Case Study - Vetiver Grass on steep batter slopes at Gove

Summary
The Alcan (formerly Nabalco) Gove mine, located in the Northern territory, experienced severe gully erosion and soil slipping on a number of batter slopes on a major water retention pond after an extreme rainfall event in 1999. Landloch Pty Ltd was asked for advice on both rehabilitating this site and the prevention of similar slope failure in the future. The batter slopes were reformed and a program of vetiver planting undertaken to stabilise the slopes and to help anchor the topsoil to the underlying clay layer. At present, the vetiver grass is well established and minimal erosion has since occurred.

The Problem
The Residue Disposal Area (RDA) of the Gove Mine experienced an extreme rainfall event on 21 and 22 April 1999. Monitoring at the RDA indicated that maximum rain in a 24 hour period was 294 mm, with a total of 306 mm falling in 48 hours. Large areas of outer batter slopes of a water retention dam designated as Pond 5 were affected by slipping of the surface soil layer and associated gullying.

It appears that most of the erosion initially started on the upper tier, causing the table drain on the middle berm road to block and overflow down the lower tier. This resulted in further soil slips and associated gullying. In all, about 5 ha of batter slopes were affected by erosion and required remedial works.

Plate 1: View of upper and lower batter slip areas

To stabilise steep slopes such as those at Pond 5 against landslips, it is necessary to both minimise the discontinuity between the topsoil and underlying clay and to increase the shear strength of the topsoil layer. Vetiver grass is ideal for this purpose due to its deep rooting nature.

Vetiver Planting Program
For batter slopes where significant widths of topsoil slipped off the underlying clay, it was initially proposed to have topsoil replaced, and then plant vetiver hedgerows and seed a grass/legume mix in the inter-row areas in October 1999. On steep slopes (>45%), vetiver rows were to be placed on a 1 metre vertical interval (VI). For areas where widths of topsoil slips were smaller, it was planned to plant vetiver later in the wet season.

However, after the slopes had been cleared and topsoil replaced, the area of disturbed, bare soil on the pond wall was greatly increased. A decision was taken that all vetiver planting (including that initially planned for later in the wet season) would be completed by the start of the wet season. With some increases in

disturbed area resulting from earthworks, this led to a requirement for planting of approximately 110,000 vetiver slips by 2 November 1999. With vetiver planting commencing on 9 September, this presented a challenging timetable.

The vetiver planting program included sourcing vetiver, developing and operating a temporary on-site nursery for handling vetiver slips, planting of vetiver, watering, weeding, and (where necessary) replacement of plants. The work was carried out by staff from the local company YBE, with supervision from Landloch field staff.

Plate 2: *Initial planting operations.*

At all times, watering was the major factor affecting vetiver establishment and growth. After the first week of October, temperatures increased and weed growth also become important, particularly where vetiver was stressed by inadequate watering.

On the batter slopes, vetiver typically took 2 weeks after planting to show active growth, whereas growth could normally have been expected after 5-7 days. This pronounced planting shock was associated with the difficulty of providing adequate pre- and post-planting watering under the hot conditions experienced, with the large area planted adding to the challenge of providing adequate watering.

Although vetiver is a hardy fast growing perennial, its growth is affected by shading, particularly during establishment. Therefore it is critical that initial stages of establishment have an effective weed control program. Fast growing annual plants such as *Brachiaria pubigera* and *Crotalaria pallida* (rattlepod) quickly outgrew the vetiver and required manual hand weeding. By the late wet season there was a marked difference between the areas that were weeded compared to those that were not. In hindsight, the use of pre-emergence herbicides immediately after planting would probably have provided effective weed control. However, it is important to identify potential weed species and to ensure that the herbicide selected will give control. For example, Atrazine has been used to control weeds in vetiver, but *Brachiaria* species are commonly resistant to Atrazine.

By late November, the earlier vetiver plantings were 1.3 metres high, with vetiver plantings that were weeded reaching heights of approximately 2 metres late in the wet season. By June the vetiver roots had extended about 1.0 m into the soil profile.

Performance to Date

With the exception of a small section on the upper tier, there was no erosion on Pond 5 batter slopes during 1999/2000 wet season. However, although the 1999/2000 wet

season rainfall of about 1600mm was above average, there were few major storm events, with the largest single day rainfall being 75mm. As most erosion only occurs during extreme rainfall, the erosion control effectiveness of vetiver has yet to be fully tested.

Plate 3*: Vetiver approximately 1.3 metres high. (Area planted on September 9-12, photograph taken 12 weeks later).*

Further vetiver plantings

The existing vetiver nursery has been continued, with additional plantings of vetiver slips on sections of Pond 5 and Pond 7 batters.

Vetiver may be also be used on decommissioned residue impoundments, where It is envisaged that contour hedge-rows could be planted to provide erosion control while other vegetation establishes. Another possible application is in conjunction with rock mulch on steep batters and other physical structures.

Plate 4: *Vetiver on Pond 5 batter slope, photograph taken in July 2001*

Reference:

Loch, R.J., Truong, P., Smirk, D., and Fulton, I. (2000). Vetiver Grass for Land Management and Reclamation. In Proceedings of the Third AMEEF Innovation Conference "On the Threshold: Research Into Practice", Brisbane, Qld, 15-17 August 2000, pp. 116-122.