Lot 100 Lawrence Hargrave Drive, Coalcliff: Vegetation Management Plan

FINAL REPORT

Prepared for Austcorp 601 Pty Ltd

14 March 2019

Biosis offices

NEW SOUTH WALES

Newcastle
Phone: (02) 4911 4040
Email: newcastle@biosis.com.au

Sydney
Phone: (02) 9101 8700
Email: sydney@biosis.com.au

Wollongong
Phone: (02) 4201 1090
Email: wollongong@biosis.com.au

Albury
Phone: (02) 6069 9200
Email: albury@biosis.com.au

VICTORIA

Melbourne
Phone: (03) 8686 4800
Email: melbourne@biosis.com.au

Ballarat
Phone: (03) 5304 4250
Email: ballarat@biosis.com.au

Wangaratta
Phone: (03) 5718 6900
Email: wangaratta@biosis.com.au

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Prepared by:	Tobias Scheid, Paul Price and Bianca Klein
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- NSW Office of Environment and Heritage for access to the BioNet Atlas of NSW Wildlife.

Biosis staff involved in this project were:

- Paul Price (VMP costings).
- Anne Murray (mapping).

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1 Introduction

1.1 Project background

Biosis Pty Ltd was commissioned by Austcorp 601 Pty Ltd to develop a Vegetation Management Plan (VMP) for the eastern segment of Lot 100 Lawrence Hargrave Drive, Coalcliff (the study area) (Figure 1).

Austcorp 601 Pty Ltd are proposing to undertake environmental protection works for the lot to include the development of a small amenities block, environmental restoration works, removal of coral trees and priority weeds within the study area.

The project is being assessed under Part 4 of the *Environmental Planning and Assessment Act 1979* (EP&A Act) with Wollongong City Council as the Consent Authority. The VMP has been prepared in accordance with the request for additional information provided by Wollongong City Council, to support DA-2018/1175 (dated 24 October 2018).

The proposed works do not require the removal of native vegetation and will result in the retention, enhancement and maintenance of 0.8 hectares of native vegetation which will include 0.5 hectares of revegetation of areas previously identified as being cleared or containing a cover of only exotic species (Figure 2).

This VMP herein provides controls and actions required to manage the retained ecological features within the study area (the VMP area) (Figure 1).

1.2 Description of VMP area

The VMP area is located approximately one kilometre south of Stanwell Park and approximately 22 kilometres north east of the Wollongong CBD (Figure 1).

The VMP area is within the City of Wollongong Local Government Area (LGA) and is zoned E2 Environmental Conservation, with a minimum lot size of 40 hectares imposed under the *Wollongong Local Environmental Plan 2009*. The surrounding land use is predominantly set aside for environmental conservation purposes, including the Illawarra Escarpment State Conservation Area. Low levels of residential development are present along the narrow coastal strip and bordered with the Illawarra railway.

The VMP area occurs within:

- Sydney Basin Bioregion
- Southern Rivers catchment region
- South East Local Land Services (LLS) Management Area.

The VMP area comprises of a mix of landscape features including rocky cliffs, one hollow-bearing tree, large sandstone boulders and minor rocky outcropping. The site consists of a cleared area of exotic grasses that is periodically mown surrounded by the vegetation community; *Coast Banksia - Coast Tea-tree low moist forest on coastal sands and headlands, Sydney Basin Bioregion and South East Corner Bioregion* referred to as Coast Banksia – Coast Tea-tree Forest, which is in poor to moderate condition (Figure 2).

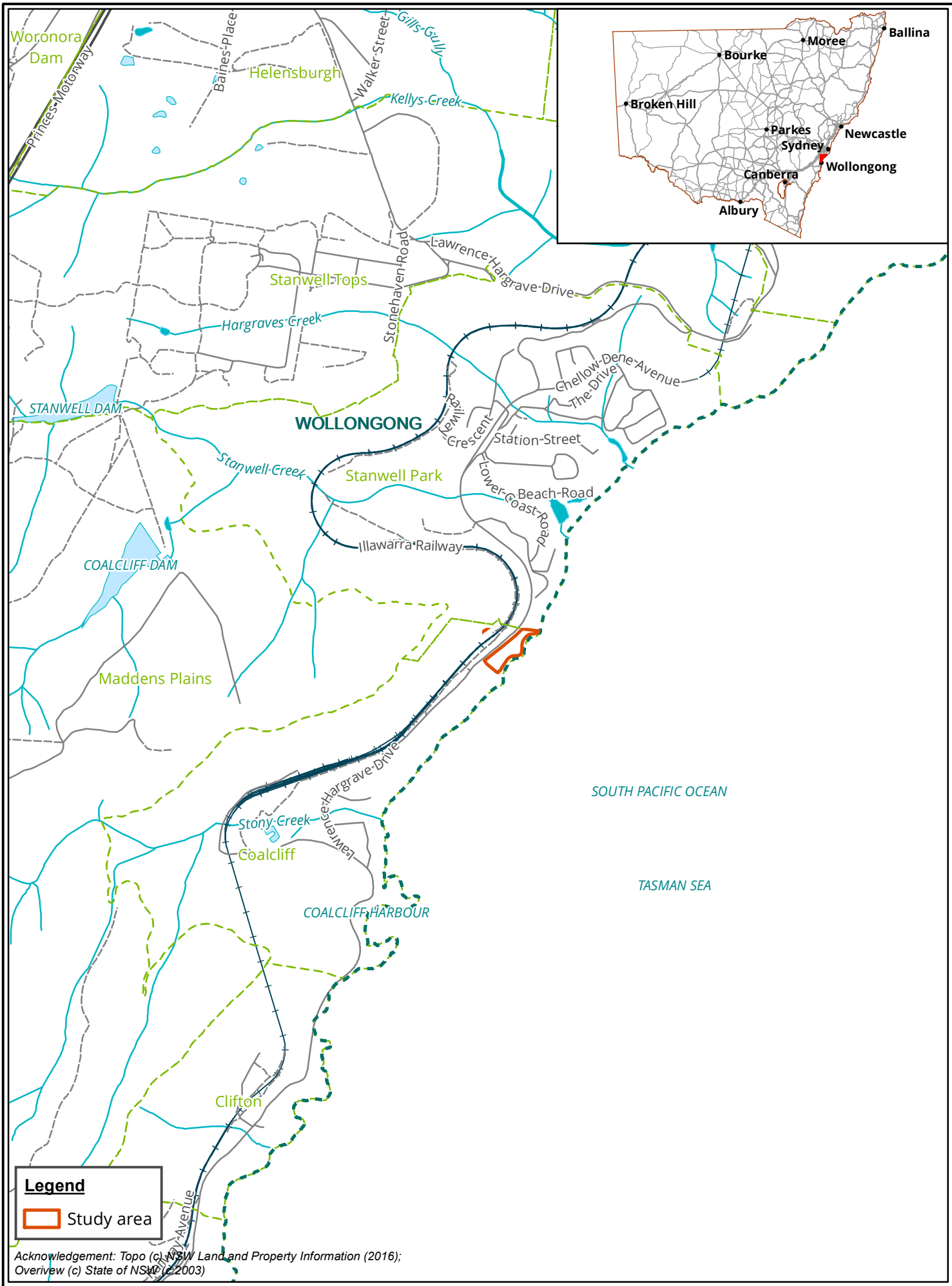
Regional soil landscape mapping indicates that the study area occurs on the Illawarra Escarpment Soils Landscape (Hazelton and Tille 1990). The Illawarra Escarpment soils landscape is characterised by steep

slopes on Quaternary talus, with loose dark brown sands, moderately pedal sandy clay loams and moderately pedal sandy clays. The composition of the soil is highly influential on the vegetation communities observed.

1.3 Potential ecological impacts

Key aspects of the proposed works that could result in potential ecological impacts include:

- Invasion of exotic species, weeds, pests and pathogens.
- Noise, vibration, light and vehicular movement impacts.
- General earth works resulting in disturbance of soils, erosion, and the mobilisation of sediment.
- Ground disturbance for the facilitation of temporary ancillary facilities including a small-sized tool storage shed and a toilet for contractor use.



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

Figure 1: Location of the study area

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

Matter: 28055
Date: 01 October 2018,
Checked by: BAK, Drawn by: DK, Last edited by: dkazemi
Location:P:\28000s\28055\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, revegetation areas and the ongoing management of weeds within the VMP area. The VMP will also outline ongoing management actions required for successful establishment of native plants within the VMP area, and actions to protect the surrounding vegetation from future impact.

The maintenance period will run for a duration of two to five years or until the objectives and performance criteria outlined in section 7 of this VMP are met.

2.2 Objectives

The specific objectives of this VMP are to:

- Outline strategies to avoid or minimise impacts on native vegetation where possible.
- Outline the management requirements for any vegetation to be retained, including details on tree and vegetation protection measures e.g. fencing and signage.
- Outline rehabilitation 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).
- Provide schedules for inspection, monitoring, management and corrective actions.
- Describe weed management activities.
- Incorporate a seed collection and revegetation strategy.
- Review flora species lists of surrounding vegetation community, Coast Banksia – Coast Tea tree low moist forest and identify a suite of flora species suitable for revegetation works within the VMP area.
- Identify native flora species present within the study area that are suitable for seed collection, propagation and planting.
- Describe planting density and composition for revegetation works within the VMP area.
- Provide schedules for inspection, monitoring, management and corrective actions.

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:

- *Biodiversity Constraints Assessment for Lot 100 Lawrence Hargrave Drive, Coalcliff* (Biosis 2018).
- Proposed Site Plans hand drawn (S Beaufils 12 November 2018).
- *Wollongong Local Environmental Plan 2009.*
- *Wollongong Development Control Plan 2009.*
- *Native Vegetation of the Illawarra Escarpment and Coastal Plain* (National Parks and Wildlife Service 2002).
- 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).
- Office of Environment and Heritage (OEH) NSW BioNet, the database for the Atlas of NSW Wildlife, for matters protected under the *Biodiversity Conservation Act 2016* (BC Act).

3.2 Field investigation

A general flora and fauna field investigation of the study area was conducted 27 September 2018 by a qualified and experienced botanist, Bianca Klein. The study area was surveyed using random meander methods over three person hours. 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, 1993, 2000, 2002), with reference to recent taxonomic changes.
- The identification and mapping of plant communities according to the structural definitions of *Native Vegetation of the Sydney Metropolitan Area* (OEH 2013) and the *Native Vegetation of the Illawarra Escarpment and Coastal Plain* (National Parks and Wildlife Service 2002).
- Identifying fauna habitats, assessing their condition and assessing their value to threatened fauna species.
- Observations of animal activity and searches for indirect evidence of fauna (such as scats, nests, burrows, hollows, tracks, scratches and diggings).
- 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 rehabilitation and bush regeneration techniques for the native vegetation of the site.

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.

3.3 Limitations

Ecological surveys provide a sampling of flora and fauna at a given time and season. There are a number of reasons why not all species will be detected at a field investigation, such as species dormancy, seasonal conditions, and ephemeral status of waterbodies and migration and breeding behaviours of some fauna.

4 Site description

4.1 Vegetation communities

The VMP area contains two vegetation communities:

- Plant Community Type (PCT) 771 *(Coast Banksia - Coast Tea-tree low moist forest on coastal sands and headlands, Sydney Basin Bioregion and South East Corner Bioregion)* Coast Banksia - Coast Tea-tree Forest.
- Exotic grassland.

The vegetation of the study area comprises one native vegetation community with patches in varying conditions; PCT 771, Coast Banksia – Coast Tea-tree Forest (Figure 2).

This community was characterised by a scrubby heath of up to five metres with a canopy of dry sclerophyll species including Coast Banksia *Banksia integrifolia*, Tuckeroo *Cupaniopsis anacardiodes* and occasional Bangalay *Eucalyptus botryoides* over a dense shrub layer of Coast Tea-tree *Leptospermum laevigatum*, and vines such as Climbing Guinea Flower *Hibbertia scandens*. Native grasses and graminoids including Spiky-headed Mat Rush *Lomandra longifolia*, Blady Grass *Imperata cylindrica*, Weeping Grass *Microlaena stipoides* were present in the groundcover. The community was assessed to be in moderate and poor condition based on extent of exotic species cover and presence of native midstorey species, likely an effect of variable exposure to prevailing coastal winds.

Exotic grassland

Exotic grassland within the VMP area consisted of patchy vegetation and bare earth. Vegetation was dominated by Annual Ryegrass *Lolium rigidum* and Kikuyu grass *Cenchrus clandestinus* with annual ground covers including Fleabane *Conyza bonariensis* and Plantain *Plantago lanceolata* also present in lower densities.

4.2 Fauna habitats

A range of fauna habitat features were present throughout the study area. Habitat within the VMP area provides potential foraging, breeding and nesting resources for a range of fauna. One hollow-bearing tree was recorded within the study area during field investigation. The habitat features relevant to each fauna group are identified in Table 1below.

Table 1 Key fauna habitat features present across the study area

Habitat features	Fauna species
Hollow-bearing trees	Arboreal mammals, microchiropteran bats and birds.
Leaf litter/woody debris	Foraging resources for birds, mammals, frogs and reptiles.
Pasture	Birds, microchiropteran bats and reptiles.

4.3 Threatened species habitats

Threatened species habitat within the VMP area is considered to be highly limited due to the past disturbance factors such as vegetation clearance, exotic species invasion and the close proximity the Illawarra Rail line. However, the vegetation directly west of the VMP area, with contiguous linkages to the north and south, has the potential to support a number of locally occurring threatened species.

Background searches identified 28 threatened flora species and 91 threatened fauna species recorded (OEH 2018) or predicted to occur (DEE 2018) within 10 kilometres of the study area. Of these locally occurring threatened species the following are considered most likely to occur, based on habitat suitability within the VMP area:

Flora

- Netted Bottle Brush *Callistemon linearifolius* (Vulnerable, BC Act)
- Prickly Bush-pea *Pultenaea aristata* (Vulnerable, EPBC Act and BC Act)
- Woronora Beard-heath *Leucopogon exolasius* (Vulnerable, EPBC Act and BC Act)
- Villous Mint-bush *Prostanthera densa* (Vulnerable, EPBC Act and BC Act)

Fauna

- Eastern Bentwing-bat *Miniopterus schreibersii oceanensis* (Vulnerable, BC Act)
- Eastern Freetail-bat *Mormopterus norfolkensis* (Vulnerable, BC Act)
- Greater Glider *Petauroides volans* (Vulnerable, EPBC Act and Endangered, BC Act)
- Grey-headed Flying-fox *Pteropus poliocephalus* (Vulnerable, EPBC Act and BC Act)
- Eastern Pygmy-possum *Cercartetus nanus* (Vulnerable, BC Act)
- Large-eared Pied Bat *Chalinolobus dwyeri* (Vulnerable, EPBC Act and BC Act)
- Little Bentwing-bat *Miniopterus australis* (Vulnerable, BC Act)
- Osprey *Pandion cristatus* (Vulnerable, BC Act)
- Powerful Owl *Ninox strenua* (Vulnerable, BC Act)
- Sooty Owl *Tyto tenebricosa* (Vulnerable, BC Act)
- Southern Myotis *Myotis macropus* (Vulnerable, BC Act)
- Spotted-tailed Quoll *Dasyurus maculatus* (Endangered, EPBC Act and Vulnerable BC Act)
- Squirrel Glider *Petaurus norfolcensis* (Vulnerable, BC Act)

4.4 Priority and environmental weeds

Four weeds listed as a priority weed in the Wollongong Local Government Area (LGA) under the NSW *Biosecurity Act 2015* (Biosecurity Act) was recorded within the subject site, with landowners and occupiers legally 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.*

The four weeds listed are also gazetted as Weeds of National Significance (WoNS) (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	Land managers should mitigate the risk of new weeds being introduced to their land. Plant should not be bought, sold, grown, carried or released into the environment.	yes
Chrysanthemoides monilifera* subsp. *rotundata	Bitou Bush	The study area is located within the 'Biosecurity Zone' of this Priority Weed, therefore the weed must be eradicated where practicable, or as much of the weed destroyed as practicable, and any remaining weed suppressed.	yes
Lantana camara	Lantana	Land managers should mitigate the risk of new weeds being introduced to their land.	yes
***Rubus fruticosus* aggregate**	Blackberry	Plant should not be bought, sold, grown, carried or released into the environment.	yes

5 Vegetation management

5.1 General approach

This VMP provides a prioritised succession of restoration works that have considered a long term commitment to biodiversity management and time frames for the reinstatement of important ecological values. The key to prioritising areas for restoration and the order of which works should be undertaken are the established principles of 'retain, regenerate and revegetate'. Inherent in this approach is the need to work from areas of more resilient bushland to areas of more degraded bushland (Buchanan 1989; DEC 2005).

5.2 Vegetation management zones

The ecological assessment completed by Biosis (2018) 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:

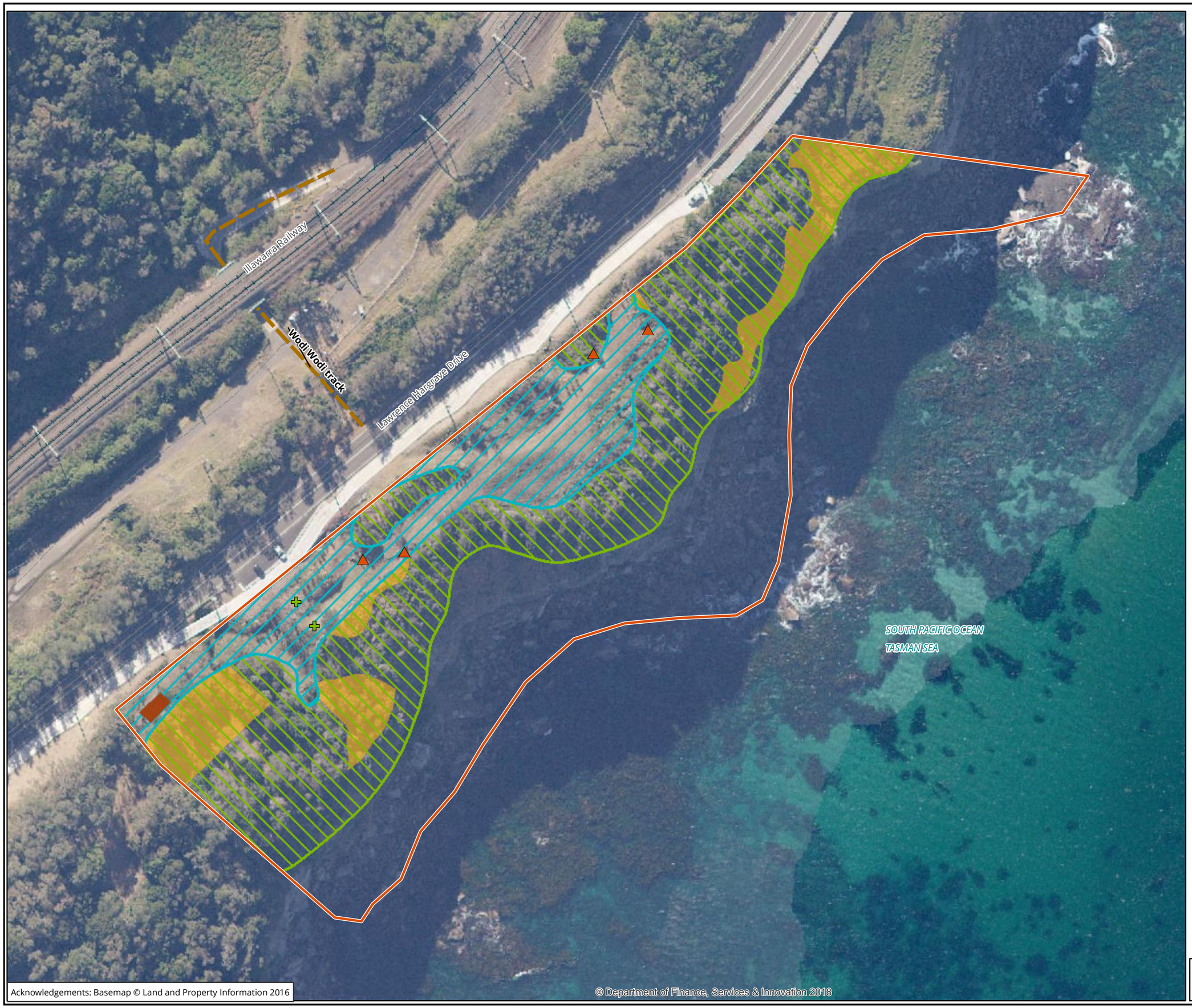
- future land use (retain or remove)
- vegetation community type
- resilience within the overstorey, shrub storey and understorey
- level of recruitment of exotic species (including priority weeds)

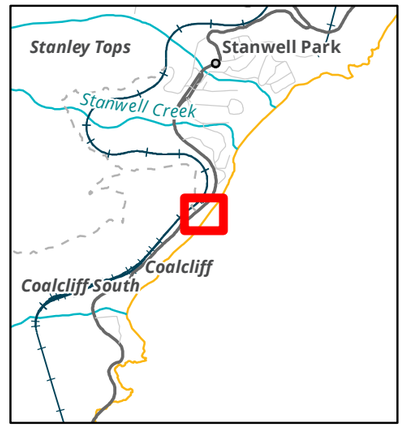
Using these attributes, two management zones have been identified within the VMP area (Table 3). The location and extent of each zone is provided in Figure 2 with corresponding summary of the management requirements for each zone provided in Table 3 below.

Table 3 Management zones

Management zone	Description
Management Zone 1: Cleared/managed exotic grasses (MZ1)	MZ1 is covers an area of 0.31 hectares within the VMP area. MZ1 has been subject to historic clearing and weed encroachment. MZ1 has been used previously as a stockpile area to resource infrastructure related projects in the general locality and as such there are some instances of dumped rubbish to be removed. Key management actions for this zone will include the removal of rubbish, maintenance of grassed areas to a suitable height and the control of priority weed species over the duration of the VMP to reduce the risk of weeds establishing and encroaching of surrounding native vegetation. The regeneration potential of the vegetation at MZ1 is low due its current level of disturbance, as such only minor revegetation works will be undertaken in this area. Planting of native grasses and shrubs at a low density is suggested, with a maintenance period of two years. Coral trees within this area are to be removed and all associated biomass is to be taken offsite for disposal.
Management Zone 2: PCT 771 Coast Banksia – Coast Tea Tree low moist forest (MZ2)	MZ2 covers an area of 0.83 hectares within the VMP area. MZ2 consists of low to moderate condition Coast Banksia – Coast Tea Tree low moist forest within the VMP area. Areas of poor condition vegetation comprising of cleared patches and areas with primarily exotic species cover have been identified as areas best suited for planting associated with the proposed environmental restoration works of the entire VMP area.

Management zone	Description
	Key management actions with the zone are to include the strategic treatment and removal of priority weeds, the removal of rubbish, revegetation and maintenance for a period of two years. All biomass generated from the weed control program is to be removed from site.





Legend

- Study area
- Proposed amenities
- Coral trees (to be removed)
- Rubbish

Vegetation communities

- Exotics within PCT 771 (to be planted out)

Managment zones

- MZ1 - Cleared/managed exotic grasses
- MZ2 - PCT 771 (Coast Banksia - Coast Tea-tree low moist forest on coastal sands and headlands, Sydney Basin Bioregion and South East Corner Bioregion)

Figure 2: VMP Management Zones

0 10 20 30 40 50

Metres
Scale: 1:1,000 @ A3
Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Albury, Ballarat, Melbourne,
Newcastle, Sydney, Wangaratta & Wollongong

Matter: 29083
Date: 30 November 2018,
Checked by: TPS, Drawn by: AEDM, Last edited by: amurray
Location:P:\29000s\29038\Mapping
29038_F2_MgmtZones

6 Specific management actions

6.1 Rehabilitation works

6.1.1 Seed collection

Although there is no loss to native vegetation as a direct impact of proposed works revegetation of cleared areas within MZ2 is recommended. The purpose of revegetation for this project includes:

- Creating buffer zones around retained native vegetation to protect it from edge effects.
- Creating or maintaining habitat corridors to help facilitate the movement of flora and fauna species.
- Maintaining native seed banks, local provenance of species endemic to the area and genetic diversity.

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 infill planting required within MZ2 as part of the environment protection works. Collection of seed from the adjoining retained vegetation to the west of the VMP area across Lawrence Hargrave Drive is recommended (depending on seasonal variations in seed production) to ensure adequate genetic diversity is maintained. Seed collection methods is provided in Appendix 1.

Seed collection is to be carried out in accordance with the Florabank Guidelines, by experienced and licenced seed collectors/ecologists (FloraBank 1999).

6.1.2 Weed management

This proposed works have the potential to introduce and promote weeds and pathogens in the development footprint as well as in the surrounding area. 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 2.

6.1.3 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 MZ2, with MZ1 likely to respond as quickly due to its current degraded condition. 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.

6.1.4 Infill planting and revegetation

Active revegetation is required in both MZ1 and MZ2. Infill planting and active revegetation are to be undertaken in general accordance with the specifications outlined below. A recommended species list for infill planting and active revegetation is provided in Appendix 3. The recommended planting list is based on species that are characteristic of PCT 771 Coast Banksia - Coast Tea-tree Forest 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.

Active revegetation should, where possible, be carried out in a manner that avoids structured plantings in straight lines and achieves a more randomised pattern.

All plants to be installed as part of the required revegetation works are to be either as hikos and/or enviro-cells sized pots. Advanced stock are not to be used for rehabilitation purposes and do not compensate for multiple plantings within the VMP area.

6.1.5 Plant numbers and densities

The following is a guide to inform the revegetation densities:

- MZ1: Currently cleared of native vegetation. Minor levels of revegetation will be required. No trees will be installed, shrubs will be installed at half the density of that at MZ2; at a rate of one plant per six square metres. Grasses and sedges will be installed at a rate of two plants per square metre and herbs and vines installed at a rate of one plant per two square metres.
- MZ2 PCT 771 Coast Banksia – Coast Tea Tree Forest: trees installed at a rate of one plant per six square metres, shrubs installed at a rate of one plant per three square metres, grasses and sedges installed at a rate of two plants per square metre and herbs and vines installed at a rate of one plant per two square metres.

The proposed planting numbers per management zone are provided in Table 4.

Table 4 Planting numbers

Zone	Trees	Shrubs	Grasses / Sedges	Herbs / vines	Total
MZ1	0	517	6,200	3,100	9,817
MZ2 (cleared/exotics to be planted out)	318	637	3,820	1,910	6,685
Total plants					16,502

An estimated 16,502 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 (1,650) has been included in the VMP costing schedule (Table 9).

6.1.6 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.

6.1.7 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 to 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 5 Recommended watering program

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

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 project manager.

6.1.8 Pest control

Predation by native macropods, introduced herbivores (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 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.

6.2 Maintenance

Maintenance works will commence following the implementation of weed control and revegetation activities and will continue for a period of 36 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 5.

Table 6 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

7 Cost and reporting

7.1 Preliminary civil works and tree removal

Costs associated with the clearing of vegetation, Coral tree removal, construction of silt fencing and site establishment have not been included in the budget. It is anticipated that the client will liaise with a chosen civil and tree removal contractor to complete the required works.

7.2 Seed collection

The collection of native seed is included into the costing. This price includes the suggested collection post vegetation clearance. Details are provided in Table 6.

7.3 VMP works

The total cost for the implementation of the VMP, including a 12 month establishment phase and a two year maintenance period is $151,319 (ex GST). A breakdown of costs per year is provided as Table 6. All costs are indicative only and are prone to fluctuation.

Table 7 VMP implementation costs

Task	Zone 1	Zone 2 (plants)	Zone 2 (no plants)	Total
Pre VMP works				
Seed Collection	$2,454	$1,671	$0	$4,125
Rubbish removal	$1,000	$1,000		$2,000
Weed Control				
Primary	$7,750	$4,775		$12,525
Secondary	$6,200	$3,820		$10,020
Maintenance	$9,300	$5,730	$19,560	$34,590
Revegetation works				
Revegetation	$38,285	$26,072		$64,357
Replacement planting	$3,829	$2,607	$0	$6,436
Watering	$7,363	$5,014	$4,890	$17,266
Total	$76,180	$50,689	$24,450	$151,319

7.4 VMP monitoring and reporting

Bi-annual monitoring reports will be provided to Wollongong City Council detailing the progress and success of the management actions, including planting survival rates and the effectiveness of weed control. Six monitoring events will occur over the three year lifetime of the VMP from commencement of rehabilitation works through to the maintenance stage.

All costs are indicative only and are prone to fluctuation.

Table 8 VMP monitoring and reporting costs

Project tasks	Subtotal	GST	Total (inc. GST)
Monitoring surveys	$2,108.00	$210.80	$2,318.80
Reports	$7,288.00	$728.80	$8,016.80
Subtotal fees	**$9,396.00**	**$939.60**	**$10,335.60**

Disbursements	Subtotal	GST	Total (inc. GST)
Field costs	$140.00	$14.00	$154.00
Mileage	$385.00	$38.50	$423.50
Subtotal disbursements	**$525.00**	**$52.50**	**$577.50**
Subtotal	**$9,921.00**	**$992.10**	
Total (inc. GST)			**$10,913.10**

8 Vegetation management actions

Table 9 Vegetation management actions and performance criteria

Management action	Management zone	Responsibility	Task / performance criteria	Timing
Define property boundary and install vegetation exclusion fencing	All Zones	Construction contractor / Vegetation management consultant	Vegetation exclusion fencing is to be installed as per the specifications above (Section 6.2.2).	• Prior to vegetation removal of earthworks.
Bush regeneration (primary and secondary weed control)	All Zones	Bush Regeneration contractor	Primary and secondary weed control works are to include the following actions: • All priority, environmental, vine and woody weeds are to undergo primary treatment within 4 weeks of the commencement of the vegetation management program. • Secondary treatments are to be ongoing as required over the next 8 weeks following completion of primary treatment works. • Commencement of maintenance works will occur once mature exotic species have been reduced to 5% Projected Foliage Cover (PFC). This is expected to be 12 weeks (3 months) after commencement of primary weed control works. • All mature priority weeds are to be successfully treated within the VMP area prior to commencement of the maintenance period.	• From the outset of vegetation management program. • As specified adjacent.
Revegetation	MZ1	Bush Regeneration contractor	• Following primary and secondary weed control, revegetation is to be undertaken to ensure sufficient vegetation cover exists to prevent soil erosion and to assist in the rehabilitation of the residing ecological community.	• At the commencement of revegetation works at MZ2.
	MZ2	Bush Regeneration	• Following primary and secondary weed control, revegetation is to be undertaken to ensure sufficient vegetation cover exists to prevent soil	• Immediately following successful

Management action	Management zone	Responsibility	Task / performance criteria	Timing
		contractor	erosion and to assist in the rehabilitation of the residing ecological community. • Where revegetation works are required, plants installed are to result in establishment of minimum of 3 total plants/m^2 (installed planting + existing native plants).	completion of secondary weed control.
Planting maintenance	MZ1 and MZ2	Bush Regeneration 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.
Bush regeneration maintenance	All Zones	Bush Regeneration contractor	• All mature priority weeds are to be successfully treated prior to commencement of maintenance period. • Seedlings of priority species are to be continually suppressed to a level of <5% Projected Foliage Cover (PFC) where they occur in the seed bank below mature specimens, and <1% PFC across remainder of the VMP area. • Works to be undertaken utilising best practice bush regeneration techniques.	• The maintenance period will run for a 24 month term following successful secondary weed control and/or installation of final

Management action	Management zone	Responsibility	Task / performance criteria	Timing
			• Less than 5% exotic species FPC to be achieved over the entire VMP area after 12 months of maintenance works. • Continual suppression at <5% for the remaining 12 months of the maintenance period (24 month total maintenance period).	plantings (whichever is later). • The commencement of this maintenance period may be adjusted if there are delays beyond the contractor's control. • Commencement and completion dates of the maintenance period will be determined by the Vegetation management consultant, following consultation with Council, the contractor and Principle.

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, plant growth and natural regeneration, and will be undertaken as follows: • Prior to commencement of works to gather baseline data. • Followed by a survey every six (6) months to gather ecological monitoring data on the progress of the project, commencing at the start of the maintenance period with a final survey and report at the completion of the 24 month program. Each six month survey should be accompanied by brief correspondence with the Bush Regenerator 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 at the commencement of maintenance works, at the 12 month stage, and a final report at the end of the 24 month period. • Achievement of performance criteria will be updated in each preceding report as milestones are achieved. • These reports are to be submitted to Wollongong Council. The restoration 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. • Compile initial and on-going weed density maps. • Assessment of weed control works including priority and woody weed control, and weed density surrounding plantings, via monitoring techniques such as weed density mapping, and quadrat / transect surveys. • Identification and assessment of any natural regeneration of native plant species. • Certification of local provenance plantings prior to installation. • Assessment of the success rate of plantings and assessment of plant replacement requirements, and convey any need to Bush Regeneration 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 (including initial and replacement plantings) is of local provenance as evidenced by the supplying nursery or bush regeneration contractor, and 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 bush regeneration contractor that is engaged to complete the work.

Table 11 Three year action plan for vegetation management

Actions	Timeframe		
	Establishment phase	Year 1	Year 2
Engage licensed seed collectors to collect seed			
Organise nursery to propagate revegetation plants from collected seed			
Implement primary weed removal			
Implement secondary weed removal			
Maintenance weeding			
Spray annual weeds and exotic grasses			
Plant out management zones			
Water revegetation			
Maintenance of stakes and bags within revegetated areas			
Photo point monitoring and six monthly 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 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 10, 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

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 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 (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 10.

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.
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 infestions 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-ionicsurfactant. As per APVMA approved Offlabel 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.
Asparagus asparagoides	Bridal Creeper	Hand remove in area of high regeneration potential ensure that all fruiting bodies and central 'rhizomes' has been removed and disposed offsite Or Chemically treat during peak growing season (Aug - Sept) using either a Metsulfuron-methyl 600 g/kg based herbicide at a diluted rate 10 g metsulfuron-methyl to 100 L water, or a 360g/L Glyphosate based herbicide at a diluted rate of 1 part glyphosate to 50 parts water. As per APVMA approved Off label permit PER9907. Introduction of a bio-control (rust) will assist in areas of heavy infestation.	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.

Botanical name	Common name	Initial treatment	Follow up control
***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.
Cinnamomum camphora	Camphor Laurel	Cut/paint, Fill/drill and apply 'neat' 360g/L Glyphosate based herbicide.	Hand remove seedlings or spot spray with a 360g/L Glyphosate based herbicide at a diluted rate of 10ml/L of water.
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.
Erythrina crista-galli	Cockspur Coral Tree	Cut/paint, Fill/drill and apply 'neat' 360g/L Glyphosate based herbicide during growing season.	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.

Botanical name	Common name	Initial treatment	Follow up control
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 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.
Sida rhombifolia	Paddy's Lucerne, Common Sida	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.

Appendix 3 Recommended planting species list

Table 13 Recommended species planting list and densities for Coast Banksia – Coast Tea-tree Forest

Management zone	Scientific name	Common name	Percentage of mix	Density
MZ2	**Trees**	**1 per 6m2**		
	Acmena smithi	Lilly Pilly	20%	0.20
	Banksia integrifolia	Coast banksia	20%	0.20
	Cupaniopsis anacardioides	Tuckeroo	20%	0.20
	Eucalyptus botryoides	Bangalay	20%	0.20
	Leptospermum laevigatum	Coast Teatree	20%	0.20
MZ1 and MZ2	**Shrubs**	**1 per 6m2 (MZ1) and 1 per 3 m2 (MZ2)**		
	Breynia oblongifolia	Coffee bush	30%	0.33
	Leucopogon parviflorus	Costal Beard-heath	20%	0.33
	Pitttosporum undulatum	Sweet Pittosporum	15%	0.33
	Westringia fruticosa	Coastal rosemary	20%	0.33
MZ1 and MZ2	**Grasses and sedges**	**2 per m2**		
	Cymbopogon refractus	barb-wire grass	20%	2
	Ficinia nodosa	Knobby club-rush	20%	2
	Imperata cylindrica	Blady grass	20%	2
	Lomandra Longifolia	Mat rush	15%	2
MZ1 and MZ2	**Herbs and Vines**	**1 per 2 m2**		
	Dichondra repens	Kidney weed	25%	0.50
	Hibbertia scandens	Climbing guinea flower	25%	0.50
	Pelargonium australe	Native storksbill	25%	0.50
	Viola hederacea	Ivy-leaved violet	25%	0.25