Lake Baroon Catchment Care Group

Working with our community...for our waterways

Projects 2018-19

Pacific Farms Weed Management & Revegetation Stage 1

seqwater WATER FOR LIFE

Sunshine Coast COUNCIL

PROJECT PLAN

Project No. 1819-004

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How to read this Plan

This Plan is split into three sections.

PART A: Executive Summary (pp. 5-6) is a two page brief description of the project and includes summarised details of the stakeholders, budgets, outputs and outcomes.
PART B: Project Background and Previous Stages (pp. 7-9) provides useful background information and summarises projects that have occurred on the property and nearby since 2000.
PART C: Project Plan (pp. 10-30) outlines the implementation of the latest Stage project.

Previous Projects

Several previous projects have been implemented on Pacific Farms. The following Plans may be useful for an improved understanding of the objectives of LBCCG on the property:

1011-005 **Upper Obi Obi Creek Restoration (four year project)**
1415-004 **Farmhouse Macadamias Waterway Crossings & Weed Management**
1516–004 **Mid to Upper Obi Obi Creek Riparian Links**

Confidentiality

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DOCUMENT VERSIONS & APPROVALS

Version	*Date*	*Version/Description*	*Result*
1.0	April 2019	Draft LBCCG Project Proposal completed. Project emailed to LBCCG Management Committee for comments.	n/a
1.0	April 2019	Project Plan will be presented at May LBCCG Management Committee meeting for approval (approved by email by Committee members).	Email approval (to be ratified at May meeting)
1.0	24/4/2019	Project Proposal forwarded to Seqwater for approval (email)	TBD

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PART A EXECUTIVE SUMMARY

PROJECT NUMBER & TITLE: **1819-004 Pacific Farms Weed Management & Revegetation Stage 1**

Pacific Farms Weed Management & Revegetation will be implemented in a moderate priority management unit (upper reaches of Obi Obi Creek) that delivers relatively high levels of nutrients and faecal material to Obi Obi Creek and ultimately Baroon Pocket Dam. Pacific Farms is the third largest property in the Baroon catchment, supports 22,000 macadamia trees and has a long frontage to Obi Obi Creek. LBCCG has been working with Pacific Farms for a long time, establishing buffers on property waterways, rehabilitating stream crossings and implementing weed management. New management approached LBCCG for assistance to expand the areas of native vegetation and enhance existing vegetation (much of it previous revegetation) to provide habitat and food sources for native pollinator insects. Additionally native vegetation, rather than weeds, provides less pest harbour (rats) and encourages a heavier density of predators. The project aims to support Pacific Farms to establish and improve pollinator and predator habitat while reducing risk to water quality by improving stream stability, establishing riparian vegetation and protecting and enhancing remnant vegetation (and threatened species).

APPLICANT/LANDMANAGER DETAILS

Names	Pacific Farms (Manager Johann Oosthuizen)

PROJECT / SITE LOCATION

Property Name & Address	Pacific Farms Maleny, 300 Maleny Stanley River Road, Maleny, 4552
Latitude/longitude	-26.774377/152.827172
RP Numbers (Lot)	SP139505 (1, 2, 3, 4); RP116239 (2)
Property Size	134 hectares
Land-use	Macadamia orchard
Sub-Catchment/MU	Obi Obi Creek OB4
M.U. Priority *(LBCCG IP)*	**Moderate**
M.U. Priority *(Pollution)*	**Moderate**
Water Quality (ANZECC)	More than 70% of samples between 1993-1998 exceeded ANZECC guideline levels (Traill 2007)

PROJECT PARTNERS/STAKEHOLDERS & ROLES

Lake Baroon Catchment Care Group (Seqwater 2018-19 CORE Project Funding)	On ground project implementation **($37,952)**
Lake Baroon Catchment Care Group (Seqwater 2018-19 CORE Administration Funding)	Project coordination, administration, reporting, monitoring & evaluation (**In kind $6,585**)
Pacific Farms	Landowner, labour, cash and in-kind contributions (**$38,200**)
Other	tbd (Sunshine Coast Council and others)

PROJECT DETAILS – STAGE 1 & 2

Start Date	Apr 2019	***Completion***	June 2019	**Duration** (implementation)	1 year
OUTPUTS					
Weed management		1.5 ha	***Drainage (length of stream)***		265 m
Riparian revegetation		1,875 stems	***Native pollinators***		40 hives
OUTCOMES					
Length of watercourse rehabilitated				265 metres	
Area of remnant vegetation enhanced				0.3 hectares	
Priority Property engagement				1 new property	

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 Pacific Farms property lies in a moderate priority sub-catchment (Management Unit) in the Obi Obi Creek catchment – MU OB4. This MU is recognised as being an important trap and processer of pollutants originating upstream from intensive livestock grazing and dairying. This is likely due to Kings Lane Weir and a high coverage of riparian vegetation. It is believed that enhancing riparian zones and improving riparian vegetation wherever possible is complementary to improving farm practices in the upper catchment.

The proposed project aims to complete four components:

Activity	Description	Funded by
Weed management	1.5 ha	LBCCG CORE
Drainage	265 metres	LBCCG CORE
Revegetation	1,875 stems	LBCCG CORE
Native pollinators	40 hives	Pacific Farms

Note: the project was identified as a <u>Preferred Project</u> in the LBCCG 2018-19 Annual Investment Strategy.

PART B BACKGROUND & PREVIOUS PROJECTS

i. INTRODUCTION

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).

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 producing high quality, competitively priced potable water for the Sunshine Coast (and greater South east Queensland) region.

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

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 shared aim of reducing risks to water quality from erosion, nutrients and pathogens and impacts on native vegetation from livestock and invasive species, the activities to install riparian fencing, control invasive environmental weeds and the revegetation of unstable slopes and watercourses are considered sensible to support.

ii. BACKGROUND

The upper Obi Obi Creek catchment has been targeted for major on ground activities (projects) since 2009 as this sub-catchment is recognised as delivering very high volumes of nutrients and other contaminants (the sub-catchment is largely agricultural). Two different approaches have been used in this part of the catchment. Many works or activities have directly targeted the sources of point and diffuse pollution – stream crossings, riparian fencing and laneway rehabilitation for example. Further downstream where there are opportunities to fence and revegetate the Obi Obi Creek riparian zone (Farmhouse Macadamias (now Pacific Macadamias, Kings Lane Weir) large scale revegetation been implemented. These plantings are believed to 'decontaminate' flows as they pass through the system as water monitoring downstream indicate.

The Lake Baroon Implementation Plan (2007) considered this part of the catchment as low to moderate priority for works as it was deemed virtually beyond repair, or at least would require cost prohibitive levels of investment to achieve worthwhile water quality gains. However changes to how catchments are assessed for priority, has resulted in a greater emphasis on areas that are identified as high contributors of contaminants. When this is taken into account the Management Unit (OB4) is considered Moderate Priority (more than 70% of samples taken between 1993-98 exceeded ANZECC guideline levels (Traill 2007). The Management Units upstream of OB4 are considered High priority due to the intensive livestock land uses – dairying and beef grazing.

Pacific Macadamias are the dominant property in the Management Unit but also supports dairy and beef grazing. Of particular note is the presence of Kings Lane Weir and although not an essential part of Maleny's water supply anymore is nevertheless an important aquatic habitat. Perhaps more importantly it is likely (as per water sampling) a significant pollutant trap and processer of nutrients, pathogens and other contaminants.

Macadamia orchard properties are characterised by intensive horticultural practices and land management. Considered to be potentially high risk to water quality, their impacts on the environment and watercourses are complex and proportional to their location in the catchment.

Macadamia orchard properties generally:

- require intensive management with high input costs;
- are large properties that have significant lengths of waterways;
- have sparse ground cover (grass) under the orchard canopy;
- are reliant on the heavy application of fertiliser;
- are reliant on heavy use of herbicides to manage weeds;
- can require regular and intensive use of insecticides;
- have orchard locations often not conducive to reliable production (susceptible to poor weather conditions);
- are often on moderate slopes with trees relatively close to watercourses;
- can have large areas of non-productive areas that require substantial management; *and*
- experience destabilisation of soil through intensive traffic, harvesting and mulching operations.

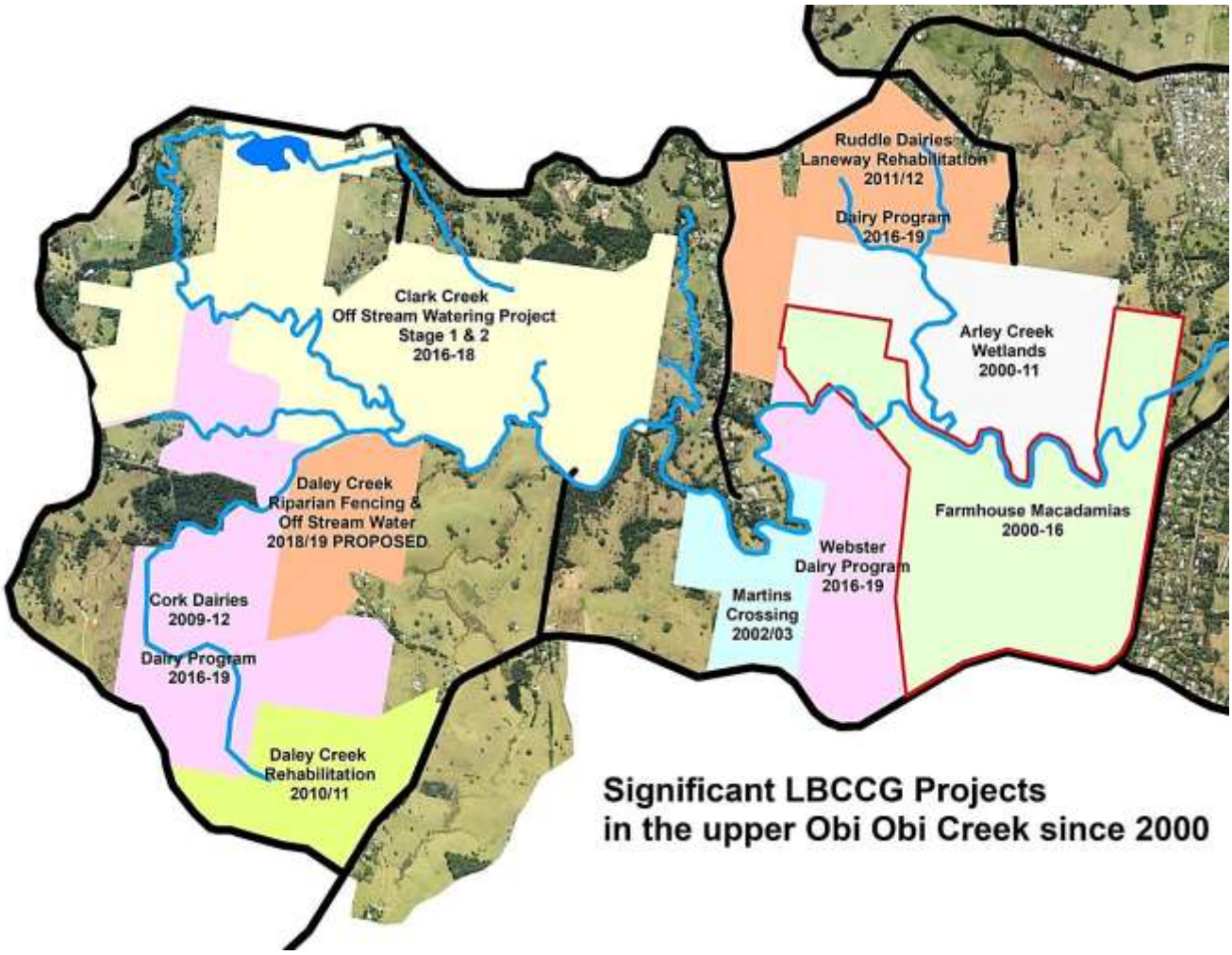
iii. PREVIOUS PROJECTS IN AREA/CATCHMENT

Numerous large projects have occurred in the upper Obi Obi Creek catchment – where large agricultural properties still dominate. Since 2008 there has been a concerted effort made to engage the landholders in this area as the sub-catchment provides high levels of nutrients (including faecal material, fertiliser run-off and other pollutants) and likely pathogens.

Previous major LBCCG projects in the immediate location include:

Project Name	*Years implemented*	*Project outputs*	*Total Project Value*
Martins Crossings (Martin)	2002/03	Stream crossings	$1,337
Daley Creek Rehabilitation (Woods)	2002/03 2010/11	Riparian fencing, stream crossing construction and repair	$36,420
Arley Creek Wetlands (Stevens) and other various projects	2002-2011	Riparian fencing, revegetation, stream crossings, off stream watering and weed management	$102,810
Obi Obi Partnership	2003-06	Riparian revegetation	$114,225
Kings Lane Weir	2005-10	Riparian fencing and revegetation	$21,331
Clark Creek Riparian (Barlow)	2009/10	Stream crossing, riparian fencing and revegetation	$13,197
Cork Dairies (Cork) (various projects)	2009-12	Stream crossings, laneway rehabilitation	$118,135

Farmhouse Macadamias (various projects)	2010-2016	Revegetation, stream crossings and weed management	$128,572
Ruddle Dairies Laneway Rehabilitation (Ruddle)	2011/12	Laneway rehabilitation	$60,729
Obi Obi Creek Fencing and Revegetation (Macleod)	2014/15	Riparian fencing, revegetation and alternative watering	$22,808
Webster Dairy API Program	2016-18	Off stream watering, fencing, laneway rehabilitation	$51,865
Clark Creek Off Stream water Project Stage 1	2016/17	Riparian fencing, off stream watering, stream crossings	$103,594
Clark Creek Off Stream water Project Stage 2	2017/18	Riparian fencing, off stream water, weed management, revegetation, wetland bank repair	$61,686



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. Proposed project property is identified by red border.

PART C PROJECT PLAN

1.0 WHAT

(What activities will be implemented?)

The proposed project aims to complete four components before June 30, 2019 (weather dependent).

Activity	Description	Funded by
Weed management	1.5 hectares	LBCCG CORE
Drainage	265 metres	LBCCG CORE
Revegetation	1,875 stems	LBCCG CORE
Native pollinators	40 hives	Pacific Farms

Project site on Pacific Farms. Note the small remnant to the right and Webster grazing property in background.

2.0 WHERE

(Where in the catchment will the project occur?)

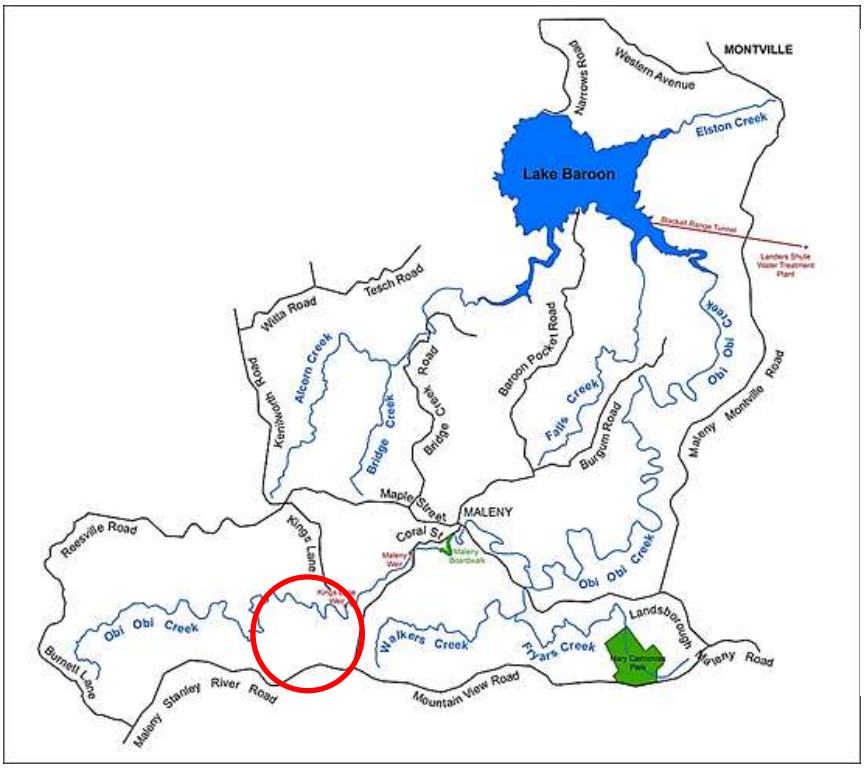
Pacific Farms (previously known as Farmhouse Macadamias) orchard
300 Maleny Stanley River Road, Maleny

Property is approximately 134 hectares – currently comprising the following:

- 106 ha of macadamia orchard (including non-fruiting immature trees);
- 18 ha of mown unimproved pasture (including ephemeral riparian zones);
- 4 ha of regrowth vegetation;
- 4 ha of revegetation;
- 0.4 ha of remnant vegetation (RE12.8.3); and
- 1.6 ha dwellings and sheds;

In addition Pacific Farms has significant frontage to Obi Obi Creek - approximately 2,500 metres. Additionally Pacific Farms currently manages significant area of Council 'esplanade' (12.5 ha) and southern bank of Kings Lane Weir (2.2 ha).

2.1 LOCATION



The Pacific Farms property is located in LBCCG Management Unit OB4. This MU lies in the upper Obi Obi Creek catchment and immediately downstream of intensive agriculture including dairies. The MU with its good riparian vegetation and large storage of water in Kings Lane Weir is likely an important processer of dissolved nutrients and faecal material. Any revegetation of riparian zones and establishment of buffers between agricultural activities and watercourses is likely to reduce risk to raw water quality.

2.2 THE OBI OBI CREEK CATCHMENT

The Obi Obi Creek is the most significant watercourse in the Lake Baroon catchment, consisting of 71 km of waterway in a sub catchment of 2,880 ha. A mere 18% of the sub catchment is covered in vegetation, with much of the area significantly disturbed, mostly supporting beef or dairy cattle; but also including urban Maleny (Dunstan 2007).

Dairy grazing (three farms) remains a significant land use although has been in decline since deregulation in 2000. However, dairying has made a resurgence since 2016 with all local milk being processed by either Maleny Dairies or Maleny Cheese. Beef grazing has replaced dairying as the dominant land use.

Kings Lane Weir on Obi Obi Creek. High nutrient and E.coli loads originating from intensive agriculture in the upper reaches of the catchment have been significantly reduced when flows reach Kings Lane Weir. It is believed riparian and aquatic vegetation to help filter and process raw water contaminants such as nutrients, pathogens and sediment.

2.3 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:

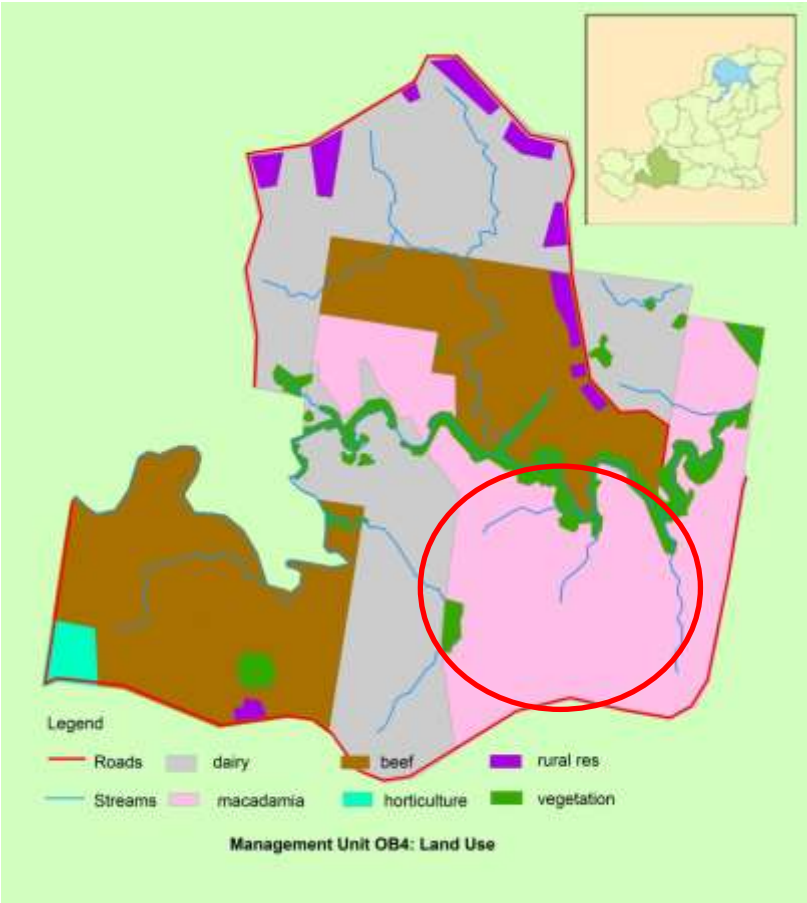
- poorly managed dairying and cattle grazing;
- new developments and increased stormwater runoff;
- runoff from impervious surfaces of existing developed areas;
- irrigation of treated effluent associated with the Maleny Sewage Treatment plant;
- uncontrolled stock access to the lake and its tributaries;

- 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.

Obi Obi Creek has been divided into nine Management Units that reflect property boundaries, physiography, vegetation, land use, point and diffuse source impacts. This provides administrative convenience and the ability to prioritise stream zones more accurately according to various threats.

The project lies in Management Unit OB4.

2.3.1 Land-use in Management Unit OB4



Management Unit OB4 covers an area of approximately 480 hectares with beef grazing (46%) as the dominant land use, macadamia horticulture (28%) with one remaining dairy farm (15%) and minor rural residential (3%). Less than 3% of the catchment is vegetated, however 31% of waterways have riparian cover (Dunstan 2007 & Amos 2019).

Major land use in MU OB4 include beef grazing (46%), macadamia orchard (Pacific Farms 28% and dairy farming (15%). Note the dairying property in the lower centre of the map has recently converted to beef (Webster's).

3.0 WHY

(What benefits will the project provide?)

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.

Lake Baroon Catchment Care Group is focussed on improving raw water quality in the Lake Baroon catchment and achieves this by working with private landholders in the catchment. Supporting landholders to improve land management, in turn provides multiple beneficial outcomes; water quality and broader environmental benefits while enhancing property management. Catchment activities not only benefit the raw water flowing into one of south east Queensland's most important water storages (hence Seqwater's significant support) but by providing a range of other environmental outcomes, generates support from other funding providers (most notably Sunshine Coast Council).

3.1 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 project's objectives and outcomes are consistent with:

- 2018-19 LBCCG Annual Investment Strategy (Lake Baroon Catchment Care Group 2018)
- Lake Baroon Catchment Implementation Plan (AquaGen/LBCCG 2007)
- Seqwater Natural Assets Management Plan – Lake Baroon Catchment (Seqwater 2012)
- Sanitary Survey of Baroon Pocket Catchment Report (Seqwater 2015)
- 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)
- Lake Baroon Catchment Management Strategy (AquaGen/LBCCG 2004) ***see below***

3.1.1 PRIORITY ACTIONS FOR OBI OBI CREEK AND PROJECT OBJECTIVES

Despite the 2004 Lake Baroon Catchment Management Strategy being a relatively outdated document, the identified actions to address poor water quality are sound and at a level where a local catchment group such as LBCCG can manage and have a beneficial impact.

The Obi Obi Creek has three distinct reaches commencing from its head waters to the Baroon Pocket dam. The first reach is from the head waters to the township weirs, the second from the weirs to Gardners Falls and the third from Gardners Falls to the Dam ending at the Narrows Gorge. Each reach has similar physical characteristics, experiences similar land uses and each requires its own unique strategy to address its particular attributes.

Obi Obi Creek Headwaters to the Weir and the Weir to Gardners Falls

The problems identified (in priority order):

i. Elevated nutrient levels from catchment land use, stock access and fragmented poor riparian buffers leading to poor water quality, blue green algal blooms and colonisation of aquatic weeds.

ii. Bank instability resulting from riparian clearance, cattle tracking (and other reasons), potentially increasing sedimentation of waterways.

iii. Invasion of woody and viny environmental weed eg. Camphor laurel, cats claw, and privet impacting upon aquatic ecology. (Note Celtis, Cats claw and Madeira vine are now considered priority weed species due to their ability to negatively impact riparian zones).

Priority Actions for Headwaters of Obi Obi Creek to the Weir

Priority Action (AquaGen 2004)	Activities to address Priority Action	Objectives met
1. Maintain adequate riparian buffers and erect riparian fencing and exclude or actively manage stock access to waterways, including the provision for off stream watering and shade and hardened access points.	a) Improve riparian buffer by replacing environmental weeds (including priority Madeira vine and Celtis) with robust native vegetation; b) Protect and enhance existing high value remnant vegetation including near threatened Birdwing butterfly vine;	• Improve water quality by establishing native vegetation in riparian zones; • reduce risk to water quality from agricultural practices by establishing a buffer to aerial drift and overland flow;
2. Actively promote the implementation of Industry relevant Environmental Codes of Practice.	a) Support Pacific Farms to actively reduce reliance on the use of insecticides by providing habitat for native pollinators.	• reduce insecticide use and improve management of riparian zones ; • build land manager engagement (including Priority Properties).
3. Provide incentives, advice and encouragement for riparian landholders to retain and actively manage existing native vegetation within riparian buffers.	a) Provide weed management within existing riparian vegetation (remnant) and to establish new riparian vegetation.	• support Pacific Farms to establish native pollinators and predators on the macadamia orchard • encourage and support horticulture to value robust riparian vegetation as a farm asset and incorporate into farm management
4. Encourage good farming practices, particularly on floodplains and steep slopes which reduces the rate of soil loss to below that of natural soil forming processes.	a) Minor modification of watercourse to improve drainage.	• Minimise waterlogging and erosion during high rainfall events • Establish riparian buffer to intercept sediments originating from the macadamia orchard.

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

3.2 WATER QUALITY

The environmental health of the Lake Baroon catchment is considered generally poor, and in some respects declining (personal communication with Seqwater water quality staff). 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 Obi Obi Creek originate 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.

3.2.1 Statistical Analysis of the Raw Water Quality Data Recorded from Kings Lane Weir 1993-98

Analysis of the raw water sampled from the Kings Lane Weir (approximately one kilometre downstream from the project site) sampling site between 1993 – 98 (Traill 2007) shows:

- Turbidity levels exceeded guideline levels (ANZECC) only once however it is unlikely the sampling program accurately captured the likely events (the topography of the catchment means flood waters rapidly disperse when rainfall ceases and it is unlikely sampling occurs during peak flows);
- Nitrate levels exceeded the guideline value 40% of the time and was significantly less than the upstream Aplin Road sampling, remaining consistent throughout the sampling period;
- Ammonia levels exceeded the guideline value 62% of the time and like nitrates remained consistent throughout the sampling period ;
- Phosphate levels at the end of the sampling period exceeded the guideline level 22% of the time although early samples were considerably higher than this.;

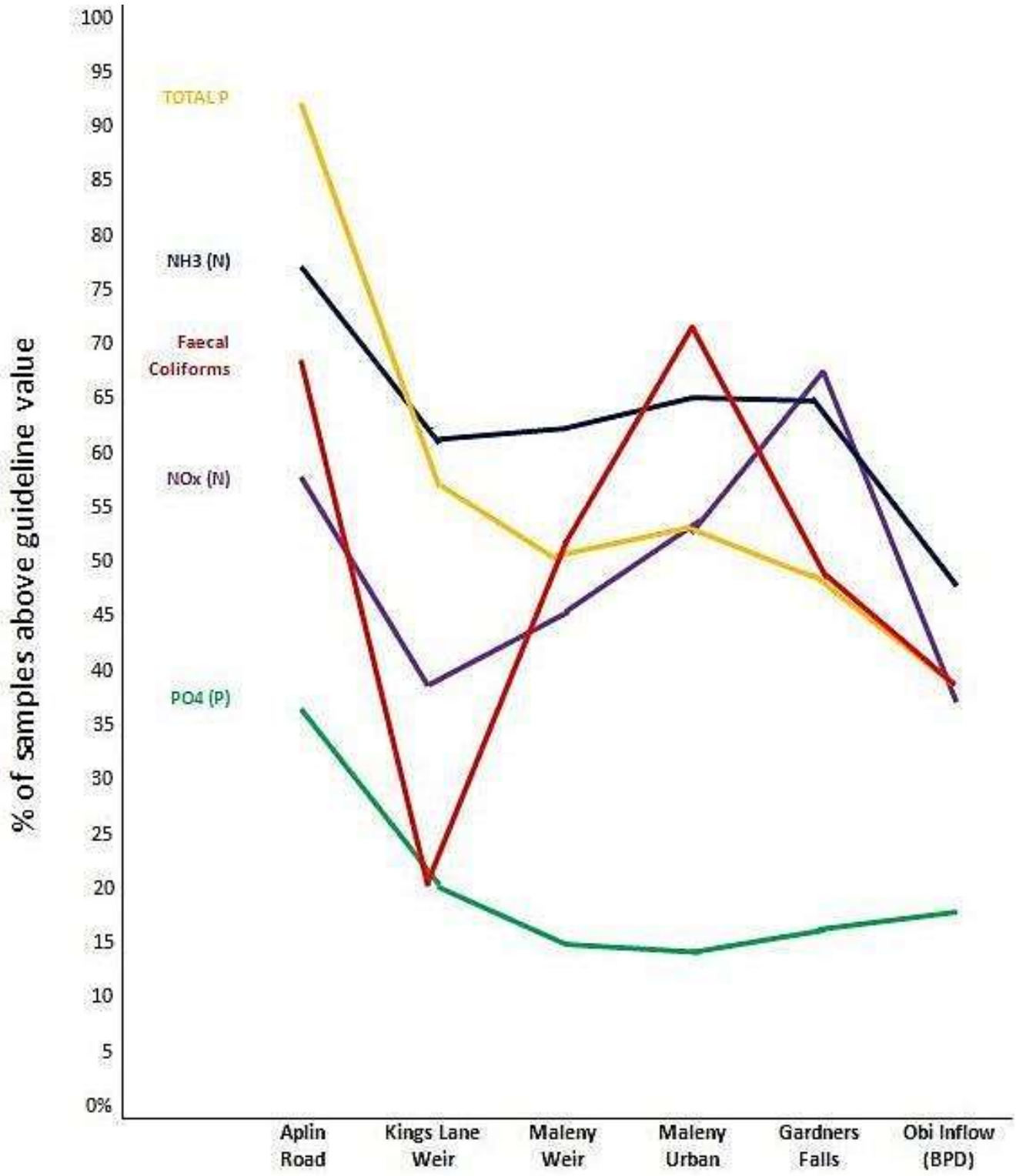
- Similar to Phosphate levels, Total phosphorus levels exceeded the guideline level 59% of the time, decreasing from initially high levels; *and*
- Faecal coliforms exceeded the guideline level 22% of the time, mainly early in the sampling period.

ANZECC - Australian and New Zealand Environment and Conservation Council.
These guidelines were part of a suite of 21 documents forming the Australian National Water Quality Management Strategy (NWQMS) originally released in 1992. The guidelines are intended to provide government, industry, consultants and community groups with tools to facilitate the assessment and management of water quality in a range of water resource types.

3.2.2 Comparison of the Raw Water Quality Data recorded from Obi Obi Creek 1991-2005

Sampling at Kings Lane Weir was only performed for a relatively short period (1993-98) with the actual sample site varying due to the observed effects of the weir (early sampling was conducted in flowing water below the weir; moved 200 metres upstream in 1997) and was abandoned in late 1998 as it was considered results closely mirrored the Aplin Road sampling site a short distance upstream.

Comparing the data from Kings Lane Weir and the upstream Aplin Road sampling site clearly shows significantly lower levels of Nitrates, Ammonia, Phosphates and Total Phosphorus, and a substantial reduction in faecal coliforms. This is likely due to the upper Obi supporting intensive agriculture with large dairies and beef grazing. The drop in nutrients and faecal coliforms at Kings Lane Weir may be attributed to several causes; the dilution impact of the large body of water, less intensive agriculture between Aplin Road and Kings Lane, varying sampling points at Kings Lane Weir and quite possibly the improved coverage of riparian vegetation (and general catchment vegetation) and instream diversity between the two sampling points. Riparian vegetation, including woody weeds is likely to assist in trapping and processing nutrients and faecal material. This is supported by sampling points downstream of urban Maleny; Gardners Falls and the Obi Inflow at Baroon Pocket Dam. Between these two sampling points riparian vegetation is prominent, agriculture is much less intensive (no dairies) and livestock access to major watercourses is much more limited.



NOx (N) – Nitrates	58.65	40.32	45.93	53.33	67.23	37.84
NH3 (N) – Ammonia	76.38	62.3	63.28	66.67	66.38	49.52
PO4 (P) - Phosphates	37.59	21.88	16.42	15.74	17.65	18.92
Total P – Total Phosphorus	92.74	58.73	51.97	53.77	49.57	40.54
Faecal Coliforms	69.92	22.22	52.99	72.48	50.85	41.44

Note: The routine sampling programs (CalAqua, AquaGen, Seqwater and others) are suspected of not accurately capturing major pollution events. Conducted monthly (1991 – 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).This is evidenced by the lack of turbidity results.

3.3 OPTIONS ANALYSIS

Proposed option highlighted.

Option	Description	Benefits/Cons	Cost (estimated)
Do nothing	Heavy infestation of environmental weeds in riparian zone and adjacent to (and invading) remnant vegetation. Weeds have affected the ability of the watercourse to free drain creating waterlogging issues.	No water quality or environmental improvements. Likely deterioration over time as waterlogged area expands. Priority weeds spread as there is currently limited access. Weeds continue to encroach onto mown areas.	$0
Drainage	Minor modification of watercourse reinstating a defined channel to improve drainage.	Dramatically reduce waterlogging which in turn improves access for slashing and weed management. Remove existing sediment slugs reducing likelihood of export. Note – drainage without significant weed management is virtually impossible due to severely restricted access.	$2,120
Weed management	Remove all weeds in riparian zone and adjacent to remnant.	Short term solution, weeds will return without replacement with robust native vegetation (ongoing cost). No water quality improvements – may worsen water quality. Waterlogging will limit access by slashing equipment. Destabilised waterlogged areas may erode during high rainfall events.	$13,600
Weed management & revegetation	Control weeds and replace with native vegetation.	Improves ecological function, provides access for priority weed control (Madeira vine, Celtis and others?). Provides habitat for pollinators and predators. Improves access for maintenance machinery (slashers, mowers). Without drainage works would require a far greater proportion of waterlogging tolerant plant species which affects ecological function and long term water quality benefits. Establishes an improved buffer to aerial drift and to overland flows. Best practice demonstration to adjacent neighbour.	$52,232
Weed management, drainage & revegetation	Control weeds and replace with native vegetation. Minor modification of watercourse reinstating a defined channel to improve drainage.	Improves ecological function, provides access for priority weed control (Madeira vine, Celtis and others?). Provides habitat for pollinators and predators. Improves access for maintenance machinery (slashers, mowers). Establishes an improved buffer to aerial drift and to overland flows. Best practice demonstration to adjacent neighbour. Reduces likelihood of sediment slugs mobilising and exporting to Obi Obi Creek.	$55,552 (*does not include pollinator hives*)

3.4 POLLINATION AND INTEGRATED PEST CONTROL IN MACADAMIA ORCHARDS

The introduction of native bee hives on Pacific farms represents a significant shift in pest control and pollination practices in the business. Native bees would certainly be present on the property utilising the macadamia trees themselves and vegetation along watercourses for hives (and undisturbed areas for burrowing species) however research has indicated between 5 – 8 hives are required per hectare of macadamias to provide effective pollination and subsequent higher yields (http://beeaware.org.au/pollination/pollinator-reliant-crops/macadamias/).

The introduction of native bee hives is an economic decision by the business however the costly investment (approximately $500 per hive) must be protected by changing traditional pest control methods. Hives are installed both in the orchard itself and in stands of vegetation throughout the farm. This is to ensure hives are located near alternative food sources when the macadamias are not flowering. The spraying of the orchard for pests needs to be managed to ensure the native bees are wiped out. This includes spraying at night when bees are not active (and generally chemicals are more efficient), only spraying when absolutely necessary and selecting less toxic pesticides. It would be expected that pesticide use will be significantly reduced and more care taken when applying.

The protection of existing bees and the introduction of more bees directly reduce the risk to water quality on the property through the change in pesticide practices –less chance of pesticides reaching watercourses. Additionally to provide food sources for the bees when macadamias are not flowering the business must enhance and establish native vegetation throughout the property. Although some species of local native trees are preferred for the bees, a broad suite of species where flowers are available all year round is required to support large and active populations. This provides pockets of refuge for bees around the farm to assist them to forage for food and water without stress.

In many ways native bees as pollinators are preferable to the introduced European bee. Native bees pollinate a far wider range of flora species than introduced bees and do not compete with native fauna; occupation of nesting and habitat hollows. Native hives once established do not require high levels of management (honey removal, moving on a regular basis and treatment for disease and pests). Native bees are either stingless or are reluctant to sting. Native bees evolved side by side with native vegetation (hence their suitability for pollinating macadamia trees) and therefore are part of a robust, healthy native vegetation which ultimately provides the best possible buffers along watercourses.

4.0 HOW

(How will the activities be implemented?)

Activity/works	Description	Benefits	Responsibility
1a. Initial riparian weed management	Woody weeds currently dominate the riparian zone including coral trees, lantana, Celtis and madeira vine. There are virtually no native species present. The most efficient and effective method of initial control is using a posi-track or excavator mounted mulcher.	Efficient and reduces woody weeds to ground level mulch. The mulch is useful for the later revegetation and returns organic material and nutrients back to the soil.	Contractors – preferably excavator mounted mulcher.
1b. Follow up riparian weed management	Mulching does not kill woody weeds. Follow up herbicide spraying will be completed when weeds reshoot.	Reshooting weeds less than one meter in height can then be spot sprayed reducing quantity of herbicide used and avoiding contact with flowing water. Any native species germination can be protected. Priority weeds (Madeira vine and Celtis can be treated.	Contractors – appropriately skilled and insured bush regeneration team. Pacific Farms – where appropriate.
1c. Remnant vegetation weed management	The remnant although small supports a good stand of Birdwing vine and is being degraded by weed invasion (high edge to area ratio). To avoid damage hand clearing on the edge is required by skilled bush regenerators.	Remnant is an important 'stepping stone' in a largely fragmented landscape. Protection of near threatened Birdwing vine.	Contractors – appropriately skilled and insured bush regeneration team.
2. Drainage	Woody weeds (primarily Coral trees) have altered natural flow patterns and resulted in loss of defined channel that would have existed prior to clearing of original vegetation. Build-up of sediment originating upstream on the neighbouring dairy farm has created large areas of waterlogging which in turn encourages further woody weed growth. Following clearing of weeds use excavator to re-establish a flow path. Spread sediment away from watercourse and revegetate to stabilise.	Drainage of watercourse (and suspected spring) will dramatically reduce waterlogged areas and permit revegetation with a diverse range of native plant species. Weed growth will be minimised and access for revegetation maintenance will be improved. At the same time as drainage the site can be profiled to permit maintenance (access for mowers etc).	Contractors – small excavator.
3. Revegetation	Revegetation with native species following weed management will minimise long term maintenance of a currently difficult area to manage.	Diverse range of native species (including native bee appropriate species) initially planted at sufficient density to promote rapid canopy cover reducing maintenance. Vegetation of watercourse will provide stability and shade water increasing dissolved oxygen. Aquatic	Contractors – appropriately skilled and insured planting team.

		vegetation will trap and process nutrients, faecal material and pathogens. Enhance protection of remnant vegetation by reducing weed threat. Enhance wildlife corridor. Provide native bee and pollinator habitat reducing Pacific Farms reliance on insecticides.	
4. Revegetation maintenance	All revegetation requires between 3 – 5 years of maintenance to ensure establishment.	Establishment of a robust revegetation site with the appropriate diversity and ability to outcompete weed species.	Contractors – appropriately skilled and insured planting team. Pacific Farms – where appropriate.

4.1 WEED MANAGEMENT

Normally LBCCG does not actively manage woody weeds in riparian zones as any vegetation in riparian zones is better than none (except for a few key species that have a detrimental impact on water quality). Weed management is only completed where:

- Priority weeds are present (Chinese elm, Madeira vine, Cats claw creeper)
- There is a long term plan to ensure the weeds do not return (revegetation)
- Weedy vegetation is affecting water quality (blocking flows, causing erosion, diverting flows etc)

Weed management will be completed on the Pacific Farms watercourse to:

- Provide access to control Madeira vine
- Remove coral trees that have fallen over in the watercourse blocking and diverting flows resulting in a large are of waterlogging
- To permit the establishment of native vegetation that will provide bed and bank stability, enhance the riparian wildlife corridor, assist in the protection of the small patch of remnant vegetation
- Compliment previous activities on the neighbouring ex-dairy farm (Websters) – riparian fencing on the upstream reach of the watercourse
- Enhance the habitat for native pollinators that are useful for macadamia production (provides food sources when macadamias are not flowering)

Several methods of weed control will be utilised:

- Initial knock down with excavator mounted mulcher
- Follow up spot spraying of re-shooting weeds
- Cut and paste of larger weeds that cannot be mulched or sprayed (particularly important within and adjacent to remnant)
- Regular follow up over several years (as part of revegetation maintenance)

Top: The riparian zone is dominated by woody weeds and vine weeds, primarily Coral trees and Orange trumpet. Other weeds include Chinese elm, Madeira vine, lantana and Ipomea species. A mechanical mulcher will be used for initial knockdown and provide a mulch layer in preparation for revegetation.

Left: The Orange Trumpet vine has invaded the small but valuable remnant climbing into the canopy. Trumpet vine is relatively straightforward to control however it must be completed by hand in the sensitive vegetation.

4.2 DRAINAGE

The Maleny Plateau before the arrival of Europeans was covered in rainforest and wet sclerophyll forest. Watercourses were generally free draining due to the steep catchment with rocky beds and banks. The widespread clearing at the turn of the nineteenth century interrupted catchment stability with over time extensive landslides (landslips) developing and general diffuse paddock erosion occurring. Exotic pasture grasses planted in open paddocks spread to riparian zones and trap the sediments eroding off paddocks raising the height of the watercourse bed. The watercourses over time lose definition and waterlogged areas develop. If the watercourse is relatively flat these waterlogged areas can become very large and instream vegetation continues to trap sediment. Often these waterlogged areas will grow nuisance vegetation; reeds, rushes, non-palatable grasses, annual and perennial weeds including woody weeds such as Coral trees and so on.

Reinstating the watercourse channel allows the waterlogged areas to freely drain and over time can be accessed for mowing. It is important to revegetate the newly created bank to minimise the reformation of sediment slugs. The material removed can be spread evenly on the adjacent bank and revegetated.

It is likely a follow up to the initial drainage works will be required. This will be to ensure all waterlogged areas will be sufficient drained to be able to revegetate and be accessible for maintenance.

The watercourse under the heavy layer of weeds has lost its definition due to waterlogging and sediment deposition. Clearing the weeds from the bed and banks and replacing with native vegetation will re-establish a free draining natural stream.

4.3 RIPARIAN REVEGETATION

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.

Buffer strips provide a strip of vegetation that acts as a filter for sediment. They are designed to remove sediment, organic material, nutrients and chemicals carried in run-off. Buffer strips include both vegetative filters adjacent to agricultural land and riparian zones that maintain bank and channel stability.

Small spring fed dam in riparian zone. This will be retained however revegetation will be planted to the water's edge reducing the incidence of nuisance weeds and improve water quality.

4.4 REVEGETATION MAINTENANCE

The ongoing maintenance of revegetation is essential to establish robust, functioning vegetation that is resistant to weeds and requires little ongoing management (beyond five years of planting). At least 90% of trees need to survive to maturity to ensure no substantial gaps in the canopy exist that will let sun into the plot encouraging the growth of weeds. Follow up maintenance may include the requirement to achieve at least 90% establishment.

Revegetation maintenance generally involves regular mowing and/or brush cutting of tree rows, ring spraying around guards and when necessary hand weeding inside guards. It is usually unnecessary to water plants beyond an initial watering in at planting. Occasional fertiliser application may be required if deficiencies are suspected. Corflute

tree guards are removed when individual trees exceed the height of maintenance personal. New fully biodegradable waxed cardboard guards are being trilled by LBCCG and have been budgeted for on this proposed project on Pacific Farms. This hopefully negates the need to remove guards.

Maintenance is required between three to five years depending on plant growth. Generally LBCCG plants a high proportion of pioneer and fast growing mature phase species with the aim of achieving fast growth rates, rapid site capture (establishment of shade) and fast reduction in weed growth.

The mowing between rows is a relatively low-skilled role and can generally be done by anyone if the correct equipment is used. Pacific Farms will be able to assist in this role. Other maintenance roles require skilled practitioners, ideally those trained in bush regeneration techniques who can recognise weeds from native regeneration and can make informed decisions 'on the run'.

4.5 FUTURE STAGES AND ACTIVITIES

Pacific Farms is committed to improving macadamia pollination and integrated pest management program. Key to this is the establishment of new areas of native vegetation particularly where possible amongst the macadamia orchards (watercourses) and the enhancement of existing vegetation. Native vegetation will provide a food source for the pollinators when macadamia trees are not flowering and also provide habitat and hive opportunities other than the purchased hives. The replacement of weeds with native vegetation is also more likely to reduce pest harbour – rats prefer weedy ground cover to established native vegetation that tends to minimal understorey and groundcover.

LBCCG will assist with maintenance of the proposed revegetation beyond the budgeted one year (revegetation requires between 3-5 years of maintenance to sufficiently establish). Additionally it is planned to continue assisting Pacific Farms to establish native vegetation in riparian zones. Weed management within existing riparian zones (Obi Obi Creek) is also required although it is unconfirmed at this stage who will assist with funding support (Sunshine Coast Council?).

The small remnant is in relatively good condition despite the invasion by orange trumpet vine and minor large leaf privet. Vegetation (remnant and good quality revegetation) provides both habitat and food sources for native bee species particularly when

the Macadamia orchard trees are not flowering.

5.0 WHEN

(When will the activities be implemented?)

5.1 SCHEDULE & MILESTONES

Milestone	*Action*		*Completion Date*
1	LBCCG Project Plan (Stage 1) completed and approved, pre works monitoring completed		Apr 19
2	***IMPLEMEMNTATION 2018/19***	Initial 'knockdown' weed management	May 19
		Follow up weed management	June 19
		Remnant vegetation weed management	May 19
3		Drainage	May 19
4		Riparian revegetation	Jun 19
5		Revegetation maintenance/weed monitoring & management	Dec 19
6	Year 1 implementation completed, monitoring & evaluation completed, recommendations finalised		Jun 19
n/a	Final Report. Year 2 Project Plan completed for approval (if applicable)		Feb 20

As per ALL LBCCG projects, completion of activities is weather dependent.

5.2 MONITORING, EVALUATION & REPORTING

Monitoring of rehabilitation activities, 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). This may, depending on the severity of the event, be achieved by a phone call to the landholders.

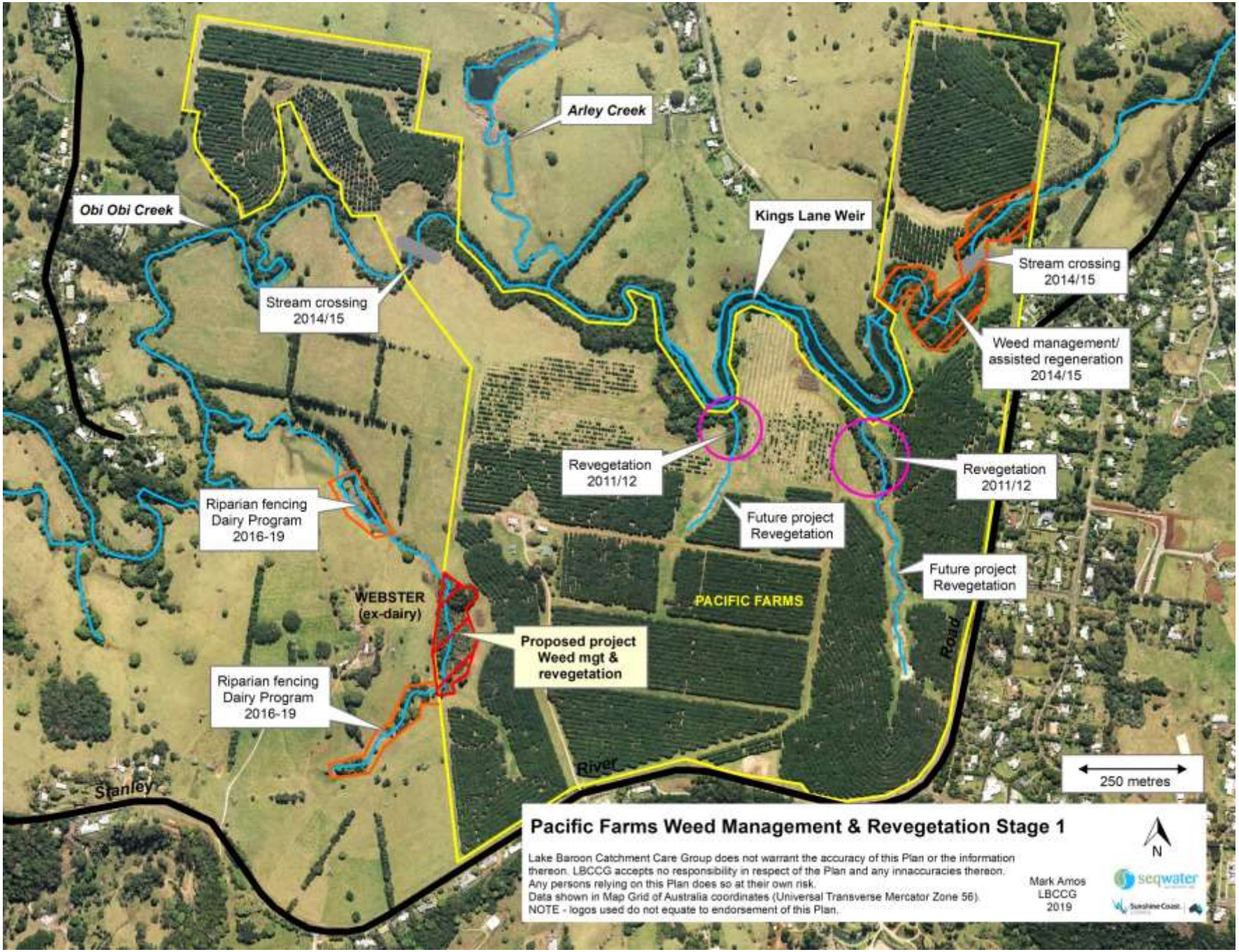
Photo point monitoring will provide valuable evidence of works completion, a record of changes over time, and provide an important assessment tool to evaluate the project.

Project updates will be provided at monthly LBCCG meetings.

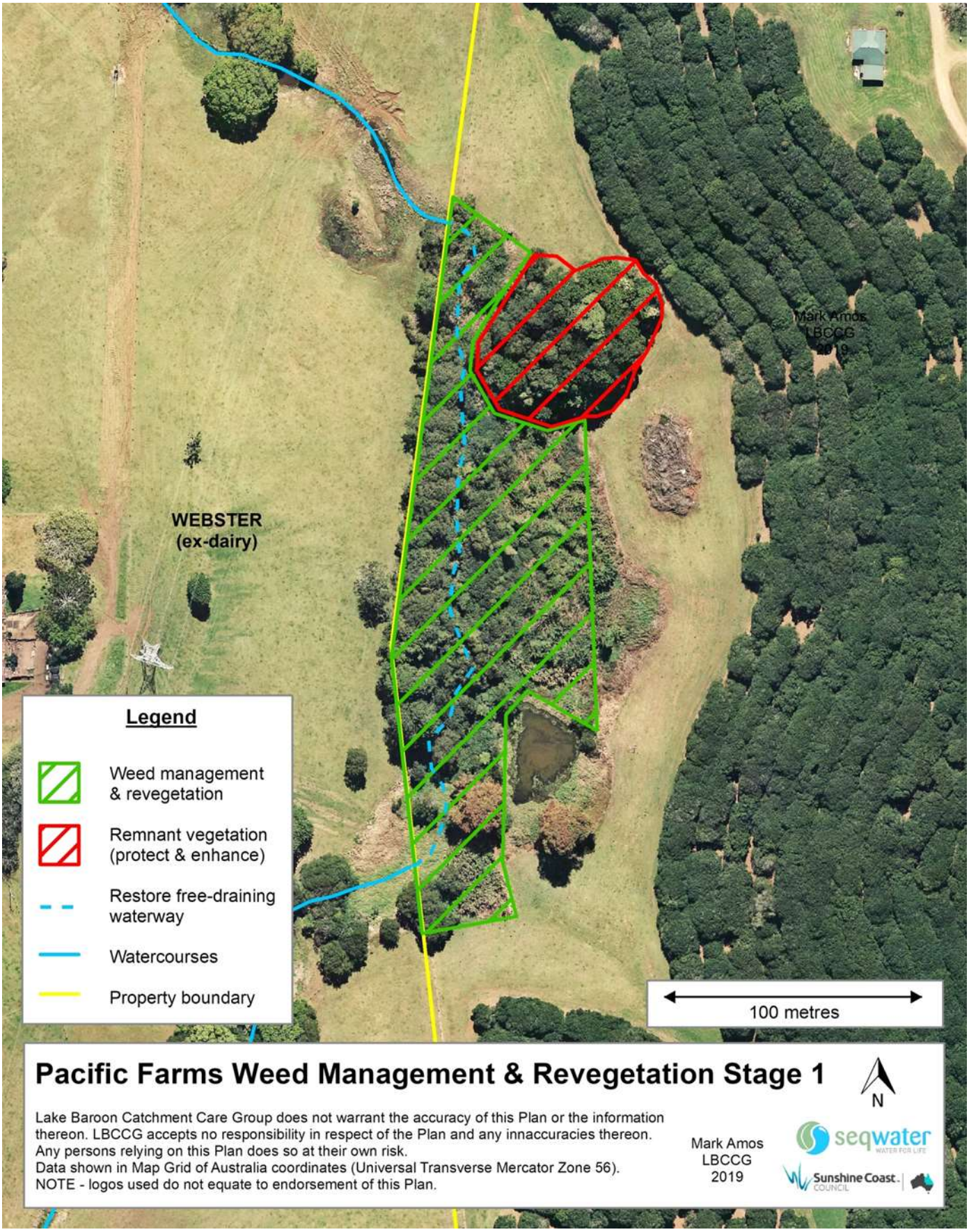
A modified version of the Project Plan (specific financial details and landholder contact details deleted) will be placed on the LBCCG website: www.lbccg.org.au.

6.0 MAP

6.1 Project overview



6.2 Project Map



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.

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