"Bridge Creek Landslip Remediation"

Final Report & Acquittal (Sunshine Coast Council Minor Grant)

(July 2011)

Prepared by Mark Amos

LBCCG Project No. 1011-010

This report has been prepared by:

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Cover photo: *The land slip on Wells Road, Maleny in August 2009 before remediation commenced.*

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(*Sunshine Coast Council Minor Grant)*

PROJECT TITLE: **Bridge Creek Landslip Remediation** *(LBCCG Project No. 1011-010)*

1. PROJECT SUMMARY

The project revegetated a landslip in the Bridge Creek (Lake Baroon) catchment. The site was assessed by a geotechnical consultant who recommended the installation of sub-surface drains and profiling of the site to create a free draining surface, and revegetation with native species to provide long-term stability. The revegetation over time will reinforce the soil profile, increasing the sheer strength and reduce susceptibility to erosion. Additionally a dense cover of native vegetation will extract moisture from the soil profile through transpiration leading to lower ground water pressure. Furthermore, the revegetation will extend existing corridor linkages and habitat nodes.

LANDHOLDER DETAILS

Name/s	Rob & Janice McLauchlan	David Bull
Postal Address	[redacted]	[redacted]
Phone Numbers	[redacted]	[redacted]
E-mail	[redacted]	[redacted]

SITE LOCATION

Property Address	Wells Rd, Maleny	16 Wells Rd, Maleny	
RP Number (Lot Number)	RP208215 (3)	RP208215 (2)	
Property Size (ha)	0.75 (40ha in total)	8.5	
Existing Land-use	Residential (Beef cattle)	Residential & Beef cattle	
Stock Carried	0 (60 in total)	20	
Sub-Catchment	Bridge Creek	**LBCCG Management Unit**	BR3
M.U. Priority (LBCCG IP)	**Low**	**M.U. Priority** (Pollution)	**High**

STAKEHOLDERS, ROLES & INVESTMENT

Lake Baroon Catchment Care Group	Major funding provider (Seqwater), Project coordinator, technical advice, equipment supplied	$5,156 (cash) $2,910 (in-kind)
Sunshine Coast Council	Funding (SCC Minor Grants program), vegetation technical advice (Alan Wynn)	$1,800 (cash)
Rob & Janice McLauchlan	Landowners, labour, maintenance	$7,260 (cash & in-kind)
David Bull	Landowner, labour, maintenance	$7,905 (cash & in-kind)
Civil Quality Assurance	Geotechnical advice	-
Conservation Volunteers Australia	Planting labour	$1,620 (in-kind)
TOTAL PROJECT VALUE (exclusive of GST)		**$26,651**

PROJECT OUTPUTS

Fencing	140 metres permanent (190 metres temporary electric)
Tube-stock planted	1,200

2. PROJECT LOCATION

The Lake Baroon Catchment Implementation Plan 2007 asserts the Bridge Creek sub-catchment is dominated by natural vegetation, though dairying and cattle grazing is a significant land use in several Management Units. The sub-catchment covers an area of 2,134 hectares and has a total significant stream length of 52 km. Approximately 43% of the sub-catchment has vegetation cover.

Figure 1: Bridge Creek has good riparian vegetation and displays excellent bed diversity and bank stability. The creek however is threatened by sediment loads entering the waterway through excessive erosion in the catchment.
Lake Baroon, the main potable water supply for the Sunshine Coast is less than 1,000 metres downstream from the project site.

Bridge Creek has been divided into six management units that reflect property boundaries, physiography, vegetation, land use, point and diffuse source impacts, and administrative convenience.

The proposed project is located within Management Unit BR3. This MU is 518 ha in size and has 14 km of significant waterways. The dominant land use in the MU is beef production. Riparian vegetation is present alongside 40% of the waterway length.

The relatively steep nature of the land, moderate instability (63% of land unstable) and lack of natural cover in some areas of the catchment means that there is high erosion potential, and minimal filtering of run-off, therefore inputs of nutrients are significant (70% of samples exceeding guideline levels).

Figure 2: A number of landholders in this sub-catchment have, with the assistance of LBCCG and other organisations, invested considerable time and effort into revegetating previously bare stream banks and protecting, and enhancing the regeneration of small pockets of remnants.

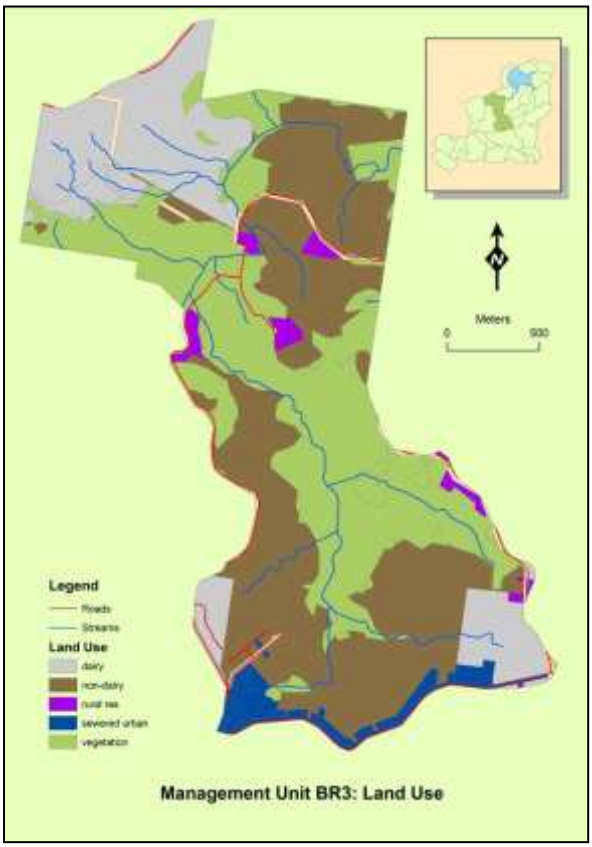

Figure 3: The McLauchlan & Bull properties are shown as the brown shading at the top of the map. Beef production is the dominant land use in the Management Unit with a significant proportion of the catchment covered with vegetation.

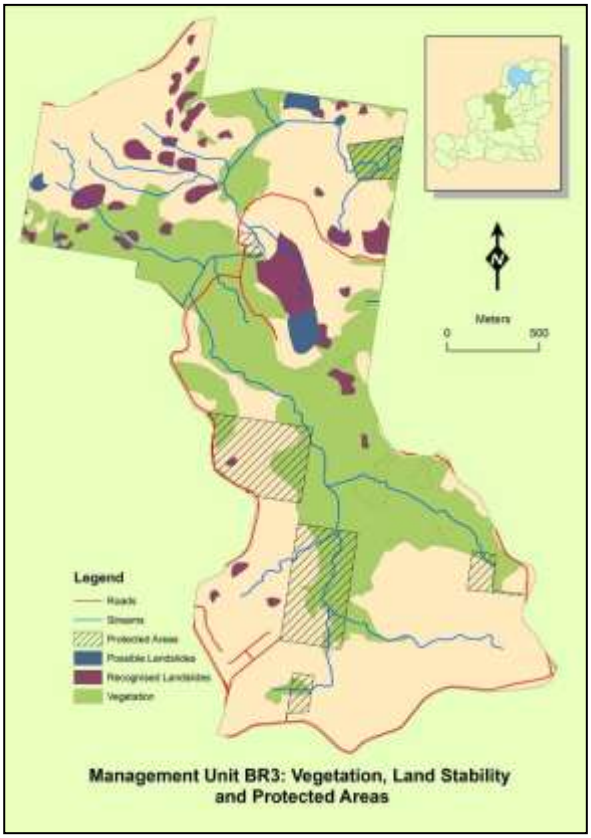

Figure 4: This map shows BR3's instability and likelihood of suffering landslides (landslips).The proposed project site has not been previously identified as having a high likelihood of slipping.

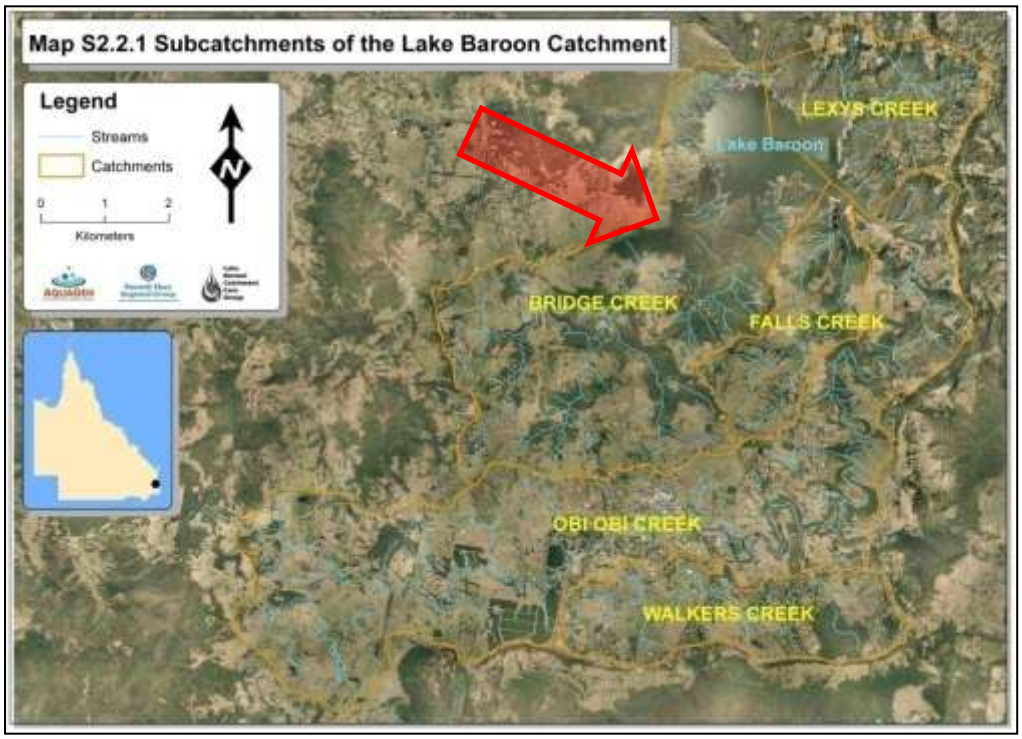

Figure 5: Bridge Creek forms the western sub-catchment of Lake Baroon.
Part of Maleny is situated in the headwaters of Bridge Creek.

3. MASS MOVEMENT & LANDSLIPS IN THE BAROON CATCHMENT

Mass movements (landslips) are a characteristic of the Lake Baroon catchment because of the catchment's specific attributes - very dry to drought conditions through winter and high rainfall (approximately 2 000 mm/year) through summer; steep slopes; shallow soils on impermeable sub-surfaces; cracking clays; and a lack of deep-rooted vegetation to bind the profile and manage soil moisture. These all contribute to the occurrence of mass movement and slips.

The majority and biggest of the mass movements in the Lake Baroon catchment are associated with the Bridge Creek sub-catchment – a basalt cap overlaying a much older sandstone geology. Furthermore, landslips are usually associated with the edges of the plateau where the basalt layers have suffered significant erosion and the sandstone layer is close to the surface.

The basalt-derived soils in the Bridge Creek catchment contain large amounts of the clay mineral montmorillonite, which has a pronounced loss of strength on wetting. On drying, montmorillonite forms large and deep cracks that permit rapid intake of moisture from rainfall runoff, which increases the risk of slope failure.

Furthermore the basalt-derived soils of the Baroon catchment are characterised by high concentrations (up to 0.22 % or 2 200 ppm) of exchangeable sodium ions. Sodium ions are naturally dispersive, and mixed with the characteristics of the montmorillonite clay mineral; accentuate their loss of strength on wetting.

Geotechnical and Environmental Consultant Paul Fraser described the Wells Road landslip as a 'complex' type of movement comprising a combination of rotational land sliding and debris flow (Fraser 2009) described the landslip in Wells Road, Bridge Creek. The source area has a diameter of some 35 to 40 metres with a circular main scarp and numerous minor scarps. The debris track is some 70 metres in length with the depositional area in a small earth dam on Lot 2 (Bull's).

A small earth dam has been constructed in the centre of the source area on Lot 3 (McLauchlan's) and it is understood that a constant water supply is maintained via seepage (springs).

It appears the landslide has resulted from a combination of past vegetation clearing, relatively unstable colluvial soils from historic erosion and mass movement and groundwater pressure which peaked during the prolonged wet weather period.

Since the assessment by Fraser in 2009 there has been further movement in the immediate area. The recently constructed concrete driveway to the McLauchlan dwelling above the identified slip has been shifting. In 2011, following the extreme wet conditions experienced over the summer period there was significant movement on the Ward property (RP227535, Lot 5) further up-slope. This indicates the entire slope spanning the three properties is subject to mass movement.

Figure 6: The most recent landslip in the area has affected the Ward property, which is up-slope from the McLauchlan & Bull properties. Note the electricity pole in the centre of the photo.

4. BACKGROUND

The Bridge Creek catchment is recognised as being prone to mass landslides (slips). This area has a history of landslips and movement; however the high rainfall experienced in the first half 2009 in the Maleny district contributed to a serious land slip spanning two properties.

Figure 7: The project site in 1988. The properties had better pasture coverage however the instability of the area can be seen.
Note the change in slope

The heavy rainfall saturated the soil profile of the site and caused the instability. Further rainfall resulted in the small spring-fed dam near the top of the rise failing, with the resultant debris and sediment 'flowing' downhill into the neighbouring property. A small farm dam has captured and contained the majority of sediment; however, this dam was likely to be filled to capacity with soil in the near future.

Figure 8: The project site in June 2009. The willow tree in the slip (red arrow) was originally planted above the fence on top of the rise.
The areas on and adjacent to the slip require vegetation to help stabilise the site.
Note the revegetation and regeneration in the background that has occurred since the removal of stock in these areas.

The Lake Baroon Catchment Implementation Plan 2007 rates Management Unit BR3 as a low priority for waterway rehabilitation. However the proximity of the landslip to Lake Baroon, and the consequences if no action is taken, plus the relatively low cost of remediation works, demands the project is given higher importance.

Figure 9: The landslip from down-slope. The two willows (green willow in centre of photo and dead willow in the dam) in the centre of the photo were originally growing above the boundary fence on top of the rise.

Figure 10: Typical of landslips in Kikuyu dominated pasture – the ground cracks and shears but retains some structure from the grass roots and tends to 'fold' rather than slide. This usually results in a 'bulbous toe' at the leading edge of the slip.

Figure 11: The small dam at the top of the landslip. This dam was roughly circular in shape – note the encroach of material into the dam from up-slope (to the left of the photo). The debris slide associated with the landslip was caused by the failure of the dam wall (bank).

Figure 12: Boundary fence between the McLauchlan and Bull properties damaged from the landslip.

5. PROJECT ACTIVITIES

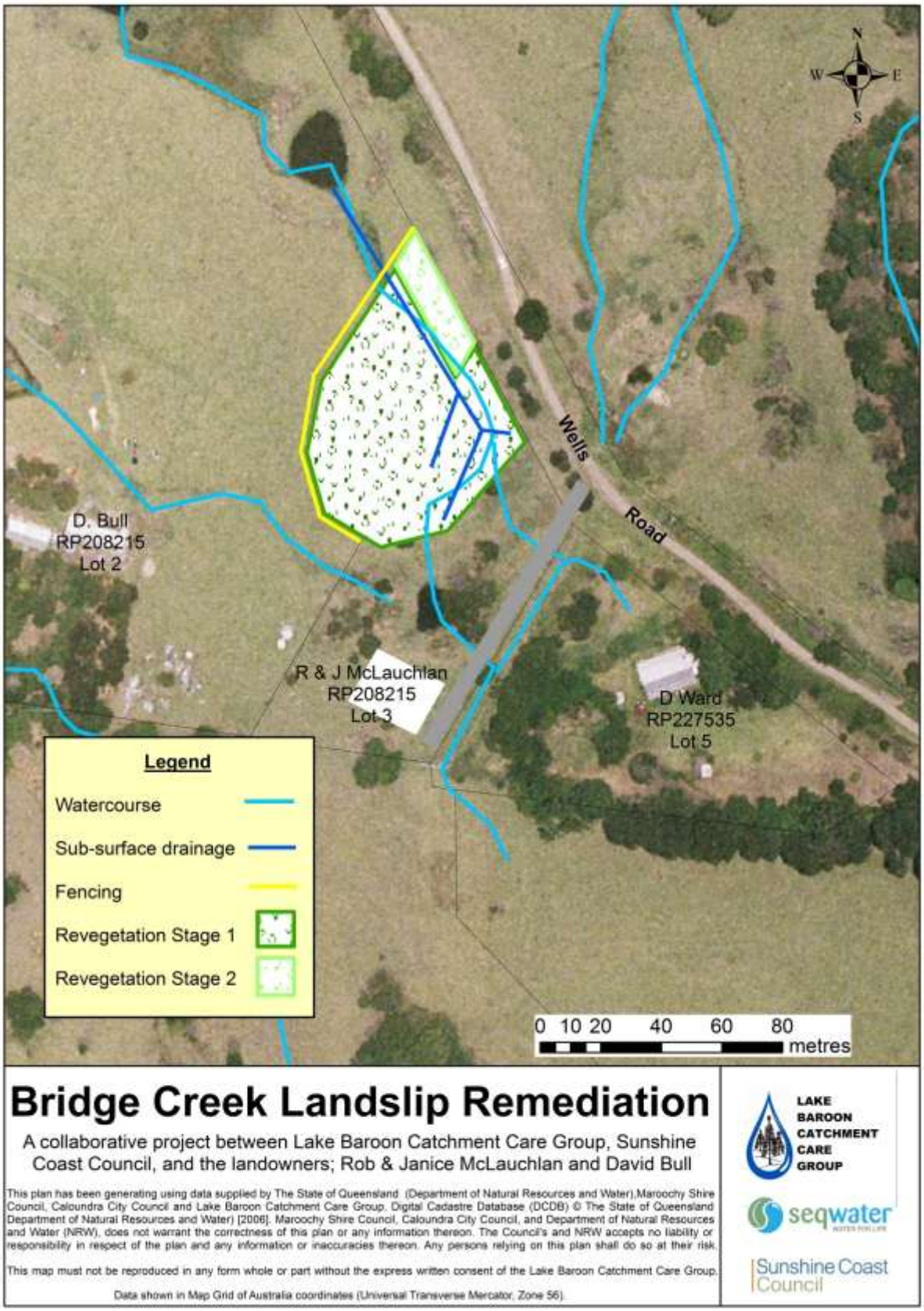

Figure 13: Project map and activities.

5.1 Fencing & Seeding

Although the hill-slope has been somewhat unstable for the past twenty years, this latest and most visually dramatic slip occurred in late summer 2009. With landholders contacted and an action plan agreed on the first stage was to restrict stock access so the existing grass cover was protected. Further rye grass seeding was required to stabilise bare areas.

Completed July 2009

5.2 Landslide Assessment

Paul Fraser from Civil Quality Assurance assessed the site and produced a brief report offering recommendations and solutions. The report identified the likely causes and remediation options dependent on the level of stability (and cost) required.
Both landholders agreed to implement the option with the alternative providing the greatest certainty of long term stability – surface profiling, sub-surface drainage and revegetation.

Completed August 2009

5.3 Site Profiling

The site was profiled to remove the small dam at the head of the slip and to reinstate a gradual slope to facilitate water run-off. To prevent rilling from heavy rainfall, David Bull constructed diversion banks across the slope on his property to slow run-off and direct it to a stable point.
The down-stream dam that was collecting sediment was de-silted.

Completed September 2010

5.4 Sub-surface Drainage

Sub-surface drainage was installed – consisting of a series of drains to intercept the sub-surface seepage (springs) and deliver it safely to the downstream dam.
This occurred in two stages as following completion of the first stage two additional springs were identified.
Drains consisted of trenches lined with geo-fabric and filled with coarse drainage material with top soil placed over the top to provide a soil surface that could be pasture seeded and revegetated.

Completed September 2010

5.5 Seeding

The site was seeded following earthworks to provide surface erosion (rilling) protection. A combination of japanese millet, rye grass and kikuyu was broadcast.
Some natural regeneration of the previously existing grasses (cooch grass) also occurred.

Completed September 2010

5.6 Permanent Fencing

Permanent fencing was placed around the bottom of the slip and the boundary fence seperating the two properties was reinstated. This replaced the temporary electric fencing erected 12 months previously.
Fencing will protect the revegetation until it is established with possible managed grazing in the future.

Completed September 2010

5.7 Revegetation Stage One

Once the seeded grass had established a National Green Jobs Corps team planted Stage One. This was the area disturbed by drainage and profiling works.
Conditions were poor with regular rainfall making the site very muddy and slippery. Planting holes were drilled using a 75mm post hole auger that could be used in the rocky conditions.

Completed November 2010

5.8 Revegatation Stage Two

Approximately six weeks after the first stage of planting a further 120 tube-stock were planted on an undisturbed area (grass was sprayed out before it could be planted).
The majority of species selected where the same as planted in Stage One although numbers were modified to reflect the success (or otrherwise) of the Stage One plantings.
Guards are 2 litre cardboard cartons with bamboo stakes and a 300mm x 300mm jute mat was used for mulching.
Planting was completed by David Bull, LBCCG Coordinator and an LBCCG Work Placement student.

Completed December 2010

5.9 Re-planting

Between March and June the site was replanted to replace dead stock. Although the species initially chosen were selected for their hardiness, the extremely wet summer resulted in moderate losses (approximately 15%) due to waterlogging. Wallaby predation also contributed to losses although the wallabies tend to ‘nip’ the tops out of the tubestock.

Completed June 2011

6. PROJECT EVALUATION

Plant species were selected on several criteria. Fast growing hardy species were the main characteristics chosen, although there had to be sufficient variety to be able to select 'edge' species, and 10% of the total number were Araucaria bidwillii (Bunya Pine) which were deemed to be ideal in land slip planting despite their slow growth habits.

Growth rates have varied. On what could be considered a control area (the undisturbed soil on the northern end of Bulls) growth has been excellent – particularly the pioneer species (Homolanthus, Macaranga and Eucalyptus species). On the rest of the site however, the soil has been disturbed greatly – through the land slip itself, sub-surface drain installation and surface profiling. Additionally as the site has numerous springs of varying volume, waterlogging is also a major issue. Therefore growth rates from tree to tree vary considerably although several species have shown site-wide hardiness; Eleaeocarpus grandis (Blue Quandong) particularly so.

To further complicate plant survival and growth has been the prevalence of wallabies – particularly when the grass on the Bull property reached the stage where it was providing dense cover and the wallabies would remain on site day and night.

Without a doubt waterlogging has caused the majority of the approximately 15% of plant deaths and when very unhealthy individuals were replaced almost uniformly these plants were suffering from advanced root rot.

Surprisingly the Ficus coronata (Creek Sandpaper Fig) and Glochidion ferdinandi (Cheese Tree) have both struggled to establish which is disappointing as these two species were selected for their tolerance to wet conditions.

Maintenance has varied over the two sites. The Mclauchlan site is regularly mowed and the grass surrounding the plant and guard is sprayed with herbicide. The Bull site on the other hand has only been brush cut once sinec revegetation and herbicide has been sprayed around the plant and guard twice. The grass on the Bull site when brush cut was very tall (up to 1.5 metres). There does not appear to be any advantage to keeping the grass regularly mown except for aesthethic purposes (although the grass must be managed immediately around the plant and guard) and keeping weeds from establishing.

Figure 14: Grass has been retained and encouraged between the rows to provide surface stability. Grass is kept clear immediately around each individual plant to reduce competition. There does not appear to be any need to keep the inter-row grass short as lack of moisture is not a major concern on the site – indeed most plant losses have been from waterlogging.

Figure 15: circa 1988.

Although relatively stable, the area displays the unmistakeable 'hummocky' appearance of a landslip. The colluvium present would have resulted from tree-clearing activities and lack of ground cover in the past.

Figure 16: September 2009.

The landslip that occurred in the summer of 2009 largely resulted from high rainfall, the small dam at the head of the slip, and the lack of soil binding vegetation on the site.

Figure 17: September 2010.

Site profiling and sub-surface drainage completed.

Figure 18: October 2010.

Pasture grass establishment was slow as the soil surface was predominantly clay and stone.

Figure 19: November 2010.

Stage one of revegetation complete.

Figure 20: December 2010.

Stage two of revegetation complete. Note the guards on the left of the photo adjacent to Wells Road.

Figure 21: January 2011.

Grass still very slow to establish on the heavier clay soils.

Figure 22: March 2011.

Better quality soil has excellent grass growth and in these areas tree growth has been good. growth on the undisturbed area on the left (adjacent to Wells Road) has been excellent.
Grass growth on heavy clay soil still virtually non-existent.

Figure 23: May 2011.

Site following completion of project.

7. PROJECT OUTCOMES

Sunshine Coast Council Priorities

The project addressed the Sunshine Coast Council Priorities of:

1. Prevent erosion and sediment run-off to waterways;
2. Contributes to landscape scale protection, monitoring and rehabilitation of biodiversity;
3. Strengthens vegetation and riparian corridors and linkages; and
4. Build community capacity, engagement and participation.

LBCCG Priorities

The project addressed the following Lake Baroon Catchment Care Group Priorities of:

1. **Water Quality Improvements**
   The primary aim of the project was to improve the water quality of the Bridge Creek Catchment. This was achieved by repairing the damage caused by the landslip, minimising the amount of sediment (and associated nutrients) entering Bridge Creek. Ultimately, this improves the quality of raw water entering Lake Baroon, reducing potable water production costs.

2. **Extension of habitat.**
   The project expanded the vegetation in the local area and will provide valuable habitat for fauna. Species selection was based on hardiness and suitability to a landslip site however subsequent plantings will be consistent with the local Regional Ecosystems and will include rare and threatened flora species of these RE's so that the site will also assist in the long term preservation of species.

3. **Community Education**
   The property is located in a high visibility area. The project will serve as a demonstration site in best practice management of landslips, and provide the opportunity for LBCCG and stakeholders to monitor and evaluate on-ground works and techniques. Field Days could potentially be held on site once the project outcomes are fully understood. Both landholders have been previously involved in revegetation projects on their properties with varying success. The works will further enhance the properties demonstration values, and improve understanding and technical capacity of the agricultural community.

4. **Improvements in farm productivity**
   Farm productivity will be enhanced by improving the manageability of the property, while contributing to productivity by reducing nutrient and soil loss through erosion and chemical export through run-off.

5. **Whole farm approach to property planning.**
   The McLauchlan property was assessed through the Property Management Planning program initiated by Lake Baroon Catchment Care Group, which evaluated the property from both an environmental perspective and a productive agricultural perspective. Environmental and primary production issues were identified and as a result, a series of prioritised actions and works are currently being implemented. The works program addresses priorities that deliver benefits to the Sunshine Coast (and beyond) by improving the water quality in Lake Baroon.

8. COMMUNITY EDUCATION

Figure 24: National Green Jobs Corps participants studying erosion in the Lake Baroon catchment.

In early May 2011, LBCCG conducted two Field Walks for National Green Jobs Corps participants as part of their Land Management studies.

The landslip site was the focus of the Field Walks – particularly the identification of landslips and their remediation. A walk to lower Bridge Creek where it enters Lake Baroon highlighted the impacts of landslips and erosion in the catchment through the deposition of sediments in the tail water of the storage.

9. PROJECT EXPENDITURE

LBCCG has a policy of keeping Project Budgets confidential as individual project costings vary and can give misleading information.

Detailed Budgets can be supplied on request. Please contact the LBCCG Project Manager on info@lbccg.org.aufor further information.

10. ATTACHMENTS

10.1 Revegetation Species List

Species	Common Name	Number
Argydodendron trifoliatum	White Booyong	50
Hymenosporum flavum	Native Frangipani	50
Homolanthus nutans	Bleeding Heart	100
Macaranga tanarius	Macaranga	50
Ficus fraseri	Sandpaper Fig	100
Syzygium smithii	Creek Lilly-pilly	60
Litsea australis	Southern Brown Bolly-gum	50
Toona australis	Red Cedar	50
Cryptocarya macdonaldii	Cooloola Laurel	50
Elaeocarpus grandis	Blue Quandong	100
Syzygium ingens	Red Apple	50
Guioa semiglauca	Wild Quince	50
Glochidion ferdinandi	Cheese Tree	50
Sambuccus australasica	Native Elderberry	50
Pittopsporum undulatum	Sweet Pittosporum	50
Flindersia schottiana	Bumpy Ash	100
Araucaria bidwillii	Bunya Pine	100
Ficus coronata	Creek Sandpaper Fig	60
Eucalyptyus pilularis	Blackbutt	20
Eucalyptus grandis	Flooded Gum	10
		1200
Re-plant Species		
Lophostemon confertus	Brush Box	100