Tallawarra Lands Part 3A Concept Plan Application
Riparian Assessment

Report prepared for TRUenergy

4 February 2011

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Abbreviations

ABBREVIATION	DESCRIPTION
CRZ	Core Riparian Zone
DECCW	Department of Environment, Climate Change and Water
DIPNR	Department of Infrastructure Planning and Natural Resources (now DECCW)
DoP	Department of Planning
DWE	Department of Water and Energy
EA	Environmental Assessment
NoW	NSW Office of Water
RCMS	Riparian Corridor Management Strategy
RFS	NSW Rural Fire Service
VB	Vegetated Buffer
WSUD	Water Sensitive Urban Design

1 Introduction

This Riparian Assessment Report addresses the riparian components of the Environmental Assessment for the Tallawarra Lands Part 3A Concept Plan Application. This report responds to the requirements of the Director General of the NSW Department of Planning under Part 3A of the NSW Environmental Planning & Assessment Act 1979 for this project (MP 09_0131) concerning riparian issues, which are as follows:

4. Riparian Impacts

a) The EA shall identify the appropriate location and width of riparian areas and buffers to wetlands, foreshore and riparian areas (including SEPP 14 wetlands, other wetlands, saltmarsh and mangroves), other important aquatic habitats, other significant and ecologically sensitive areas. The buffer zones and any other safeguards to mitigate any impacts upon aquatic environments and riparian habitats, should include full details and maps, identification of all waterways, conservation area dedications, foreshore wetland rehabilitation and vegetation plans for the site. Vegetated buffers to protect wetlands are to allow for cyclic and successional change in the wetland boundaries including provision for upslope migration of estuarine wetland due to possible sea level rise.

c) The EA shall identify current riparian zone areas and proposed rehabilitation, including details of where native vegetation will be retained and replanted and how any current and future areas will be rehabilitated. The EA shall incorporate a sufficient vegetated riparian zone along the lake.

Part 4b of the DGRs is shown below. The matters of relevance to 4(b) are addressed by Drainage and Water Sensitive Urban Design (BMT WBM in prep) and a Groundwater Assessment (Coffey, in prep)

b) The EA shall assess the effects of potential changed nutrient and sediment transport from the proposal on the nearby wetlands and the vegetation communities as well as the lake itself. Develop scenarios and mitigation measures for managing potential increased sediment and nutrients as a result of the increased urbanization of the wetland and lake catchments.

The Director General's requirements of relevance to riparian assessment (4 (a) and (c)) have been summarised in the following table, along with the section of this report where they are addressed:

Summary of Riparian DGRs	Section
Describe all waterways, aquatic environments and riparian habitats	2.0
Identify the location and width of riparian areas and buffers to wetlands and foreshore areas	3.0
Provide details on conservation area dedications, rehabilitation and revegetation plans for the site	3.0 and ELA 2010c

In addition to the DGRs, this report has also taken into consideration matters raised by the NSW Office of Water (NoW) in its correspondence to the Department of Planning dated 15 September 2009. NoW specifically recommended that:

- The Regional Corridor Management Study (RCMS) methodology (DIPNR 2004) for mapping of streams, categorisation and riparian buffer widths (CRZ and VB) be applied;
- Duck Creek requires a corridor of at least 100m width each side of the waterway for provision of a regional corridor;
- Provision of buffer setbacks to wetlands (including SEPP 14); and
- A 50m wide vegetated setback be provided along the Lake Illawarra foreshore.

This report addresses the DGR and DECCW requirements and applies these requests to the site and proposed development. Related detail reference in this report can be found in the following documents:

- Ecological Assessment (ELA 2010b);
- Vegetation Management Plan (ELA 2010c); and
- Bushfire Assessment (ELA 2010a).

1.1 THE SUBJECT SITE

The site is known as Tallawarra Lands, and is located in Wollongong Local Government Area, on the western foreshore of Lake Illawarra, approximately 13 kilometres south of Wollongong town centre. It is approximately 536 hectares in area with an additional 36 hectares utilised by Tallawarra power station (not part of this assessment).

The established suburbs of Koonawarra and Dapto are located immediately to the north of the site, and the newly established Haywards Bay development area is located to the south.

The site is a mix of steep ridges and undulating to flat cleared land and low lying flood affected wetland areas, including Coastal Wetlands identified under State Environmental Planning Policy 14.

Figure 1 shows the Concept Plan for the site.

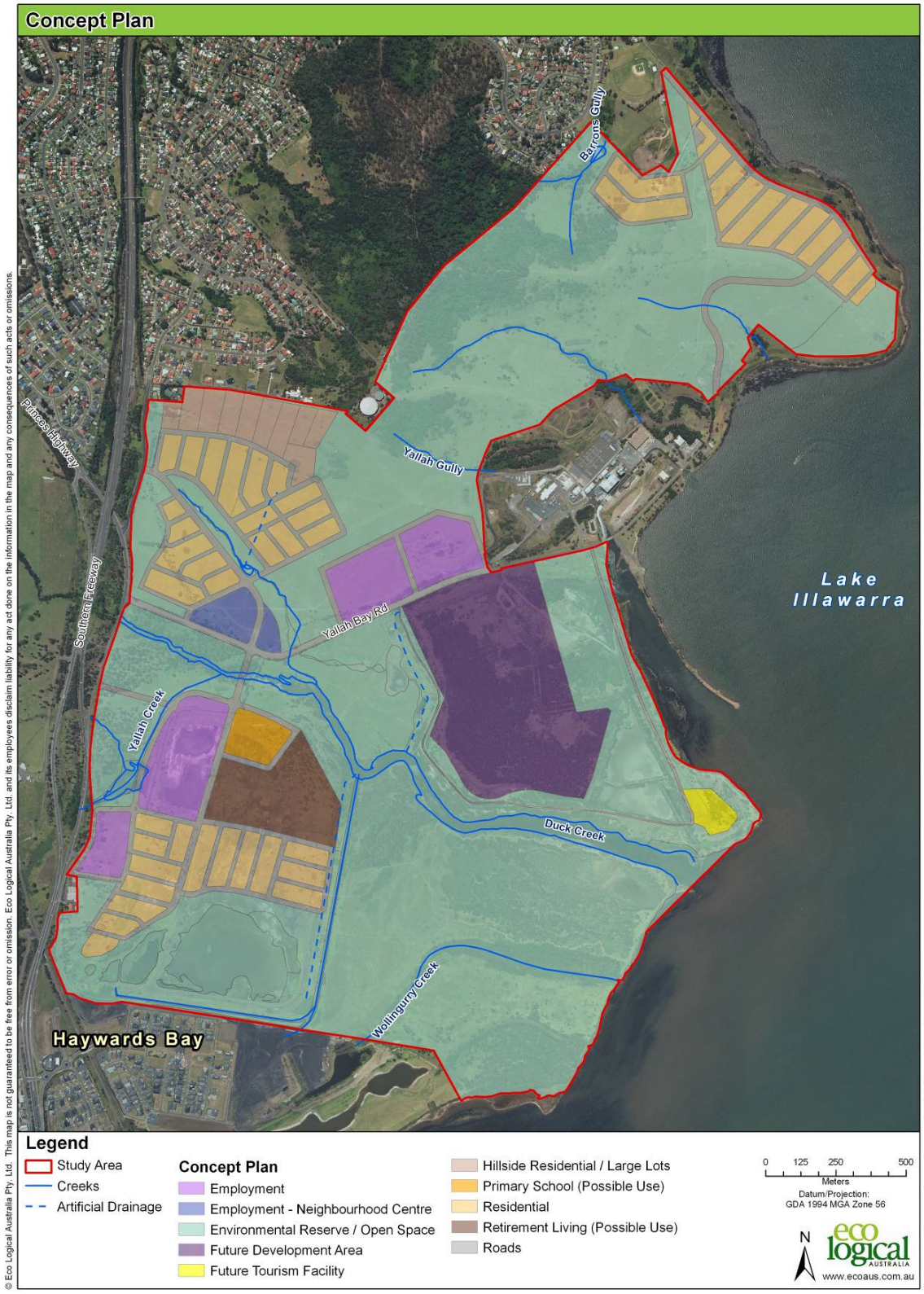

Figure 1: Concept Plan

2 Methodology

The broad approach taken with the Tallawarra Lands riparian assessment was to document the characteristics of aquatic features and also to assess their condition, recovery potential, habitat value and general significance. This section of the report provides a description of the condition of the waterways, artificial wetlands and SEPP 14 wetlands found on the Tallawarra site. Figure 2 provides a map of these features.

The riparian features of the Tallawarra site were inspected in the field to inform this assessment as follows:

- Documentation of stream type consistent with the categories outlined in the *Geomorphic Categorisation of Streams in the Hawkesbury Nepean Catchment* (DLWC 2000);
- Character including hydrological setting, geomorphic character, size and habitat values;
- The condition was classified into one of the following categories (DLWC 2000):
    - Near intact condition;
    - Good condition;
    - Moderate condition; and
    - Degraded condition.
- The recovery potential (DLWC 2000) was classified into the following categories (based on the observable history of disturbance to soil/sediments, channels and vegetation):
    - Very High Recovery Potential;
    - High Recovery Potential;
    - Moderate Recovery Potential; and
    - Low Recovery Potential.

Further, the riparian zone assessment utilised the riparian categories identified in the RCMS (DIPNR, 2004). The RCMS categorizes riparian areas based on their core functions and environmental significance as follows:

a) Category 1. Environmental Corridor – provide biodiversity linkages ideally between one key destination to another, (the coast and the escarpment, or large nodes of vegetation).

b) Category 2. Terrestrial and Aquatic Habitat – provides basic habitat and preserves the natural features of a watercourse (not necessarily linking key destinations).

c) Category 3. Bank Stability and Water Quality – has limited (if any) habitat value but contributes to the overall basic health of a catchment.

2.1 DESCRIPTION OF RIPARIAN AREAS

2.1.1 Duck Creek

Duck Creek is considered a Category 1 riparian zone by RCMS (DIPNR, 2004) due to the link it provides between Lake Illawarra and lowland woodlands west of the freeway.

The assessment of Duck Creek is described in Table 1. In general the Duck Creek riparian zone is in moderate to good condition. Although weeds are present along much of the core riparian zone, there is generally a moderate to high recovery potential for most reaches.

Due to the size of the requested corridor and length of Duck Creek through the site, additional top of bank mapping was conducted to inform the development of the concept plan. The top of bank of Duck Creek was undertaken using a differential Global Positioning System with an accuracy of 1m. The top of bank is depicted in Figure 2.

Table 1: Reach Condition, Recovery Potential and field survey notes for Duck Creek

Reach ID*	Condition[1]	Recovery Potential[1]	Notes
1	Moderate	Moderate	Bedrock exposed, bank erosion evident mainly on south side of creek. Understorey dominated by weeds such as Lantana. Large Eucalypts and Casuarinas. Tributary on southern bank
2	Moderate/Good	Moderate/High	Very weedy with some native overstorey vegetation present. Some erosion. Bridge causing wash out.
3	Moderate/Low	Low	Nick point back from main channel.
4	Moderate	Moderate	Bedrock exposed with steep erosion opposite. Vegetation dominated by weeds with young regrowth Casuarinas. Creek widens. Tributary at end of reach
5	Moderate/Good	Good	Well vegetated on southern bank. Active bank erosion.
6	Moderate/Good	Moderate	Creek widens. Limited canopy on northern bank. Southern bank well vegetated. Weeds present.
7	Moderate/Good	Moderate/High	Wollingurry Creek at start of reach. Small tributary on northern bank. Some small backflows. Higher weed density
8	Moderate/Good	Moderate/High	Just south of concrete channel. Good canopy cover and mid storey vegetation cover. Higher abundance of Lantana and other weeds.
9	Moderate	Moderate	Thick Lantana. Good canopy cover. Stormwater pipe in northern bank. Creek widens heading towards lake.

*Reach IDs for Duck Creek are prefixed with a “dc” on Figure 2 for identification.
[1]DLWC (2000)

Figure 2: Riparian Features

2.1.2 Other Waterways

In addition to the detailed work undertaken for Duck Creek, all other waterways found onsite were assessed for condition and validation of RCMS category. Their location was broadly assessed in the field followed by a more detailed desktop analysis using high resolution aerial photos and terrain information. Table 2 provides these details for each waterway and identified reach.

Table 2: Riparian Categories (excluding Duck Creek, Wetlands and Lake Illawarra Foreshore)

Stream No & Reach ID	Waterway Name	RCMS Category[2]	Stream Type[1]	Description	Vegetation Communities	Stream Width	Condition[1]	Field RCMS Assessment[2]
1a	Wollingurry Creek (eastern portion)	2	Meandering lateral	○ Sandy substrate; ○ Bank erosion not evident; ○ Vegetated to top of bank; ○ Channel is a shallow depression; ○ Saltmarsh present at mouth of waterway; ○ Heavy *Lantana camara* invasion in riparian understorey.	**Swamp Oak Floodplain Forest; Alluvial Swamp Mahogany Forest**	2 – 3 m	Near Intact	2
1b	Wollingurry Creek (western portion)	2	Meandering lateral	○ Channel is a shallow depression; ○ Riparian zone comprised of exotic grassland for most part; ○ Channel covered in exotic grasses.	Patchy **Alluvial Swamp Mahogany Forest** (north-western bank); **Exotic grassland** (south-eastern bank)	1 - 2 m	Moderate Condition	3
2a	Un-named Creek (northern channel section)	n/a	Meandering lateral	○ Shallow 'formed' drainage channel; ○ Dense Typha orientalis instream; ○ Patches of remnant vegetation surrounding; ○ Kikuyu, Paspallum, Chloris and Bracken fern patches; ○ Informal track crossing; ○ High level of disturbance in this area including modified substrate and landform.	**Weed and exotics** / **Floodplain wetland; &** **Lowland Woollybutt-Melaleuca Forest:** *Phragmites australis* and exotic grassland with scattered *Melaleuca ericifolia* patches	Up to 2m	Moderate – Degraded Condition	3

Stream No & Reach ID	Waterway Name	RCMS Category[2]	Stream Type[1]	Description	Vegetation Communities	Stream Width	Condition[1]	Field RCMS Assessment[2]
2b	Un-named Creek (southern channel section)	n/a	Meandering lateral	○ Shallow 'formed' (rock lined) drainage channel; ○ Dense Typha orientalis instream; ○ No surrounding natural vegetation; ○ Adjoined by a Kikuyu groundcover; ○ High level of disturbance in this area including modified substrate (coal wash deposits) and landform; ○ Connects to AW3 which connects to AW4.	**Weeds and Exotics** (mostly exotic pasture grasses).	Up to 2 m	Degraded Condition	3
3a	Yallah Creek (northern sections)	2	Other – man-made channel	○ Man-made channel, created following construction of the ash dam in this area; ○ Man-made channel has steep banks, some sections with concrete (east); ○ Riparian zone vegetation is primarily exotic species dominated by Kikuyu on bank with *Typha orientalis* present instream; ○ Riparian zone grazed by stock (horses); ○ Informal crossing used by stock present just south of confluence with Duck Creek.	**Exotic grassland** Small amount of **Swamp Oak Forest and Lowland Woollybutt – Melaleuca Forest** near the confluence with Duck Creek.	1 – 2 m	Degraded Condition	3
3b	Yallah Creek (southern sections	2	Meandering lateral / Other – artificial wetland	○ Combination of waterway flowing from site boundary into small dam (artificial wetland); ○ Mostly natural substrates in this area (apart from modifications to create the dam); ○ Riparian zone vegetation is found in the western and southern parts. Mostly dominated by exotics including Coral trees, Kikuyu and pasture grasses with *Typha orientalis* present instream; ○ The dam has *Typha orientalis* on its southern boundary that would provide terrestrial and aquatic habitat.	**Exotic grassland; Lowland Woollybutt – Melaleuca Forest** lower (weed infested) condition. **Artificial wetland**	1 m	Degraded condition	2

Stream No & Reach ID	Waterway Name	RCMS Category[2]	Stream Type[1]	Description	Vegetation Communities	Stream Width	Condition[1]	Field RCMS Assessment[2]
4	Central Precinct (Town Centre) drainage line	3	Meandering lateral / channel wetlands	○ Waterway on steep southern slope of Mount Brown with partial incisions; ○ Evidence of erosion; ○ Natural sediments but disturbed by previous clearing and stock impacts; ○ No natural riparian vegetation remaining; ○ Weir present; ○ Small farm dams present along waterway provides very limited habitat; ○ Box culvert under Yallah Road.	**Exotic grassland** with scattered trees **Artificial wetlands** / dams present along stream	Mostly < 1 m	Degraded Condition	3
5	Yallah Gully	3	Meandering vertical	○ Steep drainage line on eastern hill slope of Mt Brown; ○ Shallow channel within natural sediments; ○ Limited to no native riparian vegetation.	**Weeds and exotics** / exotic grassland Exotic shrubland (west), exotic grassland (centre) and planted vegetation (east)	< 1 m	Degraded Condition	3
6a	Brooks Creek	1	Meandering vertical	○ Steep upperslope reach of Brooks Creek; ○ Riparian zone vegetation fragmented to the east – limited potential connectivity value; ○ Heavy Lantana infestation in this section with limited native species; ○ Narrow section of stream with grassy channel;	**Weeds and exotics** / exotic grassland	Mostly < 1 m	Degraded Condition	2

Stream No & Reach ID	Waterway Name	RCMS Category[2]	Stream Type[1]	Description	Vegetation Communities	Stream Width	Condition[1]	Field RCMS Assessment[2]
6b	Brooks Creek	1	Meandering vertical / channel wetlands	o Steep midslope reach of waterway; o No native riparian zone vegetation; o Grassy channel; o A small farm dam is present instream in this section; o Natural sediments; o Previous and current disturbance from clearing and grazing.	**Exotic grassland / Artificial wetlands**	1 - 2 m	Degraded Condition	3
6c	Brooks Creek	1	Meandering lateral	o Topography flattens on this lower slope reach; o Riparian zone vegetated by rainforest patch with an understorey invaded by exotic species. o Fragmented riparian vegetation and not part of a clear corridor. Offers stepping stone habitat.	**Lowland Dry Subtropical Rainforest**	1 - 2 m	Moderate condition	2
6d	Brooks Creek (power station buffer)	1	Meandering lateral	o On the flatter foot slope; o Riparian vegetation present but heavily invaded by exotic species (Lantana) particularly eastern portions.	**Lowland Dry Subtropical Rainforest / Weeds and exotics**	1 - 2 m	Moderate – degraded condition	2
7a	Unnamed drainage line north of Power Station	2	Meandering lateral	o Eroded shallow channel; o Riparian zone comprised of exotic grassland; o Natural sediments but disturbed through current and previous clearing and grazing; o Small farm dam present with very limited habitat value.	**Exotic grassland**	< 1 m	Degraded condition	3

Stream No & Reach ID	Waterway Name	RCMS Category[2]	Stream Type[1]	Description	Vegetation Communities	Stream Width	Condition[1]	Field RCMS Assessment[2]
7b	Unnamed drainage line north of Power Station	2	Meandering lateral	o Grassy drainage channel; o Provides connection to the lake although fragmented from other vegetation to west; o Comprised of a mixture of native (Swamp Oak), planted vegetation and pasture grass.	**Swamp Oak Floodplain Forest** / **Weeds and exotics**	< 1 m	Degraded condition	2
8a	North Shore Creek	1	Meandering lateral	o Narrow channel with a highly disturbed understorey dominated by Lantana on the east bank; o Western bank supports exotic grassland; o Riparian zone < 10 m wide; o Grassy channel. o Maintains link through narrow and disturbed riparian zone (< 10 m wide) to remnant vegetation in the west.	**Moist Box – Red Gum Foothills Forest** (north and south) / **Coastal Grassy Red Gum Forest** (south)	1 - 2 m	Moderate condition	2
8b	North Shore Creek	1	Meandering lateral	o Narrow channel with a highly disturbed understorey dominated by Lantana and pasture grasses; o Patch of Swamp Oak Floodplain Forest amongst Red Gum Woodland. o Farm dam (artificial wetland) in north dominated by *Typha orientalis* that provides some habitat for fauna (instream macrophytes); o Creates linkage to larger stand of vegetation to the west; o Narrow and disturbed riparian zone; o Natural sediments but disturbed through current and previous clearing and grazing.	**Moist Box – Red Gum Foothills Forest** / **Swamp Oak Floodplain Forest** / **Artificial wetland.**	1 – 2 m	Moderate condition	2

Stream No & Reach ID	Waterway Name	RCMS Category[2]	Stream Type[1]	Description	Vegetation Communities	Stream Width	Condition[1]	Field RCMS Assessment[2]
9	Ephemeral drainage line into Waterway 4	n/a	Meandering lateral	○ Grassy swale; ○ Primarily exotic grassland; ○ Limited terrestrial or aquatic habitat value.	**Exotic grassland**	< 1m	Degraded condition	3
10	Man made drainage ditch from Tallawarra Road to Duck Creek	n/a	Meandering lateral	○ Small man-made drainage channel, concrete in parts; ○ No defined riparian zone or riparian vegetation ○ Two artificial wetlands with limited habitat value present. ○ A very small area of saltmarsh is present on the edge of the southern wetland.	**Exotic grassland**/ **Artificial wetland** / **Saltmarsh**	< 1 m	Degraded condition	3
11	Swale parallel to Wollingurry Creek and then Haywards Bay Road	n/a	Meandering lateral	○ Man-made drainage swale draining from Haywards Bay development around coal wash deposits to Duck Creek; ○ *Typha orientalis* dominated channel; ○ Riparian zone supports weeds and exotics except in the north where a small amount of Swamp Oak Floodplain Forest and Lowland Woollybutt – Melaleuca Forest is present; ○ Modified topography and sediments due to history of disturbance from use of this area as a coal wash deposit.	**Weed and exotics** / **Swamp Oak Floodplain Forest** / **Lowland Woollybutt – Melaleuca Forest**	< 1 m	Degraded condition	*3*

[1]**Stream condition and stream type** are consistent with the categories outlined in the *Geomorphic Categorisation of Streams in the Hawkesbury Nepean Catchment* (DLWC 2000)
[2]**Stream** / **RCMS categories** are consistent with those outlined in Table 4 of the *Riparian Corridor Management Study* (DIPNR 2004)

2.2 NATURAL AND ARTIFICIAL WETLANDS

Natural and artificial wetlands are present across the study area including two that are protected under SEPP 14. The SEPP 14 wetlands occur in the south eastern portion of the site and are in good condition with limited weed invasion. The SEPP14 wetlands support the vegetation associations of Estuarine Alluvial Wetland, Saltmarsh and Coastal Swamp Oak Forest (ELA 2010b). These wetlands provide potential habitat for a variety of species including birds, reptiles, mammals and amphibians. An inventory of flora species present within each of the SEPP 14 wetlands is provided in an Environmental Assessment for Tallawarra Lands (ELA 2010b).

A number of artificial wetlands are also present across the site with the largest occurring in the south west. Some of these artificial wetlands provide habitat for waterbirds, reptiles and amphibians although they vary in the quality of habitat provided (ELA 2010b). Figure 2 shows the location of natural and artificial wetlands across the study area and Table 3 describes the wetlands.

Table 3: Natural and Artificial Wetlands

Wetland ID	Wetland Type	Character			Area (ha)	Vegetation Communities	Description and Habitat Characteristics	Environmental Significance[1]
		Hydrology	Substrate form	Form				
SEPP 14 (383)	Natural	Inundation likely from Lake Illawarra and Duck Creek during high tide / flow events. Small local hydrological catchment.	Natural sediment.	Natural estuarine wetland.	8.86	Estuarine Alluvial Wetland Coastal Saltmarsh Swamp Oak Floodplain Forest	Large area of natural wetland comprised mostly of Estuarine Alluvial Wetland with fringing forested wetland. Some medium sized patches of saltmarsh also occur. Fully vegetated with low weed density within wetland area. **Habitat characteristics:** Sedges and rushes provide high quality habitat for waterbirds and amphibians particularly given the limited weed invasion in this wetland.	High
SEPP 14 (381b)	Natural	Inundation likely from Lake Illawarra. Small local hydrological catchment.	Natural sediment.	Natural estuarine wetland.	3.55	Coastal Saltmarsh; Swamp Oak Floodplain Forest	Medium sized natural wetland comprised of Saltmarsh and fringing forested wetland (Coastal Swamp Oak Forest). **Habitat characteristics:** Saltmarsh provides habitat for some waterbirds as does the Swamp Oak Forest. Habitat value slightly less than SEPP 14 wetland (383).	High

Wetland ID	Wetland Type	Character			Area (ha)	Vegetation Communities	Description and Habitat Characteristics	Environmental Significance[1]
		Hydrology	Substrate form	Form				
AW1	Artificial	Hydrologic connection to Yallah Creek, a tributary of Duck Creek. Small upstream catchment, part offsite.	Natural sediment.	Farm dam.	1.40	Artificial wetland – portions fringed by aquatic vegetation (Typha) Surrounded by Lowland Woollybutt – Melaleuca Forest and exotic grassland	Waterbody with fringing sedges and rushes around part of the margin. Gambusia present. Heavily weed infested riparian zone. **Habitat characteristics:** Some fringing vegetation. Habitat for birds, reptiles, bats and amphibians.	Moderate
AW2	Artificial	Not connected to natural streams. Internal drainage within form coal wash / ash dam area.	Modified sediment.	Former coal wash settling pond.	0.89	Artificial Wetland Surrounded by: Weeds and Exotics including Whisky Grass	Large shallow waterbody in two sections with rushes and sedges around parts of the margins of both ponds. Evidence of saline influence. Large area of peripheral weeds in sections currently not inundated. **Habitat characteristics:** Some fringing vegetation, limited habitat value.	Low
AW3	Artificial	Connected to AW 4. Overflow pond for AW 4. Connected to drainage channel that runs along the south of the site and then heads north before joining Duck Creek.	Modified sediment.	Former coal wash settling pond.	1.50	Surrounded by: Weeds and Exotics	Medium sized waterbody with Typha lined input and output channels. Large areas of fringing sedges and rushes. Gambusia present. **Habitat characteristics:** Some fringing vegetation and open water. Habitat for birds, reptiles, bats and amphibians. Interconnecting channel (with concrete pit) between ponds AW3 and AW4 provides good amphibian breeding habitat value.	High

Wetland ID	Wetland Type	Character			Area (ha)	Vegetation Communities	Description and Habitat Characteristics	Environmental Significance[1]
		Hydrology	Substrate form	Form				
AW4	Artificial	Modified hydrological setting. Small catchment within former coal wash deposit area, bounded by formed mounds. Drains to AW 3 which is the overflow pond.	Modified sediment.	Previously used as a coal wash settling pond.	9.26	Artificial wetland / Saltmarsh	Largest waterbody although shallow and subject to large fluctuation in wetting and drying. Extensive areas of fringing vegetation that include sedges and rushes as well as mudflats and shallows. Fringed by Saltmarsh species on the north and eastern edge. Surrounding areas are heavily weed infested. **Habitat characteristics:** Some fringing vegetation, mudflats and open water. High quality habitat for birds, reptiles, bats and amphibians. Gambusia present.	High
AW5	Artificial	Not connected to natural streams but may receive overflow from adjacent channel.	Unknown	Formed ponds on power station land.	0.38	Artificial wetland Surrounded by: Weeds and Exotics, Exotic Pasture and Illawarra Subtropical Rainforest	Series of treatment ponds on power station buffer lands. **Habitat characteristics:** Some fringing vegetation low to moderate quality habitat for birds and amphibians.	Low
AW6	Artificial	Not connected to natural streams but may receive overflow from adjacent channel.	Natural sediment.	Constructed dam.	0.25	Artificial wetland Surrounded by: Weeds and Exotics	Constructed dam surrounded by bunded area of Kikuyu but with a complex mix of sedges and rushes surrounding the pond. Pond has variable water depth and lacks Gambusia. **Habitat characteristics:** Limited habitat characteristics and value.	Low
AW7	Artificial	Overland flow and very minor drainage inputs. Flows through AW 13 then into Duck Creek.	Natural sediment.	Constructed dam.	1.42	Artificial Wetland Surrounded by: Exotic pasture	Constructed pond with little fringing vegetation. No Gambusia present. **Habitat characteristics:** Limited habitat characteristics and value.	Low

Wetland ID	Wetland Type	Character			Area (ha)	Vegetation Communities	Description and Habitat Characteristics	Environmental Significance[1]
		Hydrology	Substrate form	Form				
AW8	Artificial	Not connected to natural streams.	Modified sediment.	Part of disturbed coal wash area.	0.15	Artificial Wetland Surrounded by: Weeds and Exotics	Artificial wetland with *Typha orientalis*. Surrounded by weeds particularly exotic grasses. **Habitat characteristics:** Limited habitat characteristics and value.	Low
AW9	Artificial	Constructed farm dam on upper slopes of Mount Brown, connected to drainage channel leading to power station.	Natural sediment.	Constructed dam.	0.12	Exotic pasture	Constructed dam within grazing pasture. No fringing vegetation. **Habitat characteristics:** Limited habitat characteristics and value.	Low
AW10	Artificial	Instream farm dam within Barrons Gully.	Natural sediment.	Constructed dam.	0.24	Artificial Wetland Surrounded by: Moist Box – Red Gum Foothills Forest and Weeds and Exotics	Constructed dam with *Typha orientalis* and areas of open water. **Habitat characteristics:** Instream and fringing vegetation – potential habitat for amphibians, reptiles, bats and some birds.	Moderate
AW11	Artificial	Part of the water discharge system for the Power Station. Flows AW12, then to Duck Creek.	Modified sediment, clay lined.	Settling pond for power station.	2.43	Saltmarsh Weeds and Exotics Surrounded by: Planted Swamp Oak and Weeds	Settling Pond for power station. Periodically inundated with surplus water from the power station. **Habitat characteristics:** Limited habitat value, fauna habitat value would increase when filled with water.	Moderate
AW12	Artificial	Part of the water discharge system for the Power Station. Flows to Duck Creek via a weir.	Modified sediment , clay lined.	Settling pond for power station.	0.85	Saltmarsh / Weeds and Exotics Surrounded by: Planted Swamp Oak and Weeds	Settling Pond for power station. Periodically inundated with surplus water from the power station. **Habitat characteristics:** Limited habitat value, habitat value would increase when filled with water.	Low

Wetland ID	Wetland Type	Character			Area (ha)	Vegetation Communities	Description and Habitat Characteristics	Environmental Significance[1]
		Hydrology	Substrate form	Form				
AW13	Artificial	Thought to receive low volume flows from AW7. Flows into Duck Creek. Possible saline influence from Duck Creek	Natural sediment.	Appears to be a constructed dam.	0.19	Artificial Wetland / Saltmarsh Surrounded by: Exotic pasture	Small pond with little fringing vegetation. No Gambusia present. Appears to have saline influence and supports Saltmarsh species. **Habitat characteristics:** Limited habitat value as little fringing vegetation.	Low

[1]**Environmental Significance** codes were assigned based on the presences of legislative or statutory requirements, such as SEPP 14, TSC Act or EPBC Act matters, assessed value of the habitat provided (to terrestrial and aquatic species), status and condition of the vegetation present, disturbance/modification history and hydrological context.

2.3 LAKE ILLAWARRA FORESHORE

The Tallawarra Lands site is found on the western foreshore of Lake Illawarra. The lake foreshore provides the eastern boundary of the site for approximately 5.2km. The foreshore is distinguished by three broad areas (zones) being northern hillslope foreshore, central foreshore and southern floodplain foreshore. A description of these foreshore zones is provided in Table 4 below. The lower tidal portions of Duck Creek are considered in section 2.1 above.

Table 4: Description of Lake Illawarra Foreshore

Zone Name	Location	Description of Foreshore
Northern Hillslope Foreshore	Northern boundary of the site to the power station	Relatively natural foreshore on moderate lower slopes of the ridges running down from Mount Brown. Mix of rocky reef and shell/gravel/sand foreshore types. Limited aquatic vegetation is mapped in this area of the Lake. Most of the foreshore intertidal area contains Saltmarsh in a narrow band generally 1-2m in width, which is fairly contiguous. Above the intertidal area the vegetation is predominately pasture grass with some noxious and environmental weeds. Occasional patches of native vegetation are also found, mostly Casuarinas, including areas that have recently been planted. Beyond this is primarily land used for grazing purposes and is almost entirely cleared.
Central Foreshore	Power station to Duck Creek	This zone contains 2 sub-zones, being the power station foreshore in the north and the power station water outlet channel to Duck Creek in the south. Most of the foreshore has received some degree of modification with the degree of modification higher for sub-zone 1. Modifications of the foreshore have been in the form of : o foreshore realignment (reclamation into the Lake); o changes to the foreshore composition (installation of rock walls and placement of boulders for reclamation and wave/wash protection); and o topographic (grading) changes to the foreshore environment from the modification of areas beyond the immediate foreshore zone for construction of power station, roads, water settling ponds and the like. Given the level of modification, natural values within sub-zone 1 are limited. Natural values within sub-zone 2 include: o a moderate quantity of seagrass adjoining the foreshore; o isolated patches of saltmarsh (2-5m in width); and o thickets of native trees (mostly planted Casuarinas and Acacias).
Southern Floodplain Foreshore	Duck Creek to southern boundary of the site	Primarily natural foreshore found on level estuarine floodplain environment. Remnant native vegetation found along and behind much of the foreshore area although interspersed with small cleared patches, generally dominated by pasture grasses. Vegetation includes EEC listed communities (including large patches of Saltmarsh) and SEPP 14 wetlands. Large beds of seagrass are found within the adjoining portions of the lake.

3 Riparian Protection and Management

This section of the report describes the means by which riparian zones will be protected and managed at the Tallawarra site. The strategy for the site entails:

- Provision of a regional linkage from the Ocean to the Escarpment in the form of a large Duck Creek corridor;
- Provision of a series of secondary riparian corridors to support important waterways; and
- Provision of sufficient CRZs for remaining riparian zones to provide for bed and bank stability.

3.1 RIPARIAN BUFFER LOCATION AND WIDTH

Figure 3 displays the recommended riparian widths and buffer zones for the Tallawarra site. These are consistent with the recommendations in the RCMS as shown in Table 5. Section 4 and Table 6 summarise the proposed provision of riparian buffers for each waterway.

Table 5: Riparian Categories and minimum Environmental Objectives (DIPNR 2004)

Minimum Environmental Objective for Riparian Land	Category 1 Environmental Corridor	Category 2 Terrestrial & Aquatic Habitat	Category 3 Bank Stability & Water Quality
Delineate riparian zone on a map & map appropriately for environmental protection	Yes	Yes	If resources are available
Provide a minimum core riparian zone width	40m from top of bank	20m from top of bank	Usually 10m from top of bank
Provide additional width to counter edge effects on the urban interface	10m	10m	Generally not required
Provide continuity for movement of terrestrial & aquatic habitat	Yes (including piered crossings)	Yes (with appropriate crossing design)	Where appropriate
Rehabilitate/re-establish local provenance native vegetation	Yes	Yes	Where appropriate
Locate services outside the core riparian zone wherever possible	Yes	Yes	Merit consideration
Locate playing fields and recreation activities outside core riparian zones	Yes	Yes	Merit consideration
Treat stormwater runoff before discharge into riparian zone of the watercourse	Yes (outside CRZ and buffer)	Yes (outside CRZ and buffer)	Yes

3.1.1 Duck Creek

Whilst the RCMS recommends a buffer zone of 50m each side of the waterway (40m core riparian zone plus 10m vegetated buffer) for Category 1 creeks, the concept plan provides a significantly larger buffer for Duck Creek (~100m). This is in recognition of the role this corridor has in linking Lake Illawarra with the lowlands areas to the west and provision of the proposed Yallah to Calderwood regional corridor. The Duck Creek corridor (Figure 3) proposed in the Concept Plan is also consistent with the recommendations of the NSW Office of Water.

The Vegetation Management Plan (ELA 2010c) prepared for the concept plan application outlines the management framework for this part of the site. Fully structured native vegetation will 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 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.

3.1.2 Other Waterways

The concept plan allows for a riparian zone (CRZ plus a VB where relevant) for all other affected waterways in line with the RCMS approach (DIPNR, 2004). Most other waterways are afforded a high degree of separation from the proposed development due to the abundance of open space and environmental reserves established by the concept plan.

Two areas of minor constraint are known, being Yallah Creek and also with unnamed creek number 4. These issues and the proposed management strategy are discussed below:

1. The downstream (northern) portion of Yallah Creek (existing dam to Duck Creek) was observed to have been modified from it's original (pre-disturbance) alignment during works associated with the former Tallawarra coal fired power station. Parts of this downstream section have been channelised with some banks formed with concrete. It is proposed to create a more functional waterway than what is currently present that improves water quality and better mimics natural flow regimes. 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 current concept plan is slightly misaligned in this area (**Figure 3**) however it is the intent of the applicant to provide for the above approach to this waterway;

2. Based on field assessment and detailed desktop mapping utilising high resolution aerial photographs and digital terrain data Unnamed creek number 4 was observed to be in a different location than previously mapped (by RCMS and others). The implication here is that the rezoning covering the Tallawarra Lands site and the riparian zone allowed for in the rezoning plans is sightly misaligned. The proposed approach to this issue is that the current alignment of the creek is maintained and that the CRZ is revegetated (in line with Category 3 requirements) and that the minor misalignment with the current zoning (and concept plan which matches the zoning) is dealt with at a later date through a separate process (such as a spot rezoning as part of detailed precinct releases or through the Gateway process).

3.2 MANAGEMENT OF RIPARIAN ZONES

As described in section 2, 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.

The management approaches for riparian zones are detailed in the Vegetation Management Plan prepared for the concept plan (ELA 2010c) and overviewed in Table 6. Figures 4 and 5 summarise the management intent and proposed revegetation detailed in ELA (2010c). In summary, 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-nammed creek number 4 and Barrons Gully.

This is consistent with the NSW Government move towards a policy of greater integration of riparian corridors into the urban environment as evidenced by the following recent extract from a draft *Policy Statement – Development Contributions (Part 5B)* December 2009 which states:

- *A definition will be provided for Riparian Corridors that will identify that stormwater facilities and systems, cycleways and land for passive open space are considered to be key community infrastructure even if they are located within a riparian corridor;*
- *The Minister will be able to approve the dedication of land for riparian corridors through a planning agreement.*

The funding and ownership structure of these management areas is detailed in the Vegetation Management (ELA 2010c). In the longer term, the proponent envisages that major riparian zones will be held under the ownership of a public authority such as Wollongong City Council or the Lake Illawarra Authority. These changes in tenure will be reflected in the Planning Agreement between the proponent and the Council/Lake Illawarra Authority.

3.3 WETLANDS

The two SEPP 14 wetlands found on the site provide potential habitat for a variety of species including birds, reptiles, mammals and amphibians. Given their statutory listing and habitat value, these wetlands require a minimum 50m buffer. The concept plan provides a significantly greater buffer than this by retaining the surrounding landscape in an Environmental Reserve (Figure 3). These wetlands are in good condition however the fringing vegetation is affected by weed incursion. This weed incursion is proposed to be managed within the VMP (ELA 2010c) to protect the values of the SEPP 14 wetlands.

With regard to the artificial wetlands, the Concept Plan retains those with high environmental significance and provides each with a buffer setback to development. This applies to the large artificial wetlands AW3 and AW4 in the south of the site which are considered to be the artificial wetlands of highest environmental significance. The largest wetland in the south west of the study area (AW4) supports mudflats, is fringed by macrophytes, is utilised by a large variety of water birds and provides potential amphibian (ELA 2010b, ELA 2010c). Management is proposed in ELA (2010c) to maintain and improve the values of these artificial wetlands.

All other artificial wetlands have been assessed as low or moderate environmental significance. Most of these features are retained within the concept plan and are also afforded setbacks to development. Vegetation management proposed for the site (ELA 2010c) will assist in the maintenance and improvement of these features.

3.4 LAKE ILLAWARRA FORESHORE

The Lake Illawarra foreshore is afforded a setback within the concept plan along its entire length of the Tallawarra Lands site. The following summarises the approach:

- Northern Hillslope Foreshore – foreshore previously transferred to Lake Illawarra Authority and subject of current improvement works under a masterplan (Siteplus 2007). Further and substantial open space setbacks provided in the southern portion of this zone;
- Central Foreshore (sub zone 1) – not part of this application;
- Central Foreshore (sub zone 2) – afforded significant open space in an environmental reserve linking to Duck Creek. Native vegetation rehabilitated along the foreshore and within the wider buffer. Remnant patches of saltmarsh along the foreshore protected with buffer vegetation and access restriction;
- Southern Floodplain Foreshore – afforded a significant setback to proposed development areas by a large environmental reserve. Significant environmental features including SEPP14 wetlands, saltmarsh and EEC listed vegetation protected and improved through vegetation management works (ELA 2010c).

The NoW recommended that a 50m buffer to the lake be provided. The concept plan affords this setback and proposes to manage this area for environmental and open space uses. The concept plan protects the foreshore through dedication of environmental reserves and open space along the length of the foreshore land owned by the applicant. Vegetation management of these areas will seek to improve the condition of remnant native vegetation, protect sensitive features such as SEPP 14 wetlands and saltmarsh patches, and to revegetate and regenerate currently degraded areas.

The 50m buffer to the lake is shown on Figure 3 as well as an indication of a 100m buffer that has been sought by the Lake Illawarra Authority for other parts of the lake. With the exception of a small section of the northern residential precinct and the proposed tourism area (both identified and consistent with previous rezoning) the proposed concept plan provides setbacks in excess of these 50 and 100m buffers.

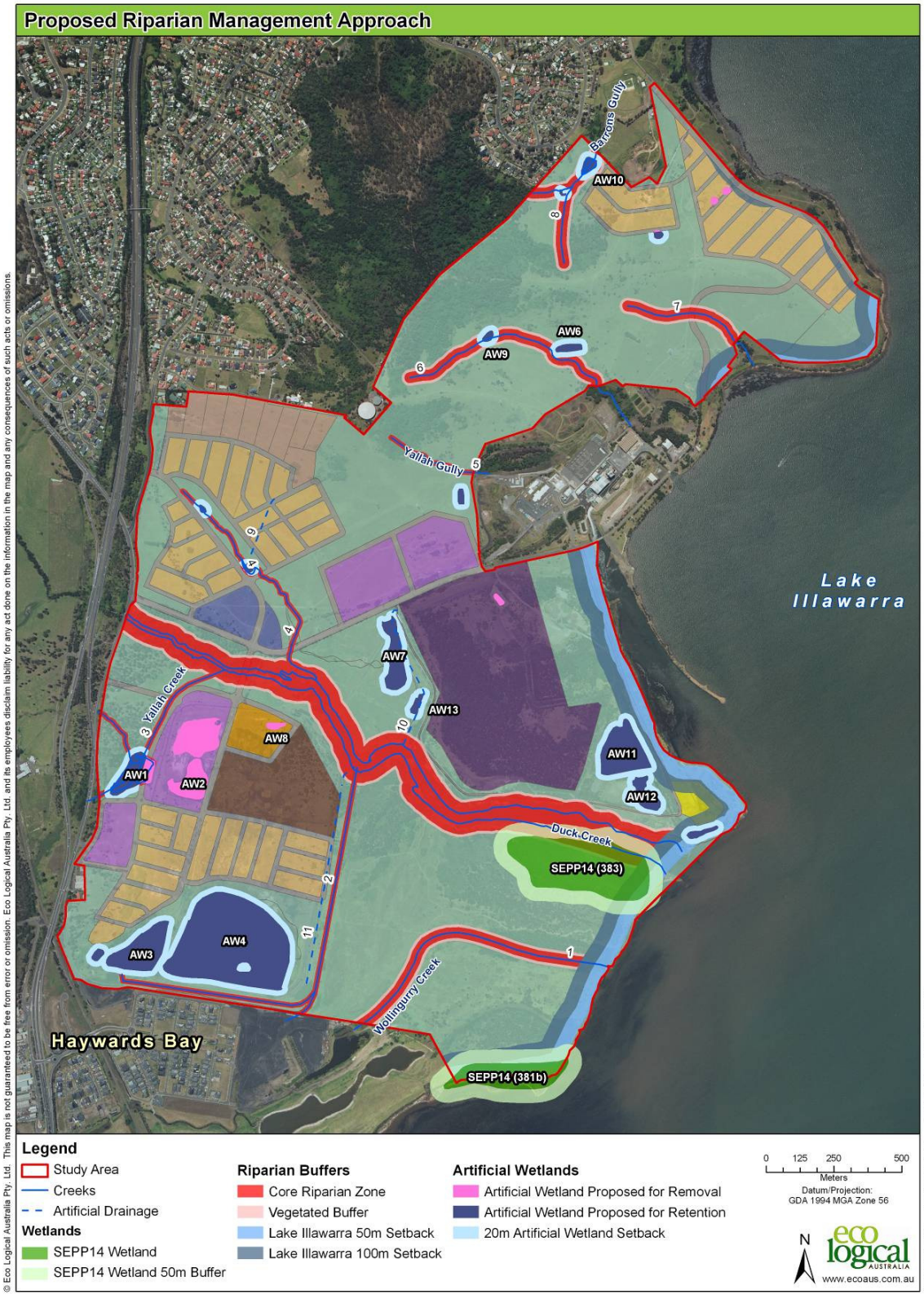

Figure 3: Riparian Zone and Wetland Management

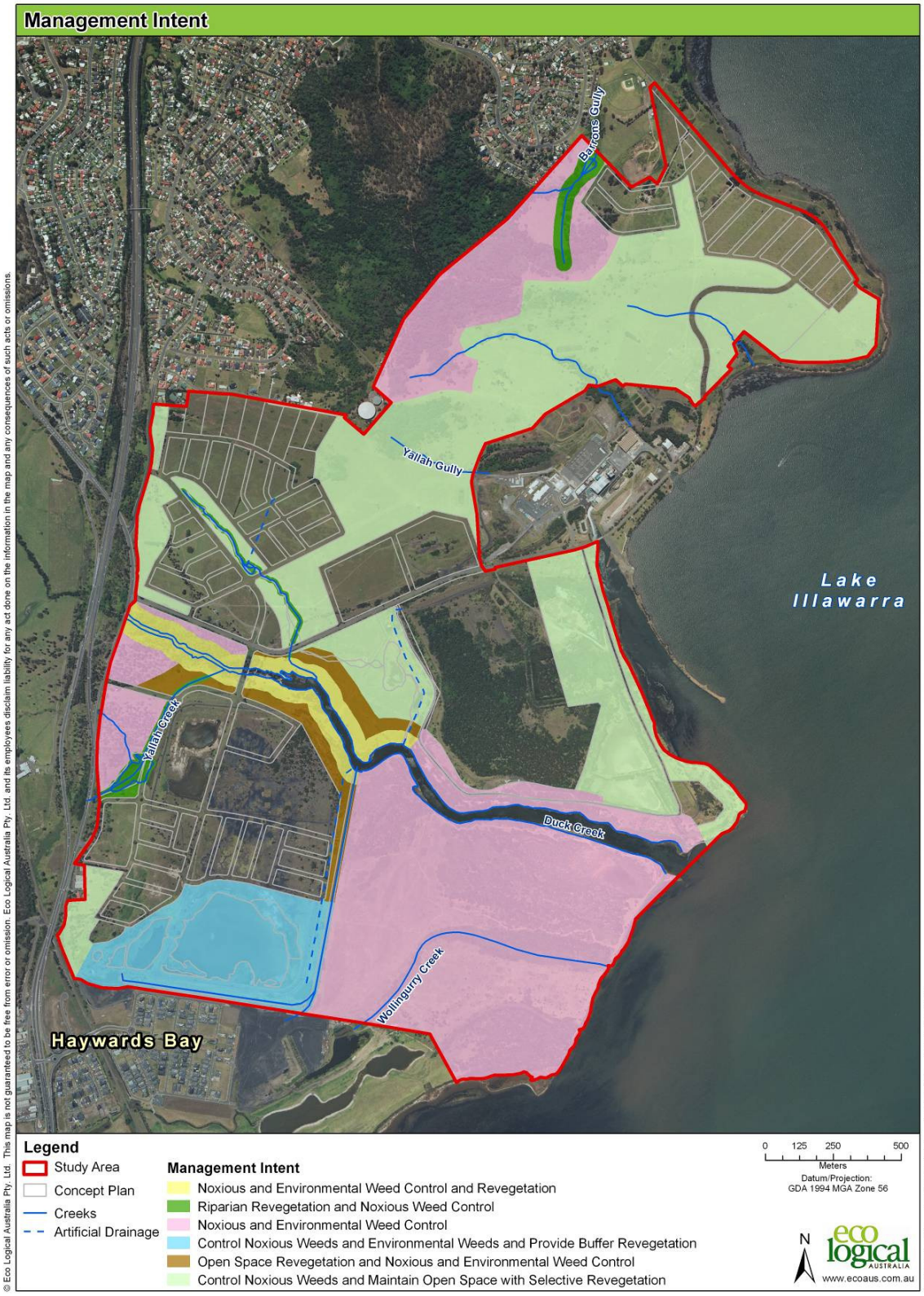

Figure 4: Intent of proposed vegetation management (ELA 2010c)

Figure 5: Vegetation management and proposed revegetation works (ELA 2010c)

4 Assessment and Conclusion

This section assesses the extent to which this report meets the DGRs and the extent to which riparian zone management is consistent with state government policy, which is largely embodied in SEPP14 and the RCMS for this site.

In terms of consistency with SEPP 14, both SEPP 14 wetlands are to be retained in an Environmental Reserve that will ultimately be held in the ownership of a public authority (ELA 2010c). As no development is planned within the wetlands and the upstream riparian zones are protected, there is anticipated to be no negative effects on the SEPP 14 wetlands. Further the fringing vegetation will be managed to limit the impact from edge effects.

In terms of consistency with the RCMS, the following tables (Table 6 and 7) summarise the planning and management approaches for each riparian zone and wetland.

Table 6: Summary of Proposed Riparian Zone Management Approach

Feature	RCMS Buffer zone protected	Proposed landuse within buffer zone	Rehabilitation
Duck Creek	Yes	Environmental Reserve. Open space landuses consistent with the objectives of the corridor sighted outside the RCMS buffer zone.	Extensive weed control. Full structural native revegetation of currently cleared buffer zone areas.
1. (Wollingurry)	Yes	Environmental Reserve	Weed control
2. (Un-named)	Yes	Environmental Reserve	Weed control
3. (Yallah Creek)	Yes	Riparian zone	Reconstruction of currently modified waterway to a more natural system including geomorphic works, creation of instream habitat, riparian zone revegetation and weed control.
4. (Un-named)	Yes, requires spot rezoning to align zoning to actual waterway alignment.	Riparian zone	Riparian zone revegetation and weed control.
5. (Yallah Gully)	Yes	Open Space	Weed control
6. (Brooks Creek)	Yes	Environmental Reserve and Open Space	Weed control, assisted natural regeneration
7. (Un-named)	Yes	Open Space	Weed control
8. (Barrons Gully)	Yes	Environmental Reserve	Native revegetation of riparian zone and weed control

Feature	RCMS Buffer zone protected	Proposed landuse within buffer zone	Rehabilitation
9. (Un-named)	NA – man made channel	Residential	n/a
10. (Un-named)	NA – man made channel	Local park	Weed control
11. (Un-named)	NA – man made channel	Residential and open space	Weed control

Table 7: Summary of Proposed Wetland Management Approach

Feature	Retained	Proposed landuse	Rehabilitation
SEPP14 (383)	Yes	Environmental Reserve	Weed control
SEPP14 (381b)	Yes	Environmental Reserve	Weed control
AW1	Yes – partially modified	Riparian zone	Weed control and buffer revegetation
AW2	No	Employment	n/a
AW3	Yes	Open Space, environmental protection and management	Buffer revegetation and weed control
AW4	Yes	Open Space, environmental protection and management	Buffer revegetation including fringing aquatic vegetation and weed control.
AW5	Yes	Power station	n/a – offsite
AW6	Yes	Open Space	Weed control
AW7	Yes	Open Space, WSUD	Weed control and target revegetation
AW8	No	Employment	n/a
AW9	Yes	Open Space	Weed control
AW10	Yes	Riparian zone	Weed control, riparian zone revegetation
AW11	Yes	Retained, for current power station use	Weed control
AW12	Yes	Retained, for current power station use	Weed control
AW13	Yes	Open Space, WSUD	Weed control and target revegetation

The approach taken with the concept plan with regard to management of the existing natural riparian features on site generally exceeds the prescriptive requirements established under SEPP 14 and RCMS. Further, the approach adopted recognises the hierarchy and significance of Duck Creek and the SEPP 14 wetlands and will establish both land tenure and management controls to enhance their viability and resilience in the future.

Currently degraded riparian and wetland areas are integrated into the existing zoning and measures are established through buffers and vegetation management to protect and promote hydrological and habitat values.

One waterway, Yallah Creek, is proposed (Section 3.1.2) to receive some physical restoration in order to meet hydrological and geomorphic requirements and to enhance the quality of water to receiving environments.

Two artificial wetlands that provide limited hydrological and habitat value are proposed to be removed in order to better align and manage water flows and quality on site.

A sound approach to WSUD (BMT WBM, in prep.) has been developed for the concept plan which integrates drainage matters with riparian management covered in this riparian assessment and in the VMP (ELA 2010c).

This report has demonstrated that the concept plan for development at Tallawarra Lands meets the requirements of the DGRs for Riparian Impacts and the requirements of the NSW Office of Water.

References

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

Coffey. In prep. Groundwater Assessment, Tallawarra Lands

Department of Planning, 2009. Policy Statement – Development Contributions (Part 5B).

Department of Water and Energy, 2008. Guidelines for controlled activities - Riparian corridors

DIPNR, 2004. Riparian Corridor Management Study, Covering all of the Wollongong Local Government Area and Calderwood Valley in the Shellharbour Local Government Area. Prepared for Wollongong City Council by Department of Infrastructure, Planning and Natural Resources.

DLWC. 2000. Geomorphic Categorisation of Streams in the Hawkesbury Nepean Catchment. Department of Land and Water Conservation.

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

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, Vegetation Management Plan. Prepared by Eco Logical Australia for TRUenergy.

NSWRFS. 2006. *Planning for Bushfire Protection: A Guide for Councils, Planners, Fire Authorities and Developers* including the 2010 Appendix 3 Addendum. Australian Government Publishing Service, Canberra.

Siteplus. 2007. Lake Illawarra Foreshore, Yallah Bay Precinct. Proposed Master Plan Report. Prepared for Lake Illawarra Authority by Site Plus Pty Ltd.

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