



Natural Area
CONSULTING MANAGEMENT SERVICES

Shire of Capel

Offset Site and Mitigation Site Revegetation Plan

V3: 24 July 2020

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Contents

1.0	Introduction.....	5
1.1	Location	5
1.1.1	Kemerton Site.....	5
1.1.2	Boyanup Road West Site	5
1.2	Tenure.....	8
1.2.1	Kemerton Site.....	8
1.2.2	Boyanup Road West Site	8
1.3	Current Condition.....	8
1.3.1	Kemerton Site.....	8
1.3.2	Boyanup Road West	8
2.0	Site Characteristics – Lot 150	10
2.1	Biogeographic Regionalisation	10
2.2	Climate.....	10
2.3	Topography and Soils	10
2.4	Vegetation Complex	12
2.5	Vegetation Type	12
2.6	Vegetation Condition.....	12
2.7	Hydrology	12
3.0	Revegetation Requirements – Lot 150 Zone 1	14
3.1	Revegetation Aims.....	14
3.2	Flora Species.....	14
4.0	Revegetation Plan – Lot 150.....	19
4.1	Flora Species List.....	19
4.2	Planting Zones and Ratios	20
4.3	Pre-planting Activities	20
4.3.1	Ripping.....	20
4.3.2	Weed Control	20
4.3.3	Pest Animal Control.....	24
4.3.4	Fencing.....	25
4.3.5	Rubbish Removal	25
4.3.6	Track Realignment.....	25

4.3.7	Firebreak.....	26
4.4	Revegetation Methodology.....	26
4.4.1	Revegetation – Tubestock	26
4.4.2	Revegetation – Tuart (<i>Eucalyptus gomphocephala</i>)	26
4.4.3	Revegetation – Seed	27
4.5	Watering.....	27
4.6	Completion Criteria	27
4.6.1	Contingency Measures	28
4.7	Monitoring.....	28
4.8	Annual Reporting.....	29
4.9	Permitting.....	29
5.0	Implementation – Lot 150 Zone 1	30
6.0	Indicative Cost Schedule – Lot 150 Zone 1	32
7.0	Revegetation Requirements – Boyanup Road West	33
7.1	Revegetation Aims.....	33
7.2	Flora Species.....	33
8.0	Revegetation Plan – Boyanup Road West	36
8.1	Flora Species List.....	36
8.2	Planting Zones and Numbers.....	37
8.3	Pre-planting Activities	37
8.3.1	Weed Control	37
8.3.2	Ripping.....	37
8.4	Revegetation Methodology.....	37
8.5	Watering.....	38
8.6	Completion Criteria	38
8.6.1	Contingency Measures	38
8.7	Monitoring.....	38
9.0	Implementation – Boyanup Road West	40
10.0	Indicative Cost Schedule – Boyanup Road West	42
11.0	References	43
Appendix 1:	Planting Numbers – Lot 150 Zone 1	44
Appendix 2:	Plant Availability by Nursery.....	46
Appendix 3:	Regulation 4 Permit Application.....	49

Appendix 4: Planting Numbers and Locations – Boyanup Road West51

1.0 Introduction

Natural Area Consulting Management Services (Natural Area) was contracted by the Shire of Capel to prepare a revegetation plan for the required offset requirements associated with the approval of clearing permit CPS 8116/2 to offset the loss of black cockatoo habitat as a result of clearing in road reserves to support road upgrades. One primary site offset location has been nominated, comprising 3.6 ha in Kemerton, with a secondary mitigation site comprising 47 small Plots along Boyanup Road West (approximately 1.6 ha).

Accordingly, this plan will:

- describe the Kemerton site, including its location and description of key characteristics; as the nature of restoration activities along the Boyanup West Road revolve around the installation of individual trees and shrubs, site characteristics have not been provided in this document
- outline management aims and objectives for each site
- describe rehabilitation activities, their rationale, and methodology for each site
- provide success criteria, monitoring and reporting requirements for each site
- describe contingency plans if success criteria are not met for each site
- outline weed and pest control activities for the Kemerton site
- provide an indicative implementation schedule and costings for each site.

1.1 Location

1.1.1 Kemerton Site

The offset site is located within the Kemerton Industrial Estate Buffer (Figure 1) at Lot 150 of the proposed 5(1)(h) reserve off Treasure Road in Kemerton within the Shire of Harvey (Figure 1). The offset site location and area was agreed in consultation with the Department of Water and Environmental Regulation (DWER) and the Department of Biodiversity, Conservation and Attractions (DBCA). It is accessed by a track from Treasure Road, with other tracks present in the vicinity also likely to provide access from other directions.

The Lot 150 site is approximately 7 ha in area, of which about 3.6 ha will be restored in the first instance. Vegetated land is present to the north, east and south, with pastureland with some patchy trees present to the west

1.1.2 Boyanup Road West Site

The Boyanup Road West Site comprises 47 small Plots within the existing vegetated road reserve where the infill planting of trees and shrubs will occur (Figure 2, with more detailed maps provided in Appendix 4).





Figure 2:
Location, Mitigation Site Plots
Boyanup Road West

Not to Scale



Client: Shire of Capel
Date: 10 June 2020
Created by: S. Brand
Image Source: Nearmap, 2018
Datum: GDA 94

1.2 Tenure

1.2.1 Kemerton Site

Lot 150 of the proposed 5(1)(h) reserve in Kemerton is freehold land held by the Conservation and Land Management Executive Body, with the land manager being the Department of Biodiversity, Conservation and Attractions (DBCA). During the revegetation works, management of the site will be the responsibility of the Shire of Capel and will revert to the DBCA once restoration activities are finalised and completion criteria have been achieved.

1.2.2 Boyanup Road West Site

The Shire of Capel has been assigned the management orders for the Boyanup Road West road reserve, including the areas that will comprise the mitigation site.

1.3 Current Condition

1.3.1 Kemerton Site

The site is currently pastureland with most of its native vegetation cleared through its probable historical use as grazing land (Figures 1, 3). Some patchy trees present at the site will be retained and contribute to the revegetation/restoration activities.



Figure 3: Current land use

1.3.2 Boyanup Road West

The Boyanup Road West road reserve includes the current road, the road verge, and vegetated areas ranging from 4 to 9 m. Vegetation includes remnant trees and shrubs, with a largely grassy understorey (Figure 4).



Figure 4: Boyanup Road West road reserve

2.0 Site Characteristics – Lot 150

Site characteristics, including soils, vegetation complexes and climate, will inform the revegetation plan, as the aim is to restore vegetation species suitable for foraging and roosting by endangered black cockatoo species (i.e.: Carnaby's Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Cockatoo (*Calyptorhynchus banksia naso*), and Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) that will be lost during road widening works. Key characteristics are outlined in this section.

2.1 Biogeographic Regionalisation

According to Interim Biogeographical Regionalisation of Australia (IBRA) descriptions, the offset sites are located within the Swan Coastal Plain (SWA 2 – Swan Coastal Plain subregion). This area is described as being a low-lying coastal plain with sands of colluvial and aeolian origin. The region is dominated by Banksia and/or Jarrah Woodland over sandy soils associated with the dune systems, with Paperbark (*Melaleuca*) in swampy/damp areas and Jarrah Woodland to the east where the Swan Coastal Plain rises (Mitchell, Williams & Desmond, 2002).

2.2 Climate

The climate experienced in the area is Mediterranean, with dry, hot summers and cool, wet winters.

According to the Bureau of Meteorology (Bunbury, Station ID 009965, 2020):

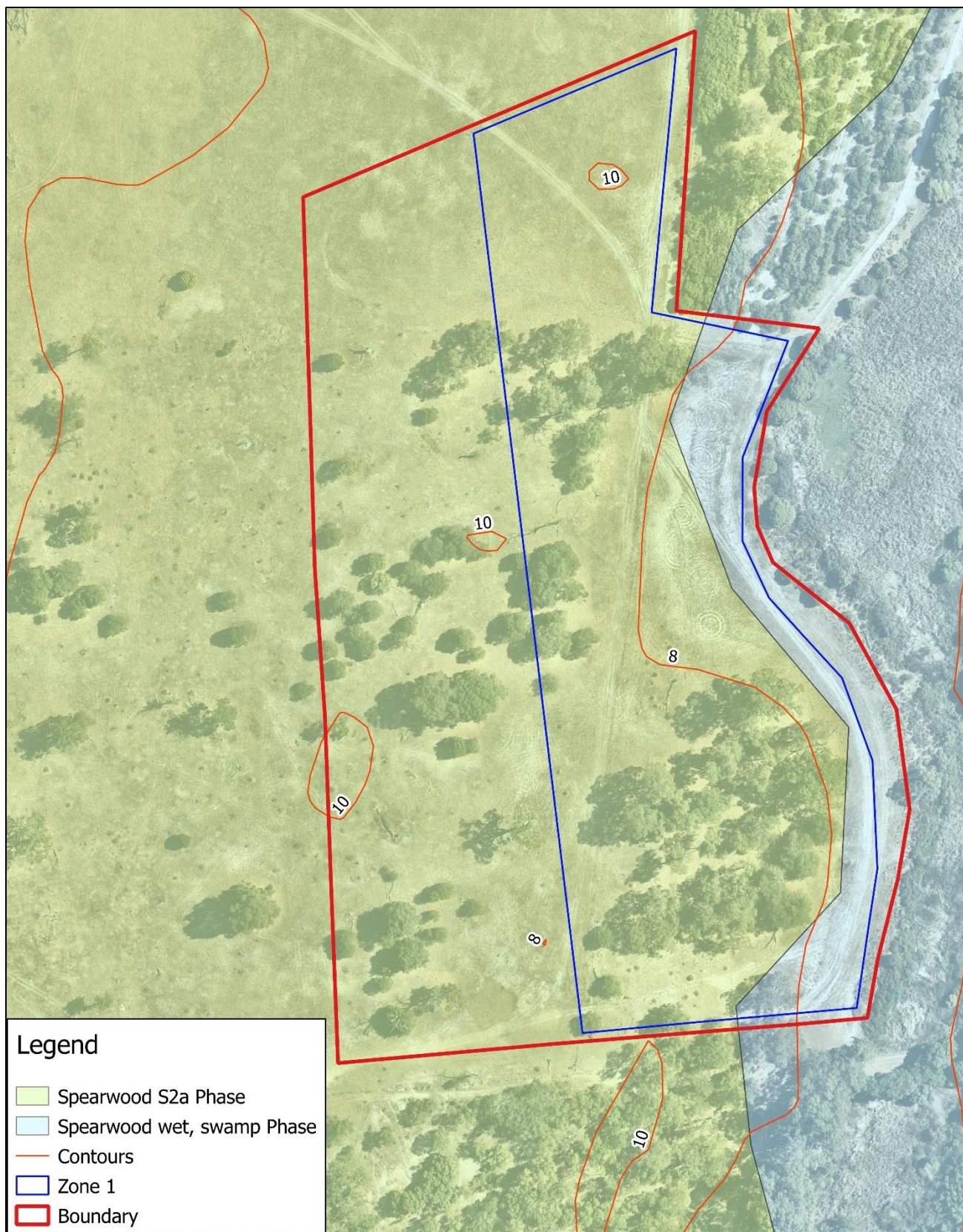
- average rainfall is 718.4 mm per annum, with the majority falling between May and September
- average maximum temperatures range from 17.3 °C in winter to 30.0 °C in summer, with the highest recorded maximum being 40.8 °C
- average minimum temperatures range from 7.1 °C in winter to 15.9 °C in summer, with the lowest recorded minimum being -3.0 °C
- winds commonly range from 12 km/h – 22.6 km/h, with higher wind speeds known during storm events
- wind direction is generally from the east and south east in the morning and westerly in the afternoon during summer.

2.3 Topography and Soils

According to the NRInfo Portal (Department of Primary Industries and Regional Development, 2020a, the site is located within the broader Spearwood Dune System. The site slopes upwards from the wetland (8 m AHD) located immediately to the east of the site to a dune crest at 10 m AHD towards the western portion of the site. Two soil types are present on the site (Table 1, Figure 5).

Table 1: Soil types

Symbol	Name	Description
211Sp__S2a	Spearwood S2a Phase	Lower slopes (1-5%) of dune ridge with moderately deep to deep siliceous yellow-brown sands or pale sands with yellow-brown subsoils and minor limestone outcrop
211SpW_SWAMP	Spearwood wet, swamp Phase	Spearwood wet, swamp Phase



2.4 Vegetation Complex

According to Heddle, Loneragan and Havel (1980), the Yoongarillup Complex vegetation complex is the only one present at the site. This complex is characterised by:

- extensive areas of Tuart (*Eucalyptus gomphocephala*) Woodland with Peppermint (*Agonis flexuosa*) in the middle storey
- in some locations, the Tuart Woodland is replaced with an open forest of Tuart, Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*), as occurs within the subject site
- typical understorey species include *Banksia attenuata*, *Hibbertia hypericoides*, *Macrozamia riedlei*, *Hypocalymma robustum* and *Jacksonia floribunda*.

The Tuart (*Eucalyptus gomphocephala*) Woodlands and forests of the Swan Coastal Plain are listed as a priority 3 ecological community under the *Biodiversity Conservation Act 2016 (WA)* (DBCA, 2020) and as critically endangered under the *Environment Protection and Biodiversity Conservation Act 1999 (Cwlth)* (Department of the Environment and Energy (DoEE), 2019). Accordingly, the rehabilitation of this site will increase the area of this ecological community and contribute to its longer term protection.

2.5 Vegetation Type

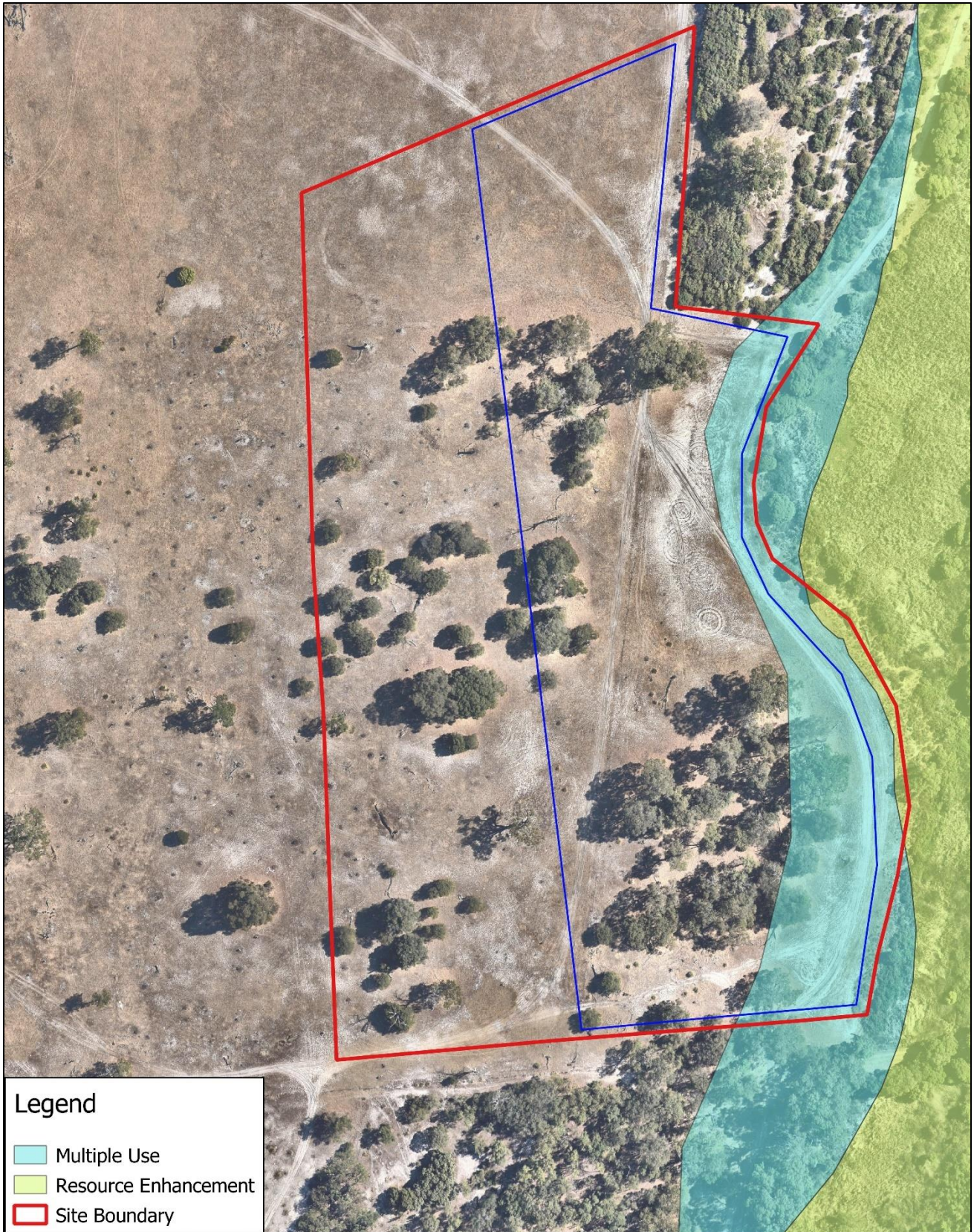
The vegetation type within the revegetation area is Tuart, Marri and Jarrah Woodland over a sparse middle storey of *Agonis flexuosa* (Peppermint Trees) and *Xanthorrhoea preissii* (Grass Trees), with an understorey that consists of weedy grasses, primarily Perennial Veldt (*Ehrharta calycina*), and other herbs.

2.6 Vegetation Condition

The current vegetation condition is Completely Degraded across the entire revegetation area, with sparse native overstorey and middle species remaining and no native understorey. The area has been parkland cleared with evidence of logging with numerous Jarrah stumps remaining, and signs of soil compaction due to previous grazing by cattle.

2.7 Hydrology

A review of information included on the Wetlands of the Swan Coastal Plain dataset maintained by the DBCA (2020) indicates the presence of a resource enhancement and a multiple use wetland area immediately to the east of the site (Figure 6). The presence of the wetland areas in combination with the slope of the land to the east mean they will have no influence of the choice of species used in the revegetation process.



3.0 Revegetation Requirements – Lot 150 Zone 1

The Shire of Capel has committed to revegetating an approximately 3.6 ha area within Lot 150 in the Kemerton Industrial area buffer zone. This will cover off the required offset of 1.6 ha associated with the approval conditions of CPS 8116/2. The remainder of the 7 ha of land will be used for future offset requirements expected from road widening in the Shire.

3.1 Revegetation Aims

The aim of the revegetation activities within the Offset site are to:

- restore the site to a self-sustaining ecosystem that extends the existing area of vegetation
- restore the key vegetative features within the offset site to reflect the Tuart-Jarraah-Marri vegetation structure present in the surrounding area
- include a range of flora species that provide a suitable feeding source for endangered black cockatoo species.

3.2 Flora Species

Flora refers to the individual plant species that are found in an area, while vegetation refers to the broader assemblage of plants associated with a habitat and ecosystem. Many Western Australian plants have a close association with one or more soils in a locality, and as a result may be found nowhere else. Desktop searches were undertaken to determine whether declared rare flora and/or threatened or priority listed ecological communities were likely to be found at the site.

The Treasure Road revegetation site was traversed by Natural Area's Lead Botanist during April 2020 to:

- ground-truth desktop information
- assess the vegetation type and condition
- assess the type and extent of weeds
- develop a floristic species list for use in revegetation activities.

Flora present in nearby vegetated areas was also reviewed to determine species that would likely be present in vegetation of good or better condition to inform this revegetation plan. Note that while the timing of the site visit was not ideal in terms of occurring during the spring flowering season, it was carried out on a degraded site at a time to enable this plan to be formulated with implementation to commence later in 2020.

Table 2 presents the aspirational flora species list based on the visit to the site, a review of NatureMap search outcomes, consideration of ease of growing/propagating, and input from DBCA. It is expected that this list will be used as the basis of sourcing tubestock from suitable nurseries when revegetation commences. Note that subject to survival rates, additional species may be added in consultation with DBCA.

As the offset site is to replace cockatoo habitat, the DBCA have indicated that a selection of preferred black cockatoo feeding and potential roosting species, such as Eucalypts, are included within the plantings; Table 2 includes eight species local to the area that are known to be preferred black cockatoo feeding sources, namely:

- *Banksia attenuata* (Slender Banksia)

- *Banksia dallanneyi* (Couch Honeypot)
- *Corymbia calophylla* (Marri)
- *Eucalyptus gomphocephala* (Tuart)
- *Eucalyptus marginata* (Jarrah)
- *Hakea prostrata* (Harsh Hakea)
- *Persoonia elliptica* (Spreading Snottygobble)
- *Persoonia saccata* (Snottygobble).

These species are to be given preference when sourcing tubestock, with higher numbers to be installed in comparison to other species (refer Section 4.4.1, Appendix 1).

Table 2: Aspirational flora species list

Species Name	Common Name	Life form	Revegetation Site	Nearby Bushland	DBCA	NatureMap	Black Cockatoo Food Source
<i>Acacia extensa</i>	Wiry Wattle	Shrub			X		
<i>Acacia pulchella</i>	Prickly Moses	Shrub	X			X	
<i>Acacia saligna</i>	Orange Wattle	Large Shrub	X			X	
<i>Acacia stenoptera</i>	Narrow Winged Wattle	Low shrub				X	
<i>Acacia willdenowiana</i>	Grass Wattle	Low shrub				X	
<i>Agonis flexuosa</i>	Peppermint	Low Tree	X				
<i>Anigozanthos humilis</i>	Catpaw	Herb				X	
<i>Anigozanthos manglesii</i>	Mangles Kangaroo Paw	Herb				X	
<i>Austrostipa flavescens</i>		Grass				X	
<i>Banksia attenuata</i>	Slender Banksia	Tree			X		X
<i>Banksia dallanneyi</i>	Couch Honeypot	Shrub			X		X
<i>Bossiaea eriocarpa</i>	Common Brown Pea	Low shrub				X	
<i>Calytrix flavescens</i>	Summer Starflower	Low shrub			X		
<i>Conostylis aculeata</i>	Prickly Conostylis	Herb				X	
<i>Conostylis juncea</i>		Herb				X	
<i>Corymbia calophylla</i>	Marri	Tree	X				X
<i>Dampiera linearis</i>	Common Dampiera	Herb			X		
<i>Dasyopogon bromeliifolius</i>	Pineapple Bush	Herb	X			X	
<i>Daviesia divaricata</i>	Marno	Shrub		X		X	
<i>Desmocladius flexuosus</i>		Herb			X		
<i>Dianella brevicaulis</i>		Herb			X		
<i>Eucalyptus gomphocephala</i>	Tuart	Tree	X				X
<i>Eucalyptus marginata</i>	Jarrah	Tree	X			X	X
<i>Gastrolobium capitatum</i>		Shrub			X		
<i>Gompholobium confertum</i>		Low shrub				X	

Species Name	Common Name	Life form	Revegetation Site	Nearby Bushland	DBCA	NatureMap	Black Cockatoo Food Source
<i>Gompholobium tomentosum</i>	Hairy Yellow Pea	Low shrub				X	
<i>Hakea prostrata</i>		Shrub				X	X
<i>Hardenbergia comptoniana</i>	Native Wisteria	Climber				X	
<i>Hibbertia hypericoides</i>		Low shrub		X			
<i>Hibbertia racemosa</i>	Stalked Guinea Flower	Low shrub				X	
<i>Hovea trisperma</i>		Low shrub				X	
<i>Hypocalymma robustum</i>	Swan River Myrtle	Low Shrub		X			
<i>Hypolaena exsulca</i>		Sedge			X		
<i>Jacksonia furcellata</i>	Grey Stinkwood	Large Shrub	X			X	
<i>Kennedia coccinea</i>	Coral Vine	Climber				X	
<i>Kennedia prostrata</i>	Scarlet Runner	Climber				X	
<i>Kunzea glabrescens</i>	Spearwood	Large Shrub	X			X	
<i>Lepidosperma squamatatum</i>		Sedge		X		X	
<i>Lomandra caespitosa</i>	Tufted Mat Rush	Herb				X	
<i>Lomandra hermaphrodita</i>		Herb				X	
<i>Lyginia barbata</i>		Herb			X		
<i>Macrozamia riedlei</i>	Zamia	shrub		X			
<i>Melaleuca thymoides</i>		Shrub			X		
<i>Microlaena stipoides</i>	Weeping Grass	Herb			X		
<i>Nuytsia floribunda</i>	Christmas tree	Tree	X	X			
<i>Opercularia hispidula</i>	Hispid Stinkweed	Herb			X		
<i>Patersonia occidentalis</i>	Purple Flag	Herb				X	
<i>Persoonia elliptica</i>	Spreading Snottygobble	Tree				X	X
<i>Persoonia saccata</i>	Snottygobble	Shrub				X	X
<i>Petrophile linearis</i>	Pixie Mops	Low shrub				X	
<i>Philothea spicata</i>	Pepper and Salt	Shrub			X		

Shire of Capel

Offset Site and Mitigation Site Revegetation Plan

Species Name	Common Name	Life form	Revegetation Site	Nearby Bushland	DBCA	NatureMap	Black Cockatoo Food Source
<i>Phlebocarya ciliata</i>		Herb				X	
<i>Phyllanthus calycinus</i>	False Boronia	Low shrub				X	
<i>Platysace filiformis</i>		Shrub			X		
<i>Sowerbaea laxiflora</i>	Purple Tassels	Herb				X	
<i>Stirlingia latifolia</i>	Blueboy	Shrub			X		
<i>Styphelia pallida</i>		Low shrub			X		
<i>Styphelia propinqua</i>		Low shrub			X		
<i>Tetraria octandra</i>		Sedge			X		
<i>Tricoryne elatior</i>	Yellow Autumn Lily	Herb				X	
<i>Xanthorrhoea brunonis</i>		Low shrub	X			X	
<i>Xanthorrhoea preissii</i>	Grass Tree	Shrub	X				
<i>Xylomelum occidentale</i>	Woody Pear	Tree		X		X	

4.0 Revegetation Plan – Lot 150

The major aim of the revegetation plan is to describe and guide revegetation activities over a four year period from site preparation works, installation and plant establishment and three years' post-installation monitoring and maintenance prior to the site being returned to the DBCA for ongoing management. The focus of the plan revolves around the restoration of a Tuart-Jarrah-Marri woodland with an appropriate middle and understorey in Lot 150 zone 1 and the five vegetation types located along the Boyanup West Road reserve.

Plan development has included the following activities:

- identification of flora species within the offset site and nearby vegetated areas, including native and weed species
- assessment of vegetation condition
- consideration of tree health issues, the presence of waste materials, and pests that could reduce the success of rehabilitation outcomes
- development of success and monitoring criteria to be implemented after the initial installation of tubestock.

4.1 Flora Species List

Based on the review process, the species list includes 63 species that have the highest probability of being sourced as local provenance stock from reputable nurseries (Table 2, Appendix 1). The aim of the list is to provide an indication of species that could be included within the restoration process, with the actual list being informed by those available from the nursery (or nurseries) contracted to provide the tubestock for the site. Note that black cockatoo species are 'primary' plants for the revegetation works due to the site being an offset for the loss of their habitat; installation of these species will be at twice the ratio of others.

Plants will need to be ordered by October/November at the latest the year before planting and meet the following requirements:

- sourced from a NIASA accredited nursery
- tubestock needs to be suited to the offset site growing conditions (local provenance)
- pot size = forestry tube (50 mm x 50 mm x 120 mm tall)
- plants shall be vigorous, established and hardened off
- have a good form consistent with species and variety
- free from disease and pests
- have large healthy root systems with no evidence of having been restricted or damaged (e.g.: root bound)
- any pruning, budding or grafting scars will be clean and well calloused
- trees will have a single leading shoot unless otherwise specified
- stock will be able to support their own weight, i.e. stand without staking
- containers will be free of weeds
- the root ball of the plant shall remain intact with only a minor amount of loose soil present.

Note that the majority of species identified as being suited for the restoration works can be easily propagated from seed, with others such as *Hibbertia racemosa* grow best from cuttings and the *Sowerbaea laxiflora* seems to only be obtained through salvage.

4.2 Planting Zones and Ratios

As the offset site will be planted out with a single vegetation type, with the planting occurring over several years; initially 3.6 ha will be planted out (Zone 1, Figure 4)) with the additional areas of the site planted out as required. Revegetation works will commence in the east in the area adjacent to the wetland and work progressively north and west over time. The nominated planting ratio is one tree (overstorey) per 10 m², two shrubs per 5 m² (middle storey) and one herb per 2 m² (understorey). This ratio will replicate the typical vegetation structure present within surrounding areas with the same vegetation type and achieve a target density of 10 000 plants per ha.

4.3 Pre-planting Activities

The success of revegetation activities can be closely linked to the effective management of other activities, particularly the presence of weeds and pests. Thus, pre-planting activities will be required ahead of the tubestock planting that is expected to occur in 2021. Pre-planting activities will include (Figure 4):

- ripping of the site
- weed control
- pest animal control (if required)
- rubbish removal
- fencing
- track realignment
- firebreak construction.

4.3.1 Ripping

Ripping the site will assist with removing any areas of compaction or other obstructions that could prevent root penetration of seedlings. The use of a winged tine will result in a rip line approximately 40 cm deep every second line and create a microclimate that will contribute to seedling establishment. Seedlings planted into these rip lines will have some protection from wind and increased water retention due to the slope of the rip line. Ripping will occur across the site where trees are absent on two occasions before any planting activities, once in year one during initial site preparation activities and again prior to planting activities that will commence in year two.

4.3.2 Weed Control

The main weed present within the site is Perennial Veldt Grass (*Ehrharta calycina*). At present, is dried and presents a fire hazard, and it has also created a monoculture that may have prevented the natural regeneration of native species. Blackberry (*Rubus laudatus*) (weed of national significance (WoNS) and declared pest listed under the *Biosecurity and Agriculture Management Act 2007* (WA)), Arum Lily (*Zantedeschia aethiopica*) (declared pest). While these species are outside of the offset boundary, there is the possibility that they could spread into the site. *Trachyandra divaricata*, and Red Ink Weed (*Phytolacca octandra*) were noted in the eastern side of the revegetation site nearer the wetland. Control methods for each of these weeds is provided in Table 3 and occurrence locations in Figure 4. Slashing of weeds can be

undertaken prior or post herbicide weed control; if slashing machinery is used in hotter spring/summer months they should be accompanied by a watering unit to reduce fire risk to the site. Given the revegetation area is to be ripped, slashing has not been included in the indicative implementation costings at this stage.

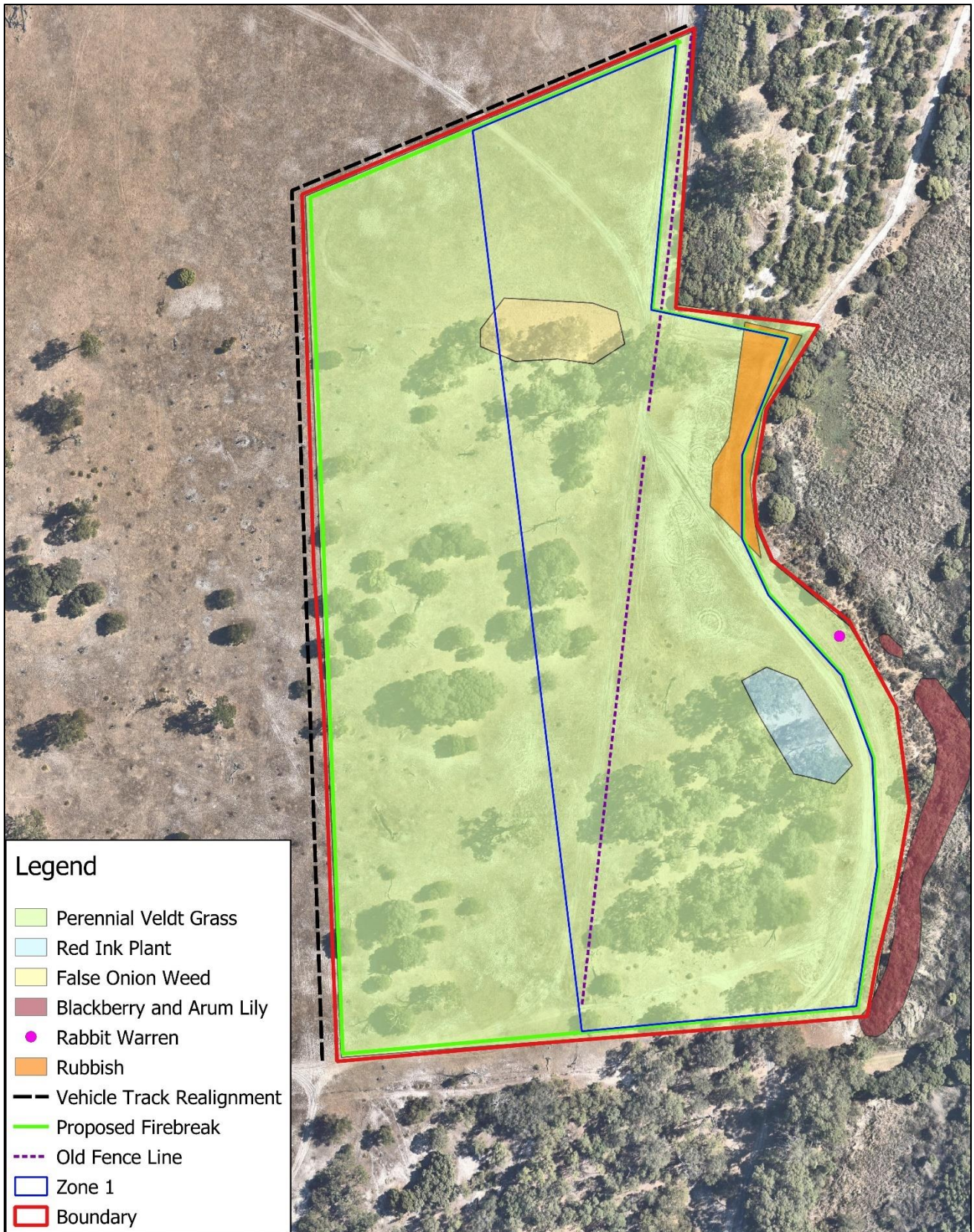


Figure 7:
 Pre-planting Activities
 Revegetation Offset Site, Kemerton



Client: Shire of Capel
 Date: 18/05/2020
 Created by: S. Hynes
 Image Source: Nearmap 2020
 Datum: GDA 94

Table 3: Weed control methods

Species	Common Name	Treatment Type	Treatment Timing
<i>Ehrharta calycina</i>	Perennial Veldt	<ul style="list-style-type: none"> Spray - selective grass spray (will affect native grass species) 	<ul style="list-style-type: none"> Nov – Feb
<i>Phytolacca octandra</i>	Red Ink Weed	<ul style="list-style-type: none"> Dig out isolated plants and cut root at least 5 cm below ground level to prevent regrowth Spray with 1% glyphosate with Pulse® 	<ul style="list-style-type: none"> Manual removal can occur all year round Oct – Dec
<i>Rubus laudatus</i>	Blackberry	<ul style="list-style-type: none"> Spray with Metsulfuron 1 g/10 L in summer and autumn (will require follow up for a number of years) For small infestations or in sensitive areas hand weed small plants and seedlings For larger plants cut and paint with 20-50% glyphosate or slash canes Spray regrowth at 50 cm with Metsulfuron methyl 1 g/ 10L in summer and autumn 	<ul style="list-style-type: none"> Aug – Jan
<i>Trachyandra divaricata</i>	False Onion Weed, Strapweed	<ul style="list-style-type: none"> Manually remove isolated or small infestations prior to flowering Wipe with 50% glyphosate solution before flowering For dense infestations in degraded areas spot spray with 0.4 g chlorsulfuron plus 25 mL wetting agent in 10 L of water when plants are actively growing 	<ul style="list-style-type: none"> Manual removal can occur year round Jun – Aug
<i>Zantedeschia aethiopica</i>	Arum Lily	<ul style="list-style-type: none"> Spot spray Metsulfuron methyl 0.4 g/15 L of water (or 5 g/ha) +225 mL glyphosate (non-selective so apply caution amongst natives) Otherwise Metsulfuron methyl or Chlorsulfuron 0.4 g/15 L of water (or 5 g/ha) for a more selective approach <p>Herbicide application can send some tubers into dormancy therefore any control program needs to continue for at least 5 years</p>	<ul style="list-style-type: none"> Jul – Sep

Source: DBCA, 2020b

4.3.3 Pest Animal Control

European Rabbit

Rabbits are a highly invasive species due to their ability to reach sexual maturity in a short period of time, their short gestation period and ability to cope with environmental variability. The direct and indirect effects of rabbits pose a threat to the ecology of local areas and the viability of rehabilitation activities as they browse on young plants and tubestock due to their high palatability and nutrient content. The grazing activities of rabbits often alter the ecology of plant communities by selecting species that are resistant to regular cropping such as grasses and reducing natural regeneration. Rabbits also have the potential to exacerbate erosion, promote weed growth as well as competing for resources with native fauna. An indirect effect of rabbit populations is to provide an increased food supply to introduced predators which in turn predate native fauna (Pech and Hood, 1998).

Signs of the European Rabbit (*Oryctolagus cuniculus*) were observed on site with one rabbit warren recorded (Figures 7, 8) and scats and diggings throughout the site. The European Rabbit is listed as a C3 declared pest on the Western Australian Organism List (WAOL) under the *Biosecurity and Agriculture Management Act 2007* (WA), this classification requires management by the landowner/manager to reduce the impact and spread of the species.



Figure 8: Rabbit evidence

The location of the site along with it being fenced will mean that the use of 1080 baits can be used for the control of rabbits and will not adversely affect any native fauna and is the best option for the area as the site will be fenced and there should be no domestic animal in or near the site. Two rounds of 1080 baiting by a licensed contractor will occur prior to planting and twice annually after seeding and planting. Baiting will occur within the rehabilitation site, at identified rabbit warrens, and in the nearby area to provide an added buffer that will assist with allowing tubestock to become established. Rabbit warrens will be destroyed (ripped) to prevent reuse.

Fox

While clearly distinguishable signs of foxes (*Vulpes vulpes*) were not apparent, the probability of their presence is high. If required, the use of 1080 baits that target foxes will be used to control any present during rehabilitation works.

4.3.4 Fencing

As rabbits and kangaroos are known within the offset site, fencing will be installed to prevent their access and thus reduce impacts associated with their presence during the plant establishment period. Existing fencing between the site and the wetland area (Figure 9) will need to be removed prior to the installation of the kangaroo/rabbit proof fencing.

The kangaroo exclusion fence will be a 10-line Ringlock with 1.8 m steel posts at 4 m intervals and will include appropriate strainer and bracing to maintain long term integrity of the fence. Galvanised metals (e.g.: Waratah or Cyclone) will be used to maintain fence integrity in the event of a fire, with an indicative example shown in Figure 6. Rabbit proof netting (maximum 30 mm mesh spacing) will be installed to prevent their entry to the site. The fence will include two 3.6 m gates located at opposite ends of the site (i.e.: the north and south sites of the site) to allow access by emergency response or other management vehicles; gates will be padlocked with keys common to those issued by the DBCA and the Shire of Capel. A one-way kangaroo gate will also be installed that will prevent animal entry but allow them to escape.



Figure 9: Indicative fence type

4.3.5 Rubbish Removal

Rubbish within the site was limited to clay remnants from clay pigeon shooting activities; these materials will be removed prior to planting activities being commenced (Figure 7).

4.3.6 Track Realignment

Existing four wheel drive vehicle tracks currently present through the proposed revegetation area and are to be realigned around the outside of the offset site boundary to meet up with existing tracks in the surrounding area (Figure 7). This will protect the revegetation works while continuing to allow vehicular access to the surrounding areas.

4.3.7 Firebreak

A 4 m wide trafficable firebreak that complies with Shire of Harvey specifications will be installed around the interior perimeter fence of the offset site that will allow access by emergency and other vehicles when required (Figure 7). Firebreak maintenance will be the responsibility of the Shire of Capel until management of the site reverts to the DBCA.

4.4 Revegetation Methodology

Revegetation activities will primarily involve infill planting at the site to restore the required species diversity. If seed is available, it will be used for direct seeding at the conclusion of all weed control activities to prevent non-target death of germinating seedlings. The largely cleared nature of the site means that an area of approximately 36 000 m² will need to be planted. The lead time associated with seed collection and plant propagation will mean that planting will not occur until 2021 at the earliest.

4.4.1 Revegetation – Tubestock

Revegetation areas will be treated for weeds prior to planting as part the weed control programme (Section 4.3.2). Plants should be installed as tubestock, rather than from smaller cells that mean less extensive root systems, with a native plant fertiliser tablet, such as Typhoon or similar, after the first major winter rains (May or June). As indicated in Section 4.2, in order to create a similar plant density to the adjacent vegetated areas, trees will be planted at a rate of one plant per 10 m², with middle storey species being planted at a rate of two per 5 m² (shrubs) and understorey species at a rate of one per 2 m² (herbs).

A total of 70 000 plants over the entire site are expected to be installed to meet completion criteria, with the allowance for 30% death rate of plantings meaning approximately 49 000 plants surviving three years post installation. Given that 3.6 ha will be planted out during 2021, 35 000 plants will be installed in Zone 1 with 24 500 surviving after three years; survival rates will be reviewed with DBCA after the survival of year 1 plantings are known.

For Zone 1, planting of 35 000 tubestock plants will occur around the end of Year 1 (2020) and will comprise:

- 3 600 trees
- 14 400 shrubs
- 17 000 herbs.

Indicative numbers based on the aspirational species list is provided in Appendix 1, with higher numbers of plants known to be favoured by black cockatoos to be installed. Planting will occur in a random pattern across the area to be revegetated rather than in clumps of the same species.

Planting in excess of the final targets may also be a strategy adopted to ensuring target completion criteria are achieved. To assist with sourcing of tubestock, the species list and indication of availability from the Leschenault Landcare Nursery, Hamel Nursery and the Natural Area Nursery are provided in Appendix 2.

4.4.2 Revegetation – Tuart (*Eucalyptus gomphocephala*)

According to the Tuart Health Research Group (THRG) (2006) survival rates for Tuart seedlings increase if fire is used to create an ash bed that provides a germination medium with sufficient nutrients and a site that is safe from microorganisms, pathogens, and herbivores. However, the degraded nature of the rehabilitation

site will mean that the amount of waste material that could be burnt and the amount of seed set likely to occur from mature Tuarts would be limited.

For degraded areas, the THRG (2006) indicate that Tuart seedling survival can be maximised through:

- being at least 7 months old before being planted out
- planted in locations away from established trees to prevent competition for light, water, and nutrients
- planted in May or June, or as soon as the soil moisture content is 3 – 5% at a depth of 5 cm
- the root ball of the seedling will be buried to at least 2 cm below the soil surface, with soil being firmed down to prevent air pockets
- planted with a native fertiliser tablet (i.e.: one 7 g tablet per tubestock, slow release such as Typhoon®) to provide the nutrients needed for establishment.

Note: if a Pottiputki planter is being used, then the fertiliser tablet can be installed at the same time as the tubestock.

4.4.3 Revegetation – Seed

If required, seed collection can be undertaken by collectors licensed by the DBCA from approved areas. Written permission will need to be obtained from the relevant landowners or managers to collect species included on the revegetation list from their land. The seed can then be used to propagate the tubestock for the rehabilitation site.

Any seed left over after rehabilitation and the conclusion of weed control works will either be direct seeded to provide further variation in the age structure of species present or used by the Shire of Capel and/or the DBCA to assist with restoration projects within the Southwest Region. The seeding should occur at a rate of 2 kg/ha. Seed will be treated according to the type collected, bulked, and blended prior to distribution. Seed will be broadcast manually using a hand seeder in locations where tubestock planting has occurred. Note that seed collection and direct seeding has not been costed in the implementation estimates provided.

4.5 Watering

With a drying climate, it is increasingly common for plants to be watered on installation and, where possible to do so, over summer months to assist with plant establishment. The typical watering rate is 2 L per plant per visit, with visits scheduled according to the number of very hot days occurring in the area that could otherwise lead to plant stress and death. Due to the amount of plants, offset site area and location, watering may not be a feasible option for this site; additional infill planting may be a more cost effective method to achieve completion criteria for plant survival.

4.6 Completion Criteria

In order to determine when desired revegetation outcomes have been achieved, it is necessary to formulate completion criteria and monitor those over time. Completion criteria for the rehabilitation of the offset site three years post planting are:

- an overall 70% survival rate for all plants (i.e.: if 35 000 are installed, then 24 500 surviving); criteria for individual strata are:
 - 75% of trees (overstorey)

- 55% of shrubs (middle storey)
- 75% of herbs (understorey)
- maximum patch size of bare ground is 30 m²
- reduction of more than 70% in the affected area and population density of the Perennial Veldt Grass (*Ehrharta calycina*)
- 90% reduction in Red Ink Plant (*Phytolacca octandra*) population
- 90% reduction in False Onion Weed (*Trachyandra divaricata*) population
- no Blackberry (*Rubus laudatus*) or Arum Lily (*Zantedeschia aethiopica*) within the offset site boundary
- no obvious presence of rabbits or kangaroos
- a maximum of 5% of plants affected by rabbit and/or kangaroo herbivory
- gates and boundary fence to be in good condition with no obvious damage that will enable the entry of fauna including rabbits and kangaroos into the site.

During site visits whilst on ground works are being carried out, informal monitoring of the site will be carried out by the on-ground Project Managers and the works contractor to ensure that any issue arising such as plant death, increased weed presence, or grazing can be attended to in a timely manner.

4.6.1 Contingency Measures

Monitoring activities will be carried out the two years after initial planting to ensure completion criteria, particularly required numbers and planting densities are being met. In the event monitoring indicates completion criteria have not been achieved, the following will be implemented:

- assessment of potential reasons why seedlings have failed (in consultation with DBCA)
- infill planting
- further weed and/or pest control if required.

In terms of planting numbers, the following will serve as a trigger for the need of infill planting:

- a 65% survival rate for all plants criteria, with the following applied to individual strata:
 - 70% of trees (overstorey)
 - 50% of shrubs (middle storey)
 - 70% of herbs (understorey)
- patch size of bare ground is 40 m².

In the event Dieback (*Phytophthora cinnamomi* or some other species) is suspected as being the cause of the decline, discussions with the DBCA and the Shire of Capel will occur to review and refine the revegetation plan and completion criteria as appropriate.

4.7 Monitoring

Monitoring of revegetation activities within the rehabilitation site will occur twice annually in spring and autumn for a minimum of three years after the last year plants were established, i.e.: if original planting is 2021 and infill planting 2022, assuming no large failure gaps and additional infill planting is not required beyond this, then monitoring would cover the years 2023, 2024, 2025. The monitoring will consider the survival of the preferred black cockatoo species along with the mix of other native species and use this information to guide species choice for infill planting activities. Monitoring will also include an assessment of weeds present and signs of pest animal species such as rabbits and kangaroos.

Three monitoring methods will be implemented, namely:

- six photo monitoring points will be set up to enable comparison of the area over time, with photos taken from the north west corner towards the south east
- eight 5 m x 5 m quadrats will be set up within the rehabilitated area placed evenly across the site, these will be traversed on foot with plant survival, vegetation health and community structure noted
- as revegetation activities can be of varying success within a nominated site, a review of aerial imagery showing change in vegetative coverage over time will provide a broader measure of success.

4.8 Annual Reporting

An annual report will be provided to the Shire of Capel in the first instance, describing:

- weed control
- pest animal control
- revegetation activities carried out
- survival rates; including progress towards completion criteria
- any recommendations on the need for infill planting
- any recommendations on the need for pest animal control.

This document will also contribute to reporting requirements associated with:

- approval conditions on the clearing permit(s) issued to the Shire; particularly those outlined in Part III of the permit relating to record keeping and reporting
- the DBCA to enable them to have confidence in the likely long term success of revegetation process and eventually accept management responsibility when handback of the site occurs; note that the DBCA requires the opportunity to participate in a minimum of one inspection visit to the site annually with the Shire of Capel and/or their representatives
- compliance with DBCA licencing conditions, particularly with the prior notification of the commencement of all on-ground works to the Wellington District Office (Attention: Nature Conservation Program Coordinator).

Note that both DWER and the DBCA require submission of the annual report by June 30 each year.

4.9 Permitting

As the offset site is located on land managed by the DBCA, a *Regulation 4 Authority – 8(1)* will be required prior to works commencing on site. The permit can be applied for by the Shire of Capel, with the name of contractors that will also carry out works on the site specified or applied for directly the contractor(s). The licence will be issued for a maximum period of 12 months and will need to be applied for ahead of each year's planned activities. A copy of the application form is provided in Appendix 3.

5.0 Implementation – Lot 150 Zone 1

Initial on-ground works including rubbish removal, weed control, fencing, track realignment, firebreak installation and planting activities will occur during 2020 – 2021 with planting and other associated activities such as infill planting and monitoring occurring in subsequent years (Tables 4 – 8).

It should be noted that the photo monitoring points and quadrats to enable an assessment of the degree of rehabilitation success over time will be established prior to the commencement of on ground activities. Monitoring will continue to occur for three years post-plant installation to confirm the project has achieved its completion criteria and in accordance with this revegetation plan. A final meeting will be held with DBCA representatives to confirm the success criteria have been met and that the management responsibility for the site will revert to the DBCA.

Table 4: Year 1 implementation schedule for Zone 1 works 2020 - 2021

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Regulation 4 permit application												
Fencing												
Track realignment												
Firebreak installation												
Rubbish removal												
Weed control												
Rabbit control												
Fox control (if required)												
Site ripping												
Order plants for following season												
Planting Zone 1												

Table 5: Year 2 implementation schedule for Zone 1 works 2021 - 2022

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Renew Reg 4 permit												
Follow up weed control												
Monitoring visit 1												
Order plants for following season												
Infill planting Zone 1												
Monitoring visit 2												
General maintenance												

Table 6: Year 3 implementation schedule for Zone 1 works 2022 - 2023

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Renew Reg 4 permit												
Follow up weed control												
Monitoring visit 1												
Order plants for following season (if required)												
Infill planting Zone 1												
Monitoring visit 2												
General maintenance												

Table 7: Year 4 implementation schedule for Zone 1 works 2023 - 2024

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Renew Reg 4 permit (if required)												
Follow up weed control												
Monitoring visit 1												
Order plants for following season (if required)												
Infill planting Zone 1 (if required)												
Monitoring visit 2												
General maintenance												

Table 8: Year 5 implementation schedule for Zone 1 works 2024 – 2025

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Renew Reg 4 permit (if required)												
Follow up weed control												
Monitoring visit 1												
Order plants for following season (if required)												
Infill planting Zone 1 (if required)												
Monitoring visit 2												
General maintenance												
DBCA sign-off meeting												

6.0 Indicative Cost Schedule – Lot 150 Zone 1

An indicative cost schedule for Lot 150 Zone 1 works is provided in Table 9. Note that actual costs will vary according to contractor(s) engaged to complete the works and their rates.

Table 9: Indicative costings – Lot 150 Zone 1

Activity	Year 1 (Jul 2020 - Jun 2021)				Year 2 (Jul 2021 - Jun 2022)				Year 3 (Jul 2022 - Jun 2023)				Year 4 (Jul 2023 - Jun 2024)				Year 5 (Jul 2024 - Jun 2025)			
	Unit	Qty	Unit rate	Cost (\$ ex GST)	Unit	Qty	Unit rate	Cost (\$ ex GST)	Unit	Qty	Unit rate	Cost (\$ ex GST)	Unit	Qty	Unit rate	Cost (\$ ex GST)	Unit	Qty	Unit rate	Cost (\$ ex GST)
Boundary fence installation, including 2 x vehicle gates and a one way kangaroo gate	Lm	1,200	32.50	39,000.00	Lm				Lm				Lm				Lm			
Removal and disposal of old fence alignment	Lm	275	20.00	5,500.00	Lm				Lm				Lm				Lm			
Rabbit and fox control (if required)	Event	1	3,500.00	3,500.00	Event				Event				Event				Event			
Installation of firebreak	Lm	1,200	8.00	9,600.00	Lm				Lm				Lm				Lm			
Installation of vehicle track	Lm	510	8.00	4,080.00	Lm				Lm				Lm				Lm			
Rubbish removal and disposal	Item	1	5,000.00	5,000.00	Item				Item				Item				Item			
Site ripping	Item	1	10,000.00	10,000.00																
Initial weed control - Zone 1	Event	3	1,850.00	5,550.00	Event				Event				Event				Event			
Post planting weed control - Zone 1	Event				Event	2	6,000.00	12,000.00	Event	2	6,000.00	12,000.00	Event	2	4,000.00	8,000.00	Event	2	4,000.00	8,000.00
Plant supply initial - Zone 1	Ea.	35,000	2.10	73,500.00	Ea.				Ea.				Ea.				Ea.			
Initial plant installation	Ea.	35,000	1.20	42,000.00	Ea.				Ea.				Ea.				Ea.			
Infill plant supply - Zone 1	Ea.				Ea.	10,500	2.10	22,050.00	Ea.				Ea.				Ea.			
Infill plant installation	Ea.				Ea.	10,500	1.20	12,600.00	Ea.				Ea.				Ea.			
General maintenance	Event				Event	2	2,100.00	4,200.00	Event	2	2,100.00	4,200.00	Event	2	2,100.00	4,200.00	Event	2	2,100.00	4,200.00
Monitoring	Event				Event	2	2,000.00	4,000.00	Event	2	2,000.00	4,000.00	Event	2	2,000.00	4,000.00	Event	2	2,000.00	4,000.00
Yearly Total (ex GST)				197,730.00				54,850.00				20,200.00				16,200.00				16,200.00
GST				19,773.00				5,845.00				2,020.00				1,620.00				1,620.00
Yearly Total (inc GST)				217,503.00				60,335.00				22,220.00				17,820.00				17,820.00
Project Total (ex GST)				305,180.00																
GST				30,518.00																
Project Total (inc GST)				335,698.00																

7.0 Revegetation Requirements – Boyanup Road West

The Shire of Capel has committed to revegetating an approximately 1.6 ha area within a series of 47 pockets of varying areas along the length of Boyanup Road West a contribution to the mitigation requirements associated with CPS 8116/2.

7.1 Revegetation Aims

The aim of the revegetation activities within the road reserve are to:

- restore vegetative overstorey cover in the various cleared pockets along the road reserve to a similar standard as the existing vegetation within the road reserve
- in time, it is expected that the installed plants will become self-sustaining
- include several species that provide a suitable feeding source for endangered black cockatoos.

7.2 Flora Species

The mitigation site is to replace ecological linkage to maintain connectivity that will be cleared during the road widening process. As evidence of foraging by endangered black cockatoo species was noted by Natural Area during the 2018 flora and vegetation survey within the road reserve, the flora species list includes those known to be preferred as food sources, such as Eucalypts and Banksias, and are included within the plantings; Table 10 includes five species local to the area that are known to be preferred black cockatoo feeding sources, namely:

- *Banksia attenuata* (Slender Banksia)
 - *Banksia grandis* (Bull Banksia)
 - *Corymbia calophylla* (Marri)
 - *Eucalyptus marginata* (Jarrah)
 - *Hakea varia* (Variable-leaved Hakea).
-
- The flora species that will be installed at the site will be consistent with the four dominant vegetation types identified by Natural Area during their 2018 flora and vegetation assessment; for the purposes of this process, the Foreign (non-native) Eucalyptus Woodland will reflect the Marri Woodland vegetation type. Table 10 presents the flora species list based on the outcomes of Natural Area's 2018 site assessment along with the vegetation type with which they are associated; given the degraded nature of the site, herb species have not been included. Consideration has also been given to the ease of growing/propagation. It is expected that this list will be used as the basis of sourcing tubestock from suitable nurseries when revegetation commences.

Table 10: Boyanup Road West species list and associated vegetation types

Species	Common Name	Life Form	Vegetation Type			
			Marri Woodland	Peppermint Woodland	Flooded Gum Woodland	Melaleuca Woodland
<i>Acacia lasiocarpa</i>	Panjang	Shrub			x	
<i>Acacia pulchella</i>	Prickly Moses	Shrub	x		x	
<i>Acacia saligna</i>	Orange Wattle	Shrub	x		x	
<i>Acacia semitrullata</i>		Shrub		x		
<i>Acacia stenoptera</i>	Narrow Winged Wattle	Shrub	x	x		
<i>Adenanthos meisneri</i>		Shrub		x		
<i>Agonis flexuosa</i>	Peppermint	Tree	x	x		
<i>banksia attenuata</i>	Slender Banksia	Tree	x	x		
<i>Banksia grandis</i>	Bull Banksia	Tree	x			
<i>Corymbia calophylla</i>	Marri	Tree	x			
<i>Daviesia physodes</i>		Shrub	x			
<i>Eucalyptus marginata</i>	Jarrah	Tree		x		
<i>Eucalyptus rudis</i>	Flooded Gum	Tree			x	
<i>Gompholobium marginatum</i>		Shrub	x			
<i>Hakea varia</i>	Variable-leaved Hakea	Shrub			x	
<i>Hibbertia diamesogenos</i>		Shrub	x			
<i>Hypocalymma angustifolium</i>	White Myrtle	Shrub	x			
<i>Jacksonia furcellata</i>	Grey Stinkwood	Shrub	x	x		
<i>Jacksonia sternbergiana</i>	Stinkwood	Shrub	x	x		
<i>Juncus holoschoenus</i>	Jointleaf Rush	Sedge			x	x
<i>Juncus pallidus</i>	Pale Rush	Sedge				x
<i>Kunzea glabrescens</i>	Spearwood	Shrub		x		
<i>Lepidosperma pubisquameum</i>		Sedge	x			
<i>Lepidosperma squamatum</i>		Sedge	x			

Species	Common Name	Life Form	Vegetation Type			
			Marri Woodland	Peppermint Woodland	Flooded Gum Woodland	Melaleuca Woodland
<i>Melaleuca lateritia</i>	Robin Redbreast Bush	Shrub			x	x
<i>Melaleuca preissiana</i>	Moonah	Tree				x
<i>Melaleuca raphiophylla</i>	Swamp Paperbark	Tree				x
<i>Melaleuca viminea</i>	Mohan	Shrub			x	x
<i>Mesomelaena tetragona</i>	Semaphore Sedge	Sedge	x			
<i>Nuytsia floribunda</i>	Christmas Tree	Tree		x		
<i>Phyllanthus calycinus</i>	False Boronia	Shrub	x			
<i>Xanthorrhoea brunonis</i>		Shrub	x			
<i>Xanthorrhoea preissii</i>	Grasstree	Shrub	x	x	x	x
<i>Xanthosia ciliata</i>		Shrub	x			

8.0 Revegetation Plan – Boyanup Road West

The Boyanup Road West mitigation site comprises 47 smaller areas within the road reserve where non-native flora species, mainly in the form of grasses, are dominant. The major aim of the revegetation plan for Boyanup Road West is to reintroduce native middle and overstorey species into the areas that will result in a similar vegetative type and structure to the existing vegetation within the road reserve. The restoration activities will occur over a four year period from site preparation works, installation and plant establishment and three years' post-installation monitoring and maintenance. The plan revolves around the planting of appropriate native tree species along with a small number of under and middle storey species to increase vegetative cover. Plantings will consider the current condition of the site, the vegetation types identified by Natural Area during the flora and vegetation assessment carried out in spring 2018, along with the need for planting to occur towards the boundary of the road verge and neighbouring properties to ensure the safety of road users.

Plan development has included the following activities:

- identification of flora species within the length of the road reserve, including native and weed species
- assessment of vegetation condition
- development of success and monitoring criteria to be implemented after the initial installation of tubestock.

8.1 Flora Species List

Based on the review process, the species list includes 36 species that have the highest probability of being sourced as local provenance stock from reputable nurseries (Table 9). The aim of the list is to provide an indication of species that could be included within the restoration process, with the actual list being informed by those available from the nursery (or nurseries) contracted to provide the tubestock for the site. Plants will need to be ordered by November at the latest the year before planting and meet the following requirements:

- sourced from a NIASA accredited nursery
- tubestock needs to be suited to the offset site growing conditions (local provenance)
- pot size = forestry tube (50 mm x 50 mm x 120 mm tall)
- plants shall be vigorous, established and hardened off
- have a good form consistent with species and variety
- free from disease and pests
- have large healthy root systems with no evidence of having been restricted or damaged (e.g.: root bound)
- any pruning, budding or grafting scars will be clean and well calloused
- trees will have a single leading shoot unless otherwise specified
- stock will be able to support their own weight, i.e. stand without staking
- containers will be free of weeds
- the root ball of the plant shall remain intact with only a minor amount of loose soil present.

8.2 Planting Zones and Numbers

The Boyanup Road West planting zones comprise a series of 47 areas along the length of the road within four vegetation types as identified by Natural Area during their 2018 flora and vegetation assessment of the site. Numbers have been determined based on the area to be revegetated, final form, and the primarily linear nature of the planting that will be necessary within the road reserve. Appendix 4 provides details each of the planting zones and the number of plants to be installed into each.

8.3 Pre-planting Activities

The success of revegetation activities can be closely linked to the effective management of other activities, particularly the presence of weeds and pests. Thus, pre-planting activities will be required ahead of the tubestock planting that is expected to occur in 2021. Pre-planting activities will include weed control and ripping of the site.

8.3.1 Weed Control

The main weeds present are grasses along with some flat weeds, herbs, and woody weeds. Two rounds of spraying with Glyphosate will occur prior to planting activities, taking care to avoid native trees, shrubs, and herbs present. Any woody weeds present will need to be removed manually. Weed control after the installation of plants will include the application of grass-selective herbicide such as Fusilade or Quizalofop and/or the spot spraying of Glyphosate, again avoiding native species present. Additional weed control may be required during the seedling establishment phase to minimise competition for nutrients and moisture with weed species.

8.3.2 Ripping

Ripping the site will assist with removing any areas of compaction or other obstructions that could prevent root penetration of seedlings. The small areas associated with each of the revegetation sites mean a rotary hoe or similar will be most effective for ripping.

8.4 Revegetation Methodology

Revegetation activities will primarily involve infill planting at the site to restore over and middle storey species consistent with the remainder of the road reserve. Planting will primarily be linear away from the road edge towards the boundary of the road reserve and neighbouring properties. The lead time associated with plant propagation will mean that planting will not occur until 2021 at the earliest.

Revegetation areas will be treated for weeds prior to planting as part the weed control programme (Section 8.3.1). Plants should be installed as tubestock, rather than from smaller cells that mean less extensive root systems, with a native plant fertiliser tablet, such as Typhoon or similar, after the first major winter rains (May or June). The use of tree guards and stakes will provide some protection for plants as they become established. Planting numbers will be on a per revegetation plot basis, as indicated in Appendix 4.

A total of 210 plants over the 47 areas are expected to be installed to meet completion criteria, with the allowance for 30% death rate of plantings meaning approximately 147 plants surviving three years post installation.

8.5 Watering

With a drying climate, it is increasingly common for plants to be watered on installation and, where possible to do so, over summer months to assist with plant establishment. The typical watering rate is 2 L per plant per visit, with visits scheduled according to the number of very hot days occurring in the area that could otherwise lead to plant stress and death. The small number of plants and the linear nature of the planting zone means that watering will be a feasible option for this site. Alternatively, additional infill planting may be a more cost effective method to achieve completion criteria for plant survival. Due to the small number of plants and multiple areas, watering may not be a feasible option for this site; additional infill planting may be a more cost effective method to achieve completion criteria for plant survival.

8.6 Completion Criteria

In order to determine when desired revegetation outcomes have been achieved, it is necessary to formulate completion criteria and monitor those over time. Completion criteria for the rehabilitation of the offset site three years post planting are a 70% survival rate for all plants (i.e.: if 210 are installed, then 147 surviving).

During site visits whilst on ground works are being carried out, informal monitoring of the site will be carried out by the on-ground Project Managers and the works contractor to ensure that any issue arising such as plant death or grazing can be attended to in a timely manner.

8.6.1 Contingency Measures

In the event monitoring indicates completion criteria have not been achieved, the following will be implemented:

- assessment of potential reasons why seedlings have failed (in consultation with DBCA)
- infill planting
- further weed control if required.

In the event Dieback (*Phytophthora cinnamomi* or some other species) is suspected as being the cause of the decline, discussions with the DBCA and the Shire of Capel will occur to review and refine the revegetation plan and completion criteria as appropriate.

8.7 Monitoring

Monitoring of revegetation activities within the mitigation areas will occur twice annually in spring and autumn for a minimum of three years after planting and will consider the survival of the trees and shrubs.

Monitoring will involve the assessment of each revegetation plot along Boyanup Road West and will include:

- a count of trees and shrubs installed
- a photograph of each plot from the NW corner.
-

An annual report will be provided to the Shire of Capel describing the monitoring outcomes, along with any recommendations on the need for infill planting, progress towards completion criteria, and any additional

weed control. That document will also contribute to reporting requirements associated with approval conditions on the clearing permit issued to the Shire.

9.0 Implementation – Boyanup Road West

Initial on-ground works weed control and ripping and the initial plant out of the site will occur during 2020 – 2021 with infill planting, maintenance and monitoring occurring in subsequent years (Tables 11 – 15).

The small size of each of the Plots along limited number of plants to be installed mean that the most appropriate monitoring method will be a count of each Plot along with a photograph showing growth over time. Note that the use of aerial imagery to show change over time is unlikely to be effective due to the 2-3 year period between image capture dates. Monitoring will continue for three years post-construction to confirm the project has achieved its completion criteria and in accordance with this revegetation plan.

Table 11: Year 1 implementation schedule 2020 - 2021

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Weed control												
Site ripping												
Order plants for following season												
Planting												

Table 12: Year 2 implementation schedule 2021 - 2022

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Follow up weed control												
Monitoring visit 1												
Order plants for following season												
Watering (if required)												
Infill planting												
Monitoring visit 2												
General maintenance												

Table 13: Year 3 implementation schedule 2022 - 2023

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Follow up weed control												
Monitoring visit 1												
Order plants for following season if required												
Infill planting												
Monitoring visit 2												
General maintenance												

Table 14: Year 4 implementation schedule 2023 - 2024

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Follow up weed control												
Monitoring visit 1												
Order plants for following season if required												
Infill planting												
Monitoring visit 2												
General maintenance												

Table 15: Year 5 implementation schedule 2024 – 2025

Activity	Month											
	July	Aug	Sept	Oct	Nov	Dec	Jan	Feb	Mar	April	May	June
Follow up weed control												
Monitoring visit 1												
Order plants for following season if required												
Infill planting												
Monitoring visit 2												
General maintenance												

10.0 Indicative Cost Schedule – Boyanup Road West

An indicative cost schedule for the Boyanup Road West works is provided in Table 16. Note that actual costs will vary according to contractor(s) engaged to complete the works and their rates.

Table 16: Indicative costings – Boyanup Road West

Activity	Year 1 (Jul 2020 - Jun 2021)				Year 2 (Jul 2021 - Jun 2022)				Year 3 (Jul 2022 - Jun 2023)				Year 4 (Jul 2023 - Jun 2024)				Year 5 (Jul 2024 - Jun 2025)			
	Unit	Qty	Unit rate	Cost (\$ ex GST)	Unit	Qty	Unit rate	Cost (\$ ex GST)	Unit	Qty	Unit rate	Cost (\$ ex GST)	Unit	Qty	Unit rate	Cost (\$ ex GST)	Unit	Qty	Unit rate	Cost (\$ ex GST)
Site ripping	Item	1	5,500.00	5,500.00																
Initial weed control	Event	3	1,600.00	4,800.00	Event				Event				Event				Event			
Post planting weed control	Event				Event	2	2,475.00	4,950.00	Event	2	2,475.00	4,950.00	Event	2	2,475.00	4,950.00	Event	2	2,475.00	4,950.00
Plant supply initial	Ea.	210	2.10	441.00	Ea.				Ea.				Ea.				Ea.			
Initial plant installation	Ea.	210	1.20	252.00	Ea.				Ea.				Ea.				Ea.			
Infill plant supply	Ea.				Ea.	65	2.10	136.50	Ea.				Ea.				Ea.			
Infill plant installation	Ea.				Ea.	65	1.20	78.00	Ea.				Ea.				Ea.			
General maintenance	Event				Event	2	1,200.00	2,400.00	Event	2	1,200.00	2,400.00	Event	2	1,200.00	2,400.00	Event	2	1,200.00	2,400.00
Monitoring	Event				Event	2	2,000.00	4,000.00	Event	2	2,000.00	4,000.00	Event	2	2,000.00	4,000.00	Event	2	2,000.00	4,000.00
Yearly Total (ex GST)				10,993.00				11,564.50				11,350.00				11,350.00				11,350.00
GST				1,099.30				1,156.45				1,135.00				1,135.00				1,135.00
Yearly Total (inc GST)				12,092.30				12,720.95				12,485.00				12,485.00				12,485.00
Project Total (ex GST)				56,607.50																
GST				5,660.75																
Project Total (inc GST)				62,268.25																

11.0 References

Biodiversity Conservation Act 2016 (WA)

Biosecurity and Agriculture Management Act 2007 (WA)

Bureau of Meteorology, (2020) *Climate and Weather Statistics – Bunbury Site ID 9965*, accessed May 2020 via: http://www.bom.gov.au/climate/averages/tables/cw_009965.shtml.

Department of the Environment and Energy, (2019), *Tuart Woodlands and Forests of the Swan Coastal Plain: A Nationally Significant Ecological Community*, accessed May 2020 via <http://www.environment.gov.au/biodiversity/threatened/publications/tuart-woodlands-forests-swan-coastal-plain-guide>.

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Department of Primary Industry and Regional Development, 2020, *NRInfo portal – Soils and Contours*, accessed May 2020 via: <https://maps.agric.wa.gov.au/nrm-info/>.

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Pech, R. and Hood, G. (1998), 'Foxes Rabbits and Alternative Prey', in *Journal of Applied Ecology*, 35: 434-453.

Ruthrof, K., and Close, D., (2006), *Tuart Regeneration and Restoration*, accessed May 2020 via: <https://researchrepository.murdoch.edu.au/id/eprint/4598/>.

Appendix 1: Planting Numbers – Lot 150 Zone 1

The plant numbers below represent those for Stage 1, which will be the planting out of 29 500 plants. The same list can be used for the planting of the remainder of the offset site, with numbers being adjusted to reflect the area being planted at the time.

Species Name	Common Name	Life Form	Indicative Numbers
<i>Acacia pulchella</i>	Prickly Moses	Shrub	700
<i>Acacia saligna</i>	Orange Wattle	Large Shrub	700
<i>Acacia stenoptera</i>	Narrow Winged Wattle	Low shrub	700
<i>Acacia willdenowiana</i>	Grass Wattle	Low shrub	700
<i>Agonis flexuosa</i>	Peppermint	Low Tree	600
<i>Anigozanthos humilis</i>	Catspaw	Herb	1500
<i>Anigozanthos manglesii</i>	Mangles Kangaroo Paw	Herb	1500
<i>Austrostipa flavescens</i>		Grass	1500
<i>Bossiaea eriocarpa</i>	Common Brown Pea	Low shrub	700
<i>Conostylis aculeata</i>	Prickly Conostylis	Herb	1000
<i>Conostylis juncea</i>		Herb	1000
<i>Corymbia calophylla</i>	Marri	Tree	600
<i>Dasypogon bromeliifolius</i>	Pineapple Bush	Herb	1000
<i>Daviesia divaricata</i>	Marno	Shrub	1000
<i>Eucalyptus gomphocephala</i>	Tuart	Tree	500
<i>Eucalyptus marginata</i>	Jarrah	Tree	600
<i>Gompholobium confertum</i>		Low shrub	700
<i>Gompholobium tomentosum</i>	Hairy Yellow Pea	Low shrub	700
<i>Hakea prostrata</i>	Harsh Hakea	Shrub	700
<i>Hardenbergia comptoniana</i>	Native Wisteria	Climber	1000
<i>Hibbertia hypericoides</i>		Low shrub	700
<i>Hibbertia racemosa</i>	Stalked Guinea Flower	Low shrub	700
<i>Hovea trisperma</i>		Low shrub	700
<i>Hypocalymma robustum</i>	Swan River Myrtle	Low Shrub	700
<i>Jacksonia furcellata</i>	Grey Stinkwood	Large Shrub	700
<i>Kennedia coccinea</i>	Coral Vine	Climber	1000
<i>Kennedia prostrata</i>	Scarlet Runner	Climber	1000
<i>Kunzea glabrescens</i>	Spearwood	Large Shrub	700
<i>Lepidosperma squamatum</i>		Sedge	200
<i>Lomandra caespitosa</i>	Tufted Mat Rush	Herb	1200
<i>Lomandra hermaphrodita</i>		Herb	1200
<i>Macrozamia riedlei</i>	Zamia	Shrub	500
<i>Nuytsia floribunda</i>	Christmas tree	Tree	300
<i>Patersonia occidentalis</i>	Purple Flag	Herb	1000
<i>Persoonia elliptica</i>	Spreading Snottygobble	Tree	600
<i>Persoonia saccata</i>	Snottygobble	Shrub	450

Shire of Capel
Offset Site Revegetation Plan

Species Name	Common Name	Life Form	Indicative Numbers
<i>Petrophile linearis</i>	Pixie Mops	Low shrub	700
<i>Phlebocarya ciliata</i>		Herb	1000
<i>Phyllanthus calycinus</i>	False Boronia	Low shrub	700
<i>Sowerbaea laxiflora</i>	Purple Tassels	Herb	1000
<i>Tricoryne elatior</i>	Yellow Autumn Lily	Herb	1100
<i>Xanthorrhoea brunonis</i>		Low shrub	700
<i>Xanthorrhoea preissii</i>	Grass Tree	Shrub	350
<i>Xylomelum occidentale</i>	Woody Pear	Tree	400
		Total	35 000

Appendix 2: Plant Availability by Nursery

Note:

- this information is provided to assist with sourcing tubestock and to provide an indication of what is available; it is not intended to imply endorsement of one nursery over another
- availability has been determined by accessing online species lists, with the potential that these lists are incomplete.

Species Name	Common Name	Life form	Leschenault Nursery	Hamel Nursery	Natural Area Nursery
<i>Acacia extensa</i>	Wiry Wattle	Shrub	X	X	
<i>Acacia pulchella</i>	Prickly Moses	Shrub	X	X	X
<i>Acacia saligna</i>	Orange Wattle	Large Shrub	X	X	X
<i>Acacia stenoptera</i>	Narrow Winged Wattle	Low shrub			X
<i>Acacia willdenowiana</i>	Grass Wattle	Low shrub			X
<i>Agonis flexuosa</i>	Peppermint	Low Tree	X	X	X
<i>Anigozanthos humilis</i>	Catspaw	Herb			X
<i>Anigozanthos manglesii</i>	Mangles Kangaroo Paw	Herb	X	X	X
<i>Austrostipa flavescens</i>		Grass			X
<i>Banksia attenuata</i>	Slender Banksia	Tree	X	X	X
<i>Banksia dallanneyi</i>	Couch Honeytot	Shrub			X
<i>Bossiaea eriocarpa</i>	Common Brown Pea	Low shrub	X		X
<i>Calytrix flavescens</i>	Summer Starflower	Low shrub			X
<i>Conostylis aculeata</i>	Prickly Conostylis	Herb	X		X
<i>Conostylis juncea</i>		Herb			X
<i>Corymbia calophylla</i>	Marri	Tree	X	X	X
<i>Dampiera linearis</i>	Common Dampiera	Herb			X
<i>Dasypogon bromeliifolius</i>	Pineapple Bush	Herb			X
<i>Daviesia divaricata</i>	Marno	Shrub			X

Species Name	Common Name	Life form	Leschenault Nursery	Hamel Nursery	Natural Area Nursery
<i>Desmocladius flexuosus</i>		Herb			X
<i>Dianella brevicaulis</i>		Herb			
<i>Eucalyptus gomphocephala</i>	Tuart	Tree	X	X	X
<i>Eucalyptus marginata</i>	Jarrah	Tree	X	X	X
<i>Gastrolobium capitatum</i>		Shrub			X
<i>Gompholobium confertum</i>		Low shrub			X
<i>Gompholobium tomentosum</i>	Hairy Yellow Pea	Low shrub	X		X
<i>Hakea prostrata</i>		Shrub	X	X	X
<i>Hardenbergia comptoniana</i>	Native Wisteria	Climber	X	X	X
<i>Hibbertia hypericoides</i>		Low shrub			X
<i>Hibbertia racemosa</i>	Stalked Guinea Flower	Low shrub	X		X
<i>Hovea trisperma</i>		Low shrub			X
<i>Hypocalymma robustum</i>	Swan River Myrtle	Low Shrub	X		X
<i>Hypolaena exsulca</i>		Sedge			X
<i>Jacksonia furcellata</i>	Grey Stinkwood	Large Shrub	X		X
<i>Kennedia coccinea</i>	Coral Vine	Climber	X	X	X
<i>Kennedia prostrata</i>	Scarlet Runner	Climber	X	X	X
<i>Kunzea glabrescens</i>	Spearwood	Large Shrub	X		X
<i>Lepidosperma squamatum</i>		Sedge			X
<i>Lomandra caespitosa</i>	Tufted Mat Rush	Herb			X
<i>Lomandra hermaphrodita</i>		Herb			X
<i>Lyginia barbata</i>		Herb			X
<i>Macrozamia riedlei</i>	Zamia	shrub	X		X
<i>Melaleuca thymoides</i>		Shrub			X
<i>Microlaena stipoides</i>	Weeping Grass	Herb			X
<i>Nuytsia floribunda</i>	Christmas tree	Tree			X
<i>Opercularia hispidula</i>	Hispid Stinkweed	Herb			X

Shire of Capel

Offset Site Revegetation Plan

Species Name	Common Name	Life form	Leschenault Nursery	Hamel Nursery	Natural Area Nursery
<i>Patersonia occidentalis</i>	Purple Flag	Herb	X		X
<i>Persoonia elliptica</i>	Spreading Snottygobble	Tree	X		
<i>Persoonia saccata</i>	Snottygobble	Shrub			
<i>Petrophile linearis</i>	Pixie Mops	Low shrub			X
<i>Philothea spicata</i>	Pepper and Salt	Shrub			X
<i>Phlebocarya ciliata</i>		Herb			X
<i>Phyllanthus calycinus</i>	False Boronia	Low shrub	X		X
<i>Platysace filiformis</i>		Shrub			
<i>Sowerbaea laxiflora</i>	Purple Tassels	Herb			
<i>Stirlingia latifolia</i>	Blueboy	Shrub			X
<i>Styphelia pallida</i>		Low shrub			X
<i>Styphelia propinqua</i>		Low shrub			X
<i>Tetralix octandra</i>		Sedge			X
<i>Tricoryne elatior</i>	Yellow Autumn Lily	Herb			X
<i>Xanthorrhoea brunonis</i>		Low shrub			X
<i>Xanthorrhoea preissii</i>	Grass Tree	Shrub	X		X
<i>Xylomelum occidentale</i>	Woody Pear	Tree		X	X

Appendix 3: Regulation 4 Permit Application



Application for a Regulation 4 Authority- 8(1)

To authorise a person to **undertake Other Activities** in CALM managed lands/waters that would, but for such a notice, be unlawful under the Conservation and Land Management Regulations 2002.

<p>Completed forms should be returned to: Department of Parks and Wildlife Locked Bag 30 Bentley Delivery Centre WA 6983 Or faxed to (08) 9219 8242 or emailed.</p>	<p>Further information on the licensing requirements is available from DPAW Wildlife Licensing Section Phone: (08) 9219 9836 Email: wildlifelicensing@dpaw.wa.gov.au</p>
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PLEASE SEE “APPLICATION FOR A REGULATION 4 AUTHORITY – FLORA AND FAUNA” IF YOUR PROPOSED ACTIVITIES RELATE TO REGULATION 8(1) – TAKING FLORA OR FAUNA.

THERE IS NO FEE ASSOCIATED WITH A REGULATION 4 AUTHORITY.

PLEASE ALLOW TWENTY (20) WORKING DAYS TO PROCESS COMPLETE AND CORRECT APPLICATIONS.

REGULATION 4 AUTHORITIES ARE ISSUED PER PROJECT/ACTIVITY, THEREFORE SPECIFIC DETAILS OF THE PROJECT/ACTIVITY MUST BE PROVIDED IN ORDER FOR ASSESSMENT OF APPLICATION TO BE COMPLETED.

UNDER THE WILDLIFE CONSERVATION ACT 1950, THE TAKING OF PROTECTED (NATIVE) FLORA OR FAUNA, FROM CROWN LAND REQUIRES A SCIENTIFIC OR OTHER PRESCRIBED PURPOSES (SOPP) LICENCE OR A REGULATION 17 LICENCE (RESPECTIVELY), WITH ARE OBTAINED THROUGH DPaW. THIS IS A SEPARATE REQUIREMENT TO THE REGULATION 4 AUTHORITY.

Applicant:

Surname Dr/Mr/Mrs/Miss/Ms		Other Names	
Address (residential)		Postcode	
Address (postal)		Postcode	
Address Change Yes/No (please state previous address)		Day Phone No.	
Associated Research Institution/Company/Group (if applicable)		Date of Birth: / /	
Previous Authority No.: CE0.....	Expiry Date: / /	Email Address: @	

Applicant’s Declaration:

<p>I AGREE THAT: If approved I will comply with the provisions of the Wildlife Conservation Act and Regulations and the Conservation and Land Management Act and Regulations, and all conditions (including those added specifically for this activity) applicable to the issue of this authority and licence.</p>	
<p>_____</p>	<p>_____ / /</p>
Signature of Applicant	Date



Purpose of Project/Activity: (Detail why the samples listed needs to be taken and how they will be used):

Applicants are required to submit a **research proposal** with this application. Research proposal attached (tick)

Land to which application relates (Either list the specific locations in the spaces provided, or tick the 'List attached' box and attach a list that includes the same fields as below): List attached

Name of CALM managed land (eg. State Forest, National Park, Nature Reserve, Marine Park, etc)	DPaW District

Applicants are required to submit a **map of the proposed sites** with this application. Map attached (tick)

Details of the Collection (Either list the details in the spaces provided, or tick the 'List attached' box and attach a list that includes the same fields as below): List attached

Materials to be taken	
Quantity to be taken	
Method of collection	
Where specimens will be lodged	

Other Details:

a) Detail if there are vehicles/vessels to be used in the CALM managed lands? If so, provide details including make, type, registration number, vessel call sign and marine radio type (27 MHz or Mar VHF)

b) Are you planning on camping within the CALM managed lands? If so, provide details of the location

c) Will the study site/s be reference marked? If so, provide details of what kind of marking will be done, including when any physical markers will be removed

Other Participants (List each person that will be present during the activity):

Period for which licence will be required/duration of activity (Note: exact dates must be specified; if a continuous, long-term project please note that the maximum period that a licence can be issued for is 12 months):

Starting Date: _____ **Finishing Date:** _____

Expected overall finish date of project _____



Appendix 4: Planting Numbers and Locations – Boyanup Road West

Plot No.	Area	Trees	Shrubs	Vegetation Type
1	85.33	1	2	Marri Woodland
2	121.26	2	2	Marri Woodland
3	1053.89	15	7	Flooded Gum
4	79.03	1	1	Marri Woodland
5	71.29	1	1	Marri Woodland
6	50.43	1	1	Marri Woodland
7	136.8	6	0	Flooded Gum
8	142.2	6	0	Flooded Gum
9	297.02	8	2	Marri Woodland
10	418.12	2	3	Marri Woodland
11	210.78	1	3	Marri Woodland
12	336.28	2	2	Marri Woodland
13	178.88	1	1	Marri Woodland
14	233.86	1	2	Marri Woodland
15	382.78	2	3	Marri Woodland
16	203.49	1	0	Marri Woodland
17	626.32	5	3	Marri Woodland
18	260.18	5	0	Marri Woodland
19	926.38	4	2	Marri Woodland
20	125.99	1	0	Marri Woodland
21	180.58	1	1	Marri Woodland
22	108.45	0	2	Marri Woodland
23	63.77	0	1	Marri Woodland
24	86.21	0	1	Marri Woodland
25	313.73	3	5	Marri Woodland
26	356.3	2	1	Marri Woodland
27	367.13	5	5	Marri Woodland
28	331.16	2	3	Marri Woodland
29	627.49	3	3	Marri Woodland
30	160.61	0	3	Marri Woodland
31	172.51	1	2	Marri Woodland
32	105.55	1	0	Marri Woodland
33	249.66	0	1	Marri Woodland
34	263.55	1	1	Peppermint Woodland
35	414.88	1	1	Peppermint Woodland
36	529.13	3	2	Marri Woodland
37	295.26	3	2	Marri Woodland
38	285.02	1	2	Marri Woodland
39	499.83	2	2	Marri Woodland
40	632.25	3	2	Melaleuca Woodland

Shire of Capel
Offset Site Revegetation Plan

Plot No.	Area	Trees	Shrubs	Vegetation Type
41	210.94	1	0	Marri Woodland
42	462.72	3	2	Marri Woodland
43	352.99	3	2	Melaleuca Woodland
44	503.2	4	2	Melaleuca Woodland
45	580.13	3	3	Marri Woodland
46	583.12	3	2	Marri Woodland
47	1541.22	5	4	Marri Woodland
		120	90	



