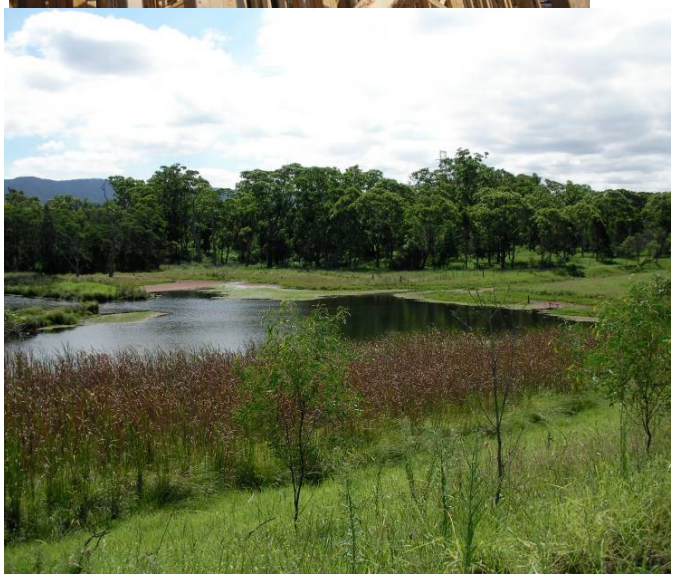
Tallawarra Lands Part 3A Concept Plan Application

Vegetation Management Plan

Prepared for
TRUenergy

4 February 2011



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Abbreviations

ABBREVIATION	DESCRIPTION
APZ	Asset Protection Zone
CRZ	Core Riparian Zone
EEC	Endangered Ecological Community
EPBC Act	Environment Protection and Biodiversity Conservation Act
LEP	Local Environment Plan
LIA	Lake Illawarra Authority
SEPP	State Environmental Planning Policy
TSC Act	Threatened Species and Conservation Act
VB	Vegetated Buffer
VMP	Vegetation Management Plan
VPA	Voluntary Planning Agreement
WCC	Wollongong City Council
WSUD	Water Sensitive Urban Design

Executive Summary

The Director General's Requirements for the development of the Tallawarra Lands (the lands) require that a Vegetation Management Plan (VMP) be developed for all of the lands which will be retained as part of the proposed development. This includes lands set aside for both environmental and open space uses. Across the Tallawarra Lands there is approximately 353 hectares of retained land that will require native vegetation and weeds to be managed as part of the development proposal. This Vegetation Management Plan (VMP) addresses requirements identified in the Tallawarra Lands Riparian Assessment (ELA 2010c), the Tallawarra Lands Ecological Assessment (ELA 2010b) and the Tallawarra Lands Bushfire Assessment (ELA 2010a) and with regard to the first 5 years of management. It has also sought integration with a Landscape Masterplan (Corkery Consulting, in prep) and plans for Water Sensitive Urban Design (WBM BMT, in prep).

The Tallawarra Lands have been split into 11 different management zones as described below and represented in **Figure 6**.

Zone	Zone Name	Proposed Management Approach
1	Duck Creek	• 100-metre buffer either side of the creek with targeted revegetation • Control of noxious and environmental weeds
2	Wetlands Environmental Reserve	• Woodland area – noxious and environmental weed control • Grassland area – noxious weed control
3	Southern Lakes	• Buffer provided from water bodies to development • Targeted revegetation including aquatic habitat • Noxious and environmental weed control
4	Yallah Creek	• Riparian management (water quality and soil erosion management works) with revegetation, habitat creation and open space plantings • Noxious weed control
5	Western Edge – Southern Area	• Control noxious and environmental weeds • Maintain remnant native vegetation
6	Western Edge – Central Area	• Noxious and environmental weed control • Revegetation may be required depending on response of native vegetation to management works
7	Western Edge – Northern Area	• Open space with amenity plantings using native overstorey species, as part of the Landscape Masterplan (Corkery Consulting, in prep) • Noxious weed control
8	Central Riparian Open Space Corridor	• Riparian management (water quality and soil erosion management works) with revegetation, habitat creation and open space plantings • Noxious weed control
9	Mt Brown Reserve	• Control of noxious and environmental weeds • Provision of stock proof fencing and vehicle access • Targeted revegetation, including Barron Gully riparian zone

Zone	Zone Name	Proposed Management Approach
10	East & West Mid slopes	• Noxious weed control • Maintain existing open space with amenity plantings provided (Corkery Consulting, in prep) and some targeted fencing of vegetation remnants
11	Foreshore Reserve	• Noxious and environmental weed control • Targeted open space revegetation

The main focus of vegetation management works will be on the control of noxious weeds, particularly *Lantana camara* (Lantana), although in areas protecting important environmental features environmental weeds will also be targeted for control.

Duck Creek has been identified as an area to be managed for conservation and therefore is a focus of this plan. Works will include fully structured native vegetation to be restored through the statutory 50m buffer either side of Duck Creek, including areas that are currently cleared of native vegetation. Remnant native vegetation within the remaining areas of the Duck Creek corridor (areas outside the statutory 50m buffer) will be treated with extensive weed control to improve their condition. Currently unvegetated areas outside the statutory 50m buffer will also receive weed control along with targeted native revegetation to support the restoration of the 50m riparian zone. Targeted revegetation along the Duck Creek corridor adjacent to development will integrate bushfire asset protection zones in line with RFS requirements (RFS 2006) and low key open space/informal recreation uses.

A number of other minor waterways require revegetation works along their riparian zones, including Yallah Creek, Barrons Gully and creek 4 within the central open space area. These works will focus on the provision and maintenance of bed and bank stability and water quality through revegetation of currently cleared riparian zones. These revegetation works will be complemented by noxious weed control.

The large wetlands in the south of the lands will be managed to maintain their current form due to the utilisation by migratory and threatened bird species. The wetlands have been setback from the development and this setback will be revegetated with native species to buffer this interface and also to integrate open space/informal recreation landuses. Fringing aquatic vegetation (including saltmarsh species) will be protected and improved (where needed) through weed control and targeted revegetation.

All other management zones will require weed control works, primarily targeting noxious weed species, with some landscape plantings using native overstorey and midstorey species, except in areas where the existing landuse (i.e. horse agistment) will be continued, where only weed control will be undertaken.

The cost to implement the VMP has been estimated at **$3,881,538** over a five year period. This includes all costs for a team of four bush regenerators, site supervisor, herbicides, equipment (including vehicles) and the cost of revegetation works.

1 Introduction

TRUenergy is preparing an Environmental Assessment to support a Part 3A Concept Plan application to the Department of Planning. The Director General's Requirements for the development of the Tallawarra Lands (the lands) require that a Vegetation Management Plan (VMP) be developed for all of the lands which will be retained as part of the proposed development. This includes lands set aside for both environmental and open space uses. The Director General's Requirements of most relevance are:

7. Public Domain/conservation areas/foreshores

a) The EA shall provide details on the interface between the proposed uses and public domain spaces and outline the long-term management and maintenance of any areas of open space, including ownership and control, management and maintenance funding, public access, and vegetation and rehabilitation works.

b) The EA shall enhance public access to and along the foreshore and provide new opportunities for public access. It shall also consider access for disabled, where appropriate.

c) The EA shall provide details regarding the tenure and responsibility for management of the conservation and foreshore areas. This shall include details on the proposed mechanisms to fund the preparation of management plans, enhancement work and the on-going management of the areas. Conservation areas should have adequate funding resources to provide for management of their values in perpetuity.

The development of this VMP has been informed by an Ecological Impact Assessment (ELA 2010b) a Bushfire Assessment (ELA 2010a) and a Riparian Assessment (ELA 2010c). It has also been developed in light of discussions and information provided by TRUenergy and other consultants on the project design team (Corkery Consulting, in prep. and WBM BMT, in prep).

1.1 BACKGROUND

The lands are 541 hectares in size on the western edge of Lake Illawarra. The concept plan for the development of the lands (**Figure 1**) includes employment lands, residential precincts, a local centre, a school, a retirement living area, a tourism site, conservation areas and local parks.

1.2 OBJECTIVES

This VMP has been developed following the guidelines identified in the Wollongong Development Control Plan (DCP) (2009). The objectives of the VMP are to manage all areas of native vegetation and areas of open space outside the development foot print (i.e. retained lands). Management actions required include:

- Prevention of soil erosion in riparian areas;
- Control of noxious and environmental weeds;
- Revegetation of degraded areas where required;

- Protection of habitats for threatened species on the lands;
- Provide linkages with other conservation projects in the vicinity;
- Provide monitoring and reporting methodologies; and
- Provide indicative costs for the implementation of the VMP.

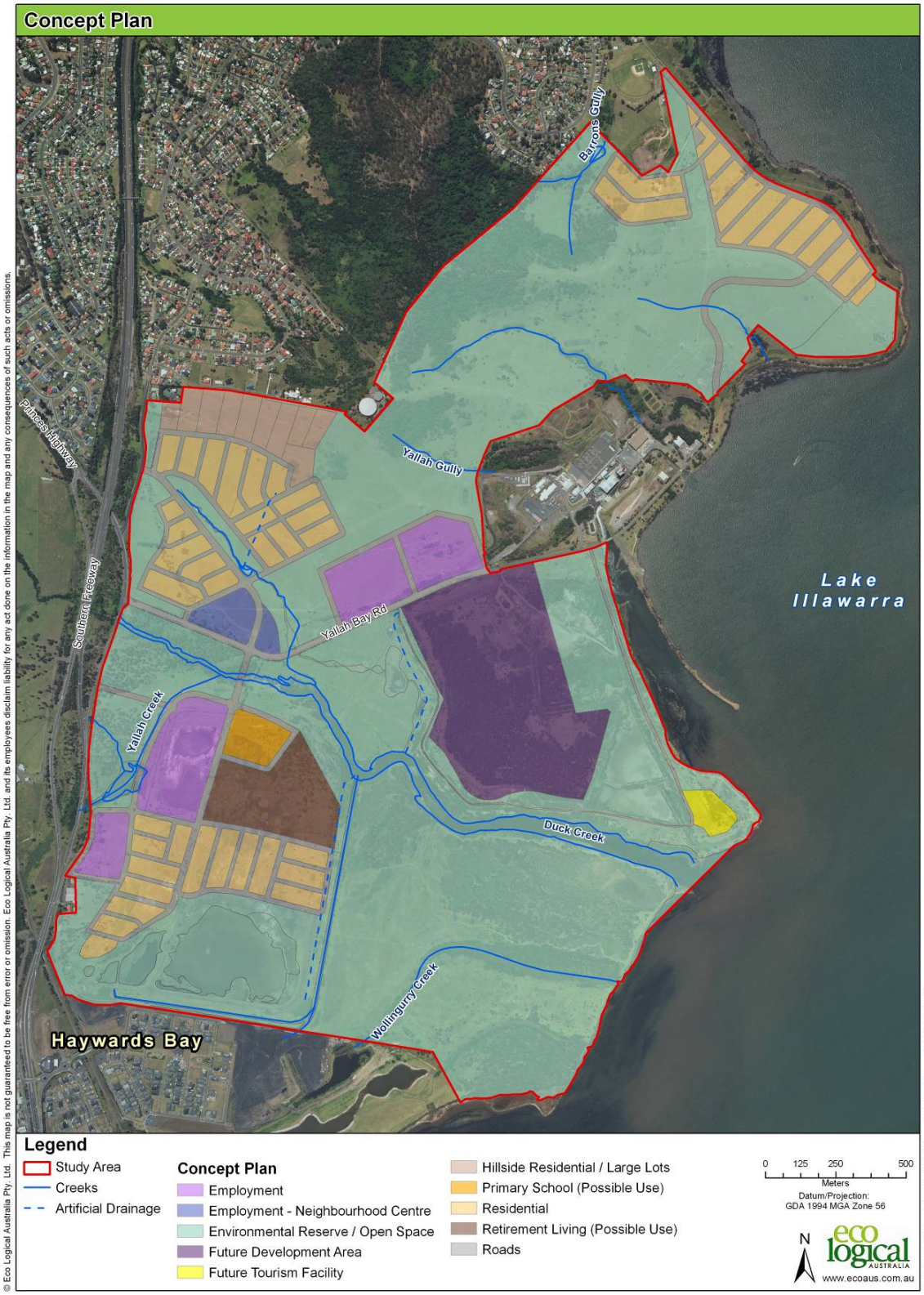

Figure 1: Concept plan for the Tallawarra Lands

2 Biodiversity Summary

A flora and fauna assessment of the Tallawarra lands is documented in ELA 2010b. The implementation of this VMP has considered the presence of Endangered Ecological Communities (EEC) and threatened flora and fauna species which is discussed further in **Section 7**. The VMP has also been informed by a Riparian Assessment (ELA 2010c) and the proposed riparian management approach.

2.1 VEGETATION COMMUNITIES

Vegetation mapping of the lands and field surveys identified 14 different vegetation communities across the lands, of which eight communities correspond with EEC listings under the NSW *Threatened Species Conservation Act 1995* (TSC Act). None of the vegetation communities are listed under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). The vegetation communities across the lands are shown in **Figure 2**, with corresponding EECs listed in **Table 1**.

Table 1: Endangered Ecological Communities recorded across the Tallawarra Lands

Vegetation Community	Abbreviation	Corresponding Endangered Ecological Community under the TSC Act
Alluvial Swamp Mahogany Forest	ASMF	Swamp Sclerophyll Forest on Coastal Floodplains on the NSW North Coast, Sydney Basin and South East Corner Bioregions
Coastal Grassy Red Gum Forest	CGRGF	Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion
Coastal Swamp Oak Forest	CSOF	Swamp Oak Floodplain Forest on the NSW North Coast, Sydney Basin and South East Corner Bioregions
Estuarine Alluvial Wetland	EAW	Swamp Sclerophyll Forest on Coastal Floodplains on the NSW North Coast, Sydney Basin and South East Corner Bioregions
Saltmarsh	SM	Coastal Saltmarsh of the Sydney Basin Bioregion
Floodplain Wetland	FW	Freshwater Wetlands on Coastal Floodplains (Freshwater Wetlands)
Lowland Dry – Subtropical Rainforest	LDSR	Illawarra Subtropical Rainforest in Sydney Basin Bioregion
Lowland Woollybutt – Melaleuca Forest	LWMF	Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion

2.1.1 Condition of Vegetation Communities

The condition of the vegetation conditions across the lands is generally poor with moderate to very high levels of weed invasion throughout most vegetation communities. However, there are some vegetation communities which do have very low levels of weed invasion and are in good condition. The density of weeds throughout each vegetation community is shown in **Figure 2**.

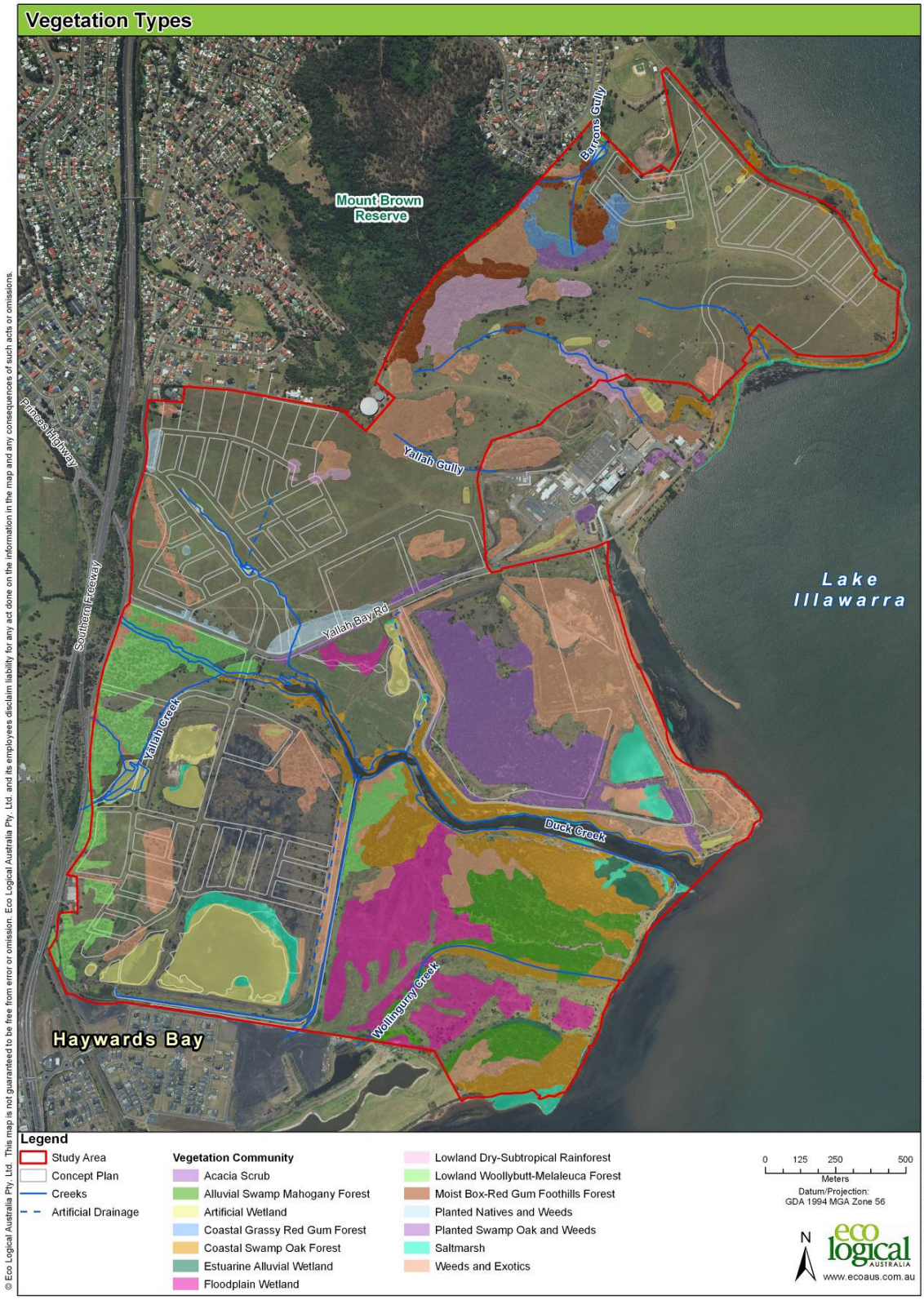

Figure 2: Vegetation communities across the Tallawarra lands

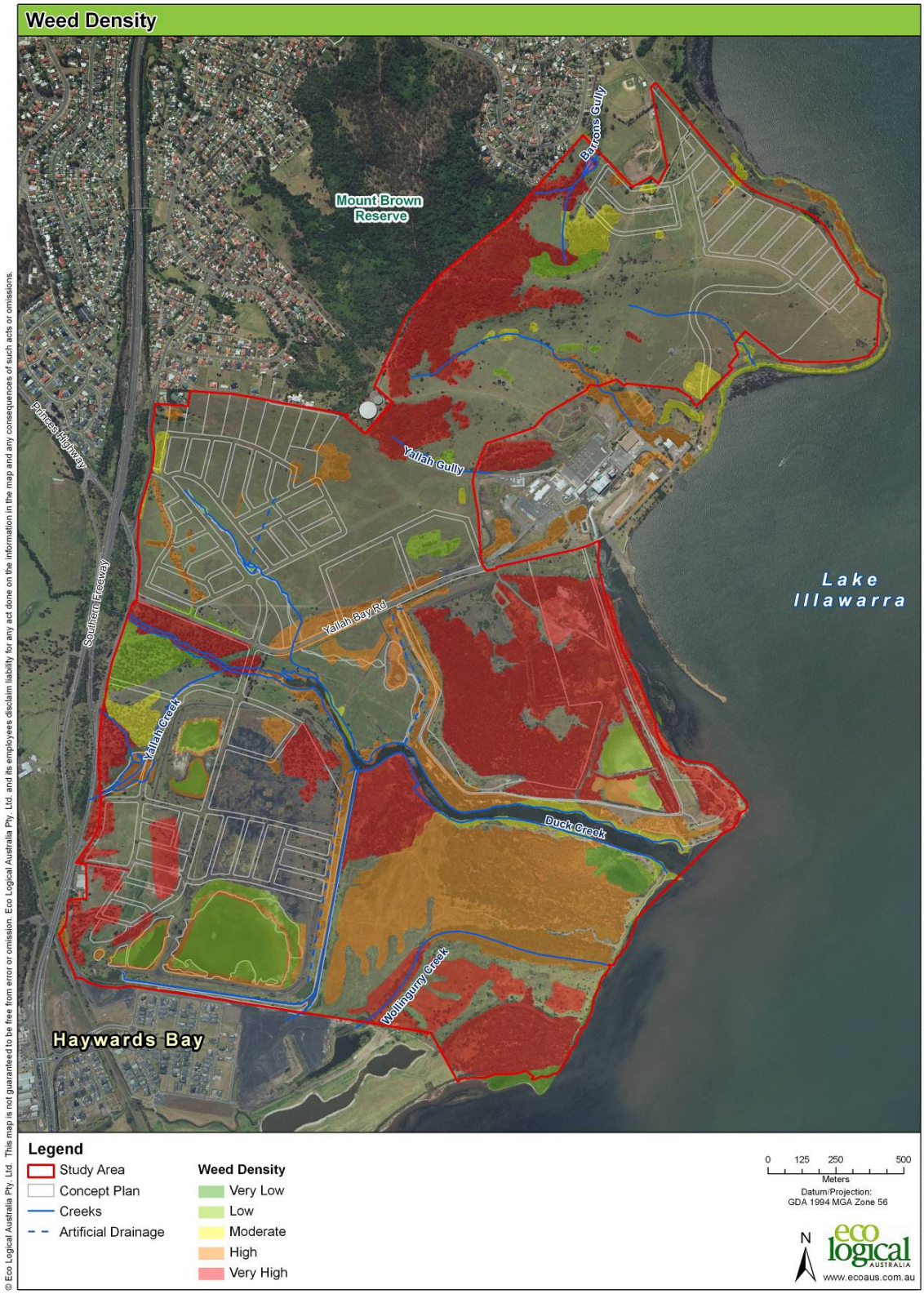

Figure 3: Weed Densities in Vegetation Communities

2.1.2 Vegetation Resilience

The recovery potential (or resilience) describes the ability of native vegetation communities to respond to management intervention, regenerate or maintain a native ecosystem without undertaking extensive weed control or revegetation works in a specific area. The resilience levels are shown in **Figure 4**. The resilience codes used in these maps and the definitions are described in **Table 2** below.

Table 2: Resilience categories for native vegetation on the Tallawarra Lands

Code	Resilience Description
VH	Very High – High levels of native species diversity and abundance with no weed invasion.
H	High – High levels of native species diversity and abundance with low weed invasion
M	Moderate – Medium levels of native species diversity and abundance with medium levels of weed invasion
L	Low – Low levels of native species diversity and abundance with high levels of wed invasion
VL	Very Low – Virtually no native species present and the site is dominated by weed species

2.2 THREATENED FLORA

Several threatened flora species have been recorded in close vicinity to the lands and potential habitat is present on the lands. These species are shown in **Table 3** along with their status and the vegetation community that provides potential habitat. No threatened flora species have been recorded on the lands through either the current field assessment (ELA 2010b) or previous surveys (as recorded in the NSW Wildlife Atlas).

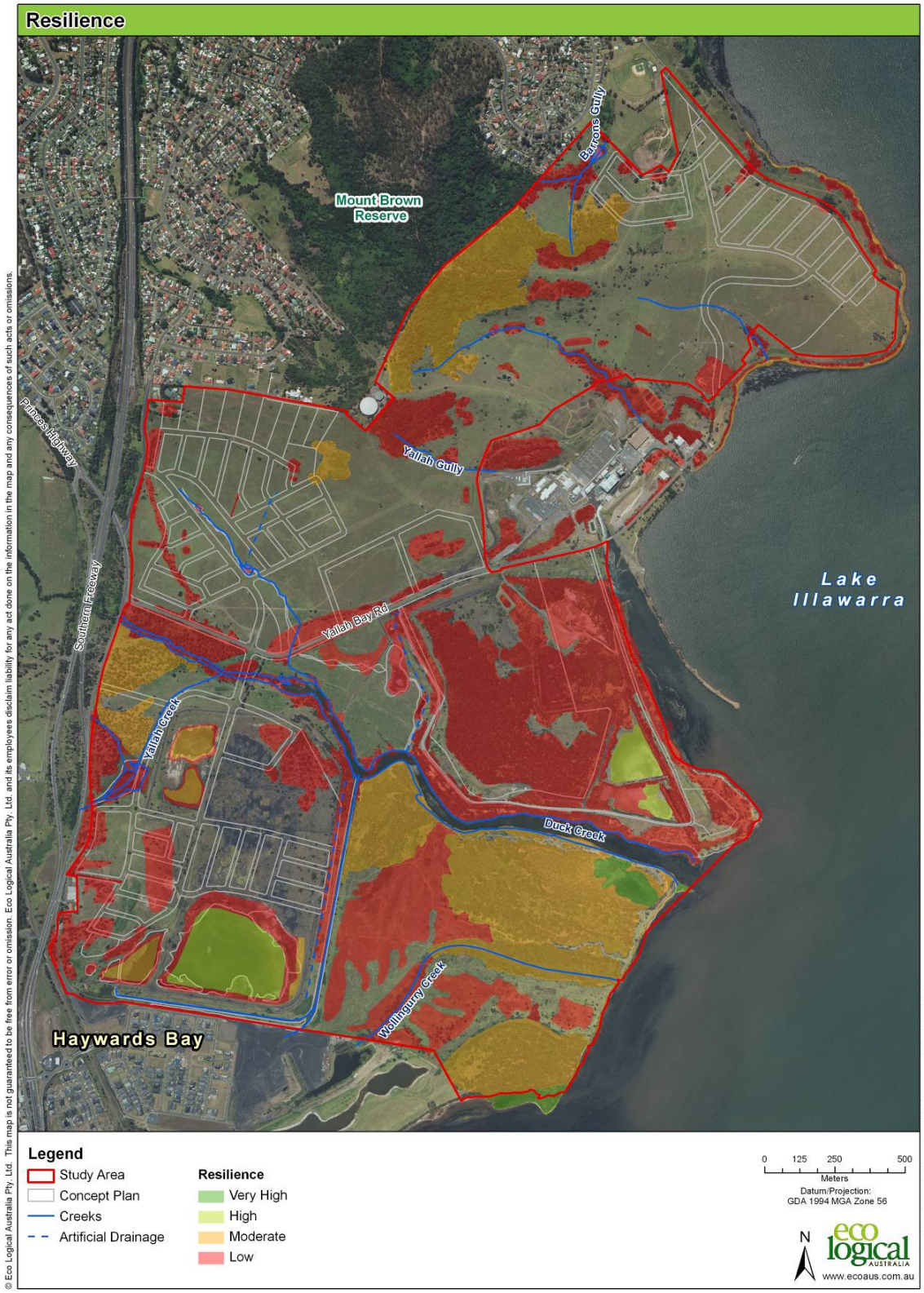

Figure 4: Resilience of vegetation across the Tallawarra lands

Table 3: Threatened flora species with potential to occur on the Tallawarra lands

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Vegetation Community						
				Lowland Dry - Subtropical Rainforest	Coastal Grassy Red Gum Forest	Moist Box – Red Gum Foothills Forest	Lowland Woollybutt – Melaleuca Forest	Alluvial Swamp Mahogany Forest	Coastal Swamp Oak Forest	Exotic Pasture
Caladenia tessellata	Thick-lipped Spider-orchid	V	V		✓		✓			
Chorizema parviflorum	*Chorizema parviflorum* population in the Wollongong LGA	EP					✓			
Cryptostylis hunteriana	Leafless Tongue-orchid	V	V		✓	✓	✓	✓		
Cynanchum elegans	White-flowered Wax Plant	E	E	✓	✓		✓	✓		
Daphnandra sp. C Illawarra	Illawarra Socketwood	E	E	✓	✓					
Haloragis exalata subsp. *exalata* var. *laevis*	Square Raspwort	V	V				✓ - riparian areas		✓	
Lespedeza juncea subsp. *Juncea*	*Lespedeza juncea* subsp. *sericea* population in Wollongong LGA	EP			✓ - north east		✓			✓ - areas adjacent Woollybutt Woodland
Pterostylis gibbosa	Illawarra Greenhood	E	E				✓			
Pultenaea aristata	Prickly Bush-pea	V	V				✓			
Solanum celatum		E		✓						
Thesium australe	Austral Toadflax, Toadflax	V	V		✓ - limited		✓ - limited			

E – Endangered, EP – Endangered Population, V - Vulnerable

2.3 THREATENED FAUNA

A total of 11 threatened fauna species have been recorded on the lands and a further 25 species have the potential to occur on the lands (ELA 2010b, DECCW 2010, Burcher 1997, Brandis (unpublished), Turton 1996, Richards 1997a, URS 2006). These species and their status are shown in **Table 4**. In addition to these species, the site provides potential habitat for a number of species listed on the EPBC Act as migratory species (ELA 2010b).

Table 4: Threatened fauna recorded or with the potential to occur on the Tallawarra lands

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Likelihood of Occurrence
REPTILES				
Litoria aurea	Green and Golden Bell Frog	E	V	Potential
BIRDS - Diurnal				
Botaurus poiciloptilus	Australasian Bittern	V	-	Potential
Calidris alba	Sanderling	V	M	Potential
Calidris tenuirostris	Great Knot	V	M	Potential
Charadrius leschenaultii	Greater Sand-plover	V	M	Potential
Charadrius mongolus	Lesser Sand-plover	V	M	Potential
Circus assimilis	**Spotted Harrier**	**V**	-	**Recorded**
Ephippiorhynchus asiaticus	Black-necked Stork	E	-	Potential
Haematopus fuliginosus	**Sooty Oystercatcher**	**V**	**-**	**Recorded – onsite 2010**
Haematopus longirostris	**Pied Oystercatcher**	**V**	**-**	**Recorded – onsite previously & 2010**
Hieraaetus morphnoides	**Little Eagle**	**V**		**Recorded**
Ixobrychus flavicollis	**Black Bittern**	**V**	**-**	**Recorded**
Lathamus discolor	Swift Parrot	E	E	Potential
Limicola falcinellus	Broad-billed Sandpiper	V	M	Potential
Limosa limosa	Black-tailed Godwit	V	M	Potential
Lophoictinia isura	Square-tailed Kite	V	M	Potential
Neophema pulchella	Turquoise Parrot	V	-	Potential
Oxyura australis	Blue-billed Duck	V	-	Potential
Pandion haliaetus	**Osprey**	**V**	**M**	**Recorded**
Petroica boodang	**Scarlet Robin**	**V**	**-**	**Recorded**
Petroica rodinogaster	Pink Robin	V	-	Potential
Rostratula benghalensis australis	Painted Snipe (Australian subspecies)	E	E	Potential
Sterna albifrons	Little Tern	E	M	Potential
Sterna fuscata	Sooty Tern	V	-	Potential
Stictonetta naevosa	**Freckled Duck**	**V**	**-**	**Recorded**
Thinornis rubricollis	Hooded Plover	E	M	Potential
Xanthomyza phrygia	Regent Honeyeater	E	E, M	Potential
Xenus cinereus	Terek Sandpiper	V	M	Potential
BIRDS - Nocturnal				
Ninox connivens	Barking Owl	V	-	Potential
Ninox strenua	Powerful Owl	V	-	Potential

Scientific Name	Common Name	TSC Act Status	EPBC Act Status	Likelihood of Occurrence
Tyto novaehollandiae	Masked Owl	V	-	Potential
MAMMALS (BATS)				
Chalinolobus dwyeri	**Large-eared Pied Bat**	**V**	**V**	**Recorded**
Falsistrellus tasmaniensis	Eastern False Pipistrelle	V	-	Potential
Miniopterus australis	**Little Bentwing-bat**	**V**	**-**	**Recorded – onsite 2010**
Miniopterus schreibersii oceanensis	**Eastern Bent-wing Bat**	**V**	**-**	**Recorded – onsite previously & 2010**
Mormopterus norfolkensis	**Eastern Freetail Bat**	**V**	**-**	**Recorded – onsite 2010**
Myotis macropus	**Large-footed Myotis**	**V**	**-**	**Recorded – onsite previously & 2010**
Pteropus poliocephalus	**Grey-headed Flying-Fox**	**V**	**V**	**Recorded**
Saccolaimus flaviventris	**Yellow-bellied Sheathtail-bat**	**V**	**-**	**Recorded**
Scoteanax rueppellii	Greater Broad-nosed Bat	V	-	Potential
	Species recorded onsite during ELA 2010 survey			

CE – Critically Endangered, E – Endangered, V – Vulnerable, M – Migratory

2.4 RIPARIAN MANAGEMENT

Across the lands, most riparian zones have some level of degradation such as clearing of native vegetation or invasion by noxious or environmental weeds. As such, riparian management will be undertaken to ensure the riparian zones can achieve the set objectives (ELA 2010c).

Duck Creek will be the focus of extensive restoration with widespread environmental and noxious weed control throughout the corridor with full structural native revegetation proposed for the riparian zone (including currently cleared areas) and supported with open space revegetation in areas within the corridor that are outside the riparian zone. Weed control and structural revegetation is also proposed for category 2 and 3 creeks that are potentially affected by the proposed development including Yallah Creek, un-named creek number 4 and Barrons Gully.

In the longer term, the proponent envisages that most riparian zones will be held under the ownership of a public authority such as Wollongong City Council (WCC) or the Lake Illawarra Authority (LIA). This change in tenure would be managed via a Planning Agreement between the proponent and the WCC/LIA. Ownership and Control is discussed in more detail in Section 4. This VMP sets the management framework for the first 5 years, after which time the management of vegetation on the lands should be able to be maintained with less intensive investment.

2.5 STATE ENVIRONMENTAL PLANNING POLICIES

Three State Environmental Planning Policies (SEPP) are relevant to the lands, these being SEPP 14 – Coastal Wetlands, SEPP 19 – Urban Bushland and SEPP 44 – Koala Habitat Protection and have been considered in the development of this VMP.

2.5.1 SEPP 14 – Coastal Wetlands

SEPP 14 – Coastal Wetlands applies to this project and two SEPP 14 wetlands are present on the lands. These wetlands will not be impacted by the proposed development as they are located outside of the proposed development foot print.

Vegetation management actions proposed in the vicinity of these wetlands are minor and focus on weed control around the edge of the wetlands. Weed species to be targeted are mainly woody weeds which will be controlled by the cut and paint technique. The control of some introduced grasses around the edge of the wetlands may be required, which will be undertaken by spot spraying using a non-specific herbicide suitable for use near water. Further details are provided in **Section 1.1** and **3.2**.

2.5.2 SEPP 19 – Urban Bushland

The general aims of SEPP 19 Bushland in Urban Areas is to protect and preserve bush land in urban areas because of its value to the community, its atheistic value and its value for recreational, educational and scientific resources.

The SEPP requires that a plan of management be prepared for the area of bushland which the SEPP applies. This VMP addresses all of the requirements for a management plan required by SEPP 19 Bushland in Urban Areas.

2.5.3 SEPP 44 Koala Habitat Protection

As the proposed project is part 3A, SEPP 44 – Koala Habitat Protection does not formally apply. Further to this, the site has not been identified as core Koala habitat, but as potential Koala habitat. The presence of two Koala feed trees on the lands, these being *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus robusta* (Swamp Mahogany), indicates that potential Koala habitat is present on the lands.

In the context of this VMP prescribed management actions are unlikely to impact upon Koala feed trees and therefore any Koala's which might utilise the area. In addition, any sightings of Koalas on the lands made during the implementation of this VMP will be recorded and submitted to the Atlas of NSW Wildlife.

3 Management Prescriptions

The management intent for lands subject to the VMP is shown in **Figure 5**. In the context of this VMP, the lands have been divided into 11 different management zones. The management zones are shown in **Figure 6** and their broad management prescription outlined in **Table 5**. This VMP provides management recommendations for the retained lands including environmental reserves and open space areas. The following sections detail the management intention for each of these management zones, along with the recommended on ground works, with specific weed control techniques described in **Appendix 1**.

Table 5: Summary of management zones and management approach

Zone	Zone Name	Proposed Management Approach
1	Duck Creek	• 100-metre buffer either side of the creek with targeted revegetation • Control of noxious and environmental weeds
2	Wetlands Environmental Reserve	• Woodland area – noxious and environmental weed control • Grassland area – noxious weed control
3	Southern Lakes	• Buffer provided from water bodies to development • Targeted revegetation including aquatic habitat • Noxious and environmental weed control
4	Yallah Creek	• Riparian management (water quality and soil erosion management works) with revegetation, habitat creation and open space plantings • Noxious weed control
5	Western Edge – Southern Area	• Control noxious and environmental weeds • Maintain remnant native vegetation
6	Western Edge – Central Area	• Noxious and environmental weed control • Revegetation may be required depending on response of native vegetation to management works
7	Western Edge – Northern Area	• Open space with amenity plantings using native overstorey species, as part of the Landscape Masterplan (Corkery Consulting, in prep) • Noxious weed control
8	Central Riparian Open Space Corridor	• Riparian management (water quality and soil erosion management works) with revegetation, habitat creation and open space plantings • Noxious weed control
9	Mt Brown Reserve	• Control of noxious and environmental weeds • Provision of stock proof fencing and vehicle access • Targeted revegetation, including Barron Gully riparian zone
10	East & West Mid slopes	• Noxious weed control • Maintain existing open space with amenity plantings provided (Corkery Consulting, in prep) and some targeted fencing of vegetation remnants
11	Foreshore Reserve	• Noxious and environmental weed control • Targeted open space revegetation

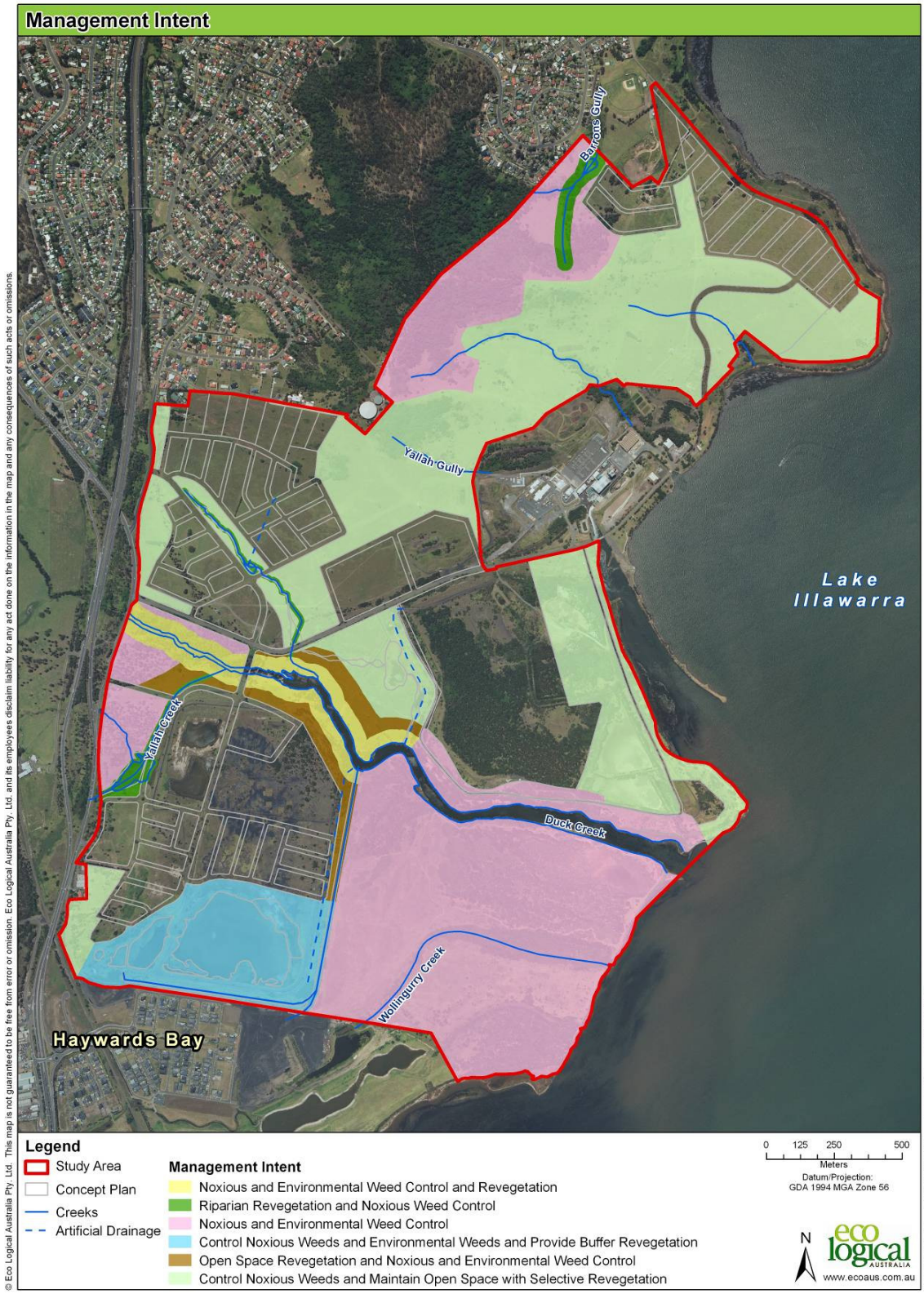

Figure 5: Management intent for lands subject to this VMP across the Tallawarra Lands

Figure 6: Location of Management Zones across the Tallawarra Lands

3.1 ZONE 1: DUCK CREEK

3.1.1 Legislative Requirements

Duck Creek is zoned E2 under the WCC LEP.

Duck Creek also contains four EEC, these being:

- Estuarine Alluvial Wetland (Freshwater Wetlands on Coastal Floodplains EEC & SEPP 14 Wetland);
- Saltmarsh (Coastal Saltmarsh of the Sydney basin Bioregion EEC);
- Coastal Swamp Oak Forest (Swamp Oak Floodplain Forest on NSW north coast, Sydney Basin and south east corner bioregion EEC); and
- Lowland Woolybutt – Melaleuca Forest (Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion).

Other legislative requirements include the control of noxious weeds (i.e. Lantana) listed under the NSW *Noxious Weeds Act 1995*, the provision of Asset Protection Zones under the NSW *Rural Fires Act 1997,* the presence of suitable habitat for migratory bird species (i.e. Greater Sand-plover, Lesser Sand-plover, Great Knot, Broad-billed Sandpiper, Black-tailed Godwit, Little Tern and Sanderling) listed under the *TSC Act* and *EPBC Act* and under the NSW *Water Management Act 2000,* Duck Creek requires a Core Riparian Zone (CRZ) of 40 metres and a Vegetated Buffer (VB) of 10 metres (total of 50m either side of the bank).

3.1.2 Management Intent

The management intent of this zone is to:

- Maintain and improve the existing vegetation found through the Duck Creek corridor.
- Revegetate currently cleared or highly degraded areas of the riparian zone.
- Support the riparian zone with revegetation of cleared areas of the corridor outside the riparian zone.
- Control noxious and environmental weeds throughout the entire zone.

3.1.3 Management Actions

Management actions have been proposed to restore remnant vegetation within this zone and rehabilitate currently cleared areas. The approach is outlined below and detailed following. **Figures 5 and 6** outline the type and location of proposed management across the Duck Creek corridor.

Fully structured native vegetation will be restored through the statutory 50m riparian buffer either side of Duck Creek, including areas that are currently cleared of native vegetation. Remnant native vegetation within the remaining areas of the Duck Creek corridor (areas outside the statutory 50m buffer) will be treated with extensive weed control to improve their condition. Currently unvegetated areas outside the statutory 50m buffer will also receive weed control along with targeted native revegetation to support the restoration of the 50m CRZ and VB. Targeted revegetation along the Duck Creek corridor adjacent to development will integrate bushfire asset protection zones in line with RFS requirements (RFS 2006) and low key open space/informal recreation uses.

Weed Control

Noxious weeds observed through this management zone and the appropriate control techniques are shown in **Table 6**. Other environmental weeds which are recommended for control and appropriate control techniques are also included. Several introduced pasture grasses are also present throughout this zone and require control by spot spraying. As there are many different species of pasture grass present in this area, they have not been identified in **Table 6**. The control of these species is required in the CRZ and VB.

Table 6: Noxious and environmental weeds observed within Duck Creek zone

Scientific Name	Common Name	Noxious Weed Class	Control Technique
Acetosa sagittata	Turkey Rhubarb		Spot spray using specific herbicide
Alternanthera philoxeroides	Alligator Weed	2	Hand pulling or spot spray
Araujia sericifera	Moth Vine		Stem scrape and hand pulling
Erythrina x sykesii	Coral Tree		Drill and fill
Gomphocarpus fruticosus	Cotton Bush		Hand pulling
Lantana camara	Lantana	4	Cut and paint, and hand pulling
Phytolacca octandra	Ink Weed		Hand pulling
Ricinus communis	Castor Oil Plant		Cut and paint
Rubus fruiticosus agg.	Blackberry	4	Spot spraying using specific herbicide
Salix spp.	Willow	5	Drill and fill
Sida rhombifolia	Paddy's Lucerne		Spot spraying
Tagetes minuta	Stinking Roger		Hand pulling

Revegetation

The rehabilitation of remnant patches of native vegetation in the western half of the riparian zone will be supported by understorey revegetation given the degraded nature of this vegetation. Revegetation will be aligned with the vegetation associations naturally occurring along Duck Creek, these being Coastal Swamp Oak Forest and Lowland Woolybutt – Melaleuca Forest. Where Lowland – Woolybutt Forest is found, revegetation of the understorey will use species listed in **Table 7** for this community. Where remnants of Coastal Swamp Oak Forest are present, these areas will be revegetated with species from the Coastal Swamp Oak Forest vegetation community in **Table 7**. The species to be used and the densities at which plants will be planted in the in the riparian zone is provided in **Table 7**.

Targeted revegetation of currently cleared areas within the 50m riparian zone will focus on full structural revegetation. This will utilise species listed in **Table 7** with the preference for Coastal Swamp Oak

Forest species in proximity to Duck Creek whilst utilising species from Lowland Woolybutt – Melaleuca Forest when further from the creek.

Currently cleared areas outside the 50m riparian zone will receive targeted revegetation to support the fully structured vegetation within the riparian zone. The revegetation in this area will provide additional buffer to the riparian zone (significantly above the VB) and will also integrate APZ and open space requirements. The revegetation proposed will seek to develop an open woodland form of Lowland Woolybutt – Melaleuca Forest and will focus on reinstatement of a native tree canopy to these currently cleared areas, as well as being supported by the proposed weed control. Provided the canopy is discontinuous and the understorey is managed, then this area will be able to meet the APZ requirements of the RFS (ELA 2010a) whilst also providing open space/informal recreation, along with additional habitat and supporting buffer lands to the formal riparian zone.

Only minimal revegetation of the eastern end of Duck Creek is proposed as this area has better resilience due to variation in the history of disturbance and the presence of an existing overstorey.

Table 7: Species to be planted along Duck Creek in the Core Riparian Zone

Species Name	Common Name
Coastal Swamp Oak Forest	
OVERSTOREY	1 plant per five square metres
Casuarina glauca	Swamp Oak
GROUND LAYER	3 plants per square metre
Alternanthera denticulata	Lesser Joyweed
Commelina cyanea	Scurvy Weed
Juncus kraussii	Juncus
Samolus repens	Brookweed
Selliera radicans	Swamp Weed
Oplismenus imbecillis	Basket Grass
Pseuderanthemum variabile	Pastel Flower
Lowland Woollybutt – Melaleuca Forest	
OVERSTOREY	1 plant per 10 square metres
Eucalyptus tereticornis	Forest Red Gum
Eucalyptus longifolia	Woolybutt
Melaleuca decora	Snow in Summer
MIDSTOREY	1 plant per square metre
Acacia falcata	Sickle Wattle
Daviesia ulicifolia	Bitter Pea
Kunzea ambigua	Tick Bush
Ozothamnus diosmifolius	Rice Flower
GROUNDLAYER	3 plants per square metre
Aristida vagans	Three Awn Grass
Austrodanthonia caespitosa	Wallaby Grass
Austrodanthonia pilosa	Wallaby Grass
Dianella longifolia	Flax Lily
Dianella revoluta	Flax lily
Dichondra repens	Kidney Weed
Glycine clandestina	Glycine
Glycine tabacina	Glycine
Goodenia hederacea	Goodenia

Species Name	Common Name
Imperata cylindrica	Blady Grass
Pratia purpurascens	White Root
Themeda australis	Kangaroo Grass

3.2 ZONE 2: WETLANDS ENVIRONMENTAL RESERVE

The Wetlands Environmental Reserve is located in the south east corner of the lands and is of high conservation priority. It has been further split into four sub-zones based on variation within it.

3.2.1 Legislative Requirements

The majority of this land is zoned E2, with some areas zoned E3 under the WCC LEP.

Other legislative requirements include the control of noxious weeds listed under the NSW *Noxious Weeds Act*, and the presence of suitable habitat for migratory bird species listed under the *TSC Act* and *EPBC Act.*

The biodiversity values of conservation significance for this zone include:

- Alluvial Swamp Mahogany Forest (corresponds with Swamp Sclerophyll Forest EEC);
- Estuarine Alluvial Wetland (SEPP 14 Wetland) (corresponds with Swamp Sclerophyll Forest EEC);
- Coastal Swamp Oak Forest (corresponds with Swamp Oak Floodplain Forest EEC);
- Low Land Woollybutt – Melaleuca Forest (corresponds with Illawarra Lowlands Grassy Woodland (EEC); and
- Saltmarsh (corresponds with Coastal Saltmarsh EEC).

3.2.2 Management Intent

The management intent of this zone is to maintain and improve the existing vegetation found throughout this management zone and manage it for conservation purposes. Weed control works will target all noxious weeds and some environmental weeds in the woodland and forest areas, while in the open grasslands areas only noxious weeds will be controlled. No revegetation works are required in this management zone. Minimal impact recreation activities such as walking and bike riding will be permitted along designated trails in this management zone.

3.2.3 Management Actions

The site can be split into four sub-zones, these being Estuarine Alluvial Wetlands, woodland and forest areas, open grassland areas and patches of Saltmarsh.

Estuarine Alluvial Wetlands

There is one area of Estuarine Alluvial Wetland which is in moderate condition and does not require any management works within the wetland itself. However, around the edge of this wetland, weeds such including *Lantana camara* (Lantana) and *Rubus fruiticosus* agg. (Blackberry) and several grassy weeds including *Cynodon dactylon* (Cooch) and *Pennisetum clandestinum* (Kikuyu) are found. These species will be controlled around the edges of the wetland to prevent weed invasion occurring.

Lantana will be controlled by the cut and paint technique, while Blackberry, Kikuyu and Cooch will be controlled by spot spraying.

Woodland and Forest Areas

Throughout the woodland and forest areas there are extensive thickets of Lantana, which forms the dominant midstorey. Amongst and below this dense layer of Lantana, native species can be commonly observed indicating that this area has a moderate level of resilience. Other weed species present in the area in low densities include *Solanum mauritianum* (Wild Tobacco), *Andropogon virginicus* (Whiskey Grass), *Delairea odorata* (Cape Ivy), *Gomphocarpus fruiticosus* (Cotton Bush) and *Paspalum dilatatum* (Paspalum).

Lantana thickets and Wild Tobacco will be controlled by the cut and paint method or by hand pulling of seedlings. Cotton Bush will be controlled by hand pulling while all grasses and Cape Ivy will be controlled by spot spraying using a non-specific herbicide.

Open Grassland Areas

The Open Grassland Areas are dominated by introduced pasture grass species, including Kikuyu, Paspalum and Phalaris. Other weed species in this area include several noxious weed species. Scattered clumps of Lantana are present, along with *Chrysanthemoides monilifera rotunda* (Bitou Bush) and Blackberry. Lantana will be controlled by using the cut and paint technique, while Blackberry (using a specific herbicide) and Bitou Bush will be controlled by spot spraying. Some environmental weeds such as Cape Ivy and *Araujia sericifera* (Moth Vine) may be present in this area and will be controlled by spot spraying. The grass weed species will not be controlled except at the interface between the Open Grassland Area and the Woodland and Forest Areas.

Saltmarsh

Saltmarsh is present on the edge of Lake Illawarra. The main threat to the saltmarsh is Kikuyu, which will be controlled by spot spraying using a non-specific herbicide. Other weed species in this area include Lantana and Blackberry. Lantana will be controlled by the cut and paint technique, while Blackberry will be controlled by spot spraying.

3.3 ZONE 3: SOUTHERN LAKES

The southern lakes area is a series of wetlands on the southern boundary of the lands. These wetlands are artificial wetlands which were created during the previous use of this area as a deposition area for coal wash.

3.3.1 Legislative Requirements

This area is zoned E3 under the WCC LEP. Under the TSC Act and EPBC Act there are requirements to protect existing habitat for threatened species. These wetlands are of high conservation significance as several migratory bird species (e.g. Greater Sand-plover, Lesser Sand-plover, Great Knot, Broad-billed Sandpiper, Black-tailed Godwit, Little Tern and Sanderling) have been recorded on these wetlands and the zone provides suitable habitat for other species of migratory birds. One EEC, Saltmarsh on Coastal Floodplains, has been recorded in this management zone. There is also a legal requirement to control Noxious Weeds throughout this zone.

3.3.2 Management Intent

The management intent is to maintain the wetland in its current form and to maintain and improve the fringing aquatic vegetation around the edge of the wetland. Furthermore, revegetation of the setback to development is proposed, so as to provide a buffer to indirect impacts and improve the amenity and habitat value of the wetlands whilst integrating with open space land uses for the area.

Throughout the management zone all noxious weeds, Lantana and Blackberry, will be controlled. Minimal impact recreation activities such as walking trails will be established in the zone and there is the opportunity to establish bird hides or viewing areas for the wetlands. Open space and informal recreation needs will be integrated in this zone although will be focused on the northern side with less availability on the southern side. To compliment this, the southern portions will receive more intensive buffer revegetation. Fringing aquatic vegetation will be managed and restored with a focus on the southern and eastern edges of the main wetland.

3.3.3 Management Actions

The wetlands are surrounded by fringing aquatic vegetation primarily consisting of *Phragmites australis* (Phragmites) and saltmarsh species such as *Sarcocornia quinqueflora*. This fringing aquatic vegetation provides suitable habitat for several species of migratory and threatened bird species and is of high conservation significance. The Illawarra Bird Observers Society has recorded a number of threatened species utilising these artificial wetlands including the Freckled Duck (*Stictonetta naevosa*), Painted Snipe (*Rostratula benghalensis australis*) and the Black Bittern (*Ixobrychus flavicollis*). There is also potential for several other migratory and threatened bird species to utilise these wetlands. The maintenance and improvement of the fringing aquatic vegetation is of high importance to maintain the ecological integrity of the wetlands which will be supported by a setback to development and provision of buffer vegetation around the wetlands. WSUD for the site will also aim to maintain the pre development hydrology of this area (WBM BMT, in prep).

Weed Control

All noxious weed species and several environmental weed species will be controlled throughout this zone. These weed species include Lantana, Blackberry, *Foeniculum vulgare* (Fennel) and Moth Vine. These weed species are in relatively low abundance and all species will be controlled by spot spraying, except Moth Vine, which will be controlled by the stem scrape method.

Throughout the wider area of this management zone, there are many other weed species, including *Conyza bonariensis* (Fleabane), *Chloris gayana* (Rhodes Grass) and *Melinis repens* (Red Natal Grass). These species will be required to be controlled before and after revegetation and open space works are undertaken. Fleabane will be hand pulled while Rhodes Grass and Red Natal Grass will be spot sprayed using a non-specific herbicide suitable for use near water.

Revegetation

Revegetation within this zone will be provided by two approaches, firstly for wetland fringing aquatic vegetation and secondly for the open space vegetation buffer.

Fringing aquatic vegetation will be managed with a focus on the southern and eastern edges of the main wetland. This will be supported by the retention and maintenance of saltmarsh on the north eastern edge and the provision of fringe planting on the north western edge. The approach will be to retain native aquatic species (i.e. saltmarsh species and Phragmites) where present and to supplement with additional planting if needed or in areas of weed removal. Species selection around the fringe of the wetland will be primarily Phragmities and saltmarsh species (those known from the area). Revegetation of the banks may also be sought dependant on response to other treatments. The maintenance and improvement of habitat and viability will be the focus of the works.

To compliment the aquatic vegetation, the area of setback to development (wetland buffer open space revegetation area shown on **Figure 6**) will be revegetated to further buffer the wetlands. Again, the southern, eastern and north-eastern portions of the main wetland and the southern portions of the two smaller wetlands will receive more intensive buffer revegetation. Buffer vegetation will also be provided

on the north and western sides, albeit at lower density. The coal wash in these areas will likely restrict the type of species that can be successfully grown however some fill may be required as part of the Landscape Masterplan (Corkery Consulting, in prep) which may permit a wider selection of species to be utilised. The following species are those considered most likely of survival in coal wash sediments including *Casuarina glauca* (Swamp Oak), *Lomandra longifolia* (Matt Rush), *Melaleuca ericifolia* (Swamp Paperbark), *Acacia mearnsii* (Black Wattle) and Kikuyu. Trial utilisation of other native species in these areas may also be sought to increase diversity. The focus of these works will be to support the provision of wetland habitat and seek to minimise potential indirect impacts as described in ELA (2010b).

Within the wetland buffer open space revegetation area (**Figure 6**) the tree species listed above will be planted at a density of one plant per five square metres in the proposed denser patches in the south and east. Planting densities in the north and western sections will be determined by the Landscape Masterplan (Corkery Consulting, in prep). Tree plantings will be supplemented with understorey species where applicable. Tree plantings will be planted as tube stock and will require tree guards.

Further, it must be noted that Swamp Oak has been observed invading areas of Coastal Saltmarsh which is also found around the boundary of the wetland. If this species is observed invading areas of Coastal Saltmarsh it will be controlled by the cut and paint method.

3.4 ZONE 4: YALLAH CREEK

This management zone comprises the riparian zone and surrounds of Yallah Creek from the site boundary to the Duck Creek corridor.

3.4.1 Legislative Requirements

The Yallah Creek management zone is primarily zoned E2 under the WCC LEP. There is the requirement to control all noxious weeds (Lantana) throughout this management zone. Further, as the instream dam and lower portion of the waterway (with a currently partly concreted channel) is to receive re-engineering and habitat construction works (ELA 2010c), key considerations are that:

- the creek line is stable and that opportunities for soil erosion are restricted;
- the vegetation along the creek line contributes to maintaining and improving water quality and habitat; and
- that natural flow regimes can be provided for.

In order to achieve this it is proposed that the creek bed and banks are lined with Kikuyu to aid in their stabilisation and the riparian zone is revegetated using native overstorey and midstorey species. Additional riparian construction works may be required however are outside the scope of this report.

3.4.2 Management Intent

The management intent for this zone is to create a more functional waterway than what is currently present that improves water quality and better mimics natural flow regimes (ELA 2010c). It is proposed that this is achieved through the removal of concrete banks and installation of appropriate drainage controls, geomorphic features (pools, riffles and alignment variability), instream habitat and riparian zone vegetation. The provision of this riparian zone vegetation and improvement of existing native vegetation through weed control is thus the focus of the proposed vegetation management works.

The management zone will also provide low key open space uses complimentary with the above objectives, although primarily outside of the riparian zone buffer.

3.4.3 Management Actions

In its current form Yallah Creek has low biodiversity values as it has been historically used for agriculture production and modified during the use of this area as a coal wash depository. There is very little native vegetation along the creek line and it has a very low level of resilience. Management actions will include weed control and riparian zone creation including riparian revegetation.

The only noxious weed observed in this area was Lantana, which will be controlled by the cut and paint method or by hand pulling, along with several environmental weeds including Castor Oil Plant and Wild Tobacco.

Revegetation

The upper section of the creek line is stable showing no signs of erosion due to the creek being covered by Kikuyu which has successfully stabilised the bed and banks of the creek line. The presence of Kikuyu on the banks and in the creek line is efficient at filtering sediments and other materials which impact the water quality. Hence, the creek line currently has the ability to maintain and improve water quality. In the lower sections (below the instream dam) where the creek line is to be recreated, it will be covered with Kikuyu in order to stablise the realigned creek line.

Further, it is proposed to revegetate the entire length of the riparian zone, to a distance of 10 metres either side of bank. This will be achieved using native species found in the overstorey and midstorey of the vegetation communities naturally occurring in the area. The ground layer will be maintained as Kikuyu to ensure the stability of the creek bed and bank.

This creek line was likely to have been dominated by the vegetation community, Lowlands Grassy Woodland of the Sydney Basin Bioregion EEC. Common overstorey and midstorey species found in the Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion have been identified in **Table 8**, along with the densities which they should be planted. Not all of these species are required to be planted, rather a selection based on seed availability.

Table 8: Species to be used in the revegetation of Yallah Creek

Species Name	Common Name
OVERSTOREY	1 plant per 50 sq metres
Eucalyptus longifolia	Woollybutt
Eucalyptus tereticornis	Forest Red Gum
MIDSTOREY	1 plant per 20 sq metres
Acacia falcata	Sickle Wattle
Daviesia ulicifolia	Bitter Pea
Kunzea ambigua	Tick Bush
Leucopogon juniperinus	Prickly Beard Heath
Melaleuca decora	Snow in Summer

Species Name	Common Name
Ozothamnus diosmifolius	Rice Flower
Pultenaea retusa	Bush Pea
Pultenaea villosa	Bush Pea

3.5 ZONE 5: WESTERN EDGE SOUTHERN AREA

3.5.1 Legislative Requirements

The Western Edge South is zoned B6 and E3 under the WCC LEP. There is a legal requirement to control all noxious weeds through this management zone and to maintain or improve the current condition of native vegetation in this management zone.

3.5.2 Management Intent

This zone is located in the south western corner of the lands adjacent the Princes Highway and is currently used for horse agistment. It is currently in a degraded condition with sparse scattered remnant overstorey species with no midstorey and grazed ground layer consisting mostly of introduced pasture species.

Management intent is to maintain and improve areas of remnant native vegetation, manage noxious weeds and to provide open space and informal recreation opportunities. Recommended management actions include noxious weed control and targeted revegetation.

3.5.3 Management Actions

Weed Control

Two noxious weed species have been recorded in this area, these being Lantana and Blackberry along with several other significant environmental weeds including Moth Vine and Wild Tobacco. Lantana and Wild Tobacco will be controlled by the cut and paint method, Moth Vine will be controlled by the stem scrape method and Blackberry by spot spraying. Management of introduced pasture grasses may also be required dependant on the response to the removal of grazing and other management techniques.

Revegetation

Targeted revegetation will be provided within this zone to assist maintain and also improve the condition of remnant native vegetation. This work will focus on consolidating existing patches of vegetation and developing connections between remnants.

Revegetation will be undertaken by planting canopy species native to Lowland Woollybutt-Melaleuca Forest such as *Melaleuca decora* (Son in Summer), *Eucalyptus tereticornis* (Forest Red Gum) and *Eucalyptus longifolia* (Woolybutt). Approximately 100 plants will be required.

To support the above work it is recommended that low key fencing, edging or another landscaping treatment is provided to minimise access within remnant patches of native vegetation.

3.6 ZONE 6: WESTERN EDGE CENTRAL AREA

This area is located on the western boundary of the lands and contains some of the lowest weed densities across the lands and has a moderate level of resilience.

3.6.1 Legislative Requirements

The Western Edge North is zoned E2 under the WCC LEP. The vegetation community in this area is Lowland Woollybutt – Melaleuca Forest which corresponds with the EEC Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion. There is a legislative requirement to maintain or improve the condition of this vegetation association. Noxious weeds are required to be controlled throughout this management zone.

3.6.2 Management Intent

The management intent for this zone is to manage it for conservation through the management of all noxious and environmental weeds in this management zone. Minimal impact recreation activities such as walking trails are permitted in this zone.

3.6.3 Management Actions

The only vegetation management works required are weed control works. However, currently cleared areas within this zone will receive open space revegetation using native species to support the Landscape Masterplan (Corkery Consulting, in prep).

Despite having low levels of weed density, there are several noxious and environmental weed species found in this area. Only one noxious weed species is found in this area, this being Lantana with other woody weed species being found in **Table 9.** All of these woody weed species were in low densities. Other weed species are pasture grasses, including Paspalum, Rhodes Grass and Pigeon Grass and herbaceous weeds including *Agapanthus praecox* (Agapanthus), Paddy's Lucerne and Purple Tops, with Coolatai Grass and Moth Vine recorded along the western boundary of the lands. All of these weed species are in low densities.

Table 9: Weed species to be controlled and the appropriate techniques on the Western Edge North

Scientific Name	Common Name	Noxious Weed Class	Control Technique
Agapanthus praecox	Agapanthus		Spot spray
Araujia sericifera	Moth Vine		Stem scrape and hand pulling
Chloris gayana	Rhodes Grass		Sot spray
Grevillea sericea	Silky Oak		Drill and fill
Hyparrhenia hirta	Coolatai Grass		Spot spray
Ilex aquifolium	Holly		Cut and paste or drill and fill
Lantana camara	Lantana	4	Cut and paint, and hand pulling
Ligustrum sinense	Small-leaf Privet		Cut and paint, and hand pulling
Lycium barbarum	Chinese Boxthorn		Cut and paint
Pinus radiata	Radiata Pine		Cut and paint or ring bark

Scientific Name	Common Name	Noxious Weed Class	Control Technique
Prunus sp.			Drill and fill
Setaria sp.	Pigeon Grass		Spot spray
Sida rhombifolia	Paddy's Lucerne		Spot spray
Verbena bonariensis	Purpletops		Hand pulling

3.7 ZONE 7: WESTERN EDGE NORTHERN AREA

3.7.1 Legislative Requirements

The Central Parks Edge is zoned E3 under the WCC LEP and there is a legal requirement to control noxious weeds throughout this zone.

3.7.2 Management Intent

The management intent is to control noxious and environmental weed species throughout this zone, retain the existing areas of revegetation (previous works) and undertake further revegetation for open space and amenity purposes using native overstorey species. This management zone is also suitable for a variety of open space activities.

3.7.3 Management Actions

Weed Control

This area has low biodiversity values and is dominated by open pasture with some previous efforts of revegetation being undertaken using overstorey species. Only one noxious weed species was recorded in this area, this being Lantana, and it is present in low densities. Other weed species to be controlled include Chinese Boxthorn, *Tecoma capensis* (Cape Honeysuckle), *Nerium oleander* (Oleander), *Pinus* sp. (Pine), *Hyparrhenia hirta* (Coolatai Grass), *Anredera cordifolia* (Madeira Vine) and pasture grasses. The woody weeds identified will be controlled by the cut and paint method, while Madeira vine will be controlled by the stem scrape method and Coolatai Grass by spot spraying.

Revegetation

Revegetation within this zone is proposed by the Landscape Masterplan and has not been considered further here, suffice to say that all works will need to utilise species from the native vegetation that would have naturally occurred in this area.

3.8 ZONE 8: CENTRAL RIPARIAN OPEN SPACE CORRIDOR

3.8.1 Legislative Requirements

This zone can be further split into two sub zones 8.1 and 8.2 (**Figure 6**). Sub zone 8.1 is found above Yallah Bay Road and is essentially a riparian and open space corridor on a side slope of Mount Brown. Sub zone 8.2 is found beneath Yallah Bay Road on a low lying floodplain area extending towards the Duck Creek corridor.

The Central Parks Riparian management zone is classed as E3 and RE1 in the WCC LEP (sub zone 8.1 and 8.2 respectively). The zone has a category 3 waterway running through it (ELA 2010c) and

there is a requirement to effectively manage the waterway, including a riparian buffer zone and to control noxious weeds across the management zone.

3.8.2 Management Intent

The management intent is to ensure the creek bed and bank is stable and that there is no soil erosion occurring. Further, that an effective riparian zone is provided for and that noxious and environmental weeds are controlled through the zone.

The zone will also permit Water Sensitive Urban Design (WSUD) features and open space opportunities.

3.8.3 Management Actions

The following management actions primarily relate to sub zone 8.1. Sub zone 8.2 is proposed to contain WSUD features and to be selectively revegetated under the Landscape Masterplan. Thus, noxious weed control is the only proposed action for sub zone 8.2.

3.8.3.1 Sub Zone 8.1

As the sub zone is currently in a highly degraded condition with the ground layer dominated by pasture grasses, only noxious weeds will be controlled. Further works involve improvements to the riparian zone including revegetation works.

Weed Control

No noxious weeds were observed in this management sub zone and it is dominated by pasture grasses. However, the removal of grazing pressure has the potential to promote the regeneration of Lantana, which will be required to be controlled (if it is found) as it is a noxious weed.

The removal of the existing pasture grasses is not desirable as it will result in the destabilisation of the creek bank and decrease the water quality through the creek line. The revegetation of the creek line using understorey species is not considered feasible as the removal of the pasture grasses will leave bare soil making it vulnerable to soil erosion particularly given the steeper slopes. Hence it is proposed to revegetate the overstorey and midstorey of the riparian zone (10m either side of bank) only and to maintain the ground layer in its current form, dominated by pasture grasses, particularly Kikuyu.

Revegetation

It is proposed to revegetate the entire length of the riparian zone to a distance of 10 metres either side of the bank, using native species found in the overstorey and midstorey of the vegetation communities which were naturally occurring along the creek line. The ground layer will be maintained as Kikuyu to ensure the stability of the creek bed and bank.

This creek line was likely to have been dominated by the vegetation community, Lowlands Grassy Woodland of the Sydney Basin Bioregion EEC. Common overstorey and midstorey species found in the Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion have been identified in **Table 8**, along with the densities which they should be planted. Not all of these species are required to be planted, rather a selection based on seed availability.

Recreational Opportunities and Water Sensitive Urban Design

The remainder of this zone (outside the riparian zone) will be available for landscaping, recreation or WSUD purposes.

3.9 ZONE 9: MT BROWN RESERVE

3.9.1 Legislative Requirements

Mt Brown is zone E2 under the WCC LEP. It also contains five different vegetation associations, of which two are listed as EECs, these being:

- Lowland Dry – Subtropical Rainforest (Corresponding EEC: Illawarra Subtropical Rainforest in Sydney Basin Bioregion); and
- Coastal Grassy Red Gum Forest (Corresponding EEC: Illawarra Lowlands Grassy Woodland of the Sydney Basin Bioregion);

Under the TSC Act there is a requirement to maintain or improve the condition of these EECs on the property. There is also a legal requirement to control noxious weeds throughout this zone and there are riparian management requirements for Barron's Gully on the north eastern corner of the zone.

3.9.2 Management Intent

This is a high value conservation area and it is intended to manage the area for conservation purposes, focussing on the control of noxious and environmental weed species. The protection and improvement of Barrons Gully is a further objective for this zone.

There is also the ability to allow minimal impact recreation activities such as walking trails.

3.9.3 Management Actions

Weed Control

The understorey throughout the Mt Brown area is in poor condition with heavy infestations of Lantana dominating the understorey of these vegetation communities, with low levels of African Olive, Wild Tobacco, Chinese Boxthorn and *Senna pendula* (Easter Cassia). In areas where this Lantana has been cleared native grasses and herbaceous species were observed regenerating indicating that the zone has a moderate level of resilience.

Primary weed control works will focus on the control of Lantana in this zone. This is required to be undertaken progressively so as to allow native vegetation to regenerate as the Lantana is removed and to limit the amount of exposed soil across the hillside and prevent soil erosion. The control of Lantana will begin at the top of the hill and work towards the bottom of the hill. Lantana will be controlled by the cut and paint method. At no time will the dense thickets of Lantana be sprayed. Follow up control will be required to control seedlings of Lantana, these will be controlled by hand pulling individuals. If this is not feasible due to high levels of regeneration of Lantana, it will be spot sprayed using a specific (broad leaf) herbicide. Secondary weed control works will be required to control other woody weeds and any emerging herbaceous and grass weed species. Mature woody weeds will be controlled by the cut and paint method, with seedlings being hand pulled. Grasses will be spot sprayed using a grass specific herbicide.

Revegetation

In the north east corner of the zone is Barrons Gully, which is a small waterway which will require revegetation works to satisfy riparian management requirements. No signs of soil erosion were observed and no soil remediation works are proposed. Maintenance of bed and bank stability along with the provision of habitat is the focus of these works.

The CRZ for Barrons Gully is 20 metres from the bank, with a 10 metre VB, on both sides of the creek line. The creek line will be revegetated using overstorey, midstorey and understorey species to

resemble a Moist Box-Red Gum Foothills vegetation community as the vegetation found along the creek line is in a degraded state of this vegetation community. The species to be used in the revegetation and the recommended densities for Barron's Gully are identified in **Table 10**. All overstorey and midstorey species will be planted as tube stock and will require tree guards, while understorey species will be planted as hiko cells and will not require tree guards.

Table 10: Species to be used in the revegetation of Mt Brown

Species Name	Common Name
Moist Box – Red Gum Foothills Forest	
OVERSTOREY	1 Plant per 10 Square metres
Eucalyptus quadrangulata	Moist Box
Eucalyptus tereticornis	Forest Red Gum
MIDSTOREY	1 Plant per 10 Square metres
Acmena smithii	Lilly Pilly
Backhousia myrtifolia	Grey Myrtle
Cassine australis	
Pittosporum multiflorum	Orange Thorn
Pittosporum revolutum	Sweet Pittosporum
Notelaea venosa	Mock Olive
UNDERSTOREY	3 plant per square metre
Croton verreauxii	Green Cascarilla
Doodia aspera	Rasp Fern
Microlaena stipoides	Weeping Rye Grass
Pellaea falcata	Sickle Fern
Rapanea variabilis	
Streblus brunonianus	Whalebone Tree
Oplismenus imbecillis	Basket Grass

3.10 ZONE 10: EAST AND MID-SLOPES

3.10.1 Legislative Requirements

The East and Mid Slopes area is zoned E3 in the WCC LEP. There is a requirement to control all noxious weeds throughout this zone and there is also a requirement to maintain or improve the condition of remnant vegetation throughout this zone.

3.10.2 Management Intent

The management intent is to control all noxious weeds, of which Lantana is widespread in varying levels of abundance throughout the zone, and maintain the condition of patches of remnant native vegetation. Maintenance of the current land use of the zone, which is currently used for horse agistment, will be used as a management technique. Strategic fencing to exclude stock and general access to remnant patches of native vegetation is also recommended. Parts of the zone will be used for open space land uses, which will include amenity and landscape plantings.

3.10.3 Management Actions

Weed Control

The control of noxious weeds is required through this zone. Lantana is widespread and varies in density from low to high in some areas. Two other woody weed species were recorded in low densities, these being Chinese Boxthorn and Wild Tobacco. These species have the potential to invade the conservation areas if they are not controlled across the lands. Hence, the control of these weed species is strongly recommended throughout this management zone. These species will be controlled by the cut and paint method.

Maintain Current Land Use

This management zone has low conservation value as it is almost entirely cleared of native vegetation and dominated by pasture grasses. However, there are small pockets of remnant vegetation in some areas of this zone. Primary management actions include noxious weed control along with the continuance of horse agistment to limit the abundance of pasture grasses throughout this zone. Strategic fencing to exclude stock and general access to remnant patches of native vegetation is also recommended.

Soil Erosion

The potential for soil erosion in this management zone is high due to the steep slopes and needs to be considered when management works are being implemented. Where the removal of these woody weeds has the potential to destabilise the soil and cause soil erosion, remediation works will be required to prevent soil erosion from occurring in this area after weed control has been undertaken. This may include the use of jute matting and some strategic revegetation to stablise areas where weed control is undertaken.

3.11 ZONE 11: FORESHORE RESERVE

3.11.1 Legislative Requirements

The Foreshore Reserve is predominantly zoned as IN 1, with a narrow strip of RE 1 along the foreshore. The control of noxious weeds is the primary management required throughout this zone. One EEC, Coastal Saltmarsh, is also present in this area which is required to be maintained or improved.

3.11.2 Management Intent

The management intent for this zone is to provide opportunities for open space and recreational activities whilst managing the Coastal Saltmarsh to maintain or improve its current condition and to control noxious weeds.

3.11.3 Management Actions

The zone has been highly disturbed due to previous land uses including the deposition of coal wash as well as the formation of a number of water overflow ponds from the power station. Although currently in poor condition due to high levels of weed invasion this zone contains several areas of Coastal Saltmarsh (listed as an EEC) and also provides fauna habitat.

Weed Control

The zone supports noxious weeds in high densities. The noxious weed species found in this management zone is Lantana, which is abundant. Other weeds in this area include *Acacia saligna* (Golden Wreath Wattle) and Rhodes Grass. Lantana and Golden Wreath Wattle will be controlled by the cut and paint technique and Rhodes Grass by spot spraying. These weed species do not threaten the Coastal Saltmarsh.

Coastal Saltmarsh

The main threats to the Coastal Saltmarsh are trampling by recreational activities and weed invasion by Swamp Oak and some species of pasture grasses. To address the trampling threat to areas of Coastal Saltmarsh a landscape design solution is required to prevent foot access to these areas. This may incorporate sensitive sighting or design of recreation trails and facilities or include fencing or barriers of buffer vegetation to prevent access to areas of Coastal Saltmarsh.

The weed threat to the Coastal Saltmarsh is from pasture grasses and predominantly *Paspalum dilatatum* (Paspalum). Pasture grasses are difficult to control in this environment as non-specific herbicides will have off target damage, while the use of grass specific herbicides will have potential off target damage on aquatic and marine life. Hence these species will not be controlled by spraying, and will be managed by hand pulling and if possible inundation by saltwater which will kill the target species.

The native species Swamp Oak, can invade areas of Coastal Saltmarsh. If this species is observed invading the Coastal Saltmarsh it will be controlled by hand pulling or the cut and paint method.

Recreation Opportunities

This management zone is open to various recreation options, with the only constraint being that these options avoid areas of Coastal Saltmarsh.

4 Ownership and Control

This VMP provides only one input into the Voluntary Planning Agreement (VPA) process and considerations for the ownership and control of retained lands. ELA understand that in the longer term, the proponent envisages that most riparian zones will be held under the ownership of a public authority such as WCC or the LIA.

This change in tenure would be managed via a Planning Agreement between the proponent and the WCC/LIA.

Table 11 recommends ownership patterns from a natural area management perspective. It is important to note that this VMP costs all works in all management zones for the first five years so as to transfer lands with only minimal ongoing maintenance requirements.

Table 11: Ownership and Control

Zone	Zone Name	Ownership Options	Ongoing Vegetation Management Requirements *
1	Duck Creek	Lake Illawarra Authority	Management of noxious and environmental weeds. Management of open space/recreation areas.
2	Wetlands Environmental Reserve	Lake Illawarra Authority	Management of noxious and environmental weeds
3	Southern Lakes	Wollongong City Council or retained by developer	Management of noxious and environmental weeds and open space areas.
4	Yallah Creek	Wollongong City Council or retained by developer	Management of noxious weeds and pasture weeds if required.
5	Western Edge – Southern Area	Wollongong City Council or retained by developer	Management of noxious weeds and pasture weeds if required. Management of open space/recreation areas.
6	Western Edge – Central Area	Wollongong City Council or Lake Illawarra Authority as part of the Duck Creek system	Management of noxious and environmental weeds
7	Western Edge – Northern Area	Wollongong City Council or retained by developer	Management of noxious weeds and pasture weeds if required. Management of open space/recreation areas.
8	Central Riparian Open Space Corridor	Wollongong City Council or retained by developer	Management of noxious weeds and pasture weeds if required. Management of open space/recreation areas.
9	Mt Brown Reserve	Wollongong City Council	Management of noxious and environmental weeds

Zone	Zone Name	Ownership Options	Ongoing Vegetation Management Requirements *
10	East & West Mid slopes	TRUenergy (retained)	Management of noxious weeds. Management of open space/recreation areas.
11	Foreshore Reserve	TRUenergy and Lake Illawarra Authority jointly as water settling ponds required for Power Station.	Management of noxious weeds and pasture weeds if required. Management of open space/recreation areas.

*Assuming successful implementation of the first 5 years of management (Section 3)

5 Seed Collection and Revegetation

All seed for revegetation works will be collected from bushland found across the lands, including in EECs. If appropriate quantities cannot be sourced on site, seed will be sourced within a 5 km radius of the lands. All seed collected will be of local provenance with seed collection undertaken in accordance with Florabank Guidelines (Mortlock 1998). Ideally, seed would be collected 1-2 years in advance of it's planned use to allow for propagation and development.

All seed collected will be propagated at a commercial nursery either as hiko cells or tube stock. Trees will require tree guards to protect them from grazing, heat stress and frost (although unlikely), while shrubs, grasses and herbaceous species do not require tree guards as they are more tolerant of these effects. All revegetation will be watered when it is planted to improve survival rates.

Areas greater than 20 square metres where revegetation does not survive will be required to be replanted and a 10% mortality rate has been factored into the number of plants required for revegetation purposes.

A Section 132C licence under the NSW *National Parks and Wildlife Act 1974* is not required to undertake seed collection works and collection within EECs on the lands as it has been identified as an action in this VMP. However, if seed collection is undertaken outside of the lands, land owner permission will be required and a Section 132C licence under the NSW *National Parks and Wildlife Act 1974* will be required.

6 Feral Animal Control

Four feral animal species have been recorded on the lands, these being the Rabbit (*Oryctolagus cuniculus*), deer, Red Fox (*Vulpes vulpes*) and the Feral Cat (*Felis catus*). The Feral Pig (*Sus scrofa*) also has the potential to be present. Viable management options are only available to control the Rabbit, Feral Pigs and deer.

Red Fox control programs require the use of poison meat baits to control foxes. Currently the lands are a semi urban area and baiting in such areas is problematic as Domestic Dogs (*Canis lupus*) are susceptible to the poison used in Fox baits. Hence, fox baiting is not a plausible option. Similarly shooting is not an option as it is not effective at removing a high percentage of the population and it is in a semi-urban environment where shooting is not appropriate. Hence, no control of Red Fox populations will be undertaken.

There are no viable options available to control the Feral Cat as they do not take baits, rarely enter traps and shooting is not an effective control means. Hence, no control of Feral Cat populations will be undertaken.

6.1 RABBIT CONTROL

Rabbits are widespread across the lands. Where rabbit warrens are observed, two forms of Rabbit control will be undertaken.

Firstly, warren fumigation will be undertaken using phostoxin tablets and secondly, baiting will be undertaken using Pindone baits (an accumulative poison). This will be undertaken in consultation with the local Livestock Health and Pest Authority.

6.2 DEER

It is unclear what species of deer have been observed on the lands and more than one species may be present. The most effective method to control deer is through shooting. However, this is unsuitable in a semi-urban environment and will not be undertaken. The alternative is trapping, which will be undertaken across the lands as part of any regional deer control programs. This will be undertaken in consultation with the local Livestock Health and Pest Authority.

6.3 FERAL PIGS

The most effective method to control Feral Pigs is through a trapping program. Any feral Pig trapping will be undertaken across the lands as part of a regional Feral Pig control program. This will be undertaken in consultation with the local Livestock Health and Pest Authority.

7 Threatened Species Considerations

As identified in **Section 4** all threatened species and EECs have been identified. No threatened flora species have been recorded on the lands, although 11 species (**Table 3**) have been identified as potentially occurring on the lands. Ten threatened fauna species have been recorded on the lands and a further 15 species have the potential to occur on the lands, while eight EECs have been recorded across the lands.

The works in this VMP will improve the condition of EECs across the lands, and will have a positive effect on these EECs. However, the works do have the potential to disturb threatened fauna species previously recorded on the lands, in particular bird species utilising the southern lakes area. It is extremely important that the fringing aquatic vegetation around the lake is not disturbed by any works as this will affect many of the aquatic bird species which utilise the lakes and potentially the threatened bird species. All other actions are unlikely to have an effect on threatened fauna recorded across the lands.

No bush regeneration works in areas that are listed EECs on the lands can be undertaken until part 3A approval is received. Once Part 3A approval is received a Section 132C license under the NSW *National Parks and Wildlife Act 1974* will not be required to undertake bush regeneration works identified in the VMP.

8 Cost

The cost to implement this VMP has been estimated to cost **$3,881,538** over a five year period. This cost has been calculated on the number of days required for a team of four bush regenerators, plus a supervisor to undertake the management works, plus the cost of revegetation works.

The cost of the bush regeneration team and supervisor has been calculated at $2,100 per day. This includes a supervisor and a team of four bush regenerators undertaking an eight (8) hour day. This cost includes the cost of equipment (i.e. back pack spray, chainsaws, brush cutters, etc), running of vehicles across the site and the cost of herbicides. It has been estimated that 1080 bush regeneration days will be required to implement the VMP.

The cost of revegetation has been calculated on different costs for trees and shrubs, grasses and herbs. Trees will cost $4.50 which includes the cost of growing the plant, planting and erection of tree guards, while shrubs, grasses and herbs will cost $3 including the cost of growing the plant and planting. These costs also include seed collection costs. It has been estimated that 16,880 trees, 71,225 midstorey plants (shrubs and small trees) and 429,430 grasses and herbs will be required to revegetate areas within the VMP. These costs have not been indexed to inflation and may be subject to change depending on this and the cost of materials in the market place.

Some costs discussed in this VMP have not been included, such as costs relating to fencing, open space revegetation or amenity planting, drainage related works and other works orientated with the Landscape Masterplan or WSUD.

A detailed break down over the five years for the number of days required and the total costs are provided in **Table 12** and **Table 13**.

Table 12: Number of bush regeneration days and plants required per management zone

Zone	Zone Name	Area (ha)	Year & Number of Days					Plants Required		
			Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Overstorey	Midstorey	Understorey
1	Duck Creek	61	90	60	40	30	20	9650	64300	351790
2	Wetlands Environmental Reserve	81	100	80	55	40	30	0	0	
3	Southern Lakes	29	32	20	15	10	10	4330	2880	1590
4	Yallah Creek	2	4	2	2	2	2	230	580	2550
5	Western Edge - Southern Area	4	6	4	4	4	4	200	350	
6	Western Edge - Central Area	6	12	8	6	4	4	0	0	
7	Western Edge - Northern Area	5	6	4	2	2	2	0	0	
8	Central Riparian Open Space Corridor	20	10	8	6	4	4	270	665	
9	Mt Brown Reserve	31	65	50	40	25	20	2200	2450	73500
10	East & West Mid Slopes	86	20	18	10	10	10	0	0	
11	Foreshore Reserve	28	20	15	15	7	7	0	0	
Totals		**353**	**365**	**269**	**195**	**138**	**113**	**16880**	**71225**	**429430**

Table 13: Cost to implement the VMP over five years

Zone	Zone Name	Area (ha)	Year & Cost ($)					Material Costs (S)			Totals
			Yr 1	Yr 2	Yr 3	Yr 4	Yr 5	Overstorey	Midstorey	Understorey	
1	Duck Creek	61	189000	126000	84000	63000	42000	43425	225050	1055370	**$1,827,845**
2	Wetlands Environmental Reserve	81	210000	168000	115500	84000	63000	0	0	0	**$640,500**
3	Southern Lakes	29	67200	42000	31500	21000	21000	19485	10080	4770	**$217,035**
4	Yallah Creek	2	8400	4200	4200	4200	4200	1035	2030	7650	**$35,915**
5	Western Edge - Southern Area	4	12600	8400	8400	8400	8400	900	1225	0	**$48,325**
6	Western Edge - Central Area	6	25200	16800	12600	8400	8400	0	0	0	**$71,400**
7	Western Edge - Northern Area	5	12600	8400	4200	4200	4200	0	0	0	**$33,600**
8	Central Riparian Open Space Corridor	20	21000	16800	12600	8400	8400	1215	2327.5	0	**$70,743**
9	Mt Brown Reserve	31	136500	105000	84000	52500	42000	9900	8575	220500	**$658,975**
10	East & West Mid Slopes	86	42000	37800	21000	21000	21000	0	0	0	**$142,800**
11	Foreshore Reserve	28	42000	31500	31500	14700	14700	0	0	0	**$134,400**
Totals		**353**	**$766,500**	**$564,900**	**$409,500**	**$289,800**	**$237,300**	**$75,960**	**$249,288**	**$1,288,290**	$3,881,538

9 Monitoring and Reporting

The bush regeneration contractor will be responsible for monitoring changes in the vegetation across the lands over time. The objective of the monitoring and reporting program is to record changes to the vegetation as a result of vegetation management works. Monitoring reporting will also require site inspections with the clients representative, a WCC representative (if required) and the Bush Regeneration Team leader.

The bush regeneration contractor will prepare regular reports to describe the progress of their work and demonstrate compliance with the VMP. Reports will include a brief quarterly work report and an annual audit and assessment of compliance with the performance criteria in **Section 9.4**. The requirements of monitoring and reporting are described in detail in the sections below.

9.1 PHOTO MONITORING POINTS

Photo monitoring points will be established across the lands in all management zones. **Table 14** shows the minimum number of photo monitoring points that will be required to be established in each management zone. Associated with each photo monitoring point, detailed notes on how the vegetation has changed due to actions implemented through the VMP will be recorded.

Table 14: Number of Photo Monitoring Points to be established in each management zone

Management Zone	Number of Photo Monitoring Points
1	4
2	3
3	2
4	1
5	1
6	2
7	1
8	1
9	4
10	2
11	1

Photo monitoring points (using a digital camera) will be established at locations that can provide a visual reference of changes in the vegetation through time. These photo monitoring points will be established prior to the commencement of works, followed up by a 6, 12, 18 and 24 months monitoring and from then on a yearly basis. The method to establish and take photo monitoring points is as follows. The bush regeneration contractor will:

- Establish photo monitoring points across all areas where the VMP works will be undertaken;
- Permanently place two six foot star pickets 10-metres apart and mark with flagging tape for easy relocation;
- the location of the first star picket will be recorded with a GPS;
- take a digital photo of each photo monitoring point from the first star picket, towards the second star picket, with the whole length of the second star picket visible in the photo to act as a reference point;
- a range pole with a white board strapped to it with the date, photo monitoring point number and management zone will be recorded on the white board; and
- organise the digital photos logically with each image labelled with a unique reference number indicating the location of the photo monitoring point and the date the photo is taken (i.e. "01_2010_07_01" for photo point 1 taken on the 1 July 2010)

Where photo monitoring points are established in management zones 3, 4, 5, 7, 8, 10 and 11, star pickets will not be used to permanently mark the photo monitoring points as this will be a potential hazard in recreational areas. Instead a hard wood peg 4 cm square and 20-30cm long will be used to mark the point. Details of the photo monitoring point will be written on the peg. These pegs may need to be replaced periodically due to termites.

9.2 TRANSECTS

In management zones 1, 2, 6 and 9, two transects in each management zone will be established to record the change in vegetative cover of weeds and native species through time. A 50 metre tape will be rolled out and at every metre a range pole will be placed. Every species touching the range pole will be recorded and classified into 5 height classes:

- >10 cm;
- 11 – 50 cm;
- 51 – 100 cm;
- 101 – 201 cm
- >200 cm.

This information will be used to determine how the cover of weed and native species has changed through the implementation of this VMP.

9.3 BUSH REGENERATION REPORTING

A detailed report outlining work undertaken by the bush regeneration contractor will be prepared once every six months in the first two years and yearly after that. The report will be submitted to the client and include:

- a summary of works carried out during the period in each management zone with a copy of the photo monitoring point for that time period;
- an approximation of the time spent on each task;

- a description of any problems encountered in implementing the works recommended in the VMP for the particular management zone and how they were overcome;
- any observations made, including new plant species recorded (native and weed species), comments on rates of regeneration and any problems which impact on the implementation of the VMP; and
- a discussion on the results of the vegetation transects.

9.4 PERFORMANCE CRITERIA

The progress and compliance with the VMP will be monitored and reviewed annually. This process will involve the bush regeneration contractor, the client and a WCC representative. A report will be prepared commenting on each performance criteria, followed by a site visit to discuss each performance criteria. The performance criteria are:

1. Commencement of all tasks outlined in the VMP or evidence of planning for their implementation for each management zone;
2. Demonstrated control works undertaken on noxious and environmental weeds across the site;
3. A 50% reduction of weed cover across the vegetation transects after 2 years and a 90% reduction in weed cover after five years;
4. No adult seeding woody weeds present across the VMP area after five years; and
5. Monitoring and reporting undertaken in accordance with **Section 9.3**.

References

Brandis, C. 2006. *Birds of the Tallawarra Site*. Illawarra Bird Observers Club Inc. (unpublished report).

Burcher, P. 1997. *Assessment of Fauna and Flora – Lands Assocaited with the Tallawarra Power Station*. Prepared for Pacific Power.

Corkery Consulting. in prep. *Tallawarra Lands Landscape Masterplan*. Prepared for TRUenergy.

Department of Environment, Climate Change and Water. 2010a *DECCW Threatened Species Database Records.*

ELA. 2010b. *Tallawarra Lands Part 3A Concept Plan Application, Ecological Assessment*. Prepared by Eco Logical Australia for TRUenergy.

ELA. 2010c. *Tallawarra Lands Part 3A Concept Plan Application, Riparian Assessment*. Prepared by Eco Logical Australia for TRUenergy.

Greg Richards & Associates. 1997a. *Illawarra EcoEnergy Park Combined Cycle Generation Plant – An assessment of the Large Bentwing Bat and a survey of the microchiropteran bat fauna*. Prepared for Pacific Power.

Mortlock, W. 1998. *Guidelines for Seed Collection for Native Vegetation*. Florabank Guidelines. Accessed 28 May 2010.

Turton, M. 1996. *Bat Survey – Tallawarra Power Station, Lake Illawarra*. Prepared for Pacific Power.

URS. 2006. *Flora and Fauna Survey and Assessment for Proposed Installation of a Gas Pipeline*, Tallawarra, NSW. Prepared for TRUenergy.

WBM BMT. in prep. *Drainage and Water Sensitive Urban Design, Tallawarra Lands*.

Wollongong City Council. 2009. Wollongong Development Control Plan 2009. Wollongong City Council

Appendix A: Weed Control Techniques

The techniques for the weed control methods described in **Section 3** are described below in more detail, including the use of herbicides.

CUT AND PAINT

The cut and paint method is suitable for the control of woody weeds and climbers. It is used when the biomass is to be removed from the site following the weed control being undertaken. It is most suitable for plants with a small diameter at the base and a single stem or trunk. Where plants have a larger diameter at the base or multiple stems, the drill and fill method is more suitable.

The plant needs to be cut as close to the base as possible, below any branches and it needs to be horizontal. The tools required to make the cut should be either a handsaw or secateurs. A chainsaw may be used on hard woods, but if this is required the drill and fill technique should be considered. Any dirt on the stump needs to be removed and the herbicide needs to be directly applied to the stump using a dabber bottle (**Figure 7**). Some plant species resprout after this treatment and follow up work may be required to kill the plant effectively. A non-specific herbicide will be used for the cut and paint method.

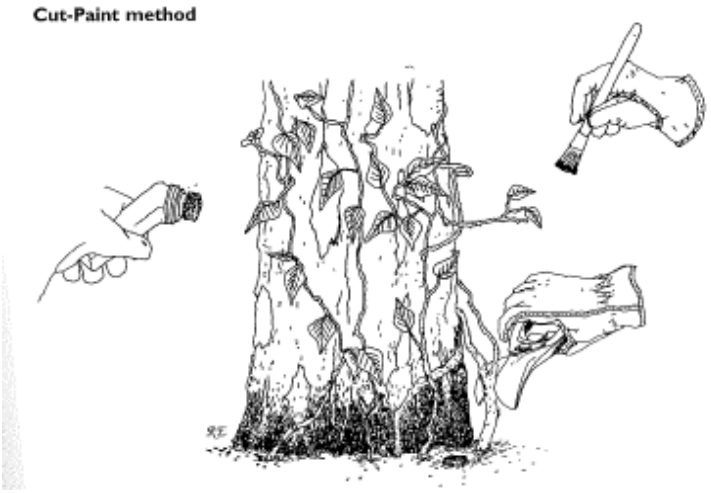

Image from Muyt (2001)

Figure 7: The cut and paint method

DRILL AND FILL

The drill and fill method is suitable for woody weeds with a large diameter at ground height or for plants with multiple stems at the base. This control method is useful where dead trees are intended to be left standing as habitat trees.

The drill and fill method involves drilling a hole into the base of a tree below any branches with a hand drill bill using a 9 or 10mm drill bit at an angle of 40-60^{O}. The hole should only penetrate through the sap wood and not through to the heart wood (**Figure 8**). The hole should then be filled immediately with the appropriately mixed herbicide. An eye dropper or a squeeze bottle with a narrow nozzle can be

used to fill the hole. If the plant re-sprouts follow up work will required to kill the plant. A non-specific herbicide will be used for the drill and fill method.

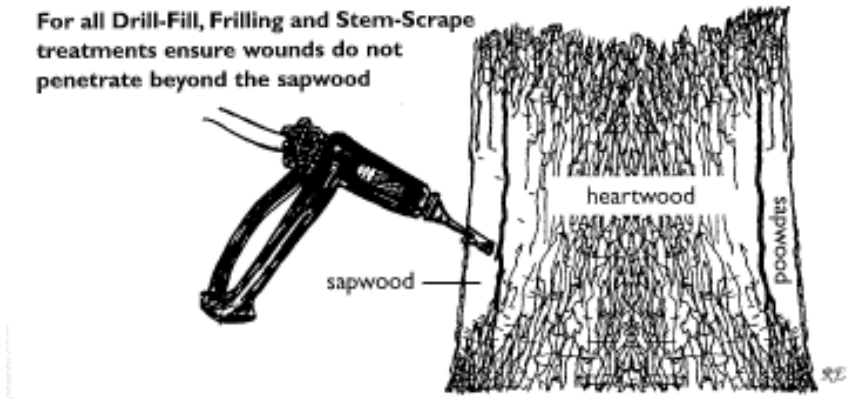

Image from Muyt (2001)

Figure 8: The drill and fill method

STEM SCRAPE

The stem scrape method is used to control climbing weed species with a woody stem. One climbing weed species found on the lands that this method is not suitable for is Cape Ivy.

The stem scrape method involves using a sharp knife to scrape back the top layer of bark from the vine 10-20cm long. An appropriately mixed herbicide needs to be applied immediately using a using a dabber bottle. Every individual vine needs to be treated and more than one scrape can be applied to a vine, as long as it is on the opposite side (**Figure 9**). The root system of the plant should not be disturbed until the plant has died as this may reduce the effectiveness of the herbicide. A non-specific herbicide will be used for the stem scrape method.

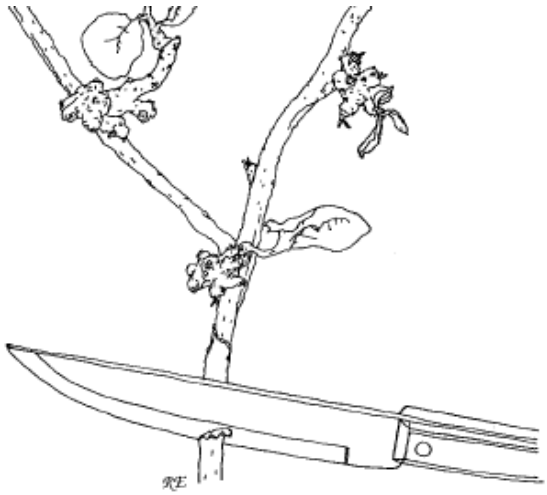

Image from Muyt (2001)

Figure 9: The stem scrape method

SPOT SPRAYING GRASSES

There are many introduced species of pasture grass found across the lands. The most important issue to consider when controlling grasses is to understand their active growing period. Some species are only actively growing in late winter - spring, while other species are actively growing in spring – summer.

The control of grasses needs to be undertaken before their flowering season to prevent seed set. All grasses need be slashed using a brush cutter before they are sprayed to remove any dead foliage and to promote the growth of new foliage. The grasses should then be sprayed, using a back pack spray, once new growth has sprouted ensuring herbicide mix is sprayed carefully to prevent off target damage from occurring.

If adjacent aquatic environments, a non-specific herbicide suitable for use near waterways (i.e. RoundUp© Biactive™) will be used. However, in circumstances away from aquatic environments the use of grass specific herbicides may be suitable to be used (i.e. Fusillade©).

SPOT SPRAYING BLACKBERRY

Blackberry can be an extremely difficult plant to control. The Blackberry complex consists of a large number of different species which can be very difficult to identify. These different species can all have different growing periods, although many species are actively growing during warmer months from November - February, with many species fruiting in December - January. Infestations of Blackberry need to be controlled when they are actively growing to ensure that the herbicide is absorbed properly, hence infestations are required to be monitored to determine if they are actively growing.

Blackberry infestations need to be sprayed, using a back pack spray, once new growth has sprouted and prior to or during flowering, using an appropriately mixed herbicide mix. The herbicide needs to be sprayed carefully to prevent off target damage from occurring.

The most suitable herbicide for the control of Blackberry is Triclopyr (i.e. Garlon©). However, care needs to be taken using this herbicide as it is a broadleaf herbicide which will kill native species and it can be extremely toxic to aquatic life.

HAND PULLING

The hand pulling of weeds is suitable for many species of weeds as long as they have a shallow root system. It is useful for follow up work on woody weeds to control seedlings. The hand pulling of weeds involves pulling the plant as close to the base as possible and ensuring the entire tap root is pulled out of the soil. This usually results in soil disturbance and the soil should be replaced and compressed to prevent further weed invasion.

HERBICIDE USE

Herbicides are required for the management of woody, vine and grass weeds across the lands. Several different herbicides will be required to be used and these are discussed below in more detail.

The grass specific herbicide Fusilade© can be used for grass control. It will not be used in or adjacent waterways as it is extremely toxic to aquatic life. This herbicide is to be used where introduced grasses are found in areas of remnant vegetation with low native grass cover and abundance. If there is a high cover and abundance of native grasses a non-specific herbicide should be used as it is less toxic.

Herbicides with the active ingredient Triclopyr will only be used to control Blackberry. These types of herbicides are extremely toxic to aquatic life and will not be used in or adjacent waterways.

Where an alternative broad leaf herbicide is required to be used to control different broad leaf herbicides, BrushOff of metsulfuron methyl will be used. This herbicide is not suitable for use on Blackberry, but can be used on other weed species.

Where non-specific herbicides are required for use glyphosate is the most suitable herbicide to be used. If herbicides are required to be used near waterways a glyphosate based herbicide suitable for use near water ways will be used (i.e. RoundUp© Biactive™).

All staff using herbicide will have appropriate training in the use of herbicides and appropriate records will be kept in accordance with the NSW *Pesticide Regulation 2009*.

WEED WASTE

Due to the dense thickets of Lantana and other weeds across the lands, the removal of weed waste from the site is not feasible. Where weed control occurs, the weed waste should be left in situ to decompose on the site. This will also breakdown through time to provide a layer of mulch in the soil. Exceptions to this are the areas currently used for horse agistment. The waste from woody weeds from these areas will be removed and disposed of at a site licensed to receive green waste.

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