# SOIL BIOENGINEERING FOR CONTROL OF SOIL EROSION IN A RE-CONSTRUCTED WATERWAY ON AN ALBERTA OIL SANDS OVERBURDEN DUMP

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## ABSTRACT

In 2003 a waterway swale was retrofitted into an Alberta oil sands overburden dump. In spring 2004, Terra Erosion Control Limited was retained to develop and implement an erosion control prescription using a soil bioengineering approach. Repair and maintenance work were carried out in 2005 and 2006. The site was monitored in 2005, 2006, 2007 and 2009, results demonstrated that the use of contour fascines type structures were more efficient at dispersing intermittent water flow than brush sills. Overall the work was considered to be successful in preventing accelerated gully formation in the swale, as well as creating wildlife habitat.

**Key Words:** Contour fascines; brush sills; live stakes; wetlands; enhancement of habitat

## BACKGROUND

In 2003 a waterway swale was retrofitted into an Alberta oil sands overburden dump. In spring 2004, Terra Erosion Control Limited was retained to develop and implement an erosion control prescription using a soil bioengineering approach.

The constructed swale has an average gradient of 7% (4˚) and is approximately 600 m long (see figure 1). It is composed of two minor lateral swales connecting onto the main swale. The substrate consists of muskeg placed over clay capping and oil-sands tailings.

**Figure 1. Prior to treatment 2004.**

## SOIL BIOENGINEERING PRESCRIPTION AND IMPLEMENTATION

The prescription and implementation in 2004 consisted of the following:

- Twenty nine brush sills installed across the swale (see figure 3).
- Smaller diameter cuttings installed in the middle of each sill to improve water dispersion.
- Contour fascines installed across the swale in two locations above the brush sills as a trial (see figure 2).
- An upstream wetland was created as a result of seeds germinating from within the seed bank of the applied muskeg; the area was also planted with long live stakes.
- The swale was fertilized and broadcast seeded with a nurse crop of barley.

**Figure 2. Contour Fascine and Brush Sill**

**Figure 3. Brush Sill Installation 2004.**

## MONITORING AND SURVIVAL

The site was monitored in 2004 and survival of brush sill cuttings was estimated at approximately 70%, with shoot growth averaging 60 cm (see figures 4 and 5).

In 2005, survival and growth of the brush sills and fascines was assessed as good and the trial sections of contour fascines installed above the brush sills were found to perform much better than the brush sill structures alone at dispersing water.

Some areas had minor rilling due to water flow and some sections of brush sills had poor survival due to water undermining.

**Figure 4. August 2004.**

**Figure 5. August 2004.**

## REPAIR AND MAINTENANCE

Measures to address problem areas were implemented in October 2005 and included:

- Replacement of brush sill sections where mortality occurred.
- Addition of contour fascines above all existing brush sills.
- Live staking in the centre of the swale.
- Installation of muskeg and seed-filled burlap sacks to fill in eroded areas (see figure 6).
- Application of additional soil amendments and broadcast seeding with a native grass mix.

**Figure 6. Muskeg Filled Burlap Sacks, October 2005.**

Minor maintenance work was also required after the spring 2006 snowmelt. Condition of the swale and created wetland was monitored in 2007 and 2009 and assessed as good to excellent (see figures 7, 8 and 9).

**Figure 7. July 2007.**

**Figure 8. Created wetland, (note Salix exigua and Populus balsamifera surrounding established aquatic species), July 2009.**

**Figure 9. Alpha Swale, July 2009.**

**LESSONS LEARNED**

Brush sills result in channel erosion. When combined with accumulated organic debris these results in falling water (hydraulic jump) and the creation of splash erosion (see figures 10 and 11). The use of contour fascines, without brush sills, appears to be diffusing water instead of creating channels and splash erosion (see figures 12 and 13).

Based on these findings, trial sites, using large diameter (30 cm) contour fascines, were established in the spring of 2010 over two newly constructed swales (waterways) within an overburden mine dump.

**Figure 10. Accumulating organic debris above brush sills.**

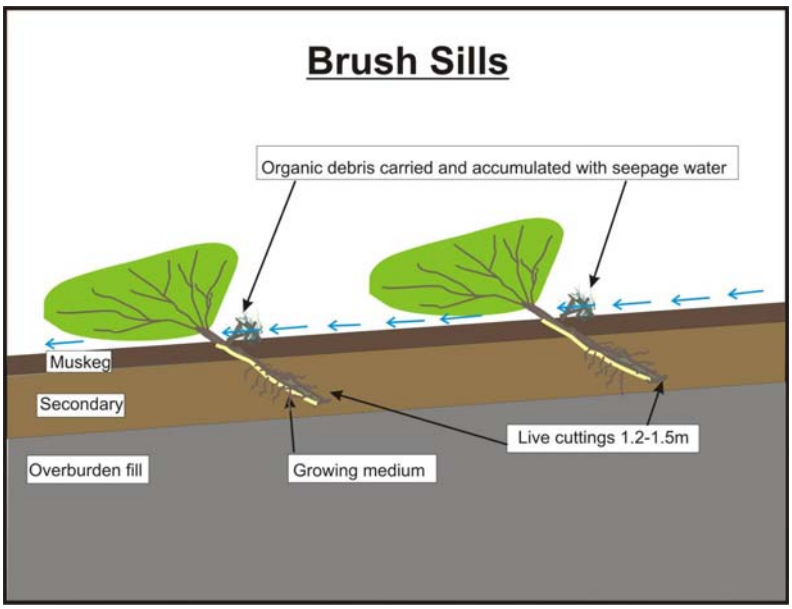

**Figure 11. Splash erosion and channeling created below brush sills.**

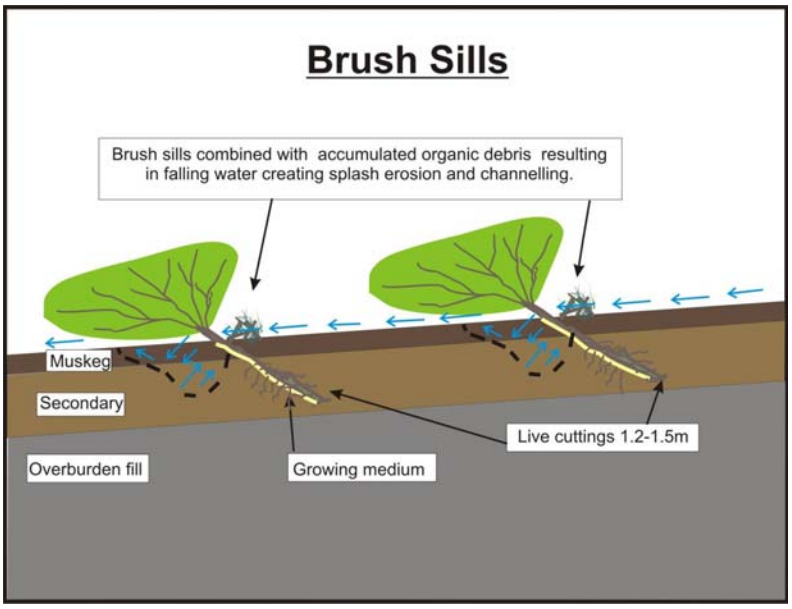


**Figure 12. Diffusion of water flow using contour fascines.**

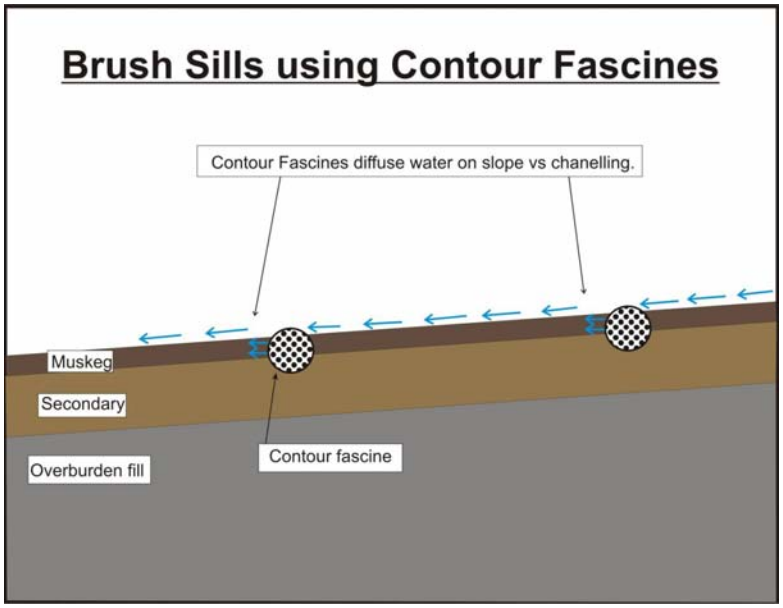

**Figure 13. Diffusion of water flow vs. channeling.**