Richfield Creek Riparian Exclusion Fencing and Restoration

Installation Report

Prepared for: Society for Ecosystem Restoration in Northern British Columbia

Prepared by: Adam Wrench BNRSc.

February 2023

Acknowledgements

Thank you to the staff from the Office of the Wet’suwet’en (OW) for their support in making this project a success. I want to acknowledge the generous permission provided by Samantha Vincent, the landowner directly south of the project, for providing access to the site through her property and the general permission and support from the Wet’suwet’en through the OW. I would also like to thank the licensee, Roger Groot (Hatch Creek Ranch Ltd.), for providing expert guidance and making this project possible.

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Digital Attachments:

1. GeoPackage – includes spatial files for fence and treatment polygons
2. Lidar and thermal imagery for project site
3. Pre-project orthomosaic

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Figures & Tables

1 Overview

Beginning in fall 2021, the Richfield Creek corridor has received significant investments from the Healthy Watersheds Initiative (HWI), Society for Ecosystem Restoration in Northern British Columbia (SERNBC), Department of Fisheries and Oceans (DFO) and the Morice Watershed Monitoring Trust (MWMT). This project is a logical continuation of the restoration work initiated in 2021 (Figure 3) and carries the cattle exclusion and restoration work farther upstream to the beginning of a rock canyon north of Highway 16w. Figure (1), is an overview map of the project covered in this report and Figure (2) is an overview map of all work completed along Richfield creek since 2021.

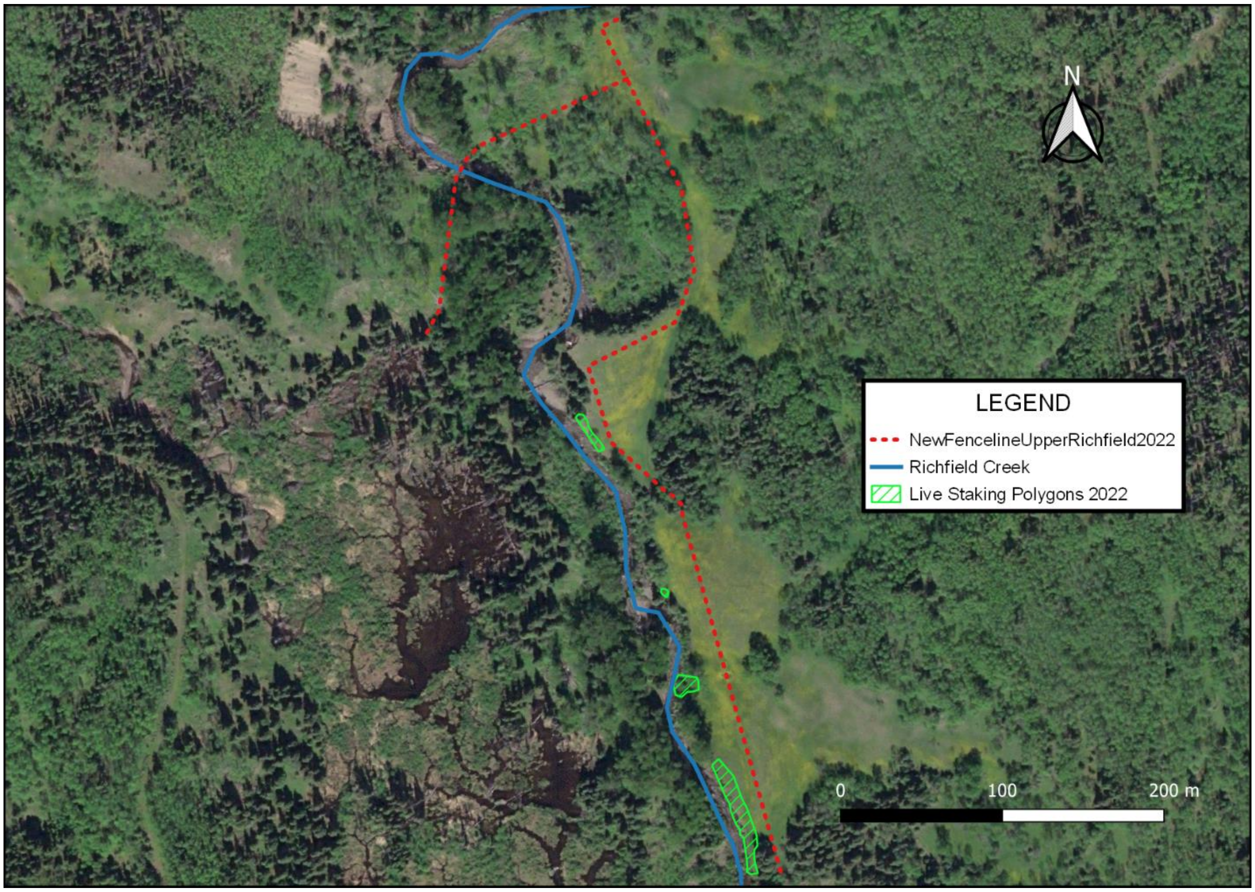

Figure 1: Project overview map showing new fence and restoration polygons installed November 2022.

This project included the installation of 840 m of cattle exclusion fencing where no fencing existed and riparian restoration in four distinct polygons. A 5.2 ha exclusion area was created on both sides of Richfield Creek (Figure 3) and 866 m^2 of riparian habitat was restored in highly degraded locations. Fencing costs were ~\$17/m, three dollars per meter lower than contract fencing rates, and restoration costs were ~\$12/m^2.

Work began on this project on October 26, 2022 and was completed November 17, 2022. Staff from the Office of the Wet'suwet'en (OW) assisted private planting contractors with collection and installation. A staff person from A Rocha in Houston also provided assistance.

Project scheduling was hindered somewhat by a significant cold weather system that brought temperatures more than twenty degrees below average for a period of approximately one week. Despite the challenges of weather, this project was implemented successfully and came in under budget.

Cattle exclusion fencing and targeted riparian restoration has substantially improved the health of Richfield Creek as evidenced by reduced erosion, increased riparian vegetation and the creation of a ~2100 m long protected riparian corridor (all work combined). Successes and statistics from Richfield Creek can inform additional work of this type on similarly degraded, but important salmon streams. I recommend applying these techniques to other degraded streams throughout the upper Bulkley River watershed as a means of reclaiming important salmon habitat lost from many years of neglect. Our very positive relationships with landowners in this area makes access to private lands for this type of restoration work certain for many degraded streams.

In collaboration with the OW and many others, fish passage planning work was completed by New Graph Environment Ltd. on behalf of the Society for Ecosystem Restoration in Northern BC with support from Habitat Conservation Trust Foundation, BC Fish Passage Remediation Program, Ministry of Transportation and Infrastructure and the Canadian Wildlife Federation (Irvine 2022 and Irvine 2021). This large body of work should inform site selection and prioritization for future work of this type.

Included with this report is a GeoPackage that includes shapefiles for the polygons and fencing along with an orthomosaic created following completion of the fence line and riparian restoration work. Hi-resolution Lidar imagery and thermal imagery were also collected as part of this work and are included as digital attachments. Photos of the work are provided in Appendix A.

2 Background

2.1 Richfield Creek

Richfield Creek drains a ~155 km^2 lake headed watershed and joins the Upper Bulkley River approximately 3 km west of Topley (Figure 2). Richfield Creek is the largest tributary to the Bulkley River downstream of Maxan Creek and upstream of Buck Creek. High elevation areas around Nez Lake provide sustained flows during low flow periods, but at times partial dewatering can still occur (Gottesfeld et. al. 2002). Approximately 3 km upstream of the confluence with the Bulkley River is an ~18 m high waterfall. From the falls to the confluence exist high habitat values that are currently degraded by adjacent land use and historical stream training.

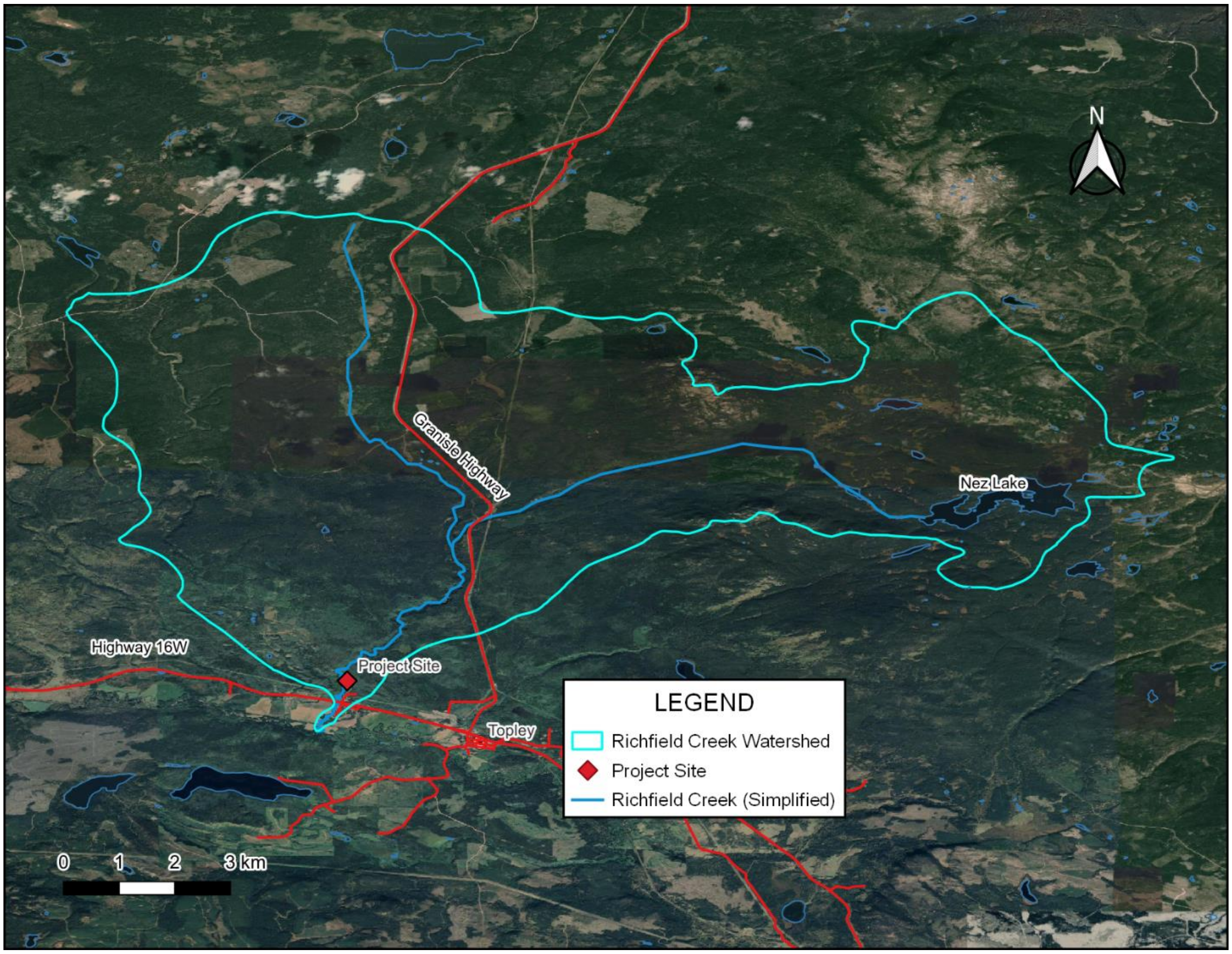

Figure 2: Map of Richfield Creek watershed.

Richfield Creek provides high habitat values for numerous fish species and is known for providing excellent coho salmon spawning and rearing habitat (Irvine 2021). Species recorded in Richfield Creek include coho, chinook, streelhead, rainbow trout, longnose dace and sucker (MoE 2022). Recent work by Biologist Al Irvine and the Office of the Wet'suwet'en (Irvine 2022 and Irvine 2021) confirms the high habitat values within Richfield Creek including habitat modelling that indicates the potential for significant habitat additions if the fish passage issues under Highway 16 are resolved.

Ongoing water temperature monitoring indicates water temperatures in Richfield Creek are on average 3-5° C below that of Bulkley River. Cool water refugia are critical in this system considering temperatures regularly exceed the maximum tolerable temperatures for salmonids (Westcott 2022). Provided the excellent habitat values, this stream likely provides critical thermal refugia during warm summer and fall periods as well.

Generally, Richfield Creek exists in various stages of degradation when compared to what would be expected in the absence of adjacent land use activities (Irvine 2021, Irvine 2022, NCFDC 1998). Eroding stream banks, insufficient flows during low water periods, challenging fish passage through the highway culverts, soil compaction, lack of large woody debris and general reduced habitat complexity are documented for this stream (Irvine 2021, Irvine 2022 and NCFDC 1998). NCFDC (1998) provided a restoration prescription for Richfield Creek below the falls that included:

- Bank stabilization
- Bar stabilization
- Backwatering the culverts to improve fish passage

A portion of this project included procuring high resolution Lidar data of the area above the highway. We produced a digital elevation model from this data and created a hill shade model of the bare earth elevation model to illustrate current channels and historic channels alike. Part of Richfield Creek below the powerline and above the highway appears to have been channelized at some point, likely to direct flows to the culvert under Highway 16.

From the elevation data, it is clear that Richfield Creek has down cut considerably from the historical floodplain elevations that are now an agricultural field. This downcutting has certainly reduced connectivity to the floodplain and lowered the groundwater elevations. Much of this incisement is likely a response to channelization and down cutting of the Bulkley River and the physical necessity of matching grade. What is clear, is that compared to pre-development conditions, habitats within this stream are degraded as a result.

2.2 Restoration

Richfield Creek was included in a larger riparian restoration initiative through the MWMT that received a significant grant from HWI in 2021[1]. SERNBC and DFO added to the work in 2021 by funding a cattle exclusion fence from the high voltage transmission line, south to the CN rail line (Wrench 2021). In total, 2021 works on Richfield Creek included:

- streambank stabilization and riparian restoration at four locations
- riparian planting using rooted willow cuttings in a large polygon south of Highway 16w
- installation of ~1100 m of cattle exclusion fencing

Additional riparian live staking was completed by the MWMT and A Rocha Houston in spring 2022, adding three additional large treatment polygons inside the cattle exclusion fencing. Figure (3) is a map depicting the work completed along the Richfield Creek corridor since 2021 including this current project.

[1] https://data.skeenasalmon.info/dataset/upper-bulkley-river-riparian-restoration

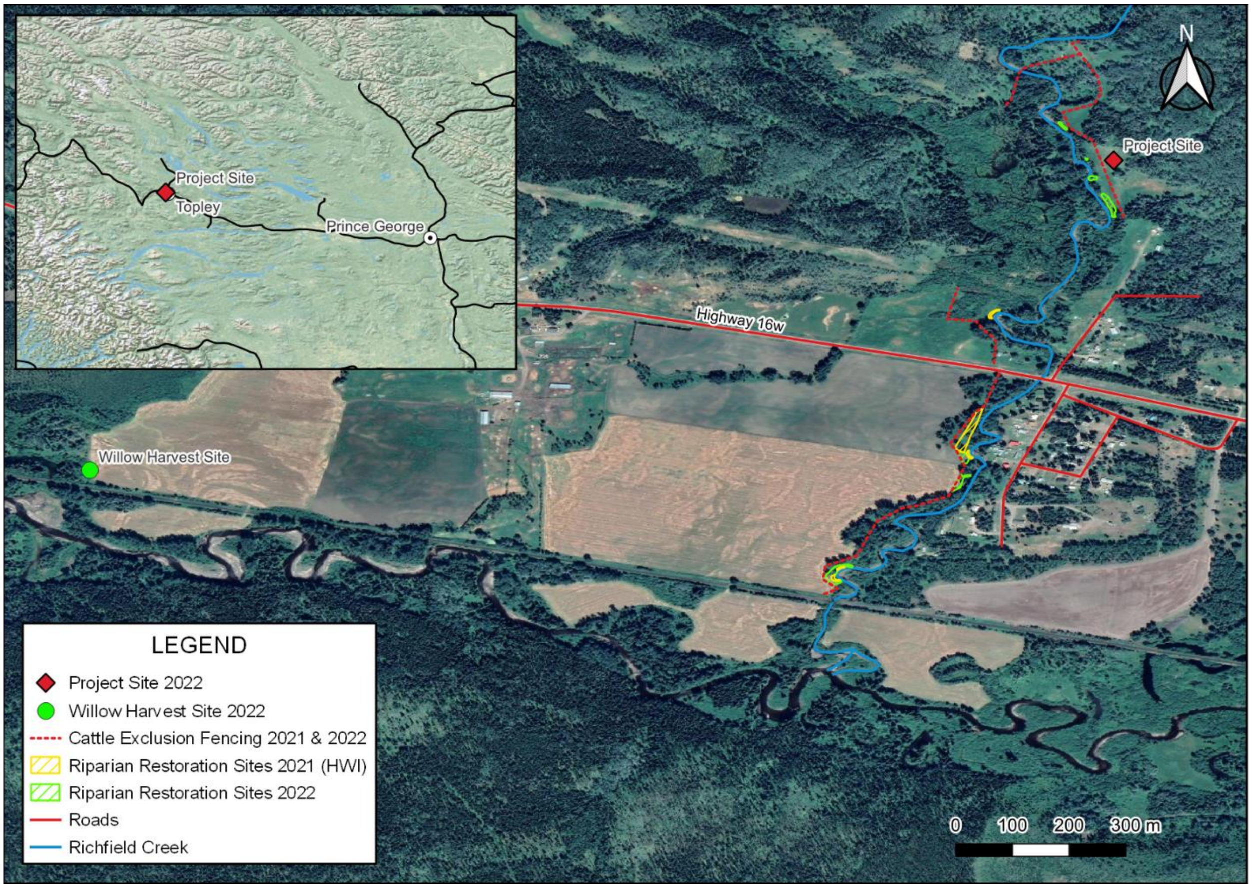

Figure 3: Map showing 2022 project in context of past work along Richfield Creek. Note the harvest location of the willow stakes for the 2022 project in the mid-western portion of the map.

3 Riparian Exclusion Fence

An 840 m long cattle exclusion fence formed the foundation of this project. No riparian fencing existed along this portion of Richfield Creek prior to this work. A four-strand barbed wire fence was built following existing clearings as much a possible beginning at an existing range boundary fence along the southern edge of the project area, terminating at a large wetland complex that forms a natural barrier to cattle movement. Just over five hectares of riparian area is now protected by this exclusion fence.

Sections 3.1 and 3.2 discuss specific details of route selection and expected outcomes respectively. Section (5.1) provides a summary of the costs of the fencing portion of this project. Figure (3), is an overview map of the new fence line (in yellow) and the corresponding 5.2 ha cattle exclusion area created by the fence (in red cross-hatch).

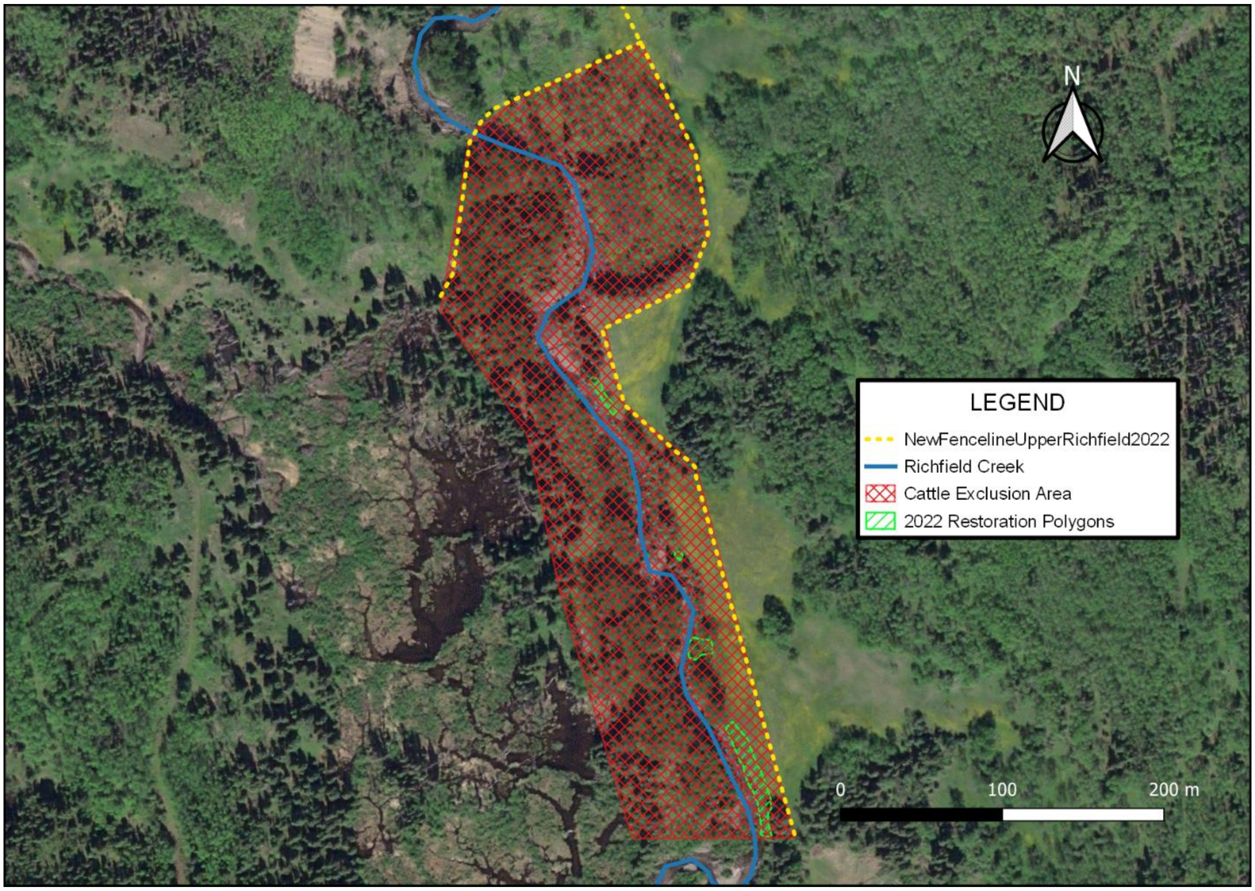

Figure 4: Map showing cattle exclusion area (~5.2 ha) created by the project.

3.1 Route Selection

Route selection was guided by a desire to:

- securely exclude cattle from Richfield Creek
- minimize overall fence length
- maximize overall riparian area
- utilize existing openings to reduce clearing

Figure (4) is a map showing our proposed fence line route and the as-built route. Our original route plan, developed from imagery and some knowledge of the area, proved unworkable due to problematic terrain and soils. A significant groundwater seepage area along the north side of Richfield creek at the top end of the site made traversing the slope with machinery impractical. Significant clearing of timber and earthworks would have been required to move the new fence up hill and connect to the slide area, shown in in Figure (4) as the light brown patch at the northwest end of the “proposed fence line” route.

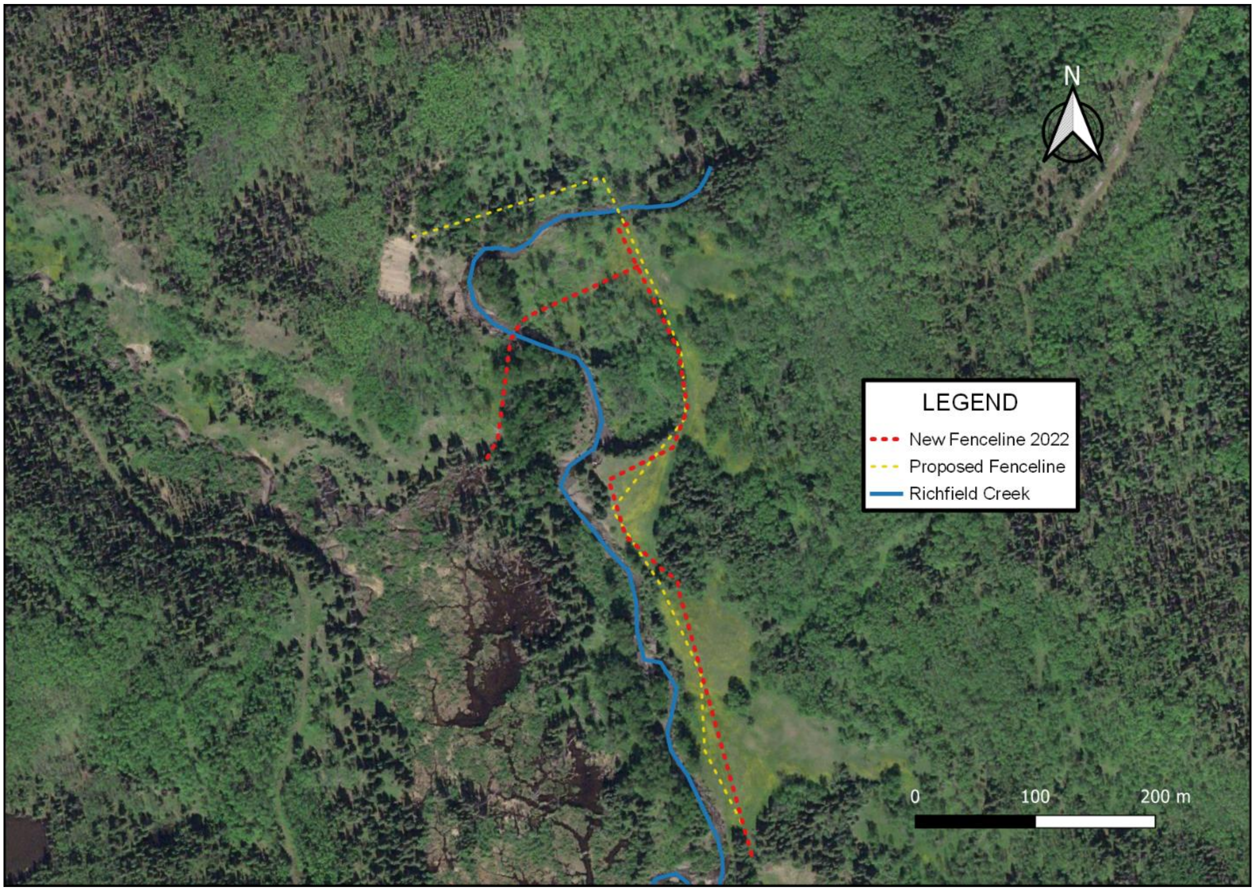

Figure 5: Map showing proposed fence line route compared to as-built.

During the field layout of the fence, a second issue became apparent. Cattle were able to circumvent the slide area, a fact previously unknown. The lease holder had assumed the cattle were crossing the creek lower down to access the western side of Richfield Creek, which they were, but they were also descending from higher elevation range areas to meadows north and west of the large wetland area shown in Figure (4). We concluded that the fence needed to cross Richfield Creek at a broad flat crossing site with large substrate located downstream of the slide and terminate at the wetland complex, a natural barrier to cattle movement. This route slightly increased the overall length of the fence from what was originally proposed.

3.2 Expected Outcomes

We expect that the new fence will effectively eliminate access by cattle to the Richfield Creek corridor downstream of where the new fence crosses the creek. We also expect that cattle will follow the new fence line to access meadows on both the east and west side of Richfield Creek (Figure 5) and will spend little to no time in the riparian corridor immediately north of the northern portion of the new fence as it provides little feed and shows little sign of cattle pressure due to terrain and lack of feed.

Existing well established and good crossing points exist at the locations shown in Figure (5) and cattle will prefer the easy crossing points and new easy travel afforded by the fence line to grazing areas. Cattle will water at the crossings and are not likely to damage the creek bed due to the large cobbles that form the substrates at these crossing locations. Overall, this new fence is expected to *reduce* cattle pressure to the riparian area immediately north of the fence line and *eliminate* cattle pressure within the exclusion area created by the fence and wetland (Figure 3).

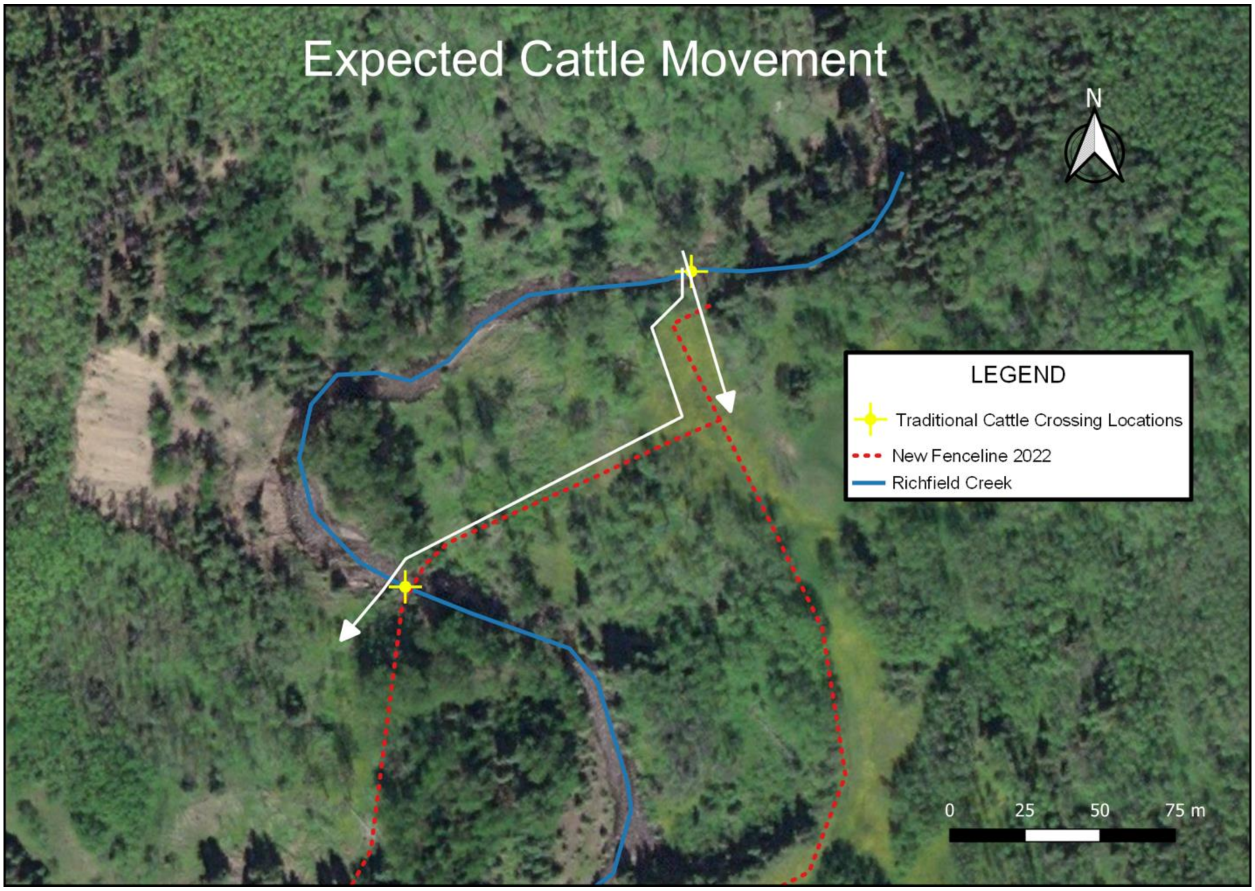

Figure 6: Map showing expected cattle movement post fencing (white arrows) and historic cattle crossing locations.

4 Riparian Restoration

Riparian restoration began with harvesting dormant willow from private land owned by Hatch Creek Ranch Ltd. located ~2 km southwest of the project site (see Figure 2). Harvesting was completed over two days (October 27 and 28) by a crew of six.

Installation of live cuttings was completed on November 2 and 3 in four distinct polygons (Figure 6). Areas void of riparian vegetation were selected for restoration and each site was planted from the water's edge back until all available cuttings were installed. A summary of the installations is provided in Table (1) and a detailed summary for each treatment polygon is provided in Table (2).

Table 1: Summary of riparian restoration work.

Restoration Polygons	Area Restored (m^2)	Total Live Stakes Installed	Total Fascines Installed	Total Cuttings Installed	Avg. Stakes /m^2	Total Person Days (harvest)	Total Person Days (installation)	Species Installed
4	866	715	60	1315	2	8	12	Salix (sp.)

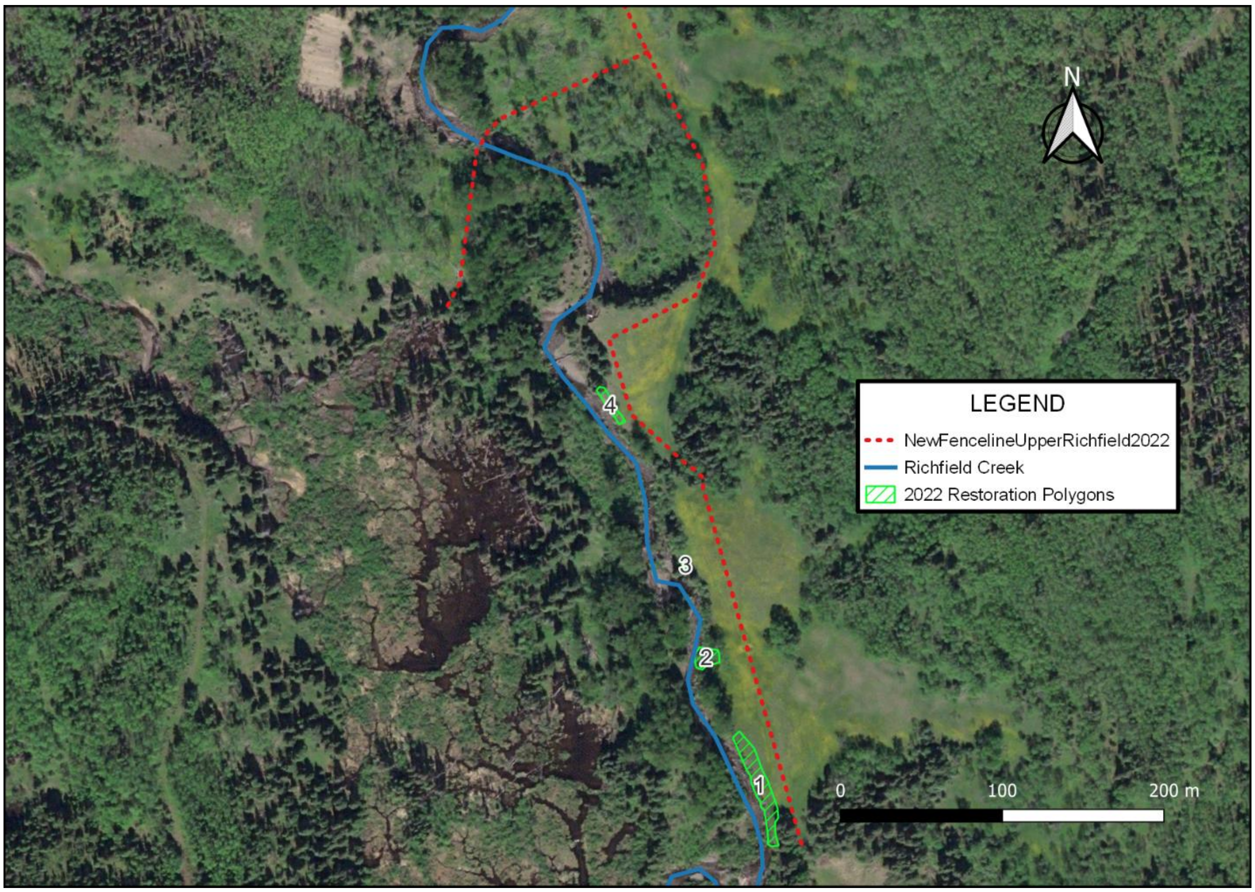

Figure 7: Map showing restoration polygons with ID that corresponds to Table (2).

4.1 Harvest & Preparation

Live, healthy willow free of rot were chosen for staking materials. Stems were cut to between 2.5-3.5 m long with lateral branches and terminal buds removed using hand sheers. Stems were felled using a chainsaw and trimmed using hand clippers. Cut materials were bundled and lashed[2] in groups of ten to speed counting and handling and were left full length until they were delivered to the sites where they were then broken down.

4.2 Installation

Although our original plan was to soak the live cuttings for ten days prior to installation, a rapidly moving cold-front necessitated moving the installation date ahead by one week to avoid daily low temperatures below -20°C that began November 4 for about one week. Exposed soils in the treatment polygons quickly began to freeze even before the cold front arrived, making installation of the cuttings challenging.

Our initial plan was to live stake only, but the lack of topsoil in the treatment polygons necessitated a change to our approach. Gravel and cobble comprised the bulk of the soil and made live staking difficult in most areas and not appropriate in other areas. Fascines provided an option to maximize soil contact and rooting in the poor soils encountered at the site and so these were added to the prescription once in the field. Elevated waters during spring and most of summer will ensure constant water contact with the willow cuttings that will maximise survival and growth.

Our first step was to break down the bundles of cuttings transported from the harvest site. Two products were created from the willow cuttings:

- Stakes: 0.5 m - 2 m long and 1.5-5 cm in diameter
- Fascines: bundles of 6-10 willow stems 2.5-3.5 m long with butt diameters of 2.5-5 cm

Following installation of the fascines, live stakes were installed using both a waterjet stinger and a handheld gas-powered post pounder. Stakes were installed to maximum possible depths, ranging from 0.2 m to 1 m. Most stakes were about 0.5 m in the ground. Following installation, the stakes were trimmed leaving approximately 15 cm protruding from the ground. Off cuts from trimming were either pushed into the same hole with the butt end down in the case of the waterjet stinger or pounded into a new location if large enough. Holes from the waterjet stingers were closed by kicking moist soil around the cutting. A summary of riparian restoration work in each polygon is provided in Table (2).

[2] Biodegradable sisal twine was used to lash the willow.

Table 2: Restoration polygon information.

ID	Planting Method	Planting Date	Species Planted	Planting Density (m2)	Type	# stakes	# fascines	Area (m2)	Comments
1	stinger & post pounder	2022-11-02	Salix (sp.)	1	live stake	440	27	591	vertical fascines installed from water edge up (~2.5m long bundles of 10)
2	handheld postpounder	2022-11-03	Salix (sp.)	2	live stake	105	11	154	fascines placed and partially buried, cobbly ground not suitable for stinger
3	shovel plant or bar plant	2022-11-03	Salix (sp.)	2	live stake	30	5	16	cobbly ground, bank seep, fascines partially buried
4	shovel plant or bar plant	2022-11-22	Salix (sp.)	2	live stake	140	17	105	steep (4m high bank), cobble/gravel, verticle fascines partially buried

5 Discussion

Investments in the Richfield Creek riparian corridor have significantly improved the condition of this stream. Beginning with cattle exclusion fencing, numerous investments have occurred between Richfield Creek and the exclusion fence since the installation because cattle cannot destroy cuttings and plantings. Cattle exclusion fencing is a necessary first step in restoring riparian function along important salmon streams as it allows for restoration work to be completed and left undisturbed to grow.

In combination with targeted restoration, cattle exclusion fencing can begin rapid recovery of important salmon streams in the Upper Bulkley River watershed. Beginning at the Bulkley River, tributary streams can be effectively restored by progressive cattle exclusion fencing and targeted restoration moving upstream. Fencing is a significant capital cost that once expensed, opens the door to much smaller community lead restoration work. A small investment by MWMT and A Rocha this past spring leveraged eager volunteers to accomplish a significant riparian planting program along the newly secured Richfield Creek riparian corridor. Applying this model to the myriad of degraded riparian habitats in this region would be a significant win for the ecology and health of this watershed.

6 Recommendations

6.1 Further Restoration

Continued investment in riparian restoration and watershed health within the Richfield Creek watershed would be best focused on in-stream works to reverse channel incising and bank erosion. The riparian exclusion areas created by this project provide significant area to invest in in-stream restoration. Natural barriers such as the large wetland complex to the west of the site provide unique opportunities to work with existing ecological assets to store water and improve habitat in the upper part of Richfield Creek. This site provides a rare opportunity for in-stream works with low drawbacks as it could be done without impacting private land or high value tenured grazing.

Limited areas remain for additional staking within the project area. Poor soils and high stream banks provide unfavorable conditions for survival of live cuttings and prohibit deep staking. Rooted coniferous trees could be planted in a large area adjacent to polygons 1,2 and 4.

6.1.1 Low-Tech Process-Based Restoration

Low-tech Process-Based Restoration (PBR) provides a suit of restoration methods that use low-tech in-stream works to direct natural processes to force complexity back into a watercourse (Wheaton et. al. 2019). These techniques are proven effective on a wide range of sites throughout the world and the results are often dramatic in their effectiveness at re-connecting incised streams to their floodplains. By partnering with beavers and directing natural processes, it appears possible to re-connect Richfield Creek to it’s former floodplain in discrete locations. This process would require extensive collaboration with potentially affected stakeholders and a careful risk assessment. In their manual, Wheaton et. al. (2019) provides a comprehensive methodology for planning and executing low-tech process-based restoration.

As noted by both Irvine (2021) and NCFDC (1998), Richfield Creek is lacking complexity. It appears that much of this lack of complexity is a symptom of the current incised state of the stream and the fact that it is no longer connected to its former floodplain. NCFDC (1998) prescribed measures to stabilize banks and bars and add large woody debris to this stream. Through low-tech processes-based restoration, processes of aggradation could be initiated to raise the stream bed and re-connect it to portions of the floodplain. As demonstrated on sites around the world, benefits would include:

- Significantly greater habitat area for juvenile fish, particularly salmonids
- Increased groundwater storage and elevated groundwater table
- Increased hyporheic water movement (demonstrated to reduce water temperatures)
- Significantly improved productivity for a wide range of species including many threatened or endangered upland species

If applied on Richfield Creek, the benefits of PBR would include raising the water table and hydrating the riparian planting completed in 2021 and 2022. The biggest challenge with riparian restoration along this stream is the low water table that leaves the cuttings dehydrated during the summer months. Even with deep live staking this has proven challenging. Any aggradation achieved by PBR projects would greatly benefit the work already completed along this stream.

6.1.2 Live Staking

In terms of live staking, I recommend against spring staking programs in this region due to the increased costs and logistical challenges compared to a fall program. In this region, ideal spring staking is six to eight weeks after willow begin to break dormancy. This past spring, I coordinated a spring staking program for MWMT and though it was a success, I relied on a tree freezer in Houston for storage. A change in ownership has made this option less secure and the additional handling of materials and storage add costs. I would recommend fall restoration work as a matter of course. If spring money is available, rooted cuttings may be a preferred option to pursue, and we have experienced good success with rooted willow from Woodmere Nursery in years past. Cuttings can be harvested in early spring and taken to Woodmere Nursery for rooting and planting in late fall.

For fall staking, dormancy for preferred species typically occurs by mid-September and weather conditions are generally favorable for this type of work up to the beginning of November. The season can be extended if you employ a mini excavator to rip frost or if you have suitable silt soils where the waterjet stingers can cut through the frost. Frost can be a significant issue with staking and an almost impossible barrier to partial burial of fascines.

6.1.3 Research and Planning

Planting trials in this area would inform future prescriptions. Amendments and site preparations could be trialed to improve complexity and habitat values. Mulching with a layer of woodchips for example, may improve survival and growth of live cuttings and plantings. We could work with Woodmere Nursery to further develop availability of native plants for use in this type of work. Plant selection and placement should be informed by Traditional Knowledge. Collaboration with area House Chiefs and other Wet’suwet’en knowledge holders will ensure appropriate site selection and restoration prescriptions are applied.

These types of projects seem to be a very cost-effective means of improving and adding riparian habitat in the Upper Bulkley watershed. Nearly every important tributary stream has some level of pressure from cattle or other land use. As mentioned previously, the significant body of survey work completed in this area previously by numerous partners provides excellent information to guide selection of additional restoration opportunities (Westcott 2022, Irvine 2022, Irvine 2021 and NCFDC 1998).

The high-resolution Lidar data obtained as part of this project along with the lower resolution Lidar data available from Lidar BC could be used for planning PBR projects along Richfield Creek and other streams in this region. Mapping of floodplains, old channel habitats and values at risk from the work could be completed using this data. This work would provide the foundation for discussions with stakeholders.

6.2 Monitoring

A monitoring program would be invaluable as we continue to build the inventory of restoration sites. Long-term monitoring using randomly pre-selected plots to inventory for survival, browse and precent cover as per the Land Management Handbook 25 is a good option[3]. Drone imagery used to create high resolution orthomosaic files during leaf out in late June/early July would be a great way to evaluate percent flush initially. Another flight in late summer would be great for comparison.

6.3 Collaboration

Because licensees and landowners will be required to maintain these fences in perpetuity, some will be hesitant to participate unless there are clear benefits. Education will play an important role in moving landowners towards a desire to do this work and use it for advertising and acquiring social licence. More of this work in partnership with the landowners and licensees will naturally build these relationships as a result. I think efforts should be made to involve the landowners financially in constructing these projects because it has proven to reduce costs and increase access to these sites. Not every landowner will have the equipment and expertise necessary for successful installations, so this will need to be balanced on a case-by-case basis to achieve success.

In the Upper Bulkley these programs build relationships to ensure meaningful engagement in restoration planning, ensure consent for work is given and to build capacity for First Nations to drive and monitor restoration initiatives within their traditional territories. Engagement with Traditional Knowledge holders during planning will ensure that appropriate outcomes are achieved. Leveraging the momentum we currently have to advance restoration on other sites seems highly effective.

[3] Land Management Handbook 25. https://www.for.gov.bc.ca/hfd/pubs/docs/lmh/lmh25-2.htm

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APPENDIX A

Photos

Photo 1: Installing cuttings with waterjet stinger.

Photo 2: Buried fascine (left) – Installing cuttings with hand-held post pounder (right)

Photo 3: Buried fascines (in red circle)


Photo 4: Showing finished fence line

 

Photo 5: Wooden rail fence and crossing at Richfield Creek (Right)