MORICE WATERSHED MONITORING TRUST

Upper Bulkley Riparian Restoration

November 2022

Prepared For: Morice Watershed Monitoring Trust

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1 Overview

This report serves as a summary of works completed during the 2022 season by Northwest Research and Monitoring Ltd. (NWRM) on behalf of the Morice Watershed Monitoring Trust (MWMT). Works included the following:

- Spring live staking of approximately two thousand stakes cut down from one thousand larger live willow and cottonwood
- Photographic and observational monitoring of the 2021 Healthy Watershed's Initiative (HWI) restoration sites at various water levels between April and November 2022
- Identification and correction of problem areas on two of the 2021 HWI restoration sites

Spring live staking was a great success made possible by the waterjet stinger package built by MWMT in 2021. A Rocha Canada from Houston generously provided their staff and a volunteer to join NWRM contractors to complete the installation. Approximately two thousand individual live stakes were installed over three days in May adjacent to 2021 HWI restoration sites. Cold weather towards the end of the 2021 season prevented riparian planting along the Richfield Creek sites, so these sites were chosen for a spring 2022 plant.

Each of the 2021 HWI sites were visited at various water levels and at high water to observe site integrity and performance as well as "green-up" of the live staking from 2021. The final component of the 2022 work was to touch up some eroding areas along two of the 2021 HWI restoration sites. Although four of the six restoration sites completed in 2021 maintained integrity completely, the two highest energy sites located on the Dickson property on the Bulkley River required some low-tech touch up at the focal point of highest energy to address some natural re-grading during high-water. This work was completed in during low water in mid-October 2022 and is described in detail in the proceeding sections. The 2021 project supervisor generously volunteered their time to preparing a restoration prescription and participating in repairs of the site in the fall of 2022.

In addition to the above, a shapefile layer was created that captures each of the 2021 sites and the 2022 work described here with pertinent information contained in the attribute table. This layer can be modified and expanded into the future as more of these sites are completed or more touch-up work occurs. For the touch up work, a point layer was created to pinpoint the location of the maintenance.

2 Spring Live-staking

A substantial investment was made along Richfield Creek in 2021 as part of the Healthy Watersheds Initiative project. Works included arresting erosion in several key locations and installation of a riparian exclusion fence (funded by Department of Fisheries and Oceans Canda and Society for Ecosystem Restoration Northern BC). Opportunities remained following the 2021 work to continue live-staking efforts in the new cattle exclusion area created by the fence installed in December 2021. These areas were selected for targeted riparian planting in 2022.

Live staking was completed on three distinct polygons along Richfield creek in May 2022 (Figure 1). Live willow and cottonwood cuttings were installed using waterjet stingers over a period of two days in May. Generally, the stingers worked very well in these locations, permitting planting depths at or below the water table for most of the installations.

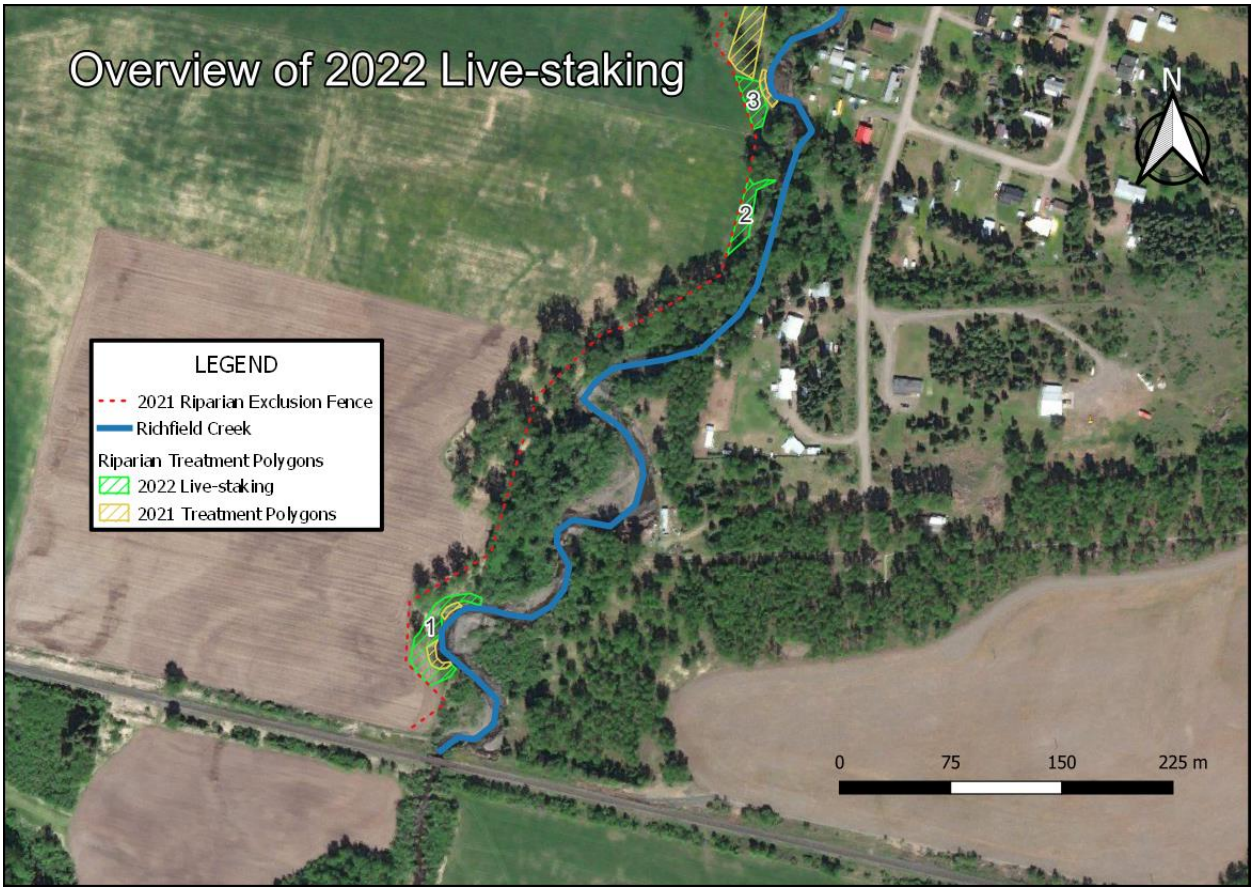

Figure 1: Overview map showing live-staking polygons in green crosshatch with polygon ID#.

The 2022 work began with harvesting dormant willow and cottonwood from around Topley in April. Live cuttings were cut and clipped to between 2.0 and 2.5 m long. All lateral branches and terminal buds were removed. Prepared cuttings were bundled and lashed in groups of ten and taken to the Houston Cold Storage facility where they were placed into their tree freezer until planting in mid-May.

On May 16th, the live cuttings were collected from the Houston Cold storage facility and taken to Richfield creek where they were placed in a back channel to soak for a minimum of 48 hours before planting on May 18th and 20th. Cuttings planted on May 20th were soaked continuously from May 16th until installation. Planting details for each polygon are provided in Table (1).

Table 1: Spring Live Staking Summary

ID	treatment type	species	stems/m	total stems	date planted	time soaked	depth of staking (cm)
1	LS	Sx/Pt	1-3	1000	May 18th	48 hrs	30 – 200
2	LS	Sx/Pt	1	500	May 20th	4 days	30 – 200
3	LS	Sx/Pt	1	500	May 20th	4 days	30 – 200

**LS = live staking
**Sx = willow (all species); Pt = black cottonwood
**ID corresponds to Figure (1)

Cuttings were planted using the waterjet stingers to maximum practicable depths (i.e., planting depths were driven by soil conditions). In areas with silt and/or sand soils, cuttings were installed to depths greater than 1.5 m and into the water table as estimated by the wetted channel level in Richfield creek. However, in some areas we encountered gravels and cobble and the waterjet stingers were ineffectual, reaching depths as little as 15 cm (primarily in the southern portion of polygon 1). Thankfully, these difficult soil types accounted for only a small portion of the planting area and we were able to achieve good planting depths for all of the cuttings by simply avoiding these discrete problem areas.

Staking was completed on a 1 m grid, with cottonwood stems placed evenly across the site at lower density to plant the future overstory. Cottonwood accounted for approximately 5% of the stakes installed. Areas where it appeared that the streambank was losing stability, staking densities were increased to 3/m or more. Planted stakes were clipped above the soil to achieve approximately 80% below surface and 20% above surface. By doing this, we hoped to promote the greatest root growth possible in the first year. Cut off stems were then installed somewhere else or straight into the existing hole beside the first stake. Finally, the holes were closed by kicking the moist soil against the stakes.

No post-staking treatments were applied to these sites (i.e., no irrigation, mechanical brushing, or mulching). Despite a lack of post installation treatment, we noticed excellent initial flush of

over 90%. Initial flush does not necessarily indicate survival, but the stems we observed in late-summer and fall appeared to be healthy and growing despite considerable vegetation pressure from grass growing at the site.

3 Observations of 2021 HWI Sites

In 2021, as part of the HWI project several sites in the upper Bulkley watershed were stabilized using low-tech restoration techniques. Some sites where stability was previously established, or thought to have been established, work was exclusive to riparian staking using live cuttings. On six sites however, low-tech restoration techniques were combined with riparian live staking to both stabilize the site and re-establish a riparian zone. As part of the work in 2022, the 2021 HWI treatment sites were visited at various times and water levels to observe:

- General site conditions
- Initial vegetative response
- Stability and integrity of the installations
- Problems or potential failures

Table (2) below contains a summary of observations.

Table 2: Summary of 2022 site observations of the 2021 HWI fall treatment sites.

Site	Waterbody	Observations
1 (Upper)	Maxan Creek	• Completed October 2021 • Slope re-shape, peg-boarding and riparian plant • Site remained essentially dry during high water as the thalweg has shifted east or away from the bank (not as a result of the installation) • Vegetative response appeared excellent with 90% + of live stake material and nearly 100% of rooted cuttings leafed out and apparently growing • No stability issues or notable concerns
1 (Lower)	Bulkley River	• High energy outside corner (~270°) • Slope re-shape, peg-boarding and riparian plant in October 2021 • Vegetative response appeared excellent with 90% + of live stake material and nearly 100% of rooted cuttings leafed out and apparently growing • Stability over majority of site excellent, but ~12 m section of toe erosion noted and flagged for repair ○ Erosion occurred at point of highest energy impact near the mid-point of the corner • Thalweg appears to have moved away from bank by ~1-2 m • Point bar opposite the site has grown more pronounced and energy appears to be moving more into the sandbar at the top end site

2 (Upper)	Bulkley River	• High energy outside corner (~200°)
		• Slope re-shape, peg-boarding and riparian plant in October 2021
		• Vegetative response appeared excellent with 90% + of live stake material and nearly 100% of rooted cuttings leafed out and apparently growing
		• Stability over majority of site excellent, but ~8 m section of toe erosion noted and flagged for repair
		  ○ Appears to be some level of undercutting in clay
		  ○ Erosion occurred at point of highest energy impact near the mid-point of the corner
		  ○ Unlike lower site, this one is setting up into a vertical face
		  ○ More concerning than the lower site

1 (Lower)	Richfield Creek	• Slope re-shape, peg-boarding and riparian plant in November 2021 • Located just north of railway • Site was fully engaged with creek during high water with water approximately 0.5 m below top of bank • Tops placed at site clearly disrupting flow and pushing water away from bank • Vegetative response appeared excellent with 90% + of live stake material and nearly 100% of rooted cuttings leafed out and apparently growing • No concerns with stability or site integrity observed
2 (Middle)	Richfield Creek	• Riparian staking and toe protection using willow burrito in November 2021 • Located just north of cross fence approximately halfway between railway and highway (see GIS data for more details) • Vegetative response appeared excellent with 90% + of live stake material and nearly 100% of rooted cuttings leafed out and apparently growing • Willow burrito placed at toe of slope remained intact and was growing • No concerns with stability or site integrity observed
3 (Upper)	Richfield Creek	• Slope re-shape, peg-boarding and riparian plant in November 2021 • Located on north side of highway, south of the high-voltage transmission line • Site was fully engaged with creek during high water with water approximately 0.5 m below top of bank • Tops placed at site clearly disrupting flow and pushing water away from bank • Vegetative response appeared excellent with 90% + of live stake material and nearly 100% of rooted cuttings leafed out and apparently growing • Willow burrito placed at toe of slope remained intact and was growing • No concerns with stability or site integrity observed

Essentially, the HWI fall treatment sites had two primary objectives:

- Arrest erosion of the streambank
- Re-establish a riparian zone for long-term stability and stream health

Overall, we were encouraged by the vegetative response across all sites. One year post construction, riparian growth appears vigorous. Integrity was also excellent at all but two sites, as noted in Table (2) above. On the Dickson property, discrete problem areas developed at the point of highest energy near the mid-point of the corner on both the upper and lower sites. All other sites maintained integrity without notable issues.

3.1 Dickson property areas of concern

Some amount of re-grade by river erosion occurred, causing some undercutting of the 2021 installation (Figure 2). The result was the creation of unprotected void space with little interaction with the river. As a result, the 2021 project supervisor prepared a restoration prescription for the site that was followed during site repairs in October 2022 (see Section 4).

Figure 2: Photo showing undercutting at Dickson site.

4 Low-tech Touch up at the Dickson Property

Some low-tech touch up work was required to address the erosional issues noted at the two sites on the Dickson property. Low-tech methods using live willow and woody debris were employed to armour the eroding areas. Figure (3), illustrates the general approach taken to address the erosional sites.

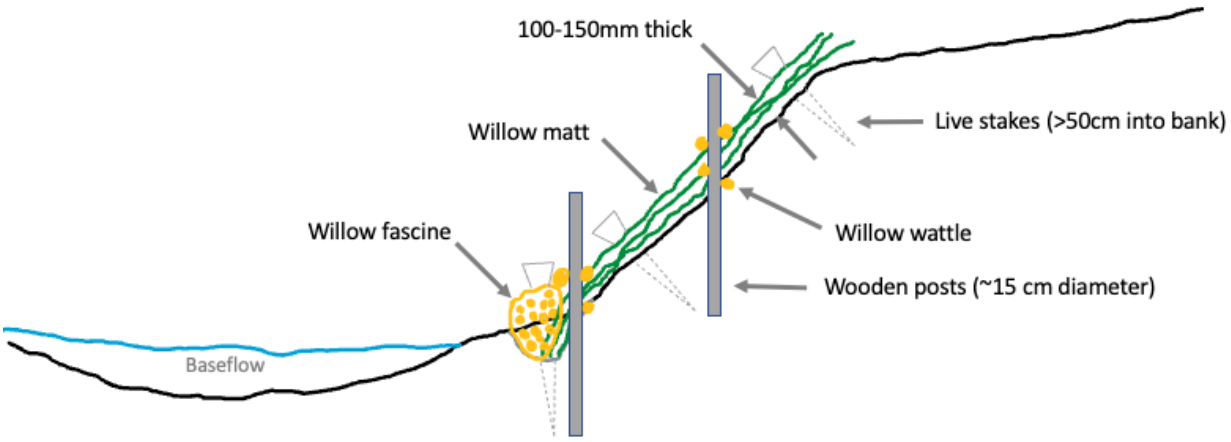

Figure 3: Restoration prescription to address erosional issues at Dickson property sites.

Vertical fascines, consisting of approximately 4-6 individual dormant willow cuttings were partially buried along the face of the erosional zone. The fascines were staked into place with angled live stakes pounded in using a gas-powered hand-held post pounder. Individual willow stems were then woven horizontally across the face with lateral branches attached to maximize roughness. Along the toe at the lower site, a horizontal fascine was partially buried to take the brunt of the erosional force. The upper site did not allow for placement of a horizontal fascine at the toe due to the undercutting clay shelf and water depth. Void spaces underneath the 2021 spruce tops were filled with large woody debris and pressured in with live willow stems. Overall, the goal was to armour the bare soils with rough woody debris and establish live material at very high density in the problem zone.

All works were completed using hand tools and labour over a period of three days. Bare soils at each site are now protected by woody debris, pressured into the existing vertical structure at the site. We felt we did about all that could be practically achieved using willow and hand tools.

5 Conclusions & Recommendations

Work initiated in 2021 by HWI through the MWMT directed the work completed in 2022. Riparian planting was a great success in part due to the equipment purchased by MWMT from the 2022 HWI funding. In addition, A Rocha's generous support with labour including coordinating volunteers and the support of the previous years project supervisor, Jeff Anderson, made the work possible.

For 2023, it is recommended that the growth and survival of the live cuttings is continued to be monitored at all of the sites established in 2021 and 2022. Accompanying GIS files contain pertinent information about each restoration polygon created in 2021 and 2022. As additional work occurs, information will continue to be added to these shapefiles so as to track restoration work through time. Alternatively, if a different GIS tool is constructed, the information contained in the GIS file, and the past reports should be added to the future GIS tool.

If erosional processes continue at the Dickson property, more significant interventions may be needed. Assessment by an engineer or geomorphologist is recommended to assist with further work at these two sites in the event that issues persist as continued erosion could lead to site failure. Placement of large logs instream directly above the site or similar measures to direct flows away from the installations should be considered in future funding proposals to ensure these sites remain effective and the initial investment is not lost.