MPERG Report 2006-1

Bioengineering Trials at Noname Creek
Post-Fire Evaluation

By

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Executive Summary

In the fall of 2001, live willow cuttings were used for stabilizing an erosion gully on a permafrost slope at Noname Creek in the Big Creek drainage. These structures (gully breaks and pole drains) were upgraded in the fall of 2003 and the early spring of 2004. In the early summer of 2004, the Noname Creek valley was burned in a wildfire. In order to assess the effects of this fire on the erosion control structures, the site was revisited in the summer of 2005.

The black spruce forest on the slope above Noname Creek had been completely burned. Although the above ground sections of the pole drains and gully breaks had been scorched, the structures remained intact and most of the lower cuttings were sprouting new growth. Falling trees had damaged a few of the structures. The willow cuttings staked in the gully between the structures had also been scorched. Although many of these staked willows were apparently dead, the older ones (staked in 2001) were sprouting new growth at ground level.

It is expected that the erosion control structures, although partially damaged, will survive and continue to function. It is also anticipated that the flow of water in the gully will increase as a result of the escalated melting of permafrost on the slope above Noname Creek.

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1.0 Background

In a 2001 MERG-funded project, bioengineering techniques were employed for stabilizing a permafrost-rich slope damaged by heavy equipment on a placer claim at Noname Creek in the Big Creek drainage west of Carmacks. This work, completed in the fall of 2001, included the installation of gully breaks and pole drains using the live, dormant cuttings of locally occurring species of willows. These techniques were described in a report submitted to the MERG by Laberge Environmental Services (2002).

In order to evaluate the success of these bioengineering installations, the Noname Creek site was monitored during a MERG-funded assessment in 2002 (Withers 2003). This evaluation included structural assessments of the gully breaks and pole drains along with estimations of their ability to survive the forces of surface water runoff, trap sediment and reduce further gully erosion. During this survey it was found that most of the willow cuttings used for this bioengineering project had survived and produced abundant new growth, although some of the gully breaks had been breached by erosion channels and erosion had occurred around the pole drains. Consequently, upgrades were made to these structures in the fall of 2003 and the spring of 2004. These upgrades included backfilling the erosion cuts and the installation of biodegradable geotextile mats behind the gully breaks (Laberge Environmental Servives 2005).

Following a forest fire in the Big Creek area in the early summer of 2004, it was discovered by staff from the Mineral Development Branch that the Noname Creek bioengineering trials site had been burned, including the surrounding black spruce forest and much of the ground cover. The site was subsequently reassessed in mid-July 2005. The focus of this MPERG-funded assessment was to determine the extent of the effects of the 2004 fire on the Noname Creek bioengineering structures.

2.0 Assessment Methods

The following observations were made at the Noname Creek bioengineering trial site:

- the fire damage and survival of each live bioengineering structure
- the continued ability of each structure to control erosion
- the vegetative growth in the erosion gully and on the recently burned adjacent land
- the extent of water seepage into the erosion gully from the surrounding burned over ground
- the measured depth to permafrost (with the use of a hand auger)

Photographs were taken of the bioengineering structures, the erosion gully and surrounding burned over landscape.

3.0 Assessment Findings

Evidence of the 2004 forest fire on the slopes above Noname Creek was obvious. The black spruce forest, the underlying shrubs and the insulating moss layer had been nearly completely destroyed. Post-fire regeneration had begun (about one year after the burn occurred). The pioneering plant species observed colonizing the adjacent black spruce forest include grey-leaf willow (*Salix glauca*), paper birch (*Betula papyrifera*), shrub birch (*Betula glandulosa*), shrubby cinquefoil (*Potentilla fruticosa*), rose (*Rosa acicularis*), Labrador tea (*Ledum groenlandicum*), blueberry (*Vaccinium uliginosum*), fireweed (*Epilobium angustifolium*), lungwort (*Mertensia paniculata*), saussurea (*Saussurea angustifolia*), dragonhead (*Dracocephalum parviflorum*), reed bentgrass (*Calamagrostis lapponica*) and rocky mountain fescue (*Festuca saximontana*). Small thick patches of black spruce (*Picea mariana*) seedlings were growing on the upper slope near the top of the project.

Vegetation was quite thick in the wet erosion gully. This growth was dominated by dense stands of blue-joint reed grass (*Calamagrostis canadensis*). Other plant species in the gully included tall Jacob's ladder (*Polemonium acutiflorum*), coltsfoot (*Petasites frigidus*), fireweed (*Epilobium angustifolium*), lungwort (*Mertensia paniculata*), ticklegrass (*Agrostis scabra*), tufted hairgrass (*Deschampsia caespitosa*), sedge (*Carex* sp.), wood rush (*Luzula rufescens*), chestnut bog rush (*Juncus castaneus*), field horsetail (*Equisetum arvense*) and green-tongue liverwort (*Marchantia* sp.).

The depth to permafrost in the burned over black spruce forest was measured with a hand auger. Several measurements were taken on the upper and lower slope near the erosion gully. The average depth to permafrost near the top of the project was 660 mm and the average depth to permafrost near the bottom of the project was 483 mm. These measurements, taken on July 19, 2005, compare to a measurement of 457 mm taken on July 6, 2001.

Water flow in the erosion gully was estimated to be <I litre/second at the top of the bioengineering project. Several small seepages into the gully were noted and the discharge at the bottom of the project was estimated to be 2 litres/second.

Pole Drains

The upper pole drain (upstream from Gully Break #1) has survived the fire and is sprouting well. Most of the willow cuttings that were staked beside and upstream from the pole drain were burned, but are resprouting near ground level. Some water is flowing through the drain; water is also flowing beside the drain in places, although very little new erosion has occurred.

The lower pole drain (between Gully Break # 6 and Gully Break # 7) has been partially burned on top, but the lower cuttings are still sprouting. Water is flowing through and beside the drain.

Gully Breaks

Gully Break # 1
Gully Break # 1 is still trapping sediment although it has been scorched by the fire. Some new shoots are sprouting from the lower cuttings. The willow cuttings staked upstream of the break have also been scorched.

Gully Break # 2
Gully Break # 2 has been scorched. Some new shoots are sprouting from the lower cuttings. The gully break has been breached near the right bank. The willow cuttings staked upstream of the break have also been charred but are resprouting at ground level.

Gully Break # 3
Although much of Gully Break # 3 has been scorched, new shoots have emerged from the lower cuttings. A breach has occurred in the gully break on the left bank. The willow cuttings staked upstream from the break have charred with very little sign of new growth.

Gully Break # 4
Although Gully Break # 4 has been scorched it is trapping sediment and new shoots are sprouting from the lower cuttings. The willow cuttings staked upstream of the break have been scorched, but are producing new shoots at ground level.

Gully Break # 5
Although Gully Break # 5 has been scorched, new shoots are sprouting from the lower cuttings. A major breach in the gully break has occurred at the right bank. The willow cuttings staked upstream of the break have also been scorched, but are producing new shoots at ground level.

Gully Break # 6
The top willow cuttings of Gully Break # 6 have been scorched but the rest of the structure has survived and new shoots have emerged. A small breach has occurred in the gully break near the middle. The willow cuttings staked upstream from the break have been charred and appear to be dead.

Gully Break # 7
Gully Break # 7 is still trapping sediment although it has been scorched. The taller shoots from previous years' growth have been scorched but new shoots are emerging. The willow cuttings staked upstream of the break have also been charred but are resprouting at ground level. Water is seeping in from the gully sides just upstream from the gully break.

Gully Break # 8
Gully Break # 8 has been badly charred with very little of new growth. The gully break has been breached at the left bank. The willow cuttings staked upstream of the break have also been charred with very little new growth.

Gully Break #9
Although Gully Break #9 has been scorched, there is an abundance of new shoots emerging from the lower cuttings. A small breach in the gully break has occurred near the left bank as a result of having been hit by a large falling tree. The willow cuttings staked upstream of the break have also been charred with little sign of new growth.

Gully Break # 10
Gully Break # 10 is still trapping sediment although it has been partially scorched. There is new growth along much of the structure. The willow cuttings staked upstream of the break appear to be mostly dead. These cuttings were staked in the fall of 2003 so there was not much time for the establishment of new roots before the fire occurred.

Gully Break # 11
The willow cuttings of Gully Break # 11 are mostly still alive. Some of the taller shoots from previous years' growth have been scorched, but there is lots of new growth. The willow cuttings staked upstream of the break have been scorched but there is new growth at ground level.

4.0 Conclusions

The following conclusions can be drawn from these observations:

- The black spruce forest on the east slope above Noname Creek, including the trees, shrubs and insulating ground cover, was largely destroyed in the forest fire that occurred in the early summer of 2004. In the summer of 2005, one year after the fire, normal post-fire successional processes are evident on this hillside.

- Most of the above-ground parts of the erosion stabilization structures, installed in 2001 and upgraded in 2003/2004, were scorched in this fire. In 2005, the new shoots emerging from the lower (near-ground or below-ground) willow cuttings in most of these structures indicate that they (gully breaks and pole drains) will remain intact (the willows, common post-fire successional shrubs, will probably thrive on the additional moisture resulting from the melting permafrost). The breached gully breaks, however, may not be able to function as erosion control structures unless they are repaired.

- The older willows staked in the gully (the ones staked in the fall of 2001) appear to have a higher rate of survival than those staked during the later upgrades (fall of 2003 and spring of 2004). This probably results from the well formed roots in the older staked cuttings.

- Water flow in the erosion gully will probably increase during subsequent summer seasons. This increased in flow is anticipated because of the damaged insulating ground cover and the resulting increase in permafrost melting.

- The fairly dense growth of grasses and forbs colonizing the erosion channel upstream from the most of the gully breaks should contribute to the stabilization of this part of the gully.

References

Laberge Environmental Services. 2002. Experimental Trials for Restoring Disturbed Sites in Permafrost Areas Using Bioengineering Techniques. Prepared for the Mining Environmental Research Group. Whitehorse, Yukon.

Withers, S.P. 2003. Follow-up Monitoring: Shrub Trial Plots at Brewery Creek Mine and Bioengineering Trials at Noname Creek. Prepared for the Mining Environmental Research Group. Whitehorse, Yukon.

Laberge Environmental Services. 2005. Upgrades to the Bioengineering Installations at Noname Creek 2003/2004. Prepared for the Mining Environmental Research Group. Whitehorse, Yukon.

Appendix A
Site Photographs

Upper pole drain – note willows are scorched on top but resprouting below

Lower pole drain – between gully breaks #6 and #7

Gully Break #4

Gully Break #5

Gully Break #9 – fallen tree has caused breach

Looking upstream from Gully Break #11

Looking upstream from Gully Break #10

Gully Break #11

Seepage entering gully by Gully Break #1

Seepage entering gully by Gully Break #7