though it would stand up to weather events and disturbance from animals.

Figure 5: Trees dropped in a pile across the seismic line that was unsatisfactory as it was easy to climb over and unlikely to prevent the movement of animals down the line.

Figure 6: Trees dropped in a pile across the seismic line that easy to climb over and unlikely to prevent the movement of animals down the line.

Figure 7: The completed brush fence spanned the width of the line, was densely built and hard to see through, and was installed using trees on either side to aid stability.

2.3 Planting

WSP-Golder assessed planting throughout the field visit and on multiple lines with different treatments. Species planted were black spruce (*Picea mariana*), tamarack (*Larix laricina*), and speckled alder (*Alnus incana*) in lowland areas, and white spruce (*Picea glauca*), lodgepole pine (*Pinus contorta*), and sitka alder (*Alnus viridus*) in upland areas.

In general, the seedlings were well planted with none of them being loose in the soil. During the span of WSP-Golder's visit areas that were mounded (*Figure 8*) or had no ground treatment were planted, but at the time of the visit no sections of machine screefing had been planted yet. In the areas with no ground treatment, straight planting with boot screefing (i.e., exposing mineral soil by removing the organic layer with a boot) was employed (Figure 9).

Figure 8: Trees planted in a section of seismic line that was mounded as a site preparation prior to planting.

Figure 9: A white spruce planted using a boot screef method.

WSP-Golder performed five plots at planting locations to determine the density of seedlings planted. Plots were an 8 m circular plot. Some plots indicated that species distribution was not being maintained consistently across the site, with planting densities different from those recommended in the treatment plan/table. Generally, sites had more seedlings planted per hectare than was recommended. Results are shown in Table 1.

Table 1: Planting Assessment Plots

Plot	Location	Seedling Species 1	Seedling Species 2	Seedling Species 3	Notes
1	10V 502055 E; 6318212 N	Black Spruce	Speckled Alder		Density slightly low with 1200 seedlings/ha vs a recommended planting of 1400/ha. Boot screefing was the ground preparation method.
Number		4	2		
Density/ha		800	400		
2	10V 501823 E; 631812 N	Black Spruce	Tamarack	Speckled Alder	Mounds in this section were small and widely spaced and WSP-Golder requested they plant at higher densities to account for the lack of ground preparation.
Number		18	10	14	
Density/ha		3600	2000	2800	
3	10V 498781 E; 6316718 N	Lodgepole Pine	White Spruce	Sitka Alder	Overall density was adequate, but species variety was skewed towards white spruce. Boot screefing was the ground preparation method.
Number		1	10	2	
Density/ha		200	2000	400	
4	10V 501664 E; 6318043 N	Black Spruce	Tamarack	Speckled Alder	Planted on mounds with black spruce higher on the mounds and tamarack and alder on the lower sections of the mound.
Number		5	4	6	
Density/ha		1000	800	1200	
5	10V 499254 E; 6316822 N	Lodgepole Pine	White Spruce	Sitka Alder	Density of lodgepole pine was elevated compared to white spruce. Boot screefing was the ground preparation method.
Number		5	4	2	
Density/ha		1000	800	200	

2.4 Long Term Monitoring Plots

A number of ground plots had been set up in the locations outlined in the Monitoring Plan with minor adjustments to accommodate future access. Ground plots were 25 m in length and were located near access points to facilitate the ability to monitor in the future. When interviewing field crews, it was unclear if the ground plots had an untreated 25 m section to pair with the treated section and direction was given to ensure all plots had an untreated adjacent pair moving forward.

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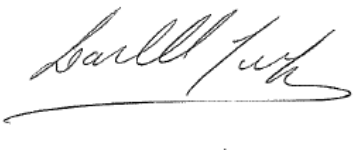

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Ecologist

Paula Bentham
Senior Biologist

LJY/PB/lih

https://golderassociates.sharepoint.com/sites/146327/project files/6 deliverables/3.0_issued/21466737-005-tm-rev0/21466737-005-tm-rev0-field qa rpt 17nov_22.docx

APPENDIX B

Photos

Spring Training Camp 2021

First meeting spot to head to the field

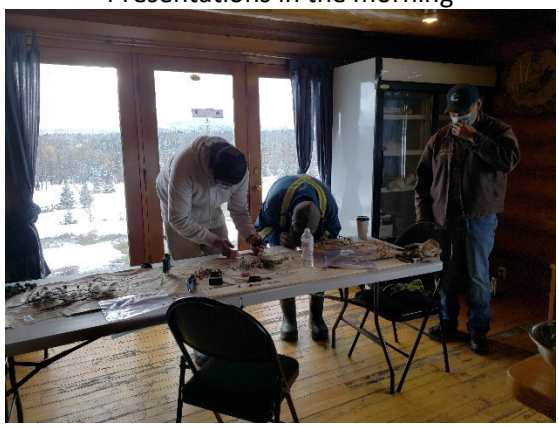
Indoor instruction at Pink Mountain lodge

Trail camera setup

Collecting cones

Presentations in the morning

Collecting live shrub stakes



Looking at seeds under the microscope

Processing seed

Building the wattle fence

Wattle fence preparation

Spring training 2022

Discussing the line site limiting factors

Learning about plants

Field instruction

Difficulties of spring training sessions


Completing vegetation monitoring plots


Talking about vegetation monitoring plots


Learning about water sampling


Difficulties of spring training


Building a brush fence


Building a brush fence

Fall Training 2022

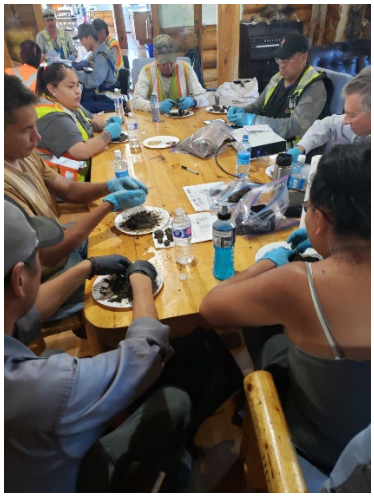

Classroom instruction


Field instruction


Field instruction


Seedlings arrive


Seedlings stored in the forest


Creating seedballs

Seedball preparation

Field preparation

Tree Planting

Tree Planting

Tree Planting

Observing the tree fellers

Restoration Implementation 2022


Tree Planting


Setting up wildlife cameras


Discussing mounding


Tree Planting


Manual screefing techniques


Planting on mounding line


Planting around tree felling


Tree Planting


Tree Planting


Setting up a wildlife camera

APPENDIX C

Detailed Treatment Data

Line Number*	Treatment Type	Planted Species**	Length (m)	Notes
001	Falling + Planting	Pl, Sx, Dg	207	
002	Falling + Planting	Pl, Sb, Sx, Dg	530	
003	Falling + Planting	Lt, Sb, Dm	498	
004	No Treatment	-	110	
005	Planting	Lt, Sb, Dm	134	
006	Falling + Planting	Sx, Sb, Pl, As	547	
007	No Treatment	-	1077	
008	No Treatment	-	1323	
009	No Treatment	-	978	
010	No Treatment	-	291	
011	No Treatment	-	245	
012	Falling + Planting	Pl, Sx, Dg	1180	
013	Falling + Planting	Pl, Sx, Dg	244	
014	Falling + Planting	Pl, Sx, Dg	1053	mostly dry species with spot plantings where wet
015	Falling + Planting	Pl, Sx, Dg	307	
016	Falling + Planting	Pl, Sx, Dg	558	
017	No Treatment	-	2348	Natural regeneration
018	Falling + Planting	Pl, Sx, Dg	222	light random planting on south side
019	Planting	Pl, Sx, Dg	230	light random planting on south side
020	No Treatment	-	342	
021	No Treatment	-	191	
022	Falling + Planting	Pl, Sx	113	
023	Falling + Planting	Pl, Sx	154	
024	No Treatment	-	3061	
025	No Treatment	-	417	
026	No Treatment	-	756	
027	No Treatment	-	1058	
028	No Treatment	-	1284	
029	No Treatment	-	438	
030	No Treatment	-	112	
031	No Treatment	-	244	
032	No Treatment	-	248	
033	No Treatment	-	837	
034	No Treatment	-	197	
035	No Treatment	-	142	
036	No Treatment	-	660	

037	No Treatment	-	156	
038	Falling + Planting	Pl, Sx, Sb, Dg	300	
039	No Treatment	-	1496	Natural regeneration
040	No Treatment	-	1047	Natural regeneration
041	No Treatment	-	311	
042	No Treatment	-	1349	
043	No Treatment	-	1859	
044	No Treatment	-	224	
045	No Treatment	-	342	Too wet
046	Falling + Planting	Sb, Sx, Dm	139	
047	Falling + Planting	Pl, Sb, Sx, Dg	99	
048	Falling + Planting	Sb, Sx, Dm	60	
049	Falling + Planting	Sb, Sx, Dg	151	
050	Falling + Planting	Sb, Sx, Dg	48	
051	Falling + Planting	Sx, Dg	53	
052	Falling + Planting	Lt, Sb, Dm	86	
053	Falling + Planting	Lt, Sb, Sx, Dm	102	
054	Falling + Planting	Pl, Sb, Sx, Dg	221	
055	Falling + Planting	Pl, Sx, Dg	161	
056	Falling + Planting	Pl, Sb, Sx, Dg	572	
057	No Treatment	-	956	Natural regeneration
058	No Treatment	-	77	
059	Planting	Pl, Sx, Dg	166	
060	Falling + Planting	Pl, Sb, Sx	129	
061	Screefing + Mounding + Falling + Planting	Sb, Sx, Dm	52	
062	Screefing + Mounding + Falling + Planting	Pl, Sx, Dg	55	
063	Falling + Planting	Pl, Sx, Dg	287	
064	Screefing + Mounding + Falling + Planting	Pl, Sx, Dg	75	
065	Screefing + Mounding + Falling + Planting	Pl, Sb, Sx, Dg	102	
066	Falling + Planting	Pl, Sb, Sx, Dg	38	
067	Screefing + Falling + Planting	Pl, Sb, Sx, Dg	318	
068	Mounding + Falling + Planting	Lt, Sb, Dm	174	
069	Falling + Planting	Pl, Sb, Sx, Dg	64	
070	Mounding + Falling + Planting	Lt, Sb, Dm	78	
071	Screefing + Falling + Planting	Pl, Sb, Sx, Dg	781	
072	No Treatment	-	788	Natural regeneration
073	No Treatment	-	154	Natural regeneration
074	No Treatment	-	280	Natural regeneration

075	No Treatment	-	3946	Natural regeneration
076	No Treatment	-	189	
077	No Treatment	-	250	Natural regeneration
078	Mounding + Falling + Planting	Lt, Sb, Dm	1106	
079	No Treatment	-	1205	Natural regeneration
080	No Treatment	-	917	
081	No Treatment	-	349	
082	No Treatment	-	460	
083	No Treatment	-	3328	
084	No Treatment	-	1537	
085	No Treatment	-	129	
086	No Treatment	-	213	
087	No Treatment	-	972	
088	No Treatment	-	492	
089	No Treatment	-	91	
090	No Treatment	-	530	
091	No Treatment	-	731	
092	No Treatment	-	613	
093	No Treatment	-	1260	
094	Falling + Planting	Sb, Sx, Dg	166	
095	No Treatment	-	43	Natural regeneration
096	Falling + Planting	Lt, Dm	55	
097	No Treatment	-	101	Too wet
098	Falling + Planting	Lt, Sx, Dm	136	
099	Falling + Planting	Sb, Sx, Dg	50	
100	Falling + Planting	Sb, Sx, Dg	388	
101	No Treatment	-	135	
102	No Treatment	-	2822	
103	No Treatment	-	214	
104	Falling + Planting	Pl, Sx, Dg	82	
105	Screefing + Falling + Planting	Pl, Sx, Dg	151	
106	Screefing + Mounding + Falling + Planting	Pl, Sx, Dg	231	
107	Mounding + Falling + Planting	Lt, Sb, Dm	116	
108	Falling + Planting	Lt, Pl, Sb, Sx, Dg, Dm	534	
109	Mounding + Falling + Planting	Lt, Sb, Dm	292	
110	Falling + Planting	Lt, Sb, Dm	354	
111	Screefing + Falling + Planting	Lt, Sb, Dm	328	
112	Mounding + Falling + Planting	Lt, Pl, Sb, Sx, Dg, Dm	197	

113	No Treatment	-	343	
114	No Treatment	-	517	Natural regeneration
115	Falling + Planting	Pl, Sb, Sx, Dg	46	
116	Falling + Planting	Lt, Sb, Sx, Dm	531	
117	No Treatment	-	122	Natural regeneration
118	Falling + Planting	Sb, Sx, Dm	99	
119	Falling + Planting	Pl, Sx	156	
120	Falling + Planting	Pl, Sx, Dg	167	
121	Falling + Planting	Lt, Sb, Sx	227	
122	Falling + Planting	Pl, Sx, Dg	344	
123	No Treatment	-	138	

*Line number is in reference to the map displayed in Figure 2.

**Pl = lodgepole pine, Sb = black spruce, Sx = hybrid white spruce, Lt = tamarack, Dg = Sitka alder, Dm = grey alder