



STAGE 2A: THORNTON PARK

Bushland Plan of Management

Prepared for
Landcom

25 October 2012



DOCUMENT TRACKING

ITEM	DETAIL
Project Name	Penrith - Stage 2A North Penrith Review of Plans
Project Number	12SUTPLA-0009
File location	G:\Synergy\Projects\12SYDPLA\12SYDPLA-0009 Penrith - Stage 2A North Penrith Review of Plans\Report\Draft Reports
Project Manager	Name: Steven Ward Phone: (02) 8536 8652 Office address: Level 6, 299 Sussex Street Sydney, NSW
Prepared by	Andrew Whitford
Approved by	Steven Ward
Status	FINAL
Version Number	1
Last saved on	25 October 2012
Cover photo	View from the centre of the site facing north Photo by Andrew Whitford, 16 October 2012

This report should be cited as 'Eco Logical Australia Pty Ltd. 2010. *Stage 2A: North Penrith Mixed Use Development: Bushland Plan of Management*. Prepared for Landcom.'

ACKNOWLEDGEMENTS

This document has been prepared by Eco Logical Australia Pty Ltd with support from Bugrahan Guner (Landcom) and Paul Kohn (Place Design).

Disclaimer

This document may only be used for the purpose for which it was commissioned and in accordance with the contract between Eco Logical Australia Pty Ltd and Landcom. The scope of services was defined in consultation with Landcom, by time and budgetary constraints imposed by the client, and the availability of reports and other data on the subject area. Changes to available information, legislation and schedules are made on an ongoing basis and readers should obtain up to date information.

Eco Logical Australia Pty Ltd accepts no liability or responsibility whatsoever for or in respect of any use of or reliance upon this report and its supporting material by any third party. Information provided is not intended to be a substitute for site specific assessment or legal advice in relation to any matter. Unauthorised use of this report in any form is prohibited.

Contents

1	Introduction.....	5
1.1	Background.....	5
1.2	Site location and description.....	5
1.3	Scope and objectives of BPOM.....	5
1.4	Implementation of Works.....	6
2	Description of environment.....	11
2.1	Existing environment	11
2.2	Vegetation communities	11
2.3	Flora.....	12
2.4	Habitat	13
2.5	Fauna.....	13
3	Vegetation management works.....	14
3.1	Preliminary works	14
3.1.1	Fencing	14
3.1.2	Site preparation works for Zone 3	14
3.1.3	Seed collection	15
3.2	Treatments.....	15
3.2.1	Zone 1: Moderate Resilience.....	15
3.2.2	Zone 2: Low Resilience	16
3.2.3	Zone 3: Very Low Resilience.....	17
3.3	Maintenance	18
4	Specifications / standards	21
4.1	Bradley method	21
4.2	Integrated weed management.....	21
4.3	Weed control techniques	22
4.3.1	Woody weeds	22
4.3.2	Creepers and climbers	23
4.3.3	Annual grasses	23
4.3.4	Perennial grasses.....	23
4.3.5	Herbaceous weeds.....	24
4.3.6	Management of weed waste.....	24
4.4	Herbicide use.....	24
4.5	Revegetation.....	24

4.5.1	Seed collection	26
4.6	Erosion control devices	26
4.7	Threatened species considerations.....	26
5	Environmental safeguards	27
5.1	Limitations.....	27
5.2	Techniques	27
6	Monitoring and reporting.....	30
6.1	Photo monitoring points	30
6.2	Bush regeneration reporting	30
6.3	Performance criteria	31
7	Implementation schedule & cost	32
7.1	Preliminary works	32
7.1.1	Fencing	32
7.1.2	Site preparation	32
7.1.3	Seed collection	32
7.2	Weed control treatments	32
7.3	Revegetation treatments	32
	References	35
	Appendix A: Flora on-site.....	37
	Appendix B: Fauna on-site.....	40
	Appendix C: Recommended Erosion Controls for Bushland Area Boundaries.....	41

List of Figures

Figure 1: Thorton Park Concept Plan (Place Design, April 2012).....	7
Figure 2: Site context	8
Figure 3: Thornton Park works area.....	9
Figure 4: Subject site (Place Design, April 2012).....	10
Figure 5: Typical current condition: Zone 1.....	16
Figure 6: Typical current condition: Zone 2.....	17
Figure 7: Typical current condition: Zone 3 (pink pegs and blue marks show boundary of subject site).18	
Figure 8: Vegetation management zones	20

List of Tables

Table 1: Noxious weeds and Weeds of National Significance (WoNS) found in the subject site	13
Table 2: Revegetation species for subject site (subject to availability).	25
Table 3: Flora & Fauna Impacts & Safeguards	27
Table 4: Erosion & Sediment Control Impacts & Safeguards	28
Table 5: Indicative costings for subject site.....	33
Table 6: Implementation schedule for establishment phase.....	33

Abbreviations

ABBREVIATION	DESCRIPTION
AABR	Australian Association of Bush Regenerators
APVMA	Australian Pesticides and Veterinary Medicines Authority
BOM	Bureau of Meteorology
BPOM	Bushland Plan of Management
CEEC	Critically Endangered Ecological Community
Civil contractor	Construction contractor who is responsible for implementing the construction controls
CPW	Cumberland Plain Woodland
ELA	Eco Logical Australia Pty Ltd
EPBC Act	Commonwealth <i>Environment Protection and Biodiversity Conservation Act 1999</i>
OEH	Office of Environment and Heritage
OH&S	Occupational Health and Safety
TSC Act	NSW <i>Threatened Species Conservation Act 1995</i>
WoNS	Weeds of National Significance

1 Introduction

1.1 BACKGROUND

This Bushland Plan of Management (BPOM) has been prepared by Eco Logical Australia Pty Ltd on behalf of Landcom. This plan identifies the rehabilitation and revegetation of the bushland areas to be retained as part of Stage 2A of the North Penrith Mixed Use Development (SSD 5243). These areas are shown in the 'Thornton Park Concept Plan' prepared by Place Design in April 2012 (**Figure 1**). These bushland areas included in the BPOM are referred to hereafter as the 'subject site'.

Preparation and implementation of a BPOM is required by statement of commitment number 29 from the concept plan approval for North Penrith. The commitment is:

'Landcom will prepare a Bushland Plan of Management for the Cumberland Plain Woodland within OS2 (Thornton Park). This Plan will include a suggested planting palette that preferences local plantings and seed banks over other resources in the Penrith LGA or broader Western Sydney.'

This BPOM is intended to address this statement of commitment.

1.2 SITE LOCATION AND DESCRIPTION

The Stage 2A works of the North Penrith site is approximately 50 km from the Sydney CBD on the northern side of Penrith CBD (**Figure 2**). The location of Thornton Park in relation to the Stage 2A works area is shown in **Figure 3**. The subject site is shown in **Figure 4**.

The Thornton Park Concept Plan (Place Design, April 2012) is shown in **Figure 1**.

1.3 SCOPE AND OBJECTIVES OF BPOM

The Stage 2A development includes Thornton Park which will retain will manage 0.33ha as 'bushland', including Cumberland Plain Woodland (CPW). This BPOM will direct the management of this CPW through the establishment phase of three years. While works will be required post-establishment (i.e. a 'maintenance' phase) these works are not covered by this BPOM. Adjacent to the subject site (outside of the BPOM area) will be landscaping which will include: areas of native and exotic vegetation plantings, footpaths, retaining walls, drainage works, roads, and Thornton Hall heritage precinct. The aims of the management in this BPOM are detailed below:

- Protect remnant CPW within the subject site;
- Undertake bush regeneration works to improve the condition of the CPW within the subject site, including revegetation and weed control, through the establishment phase;
- Control noxious and environmental weeds within the subject site;
- Identify the costs associated with the implementation of this BPOM; and
- Provide advice on management of the site during the maintenance phase, which is not covered in this BPOM.

1.4 IMPLEMENTATION OF WORKS

All vegetation management works will be undertaken by suitably qualified and experienced bush regeneration contractors who are members of the Australian Association of Bush Regenerators (AABR) or fulfil the membership criteria. All weed control techniques will utilise techniques recognised by the AABR. Suitable minimum qualifications are considered to be a TAFE Certificate III in Conservation & Land Management or equivalent.

A project specific, comprehensive environmental and Occupational Health and Safety (OH&S) plan is to be prepared by the contractors prior to undertaking works and all staff are to be inducted to the site.



Figure 1: Thorton Park Concept Plan (Place Design, April 2012)

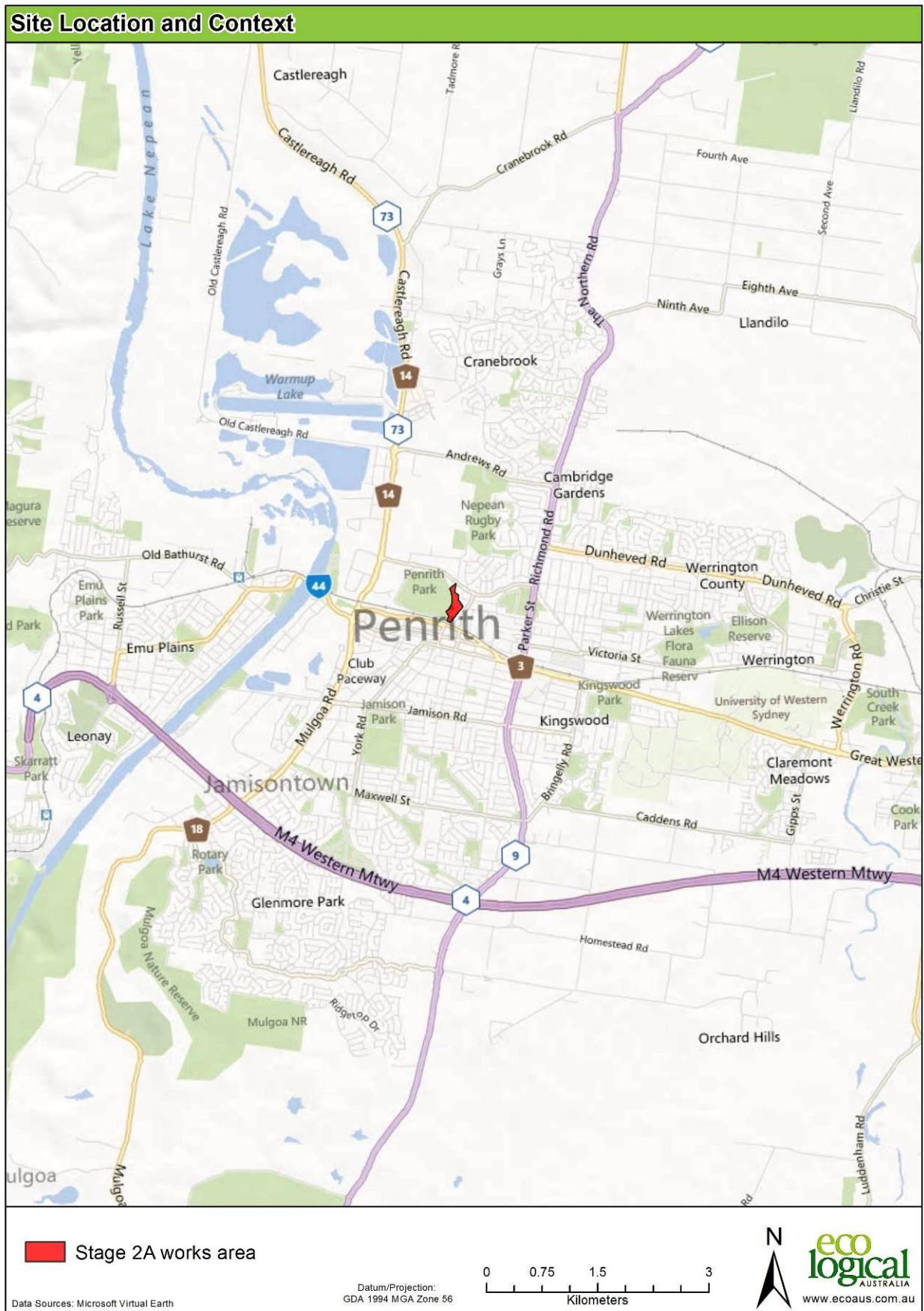


Figure 2: Site context



Figure 3: Thornton Park works area



Figure 4: Subject site (Place Design, April 2012)

2 Description of environment

2.1 EXISTING ENVIRONMENT

The subject site is on a slight hill, rising to the east. It fronts onto Mountain View Crescent and has access The Crescent.

The site contains a mixture of native and exotic flora species. The majority of these species have been planted or are weeds that have colonised the site in the absence of management. Remnant vegetation remains onsite and has been mapped to be Shale Plains Woodland (NPWS 2002), which is a subcommunity of the Critically Endangered Ecological Community (CEEC) CPW, as listed under the *Threatened Species Conservation Act 1995* (TSC Act).

The climate of the area is typical of the Sydney region, which can generally be described as temperate (BOM 2012).

The site is located on the boundary of the 'Richmond' fluvial soil landscape which extend west to the Hawkesbury-Nepean River and the 'Luddenham' erosional soil landscape in the higher ground to the east (Bannerman and Hazelton 1990). The dominant soil materials at high elevations for the 'Richmond' soil landscape and low elevations of the 'Luddenham' soil landscape are considered highly erodible and, in some cases sodic. Soil depth for the 'Richmond' soil landscape at higher elevations is >300cm, with up to 100cm of brown sandy clay loam overlaid on up to 150cm of light clay and >100cm medium or heavy clay. Soil depth for the 'Luddenham' soil landscape at lower elevations is >200cm, with up to 40cm of clay loam overlaid on <50cm of sandy clay and >100cm whole-coloured medium clay (Bannerman and Hazelton 1990).

2.2 VEGETATION COMMUNITIES

Currently, one small patch of modified Cumberland Plain Woodland (Tozer 2003) is located on the subject site. This remnant is dominated by *Eucalyptus moluccana* (Grey Box) along with other common indicator species of Cumberland Plain Woodland such as *Eucalyptus tereticornis* (Forest Red Gum) and *Corymbia maculata* (Spotted Gum).

Through the current patch, the understorey consists of predominantly exotic species, though there were natives present in low abundance. Only one native shrub species was found in the patch, *Bursaria spinosa* (Native Box-thorn), Exotic shrub species in the understorey included *Ochna serrulata* (Mickey Mouse Plant), *Sida rhombifolia* (Paddy's Lucerne), *Olea europaea* subsp. *cuspidata* (African Olive), *Ligustrum lucidum* (Large Leaved Privet) and *Ligustrum sinense* (Small Leaved Privet). Other exotics found in the understorey included *Araujia sericifera* (Moth Vine), *Plantago lanceolata* (Lambs Tongue), *Bidens pilosa* (Cobblers Pegs) and *Asparagus aethiopicus* (Asparagus Fern) and *Solanum nigrum* (Black-berry Nightshade).

The groundcover in the current patch consists of a mixture native and exotic species. The predominantly exotic groundcover was dominated by the grasses, *Chloris gayana* (Rhodes Grass), *Ehrharta erecta* (Panic Veldtgrass), *Eragrostis curvula* (African Lovegrass) and *Pennisetum clandestinum* (Kikuyu). The native species present were in low abundance and included *Aristida ramosa* (Purple Wiregrass), *Aristida vagans* (Three Awn Grass), *Austrodanthonia* sp. (Wallaby Grass), *Microlaena stipoides* (Weeping Grass), *Themeda australis* (Kangaroo Grass) and *Sporobolus* sp. Other native species in the understorey included the herbs *Commelina cyanea*, (Creeping Christian),

Dichondra repens (Kidney Weed), *Oxalis* sp. (Oxalis) and *Wahlenbergia* sp. (Bluebell). See **Appendix A** for full floristic data.

The current patch of CPW will be separated by paths and other landscaping works, which will create five areas of CPW with paths and other landscaping between them. The condition of the remnant vegetation within each bushland area, as observed on 8 October 2012, varies. A brief description of each bushland area, with numbering of bushland areas on **Figure 4**, is described briefly below:

1. 1,415m². Moderately-Highly disturbed. Native canopy present over part of the site, though exotic canopy species are present as well. Small areas of native midstorey and understorey regeneration though the majority of the area is dominated by exotic understorey speics.
2. 174m². Severely disturbed. No canopy or midstorey present. No native understorey present though exotic species are present. Soil has been disturbed over much of this area including excavation and introduction of fill.
3. 603m². Moderately disturbed. Native canopy present throughout. Some regeneration of native midstorey and understorey though exotic species are present in high densities as well.
4. 476m². Severely disturbed. No canopy or midstorey present. No native understorey present though exotic species are present. Soil has been disturbed over much of this area including excavation and introduction of fill.
5. 645m². Severely disturbed. Native canopy present over part of the site (one tree). No native midstorey or understorey present though exotic species are present in both. Much of this area is covered in asphalt from a former road.

2.3 FLORA

A total of 51 flora species were recorded within the current CPW area by ELA in 2010 and 2012. This includes 12 locally native species, 1 non-endemic (i.e. introduced native species) and 38 exotic species. None of these flora species recorded are listed as threatened under the TSC Act or EPBC Act. See **Appendix A** for full floristic data.

Twenty six threatened flora species have been recorded within a 10 kilometre radius of the North Penrith development area that are listed under either the TSC or EPBC Acts (ELA 2010). Of these, *Persoonia nutans* (Nodding Geebung) was the only species considered to have potential to occur within the study area due to the presence of a record of this species on site from 2001. However, this species was not found during either the original flora and fauna assessment or the site survey for this BPOM.

A total of 38 exotic flora species were recorded in the subject site (**Appendix A**). Four weed species listed as noxious within the Penrith LGA (DI&I 2012) under the *Noxious Weeds Act 1993* were recorded within the subject site (**Table 1**). These species were all listed under the act as 'Class 4'. The growth of Class 4 noxious weeds must be managed in a manner that reduces its numbers spread and incidence and continuously inhibits its reproduction. One of these species, African Boxthorn, and two species not listed as noxious within Penrith LGA, *Asparagus aethiopicus* (Asparagus Fern) and *Senecio madagascariensis* (Fireweed), are also classified as Weeds of National Significance (WoNS) (AWC 2012). Some significant environmental weeds found in the subject site include African Lovegrass and Rhodes Grass.

Table 1: Noxious weeds and Weeds of National Significance (WoNS) found in the subject site

SCIENTIFIC NAME	COMMON NAME	NOXIOUS	WONS	FORM
<i>Asparagus aethiopicus</i>	Asparagus Fern	-	Y	Shrub
<i>Ligustrum lucidum</i>	Large-leaved Privet	Class 4	-	Tree
<i>Ligustrum sinense</i>	Small-leaved Privet	Class 4	-	Tree
<i>Lycium ferocissimum</i>	African Boxthorn	Class 4	Y	Shrub
<i>Olea europaea</i> subsp. <i>cuspidata</i>	African Olive	Class 4	-	Tree
<i>Senecio madagascariensis</i>	Fireweed	-	Y	Herb

2.4 HABITAT

The subject site provides one broad fauna habitat types associated with the one vegetation communities, open woodland. Within this habitat type specific habitat features including deep leaf litter, dense shrub layers, large woody debris.

Woodland habitat provides more complexity by possessing a canopy, shrub strata and ground cover. The woodland would contain a broad array of breeding, nesting, roosting and foraging habitat, which could provide habitat formobile fauna species, as the native vegetation is relatively isolated. Large woody debris also occurs within the woodland area, which may provide refuge for some native ground dwelling mammals, and reptiles.

2.5 FAUNA

A total of 25 fauna species were recorded on the subject site and adjacent; of which there were 21 bird species, one amphibian, two mammals and one reptile (See **Appendix B** for full species inventory). The bird species recorded are considered common in urban areas, including the introduced species *Acridotheres tristis* (Indian Mynah), *Columba livia* (Common Rock Dove) *Ocyphaps lophotes* (Crested Pigeon) and *Streptopelia chinensis* (Spotted Turtle Dove). Other native fauna recorded included *Pseudechis porphyriacus* (Red-bellied Black Snake) and the *Crinia signifera* (Common Eastern Froglet). The introduced *Oryctolagus cuniculus* (European Rabbit) was sighted during survey work and a *Vulpes vulpes* (European Fox) scat was also recorded.

Survey for microbats using Anabat detectors recorded only three calls during two different survey periods (Ecotone 1999, ELA 2010). Of these, two were identified as *Miniopterus schreibersii oceanensis* (Eastern Bentwing Bat), listed as Vulnerable under the TSC Act and one was unidentifiable.

Fifty six fauna species listed as either threatened or migratory under either the TSC or EPBC Acts have been recorded within a 10 kilometre radius of the North Penrith development area (ELA 2010). Of these one threatened bird, *Stagonopleura guttata* (Diamond Firetail) and one threatened invertebrate, *Meridolum corneovirens* (Cumberland Plain Land Snail) were considered to potentially occur onsite, one threatened bat, Large Bent-wing Bat, was considered known on site and one migratory species, Rainbow Bee-eater (*Merops ornatus*) was considered to potentially occur. None of these species were recorded during either the flora and fauna assessment (ELA 2010) or the site survey for the BPOM.

3 Vegetation management works

The subject site is shown in **Figure 8**. The resilience of the subject site is highly variable. The westernmost sections of the subject site have been highly disturbed by approved construction activities including tree removal, excavation and the installation of fill. These areas have very low resilience. Likewise the south-east portion of the subject site has been covered with asphalt as part of its historical use and so has very low resilience as well. The central and northern portions of the subject site have higher resilience, with established trees and an intact soil profile. However, even within these areas weed densities range from moderate to very high, indicating that there may be issues with relying on natural resilience. As such vegetation management works for this BPOM are focused on revegetation and weed removal. The subject site is divided into three zones based on resilience levels. Specifically, these treatment zones are:

- Zone 1: Moderate resilience
- Zone 2: Low Resilience
- Zone 3: Very Low Resilience

This BPOM covers the establishment phase only. The establishment phase will last for approximately three years following substantial completion of construction works. The current condition of the site, including the CPW vegetation, is poor. To allow the revegetation works to establish effectively, management will need to extend beyond the initial three years timeframe. Advice as to the nature of maintenance works has been provided in **Section 3.3**. Recommendations for specific weed control techniques are found in **Section 1**.

3.1 PRELIMINARY WORKS

3.1.1 Fencing

Temporary fencing to prevent construction impacts from Stage 2A works to the bushland areas must be in place prior to construction commencing.

Fencing must not be placed outside of the clearing limits. Any shrubs that are located within 1m of the fencing line may be pruned, or removed if the base is within 0.5m of the fencing line. Trees may only be removed if their trunk is on the fencing line, or within 0.5m. The temporary fencing around the training field is to comply with section 4 of AS 4970 – 2009 Protection of Trees

3.1.2 Site preparation works for Zone 3

The construction impacts on the western portion of the subject site involved the removal of trees, excavation and regrading of soil and the introduction of fill, including gravel. As such, the natural resilience of this area has been severely minimised. To ensure adequate establishment of plants and to reduce the potential for weed invasion in these areas, the following works are required prior to planting in Zone 3:

1. Removal of any construction rubbish that may be present;
2. Mechanical removal of any exotic vegetation (note: this material must be disposed of as outlined in **Section 4.3**);
3. Removal of asphalt in the south-east corner of the subject site to a required depth;

4. Excavation of any non-organic fill (e.g. roadbase, gravel or concrete pieces) to a depth of ~200mm and removal from subject site as required (Note: when the asphalt is removed from the south-east corner of the site this area will be assessed whether further excavation is necessary); and
5. Ripping of specified areas (including all areas where asphalt has been removed) to a depth of ~200mm. Given the possibility of sodic soils and the risk of dispersal of fine clays brought to the surface, Gypsum should be added to the ripped soil at the recommended rate (e.g. 0.25kg per m²); and
6. Installation of new topsoil to a depth of 200mm. Topsoil should be mixed with organic compost at the recommended rate for native vegetation.

During excavation and ripping works it is important that the clay layer not be disturbed. In addition, excavation and ripping may not be required in all parts of this zone. As such, an ecologist or qualified bush regenerator should be on hand to direct the removal. Maximum soil depth has been assumed to 200-300cm (**Section 2.1**). The boundaries between soil materials should be sharp and the clay layers should not be disturbed.

After works are complete coir logs should be installed as required for erosion control. Examples of best practice specifications for straw bales are provided in **Appendix C**, however straw bales should not be used as these can carry seed material which has potential spread on to the site and create a new weed issue on site. In addition, sediment fences should be installed around the perimeter. Best practice specifications for sediment fencing are also provided in **Appendix C**.

3.1.3 Seed collection

Seed collection should take place during the construction phase to ensure the supply of sufficient local provenance tubestock for revegetation. Seed collection should be as per the specifications found in **Section 4.5.1**.

3.2 TREATMENTS

3.2.1 Zone 1: Moderate Resilience

This zone encompasses the area of highest resilience within the subject site as it has an intact soil profile, native canopy species and some native mid and understory species. However, this zone still has moderate to high weed densities and a fairly homogeneous species mix, indicating that ecological resilience is moderate. This area has potential for some unassisted regeneration, especially of canopy species, but is unlikely to regenerate a diverse native community on its own. Primary management actions in this zone are weed removal, erosion control and revegetation of understorey species. Weed control works will involve primary and secondary weed removal before revegetation works are undertaken. This zone does not need extensive soil preparation works to enable it to be revegetated.

Woody weeds such as African Olive, Large Leaved Privet, Small Leaved Privet and *Phoenix sp.* (Date Palm) are present in this zone, largely mixed amongst regrowth of Spotted Gum. Woody weeds will be removed by hand using the cut and paint method to avoid damage to native saplings. Seedlings should be hand pulled. Grass weeds such as African Lovegrass and Rhodes grass are also present in moderate densities through this zone. These may be sprayed using a monocot specific herbicide, though care must be taken to avoid any regeneration of native grass species. Herbaceous weeds including *Cirsium vulgare* (Spear Thistle), *Verbena bonariensis* (Purpletop) and *Senecio madagascariensis* (Fireweed) are found adjacent to the subject site will be hand pulled or spot sprayed with a non-specific herbicide if they are present.

Once primary weed removal works have been undertaken, this zone will require planting using species appropriate to CPW as shown in **Table 2**. No overstorey species will be planted, however midstorey species will be planted at a density of one plant per 10 square metres, and understorey species at a density of one plant per square metre. The aim of revegetation works in this zone is to increase diversity of mid and understorey species. Revegetation should be undertaken as per the specifications in **Section 4.5**.

All overstorey species will require tree guards to protect them from grazing by Rabbits. A total of approximately 869 plants will be required to revegetate this area. An attrition rate of 10% has been estimated for all revegetation species.

The total area of Zone 1 is 0.07 ha.



Figure 5: Typical current condition: Zone 1

3.2.2 Zone 2: Low Resilience

This zone encompasses the areas of the subject site with an intact soil profile but high weed densities, indicating low ecological resilience. This area is unlikely to regenerate a diverse native community on its own and so will require revegetation. However, this zone will not need extensive soil preparation works to enable it to be revegetated. Primary management actions in this zone are weed removal, erosion control and revegetation. Weed control works will involve primary and secondary weed removal before revegetation works.

Some woody weeds, such as African Olive and Large Leaved Privet, are present in this zone, though the area is dominated by grass weeds such as African Love Grass and Rhodes Grass. Woody weeds

will be removed by hand using cut and paint. Seedlings will be hand pulled. Grass weeds may be sprayed using a monocot specific herbicide, though care must be taken to avoid any regeneration of native grass species. Herbaceous weeds will be hand pulled as required.

It is recommended that the large *Pinus* sp. (Pine Tree) be removed while construction works are still in progress for reasons of efficiency and economy. This tree should be removed by suitably qualified arborists to ensure no impact on the subject site.

Once primary weed removal works have been undertaken, this zone will require planting using species appropriate to CPW as shown in **Table 2**. Over-storey species will be planted at a density of one plant per 30 square metres, while midstorey species will be planted at a density of one plant per five square metres, and understorey species at a density of two plants per square metre. Revegetation should be undertaken as per the specifications in **Section 4.5**.

All overstorey species will require tree guards to protect them from grazing by Rabbits. A total of approximately 2,948 plants will be required to revegetate this area. An attrition rate of 10% has been estimated for all revegetation species.

The total area of Zone 2 is 0.12 ha.



Figure 6: Typical current condition: Zone 2.

3.2.3 Zone 3: Very Low Resilience

This zone has little chance of regenerating a diverse native community on its own. As such, the primary management action in this zone during the establishment phase will be soil preparation, revegetation

and maintenance of that revegetation. Soil preparation should take place as per the treatment outlined in **Section 3.1.2**.

Once the site is prepared, these areas will require planting using species appropriate to CPW as shown in **Table 2**. Over-storey species will be planted at a density of one plant per 20 square metres, while midstorey species will be planted at a density of one plant per three square metres, and understorey species at a density of four plants per square metre. Revegetation should be undertaken as per the specifications in **Section 4.5**.

All overstorey species will require tree guards to protect them from grazing by Rabbits. A total of approximately 6,754 plants will be required to revegetate this area. An attrition rate of 10% has been estimated for all revegetation species.

The total area of Zone 3 is 0.14 ha.



Figure 7: Typical current condition: Zone 3 (pink pegs and blue marks show boundary of subject site).

3.3 MAINTENANCE

This BPOM covers the establishment phase of the bushland management works over the first three years. Subsequent maintenance works will be required and they should conform to the recommendations below.

The maintenance phase should be implemented at the conclusion of the establishment phase, approximately three years after substantial completion of construction works, and continue for a further three years. Works will be undertaken in all management zones during the maintenance phase. Priorities will be the treatment of any regrowth of primary treated weed species and control of subsequent growth of other weed species (secondary weed control). Maintenance will be required on a regular basis especially in the peak growing seasons and less frequently in the cooler periods. The frequency of maintenance required will depend on the rate of native regeneration and persistence of exotic species. It is expected that maintenance works following establishment phase will be required at least monthly during the peak growing seasons and quarterly in the cooler periods. Maintenance will be undertaken for approximately three years after completion of the establishment phase (three years).



Figure 8: Vegetation management zones

4 Specifications / standards

4.1 BRADLEY METHOD

All works will employ the principles of bush regeneration and will follow the Bradley Method and use other techniques to promote natural regeneration described in Buchanan (2000), summarised below:

- Where available, refer to best practice guidelines for individual weed species and apply these to the site bearing in mind that a) these guidelines are usually written from an agricultural perspective and so may need to be adapted to a natural setting and ecological outcome b) the potential for off-target damage;
- Ensure correct plant identification – many weed species are difficult to identify because they resemble native species or typically occur in a vegetative (i.e. non-flowering) form;
- Limit the creation of bare patches of soil and soil disturbance in general, since this will encourage weeds to establish and grow – do not create unnecessary tracks with vehicles or other machinery;
- As a first option for weed control, consider methods that don't use herbicide (e.g. hand pulling and crowning) and which create very little soil disturbance;
- When using herbicides, use the least toxic chemical whenever possible and always follow the instructions;
- When working on or near water, use an approved herbicide for this environment (e.g. RoundUp® Biactive™); Refer to Australian Pesticides and Veterinary Medicines Authority (APVMA) website (www.apvma.gov.au) for information on off-label permits;
- Apply herbicides when the plants are actively growing and prior to seed set to achieve the best results;
- Regularly monitor for new infestations and report on the outcomes of the Landscaping and Weed Management Program; and,

4.2 INTEGRATED WEED MANAGEMENT

Integrated weed management techniques has been considered the most effective method to control weeds. Integrated weed management may use a combination of any of the following techniques; mechanical, chemical, manual handling and biological methods. According to the Department of Primary Industries' *Noxious and environmental weed control handbook* the best management practices considers a long-term perspective and does not rely solely on herbicide application (DPI 2010).

Weed control can be broken down into three main categories:

Primary Weed Control:	the first weeding of the site.
Secondary Weed Control:	the second weeding of the site which may be very intensive as all regrowing/germinating weeds should be removed before they seed and out-compete native plants.
Maintenance/Follow-up Weed Control:	every re-weeding of the site after the secondary phase.

Primary weed control refers to the first time an area is weeded; it can be labour intensive and time consuming and depending on the target species and site conditions, it may take over several months to

complete for one species (Buchanan 2009). In areas of high weed infestation and with no native resilience and/or native plants present, primary weeding may be accelerated as preparatory works for revegetation. However, in areas where native plants may occur, primary weeding should be undertaken at a pace that assists with the natural regeneration of the site.

Secondary weed control is the second weeding of an area and it may take longer than primary treatment (Buchanan 2009). Secondary weed control needs to be carefully timed to:

- Prevent weeds from setting seed
- Suppress vegetative regrowth while plants are still small
- Allow native plants to recruit without being smothered or out-competed by weeds

However, secondary weed control should allow enough time for the soil profile to recover following primary weed control and the establishment of weed growth from the soil seed bank.

Maintenance weed control refers to weed control that is carried out after the secondary treatment (Buchanan 2009). The goal of follow-up control is to remove weedy recruits so that native species can re-colonise the area; frequent visits are likely to be needed at first, although the amount of time and resources used should gradually decrease through time.

4.3 WEED CONTROL TECHNIQUES

Detail of specific weed control techniques to be used such as cut and paint, scrape and paint, herbicide spraying and hand weeding are given in Brodie (1999). The principles of bush regeneration and techniques to trigger natural regeneration are to be in accordance with the Bradley Method and other techniques described in Buchanan (2000). Management techniques for different types of weeds are provided below, with specific recommendations for significant weeds, including noxious species and/or WoNS. Regeneration will consist of the removal of weeds as specified in **Section 3.2** and the promotion of native species as per the Best Practice Guidelines for restoring Cumberland Plains Woodland (DEC 2005).

4.3.1 Woody weeds

All woody weeds, will be controlled by the cut and paint or drill and fill method using a non-selective herbicide. The most appropriate method to be used depends on the size of the individual to be removed and will be determined by the bush regeneration contractor. Primary weed control should use techniques that will not encourage flushes of secondary weed growth. All seedlings of woody weeds will be hand pulled or spot-sprayed with a non-selective herbicide.

African Boxthorn, a Class 4 noxious weed and WoNS, should be controlled by the cut and paint method. Larger individuals may need to be treated by progressively cutting back stems until the main trunk and crown is exposed. The crown should be left with at least 1m of trunk attached until woody debris has been cleared. The trunk should then be cut as low to the crown as possible and the non-selective herbicide applied. Cut stumps should be low to the ground (e.g. not higher than 5cm) and level to allow the poison to penetrate.

Large-leaved and Small-leaved Privet, Class 4 noxious weeds, should be controlled by the cut and paint method. The effectiveness of herbicide application, especially for larger plants, will be enhanced by peeling back the bark below the cut stump to increase surface area. For larger individuals the drill and fill method can be used, taking care to remove any dirt from the stump and drilling directly into the crown. Larger individuals are likely to resprout, so follow up treatments will be needed. Smaller individuals and seedlings can be hand removed, taking care to remove all root material.

African Olive, a Class 4 noxious weed, can be treated using the cut and paint method. This should be undertaken in spring-early summer when plants are actively growing but fruit has not developed. Smaller plants and seedlings can be hand removed.

4.3.2 Creepers and climbers

The control of creepers, including Moth Vine, varies depending on the species. For the most part, seedlings will be hand pulled, while mature plants can be controlled by the stem-scrape method or spot spraying using a non-selective herbicide. The precise method to be used will be determined by the bush regeneration contractor depending on the species, size and reproductive status of the individual.

Asparagus Fern, a WoNS, has the potential to establish in great numbers in any areas disturbed during construction and vegetation removal works. This species has the potential to spread vegetatively, by water or via bird-dispersed seed. Any large infestations of Asparagus Fern will be controlled by spot spraying using a selective herbicide while it is flowering in spring. Individual plants should be hand removed by gently levering out the rhizome during the moister months (autumn-winter). Tuberous and fibrous roots can be left in the ground, but ensure that the entire rhizome mass is removed as any remaining pieces can resprout vegetatively. Alternately, the rhizome can be treated using the drill and frill technique using selective herbicide. Ensure that stems are severed and dirt is cleared away from the rhizome. All vegetative material removed should be bagged, removed from site and disposed of appropriately.

4.3.3 Annual grasses

Annual grasses, including *Bromus catharticus* (Prairie Grass), should be hand removed where isolated or in low concentrations. Larger patches of annual grasses may be slashed/brush cut in late spring to early summer, after flowering, but prior to seed set. Slashing/brush cutting prior to late spring through to early summer will promote vigorous growth and should not occur. Monitoring of these species will occur and if new growth occurs, the same treatment will be applied to the new growth to prevent seed production. Individual plants should be hand removed, bagged and disposed of appropriately offsite.

Some annual grasses can grow and produce seed at any time of the year dependent on climatic conditions such as high rainfall and warm temperatures. Therefore, monitoring of these species is crucial and plants need to be treated if flowering is observed.

4.3.4 Perennial grasses

Perennial grasses, including African Love Grass, Rhodes Grass and Kikuyu, will be slashed prior to seed production in spring or summer (depending on the growth cycle of the species) and the regrowth will be spot sprayed 2-3 weeks later when it is actively growing and approximately 10 cm in length.

African Lovegrass is identified to be one of the key weed species requiring control across the proposed offset site as it dominates the ground layer and is largely responsible for the loss of diversity in the community. African Lovegrass will flower opportunistically after rain from September – February. Bush regeneration works must be able to respond to the flowering of this species to control it effectively across the proposed offset site.

A grass specific herbicide (e.g. Fusilade®: active ingredient Fluazifop-P) will be used to control African Lovegrass and all other grass weeds across the subject site, especially Zone 2. This will allow for broad scale application of herbicide to control African Lovegrass, without impacting upon native broad leaf species. Care will be required when spot spraying is being undertaken to prevent native grasses from being killed by the spot spraying process. If African Lovegrass or other weed grasses are found in the vicinity of native grasses they will be hand pulled to prevent off target damage to native species from occurring.

It is likely that the treatment cycles and techniques for various grass weeds will overlap. For example, Rhodes Grass often comes up after African Lovegrass is removed, requiring primary treatment of Rhodes Grass even while secondary treatment of African Lovegrass is underway.

It is recommended that *Cynodon dactylon* (Couch) should only be managed if it begins to smother native vegetation or dominates large areas. If necessary to control it should be sprayed with a monocot specific herbicide (e.g. Fusilade®) between September and March. .

4.3.5 Herbaceous weeds

Where individual plants of other herbaceous weeds, including Cobbler's Pegs, Catsear, Purpletop, and *Conyza* sp. (Fleabane), are found, they will be hand pulled prior to flowering. Where large swaths of these species occur they will be sprayed using a non-selective herbicide. If high densities of mature stands occur, weeds may be slashed first using a brush cutter and any subsequent regrowth sprayed. Regular monitoring of these species will be required to prevent seed production. Spear Thistle will not be hand-pulled due to its thorns and instead will be spot sprayed using a non-selective herbicide. All vegetative material that is pulled out and has the potential to regrow if deposited on ground will be bagged and removed from site.

Fireweed, a WoNS, should be treated by hand removal or herbicide application in the spring before flowers appear.

4.3.6 Management of weed waste

All exotic vegetation material should be removed from site and composted at a registered green waste disposal facility. Fruiting parts and tubers should be bagged before being removed from site. On-site composting or the laying of exotic 'brush matting' is not appropriate at this site.

4.4 HERBICIDE USE

The use of herbicide to control weeds should be carefully considered. Herbicide use should assess potential long-term impacts of the technique including whether the proposed works actually address the source of the weed infestation. However, herbicide application forms an important and useful component of an integrated weed management approach and can be the most appropriate method to control some weed species.

Herbicide use should occur during the active growing season for plants to encourage the chemical uptake into the plant. The selection of herbicides should also consider the type of weed and the location. Where non-selective herbicides are required for use, glyphosate is the most suitable. If herbicides are required to be used near waterways, a glyphosate-based herbicide formulated for use near waterways will be used (e.g. RoundUp® Biactive™).

Broad-leaf selective herbicide may be used as per the NSW Department of Primary Industries (DPI) *Noxious and environmental weed control handbook*. However, this type of herbicide is extremely toxic to aquatic life and must not be used in, or adjacent to, waterways. Registration and records must be kept in accordance with the NSW *Pesticide Regulation 2009*.

4.5 REVEGETATION

Plantings will be required during the establishment phase to supplement natural regeneration. Any plantings should consist of local provenance stock (**Section 4.5.1**). Planting should be conducted in the shoulder months (early spring or early autumn) to prevent shock to young saplings and reduce exposure to frost or drought conditions. Prior to planting, each sapling should be soaked in a plant tonic

(e.g. Seasol™) for at least 1-2 hours to reduce transplant shock. Water crystals or wetting agents should be added to each plant hole. This will increase the water holding capacity of the soil and reduce watering schedules especially in difficult to access locations.

Tree guards will need to be installed on each plant to protect seedlings from extreme weather (frosts and heat), herbivorous grazing and herbicide drift during maintenance. Bio-degradable tree guards are recommended to protect the seedlings, especially those in the more exposed Buffer zone. Depending on the weather, irrigation needs to be undertaken for at least 4-6 weeks following planting to aid establishment of the plants.

Planting of tube-stock for trees and shrubs species and *Hiko* or *Viro* cells for grasses and other groundcover species is the preferred method in all zones.

Table 2: Revegetation species for subject site (subject to availability).

Scientific Name	Common Name	Zone 1 (0.07ha)	Zone 2 (0.12ha)	Zone 3 (0.13ha)
Overstorey		N/A	~1 per 30m²	~1 per 20m²
<i>Casuarina glauca</i>	Swamp Oak	-	5	5
<i>Corymbia maculata</i>	Spotted Gum	-	5	15
<i>Eucalyptus moluccana</i>	Grey Box	-	10	15
<i>Eucalyptus tereticornis</i>	Forest Red Gum	-	10	15
<i>Melaleuca decora</i>	White Feather Honeymyrtle	-	10	15
Midstorey		~1 per 10m²	~1 per 5 m²	~1 per 3 m²
<i>Acacia parramattensis</i>	Sydney Green Wattle	10	40	75
<i>Bursaria spinosa</i>	Blackthorn	10	40	100
<i>Daviesia ulicifolia</i>	Gorse Bitter Pea	10	40	75
<i>Dodonaea viscosa subsp. cuneata</i>	Wedge-leaf Hopbush	15	40	75
<i>Indigofera australis</i>	Native Indigo	15	40	75
<i>Pultenaea microphylla</i>		10	40	75
Understorey		~1 per m²	~2 per m²	~4 per m²
<i>Aristida ramosa</i>	Purple Wiregrass	40	150	350
<i>Aristida vagans</i>	Threeawn Speargrass	40	150	350
<i>Austrodanthonia racemosa var. racemosa</i>		40	150	350
<i>Austrodanthonia tenuior</i>		40	150	350
<i>Bothriochloa macra</i>	Red-leg Grass	50	150	350
<i>Dianella longifolia</i>	Blue Flax-lily	50	150	350
<i>Dichelachne micrantha</i>	Shorthair Plumegrass	40	150	350
<i>Dichelachne parva</i>	Flax-lily	40	150	350
<i>Echinopogon caespitosus</i>	Tufted Hedgehog Grass	50	150	350
<i>Eragrostis leptostachya</i>	Paddock Lovegrass	50	150	350
<i>Goodenia hederacea subsp. hederacea</i>	Forest Goodenia	50	150	350
<i>Hardenbergia violacea</i>	Purple Coral Pea	50	150	350
<i>Lomandra filiformis subsp. filiformis</i>	Wattle Mat-rush	40	150	350
<i>Lomandra multiflora subsp. multiflora</i>	Many-flowered Mat-rush	40	150	350
<i>Microlaena stipoides</i>	Weeping Grass	50	150	350
<i>Themeda australis</i>	Kangaroo Grass	50	150	350
TOTAL		790	2680	6140
10% Attrition		79	268	614
TOTAL		869	2948	6754
GRAND TOTAL				10571

4.5.1 Seed collection

It is desirable that local provenance species are used for plantings. Provenance refers to where the plants, or seeds, come from. In accordance with best practice standards, all plants (or the seed used to grow them) need to be sourced from nearby areas that have the same vegetation community, landforms, soil landscapes, soil types and weather conditions (Buchanan 2009). Groundcovers, shrubs and trees should be collected from within 3km of the site. Should seed not be available within 3km, this radius can be extended to a maximum of 10km. Native grasses typically have much larger dispersal ranges and are to be collected from within a 10km radius of the site. Should seed not be available within the specified radius, OEH may provide written approval for seed supply from other areas of western Sydney.

Where the species identified in this BPOM cannot be sourced, they may be substituted for other local endemic species as identified in *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area* (DECCW 2009). Trees must be substituted with trees, shrubs with shrubs etc. Only wild native species are to be used. Plants are not to be substituted with horticultural varieties under any circumstances.

Record keeping of seed collection and planting locations is to be as per the Flora Bank guidelines (Mortlock 2000). The bush regeneration contractor is responsible for recording this information and providing it to OEH. A Section 132C licence under the NSW *National Parks and Wildlife Act 1974* from the subject site or CPW to be removed within stage 2A will not be required to undertake seed collection works as it will be approved through the planning process. Section 132C licence(s) under the NSW *National Parks and Wildlife Act 1974* will be required for seed collection from areas other than Stage 2A.

4.6 EROSION CONTROL DEVICES

Mulch or other erosion control material (e.g. Jute Matting) should be used as part of revegetation. The use of erosion control material is important because it provides organic matter to the top soil, improves soil structure and aeration, water infiltration, nutrient availability, and is also useful in the suppression of weed growth (Buchanan 2009). Erosion control material is especially important in Zone 3 and depending on the weed removal works, Zone 2 due to the lack of significant native vegetation to assist in holding soil together. If mulch is used it should be sourced from within the local area and be free of weed propagules and invasive woody species such as *Erythrina x sykesii* (Coral Tree). Further, examples of best practice specifications for sediment fencing and straw bale installation are shown in **Appendix C**.

4.7 THREATENED SPECIES CONSIDERATIONS

There are no specific considerations for threatened species across the BPOM subject site. One threatened ecological community does occur on the site, this being CPW. This community is listed as a CEEC under the NSW TSC Act, but does not meet Commonwealth EPBC Act criteria for listing under this act. A section 132C license under the NSW *National Parks and Wildlife Act 1974* is required to undertake works in a CEEC. However, as this BPOM has been prepared as part of an approvals process, this license is not required.

5 Environmental safeguards

5.1 LIMITATIONS

It has been assumed that bushland to be retained in the subject site will not have excavation works, fencing (whether permanent or temporary), drainage, spoil, machinery storage, lighting, services, or other matters impacting on the bushland areas (as per Figure 4). Nine trees adjacent to the bushland areas are currently identified for removal. It is assumed that all works have been designed to avoid impacts to tree root zones for trees within the bushland areas to be retained. The techniques outlined in **Section 5.2** should also be applied to all areas of the Stage 2A works area, especially those areas adjacent to the bushland areas to be retained. It is assumed that controls outside of the bushland areas will deal with any erosion leaving the bushland areas.

It is understood that permanent fencing after construction works are completed are not required as the design of the landscaped areas will direct the public away from accessing the native areas. However, this may need to be revised as plantings will be susceptible to impacts until fully mature and the landscaped areas risk informal access tracks in the longer term.

The management actions prescribed in this document are based on the current level of disturbance. While the current level of disturbance is high, if construction works have a further impact then management actions may need to be updated.

5.2 TECHNIQUES

Given the proximity of the subject site to the Stage 2A construction works, construction impacts need to be managed. As such, the following details will be addressed:

- Protection of flora and fauna
- Soil and water management

The following tables highlight the requirements for the protection of existing bushland on site during construction. The safeguard and mitigation measures will be used to limit impacts to the environment during construction.

Table 3: Flora & Fauna Impacts & Safeguards

POTENTIAL IMPACT	SAFEGUARD/ MITIGATION	RESPONSIBILITY
Damage to roots & trunks can be detrimental to the health of trees	Exclusion fencing will be placed at the bushland area boundaries as per AS 4970. Any works within tree drip lines of the CPW vegetation is to be performed so as to prevent damage to their root systems.	Site Supervisor
	Any excavation under the drip line of trees will be done by hand (where possible). If project timelines and safety are concerns, machinery may be used.	Site Supervisor
	No equipment or stockpiles will be placed against the trunk or under the canopy of any vegetation.	Site Supervisor

POTENTIAL IMPACT	SAFEGUARD/ MITIGATION	RESPONSIBILITY
Unnecessary damage to vegetation can occur if plants are not clearly identified	Trees that are to be trimmed or removed if necessary will be clearly marked. Any vegetation to be protected adjacent to the subject site will be protected within exclusion fencing.	Site Supervisor
Work activities can potentially increase the extent of weeds	Any noxious weed within the work area will be removed and stored in sealed containers and disposed of appropriately. See Section 4.3 .	Site Supervisor / Bush Regeneration Contractor
	Any weeds and or noxious weeds will be disposed of appropriately.	Site Supervisor / Bush Regeneration Contractor
	Lay down areas and set up sites are to be located on flat, cleared ground within the construction footprint in a manner that minimises impacts on surrounding vegetation.	Site Supervisor
	If any damage occurs to vegetation within the bushland areas, mitigation of impacts and site restoration works will be performed as required.	Site Supervisor
	Construction machinery should be washed prior to entering and leaving site to ensure weed propagules are not transported.	Site Supervisor
	At the completion of the works, all areas will be revegetated as per this BPOM.	Site Supervisor

Table 4: Erosion & Sediment Control Impacts & Safeguards

POTENTIAL IMPACT	SAFEGUARD	RESPONSIBILITY
Erosion of subject site and increased nitrification from water entering site.	If works take place upslope of the subject site overburden will be placed in the form of a bund upslope of the site where necessary to reduce surface water entering the site (only where safe to do so).	Site Supervisor
	Sandbags, hay bales wrapped in geotextile fabric, etc. will be used to slow water flow and trap sediment using best practice specifications for straw bales(e.g. Appendix C). However, hay bales should be used in preference to straw bales.	Site Supervisor
	Linear silt stop fencing to be installed down slope of all affected areas and stockpiles using best practice specifications for sediment fencing(e.g. Appendix C). Silt fencing will be installed before excavation begins.	Site Supervisor

POTENTIAL IMPACT	SAFEGUARD	RESPONSIBILITY
	Site management will incorporate best management erosion and sediment control practices such as those found in the Department of Housing's "Blue Book (4 th Edition) on erosion and sediment control (Landcom 2004).	Site Supervisor
	All erosion and silt control devices will be visually inspected weekly as well as after each rainfall event to ensure effectiveness.	Site Supervisor
To remain effective, erosion controls need to be regularly maintained	Any sediment that accumulates behind the silt fences or hay bales will be cleaned out and used during rehabilitation where possible, otherwise disposed of offsite.	Site Supervisor
	The work area adjacent to the subject site will be kept to the smallest possible size. The work area will be rehabilitated as soon as work is finished in an area as required in the contract.	Site Supervisor
Surface disturbance makes the site more susceptible to erosion	All sediment control measures will be left in place until the site has been stabilised.	Site Supervisor
	Any excess soil or excavated material that cannot be used in site rehabilitation will be disposed of at an appropriate EPA licensed facility.	Site Supervisor
	If excavated material or redundant equipment is left on site overnight it will be covered and adequately contained with silt stop fencing.	Site Supervisor
	The tyres of work vehicles and machinery will be checked and cleaned as necessary before leaving the work site to ensure that soil or other erodible materials are not transferred from work sites to sealed access routes or roadways.	Site Supervisor
	Where possible works will not take place during or immediately after heavy rain, or if the onset of rain is likely.	Site Supervisor
	In the event of heavy rainfall conditions developing during works execution, all construction materials and equipment in the vicinity of disturbed surfaces are to be removed and the site made secure against erosion. Work will only recommence after rainfall has stopped and the ground surfaces have sufficiently dried out. Any areas that are disturbed or damaged by the works will be restored to the pre-works condition or better.	Site Supervisor

6 Monitoring and reporting

The bush regeneration contractor and the Landcom will monitor the vegetation for changes 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 works will require liaison with Landcom, the bush regeneration contractor and the approval agency.

The bush regeneration contractor will establish photo monitoring points and prepare the initial reports template to record the progress of their work and demonstrate compliance with the BPOM. This will be undertaken during the establishment phase. During the maintenance phase the land manager will complete the reports in consultation with the approval agency. Reports will include a brief work report and an annual audit and assessment of compliance with the performance criteria in **Section 6.3**. The requirements of monitoring and reporting are described in detail in the sections below.

6.1 PHOTO MONITORING POINTS

Three photo monitoring points will be established across the site to provide a visual reference of changes in the vegetation through time. This will be undertaken prior to the commencement of works and at the beginning of each summer season. The bush regeneration contractor will:

- Set up three photo monitoring points spread across the site to include areas of very low, low and moderate resilience.
- The location of each photo monitoring point will be recorded with a GPS and should include an established reference point such as a fence line or large tree.
- Digital photos should be taken of each photo monitoring point with the established reference point in the frame. If no reference point is available then a photo should be taken in the four cardinal directions (i.e. north, south, east, and west).
- Organise the digital photos logically with each image labelled with a unique reference number indicating the location of the photo monitoring point, direction and the date the photo is taken (i.e. "01_2012_12_08_N" for photo point 1 taken on the 8 December 2012 facing north).

6.2 BUSH REGENERATION REPORTING

A brief report outlining work undertaken by the bush regeneration contractor will be prepared every six months during the establishment phase. These reports will be submitted to the Landcom. During the maintenance phase, a schedule for the preparation of reports will be negotiated by the landowner with OEH based on the success of the establishment phase. Reports will include:

- A summary of works carried out within the period;
- An approximation of the time spent on each task;
- A description of any problems encountered in implementing the works recommended in the BPOM and how they were overcome; and
- 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 BPOM.

6.3 PERFORMANCE CRITERIA

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

- Commencement of all tasks outlined in the BPOM or evidence of planning for their implementation
- Demonstrated control works undertaken on noxious and environmental weeds across the subject site
- No adult seeding woody weeds present by the end of the establishment phase
- No more than 5% total cover of exotic grasses over all zones
- No more than 10% total weed cover over all zones
- Evidence that noxious and significant weeds have been removed from site by the end of the establishment phase;
- Greater than 60% native groundcover by foliage cover across the subject site by end of establishment phase
- Suitable evidence (e.g. site locations and date collected, record of provenance from nursery) of the location of all seed collected in any revegetation programmes
- Minimum survival rate of 80% of the original revegetation works, not including replacement plantings, by the end of the establishment phase
- Areas of revegetation that failed to establish are not larger than two square metres
- Monitoring and reporting undertaken in accordance with **Section 6.1** and **Section 6.2**

Based on the success of the establishment phase, further performance criteria should be developed for the maintenance phase.

7 Implementation schedule & cost

The cost to implement all works identified in this VMP has been estimated at **\$108,502** over the three year establishment phase (**Table 5**). Furthermore, the implementation schedule summarises the actions required in the establishment phase (**Table 6**). It identifies who will be responsible for each task, when the task is to be undertaken and performance criteria which actions will be monitored against.

7.1 PRELIMINARY WORKS

7.1.1 Fencing

Costs for any fencing works required are understood to be incurred by Landcom and have not been included in this budget.

7.1.2 Site preparation

The expense of machinery and staff time for the implementation of the site preparation works is understood to be incurred by Landcom. However, budget has been included for the supervision of the works by an ecologist. In addition, no provision for supply of coir logs has been included in this budget, but these are estimated to cost approximately \$23 per metre for coir logs with a 200mm diameter.

7.1.3 Seed collection

Budget for the collection of seed from the site and surrounding area has been included for the establishment phase. These costs do not include the propagation of these seeds, which is addressed in **Section 7.3** below. Savings can be achieved here if nurseries have sufficient stock of local provenance seed for the required species.

7.2 WEED CONTROL TREATMENTS

Bush regeneration contractors will implement this BPOM, including the weed management treatments. These works have been calculated at an estimated cost of \$1,938 for a team of four bush regenerators per day. The cost of bush regeneration works includes the costs of herbicide, vehicles and equipment which are required to implement the BPOM.

7.3 REVEGETATION TREATMENTS

Bush regeneration contractors will implement this BPOM, including the planting treatments. These costs have been budgeted at an estimated \$5 per plant including planting, tree guards, water crystals and initial watering for overstorey species, and an estimated \$3 per plant including planting, water crystals and initial watering for midstorey and understorey species. Initially 9,610 plants will be required at an estimated cost of \$29,040 across the subject site. A 10% mortality rate has been calculated for all other species and requires an additional 961 plants at an estimated cost of \$2,904. These supplementary plantings have been budgeted over a one year period (.

Table 5: Indicative costings for subject site

TREATMENT	YEAR 1	YEAR 2	YEAR 3
Site Preparation	\$ 2,080	\$ -	\$ -
Seed Collection	\$ 5,814	\$ 1,938	\$ -
Zone 1: Initial Weed Control	\$ 3,876	\$ -	\$ -
Zone 2: Initial Weed Control	\$ 5,814	\$ -	\$ -
Follow up weed control	\$ 9,690	\$ 19,380	\$ 15,504
Revegetation	\$ 29,040	\$ 2,904	\$ -
Project Management, Monitoring and Reporting	\$ 4,160	\$ 4,160	\$ 4,160
<i>TOTAL</i>	<i>\$ 60,474</i>	<i>\$ 28,382</i>	<i>\$19,664</i>
GRAND TOTAL	\$ 108,520		

Table 6: Implementation schedule for establishment phase

TASK	WHERE	WHO	WHEN	PERFORMANCE CRITERIA
Site Preparation				
Install temporary and sediment fencing as proscribed in Section 3.1.1 and Section 5	All zones	Civil contractor	Prior to construction works	Fencing installed
Soil preparation works as per Section 3.1.2	Zone 3	Civil contractor	At completion of construction works	Soil preparation completed
Seed collection	All zones	Bush regeneration contractor	During construction works (allow at least 9 months before tubestock will be required)	Propagation of required number of tubestock
Set up of photo monitoring points	All zones	Bush regeneration contractor	Prior to any bush regeneration works	At least three photo monitoring points in each management zone
Weed Removal				
Initial woody weed removal works	Zone 1, Zone 1	Bush regeneration contractor	Within 3 months of substantial completion of construction works	No adult woody weeds present in the subject site.
Initial weed removal works focussing on control of African Lovegrass within Zones 1 and 2	Zone 1, Zone 2	Bush regeneration contractor	Within 3 months of substantial completion of construction works	75% removal of African Lovegrass biomass

TASK	WHERE	WHO	WHEN	PERFORMANCE CRITERIA
Removal of Privet, African Olive, and other significant herbaceous and grass weeds	Zone 1, Zone 2	Bush regeneration contractor	Within 3 months of substantial completion of construction works	75% removal of mature herbaceous weeds biomass (including noxious weeds)
Follow up weed control including regular 'spot' herbicide application and manual removal		Bush regeneration contractor	To commence after revegetation works and be undertaken on a regular basis throughout the year and in response to peak weed growth periods (e.g. 3 visits during the warmer months and two during the cooler months).	Weed species cover and abundance less than 5% by the end of phase Greater than 75% native groundcover in all management zones by the end of the phase.
Revegetation				
Revegetation of all zones as per Section 3.2 and Section 4.4	All zones	Bush regeneration contractor	First winter or spring after construction works are substantially completed and initial weed control works have been undertaken	80% survival of tubestock by end of phase
Revegetation of replacement plantings as per Section 3.2 and Section 4.4	All zones	Bush regeneration contractor	1 year after initial planting	80% survival of tubestock by end of phase
Monitoring and reporting				
Reporting as per the specifications in Section 6.		Bush regeneration contractor	Quarterly	Reports submitted on time.
Site Inspection	Bush regeneration contractor	Half yearly	Site inspection by Bush regeneration contractor is undertaken within the required timeframe.	N/A
Reporting	Bush regeneration contractor	Half yearly.	Reports submitted on time. Reports to include works undertaken, progress in relation to performance criteria, problems encountered and how they were overcome	N/A

References

- AS 4970 – 2009 *Protection of Trees on Development Sites*. (Australian Standard published by Standards Australia, Sydney)
- Australian Association of Bush Regenerators (AABR). 2010. Management Guides. Retrieved from Australian Association of Bush Regenerators (www.aabr.com.au)
- Australian Weeds Committee (AWC). 2012. Australian Weeds Committee website: <http://www.weeds.org.au/natsig.htm>. Accessed 15 October 2012.
- Bannerman S.M. and Hazelton. 1990 *Soil Landscapes of the Penrith 1:100 000 Sheet*. Soil Conservation Service of NSW, Sydney.
- Brodie L. 1999. *The National Trust Bush Regenerators Handbook*. National Trust of Australia (NSW).
- Buchanan R.A. 2000. *Bush regeneration: recovering Australian landscapes*. 2nd edn, TAFE NSW, Sydney.
- Buchanan R.A. 2009. Restoring Natural Areas in Australia. NSW Industry and Investment
- Bureau of Meteorology (BOM). 2012. www.bom.gov.au
- Eco Logical Australia Pty. Ltd. (ELA). 2010. *North Penrith – Flora and Fauna Assessment*. Prepared for Landcom by Eco Logical Australia, Sutherland.
- Ecotone (1999) Report on Bat Monitoring carried out on the North Penrith Army Land. Report prepared by Ray Williams of Ecotone Ecological Consultants for Fitzwalter and Associates.
- Landcom. 2004. Managing Urban Stormwater: Soils and Construction Volume 1
- Mortlock W., The Hawkesbury-Nepean Catchment Management Authority. 2000. *Florabank Guideline 10: Seed collection ranges for revegetation*. <http://www.florabank.org.au/> Florabank, Yarralumla, ACT
- Muyt, A. (2001) *Bush Invaders of South-East Australia*. R.G. & F.J. Richardson. Meredith, Victoria.
- NSW Department of Environment and Conservation (DEC). 2005. *Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland*. Department of Environment and Conservation (NSW), Sydney.
- NSW Department of Environment, Climate Change and Water (DECCW). 2010. Atlas of NSW Wildlife website. [online]. Available: <http://wildlifeatlas.nationalparks.nsw.gov.au/wildlifeatlas/watlas.jsp> (8 April 2011)
- NSW Department of Environment, Climate Change and Water (DECCW). 2009. *The Native Vegetation of the Sydney Metropolitan Catchment Management Authority Area*. NSW Department of Environment, Climate Change and Water, Hurstville.
- NSW Department of Primary Industries (DPI). 2010. *Noxious and environmental weed control handbook – a guide to weed control in non-crop aquatic and bushland situations* 5th ed. NSW.

NSW Department of Primary Industry (DPI). 2012 Noxious Weeds Declarations:
<http://www.dpi.nsw.gov.au/agriculture/pests-weeds/weeds/noxweed>

Tozer, M. 2003. Native Vegetation of the Cumberland Plain, Western Sydney. NSW NPWS, Hurstville.

Appendix A: Flora on-site

Native flora species found on-site

SCIENTIFIC NAME	COMMON NAME	FORM	WPT31: BELOW CPW (ELA 2010)	WPT35: Q2 - CPW (ELA 2010)	ELA 2012
<i>Bursaria spinosa</i>	Native Blackthorn	Shrub			X
<i>Casuarina glauca</i>	Swamp Oak	Tree	x		
<i>Commelina cyanea</i>	Creeping Christian	Herb		2	X
<i>Corymbia maculata</i>	Spotted Gum	Tree	x	4b	X
<i>Dichondra repens</i>	Kidney Weed	Herb		2	
<i>Eucalyptus moluccana</i>	Grey Box	Tree	x	4b	
<i>Eucalyptus tereticornis</i>	Forest Red Gum	Tree		1	X
<i>Glycine microphylla</i>		Vine		3	
<i>Glycine tabacina</i>	Glycine	Vine		3	X
<i>Melia azedarach</i>	White Cedar	Tree		2	
<i>Microlaena stipoides</i>		Grass		3	
<i>Oxalis spp.</i>		Herb		2	

Exotic flora species found on-site

SCIENTIFIC NAME	COMMON NAME	NOXIOUS	WONS	FORM	SUBJECT SITE (OS2)		LOCAL AREA	
					ELA 2010		ELA 2010	ELA 2012
					WPT31	WPT35: Q2	ELA 2012	
<i>Anagallis arvensis</i>	Scarlet Pimpernel			Herb				X
<i>Araujia sericifera</i>	Moth Vine			Vine	x	2	X	3

SCIENTIFIC NAME	COMMON NAME	NOXIOUS	WONS	FORM	SUBJECT SITE (OS2)			LOCAL AREA	
					ELA 2010		ELA 2012	ELA 2010	ELA 2012
					WPT31	WPT35: Q2		WPT32: Q1	
<i>Arctotheca calendula</i>	Capeweed			Herb					X
<i>Asparagus aethiopicus</i>	Asparagus Fern		Y	Shrub		1	X		
<i>Bidens pilosa</i>	Cobbler's Pegs			Shrub	x	2	X		
<i>Bromus catharticus</i>	Prairie Grass			Grass			X		
<i>Chloris gayana</i>	Rhodes Grass			Grass	x		X	5	X
<i>Cinnamomum camphora</i>	Camphor Laurel			Tree					X
<i>Cirsium vulgare</i>	Spear thistle			Herb					X
<i>Conyza sp.</i>	Fleabane			Herb					X
<i>Cotoneaster glaucophyllus</i>	Cotoneaster			Tree		1			
<i>Cynodon dactylon</i>	Couch			Grass			X		X
<i>Cyperus eragrostis</i>				Sedge			X		
<i>Ehrharta erecta</i>	Panic Veldtgrass			Grass		3	X		
<i>Eragrostis curvula</i>	African Lovegrass			Grass	x	5	X		X
<i>Eucalyptus microcorys</i>	Tallowwood			Tree	x				
<i>Galium sp.</i>				Herb					X
<i>Hypochaeris radicata</i>	Catsear			Herb			X		
<i>Ipomoea indica</i>	Blue Morning Glory			Vine	x				
<i>Ipomoea cairica</i>	Coastal Morning Glory			Vine			X		
<i>Lactuca serriola</i>	Prickly Lettuce			Herb					X
<i>Lepidium africanum</i>				Herb			X		
<i>Ligustrum lucidum</i>	Large-leaved Privet	Class 4		Tree		2	X		

SCIENTIFIC NAME	COMMON NAME	NOXIOUS	WONS	FORM	SUBJECT SITE (OS2)			LOCAL AREA	
					ELA 2010		ELA 2012	ELA 2010	ELA 2012
					WPT31	WPT35: Q2		WPT32: Q1	
<i>Ligustrum sinense</i>	Small-leaved Privet	Class 4		Tree		2	X		
<i>Lycium ferocissimum</i>	African Boxthorn	Class 4	Y	Shrub			X		
<i>Modiola caroliniana</i>	Red-flowered Mallow			Herb					X
<i>Ochna serrulata</i>	Mickey Mouse Plant			Shrub				1	
<i>Olea europaea subsp. cuspidata</i>	African Olive	Class 4		Tree		3	X	2	
<i>Pennisetum clandestinum</i>	Kikuyu			Grass	x			4b	X
<i>Phoenix sp.</i>	Date Palm			Tree			X	1	
<i>Pinus spp.</i>	Pine Tree			Tree	x		X		
<i>Plantago lanceolata</i>	Plantain			Herb		2			X
<i>Senecio madagascariensis</i>	Fireweed		Y	Herb					X
<i>Sida rhombifolia</i>	Paddy's Lucerne			Shrub	x	3	X	3	
<i>Solanum nigrum</i>	Black-berry Nightshade			Herb		1	X		
<i>Sonchus oleraceus</i>	Common Sowthistle			Herb					X
<i>Taraxacum officinale</i>	Dandelion			Herb			X		
<i>Verbena bonariensis</i>	Purpletop			Herb					X
<i>Verbena rigida</i>				Herb			X		

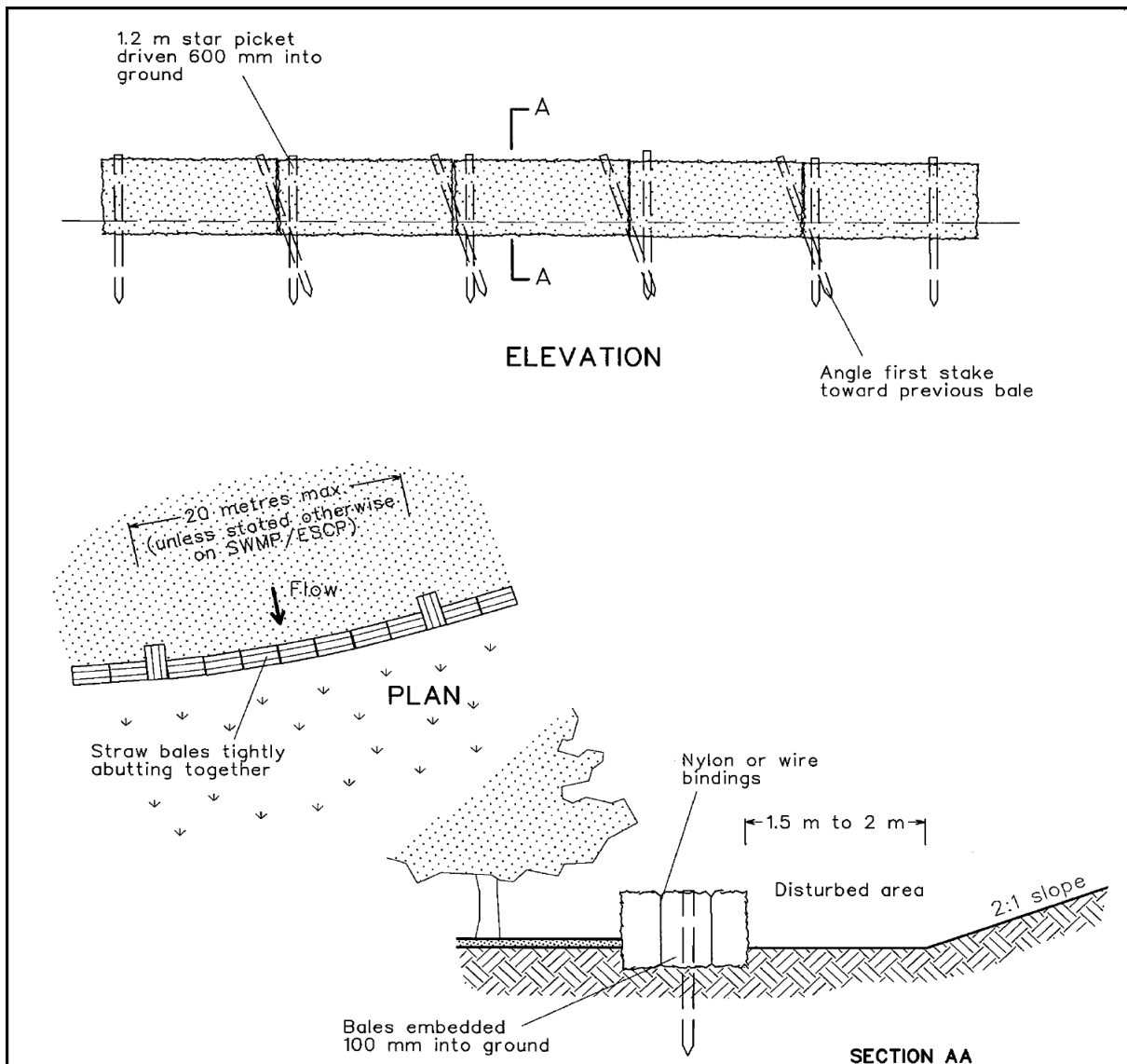
Appendix B: Fauna on-site

Fauna species found on-site

KINGDOM	SCIENTIFIC NAME	COMMON NAME	SUBJECT SITE	LOCAL AREA
Amphibian	<i>Crinia signifera</i>	Eastern Common Froglet		H
Aves	<i>Acridotheres tristis</i> *	Indian Mynah		O
Aves	<i>Anthochaera carunculata</i>	Red Wattlebird		O
Aves	<i>Cacatua galerita</i>	Sulphur Crested Cockatoo		H
Aves	<i>Columba livia</i> *	Common Rock Dove		O
Aves	<i>Coracina novaehollandiae</i>	Black-faced Cuckoo Shrike		O
Aves	<i>Corvus coronoides</i>	Australian Raven	O	O
Aves	<i>Cracticus tibicen</i>	Australian Magpie	O	O
Aves	<i>Dacelo novaeguineae</i>	Laughing Kookaburra		H
Aves	<i>Falco cenchroides</i>	Nankeen Kestrel		O
Aves	<i>Grallina cyanoleuca</i>	Magpie Lark	H	O
Aves	<i>Hirundo neoxena</i>	Welcome Swallow	O	O
Aves	<i>Lichenostomus penicillatus</i>	White-plumed Honeyeater		O
Aves	<i>Malurus cyaneus</i>	Superb Fairy Wren		O
Aves	<i>Manorina melanocephala</i>	Noisy Miner	O	O
Aves	<i>Ocyphaps lophotes</i> *	Crested Pigeon	O	
Aves	<i>Pycnonotus jocosus</i>	Red-whiskered Bulbul		O
Aves	<i>Rhipidura leucophrys</i>	Willy Wagtail		O
Aves	<i>Strepera graculina</i>	Pied Currawong		O
Aves	<i>Streptopelia chinensis</i> *	Spotted Turtledove	O	
Aves	<i>Sturnus vulgaris</i>	European Starling		O
Aves	<i>Trichoglossus haematodus</i>	Rainbow Lorikeet	O	O
Mammalia	<i>Oryctolagus cuniculus</i> *	European Rabbit		O
Mammalia	<i>Vulpes vulpes</i> *	European Red Fox		Scat
Reptilia	<i>Pseudechis porphyriacus</i>	Red-bellied Black Snake		Anecdotal
O=Observed	H=Heard	Totals	8	23

Appendix C: Recommended Erosion Controls for Bushland Area Boundaries

Source: *Managing Urban Stormwater: Soils and Construction* (Landcom 2004).

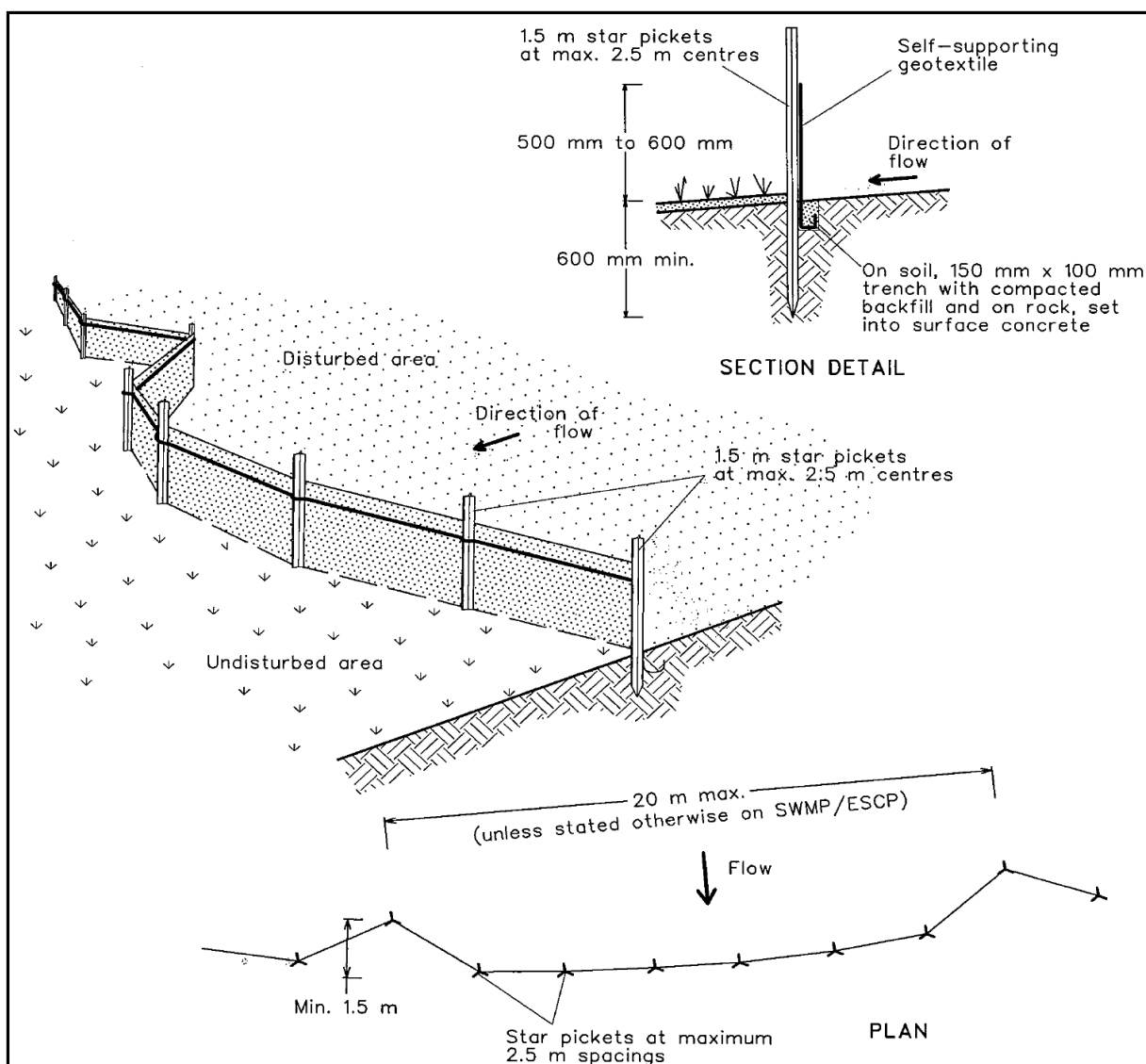


Construction Notes

1. Construct the straw bale filter as close as possible to being parallel to the contours of the site.
2. Place bales lengthwise in a row with ends tightly abutting. Use straw to fill any gaps between bales. Straws are to be placed parallel to ground.
3. Ensure that the maximum height of the filter is one bale.
4. Embed each bale in the ground 75 mm to 100 mm and anchor with two 1.2 metre star pickets or stakes. Angle the first star picket or stake in each bale towards the previously laid bale. Drive them 600 mm into the ground and, if possible, flush with the top of the bales. Where star pickets are used and they protrude above the bales, ensure they are fitted with safety caps.
5. Where a straw bale filter is constructed downslope from a disturbed batter, ensure the bales are placed 1 to 2 metres downslope from the toe.
6. Establish a maintenance program that ensures the integrity of the bales is retained - they could require replacement each two to four months.

STRAW BALE FILTER

SD 6-7



Construction Notes

1. Construct sediment fences as close as possible to being parallel to the contours of the site, but with small returns as shown in the drawing to limit the catchment area of any one section. The catchment area should be small enough to limit water flow if concentrated at one point to 50 litres per second in the design storm event, usually the 10-year event.
2. Cut a 150-mm deep trench along the upslope line of the fence for the bottom of the fabric to be entrenched.
3. Drive 1.5 metre long star pickets into ground at 2.5 metre intervals (max) at the downslope edge of the trench. Ensure any star pickets are fitted with safety caps.
4. Fix self-supporting geotextile to the upslope side of the posts ensuring it goes to the base of the trench. Fix the geotextile with wire ties or as recommended by the manufacturer. Only use geotextile specifically produced for sediment fencing. The use of shade cloth for this purpose is not satisfactory.
5. Join sections of fabric at a support post with a 150-mm overlap.
6. Backfill the trench over the base of the fabric and compact it thoroughly over the geotextile.

SEDIMENT FENCE

SD 6-8

**HEAD OFFICE**

Suite 4, Level 1
2-4 Merton Street
Sutherland NSW 2232
T 02 8536 8600
F 02 9542 5622

CANBERRA

Level 2
11 London Circuit
Canberra ACT 2601
T 02 6103 0145
F 02 6103 0148

COFFS HARBOUR

35 Orlando Street
Coffs Harbour Jetty NSW 2450
T 02 6651 5484
F 02 6651 6890

PERTH

Suite 1 & 2
49 Ord Street
West Perth WA 6005
T 08 9227 1070
F 08 9322 1358

DARWIN

16/56 Marina Boulevard
Cullen Bay NT 0820
T 08 8989 5601

SYDNEY

Level 6
299 Sussex Street
Sydney NSW 2000
T 02 8536 8650
F 02 9264 0717

NEWCASTLE

Suites 28 & 29, Level 7
19 Bolton Street
Newcastle NSW 2300
T 02 4910 0125
F 02 4910 0126

ARMIDALE

92 Taylor Street
Armidale NSW 2350
T 02 8081 2681
F 02 6772 1279

WOLLONGONG

Suite 204, Level 2
62 Moore Street
Austinmer NSW 2515
T 02 4201 2200
F 02 4268 4361

BRISBANE

PO Box 1422
Fortitude Valley QLD 4006
T 0400 494 366

ST GEORGES BASIN

8/128 Island Point Road
St Georges Basin NSW 2540
T 02 4443 5555
F 02 4443 6655

NAROOMA

5/20 Cauty Street
Narooma NSW 2546
T 02 4476 1151
F 02 4476 1161

MUDGEES

Unit 1, Level 1
79 Market Street
Mudgee NSW 2850
T 02 4302 1230
F 02 6372 9230

GOSFORD

Suite 5, Baker One
1-5 Baker Street
Gosford NSW 2250
T 02 4302 1220
F 02 4322 2897