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## Woodvale Lots 1, 200 & 300

### Wetland Management Plan

Prepared for  
ABN Developments  
by Strategen

November 2010



## **Woodvale Lots 1, 200 & 300**

### Wetland Management Plan

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November 2010

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**Wetland Management Plan for Lots 1, 200 and 300 Wanneroo Road, Woodvale**

This Wetland Management Plan for Lots 1, 200 and 300 Wanneroo Road, Woodvale has been approved by the Department of Environment and Conservation.

Signed:

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Approved on behalf of the Department of Environment and Conservation

Name:

Position:

Date:



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## **1. INTRODUCTION**

This Wetland Management Plan (WMP) describes the management actions required to be implemented in order to protect, enhance and maintain the wetland values of the portion of Walluburnup Swamp within and adjacent to Lots 1, 200 and 300, Wanneroo Road (the Project area).

### **1.1 BACKGROUND**

The City of Wanneroo (CoW) Structure Plan 64 (SP64) covers a 25 ha parcel of land in the locality of Woodvale comprising 15 individual lots. One of the key aspects that required consideration during the preparation of the structure plan was the presence of the Walluburnup Swamp, a Conservation Category wetland, adjacent to SP64. As part of the structure planning process, a Wetland Management and Rehabilitation Strategy (WMRS) was developed that detailed the strategic measures to be undertaken by developers of the SP64 area to protect and enhance the wetland area (Cardno 2009).

ABN Developments has received approval from the Western Australian Planning Commission (WAPC) to develop Lots 1, 200 and 300 for subdivision subject to 48 approval conditions. Amongst the range of conditions is a requirement to submit to the WAPC, a WMP consistent with the framework outlined in the WMRS.

### **1.2 LOCATION**

The Project area is located approximately 20 km north of Perth in the City of Wanneroo. The development is bounded by Wanneroo Road to the east, Woodvale Drive to the north and Walluburnup Swamp to the west (Figure 1). Walluburnup Swamp is part of the Yellagonga Regional Park.

### **1.3 PURPOSE AND SCOPE OF DOCUMENT**

This WMP focuses on the Walluburnup Swamp and an associated buffer zone within and adjacent to the boundary of the Project area. The WMP has been prepared to comply with Condition 31 of the WAPC subdivision approval (Application No. 140326) which requires:

*“The preparation and implementation of a Wetland Management Plan, in consultation with the City of Wanneroo, to the satisfaction of the Western Australian Planning Commission. (Department of Environment and Conservation)”.*

The WMP also addresses advice from the Department of Environment and Conservation (DEC) included in the WAPC Approval in regards to Condition 31, specifically:

- a) The Wetland Management Plan is to be consistent with the approved Wetland Management and Rehabilitation Strategy (WMRS), be prepared by a qualified revegetation specialist and submitted to DEC for approval prior to implementation.*
- b) The WMP is to address issues such as (but not limited to): site preparation; fencing; mulching; revegetation planting densities and species; planting locations; weed control; timing of operations; ongoing care and maintenance; completion criteria; monitoring programs; and a budget.*
- c) The WMP should also address the issue of how necessary ongoing works will be secured after the issue of titles. The WMRS indicates that works will be bonded with the City of Wanneroo which is supported by DEC.*
- d) The WMP must address the required rehabilitation works outside the application area (within the adjoining Yellagonga Regional Park).*

The WMP has also been prepared in accordance with the *Guidelines checklist for preparing a wetland management plan* (DEC 2008).

## **1.4 RELATED DOCUMENTS**

The WMP should be read in conjunction with the following management plans:

- *Woodvale Lots 1, 200 & 300 Dieback Management Plan* (Strategen 2010a) – prepared to comply with Condition 39 of the WAPC subdivision approval (Application No. 140326)
- *Woodvale Lots 1, 200 & 300 Fire Management Plan* (Strategen 2010b) – prepared to comply with Condition 38 of the WAPC subdivision approval (Application No. 140326)
- *Woodvale Lots 1, 200 & 300 Midge Management Plan* (Strategen 2010c) – prepared to comply with Condition 33 of the WAPC subdivision approval (Application No. 140326)
- *Urban Water Management Plan* (JDA 2010) – prepared to comply with Condition 23 of the WAPC subdivision approval (Application No. 140326)
- *Chianti Private Estate Landscape Management Plan for ABN Group* (Plan E 2010)
- *Hydrant Plan* (WC Engineering 2010) – prepared to comply with Condition 38 of the WAPC subdivision approval (Application No. 140326).



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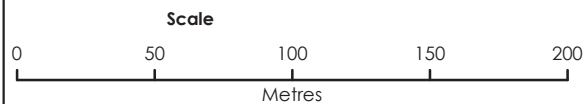


Figure 1 Location of Project area



Coordinate System: GDA 1994 MGA Zone 50  
Date: 24/05/2010  
Prepared By: Dlee  
File: Fig1 Regional location.mxd

Original scale: 1:2,745 at A4  
Source:  
Note that positional errors may occur in some areas



## **2. EXISTING NATURAL ENVIRONMENT**

### **2.1 CLIMATE**

The Project area experiences a Mediterranean climate with cool wet winters and hot dry summers. The dry period extends from October – March with the hottest month being February with average minimum and maximum temperatures of 18.0°C and 31.2°C respectively in the Perth Metropolitan area. The coolest month is July with average minimum and maximum temperatures of 7.8°C to 18.4°C respectively (Bureau of Meteorology 2010).

The long-term average annual rainfall is approximately 867 mm with a pan evaporation of approximately 1650 mm (Bureau of Meteorology 2010). Perth receives more than 76% of its rain during May to October (Bureau of Meteorology 2010), with the remainder from thunderstorms and occasional cyclonic depressions in the warmer months.

Predicted regional implications of climate change include an increase in mean daily temperatures and reduced rainfall (particularly winter rainfall) in south Western Australia over the coming decades (CSIRO 2007). It is possible that the water levels of wetlands will continue to lower as a consequence of these effects, resulting in decreases in inflow (direct and from runoff), lowered groundwater levels and an increase in evaporation. An ongoing reduction in lake water levels threatens the current ecological values of the lake, including the health of fringing vegetation and associated habitat value for water birds.

### **2.2 REGIONAL CONTEXT**

The Project area is located within the Swan Coastal Plain 2 subregion of the Interim Biogeographic Regionalisation for Australia (IBRA). The subregion contains a number of nationally recognised wetlands comprising relatively high ecosystem or species diversity, most notably on the eastern side of the coastal plain (Mitchell et al 2002).

Walluburnup Swamp forms part of Yellagonga Regional Park. The Park, comprised of Lake Joondalup, Beenypup and Walluburnup Swamps; and Lake Goollelal and its surrounds, is regionally significant due to the natural, cultural and recreational resources it provides within a rapidly growing suburban area. The Park also provides an important (north/south) link with Neerabup National Park and Yanchep National Park (CALM 2003).

### **2.3 GEOLOGY, GEOMORPHOLOGY AND SOILS**

The Project area is moderately sloping with elevation ranging from 33 m Australian Height Datum (AHD) to 22 mAHD generally east to west across the Project area with a 5% grade (Cardno 2009).

The Project area is located on Karrakatta soils within the Spearwood Dune system. Wetland soils are generally black, fine-grained peaty soils with an organic topsoil layer. These soils are inundated and saturated in some areas, with hydric soils also evident (Cardno 2006). Dry land soils are categorised as grey, medium to fine-grained sands, dry to a depth of at least 0.5 m (Cardno 2006).

Regional Acid Sulphate Soil (ASS) mapping indicates that the western portions of the lots are within an area where there is a high risk of ASS being found within 3 m from the surface. However, the majority of this high risk area is located in areas that will be used for Public Open Space (POS), therefore it is not expected that these potential ASS will be disturbed.

A Preliminary Site Investigation established several potential sources of contamination on the site including the removal of buildings that may have contained asbestos as well as evidence of market gardening. A small quantity of uncontrolled fill material with some isolated fragments of asbestos containing material (ACM) were noted by Ace Environmental (2010) during a Detailed Site Investigation. Ace Environmental proposed a strategy to resolve the issue, which involved systematic inspection and removal of the ACM fragments, followed by a validation program using raking validation and grid-based sampling as per Department of Health guidance. Analytical results of the soil grid samples found that organochlorine pesticides and organophosphorus pesticides and metals (Pb, As, Cd, Cr, Cu, Hg, Ni and Zn) were either reported at below the laboratory detection limits or at concentrations less than the Ecological Investigation Levels (EILs) and Health Investigation Levels (HIL-A) for all soil samples (Ace Environmental 2010).

## 2.4 HYDROLOGY

Groundwater within the Project area flows in a westerly direction towards Walluburnup Swamp with groundwater at its greatest depth in the east with a gradual rise across the Project area to the west. Groundwater is greater than 3 m below ground level over 60% of the Project area. Within the wetland area, predicted Maximum Groundwater Levels give an estimated depth to groundwater of 0 – 2 m with some ponding on the surface within the wetland in the very west of the Project area (Figure 2).

Surface water drains generally north-east to south-west from Wanneroo Rd across the Study Area to Walluburnup Swamp. No natural or artificial drainage channels are located within the Project area (JDA 2010).

## 2.5 VEGETATION AND FLORA

The Project area is cleared of native vegetation and has been historically used for market gardening purposes. Currently the Project area is in a Completely Degraded state according to the Keighery vegetation condition scale (Keighery 1994) and is covered in a range of exotic species including:

- Upland:
  - Kikuyu (*Pennisetum clandestinum*)
  - Veldt grass (*Ehrharta calycina*)
  - *Paulownia* sp.
  - Pelargonium (*Pelargonium capitatum*)
  - Pigface (*Carpobrotus edulis*)
  - Fennel (*Foeniculum vulgare*)
  - Olive (*Olea europaea*)
- Wetland
  - Bulrush or *Typha* (*Typha orientalis*)
  - Couch (*Cynodon dactylon*)
  - Mint (*Mentha* sp.)
  - Cotton Bush (*Gomphocarpus fruticosus*)
  - Fennel (*Foeniculum vulgare*)
  - Fig (*Ficus* sp.).

Vegetation and flora surveys undertaken of the wider area (the entire Walluburnup Swamp) identified three plant community types present (Cardno 2006; Figure 3). Communities were classified as:

- *Melaleuca-Eucalyptus rudis* woodland
- *Melaleuca-Typha* shrubland
- Exotic grassland dominated by *Typha* and Kikuyu with intermittent exotic trees.

No Declared Rare or Priority flora species or Threatened Ecological Communities were identified in the wetland.

## 2.6 FAUNA

No fauna surveys have been undertaken for the Project area. The site is cleared of native vegetation; however the vegetation that does exist, particularly the *Typha* within the wetland area is known to provide habitat for some native bird species such as swamp harriers and black-shouldered kites.

Yellagonga Regional Park, directly adjacent to the Project area also provides suitable habitat for many birds, mammals and reptile species (CALM 2003).

## 2.7 ECOLOGICAL LINKAGES

Currently, the Project area has limited ecological linkage value as it is completely cleared of native vegetation. However, the site forms the part of the eastern boundary of Walluburnup Swamp, which forms part of Yellagonga Regional Park. The Park provides a north-south link with Neerabup National Park and Yanchep National Park. Rehabilitation with the Project area may provide an island of vegetation with some in-situ ecological value, but would have limited ability to enhance the north-south ecological linkage until appropriate rehabilitation has been undertaken in all developments within the SP64 area.

## 2.8 DISEASE

A dieback assessment was not conducted for the Project area due to the lack of indicator species present. Therefore, a precautionary approach will be undertaken with regards to dieback management, particularly near the wetland.

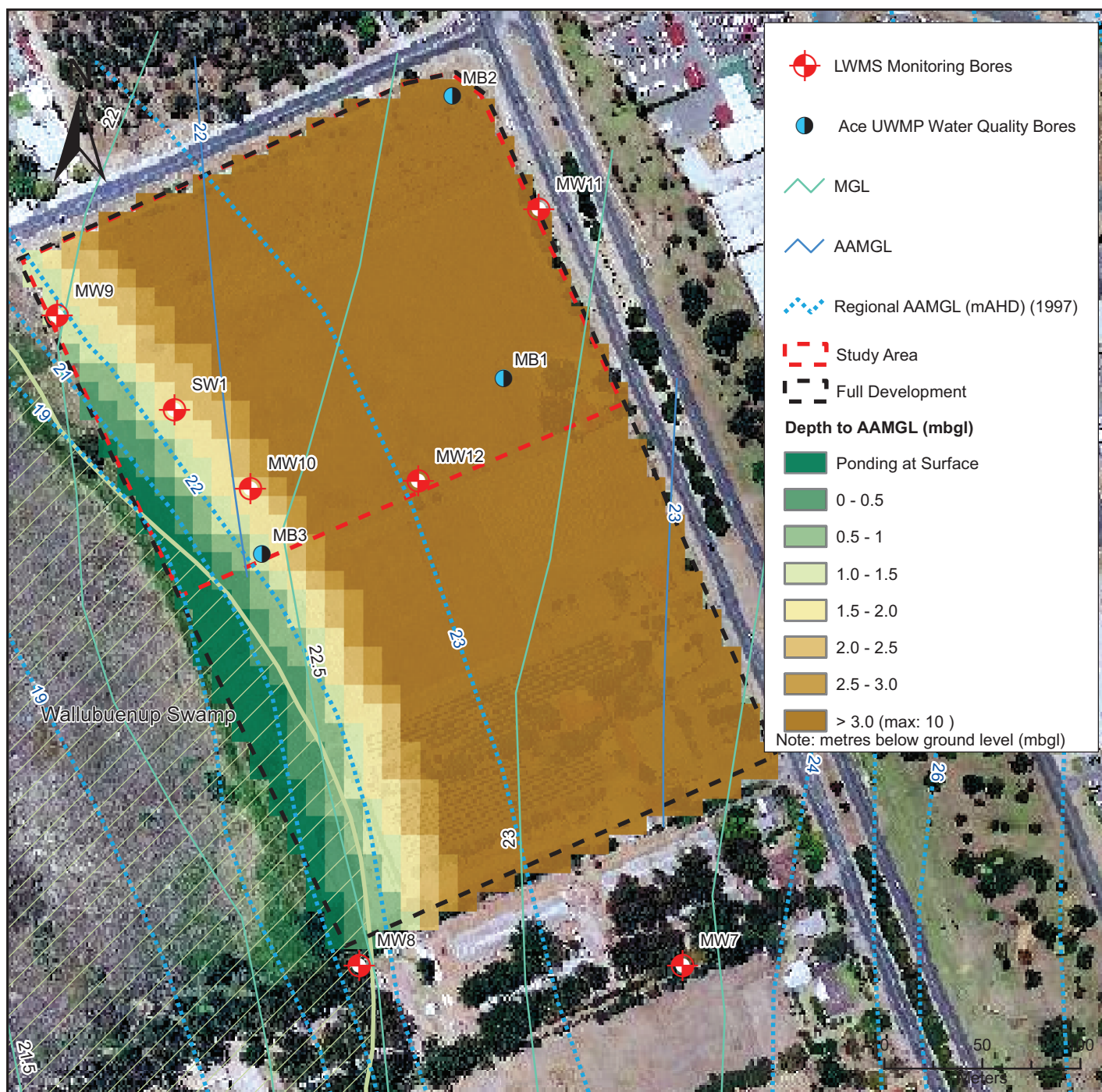
A Dieback Management Plan (Strategen 2010) has been prepared to comply with Condition 39 of the WAPC subdivision approval (Application No. 140326) which requires a dieback management plan to be prepared and implemented to the satisfaction of the WAPC. Therefore dieback management is not discussed further in this document. The Dieback Management Plan should be referred to for all management actions in regards to this disease.

## 2.9 FIRE

Wildfire is a significant risk within Yellagonga Regional Park (CALM 2003). In wetland areas, such as Walluburnup Swamp, heavy infestations of *Typha* constitute a significant fire hazard. Fires in *Typha* are extremely difficult to control and can cause severe damage to fringing paperbark vegetation. Frequent wild fires in wetland areas will prevent the establishment of paperbark vegetation and encourages further invasion of *Typha* because it regenerates far quicker than other local rush species.

*Typha* is highly flammable in late summer and early autumn when most of the mature leaves have died. If a fire occurs during this period, permanent damage to stands of *Typha* is minimal since the plants are dormant (CALM 2003).

Currently there are no firebreaks within the Project area as the area is completely cleared of native perennial vegetation and has not been used for horticultural purposes for a number of years. Historically, DEC has managed fire in the area by slashing kikuyu along property boundaries.



### Pre development Water Quality

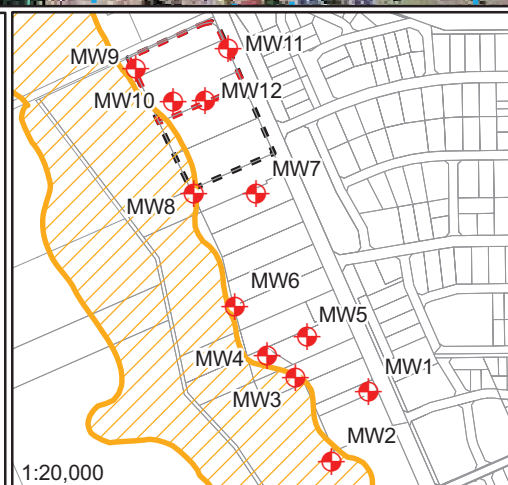
LSP64 LWMS Results (Cardo 2009)

Bore	TN (mg/L)	TKN (mg/L)	NOx (mg/L)	NH4 (mg/L)	TP (mg/L)
Upstream	4.43	2.2	2.2	<0.01	1.12
Downstream	3.85	1.3	3.8	0.05	0.75

Ace Environmental UWMP Monitoring (2007,2010)

TN (mg/L)	TKN (mg/L)	NOx (mg/L)	RP (mg/L)
8.2	3.1	5.2	<0.01

Data Source: LSP64, LWMS (Cardno, 2009)



Job No. J4651  
Scale 1:3,000

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Hargate Pty Ltd  
Lots, 1, 200 & 300 Wanneroo Rd, Woodvale: UWMP

**Figure 2: Groundwater levels**






DATE	Nr.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHKD	APPD	DATE	Nr.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHKD	APPD	DATE	Nr.	ACTIVITY - REVISION DESCRIPTION	DES	DRN	CHKD	APPD

**Figure 3 Vegetation communities of Walluburnup Swamp**

**Watson Property Group Northern Aspects Pty Ltd**

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Of 1



### **3. EXISTING CULTURAL AND SOCIAL VALUE AND USE**

#### **3.1 CULTURAL HERITAGE**

##### **3.1.1 Aboriginal heritage**

A search of the Department of Indigenous Affairs Aboriginal Site register system did not identify any known Aboriginal sites occurring within or adjacent to the Project area. Two known sites occur in the immediate area. One site is to the west of Walluburnup Swamp, approximately 1 km from the Project area and is listed on the Aboriginal Sites Register as “artefacts/scatter”. The second site is Lake Goollelal, approximately 2 km south of the Project area. It is also possible that there are other sites that have not been entered on the Aboriginal Site Register.

There is significant Indigenous history associated with the wetlands of Yellagonga Regional Park. Wetlands were, and continue to be, places of spiritual importance for Aboriginal people.

##### **3.1.2 Non-indigenous heritage**

The local area was important for European settlers for market gardening and agriculture. There are several known European heritage sites in close proximity to the Project area that are listed on the Register of the National Estate or appear on the City of Wanneroo (CoW) Municipal Inventory of Heritage Places. None of these are within or directly adjacent to the Project area. The closest Heritage site to the Project area is Conti Winery and Restaurant 529 Wanneroo Road, Wanneroo (listed on Register of National Estate and CoW Municipal Inventory), located approximately 100 m south of the Project area.

#### **3.2 COMMUNITY USE AND APPRECIATION**

Historical land use as a market garden has left the Project area and the portion of Walluburnup Swamp within and adjacent to the Project area in a completely degraded state with limited value for community use and appreciation. There is no formal access through the area or facilities within or adjacent to the Project area.

The western side of Walluburnup Swamp, particularly the north-west at Perry’s Paddock, is highly utilised as recreational area, with an estimated 61,000 visits to Perry’s Paddock per year (Colmar Brunton 2001). In this area, walking is the dominant recreational activity with jogging and dog-walking also popular activities.

#### 4. ENVIRONMENTAL FACTORS, ASPECTS AND POTENTIAL IMPACTS

A range of aspects resulting from the Project have the potential to affect a number of environmental factors by threatening values, attributes and functions of the management area (refer to Table 1).

**Table 1 Environmental factors, aspects and potential impacts**

Factor	Aspect	Potential impact
Geology, geomorphology and soils	Earthworks	May cause erosion and subsequent sedimentation into wetland
Hydrology	Runoff from construction sites	May affect wetland water quality and quantity
	Stormwater runoff from site	May affect wetland water quality and quantity
	Hydrocarbon spills from storage of fuels and re-fuelling of vehicles and machinery	May affect water quality
	Dewatering during construction	May affect groundwater levels in the vicinity of Walluburnup Swamp
Vegetation and flora	Vehicle and machinery movement	May increase the risk of the introduction and/or spread of disease (i.e. dieback) into Yellagonga Regional Park
	Welding and the use of vehicles and machinery	May increase the risk of fire, which may spread to the adjacent Yellagonga Regional Park
	Increased human access	May increase the risk of fire, which may spread to the adjacent Yellagonga Regional Park
Fauna	Construction activities and presence of workforce	May alter the behaviour of native fauna
	Rubbish generated by construction activities	May provide opportunities for feral fauna to inhabit the area
Amenity (community use and appreciation)	Increased community use	May affect the value of the adjacent wetland by enabling access into wetland areas

While there are a number of aspects that may adversely affect the environment if not managed appropriately, the Project has the potential to also result in some positive outcomes, such as:

1. **Vegetation and flora:** as the Project area is totally cleared of native vegetation, rehabilitation works planned for wetland area and associated buffer are expected to result in positive impacts to vegetation and flora within and in proximity to the Project area.
2. **Fauna:** as the Project area is totally cleared of native vegetation, rehabilitation works planned for the wetland area and associated buffer are expected to result in positive impacts to fauna within and adjacent to the Project area.
3. **Ecological linkages:** currently the area and its surroundings is mostly cleared, therefore rehabilitation activities associated with the Project are expected to result in an improvement to the ecological linkages of the area. Revegetation within the Project area and adjacent areas within Yellagonga Regional Park should enhance the link to the wetland vegetation north of Woodvale Drive and once all development of the SP64 area has been completed, ecological linkage to southern bushland areas should be further enhanced.
4. **Amenity (community use and appreciation):** the Project area currently has limited ecological, recreational or visual amenity value due to its completely degraded state and due to the lack of facilities within the Project area or the surrounding area. However, the area provides vistas of the adjacent Walluburnup Swamp which ideally should be maintained. The Project is expected to improve the visual amenity and ecological value of the area through rehabilitation, landscaping and establishment of access paths.

## 5. ENVIRONMENTAL OBJECTIVES, TARGETS AND PERFORMANCE INDICATORS

Specific targets and performance indicators have been developed for the each key environmental factor (Table 2).

The targets for the rehabilitation area were adapted from the performance criteria outlined in the WMRS. The targets represent that which is expected to be achieved within the rehabilitation and maintenance period of three years, under normal circumstances. However, there are a number of factors that may affect achievement of the targets, which are beyond the control of ABN Developments and their Contractors (e.g. fire, vandalism, climate change and weed management [particularly *Typha*] in adjacent areas).

**Table 2 Environmental objectives, targets and performance indicators**

Factor	Objective	Performance criteria	Performance indicators
Geology, geomorphology and soils	Protect and conserve the existing geological structure and soil associations within Walluburnup Swamp and its associated buffer	No erosion of wetland or wetland buffer areas	Visual inspections
		No sediment runoff into wetland areas	Visual inspections
Hydrology	Ensure the Project does not affect groundwater levels in Walluburnup Swamp	Maintenance of existing groundwater level fluctuations	Groundwater monitoring levels
	Maintain desirable surface water flows into Walluburnup Swamp	No overland stormwater from residential areas to enter wetland	Capacity and integrity of stormwater systems
	Ensure the Project does not result in increases in nutrient levels in Walluburnup Swamp	No overland stormwater from residential areas to enter wetland	Capacity and integrity of stormwater systems
Vegetation and flora	Wetland revegetation areas		
	Community Type 1 To establish a <i>Baumea articulata/Schoenoplectus validus</i> sedgeland community consistent with the original structure and composition of the natural local vegetation in seasonally inundated areas within and adjacent to the Project area	<i>B. articulata</i> and <i>S. validus</i> represented in the areas targeted for the establishment of this vegetation community	Nursery order Planting scope/contract Visual inspections Rehabilitation monitoring reports – plant surveys
		Plants are established to an average projective foliage cover of 75% and/or at a minimum rate of 6 plants per m <sup>2</sup> and both species are present over at least 70% of the area planted	Planting scope/contract Visual inspections Rehabilitation monitoring reports – plant surveys
		Weeds comprise less than 20% of the groundcover	Weed control scope/contract Visual inspections Rehabilitation monitoring reports – weed infestation

Factor	Objective	Performance criteria	Performance indicators
Vegetation and flora	Community Type 2 To establish a <i>Melaleuca raphiophylla</i> open forest community consistent with the original structure and composition of the natural local vegetation in transitional wetland areas within and adjacent to the Project area	All species used in rehabilitation of <i>Melaleuca raphiophylla</i> open forest community areas are suitable for this vegetation community (as listed in Appendix 1)	Nursery order Planting scope/contract Visual inspections Rehabilitation monitoring reports – plant surveys
		Rush/sedge species are established with an average projected foliage cover of 50% and/or at a rate of 5 plants per m <sup>2</sup> and have a diversity of at least 4 species per 10m <sup>2</sup> over at least 70% of the area planted	Planting scope/contract Visual inspections Rehabilitation monitoring reports – plant surveys
		Tree species are established at a rate of 3 per 10 m <sup>2</sup> over at least 70% of the areas planted	Planting scope/contract Visual inspections Rehabilitation monitoring reports – plant surveys
		Shrub species are established at a rate of 0.75m <sup>2</sup> over at least 70% of the planted area	Planting scope/contract Visual inspections Rehabilitation monitoring reports – plant surveys
		Weeds comprise less than 20% of the groundcover	Weed control scope/contract Visual inspections Rehabilitation monitoring reports – weed infestation
	Dryland revegetation areas		
	Community Type 3 To establish a <i>Melaleuca raphiophylla/Eucalyptus rudis</i> forest community consistent with the original structure and composition of the natural local vegetation in upland areas within the Project area	All species used in rehabilitation of <i>Melaleuca raphiophylla/Eucalyptus rudis</i> forest community areas are suitable for this vegetation community (as listed in Appendix 1)	Nursery order Planting scope/contract Visual inspections Rehabilitation monitoring reports – plant surveys
		Plants are established at a rate of 0.75 plants per m <sup>2</sup> and have a diversity of at least 4 species per 10m <sup>2</sup> over at least 70% of the area planted	Planting scope/contract Visual inspections Rehabilitation monitoring reports – plant surveys
		Weeds comprise less than 20% of the groundcover	Weed control scope/contract Visual inspections Rehabilitation monitoring reports – weed infestation
	Fire		
Fauna	Protect existing wetland and bushland values and functions.	No instances of the spread of fire from the construction site to outside pre-defined boundaries	Visual observations Environmental Incident Reports
	Minimise impacts to local native fauna populations	No fauna deaths as a result of construction activities	Environmental Incident Reports
	Minimise the effect of construction on feral animal numbers	All domestic rubbish deposited into covered rubbish bins	Covered rubbish bins Visual observations Environmental Incident Reports
Amenity (community use and appreciation)	Prevent access into wetland areas	Installation of fencing along boundary of POS and wetland buffer	Design plans Fencing
	Enable community appreciation of Walluburnup Swamp and surrounds	Construction of suitable access through the revegetated areas	Design plans Access paths

## 6. MANAGEMENT APPROACH

### 6.1 REHABILITATION

As there is no native vegetation present within the Project area, the key component of the wetland management approach is with respect to rehabilitation of wetland and associated buffer areas. This section of the Plan describes the general approach to rehabilitation that will be undertaken to restore vegetation to a condition consistent with the original structure and composition of the natural local vegetation. Some actions will be required to be implemented during the construction phase of the Project and others will be ongoing post-construction.

Landscaping that will be undertaken within the development area, to enhance the amenity and add to the biodiversity values of the area, is addressed separately in the Landscape Plan (PlanE 2010).

#### 6.1.1 Rehabilitation and maintenance strategy

The following provides a broad overview of the rehabilitation and maintenance strategy that will be applied to the wetland, wetland buffer areas and POS. Specific rehabilitation and maintenance management actions are contained in Table 3.

The Project Landscape Architects will have overall responsibility for the implementation of the rehabilitation and maintenance works but will engage appropriately qualified revegetation contractor/s to undertake the on-ground rehabilitation works.

#### **Wetland and wetland buffer**

The wetland and buffer area of the Project area has been divided into three planting areas (Figure 4) based on the three vegetation communities to be re-established in the area:

- Community Type 1 – *Baumea articulata/Schoenoplectus validus* sedgeland community will be established in the area of the wetland that is inundated with water for part of the year (location of this area has been based on groundwater levels mapped by JDA 2010; Figure 2)
- Community Type 2 – *Melaleuca raphiophylla* open forest community will be established between the wetland and dryland areas of the buffer zone
- Community Type 3 – *Melaleuca raphiophylla/Eucalyptus rudis* will be established in the dryland areas of the wetland buffer.

Species acceptable for use in the re-establishment of each of these vegetation communities are listed in Figure 4 and Appendix 1. Planting densities of these species will be based the suggested planting densities provided in the WMRS and advice provided by the revegetation contractor. Indicative planting numbers for species in each community type are outlined in Figure 4; however, these are indicative only and subject to change based on plant availability, site conditions and revegetation contractor advice.

#### **Stormwater management area**

During construction earthworks, a water quality and flood attenuation/infiltration area will be constructed within the POS area to infiltrate/attenuate stormwater runoff from the development area.

The stormwater management area will be constructed on the east side of the dual-use pathway within the POS (Figure 5). This area will be vegetated with native wetland species (such as *Melaleuca* species, rushes and sedges) that tolerate both dry and wet conditions.

### **Public Open Space**

The POS will be planted with a strong reference to locally native plant species. These species will include those found listed within the WMRS and other locally native species (Appendix 1).

### **Weed control**

Control of weed species within the site will be undertaken as part of the landscape and rehabilitation works and will involve both physical and chemical techniques as required. Weed control of all revegetation areas will be undertaken at least 12 months prior to detailed rehabilitation works being implemented, as well as at appropriate times to address the variety of weeds encountered. On-going weed control, once revegetation has occurred, will be undertaken as part of overall site maintenance.

The broad aims of the weed control program are to:

- eradicate or significantly control the presence of weed species (including woody weeds), consistent with the Yellagonga Regional Park Weed Control and Revegetation Plan
- limit potential threat of weed re-establishment in rehabilitation and revegetation areas.

### ***Typha***

Effective management of *Typha* requires an integrated approach and the use of both physical and chemical techniques. Preventing establishment of seedlings is vital to limiting the spread of *Typha*. Control methods may include:

- cultivating seedling populations in late Autumn when most seed has germinated to prevent seedling establishment (for example, by dragging a piece of weld mesh behind a quad bike fitted out with balloon tyres)
- cutting shoots 15 cm below the water surface two to three times in one season when plants are actively growing, but before seeds are fully formed
- applying the herbicide Roundup Biactive (360 g/L) at 13 mL/L in the period between male flowers opening and six weeks after female flowers emerge
- removing emerging flower spikes from established populations.

*Typha* will be controlled throughout the rehabilitation area as required with spraying extending a further 10 m into the wetland to create a buffer between rehabilitation efforts and the remaining *Typha* infestation in Walluburnup Swamp during the course of the rehabilitation period. The establishment of this weed-controlled buffer is aimed at reducing competition in the rehabilitation area long enough for sedges and other plants to become established and before the *Typha* can re-establish itself. The buffer will also act as a fire management tool should a fire occur within other areas of Walluburnup Swamp.

### ***Site preparation for revegetation***

Prior to planting and seeding, all areas shall be prepared to maximise the survival rate of plantings. The key elements of site preparation will be weed control and soil treatment to ensure friable, uncompacted soil so that air, water and roots can penetrate the soil. The site preparation in each area will depend on the existing site condition but will include preliminary clearing of surface weeds and initial weed control.

Site preparation may also include ripping of the surface to allow penetration of air and water.

### ***Planting of tubestock***

Planting of tubestock will be the primary means of revegetation in both the wetland and dryland areas. Tubestock will be sourced from the nursery of Friends of Yellagonga, if available, and Nursery Industry Accreditation Scheme (NIASA) accredited nurseries.

The seedlings will be grown for an appropriate length of time prior to planting to ensure the plant is at the optimum age for establishment under natural rainfall conditions (usually ranges from six months from time seed is sown to a maximum of 12 months). At this age, seedlings readily develop root systems, while larger stock may suffer moisture stress due to large foliage areas. Seedlings will be planted when conditions are suitable, generally in late autumn or winter to allow them to establish before summer (or, for sedges in the sedgeland community area, spring or early summer while water levels in the lake are low). Planting in wetland areas is only to be undertaken when a minimum of 10 cm of plant material can be above the waterline and will likely be in late spring or early summer.

### ***Maintenance***

Maintenance will be required within the rehabilitation areas to ensure performance targets are met. ABN Developments will undertake maintenance works for three years following planting and seeding. Maintenance will include ongoing monitoring (refer to Section 7), top-up plantings/seeding and weed control within the rehabilitation areas, as well as contingency actions that may be required (refer to Section 8).

To minimise fire risk, fuel loads will be assessed annually and where recommended, fuel loads reduced by physical removal.

### ***Management handover***

ABN Developments has committed to undertaking three years of maintenance works following initial planting and seeding. The management of the revegetation areas will revert to the management of the authority in which the reserve is vested after the three year maintenance period. The location of the dual-use path will define the future management zones, with all areas located to the west to be vested with the DEC and all areas to the east (including the dual-use path) with CoW (Figure 5). Prior to handover, monitoring of the rehabilitation areas will be undertaken to determine whether the performance targets have been adequately met. Upon meeting the targets, consultation with the CoW and DEC will be undertaken to determine the manner in which management handover will occur.