EDI ENVIRONMENTAL DYNAMICS INC.
Natural Resource Consultants

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Chris Alway, Community Assessment & Regulatory Advisor

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Re: Mt. Nansen Mine Site – Summary of 2008 Bioengineering Works

In the spring 2008 EDI Environmental Dynamics Inc. (EDI) was retained to carry out revegetation/bioengineering works at the abandoned Mt. Nansen mine site. Initially, the project consisted of revegetation/bioengineering directly downstream of the Pony Creek adit site. A large amount of waste rock was to be removed from this location, leaving the slope exposed to potential erosion downslope into Pony Creek. This bioengineering was to be conducted in conjunction with a bioengineering course in partnership with Little Salmon/Carmacks First Nation (LSCFN).

In preparation for the course, harvesting of willow stakes was carried out in May 2008 by one EDI biologist together with LSCFN assistants; Kyle Cashin, Jamie Birckel, Jarad Skookum, Francis Caouette and John Tizya made up the harvesting crew and Sharon Silverfox took care of general kitchen duties, such as cooking for the crew. Stems were collected from within the general area of the mine site and along the Mt. Nansen access road not more than 15 km from the mine. Willow (*Salix spp.)* and balsam poplar (*Populus balsamifera*) were gathered, soaked in a pond for up to 5 days and stored at a cool dark corner of a building at the mill site.

Unfortunately, the waste rock at Pony Creek was not removed until mid/late summer and, as such the bioengineering at this site was delayed until the fall. To make use of stems cut in the spring, some bioengineering was conducted at the recently contoured Huestis site and within the blackened vegetation along upper Dome Creek during the summer. Given the late timing (July2 to July 4) this work should be considered as a trial/test and interpretation of results from these site should consider this less-than-ideal timing.

The waste rock site at Pony Creek became available for the bioengineering course and the intended revegetation works in the fall. Details of the bioengineering/revegetation works at each site are described below.

Huestis Bioengineering

A portion of the Huestis site was treated in late June using some of the willow that was harvested during the spring of 2008. The LSCFN assistants who worked on this component of the project included Kyle Cashin, Tyrell Vance and Travis Johnny.

A bioengineering method known as live staking was conducted which entails planting willow into the soil vertically. The rocky soil proved difficult to penetrate using conventional means (shovel and pick); however, two 12 m X 12 m grids were eventually planted with the use of dibblers (a hand-tool used to make holes approximately 5 cm in diameter and 50 cm deep). One grid was positioned on the crest of the site while another grid was situated on the slope (Photo 1). On average, stems were driven into the soil to a depth of approximately 40 cm. This depth is considered shallow and, combined with the porous soils (gravel) at the site, the success of the stakes may not be sufficient. Later in the summer we observed sprouting of leaves on many of the planted stakes, but it is not yet known if roots have been established. Whether or not the roots were successfully established will be evident through the presence of new growth next spring.

Photo 1. Live stakes planted on the slope of the Huestis site (please note the tops of the stakes were trimmed following the photo).

Dome Creek Bioengineering

In conjunction with planting at the Huestis site, the blackened vegetation along the southwest banks of Dome Creek was treated for an approximate distance of 130 m, beginning directly downstream of the seepage pond. A modified form of live staking was carried out at this location. Due to permafrost, stems were planted in a diagonal fashion above the permafrost layer (Photo 2).

Photo 2. LSCFN assistants, Tyrell Vance (right) and Travis Johnny (left) planting willow at Dome Creek.

The site is moist and there is a notably rich organic layer here, albeit shallow. The presence of permafrost and known elevated concentrations of metals may be factors influencing growth. Leaves sprouted during the summer on many of the stems that have been planted here; however, it is still unknown whether rooting has taken place.

Pony Creek Revegetation & Bioengineering Course

In late September, the bioengineering course was held at the Mt. Nansen site. LSCFN members who attended the course included Grayson Skookum, Nelson Billy and Jeff Jonathon. This project also employed a cook, Brenda Sam and her helper, Cynthia Blackjack.

The works took place from September 29 to October 3 and consisted of three main components; proper harvest of willow, a course/presentation on bioengineering and hands-on planting based on techniques from the presentation (conducted at the Pony Creek site). One of the main goals of the project was to provide training for LSCFN citizens and give them an understanding of bioengineering and the abilities to

implement similar projects with minimal supervision. Such training should be valuable for future reclamation works at Mt. Nansen as well as other sites around the Carmacks area.

Even though there was a substantial amount of stems that remained from the initial spring harvest, it was determined that new willow cuttings would be preferable. It was felt that the long storage of the old willow would compromise the success of the bioengineering works. As a side benefit, cutting of additional stems allowed us to demonstrate proper harvesting methods to the crew/students. A portion of the spring harvested stems were used in one prescription applied at the site (the live pole drain). While the success of these cuttings cannot be guaranteed, this application should allow these cuttings to receive moisture.

To provide the students/crew with a general understanding of bioengineering, a 'classroom' session was completed at the mine site. A 3 hour presentation was made showing basic concepts of revegetation and bioengineering. Basic rationale, application, and techniques were described with many Yukon and northern Canada examples. Students showed significant interest in the presentation, asked many questions and promoted good discussion about revegetation at the Mt. Nansen mine site. As part of this theoretical element, attendees were asked to provide input into the prescription for the Pony Creek site. The students responded well to this opportunity and suggested many prescriptions that were appropriate for the site conditions. As such, many of the techniques that the students suggested were implemented on the site.

Figure 1 shows the prescriptions used at the site. The goals of the revegetation were to accelerate natural succession and provide erosion and sediment control. There was evidence of notable drainage from the access road that flowed down the middle portion of the site directly into Pony Creek (i.e. during rain events). As such, a number of prescriptions were geared to capture, slow down and/or direct this drainage into the adjacent vegetation (live pole drain, wattles). Efforts were concentrated near Pony Creek to establish riparian vegetation and stabilize the area (brush layers). In addition, live stakes were planted in various locations to aid in acceleration of succession. A light seeding of native grasses was applied to address short term erosion concerns. All methods are summarized below.

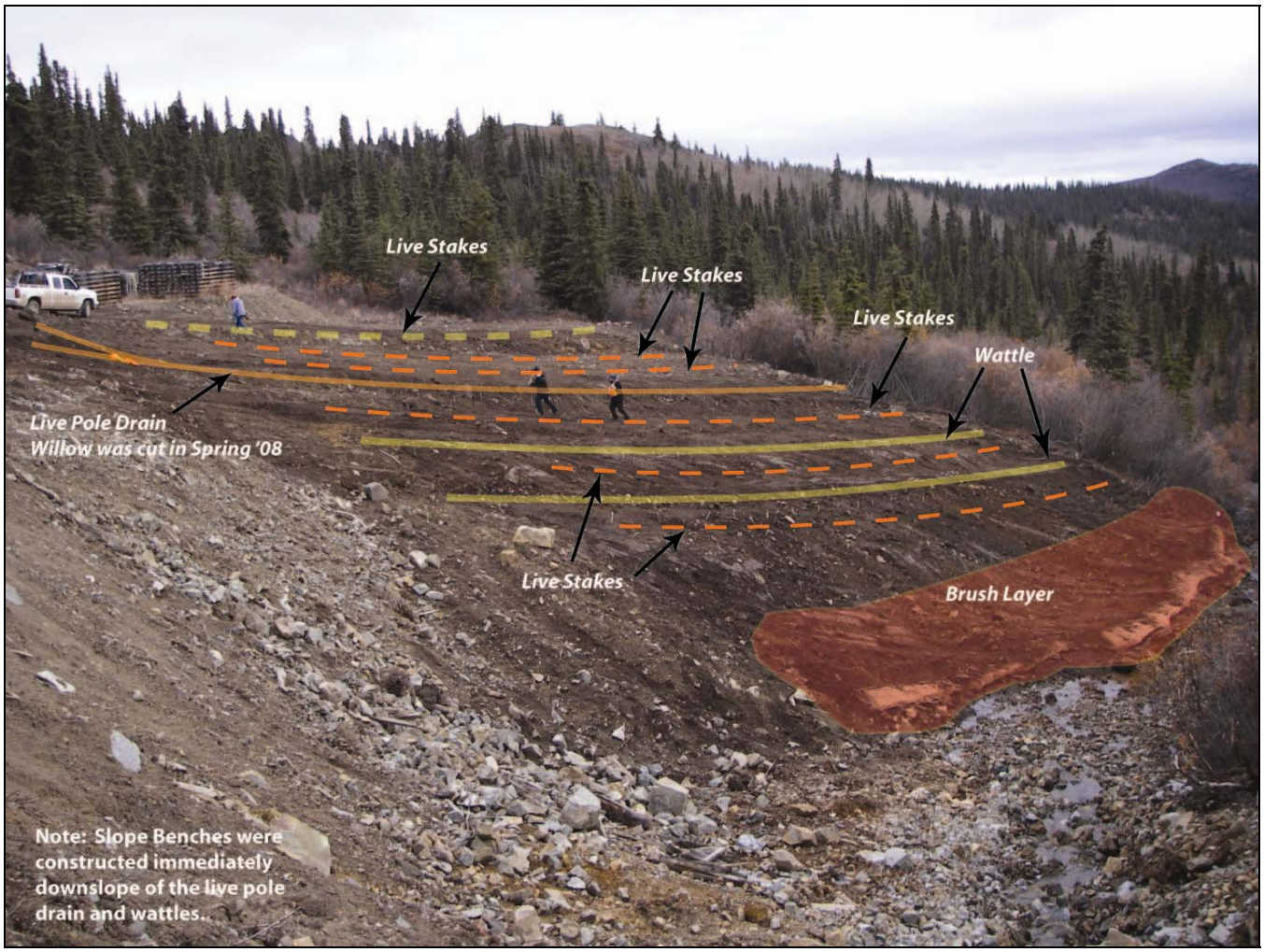

Figure 1. Illustration of bioengineering works at the Pony Creek site.

- Two brush layers were placed at the toe of the slope for stream-side bank stabilization (Photo 3). To prevent erosion from Pony Creek a biodegradable erosion blanket was used between the two brush layers.
- Shallow trenches were dug midslope and willow was bundled, placed and buried to create wattles (Photo 4). At the crest of the slope, a trench approximately 1 metre deep was excavated and stakes were placed on both sides and partially covered (Photo 5).
- A live pole drain was constructed on the upper section of the slope in order to prevent erosion due to water runoff originating from the access road to the site (Photo 6).
- Live willow stakes were planted between each of the above mentioned concepts (Photo 7).

As a bi-product of the works, slope benches were created adjacent and directly downslope of the live pole drain and the wattles, further protecting the site from runoff erosion. These benches will slow water thus promoting infiltration into the bioengineering structures.

Photo 3. Constructing the brush layer at the toe of the Pony Creek site.

Photo 4. Willow placed (not yet bundled) into the trench to create the wattle.

Photo 5. Willow stakes placed into the 1 metre deep trench prior to covering.

Photo 6. Live pole drain bundled and prepared for soil coverage.

Photo 7. Jeff Jonathon (right) and Nelson Billy (left) going through the necessary motions of live staking.

On October 15, 2008, native grass seed was spread over an area of 0.2 ha at a rate of 25 kg/ha resulting in approximately 5 kg of seed that had been dispersed over the site (Photo 8). Grass species used included Slender wheatgrass, Alpine bluegrass, Tufted hairgrass, Fringe brome, Rocky Mountain fescue, Trisetum, Fowl bluegrass, Alkali grass and Awned wheatgrass. Two separate mixes were used containing varied percentages of each species.

Photo 8. Meghan Marjanovic of EDI dispersing seed at the Pony Creek site.

In summary, we feel the revegetation works at the Mt. Nansen site represent a good trial of a number of bioengineering and revegetation methods. It is likely that many of these methods will be relevant to other components of the reclamation of the minesite. As such, it will be important to monitor and learn from the techniques used in 2008, specifically the works completed at the Pony Creek site. We feel the theoretical knowledge along with hands-on training that the LSCFN crew received during this project will be valuable for future works in the Carmacks region. LSCFN were instrumental in implementation of the project; specifically, Leta Blackjack was key in coordinating the field crews and cooks. If you have any questions or concerns regarding this letter please call Pat Tobler or myself at (867) 393-4882.

Sincerely,

EDI ENVIRONMENTAL DYNAMICS INC.

Matt Power, AScT.

Cc: Hugh Copland, Frank Patch, Rachel Pugh, Assessment and Abandoned Mines Branch
Leta Blackjack, LSCFN
Pat Tobler, EDI