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REVISED VEGETATION MANAGEMENT PLAN

Lot 112 DP 1073791
Lyons Road, Toormina

A Report Prepared for Utila Pty Ltd

MAY 2013

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1. INTRODUCTION

1.1 Background

JWA Pty Ltd has been engaged by Utila Pty Ltd to prepare a Vegetation Management Plan (VMP) for the Riparian Corridors within Lot 112 DP 1073791, Lyons Road, Toormina **(FIGURE 1).**

Concept approval has been granted by the Department of Planning (DoP) – Application No. 08_0080 and Director General's Requirement (DGRs) issued. The DGRs require the consideration of the existing aquatic and riparian environment and proposed water courses.

Flora and Fauna Assessments were completed by Gunninah Environmental Consultants in 1997 and by JWA in November 2008. A summary of the results of the JWA assessment is included in this report **(SECTION 2).**

1.2 The Subject Site

1.2.1 Description and location

The Subject site, Part Lot 112 DP 1073791, is situated on the outskirts of Sawtell on the NSW mid-north coast. The total Lot 112 covers an area of approximately 38.5ha **(FIGURE 2)**. Forested wetland covers the eastern third of the site and partially vegetated wetland extends along drainage lines running from the north-west and south-west. The remainder of the site subject of this Development Application is cleared land currently used for grazing (approximately 25.8ha). The site adjoins Bongil Bongil National Park.

1.2.2 Land use zones

The site contains the following land use zones:

- 2(a) Residential – Low Density;
- 6(a) Open space – Public Recreation; and
- 7(a) Environmental Protection – Habitat & Catchment.

Land zones are shown in **FIGURE 3.**

1.3 The Proposed Development

The Proposed development is for a residential subdivision comprising of 165 low density lots. The development will also include associated roads, infrastructure, and public open space areas (**FIGURE 4**).

1.4 Aims and Objectives

1.4.1 Overall aim

The aim of this VMP is to provide guidelines for the restoration and management of the native vegetation along the riparian corridors of the Subject site.

SOURCE: Google Maps SCALE: 1 : 15 000 @ A4 JAMES WARREN & ASSOCIATES PTY LIMITED Environmental Consultants	CLIENT Utila Pty Ltd PROJECT Vegetation Management Plan Lot 112 on DP1073791 Lyons Road, North Bonville, NSW Coffs Harbour City Council LGA	**FIGURE 1** PREPARED: BW DATE: 08 May 2013 FILE: N08022_VMP_Locality.cdr	TITLE **LOCALITY PLAN**

Legend
Subject Site

0 100m
1 : 3000

SOURCE: Department of Land and Property Information 2012 Aerial Photograph

SCALE: 1 : 3000 @ A3

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FIGURE 2

PREPARED: BW
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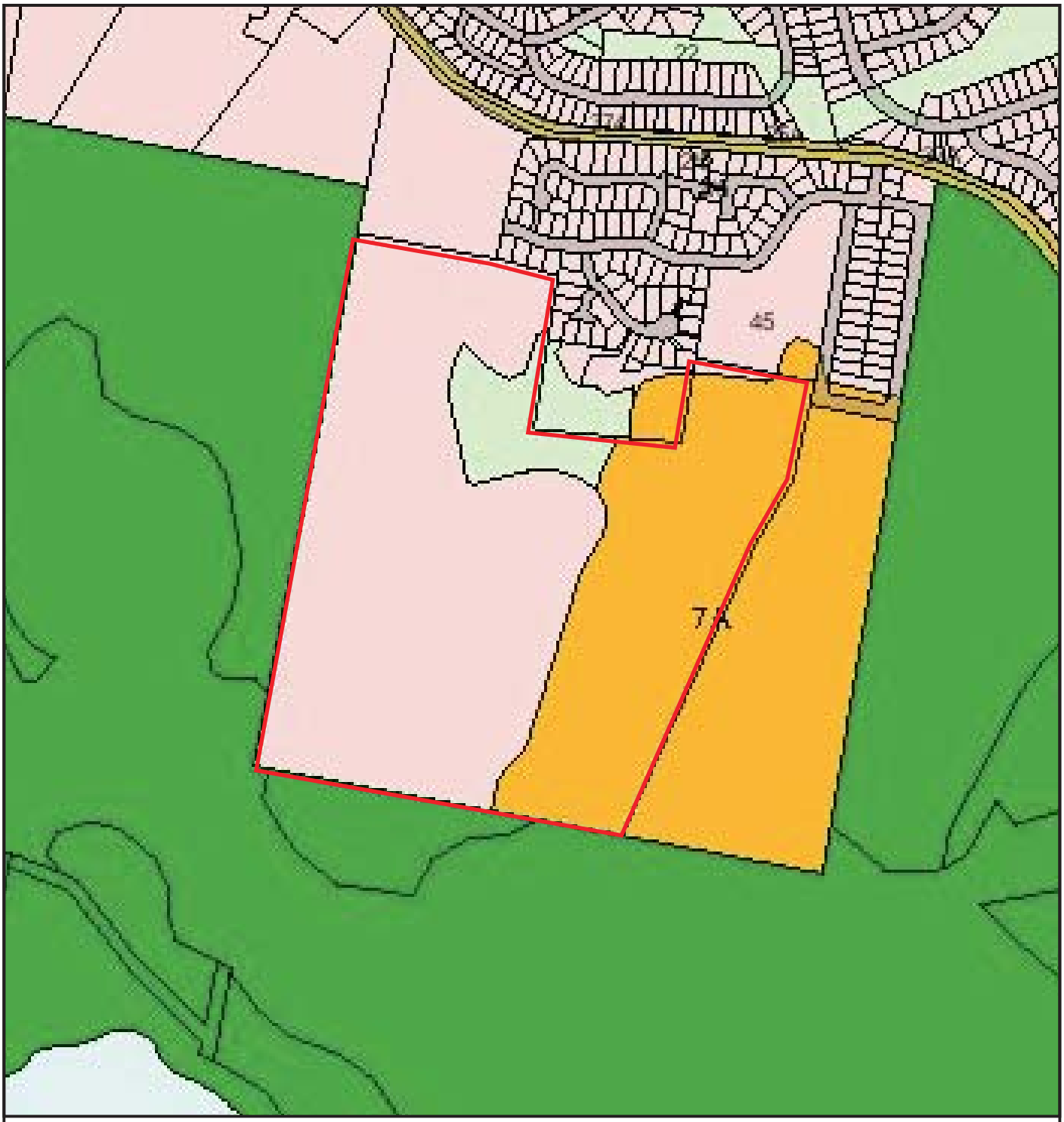
FILE: N08022_VMP_Aerial.cdr

TITLE

AERIAL PHOTOGRAPH



Legend

- 2a Residential - Low Density
- 6a Open Space - Public Recreation
- 7a Environmental Protection - Habitat & Catchment
- 8 National Park & Reserves
- Subject Site

N

0 100m 200m

SOURCE: Coffs Harbour City Council - LEP Maps Online

SCALE: 1 : 8000 @ A4

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FIGURE 3

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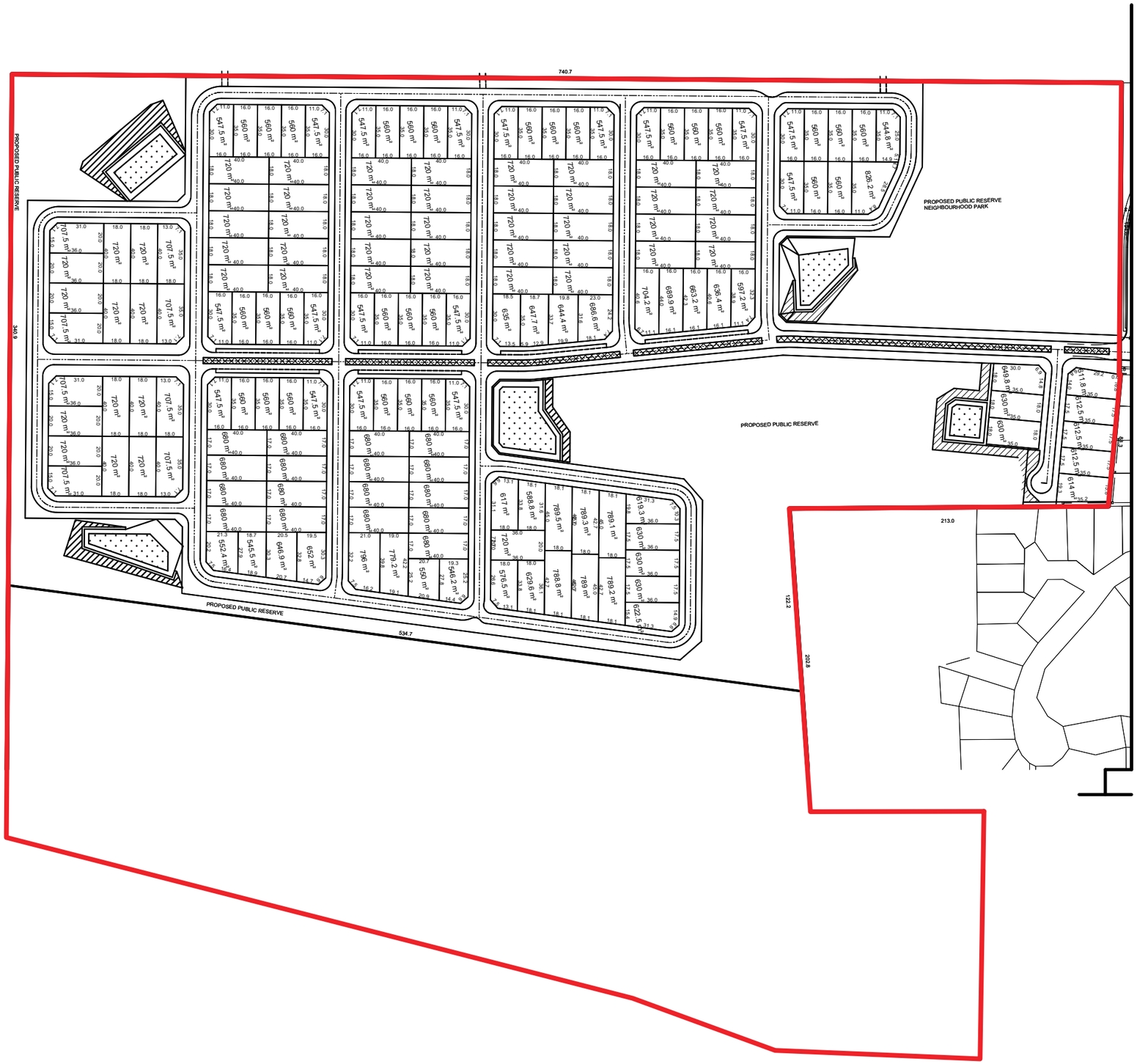
TITLE

ZONING PLAN



Legend
Subject Site

0 100m
1 : 3000

SOURCE: Geoff Slattery & Partners (Ref: dwg 104 dimensions.pdf & dwg 110a wsud basins.pdf)
SCALE: 1 : 3000 @ A3

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FIGURE 4

PREPARED: BW
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FILE: N08022_VMP_Layout.cdr

TITLE
PROPOSED DEVELOPMENT LAYOUT

1.4.2 Specific objectives

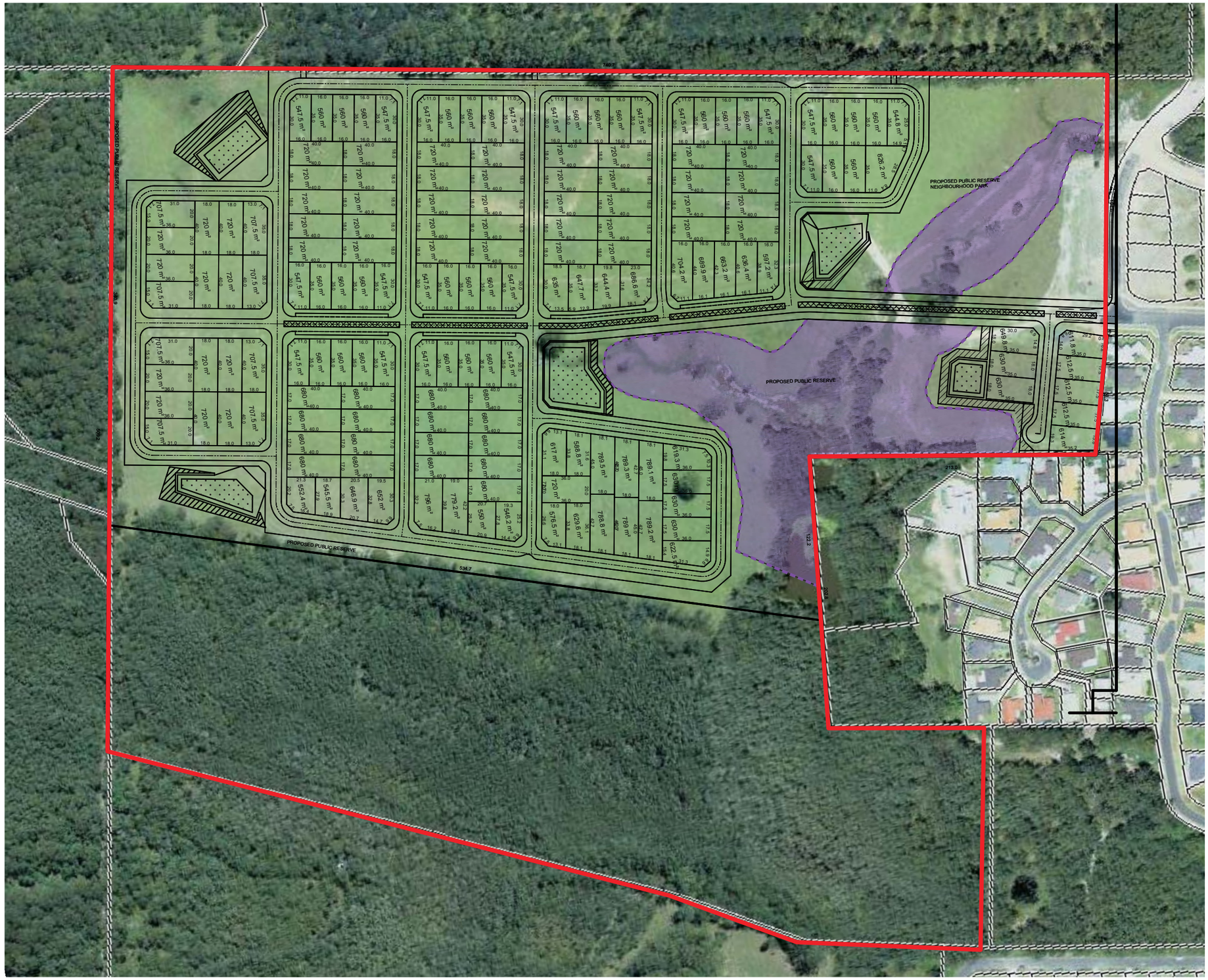
The specific objectives of the VMP are:

- To enhance the conserved vegetation by revegetating with indigenous species;
- To buffer the waterways from edge effects and other disturbance related impacts;
- To ensure retained vegetation is of low fire risk;
- To improve the value of the Subject site as habitat for fauna groups;
- To improve the value of the Subject site as a wildlife corridor;
- To manage weeds using revegetation best practice weed control methods; and
- To utilise revegetation to reduce nutrient and sediment loads and other potential impacts arising from the Proposed development.

1.4.3 Areas of focus – Rehabilitation Area

The Water Management Act 2000 requires that controlled activities carried out in or under waterfront land are now regulated. The document "Guidelines for riparian corridors on waterfront land" (NOW 2012) outlines appropriate widths for riparian corridors and how much riparian vegetation should be protected or re-established.

In accordance with the NOW Guidelines (NOW 2012) the Rehabilitation Area (RA) will cover the Riparian Corridor, which consists of the channel (comprising the bed and banks of the watercourse to the highest bank) and the Vegetated Riparian Zone (VRZ) adjoining the channel. The area roughly covers the Freshwater Wetlands, the north-west and south-west drainage lines, and a portion of the Swamp Sclerophyll Forest in the east of the site **(SECTION 2.3) (FIGURE 5).**



Legend
Riparian Corridor
Subject Site

0 100m
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SOURCE: JWA; Geoff Slattery (Ref: borsato lyons080513.dwg, dwg 103b overall layout.pdf & dwg 110a wsud basins.pdf); LPI 2012 Aerial Photo

SCALE: 1 : 3000 @ A3

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FIGURE 5

PREPARED: BW
DATE: 08 May 2013
FILE: N08022_VMP_CRZ.cdr

TITLE
REHABILITATION ZONE - RIPARIAN CORRIDOR

2. EXISTING VEGETATION VALUES

2.1 Introduction

The Subject site consists of a combination of forested wetland, wetland and grazing land. The majority of native vegetation has been cleared leaving the site highly degraded and modified. Forested wetland covers the eastern third of the site and partially vegetated wetland extends along drainage lines which drain from a north-west and south-west direction.

2.2 Vegetation Communities

2.2.1 Background

A vegetation assessment was completed by two (2) scientists from JWA in November 2008. Six (6) vegetation communities were identified and are listed in **TABLE 1**. A species list compiled and is contained in **APPENDIX 1.** The location and extent of vegetation communities is shown in **FIGURE 6.** A further assessment was carried out in October 2009 specifically examining the riparian corridors and compiling a weed species list **(APPENDIX 1).**

TABLE 1
VEGETATION COMMUNITIES PRESENT ON THE SUBJECT SITE

1	Tall open swamp sclerophyll forest *(Eucalyptus robusta)*
2	Tall open/closed swamp sclerophyll forests *(Melaluca quinquenervia)*
3	Tall open dry sclerophyll forest (Mixed species)
4	Low closed sedgeland/wet pasture *(Juncus usitatus +/- Chorizandra cymbaria / Philydrum lanuginosum)*
5	Low closed grassland with scattered trees
6	Dams

2.2.2 Community 1 - Tall open swamp sclerophyll forest (Eucalyptus robusta)

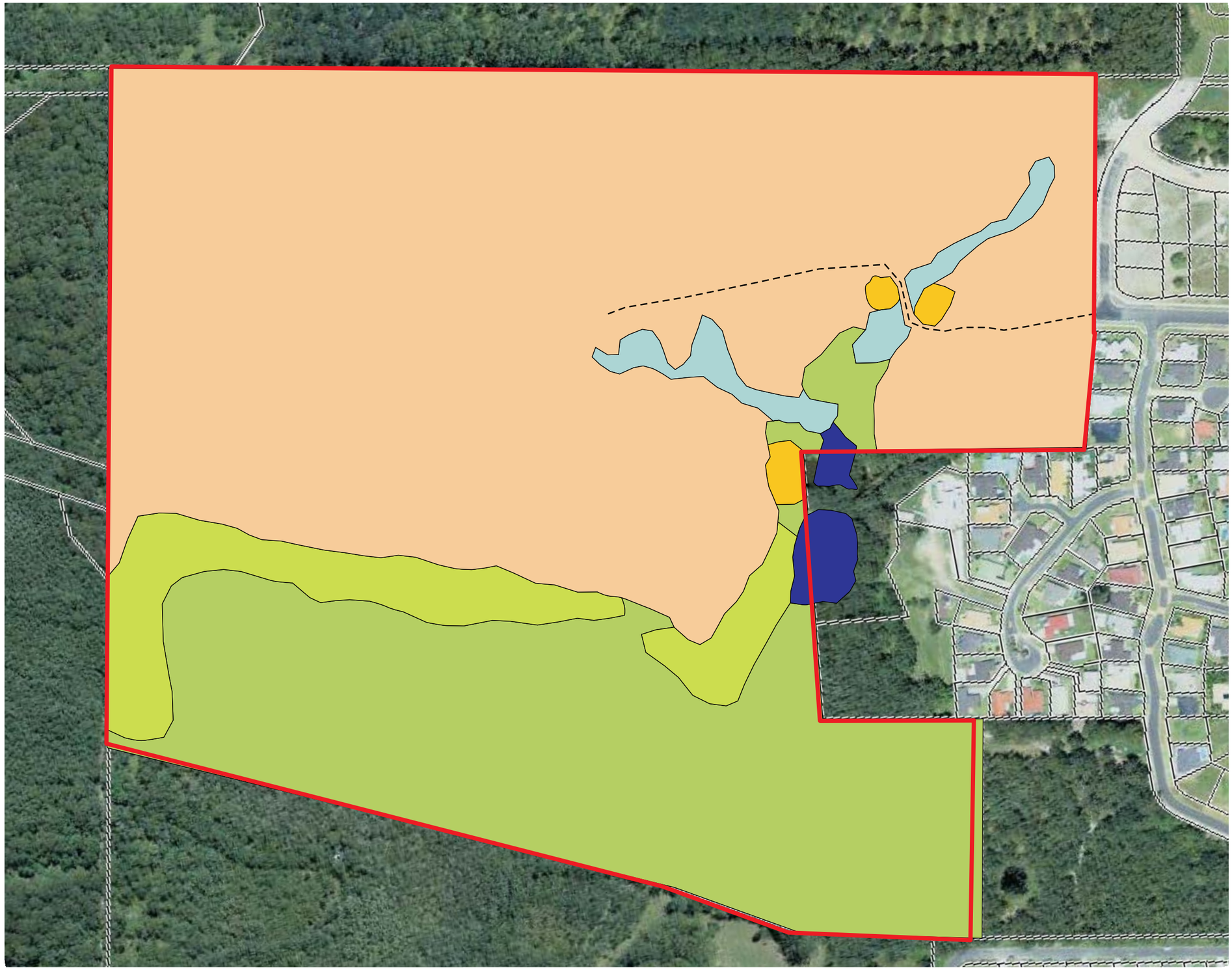
Location and area

This community occurs in the low-lying eastern portion of the Subject site fringing the paperbark swamp and also as a small patch adjacent to the constructed dams **(FIGURE 6).**

Description

The canopy of this community is generally comprised of mature Swamp mahogany (*Eucalyptus robusta*) up to 25m in height. There are also scattered occurrences of mature Broad-leaved paperbark (*Melaleuca quinquenervia*) and Blackbutt (*E. pilularis*), particularly adjacent to the constructed dams.

The midstorey in this community is generally comprised of a mixture of Blueberry ash (*Elaeocarpus reticulatus*), Willow bottlebrush (*Callistemon salignus*) and Black wattle (*Callicoma serratifolia*) and is quite dense in some areas. Blackwood wattle (*Acacia*



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SOURCE: JWA Site Investigations; LPI 2012 Aerial Photograph

SCALE: 1 : 3000 @ A3

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FIGURE 6

PREPARED: BW
DATE: 08 May 2013
FILE: N08022_VMP_Vegetation.cdr

TITLE

VEGETATION COMMUNITIES

melanoxylon) is common along the interface of this community and adjacent cleared land.

The groundcover is generally dominated by a mixture of Red-fruited saw-sedge (*Gahnia sieberana*) and Curly sedge (*Restio tetraphyllus*). Other species present include Blady grass (*Imperata cylindrica*), Bracken (*Pteridium esculentum*), Kangaroo grass (*Themeda triandra*), Long-leaved matrush (*Lomandra longifolia*), and Wiry panic (*Entolasia stricta*) in drier areas, as well as Bristle rush (*Chorizandra cymbaria*) and *Blechnum camfieldii* in wetter areas.

Conservation status

This vegetation community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on the floodplain as gazetted by the NSW Scientific Committee on 17th December 2004.

The conservation status of this community is therefore considered to be high.

2.2.3 Community 2 - Tall open/closed swamp sclerophyll forest (Melaleuca quinquenervia)

Location and area

This community occurs in the low-lying eastern portion of the Subject site and also fringing the constructed dams **(FIGURE 6)**.

Description

The canopy of this community is comprised entirely of Broad-leaved paperbark (*Melaleuca quinquenervia*) up to 20m in height. The midstorey in this community is generally absent and restricted to scattered occurrences of Melastoma (*Melastoma affine*), Cheese tree (*Glochidion ferdinandi*) and Blueberry ash.

The groundcover is also generally absent due to the presence of standing water, however, Common reed (*Phragmites australis*) occurs in some areas. There are also scattered occurrences of Red-fruited saw-sedge, Curly sedge, Bristle rush, *Blechnum camfieldii* and Swamp millet (*Isachne globosa*). Slender knotweed (*Persicaria decipiens*) is common fringing the constructed dams.

Conservation status

This vegetation community is representative of the Endangered Ecological Community (EEC) Swamp sclerophyll forest on the floodplain as gazetted by the NSW Scientific Committee on 17th December 2004.

The conservation status of this community is therefore considered to be high.

2.2.4 Community 3 - Tall open dry sclerophyll forest (Mixed species)

Location and area

This community occurs as scattered patches of mature trees retained within the grassland community and adjacent to the constructed dams **(FIGURE 6)**.

Description

The canopy of this community is comprised of a mixture of species including Tallowwood (*E. microcorys*), Blackbutt, Red mahogany (*E. resinifera*), Pink bloodwood (*Corymbia intermedia*), Swamp mahogany, Smooth-barked apple (*Angophora costata*) and Turpentine (*Syncarpia glomulifera*).

The midstorey in this community is absent due to past clearing activities and continued grazing of cattle. The groundcover is comprised of a mixture of introduced grasses and common agricultural weeds.

Conservation status

The conservation status of this vegetation community is considered to be low to moderate because it is a small and isolated, and is highly disturbed by grazing cattle.

2.2.5 Community 4 - Low closed sedgeland/wet pasture (Juncus usitatus +/- Chorizandra cymbaria / Philydrum lanuginosum)

Location and area

This community occurs in the low-lying drainage lines in the central and northern portions of the Subject site **(FIGURE 6)**.

Description

This community is comprised of a mixture of hydrophytic plant species the most common of which include Common rush (*Juncus usitatus*), Swamp buttercup (*Ranunculus inundatus*), Bristle rush and Frogsmouth (*Philydrum lanuginosum*), and introduced pasture grasses. There are also occurrences of Swamp water fern (*Blechnum indicum*), Slender knotweed, Jointed twig-rush (*Baumea articulata*) and Tall sedge (*Carex appressa*).

Regenerating Broad-leaved paperbarks also occur sporadically within this community.

Conservation status

This vegetation community is representative of the EEC Freshwater wetlands on coastal floodplain as gazetted by the NSW Scientific Committee on 17th December 2004. However, continued disturbance by grazing cattle, and the presence of introduced grasses and agricultural weeds have significantly reduced the conservation value of this area. This community is therefore considered to have a moderate conservation status.

2.2.6 Community 5 - Low closed grassland with scattered trees

Location and area

The majority of the Subject site is comprised of grassland with scattered trees having been substantially cleared for grazing purposes **(FIGURE 6)**.

Description

This community is comprised of a mixture of native and introduced grasses as well as commonly occurring agricultural weeds, and is heavily grazed by cattle.

Conservation status

The conservation status of this community is considered to be low.

2.2.7 Community 6 - Dams

Location and area

Two (2) constructed dams occur on the northern boundary of the Subject site **(FIGURE 6)**.

Description

Fringing vegetation is comprised of a mixture of Eucalyptus species (Community 3) and Broad-leaved paperbarks (Community 2).

Vegetation within the dams includes Slender knotweed, Grey sedge (*Lepironia articulata*), Common rush, Water lilies (*Nymphaea sp.*), Java pondweed (*Potamogeton javanicus*) and Cumbungi (*Typha orientalis*). Water primrose (*Ludwigia peploides*) also occurs and forms dense floating mats in some areas.

Conservation status

The conservation status of the dams on the Subject site is considered to be low-moderate.

2.3 Endangered Ecological Communities

There are two EECs on the Subject site:

- Swamp sclerophyll forest on the floodplain (i.e. Vegetation communities 1 & 2)
- Freshwater wetlands on coastal floodplain (i.e. Vegetation community 4)

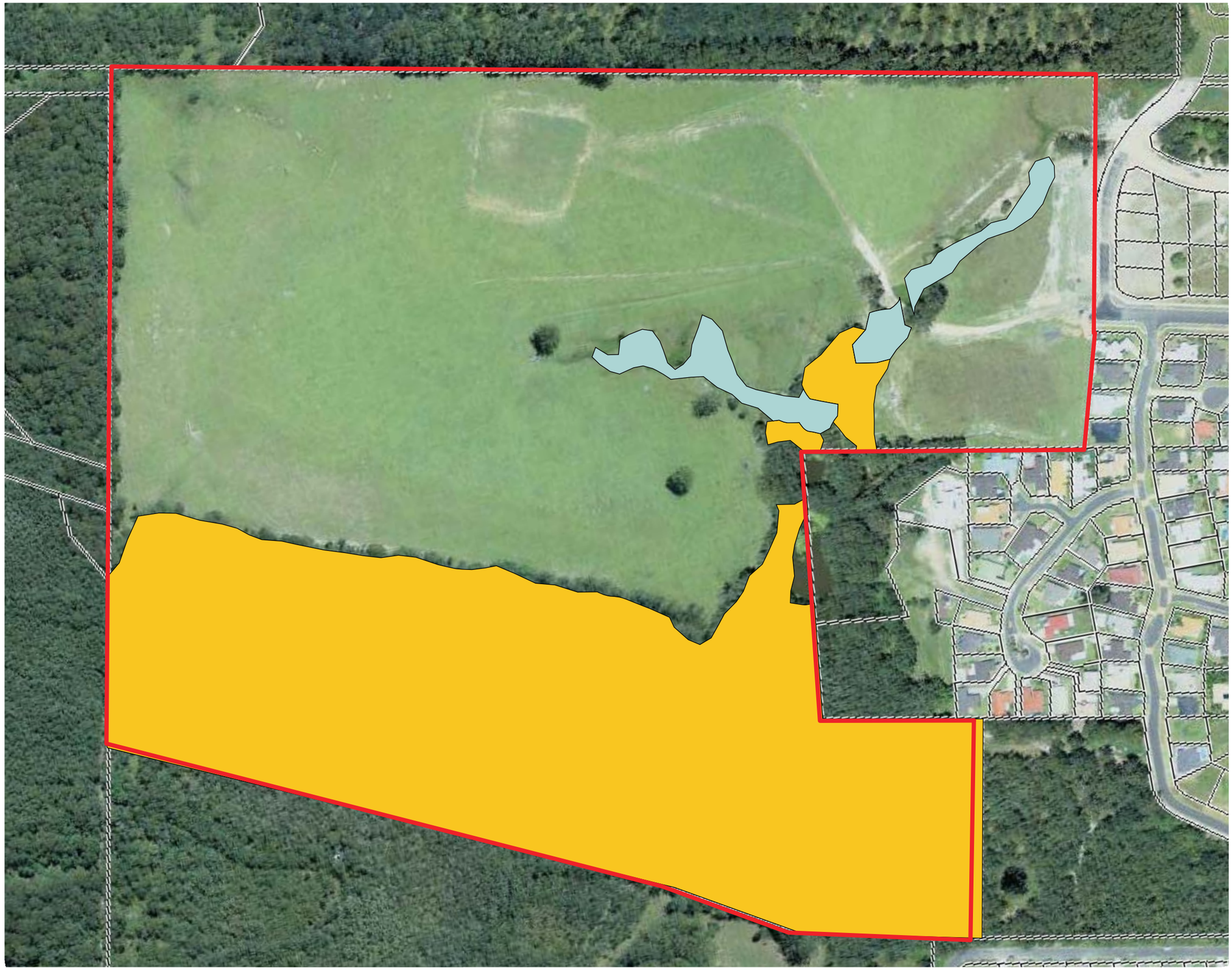
EECs are shown in **FIGURE 7.**

2.4 Significant Flora

No Threatened species, as defined by the Threatened Species Conservation Act 1995 and the Fisheries management Act 1994, were recorded from the Subject site.

2.5 Fauna Corridors

The central and western portions of the site are almost completely cleared of vegetation and have been utilised for grazing purposes for a long period of time. Extensive areas of natural forested habitat occur in the eastern part of the Subject site (as land zoned 7(a) Environmental Protection) and immediately adjacent to the site in the south and west in Bongil Bongil National Park. Scattered patches of degraded vegetation along the major drainage lines on the site provide a less than adequate corridor for east-west fauna movement between these habitat areas **(FIGURE 2).** Rehabilitation of the drainage lines will increase the extent and continuity of vegetation through this corridor. This will significantly improve the



Legend

- Swamp Sclerophyll Forest on Coastal Floodplain
- Freshwater Wetland on Coastal Floodplain (Degraded)
- Subject Site

0 100m

1 : 3000

SOURCE: JWA Site Investigations; LPI 2012 Aerial Photograph

SCALE: 1 : 3000 @ A3

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FIGURE 7

PREPARED: BW
DATE: 08 May 2013
FILE: N08022_VMP_EEC.cdr

TITLE

ENDANGERED ECOLOGICAL COMMUNITIES

value of the riparian corridor for connectivity between the 7(a) Environmental Protection land on the site and Bongil Bongil National Park to the west.

3. SITE REHABILITATION STRATEGY

3.1 Introduction

Large areas of the Subject site have been cleared and used for agriculture, which has provided opportunities for exotic weeds to colonise and establish. While most areas of intact vegetation remain in good condition, with only low to moderate levels of weed invasion, exotic species will persist and compete with native species for limited resources (e.g. light, nutrients and water). This acts as a limiting factor for regeneration of native species. Therefore, in order to enhance the natural values of the site, weed removal and weed control is required.

Regeneration will be encouraged within the RA. The drainage lines within the Riparian Corridor, including the VRZ, will be subject to management through weed removal and control, assisted regeneration and extensive revegetation. Initial works are expected to be completed within one (1) year of commencement, followed by a minimum five (5) years monitoring and maintenance period.

3.2 Rehabilitation Aims

The objectives of the site rehabilitation strategy are to:

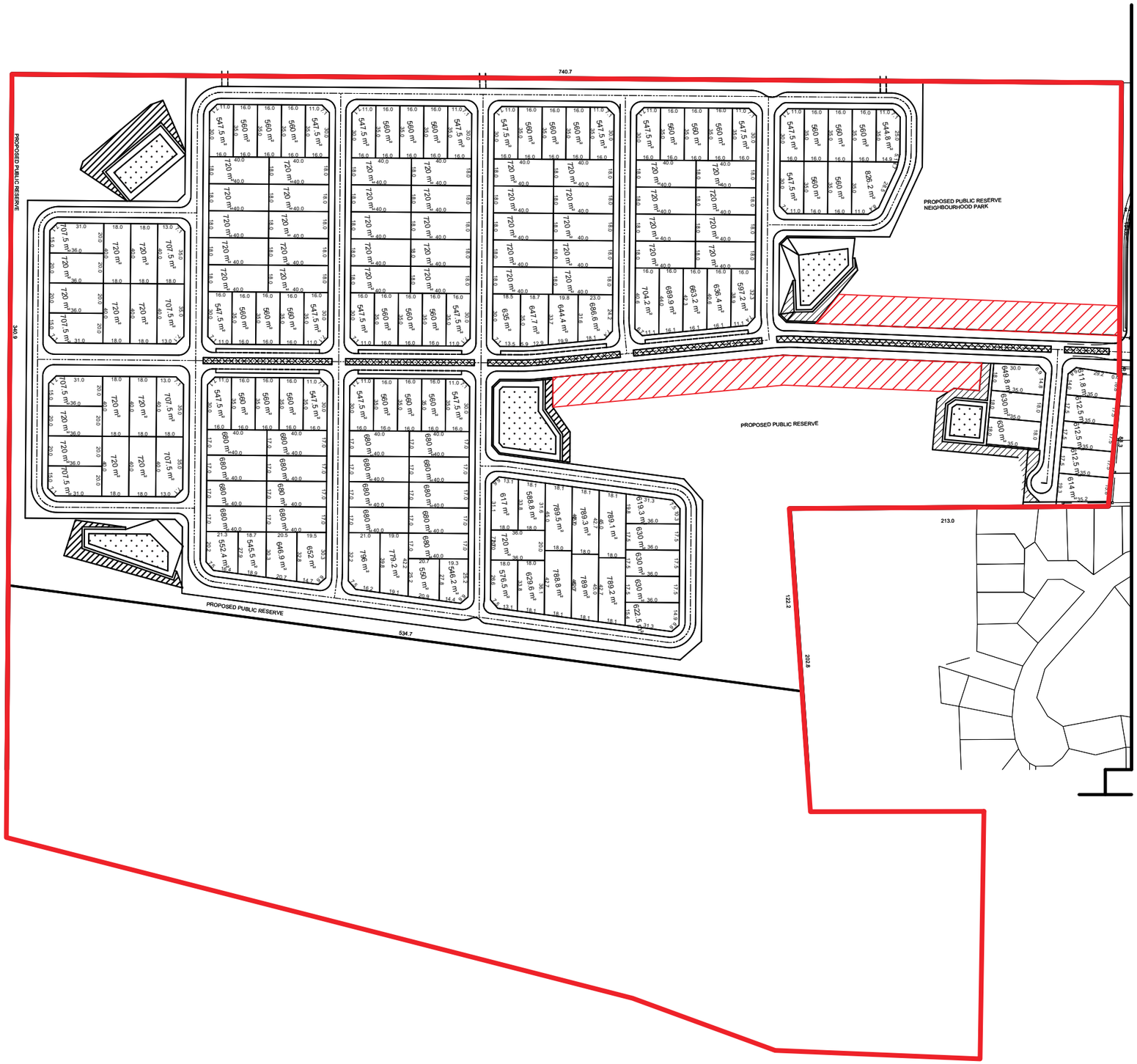
- Remove weeds utilising "best practice" protocols (**APPENDIX 2**);
- Improve the current habitat values of the site; and
- Provide a buffer to ecological features from potential impacts of the Proposed development.

The site rehabilitation strategy consists of three phases as follows:

- Weed Control;
- Assisted Regeneration; and
- Revegetation.

3.3 Bushfire Management Requirements vs. Revegetation Requirements

According to the Guidelines for riparian corridors on waterfront land (NOW 2012), the VRZ should remain, or become, vegetated with fully structured native vegetation (including groundcovers shrubs and trees). The complete revegetation of the Riparian Corridor in this way however, presents a significant bushfire hazard on the proposed development. In particular, there is only one entry-exit road to the proposed development, therefore revegetation in the immediate vicinity of the road has the potential to create a traffic pinch-point. In order to comply with the Standards for Asset Protection Zones (NSW RFS undated) and eliminate the potential pinch-point, a restricted planting area (~20m wide) adjacent to each side of the entry-exit road (~0.42 ha) is proposed (**FIGURE 8**).



Legend
Restricted Planting Zone
Subject Site

0 100m
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SOURCE: Geoff Slattery & Partners
(Ref: dwg 103b overall layout.pdf, dwg 110a wsud basins.pdf & dwg 113d apz A1.pdf)

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FIGURE 8

PREPARED: BW
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FILE: N08022_VMP_APZ.cdr

TITLE
RESTRICTED PLANTING ZONE

The restricted planting area will largely be revegetated in accordance with the composition of the Freshwater wetland EEC. This community is naturally occurring in the Riparian Corridor on the site and typically has a limited number or no woody species (DECC 2008). **SECTION 6.5** details the specific composition of the revegetation planting in the restricted planting zone.

There will be no removal of vegetation from the restricted planting area.

3.4 Dangerous Trees

Prior to construction and implementation of weed control and regeneration strategies, a Level 5 arborist will be consulted to assess the site for dangerous trees. Relevant approval will be sought from adjoining land holders before works to remove dangerous trees commence. Ongoing management of dangerous trees will be the proponent's responsibility for the first five (5) year period. After this time responsibility will lie with the Coffs Harbour City Council.

4. WEED CONTROL

4.1 Introduction

The vegetation within the riparian areas consists of both native species and weeds. The introduction of weeds is likely to be due to the use of the site for cattle grazing purposes. This section of the report provides an assessment of the weeds present and a plan for weed control. The weed control program is divided into two phases: primary and secondary weeding. Primary weeding involves the removal of established weed species and secondary weeding involves the maintenance of the Rehabilitation Areas to prevent subsequent weed infestations. Weed control will be undertaken over the entire RA identified in **SECTION 1.4.3 (FIGURE 5)**.

4.2 Weed Species Inventory

Vegetation communities have been assessed as containing low to moderate weed infestations. Most weeds occur in riparian areas in the north-west of the site, while fewer weeds occur within the Swamp Sclerophyll Forest. The field survey identified a number of weed species occurring within the proposed RA **(TABLE 2)**.

TABLE 2
WEED SPECIES OCCURRING WITHIN THE RIPARIAN CORRIDOR

Family	***Botanical Name***	**Common Name**
Asclepiadaceae	*Asclepias curassavica*	Cotton Bush
Asteraceae	*Ageratina adenophora*	Crofton weed
Asteraceae	*Baccharis halimifolia*	Groundsel Bush
Asteraceae	*Cirsium vulgare*	Spear Thistle
Asteraceae	*Senecio madagascariensis*	Fireweed
Cunoniaceae	*Tradescantia albiflora*	Wandering Jew
Juncaceae	*Juncus cognatus*	
Lauraceae	*Cinnamomum camphora*	Camphor laurel
Ochnaceae	*Ochna serrulata*	Mickey mouse plant
Poaceae	*Andropogon virginicus*	Whiskey grass
Poaceae	*Axonopus fissifolius*	Narrow leaf carpet grass
Poaceae	*Paspalum dilatatum*	Paspalum
Poaceae	*Urochloa panicoides*	Liverseed Grass
Verbenaceae	*Lantana camara*	Lantana

4.3 Primary Weeding

Weed eradication will be undertaken on a progressive basis through localised treatment of grass and herbaceous species via mechanical removal (hoe/rake, hand pulling and/or slashing) or with Roundup Biactive©. Woody weed species will be hand pulled or controlled using weed control techniques listed within **APPENDIX 2.**

All chemical users should be experienced and licensed in accordance with the relevant legislation. Utmost care must be taken when utilising chemicals to ensure that no drift occurs outside of the treatment area, especially into the adjacent creek. Spraying should not occur on windy days or within 24 hours of predicted rainfall.

Primary weeding should commence at the start of the active growing period (approximately November), or on an as needed basis.

Preparation before spraying, in the form of manual clearing weeds from around native plants, must be carried out.

Weed material that does not contain any fertile parts will be mulched and spread on the ground and any weeds that may have fertile parts present will be disposed of at an approved waste disposal facility such as Council landfills or transfer stations.

The following additional procedures will be followed:

- Before any primary weeding commences all native species within the treatment areas will be located and clearly marked for retention;
- Native seedlings/saplings will be mulched; and
- Careful hand weeding will occur at least 50cm around retained native species.

4.4 Secondary Weeding

Secondary weeding involves the eradication of weeds that have been overlooked or re-shoot after primary treatment. Secondary weeding will occur 3 to 4 months after primary weeding and no later than 6 months.

Maintenance should be undertaken at the following times:

- 2 weeks after primary weeding;
- Monthly for the 1st year;
- Quarterly for the 2nd and 3rd years; and
- Half-yearly in the 4th and 5th years.

5. ASSISTED REGENERATION

5.1 Introduction

Natural regeneration refers to the natural process by which plants replace or re-establish themselves. Natural regeneration can be described as the "regrowth" or "vegetative recovery" which occurs spontaneously, by seed or otherwise, and after a stress or disturbance (Cremer 1990; Temple & Bungey 1980). As long as mature and healthy native plants occur on the Subject site, natural regeneration is an option (Petrie 1999). Natural regeneration is a powerful tool that can be used to re-establish native vegetation. It ensures that the new growth is derived from genetic material that currently occupies the site and is adapted to local conditions. Additionally, the chance of out breeding depression is reduced.

Assisted regeneration involves actively protecting and promoting natural succession and aims to accelerate the regeneration process. In addition to protective measures, supplementary planting is completed if necessary.

5.2 Implementation

Assisted regeneration will take place, after primary weeding, in areas where there is significant cover of native vegetation (approximately 1.11ha) (**FIGURE 9**). Natural regeneration will be continually monitored for the life of the program (**SECTION 8**). Where natural recruitment is poor, active revegetation through planting will be completed (i.e. Adaptive Management **SECTION 9**). Revegetation methods will follow those outlined in **SECTION 6** of this report.

Legend

- Assisted Regeneration Areas
- Dams
- Restricted Planting Zone
- Riparian Corridor
- Subject Site

0 100m

1 : 3000

SOURCE: JWA Site Investigations; Geoff Slattery (Ref: borsato lyons080513.dwg, dwg 103b overall layout.pdf, dwg 110a wsud basins.pdf & dwg 113d apz A1.pdf)

SCALE: 1 : 3000 @ A3

JAMES WARREN & ASSOCIATES PTY LIMITED
Environmental Consultants

CLIENT
Utila Pty Ltd

PROJECT
Vegetation Management Plan
Lot 112 on DP1073791
Lyons Road, North Bonville, NSW
Coffs Harbour City Council LGA

FIGURE 9

PREPARED: BW
DATE: 10 May 2013
FILE: N08022_Regen.cdr

TITLE

ASSISTED REGENERATION AREAS

6. REVEGETATION

6.1 Introduction

Revegetation planting will be undertaken in areas cleared of native vegetation within the Riparian Corridor (approximately 2.24ha). Revegetation will involve Riparian revegetation (1.55ha) and Freshwater wetland revegetation (0.69ha) **(FIGURE 10)** based on site topography, areas of proposed topsoil fill and existing vegetation. Additional plantings may be undertaken as Adaptive Management dictates **(SECTION 9).** This section outlines the species, planting layouts and methods that will be used for plantings.

6.2 Riparian Revegetation

6.2.1 Species list

Species to be planted will include groundcovers, shrubs and trees in order to obtain a fully structured native vegetation community. Species will be chosen from those naturally occurring on the site **(APPENDIX 1)** and reflect species characteristic of the Swamp Sclerophyll floodplain forest EEC. If possible seed should be collected from the area and used to grow seedlings to plant. If this is not possible, plants should be obtained from a local nursery that can demonstrate local provenance.

6.2.2 Planting methodology

During planting the following actions will be implemented:

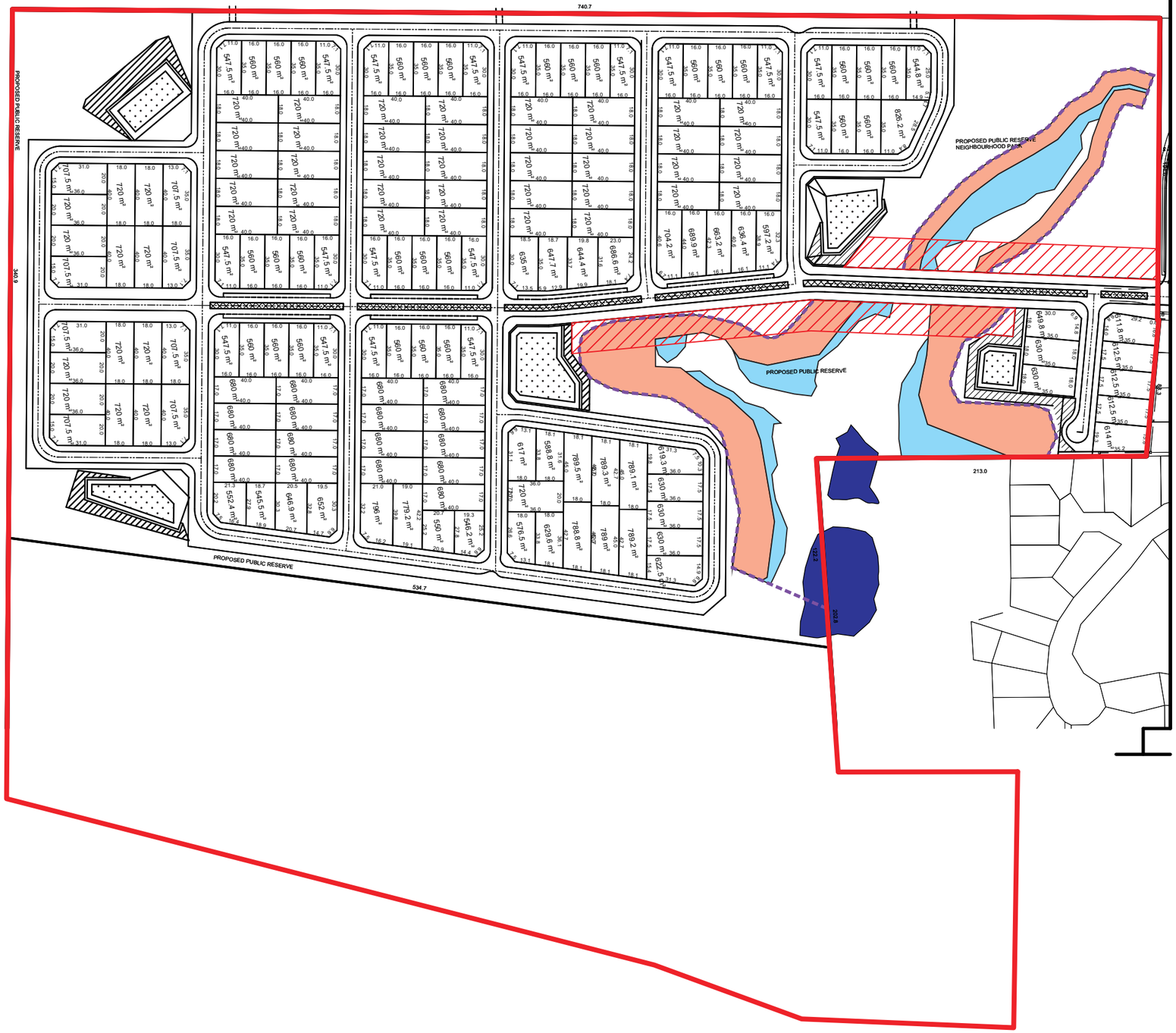
- Planting will commence after the completion of primary weeding;
- Trees, shrubs and groundcovers will be planted at spacings of 5m, 2m and 1m respectively;
- In the proposed public reserve in the north-west of the site, plantings will be arranged so that view lines between each neighbourhood park area (i.e. either side of the Riparian Corridor) can be achieved;
- All plants will be sun hardened;
- All plantings will be well watered, appropriately fertilised and heavily mulched with organic material or weed mat;
- Plants will be hand watered as necessary; and
- Plants that fail to survive will be replaced.

6.2.3 Maintenance requirements

Fertiliser and mulch will be applied again in the second and subsequent growing seasons or when needed. All plantings that fail will be replaced.

Maintenance should be undertaken at the following times:

- 2 weeks after initial plantings;
- Monthly for the 1st year;
- Quarterly for the 2nd and 3rd years; and



Legend

- Riparian Revegetation Areas
- Wetland Revegetation Areas
- Dams
- Restricted Planting Zone
- Riparian Corridor
- Subject Site

0 100m

1 : 3000

SOURCE: JWA Site Investigations; Geoff Slattery (Ref: borsato lyons080513.dwg, dwg 103b overall layout.pdf, dwg 110a wsud basins.pdf & dwg 113d apz A1.pdf)

SCALE: 1 : 3000 @ A3

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Environmental Consultants

CLIENT
Utila Pty Ltd

PROJECT
Vegetation Management Plans
Lot 112 on DP1073791
Lyons Road, North Bonville, NSW
Coffs Harbour City Council LGA

FIGURE 10

PREPARED: BW
DATE: 10 May 2013
FILE: N08022_VMP_Reveg.cdr

TITLE

REVEGETATION AREAS

- Half-yearly in the 4th and 5th years.

6.3 Freshwater Wetland Revegetation

6.3.1 Species list

Species to be planted include grasses, herbs, reeds, sedges and rushes, and aquatic herbs in order to obtain a vegetation community that more closely reflects the Freshwater wetland EEC composition. Species will be chosen from the Freshwater wetland EEC characteristic species list (DECC 2008) **(TABLE 3).** If possible seed should be collected from the area and used to grow seedlings to plant. If this is not possible, plants should be obtained from a local nursery that can demonstrate local provenance.

TABLE 3
FRESHWATER WETLAND EEC CHARACTERISTIC SPECIES LIST

Scientific Name	Common Name
Grasses	
Hemarthria uncinata	Matt grass
Leersia hexandra	Swamp rice grass
Panicum obseptum	White water panic
Paspalum vaginatum	Saltwater couch
Paspalum distichum	Water couch
Pseudoraphis spinescens	Spiny mud-grass
Herbs	
Centipeda minima	Spreading sneezeweed
Eclipta platyglossa	Yellow twin-heads
Eclipta prostrata	White eclipta
Gratiola pedunculata	Stalked brooklime
Ludwigia peploides subsp. *montevidensis*	Water primrose
Maundia triglochinoides	Small water-ribbons
Myriophyllum crispatum	Water-milfoil
Myriophyllum latifolium	Upright water-milfoil
Myriophyllum variifolium	Variable water-milfoil
Nymphoides geminata	Entire marshwort
Nymphoides indica	Water snowflake
Persicaria attenuata	Smartweed
Persicaria decipiens	Slender smartweed
Persicaria hydropiper	Water pepper
Persicaria lapathifolia	Pale knotweed
Persicaria strigosa	Prickly smartweed
Ranunculus inundatus	River buttercup
Utricularia australis	Floating bladderwort
Reeds	
Phragmites australis	Common reed
Typha orientalis	Broad-leaved cumbungi
Sedges and Rushes	
Baumea articulata	Jointed twig-rush
Baumea rubiginosa	Twig-rush

Bolboschoenus caldwellii	Club-rush
Bolboschoenus fluviatilis	Marsh club-rush
Carex appressa	Tall sedge
Cyperus lucidus	Leafy flat sedge
Eleocharis acuta	Common spike sedge
Eleocharis equisetina	A spike sedge
Eleocharis sphacelata	A spike sedge
Fimbristylis dichotoma	Common fringe-sedge
Juncus polyanthemos	A sharp rush
Juncus usitatus	Common rush
Lepironia articulata	Lepironia
Schoenoplectus litoralis	Shore club-rush
Schoenoplectus mucronatus	A club sedge
Schoenoplectus validus	River club sedge
Aquatic herbs	
Alisma plantago-aquatica	Water plantain
Azolla filiculoides var. *rubra*	Red azolla
Azolla pinnata	Azolla
Brasenia schreiberi	Watershield
Ceratophyllum demersum	Hornwort
Hydrilla verticillata	Water-tyme
Hydrocharis dubia	Frogbit
Lemna spp.	Duckweed
Marsilea mutica	Nardoo
Najas marina	Prickly waternymph
Najas tenuifolia	Waternymph
Nymphaea gigantea	Giant waterlily
Ottelia ovalifolia	Swamp lily
Philydrum lanuginosum	Woolly waterlily
Potamogeton crispus	Curly pondweed
Potamogeton ochreatus	Blunt pondweed
Potamogeton perfoliatus	Clasped pondweed
Potamogeton tricarinatus	Floating poindweed
Spirodella spp.	Thin duckweed
Triglochin procera sensu lato	Water ribbons
Vallisneria spp.	Ribbonweed
Wolffia spp.	Wolffia

6.3.2 Planting methodology

Habitat components of the site will guide the planting methodology. An aquatic revegetation planting guide is provided in **APPENDIX 3** which outlines the planting zones and densities for common macrophyte species listed above. During planting the following actions will be implemented:

- Planting will commence after the completion of primary weeding;
- Macrophytes and groundcovers will be planted at spacings of 1m and 0.5m respectively;
- All plants will be sun hardened;

- All plantings will be well watered, appropriately fertilised and heavily mulched with organic material or weed mat where necessary;
- Plants will be hand watered as necessary; and
- Plants that fail to survive will be replaced.

6.3.3 Maintenance requirements

Fertiliser and mulch will be applied again in the second and subsequent growing seasons or when needed. All plantings that fail will be replaced.

Maintenance should be undertaken at the following times:

- 2 weeks after initial plantings;
- Monthly for the 1st year;
- Quarterly for the 2nd and 3rd years; and
- Half-yearly in the 4th and 5th years.

6.4 Koala Habitat Revegetation

6.4.1 Species list

Tree species that constitute koala habitat occurring onsite include:

- Swamp mahogany (*Eucalyptus robusta*);
- Tallowood (*E. microcorys*);
- Red mahogany (*E.resinifera*);
- Pink bloodwood (*Corymbia intermedia*); and
- Broad- leaved paperbark (*Melaleuca quinquenervia*)

Riparian revegetation will utilise preferred koala food trees that are found on site where appropriate. If possible, seed should be collected from the area and used to grow seedlings to plant. If this is not possible, plants should be obtained from a local nursery that can demonstrate local provenance.

6.4.2 Planting methodology

Generally, Tallowwood can be planted in most elevated areas, while Swamp mahogany and Broad-leaved paperbark are more suitable for seasonally wet locations. Red mahogany and Pink bloodwood may also be suitable depending on site specifications (Lunney *et al* 1999). Trees that drop limbs (e.g. Blackbutt) are unsuitable for public areas or adjacent to buildings.

Tree planting programs should also incorporate understorey species for variety, ecological health and koala refuge especially during hot weather. The intent of replanting is to create additional koala habitat areas representative of Sclerophyll Forest, rather than a monoculture of koala food trees. Therefore, koala tree planting will complement riparian planting (**SECTION 6.2**) with the number of koala food trees to be planted comprising no less than 35% of the proposed vegetation cover. In

addition, it is preferable to plant koala food trees in clusters in the vicinity of existing trees which a koala may occasionally use, rather than in an even spaced 'plantation' or in lines (Lunney *et al* 1999).

During planting the following actions will be implemented:

- Planting will commence after the completion of primary weeding;
- Koala food trees will be planted in clusters rather than being evenly spaced and comprise >35% of vegetation cover;
- All plants will be sun hardened;
- All plantings will be well watered, appropriately fertilised and heavily mulched with organic material or weed mat;
- Plants will be hand watered as necessary; and
- Plants that fail to survive will be replaced.

6.4.3 Maintenance requirements

Fertiliser and mulch will be applied again in the second and subsequent growing seasons or when needed. All plantings that fail will be replaced.

Maintenance should be undertaken at the following times:

- 2 weeks after initial plantings;
- Monthly for the 1st year;
- Quarterly for the 2nd and 3rd years; and
- Half-yearly in the 4th and 5th years.

6.5 Restricted planting area revegetation

Revegetation in the restricted planting area (approximately 0.42ha) will generally be of less diversity/density than other areas of the VRZ. The restricted planting area will largely be revegetated in accordance with the species composition, methodology and maintenance used in the Freshwater wetland revegetation (**SECTION 6.3**).

To comply with the Standards for Asset Protection Zones (NSW RFS undated), tree canopy cover in the restricted planting zone must be less than 15%, flammable shrubs must not be located under trees, and trees should have lower limbs removed up to a height of 2 meters above the ground. Plantings of trees or shrubs within the restricted planting area will therefore be sparsely spaced. Plantings at approximately 25m centres would achieve canopy cover of less than 15%.

Any tree plantings in this area will be in accordance with the species composition, methodology and maintenance used in Riparian revegetation (refer to **SECTION 6.2** and **APPENDIX 1**). However, the planting of non-volatile tree and shrub species are preferential in the restricted planting area e.g. Black She-oak, Swamp Oak, Sandpaper Fig, Strangler fig, Blueberry Ash, Black Wattle, Lilly Pilly, Bleeding Heart, Sweet Pittosporum, Geebung, Red Ash, etc.

It is important that the restricted vegetation area is maintained in accordance with the Standards for Asset Protection (NSW RFS undated). Natural regeneration that may occur subsequent to initial revegetation plantings should be managed to ensure the tree canopy cover in the restricted planting zone remains less than 15% and that flammable shrubs that may naturally recruit beneath trees do not establish.

7. PROTECTIVE MEASURES

7.1 Introduction

This section outlines how the natural values of the site will be protected.

7.2 Signage

Signs will be posted along the RA boundary stating "No Entry – Native Plant Revegetation Area". Signage should also have an educational theme providing information about Wetlands and Swamp Sclerophyll Forests and the associated flora and fauna.

7.3 Fencing

If it is considered that the RA is exposed to physical damage, through trampling and/or vandalism, or weeds are being introduced via dispersal by humans and/or animals, an exclusion fence will be erected. This will be part of an adaptive management strategy. A fencing plan will be developed by a Fencing Contractor in consultation with the Bush Regenerator. The fencing plan should consider the following issues:

- Construction (either temporary, constructed with star pickets and smooth galvanized wire, or permanent constructed using koppers logs);
- Fauna exclusion of fauna friendly (depending on the rate of mammal herbivory); and
- The fence will be retained until the plantings are considered to be sufficiently established.

8. MONITORING AND REPORTING

8.1 Introduction

Monitoring is very important in ensuring the continuing success of the rehabilitation of the Riparian Corridor. Monitoring and reporting ensures that rehabilitation and management activities are meeting set objectives and allows for adaptive management strategies to be introduced if necessary. The existing landowner should be responsible for engaging an appropriately qualified person to develop and implement a monitoring plan.

Monitoring and reporting can be divided into three phases:

- Monitoring of all activities including weeding and planting (Bush Regenerator).
- Monitoring of progress of rehabilitation including plant growth and natural recruitment (Ecologists).
- Reporting that evaluates the result of the above monitoring against performance criteria (Ecologists).

8.2 Bush Regeneration Monitoring

The Bush Regenerator will keep detailed work sheets recording:

- All work completed each day;
- Site conditions;
- Chemicals used;
- Problems encountered; and
- Future works required.

An example of a Daily Work Record Form is provided (**APPENDIX 3).** These records and general comments on progress will be provided to the Ecologist for consideration and inclusion in the overall monitoring reports.

8.3 Ecological Monitoring

Ecological Monitoring should be carried out for a minimum of five (5) years. The first monitoring visit should be undertaken six (6) weeks after primary weeding, followed at quarterly intervals for first year, then half-yearly until the completion of the project.

The following data should be collected:

- Name of data recorder;
- Date and prevailing weather;
- Canopy height of native and exotic species;

- Percentage cover of canopy and ground strata – native and exotic species;
- Number and relative abundance - native and exotic species;
- Four (4) photos (north, east, south, west) are to be taken at two (2) permanent photo points;
- Damage which may have occurred since the last visit;
- General check on the plants growing conditions (water, mulch, nutrients/fertiliser);
- Notification of weeds species present should be recorded and reported to the contracted Bush Regenerator;
- Loss or erosion of topsoil from re-vegetated areas;
- Records of new native volunteer species, their location and number;
- Increase or decrease in cover of native and weed species within the ground and canopy strata;
- Survival rate and condition of planted species; and
- Likely reason(s) for the death or failure to thrive of any plants.

An example of a Monitoring and Evaluation Record sheet is provided in **APPENDIX 4.**

8.4 Monitoring Reports

All reports will be submitted to the existing owner for distribution to the Coffs Harbour City Council and the Department of Planning. The first report will be submitted three (3) months after the initial plantings. Subsequent reports will be provided every six (6) months for a period of three (3) years, then annually for the final two (2) years.

The monitoring reports should discuss the following:

- Results of the bush regeneration monitoring including any general comments from the Bush Regeneration Team Leader and all daily work record forms**;**
- Problems since the previous inspection (i.e. plant mortality, broken tree guards, fertiliser or mulch requirements, vandalism or broken fences);
- The effect the above problems;
- Measures taken or proposed to rectify any problems; and
- The success or failure of measures implemented to rectify problems.

The Coffs Harbour City Council and the DoP will acknowledge the receipt of each monitoring report and provide comments as necessary.

9. ADAPTIVE MANAGEMENT

9.1 Introduction

Adaptive management is an approach that involves learning from management actions and using those lessons to improve upon the overall plan. The principles of adaptive management have been incorporated into the administration of restoration projects within a variety of governmental authorities and programs (Thom 1997). Comprehensive, long-term monitoring is a component of adaptive management as adaptive management strategies rely on the accumulation of evidence supporting decisions that demand changes in action.

9.2 Adaptive Management Approach

An adaptive management approach to this VMP involves an integrated process of firstly monitoring, then reviewing and responding to the health and condition of plantings, natural regeneration and the status of any weed infestation. Alteration to the design and maintenance of works required, to ensure the objectives of the VMP are achieved, are then made as necessary.

Adaptive management strategies that may be required but not confined to are:

- Variation in areas that will be planted (i.e. where assisted regeneration fails to result in an acceptable level of natural recruitment);
- Variation of species to be planted according to soil and moisture conditions;
- Replacement of plantings that do not survive;
- Fencing; and
- Alteration of timing of weed control or weed control methods.

Before the implementation of any adaptive management strategy a brief report is to be provided to the Landowner and the Coffs Harbour City Council detailing the proposed management actions and the predicted outcomes. These will be determined on the basis of information from the reports provided by either the Bush Regenerator or the Ecologist's reports. Coffs Harbour City Council must then approve the adaptive management techniques in writing prior to implementation.

Future maintenance and ongoing management will be the proponent's responsibility for the first five (5) year period. After this time responsibility will lie with the Coffs Harbour City Council.

10. COSTED SCHEDULE OF WORKS

10.1 Introduction

This section provides approximate costs associated with the implementation of rehabilitation works.

10.2 Costing Schedule

Approximate total costing for the five (5) year rehabilitation program is provided in **TABLE 4**.

TABLE 4
TOTAL COST OF REHABILITATION WORKS

Works	Total cost
Arborist assessment	$2,400
Revegetation	$256,125
Weeding, assisted regeneration and maintenance	$57,700
Monitoring and reporting	$11,700
	$327,925*

* If protective fencing is required total cost increased to $342,345.

The costs outlined above include:

- Arborist assessment (**TABLE 5**);
- Revegetation (**TABLE 6**) (tube stock and average cost per plant for planting, site prep, mulch, fertiliser, tree guard; and revegetation maintenance);
- Weed control (**TABLE 7**) (team of 3 trained bush regenerators), herbicide and use of all equipment inclusive of bush regeneration: tools, back pack sprayers, chainsaws and 300 litre quick spray unit with 2 x 200m remote control hoses);
    - Primary weeding
    - Secondary weeding (2 weeks after initial plantings; monthly for the 1st year; quarterly for the 2nd and 3rd years; and half-yearly for the 4th and 5th years)
- Assisted regeneration (**TABLE 7**); and
- Monitoring and reporting (**TABLE 8**)
    - Monitoring: 6 weeks after primary weeding; quarterly intervals for the first year; half-yearly until the completion of the project or for 5 years.

- Reports: 1 x 3 months after initial plantings, half-yearly for a period of 3 years and yearly for the final 2 years.

Costs will vary depending on site conditions and effort required for future maintenance.

TABLE 5
APPROXIMATE COST OF ARBORIST ASSESSMENT

Works	Estimated hours	Hourly rate	Total cost
Arborist assessment	40	$60	**$2,400**

TABLE 6
APPROXIMATE COST OF REVEGETATION WORKS

	Total area to be planted (ha)	Average planting density per ha	Number of plants	Average cost per plant*	Total Cost
Riparian	1.20	13,000**	15,600	$7.50	$117,000
Wetland	0.63	25,000	15,750	$5.30	$83,475
Restricted planting area (Shrubs and wetland plants, etc.)	0.42	25,000	10,500	$5.30	$55,650
					$256,125

* Includes site preparation, seedling, planting, mulch, fertiliser, tree guard, etc.
** Includes trees, shrubs and groundcovers

TABLE 7
APPROXIMATE COST OF 5 YEAR WEEDING, ASSISTED REGENERATION AND MAINTENANCE WORKS

Works	Estimated team days	Daily rate prices excl. GST	Total Cost
Primary weeding	7	$1,100	$7,700
Secondary weeding/ Assisted regeneration (5 years)	25 (1 day per follow up visit)	$1,100	$25,000
Revegetation maintenance (5 years)	25 (1 day per follow up visit)	$1,100	$25,000
			$57,700

TABLE 8
APPROXIMATE COST OF 5 YEAR MONITORING WORKS

Works	Estimated hours	Hourly rate	Total Cost
Monitoring and reporting	78 (13 site visits)	$150	**$11,700**

Further costs may be incurred if protective measures are required based on the results of monitoring and adaptive management (**TABLE 9**).

TABLE 9
APPROXIMATE COST OF PROTECTIVE WORKS

Works	Estimated no.	Unit price	Total Cost
Fencing: star pickets	500	$4.60	$2,300
Fencing: wire	40 (200m)	$32	$5,120
Fencing: labour	2,000	$3.50/m	$7,000
			$14,420

REFERENCES

DECC (2008) Freshwater Wetlands on Coastal Floodplains (Freshwater Wetlands). NSW Government Department of Environment and Climate Change.

Cremer K W (ed)(1990) Trees for Rural Australia, Inkata Press.

Lunney, D., Moon, C., Matthews, A., and Turbill, J. (1999). Coffs Harbour City Koala Plan of Management. Part A The Plan. NSW National Parks and Wildlife Service, Hurstville.

New South Wales Rural Fire Service (NSW RFS) (undated). Standards for Asset Protection Zones.

NOW (2012) Guidelines for riparian corridors on water front land. NSW Government Department of Primary Industries Office of Water

Petrie (1999) Natural Regeneration: Principles and Practice. Land for Wildlife Note No. 8 November 1999.

Temple and Bungey (1980) Revegetation: methods and Management, State Pollution Control Commission, NSW.

Thom, Ronald M. (1997). From Advanced Habitat Restoration Training materials, presented at Norrie Point Environmental Centre, Staatsburg, NY, June 1997.

APPENDIX 1 – NATIVE PLANT SPECIES LIST

Family	*Botanical Name*	Common Name
Apiaceae	*Centella asiatica*	Pennywort
Apocynaceae	*Parsonsia straminea*	Common silkpod
Araceae	*Gymnostachys anceps*	Settlers flax
Araliaceae	*Polyscias sambucifolia*	Elderberry panax
Blechnaceae	*Blechnum indicum*	Swamp Fern
Casuarinaceae	*Allocasuarina torulosa*	Forest Oak
Casuarinaceae	*Casuarina glauca*	Swamp Oak
Cunoniaceae	*Callicoma serratifolia*	Black Wattle
Cyperaceae	*Cyperus stradbrokensis*	
Cyperaceae	*Gahnia sieberana*	Saw Sedge
Cyperaceae	*Restio tetraphyllus*	Curly Sedge
Cyperaceae	*Gahnia clarkei*	Tall saw-sedge native
Dennstaedtiaceae	*Histiopteris incisa*	Batswing fern
Dennstaedtiaceae	*Pteridium esculentum*	Soft Bracken Fern
Dilleniaceae	*Hibbertia scandens*	Guinea Flower
Dilleniaceae	*Hibbertia vestita*	
Epacridaceae	*Leucopogon lanceolatus*	Lance-leaf Beard-heath
Euphorbiaceae	*Phyllanthus gunnii*	Blunt Spurge
Fabaceae Faboideae	*Hardenbergia violacea*	False Sarsparilla
Fabaceae Faboideae	*Indigofera australis*	Native Indigo
Fabaceae Faboideae	*Pultenaea dentata*	Egg and Bacon Pea
Fabaceae Mimosoideae	*Acacia melanoxylon*	Blackwood
Fabaceae Mimosoideae	*Acacia floribunda*	Sally wattle
Flacourtiaceae	*Scolopia braunii*	Flintwood
Juncaceae	*Juncus continuus*	
Juncaceae	*Juncus polyanthemus*	
Juncaceae	*Juncus usitatus*	Rush
Lobellaceae	*Pratia purpurascens*	Whitroot
Lomandraceae	*Lomandra hystrix*	
Lomandraceae	*Lomandra longifolia*	Spiny-headed Mat-rush
Luzuriagaceae	*Geitonoplesium cymosum*	Scrambling lily
Moraceae	*Ficus watkinsiana*	Strangler fig
Myrtaceae	*Angophora costata*	Smooth barked apple
Myrtaceae	*Archirhodomyrtus beckleri*	Rose Myrtle
Myrtaceae	*Callistemon salignus*	Willow-Leaved Bottlebrush
Myrtaceae	*Eucalyptus grandis*	Flooded Gum
Myrtaceae	*Eucalyptus intermedia*	Pink Bloodwood
Myrtaceae	*Eucalyptus microcorys*	Tallowwood
Myrtaceae	*Eucalyptus pilularis*	Blackbutt
Myrtaceae	*Eucalyptus resinifera*	Red Mahogany
Myrtaceae	*Eucalyptus robusta*	Swamp Mahogany
Myrtaceae	*Leptospermum juniperinum*	Prickly Tea tree
Myrtaceae	*Lophostemon suaveolens*	Swamp turpentine
Myrtaceae	*Lophostemon confertus*	Brushbox
Myrtaceae	*Melaleuca quinquenervia*	Broad-Leaved Paperbark
Myrtaceae	*Syncarpia glomulifera*	Turpentine
Philydraceae	*Philydrum lanuginosum*	Frogsmouth
Phormaceae	*Dianella caerulea*	Blue Flax Lily

Family	*Botanical Name*	Common Name
Pittosporaceae	*Pittosporum undulatum*	Sweet pittosporum
Poaceae	*Cynodon dactylon*	Couch
Poaceae	*Imperata cylindrica*	Blady grass
Poaceae	*Leersia hexandra*	Swamp ryegrass
Poaceae	*Themeda australis*	Kangaroo Grass
Proteaceae	*Banksia spinulosa*	Hill Banksia
Proteaceae	*Persoonia stradbrokensis*	Geebung
Rhamnaceae	*Alphitonia excelsa*	Red Ash
Santalaceae	*Exocarpus cupressiformis*	Native Cherry
Sapindaceae	*Dodonaea viscosa*	Hop Bush
Thymeleaceae	*Pimelea ligustrina subsp. ligustrina*	Tall rice Flower
Ulmaceae	*Trema tomentosa*	Native Peach
Xanthorrhoeaceae	*Xanthorrhoea fulva*	Grass Tree

APPENDIX 2 - WEED CONTROL METHODS

The following are control techniques that are to be utilised during site regeneration works:

- **Cut Stump Method** - This method involves cutting plant stems as close to ground level as possible and immediately painting the cut stump with herbicide. This treatment can also be applied as a basal bark application to the first 15-20cm (entire circumference) of an uncut stem if the adult bark has not yet developed. Chemical use with this application is dependent on the proximity of the weed to naturally ponding water or waterways and whether or not the chemical is registered for aquatic use.

- **Basal Bark Method** - This method involves applying a herbicide to the lower 35-45cm bark around the entire stem using a hand-pump backpack sprayer fitted with a shut-off at the wand tip and an adjustable cone nozzle or a small, ATV (All-Terrain Vehicle)-mounted sprayer with a shut-off at the wand tip and an adjustable cone nozzle.

- **Ring Barking -** This method involves removing the lower bark from the stem using a sharp implement to expose the phloem and xylem tissue to the outer environment thereby destroying it.

- **Spray Method** - There are two (2) types of spraying methods that will be employed where appropriate:

    - Selective blanket spraying: The area must initially be checked for the presence of any native species. Any weeds within 2m of the drip zone of existing native species will be removed by hand. Alternatively, native species will be covered with impermeable material (e.g. a tarpaulin) for protection during spraying;
    - Spot spraying: The spray nozzle will be kept close to ground to avoid any overspray. Individual weeds will be spot-sprayed at the site. This method of spraying will be employed as native species are interspersed throughout the exotic grasses; and
    - Herbicides specific to each target species, where appropriate, will be identified prior to the implementation of any works. Herbicides will be applied in accordance with the manufacturer's specifications and when environmental conditions are most preferred (e.g. wind and rainfall).

- **Stem Injection** - Herbicides may be applied directly to the plant via stem injection. This involves applying a herbicide to the plant directly through drilling a hole into the stem and inserting the chemical. Axe cuts for stem injection can also be used. Cuts can be made at regular intervals around the stem and should leave a "pocket" in to which the chemical must be immediately injected. Axe cuts should penetrate the cambium layer, but not the hardwood.

- **Wick Wiping** - This method employs vehicle-mounted (broad acre application) or hand-held equipment (small area/single plant application) to wipe or brush concentrated herbicide onto weeds. The herbicide is

applied from permeable rope that is permanently connected to a reservoir containing Glyphosate. For purposes of weed control where accessibility to the infestation is low, a hand held 'wick wipe' will be used. This will also be incorporated for the control of emergent species. This method is particularly safe to use in areas where weed species are interspersed with native plants as there is no spray drift of herbicide.

- **Cutting and Chipping** - Manual weeding may involve cutting and chipping, pulling, digging or slashing and is preferred, depending on the growth stage and situation as detailed:

    - Where native plants are growing within a weed infestation and the use of selective herbicide is not possible;
    - Where inadequate foliage is present to allow for successful uptake of herbicide e.g. Mile-a-minute runners typically exhibit this trait; and
    - When hand weeding, the stem must be grasped firmly at the base of the plant and pulled. A trowel, mattock or sharp knife may be needed to loosen the soil. Care must be taken not to leave behind stems or other plant pieces that may re-shoot. Hand weeding should also be undertaken at times when weeds are not seeding to reduce dispersal and spread. Hand pulling is not recommended for some weed species as they readily sucker if their roots are disturbed e.g. *Lantana camara*. This method will be employed when removing exotic grass species within retained vegetation.

APPENDIX 3 – AQUATIC REVEGETATION

A palette of species recommended for planting in the wetland areas of the site has been developed based on the existing local flora assemblages and the recommendations contained in the Constructed Wetlands Manual (DLWC 1998). A comprehensive wetland species list is provided below.

AQUATIC REVEGETATION SPECIES LIST

Planting zone	Common Name	Botanical Name	Plant Density/m^2*
1	Bare twigrush	*Baumea juncea*	2-3
	Gristle fern	*Blechnum cartilagineum*	
	Swamp water fern	*Blechnum indicum*	
	Rough saw sedge	*Gahnia aspera*	
	Red-fruited saw sedge	*Gahnia sieberiana*	
	Slender matrush	*Lomandra hystrix*	
	Long-leaved matrush	*Lomandra longifolia*	
	Water Couch	*Paspalum distichum*	
	Common spike-rush	*Eleocharis acuta*	
2	Twigrush	*Baumea rubiginosa*	3-4
		Carex appressa	
	Sedge	*Cyperus exaltatus*	
	Knobby club rush	*Isolepis nodosa*	
	Soft rush	*Juncus kraussiana*	
	Common rush	*Juncus usitatus*	
	Giant sedge	*Lepironia articulata*	
	Variable sword sedge	*Lepidosperma laterale*	
	Marsh Clubrush	*Bolboschoenus fluviatilis*	
	River clubmarsh	*Schoenoplectus validus*	
	Spike rush	*Eleocharis equisetina*	
3	Jointed Twigrush	*Baumea articulata*	3
	Rusty finger rush	*Fimbristylis ferruginea*	
		Schoenoplectus mucronatus	
4	Tall spikerush	*Eleocharis sphacelata*	3-4
	Giant sedge	*Lepironia articulata*	

* Denotes total plant density within each zone.

Planting zones have been derived from the Constructed Wetlands Manual (DLWC 1998) and are as follows:

1) Mostly dry (75%) – some seasonal water logging
2) Wet (50%)/ Dry (50%)
3) 0.25m – 0.5m deep
4) 0.5m – 2m deep

It should be noted that planting densities shown are the estimated maximum planting density for each planting zone. Natural recruitment of native species in some areas will reduce necessary planting densities.

APPENDIX 4 - BUSH REGENERATOR'S DAILY WORK RECORD

Name……
Date ……
RA ……
Site Name / Location _____
Date _____ Time _____ to _____
Team/Staff_____
____

Growing conditions			Temperature / Humidity			Weather conditions		Wind direction / Speed	
Zone(s) / Work locations			Hours	Weeds treated				Method	New T.S. encountered / Location
Chemicals used / Rates / Totals								Notes and comments	
Equipment used	Round-up	Associate	Herbidye	Pulse		Water	Number mixed		
Daily Chemical Totals									

APPENDIX 5- MONITORING AND EVALUATION FORM

Assessor……					Progress on Weed Control
Date……					……
MZ……					……
Weather……					Progress on Enhancement Plantings
General Conditions ……					……
	Existing Natives	Volunteer Natives	Weeds	Plantings	……
Canopy Height	…….	…….	…….	…….	Progress on Natural Regeneration
% Cover Canopy	…….	…….	…….	…….	……
% Cover Ground	…….	…….	…….	…….	……
Photos (Photo #)	North	South	East	West	Damage to Site
Point 1	…….	…….	…….	…….	……
Point 2	…….	…….	…….	…….	Adaptive Management Strategies
Summary of Management Works……					……
……					Requirements for on Going Maintenance
……					……