West Moberly-DWB Limited Partnership

Nachii Adaage Area Restoration Project, Phase 1: Final Report

Contract: RMC-2022-08
Project: PNG Legacy Site Restoration Program

Prepared for: **BC Oil and Gas Research and Innovation Society**
Attn: Brian Thomson

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Signature Page

West Moberly DWB Limited Partnership is pleased to submit this report for your review. This report has been prepared using sound technical and professional judgement, based on our knowledge and experience, applicable regulatory framework, industry best management practices, and current understanding of project conditions, design, and project setting.

Report Title: Nachii Adaage Area Restoration Project, Phase 1: Final Report

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Revision: 1 (Redacted)

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We do not represent, warrant, undertake or guarantee:

- That all project environmental-related information has been received.
- That regulations and standards of practices shall remain constant through the duration of the project.
- That the use of guidance in the report will lead to any particular outcome or result; or, in particular,
- That by using the guidance in the report, the client will be approved by the contract holder for the applied works.

ACKNOWLEDGEMENTS

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West Moberly-DWB Limited Partnership would like to thank West Moberly First Nations, McLeod Lake Indian Band, and Saulteau First Nations for providing guidance on selecting the project area in the vicinity of Big Lick Creek, and for additional valuable land stewardship insight during engagements.

Thank you to TDB Consultants Inc. for taking high resolution digital air photos of the study area and providing the air photo mosaic, and to M. R. Concepts for graphic design.

Thank you to Clarence Willson, West Moberly First Nations, for the cover photo ("The Teepee").

EXECUTIVE SUMMARY

West Moberly-DWB Limited Partnership (WM-DWB LP) obtained funding from the BC Oil and Gas Research and Innovation Society (BC OGRIS) to complete a Phase 1 Petroleum & Natural Gas Legacy Site Restoration Project (the "Project") in the Nachii Adaage (Big Lick) study area. The Nachii Adaage study area, which is located east of Tumbler Ridge, BC, was selected by West Moberly First Nations, and it is within Treaty 8 Traditional Territory.

The objectives of this Project were to assess legacy sites (seismic lines and well access roads) within the study area, to identify sites with potential for restoration, and to develop site-specific restoration prescriptions for each candidate feature. Land stewardship insight from Indigenous groups was incorporated into the project.

TDB Consultants Inc. took high resolution digital aerial photographs of the entire study area, and the project team analyzed the air photos using QGis. Based on abundance of vegetation visible in the air photos, seismic lines were categorized as having restoration potential or not. Two field days were completed (using a truck and helicopter) to examine each of the seismic lines identified as having restoration potential. Field work was used to determine which seismic lines would benefit from restoration, and what treatment(s) would be most effective.

The air photos and field work showed that many seismic lines built in the 1960's to 1990's already have enough vegetation growing on them to reduce predator visibility and human mobility, and therefore do not require restoration work. The seismic lines that do not have much vegetation growing are typically those that have been used recently by humans (e.g., used as quad trails or developed into roads). We developed restoration prescriptions for 11 seismic lines and 8 seismic line junctions. Treatments are designed to prevent human access to seismic lines, to reduce sight lines for predators, and to promote vegetation regrowth.

We engaged with West Moberly First Nations, McLeod Lake Indian Band, and Saulteau First Nations during this project and used information from engagement sessions to enhance our treatment prescriptions. Key ideas from engagement included the importance of reducing human access on seismic lines and planting traditional forage plant species. These ideas were incorporated into treatment prescriptions.

In total, we examined 67 2D seismic lines (232 km total length), and developed restoration prescriptions for 11 seismic lines (36.47 km total length) and 8 seismic line junctions. Treatment options used in the prescriptions include ripping, planting, staking, constructing zigzag fences, and removing seismic line junctions. The treatment prescriptions can be used on the ground during Phase 2 of this project, when funding is secured.

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1.0 INTRODUCTION

1.1 PROJECT SCOPE AND OBJECTIVES

West Moberly-DWB Limited Partnership (WM-DWB LP) obtained funding from the BC Oil and Gas Research and Innovation Society (BC OGRIS) to complete a Phase 1 Petroleum & Natural Gas Legacy Site Restoration Project (the "Project") in the Nachii Adaage (Big Lick) study area.

The objectives of this Project were to assess legacy sites (seismic lines and well access roads) within the study area, to identify sites with potential for restoration, and to develop site-specific restoration prescriptions for each candidate feature. This project was completed with input from Indigenous groups and other stakeholders.

1.2 TARGET RESTORATION PRIORITIES

Wide 2D (~5.6 m wide) seismic lines, abandoned well pads, and access roads that were built from the 1960's to the 1990's were targeted in this project. The seismic lines from that era were not mapped in the publicly available data sets, including those from the BC Oil and Gas Commission. Therefore, during project definition, all visible seismic lines were mapped in the study area from Google Earth imagery. As described in section 2.0, the study area is a prime gathering area for traditional use native plants, and contains potentially high value caribou habitat which is not currently being utilized.

Based on engagement with Indigenous groups, as described further in section 5.0, restoration priorities in the area include enhancing/protecting traditional forage and hunting areas, enhancing wildlife habitat, and preventing human access to otherwise undisturbed areas that seismic lines intersect.

1.3 SUMMARY OF ACTIVITIES

This report describes activities completed in this Phase 1 project, including:

- Identification of seismic lines with potential for restoration
- Indigenous engagement and capacity building
- Data acquisition and field work
- Development of site-specific restoration prescriptions for use in Phase 2
- Development of planting treatments with a focus on Indigenous forage plant species (for use in Phase 2)

2.0 NACHII ADAAGE STUDY AREA

2.1 NACHII ADAAGE STUDY AREA

The Nachii Adaage (Big Lick) study area is located east of Tumbler Ridge, BC (Figure 1). The study area is approximately 37,000 ha and 67 2D seismic lines were mapped (approximately 232 km total length). The study area was selected by West Moberly First Nations (WMFN). According to WMFN, the Nachii Adaage area contains potentially high value caribou habitat which is not currently being utilized by caribou. The area is also a prime gathering area for traditional use native plants and a hunting area.

The Nachii Adaage area is within the Treaty 8 Traditional Territory, and several Indigenous communities reside in and/or use the land, including WMFN, McLeod Lake Indian Band (MLIB), Saulteau First Nations (SFN), Blueberry River First Nations, Doig River First Nations, Halfway River First Nations, and Horse Lake First Nations.

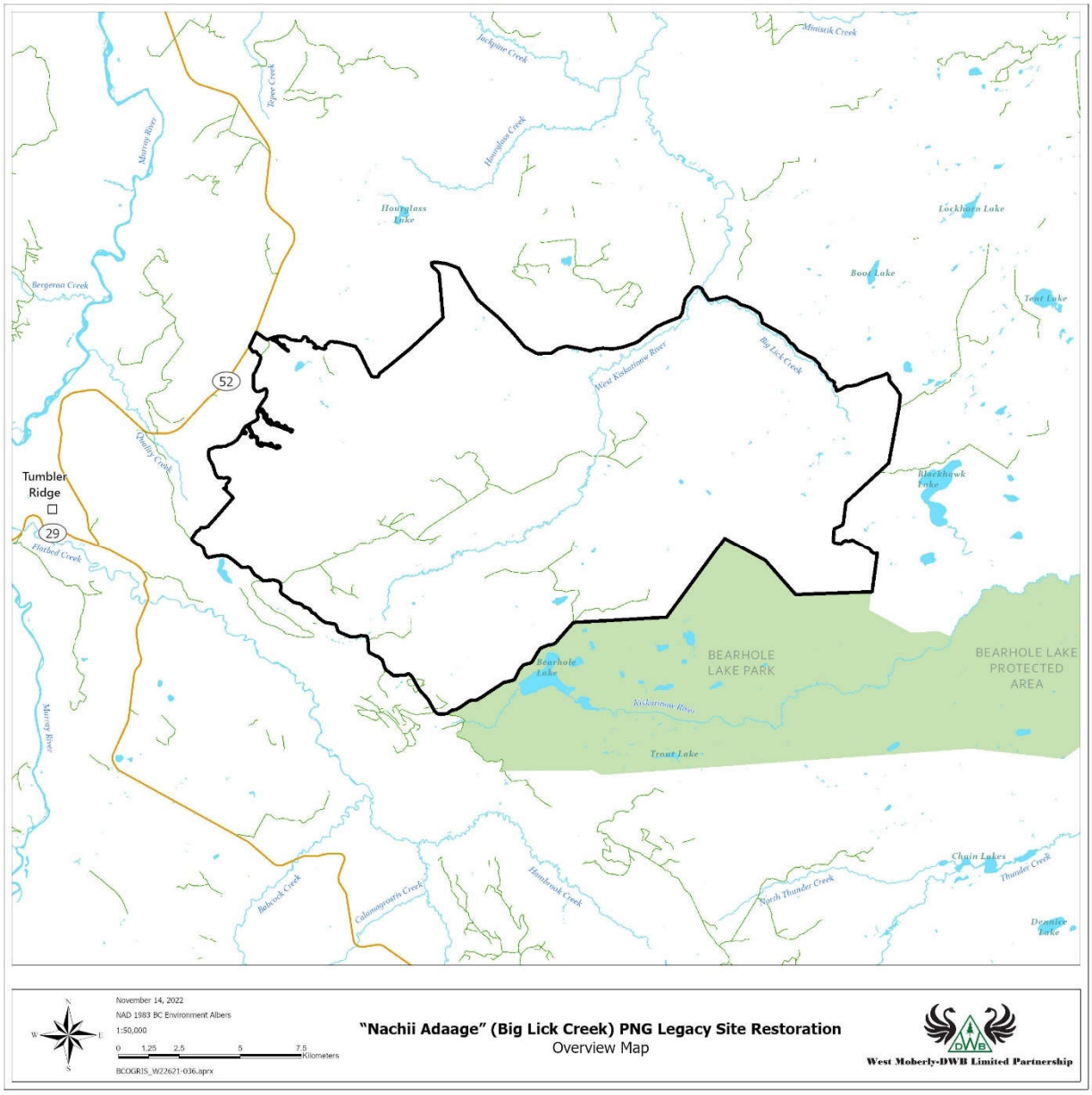

Figure 1. Overview of the Nachii Adaage study area.

2.2 CURRENT LAND USE

2.2.1 Oil and Gas

The study area has been heavily disturbed by oil and gas exploration and development. Over 65 2D seismic lines were mapped in the study area. In addition to those 1960-1990's era seismic lines, there are also more recent seismic lines (1990's-2006) throughout the area and 3D seismic lines in the eastern area. There are at least 7 active well sites and 26 inactive/dormant/completed well sites.

2.2.2 Existing Forest Harvest Authorizations

The study area is located within the Dawson Creek Timber Supply Area, and the western area also overlaps with the Tumbler Ridge Community Forest.

2.2.3 Trappers, Guides and Range Tenure Holders

Four traplines are present in the study area (Figure 2), but although we found the trapline holders names, we were not able to find contact information for them. There is one vacant guide tenure (701254) in the area; however, there are no range tenures.

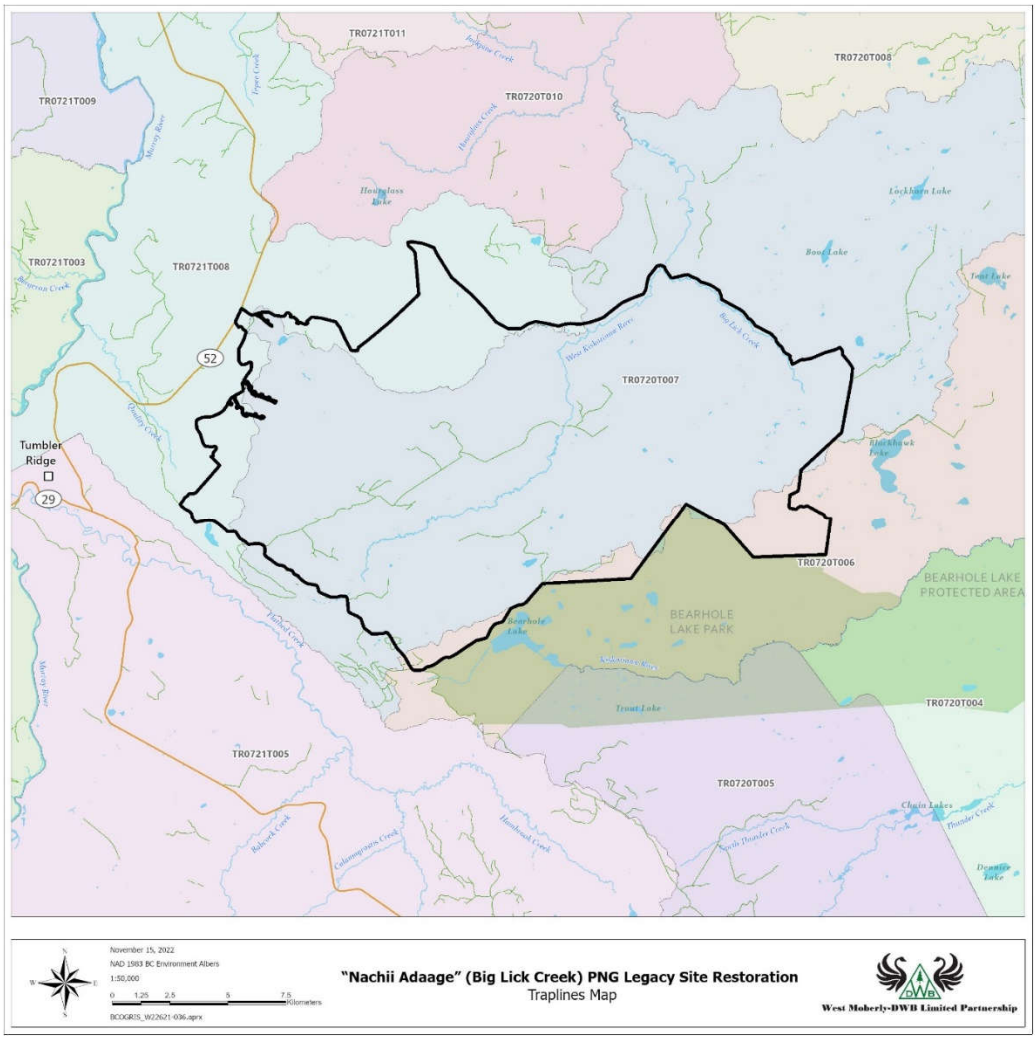

Figure 2. Traplines in the Nachii Adaage study area.

2.2.4 Parks and Protected Areas

The study area borders the north edge of Bearhole Lake Protected Area. The Bearhole Lake Protected Area is protected from all resource extraction unless a management plan is established that would include resource extraction. It is a designated Provincial Park and does not have a Management Plan.

The west portion of the study area is within the Tumbler Ridge Global Geopark. The Geopark is a UNESCO Global Geopark and is one of only 5 in Canada. Resource extraction is allowed in the Geopark as long as it is compatible with the park objectives.

There are two Old Growth Management Areas (OGMA) within the study area. The objective of an OGMA is to maintain interior forest attributes. Interior forests are those that are a specific distance from the edge of a forest. Basically, interior forest is area that is not influenced by the forest edge. Allowable disturbance and use objectives within the OGMAs are described in the Land Use Objectives for the Dawson Creek Timber Supply Area (Ministry of Agriculture and Lands, 2009).

2.2.5 Hunting and Foraging

This area is regularly used by Indigenous communities for hunting and foraging. Forage species that may be present within the study area include, but are not limited to, the species listed in the following table.

Table 1. Traditional Plants potentially present in the Nachii Adaage study area.

COMMON NAME	TSE'KHENE NAME	SCIENTIFIC NAME
Bunchberry	Oosk'kah'jah'mye'yeh	*Cornus canadensis*
Sweetgrass	Dene'ye'chin'na'da glee'e	*Fragaria x ananaassa*
Horsetail	Cli'cho'ch'en	*Equisetum*
Stinging Nettle	Sus'txi	*Urtica dioica*
Arctic Lupine	Moo'we'eeh'jii	*Lupinus arcticus*
Stiff Clubmoss	Gah yestloo	*Lycopodium torridum Gaudich*
Sweet Alpine Vetch	Txahns	*Hedysarum alpinum*
Paper Birch	Kea	*Betula*
Soapberry	Niswhush	*Shepherdia canadensis*
High-Bush Cranberry	Ma'sin'lou	*Viburnum edule*
Black Gooseberry	Uzzun'na	*Ribes lacustre*
Lingonberry	inLhut	*Vaccinium vitis-idaea*
Black Huckleberry	Mye'cho	*Vaccinium membranaceum*
Reindeer Lichen	Nay'dzooh	*Cladina* spp.

2.3 TERRESTRIAL, WILDLIFE AND AQUATIC HABITAT

2.3.1 Terrestrial Habitat

The study area is mostly within the Boreal White and Black Spruce wet cool (BWBSwk1) biogeoclimatic (BEC) zone, with some areas within Boreal White and Black Spruce moist warm (BWBSmw) and Englemann Spruce-Subalpine Fir moist very cool (ESSFmv2) BEC zones. Mixed forests consist of spruce dominated stands with lodgepole pine, subalpine fir, and trembling aspen. Tamarack dominates the extensive wetland areas, with black spruce also present. Understory and shrub layers consist primarily of alder and willow species, and several species of harvestable berries are present.

2.3.2 Wildlife Habitat

The Nachii Adaage area consists of low elevation winter range with important habitat for the Quintette and Narraway caribou herds, as identified through radio collaring studies discussed in the Quintette Caribou Habitat Restoration Plan (Golder, 2017) and the Preliminary Tactical Restoration Plan for the South Peace Northern Caribou Ranges (Golder, 2018). The study area is primarily located within Restoration Zone 1 of the Quintette range, with the eastern part extending into Restoration Polygon 4 of the Narraway range. Approximately 58 % of the low- and mid-elevation portions of the Quintette range, and 63 % of the Narraway range have recent (since 1900) resource development. Therefore, both areas have less than the minimum 65 % undisturbed habitat that is considered the threshold for self-sustaining caribou populations (ECCC and MOE, 2017).

Although the Quintette Restoration Zone 1 and the Narraway Restoration Polygon 4 are not considered the highest priority areas according to the Preliminary Tactical Restoration Plan, there is the potential to restore caribou habitat and reduce disturbance in an area of cultural importance to Indigenous communities.

A large portion of the area also falls within mapped Ungulate Winter Range.

2.3.3 Aquatic Habitat

There are several wetlands and streams in the study area, including the West Kiskatinaw River, Big Lick Creek, and many tributaries of each. Several fish species are known to inhabit streams in the area, including arctic grayling, bull trout, burbot, chub, longnose dace, rainbow trout, redside shiner, sculpin, and sucker.

3.0 METHODOLOGY

3.1 Desktop Assessment and Preliminary Mapping

A preliminary desktop assessment was completed to identify current land use and environmental features present within the study area. The DWB mapping department collected data layers for biological information (Wildlife Habitat Areas, Ungulate Winter Range, Old Growth Management Areas), terrestrial information (vegetation, cutblocks, wildfires), and aquatic information (streams and wetlands). Information on existing land use within the study area (cutblocks, private lands, parks) was also collected. Using these data layers, the DWB mapping department created preliminary site maps for use during field work.

3.2 Data Collection and Analysis

3.2.1 Aerial Photography Acquisition and Analysis

TDB Consultants Inc. was engaged to fly the study area with a fixed-wing airplane and take high resolution digital photographs of the entire study area. The digital photos were taken at a 15 cm resolution. This was completed in late-July 2022. TDB then stitched all of the aerial photographs into a mosaic that our team could open and view using the QGis software package. DWB received the air photo mosaic in mid-August, and our analysis then began.

Our team examined imagery of each seismic line and all surrounding features for the following:

- Presence of vegetation growing on the seismic line
- Bare ground or ground that appeared compacted
- Evidence of use by humans (quad trails) or wildlife (wildlife trails)
- Approximate lines of sight along the seismic line
- Access constraints

Based on the assessment of the air photos, seismic lines were classified according to restoration potential (yes or no). Sites with restoration potential were then examined in the field.

3.2.2 Field Work

During field work each seismic line with restoration potential was examined, as identified from the aerial photographs, and crews determined whether each would benefit from restoration work. This decision was based on:

- Amount of vegetation growing on the seismic line and whether it reduced line of sight
- Access constraints or limitations

Other observations included:

- Type of vegetation present, for use in developing planting prescriptions
- Signs of wildlife activity in the area (e.g., tracks, scat, browse)
- Signs of human use (e.g., quad tracks, brushing or sawing)

One day of field work was completed using a truck to access seismic lines where they intersect with an accessible road. The intent of this field day was to confirm that assumptions made from the air photos correlated to what we saw in the field. We found that there was more vegetation than expected from our air photo assessment as smaller shrubs or young trees were not visible in the photos.

Back in the office, we reassessed lines to narrow down the list of seismic lines with rehabilitation potential. Then another field day was completed with a helicopter during which we flew over every seismic line identified as having potential for restoration. While in the air, we further confirmed and sometimes changed whether each seismic line was a candidate for restoration. We also identified treatment opportunities for each seismic line.

It is important to note that timelines for the field work portion of this project were adjusted due to the Bearhole Lake wildlife, which was discovered August 31, 2022, and resulted in Area Restrictions over the eastern half of the project area through much of September 2022.

Information from the aerial photographs and field work was used to develop site-specific restoration prescriptions for select features.

3.3 Site-Specific Restoration Prescriptions

Based on information gathered from air photos and from field work, we finalized a list of seismic lines that would benefit from restoration work. We developed site-specific restoration prescriptions that can be applied on the ground in Phase 2 of this project. The mapping department created maps that show the treatment that will be applied to each seismic line, and tables were built to clearly identify pertinent information for each line.

Planting prescriptions are included in the treatments. Planting prescriptions were developed by a Registered Professional Forester, and they are established based on applicable site conditions (e.g., moisture regime, slope, elevation) and adjacent forest stand cover.

4.0 RESULTS

4.1 Site Specific Restoration Prescriptions

We found that many of the seismic lines constructed in the 1960-1990's have substantial vegetation growth and line of sight is already obscured by the re-established vegetation. In that case, no treatment is prescribed. We also observed that although the break in canopy cover will likely always be present along a seismic line, there is often a dense shrub layer already growing on the seismic line. When seismic lines have been accessed for use by humans (quads or vehicles) or used as roads, the resulting surface compaction and ongoing vehicle use have largely prevented vegetation regrowth. These seismic lines are therefore prime candidates for restoration treatment.

We examined 67 seismic lines (232 km total length) within the Nachii Adaage study area. After analyzing the data and completing field work, site-specific restoration prescriptions were developed for 11 seismic lines, for a total of 36.47 km or approximately 20.4 ha of treatment. We also identified 8 junctions that should be removed to prevent vehicle access to the seismic lines. Refer to Appendix A for a map of treatment locations and types, and Appendix B for the prescription documents. Project photographs are provided in Appendix C.

Table 2. Spatial summary of prescriptions developed for the Nachii Adaage study area.

SUMMARY OF TREATMENTS PRESCRIBED	
SEISMIC LINES	
Number of Seismic Lines	11
Total Length (m)	36,470 m
Total Area (ha)	20.4 ha
SEISMIC LINE JUNCTION REMOVALS	
Number of Junction Removals	8
Total Treatment Area (ha) at Junctions	0.07
Total Planting Area (ha) at Junctions	0.07

4.2 Description of Restoration Treatments

The following restoration treatments were prescribed in this project. More information can be found in Appendix D of this report, and in the Operational Restoration Framework for Woodland Caribou Habitat Restoration in Northern BC (MOF, 2021).

4.2.1 Junction Removal

Junction removals are prescribed to prevent vehicle access to seismic lines. Junction removals can include at least 50 m of a combination of ripping, mounding, dropping trees, spreading coarse woody debris, and planting/staking (trees, shrubs, and/or live stakes).

During community engagement, the McLeod Lake Indian Band suggested live staking junctions with species that sprout from branches such as willow. When staking, 5-15 cm of the stake is left above ground. This stub punctures tires of all terrain vehicles. Staking at very high densities creates a space that is very difficult to reactivate as there are too many stakes to dig up. Once the stakes begin to root, they are even more difficult to remove.

4.2.2 Zigzag Fences

Zigzag log fences can be constructed using trees in proximity to the seismic lines. Zigzag fences create a large physical barrier and can be effective at reducing predator sight lines. Zigzag fences should be constructed from trees in proximity to the site, and should be 4-5 logs high to create a visual barrier. They are constructed of entirely organic material (e.g., logs), so they will decay over time and nothing remains to clean up from the landscape. Zigzag fences also create microclimates and weather/snow shelter for shrubs and trees that are planted nearby. By the time the fences decay, the planted vegetation should be well established.

4.2.3 Ripping With Heavy Equipment

Ripping a compacted surface is prescribed where seismic lines have little to no vegetation growing and are easily accessible by equipment. If there is vegetation growing on the seismic line, or if there is no existing equipment access to a site, then ripping with equipment is not recommended since it will destroy any vegetation that has already established.

Ripping with heavy equipment is a standard road rehabilitation site preparation method used to rip up the soil to reduce compaction. Ripping is used in combination with planting, as ripping allows for improved root development and creates microsites to enhance vegetation growth.

Dozers, skidders or excavators are usually used to rip soil. The attachment used is a tooth or multiple teeth that dig into the ground at a set depth. It works rather like a plow in agriculture settings, but can go deep enough to treat the entire compacted layer. This treatment will allow more moisture and air into the soil profile, allowing vegetation to root and flourish.

4.2.4 Planting

Planting is prescribed in several locations to promote vegetation regrowth. Planting treatments were developed by a Registered Professional Forester. Live staking is also prescribed to achieve the combined goals of preventing vehicle access to a seismic line and re-establishing vegetation in an area. Traditional forage species are included in the planting prescriptions.

5.0 INDIGENOUS PARTICIPATION

5.1 INDIGENOUS ENGAGEMENT

We engaged with West Moberly First Nations, the McLeod Lake Indian Band, and Saulteau First Nations during this project, under direction from our team's Indigenous Lead. Engagement was different with each Indigenous community. Engagement provided valuable land stewardship insight and some specific recommendations that were incorporated into the prescriptions.

West Moberly First Nations

West Moberly First Nations assisted in selecting the study area for this project. During our final project meeting with the WMFN Land Use Manager, we presented the project and our ideas about restoration treatment. Key ideas that came of the meeting included:

- Questioning the zigzag fence and potential for ungulate calves being unable to get over or around the fence. After the meeting, we changed the zigzag fence design to make it easier for calves to get around, while still reducing sight lines for predators.

A WMFN member joined our team for a day of helicopter field work. Throughout the day, we discussed ways in which seismic line restoration would benefit the environment, and restoration options that would provide the most benefit. The following ideas were identified throughout the day, which were incorporated into the treatment prescriptions:

- Preventing vehicle access along seismic lines is important, and can be achieved by constructing large deterrents at junctions and installing barriers to access.
- It is beneficial to reduce line of sight for predators to see into wetlands. This could be achieved by falling trees or constructing visual barriers on seismic lines just outside of the wetland areas.
- Restoration should be viewed at a watershed level.

McLeod Lake Indian Band

Our team met with members of the MLIB. We discussed the project and provided overview maps showing proposed treatment locations and types. The following themes were generated during the discussions.

- The Nachii Adaage area is used by several MLIB families for hunting and foraging. They shared with us that hunting one moose, for example, does not only benefit one family. If one family hunts a moose and shares the meat with other families who gather together, then the moose has not only fed the families, but likely contributed to traditional knowledge, culture and language sharing between families. Therefore, how can one quantify the impact of land disturbance on MLIB members?
- Preventing vehicle access to undisturbed land is a priority. They mentioned that live staking (willow, red-osier dogwood) is a high deterrent to quads and vehicles, and that MLIB has used live staking successfully as a deterrent in the past. Based on this discussion, we added live staking to restoration prescriptions.
- MLIB provided our team with a booklet of traditional use forage plant species. The study area is used by members for forage, and many berry species are present.
- MLIB is concerned with identifying and enhancing safe food forage locations for their members.

- The MLIB also introduced us to their Safe Forage Food App that is available on the App Store and the Google Play Store. It shows where areas have been treated with herbicides in an effort to keep Band Members informed. They also have a program that includes companies planting forage species and getting a green dot on the app to show safe forage sites.

Saulteau First Nations

Saulteau First Nations (SFN) completed an independent desktop review of our project and submitted a written response. The response states that SNF members spend time in the Nachii Adaage area hunting, fishing, gathering, and practicing Treaty 8 rights. SFN's review suggested that there is a data gap, and that a Traditional Use Study would be beneficial for the study area. SFN suggested that it would be beneficial to set up a focus group to identify traditional use within the data gap; unfortunately, project timelines did not allow for this.

5.2 CAPACITY BUILDING

Capacity building in our Phase 1 project included the following:

1. A WMFN member, who is an employee, joined our project team on the helicopter field day, where we assessed seismic lines and discussed possible restoration measures. There were several discussions about treatment objectives and the desired outcome of treatment. This 8-hour day provided training and an on-the-ground look at what seismic lines could require restoration and what possible treatments could be prescribed.
2. A WMFN member (new WM-DWB LP term employee) is enrolled in a series of photography courses. The skills learned in the photography courses will be valuable for him in future field work, as it is important to properly photo-document observations. The courses also cover film making and story telling through photos.
3. We also engaged a WMFN member in researching seismic lines and West Moberly First Nations, and to provide information used in this document and in the film.

6.0 DISCUSSION AND CONCLUSION

6.1 PROJECT SUCCESSES

We view the project methodology as a success, and would recommend using a similar methodology in future Phase 1 projects. High resolution air photos allowed us to view the entire project area prior to field work, including areas that are not accessible by vehicle or foot due to distance or water features. Our preliminary assessment from the air photos identified several seismic lines that are not candidates for treatment, because there is already a significant amount of vegetation growing. Thus, we were able to focus our field days on those seismic lines with restoration potential, reducing the amount of field work required. Seismic lines that had potential for rehabilitation tended to be lines that were easily accessed by a main road or connected to other lines that also exhibited rehabilitation potential.

The air photos also allowed us to view portions of the seismic lines that are not easily accessible by foot, and would have required an immense amount of time to walk. During our field days, we looked at some of the seismic lines classified as 'no treatment required', and verified that there was in fact enough vegetation growing to reduce line of sight. We were then able to extrapolate this information on a project wide basis, and determine that if seismic lines appear vegetated in the air photos, then no treatment is required. This methodology can be extrapolated to other areas in future projects.

Another success of the project is the finding that many seismic lines constructed in the 1960's to 1990's already have a significant amount of vegetation growing and do not require any restoration efforts. The seismic lines that were disturbed by humans (e.g., turned into a road or used as a quad trail) or that have greater compaction have less vegetation growing and are good candidates for restoration. These general observations can be used to prioritize areas for restoration assessment in future projects.

We were fortunate to engage with three Indigenous communities during this project, and valuable land stewardship information added to the success of the project. We were able to use Indigenous knowledge and land stewardship considerations in restoration treatment development. We are grateful for the insight provided to us by Indigenous communities.

6.2 LESSONS LEARNED

We learned several lessons in this project that will be beneficial in future projects:

1. We found it was easier to focus Indigenous engagement conversations after all field work was completed as then we could point to one line with rehabilitation requirements and discuss that specific area. Earlier engagement with just the study area was too broad of a conversation and was overwhelming. Engagement would be most beneficial after the prescriptions are drafted. This would require time, at a minimum 6 months.
2. High resolution digital air photos provide good coverage of the landscape and are useful to categorize seismic lines according to restoration potential. It is helpful to view the entire landscape and to refer back to air photos when further discussion is required.
3. Seismic lines will always appear as a straight line and a break in forest canopy from the air. This does not mean that a seismic line requires restoration.
4. Many seismic lines constructed in the 1960-1990's already have well established vegetation, particularly if they have not had additional human disturbance. Seismic lines that have been compacted by quads/vehicles or used as roads have not revegetated naturally.

5. Live staking is more successful at keeping vehicles off the land than falling trees. Trees can be cleared with a chainsaw, but high-density willow stakes prevent vehicle access and are difficult to remove.
6. Reducing access into the forest is important to First Nations. Removing access to motorized vehicles is important to First Nations.

6.3 Recommendations for Phase 2 of This Project

1. Prior to completing the restoration work in Phase 2 of this project, we recommend that further engagement be completed with Indigenous communities.
2. When funding is secured, Indigenous-owned companies should be used to complete the field work as much as possible, including heavy equipment work and planting.
3. Plants should be sourced from Twin Sisters Native Plant Nursery at Moberly Lake, BC, which is jointly owned and operated by Saulteau First Nations and West Moberly First Nations. Another option recommended by MLIB was Nats Nursery in Langley, BC.
4. Permitting will be required by the Ministry of Forests to plant, rip, or remove junctions.

6.4 Recommendations for Future Phase 1 Projects

Based on the lessons we learned and project successes, we make the following recommendations for future Phase 1 projects:

1. Initiate engagement with Indigenous groups as early as possible in the project to allow time to gain valuable insight from community members. Early engagement allows Indigenous communities to determine the most appropriate avenues to distribute information to community members (e.g., community events and meetings), and allows project team members to attend community events that are already planned. This reduces the amount of time and resources required by Indigenous communities, and might allow engagement with more community members.
2. Meaningful engagement takes time and requires relationship building and open communication. During project development, set specific project milestones when engagement would be most beneficial (e.g., during site selection, during project development, after treatment prescriptions are drafted, etc.). Communicate with Indigenous communities regarding the type(s) and timing of engagement that they would prefer.
3. Ensure there is time after the treatments are drafted to reconnect with Indigenous groups and allow time for discussion among their members.
4. Use high resolution digital air photos to get a visual overview of the entire study area.
5. Complete field work in multiple steps: initial field work and subsequent field days to verify restoration treatments. Allow room in the budget and time in the work plan for a series of field days.

7.0 REFERENCES

BC Ministry of Agriculture and Lands. 2009. Ministerial Order. Land Use Objectives for the Dawson Creek Timber Supply Area.

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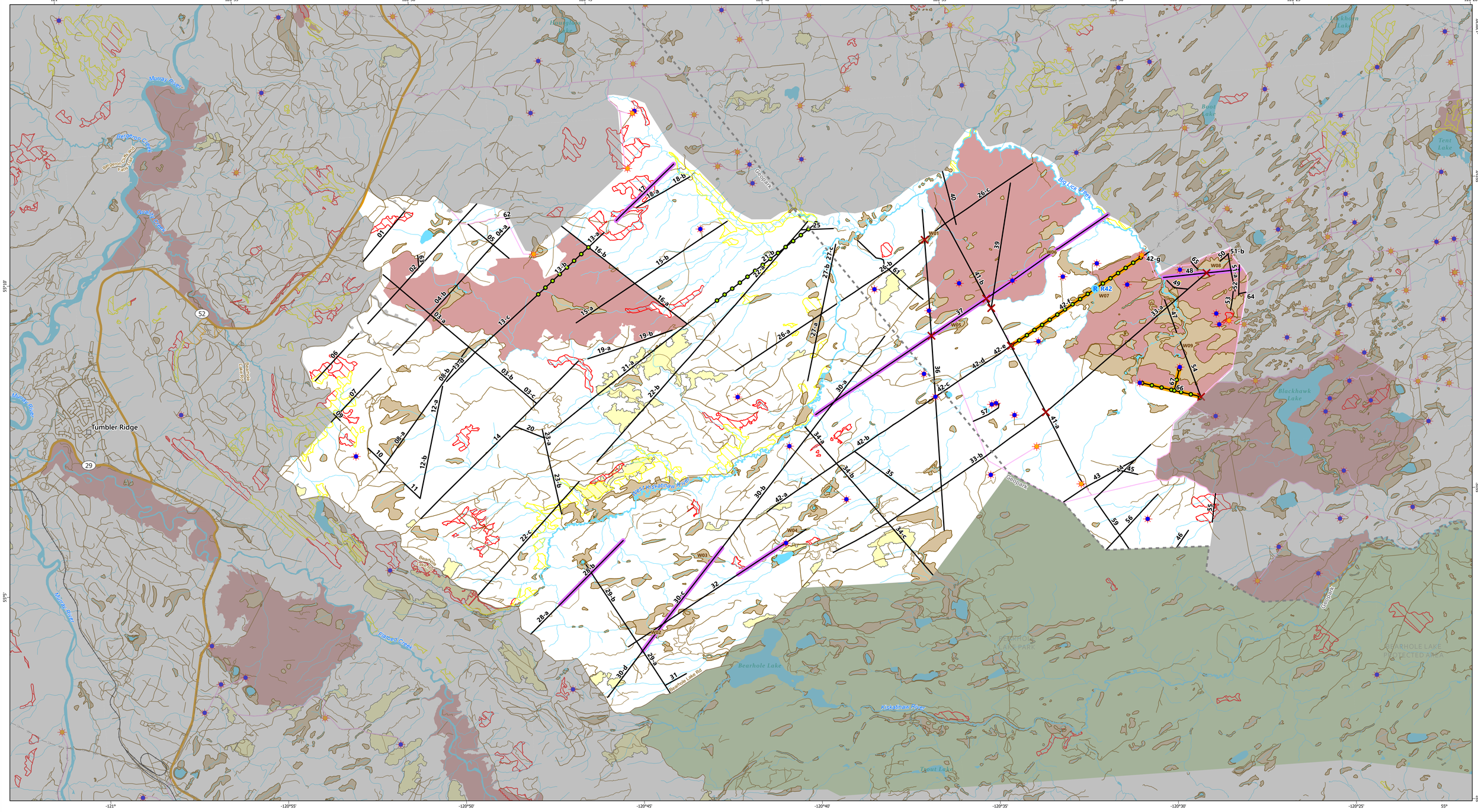
Ministry of Forests, Lands, Natural Resource Operations and Rural Development (MOF). 2021. Operational Restoration Framework. Woodland Caribou Habitat Restoration in British Columbia.

APPENDIX A – Prescription Map



November 30, 2022

NAD 1983 BC Environment Albers

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BCOGRIS_W22621-036.aprx

West Moberly-DWB Limited Partnership

"Nachii Adaage" (Big Lick Creek) PNG Legacy Site Restoration Prescription Map

BC OGRIS RFP_RMC_2022_02 West Moberly First Nations Phase 1 Project

- Seismic Line

Prescription
- Drop Trees
- Rip Road

Treatment
- Planting
- Junction Removal

- Riparian Feature
- Major Highways
- Road
- OGC Road Segments (Permitted)
- Pipline
- Railway
- Stream

- Waterbody
- Geopark Boundary
- Park
- OGMA
- Active FTEN Cut Block
- Wetland

Old Growth Priority Deferral

Classification
- Ancient forest
- Prioritized big-treed old growth
- Remnant old ecosystems

Well Activity
- Active
- Abandoned / Cancelled / Cased / Completed / Drilling / Drilling Suspended / Gas Testing / Prep to Resume / Prep to Spud / Suspended / Well Auth Granted / Abandoned Zone

APPENDIX B – Restoration Prescriptions

West Moberly-DWB Limited Partnership

Nachii Adaage, Phase 1 Project
Treatment Prescription

Area Overview

Number of Features in Prescription	Total Length (m) of Features with Prescriptions	Total Area (ha) of Features with Prescriptions, Based on 5.6m Wide Seismic Lines
11 Seismic Lines 8 Junctions	36,470 m	20.4 ha (lines) + 0.07 ha (junctions) Total area = 20.47 ha

General Description of Site

The Nachii Adaage study area is located east of Tumbler Ridge, and part of the area borders on Bearhole Lake Park to the southeast. The study area can be accessed via existing Forest Service Roads (Bearhole FSR, Kiskatinaw FSR), multiple forestry roads, and oil and gas exploration and well site access roads. There are several OGMAs and Old Growth Priority Deferral areas within the area, and there are many streams and wetland areas.

Directions and Access Requirements

Directions	Vehicle Access Requirements
The study area is located east of Tumbler Ridge, BC. From Tumbler Ridge, travel north on Mackenzie Way then turn left onto Highway 52. Travel on the Highway for approximately 6.6 km. This is the beginning of the Bearhole FSR. The Bearhole FSR is the Eastern boundary of the Study Area.	4-wheel drive truck, ATV, and helicopter

Constraints

Permit	How it Applies to the Site
	Presently there are not any permits that would constrain rehabilitation. However, to begin rehabilitation, a permit will need to be obtained from the Ministry of Forests. The Dawson Creek Forest Service requires a permit to operate on crown land. This will likely be an Occupant Licence To Cut (OLTC).
Regulation	**How it Applies to the Site**
Forest and Range Practices Act (FRPA) Sections 149	An authorized person carrying out a primary forest activity must ensure that the activity does not create an adverse effect in relation to one or more of the subjects listed in section 149 of the Forest and Range Practices Act (FRPA). This section of FRPA covers: soils, visual quality, timber, forage and associated plant communities, water, fish, wildlife, biodiversity, recreation resources, resource features, and cultural heritage resources. Visual quality resources, resource features and recreation resources have been addressed in the Management Plan that accompanies this document. These resources to do not apply to the sites addressed in this prescription. Protection of all other resources listed in Section 149 of FRPA are addressed below. This section of FPPR will only apply once a permit is obtained for rehabilitation.
Forest Planning and Practices Regulation (FPPR) Sections 37 – Landslides	There were no signs of slope instability or failure identified during assessments. As a result, the rehabilitation of roads in this prescription are not expected to trigger a landslide. If any signs of old slumps, jack-strawed trees, pistol butt trees or wet sites on slopes 50% are noted during field work, notify the on-site supervisor and halt operations in the area. This section of FPPR will only apply once a permit is obtained for rehabilitation.

FPPR Section 40: Revegetation	Any soil that is exposed as a result of deactivation must be revegetated within 2 years following deactivation, so that sediment would not enter a stream, wetland or lake, or adversely affect one of the values listed in section 149 of FRPA. This section of FPPR will only apply once a permit is obtained for rehabilitation.
FPPR Section 43: Use of Seed	Trees ordered for reforesting road rehabilitated sections will follow section 43 of the FPPR regulation; as such, seed selected for planting out roads must follow the Chief Forester's Standards for Seed Use. It is recommended that climate based transfer (CBT) guidelines be used. This section of FPPR will only apply once a permit is obtained for rehabilitation.
FPPR secs.47-53, 55, 56, 57: • Stream Riparian Classes (47) • Wetland Riparian Classes (48) • Lake Riparian Classes (49) • Restrictions in an RMA (50) • Restrictions in an RRZ (51) • Restrictions in an RMZ (52) • Temperature Sensitive Streams (53) • Stream Crossings (55) • Fish Passage (56) • Protection of fish and fish habitat (57)	Streams on these road systems are assumed to have been assessed and crossed under either the Forest Practices Code or the Forest and Range Practices Act prior to construction. Most of the roads under this prescription have already been deactivated. When rehabilitating these roads, crossings will be assessed as per sections 47, 48 and 49 of the FPPR. Riparian crossings will be managed as per sections 50(2), 50(3), 51(2), 52, 55 and 56 of the FPPR. Where the road is within a Riparian Management Area (RMA), road maintenance activities must not occur beyond the cleared width of the road. Machine activity within the RMA of all streams, wetlands or lakes will not have gravel or fill removed from the road prism or the stream bed. The rehabilitation operations within an RMA will not include mechanical activities that will loosen soil as this soil may erode into the water way. See the prescription tables for site specific direction along classifiable riparian features. Any temporary crossings that are required to be installed must be designed and installed in compliance with Sections 55 and 56 of the FPPR; allowing passage of fish and protection of the stream channel and stream bank immediately above and below the crossing. The crossings must be built and used in a manner that mitigates the disturbance to the stream channel and bank at the crossing. Temporary crossings must be removed when no longer required. All activities completed under this prescription must be done at a time and in a manner that is unlikely to harm fish or destroy, damage or harmfully alter fish habitat. This section of FPPR will only apply once a permit is obtained for rehabilitation.
FPPR Sec. 69 and 70 • General Wildlife Measures (69) • Resource Features and Wildlife Habitat Features (70)	These two sections specify that primary forest activities that are undertaken on the land base must comply with each Wildlife measure that applies in the area. This prescription has done so through these legislative sections. Section 70 says that those undertaking primary forest activities must ensure that the activity is not rendering a resource or wildlife feature ineffective. If a wildlife feature is identified during operations, work will stop in that area until the project manager can identify and follow a course of action This section of FPPR will only apply once a permit is obtained for rehabilitation.

Heritage Conservation Act	In the event that a Cultural Heritage Resource (CHR's) or Culturally Modified Tree (CMT's) is identified, operations shall cease and the project manager shall contact a qualified professional to conduct a CHR evaluation. This Act applies regardless of permitting. It also applies to both crown land and private land.
Wildlife Act Sec 33.1, 34 Attracting Dangerous Wildlife (33.1)	During operations any garbage or food must be removed from site to avoid attracting wildlife. It is against the Wildlife Act to intentionally feed/attract wildlife and precautions must be taken in regards to dangerous wildlife on site. This Act applies regardless of permitting. It also applies to both crown land and private land.
Migratory Birds Regulation Sec 6, Migratory Birds Convention Act, Wildlife Act Sec 34	This site plan includes clearing activities within potential bird nesting habitat. Therefore, bird nest sweeps may be required if works occur within the sensitive timing windows for the area which fall between April 20 – August 25. Any clearing or removal of vegetation or woody debris piles must be completed outside of sensitive timing windows to reduce the chances of disturbing bird nests. This Act applies regardless of permitting. It also applies to both crown land and private land.
Invasive Plant Regulation	Ensure all equipment operators have been provided with a current edition of the Field Guide to Noxious Weeds and Other Selected Invasive Plants of British Columbia in order to identify target invasive plant species upon occurrence. Identified invasive plants will be reported via Report Invasives BC application within 5 business days of identification. Within the areas to be disturbed during heavy machinery operations, locations and population size of target invasive plants will be ascertained. If a population of target invasive plants are identified within areas to be rehabilitated, the machinery must be cleaned to an extent such that invasive spread will not be accelerated as result of operations undertaken as apart of this prescription. Ripping and soil disturbance of any kind are not to occur on any of the sites where a significant invasive population is identified prior to rehabilitation activities. In these cases, prescriptions should be reviewed and revised by the signing professional. Prior to machinery entering a new site, all equipment will be cleaned (both interior and exterior), removing all mud and other matter that may contain seeds. During operations, if machinery comes into contact with invasive plants, the machinery will be cleaned in an area at least 30 metres from a waterway. If grass seed is used, use a seed mix that meets or exceeds Canada Common # 1 specifications as defined by the Canada Seeds Act and applicable regulations. A seed certificate shall be requested for seed. The seed certificate must show that there is less than 0.5% invasive plant seeds in the mix in order to be utilized. This section of FPPR will only apply once a permit is obtained for rehabilitation.

Water Sustainability Regulation, sec 44	This section defines timing windows as a period of the calendar year when changes in and about a stream can be made without causing a risk of significant harm to fish, wildlife or the aquatic ecosystem of the stream. Fish timing windows apply to all fish bearing streams and watercourses with connectivity to fish bearing watercourses. The default least risk timing window for the streams in this area is July 15-August 15, which is based on the assumed presence of both spring and fall spawning fish species, or unknown fish presence. This window applies for all instream work required at a crossing. If instream work cannot be completed within the timing window, a variance to the timing window will be required. This regulation applies to all crown land.
PHOTOS OF INTEREST	
Seismic Line not requiring treatment	
Seismic Line not requiring treatment	

Site Characteristics										
Site	Linear Features							Vegetation		Comments / Major Changes in Vegetation
	Type	Length (m)	Visible Bedrock	Coarse Woody Debris (%)	Longest Line of Sight (m)	Approximate Year of Construction	Access Constraints / Comments	Forest Cover Description	Successional Stage Description	
13-b	Seismic Line	2060	None	None	120	1960-1990's	There is no road access to this site. Helicopter access only.	Mixed of forests stands dominated by Pli, Sb, and Lt. Projected age from 120-170 years, and projected height from 11.3-18.1 m.	H, MF	This feature runs through an OGMA. This feature crosses a stream on south west end.
17	Seismic Line	2418	None	None	175	1960-1990's	There is no road access to this site. Helicopter access only.	Mature forest dominated by Pli and Sw. Project age from 140-190 years and projected height form 19.1-29.6 m. One younger forest in a cutblock replanted around 2002 at the southwest end.	H, MF, YF	This feature goes through two mapped Prioritized big-treed old growth areas (Old Growth Priority Deferral).
21-b	Seismic Line	3769	None	None	625	1996-2004	There is no road access to this site. Helicopter access only.	Mature forests dominated by Pli and Sb. Projected age from 100-170 years and projected height from 11.3-20.7 m.	H, MF	Visible wildlife trails. This feature is mapped in the OGC 1996-2004 layer.
26-b	Seismic Line	3667	None	None	N/A	1960-1990's	There is no road access to this site. Helicopter access only.	At the junction removal location, the forest is dominated by Sb, with a projected age of 120 years and a projected height of 15.2 m.	H, MF	The junction is mapped as a wetland in the Freshwater Atlas.
28-b	Seismic Line	2678	None	None	185	1960-1990's	There is no direct access to the site, but there is a block road in proximity to the northeast. Helicopter likely required for access.	Mature forests dominated by Pli and Sb. Projected age from 120-180 years and projected height from 13.7-18.9 m.	H, MF	There are visible wildlife trails in open areas on the southwest part of this seismic line. There are patches of thicker vegetation along the seismic line, so full restoration (e.g., ripping) is not recommended.
30-c	Seismic Line	3891	None	None	275	1960-1990's	This line can be accessed from block roads in the southwest, but a helicopter might be required for crew transfer.	Mature forest with a more recent cutblock on the southwest side. Mature forest consists of Pli, Lt, Sb, Bl and small amounts of Ac. Mature stand projected age from 100-180 years, and projected height 15.5-19.8m. Recent cutblock consists predominantly of 5 year old Sx.	H, MF, YF	This seismic line cuts through forest stands of varying ages, including a more recent cutblock in the southwest. It also cuts through at least two wetland areas.
32	Seismic Line	1585	None	None	150	1996-2006	This line can be accessed from a block road that	Mature Pli stands with projected age 130-160 years and projected height age 21.1 m.	H, MF, YF	This seismic line cuts through forest stands of varying ages, including a more recent cutblock in the southwest. It also cuts through at least two

Site Characteristics										
Site	Linear Features							Vegetation		Comments / Major Changes in Vegetation
	Type	Length (m)	Visible Bedrock	Coarse Woody Debris (%)	Longest Line of Sight (m)	Approximate Year of Construction	Access Constraints / Comments	Forest Cover Description	Successional Stage Description	
							crosses near the middle of the treatment line.	Some young Pli stands with projected age 4-40 years and projected height 0.5-8.6 m.		wetland areas. One section of the seismic line was likely converted into a block road for approximately 330 m. This seismic line is mapped as both a 1996-2004 and 2002-2004 OGC line.
37	Seismic Line / Old FTEN Roads	10629	None	None	425	1960-1990's	The west side of this line can be accessed from a road, and there is another road access point at the junction with 41. There are also multiple 3D lines that might be potential access points.	Mostly mature stands dominated by Sw, Sb, Pli and Lt, with projected age from 80-180 years and projected height from 10.1-26.8m. Some young Pli forest with projected age 18 years and projected height 4.3 m.	H, MF, YF	This seismic line crosses the Kiskatinaw FSR in one location. The seismic line cuts through forest and wetland areas. Two sections of this seismic lines are mapped as FTEN (Forest Tenure) roads. Those sections appear to have been converted to roads, as there is less vegetation and more bare ground visible. Wildlife trails are visible along this seismic line.
41-a 41-b	Seismic Line / Pipeline	9398	None	None	N/A	1960-1990's	There is road access to junction with 37 and 42. The junction with 33 can be accessed from active well sites to the south and southwest.	At junction with 33-a: mature Sb/Pli forest with projected age 120 years and projected height 14.2m. At junction with 37: mature Pli(Sb) forest with projected age 140 years and projected height 21.1m. At junction with 39: mature Pli forest with projected age 120 years and projected height 22.4 m. At junction with 42-e: young AcAt(PliSb) forest with projected age 35 years and projected height 6.8m.	H, MF, YF	There is an active well site at the south end of this feature. Treatment along this feature is designed to prevent access at junctions and reduce line of sight. 41-a is likely a pipeline. 41-b is a seismic line.
42-f	Pipeline	4689	None	None	375	1960-1990's	This line can be accessed from a road on the west and an active well site on the east.	Mostly mature forests dominated by Sb, Pli and Sw, with some Lt and At stands. Projected age 90-160 years and projected height 10.1-18.9m. Some young Lt dominated forests with projected age 60 years and projected height 9.3m.	H, MF, YF	There is a stream and large wetland area in the middle of this feature. There is an active well at the east end of the feature. Confirm with well owner prior to work to determine access requirements. The east part of this line cuts through an OGMA.
48	Seismic Line / Pipeline	2294	None	None	150	1960-1990's	There are multiple access points from roads and other seismic lines.	Mature forests dominated by Sb with Lt, Ac and Pli also present. Projected age 120-160 years. Projected height 9.1-10.8m. Wetland is a mature Lt forest, projected age 90 years and projected height 9.9m.	H, MF, YF	This feature can be accessed from the road on the east end. The feature cuts through a large wetland on the east side. The entire feature is within an OGMA.
66	Road to well site	1802	None	None	130	1960-1990's	This site can be easily accessed from a well-maintained road.	Mature mixed Sb and Pli forest. Projected age 100-120 years. Projected height 11.2-21.7m.	H, MF	This line is directly adjacent to an OGMA.

Site Characteristics										
Site	Linear Features							Vegetation		Comments / Major Changes in Vegetation
	Type	Length (m)	Visible Bedrock	Coarse Woody Debris (%)	Longest Line of Sight (m)	Approximate Year of Construction	Access Constraints / Comments	Forest Cover Description	Successional Stage Description	
67	Road to well site	656	None	None	180	1960-1990's	This site can be easily accessed from a well-maintained road.	Mature mixed Sb and Pli forests, with some mature Lt stands at the north end of the site. Projected age 100-165 years and projected height 10.4-18.6m.	H, MF	This line is entirely within an OGMA.

DESCRIPTION: H= HEALTHY, B= BURNED, BK= BEETLE KILL, YF=YOUNG FOREST, MF=MATURE FOREST

PLI = LODGEPOLE PINE (INTERIOR), SW = WHITE SPRUCE, SB = BLACK SPRUCE, LT = TAMARACK, BL = SUB ALPINE FIR, SX = SPRUCE HYBRID, AC = COTTONWOOD, AT = TREMBLING ASPEN

Riparian and Wetland Values									
Riparian Site	Sites Impacted	Stream, Lake or Wetland					Access / Permit Constraints		Comments
		Feature	UTM	watershed code (WSC)	Classification	Name	Instream Work Window	Other Constraints	
R42	42-f	Stream	10U 660441 6113253	232-646800-64800-39900	Assumed S3	Unnamed Tributary to Big Lick Creek	N/A – Do not cross	**Do not cross with equipment**	This stream is within a wetland complex. **Do not cross stream/wetland with equipment**. Access work sites from both sides instead of crossing feature.
N/A	None	Stream	N/A	200-948755-789717-804102	Assumed S3	Big Lick Creek	N/A	No equipment crossing required	This stream flows along the northeast side of the study area, and is in proximity to sites 48, 42 and 37.
N/A	None	Stream	N/A	200-948755-789717-635645	Assumed S2	West Kiskatinaw River	N/A	No equipment crossing required	This stream is in proximity to site 37.
W01	26-b / 36 junction	Wetland	10U 652976 6115353	200-948755-789717-635645-648659-424174	W1	N/A	N/A	No heavy equipment required	5.3 ha wetland at the junction of 26-b and 36. Junction removal prescribed at this location.
W02	30-c	Wetland	10U 644443 6103957	200-948755-789717-635645-872906	W1	N/A	N/A	No heavy equipment required	69.6 ha wetland. Treatment on 30-c includes dropping trees or constructing zigzag fences.
W03	30-c	Wetland	10U 646253 6106083	200-948755-789717-635645-739727-707178	W1	N/A	N/A	No heavy equipment required	18.7 ha wetland. Treatment on 30-c includes dropping trees or constructing zigzag fences.
W04	32	Wetland	10U 649046 6106848	200-948755-789717-635645-739727-694284	W1	N/A	N/A	No heavy equipment required	10.9 ha wetland at the very east end of the seismic line. Treatment on 32 includes dropping trees or constructing zigzag fences.
W05	37	Wetland	10U653209 6112579	200-948755-789717-635645-723854-480906	W1	N/A	N/A	No heavy equipment required	Site 37 runs through a small portion of this 14.1 ha wetland. Treatment on 37 includes dropping trees or constructing zigzag fences.
W06	37	Wetland	10U 656798 6114833	200-948755-789717-635645-618172-291554	W1	N/A	N/A	No heavy equipment required	5.4 ha wetland. Treatment on 37 includes dropping trees or constructing zigzag fences.
W07	42-f	Wetland	10U 658122 6113710	200-948755-789717-635645-618172-358641	W1	N/A	N/A	Permit required under FRPA prior to ripping work.	85.2 ha wetland. Treatment on 42-f includes ripping and planting.
W08	48	Wetland	10U 661503 6114023	200-948755-789717-635645-618172-489466	W1	N/A	N/A	No heavy equipment required	32.9 ha wetland. Treatment on 48 includes dropping trees or constructing zigzag fences, and removal of a junction 48/33-a.
W09	67	Wetland	10U 660417 6111040	200-948755-789717-635645-618172	W1	N/A	N/A	Permit required under FRPA prior to ripping work.	278 ha wetland. Treatment on 67 includes ripping and planting.

STREAM CLASSIFICATION: S1 = > 20 M (FISH BEARING); S2 = > 5-20 M (FISH BEARING); S3 = 1.5 – 5 M (FISH BEARING); S4 = < 1.5 M (FISH BEARING); S5 = >3 M (NON-FISH BEARING); S6 = ≤ 3 M (NON-FISH BEARING)

ROAD REHABILITATION					
SITE	JUNCTION REMOVAL	LINEAR FEATURE RESTORATION		PLANTING REQUIRED YES/NO	COMMENTS
		TREATMENT	TREATMENT EXTENT		
13-b	None	Plant	Entire Line	Yes	**This line is entirely within an OGMA. Confirm OGMA work restrictions with BC MFLNRORD before work**. Helicopter access only.
17	None	Drop Trees OR Zigzag Fences and Live Staking / Planting	At 100-150 m intervals: 16-24 fences	Yes	**Part of this is within a Prioritized big-treed old growth area. Confirm Old Growth Priority Deferral work restrictions prior to work**. Helicopter access only. Treatment is either drop trees, construct zigzag fences, or a combination of the two. Drop tree treatment includes falling/breaking trees onto the line, or piling woody debris on the line. Piles of trees or woody debris provide connectivity between the two sides of the road and reduces line of sight and predator moveability. If constructing zigzag fences, locations should be ribboned in the field prior to work. Spacing should be every 100-150 m, and will be field fit according to naturally occurring vegetation and topography. Each set of 2 fences should be constructed to block predator line of sight. Construct according to diagram. Plant each set of fences with 15 conifers and 30 live stakes.
21-b	None	Plant	Entire Line	Yes	Helicopter access only. Treatment on this line is designed to promote vegetation regrowth and supplement existing vegetation. See planting table below.
26-b / 36	50 m of treatment: Live Staking Spreading Small Logs	None	None	Yes at Junction	**This junction is in a wetland, so heavy equipment cannot enter.** Work to be done by hand. No access for heavy equipment. Treatment includes live staking (willow, alder, dogwood, etc.) at a density of at least 1 stem / m^2. Also spread small logs that may be present near the site.
28-b	None	Drop Trees OR Zigzag Fences and Live Staking / Planting	At 100-150 m intervals: 17-26 fences	Yes	Helicopter likely required for access. Treatment is either drop trees, construct zigzag fences, or a combination of the two. Drop tree treatment includes falling/breaking trees onto the line, or piling woody debris on the line. Piles of trees or woody debris provide connectivity between the two sides of the road and reduces line of sight and predator moveability. If constructing zigzag fences, locations should be ribboned in the field prior to work. Spacing should be every 100-150 m, and will be field fit according to naturally occurring vegetation and topography. Each set of 2 fences should be constructed to block predator line of sight. Construct according to diagram. Plant each set of fences with 15 conifers and 30 live stakes.
30-c	None	Drop Trees OR Zigzag Fences and Live Staking / Planting	At 100-150 m intervals: 26-38 fences	Yes	Helicopter likely required for crew transfer. Treatment is either drop trees, construct zigzag fences, or a combination of the two. Drop tree treatment includes falling/breaking trees onto the line, or piling woody debris on the line. Piles of trees or woody debris provide connectivity between the two sides of the road and reduces line of sight and predator moveability. If constructing zigzag fences, locations should be ribboned in the field prior to work. Spacing should be every 100-150 m, and will be field fit according to naturally occurring vegetation and topography. Each set of 2 fences should be constructed to block predator line of sight. Construct according to diagram. Plant each set of fences with 15 conifers and 30 live stakes.
32	None	Drop Trees OR	At 100-150 m intervals: 10-15 fences	Yes	Work to be completed by hand.

		Zigzag Fences and Live Staking / Planting			Treatment is either drop trees, construct zigzag fences, or a combination of the two. Drop tree treatment includes falling/breaking trees onto the line, or piling woody debris on the line. Piles of trees or woody debris provide connectivity between the two sides of the road and reduces line of sight and predator moveability. If constructing zigzag fences, locations should be ribboned in the field prior to work. Spacing should be every 100-150 m, and will be field fit according to naturally occurring vegetation and topography. Each set of 2 fences should be constructed to block predator line of sight. Construct according to diagram. Plant each set of fences with 15 conifers and 30 live stakes.
37	At junctions with 41 and 36 (see rows below)	Drop Trees OR Zigzag Fences and Live Staking / Planting	At 100-150 m intervals: 70-100 fences	Yes at Junction	**Part of this line is within an OGMA. Confirm OGMA work restrictions with BC MFLNRORD before work**. Treatment is either drop trees, construct zigzag fences, or a combination of the two. Drop tree treatment includes falling/breaking trees onto the line, or piling woody debris on the line. Piles of trees or woody debris provide connectivity between the two sides of the road and reduces line of sight and predator moveability. If constructing zigzag fences, locations should be ribboned in the field prior to work. Spacing should be every 100-150 m, and will be field fit according to naturally occurring vegetation and topography. Each set of 2 fences should be constructed to block predator line of sight. Construct according to diagram. Plant each set of fences with 15 conifers and 30 live stakes.
37 / 41-b	50 m of treatment: Live Staking / Planting Spreading Small Logs	N/A	N/A	Yes at Junction	**This junction is within an OGMA. Confirm OGMA work restrictions with BC MFLNRORD before work**. Remove junction to prevent vehicle access and reduce predator line of sight down the seismic lines from the junction. At least 50 m of treatment is recommended to fully block access. Treatment includes live staking (willow, alder, dogwood, etc) at a density of at least 1 stem / m^2. Also spread small logs that may be present near the site. Work to be done by hand, as there is no equipment access.
37 / 36	50 m of treatment: Live Staking / Planting Spreading Small Logs	N/A	N/A	Yes at Junction	Remove junction to prevent vehicle access and reduce predator line of sight down the seismic lines from the junction. At least 50 m of treatment is recommended to fully block access. Treatment includes live staking (willow, alder, dogwood, etc) at a density of at least 1 stem / m^2. Also spread small logs that may be present near the site. Work to be done by hand, as there is no equipment access.
41-b / 39	50 m of treatment: Live Staking / Planting Spreading Small Logs	N/A	N/A	Yes at Junction	There is access to this site along an old road, although it appears to have been deactivated. Therefore, it is recommended that work be done by hand, without heavy equipment. Quad access is likely possible along the old road. Remove junction to prevent vehicle access and reduce predator line of sight down the seismic lines from the junction. At least 50 m of treatment is recommended to fully block access. Treatment includes live staking (willow, alder, dogwood, etc) at a density of at least 1 stem / m^2. Also spread small logs that may be present near the site.
41-b/33-a	50 m of treatment: Live Staking / Planting Spreading Small Logs	N/A	N/A	Yes at Junction	Remove junction to prevent vehicle access and reduce predator line of sight down the seismic lines from the junction. At least 50 m of treatment is recommended to fully block access. Treatment includes live staking (willow, alder, dogwood, etc) at a density of at least 1 stem / m^2. Also spread small logs that may be present near the site. Work to be done by hand, as there is no equipment access.
42-f	At junction with 41 (see row below)	Rip and Plant	Line except wetland/stream area	Yes at junction and along the line	**The east half of this line is within an OGMA. Confirm OGMA work restrictions with BC MFLNRORD before work**. **Do not drive equipment through wetland or stream; access work sites from both sides instead.** Rip and plant line. Refer to planting table.
42-f / 41	50 m of treatment: Large mounds Live Staking / Planting Spreading CWD	N/A	N/A	Yes at Junction	This junction should be removed before 42-f is ripped, while equipment can still access the site. Since equipment can be used at this site, treatment can include constructing large mounds, spreading coarse woody debris, live staking, and planting. At least 50m should be treated to fully remove access along the ripped seismic line.
48	At junction with 33 (see row below)	Drop Trees OR	At 100-150 m intervals: 15-22 fences	Yes	**This line is entirely within an OGMA. Confirm OGMA work restrictions with BC MFLNRORD before work**. Work to be done by hand, since there is no access for heavy equipment.

		Zigzag Fences and Live Staking / Planting			Treatment is either drop trees, construct zigzag fences, or a combination of the two. Drop tree treatment includes falling/breaking trees onto the line, or piling woody debris on the line. Piles of trees or woody debris provide connectivity between the two sides of the road and reduces line of sight and predator moveability. If constructing zigzag fences, locations should be ribboned in the field prior to work. Spacing should be every 100-150 m, and will be field fit according to naturally occurring vegetation and topography. Each set of 2 fences should be constructed to block predator line of sight. Construct according to diagram. Plant each set of fences with 15 conifers and 30 live stakes.
48 / 33	50 m of treatment: Live Staking / Planting Spreading Small Logs	N/A	N/A	Yes	**This junction is within an OGMA. Confirm OGMA work restrictions with BC MFLNRORD before work**. Remove junction to prevent vehicle access and reduce predator line of sight down the seismic lines from the junction. At least 50 m of treatment is recommended to fully block access. Treatment includes live staking (willow, alder, dogwood, etc) at a density of at least 1 stem / m^2. Also spread small logs that may be present near the site. Work to be done by hand, as there is no equipment access.
66	At junction with FSR 50 m of treatment: Large mounds Live Staking / Planting Spreading CWD	Rip and Plant	Entire Line	Yes at junction and on the line	**This line borders on an OGMA.** Rip and plant entire line. Refer to planting table. Since equipment can be used at this site, treatment can include constructing large mounds, spreading coarse woody debris, live staking, and planting. At least 50m should be treated to fully remove access along the ripped seismic line.
67	None	Rip and Plant	Entire Line	Yes	**This line is entirely within an OGMA. Confirm OGMA work restrictions with BC MFLNRORD before work**. Rip and plant entire line. Refer to planting table.

Planting Prescription								
Site	Vegetation		Planting Prescription					
	BEC	Elevation (m)	Planting Treatment	Approximate Planting Area (ha)*	Total Stems	Recommended Species	Minimum Inter-Tree Distance (m)	Comments
13-b	ESSFmv2	1190	Yes	1.2	1846	Pine, Spruce, Balsam, Aspen	1.6	Plant entire line at 1600 stems per hectare. The minimum inter tree distance is 1.6 but spacing should depend on microsite selection. Space trees in a scattered manner, sometimes creating clumps with spacing being closer to 1.6 m between each tree and in other areas leaving small gaps for song birds and other gap loving wildlife.
17	BWBSwk1	1010-1100	Yes, along zigzag fences if installing	16-24 fences	160-240 conifers; 320-480 live stakes	Conifers: Pine, Spruce Stakes: Willow, Alder, Cottonwood, Dogwood	N/A	If installing zigzag fences plant 10 conifers and 20 live stakes at each set of fences. Ensure seedlings are planted within 1m of the fence.
21-b	BWBSwk1 / BWBSmw	900-1045	Yes	2.1	3377	Pine, Spruce, Aspen	1.6	Plant entire line at 1600 stems per hectare. The minimum inter tree distance is 1.6 but spacing should depend on microsite selection. Space trees in a scattered manner, sometimes creating clumps with spacing being closer to 1.6 m between each tree and in other areas leaving small gaps for song birds and other gap loving wildlife.
26-b / 36 Junction	BWBSmw	1000	Yes	0.01	100	Willow, Alder, Cottonwood, Dogwood	1.0	For each area where stakes will be used to reduce line of sight and reduce mobility, stake a 10-metre-long stretch of the road. The stakes should only be 15 to 20cm above the road surface. Plant the stakes 1 metre apart and cover the entire area, up to the tree line and for the entire length, establishing a grid pattern. Over time the shrubs will grow, blocking passage and sight lines. This is in a wetland.
28-b	BWBSwk1	1025	Yes, along zigzag fences if installing	17-26 fences	170-260 conifers; 340-520 live stakes	Conifers: Pine, Spruce Stakes: Willow, Alder, Cottonwood, Dogwood	N/A	If installing zigzag fences plant 10 conifers and 20 live stakes at each set of fences. Ensure seedlings are planted within 1m of the fence.
30-c	BWBSwk1	1050-1150	Yes, along zigzag fences if installing	26-38 fences	260-380 conifers; 520-760 live stakes	Conifers: Pine, Spruce Stakes: Willow, Alder, Cottonwood, Dogwood	N/A	If installing zigzag fences plant 10 conifers and 20 live stakes at each set of fences. Ensure seedlings are planted within 1m of the fence.
32	BWBSwk1	1030	Yes, along zigzag fences if installing	10-15 fences	100-150 conifers; 200-300 live stakes	Conifers: Pine, Spruce Stakes: Willow, Alder, Cottonwood, Dogwood	N/A	If installing zigzag fences plant 10 conifers and 20 live stakes at each set of fences. Ensure seedlings are planted within 1m of the fence.
37	BWBSmw / BWBSwk1	925-1050	Yes, along zigzag fences if installing	70-100 fences	700-1000 conifers; 1400-2000 live stakes	Conifers: Pine, Spruce Stakes: Willow, Alder, Cottonwood, Dogwood	N/A	If installing zigzag fences plant 10 conifers and 20 live stakes at each set of fences. Ensure seedlings are planted within 1m of the fence.
37 / 41-b Junction	BWBSwk1	1040	Yes	0.01	100	Willow, Alder, Cottonwood, Dogwood	1.0	For each area where stakes will be used to reduce line of sight and reduce mobility, stake a 10-metre-long stretch of the road. The stakes should only be 15 to 20cm above the road surface. Plant the stakes 1 metre apart and cover the entire area, up to the tree line and for the entire length, establishing a grid pattern. Over time the shrubs will grow, blocking passage and sight lines. This is in a wetland.

Planting Prescription								
Site	Vegetation		Planting Prescription					
	BEC	Elevation (m)	Planting Treatment	Approximate Planting Area (ha)*	Total Stems	Recommended Species	Minimum Inter-Tree Distance (m)	Comments
37 / 36 Junction	BWBSwk1	1040	Yes	0.01	100	Willow, Alder, Cottonwood, Dogwood	1.0	For each area where stakes will be used to reduce line of sight and reduce mobility, stake a 10-metre-long stretch of the road. The stakes should only be 15 to 20cm above the road surface. Plant the stakes 1 metre apart and cover the entire area, up to the tree line and for the entire length, establishing a grid pattern. Over time the shrubs will grow, blocking passage and sight lines. This is in a wetland.
41-b / 39 Junction	BWBSwk1	1040	Yes	0.01	100	Willow, Alder, Cottonwood, Dogwood	1.0	For each area where stakes will be used to reduce line of sight and reduce mobility, stake a 10-metre-long stretch of the road. The stakes should only be 15 to 20cm above the road surface. Plant the stakes 1 metre apart and cover the entire area, up to the tree line and for the entire length, establishing a grid pattern. Over time the shrubs will grow, blocking passage and sight lines. This is in a wetland.
41-b / 33 Junction	BWBSwk1	1050	Yes	0.01	100	Willow, Alder, Cottonwood, Dogwood	1.0	For each area where stakes will be used to reduce line of sight and reduce mobility, stake a 10-metre-long stretch of the road. The stakes should only be 15 to 20cm above the road surface. Plant the stakes 1 metre apart and cover the entire area, up to the tree line and for the entire length, establishing a grid pattern. Over time the shrubs will grow, blocking passage and sight lines. This is in a wetland.
42-f	BWBSmw / BWBSwk1	985-1035	Yes	2.6	4201	Pine, Spruce, Aspen	1.6	Plant entire line at 1600 stems per hectare. The minimum inter tree distance is 1.6 but spacing should depend on microsite selection. Space trees in a scattered manner, sometimes creating clumps with spacing being closer to 1.6 m between each tree and in other areas leaving small gaps for song birds and other gap loving wildlife. Do not allow machinery in wetland or stream areas.
42-f / 41 Junction	BWBSwk1	1035	Yes	0.01	100	Willow, Alder, Cottonwood, Dogwood	1.0	For each area where stakes will be used to reduce line of sight and reduce mobility, stake a 10-metre-long stretch of the road. The stakes should only be 15 to 20cm above the road surface. Plant the stakes 1 metre apart and cover the entire area, up to the tree line and for the entire length, establishing a grid pattern. Over time the shrubs will grow, blocking passage and sight lines. This is in a wetland.
48	BWBSwk1 / BWBSmw	1000	Yes, along zigzag fences if installing	15-22 fences	150-220 conifers; 300-440 live stakes	Conifers: Pine, Spruce Stakes: Willow, Alder, Cottonwood, Dogwood	N/A	If installing zigzag fences plant 10 conifers and 20 live stakes at each set of fences. Ensure seedlings are planted within 1m of the fence.
48 / 33 Junction	BWBSwk1	1020	Yes	0.01	100	Willow, Alder, Cottonwood, Dogwood	1.0	For each area where stakes will be used to reduce line of sight and reduce mobility, stake a 10-metre-long stretch of the road. The stakes should only be 15 to 20cm above the road surface. Plant the stakes 1 metre apart and cover the entire area, up to the tree line and for the entire length, establishing a grid pattern. Over time the shrubs will grow, blocking passage and sight lines. This is in a wetland.
66	BWBSwk1	1010	Yes	1.0	1600	Pine, Spruce, Aspen	1.6	Plant entire line at 1600 stems per hectare. The minimum inter tree distance is 1.6 but spacing should depend on microsite selection. Space trees in a scattered manner, sometimes creating clumps with spacing being closer to 1.6 m between each tree and in other areas leaving small gaps for song birds and other gap loving wildlife. Do not allow machinery in wetland or stream areas.
67	BWBSwk1	1010	Yes	0.4	588	Pine, Spruce, Aspen	1.6	Plant entire line at 1600 stems per hectare. The minimum inter tree distance is 1.6 but spacing should depend on microsite selection. Space trees in a scattered manner, sometimes creating clumps with spacing being closer to 1.6 m between each tree and in other areas leaving small gaps for song birds and other gap loving wildlife. Do not allow machinery in wetland or stream areas.

Planting standards: Seedlings should be planted on raised microsites wherever possible. A varied distance between trees adds a vertical diversity component to the new stand, which increases habitat for song birds and other wildlife. Clumps and thicker spacing should be used in areas with long straight stretches.
Use the Climate Based Seed Transfer guidelines when choosing seed.
*Approximate planting area was calculated using an average seismic line width of 5.6m

APPENDIX C – Project Photographs

PROJECT PHOTOGRAPHS

Photos 1-2. The above photos show one method to assess how much existing vegetation obscures sight lines. One crew member holds up the tarp and walks forward. A second crew member counts how many squares on the tarp are clearly visible through the vegetation. These photos were taken on seismic line 59. No treatment required.

Photos 3-4. From the air photos, seismic line 14 was classified as 'no treatment required' due to thick vegetation. Our assessment in the field confirmed this classification, as the dense vegetation on the seismic line greatly reduced sight lines on the ground.

Photos 5-6. From the air photos, seismic line 30-a was classified as 'no treatment required' due to thick vegetation. Our assessment in the field confirmed this classification. The seismic line has thick vegetation (top photo) and there is no need for restoration work. As shown in the bottom photo, the seismic line is not visible from the road.

Photos 7-8. The above photos show signs of wildlife that were observed in the field, including moose tracks and browse.

Photos 9-10. Seismic line 37 has some vegetation present but could benefit from restoration work. It might have been used as a road or quad trail so vegetation is not well established in all locations. Recommended treatment involves constructing barriers to line of sight (e.g., falling trees or constructing zigzag fences). Work should be done by hand to prevent disturbance to existing vegetation.

Photo 11. Old well site at the end of seismic line 67, with line 67 at the top left.

Photo 12. Seismic lines 21-b and 22-a. Recommended treatment on 21-b includes planting to help re-establish vegetation.

Photo 13. Recommended treatment on seismic line 28-b includes dropping trees or constructing zigzag fences.

Photo 14. The above photo shows a stream/wetland area at the south end of seismic line 30-c. Recommended treatment includes dropping trees or constructing zigzag fences. Barriers can be placed just outside of wetlands to reduce predator line of sight into wetlands.

Photo 15. Overview photo showing seismic line 33 running through one of the many wetlands present in the study area.

APPENDIX D – Rehabilitation Guidelines

The following rehabilitation guidelines are summarized from the 'Pine D and Clearwater Klinse-Za Caribou Habitat Restoration Management Plan', which was prepared by West Moberly-DWB Limited Partnership for the BC Ministry of Forests (2022). Some specific information from that project has been removed from the summary below. Although the guidelines refer to road rehabilitation, the general methods can be applied or adapted for seismic line restoration.

1.0 REHABILITATION GUIDELINES

The following general guidelines are to be implemented for road deactivation and rehabilitation measures which have been specified in the prescription documents and accompanying maps. For more detailed instructions on how to apply these techniques, several guidance documents are available as listed below.

- Operational Restorational Framework for Woodland Caribou Habitat Restoration in British Columbia (FLRNORD, 2021)
- Boreal Caribou Habitat Restoration Operational Toolkit for BC (Golder, 2015)
- BC Engineering Manual (MFLNRO, 2019)
- Best Management Practices Handbook: Hillslope Restoration in BC (MOF, 2001)

1.1 MECHANICAL SITE PREPARATION

The intent of mechanical site preparation (MSP) is to create ground amendable to spring and/or summer planting. MSP treatments will de-compact the road prism (running surface compacted from vehicle use) by ripping trenches or mounding to create microsites suitable for planting. MSP is also applied in order to control site access. Most commonly, MSP involves Mounding and Ripping. These activities will abide by the practice requirement within the Forest Planning and Practices Regulation (FPPR), other Acts and Regulations, and higher-level plans.

1.1.1 Mounding

Mounding involves the development of microsites by flipping the soil to provide a raised planting site. Skidders with a mound attachment or excavators with a bucket are used to dig holes and place soil beside the hole, creating the elevated mound. The elevated microsite improves growth of planted seedlings with an increased soil temperature. Mounding is suitable for wet sites or areas with a high brush component but not very useful on dry sites unless the site is compacted. Mounding may also be used for access control; in which case a minimum depth of 0.75 m is recommended for the mound holes.

Appropriate mound sizing is dependent on the soil; in most conditions the mounded height should not exceed 30 cm; however, it is far more important that the mounds consist of suitable planting medium. For example, mounds should not have a thick clay cap over a humus layer. Mound density is dependant on planting density selected at the site; in most areas 1,000 to 1,200 mounds/ha are appropriate. Mounds should be created in an irregular pattern along the road, especially on slopes.

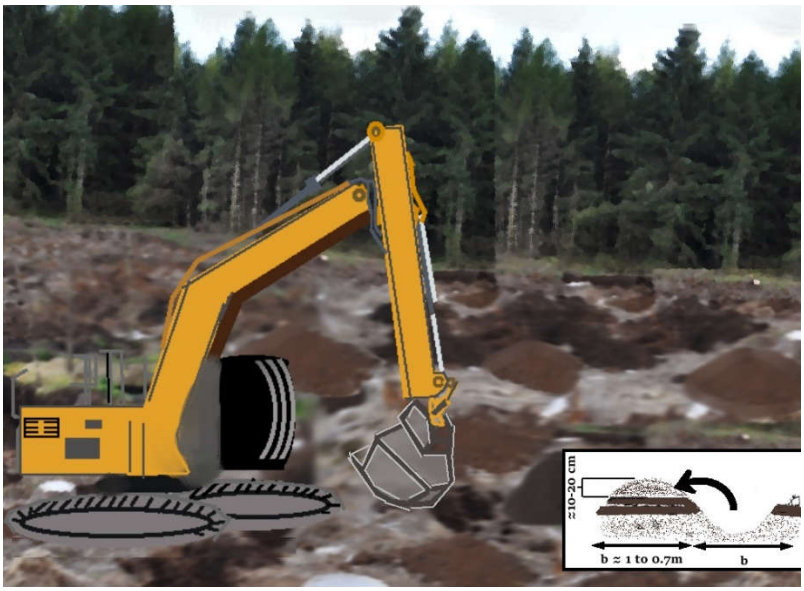


Figure 1. Mounding Technique.

1.1.2 Ripping

Ripping is a standard road rehabilitation site preparation method used to rip up soil at sites where soil compaction may be a concern, and the risk of rill erosion is low (e.g., upland areas). Using an excavator, dozer or skidder with an attachment for ripping, the soil is de-compacted to allow for improved root development.

Figure 2. Ripping Technique.

1.2 Seeding and Tree/Shrub Planting

Linear development that have been classified to not revegetate sufficiently on their own are potential candidates for seeding and/or planting of tree and shrub seedlings to regenerate habitat. Replanting roads

with tree and shrub seedlings will also serve to break-up sightlines along longer linear corridors in a shorter period of time and reduce ease of movement for predators.

One objective for reforestation is to increase site occupancy and the stand's ability to sequester carbon. Planting prescriptions consider the Chief Forester's Climate-Change Stocking Standards (2013) with regards to species selection; however, an increased planting density is recommended to meet the goal for increased carbon sequestration and account for mortality. A minimum inter-tree distance (MITD) is provided for target spacing; however, microsite selection is more important as a result of MSP treatments. Prescriptions were chosen based on a number of factors and individual site characteristics including consideration for the surrounding landscape/stand (e.g., burned, healthy), soil (e.g., compacted), and maturity (e.g., young, middle, mature stand).

Planting densities have been established based on applicable site conditions (e.g., moisture regime, slope, elevation) and adjacent forest stand cover, as outlined in the prescription document. Planting densities have been prescribed at 1600 stems per hectare, unless specified otherwise. Cottonwood staking has also been proposed within select riparian areas to block predator mobility across stream crossings as well as to increase bank stability.

For the purposes of caribou habitat restoration, coniferous species are generally recommended since conifers are an important component of caribou habitat and provide a better sight line break year-round compared to deciduous trees. Other factors that were considered during plant selection include:

- **Biogeoclimatic (BEC) zone**; whether species are naturally found, or will thrive, within a designated BEC zone.
- **Low-Palatability** to other ungulates, such as moose and deer, to avoid drawing predators into areas where caribou are expected to be.
- **Competition**; planting particular species and seeding at densities that will not compete with native tree and shrub cover, or with lichen colonization at locations where lichen is naturally found. Revegetation should still allow for natural establishment of native species over time.

1.2.1 Seed Use

Planting prescriptions are consistent with the Chief Forester's Standards for Seed Use, Climate Based Seed Transfer guidelines. For this project, planting prescriptions do not detail seedlot information so that the best available option can be selected prior to implementing the sowing phase. All information required to select seed is within the planting prescription table.

Seedlots selected during seed orders must be consistent with the seed selection "best practices" for projects that include the establishment of plantations for rehabilitation purposes:

- Use tree seed of the highest available genetic worth (GW)
- Apply Climate-Based Seed Transfer Guidelines as per the Chief Forester's Standards for Seed Use[1]
- Maintain genetic diversity at the landscape level.

[1] https://www2.gov.bc.ca/gov/content/industry/forestry/managing-our-forest-resources/tree-seed/legislation-standards/chief-forester-s-standards-for-seed-use

1.3 Spreading of Coarse Woody Debris (CWD)

The spreading of large or small woody material may serve as access control at the road point of commencement (POC) to prevent human and predator movements into restored road surfaces. It may also serve as a site preparation technique by creating microsites. Woody debris may encourage seedling establishment and supplement sites left to revegetate naturally.

Spreading of CWD along deactivated roads may be done in conjunction with mechanical site preparation and revegetation wherever CWD is available on the landscape. Longer stretches of scattered CWD are considered more effective for access control. CWD may also be beneficial on slopes to prevent soil erosion, especially on slopes near sensitive environmental receptors (e.g., streams).

It is recommended that larger pieces of CWD be utilized since they last longer and provide more nutrients to the soil. Generally, a minimum diameter of 7.5 cm and a density of approximately 100-200m³/ha is recommended unless specified otherwise (based on FLRNO, 2021).

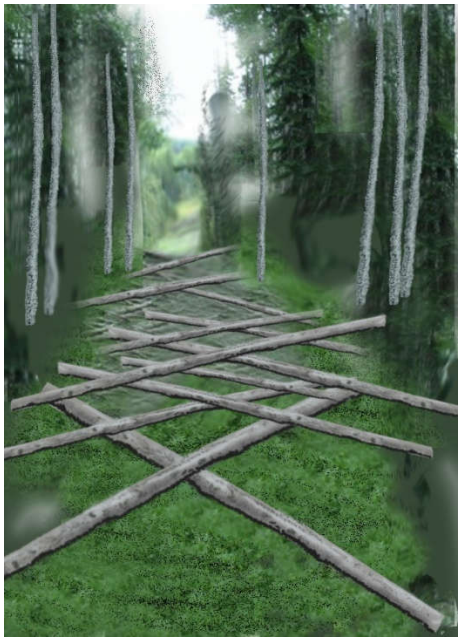


Figure 3. Large woody debris spread along a linear feature.

1.4 Tree Felling and Bending

Tree stem bending/hinging or tree felling may be suitable for reducing sightlines and impeding predator travel along roads, especially where CWD is not available on the landscape to accomplish the same task. An excavator is used to bend or fall trees across the line by either pushing over trees or lifting them from the roots. One advantage of bending versus felling is that branches of certain tree species (e.g., Engelman spruce) that touch the ground can grow into mature trees on their own structure.

These techniques are often combined with mounding and tree planting to control access. However, one potential problem associated with tree bending/hinging or felling/tipping is that deer and moose may be attracted to browse on easily accessible trees. Thus, it is recommended that tree species unpalatable to ungulates are chosen for this treatment, such as spruce or pine. Tree felling/bending is generally at 15-20 m apart unless otherwise specified. A higher density is recommended for blocking access points.

Figure 4. Tree felling.

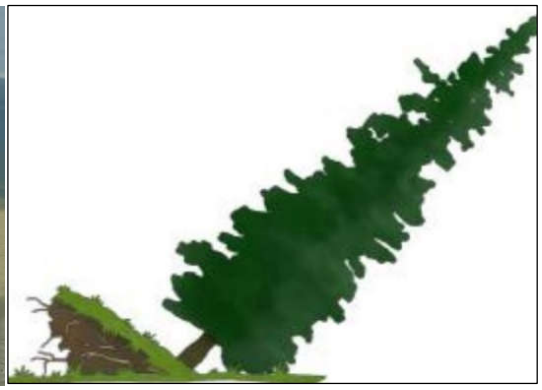


Figure 5. Tree tipping.

1.5 ZIG ZAG LOG FENCES

In areas where tree felling/bending is not possible due to lack of trees adjacent to the rehabilitation site, log fences may be installed as an alternative. While the use of log fences for road rehabilitation is largely untested, it is assumed that they provide a similar benefit by reducing sightlines and impeding predator travel along roads. Since materials are limited to logs that are stacked to form a zig zag fence (i.e., no wire, nails or bolts), wildlife cannot get tangled in wire and maintenance will not be required as these types of fences can be left in place to decay. As the fences rot, they still reduce the line of sight. As required, biodegradable material such as hemp or sisal rope may be used to tie the top log to the next one at the joints to prevent the top log from falling off. A stick can be helpful to tighten the rope by twisting the rope.

These types of fences can also assist in forest regeneration where trees are planted on both sides of the fence at an increased density. Overtime the trees will replace the fence and help to reduce line of site. The fences offer the trees protection from snow press and wind, and they would also cause the ground to warm earlier in the spring to provide a microsite for growth. It is recommended that log fences be installed along straight road stretches every 100-150m.

Figure 6. Zig zag log fence.

Zig-zag Method

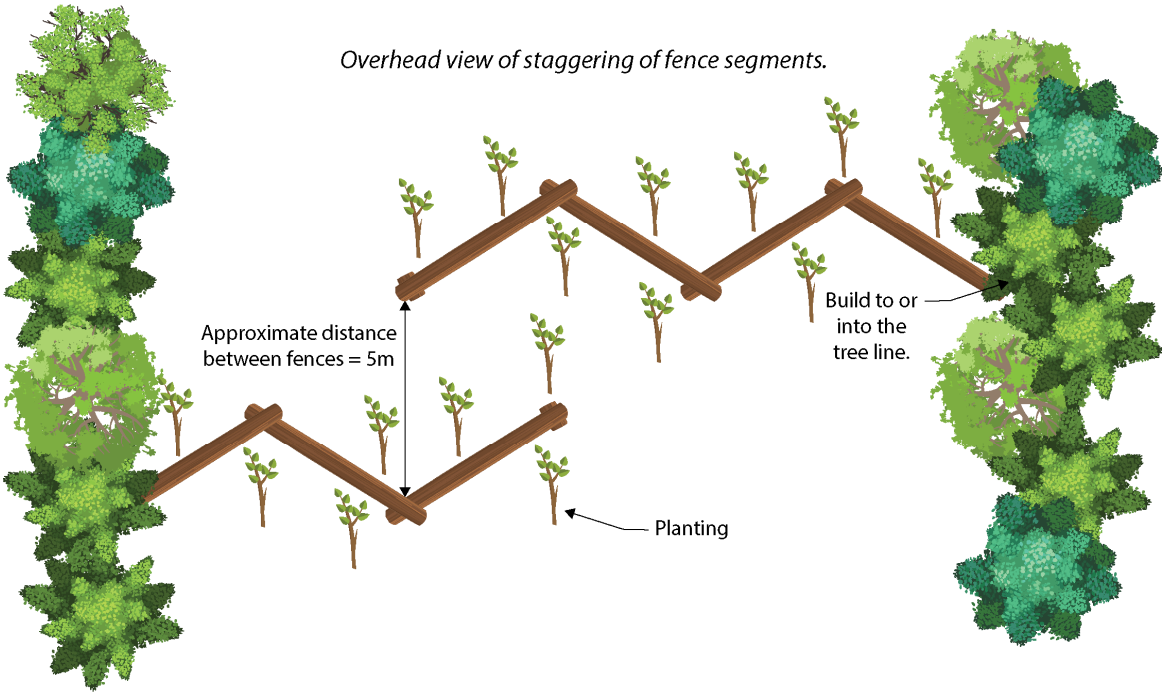
Fall trees close together, cut into 6 or 8 foot length and stack into two (2) log zig-zag fences that cross the road in the pattern shown below. The length of logs and number to stack will be dependent on availability and weight of the log. The height of the fence should be 1.25 m at a minimum.

Tie the top log onto the next log using sisal or cotton rope (Tie Method inset).

Trees can be planted or willow/cottonwood/alder/red osier staked on either side of the fence. As the fence degrades, the trees/shrubs will grow continuing to block the line of sight.

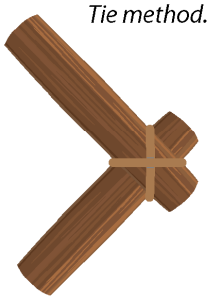
Place this fence system every 100-150 m.

Overhead view of staggering of fence segments.



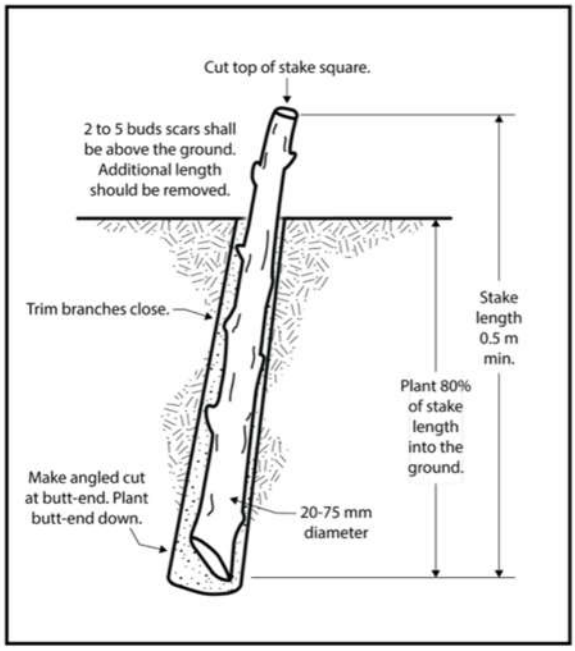
Side view of zig-zag fence.

Tie method.



1.6 Staking Willow/Alder or Cottonwood

Staking road junctions was recommended by the McLeod Lake Indian Band as a means to reduce vehicle access onto linear features such as roads. The stakes, when installed stick out of the ground. The exposed stakes can puncture ATV tires. When a large number of stakes are put into the ground, it is too much work to pull them out. As the stakes begin to root, they become even more difficult to remove.



Species that can be staked include willow, alder and cottonwood. The stake should be at least 50cm long with all branches removed. The stake should be free of damage.

Install the stakes for the width of the road, approximately a metre apart. Install at least 10 metres along the road. This will provide sufficient coverage to create a visual barrier as well as a physical barrier over time. The number of stakes also will deter individuals from pulling up the stakes due to the sheer quantity.

Ensure that the stakes are collected while the plant is dormant and install when in the spring or late fall. Alder should be used in areas that are drier. Use willow in the wetter sites. Cottonwood has special spiritual meaning to the McLeod Lake Members. Try to stake some cottonwood in each site that is to be staked.