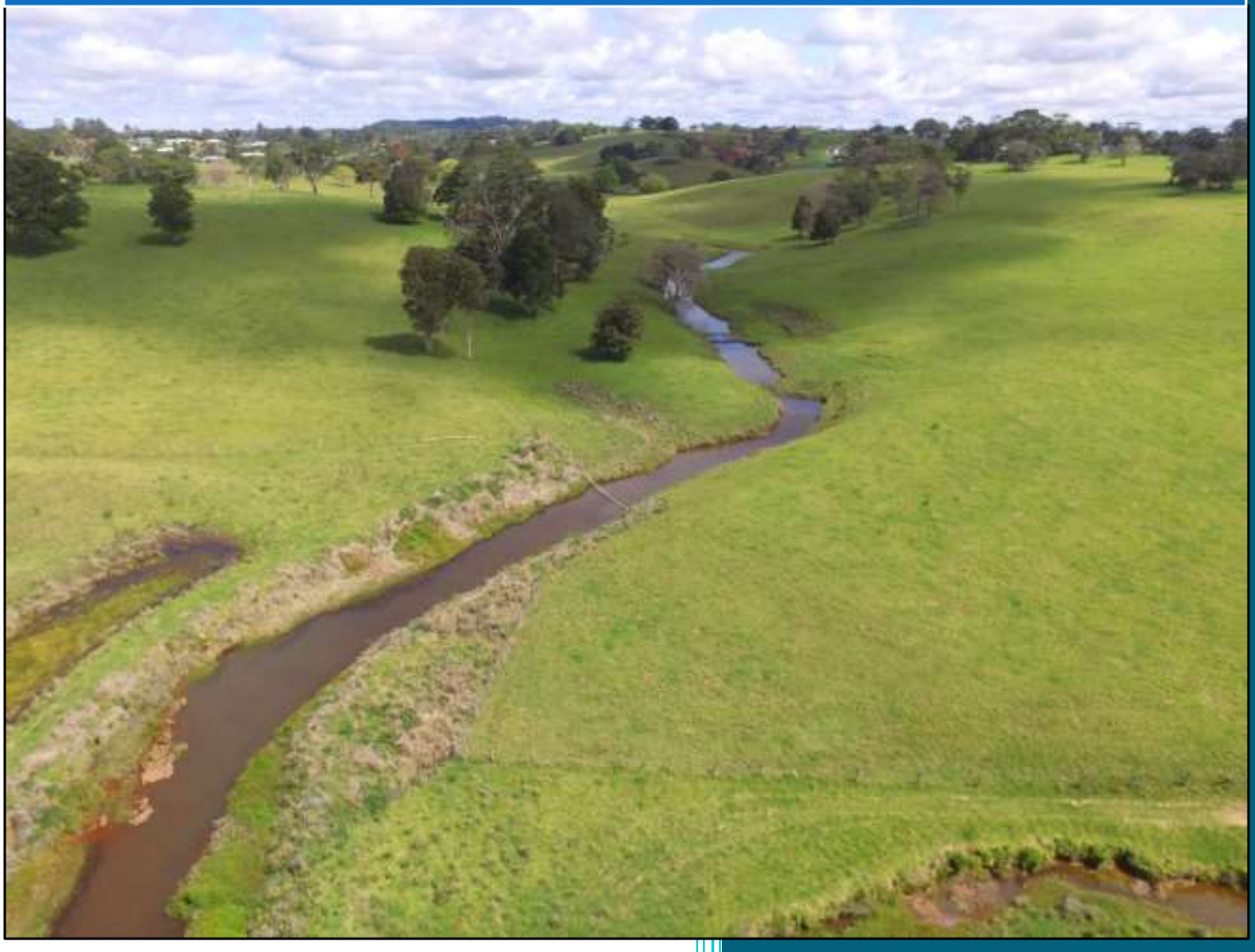
Lake Baroon Catchment Care Group

Working with our community...for our waterways

Projects 2015-16

Walkers Creek Dairy Project

(Muller & Maleny Dairies)



Sunshine Coast Council

Maleny Dairies

seqwater WATER FOR LIFE

PROJECT PLAN

Project No. 1516-015

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How to read this Plan

This Plan is split into three distinct sections.

The **Summary** (pp. 5-6) is a two page brief description of the project and includes summarised details of the stakeholders, budgets, outputs and outcomes.

The **Project Plan** (pp. 7-15) outlines the detail involved in implementing the project and in most cases should explain the project sufficiently.

The **Attachments** (pp. 16-36) provide additional information to support the Project Plan. The various numbered Contents in the Project Plan directly correspond with the numbered sections in the Attachments.

Terms used in this Plan

Lake Baroon and Baroon Pocket Dam are used interchangeably, although *Lake Baroon* is usually used when referring to the catchment and *Baroon Pocket Dam* refers to the dam as commercial water storage.

Confidentiality

Much of the information contained herein is confidential and must not be reproduced or passed on to any person outside Seqwater without prior written permission from Lake Baroon Catchment Care Group.

PROJECT VERSIONS & APPROVALS

Version	*Date*	*Version/Description*	*Result*
1.0	18/11/2015	Draft LBCCG Project Proposal completed	n/a
1.0	19/11/2015	Project presented (emailed) to LBCCG Committee Project Plan will be presented at December LBCCG Meeting	(Minutes 84.6.2)
1.0	20/11/2015	Project Proposal forwarded to Seqwater for approval (email)	Approved (T. Packer)

AUTHORISATIONS

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Approved by (Seqwater): Tim Packer		***Approved***

Cover photo: *Walkers Creek on the Muller property.*

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Sunshine Coast COUNCIL
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PART A EXECUTIVE SUMMARY

PROJECT NUMBER & TITLE: **1516-010 Walkers Creek Dairy Project (Muller & Maleny Dairies)**

Walkers Creek Dairy Project will be implemented on a large ex-dairy farm that has been recently leased to neighbouring Maleny Dairies. The Muller property converted to beef in the early 2000s when changes in the dairy industry challenged viability. With the success of Maleny Dairies and the demand for locally produced and bottled milk, along with the retirement of Gavin Muller, the 74 hectare property has been leased to Keith Hopper from Maleny Dairies. This addition to Maleny Dairies effectively doubles the grazing resource and allows a doubling of the milking herd. Although the Muller property has been exceptionally well run, current infrastructure (laneways, fencing and stream crossings) is designed to manage livestock movement to the central dairy. Maleny Dairies will not be utilising the existing non-operational dairy but rather the existing facility on the Hopper property. New laneways and a stream crossing over Walkers Creek is therefore required to prevent erosion of high traffic paths and delivery of faecal material to the creek.

APPLICANT/LANDMANAGER DETAILS

Names	[redacted]
Postal Address	
Phone Number	
E-mail	

PROJECT / SITE LOCATION

Property Address	Mountain View Rd, Maleny, 4552		
Latitude/longitude	-26.776429 152.850382		
RP Numbers (Lot)	RP163942 (3); RP207173 (16); RP26386 (1 & 2); RP46826 (2)		
Property Size	74 hectares		
Existing Land-use	Dairy grazing	***Stock Carried***	100+
Sub-Catchment	Walkers Creek	***Management Unit***	WA1
M.U. Priority *(LBCCG IP)*	**Moderate**	***M.U. Priority*** *(Pollution)*	**High**
Water Quality	More than 86% of samples between 1999-2005 exceeded ANZECC guideline levels (Traill 2007)		

PROJECT PARTNERS/STAKEHOLDERS & ROLES

Lake Baroon Catchment Care Group (Seqwater 2015-16 Project Funding)	On ground project implementation **($40,000**)
Lake Baroon Catchment Care Group (Seqwater 2015-16 Administration Funding)	Project coordination, administration, reporting, monitoring & evaluation (**In kind $4,800**)
Gavin Muller	Landowners, lessee, labour, cash and in-kind contributions (**$55,550** cash & in-kind)
Keith Hopper	

PROJECT DETAILS

Start Date	Nov 2015	***Completion***	June 2016	**Duration** (implementation)	1 year
OUTPUTS					
Stream crossing	1	***New laneway***	1,300 m	***Laneway rehabilitation***	600 m
OUTCOMES					
Reduced erosion and sediment delivery to Walkers Creek (compared to do-nothing option)					highly likely
Reduced faecal material deposited in Walkers Creek and tributaries (compared to do-nothing option)					highly likely
Landholder engagement					2 land managers

Maintaining water quality is critical to providing safe bulk drinking water for the population of South east Queensland. All of the raw water storages managed by Seqwater are located in catchments which are developed to varying extents and support active and growing communities, including important industrial and rural economic activity. To provide a multi-barrier approach to the supply of drinking water, Seqwater must influence the management of land not owned by, but which exert an influence on Seqwater's core business.

The proposed project aims to complete three components:

1. Install stream crossing on Walkers Creek ;
2. Construct 1,300 metres of new livestock laneway; *and*
3. Rehabilitate 600 metres of existing livestock laneway.

The Muller property has recently been leased to the neighbouring Maleny Dairies. With the addition of close to 75 hectares of high quality grazing, Maleny Dairies is increasing their herd of Guernsey cows by a minimum 100%. Initially this was to be achieved through an on-farm breeding program however a herd of approximately 70 animals was recently purchased. These animals require immediate integration into the Maleny Dairies program and therefore expansion onto the Muller property has been fast-tracked. Infrastructure such as a stream crossing and laneways is a critical and immediate priority.

LBCCG therefore must act immediately if risks to water quality are addressed. Additionally we must ensure that subsequent activities, to be implemented in coming years, are influenced by LBCCG to ensure appropriate water quality outcomes are achieved.

Formalised crossings protect livestock and watercourses from the issues associated with unrestricted access. Benefits include:

- reducing risk to water quality by limiting sedimentation and nutrient enrichment;
- enhanced livestock health through access to cleaner water;
- reduced loss of productive land and livestock deaths;
- maintaining river pools to provide a water source that is available for longer periods of year;
- stabilisation of stream banks and bed; *and*
- improved riparian vegetation and riverine habitats.

Rehabilitated laneways significantly reduce erosion in high stock traffic areas resulting in less sediment run-off and turbidity in adjacent watercourses. Carefully designed laneways are shaped with strategic cross drainage (whoa-boys) to shed water to the sides (onto pasture) and direct run-off contaminated with faecal material (nutrients, chemicals and pathogens) to pasture that can trap and filter contaminants, rather depositing directly to watercourses.

Note: the project was not identified in the 2015-16 Annual Investment Strategy due to the recent leasing of the Muller property by Maleny Dairies. Therefore the project is deemed an '*emerging threat or opportunity*'.

PART B PROJECT PLAN

i. INTRODUCTION

Lake Baroon Catchment Care Group (LBCCG) is a not for profit community group focussed on reducing the risks to water quality in the Lake Baroon catchment - primarily through the implementation of on-ground remediation projects. This aim is consistent with Seqwater's objectives of efficiently producing high quality potable water for the Sunshine Coast (and greater South east Queensland) region.

Maintaining water quality is critical to providing safe bulk drinking water for the population of SEQ. All of the storages managed by Seqwater involve catchments which are developed (to varying extents) and support active and growing communities, along with important industrial and rural economic activity (SKM 2012).

The project will be implemented over two properties and staged over one year (monitoring and evaluation ongoing) and is effectively a continuation of recent projects on neighbouring properties both upstream and downstream (*see Table below*).

The activities of LBCCG are supported by Seqwater as they align with Seqwater's commitment to the NHMRC Framework and to environmental stewardship by supporting catchment planning and targeted remediation for reduction of catchment based risks to water quality (Smolders 2011).

As this project is consistent with the LBCCG (and Seqwater) aim of reducing risks to water quality from erosion, nutrients and pathogens, the activities to construct a stream crossing, construct laneways and rehabilitate existing laneways are considered sensible to support.

ii. BACKGROUND

The project has developed from a long and productive partnership with Maleny Dairies.

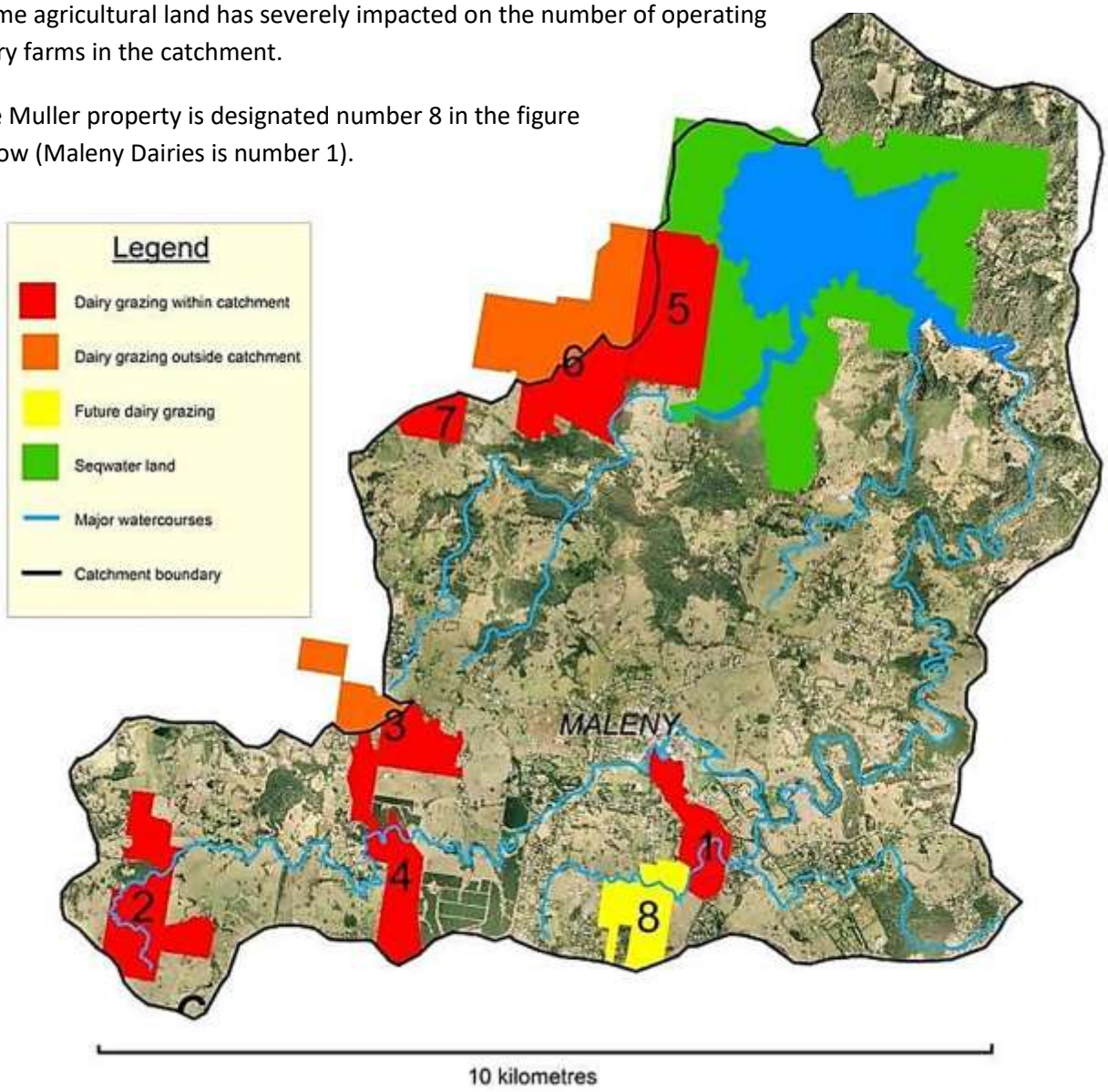
Over the past several years LBCCG have been very active in this location (the confluence of Obi Obi and Walkers Creeks). These projects have demonstrated to neighbouring landholders the benefits of rehabilitation and remediation leading to further enquiries about being involved in remediation activities. Eventually it is LBCCG's aim to 'capture' as much of the Walkers and Fryars Creek catchments as possible providing not only water quality benefits but also broader environmental outcomes such as linking Mary Cairncross Park with remnant vegetation in the lower Obi Obi Creek.

Guernsey cows on Maleny Dairies

Dairies in the Lake Baroon catchment

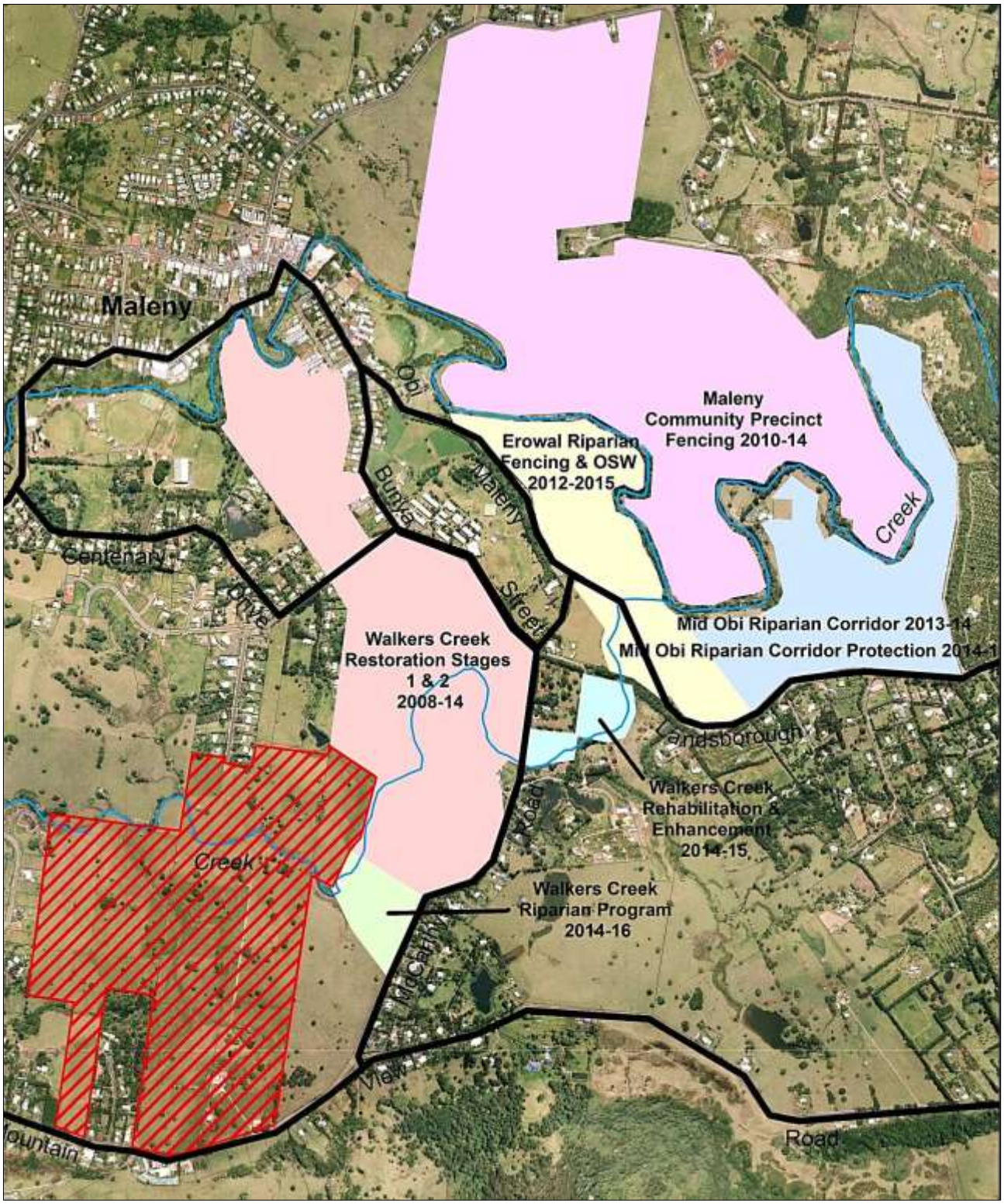
Dairy regulation in 2000, poor milk returns and the prohibitive value of prime agricultural land has severely impacted on the number of operating dairy farms in the catchment.

The Muller property is designated number 8 in the figure below (Maleny Dairies is number 1).



LBCCG projects in the immediate location include:

Project Name	*Years implemented*	*Project outputs*	*Total Project Value*
Walkers Creek Restoration Stage 1	2008-09	Waterway crossings, laneway hardening, dairy hardstand concreting, riparian fencing, riparian revegetation	$196,057
Erowal Riparian Fencing & Off Stream Watering	2013-2015	Riparian fencing, off stream watering, weed management	$47,910
Walkers Creek Restoration Stage 2	2013-14	Dairy hardstand concreting, dairy effluent management	$54,289
Mid Obi Riparian Corridor	2013-14	Riparian fencing, off stream watering, weed management	$60,122
Mid Obi Riparian Corridor Protection	2015-16	Weed management, revegetation	$59,750
Walkers Creek Riparian Program (Harris)	2014-16	Riparian fencing, revegetation, off stream watering	$24,583



LBCCG projects since 2008 in the immediate area of the proposed project. Note the figure indicates the property individual projects occurred – not the actual on-ground activity.

1.0 WHAT

(What activities will be implemented)

The proposed project aims to complete three components before December 31, 2015:

1. Install stream crossing on Walkers Creek;
2. Construct 1,300 metres of new dairy laneway; *and*
3. Rehabilitate 600 metres of degraded laneway.

Proposed stream crossing site on Walkers Creek.

1.1 Project Schedule

Activity	*Timing*	*Output*
Stream crossing	ASAP November 2015	Access to the Muller property from the Hopper property is currently limited. The construction of a low level concrete crossing will enable the construction of laneways.
Laneway rehabilitation	Dec 2015	1,300 metres new; 600 metres old laneways rehabilitated.

1.2 Stream crossing

Formalised crossings protect livestock and watercourses from the issues associated with unrestricted access. The benefits include (Water and Rivers Commission 2000):

- improved water quality by limiting sedimentation and nutrient enrichment;
- enhanced livestock health through access to cleaner water;
- reduced loss of productive land and livestock deaths;
- provision of a relatively cheap option for providing livestock watering;
- maintaining river pools to provide a water source that is available for longer periods of year;
- stabilisation of the river banks and bed; *and*
- improved riparian vegetation and riverine habitats.

1.3 Laneway rehabilitation

An estimated 80% of sediment and 35% of nitrogen in the waterways in South East Queensland come from non-urban diffuse loads. Dairy farms are an intensive form of agriculture with high levels of livestock movement (to and from the milking facility) and therefore have significant impacts on property laneways.

Poorly designed or constructed laneways are prone to erosion. The farm environment is greatly improved by hardening laneways, not only because erosion is minimised but also cows tend to move faster between

Laneway construction utilising locally sourced road base

paddock and dairy resulting in less manure deposited on laneways and therefore reduces the risk of faecal material entering drainage lines and watercourses.

Rehabilitated laneways significantly reduce erosion in high stock traffic areas resulting in less sediment run-off. Carefully designed laneways are shaped with strategic cross drainage (whoa-boys) to shed water to the sides (onto pasture) and direct run-off contaminated with faecal material (nutrients) to pasture that can trap and filter nutrients, rather depositing directly to watercourses.

2.0 WHERE

(Where in the catchment will the project occur)

The project will be implemented on two adjoining (but primarily the Muller property) properties in the Walkers Creek catchment.

(a) Gavin Muller property (dairy until early 2000's, beef until late 2015).
456 Mountain View Rd, Maleny

Property is approximately 74 hectares – comprising the following:

- 66 ha of improved pasture;
- 4.5 ha of seasonally wet pasture associated with degraded (from sedimentation) minor drainage lines and springs;
- 1 ha of residential;

Walkers Creek enters the property from the west, meandering in and out of the property before splitting the eastern portion of the property in two with a total combined length of approximately 680 metres. The riparian zone is virtually totally devoid of woody vegetation with pasture to the water's edge. Most of the isolated native species scattered over the property are either introduced shade trees or individual remnant species. The sole purpose of these sparse trees is the provision of shade for livestock.

Minor watercourses total approximately 1,400 metres.

The Muller property and Walkers Creek

3.0 WHY

(What benefits will the project provide)

3.1 Walkers Creek

Walkers Creek (including Fryars Creek) is the most disturbed and polluted waterway in the Lake Baroon catchment, consisting of 15 km of major waterway in a sub-catchment of 697 ha. Less than 10% of the sub-catchment is covered in vegetation, with much of the area significantly disturbed mostly supporting beef or dairy cattle. Riparian lands have been predominantly cleared up to the waterways edge with only one significant area of intact remnant vegetation remaining (Mary Cairncross Park - 65 ha) (Dunstan 2007).

Of the five dairy farms operating in this catchment in 1997, only one remains operational. Despite this, results of water quality monitoring continue to indicate that faecal coliform counts exceed the ANZECC guideline for primary contact. These faecal coliform counts are further exacerbated after heavy rainfall events (AquaGen 2004).

Poorly performing on-site wastewater disposal treatment systems (including septic systems) continue to be one of the highest risk contributors to faecal coliform counts (supported by nitrate and ammonia sampling) (AquaGen 2004).

3.2 Risks to water quality

In excess, faecal material and associated nutrients (largely nitrogen and phosphorus) and pathogens are high risk to water quality. High levels of nutrients in surface water contribute to algae blooms that result in hypoxic or oxygen-deprived dead zones in water bodies (Baroon Pocket Dam). Throughout history, consumption of drinking water supplies of poor sanitary quality has been linked to illnesses in human populations. These illnesses most commonly present as gastrointestinal-related symptoms, such as diarrhea and nausea (Health Canada 2013).

Sampling for these pathogens is difficult and largely impractical due to the number of types and distribution variability of bacterial pathogens that can be present in animal and/or human wastes, and because detection requires significant resources. As a result, monitoring for a broad indicator of faecal contamination such as

Escherichia coli is useful in verifying the microbiological quality and safety of the drinking water supply.

Although livestock in watercourses are an obvious risk, contamination can originate in many ways; failing or poorly performing wastewater systems, wildlife and birds, stormwater and so on.

Faecal material can also contain pharmaceuticals — anti-bacterials and hormones — given to some dairy cows to fight disease and promote growth. (Health Canada 2013).

3.3 Water quality monitoring

Analysis of the raw water sampled from the Muller property between 1999 – 2005 (Traill 2007) shows:

- Turbidity levels exceeded guideline levels only once however it is unlikely the sampling program is accurately capturing the extent;
- Nitrate levels exceeded the guideline value 80% of the time although this was falling as dairy farms converted to beef;
- Ammonia levels exceeded the guideline value 95% of the time;
- Phosphate levels exceeded the guideline level 9% of the time although this is likely to be higher in reality as phosphates attach to sediment and turbidity levels have already been identified as unusually low;
- Total phosphorus levels exceeded the guideline level 84% of the time; *and*
- Faecal coliforms exceeded the guideline level 87% of the time.

3.4 Objectives

The implementation of the planned activities will reduce threats to catchment water quality by:

- reducing erosion of the bed and banks of Walkers Creek reducing turbidity and sedimentation;
- reduce direct faecal deposition (nutrients and pathogens) to Walkers Creek;
- minimise erosion of laneways and the delivery of sediments to the properties watercourses;
- improve livestock management (important for gaining landholder acceptance);
- build land manager engagement (previously unengaged high priority property – see *Priority Landholders: 2015-16 Annual Investment Strategy*); *and*
- provide a base for ongoing activities under proposed Seqwater Dairy Best Practice Program *(2016-2018).*

Baroon Pocket Dam in September 2013 (storage remained closed for almost 12 months). Cyanobacteria blooms disrupt recreational use of the storage and create difficulties in the production of potable water.

3.5 Priority actions for Walkers Creek (AquaGen 2004):

1. Provision of advice, encouragement and incentives to landholders to maintain adequate riparian buffers and erect riparian fencing and manage stock access to waterways. This includes the provision for off stream watering, shade and hardened waterway access points and livestock laneways.
2. LBCCG in partnership with AquaGen (Seqwater) and Sunshine Coast Council control Salvinia (*Salvinia molesta*) infestations and seasonal outbreaks.
3. LBCCG, residents and Sunshine Coast Council address the untreated stormwater run-off from residential developments approved under previous planning schemes (notably Avocado Lane).
4. Reduce faecal counts within the Walkers Creek catchment by targeting education programs to residents to address existing on-site effluent and wastewater disposal systems and their maintenance requirements.

4.0 HOW

(How will the activities be implemented)

4.1 – Stream crossing

Effective crossings are essential for safe negotiation of watercourses for livestock, vehicles and people. Crossing design can vary greatly but due to the hydrology and topography of the Lake Baroon catchment the low level crossing is usually the ideal design. One suitable crossing will be constructed on Walkers Creek allowing vehicle and livestock passage.

Low level crossings sit at bed level and therefore provide little to no obstruction to water flow and are therefore unlikely to be damaged by floods and/or debris. Furthermore they do not greatly obstruct aquatic passage – relative to natural obstructions commonly found throughout the catchment.

Constructed with reinforced concrete the expected useful life of these crossings are anticipated to be at least fifteen years but more likely 20 years, resulting in these crossings being very cost effective.

4.2 – Laneway rehabilitation

Maleny Dairies have leased the Muller property, an ex-dairy farm that converted to beef production in around 2000. Maleny Dairies will continue to use their milking facility however there are no laneways between the two properties. Therefore an entirely new laneway is required to enable efficient movement between the two properties (approximately 1,300 metres) and the rehabilitation of a further 600 metres of degraded laneway (part of the old Muller dairying).

New laneways require stripping of the layer of grass and soft topsoil, profiling of the soil to ensure run off and digging of drains to channel water away from the laneway. Locally sourced road-base which has a mixture of variable sized stone and sufficient clay to bind the stone when compacted is laid at a compacted thickness of 150 mm.

A grader is necessary to achieve the correct profile and on steeper sections (and near watercourses) diversion banks (whoa-boys) are inserted into the laneway to ensure run off is diverted to pasture areas and not permitted to flow directly to watercourses. Additionally this will prevent erosion of the laneway surface.

It is essential the road-base is compacted with a suitable heavy roller while sufficiently damp to achieve adequate compaction. Compaction using tracked earthmoving equipment is not acceptable.

New laneway alignment

5.0 WHEN

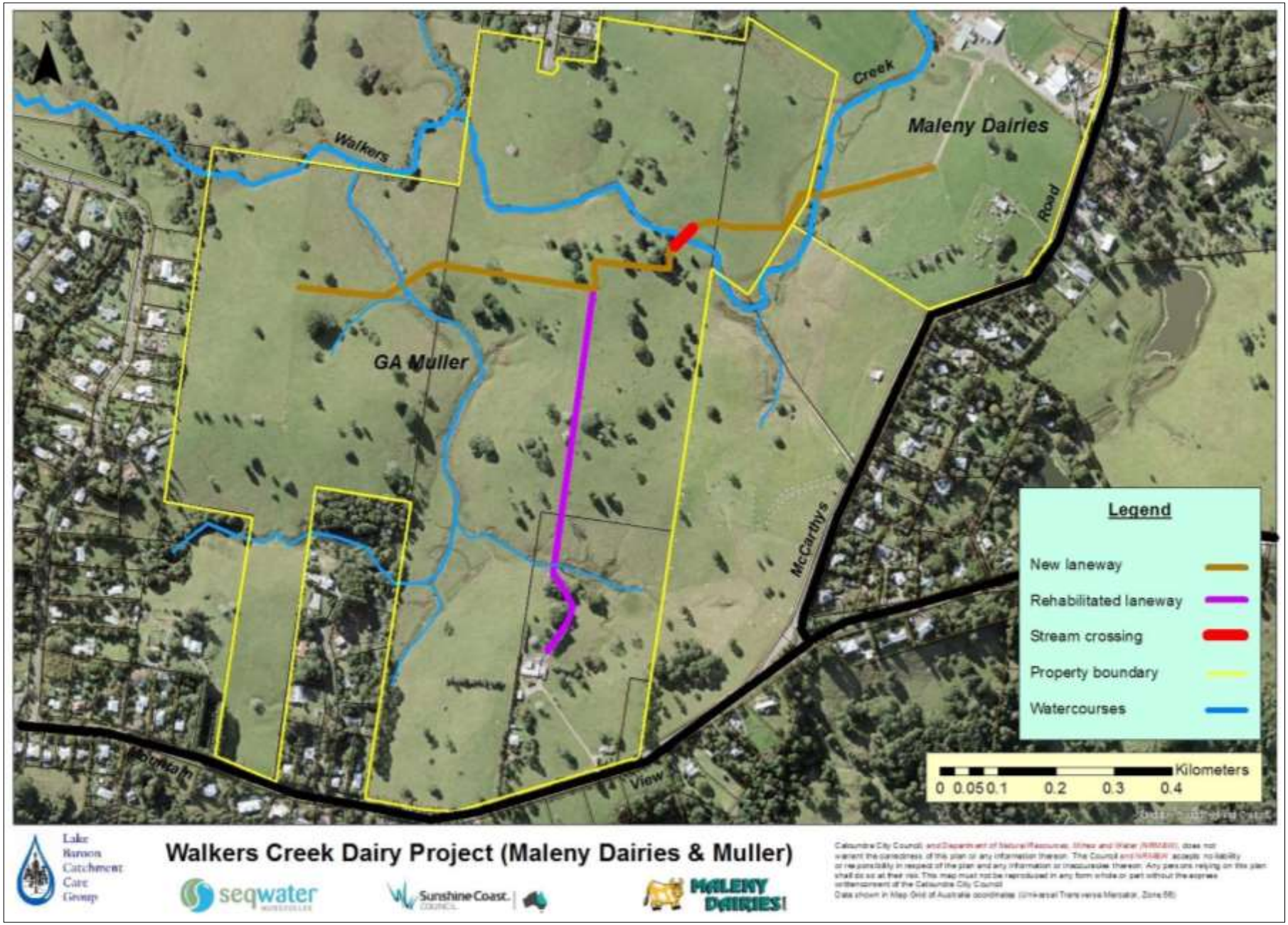
(When will the activities be implemented)

The leasing of the Muller property to Maleny Dairies occurred extremely quickly. Therefore the project was not identified in the 2015-16 Annual Investment Strategy. However it is critical LBCCG (and Seqwater) treat this project as an 'emerging' opportunity and support both landholders.

It is essential LBCCG with the support of Seqwater are involved in the changing of land use as delay will result in less than optimum activities (stream crossing and laneway construction) by the lessee who will be constrained by budget and could result in poor installation techniques and subsequent poor water quality outcomes. Additionally LBCCG will be in a good position to influence the next stage of activities – such as the fencing of watercourses etc.

Consequently this project has urgency with the need to commence on ground activities before December 2015. However as per ALL LBCCG projects, completion of activities is weather dependent. We will not compromise the quality of the completed work by adhering to inflexible financial deadlines.

6.0 MAP


Walkers
Creek
Maleny Dairies
Road
GA Muller
McCarthys
View
Legend
New laneway
Rehabilitated laneway
Stream crossing
Property boundary
Watercourses
Kilometers
0 0.05 0.1 0.2 0.3 0.4
Lake Baroon Catchment Care Group
Walkers Creek Dairy Project (Maleny Dairies & Muller)
seqwater
Sunshine Coast.
MALENY DAIRIES

7.0 BUDGET

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.au for further information

PART C ATTACHMENTS

1.0 PROJECT RATIONALE

1.1 INTRODUCTION

In an ideal world, all waterways in the Lake Baroon catchment would be rehabilitated to provide riparian buffers and provide suitable habitat for aquatic ecology. However the limited resources available means the catchment must be prioritised into areas where the greatest gains can be achieved through the smallest investment. We cannot realistically completely restore cleared riparian zones to pre-European conditions, but we can improve the ability of the zone to maintain the quality of water delivered downstream.

Baroon Pocket Dam. Although the dam and immediate surrounds are owned and managed by Seqwater, the vast majority of the catchment is privately owned. To influence land management that reduces the risk to water quality in the storage, Seqwater must engage the community. The most effective method to do this is work with existing community groups. (Photo: Dan Garcia, Seqwater)

An estimated 80% of sediment and 35% of nitrogen in the waterways in south east Queensland comes from non-urban diffuse loads; sources such as unmanaged livestock grazing. Reduction of these loads clearly represents a major target for action if significant improvements in water quality are to be achieved in South East Queensland (DERM 2010).

Maintaining a healthy riparian system is essential for a productive landscape. When a riparian area is healthy it contains lush, thick vegetation, providing habitat for wildlife and aquatic species, maintains stream bank stability, influences morphology and provides shade which in turn lowers water temperatures and increases the oxygen carrying capacity of the stream. Additionally, riparian vegetation filters, utilizes and stores nutrients, thus preventing them from entering water systems. Weed invasion is an indicator that the riparian system is in decline and has the potential to alter the vegetation structure to such an extent that habitat and water quality outcomes are threatened.

The Lake Baroon Catchment Implementation Plan (2007) prioritisation of sub-catchments for works is effective and useful for rehabilitating waterways in the catchment through traditional fencing and revegetation but does not adequately reflect the nutrient and sediment inputs to the waterways through land use, particularly intensive dairy and beef grazing (Dunstan 2007). This method follows traditional 'bush restoration' techniques where sub catchments that are in the best condition that require minimal intervention to realise improvements. However an example of this theory and its application in the Lake Baroon catchment would result in the largely protected, Sunshine Coast Council managed and natural Mary Cairncross Park sub catchment receiving the highest priority for works.

1.2 STREAM CROSSINGS

Formalised crossings protect livestock and watercourses from the issues associated with unrestricted access. The benefits include (Water and Rivers Commission 2000):

- improved water quality by limiting sedimentation and nutrient enrichment;
- enhanced livestock health through access to cleaner water;
- reduced loss of productive land and livestock deaths;
- provision of a relatively cheap option for providing livestock watering;
- maintaining river pools to provide a water source that is available for longer periods of year;
- stabilisation of the river banks and bed; *and*
- improved riparian vegetation and riverine habitats.

Crossings can be designed to provide many other ecological benefits such as (Water and Rivers Commission 2000):

- having a riffling effect which aerates the water and provides a variety of riverine micro-habitats;
- allowing for aquatic passage;
- maintaining stream pools that are important in providing summer refuges and breeding areas for certain aquatic animal species, such as platypus, fish and crayfish; *and*
- contributing to channel stability by controlling the velocity of flow and reducing the downstream movement of sediments.

Low level concrete crossing construction

Installation of a stream crossing will reduce risks to water quality, reducing nutrient, sediment, pathogen, and organic matter loads to streams. A formal crossing will also reduce streambank and streambed erosion. Stream crossings can provide cattle with improved access to pastures thereby improving grazing distribution while reducing the likelihood that cattle will be injured. Stream crossings also improve vehicle access for weed management, pasture improvement, erosion management and other activities that influence the quality of water flowing off properties. Stable stream crossings can help prevent farm equipment damage by providing a smooth entrance and exit.

A good crossing is one that serves the purpose for a long time and requires minimal maintenance. The design must allow for a range of flow conditions and sustain as little damage as possible when flooding occurs. It is also essential to ensure that the crossing will have negligible environmental impacts.

Other than providing access across a stream for people, vehicles and livestock, a well-designed crossing provides environmental benefits. Restricting crossings to one point will greatly reduce local erosion and protect riparian vegetation from stock; further stabilising stream banks, and can greatly assist in managing nutrient input to the stream system (Janicke & Murray 2008).

1.3 LANEWAY REHABILITATION

An estimated 80% of sediment and 35% of nitrogen in the waterways in South East Queensland come from non-urban diffuse loads. Dairy farms are an intensive form of agriculture with high levels of livestock movement (to and from the milking facility) and therefore have significant impacts on property laneways.

Poorly designed or constructed laneways are prone to erosion. The farm environment is greatly improved by hardening laneways, not only because erosion is minimised but also cows tend to move faster between

Laneway construction utilising locally sourced road base

paddock and dairy resulting in less manure deposited on laneways and therefore reduces the risk of faecal material entering drainage lines and watercourses. Rehabilitated laneways significantly reduce erosion in high stock traffic areas resulting in less sediment run-off. Carefully designed laneways are shaped with strategic cross drainage (whoa-boys) to shed water to the sides (onto pasture) and direct run-off contaminated with faecal material (nutrients) to

pasture that can trap and filter nutrients, rather depositing directly to watercourses.

Laneway construction

Mud from boggy laneways pose health risks for the dairy herd and for raw milk and must be washed from udders before milking, requiring increased labour and water use. Boggy laneways increase the time taken (and energy expended) to travel between the paddock and dairy (for cows and vehicles). Poor access to grazing pastures, particularly during wet periods, limits efficient pasture use which can have a detrimental effect on run-off (overgrazed paddocks increase nutrient and sediment run-off).

Mastitis can be significantly reduced when dairy cows have reduced contact with mud and contaminated water (such as natural water bodies). Mastitis in dairy cattle is the persistent, inflammatory reaction of the udder tissue. Milk from cows suffering from mastitis has an increased somatic cell count and usually occurs in response to bacteria invading the teat canal.

2.0 PROJECT LOCATION

2.1 BACKGROUND

Lake Baroon is situated on the Maleny Plateau in the headwaters of the Mary River, located inland from Sunshine Coast approximately 13 km south west of Nambour and 7 km North East of Maleny. Obi Obi Creek forms both the primary inflow and outflow of the dam. Walkers, Falls, Bridge, and Elston Creeks constitute the remaining significant creeks within the catchment providing water to Lake Baroon. The catchment encompasses an area of 74 km^2 (including the dam surface).

2.2 THE WALKERS CREEK CATCHMENT

Walkers Creek is the most disturbed and polluted waterway in the Lake Baroon catchment, consisting of 15 km of waterway in a sub catchment of 697 ha. Less than 10% of the sub catchment is covered in vegetation, with much of the area significantly disturbed mostly supporting beef or dairy cattle (Dunstan 2007).

The Walkers Creek catchment has a high proportion of rural residential properties with associated wastewater systems, roads and stormwater infrastructure – all likely contributing to the poor water quality results.

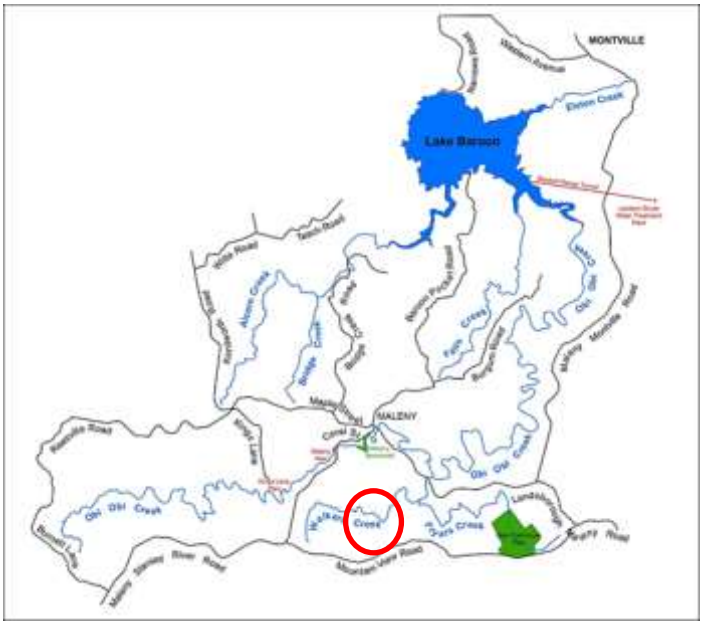
Walkers Creek (including its tributary Fryars Creek) has been divided into four Management Units that reflect property boundaries, physiography, vegetation, land use and point and diffuse pollution sources. This provides administrative convenience and the ability to prioritise stream zones more accurately according to various threats.

Walkers Creek on Maleny Dairies. This is largely typical of the MU – little to no riparian vegetation.

The proposed project is located within Management Unit WA1. This MU is 340 ha in size and has 8 km of significant waterways.

Riparian vegetation is virtually absent alongside the waterway length, and what is present is largely degraded by environmental weeds.

2.3 LOCATION MAP



The Harris property is located in LBCCG Management Unit WA1 which lies in the mid to lower reaches of Walkers Creek. This MU is a significant contributor of nutrients primarily due to land use and the lack of vegetation remaining – particularly riparian vegetation.

2.4 CATCHMENT REVIEW

2.4.1 Background

Since the arrival of European Settlers, Lake Baroon and its catchment area have undergone significant change. Timber operators first settled in the region in 1853 and selectively cleared the best timber from the area. Following the removal of the most valuable timber (1906), the majority of remaining vegetation was cleared for beef and dairy cattle (1918) (Dunstan, 2007).

As a result riparian zones have been irreparably impacted such as:

- vegetation fragmentation (as a result of clearing);
- increased erosion and sediment loads due to clearing and land use practices;
- changes to hydrology and water quality;
- altered natural processes such as grazing and urban development;
- introduction of foreign fill materials; *and*
- introduction of weeds, exotic plantings and exotic fauna.

2.4.2 Geology, soils & stability

The geology of the Maleny plateau is dominated by basalt lava flows occurring between 31 and 25 million years ago (MYA). However there are several other significant geological formations that influence the catchment – particularly soil type and consequently vegetation and stability.

The oldest rocks visible on the plateau are known as the North Arm Volcanics and originated somewhere in the North Arm region around 210 MYA. Multiple lava flows consisting of andesite and dacite to rhyolite form the northern bank of Lake Baroon and are visible in the lower reaches of Bridge Creek where erosion has exposed them. Rhyolite is very hard and resistant to erosion evidenced by the Narrows where the Obi Obi Creek was forced to cut a narrow gorge through (and where Baroon Pocket Dam wall was constructed). The North Arm Volcanics underlay the entire Maleny plateau and extend as far south as the Glasshouse Mountains. Between 210 and 180 MYA the North Arm Volcanics 'sagged' into broad depressions that were subsequently filled with sediment, forming the deep

Landsborough Sandstone formation (Willmott 2007). Other geological formations in the catchment include small areas of Cedarton Volcanics – visible in the upper reaches of Obi Obi Creek; andesite rock that produces lighter coloured moderately fertile soils; and an area of Amamoor Beds – 315 MYA of hard meta-sediment rocks that were historically folded and steeply inclined exposed at Howells Knob. Composed of quartzite, these rocks weather to variable cream or yellow soils. Maleny plateau basalts although outwardly appearing very hard have high concentrations of iron which promotes fracturing and therefore can be very prone to erosion. The Obi Obi, Bridge and Falls Creeks have gradually cut channels into the basalt plateau revealing the described layers underneath. The edges of the plateau have also eroded to form escarpments (Willmott 2007).

Soils on the site predominantly consist of basalt-derived red (krasnozem or ferrosol) soils. The bed of the watercourses on the site consists of thin, black alluvial soils that have been deposited by a combination of hill slope (paddock) erosion and gullying. Some sediment is likely having originated from development sites in urban Maleny (historically and currently). The velocity and volume of the Obi Obi Creek however limits sediment deposits forming.

Native vegetation is an indicator of soil types. The vegetation over the site therefore would have originally been consistent with RE 12.8.3 – as evidenced by the existing remnant in Mary Cairncross Park and several small pockets or strips adjacent to the Obi Obi Creek.

The underlying geology of the properties is tertiary olivine basalts. The majority of the properties are composed of kraznozems, characterised by uniformly of gradational red, friable structured clay soils. The soil contains aluminium oxyhydroxides and iron with the soil having considerable capacity to absorb and retain phosphate.

However, clay soils erode easily and tend to reach their infiltration capacity faster than other soils, promoting overland flow. A potential consequence is that both bound and unbound nutrients will enter the watercourses via erosion and runoff (Lake Baroon Catchment Management Strategy & Caloundra City Council 2007).

Studies by the University of Queensland in the catchment however indicate the exclusion of livestock and revegetation rapidly reduces compaction and improves infiltration (Gageler et al 2014).

2.4.3 Catchment land-use

Despite the extensive clearing, 17% of the Lake Baroon catchment is still heavily forested; a significant proportion in the immediate area around the dam, although much of this is degraded by environmental weeds. Today, the catchment is susceptible to impacts associated with an increasing diversity of land use (Keys 2009).

The area closest to the lake is popular with “tree changers” and has seen land use change from intensive grazing to smaller rural residential properties. This has resulted in the fragmentation of larger tracts of agricultural land into smaller parcels with a large increase in the number of on-site wastewater treatment systems in the catchment (Keys 2009).

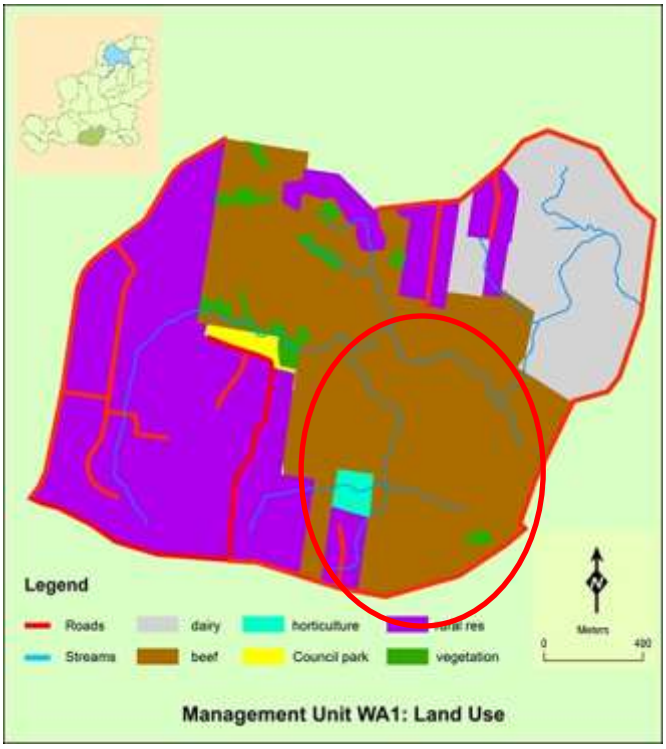
Presently the catchment is susceptible to a number of land use impacts (Traill, 2007; Dunstan, 2007) including:

- Poorly managed dairying and cattle grazing;
- new developments and increased stormwater runoff;
- runoff from impervious surfaces of existing developed areas;
- irrigation of treated effluent associated with the Maleny sewage treatment plant;
- uncontrolled stock access to the lake and its tributaries;
- lack of riparian vegetation and integrity – a result of extensive vegetation clearing;
- abundance of weeds – shift in land ownership from land managers (e.g. farmers) to inexperienced residents has potentially led to the spread and proliferation of weeds (including emerging weeds); *and*
- varying pollution sources related to increased population.

2.4.4 Land-use in Management Unit WA1

Land use in the Management Unit is split between beef grazing (41% of the management unit), rural residential properties (40% but increasing), dairying (15% - dramatically reduced over last 15 years), small area of horticulture (less than 1%) and minimal vegetation

(1%). Soils are suited to agriculture including grazing but the proximity to adjacent Maleny (and associated urban sprawl) and the spectacular views of the Glasshouse Mountains along Mountain View Road has led to high demand for smaller residential blocks.



Land use in MU WA1 is a mix of beef grazing, increasing rural residential and declining dairying.

The Maleny Dairies land parcel (adjacent to the Harris property) is the sole remaining dairy within the Management Unit (and Walkers Creek catchment) although the long term future is assured due to the value adding of dairy products through the associated milk bottling plant. Due to its relatively small size and gentle slopes, the property was virtually completely cleared (at least the land within MU WA1) with only a few scattered mature native trees remaining.

2.5 MULLER PROPERTY REVIEW

2.5.1 Land use and property management

The property is a large, highly productive parcel of land with no major management issues (stability, steep slopes etc) with the only minor concern a moderate area of seasonally wet 'swamp' that has formed by sediment build up. Originally a viable dairy, in the early 2000s dairy deregulation contributed to the cessation of dairying and conversion to beef grazing. Although dairying is considered the highest risk to water quality in the catchment, beef grazing has the potential to yield poor water quality outcomes as inputs are reduced resulting in less livestock management which can result in poorer ground cover, overgrazing, soil compaction and heavier grazing of and within riparian zones. As young stock are most likely to shed pathogens it is best practice to limit their access to, or near watercourses.

With the retirement of Gavin Muller the entire property has been leased to Maleny Dairies and once again will be utilised for dairy grazing. This provides the opportunity for LBCCG (and Seqwater) to have a greater influence in the management of the property and ability to influence water quality outcomes.

2.5.2 Hydrology

2.5.2.1 Drainage Lines, Watercourses & Wetlands

The natural drainage lines of the property flow directly into the Walkers Creek, which flows into Baroon Pocket Dam, the region's principal water supply and major recreational and scenic resource. The majority of these drainage lines have no woody vegetation present but currently have a good coverage of grasses which assists in slowing flows and filtering sediments and pollutants.

There is no fencing on either Walkers Creek or other drainage lines on the property. Despite this all watercourses have a dense coverage of pasture grasses and the lack of steep banks results in stable bed and banks. It must be noted however that Gavin Muller operated an exceptional farm and with the change in management could result in a change in conditions.

2.5.2.2 Flooding

Flooding is of minor concern as the property is high in the catchment and would rarely flood to the extent to cause major issues such as erosion etc. The change in land use and management however may impact on flooding and flooding damage.

2.5.3 Environmental Factors

2.5.3.1 Significant Vegetation & Ecosystems

The Muller property is devoid of any significant vegetation. Originally the property would have supported rainforest (RE12.8.3 – Complex notophyll

vine forest) such as found in nearby Mary Cairncross Park. It is unlikely there will be any possibility of re-establishing native vegetation on the creek banks.

2.5.3.2 Flora, Fauna & Corridors

Currently there is limited opportunity to establish wildlife linkages and corridors as downstream lies Maleny Dairies which are unlikely in the future to entertain significant revegetation; similarly the upstream Muller property will have little opportunity for environmental plantings. Nevertheless the Muller property does still support mature isolated remnant trees which still play an important role as 'stepping stones' for bird species.

Walkers Creek virtually devoid of any native vegetation. There is however a good coverage of pasture grass protecting the banks.

3.0 PURPOSE, OBJECTIVES & OUTCOMES

3.1 BACKGROUND

A healthy aquatic ecosystem is stable and sustainable; maintaining its physical complexity, biodiversity and resilience. It has the ability to provide ecosystem services that in turn contributes to good water quality, wildlife habitat and recreation.

Riparian areas are the transition zones between land and water environments. They are generally more productive in terms of total biomass than the adjoining area (which contributes to their clearing) and are critical for biological diversity. The protection, enhancement and rehabilitation of riparian zones is essential for sustainable catchment management and reducing risks to water quality.

3.2 WATER QUALITY

The environmental health of the Lake Baroon catchment is considered generally poor, and in some respects declining. A State of the Rivers Assessment (Johnson, 1996) indicated that significant sections of the waterways appear to be in moderately poor condition, with moderately to highly disturbed reach environs and considerable lengths of unstable banks and bed-streams. These were characterised by lack of native vegetation displaced by clearing, grass banks or exotic vegetation (Keys 2009).

Pollutants entering Walkers Creek occur from three main sources:

- Diffuse run-off from traditional grazing practices provides nutrient inputs (animal manure and fertiliser application) and sediments from paddock erosion;
- Urban run-off carries nutrients derived from fertilisers, car washing, heavy metals and hydrocarbons from road run-off, litter and organic matter; *and*
- There is also the potential for sewer overflows (from the urban sewer system and individual wastewater treatment systems such as septic tanks) with high nitrogen, phosphorus and pathogens.

The sheer volume of excrement produced by cattle, horses, and to a far lesser extent other domestic animals, when in large herd sizes renders them significant contributors within an open drinking water catchment. Reducing connectivity (paddock to stream), through the management of riparian fencing and revegetation, would reduce the likelihood at almost all of the sites identified as high likelihood (pers. comm. A. Smolders 2012).

Less than 10% of the sub-catchment is vegetated; with minimal length of waterways supporting riparian cover of varying quality (mostly poor). The MU contributes a large nutrient load to Bridge Creek, with more than 98% of samples exceeding guideline levels (Dunstan 2007). This is most likely due to the number of rural residential properties combined with intensive grazing although the area utilised for dairying has dramatically reduced since 2007 (fall from 66% of the MU to 15%). Recent water quality sampling is not available but it is suspected there has been little improvement and most likely a deterioration as rural residential properties have increased and diary grazing converting to beef grazing is high risk due to the sharp reduction in investment (pasture management, erosion etc). The MU is noted for its poor water quality but this is probably exacerbated by the fact there is minimal riparian vegetation to filter nutrients originating in the catchment.

The Lake Baroon Catchment Implementation Plan (2007) rates WA1 a MODERATE priority for rehabilitation works. When assessing the Management Unit using a modified version of the Prioritisation Process, which prioritises MU's on pollution input levels and land instability parameters, WA1 rates as HIGH; due to the contribution of nutrients and potentially pathogens to Walkers Creek.

Analysis of raw catchment water quality data (and targeted sampling and analysis) suggests that the Obi Obi Creek downstream of Maleny plays a significant and important role of improving water quality before it reaches Lake Baroon. It has been suggested this is due to a combination of dilution, aeration and vegetated riparian buffers over a considerable length of waterway. Therefore any activity that enhances the riparian buffer is likely to benefit raw water quality before it enters the storage (pers. comm. Peter Pollard, Griffith University 2013).

3.2.1 Statistical Analysis of the Raw Water Quality Data Recorded from Upstream Muller's 1999-2005

Parameter	*pH (pH units)*	*Turbidity (NTU)*	*NOx (N) (mg/L) (NITRATES)*	*NH3 (N) (mg/L) (AMMONIA)*	*PO4 (P) (mg/L) (PHOSPHATE)*	*Total P (mg/L) (TOTAL PHOSPHORUS)*	*Faecal Coliforms (number/100 mL)*
Guideline Value	*6.5-8.2*	*<25.0*	*<0.040*	*<0.010*	*<0.030*	*<0.030*	*<100*
Max	7.0	44.0	1.080	0.870	0.046	0.264	38,000
Min	6.2	2.4	0.018	0.001	0	0.011	30
Mean	6.6	9.5	0.179	0.106	0.008	0.065	3629
Median	6.6	6.6	0.110	0.051	0.005	0.054	340
Std Dev	0.2	7.4	0.194	0.154	0.012	0.046	8986
20th Percentile	6.5	4.7	0.044	0.030	0.000	0.034	130
80th Percentile	6.8	13.5	0.260	0.142	0.008	0.079	1148
Count outside GV	**6**	1	35	42	4	37	39
% outside GV	**13.33**	**2.22**	**79.55**	**95.45**	**9.09**	**84.09**	**86.67**

The raw data shows significant levels of Nitrates, Ammonia and Total Phosphorus and a concerning level of Faecal Coliforms which is consistent with land use on the property and upstream (grazing and non-sewered residential. Best practice management involves excluding stock from riparian zones and improving land management practices.

Note: The routine sampling programs (CalAqua, AquaGen, Seqwater and others) are suspected of not accurately capturing major pollution events. Conducted monthly (1992 – 1998) or bi-monthly (1999 – 2005), significant rainfall events in the catchment have likely been missed with the data collected over-estimating the catchment's water quality (Traill, 2007).

Muller monitoring point. The property changed from dairying to beef during the sampling period however there was little change in water quality. Note the lack of riparian vegetation and fencing.

Hoppers Crossing No. 2 monitoring point. The property remains a dairy but LBCCG has been active on the property implementing activities to reduce risk to water quality.

Livestock in waterways are high risk to water quality.

Excessive erosion and nutrients delivered from the catchment contribute to cyanobacteria (algae) blooms in Lake Baroon.

3.3 WATER SUPPLY CATCHMENT

The Harris property is within the Lake Baroon Pocket Dam Catchment. Walkers Creek (697 hectares) comprises one of Lake Baroon's three major sub-catchments. Consequently it is the major supplier of total water to the dam.

Baroon Pocket Dam (BPD) is a key source of water supply for Seqwater. Minimum flow volumes from BPD through the Northern Pipeline Interconnector (NPI) northwards are 7 ML/day (subject to availability if BPD falls below 60% capacity) to Noosa NTP; and 30 ML/day (20 ML/day if BPD falls below 70% capacity) southwards to Caboolture, Morayfield and Narangba. This indicates both surety of supply, location and cost effectiveness of Landers Shute Treatment Plant (AOP 2013).

BPD, along with Image Flat (South Maroochy System) is the predominant source of water supply for northern South east Queensland with Ewan Maddock Dam (EMD), Lake McDonald and Mary Valley Water Supply Scheme considered additional intermittent sources (AOP 2013).

EMD operates on an as needed basis, typically during high demand periods or when raw water quality in BPD is compromised by algal blooms (and possibly turbidity). EMD, relative to Landers Shute (LSTP) is more expensive to produce potable water (despite its recent construction), hence the reliance on BPD and LSTP (AOP 2013).

It's important to note that the NPI (and all pipelines for that matter) require minimum transfer flows at all times

to maintain operation and water quality. Typically this is a minimum of 5 ML/day (AOP 2013).

BPD is a reliable source of raw water (volume) but is plagued by quality issues. These issues were somewhat expected when BPD was constructed and hence the design of LSTP, however demand for supply was never intended beyond the southern half of the Sunshine Coast region.

The value of the raw water that originates in the catchment as a whole greatly exceeds the value of primary production.

Lake Baroon catchment	= 74 km^2 or 7,400 hectares
Gross yearly value of water sold by Seqwater (Saxton et al, 2013)	= $60,000,000
Value of water per hectare	= $8,108 per hectare
Area of the Muller property	= 74 hectares
Gross value of raw water originating from the property	**= $599,992 annually**

Tourism has become the dominant economic driver in the catchment but relies on both the agricultural landscape (rolling green hills) and natural values equally. This is demonstrated by the popularity of Maleny Dairies milk processing plant and farm tours (in excess of 20,000 visitors per year; pers. comm. Keith Hopper) and the popularity of Mary Cairncross Park (300,000 visitors per year?).

Seqwater who receive the benefits of raw water flowing from the catchment into BPD, have an obligation to invest back into the catchment if water quality improvements are desired; into activities that reduce risks to water quality and its maintenance and protection, and broad environmental health.

The likely scenario under climate change modelling suggests more variable and possibly severe weather events; longer and more severe droughts (below average rainfall per month) and more intense rainfall events.

This will undoubtedly impact on both raw water quality entering BPD and on the storage itself. Since 2009-10 unseasonal dry periods followed by intense high rainfall events have seen an increase in erosion (reactivation of land slips), turbidity and flood damage.

The community expects good water quality at their tap – free from discolouration, odours and the guarantee it will not impact their health, and increasingly demands the environment is protected as part of supply.

3.4 OBJECTIVES

Walkers Creek Riparian Program (Harris) is designed to reduce the impacts of livestock access on a major watercourse. Although the water quality benefits are not expected to be significant, the project is addressing a high priority issue in this part of the Lake Baroon catchment – that is livestock access to, and impacts on watercourses. The project is directly addressing the issues and risks associated with the production of a safe water supply to the Sunshine Coast and beyond. However the project provides far broader environmental benefits that increasingly the community demands and expects.

The project aims to:

- implement an on-ground project that delivers water quality benefits;
- promote integrated catchment management in the Lake Baroon catchment;
- reduce nutrient delivery to waterways;
- reduce sediment delivery to waterways;
- improve aquatic habitats;
- raise community awareness (including water quality issues);
- support and work cooperatively with like-minded community organisations;

- reduce the impact of weeds (through the enhancement of remnant and regrowth vegetation);
- restore links between vegetation and re-establish corridors;
- contribute to the conservation of threatened species;
- contribute to climate change adaptation; *and*
- demonstrate best management practice of riparian zones.

Effective riparian areas can improve water quality by trapping sediment, reducing erosion, storing nutrients and filtering contaminants before they reach water storages (Lake Baroon). Riparian zone health is a key factor in a riparian area's ability to improve water quality.

3.5 OUTCOMES

Healthy catchments lead to healthy waterways. By improving the health of riparian zones we ultimately aim to mitigate the impacts that can affect water quality. Seqwater provides generous funding and LBCCG offers appropriate incentives to landowners to implement activities that are designed to reduce risks to water quality. Through the prioritisation and implementation of riparian protection and rehabilitation throughout rural catchments – we provide multiple beneficial outcomes.

Outcomes are the 'end product' of our activities – what we actually achieve. It can be very difficult to measure outcomes as they may take many years to be fully realised and can be enormously expensive to quantify – potentially far more than the actual implementation of the project. We must rely on best management practice, anecdotal evidence and ideally partnerships with universities and/or Seqwater to produce 'hard' data to prove the effectiveness of projects.

Our project will:

1. **Reduce pathogen delivery to waterways.**
   Managing livestock in riparian zones reduces the volume of faecal material reaching waterways.

Properly constructed laneways direct run-off contaminated with faecal material (and associated pathogens) onto pasture areas where it can be trapped and filtered before reaching waterways.

2. **Reduce nutrient delivery to waterways.**
   Nutrient delivery to waterways is continuous and increases during episodic rain events.

Vegetative (pasture) buffers intercept run-off contaminated with excessive nutrients from diffuse rural sources. The project will minimise loss of nutrients to watercourses, remaining onsite to contribute to pasture growth.

3. **Reduce sediment delivery to waterways.**
   Soil from erosion leads to high turbidity and is transported to Baroon Pocket Dam and beyond.

Improved management of livestock movement (laneways and stream crossings) maintain stability of riparian zones and intercept run-off contaminated by sediments.

4. **Improve aquatic habitat.**
   Improved management of sediments, nutrients and pathogens improves instream habitat..

A reduction in turbidity, sediments, nutrients and pathogens will improve water quality and contribute to maintaining in-stream biodiversity.

5. **Raise community awareness.**
   The majority of land in the Lake Baroon catchment is privately owned and without landholder and community support, activities improving catchment health and water quality is impossible.

The project will demonstrate the value and importance of effective livestock management. On-ground works provide the opportunity for land managers to apply their knowledge and experience at the local level whilst contributing to landscape scale outcomes, increasing the skills and capacity of the community.

6. **Contribute to the viability and resilience of agriculture in the Lake Baroon catchment.**
   Primary production, particularly dairying has been in significant decline since 2000.

For long term water quality outcomes it is preferential to work with experienced landholders who understand the region and are skilled land managers. New landholders to the area are often ill equipped to manage land and are high risk to water quality.
For landholders to implement water quality an improvement project there needs to be a cost benefit rather than a burden on available resources. This project provides a win-win scenario where all stakeholders benefit.

3.6 PRIORITY LANDHOLDERS/LAND IN THE LAKE BAROON CATCHMENT

Priority landholders were initially identified in 2007 (updated in 2014) based on land-use, property size, and

proximity to Seqwater infrastructure (Baroon Pocket Dam, Maleny Weir, and King's Lane Weir) and/or their potential to adversely impact on catchment water quality.

The Muller property was identified as a priority due to its size, position within Walkers Creek and land use.

3.7 ALIGNMENT WITH KEY PLANS & STRATEGIES

Reducing the risk to water quality is particularly critical for the supply of bulk drinking water to the population of south-east Queensland. All of the storages managed by Seqwater involve catchments which are developed (to varying extents) and support active and growing communities, along with important industrial and rural economic activity. If these catchments are not managed properly, the risk of exposure to water quality hazards is heightened as development continues and the population increases. As a pre-emptive measure, Seqwater is undertaking initiatives to minimise and manage the risks to water quality in its storages. Identifying and engaging stakeholders on water quality issues is critical to developing robust risk mitigation strategies and achieving good water quality outcomes in the broader catchment (Keys 2009).

The primary area LBCCG (and other community groups) can assist in the management of risk is land use – essentially livestock grazing and the associated key issue of pathogens. A number of factors can contribute to pathogen contribution by livestock. A high likelihood ranking has been attributed by Keys 2009 to any site where the following conditions exist:

- direct animal access to waterways;
- intensive feed lots and dairies;
- heavy broad scale grazing; and
- animal deposition (including bio-solids piles) possible within 50 m of intermittent or permanent waterways.

The sheer volume of excrement produced by cattle, horses, and to a far lesser extent other domestic animals, when in large herd sizes renders them significant contributors within an open drinking water catchment (Baker 2011).

With current control measures in place, water quality is still at high risk from risk sources dominated by land use activities and human access. Key issues in this section include hazards associated with the population growth in the area and the increasing rural lifestyle and urban and peri-urban land uses. Possible future mitigation measures are dominated by improved land management practices, land acquisition (especially close to the dam's edge), reduced access to the dam wall, increased public education and enforcement, as well as monitoring and research (Keys 2009).

The project's objectives and outcomes are consistent with:

- 2015-16 LBCCG Annual Investment Strategy (Lake Baroon Catchment Care Group 2014)
- Lake Baroon Catchment Implementation Plan (AquaGen/LBCCG 2007)
- Lake Baroon Catchment Management Strategy (AquaGen/LBCCG 2004)
- Seqwater Natural Assets Management Plan – Lake Baroon Catchment (Seqwater 2012)
- Sanitary Survey of Baroon Pocket Catchment Report (Seqwater 2014)
- Catchment and In-Storage Risk Assessment for Water Quality – Baroon Pocket Dam (Seqwater 2009)
- Sunshine Coast Council Waterways & Coastal Management Strategy 2011-12 (Sunshine Coast Council 2011)
- Mary River and Tributaries Rehabilitation Plan (Mary River Catchment Coordinating Committee 2001)

4.0 IMPLEMENTATION

4.1 – Stream crossing

Effective crossings are essential for safe negotiation of watercourses for livestock, vehicles and people. Crossing design can vary greatly but due to the hydrology and topography of the Lake Baroon catchment the low level crossing is usually the ideal design. One suitable crossing will be constructed on Walkers Creek allowing vehicle and livestock passage.

Low level crossings sit at bed level and therefore provide little to no obstruction to water flow and are therefore unlikely to be damaged by floods and/or debris. Furthermore they do not greatly obstruct aquatic passage – relative to natural obstructions commonly found throughout the catchment.

Constructed with reinforced concrete the expected useful life of these crossings are anticipated to be at least fifteen years but more likely 20 years, resulting in these crossings being very cost effective.

4.2 – Laneway rehabilitation

Maleny Dairies have leased the Muller property, an ex-dairy farm that converted to beef production in around 2000. Maleny Dairies will continue to use their milking facility however there are no laneways between the two properties. Therefore an entirely new laneway is required to enable efficient movement between the two properties (approximately 1,300 metres) and the rehabilitation of a further 600 metres of degraded laneway (part of the old Muller dairying).

New laneways require stripping of the layer of grass and soft topsoil, profiling of the soil to ensure run off and digging of drains to channel water away from the laneway. Locally sourced road-base which has a mixture of variable sized stone and sufficient clay to bind the stone when compacted is laid at a compacted thickness of 150 mm.

A grader is necessary to achieve the correct profile and on steeper sections (and near watercourses) diversion banks (whoa-boys) are inserted into the laneway to ensure run off is diverted to pasture areas and not permitted to flow directly to watercourses. Additionally this will prevent erosion of the laneway surface.

It is essential the road-base is compacted with a suitable heavy roller while sufficiently damp to achieve adequate compaction. Compaction using tracked earthmoving equipment is not acceptable.

5.0 ACTION PLAN

Activity Start and Completion dates are indicative only and will be dependent on weather conditions.

Action		*Responsibility*	*Start Date*	*Completion Date*	*Measurable Output*
LBCCG Project Plan		LBCCG Project Manager	Nov 15	Nov 15	Project Plan
Project presented to LBCCG Committee for approval		LBCCG Project Manager & Committee	Nov 15	Dec 15	Approved Plan
Project Plan sent to Seqwater for final approval		LBCCG Project Manager	Nov 15	Dec 15	Approved Plan
Pre-works monitoring (including photo points)		LBCCG Project Manager	Oct 15	Dec 15	Photo & data set
IMPLEMEMNTATION	Stream crossing	Contractor, landholder	Nov 15	Dec 15	1 crossing
	New laneway construction	Contractor, landholder	Dec 15	Dec 15	1,300 linear metres
	Existing laneway rehabilitation	Contractor, landholder	Dec 15	Dec 15	600 linear metres
Post-works monitoring		LBCCG Project Manager	Nov 15	Dec 15 ongoing	Photo & data sets
Progress Reports		LBCCG Project Manager	Dec 15	Mar 16	3 Reports
Final Report (LBCCG/Seqwater)		LBCCG Project Manager	Jun 16	Dec 16	Final Report
Further stages		LBCCG Project Manager, landholder	Jul 16	ongoing	TBA

Note – the Project Action Plan will be used as the basis for Monthly Reporting (LBCCG Management Committee meetings)

6.0 PROCUREMENT

6.1 SERVICES & PRODUCTS

The Project Manager will have the authority to engage and arrange payment for services and products for all activities once the Project Plan is approved. Any deviation over $300 from the approved Project Budget requires approval from the Project Committee. Services and products will be sourced locally wherever possible and from not-for–profit community organisations if applicable.

Quotes have been received for the provision of the stream crossing and the laneway construction and rehabilitation.

Service/Product	***Supplier***	***Contact (if applicable)***
Stream crossing	P&K Nash Excavations	Phil Nash
	Sommers Bros. Earthmoving	Ron Sommers
Laneway construction	Maleny Bobcat	Richard Hood
	Sommers Bros. Earthmoving	Ron Sommers

Multiple service and product providers are listed to ensure timelines are met. In the event of a provider being unable to supply the requested service or product an alternative supplier will be selected from the list of preferred suppliers. All suppliers must demonstrate full insurance and liability requirements and that all staff or personnel on site are appropriately trained and/or experienced.

7.0 N/A

8.0 HAZARD & RISK ASSESSMENT (HRA)

LBCCG has a comprehensive Safety Management System that clearly directs all aspects of Projects; Project selection (on the basis of safety), Project development, Contractor and/or volunteer engagement, Landholder expectations and requirements, Project implementation and ongoing Project monitoring and evaluation.

LBCCG adheres to the relevant legislation, policy and standard requirements:

- **AS/NZS Risk Management Standard 4360:1999**
  Establishes and implement a risk management process that involves the identification, analysis, evaluation, treatment and ongoing monitoring of risks.
- **AS/NZS 4084:2001 Occupational Health and Safety Management Systems – General Guidelines on Principles, Systems and Supporting Techniques**
  Provides guidance on the development and implementation of occupational health and safety management systems (OHSMS) and principles, and their integration with other management systems.
- ***Workplace Health and Safety Act 2011*** **(Qld)**
  To prevent a person's death, injury or illness being caused by a workplace, by a relevant workplace area, by work activities, or by plant or substances for use at a workplace.

8.1 ASSUMPTIONS AND LIMITATIONS

Assessment of hazard and risks associated with the project was undertaken as part of the project development process. As a result, the risks and hazards identified are based on existing information about the project at the time of writing, and proposed construction and operational features. Further risks and hazards may be identified in future stages or identified risks could be downgraded or upgraded in terms of the level of risk they pose. Additional mitigation measures as required will be developed and documented in the Implementation Risk Management Plans for the project which will need to remain live documents throughout the relevant project phases. The consideration of natural hazards is based on existing information about the project area including overlay mapping from the former Caloundra and Maroochy Shire Councils (now Sunshine Coast Council). This enables a high level assessment to be made of the risk of natural hazards in the project area, however, detailed modelling or prediction of natural hazards has not been undertaken.

8.2 IDENTIFICATION OF RISKS

Landholder to coordinate Contractors and liaise with LBCCG where required.

Hazards (and related risks) have been identified relating to the three on-ground phases of the project:

1. Stream crossing; *and*
2. Laneway construction and rehabilitation.

The project is believed to be both a safe and efficient livestock management project. All activities and phases present some level of risk however, which can be identified through a HRA so that appropriate management measures can be implemented to reduce or remove the risk.

All site visitors will be provided with a site specific induction. Contractors engaged complete with the LBCCG Project Manager, a *Contractor Field Safety Induction Form* (LBCCG Form No. 007) providing current Insurances, accreditations and acknowledgement of Contractor responsibilities.

9.0 CULTURAL HERITAGE

The Native Title Determination in November 2012 awarded the Jinibara People non-exclusive title of the Maleny area including Baroon Pocket.

The paramount legislation in Queensland, with regard to Aboriginal cultural heritage issues, is the *Aboriginal Cultural Heritage Act 2003*, which states that a person who carries out an activity must take all reasonable and practicable measures to ensure the activity does not harm Aboriginal cultural heritage (the 'cultural heritage duty of care') (Section 23[1]). The Act defines cultural heritage as (S8):

- a significant Aboriginal area or Aboriginal object
- evidence, of archaeological or historic significance, of Aboriginal occupation of an area.

A significant Aboriginal area is 'an area of particular significance to Aboriginal people' because of either or both of the following:

- Aboriginal tradition
- the history, including contemporary history, of any Aboriginal party for the area (S9).

The Act states that it is an offence for a person to harm, remove or possess cultural heritage if the person 'knows or ought reasonably to know that the object is Aboriginal cultural heritage' (S26).

The Maleny area and particularly the Baroon Pocket area have significant cultural heritage values for a long period of time. Items of cultural heritage significance can be discovered anywhere in the catchment however riparian zones are a likely location.

The project will involve two activities that could potentially unearth artefacts:

1. Stream crossing– shallow excavation up to 300 mm within bed, banks and riparian zone of Walkers Creek; *and*
2. Laneway construction – shallow excavation up to 200 mm deep with some excavation up to 400 mm deep where pipes are installed.

All activity locations other than the areas of intact remnant vegetation have been largely disturbed since European settlement (deforestation) and have undergone significant movement of soil layers – particularly the areas to involve earthmoving activities. Visual inspection of the sites before and during activities will be carried out and if artefacts or suspected features are unearthed activities immediately suspended and the relevant representative contacted (Ken Murphy, Jinibara Elder).

10.0 MONITORING AND EVALUATION

10.1 INTRODUCTION

Monitoring and evaluation strategies are essential components of any environmental rehabilitation project. Evaluation is the best way to improve our knowledge about what works, what doesn't and how we can best direct our rehabilitation efforts. Monitoring strategies are key components of the overall evaluation process that allows you and others to learn from the project and assess whether rehabilitation aims have been met.

Furthermore, monitoring results and information will be used to:

1. Raise awareness and encourage further remediation works with priority landholders (primary producers and large landholders in the Lake Baroon catchment).
2. Promote cooperative projects between Lake Baroon Catchment Care Group, Seqwater, Sunshine Coast Council and other Natural Resource Management organisations.
3. Critically examine techniques and methods used throughout the project to continually improve the service to landholders conducting on-ground works in the catchment and improve best practice management.
4. Develop cost-effective strategies and techniques to perform on-ground activities.
5. Continue to develop monitoring and evaluation program that meets the requirements of funding bodies, but also provides the relevant information and feedback to the LBCCG and Seqwater to improve project delivery.

It can be very difficult to measure outcomes as they may take many years to occur or reach the final result and can be enormously expensive to quantify – potentially far more than the actual implementation of the project. We must rely on best management practice, anecdotal evidence and sometimes partnerships with universities and/or Seqwater to produce 'hard' data to the actual effectiveness of the project.

10.2 MONITORING PROGRAM

Monitoring of rehabilitation activities, particularly the LBCCG funded component – the waterway crossing and drainage works will be split into periodic and episodic monitoring.

Periodic monitoring is important to measure the effectiveness of the activities over time and will occur on a biannual basis by LBCCG.

Episodic monitoring will occur following significant storm/rainfall events (or extended dry periods) and will check all the fencing integrity. This may, depending on the severity of the event, be achieved by a phone call to the landholders.

Photo point monitoring will provide valuable evidence of works completion, a record of changes over time, and provide an important assessment tool to evaluate the project.

11.0 REPORTING

Project updates will be provided at monthly LBCCG meetings.

A modified version of the Project Plan (specific financial details and landholder contact details deleted) will be placed on the LBCCG website: www.lbccg.org.au. The project will also be included in the LBCCG newsletter.

Reporting will be ongoing until the monitoring phase of the project is complete (June 30, 2016). Powerpoint presentations presented at LBCCG Management Committee meetings will be converted to PDF and placed on the LBCCG website and forwarded to Seqwater.

12.0 REPONSIBILITIES & ROLES

The Project Manager will be responsible for project implementation, management, reporting, evaluation and general management of the project. Other contributions will be on an as-needed basis and the following register of roles will ensure the project is implemented efficiently, effectively and follow best practice.

Role	***Individual***	***Organisation***
Project Manager	Mark Amos	LBCCG
Project Owner	Peter Stevens	LBCCG (President)
Project Committee	tbc	LBCCG (Management Committee)
	tbc	
	tbc	
Technical advice	Keith Hopper	Landowner
	Gavin Muller	Landowner
	Phil Nash	Contractor
	Amos Saraber	DNRM
	Tim Odgers	Seqwater
	Matt Bateman	LBCCG Project Officer

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