Whytes Gully New Landfill Cell

Vegetation Management Plan

FINAL REPORT

Prepared for Golder Associates PTY LTD

11 February 2020

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- NSW Department of Primary Industries Fisheries for access to the predicted distribution maps for threatened species and fish communities.

Biosis staff involved in this project were:

- Lauren Harley (mapping)

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1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Golder Associates to update the existing Vegetation Management Plan (VMP) for Whytes Gully Resource Recovery Park (Biosis 2013) (the study area) with scope to include provisions the proposed Eastern Gully Stormwater Diversion Works plans (Golder 2017).

The original VMP was approved by NSW Department of Primary Industries (NSW DPI) as part of a required Construction Environmental Management Plan (CEMP) (11/19432) for the Wollongong City Council (WCC) proposal to develop a new landfill cell to help meet future landfill needs for the Wollongong Local Government Area (LGA) (referred to as the project). The VMP also formed part of the Landfill Environmental Management Plan which was approved in December 2014 by DP&E (14/19958).

Biosis conducted Flora and Fauna Assessments of the study area in March 2012 and 2016. These assessments formed part of the Environmental Assessment conducted by Golder Associates and submitted to the NSW Department of Planning and Infrastructure (DPI) for assessment. The project has now been approved with a range of consent conditions required to be met prior to the commencement of construction.

This VMP addresses conditions 49 and 50 relating to vegetation and biodiversity management. The Biosis (2012) flora and fauna assessment will inform the VMP with regard to the biodiversity values of the study area.

In addition, the VMP will look to address each of the revised requirements of consent under s75W Instrument of Modification - Whytes Gully MOD 2 (Minister for Planning 2017) (Table 1)

The proposed Eastern Gully Stormwater Diversion is to include:

- A stormwater pond 'Eastern Gully Pond' located at a local low point north of the Eastern Gully Landfill Cell.
- Installation of approximately 400 metres of pipe 'Eastern Gully Pond Outlet Pipe'.
- A new open channel stormwater channel 'Eastern Gully Stormwater Drain' that connects into the existing Southern Drain.
- A spillway to allow for emergency drainage.

Table 1 s75W Instrument of modification conditions

Requirement	Condition actions
Provide vegetation clearing protocols	Identify the location and type of vegetation to be retained and to be removed from the site
	Detail measures that would be implemented for vegetation clearing
	Ensure vegetation, including trees would not be pushed or felled into any retained bushland areas
	Detail procedures to manage impacts on fauna species that may be present
	Detail the staging of construction to avoid breeding times for key species on site
Prepare a Biodiversity	To be assessed against the OEH's 'Principals for the Use of Biodiversity Offsets in NSW

Requirement	Condition actions
Offset Strategy	Reference best practice management guidelines for restoring and managing the vegetation communities proposed for protection
	Detail how the proposed offset measures will be protected, managed, funded and monitored over the life of the project
Provide management actions to ensure the project maintains suitable buffer distances to nearby waterways in accordance with the relevant NSW DPI – Water (previously, Office of Water) guidelines to protect riparian land.	
Provide a site-wide ecological management and monitoring program to be implemented for the life of the project.	

The broad approach to the VMP will be to:

- Detail protocols required to minimise impacts of vegetation removal on fauna, fauna habitat and retained vegetation.
- Outline a restoration program including regeneration of all retained native vegetation, weed control, and revegetation of designated areas as well as a monitoring program, and strategies to ensure the protection of native vegetation across the study area in the long term.

The implementation of the VMP will offset the required removal of native vegetation. The VMP will be prepared with reference to the Office of Environment and Heritage (OEH) 'Principals for the Use of Biodiversity Offsets in NSW'.

This VMP herein provides controls and actions required to manage the retained ecological features within the study area (the VMP area) in relation to the proposed Eastern Gully Stormwater Diversion Works plans (Golder 2017) (Figure 1).

A supplement VMP (Biosis 2019) provided as Appendix 6 provides additional controls and actions required to manage the passive, operational and vegetated portions within the study area.

1.2 Objectives of the VMP

Specific objectives of the VMP are to:

- Provide vegetation clearance protocols to minimise the risk of impact to fauna and retained native vegetation.
- Provide management actions to improve the condition of retained native vegetation within the study area with a particular focus on the Illawarra Subtropical Rainforest Endangered Ecological Community (EEC) that will be retained.
- Develop a plan outlining revegetation works within the study area including revegetation of landfill areas as well as areas that can accommodate plantings to represent the native vegetation of the region and provide significant habitat.
- Provide management actions to control weeds including NSW priority weed species within the study area;
- Ensure the project maintains suitable buffer distances to waterways in accordance with the NSW Office of Water (NOW) guidelines and the Wollongong Development Control Plan (DCP) 2009.
- Provide a monitoring program based on performance criteria for each management action.
- Estimate the material and labour inputs required to implement the VMP.

- Provide a schedule of works for a five year period with scope for review at the completion of that period.
- Identify conservation mechanisms to be used to ensure the long term protection and management of native vegetation within the study area.
- Assess the VMP against OEH's 'Principals for the Use of Biodiversity Offsets in NSW.

1.3 Description of VMP area

The study area is located on public land approximately 1.5 kilometres north-west of Kembla Grange and approximately nine kilometres southwest of the Wollongong Central Business District. The study area currently operates as the Whytes Gully Resource Recovery Park and receives waste from the WCC LGA.

Apart from operational areas and infrastructure the majority of the study area supports exotic grassland with the patches of regrowth scrub and woodland/open forest. This vegetation is generally in poor condition with woody weeds throughout the understorey. An area of forest and subtropical rainforest in the north east of the study area is in better condition, with all native vegetation layers intact. Aquatic habitats across the study area include a number of surface water ponds, consisting of three large interconnected ponds, five small dams and several other additional water bodies associated with the operations of the Whytes Gully Resource Recovery Park. These provide habitat of varying condition for a range of fauna species. An unnamed drainage line flows across the southern part of the study area and is a tributary of Mullet Creek to the south. Mullet Creek forms part of the Lake Illawarra catchment.

1.4 The project

The project will be completed in four stages, the first of which is planned to be available for operational use to accept waste by late 2013. It is anticipated that the new landfill cell would be integrated with, and sit on top of, the existing two landfill cells through a 'piggy-back' style landfill in order to meet the required capacity. Works will also look to incorporate a collection pond to be located in the North East portion of the study area.

With regard to vegetation removal the project requires the removal of 0.717 hectares of native vegetation and 25.56 hectares non-native or disturbed native vegetation. The majority of the native vegetation to be removed is Forest Redgum Open Forest of which 0.477 hectares is proposed for removal. The project also requires the impact/removal of 0.24 hectares of the EEC Illawarra Subtropical Rainforest (Biosis 2012, Biosis 2016). The project will also include modification to existing dams within the study area and the removal of reeds and sedges associated with these. A detailed impact assessment which documents and quantifies the impacts of the project on vegetation communities, fauna habitat, and aquatic ecosystems is provided in Biosis (2012, 2016).

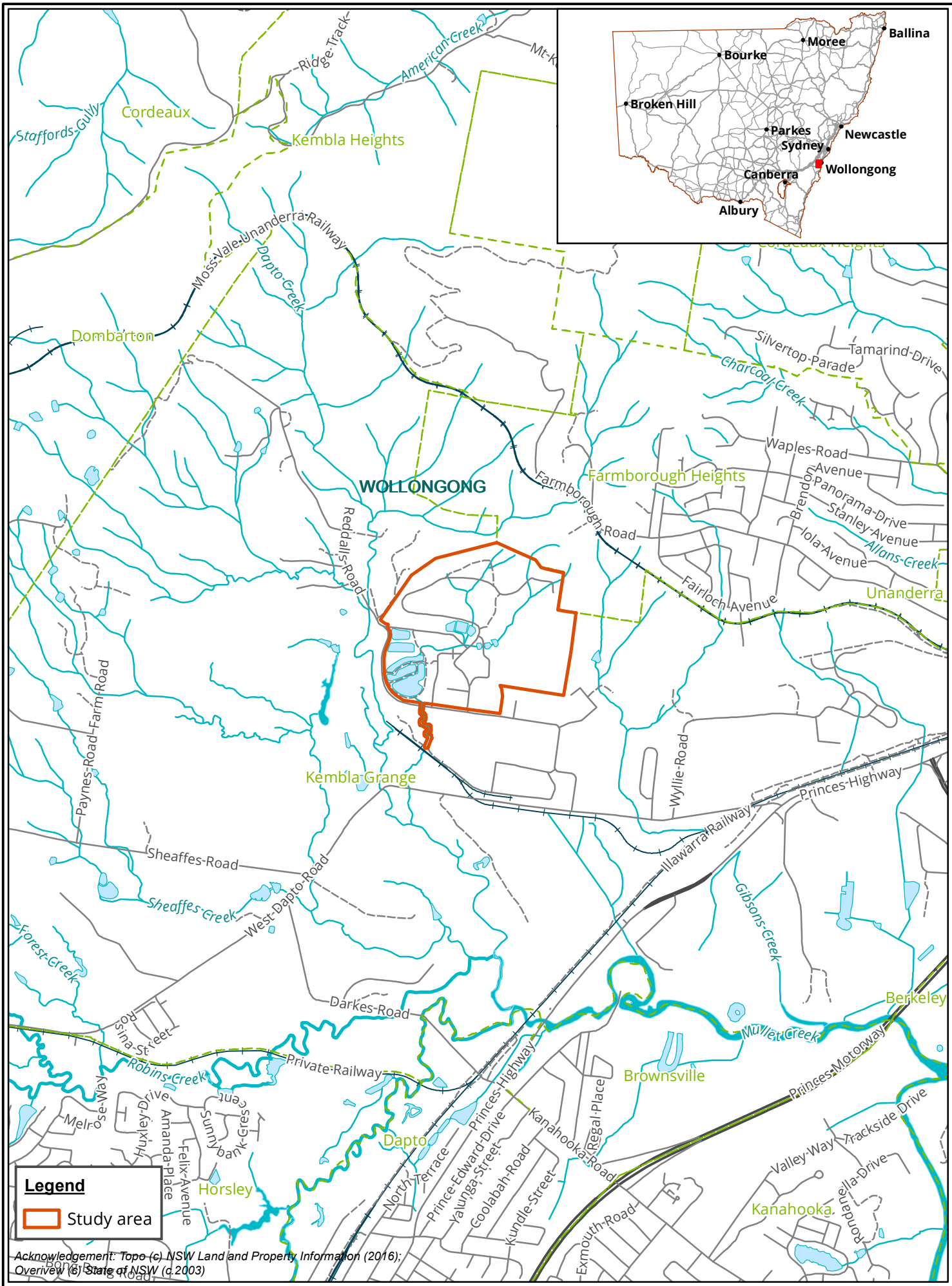

Figure 1: Location of the study area

Biosis Pty Ltd
Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Matter: 27801
Date: 20 August 2018,
Checked by: BC, Drawn by: DK, Last edited by: dkazemi
Location:P:\27800s\27801\Mapping\

Scale 1:25,000 @ A4, GDA 1994 MGA Zone 56

2 Study area assessment

Biosis (2012, 2016) identified six vegetation communities within the study area, including the following three native vegetation communities:

- Illawarra Subtropical Rainforest
- Forest-Redgum Open Forest/Woodland
- Moist-Box Redgum Foothills Forest.

- Three non-native vegetation communities identified are:
  - Acacia Scrub/Exotic
  - Closed Exotic Grassland
  - Planted.

With regard to the condition of native vegetation communities present within the study area: The Illawarra Subtropical Rainforest is in poor to moderate condition at the edges with the understory dominated by exotic species, the core area is in good condition within with native species dominating all strata. The Forest-Redgum Open Forest/Woodland is in poor condition with exotic species dominating the understory throughout. The Moist-Box Redgum Foothills Forest is in moderate condition, although all strata are dominated by native species, species diversity is low and the vegetation represents a simplified form of the community.

2.1 Biodiversity values

A summary of the biodiversity values of the study area from Biosis (2012, 2016) is provided below.

2.1.1 Objectives

The study area supports the EEC Illawarra Subtropical Rainforest.

2.1.2 Threatened flora

Based on potential habitats, and/or previous records within and surrounding the study area, three threatened species were considered likely to occur:

- *Cynanchum elegans* White-flowered Wax Plant
- *Daphnandra* sp. 'Illawarra' Illawarra Socketwood
- *Syzygium paniculatum* Magenta Lilly Pilly.

A comprehensive targeted survey conducted within potential habitat for each of these species in the study area did not record any of the three species listed above.

2.1.3 Threatened fauna

The 2012 and 2016 assessment recorded two threatened fauna species within the study area:

- Grey-headed Flying-fox *Pteropus poliocephalus*
- Southern Myotis *Myotis macropus*.

A further eighteen threatened fauna species were considered likely to occur within the study area. Eleven of these species are likely to use the study area on rare occasions, are vagrant species or are restricted to areas that are not likely to be impacted by the project:

- Blue-billed Duck *Oxyura australis*
- Freckled Duck *Stictonetta naevosa*
- Gang-gang Cockatoo *Callocephalon fimbriatum*
- White-fronted Chat *Epthianura albifrons*
- Varied Sittella *Daphoenositta chrysoptera*
- Scarlet Robin *Petroica boodang*
- Flame Robin *Petroica phoenicea*
- Pink Robin *Petroica rodinogaster*
- Barking Owl *Ninox connivens*
- Masked Owl *Tyto novaehollandiae*
- Sooty Owl *Tyto tenebricosa*.

The assessment found the remaining seven species are likely to use the study area more frequently, or may be impacted by the project:

- Green and Golden Bell Frog *Litoria aurea*
- Australian Painted Snipe *Rostratula australis*
- Four species of Microchiropteran Bats:
  - Eastern False Pipistrelle *Falsistrellus tasmaniensis*
  - Eastern Freetail-bat *Mormopterus norfolkensis*
  - Greater Broad-nosed Bat *Scoteanax rueppellii*
  - Eastern Bentwing-bat *Miniopterus schreibersii oceanensis*
  - Yellow-bellied Sheathtail-bat *Saccolaimus flaviventris.*

Comprehensive targeted surveys for Green and Golden Bell Frog and Australian Painted Snipe undertaken between the 2 November 2011 and 10 January 2012 failed to detect these species. Based on these surveys these species are considered a low likelihood of occurrence within the study area.

Assessments of Significance as required by the draft DEC & DPI (2005) guidelines and, where relevant, assessments against the Commonwealth *Environmental Protection Biodiversity Conservation Act 1999* (EPBC Act) *Significant Impact Guidelines* (DEWHA, 2009) have been conducted for these seven species and concluded the project would not have a significant impact on any threatened fauna.

2.1.4 Breeding times for key species

The breeding season for threatened species known or predicted to have breeding habitat within the study area extends primarily throughout the spring and summer months as outlined within Table 2. Construction and vegetation clearing should be scheduled to occur outside these key breeding times to avoid potential impacts to threatened species.

Table 2 Breeding times for known or predicted bat species

Key species	Breeding season
Southern Myotis	Late spring – early summer
Eastern False Pipistrelle	Late spring – early summer
Eastern Freetail-bat	Late spring – early summer
Greater Broad-nosed Bat	Late spring – early summer
Eastern Bentwing-bat	Spring - summer
Yellow-bellied Sheathtail-bat	Summer – early autumn

2.1.5 Aquatic assessment of the study area

Aquatic habitats across the study area include a number of surface water bodies, consisting of three large interconnected ponds, five small dams and several other additional water bodies associated with the operations of the Whytes Gully Resource Recovery Park. These provide habitat of varying condition for a range of aquatic and/or semi-aquatic species. An unnamed drainage line flows across the southern part of the study area and flow into Dapto Creek before reaching Mullet Creek to the South. Biosis (2012) provided greater detail on aquatic biodiversity values of the study area.

2.2 NSW priority weed species

Two weeds listed as a priority weeds in the Wollongong Local Government Area (LGA) under the NSW *Biosecurity Act 2015* (Biosecurity Act) was recorded within the study area and landowners and occupiers are under legal obligations to manage such species in line with the General Biosecurity Duty which states:

> *All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.*

One Weed of National Significance (WoNS) was also recorded within the study area (Table 3).

Table 3 Priority weeds and WoNS recorded within the study area

Scientific name	Common name	General biosecurity duty	WoNS
Eragrostis curvula	African Lovegrass.	Land managers reduce impacts from the plant on priority assets.	No
Lantana camara	Lantana	Must not be imported into the State or sold	Yes

The control of these noxious weeds is included in Section 3.6.4.

3 Vegetation Management Plan

3.1 Vegetation clearance protocols

The following vegetation clearance protocols in Table 4 below are provided to guide vegetation clearing to minimise the threat to remnant vegetation, fauna and waterways within the study area.

Table 4 Vegetation clearance protocols

Activity	Standard environmental safeguard
Stage 1. Prior to clearing	
Pre-clearing survey	Time works to consider the seasonal requirements fauna species and minimise any potential impact. Where possible and practical, avoid tree removal during peak breading season, between August and January. Pre clearance surveys are required to be conducted by an ecologist within areas to be cleared immediately prior to an initial stage of clearing (see point below). This would include marking any significant habitat features, predominately hollow bearing trees clearly with high visibility tape and inspecting any burrows, wood debris or bush rock to ensure fauna is not present or relocate onsite if present. A two-staged clearing process should be undertaken. The first stage of clearing would remove all vegetation that is not marked in the pre clearance survey as being significant habitat. An ecologist is not required to be present during the first stage of clearing once the pre clearance survey has been conducted. The second stage of clearing involves the removal of identified and marked habitat trees and should be conducted at least 24 hours after the initial clearing to allow fauna to move from the disturbed area. An ecologist is required at the second stage of clearing to advise on minimising harm to any fauna present, rescue any fauna and relocate onsite if required..
Clearing limits	All areas of retained vegetation will be delineated using high visibility parra-webbing or other similarly robust and durable material as 'no-go' or exclusion zones to minimise impacts to areas of conservation significance adjacent to the construction area. Access into the Illawarra Subtropical Rainforest EEC should be restricted prior to and during construction phases adjacent to this area using highly visible temporary fencing to ensure that clearing or indirect impacts do not extend beyond the area. Prior to and during construction, install appropriate erosion and sedimentation control devices to limit impact to retained vegetation and waterways. Clearing limits will be clearly delineated on site using highly visible barrier, Para webbing or other similarly robust and durable material as appropriate. The location of the delineation will be checked and verified by an onsite supervisor (this is not required to be an ecologist) as correct prior to the commencement of

Activity	Standard environmental safeguard
	clearing. Exclusion fencing will be maintained during construction phases and active use of the landfill area.
Communication	All site personnel and contractors should be made aware of the biodiversity values of the study area including threatened species, no-go areas and responsibilities under legislation during their site induction prior to works commencing.
Stage 2. During clearing and construction	
Removal of fauna habitat	Pre clearance surveys are required prior to vegetation removal as specified above. Should any fauna be injured during the clearing process, the animal would be taken to a veterinarian for appropriate treatment. If fauna are discovered on site they would be translocated by a suitably qualified ecologist to an area of retained vegetation on site. Should fauna be located at any time during clearing, works should cease immediately in the area to prevent any further harm to the individual, a suitably qualified ecologist should be contacted to handle and relocate fauna if the animal does not flee to safety and relocation is required. . Clearing of mature and hollow-bearing trees within the study area should be minimised where possible. Tree hollows removed for the proposal should be salvaged and relocated within adjacent areas of retained vegetation wherever feasible.
Two-stage clearing process	Habitat trees identified in the pre-clearing assessments will be cleared by a two-stage process: Stage 1- Clear non habitat vegetation and agitate habitat trees 24 hours prior to felling. This can be done using appropriate machinery such as an excavator where the bucket can be used to tap or gently shake the tree. A qualified ecologist will be present when the tree is agitated in the event that an animal emerges from a hollow and requires rescuing. Stage 2- Habitat trees will be felled as carefully as possible by skilled operators under the guidance of a qualified ecologist. If possible swivelling heads would be used so that habitat trees can be lowered to the ground with minimal impact. Contractors may be requested to roll or lift limbs that may be obscuring hollows or fauna. Felled habitat trees will be checked by an ecologist for injured fauna. A qualified ecologist would guide the clearing contractors as to limbs containing or potentially containing hollows and how these limbs may need to be cut.
Removal of native vegetation	Vegetation removal will be undertaken to ensure cleared vegetation, including trees would not be pushed or felled into any retained bushland areas.

Activity	Standard environmental safeguard
	Ensure no materials are stockpiled and no vehicles are parked under the canopy of trees to be retained. All trees (except exotic species and weeds) removed during clearing and grubbing must be mulched and stockpiled; weeds and exotic species must not be used onsite as mulch. Mulch stockpile sites must be located away from drainage lines and watercourses to prevent tannin leachate entering the waterways.

3.1.1 Protocols to manage risk to frogs and reptiles

- During clearing and construction works undertaken in proximity to Reedland vegetation communities and waterways, the following additional measures should be implemented to avoid unnecessary impact on frog habitat.
- Works should avoid impacts to stands of *Typha* sp. Bull-rush where possible.
- If creating open trenches at any stage of the proposed works, ensure trenches are not left open overnight. Trenches should be either back-filled daily or covered with metal plates and gaps filled.
- All trenches should be inspected prior to works each morning.
- Any fauna that become trapped within trenches should be released into the nearest suitable habitat if uninjured or assessed by a vet if required.

Salvage procedures will be conducted in accordance with the *Hygiene protocol for the control of disease in frogs* (DECC 2008).

Ensure the above is documented in an Environmental Management Plan.

Although Green and Golden Bell Frog was not recorded during targeted surveys and is considered a low likelihood of occurrence, the study area does provide suitable habitat for the species. As a precautionary measure a Green and Golden Bell Frog information sheet is provided in Appendix 5 and should be provided to all construction workers on site.

3.2 Managing riparian buffers

Part (e) of Consent Condition 49 requires further detail to '*ensure the project maintains suitable buffer distances to nearby waterways in accordance with Wollongong DCP 2009 to protect Riparian land.*'

With regard to the unnamed drainage line flowing south from the study area, this drainage line has been significantly modified, as a result of historic changes. Based on this previous consultation with the NSW DPI Water (Biosis 2012), no riparian buffers have been proposed within the study area.

3.3 Vegetation management zones

The study area has been divided into seven management zones according to the differing management objectives across the subject site (Figure 1) and considering key approaches for ecological restoration. Table 5 describes the management zones and the objectives and actions for each zone. The objectives for each zone guide the management actions which are given in the table and further detailed throughout Section 3 below.

The performance criteria are provided in quantifiable requirements that should be met for each zone in given timeframes and should be reported on in the annual monitoring report detailed in Section 3.10.

Table 5 Vegetation management zones, objectives, actions and performance criteria

Management zone	Vegetation management objectives	Actions	Performance criteria
Zone 1 **Landfill area (while operating as a landfill)**	• Weed control including the control of noxious weeds • Soil stabilization and erosion control	• Mechanical primary weed removal of woody weeds • Weed spraying with herbicide • Spreading mulch • Retain native vegetation for soil stability where possible • Hydro seeding with sterile grasses	• Primary weed removal is completed within 6 months of the commencement of the VMP works program. Woody weeds are not allowed to re-establish. Annual weeds are controlled and not allowed to recolonise disturbed areas • Bare soil is not left exposed and is covered with native plants, mulch or hydro seeded grasses
Zone 1 **Landfill area (Landfill closure and rehabilitation)**	• Weed control • Soil stabilization and erosion control • Provision of habitat for native flora and fauna species • Facilitate public use including open space for recreational use by the public	• Ensure the capping material is suitable for planting into • Revegetate using a variety of techniques, with locally native ground layer species, shrubs and small trees • Utilize logs where available from clearing works to lay across the slope for soil stabilisation and fauna habitat • Implement a maintenance program including maintenance weeding and irrigation of revegetation areas as required.	• Soil is stabilised and not subject to erosion by surface runoff or wind • Annual weeds are controlled and not allowed to colonise open areas • Small trees, shrubs and grasses are establishing over the capped landfill area within 6 months of the landfill closure
Zone 1b **Eastern Gully Stormwater Diversion**	• Weed control • Soil stabilization and erosion control	• Monitor and control opportunistic aquatic and aggressive exotic plant species	• Weed densities within and adjacent to the constructed asset are controlled and not allowed to colonise open areas

Zone 2 **Retained native vegetation (moderate-good condition)**	• Minimise impacts during the construction phase • Enhance the remnant patch of the Illawarra subtropical Rainforest EEC as well as the adjoining Moist-Box Redgum Foothills Forest • Implement a bush regeneration program o enhance natural regeneration and control weeds • Primary weed removal conducted to minimise fauna habitat loss and manage successional weed growth. • Enhance fauna habitat value • Offset the impact of native vegetation and fauna habitat loss through the enhancement of retained native vegetation within the study area • Control surface runoff erosion	• Implement primary and secondary weed removal throughout as well as maintenance weeding to ensure weeds do not reinvade. • Mechanical primary weed removal of woody weeds on the southern side of the concrete drainage channel only, keeping to at least 10 metres from native vegetation. • Pile woody weeds onsite to mitigate fauna habitat loss. • Monitor and report on the regeneration program.	• Primary weed removal is completed within one year of the commencement of the VMP works program. Annual weeds are controlled and not allowed to recolonise disturbed areas. • 50% or greater native vegetation cover in the ground layer by the end of year two • Native vegetation cover dominant in all structural layers and weeds limited to less than 10% cover in the ground layer at the end of year five • Woody weed piles are no greater than 2 m across x 1.5 m high.
Zone 3 **Retained native vegetation (poor condition)**	• Minimise impacts during the construction phase • Control weeds and enhance the native vegetation through bush regeneration techniques • Primary weed removal conducted to minimise fauna habitat loss and manage successional weed growth • Enhance fauna habitat value • Offset the impact of native vegetation and fauna habitat loss through the enhancement of retained native vegetation within the study area • Control surface runoff erosion	• Implement primary and secondary weed removal throughout as well as maintenance weeding to ensure weeds do not reinvade. • Mechanical primary weed removal of woody weeds is appropriate for large areas of woody weeds where access can be gained taking care to avoid steep slopes and impacts to native vegetation • The bush regeneration contractor is required to monitor native plant regeneration and if after two years recruitment of native species is not adequate in areas then revegetate these areas (Section 3.6)	• Retained native vegetation is intact and unharmed following adjacent vegetation clearance and primary weed removal • Primary weed removal is completed in the third year of regeneration works. Annual weeds are controlled before seeding and not allowed to recolonise disturbed areas • 50% or greater native vegetation cover in the ground layer by the end of year 3. • Native vegetation cover dominant in all structural layers and weeds

		• Revegetate where required using tubestock of local native species including a variety of ground layer species, shrubs and trees • Mulch around plantings • Stage woody weed removal to maintain buffers of woody weeds at edges to manage weed growth and edge effects • Pile woody weeds onsite to mitigate fauna habitat loss • Stake logs, from native vegetation removal in zone 1, across steep slopes that have been cleared of woody weeds to minimise surface runoff erosion and create fauna habitat	limited to less than 10% cover in the ground layer at the end of year 5. • Woody weed piles are no greater than 2 m across x 1.5 m high • Logs are staked against slope securely and hold mulch and prevent erosion
Zone 4 **Acacia Scrub/Exotic (outside of landfill area)**	• Control woody and annual weeds • Primary weed removal conducted to minimise fauna habitat loss • Control surface runoff erosion • Retain native vegetation occurring • Promote regeneration of native species within clumps of native vegetation • Enhance fauna habitat values • Offset the impact of native vegetation and fauna habitat loss through the enhancement of retained native vegetation within the study area	• Implement primary and weed removal • Retain native vegetation (primarily Acacia spp.) • Mechanical primary weed removal of woody weeds is appropriate where access can be gained taking care to avoid steep slopes and impacts to native vegetation • Slash open areas away from clumps of native vegetation • Conduct secondary and maintenance weeding within clumps of native vegetation where regeneration is evident. • Stake logs, from native vegetation removal in zone 1, across steep	• Primary weed removal is completed in the third year of the Works Program. Annual weeds are controlled and not allowed to recolonise disturbed areas. • Woody weed piles are no greater than 2m x 1.5 m high. • Logs are staked against slope securely and hold mulch and prevent erosion. • Clumps or clusters of native regeneration are established

		slopes that have been cleared of woody weeds to minimise surface runoff erosion and create fauna habitat	
Zone 5 **Designated revegetation areas**	• Establish revegetation areas within the study area to enhance the habitat available for native flora and fauna species • Control weeds • Offset the impact of native vegetation and fauna habitat loss through revegetation to increase the area of native vegetation and the habitat this provides	• Prepare areas to be planted by controlling weeds • Mulch to a minimum depth of 200mm using chipped leaf mulch ensuring that the mulch is free of weed seed • Revegetate using tree species representative of the appropriate native vegetation community (see section 3.6) • Limit plantings within 10 metres roads and access ways to shrubs and ground layer species. • Implement a maintenance program including maintenance weeding and irrigation of revegetation areas as required	• Mulched vegetation from onsite is spread to 200mm • Logs are spread to create fauna habitat • Species representative of the appropriate native vegetation community (Section 3.6) are used to revegetate these areas • No trees are planted within 10 m of roads or access ways • 80% survival rate for plantings at the end of the 5 year works program • Weed species are controlled and not allowed to recolonise open or disturbed areas
Zone 6 **Existing Planted vegetation**	• Maintain planted areas to control weeds • Maintain plantings	• Implement a maintenance program including maintenance weeding • Maintain and replace plantings as required	• Weed species are controlled and not allowed to recolonise open or disturbed areas • Plantings are maintained and replaced where required
Zone 7 **Closed Exotic Grassland**	• Control weeds • Provide habitat for native species particularly around dams to the south west of the study area where a variety of birds reptiles and amphibians inhabit dam edges	• Continued slashing with the exception of a 10 buffer around dam edges • Maintenance weeding throughout to target any woody weeds or listed noxious weed species	• Slashing is conducted at least two times per annum, outside of buffer areas to the dams • Woody weeds and any noxious weed species are controlled and not allowed to establish

3.4 Approach to the restoration works

The vegetation management zones outlined in Table 5 have been classified according to the three key approaches for ecological restoration as outlined by DEC (2005):

- Retain remnant indigenous vegetation. Conserving existing native vegetation should be the highest priority;
- Regenerate where bushland remains but is degraded, regeneration should be the primary objective;
- Revegetation where there is no regeneration potential.

An important concept underlying these key approaches is to manage a site according to the differing levels of resilience. Resilience refers to the ability of an ecosystem to regenerate naturally or to withstand, or recover from disturbances such as weed invasion, clearing or fire (DEC 2005). An area with a high or moderate level of resilience will generally have the natural soil profile predominately undisturbed and will have a canopy with native species occurring throughout. In an area of moderate to high resilience a regeneration approach (allowing regeneration from the soil seed bank while managing weeds) is preferable to revegetation (planting to recreate native vegetation).

3.5 Retain native vegetation

In applying this approach to the study area and proposed works, the most effective measures to conserve native vegetation within the study area is to minimise native vegetation removal wherever possible and to protect retained vegetation from indirect impacts during the construction phase. Recommendations outlined in the Biosis flora and fauna assessment (2012) and vegetation clearance protocols in Section 3.1 should be implemented to minimise impacts to retained native vegetation.

Native vegetation within Zone 1, primarily *Acacia* spp., are required to be removed to allow for the landfill, however the retention of these plants until their removal is absolutely necessary will assist the management of these areas in the short term by suppressing weed growth and providing soil stabilization . Mechanical primary weed removal is recommended for large patches of woody weeds in Zone 3 and Zone 4. Care must be taken to avoid the removal of native vegetation (again primarily *Acacia spp*.) during this process as these plants will greatly benefit the restoration process by suppressing weeds, providing a seed source and sheltering new plantings.

3.6 Bush regeneration

It should be noted that as Zone 2 includes the EEC Illawarra Subtropical Rainforest and therefore bush regeneration contractors or Council staff conducting regeneration works within this area are required under *NSW National Parks and Wildlife Act 1974* to hold a Section 132C Scientific License to work within the EEC.

Bush regeneration works are required in Zone 2, Zone 3 and Zone 4. Vegetation within Zone 2 is in moderate to good condition and is assessed as having at least a moderate level of resilience. Zone 3 is assessed as being in poor condition however an intact native canopy layer and the presence of coloniser species throughout, indicates these areas are likely to regenerate successfully. Zone 4 is in poor condition however the presence of native coloniser species throughout indicate that at least parts of these areas are likely to regenerate with native species. Follow up revegetation in areas that are not regenerating adequately is likely to be required in parts of Zone 3. The bush regeneration contractor conducting the works is required to make this assessment and discuss the management of Zone 3 and 4 with the relevant WCC staff supervising the works at the end of the second year of works. The Works Program (Appendix 4) includes planting in Zone 3 in

the third year. Planting may be required in areas where regeneration of native plants has not occurred or has occurred only sparsely, or in areas where only a low diversity of native species has regenerated. Areas within Zone 4 that have little or no native regeneration following primary weed removal are unlikely to be viable as regeneration areas and should be maintained by slashing as for Zone 7 (Section 3.8). The methods of bush regeneration adopted in this VMP are based on industry standards. Techniques and methods recommended are described in various publications such as *Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland* (DEC, 2005). The DPI publication *Noxious and Environmental Weed Control Handbook. A Guide to Weed Control in Non-crop, Aquatic and Bushland Situations, 6th Edition* (DPI, 2018) provides descriptions on general and standard weed control methods.

3.6.1 Primary weed removal

The vegetation within Zone 2, Zone 3 and Zone 4 differ with regard to the community represented and the condition of the vegetation and therefore different approaches are required to primary weed control.

- Mechanical primary weed removal including the use of an excavator or hand held brush cutters is not appropriate within Zone 2 other than on the weedy edge on the lower, southern side of the concrete drain where the vegetation is entirely comprised of woody weeds. This would require the removal of a chain wire fence to gain access and would greatly assist the removal of woody weeds in this area. Care must be taken to avoid impacts to native vegetation.
- Mechanical primary weed removal using a five tonne excavator (or similar) or hand held brush cutter is recommended for large patches of woody weeds (primarily *Lantana camara*) in Zone 3 and Zone 4 where this can be done without impacting native vegetation. The use of an excavator should be avoided on slopes prone to erosion as this may de-stabilise the soil. A suitably qualified bush regenerator is required to be flag native species prior to mechanical primary weed removal.
- Treat woody weeds, predominately Lantana, using a cut and paint method - cut at ground level and immediately (i.e. within 20 seconds) apply neat Glyphosate to the stump. Any regrowth of woody weeds following mechanical removal is to be treated using the cut and paint method
- New areas of primary weed removal should only be conducted once the initial influx of weed growth in treated areas has been controlled and weed growth has stabilised. Primary weed removal is to be staged so that a buffer of woody weeds is retained at edges. These buffers will also provide protection to regenerating native species. Woody weeds at the edges can be treated once weed growth within inner areas is reduced this is expected to be in the third year of the project. This would allow a period of two years secondary and maintenance weeding to allow the edges to stabilise following removal of woody weeds.
- Woody weeds should be placed in piles slightly elevated form the ground on other natural woody debris. Piles should not be greater than two metres in length or width and 1.5 metres high, which are the dimensions recommended by the NSW RFS (2006) for burn piles. Care should be taken not to smother native ground layer species with piles. Piling woody weeds onsite will mitigate the impact of fauna habitat loss resulting from woody weed removal.
- Where Lantana is growing into native canopy species this should be left in the canopy and the stump cut and painted. This will minimise the impact of fauna habitat loss and reduce light penetration and associated weed growth.
- Logs from removed native vegetation should be staked across slopes in areas of potential erosion.

3.6.2 Secondary / follow-up weed control

Secondary weed control will be required following primary works. Secondary weed control will require a combination of hand weeding and spot spraying. At this stage care needs to be taken to protect existing and regeneration native plants:

- Hand weeding is required throughout areas of native ground layer plants and around any clumps of native ground covers or regenerating natives.
- Hand weeding is required to create a buffer around natives as a spray preparation prior to spot spraying.
- Spot spraying using diluted glyphosate is recommended to control weeds where hand weeding is not practical.
- Care should be taken to avoid non target species.

3.6.3 Maintenance weeding

The amount of weed seed stored in the in-soil seed bank will be large. Weed seed will also enter the study area by a range of dispersal methods. Although competition from native plants will reduce the ability for these weeds to establish, regular maintenance weeding will be required:

- Maintenance weeding will require a combination of spot spraying and hand weeding.
- The amount of maintenance weeding required will diminish however it is expected that minimal maintenance weeding will be required into the future.

Application of herbicide during weed control works will depend on species targeted and the growing situation. The selection of a herbicide and the application method for a particular species of plant will be determined by factors such as the degree of infestation of target species, limiting damage to non-target native flora and preventing herbicides entering waterways. DPI (2018), cited above, should be referred to as guide for specific herbicides, record keeping and herbicide application techniques.

Use of herbicides must be according to the *NSW Pesticides Act* 1999, Material Safety Data Sheets and labelling instructions for specific trade name herbicides, off label use permits registered with the APVMA and any Wollongong City Council code of practice or use restrictions. The use of herbicide as part of this VMP will be limited to direct application to cut stumps and spot spraying. All council staff or contractors using herbicides on the site must be suitably trained and qualified.

3.6.4 Control of NSW Priority Weed species

Lantana and African Love Grass are NSW Priority Weed species identified within the study area (Biosis 2012, Biosis 2016).

The recommended treatment for Lantana is to cut woody plants to ground level and apply concentrated Glyphosate to the stump. This VMP recommends the use of a small excavator to conduct primary weed removal. In this instance the primary removal is required to be followed up by either cutting and painting stems at ground level immediately following mechanical removal, or treating the regrowth by cutting once this reshoots. Fruits and seed must be disposed of in a manner that does not allow further spread. As seed is likely to be present this plant is not appropriate to be mulched and used onsite.

African Love Grass can be spot prayed using diluted Glyphosate during active growing in Spring and Summer. This will kill the plant however managing the spread of this species in the areas of Closed Exotic Grassland (Vegetation Management Zone 7) is difficult. The NSW Department of Primary Industries recommends managing favourable pasture species as the best way to manage this species (DPI 2018). The *Pennisetum*

clandestinum Kikuyu dominating the Closed Exotic Grasslands will out compete the African Love Grass. Spot spraying annually and allowing Kikuyu to remain in infested areas will control this species.

3.7 Revegetation

Revegetation is required in Zones 5 and is likely to be required in parts of Zone 3 (depending on the level of regeneration of native species following weed control). Revegetation in Zone 5 includes trees only and does not include shrub or ground layer species. Revegetation in Zones 3 aims to support native regeneration and will include a diversity of trees shrubs and ground layer species.

The recommended species planting list is included in Appendix 3. The list is based on species recorded in the Biosis (2012) flora and fauna assessment as well as species recorded on the Illawarra database from similar environments in the surrounding area and characteristic species from vegetation communities Coastal Grassy Redgum Forest and Lowland Woolybutt-Melaleauca Forest (NPWS 2003) which are mapped in a similar position in the surrounding landscape. The recommended species are classified according to where these species are to be planted, this is shown in Figure 1. Species representative of Coastal Grassy Redgum Forest (a) are to be planted in areas above 30m elevation. Species representative of Lowland Woolybutt-Melaleauca Forest (b) are to be planted in areas occurring below 30m elevation. Species common to both communities are indicated. Appendix 3 also identifies recommended coloniser species. A proportion of coloniser species are required as a component of the plants used within all areas to be revegetated.

3.7.1 Site preparation

Revegetation areas within Zone 5 that are covered with thick exotic grasses will require the following preparation;

- Slashing at a height that retains some green leaf to assist the uptake of herbicide. These areas are then required to be sprayed using a Glyphosate based herbicide.
- The area should be left for ten days to ensure the herbicide has taken effect and then mulched to a minimum depth of 200mm using chipped leaf mulch ensuring that the mulch is free of weed seed.
- Spot spraying will be required for a period of three months following the application of mulch to control any grass runners or other weeds that will come through the mulch or invade from the edges. It is critically important for the successful establishment of the newly planted tubestock that weeds are adequately controlled prior to planting.
- Stake logs from removed native vegetation in Zone 1 across slopes in areas of potential erosion particularly across steep slopes in Zones 3 and Zone 4 where required.

Revegetation areas within Zone 3 that are covered with woody weeds will require the following preparation

- Mechanical primary weed removal (3.5.1).
- Secondary weeding to control the initial influx of weeds following primary weed removal including spot spraying.

3.7.2 Planting

Planting will require:

- Use plants of local provenance from the recommended species list given in Appendix 3.
- Use a mix of ground layer, shrub and canopy species for Zone 3 planting.
- Use a component of coloniser species in the planting mix for Zone 3 (Appendix 3).

- The recommended planting density, as required by the Wollongong City Council DCP for revegetation, is 4-5 plants per square metre for grasses, ground covers and small shrubs as will be required in Zone 3. This density will allow plantings to establish a dense cover quickly and reduce the labour input required for regular maintenance weeding.
- Tree species should be planted an average of three metres apart (DEC 2005) ensuring that the positioning of plants is random to replicate natural plant distribution. This planting density requires approximately 277 trees per hectare.
- Plant a mix of species in clusters so that dense habitats form within the revegetation areas and allow for some open areas and areas dominated by groundcovers to replicate natural plant distribution and create a diversity of habitats. Dense planting at edges will assist in weed management in the long term.

3.7.3 Fertilising

At the time of planting, fertiliser will be applied to each plant in the form of a 10 gram Agriform® tablet, or similar approved product. To avoid potential leaching of fertilisers, slow release nitrogenous (and low phosphate content) fertilisers will be used.

3.7.4 Watering

Watering of the supplementary planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. Watering is to abide by any local authority water restrictions or guidelines. To assist in this process, a soil wetting agent such as Hydrocell®, or similar approved product, will be mixed into each planting hole to maximise water retention around the root ball during the establishment period.

Watering of all supplementary planting will occur at the time of the planting itself during the construction phase, to minimise shock on the tubestock in their new conditions. Watering of stock during the construction will be on an as required basis.

During the three - six month establishment period, the frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day (morning or afternoon), and will be frequent enough to prevent wilting of plants. Tubestock is to be watered prior to planting as well as immediately after planting installation.

During the establishment phase the following watering program is recommended (dependent on weather). A suggested watering regime is provided as Table 6.

Table 6 Watering regime

Weeks 1 - 8	Months 2 - 4	Months 5 - 6
Once a day	Once a week	Once a Month

The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 – 6 months the planting will be sufficiently established such that supplementary watering will no longer be required.

Planting areas are to be monitored during the extended maintenance period to ensure that climatic conditions are not affecting the newly planted tube stock. If climate or environmental conditions are affecting the tube stock a watering program may be reinstated pending the approval by the environmental manager.

3.7.5 Pest control

Predation by native macropods, introduced herbivores (rabbits, hares and deer), insect pests and infection caused by plant diseases/pathogens can have an adverse effect on the establishment of plantings by defoliating, damaging, removing or killing young plants. To minimise the loss of plants through predation and/or disease, all new plantings will be protected by:

- Use of black plastic rigid mesh tree guards, which would be reused on new plantings once the initial planted specimens mature.
- Temporary exclusion fencing of larger areas or where initial trials indicate that the efficacy of using individual tree guards is low.

3.8 Slashing

Continued slashing at least two times a year is required throughout the grassland of Zone 7 and open areas of Zone 4. Slashing in Zone 7 should leave a 10 metre buffer around dam edges as these area provide habitat for a variety of birds, reptiles and amphibians that inhabit dam edges. Slashing is also required following the removal of woody weeds throughout Zone 4 to maintain open areas between patches of remnant vegetation as grassland.

3.9 Materials estimates and costs

Below are estimates for the materials required to implement the VMP over a 5 year Program of Works.

The approximate area for each of the Vegetation Management Zones requiring revegetation is given below. The area requiring revegetation for Zone 3 has been estimated by calculating 5% of the total area of Zone 3 as the majority of the area is expected to regenerate and the plantings are only to support this regeneration. The areas requiring revegetation are;

- Zone 3 – 0.253 ha (2532 m2)
- Zone 5 :
  - 5a – 3.587 ha (35,870 m2)
  - 5b – 3.022 ha (30,220 m2)
- The total area to be revegetated within the study area is calculated at 7.192 ha (71,920 m2).
- At a planting density of 6 tubestock per m2, **10,126** plants will be required for Zone 3. To achieve an average of three metre spacing between canopy species this would include approximately 140 plants of tree species.
- The sub total for Zone 5a and 5b is 6.609 ha (66,090 m2). At a planting rate of trees with an average of three metre spacing, **3660** plants will be required for Zone 5.

Wollongong Botanical Gardens (WBG) are recommended for the supply of the plants required. The current WBG prices are:

- Standard forestry tubes - $2.00 each (recommended for Zone 3 and 4a);
- Jumbo Forestry tubes - $3.00 each (Recommended for Zone 5); and,
- Trays of grasses and ground covers- $9.00 (can be divided into 6 units).

The cost estimate provided allows for the 3,660 trees for Zone 5 initially and 10,126 plants to planted over years two three and four of the Works Program. The cost estimates are;

- Zone 5, 3660 tree species in Jumbo Forestry Tubes - **$10,980**;
- Zone 3 (assuming 33% of plants are in trays of groundcovers and grasses and the remainder are in standard forestry tubes) – **$18,721.**

Based on these figures the total cost of plants for the restoration project over the 5 year Works Program is;

- **$29,701.**

These figures are estimates and will vary according to availability of plants from Wollongong City Council Botanical Gardens.

3.9.1 Labour costs

Table 7 below gives labour cost estimates for each year over the five year restoration project. These figures are based on current industry experience and calculate the cost of each bush regeneration worker at $300.00 for a 7.5 hour day, or $1,200.00 for a team of 4 workers for a day. Appendix 4 details a works program for each of the 5 years based on the amount of labour allowed for in Table 7. Based on the figures given in Table 7, the total labour cost to implement this VMP over 5 years is approximately $93,900.00.

Table 7 Indicative VMP implementation costs

Year	Total $	Labour
Year 1	$22,200	18.5 days for a team of 4 including, 7.5 days of primary weed removal, 6.5 days of secondary weeding, 3.25 days of planting, 1 day staking logs across unstable areas, and 0.25 days watering.
Year 2	$21,600	18 days for a team of 4 including, 4 hours primary weed removal, 9 days of secondary weeding, and 5 days of planting.
Year 3	$20,700	17.25 days for a team of 4 including, 4 days of primary weed removal, 9 days of secondary weeding and 4.25 days of planting.
Year 4	$15,900	13.25 days for a team of 4 including, 11 days of secondary weeding and 2.25 days of replacement planting
Year 5	$13,500	11.25 days for a team of 4 including 11 days of secondary weeding and 0.25 days of replacement planting.

The works program in Appendix 4 also includes WCC staff for the following activities:

- Primary weed removal works using an excavator to remove woody weed.
- Regular maintenance weeding, primarily spot spraying, in Management Zones 1, 6 and 7.
- Preparing revegetation areas.
- Slashing Vegetation Management Zone 7 and open area in Zone 4.

- The time required for these tasks have been estimated in Appendix 2. This time has not been included in the labour costs estimated above.

3.10 Monitoring and reporting

A program of monitoring for this VMP should be carried out by the bush regeneration contractor or a suitably qualified and experienced restoration ecology consultant with annual reports submitted to the WCC Environment Manager. Monitoring of the restoration works is required to ensure the management actions are implemented and performance criteria for each zone are satisfied as far as possible. The monitoring program will begin with setting up photo monitoring points prior to the commencement of the Works Program (detailed in Appendix 4) and continue for the five year period.

In the event of a 1 in 100 year rain event, the 0.058 hectares of the Illawarra Dry Subtropical Rainforest endangered ecological community (EEC) will potentially be inundated for a 24 hour period during severe rain events. Additionally, small rain events will raise the ponded area to approximately one metre above the standard height which would encompass <0.01 hectares of the EEC. As such, monitoring of these areas will be required. Activities to be included as a part of the monitoring program are to include:

- The establishment of additional photo monitoring points at strategic locations to capture impacts associated with water inundation.
- Weed density mapping and flora species lists (undertaken annually).
- Annual assessment of Projected Foliage Cover (PFC) of native species within and adjacent to inundation areas.

3.10.1 Assessment criteria

The management actions and performance criteria for each Zone are provided in Table 5. These will form the basis for the monitoring and the report will address each performance criteria specifically.

3.10.2 Photographic monitoring

Photo points are to be established within the one month of the awarding of the bush regeneration contract and be maintained on a quarterly basis over the 5 year work program. At least two monitoring point are to be established in each separate area for each Management Zone (Figure 2) requiring restoration works (no photo point monitoring is required in Zones 6 and 7). Monitoring photos are to be presented in the annual report. Methods described for photo point monitoring in *A field manual for surveying and mapping nationally significant weeds* (BRS, 2006) (http://nrmonline.nrm.gov.au/catalog/mql:22) may be used as a guide.

3.10.3 Reporting

An annual report must be submitted to WCC and should include:

- A brief assessment addressing the management actions implemented and performance criteria for each Zone.
- Observation on the condition of plantings and recruitment of native species within regeneration areas.
- Highlight ant areas observed to be eroding and sedimentation may be occurring.
- Include images from the photographic monitoring from each management zone that highlight the changes of these areas over time.
- Recommend and justify variation to the Works Program as a result of site response to the restoration works specified herein or other factors such as climatic conditions if this is required to meet the management objectives for each zone.

3.11 Long term management and protection of offset areas

Management of the study area currently and into the future is the responsibility of WCC who will also fund works for the project as well as the ongoing operational costs of the Resource Recovery Centre. This will include funding of the implementation of restoration works, outlined in this VMP which form the Biodiversity Offset for the project.

The Works Program (Appendix 4) details restoration and maintenance works to be conducted by bush regeneration contractors as well as WCC staff as part of the operational works of the Resource Recovery Centre for a five year period. Beyond this time Council staff will maintain vegetation outside of restoration areas and suitably qualified bush regeneration contractors will be required to maintain restored bushland areas including the retained patch of Illawarra Subtropical Rainforest EEC.

Part (d) of Consent Condition 49 requires this VMP to *'identify conservation mechanisms to be used to ensure the long term protection and management of Offset sites'.*

Vegetation Management Zones 2, 3, 4 and 5 (Figure 2) have restoration works outlined in this VMP and form the biodiversity offset for the project. The Illawarra Subtropical Rainforest EEC (Figure 2) forms part of Vegetation Management Zone 2, protection of this area is the most significant component of the biodiversity offset and long term protection of this area should reflect this.

Activities and actions to occur to support the long term management and protection of offset areas the satisfy part (d) of Consent Condition 49 are to include:

- A WCC budgetary commitment for the ongoing VMP implementation and progress monitoring (to be against the allocated performance criteria as provide in section 3.10 Monitoring and reporting). Where that these additional funds will be carried forward into future years to encompass the life of the project (Confirmed WCC Waste and Resource Recovery Manager, 2 February 2020).
- All prescribed works within the proposed offset areas (Figure 2) is to be undertaken by WCC approved preferred supplier in Bushland Restoration and monitored by a Restoration Ecologist with a minimum of five years' experience in the management and monitoring of bushland assets.
- All offset areas are to be designated as No Go Zones, where approval by WCC staff is required prior to accessing or work adjacent to the allocated management zones. Informative signage is to placed at the extremities of the offset areas and is to include the installation of protective fencing in form of flagged bunting. Additional preventative measures is to include a briefing to all WCC staff and preferred suppliers as a part of the study areas Work Health and Safety (WHS) induction process.

3.11.1 NSW Office of Environment and Heritage conservation agreement

A conservation agreement is a voluntary joint agreement between landholders and the Minister for the Environment. A conservation agreement can be for public or private land and provides permanent protection for the special features within designated areas. It is recommended that further consultation be conducted with WCC regarding a conservation agreement for all areas proposed for environmental restoration works within this VMP.

A conservation agreement with OEH provides permanent legal protection for the designated area. The area under the agreement is registered on the title of the land, ensuring that, if the land is sold, the agreement and management requirements remain in place.

If both the landholder and OEH (on behalf of the Minister for the Environment) wish to proceed with the agreement, a process to form a draft agreement involving a review process is jointly produced.

Under a conservation agreement WCC would still be fully responsible for the management of land covered by the agreement. OEH would provide signage, advice regarding the management and monitoring of areas under the agreement and funding may be available. More information on conservation agreements is available from the OEH website at http://www.environment.nsw.gov.au/cpp/ConservationAgreements.htm.

4 Biodiversity offset assessment

4.1 Biodiversity offset calculations

Part (d) of Consent Condition 49 requires this VMP to *'detail the proposed offset measures to be implemented and secured for removal of 23.23 hectares of native and exotic vegetation (including 0.25 hectares of Illawarra Subtropical Rainforest- in moderate to good condition).*

The implementation of this VMP forms the biodiversity offset for the vegetation removal. The restoration of retained native vegetation forms the basis of the biodiversity offset and is supported by revegetation works.

The footprint for the proposed works allows for the retention of the majority of native vegetation within the study area. 5.62 hectares of native vegetation will be retained, including 0.378 hectares (61%) of Illawarra Subtropical Rainforest.

In summary the VMP includes the following restoration works;

- 5.38 hectares of retained native vegetation in Vegetation Management Zones 2 and 3, (including the Illawarra Subtropical Rainforest EEC) to be regenerated (Section 3.6).
- 3.166 hectares of revegetation areas in Vegetation management Zone 5 (Section 3.7).
- The partial regeneration (depending on rates of regeneration) of 4.593 hectares in Vegetation Management Zone 4 (Section 3.6).

- This equates to a total of 13.12 hectares within the study area under environmental restoration.
- Section 3.9 details the materials estimates and costs of the restoration works. The implementation of the restoration works that will form the biodiversity offset will involve:

- $29,701.00 in plants for revegetation.
- $93,900.00 in Labour costs of 5 years for bush regeneration contractors.
- Approximately 16 days over the first three years of the Works Program of WCC staff contributing to the restoration works (this does not include activities for WCC staff from the Works Program outside of the restoration areas that will form the biodiversity offset).Illawarra Subtropical Rainforest.

4.2 Assessment of biodiversity offset against 'Principles for the Use of Biodiversity Offsets in NSW'

Table 8 Assessment of biodiversity offset against OEH principles

1. Impacts must be avoided first by using prevention and mitigation measures	The new landfill cell has been significantly redesigned to retain majority of the Illawarra Subtropical Rainforest and other vegetation communities. 92% of the native vegetation communities, including 61% of The Illawarra Subtropical Rainforest has been retained. Mitigation measures to offset impacts are given in Whytes Gully New Landfill Cell Terrestrial and Aquatic Flora and Fauna Assessment (Biosis 2012, 2016). Section 3.1 details further vegetation clearance protocols to mitigate the impacts of vegetation removal.
2. All regulatory requirements must be met	All offsetting provisions outlined in the Biosis report are to offset residual losses of native vegetation, following all efforts to avoid and minimise losses of native vegetation. All regulatory requirements will be met through the approvals process.
3. Offsets must never reward on-going poor performance	All efforts have been taken to avoid and minimise impact to native vegetation. The measures proposed to offset native vegetation losses include improvements to the quality of retained native vegetation.
4. Offsets will complement other government programs	The retained native vegetation to be regenerated is located adjacent to and is connected through remnant patches of bushland to the Escarpment Moist Forest Corridor mapped in the Illawarra Biodiversity Strategy (WCC et al 2010). The regeneration works within the Illawarra Subtropical Rainforest are in line with the Priority Action for the EEC 'Undertake targeted regeneration work to restore and maintain remnants'.
5. Offsets must be underpinned by sound ecological principles	The majority of works are proposed in areas of retained Illawarra Subtropical Rainforest an EEC, as well as restoration of areas of other native vegetation communities and revegetation areas. The restoration methods used in the

	development of this VMP reference best practice guidelines for environmental restoration projects. . Restoration works are to follow the guiding principles set out in DEC (2005) Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland. • Retain – Retain remnant indigenous vegetation. Conserving existing native vegetation should be the highest priority; • Regenerate – Where bushland remains but is degraded, regeneration should be the primary objective; • Revegetate – Where there is no regeneration potential, revegetation is then an option. The design of the new landfill cell has been significantly redesigned to retain the majority of the Illawarra Subtropical Rainforest. Regeneration is recommended in the Illawarra Subtropical Rainforest patch as this area has regeneration potential and an increase in native species diversity is expected following regeneration works in this area. Revegetation is recommended in disturbed areas. Briefly this would include the revegetation of areas that will not be disturbed by the ongoing operations of the Resource Recovery Centre These area are to be planted with a diversity of species of local provenance.
6. Offsets should aim to result in a net improvement in biodiversity over time	Offsetting measures include restoration of Illawarra Subtropical Rainforest and Forest Red Gum Community, as well as re-vegetation of disturbed areas. These measures will result in an increase in areas of native vegetation across the study area as well as improvements in the quality of retained vegetation
7. Offsets must be enduring - they must offset the impact of the development for the period that the impact occurs	Offsetting measures are proposed through the life of the Whytes Gully Landfill site. All areas proposed for restoration or re-vegetation are outside of the operational areas of the landfill site. A conservation agreement with OEH for all the areas under

	restoration works is recommended to ensure the long term protection of these areas. Further consultation is required with WCC.
8. Offsets should be agreed prior to the impact occurring	Regeneration and re-vegetation works are outlined in this VMP to be submitted to the DoPI for approval.
9. Offsets must be quantifiable - the impacts and benefits must be reliably estimated	The areas of native vegetation to be retained as well as areas proposed for regeneration and revegetation works are given in Section 3.7. The cost estimates for labour input and plants required are also given.
10. Offsets must be targeted	Offsets are proposed for the two vegetation communities proposed to be impacted, namely the Forest Red Gum Community and Illawarra Subtropical Rainforest. .
11. Offsets must be located appropriately	Offsetting measures are proposed for within the study area and are immediately adjacent to vegetation to be removed.
12. Offsets must be supplementary	The areas proposed for restoration works are not currently managed for conservation or funded under any conservation scheme.
13. Offsets and their actions must be enforceable through development consent conditions, license conditions, conservation agreements or a contract	Offsetting measures, and measures to monitor the success of these offsets, are outlined in this VMP. This VMP meets the requirements of consent conditions 49 and 50 of Schedule 4 issued by DPI. A conservation agreement with OEH is recommended for all the areas of retained native vegetation and restoration works. Further consultation is required with WCC.

(a) Revegetation to indicate species marked in (a) in recommended planting list (appendix 1)

(b) Revegetation to indicate species marked in (b) in recommended planting list (appendix 1)

Legend

- Study area
- Lowland Dry Subtropical Rainforest

Manangement Zones

- Zone 1: Landfill area
- Zone 1b: Eastern Gully Stormwater Diversion
- Zone 2: Retained native vegetation (moderate-good condition)
- Zone 3: Retained native vegetation (poor condition)
- Zone 4: Acacia Scrub/Exotic (ourside of landfill area)
- Zone 5: Designated revegetation areas
- Zone 6: Planted vegetation
- Zone 7: Closed Exotic Grassland

Figure 2: Whytes Gully Vegetation Management Plan: Vegetation Management Zones

0 40 80 120 160 200

Metres
Scale: 1:3,500 @ A3
Coordinate System: GDA 1994 MGA Zone 56

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 27801
Date: 08 November 2018,
Checked by: BC, Drawn by: DK, Last edited by: dkazemi
Location:\\bio-data-01\matters$\27800s\27801\Mapping\27801_F2_Management Zones

5 Adaptive management

An adaptive management approach is to be employed in respect of the works forming part of this VMP. An adaptive management approach involves an integrated process of monitoring, reviewing and then responding to the health and condition of the plantings as well as the status of the weed species to identify any alterations to the design and maintenance of works that may be required to ensure the objectives of the VMP are achieved.

For example, the application rates for fertiliser and the watering schedule should be flexible in responding to the health and vigour of the plantings and changing climatic conditions. Monitoring the plantings will also allow for a review of the selected species to enable changes in the species composition of the supplementary planting if it is determined that a particular species or stock sourced from a certain location is not performing adequately. The supplementary planting species, planting densities and planting patterns nominated within this VMP may be subject to change and review if certain species are unavailable or are performing inadequately. The weed control works are also to be reviewed and appropriate changes implemented accordingly, if required. By example, if the nominated weed suppression schedule is not achieving the Performance Indicators specified, the frequency of weed suppression activities should be increased accordingly.

It is important to note that any changes should comply with the aims of this VMP and any licensing or approval conditions issued before implementation. An Adaptive Management Statement (or similar) will be prepared and signed by both parties prior to implementation of any adaptive management actions.

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Appendices

Appendix 1 Seed collection and propagation methods

Seed collection methods

To minimise negative impacts associated with seed collection, no more than 10% of the total seed available at the site (and from individual plants) should be collected in any one year (Ralph 1993). However, this is not applicable in the project footprint where all native vegetation is to be cleared. If seed is collected from adjoining retained areas however, the 10% rule applies. General considerations for seed collection include:

- Ensure seed is collected from as many individual plants as possible to maximise genetic diversity.
- Ensure seed is collected from stands or groups of plants rather than isolated plants, even if they carry large amounts of seed.
- Neighbouring plants are likely to be related so ensure that seed is collected from plants across the entire area.
- Approximately equal amounts of seed from each plant should be collected.
- Ensure seed is collected from various parts of the plant (not just those easily accessible).
- Label each batch of seed collected with:
  - Species
  - Location
  - Date collected and collector's name
  - Number of plants collected from
  - Details on position in the landscape, percentage of seed ripe, soil type, and other relevant details.

Seed may be collected from tall trees by utilising fallen limbs and branches, or using a long-handled pruner. Seed on small trees and shrubs can be collected using secateurs or pruners, hand-picked, or the branches hand-stripped. A drop-sheet or tarpaulin under the plant can be used to catch fallen seeds and fruit when branches are shaken. For species which release their seed very quickly upon ripening (such as wattles and bush-peas), it may be worthwhile to tie paper bags or nylon stockings around the branches before the seed pods ripen (OEH 2011).

Timing of seed collection

Timing of seed collection is a critical consideration. Timing is mostly dependant on when the seed matures and how long the seed remains on the plant after maturity. The peak seed collection period in NSW usually occurs from October to December. Although seed ripens generally the same time each year, seasonal variations and local climatic factors and conditions may lead to variations in timing from year to year (Ralph 1993).

Key indications of seed maturity include:

- colour changes of fruits, seed heads or cones
- seed or fruit hardness
- dryness of fruits
- ease of removal
- opening of fruits.

Another consideration of seed collection is that many plants flower over a long period of time and therefore contain seeds of varying maturity. It is important to only collect the mature seed and a second or third visit to the plant may be required to allow time for all seed to mature.

Propagation

A nursery, local to the VMP area should be sourced at least 6 months to 12 months prior to construction and provided with the proposed planting list in Table 8, so that seed can be sourced and propagated for revegetation works on site. Seed collection should follow the procedure outline above.

All plants shall be true to scheduled nomenclature, well formed, hardened off and disease free nursery stock.

They shall be container grown in potting soil with a firmly established root system but with no large roots growing out of the container. No plant shall be pot bound.

The condition of plant stock should encourage future growth that is strong and typical of the species. Correct nursery/growing practices shall help ensure the long-term health and viability of the plant stock on site after planting.

The Bush Regeneration Contractor shall allow for an independent Horticultural certification of all stock prior to delivery to site that confirms the following:

- Stock is disease free and healthy.
- Rootball has adequately grown into the container appropriate to the specified size.
- Stock shows no evidence of spirally, being pot bound, or other undesired outcomes of growth at the nursery.

Appendix 2 Weed management measures

Standard methods

General weed management measures that should be undertaken prior to and during revegetation works:

- Use a range of weed management methods such as slashing or mowing (physical and mechanical control) as well as a range of herbicides (to avoid herbicide resistance).
- Mow/slash areas infested with weeds before they seed (avoiding native vegetation).
- Employ appropriate vehicle hygiene such as:
  - Clean machinery, vehicles and footwear before moving to a new location.
  - Securely cover loads of weed-contaminated material.
  - Dispose of weed contaminated soil at an appropriate waste management facility.
  - Remove weeds immediately and dispose of without stockpiling.
  - Separate weeds from native vegetation to be mulched – do not use weeds for mulch.
  - Minimise soil disturbance in weed infested areas.

Weed control methods adopted in the implementation of this VMP are based on a combination of the current site management, bush regeneration industry standards and botanical knowledge of the weeds. Techniques and methods recommended in following sections such as 'hand weeding' are described in detail in various publications such as *Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland.* (DEC 2005). The publication *Noxious and Environmental Weed Control Handbook. A Guide to Weed Control in Non-crop, Aquatic and Bushland Situations, 5th Edition* (DPI, 2011) provides descriptions on general and standard weed control methods.

Application of herbicide during weed control works will depend on species targeted and the growing situation. For example the selection of a herbicide and the application method for a particular species or class of plant will be determined by factors such as the degree of infestation of target species, limiting damage to off target native flora and preventing herbicides entering waterways. The DPI (2011) document cited above should be referred to as guide for specific herbicides, record keeping and herbicide application techniques.

Use of herbicides must be according to the NSW *Pesticides Act 1999*, Material Safety Data Sheets and labelling instructions for specific trade name herbicides and off label use permits registered with the APVMA. The use of herbicide as part of this VMP will be limited to direct application to cut stumps and spot spraying. Any contractors using herbicides on the site must be trained and appropriately qualified to do so (ChemCert Level 2 or equivalent for subordinates and ChemCert Level 3 or equivalent for supervisors).

Slashing can be used to prevent weeds from flowering and setting seed. This method can be undertaken with a tractor and slashing implement or by using a hand held brush cutter (DPI, 2011). In addition DEC (2005) have highlighted that slashing or mowing can also be used in bushland areas (with grassy native understorey) as an initial or holding treatment to reduce weed mass. This allows for more efficient follow up as fast growing reshooting weeds can be spot sprayed with herbicide among areas of native grasses and herbs. DEC (2005) also suggest that to effectively control exotic annual herbs and grasses, mowing or slashing must be done at least monthly in summer (possibly more frequently if conditions are warm and wet and weed growth is accelerated). For perennial weeds which mature in mid to late summer, mowing or slashing may be reduced to two to three times each season, with the final treatment being applied late in the season ideally before fruit ripens and seed becomes viable (DEC, 2005). Further simple techniques for reducing the potential for assisting the dispersal of weed species as a result of slashing are to:

- slash from areas of dominated by native species to more degraded areas dominated by introduced species
- shake or wash down slashing implements in disturbed and managed areas prior to use in more intact areas.

In summary it is recommended that a combination of reducing the height and number of occasions slashing occurs and appropriate weed hygiene protocols be implemented.

Species specific control for priority and environmental weeds recorded within the VMP area are provided in Section 3.6.

Appendix 3 Recommended planting species list

The recommended species are classified according to where these species are to be planted, this is shown in Figure 2.

Key to planting locations:

A - Species representative of Coastal Grassy Redgum Forest, to be planted in areas above 30m elevation

B - Species representative of Lowland Woolybutt-Melaleauca Forest, to be planted in areas occurring below 30m elevation

B - Species common to Coastal Grassy Redgum Forest and Woolybutt-Melaleauca Forest, to be planted throughout revegetation areas

Table A. 1 Recommended species planting list for Illawarra Subtropical Rainforest

Species name	Common name	Location to be planted
Coloniser species		
Acacia binervata	Two-veined Hickory	a,b
Acacia falcata		b
Acacia maidenii		b
Acacia mearnsii	Black Wattle	a,b
Acacia melanoxylon	Blackwood	a,b
Alphitonia excelsa	Red Ash	a,b
Casuarina glauca	Swamp Oak	b
Glochidion ferdinandi	Cheese Tree	a,b
Ozothamnus diosmifolius		b
Commersonia fraseri	Brush Kurrajong	a,b
Imperata cylindrica	Blady Grass	a,b
Longer lived species		
Acmena smithii	Lilly Pilly	a,b
Angophora floribunda	Rough-barked Apple	a,b
Backhousia myrtifolia	Grey Myrtle	a
Carex longebrachiata	Bergalia Tussock	a,b
Cassine australis	Red-Olive Plum	a
Croton verreauxii	Green Native Cascarilla	a
Cymbopogon refractus	Barbed Wire Grass	a,b
Dichondra repens	Kidney Weed	a,b
Dienella caerulea	Blue Flax Lilly	b

Species name	Common name	Location to be planted
Dienella longifolia	Blue Flax Lilly	a,b
Eucalyptus bosistoana	Coast Grey Box	b
Eucalyptus eugenioides	Thin-leaved Stringybark	b
Eucalyptus globoidea	White Stringybark	b
Eucalyptus longifolia	Woolybutt	b
Eucalyptus quadrangulata	White-topped Box	a
Cassine australis	Red-Olive Plum	a
Croton verreauxii	Green Native Cascarilla	a
Cymbopogon refractus	Barbed Wire Grass	a,b
Dichondra repens	Kidney Weed	a,b
Dienella caerulea	Blue Flax Lilly	b
Dienella longifolia	Blue Flax Lilly	a,b
Eucalyptus bosistoana	Coast Grey Box	b
Eucalyptus eugenioides	Thin-leaved Stringybark	b
Eucalyptus globoidea	White Stringybark	b
Eucalyptus longifolia	Woolybutt	b
Eucalyptus quadrangulata	White-topped Box	a
Eucalyptus tereticornis	Forest Red Gum	a,b
Ficus coronata	Creek Sandpaper Fig	a
Ficus rubiginosa	Port Jackson Fig	a
Lomandra longifolia	Spiny Headed Mat Rush	a,b
Melaleuca decora		b
Melaleuca styphelioides	Prickly-leaved Tea Tree	a,b
Notelaea venosa	Large-leaved Mock-olive	a
Pandorea pandorana	Wonga Wonga Vine	a,b
Phragmites australis	Common Reed	b
Pittosporum revolutum	Rough Fruit Pittosporum	a
Poa labillardieri	Tussock	a,b
Pultenaea retusa	Notched Bush-pea	b
Smilax australis	Sarsaparilla	a
Syzygium australe	Brush Cherry	a
Themeda australis	Kangaroo Grass	a,b
Breynia oblongifolia	Coffee Bush	a,b

Appendix 4 Works program over a 5 year period

The amount of labour required for each task is given in an amount of days for one person or 7.5 hours. Note, where 4 days is indicated this is intended to be four people for one day however this could be conducted by less people over more days (2 people over 2 days) depending on the staff resources or preferred approach of the bush regeneration contractor.

Table A. 2 Year 1 works program

Management zone	Management actions	Sequencing and timing of actions by month												Responsible
		1	2	3	4	5	6	7	8	9	10	11	12	
Zone 1 Landfill area	Primary weed control (mechanical)	1 day		1 day		1 day								WCC staff
	Secondary weeding (spot spraying)			½ day			½ day			½ day			½ day	WCC staff
	Spreading mulch				1 day			1 day						WCC staff
	Hydro seeding intermediate cover	Immediately following intermediate cover. As required												WCC staff
Zone 2 Retained native vegetation (moderate-good condition)	Primary weed control (mechanical along bottom edge)	1 day												WCC staff
	Primary weed control (manual)		4 days			2 days			2 days			2 days		Regeneration contractor
	Secondary Weeding					2 days			2 days			2 days		Regeneration contractor
Zone 3	Primary weed control (Mechanical)	1 day												WCC staff

Management zone	Management actions	Sequencing and timing of actions by month												Responsible
		1	2	3	4	5	6	7	8	9	10	11	12	
Retained native vegetation **(poor condition)**	Primary weed control (manual)			4 days			2 days			2 days			2 days	regeneration contractor
	Secondary Weeding						2 days			2 days			2 days	regeneration contractor
Zone 4 **Acacia scrub/exotic (outside of landfill area)**	Primary weed control (Mechanical)	1 day						1 day						WCC staff
	Primary weed control (manual)	4 days			2 days			2 days			2 days			regeneration contractor
	Secondary Weeding				2 days			2 days			2 days			regeneration contractor
	Stake logs across any unstable slopes				2 days			2 days						regeneration contractor
Zone 5 **Designated revegetation areas**	Preparation of planting areas	2 days												WCC staff
	Spreading mulch		2 days											WCC staff
	Planting		12 days											regeneration contractor
	Watering		1 day											regeneration contractor

Management zone	Management actions	Sequencing and timing of actions by month												Responsible
		1	2	3	4	5	6	7	8	9	10	11	12	
	Secondary weeding				2 days			2 days			2 days			regeneration contractor
Zone 6 **Planted vegetation**	Maintenance weeding	½ day			½ day			½ day			½ day			WCC staff
	Replace plantings as required	1 day												WCC staff
Zone 7 **Closed exotic grassland**	Slashing grass			1 day			1 day			1 day			1 day	WCC staff
	Maintenance weeding (spot spraying)	1 day			1 day			1 day			1 day			WCC staff

Table A. 3 Year 2 works program

Management zone	Management actions	Sequencing and timing of actions by month												Responsibility
		1	2	3	4	5	6	7	8	9	10	11	12	
Zone 1 **Landfill area**	Secondary weeding (spot spraying)			½ day			½ day			½ day			½ day	WCC staff
	Spreading mulch							1 day						WCC staff
	Hydro seeding intermediate cover	Immediately following intermediate cover. As required												WCC staff
Zone 2 **Retained native vegetation (moderate-good condition)**	Secondary Weeding		4 days			4 days			4 days			4 days		regeneration contractor
Zone 3 **Retained native vegetation** **(poor condition) (poor condition)**	Primary weed control (Mechanical)	1 day												WCC staff
	Primary weed control (manual)			2 days			2 days			2 days			2 days	regeneration contractor
	Secondary Weeding			2 days			2 days			2 days			2 days	regeneration contractor
	Planting		4 days			4 days			4 days			4 days		
Zone 4	Primary weed control (Mechanical)	1 day						1 day						WCC staff

Management zone	Management actions	Sequencing and timing of actions by month												Responsibility
		1	2	3	4	5	6	7	8	9	10	11	12	
Acacia scrub/exotic (outside of landfill area)	Primary weed control (manual)	2 days			2 days			2 days			2 days			regeneration contractor
	Secondary Weeding	2 days			2 days			2 days			2 days			regeneration contractor
Zone 5 Designated revegetation areas	Replacement planting	1 day												regeneration contractor
	Maintenance weeding	1 day			1 day			1 day			1 day			regeneration contractor
Zone 6 Planted vegetation	Maintenance weeding	½ day			½ day			½ day			½ day			WCC staff
	Replace plantings as required	1 day												WCC staff
Zone 7 Closed exotic grassland	Slashing Grass			1 day			1 day			1 day			1 day	WCC staff
	Maintenance weeding	1 day			1 day			1 day			1 day			WCC staff

Table A. 4 Year 3 works program

Management zone	Management actions	Sequencing and timing of actions by month												Responsibility
		1	2	3	4	5	6	7	8	9	10	11	12	
Zone 1 **Landfill area**	Secondary weeding (spot spraying)			½ day			½ day			½ day			½ day	WCC staff
	Spreading mulch							1 day						WCC staff
	Hydro seeding intermediate cover	Immediately following intermediate cover. As required												WCC staff
Zone 2 **Retained native vegetation (moderate-good condition)**	Secondary Weeding		4 days			4 days			4 days			4 days		regeneration contractor
Zone 3 **Retained native vegetation (poor condition)**	Primary weed control (Mechanical)	1 day												WCC staff
	Primary weed control (manual)			2 days			2 days			2 days			2 days	regeneration contractor
	Secondary Weeding			2 days			2 days			2 days			2 days	regeneration contractor
	Planting		4 days			4 days			4 days			4 days		
Zone 4	Primary weed control (Mechanical)	1 day						1 day						WCC staff

Management zone	Management actions	Sequencing and timing of actions by month												Responsibility
		1	2	3	4	5	6	7	8	9	10	11	12	
Acacia scrub/exotic (outside of landfill area)	Primary weed control (manual)	2 days			2 days			2 days			2 days			regeneration contractor
	Secondary Weeding	2 days			2 days			2 days			2 days			regeneration contractor
Zone 5 **Designated revegetation areas**	Replacement planting	1 day												regeneration contractor
	Maintenance weeding	1 day			1 day			1 day			1 day			regeneration contractor
Zone 6 **Planted vegetation**	Maintenance weeding	½ day			½ day			½ day			½ day			WCC staff
	Replace plantings as required	1 day												WCC staff
Zone 7 **Closed exotic grassland**	Slashing Grass			1 day			1 day			1 day			1 day	WCC staff
	Maintenance weeding	1 day			1 day			1 day			1 day			WCC staff

Table A. 5 Year 4 works program

Management zone	Management actions	Sequencing and timing of actions by month												Responsibility
		1	2	3	4	5	6	7	8	9	10	11	12	
Zone 1 **Landfill area**	Secondary weeding (spot spraying)			½ day			½ day			½ day			½ day	WCC staff
	Spreading mulch							1 day						WCC staff
	Hydro seeding intermediate cover	Immediately following intermediate cover. As required												WCC staff
Zone 2 **Retained native vegetation (moderate-good condition)**	Secondary Weeding		4 days			4 days			4 days			4 days		regeneration contractor
Zone 3 **Retained native vegetation (poor condition)**	Secondary Weeding			4 days			4 days			4 days			4 days	regeneration contractor
Zone 4 **Acacia scrub/exotic (outside of landfill area)**	Secondary Weeding	2 days			2 days			2 days			2 days			regeneration contractor

Management zone	Management actions	Sequencing and timing of actions by month												Responsibility
		1	2	3	4	5	6	7	8	9	10	11	12	
	Planting			4 days			4 days							
Zone 5 **Designated revegetation areas**	Replacement planting	1 day												regeneration contractor
	Maintenance weeding	1 day			1 day			1 day			1 day			regeneration contractor
Zone 6 **Planted vegetation**	Maintenance weeding	½ day			½ day			½ day			½ day			WCC staff
	Replace plantings as required	1 day												WCC staff
Zone 7 **Closed exotic grassland**	Slashing Grass			1 day			1 day			1			1 day	WCC staff
	Maintenance weeding	1 day			1 day			1 day			1 day			WCC staff

Table A. 6 Year 5 works program

Management zone	Management actions	Sequencing and timing of actions by month												Responsibility
		1	2	3	4	5	6	7	8	9	10	11	12	
Zone 1 **Landfill area**	Secondary weeding (spot spraying)			½ day			½ day			½ day			½ day	WCC staff
	Spreading mulch							1 day						WCC staff
	Hydro seeding intermediate cover	Immediately following intermediate cover. As required												WCC staff
Zone 2 **Retained native vegetation (moderate-good condition)**	Secondary Weeding		4 days			4 days			4 days			4 days		regeneration contractor
Zone 3 **Retained native vegetation (poor condition)**	Secondary Weeding			4 days			4 days			4 days			4 days	regeneration contractor
Zone 4 **Acacia scrub/exotic (outside of landfill area)**	Secondary Weeding	2 days			2 days			2 days			2 days			regeneration contractor

Management zone	Management actions	Sequencing and timing of actions by month												Responsibility
		1	2	3	4	5	6	7	8	9	10	11	12	
Zone 5 **Designated revegetation areas**	Replacement planting	1 day												regeneration contractor
	Maintenance weeding	1 day			1 day			1 day			1 day			regeneration contractor
Zone 6 **Planted vegetation**	Maintenance weeding	½ day			½ day			½ day			½ day			WCC staff
	Replace plantings as required	1 day												WCC staff
Zone 7 **Closed exotic grassland**	Slashing Grass			1 day			1 day			1 day			1 day	WCC staff
	Maintenance weeding	1 day			1 day			1 day			1 day			WCC staff

Appendix 5 Green and Golden Bell Frog fact sheet

The Green and Golden Bell Frog *Litoria aurea*

The Green and Golden Bell Frog is a nationally and state threatened species. It is listed as vulnerable under the Commonwealth *Environment Protection and Biodiversity Conservation Act 1999* and as endangered under the New South Wales *Threatened Species Conservation Act 1995*.

Photo 1: Adult female Green and Golden Bell Frog, Port Kembla. Copyright © Biosis Pty Ltd 2012

General Appearance

The Green and Golden Bell Frog is recognisable by its large size (up to 10cm) and usually striking colour combination of green and gold. Most individuals appear to have a bright green background colour with irregular large spots and stripes of gold, although sometimes the frogs appear an olive green or even brown colour. The groin is a distinctive turquoise blue colour and the frog has an obvious eardrum (dark circular disc just behind the head).

Note: there are other small green frog species which are similar in appearance although they are much smaller than adult Green and Golden Bell Frog (up to 5cm).

Habitat

Green and Golden Bell Frogs inhabit a range of habitats including creeks, drains, wetlands and dams. The Green and Golden Bell Frog can sometimes be seen basking amongst water plants during sunny weather but is most often encountered sheltering under logs or rocks in the day. It can move long distances and can sometimes be found away from water.

What should you do if you find a Green and Golden Bell Frog?

Stop work and tell your environmental manager immediately who will provide advice on what to do next.

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Appendix 6 Operational VMP

Whytes Gully Waste and Resource Recover Centre Vegetation Management Plan

FINAL REPORT

Prepared for Wollongong City Council

20 November 2019

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Biosis staff involved in this project were:

- Anne Murray (mapping)

Contents

Tables

Figures

Glossary

BC Act	*NSW Biodiversity Conservation Act 2016*
Biosecurity Act	*Biosecurity Act 2015*
CEEC	Critically Endangered Ecological Community
DPIE	NSW Department of Planning, Industry and Environment
EEC	Endangered Ecological Community
EP&A Act	*Environmental Planning and Assessment Act 1979*
EPBC Act	*Environment Protection and Biodiversity Conservation Act 1999*
GIS	Geographic Information System
LEP	Local Environmental Plan
LGA	Local Government Area
LLS	Local Land Services
NPW Act	*National Parks and Wildlife Act 1974*
NSW	New South Wales
EES	NSW Environment, Energy and Science Group
PCT	Plant Community Type
VMP	Vegetation Management Plan
WoNS	Weeds of national significance

1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Wollongong City Council (WCC) to update the Vegetation Management Plan (VMP) for the Whytes Gully Waste and Resource Recover Centre (Biosis 2013, 2018) (the study area) with scope to meet the operational needs of the landfill facility.

The original VMP was approved by NSW Department of Primary Industries (NSW DPI) and was appended to the Construction Environmental Management Plan (CEMP) (11/19432) for the WCC proposal to develop a new landfill cell to help meet future landfill needs for the Wollongong Local Government Area (LGA) (referred to as the project). The VMP also formed part of the Landfill Environmental Management Plan which was approved in December 2014 by DP&E (14/19958).

As a part of the study area's proposed expansion, a modification 2 (MOD 2) of the Whytes Gully Landfill Project Approval MP 11_0094 was approved on the 29th May 2018 by the Department of Planning and Environment. This was to include the Eastern Gully Diversion Drain (EGDD) works, which is to result in the direct impact on the remnant Illawarra Subtropical Rainforest (ISTR) Endangered Ecological Community (EEC), located in the North West corner of the study area (Figure 2).

As a result of these new works, Schedule 4 (Specific Environmental Conditions) Condition 49 of the s75W Instrument of modification conditions were amended. This relates to vegetation and biodiversity management across the site. The conditions is as follows:

> *The Proponent shall prepare and implement a Vegetation Management Plan for the project to the satisfaction of the Secretary. This plan must:*
>
> a. *Be prepared by a suitably qualified and experienced expert;*
> b. *Be updated and approved by the Secretary within 6 months of determination of MOD 2 or prior to the commencement of construction (whichever is sooner);*
> c. *Include a vegetation clearing protocol (see Condition 50 of this Schedule);*
> d. *Must specifically include a Biodiversity Offset Strategy that:*
>   - *Is assessed against OEH's 'Principles for the use of Biodiversity Offsets in NSW' and the 'Interim Policy on Assessing and Offsetting Biodiversity Impacts of Part 3A, SSD and SSI Projects';*
>   - *Detail the proposed offset measures to be implemented and secured for removing and/or impacting 0.49 hectares of native vegetation (including 0.01 hectares of Illawarra Subtropical Rainforest) relating to project approval MP 11_0094 and 0.25 hectares of native vegetation (Illawarra Subtropical Rainforest) relating to MOD 2;*
>   - *Identify conservation measures to be used to ensure the long-term protection and management of the offset sites;*
>   - *References best practice management guidelines for restoring and managing the vegetation communities proposed for protection;*
>   - *Details how the proposed offset measures will be protected, managed, funded and monitored over the life of the project;*
> e. *Ensure the project maintains suitable buffer distances to nearby waterways in accordance with Wollongong DCP 2009 to protect riparian land;*
> f. *Incorporate the recommendations of the Whytes Gully Landfill Modification: Flora and Fauna Assessment (See **Table 1** (Biosis (project number 20115) dated 11th October 2017) ; and*
> g. *Detail the site-wide ecological management and monitoring program/s to be implemented for the life of the project.*

This plan must be documented in the LEMP and CEMP (see Conditions 2 and 3 in Schedule 5).

Table 1 Recommendations in Whytes Gully Landfill Modification: Flora and Fauna Assessment

Ecological Value	Impacts	Recommendations to avoid, and minimise impacts
Native Vegetation	• 0.1723 ha of native vegetation in the form of Illawarra Subtropical Rainforest EEC will be directly cleared as part of MOD 2. An additional 0.0751 ha maximum of the EEC will be subject to inundation during 10 year and 100 year rainfall events. • The remaining vegetation to be removed has been so highly modified that it no longer represents native vegetation.	• Identifying the location of the EEC as no go zones in the project CEMP and during the site induction for personnel working in the area. • Ensure any modification to the project is adequately assessed and offset. • Install appropriate exclusion fencing and signage at the boundaries of the EEC. • Undertake weed control and revegetation works in accordance with the VMP (Biosis 2013). • Update VMP to include monitoring of areas of EEC that may be inundated.
White Flowered Wax Plant habitat	• Loss of individual through increased weed invasion following vegetation removal. • Accidental damage via foot traffic. • Accidental removal during weed control works.	Identifying the location surrounding the plant as a no go zone in the LEMP & CEMP.
Hollow bearing trees	Removal or inundation of native reptile and mammal habitat	Where hollow bearing trees or logs are to be removed, a suitably qualified ecologist should be consulted prior to any works.
Rocky Outcrops	Removal or inundation of native reptile and mammal habitat	Where feasible, avoid the removal or modification of large, rocky boulders containing cracks and crevices.
Foraging habitat for bats	0.33 ha of foraging habitat (EEC) and areas of acacia scrub and weeds will be cleared as part of MOD 2.	Where feasible, avoid the removal of large, mesic canopy species such as Port Jackson Fig.

This VMP herein provides controls and actions required to manage the passive, operational and vegetated portions within the study area (the VMP area) (Figure 1).

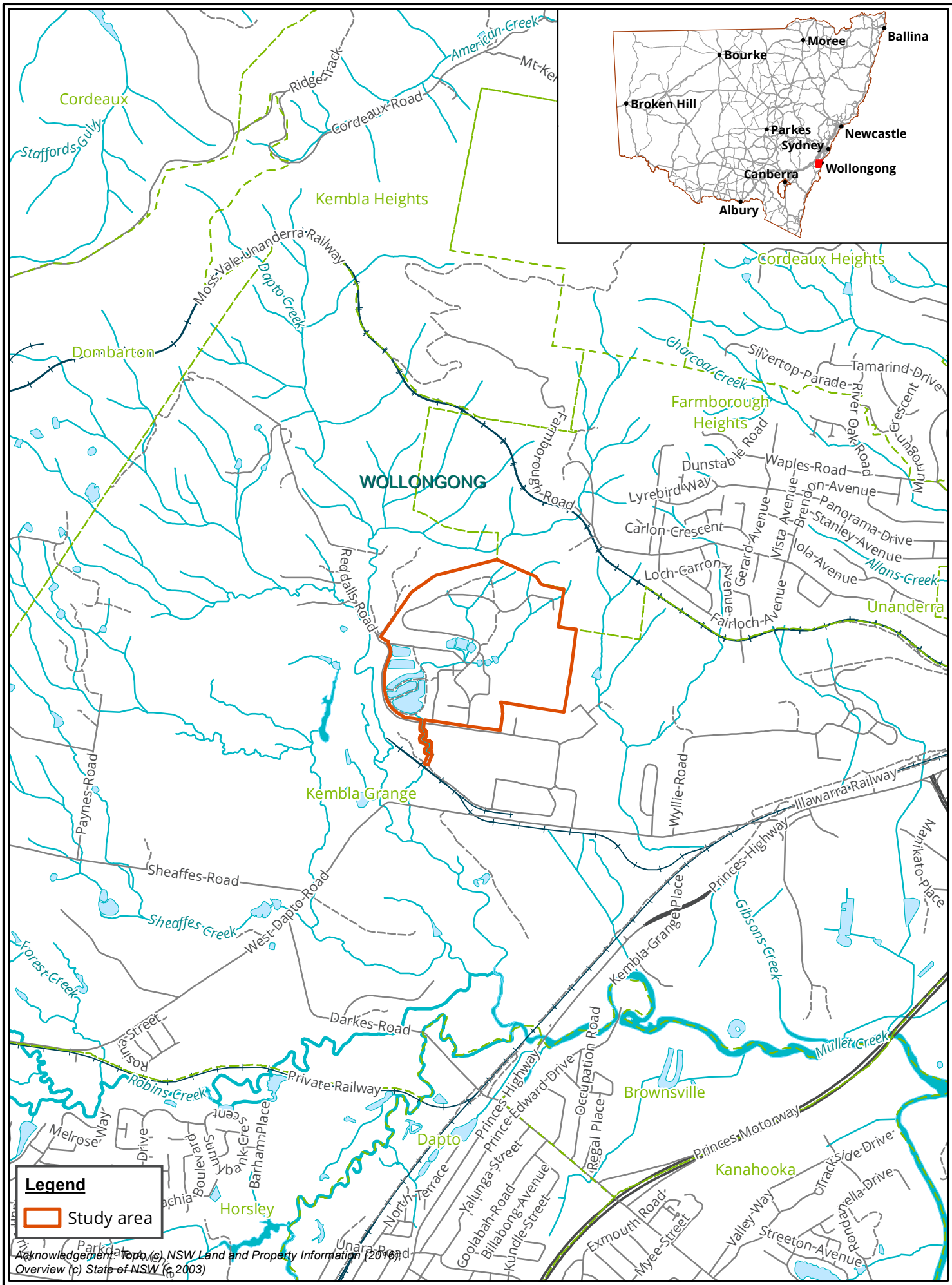
1.2 Description of VMP area

The study area is located on public land approximately 1.5 kilometres north-west of Kembla Grange and approximately nine kilometres southwest of the Wollongong Central Business District. The study area currently operates as the Whytes Gully Waste and Resource Recover Centre and receives waste from the WCC LGA. (Figure 1).

The VMP area primarily is comprised of both active and passive landfill operational areas with supporting infrastructure where the vegetation is dominated by exotic grassland with patches of regrowth scrub. This vegetation is generally in poor condition with woody weeds throughout the understorey. Other vegetation types within the study area are represented by small remnant woodland/open forest vegetation and

buffering revegetation areas that are located within the western and north-western portions of the study area.

Aquatic habitats across the study area include a number of surface water ponds, consisting of three large interconnected ponds, five small dams and several other additional water bodies associated with the operations of the Whytes Gully Waste and Resource Recover Centre. An unnamed drainage line flows across the southern part of the study area and is a tributary of Mullet Creek to the south. Mullet Creek forms part of the Lake Illawarra catchment.



Acknowledgement: Topo (c) NSW Land and Property Information (2016); Overview (c) State of NSW (c 2003)

Figure 1 Location of the study area

Biosis Pty Ltd
Albury, Ballarat, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 30815
Date: 16 October 2019,
Checked by: PP, Drawn by: AEDM, Last edited by: amurray
Location:P:\30800s\30815\Mapping\

0 250 500 750 1,000 Metres

N

Scale 1:25,000 @ A4, GDA 1994 MGA Zone 56

2 VMP scope and objectives

2.1 Scope

The scope of this VMP is to develop a framework for the management of vegetation to be retained, vegetation to be removed, and the ongoing management of weeds within the study area. The VMP will also outline ongoing management actions required for successful establishment of native plants within certain sections the VMP area, and actions to protect the surrounding vegetation from future impact.

The VMP will run for a minimum of five years or until the objectives and performance criteria outlined in this VMP are met.

As a result of the changing operational landscape and compliance requirements associated with the daily operations associated with the study area, the management of the proposed EGDD will not be included within this VMP.

2.2 Objectives

The specific objectives for the implementation of this VMP are to:

- Provide management actions with scope to inform the on ground operational and compliance requirements of the study area.
- Provide management actions to improve the condition of retained native vegetation within the study area with a particular focus on the ISTR Endangered Ecological Community (EEC).
- Provide a monitoring program based on performance criteria for each management action.
- Outline weed and vegetation management activity details, including identification of flora species and sources, and measures for the management and maintenance of rehabilitated areas (including the duration of the implementation of such measures).
- A revegetation strategy that includes the review flora species lists and identifies a suite of flora species suitable for revegetation works within the VMP area.
- Describe planting density and composition for revegetation works within the VMP area.
- Provide schedules for inspection, monitoring, management and corrective action.
- Provide a schedule of works for a five year period.
- Estimate the material and labour inputs required to implement the VMP.

3 Methods

3.1 Desktop research

A review of all available design plans and reports relating to the site and adjacent areas was conducted, as well as relevant legislation, recent vegetation mapping and other documentation relevant to the current project, including;

- Whytes Gully New Landfill Cell Terrestrial and Aquatic Flora and Fauna Assessment. Report to Macquarie Goodman (Biosis 2012)
- Whytes Gully Landfill modification: flora and fauna assessment. Report for Golder Associates Pty (Biosis 2016, 2018).
- Vegetation Management Plan Guidelines for Development Assessments Wollongong City Council, Wollongong (WCC 2006).
- Whytes Gully New Landfill Cell Project Bushfire Pre-Construction Report – Bushfire assessment APZA Services 2013.
- Department of the Environment and Energy (DEE) Protected Matters Search Tool for matters protected by the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act).
- Environment, Energy and Science (EES) Group NSW BioNet, the database for the Atlas of NSW Wildlife, for matters protected under the *Biodiversity Conservation Act 2016* (BC Act).

3.2 Site assessment

A general site survey of the study area was conducted on 6 September 2019 by a qualified and experienced Consultant Restoration Ecologist/botanist, Paul Price. The study area was surveyed using random meander methods. This involved:

- The identification of native and exotic plant species, according to *Field Guide to the Native Plants of Sydney* (Robinson 2003) and the *Flora of NSW* (Harden 1992, Harden 1993, Harden 2000, Harden 2002) with reference to recent taxonomic changes.
- An assessment of the natural resilience of the vegetation of the site.
- Identification of previous and current factors threatening the ecological function and survival of native vegetation within and adjacent to the study area.
- Determination of appropriate weed control and vegetation management techniques for study area.

The conservation significance of plant species and plant communities was determined according to:

- BC Act for significance within NSW.
- EPBC Act for significance within Australia.

4 Site description

4.1 Vegetation communities

Biosis (2012, 2016) identified six vegetation communities within the study area including the following three native vegetation communities:

- Illawarra Subtropical Rainforest
- Forest-Redgum Open Forest/Woodland
- Moist-Box Redgum Foothills Forest.

Three non-native vegetation communities identified are:

- Acacia Scrub/Exotic
- Closed Exotic Grassland
- Planted. Native and exotic species.

4.1.1 NSW priority weed species

Five weed species listed as a priority weeds in the Wollongong Local Government Area (LGA) under the NSW *Biosecurity Act 2015* (Biosecurity Act) were recorded within the subject site, and landowners and occupiers are under legal obligations to manage such species in line with the General Biosecurity Duty which states:

> *All plants are regulated with a general biosecurity duty to prevent, eliminate or minimise any biosecurity risk they may pose. Any person who deals with any plant, who knows (or ought to know) of any biosecurity risk, has a duty to ensure the risk is prevented, eliminated or minimised, so far as is reasonably practicable.*

Four Weeds of National Significance (WoNS) were also recorded within the subject site (Table 2).

Table 2 Priority weeds and WoNS recorded within the study area

Scientific name	Common name	General Biosecurity Duty	WoNS
Asparagus aethiopicus	Ground asparagus	*Must not be imported into the State or sold*	Yes
Chrysanthemoides monilifera* subsp. *rotundata	Bitou Bush	*Must not be imported into the State or sold* ***Biosecurity Zone*:** must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed. The local control authority must be notified of any new infestations of this weed within the Biosecurity Zone	Yes
Eragrostis curvula	African Lovegrass.	*Land managers reduce impacts from the plant on priority assets.*	No
Lantana camara	Lantana	*Must not be imported into the State or sold* ***Whole region:*** *Land managers should mitigate the risk of new weeds being introduced to their land. The plant should not be bought, sold, grown, carried or released into the environment* ***Core area:*** *Land managers reduce impacts from the plant on priority assets.*	Yes

Scientific name	Common name	General Biosecurity Duty	WoNS
Senecio madagascariensis	Fireweed	*Must not be imported into the State or sold*	Yes

5 Vegetation management

5.1 General approach

This VMP provides a prioritised succession of vegetation management and restoration/revegetation works that have considered a long term commitment to asset and biodiversity management.

5.2 Vegetation management zones

The ecological assessment completed by Biosis (2019) has been used to delineate the Vegetation Management Zones to which this VMP will apply. The delineation of Vegetation Management Zones was determined based on various site attributes identified during the field investigation, including:

- Current and future land use (retain or remove).
- Vegetation and management/operational type.
- Level of recruitment of exotic species (including priority weeds).

Using these attributes, six management zones have been identified within the VMP area (Table 3). The location and extent of each zone is provided in Figure 2 with corresponding summary of the management requirements for each zone provided in Table 3 below.

Table 3 Management zones

Management zone	Area (ha)	Description
Management Zone 1: (MZ 1)	51.44	MZ 1 is currently mapped as Weeds and exotics (Biosis 2012, 2016) and encompasses the main landfill operational area. Activities within the MZ will include the treatment of all of NSW priority weed species and the undertaking of general grounds maintenance for which primarily includes the slashing and treatment of exotic perennial grass and herb species. All weed control is to be undertaken using industry approved best practice techniques in bush regeneration and weed control. No revegetation will occur within this management zone. Additional activities within the management will include : • Rubbish and accumulated biomass removal (where applicable). • Slashing and weed control management regimes to maintain a low grassy exotic cover within the MZ. • Mechanical primary weed removal of woody weeds • Hydro seeding with sterile grasses • Soil stabilisation and erosion control Suggested control methods for weed species are provided in Table 12

Management zone	Area (ha)	Description
Management Zone 2: (MZ 2)	10.30	MZ 2 is currently mapped as Retained native vegetation (poor condition), Acacia scrub/exotic and Closed exotic grassland (Biosis 2012, 2016) These three vegetation types are currently located outside of the designated operational landfill area. Activities within the MZ will include the treatment of all of NSW priority weed species only, where it is anticipated that weed control works will be undertaken via high volume herbicide application supported by either spot spraying (backpack) and /or industry approved weed control methodologies such as cut and paint/scrape and paint (where applicable). No revegetation will occur within this management zone. All weed control is to be undertaken using industry approved best practice techniques in bush regeneration and weed control. All biomass generated from the weed control program is to be left in situ. Additional activities within the MZ may include : • Rubbish and accumulated biomass removal (where applicable). • Mechanical primary weed removal of woody weeds • Soil stabilisation and erosion control Suggested control methods for weed species are provided in Table 12.

Management zone	Area (ha)	Description
Management Zone 3: (MZ 3A and MZ 3B)	MZ 3A – 1.06 MZ 3B – 1.21	MZ 3 (A and B) are currently mapped as Weeds and exotics (Biosis 2012, 2016) and currently provides for the required asset protection zone (APZ) and boundary screen revegetation area and boundary access road. Activities within the MZ will include the treatment of all of NSW priority weed species where it is anticipated that weed control works will be undertaken either by mechanical clearing/slashing supported by high volume herbicide application, spot spraying (backpack) and other industry approved weed control methodologies such as cut and paint/scrape and paint (where applicable). Weed control activities will provide scope to implement a supplementary revegetation program utilising native species associated with Plant community type (PCT): *1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion* and species selected from Illawarra Native Garden Guide (WCC 2011) where revegetation works will be completed in two stages to ensure a high survival rate within the currently exposed environment. All biomass generated from the weed control program is to be left in situ. Biomass generated from weed control methodologies are to be mulched on site to maintain compliance with the current APZ requirements. Additional activities within the management will include: • Rubbish and accumulated biomass removal (where applicable). • Slashing and weed control management regimes to maintain a low grassy exotic cover within the APZ • Fencing of newly planted areas to reduce impacts associated with localised herbivory events. • Soil ripping as per specification provided as Section 6.2.7 Soil preparation • Installation of a minimum 75 mm of mulch within allocated revegetation areas. Suggested control methods for weed species are provided in Table 12. Suggested plant species for revegetation are provided in Table 13.
Management Zone 4: (MZ 4)	0.83	MZ 3 is currently mapped as the proposed EGDD. No weed control or revegetation works will be prescribed for this management zone. With scope to increase the floristic diversity of the MZ 6 Offset revegetation area, a number of clumping or rhizome producing native plant species are to be salvaged (with scope for further division and propagation) from within the proposed footprint area. Additional details pertaining to the salvage of suitable plant species and the required actions is provided as Section 6.2.1 Salvage of removed vegetation.

Management zone	Area (ha)	Description
Management Zone 5: (MZ 5)	0.31	MZ 5 is currently mapped as ISTR in a moderate condition (Biosis 2012, 2016). Activities within the MZ will include the treatment of all of exotic weed species with scope to promote natural regeneration of flora native species associated with PCT 1300. All weed control is to be undertaken using industry approved best practice techniques in bush regeneration and weed control. All biomass generated from the weed control program is to be removed from site. Additional activities within the management will include : • Rubbish and accumulated biomass removal (where applicable). • Soil stabilisation and erosion control No revegetation will occur within the MZ. Suggested control methods for weed species are provided in Table 12.
Zone 6: (MZ 6)	0.45	MZ 6 is currently mapped as Retained native vegetation (moderate-good condition) and Acacia Scrub/Exotic (Biosis 2012, 2016) and will provide for the required offset revegetation area in response to the implementation of the EGDD. Activities within the MZ will include the treatment of all of exotic weed species with scope to implement a revegetation program utilising native species associated with *PCT: 1300 Whalebone Tree - Native Quince dry subtropical rainforest on dry fertile slopes, southern Sydney Basin Bioregion.* All weed control is to be undertaken using industry approved best practice techniques in bush regeneration and weed control. All biomass generated from the weed control program is to be removed from site. Additional activities within the management will include : • Rubbish and accumulated biomass removal (where applicable). • Soil stabilisation and erosion control. Suggested control methods for weed species are provided in Table 12. Suggested plant species for revegetation are provided in Table 13.

Legend

- Study area

Management zones

- Zone 1 - Landfill operational area
- Zone 2 - Disturbed Acacia scrub
- Zone 3A - Screening and corridor planting
- Zone 3B - Screening and corridor planting
- Zone 4 - Proposed eastern gully Stormwater diversion
- Zone 5 - Illawarra subtropical rainforest
- Zone 6 - Offset revegetation area

Figure 2 Vegetation management zones

0 50 100 150 200

Metres
Scale: 1:3,500 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Sydney, Wangaratta & Wollongong

Matter: 30815
Date: 29 October 2019,
Checked by: PP, Drawn by: AEDM, Last edited by: amurray
Location:P:\30800s\30815\Mapping
30815_F2_Management Zones

Acknowledgements: Basemap © Land and Property Information 2016, Imagery © Nearmap 2019

6 Specific management actions

6.1 Weed management

Environmental weeds are exotic species considered either a high risk of dispersing and becoming established in adjacent native vegetation, or have the potential to cause significant ecological harm. Recommended methods for control of environmental weeds recorded on site, along with priority species, are outlined in Appendix 1.

6.2 Rehabilitation works

When native vegetation is lost as a result of project works, revegetation may be necessary to reinstate native vegetation and habitat in the project area. The purpose of revegetation for this project includes:

- Replacing lost or damaged flora from within ISTR vegetation community.
- Creating visual buffer zones.
- Creating or maintaining habitat corridors to help facilitate the movement of flora and fauna species.

Time should be allocated to seed collection for the project to allow for seasonal variations in seed production. Depending on timing, this may include collecting seed up to 12 months in advance of revegetation works.

Seed collection is to be undertaken for the ISTR community that will be removed as a result of the proposed works.

Collection of additional seed from the adjoining retained vegetation may be required (depending on seasonal variations in seed production) to ensure adequate genetic diversity is maintained.

Seed collection is to be carried out in accordance with the Florabank Guidelines, by experienced and licenced seed collectors/ecologists. Seed collection from a Threatened Ecological Community also requires a licence under the NSW *National Parks and Wildlife Act 1974*.

6.2.1 Salvage of removed vegetation

To increase the floristic diversity of the VMP area, a number of clumping or rhizome producing native plant species are to be salvaged (with scope for further division and propagation) from within the proposed EGDD footprint area a minimum of one month prior to its installation.

Not all native species recorded within the proposed footprint area to be removed are suitable for salvage. As such only suitable species have been included as 'target species' in Table 4 below.

Table 4 Salvage plant species and required actions

Scientific Name	Common Name	Required action
Adiantum formosum *Adiantum hispidulum* *Arthropteris tenella* *Asplenium aethiopicum* *Asplenium flabellifolium* *Carex longebrachiata* *Doodia aspera*	Giant Maidenhair Rough Maidenhair Common Maidenhair Necklace Fern Bergalia Tussock Prickly Rasp Fern	• To reduce stress during excavation and transport, a minimum of one third of the foliage is to be cut from the plant. • Individual plants are to be divided into smaller manageable clumps for *potting up* into either forestry tube or 6 inch sized pots.

Scientific Name	Common Name	Required action
Pellaea falcata	Sickle Fern	• Divided plants are to be initially watered with a nitrogen based liquid fertiliser to assist in the reduction of stress during division and promote growth and new root establishment. . • All plants are to be maintained at a local wholesale native nursery for a minimum period of 6 – 8 month (pending growth and root establishment) in preparation for future installation within the VMP area.

6.2.2 Natural regeneration

Encouraging the natural regeneration of pre-existing vegetation is an effective form of site restoration as:

- Seeds and propagules exist within the seed bank.
- Species of local provenance are better adapted to the environmental conditions in the area.
- Re-establishment of the community will follow natural patterns of re-colonisation and succession.
- Soil fauna, fungal and microbial populations that are essential to a healthy plant growing environment are already present.

Some practical and cost-effective management actions that can be used to encourage natural regrowth and regeneration include:

- Disturbing the soil surface.
- Removing weed infestations.
- Creating canopy gaps.
- Watering.

The applicability of any of the above management actions will be dependent on the pre-existing vegetation and local conditions. Natural regeneration and encouragement of natural regrowth will be most effective in MZ 5 and MZ 6. Appropriate monitoring and management of this zone must be carried out as actions such as soil disturbance and canopy gaps may also result in the establishment of weed populations.

6.2.3 Revegetation works

Revegetation is required in MZ3 (A and B) and MZ6. All revegetation works are to be undertaken in general accordance with the specifications outlined below. A recommended species list for revegetation is provided in Appendix 2The recommended planting list is based on species that are characteristic of the Illawarra region and that have been recorded in the study area. Additionally they are species that are easily propagated and established from readily available local provenance seed.

All plants to be installed as part of the required revegetation works are to be either as hikos and/or enviro-cells sized pots. With scope to allow for a stage weed removal within the study area, the revegetation will be undertaken in three distinct stages based upon priority actions and compliance requirements. Allocated revegetation stages are provided as Table 5.

Revegetation works within MZ3 (A and B) are to occur a minimum of five metres from the boundary fence to make allowances for ongoing fence and access track maintenance. The planting area is to act as a visual

buffer between the operational landfill areas and provide a vegetative corridor to allow for the movement of native fauna within the study area.

6.2.4 Mulch

Mulch is to be either of Eucalypt wood or leaf chip derived source and preferably chipped from parent material within a ten kilometre range to ensure any potential tree seeds are compatible with the corresponding vegetative communities. Where obtainable, mulch derived of recycled timber and wood products such as pallets may be used.

Mulch is not to contain any chipped Pine, Coral tree, or Palm species.

6.2.5 Plant numbers and densities

The following is a guide to inform the revegetation densities:

- Stage 1: MZ 3A Trees installed at a rate of one plants per two square metres, Shrubs are to be installed at a rate of one plant per five square metres.
- Stage 2: MZ 3A Trees installed at a rate of one plants per two square metres, Shrubs are to be installed at a rate of one plants per five square metres.
- Stage 3: MZ 6: Trees installed at a rate of one plants per square metre, Shrubs are to be installed at a rate of one plants per five square metres, sedges installed at a rate of one plant per square metre.

The proposed planting numbers per stage are provided in Table 5.

Table 5 Revegetation stage allocation and planting numbers

Zone	Stage	Trees	Shrubs	Sedges/grasses forbs/ground covers	Total
Zone 3A	1	5,470	2,188	0	7,658
Zone 3B	2	6,028	2,411	0	8,440
Zone 6	3	4,469	894	4,469	9,831
Total		15,967	5,493	4,469	25,929

An estimated 25,929 plants are to be installed as part of the proposed VMP works. In the event of plant loss, a nominated replacement of 10% of the total plants installed (2,593) has been included in the VMP costing schedule (Table 8).

6.2.6 Fertilising

At the time of planting fertiliser is be applied to each plant in the form of a native slow release product with an N: P: K ratio similar to that of 21.8: 0.7: 7.2. Water crystals may also be used to reduce the incidence of death amongst establishing plants. Such an additive will also reduce initial water costs during the establishment phase of the VMP implementation.

6.2.7 Soil preparation

With scope to improve planting conditions within MZ3a and MZ3b and rectify the heavily compacted site conditions, the management zone is to be 'ripped' to support the growth requirements for newly planted and establishing stock. Soil ripping is to be undertaken post weed control activities and prior to mulch installation. Rip lines, conducted by use of tractor, 2 to 2.5 meters apart to a maximum depth of 200 millimetres. Mulch is

then to be installed immediately to eliminate any incidence of surface or rill erosion in the event of heavy rains.

6.2.8 Watering

Watering of the supplementary planting works will be undertaken to ensure that an adequate survival and establishment rate is achieved. Watering is to abide by any local authority water restrictions or guidelines.

Watering of all supplementary planting will occur at the time of the planting itself during the construction phase, to minimise shock on the tubestock in their new conditions. Watering of stock during the construction will be on an as required basis.

During the three - six month establishment period, the frequency of watering to achieve plant establishment will depend on the prevailing climatic conditions at the time of planting and thereafter. Watering will generally be carried out in the cooler hours of the day (morning or afternoon), and will be frequent enough to prevent wilting of plants. Tubestock is to be watered prior to planting as well as immediately after planting installation.

During the establishment phase the following watering program is recommended (dependent on weather) (Table 6).

Table 6 Watering program

Weeks 1 - 8	Months 2 - 4	Months 5 - 6
Once a week	Once a fortnight	Once a month

The necessity for watering during the above program will be dependent upon rainfall. The frequency of watering will be gradually reduced as the plantings mature and it is anticipated that after period of 4 – 6 months the planting will be sufficiently established such that supplementary watering will no longer be required.

Planting areas are to be monitored during the extended maintenance period to ensure that climatic conditions are not affecting the newly planted tube stock. If climate or environmental conditions are affecting the tube stock a watering program may be reinstated pending the approval by the site manager.

6.2.9 Pest control

Predation by native macropods, introduced herbivores (deer, rabbits and hares), insect pests and infection caused by plant diseases/pathogens can have an adverse effect on the establishment of plantings by defoliating, damaging, removing or killing young plants. To minimise the loss of plants through predation and/or disease, all new plantings will be protected by:

- Use of tree guards, which would be reused on new plantings once the initial planted specimens mature.
- Temporary exclusion fencing of larger areas or where initial trials indicate that the efficacy of using individual tree guards is low.

6.3 Maintenance

Maintenance works will commence following the implementation of weed control and revegetation activities and will continue for a period of 48 months from commencement of the VMP. It is anticipated that the maintenance activities will occur quarterly during cooler months and bi-monthly in the warmer months. Required works and indicative effort are outlined in Table 7.

Table 7 Indicative maintenance works summary

Maintenance activity	Minimum effort	Frequency	Responsibility
Spot spraying of annual and perennial weeds	Two person days, Monthly	Quarterly in cooler months, monthly in warmer months	Land manager/bush regeneration contractor
Checking and repairing tree guards	One person day, 5 times per year	Bi-annually	Land manager
Watering	As required	Only during excessively hot periods of summer	Land manager/bush regeneration contractor
Replacement planting of tubestock	As required	Annual checks and planting	Land manager/bush regeneration contractor
NSW priority weed control	Regular inspections/treatments (All management zones)	Bi-monthly	Land manager/bush regeneration contractor
Vegetation slashing/mowing	Regular inspections/treatments (All management zones)	Monthly or as required under the current services contract.	Land manager/bush regeneration contractor

7 Cost

7.1 VMP works

The total cost for the implementation of the VMP is $536,018 (ex GST). A breakdown of costs per year is provided as Table 8. All costs are indicative only and are prone to fluctuation.

Table 8 VMP budget and breakdown

Task	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Preliminary works						
Seed Collection	$12,964	$0	$0	$0	$0	$12,964
Weed Control						
Primary	$60,733.47	$0	$0	$0	$0	$60,733
Maintenance	$0	$24,619.36	$24,619	$24,619	$24,619	$98,477
Revegetation						
Revegetation	$42,884	$47,262	$55,053	$0	$0	$145,200
Replacement planting	$0	$0	$0	$14,520	$0	$14,520
Mulching (supply and install)	$71,109	$78,369	$29,046			$178,524
Watering	$8,205	$9,043	$3,351	$0	$0	$20,599
Plant salvage	$0	$0	$5,000	$0	$0	$5,000
Total	$195,897	$159,293	$117,070	$39,139	$24,619	$536,018

8 Vegetation management actions

Table 9 Vegetation management actions and performance criteria

Management action	Management zone	Responsibility	Task / performance criteria	Timing	Frequency of activity
NSW Priority weed control	All Zones	Vegetation management contractor	Primary and secondary weed control works are to include the following actions: • All priority within the VMP area are to undergo primary treatment within the first 8 months (establishment phase) of the commencement of the vegetation management program. • All mature priority weeds are to be successfully treated within the VMP area prior to commencement of the maintenance period. • Commencement of maintenance works will occur once mature exotic species have been reduced to 10% Projected Foliage Cover (PFC). Primary weed control works.	• From the outset of vegetation management program. • As specified adjacent.	• Monthly visitations during the establishment phase
Environmental weed control	All Zones	Vegetation management contractor	Primary and secondary weed control works are to include the following actions: • All aggressive environmental weeds are to be successfully treated within the VMP area prior to commencement of the maintenance period. Key target species are provided as Table 12. Commencement of maintenance works will occur once mature (listed) exotic species have been reduced to 10% Projected Foliage Cover (PFC).	• From the outset of vegetation management program. • As specified adjacent.	• Monthly visitations

Management action	Management zone	Responsibility	Task / performance criteria	Timing	Frequency of activity
Mowing and slashing	MZ1, MZ 3a and MZ 3b	Council maintenance team/ vegetation management contractor	Slashing and mowing is to be undertaken as per WCC performance requirements and service levels.	• From the outset of vegetation management program. • As specified adjacent.	• As required per Council service level requirements
Revegetation	MZ3a and MZ 3b	Vegetation management contractor	Following primary weed control and mulching, revegetation is to be undertaken with scope to provide for the required visual screening and biodiversity corridor. • All installed plants are to be propagated from locally sourced seed stock collected within a 10 kilometre radius of the study area, and selected from the list for contained in Appendix 3 of this VMP. • Revegetation works are not to compromise the ongoing integrity of the APZ and will consist predominantly of trees and shrubs.	• At the completion of scheduled primary weed control works and installation of mulch. • Progression of staged planting is provided as Table 5.	• As per allocated stages.
Revegetation	MZ6	Vegetation management contractor	Following primary weed control and mulching, revegetation is to be undertaken with scope to provide for the required visual screening and biodiversity corridor. • All installed plants are to be propagated from locally sourced seed stock collected within a 10 kilometre radius of the study area, and selected from the list for contained in Appendix 3 of this VMP. • Salvaged plant species are to be installed within this MZ.	• At the completion of scheduled primary weed control works and installation of mulch. • Progression of staged planting is provided as Table 5.	• As per allocated stages.

Management action	Management zone	Responsibility	Task / performance criteria	Timing	Frequency of activity
Revegetation maintenance	MZ3a,MZ 3b and MZ6	Vegetation management contractor	• Installed plantings are to be maintained with key elements of water, prevention of predation and suppression of smothering weeds. • There will be a maximum loss of 20% of the original planting numbers for an individual species. • A minimum of 80% survivorship for each species is to be maintained. • Replacement planting is to be carried out throughout the maintenance period to sustain the 80% survival rate at the completion of the maintenance period. • Losses of greater than 20% of originally installed plantings may have the maintenance period extended until survival rates have been achieved.	• Commences immediately following final installation of all plants. • Minimum weekly watering over 8 weeks in summer, or 3 weeks in winter, immediately following installation. • Watering visits to continue as required to plant establishment. • Weed removal as required to the completion of the maintenance period.	• As required to achieve performance criteria

Table 10 Vegetation management actions - Monitoring

Management action	Specification / Requirement
Ecological Monitoring Framework	Ecological Monitoring works are to be undertaken by the Vegetation Management Consultant. Monitoring surveys will assess the success of weed removal and plant growth and will be undertaken as follows; • Prior to commencement of works to gather baseline data. • Followed by a survey every four (4) months to gather ecological monitoring data on the progress of the project. Each four month survey should be accompanied by brief correspondence with the vegetation management contractor and the proponent / project manager regarding the progress of the vegetation management works, and highlight any areas of concern / merit. • Vegetation monitoring reports are to be prepared annually • Achievement of performance criteria will be updated in each preceding report as milestones are achieved. • These reports are to be submitted to WCC. The management zones will be monitored in terms of vegetation condition and the achievement of performance criteria. Monitoring activities are to include: • Establishing a minimum of two photo-points in representative locations. • Assessment of weed control works including priority and woody weed control, and weed density surrounding plantings • Identification and assessment of any natural regeneration of native plant species. • Assessment of the success rate of plantings and assessment of plant replacement requirements, and convey any need to BR contractor. • Assessment of the site for evidence of herbivory and erosion. Monitoring works will also provide the following certifications to the proponent / project manager, and then on to Council: • Certification that the planting stock is at the required densities. • Certification of commencement of maintenance period, i.e. all primary secondary and revegetation works have been completed to acceptable standards. • Final certification that the targets of the vegetation management works have been achieved.

9 Schedule of works

The VMP will be undertaken in general accordance with the schedule of works provided below and the relevant specifications provided. The responsibility for completing the actions within the schedule of works will be attributed to the principal vegetation management /bush regeneration contractor that is engaged to complete the works.

Table 11 Five year action plan for vegetation management

Actions	Timeframe				
	Year 1	Year 2	Year 3	Year 4	Year 5
Implement primary weed removal					
Maintenance weed control (all management zones)					
Revegetation					
Replacement planting					
Maintenance of stakes and bags within revegetated areas					
Plant salvage and installation					
Photo point monitoring and annual reporting					

10 Adaptive management

An adaptive management approach is to be employed in respect of the works forming part of this VMP. An adaptive management approach involves an integrated process of monitoring, reviewing and then responding to the health and condition of the plantings as well as the status of the weed species to identify any alterations to the design and maintenance of works that may be required to ensure the objectives of the VMP are achieved.

For example, the application rates for fertiliser and the watering schedule should be flexible in responding to the health and vigour of the plantings and changing climatic conditions. Monitoring the plantings will also allow for a review of the selected species to enable changes in the species composition of the supplementary planting if it is determined that a particular species or stock sourced from a certain location is not performing adequately. The supplementary planting species, planting densities and planting patterns nominated within this VMP may be subject to change and review if certain species are unavailable or are performing inadequately. The weed control works are also to be reviewed and appropriate changes implemented accordingly, if required. By example, if the nominated weed suppression schedule is not achieving the Performance Indicators specified, the frequency of weed suppression activities should be increased accordingly.

It is important to note that any changes should comply with the aims of this VMP and any licensing or approval conditions issued before implementation. An Adaptive Management Statement (or similar) will be prepared and signed by both parties prior to implementation of any adaptive management actions.

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Appendices

Appendix 1 Weed management measures

Standard methods

General weed management measures that should be undertaken prior to and during revegetation works:

- Use a range of weed management methods such as slashing or mowing (physical and mechanical control) as well as a range of herbicides (to avoid herbicide resistance).
- Mow/slash areas infested with weeds before they seed (avoiding native vegetation).
- Employ appropriate vehicle hygiene such as:
  - Clean machinery, vehicles and footwear before moving to a new location.
  - Securely cover loads of weed-contaminated material.
  - Dispose of weed contaminated soil at an appropriate waste management facility.
  - Remove weeds immediately and dispose of without stockpiling.
  - Separate weeds from native vegetation to be mulched – do not use weeds for mulch.
  - Minimise soil disturbance in weed infested areas.

Weed control methods adopted in the implementation of this VMP are based on a combination of the current site management, bush regeneration industry standards and botanical knowledge of the weeds. Techniques and methods recommended in following sections such as 'hand weeding' are described in detail in various publications such as *Recovering Bushland on the Cumberland Plain: Best practice guidelines for the management and restoration of bushland* (DEC 2005).The publication *New South Wales Weed Control Handbook: A guide to weed control in non-crop, aquatic and bushland situations, 7th Edition* (DPI 2018) provides descriptions on general and standard weed control methods.

Application of herbicide during weed control works will depend on species targeted and the growing situation. For example the selection of an herbicide and the application method for a particular species or class of plant will be determined by factors such as the degree of infestation of target species, limiting damage to off target native flora and preventing herbicides entering waterways. The DPI (2018) document cited above should be referred to as guide for specific herbicides, record keeping and herbicide application techniques.

Use of herbicides must be according to the NSW *Pesticides Act 1999*, Material Safety Data Sheets and labelling instructions for specific trade name herbicides and off label use permits registered with the APVMA. The use of herbicide as part of this VMP will be limited to direct application to cut stumps and spot spraying. Any contractors using herbicides on the site must be trained and appropriately qualified to do so (ChemCert Level 2 or equivalent for subordinates and ChemCert Level 3 or equivalent for supervisors).

Slashing can be used to prevent weeds from flowering and setting seed. This method can be undertaken with a tractor and slashing implement or by using a hand held brush cutter (DPI 2018). In addition DEC (2005) have highlighted that slashing or mowing can also be used in bushland areas (with grassy native understorey) as an initial or holding treatment to reduce weed mass. This allows for more efficient follow up as fast growing reshooting weeds can be spot sprayed with herbicide among areas of native grasses and herbs. DEC (2005) also suggest that to effectively control exotic annual herbs and grasses, mowing or slashing must be done at least monthly in summer (possibly more frequently if conditions are warm and wet and weed growth is accelerated). For perennial weeds which mature in mid to late summer, mowing or slashing may be reduced

to two to three times each season, with the final treatment being applied late in the season ideally before fruit ripens and seed becomes viable (DEC, 2005). Further simple techniques for reducing the potential for assisting the dispersal of weed species as a result of slashing are to:

- Slash from areas of dominated by native species to more degraded areas dominated by introduced species.
- Shake or wash down slashing implements in disturbed and managed areas prior to use in more intact areas.

In summary it is recommended that a combination of reducing the height and number of occasions slashing occurs and appropriate weed hygiene protocols be implemented.

Species specific control for priority and environmental weeds recorded within the VMP area are provided in Table 12.

Table 12 Priority and environmental weed management measures

Botanical name	Common name	Initial treatment	Follow up control
Annual weed species	Various	Hand remove Or chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100)	Monitor for seedlings. Hand remove and/or remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water
Acetosa sagittata	Turkey Rhubarb	Seeds to be bagged and removed from site. Hand removal all underground tubers. Chemically treat (spray) using a 333g/L Fluroxypyr based product at a dilution rate of 300 to 600 ml per 100 L water Or with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Ageratina adenophora	Crofton Weed	Cut and paint stems with 'neat' 360g/L Glyphosate based herbicide to reduce collateral damage to natives and riparian areas Or Chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100)	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water prior to flowering. A DPI approved biocontrol (Rust) may be applied to assist in control of large and remote locations.
Ageratina riparia	Mistflower	Cut and paint stems with 'neat' 360g/L Glyphosate based herbicide to reduce collateral damage to natives and riparian areas Or chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100)	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water
Andropogon virginicus	Whiskey Grass	Hand remove Or chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100). May require brush cutting or slashing to promote new growth prior to application.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water
Araujia sericifera	Moth Plant	Hand remove Or chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100). May require the use of a penetrant for effective kill rate. Fruits to be disposed off-site	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water

Botanical name	Common name	Initial treatment	Follow up control
Asparagus aethiopicus	Ground Asparagus Fern	Hand remove in area of high regeneration potential ensure that all fruiting bodies and central 'rhizome' has been removed and disposed offsite. Aerial tubers do not require removal and can act as a preventative measure against soil erosion. Large infestations to be chemically treated (spray) with a Metsulfuron-methyl 600 g/kg based herbicide at a diluted rate of 1 –2 g per 10 L of water plus a non-ionic surfactant. As per APVMA approved Off label permit PER9907.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water. All seeds and biomass are to be disposed offsite.
Bidens pilosa	Cobblers Pegs	Hand remove Or chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100)	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Cirsium vulgare	Spear Thistle	Flowering and fruiting bodies to be removed to reduce seed dispersal. Hand remove Or Chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100)	Germination is promoted via disturbance e.g soil movement, fire. Monitor for seedlings. Treat prior to flower and seed set
Chloris gayana	Rhodes Grass	Hand remove Or chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100). May require brush cutting or slashing to promote new growth prior to application.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water
Chrysanthemoides monilifera **subsp. rotundata**	Bitou Bush	Cut and paint stems with 'neat' 360g/L Glyphosate based herbicide Or Chemically treat 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water. Larger infestations can be treated with 360g/L Glyphosate based herbicide at a dilution rate of at a diluted rate of 5ml/L of water (1:200) during the targets flowering period. Introduction of biological controls can assist with larger infestations.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.

Botanical name	Common name	Initial treatment	Follow up control
Conyza bonariensis	Fleabane	Hand remove in area of high regeneration potential. Flowers and seeds to be removed and disposed of site. Remaining biomass can be composted on site on. Larger infestations can be chemically treated using a a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water. Treatment prior to flowering to reduce seed set is recommended.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Eragrostis curvula	African Lovegrass	Hand remove or chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100). May require brush cutting or slashing to promote new growth prior to application.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water
Lantana camara	Lantana	Small or isolated infestations: Hand remove or Cut and paint stems with 'neat' 360g/L Glyphosate based herbicide in areas of high regeneration potential. Large infestations: can be cleared/treated in a mosaic pattern to reduce impacts to wildlife and the incidence of mass germination of secondary weed species. Can be chemically treated (foliage spray) via the use of a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water or a broadleaf selective herbicide such as a Metsulfuron-methyl 600 g/kg based herbicide.	Hand remove seedlings/shooting nodes or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Ligustrum lucidum	Broad-leaved Privet	Cut/paint, Fill/drill and apply 'neat' 360g/L Glyphosate based herbicide during growing season.	Hand remove seedlings/shooting nodes or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Ligustrum sinense	Small Leaf privet	Cut/paint, Fill/drill and apply 'neat' 360g/L Glyphosate based herbicide during growing season. Larger specimens may produce vegetative suckers in response treatments.	Hand remove seedlings/shooting nodes or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.

Botanical name	Common name	Initial treatment	Follow up control
Ochna serrulata	Ochna, Mickey Mouse Bush	Small specimens may be manually removed. Established specimens can be either scaped/ painted using a 'neat' Glyphosate 360g/L based product or foliage spray using of a Glyphosate 360g/L and Metsulfuron-methyl 600g/kg based herbicides at a dilution rate of 200mL glyphosate plus 1.5g Metsulfuron methyl per 10L of water (off label permit: PER9907).	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Olea europaea* subsp. *Cuspidata	African Olive	Seedlings can be manually removed. Cut/paint, scrape/paint and apply 'neat' 360g/L Glyphosate based herbicide to actively growing stems in areas of in areas of high regeneration potential (off label permit: PER9907).	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water. Monitor for secondary weed incursions post removal of large monoculture infestations.
***Onopordum* spp.**	Scotch Thistle	Flowering and fruiting bodies to be removed to reduce seed dispersal. Hand remove or Chemically treat (spray) deseeded mature specimens with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water (1:100)	Germination is promoted via disturbance e.g. soil movement, fire. Monitor for seedlings. Treat prior to flower and seed set
***Opuntia* spp.**	Prickly Pears	Foliar spray using Triclopyr 600g/L based product at a dilution rate of 3.0L in 100L of water. The introduction of biological controls Cochineal and Cactoblastis are suggested for large infestations.	Spot spray seedlings and or propagules.
Rubus fruticosus aggregate	Blackberry	Dig out single plants (biomass to remain on site) or scape and paint using a 'neat' 360g/L Glyphosate based herbicide (off label permit: PER9907). Chemically treat larger infestations using either a 360g/L Glyphosate based herbicide at a diluted rate of 10–13mL per 1L of water or a APVMA approved broad leaf selective herbicide applied at the registered rate. Slashing may be require to gain access and stimulate new growth.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Senecio madagascariensis	Fireweed	Hand remove isolated infestation in areas of high regeneration potential. Spot spray using 360g/L	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.

Botanical name	Common name	Initial treatment	Follow up control
		Glyphosate based herbicide at a diluted rate of 10ml/L of water.	
Senna pendula var glabrata	Cassia	Cut/paint, scrape/paint and apply 'neat' 360g/L Glyphosate based herbicide to actively growing stems in areas of in areas of high regeneration potential (off label permit : PER9907).	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Solanum mauritianum	Wild tabacco	Cut/paint, scrape/paint and apply 'neat' 360g/L Glyphosate based herbicide to actively growing stems in areas of in areas of high regeneration potential (off label permit : PER9907). Spot spray with a with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
Delaria oderata	Cape Ivy	Seedlings can be manually removed. Cut/paint, scrape/paint and apply 'neat' 360g/L Glyphosate based herbicide to actively growing stems in areas of in areas of high regeneration potential (off label permit: PER9907).	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water. Monitor for secondary weed incursions post removal of large monoculture infestations.

Appendix 2 Recommended planting species list

Table 13 Recommended species planting list

Botanical name	Common name
Trees (10 -20 +m)	
Acacia binervata	Two-veined Hickory
Alphitonia excelsa	Red Ash
Diploglottis australis	Native Tamarind
Eucalyptus bosistoana	Coast Grey Box
Eucalyptus eugenioides	Thin-leaved Stringybark
Eucalyptus globoidea	White Stringybark
Eucalyptus longifolia	Woolybutt
Glochidion ferdinandi	Cheese Tree
Guioa semiglauca	Guioa
Melaleuca armillaris	Giant Honey Myrtle
Pennantia cunninghamii	Brown Beach
Podocarpus elatus	Illawarra Pine
Stenocarpus salignus	Scrub Beefwood
Streblus brunonianus	Whale bone tree
Shrubs	
Elaeodendron australe	Red Olive Plum
Pittosporum multiflorum	Orange Thorn
Maclura cochinchinensis	Cockspur Thorn
Scolopia braunii	Flintwood
Wilkiea huegeliana	Veiny Wilkiea
Sedges and grasses	
Carex longebrachiata	