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Chase Caribou Road Restoration Program

Year 2 (2024-2025) Summary Report

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Chase Caribou Road Restoration Program

FWCP Grant Number: PEA-F25-W-4049

Prepared For

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11 June 2025

Recommended Citation

Chu Cho Environmental. 2025. Chase Caribou Road Restoration Program: Year 2 (2024-2025) Summary Report. Chu Cho Environmental LLP, Prince George, BC.

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Executive Summary

The Chase Caribou Road Restoration Program (CCRRP) is a collaborative initiative led by Chu Cho Environmental and Tsay Keh Dene Nation with the goal of restoring linear disturbances, primarily forest roadways, within the Chase Caribou herd range. Since the program initiation in 2018, the CCRRP has successfully restored approximately 50 kilometers of roads, including Caribou Flats Road (2019), Lay Creek (2020), Goldway (2021), and Chuyaza (2023). The restoration of linear features is a recommended recovery action identified in the Federal Recovery Strategy for Southern Mountain Caribou to make roads or linear features less suitable for predator travel and alternate prey species. As predators are documented using roads and linear features to travel faster and farther compared to in forested areas, the presence of these features on the landscape can increase predation pressure on caribou.

This work was completed with support from the Fish and Wildlife Compensation Program as it directly aligns with the Peace Region Upland Action Plan priority action PEA.UPD.SO4.HB.07 Restore linear corridors-P1: “Implement the recommendations from action #6 to strategically decommission roads and/or support the functional and ecological restoration of linear corridors.”

In 2024, the CCRRP restored a total of 2.5 kilometers of road sections within the Swannell River Valley, which was less than the targeted 9.3 km, due to the excavator break down that occurred. The road restoration activities have been completed in an area that has been identified as low-elevation core habitat for the Chase Caribou and that Tsay Keh Dene Nation has designated as the Wędzih Yinè’ (Caribou Song) Indigenous Protected and Conserved Area (IPCA), protecting this area from further industrial developments. We employed both functional and ecological restoration techniques make the road surface more suitable for vegetation establishment, as well as to create physical barriers to predator line-of-sight and movement along the former road surface. As well, we planted the road with lodgepole pine (*Pinus contorta*) seedlings to accelerate the recovery of the road to a forested ecosystem.

Additionally, we completed pre-treatment monitoring of the wildlife and vegetation using the road to understand how wildlife use of the road changes and to monitor vegetation growth and establishment through time following restoration treatments. Follow up monitoring will be completed in future years to track the development of vegetation and to compare pre- and post-treatment wildlife use of the road segments.

Overall, the goal of the CCRRP is to improve habitat within the Chase Caribou herd range to support the recovery of this Threatened species. Work will continue in 2025, focussing on non-tenured sections of roadway within the low elevation core habitat of the Chase caribou, starting with the 6.8 km of road restoration not completed in 2024.

Acknowledgements

We would like to acknowledge that this work was completed in partnership with Tsay Keh Dene Nation, and field work took place within the Core Territory of Tsay Keh Dene Nation. Thank you to our project partners for their financial support, including: Habitat Conservation Trust Foundation, Environment and Climate Change Canada, and the Fish and Wildlife Compensation Program. This report was prepared with financial support of the Fish and Wildlife Compensation Program on behalf of its program partners BC Hydro, the Province of BC, Fisheries and Oceans Canada, First Nations and Public Stakeholders.

1 Introduction

Woodland caribou (*Rangifer tarandus caribou*) are a species of cultural and ecological significance to Tsay Keh Dene Nation and are an instantly recognizable species associated with the remote, mature forests of the north. Caribou, including the Southern Mountain population that are the focus of this report, require large, intact landscapes across which they complete seasonal migrations between calving grounds, breeding grounds, and in search of sufficient food (COSEWIC 2014; Environment Canada 2014). Elevational connectivity is also important for caribou, as they move from low to high elevations in the mid-winter as snow depth at lower elevations increases the difficulty of movement and foraging, then back to lower elevations for spring green up (COSEWIC 2014). In recent decades, however, extensive changes in land use resulting from both natural (e.g., wildfire, mountain pine beetle) and anthropogenic (e.g., forest harvest, road building, mineral exploration and mining) disturbances have fragmented caribou habitat, disrupted these seasonal movements, and altered predator-prey dynamics for caribou, leading to population declines or even extirpation of herds (Environment Canada 2014; DeMars and Boutin 2018).

In response to caribou population declines, Environment Canada released the Federal Recovery Strategy for the Woodland Caribou, Southern Mountain population, which provides broad management strategies and recommended actions designed to meet the recovery goal of achieving self-sustaining populations within all herds within their current distribution (Environment Canada 2014). This recovery strategy for the southern mountain caribou, to which the Chase Herd of caribou belong, recommends several recovery actions for the species, including the urgent action to “undertake coordinated actions to reclaim southern mountain caribou habitat in all currently utilized seasonal ranges through restoration efforts (e.g., restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleaned areas; reconnect fragmented annual ranges) to make it less suitable for other prey species” (Environment Canada 2014).

Roads and other linear features are specifically identified in the recovery strategy as threats or limitations to caribou recovery (see Table 9 in Environment Canada 2014), as they are known facilitate predator movement, altering predator-prey dynamics for caribou (Dickie et al. 2017; DeMars and Boutin 2018). Within the Chase herd range, wolves (*Canis lupus*) and wolverines (*Gulo gulo*) are identified as the leading causes of predation mortalities for caribou (Sittler et al. 2022); both species are documented using roads and linear corridors for travel within our study area. Previous research has shown evidence that wolves select for and use linear disturbances when they are available on the landscape, and that once on these linear features, wolves move faster and tend to travel greater distances compared to when they are moving through forested habitat, increasing their chance of encountering and preying upon caribou (Dickie et al. 2017). Roads or linear features that span from the low elevation valley bottom to the alpine, such as mineral exploration and mining roads, can be especially problematic for caribou as they facilitate easy wolf access into high elevation areas (Whittington et al. 2011).

1.1 Chase Caribou herd

The Chase Caribou belong to the Northern group of Southern Mountain Caribou and are listed as Threatened on Schedule 1 of the Federal Species at Risk Act and Red Listed in British Columbia (BC CDC 2024). The northern most herd of Southern Mountain Caribou, the Chase Caribou herd, is bordered by the Wolverine Caribou herd to the south and the Thutade Caribou herd of Northern Mountain Caribou to the north. The Chase herd range spans approximately 12,465 km², encompassing portions of the Ingenika River, Mesilinka River, Omineca River, and Skeena River watersheds.

The Chase herd is currently considered to be stable, with recent survey work yielding a population estimate of 531 individuals (95% CI: 454-682; Anderson and Klaczek 2021). This estimate is similar to the 2019 population estimate for the Chase herd of 572 individuals (95% CI: 518-683; Anderson and Klaczek 2019). Though the population appears to be stable in recent years, provincial biologists caution that “accelerating landscape change, primarily from industry forest harvest within low-mid elevation forests, across the herd range could change the population trajectory rapidly” (Anderson and Klaczek 2021).

Within the Chase herd range, there has been significant disturbance from both natural and anthropogenic disturbances fragmenting caribou habitats, with an estimated 50.4–50.7% of low elevation core range, 54.1% of matrix range, and 9.5–13.0% of habitat within high elevation core range being disturbed as of 2021 (Bonderud et al., 2024). The Federal Recovery Strategy for the Boreal Caribou identifies that caribou require a minimum of 65% of undisturbed habitat within their range in order to maintain a 60% probability for a population to remain self-sustaining (Environment Canada 2012); while this disturbance threshold was described for boreal caribou, no alternative threshold has been described specific to southern mountain caribou. Based on the findings of Bonderud et al. (2024) and Sittler et al. (2022), low elevation habitats within the Chase range exceeds the 35% disturbance threshold, suggesting the Chase caribou may be at risk of population decline.

1.1.1 The Chase Caribou Road Restoration Program

In response to the disturbance and predation pressures on the Chase Caribou, Tsay Keh Dene Nation (TKDN) and Chu Cho Environmental (CCE) initiated the Chase Caribou Road Restoration Program (CCRRP) in 2018 with financial support from the Peace Region Fish and Wildlife Compensation Program (PEA-F19-W-2650). The goal of the CCRRP is to restore linear disturbances (i.e., roads) within the Chase Caribou herd range to increase the value of the habitat to caribou and reduce the suitability for predator and alternate prey species travel. Since program initiation, the CCRRP has prioritized restoration opportunities and restored approximately 40 kilometers of roads within the Chase Caribou range including: Caribou Flats Road (2019), Lay Creek (2020), Goldway (2021), and an 8.5 km section of forest service road within the Swannell River Valley in 2023, followed by a total of 2.5 km in 2024. The targeted length of road to be restored in 2024 (9.3 km) was not achieved due to a major mechanical failure on the excavator that was being contracted and the lack of an available replacement excavator and qualified operator, discussed in Section 5.1.

Beginning in 2023, the CCRRP shifted focus to the Swannell River Valley within the Caribou Song IPCA. The goal is to restore linear features throughout the Swannell Valley, which is identified core low elevation summer and winter habitat for the Chase caribou. Highlights from the previous work completed as part of the CCRRP can be found on the Chu Cho Environmental YouTube channel (<https://www.youtube.com/@ChuChoEnvironmental>) or by following the links below:

- Chase Caribou Road Restoration Program: https://youtu.be/tvVLogfahAk?si=Gxyzmbh_xsG6boHb
- Monitoring the Goldway Road: <https://youtu.be/6iLBj2szaDk?si=ZRk0EcUpU9ptruw6>
- Restoration of Chuyaza and Swannell Road: <https://www.youtube.com/watch?v=ugthUmPqyTE>

2 Goals and Objectives

As identified above, the goal of the CCRRP is to remove and restore linear corridors (i.e., roads) within the Chase herd range to make the habitat less suitable for predator travel and alternate prey species (i.e., moose, *Alces alces*). To achieve this, the CCRRP employed both functional and ecological restoration techniques to restore resource roads in a manner that benefits the Chase Caribou herd. We anticipate that this restoration work will benefit the Chase Caribou in the long-term by directly restoring habitat to a mature conifer forest, reducing habitat fragmentation and through reducing predation pressure by making the road less suitable for predator travel. In the short-term, this work will create physical barriers to limit predator movement and line-of-sight along restored roadways and create a road surface over which predators will have to move more slowly. Specifically, the 2024 objectives of the CCRRP were:

- Use ecological and functional restoration to restore a total of 9.3 km of non-tenured road segments near the end of the Swannell Mainline.
- Monitor linear corridor restoration success in a cost-effective manner, using an Unmanned Aerial Vehicle (UAV; drone) to collect imagery and multispectral data before and after treatment.
- Build capacity within TKDN Lands and Resources department to oversee road restoration activities.
- Share the results of this work with Tsay Keh Dene Nation citizens during a community engagement session held in the village of Tsay Keh Dene and Prince George in January 2025.

2.1 Alignment with action plans

This work directly aligns with the Peace Region Upland Action Plan priority action PEA.UPD.SO4.HB.07 Restore linear corridors-P1: “Implement the recommendations from action #6 to strategically decommission roads and/or support the functional and ecological restoration of linear corridors” (Fish and Wildlife Compensation Program 2020). Additionally, this project also aligns with the Federal Recovery Strategy for southern mountain caribou, specifically the recommended recovery action “undertake coordinated actions to reclaim southern mountain caribou habitat in all currently utilized seasonal ranges through restoration efforts (e.g., restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleaned areas; reconnect fragmented annual ranges) to make it less suitable for other prey species” (Environment Canada 2014).

3 Study Area

The 2024-2025 CCRRP activities occurred within the Swannell River Valley, a low-elevation valley entirely within the Chase Caribou herd range boundary (Figure 3.1). The Swannell River Valley is located 55 km southeast of Tsay Keh Dene, BC, and 190 km northwest of Mackenzie, BC. The planned road segments are entirely in the Chase Caribou range and consist of several non-tenured road segments off the Swannell Mainline in identified Ungulate Winter Ranges (UWR, u-7-007 and u-7-025). Tenured road segments were not considered for 2024 due to Conifex Timber Inc. not being in a position in which the company could financially support restoration activities on road segments currently under their tenure.

Habitat mapping of core and matrix habitat areas within the Chase Caribou herd range has been completed through the Tsay Keh Dene Nation – Province of British Columbia Environmental Stewardship Initiative, a government-to-government collaboration aimed at developing trusted information and stewardship recommendations for Valued Ecosystem Components, including caribou. Through this habitat mapping work, the Swannell River Valley was identified as an area supporting low elevation core habitat for the Chase Caribou in both the summer and winter seasons. Core habitat refers to areas that contain all resources required to support all life requisites (e.g., food, cover) for caribou during both seasons.

Tsay Keh Dene Nation (TKDN) has established the Wədzih Yinè' (Caribou Song) Indigenous Protected and Conserved Area (IPCA) within the Chase Caribou herd range, which includes the Swannell River Valley, the Ingenika River Valley, and the area around Chuyaza (Helicopter Lakes). The Wədzih Yinè' IPCA is a priority area for restoration efforts as TKDN has reached agreements with forest licensees operating within the Mackenzie Timber Supply Area that they will not operate within the Wədzih Yinè' IPCA. The establishment of Wədzih Yinè' IPCA provides reasonable certainty that the area will remain free from further industrial development (i.e., unlikely that restored roads will be re-activated or new roads will be established within the protected area). All the currently planned CCRRP work will occur within the Wədzih Yinè' IPCA.



Figure 3.1. Restoration activities for the 2024-2025 Chase Caribou Road Restoration Program occurred within the Swannell River Valley, which falls entirely within the Wədzih Yinè' Indigenous Protected and Conserved Area and Chase Caribou low elevation core habitat.

4 Methods

4.1 Desktop-based Planning and Prescription Development

In 2019, CCE completed a desktop-based exercise to identify and prioritize roads within the Chase Caribou range as candidates for restoration, based on Tsay Keh Dene Nation cultural considerations, logistical considerations, and discussion with forest licensees, as well as the ecological benefit to caribou (Chu Cho Environmental LLP 2019). This priority list, along with the establishment of the Wędzih Yinè' IPCA and mapping of Chase Caribou range core habitat was used to inform site selection for the 2024 restoration activities. In summer 2023, 9.3 kms of non-tenured road segments, off the Swannell Mainline between 34 – 35 km on the Swannell Forest Service Road was selected as the focal area for 2024 restoration activities, referred to here as the Chuyaza road section: part II. This section of road falls entirely within the Wędzih Yinè' IPCA and within an area identified as low-elevation core habitat for the Chase Caribou, making it a priority road segment for restoration activities. These road segments are no longer needed for forestry activities and provide easy access into low-elevation core habitat for the Chase Caribou for both predators and motorized vehicles, hence they were selected for restoration in 2024.

Following site selection, CCE staff conducted a desktop-based exercise to determine the characteristics of the Chuyaza road section: part II to be restored, including length, ecosystem type (i.e., biogeoclimatic ecosystem classification (BEC) zone), and watercourse crossings present along the road segments. Additionally, on June 6, 2024, CCE staff completed field visits to the identified road segments to verify the results of the desktop analysis by traveling the roads by ATV and on foot to identify the locations of any drainages or culverts along the road segment. This information helped inform the final restoration prescription for the road segments to be restored in summer 2024.

The detailed road restoration prescription is provided in Appendix 1: Restoration Prescription, with key concepts described below.

The restoration prescription employed both Ecological and Functional Restoration techniques to make the identified road sections less suitable for predator travel and alternate prey species. Ecological Restoration is the process of supporting the recovery of an ecosystem that has been damaged or degraded from disturbance; in this work, ecological restoration was achieved through mechanical site preparations that decompact the soil, creating microsites suitable for planting trees, and promoting the regeneration of native vegetation on the former road surface (BC MFLNRORD, 2019). Specific mechanical site preparations included:

- Road surface decompaction and scarification using an excavator and bucket.
- Machine screefing and rough and loose soil mounding using an excavator and bucket.
- Slash rollback using an excavator and bucket.
- Access management using an excavator and bucket.

Functional restoration of linear features, such as roads, can benefit caribou by making the features less suitable for predator (Keim et al., 2019) and human movement. In this project, functional restoration was achieved through the following techniques:

- Strategic coarse woody debris placement in locations to reduce predator sight lines.
- Slash rollback.
- Road decompaction.
- Tree planting.

In 2024, there was one treatment unit developed for all road sections to be restored. The restoration prescription describes restoration method that was developed; full descriptions of the treatment unit is provided in Appendix 1: Restoration Prescription. Together, the functional and ecological restoration techniques described in the restoration prescription are expected to benefit caribou by:

- Limiting access to the road from both animal predators and motorized vehicles.
- Decreasing predator line-of-sight while on the road to obscure caribou from predators.
- Decreasing predator travel speed along the roadway.
- Maintaining connectivity within and between caribou ranges.
- Accelerating the revegetation of these road surfaces by creating microsites and planting with species appropriate for the ecosystem.

4.2 Road Restoration Prescription Implementation

Fieldwork to implement the restoration prescription for the Chuyaza road section: part II occurred between August 14-19th, 2024. The implementation was completed by a crew consisting of:

- Equipment Operator: Operated a John Deere 210G excavator to implement earthworks outlined in the restoration prescription.
- Restoration Supervisor: Worked one-on-one with the machine operator to ensure earthworks were implemented according to the prescription; provided guidance on access management (e.g., cross ditching), re-contouring, and visual screening.
- Tree planter: Planted all seedlings according to the restoration prescription.
- Monitoring: 1-2 crew members who completed the pre- and post-treatment monitoring using both an unmanned aerial vehicle (UAV) and wildlife cameras.

Restoration work commenced on the most southerly spur road segments on the east side of the Swannell River, moving towards the Swannell River, and then shifting to the spur road segments on the west side, starting with the most northerly segments (Figure 3.1). No culverts were encountered along the 2.5 km of road that was restored in 2024. All target roads for restoration were in harvested areas, so there was no opportunity for hinging or falling trees, and the same treatment was applied to all roads.

On August 17th, 2024, the John Deere 210G excavator broke, with one of the connection pins on the right track snapping, damaging the surrounding connection points, and breaking the track (Figure 4.1). No

immediate fix was possible due to the remote worksite and the age of the track, so the excavator was unable to continue the work. Significant efforts over 2 days were put into finding both a replacement excavator, transportation for the excavator, and an operator. An additional operator was required because the original operator was engaged in the repair of their machine and obtaining parts from Prince George. Given the remote location, the lack of available excavators and experienced machine operators, and the cost of bringing a new excavator from Prince George to site, the decision was made to plant the road sections that had already been prepared by the excavator before it broke down, and to postpone work in the remaining 6.8 km of road sections until 2025. The crew had to make a difficult decision but chose to prioritize the long term success of the project and the resources provided by its funders. Continuing to search for an excavator, transportation, and an operator would have been a costly and inefficient use of funds.



Figure 4.1: Photo of the broken track link on the John Deere 210G excavator that was being used for restoration in 2024.

4.3 Removal of 2023 Legacy Culverts

During the CCRRP restoration activities that were completed in 2023, 29 culverts were removed, crushed, and stacked near the Swannell River bridge in preparation for future removal. As part of 2024 fieldwork, these 29 culverts were loaded into a rock truck, supplied by Chu Cho Industries, using the John Deere 210G excavator on August 15th, and were directed to transport to a storage location adjacent to the Swannell Camp, located at 17 km on the Swannell forest service road.

4.4 Baseline Data Collection and Monitoring

Baseline data collection and long-term monitoring document the conditions found in the Swannell River Valley before and after road restoration and enable tracking of changes over time. As part of the CCRRP, CCE staff developed methods for baseline data collection and monitoring of pre-treatment roads, as described below in Section 4.4.1 and Section 4.4.2. Baseline data collection on candidate roads prior to treatment is designed to confirm the road is a good candidate for restoration, specifically through confirming wildlife (both caribou and predators) use of the road and identifying potential conflicts with other land users (e.g., identifying if the road is used by TKDN citizens or local guide outfitters). As restoration occurs over long timeframes (i.e., years to decades), repeated monitoring of the road is required, both before and after treatment, to assess change in the measured conditions. The goal of monitoring is to assess if the measured conditions change in such a way that benefit caribou.

Baseline data collection and pre-treatment monitoring was completed in summer 2024, with future monitoring to occur 3, 5-8 and 20-30 years after treatment. These monitoring intervals were selected to balance cost of data collection in this remote area and the usefulness of the information obtained from monitoring (i.e., the intervals are long enough that some change in conditions can be measured). Vegetation establishment takes time, so these monitoring intervals will enable the establishment of the planted species and natural ingress of native species, allowing us to capture how conditions on the road sections change over the short, intermediate, and long-term.

4.4.1 Baseline Data Collection

In the CCRRP, many roads within the Swannell River Valley have been identified as candidates for potential restoration activities, however it may not be useful or desirable to implement restoration treatments on all candidate roads. To be a suitable candidate road for restoration, it must be used by wildlife, including both predators and ungulates, and must not be highly used by humans (e.g., roads leading to camps, cabins, recreation areas; roads used by local guide outfitters or TKDN citizens). We deployed wildlife cameras on select candidate roads throughout the Swannell River Valley to collect baseline data on use by wildlife and humans in order to confirm if the area is suitable for restoration activities.

The goal of this baseline data collection for wildlife is not to detect every individual animal or determine the total number present, but rather to confirm wildlife use and characterize the general rates of use of linear

features in the Swannell River Valley, with a specific interest in rates of predator, alternate prey (i.e., moose), and caribou use of roads. To this end, 4-8 wildlife cameras are deployed annually at strategic locations such as on roads leading from low to high elevations, transitions between habitat types (e.g., the road goes from a harvested into a mature forest stand), major road junctions, a natural draw or other topographical feature that may funnel wildlife onto the road and past the camera, near a water source, or in areas where field crews identify an abundance of wildlife sign on the road. This baseline data collection program was initiated in 2022 in the Swannell River Valley and cameras are moved periodically to collect baseline data on new candidate roads as restoration activities progress.

On August 1-3rd, 2023, during the Year 1 road restoration activities in the Swannell River Valley, cameras were collected from the road section being restored and were redeployed to other candidate roads for restoration. Two cameras in the Swannell River Valley were located on roads that were not being restored in 2023, but were target roads for the 2024 or 2025 restoration work, so those were serviced and left in place. Two additional cameras were deployed for a total of 4 wildlife cameras deployed on the Swannell River Valley Road network to monitor over the winter and into 2024 (Figure 4.2).

All cameras were Reconyx Hyperfire2 wildlife cameras, deployed in a locked box for security, mounted 1.5-2 m above the ground, and positioned to have a clear field of view of the roadway to capture caribou and other similarly sized species, as well as any humans using the road. The cameras were programmed to be triggered by motion, set to high sensitivity, and to capture three images at one-second intervals when triggered. Each camera was equipped with a SanDisk Ultra 120 MB/s 32 GB SD card to save, store, and transfer collected imagery.

Cameras were revisited on June 22-25th, 2024 to download images, change batteries, and move the cameras deployed on the roads scheduled to be restored in August 2024 (i.e., cameras RR 7 and RR9 in Figure 4.2). During this June visit, cameras RR8 and RR10 remained deployed to continue baseline data collection for those roads, and 3 cameras were deployed at new locations within the Swannell River Valley on additional candidate roads for restoration; in August 2024, an additional 2 cameras were deployed for a total of 7 cameras that are currently deployed (as these cameras were deployed in summer 2024, data from them will be presented in the Year 3 report). Deploying wildlife cameras on the pre-treatment roads allows us to build a baseline understanding on the wildlife and humans using the road, including predators and caribou or other ungulate species, enabling us to determine if the road is a suitable candidate for restoration treatment.

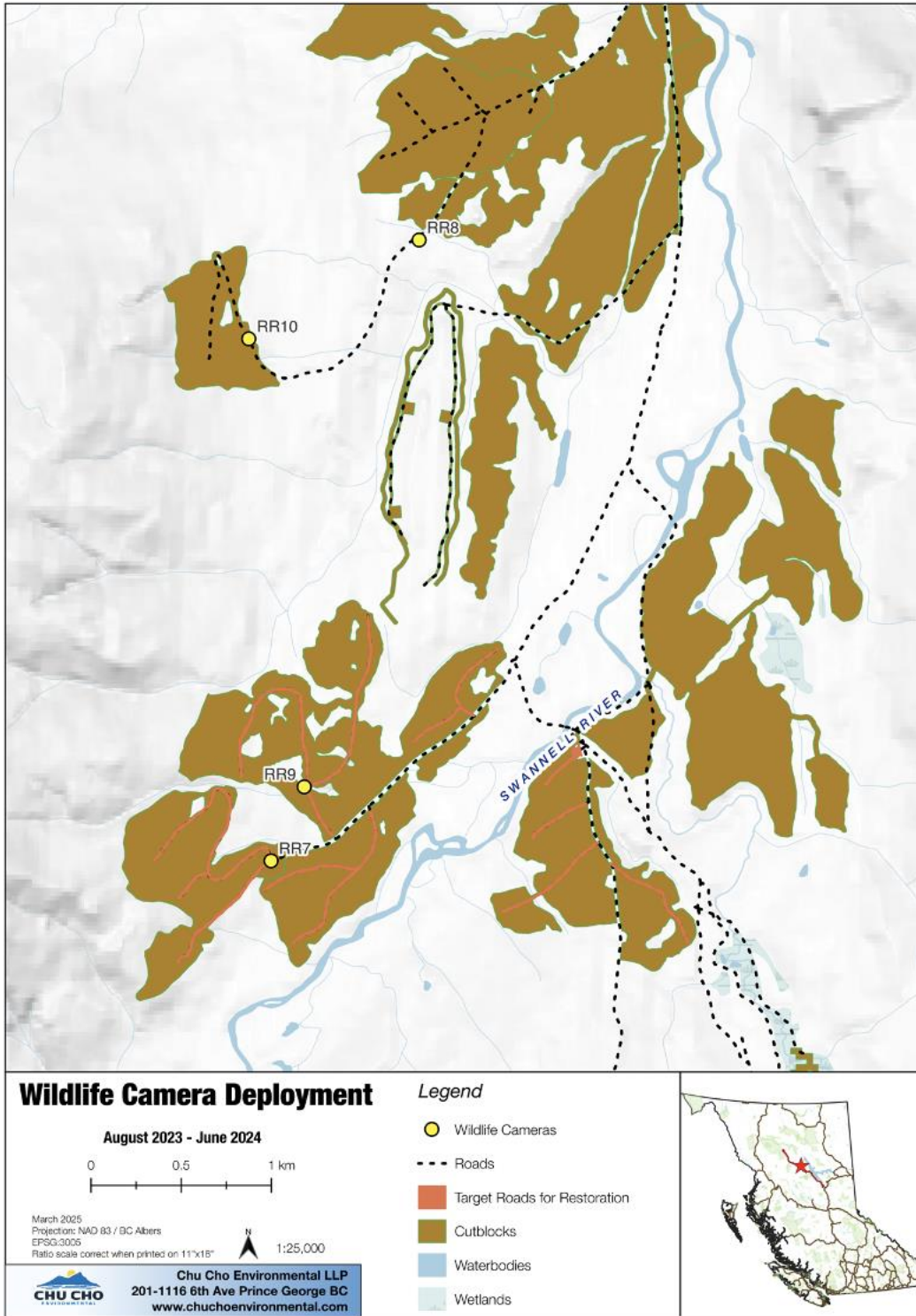


Figure 4.2. Wildlife camera deployment locations for August 2023 to June 2024 in the Swannell River Valley. Cameras RR7 and RR8 were initially deployed in 2022 and remained deployed.

4.4.1.1 Image Analysis

Images downloaded from wildlife cameras were initially classified by the program Megadetector (version 5; Beery et al. 2019), an AI classification model that can identify images with people, vehicles, or animals, effectively reducing the total number of images a human observer needs to review by removing false triggers. All classified images were reviewed for accuracy by a trained observer and analyzed using Camelot (<https://camelotproject.org/>), a free, open-source software for managing and analyzing wildlife camera data. In Camelot, a trained observer identified the species, number of individuals, sex, and life stage (i.e., adult, juvenile) of each independent animal detection. We defined independent detections as detections separated by at least 30 minutes, or any event within a 30-minute time period with distinct differences in the sighting fields, such as a different species, sex, or number of individuals from what was previously detected. If sequential detections did not meet these criteria (i.e., if detections were visually the same group composition), they were considered non-independent observations (i.e., only one detection event). For detections of humans, detections of the same individual or groups of individuals going up and then back down the road were counted as one independent detection. We compiled data summaries, including survey information, species independent sightings, animals per day, and summary statistics, including nocturnal detections (n night photos / N photos) and abundance index ($AI = 100 * [\text{independent observations} / \text{elapsed nights}]$).

4.4.2 Vegetation Monitoring

The vegetation monitoring component of the CCRRP was achieved through the collection of high-resolution multispectral drone imagery from which metrics of vegetation health and extent can be derived. Drone data collection can provide information on the extent of vegetation cover of a target area, and repeated flights of the same area over time enables tracking of changes in vegetation cover. As well, flying a drone over target areas can be done relatively quickly compared to traditional vegetation monitoring methods such as vegetation plots, allowing for larger areas to be monitored concurrently. The goal of the vegetation monitoring component of the CCRRP is to see that, over time, the extent of vegetation cover increases relative to the baseline vegetation cover. The vegetation monitoring metrics being used to evaluate restoration success are provided in Table 1.

Table 1. Vegetation monitoring metrics for the CCRRP monitoring program.

| Monitoring Metric | Description | Success Indicator |
|-------------------------|--|---|
| Vegetation Cover Extent | The total area of the road surface that vegetated. | Over time, the amount of bare ground decreases and the amount of vegetation cover increases relative to the baseline vegetation extent. |

We used a DJI Phantom 4 Multispectral (DJI, China) unmanned aerial vehicle (UAV; i.e., drone) to capture imagery of the road sections to be reclaimed, both before and immediately after treatment, to characterize the vegetation class and extent present on the road. The Phantom 4 Multispectral drone collects georeferenced imagery and is equipped with 1 visual light camera and a multispectral camera array with 5 sensors covering blue (B; 450 ± 16 nm), green (G; 560 ± 16 nm), red (R; 650 ± 16 nm), red edge (RE; 730 ± 16 nm), and near-infrared (NIR; 840 ± 26 nm) bands. We used an Emlid Reach RS+ (Emlid, Hungary) GNSS receiver to record high-precision location data; this high-precision location data was used to geocorrect the location data collected by the drone's onboard GPS unit during image processing.

We used QGIS (v3.22; QGIS.org) to create flight areas for the road; this involved creating a polygon around each section of road to be flown and exporting as a shapefile to be used in the flight planning software DJI GSPro (<https://www.dji.com/ca/ground-station-pro>). From this flight planning software we set the flight parameters and controlled the flight. The pilot completing the flights had a valid Transport Canada pilot certificate for Small Remotely Piloted Aircraft System, Visual line-of-sight, meaning that pilot was required to maintain visual line-of-sight with the drone at all times during the flight.

On June 22-25th, one crew of two CCE staff visited the site to complete the pre-treatment vegetation monitoring (Figure 4.3) concurrently with the wildlife camera maintenance shift. Flights were only completed under suitable weather (i.e., not in high winds or rain) and light conditions (i.e., not in early morning or late afternoons when the sun angle would be too low to collect good data). As the drone pilot was required to maintain visual line-of-sight with the drone at all times, the crew slowly walked down the road following the drone as it completed the flight plan; while the pilot was flying the drone, the other crew member observed the road surface and surrounding area for wildlife or other hazards. Post-treatment drone flights were completed August 14-17th 2024, following restoration prescription implementation, to document changes in the road surface. Post-treatment flights were completed for the four road sections that were restored in 2024 (i.e., flight plans 01-04; Figure 4.3), but not for the road section where the excavator experienced mechanical failure, as the excavator remained on the road and would have been captured in the imagery.

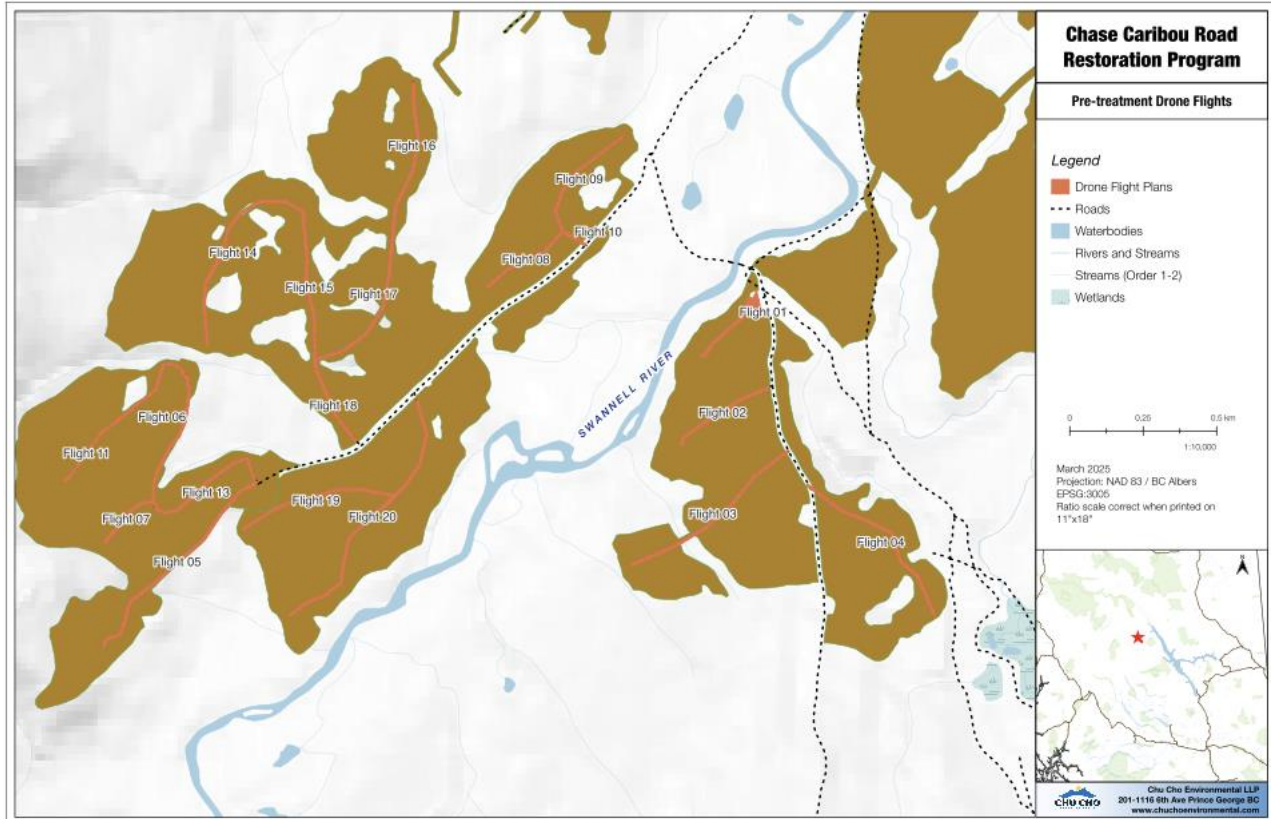


Figure 4.3. Map of the drone flights by flight number that were flown as part of the 2024 pre-treatment vegetation monitoring in the Swannell River Valley.

4.4.2.1 Drone Data Analysis

All drone images were downloaded daily and backed up on cloud storage. As the first step in image processing, we completed post-processing kinematic (PPK) correction of image geolocation using REDtoolbox v3.0.19 (REDcatch GmbH, Austria) PPK and geotagging software. We used the photogrammetry software Metashape Professional v1.8.2 (Agisoft, Russia) to complete initial image processing and then completed data analysis using QGIS v3.22 (QGIS.org, 2022). The flight imagery was clipped to a 10 m wide polygon, capturing the road surface and some of the surrounding habitat, before processing. We processed each flight separately, as light conditions and the timing of flights were variable. At this time, only pre-treatment flights were analyzed.

We calculated the Normalized Difference Vegetation Index (NDVI) to evaluate vegetation photosynthetic capacity using the formula:

$$NDVI = (NIR - Red) / (NIR + Red)$$

NDVI quantifies vegetation health and density based on measuring the difference in how near-infrared (NIR) and red light are reflected and absorbed, respectively. Repeated measurements of NDVI can provide an understanding as to how the health and composition of the vegetation present at a located changes over

time. We calculated vegetation classes using NDVI threshold values identified in previous research (Table 2; Hashim et al. 2019).

Table 2. Vegetation classes calculated from NDVI values; modified from Hashim et al. (2019).

| Vegetation Class | Code | Description | NDVI Value Range |
|------------------|------|--|------------------|
| Non-vegetated | 1 | Water, rock, and barren soil cover. | -1.0 – 0.2 |
| Low vegetation | 2 | Grass and shrub cover. | 0.201 – 0.5 |
| High vegetation | 3 | Forest cover, or low vegetation types at high productivity growth stage. | 0.501 – 1.0 |

5 Results and Outcomes

5.1 Functional and Ecological Restoration

For 2024, ecological and functional restoration techniques were physically applied to 2.5 km of road (Figure 5.1). Assuming a 5 m average roadway width, 1.15 ha was physically treated with ecological and functional restoration treatments aimed at returning the road to the pre-disturbance state. Restoration of the 2.5 km of road proceeded according to the prescription until the right excavator track broke on August 17th, after which road preparation was no longer possible. Appendix 2: Supplemental Information contains select imagery of restoration treatments from the 2024 work.

Road decompaction and preparation of the roadbed with a rough and loose treatment was done using the excavator equipped with a digging bucket. The operator would first decompact the road surface and excavate one or two buckets of soil, deposit that loosened soil beside the excavated depression, and then repeat this process adjacent to the first depression and mound (Figure 5.2). Available soil material would then be rolled back, and any available coarse woody debris would be added to the road to increase habitat complexity and provide visual screening. The operator started at the end of a road furthest away from the Swannell mainline and would walk the machine backwards, implementing the rough and loose treatment across the entire width of the road on the way back to the mainline. This prevented the operator from having to walk the excavator over the loosened road surface and allowed the operator to complete slash rollback and coarse woody debris placement on the road as part of the functional restoration treatment. The tree planter would follow behind the excavator, planting lodgepole pine (*Pinus contorta*) seedlings at the targeted 600 stems per hectare density in the sites deemed best for growth.

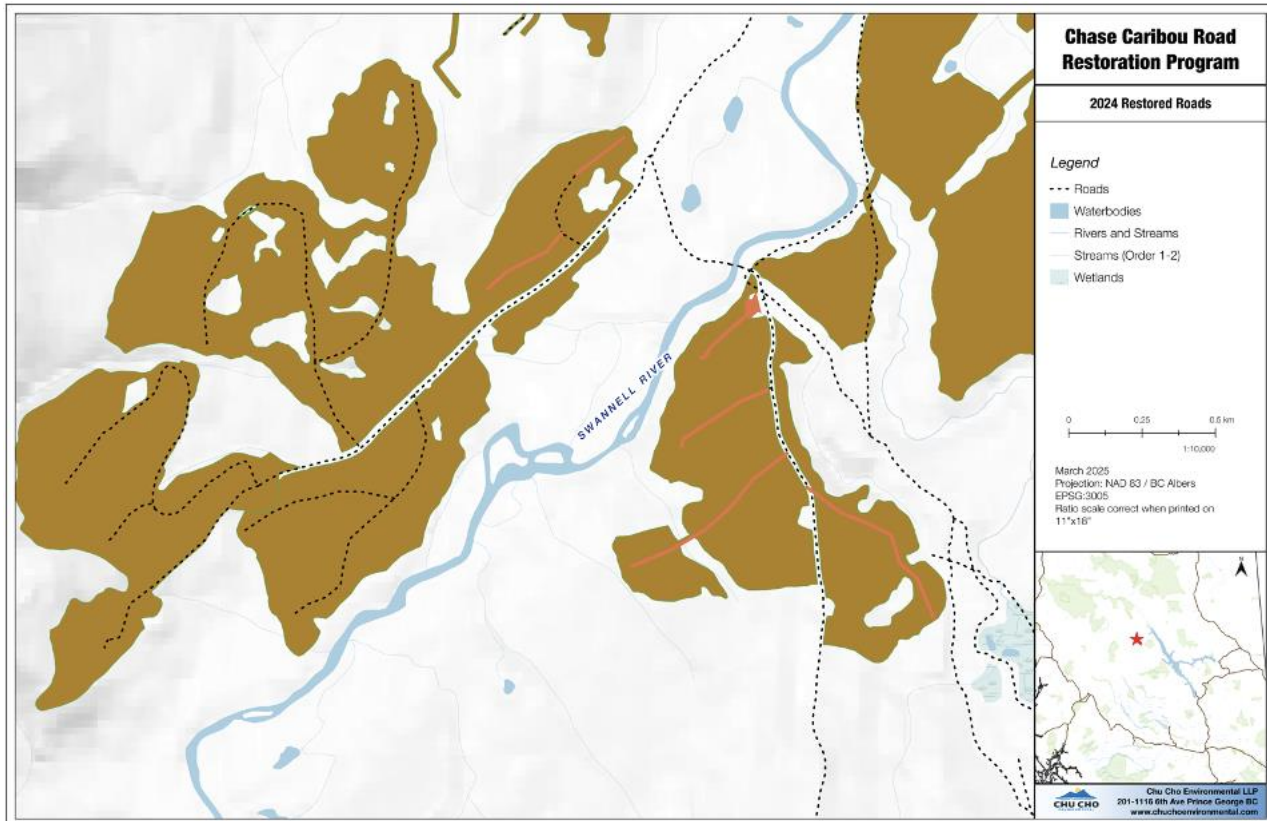


Figure 5.1. In 2024, 2.5 km of roads were successfully restored and are indicated in red. Progress was halted when the excavator track broke during activities.



Figure 5.2: The John Deere 210G excavator completing road decompaction and recontouring on a section of road in 2024.

This continued restoration of non-tenured road segments in the Swannell River Valley is helping contribute to the incremental restoration of the 110,534.8 ha Wədzih Yinè' IPCA. Since 2018, the CCRRP has helped contribute to a large road-free area in the headwaters of the Sustut, Swannell, and Ingenika Rivers, all of which are critical core habitat for the Chase Caribou.

5.2 Baseline Data Collection

There were 4 wildlife cameras deployed to collect baseline data during 2023-2024 on wildlife and human use of select candidate roads for restoration in the Swannell River Valley. Two cameras operated for 380 days (RR 7 and RR 9), one for 328 days (RR 8) and one for 382 days (RR 10), for a total of 1,470 camera-days during the 2023-2024 period. Including previous years of this work, there have been 3,270 camera-days of baseline data collection on wildlife and human use of roads in the Swannell river Valley.

We detected a total of 453 independent observations of wildlife during the 2023-2024 period, which included 15 unique and 3 unknown species (unknown bird – 1 detection; unknown Mustelidae – 1 detection; unknown mammal – 8 detections) that could not be accurately identified due to image quality (e.g., photos at night

where the animal is at the edge of the field of view). Horses (*Equus caballus*) from a local guide outfitter were frequently detected at both cameras RR 9 and RR 8. Domestic horses were the second most detected species overall which may have impacted the rates of other wildlife frequenting the area. Wolves were the most frequently detected species of wildlife on the pre-treatment roads, followed by snowshoe hare (*Lepus americanus*), and moose (Figure 5.3). Species detected in 2023-2024 that were not previously documented by the baseline data collection on roads in the Swannell River Valley include Stone’s sheep (*Ovis dalli stonei*), mountain goat (*Oreamnos americanus*), and mule deer (*Odocoileus hemionus*; Table 3).

The average daily detection rate of predators was greater than ungulates on cameras RR 8 and RR 9, but slightly lower than ungulates on cameras RR7 and RR 10 (Figure 5.4). Most predator detections consisted of wolves, however grizzly bear (*Ursus arctos*) and wolverine (*Gulo gulo*) were also detected. Caribou were detected relatively infrequently, accounting for only 27 independent detections (5.9% of total detections; Table 3). Appendix 2 contains select wildlife camera images of detected species.

Humans were infrequently detected on any of the deployed camera; detections of CCE staff (e.g., while servicing wildlife cameras or using the road to collect vegetation data) were removed from the total detections of humans using the road. Humans were detected once on the RR 7 camera (group of people in a pickup truck), once on RR 9 (one person on foot), and there were no detections of humans on RR 8 or RR 10.

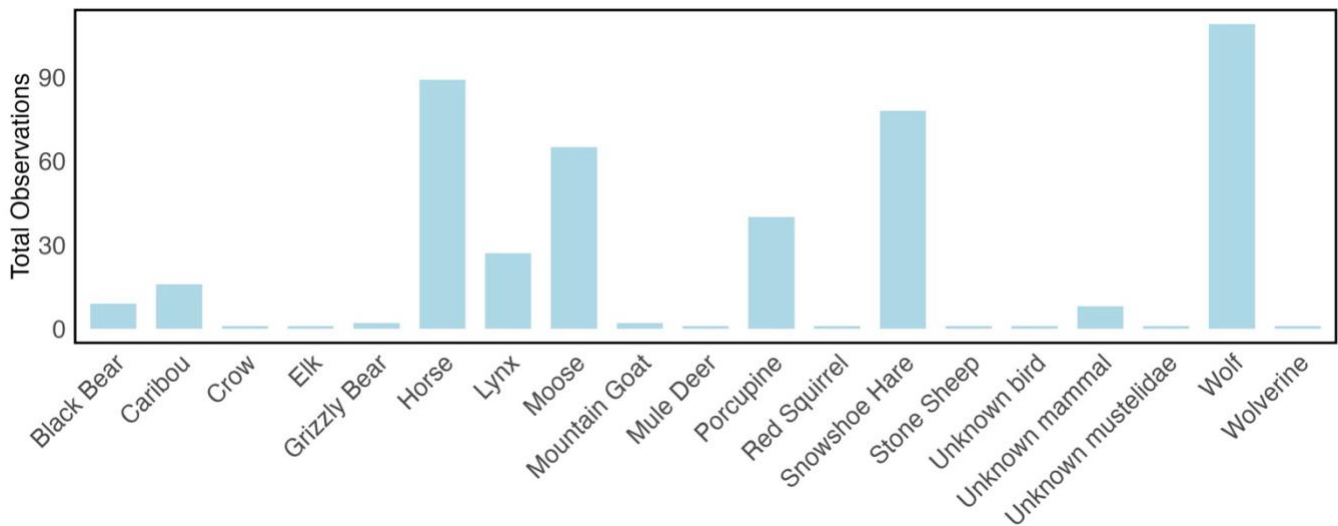


Figure 5.3. Summary of all independent wildlife detections on wildlife cameras (n = 4) deployed in the Swannell River Valley in 2023-2024, located within the Wədzih Yinè’ IPCA. Horses were the second most detected species overall, but are domestic and not wild horses.

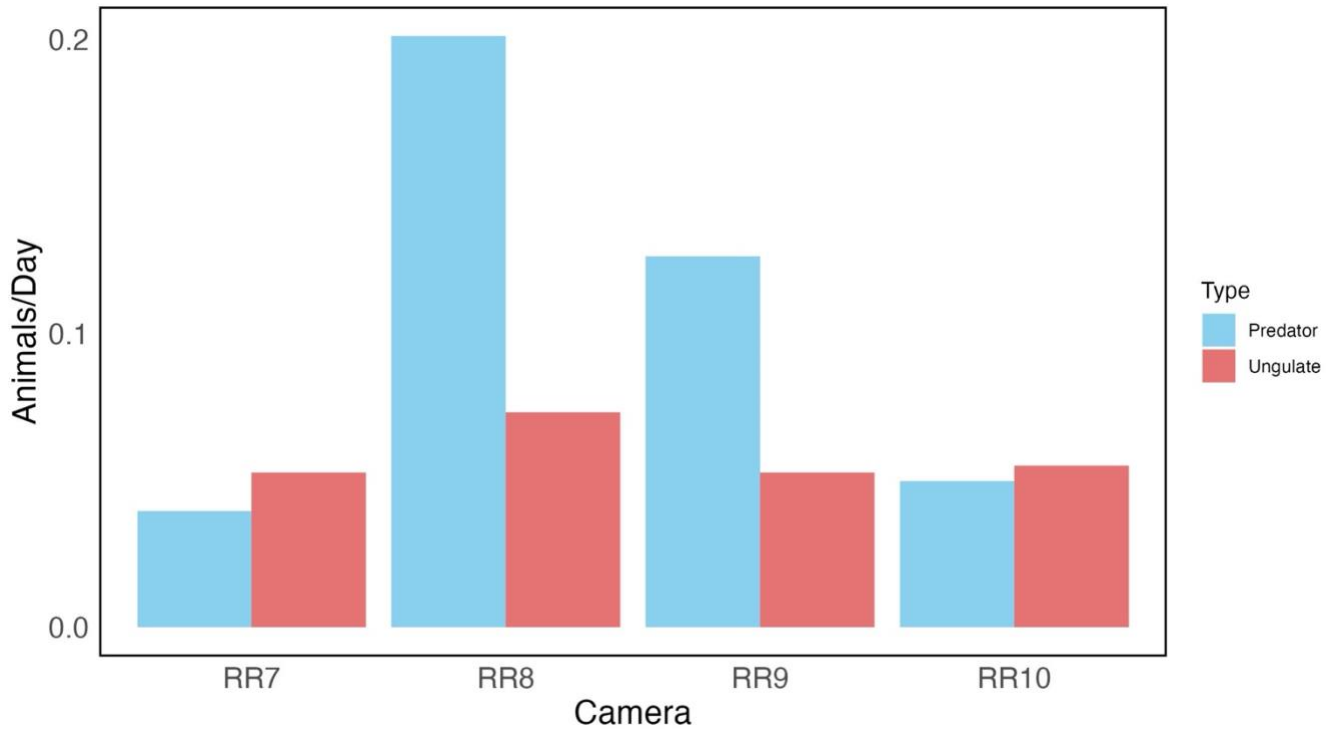


Figure 5.4. Summary of the average daily predator and ungulate detections at each camera location in 2023-2024. Predators included wolves, lynx, black bears, grizzly bears, and wolverines. Ungulates included caribou, elk, moose, deer, mountain goats, and Stone’s sheep.

Table 3. Summary statistics for the wildlife detected on cameras deployed along the Swannell River Valley during 2023-2024 and total independent detections of the species over all years of pre-treatment monitoring in the area (2022-2024). Total nights elapsed in 2023-2024 = 1470.

| Common Name | Scientific Name | Detections (Independent Observations) | Nocturnal (%) | Abundance Index | Detections All Years (2022-2024) |
|---------------|---------------------------|---------------------------------------|---------------|-----------------|----------------------------------|
| Wolf | <i>Canis lupus</i> | 109 | 56.88 | 7.415 | 246 |
| Horse | <i>Equus caballus</i> | 89 | 28.09 | 6.054 | 89 |
| Snowshoe Hare | <i>Lepus americanus</i> | 78 | 88.46 | 5.306 | 116 |
| Moose | <i>Alces alces</i> | 65 | 49.23 | 4.422 | 262 |
| Porcupine | <i>Erethizon dorsatum</i> | 40 | 72.5 | 2.721 | 122 |
| Lynx | <i>Lynx canadensis</i> | 27 | 59.26 | 1.837 | 173 |
| Caribou | <i>Rangifer tarandus</i> | 16 | 12.5 | 1.088 | 90 |
| Black Bear | <i>Ursus americanus</i> | 9 | 22.22 | 0.612 | 307 |
| Unknown | <i>Unknown mammal</i> | 8 | 62.5 | 0.544 | 26 |

| | | | | | |
|---------------|--------------------------------|------------|-----|-------|----|
| Mountain Goat | <i>Oreamnos americanus</i> | 2 | 0 | 0.136 | 2 |
| Grizzly Bear | <i>Ursus arctos</i> | 2 | 50 | 0.136 | 14 |
| Elk | <i>Cervus canadensis</i> | 1 | 0 | 0.068 | 1 |
| Crow | <i>Corvus brachyrhynchos</i> | 1 | 0 | 0.068 | 1 |
| Wolverine | <i>Gulo gulo</i> | 1 | 0 | 0.068 | 13 |
| Mule Deer | <i>Odocoileus hemionus</i> | 1 | 0 | 0.068 | 1 |
| Unknown | <i>Unknown bird</i> | 1 | 100 | 0.068 | 4 |
| Unknown | <i>Unknown mustelidae</i> | 1 | 100 | 0.068 | 1 |
| Stone Sheep | <i>Ovis dalli stonei</i> | 1 | 0 | 0.068 | 1 |
| Red Squirrel | <i>Tamiasciurus hudsonicus</i> | 1 | 0 | 0.068 | 11 |
| | Total | 453 | | | |

5.3 Vegetation Monitoring

In June 2024, we completed 18 pre-treatment drone flights for all 9.3 km of target roads to be restored and analyzed a total of 9.73 ha of road surface. The extent and classification of vegetation cover varied by road segment and the surrounding environment; most of the roads running through harvested areas with little vegetation growth had limited vegetation establishment on the road surface, but roads in areas with stands of trees and shrubby vegetation adjacent to the road tended to have more vegetation established on the road surface (e.g., Flights 05, 06, 11; Table 4). One road section in particular was highly overgrown (Flight 05, Figure 5.5), with willow shrubs (*Salix* spp.), sapling pine (*Pinus contorta*), and trembling aspen (*Populus tremuloides*) growing from the road surface and obstructing predator line-of sight, so restoration treatment of this road is not required as natural revegetation is occurring.

Post-treatment drone flights were completed on 2.03 km of roads restored in 2024 to document changes in the road surface before and immediately after treatment (Figure 5.6); as pre- and post-treatment monitoring data were collected at different points in the growing season (June versus August), the post-treatment data shows increased vegetation present on the road surface, however, this is due to the timing of image collection rather than a true increase in vegetation. In future years, follow-up vegetation monitoring will be completed at the same point in the growing season as the pre-treatment data collection to ensure results are from comparable stages of vegetation growth (i.e., collecting data in June to compare to the June pre-treatment data).

Table 4. Summary of the total flight area and extent of each vegetation class for the 18 pre-treatment drone flights in the Swannell River Valley. The percent of each vegetation class is provided in parentheses.

| Flight | Length (m) | Total Flight Area (ha) | Non-vegetated (ha) | Low Vegetation (ha) | High Vegetation (ha) |
|--------|------------|------------------------|--------------------|---------------------|----------------------|
| 1 | 303 | 0.5911 | 0.5598 (94.71%) | 0.02668 (4.51%) | 0.0046 (0.78%) |
| 2 | 401 | 0.3991 | 0.0633 (15.85%) | 0.2540 (63.65%) | 0.0818 (20.50%) |
| 3 | 675 | 0.6575 | 0.3695 (56.19%) | 0.2227 (33.88%) | 0.0652 (9.93%) |
| 4 | 652 | 0.7175 | 0.6992 (97.45%) | 0.0156 (2.17%) | 0.0027 (0.38%) |
| 5 | 727 | 0.7737 | 0.0012 (0.16%) | 0.1156 (14.95%) | 0.6568 (84.89%) |
| 6 | 822 | 0.8038 | 0.0086 (1.07%) | 0.4107 (51.10%) | 0.3844 (47.83%) |
| 7 | 227 | 0.2395 | 0.0025 (1.05%) | 0.0855 (35.69%) | 0.1515 (63.26%) |
| 8 | 329 | 0.3745 | 0.3648 (97.39%) | 0.0085 (2.27%) | 0.0013 (0.34%) |
| 9 | 428 | 0.4543 | 0.4408 (97.03%) | 0.0115 (2.54%) | 0.0019 (0.43%) |
| 10 | 93 | 0.0998 | 0.0972 (97.42%) | 0.0020 (1.99%) | 0.0006 (0.59%) |
| 11 | 239 | 0.2098 | 0.0004 (0.17%) | 0.0342 (16.31%) | 0.1752 (83.52%) |
| 14 | 732 | 0.8012 | 0.7159 (89.36%) | 0.0585 (7.30%) | 0.0267 (3.34%) |
| 15 | 557 | 0.5387 | 0.5121 (95.06%) | 0.0202 (3.75%) | 0.0064 (1.18%) |
| 16 | 449 | 0.5021 | 0.4526 (90.13%) | 0.0364 (7.25%) | 0.0131 (2.62%) |
| 17 | 647 | 0.7280 | 0.6659 (91.47%) | 0.0363 (4.98%) | 0.0258 (3.55%) |
| 18 | 335 | 0.2996 | 0.2184 (73.0%) | 0.04919 (16.42%) | 0.0317 (10.58%) |
| 19 | 550 | 0.5784 | 0.5581 (96.49%) | 0.0141 (2.45%) | 0.0061 (1.06%) |
| 20 | 961 | 0.9656 | 0.7900 (81.81%) | 0.1454 (15.05%) | 0.030 (3.13%) |



Figure 5.5. The road surface of the Flight 05 section of road was significantly overgrown with sapling pine and deciduous trees limiting potential predator line of sight. Due to the significant natural vegetation establishment on this road section, no further restoration treatment is required.

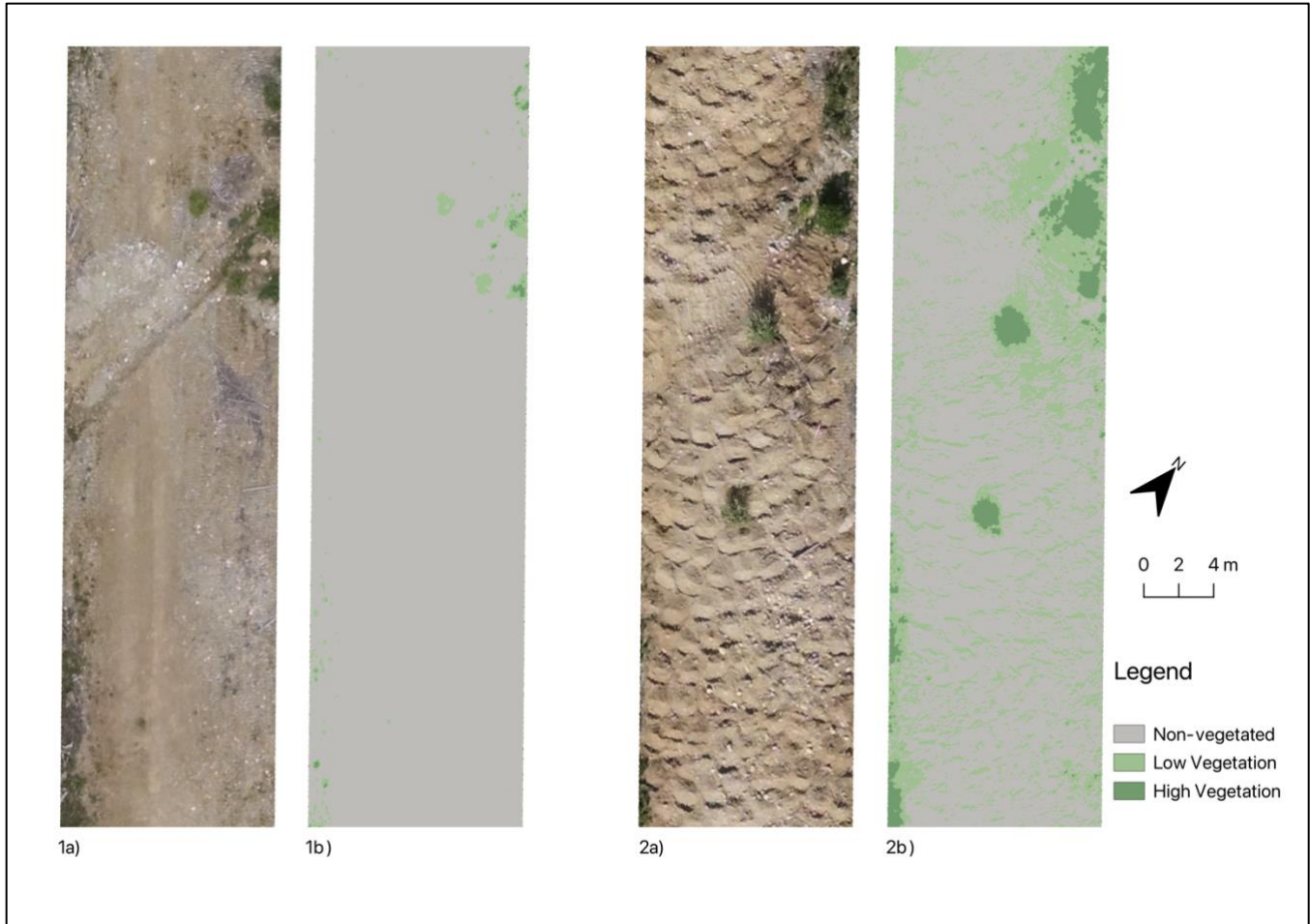


Figure 5.6. A comparison of a section of flight 04 road surface before and after treatment: 1a) RGB imagery of the pre-treatment road surface; 1b) classified vegetation cover of the pre-treatment road surface; 2a) RGB imagery of the post-treatment road surface; 2b) classified vegetation cover of the post-treatment road surface. Note: the before and after imagery were taken at different points in the growing season (June vs August), so cannot be directly compared and are presented here for illustrative purposes only. Monitoring in subsequent years will occur in at the same point in the growing season as when pre-treatment data were collected to allow for comparison of results.

6 Community Engagement

CCE is committed to fully engaging with the community of TKD, members of TKDN, and other stakeholders in the area. As a wholly owned TKDN business, CCE understands the importance of providing meaningful opportunities for project engagement, input, and opportunities for meaningful employment to TKDN citizens. Engagement with TKDN citizens about the CCRRP has occurred each year since 2018 through small group engagement sessions, TKD's annual Science Week that is organized by CCE, regular project updates to TKDN's Lands and Resources department, and site visits with TKDN community members and leadership. For this 2024-2025 funding period, CCE has had ongoing communication with TKDN and Conifex Timber Inc. (road tenure holder) about planning, implementation, and monitoring. CCE and TKDN's Lands and Resources Department also held an engagement session in TKD on January 30th and 31st, 2025, during which CCE staff spoke with several community members about the CCRRP and the work that was completed in 2024. Short videos about the CCRRP have also been created to further engage with both TKDN and the broader public about road restoration work in caribou habitat, and these can be found on the Chu Cho Environmental YouTube channel or by following the links provided in the introduction section of this report. In 2024, CCE gathered footage for an additional project video, as well as footage for three short training videos on visual screening, rough and loose treatments, and tree planting.

The 2024 CCRRP work also provided direct employment and mentoring opportunities to TKDN citizens. TKDN members were employed through the sub-contracting of Chu Cho Industries, another TKDN wholly owned business, for the culvert removal work. CCE sub-contracted 609 Contracting Ltd., a business wholly owned by a TKDN citizen, to provide the excavator and implement the earthworks required for the restoration prescription. Finally, a TKDN citizen employed by CCE worked on this project, where he helped provide guidance to the excavator operator, learned about drone operations, wildlife cameras, and worked directly with a CCE biologist on the monitoring.

7 Discussion and Recommendations

The 2024 season for the CCRRP presented some challenges, given the major excavator breakdown that occurred on August 17th which prevented the full scope of work from being completed. The project team still managed to complete 2.5 km of road restoration work and pre-restoration vegetation monitoring data was collected for all 9.3 km of planned road segments. In addition, CCE developed restoration prescriptions for an additional 11.4 km of non-tenured road and 8.1 km of road still under tenure by Conifex Timber Inc., all located within the Swannell River Valley.

It is recommended that the 2025 CCRRP efforts focus on completing the 6.8 km of road segments that could not be completed in 2024 due to the broken excavator track, while also assessing the possibility of adding a few additional road segments that CCE developed restoration prescriptions for in 2024. This will continue to support TKDN's effort to reduce road density in the Wędzih Yinè' IPCA by removing road segments, including in block roads, and to make the habitat less suitable for predator travel and alternate prey species.

The location of the current CCRRP restoration work is entirely within the Wędzih Yinè' IPCA, meaning there is relative certainty that restoration activities will not be disturbed by future industrial development based on the agreements made between TKDN and forestry licensees operating in the area. Much of the Wędzih Yinè' IPCA is low elevation caribou core habitat in both summer and winter seasons, and decreasing the disturbance within these habitats will benefit the Chase Caribou by decreasing the amount of habitat fragmentation and linear features that can be used by predators.

Lessons learned and specific recommendations for future CCRRP activities, including:

- **Heavy Machinery:** Due to the excavator breakdown that occurred in 2024, further consideration should be made about having an actionable back up plan in case a similar mechanical failure occurs to the excavator being used for mechanical site preparation. Given the remote location and limited availability of excavators and operators on short notice, a definite back up plan may not be possible. However, having a tentative back up plan with Chu Cho Industries may allow for a mechanic to be available, or for a new machine and operator to be available in the future.
- **Ecological Restoration:** Similar to 2023, the need for effective mechanical site preparation to decompact the soil was again noted, as this removes a major barrier (i.e., hard roadbed surface) for planted seedlings and natural seedling establishment. The decompaction of the roadbed helps accelerate the return of the roadway to a mature forested environment while also decreasing the ease of movement and sightlines for predators.
- **Road tenure:** As mentioned in 2023, there exist administration barriers to completing road restoration on non-tenured roads, both inside and outside of the Wędzih Yinè' IPCA, such as the requirement of a Special Use Permit authorization from the provincial government. When a road is still under tenure and the tenure holder is supportive of road restoration, there are very few barriers. However, when the road is not under tenure and a Special Use Permit is required, permit requests through the

Mackenzie District Office are required, and starting in 2024, funding deposits are required to be paid to the provincial government before any restoration work can commence. In 2024, CCE had to pay a refundable \$10,000 deposit as part of the obtained Special Use Permit to be able to complete the road restoration work. The recommendation is to build and maintain partnerships with road tenure holders wherever possible, as there are both fewer administrative barriers to completing the work, and a shared incentive and cost-saving opportunities when restoring roads.

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Appendix 1: Restoration Prescription



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Chuyaza Road Restoration Prescription: Part II

A Component of the Chase Caribou Road Restoration Program

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30 October 2023

Recommended Citation: Rapai, S.B., and Marini, K.L.D. 2023. Chuyaza Restoration Prescription Part II: A Component of the Chase Caribou Road Restoration Program. Chu Cho Environmental LLP, Prince George, BC. |

Project Overview

Project Identification

| PROJECT IDENTIFICATION | | | | |
|------------------------|--------------------------------------|---|------------------------|-----------------------------------|
| TSA | Forest District | Tenure Holder(s) | Location (Lat., Long.) | Map |
| Mackenzie | Mackenzie Natural Resource District; | Mineral tenures: N/A Guide outfitter: 710004 Trapline Identifier: TR0740T002 Forest Tenure: Conifex Timber Inc. | 56.529540, -125.427895 | See Appendix 1 (Detailed Map) |
| Geographic Location | | The road sections are located at the end of the Swannell mainline, on the southeast and southwest side of the Swannell River. A section of the road runs parallel to Chuyaza (Helicopter Lakes). The road restoration point of commencement is at ~40 km on the Swannell Forest Service Road, and the total length of restoration is 13.5 km. Sections of these roads are within the Chuyaza Conservancy, Chase Caribou low elevation Core habitat and connects areas identified as Ungulate Winter Range (UWR, u-7-007 & u-7-025). | | |
| Road Permit Holder | | Client Name | Total Length (m) | Total Area (assumes 5m width; ha) |
| Conifex Timber Inc. | | Tsay Keh Dene Nation | 13,000 | 6.5 |

Project Objectives

This Road Restoration Prescription aims to outline the Line Segments of the Swannell mainline and in block roads that will be restored.

The Recovery Strategy for the Southern Mountain population of Woodland caribou in Canada provides the following recommendation: “Undertake coordinated actions to reclaim southern mountain caribou habitat in all currently utilized seasonal ranges through restoration efforts (e.g., restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleared areas; reconnect fragmented annual ranges) to make it less suitable for other prey species.”

This project aims to restore the forest roadway located in Tsay Keh Dene Nation’s Chuyaza Conservancy, to benefit the Chase caribou.

Our project team seeks to make this road network less suitable for alternative prey species and predator travel and to enhance the seasonal caribou range for the Chase caribou. This objective aligns directly with the Federal Recovery Strategy goals for southern mountain caribou. Our team will employ both Ecological and

Functional Restoration techniques to restore the portion the Swannell mainline that falls within the Chuyaza Conservancy.

Ecological Restoration Objectives

Ecological Restoration is defined as the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed.

The Ecological Restoration techniques employed on this project will focus on mechanical site preparation (MSP), to alter the soil conditions and create suitable micro sites for the planting of trees and woody shrubs.

MSP treatments are expected to enhance the establishment, growth and survival of tree species and other target vegetation. Road decompaction, Mounding and Access Management are three types of MSP treatments that will be applied to select Line Segments.

MSP treatments are expected to improve soil infiltration capacity and reduce soil bulk density, while also creating a more favourable seed bed that will accelerate the return of the road to a mature forest environment.

More rapid forest regeneration is expected to help overcome limiting factors for the Threatened Southern Mountain caribou. Specifically, the MSP techniques in this prescription target the following guiding principles to benefit caribou:

- Maintain connectivity within and between caribou ranges.
- Limit motor vehicle access to the road, thus facilitating natural regeneration along the roadway.
- Alter microsite conditions so that it accelerates seedling growth and creates a more favourable site for native seed rain to establish and grow.

MSP will be achieved with the following techniques:

- Road decompaction and scarification using an excavator and digging bucket
- Mounding, using an excavator equipped with digging bucket
- Machine Screefing using an excavator with digging bucket
- Slash Rollback using an excavator
- Access Management using an excavator and digging bucket

Functional Restoration Objectives

The objective of Functional Restoration is to recover specific indicators of ecosystem health rather than returning it to the historical composition of the landscape. The Functional Restoration component of the Chuyaza Road restoration will use mechanical intervention to restore historic caribou-predator encounter rates. Reducing predator access to caribou (including the access of humans into caribou habitat) limits disturbance and potentially direct caribou mortality, and can improve individual fitness.

The interventions presented in this prescription for the Chuyaza Road restoration will result in:

- Controlled access to the road surface(s) to manage human access and promote natural revegetation.

- Decreased line-of-sight within the linear feature(s) to create a refuge for caribou from predators and create visual barriers to obscure caribou.
- Decreased predator travel speed on the altered road surface.

Functional restoration of roads for caribou can protect overall ecological integrity by decreasing tread by foot or tire, facilitating more rapid forest regeneration. Ultimately, the goal is to create a functionally restored landscape that can support self-sustaining caribou populations. Functional Restoration will be achieved by implementing the following techniques:

- Road decompaction using an excavator and digging bucket
- Mounding, using an excavator equipped with digging bucket
- Whole tree transplantation at strategic locations along the mounded road to reduce site lines
- Tree Felling with excavator at strategic locations to reduce site lines
- Slash Rollback, and placement of available coarse woody
- Tree Planting

Glossary

Access Management – The physical objective of making a road or area impassable to motor vehicles is expected to protect the road from further compaction and protect planted trees while simultaneously enabling environmental recovery. Barriers will include but are not limited to the creation of debris berms, cross ditches, and tree felling.

Ecological restoration - Returning a road or other linear feature to its pre-disturbance composition and structural state.

Functional restoration- Recovering chosen indicators of ecosystem health are the target over returning to the historical composition and structure of the landscape.

Mechanical Site Preparation (MSP) – The physical work to alter soil conditions to favour the establishment, growth and survival of tree species, browse or other target vegetation. In this prescription, MSP includes mounding and ripping.

Slash Rollback – Refers to spreading soil piles or vegetative debris with machinery, often left over from the timber harvest or road building activities, to cover targeted areas of linear disturbance. Slash rollback may hinder vehicle access into and along the roadway, slow predator travel, and shelter tree and vegetation seedlings for optimal regrowth.

Road Ripping – This treatment involves de-compacting the road surface and adjacent areas to enhance subsurface water infiltration by reducing soil bulk density and increasing surface infiltration.

Machine Screefing – The roadbed is disturbed with a machine to reduce compaction by moving rock, soil and woody debris.

Timber Harvesting Land Base – The portion of the Crown Forested Land Base is available for timber harvesting.

Tree Felling – Strategic tree felling uses chainsaws to lay trees across the road surface from alternating opposite directions; unlike ‘bending’ or ‘hinging’ trees in which trees are left hanging above the ground surface, tree felling allows the trees to fall to the ground.

Line Segments (LS) – The area to which Functional and Ecological restoration will be applied.

Tree planting – The transplanting of tree seedlings, generally for forestry, land reclamation, or landscaping purposes.

Restoration Prescription

Site Characteristics

| SITE CHARACTERISTICS | | | | | | | | | |
|----------------------|------------|---------------|----------------|-------------------|-----------------|--------------|------------------|-------------------|--|
| Site | | | Soils | | | | Vegetation | | |
| TU* | BEC | Elevation (m) | Road Grade (%) | Side Slope Down % | Side Slope Up % | Soil Texture | Coarse Frag. (%) | Organic Materials | Genera |
| 1 | ESSF; BWBS | 1050 to 1250 | 0 to 30 | -20 | +20 | Medium | 20-30 | None | <i>Pinus contorta</i> , <i>Picea engelmannii</i> x <i>glauca</i> . |

*TU = Treatment Unit

Treatment

| Treatment Units | | | | | | | | | |
|-----------------|----------------------|------------|----------|-------|-----------|---------------------|----------------------------|--|----------|
| | | | | | | | | | Planting |
| Treatment Unit | Treatment Difficulty | Length (m) | Road (m) | Width | Area (ha) | Drainage Structures | Non Classifiable Drainages | Species | SPH |
| 1 | Moderate | 13,000 | 5 | | 6.5 | 2 | 2 | <i>Pinus contorta</i> (300 sph), <i>Picea engelmannii</i> x <i>glauca</i> (300 sph); 600 sph total | |

| Treatment Prescriptions | |
|-------------------------|---|
| TU | Prescription |
| 1 | The roadbed will be de-compacted using a series of pits and mounds (i.e., mounding). Available soil material, where stockpiled as a berm when the road was constructed, will be rolled back to increase complexity (i.e., hills and mound, establishment of rough and loose conditions). Slash rollback will be used, to increase habitat complexity through the incorporation of coarse woody debris, and where possible, slash will be rolled piled at a height of 1.5 m to reduce line of site. The mechanical site preparation will then be followed by tree planting of coniferous trees and deciduous shrubs. There |

| | |
|---------|--|
| | <p>are limited opportunities for Tree Felling, and so whole tree/shrub transplantation with the excavator may be used at strategic locations, along with slash rollback, to decrease line-of-site. A combination of whole tree/shrub transplantation, and slash rollback will be used at intersections with spur roads, to reduce line of site at these intersections.</p> <p>Access management treatments will be applied at the road point of commencement. There are opportunities for Tree Felling, or for trees to be pushed over with the excavator. Whole tree/shrub transplantation may also be used, along with slash rollback, to decrease line-of-site. A combination of tree felling, whole tree transplantation, and slash rollback will be used to limit access, and reduce line of site. No live spruce will be felled.</p> |
| Culvert | <p>Remove culvert, re-contour the natural drainage path, to facilitate and establish natural drainage patterns and stabilize erosion prone areas, following the strategies outlined in Figure 1 through Figure 3.</p> |

Species at Risk Databases and Special Notes

The Chase caribou herd is considered by the Federal government of Canada to be part of the Northern ecotype of Southern Mountain caribou, which is listed on Schedule 1 of the Federal Species at Risk Act as 'Threatened.' The end of the Swannell mainline extends into an identified migration corridor and core habitat for the chase caribou. In addition, the road overlaps with the Ungulate Winter Range in the conditional harvest zone.

The Recovery Strategy for the Southern Mountain population of caribou (*Rangifer tarandus caribou*) in Canada has identified that "the range of the Southern Mountain Population has shrunk by up to 40% and 13 of 19 herds are declining." These herds are "threatened by decreasing habitat quantity and quality, harassment, and predation." If steps are not taken, the Southern Mountain population could become endangered.

The Federal Recovery Strategy for the Southern Mountain caribou provides the following recommendation: "Undertake coordinated actions to reclaim southern mountain caribou habitat in all currently utilized seasonal ranges through restoration efforts (e.g., restore industrial landscape features such as roads, old seismic lines, pipelines, cut-lines, temporary roads, cleared areas; reconnect fragmented annual ranges) to make it less suitable for other prey species."

Our project team now seeks to restore the section of the Swannell mainline that leads into the Chuyaza Conservancy and make this road network less suitable for alternative prey species, predator travel, and enhance caribou seasonal range. This aligns with the Federal Recovery goals for the southern mountain caribou.

This road restoration prescription does not include any known occurrences of species at risk other than caribou.

First Nations

The restoration of the Chuyaza Road was initiated by Tsay Keh Dene Nation. First Nation consultation has not yet been completed, and will be led by the British Columbia District of Mackenzie prior to work commencing.

Mineral Tenure Holders/Guide Outfitters/ Special Use Permit Holders

The Chuyaza Road does not overlap or provide access to registered Mineral Tenures. Guide outfitters operating in the area will be notified of the work. Sections of the candidate roadways are currently under the Tenure of Conifex Timber Inc., who is partnered on this road restoration project.

Permitting Requirements

The road restoration prescription will be carried out, and all stream crossings conducted in accordance with the Water Sustainability Act.

Under the Section 52 (1)(b) of the Forest and Range Practices Act, a permit will be requested to cut, damage and/or destroy Crown timber for caribou habitat restoration purposes on the Chuyaza Road to the extent described in the permit.

The restoration of roads currently under the tenure of Conifex Timber Inc., will be completed following this prescription, and at the direction of Conifex Timber Inc.

Where restoration will occur on non tenured roads, Chu Cho Environmental will apply for a Special Use Permit through the District of Mackenzie.

A copy of all permits will be retained on site during works.

Detailed Map

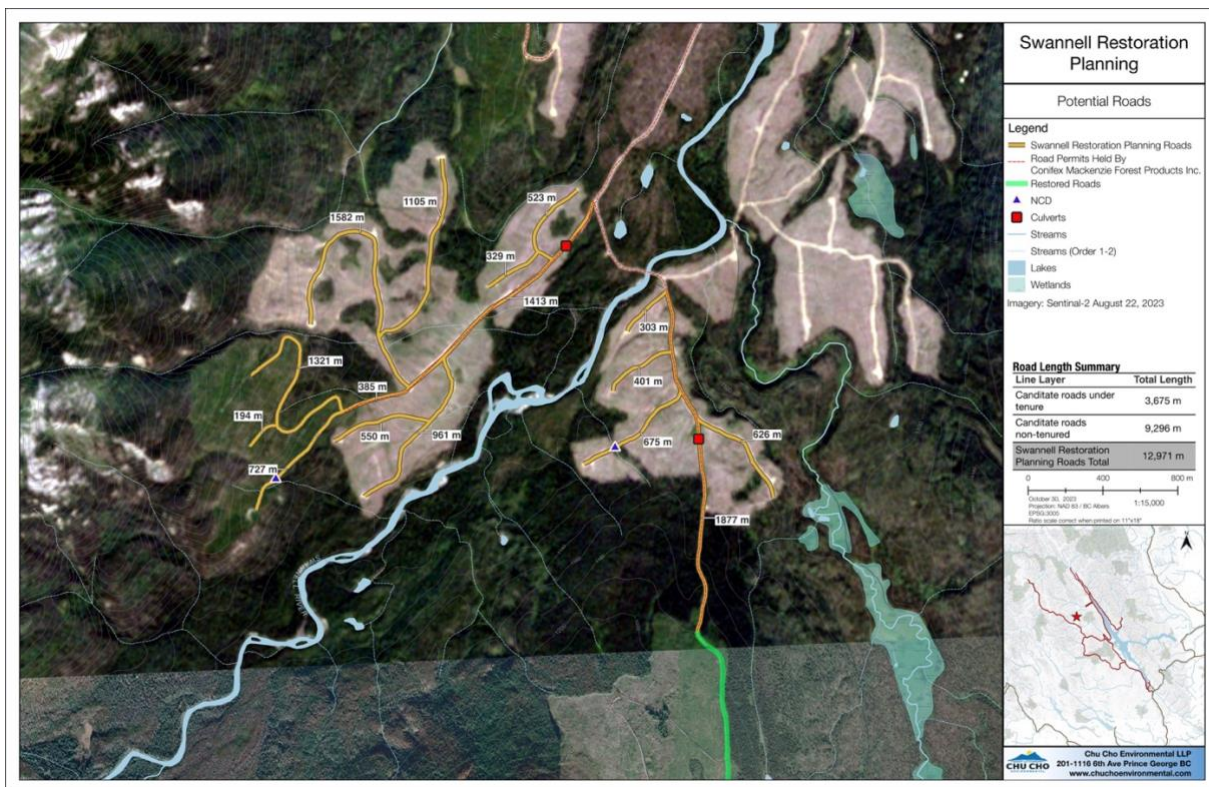


Figure 8.1. Road segments that made up the 2024 road restoration prescriptions.

Images

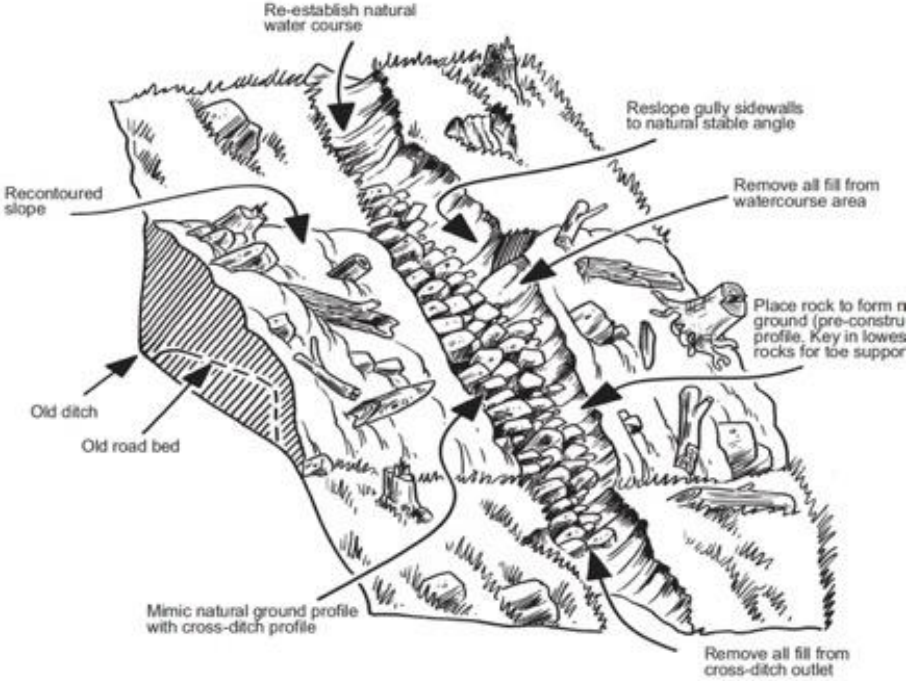


Figure 8.2. Deactivation with Culvert Removal from BC MFLNRORD (2019).

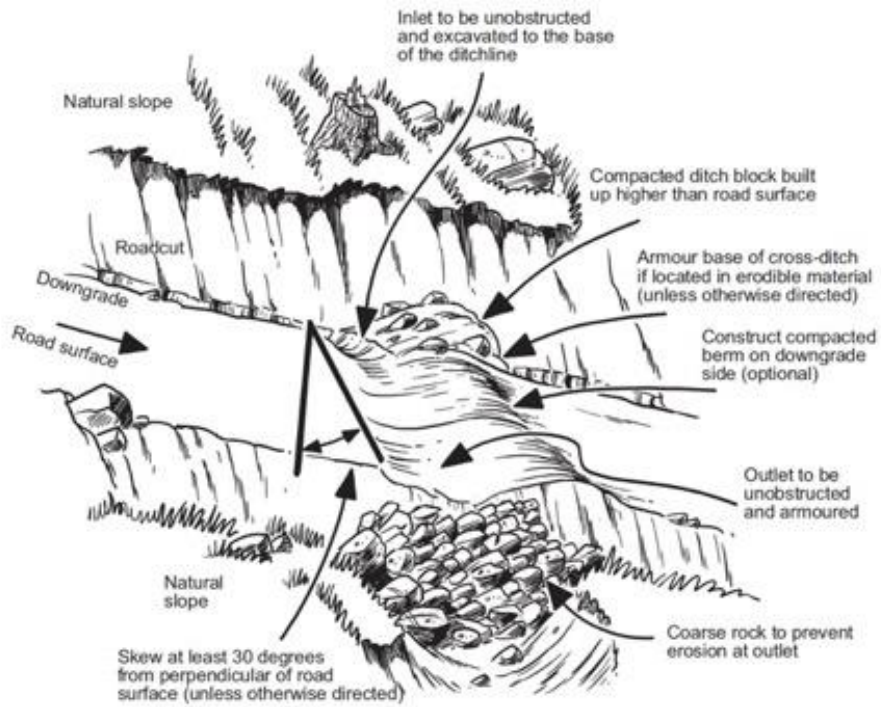


Figure 8.3. Deactivation with Cross-Ditching from BC MFLNRORD (2019).

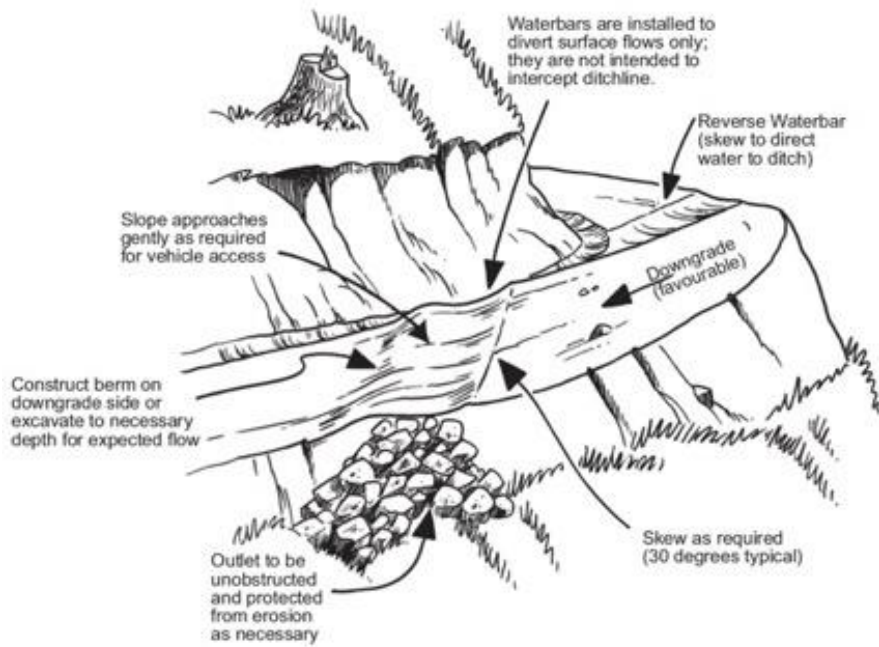


Figure 8.4. Deactivation with Waterbar from BC MFLNRORD (2019).

References

[BC MFLNRORD] B.C. Ministry of Forests, Lands, Natural Resource Operations and Rural Development. 2019. Engineering Manual. Engineering Branch, Ministry of Forests, Lands, Natural Resource Operations and Rural Development.

Appendix 2: Supplemental Information: Chuyaza Road Restoration Part II and Wildlife Camera Highlights

Select Road Restoration Highlights from 2024



Figure 8.5. The 609 excavator used to implement ecological and functional restoration of the Chuyaza road section: part II. Pictured is the excavator de-compacting and mounding a section of road.



Figure 8.6. The CCE restoration supervisor speaking with the excavator operator about the strategy for the next road segment.



Figure 8.7. An example of the excavator completing slash rollback on a segment of road.



Figure 8.8. The excavator completing some functional restoration by creating a berm of soil and coarse woody debris to break up the sightline along a road segment.



Figure 8.9. An example of functional and ecological restoration along a portion of road.



Figure 8.10. A planted lodgepole pine seedling in one of the mounds that was created by the excavator along a road segment in 2024.



Figure 8.11. A comparison of part of the road surface of flight 04 a) before and b) after treatment. The road surface decompacted, coarse woody debris stacked across the road, and the access management ditch has been enlarged.



Figure 8.9. A comparison of the road surface of flight 03 a) before and b) after treatment, including decompaction of the road surface and transplanting trees from the road margin onto the decompacted road surface.

Select Wildlife and Vegetation Imagery

Below are selected highlights from wildlife cameras deployed along the pre-treatment road. For additional wildlife or vegetation monitoring imagery, please contact admin@chuchoenvironmental.com. Camera deployment locations are illustrated in Figure 4.2.



Figure 8.12. A single caribou using the pre-treatment road.



Figure 8.13. A female caribou and two calves using the road pre-treatment.



Figure 8.14. Pack of wolves using the pre-treatment road.

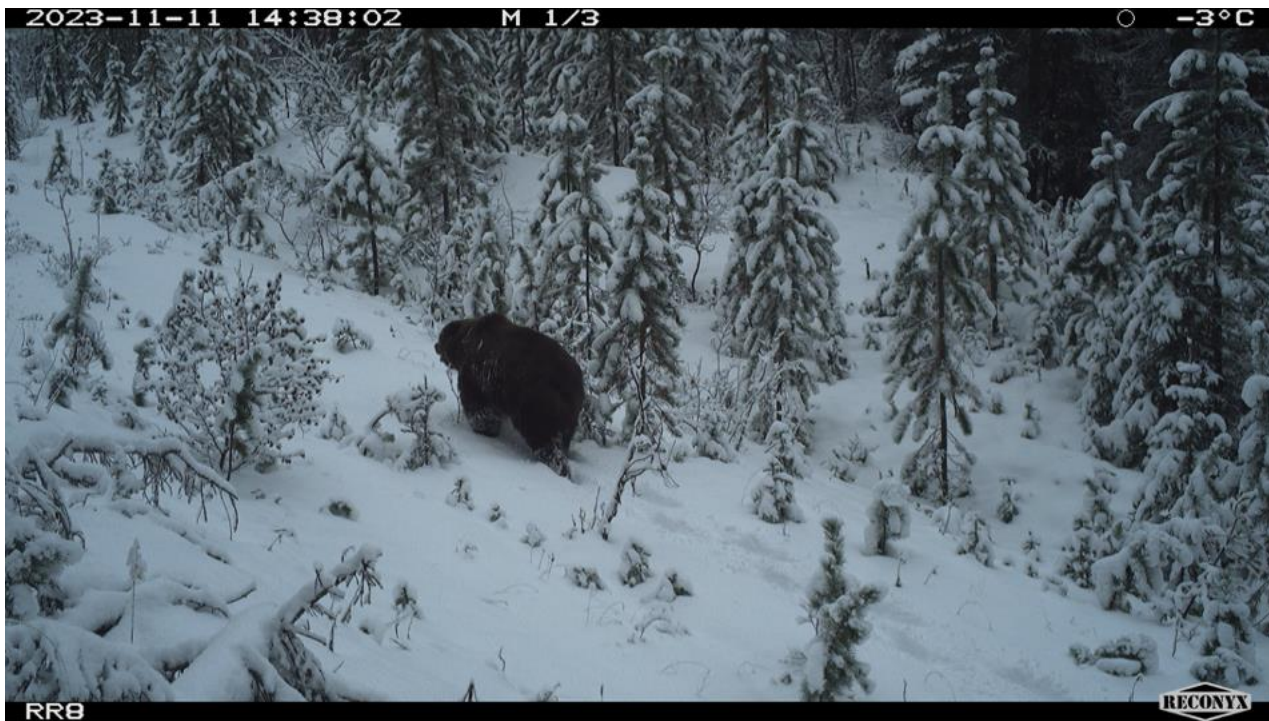


Figure 8.15. Grizzly bear using the pre-treatment road.



Figure 8.16. A snowshoe hare using a pre-treatment road.



Figure 8.17. Two moose using the pre-treatment road.



Figure 8.18. A single lynx using the pre-treatment road.