

APPENDIX D

DSE WHROA Rehabilitation Plan



**DARDANUP SOUTHERN EXTENSION
WOODLAND HABITAT
REHABILITATION AND OFFSET
AREA (WHROA) REHABILITATION
PLAN**

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LIST OF ABBREVIATIONS

AHD	Australian Height Datum
AER	Annual Environmental Report
cm	Centimetre
DEC	Department of Environment and Conservation
°C	Degrees Celsius
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
DSE	Dardanup Southern Extension
GDE	Groundwater Dependent Ecosystem
ha	Hectare
µm	Micro metre
m	Metre
m ³	Cubic metres
mg/L	Milligrams per Litre
mm	millimetre
mBGL	Metres below ground level
NES	National Environmental Significance
TDS	Total Dissolved Solids
WHROA	Woodland Habitat Rehabilitation and Offset Area
WRP	Western Ringtail Possum

1 INTRODUCTION

1.1 PROJECT BACKGROUND

Doral Mineral Sands Pty Ltd (Doral) will continue mining the strand of heavy mineral deposit immediately to the south of the existing Dardanup Mine located on Mining Leases M70/643, M70/893 and M70/675. These new deposits have an anticipated mine life of two years. The Dardanup Southern Extension (DSE) project area is located approximately 150km south of Perth and 15km east of Bunbury in Western Australia (Figure 1). The project area lies on the eastern fringe of the Swan Coastal Plain, at the foot of the Darling and Whicher Scarps.

The DSE involves the excavation of several mine pits using dry mining techniques to maximum depth of 12.5m below ground level (mBGL). Dewatering of groundwater in-flows into the mine pits will commence from 23m³/day at the start of mining and reach a maximum of 3085m³/day. Ore will be transferred by haul road to the existing wet concentrator plant at the Dardanup Mine for processing. Waste clay and sand materials from processing of this ore will be managed using existing infrastructure at the Dardanup Mine. All mine voids in the DSE will be backfilled with overburden, sand and clay tails prior to rehabilitation.

The majority of the project area has been extensively cleared of native vegetation in the past for agriculture and is currently used for stock grazing and irrigated agriculture. Patches of remnant vegetation are located throughout the project area, particularly along the creek lines and road verges. The project area has variable drainage conditions with poorly drained soils within the eastern and western portions of the site and well drained sands within the central portion of the project area.

The DSE was referred to the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC) in November 2011 relating to Matters of National Environmental Significance (NES) under the *Environment Protection Biodiversity and Conservation Act 1999* (EPBC Act). On 10 April 2012 Doral submitted a supplementary information package relating to groundwater dependent ecosystems (GDE's), rehabilitation and offset commitments. The key commitments in relation to rehabilitation of native vegetation and environmental offsets are as follows:

- The retention, enhancement (through rehabilitation) and conservation (in perpetuity) of 19ha of Woodland Habitat. This area is known as the Woodland Habitat Rehabilitation and Offset Area (WHROA). The enhancement of the WHROA will result in the establishment of at least 1600 habitat trees for Black Cockatoos over 19ha as well as additional habitat trees for Western Ringtail Possums (WRPs) and a native understorey that will enhance the conservation value of the site (a total of 1720 trees); and
- Improvement in the management of degraded and completely degraded habitat subject to rehabilitation and installation of artificial hollows within the offset area.

Approval by the Commonwealth Minister for Environment was granted for the project on 16 July 2012 under Section 130 (1) and 133 of the *EPBC Act 1999*. Approval was subject to conditions specified in Appendix A.

1.2 PURPOSE AND SCOPE

This Rehabilitation Management Plan has been prepared to meet the requirements as outlined in:

- Condition 4 of the Commonwealth environmental approval (Appendix A); and
- To fulfil commitments made by Doral with regards to rehabilitation and management of the WHROA in the Dardanup Southern Extension Offsets Management Plan (Aurora Environmental, 2012).

1.3 MILESTONES AND OBJECTIVES

Doral is committed to achieving long-term conservation gains for Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*), Baudin's Black Cockatoo (*Calyptorhynchus baudinii*) and Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) through the rehabilitation and management of a 19ha Woodland Habitat area (the WHROA). The objectives and milestones to achieve this goal are outlined below.

The objectives are as follows:

- Establish and maintain the WHROA in accordance with the DSE Offsets Management Plan (Aurora Environmental, 2012);
- Create habitat for native fauna including the provision of artificial nesting boxes and relocated logs;
- The WHROA will be rehabilitated and managed to improve the overall value of the land to Black Cockatoos and native fauna; and
- Rehabilitation and protection of no less than 19ha including the establishment of 1600 habitat trees suitable for use by the three Black Cockatoo species.

The milestones for the WHROA, in accordance with the DSE Offsets Management Plan (Aurora Environmental, 2012) are outlined in Table 1.

TABLE 1

MILESTONES FOR THE REHABILITATION AND MANAGEMENT OF THE WHORA

MILESTONE	TIMING		
	Within 2 Years Of Project Startup (January 2013)	Within 5 Years Of Project Startup (January 2013)	Prior To Mine Decommissioning
Site preparation completed (Fencing, soil preparation, exclusion of stock and kangaroos)	X		
Pest and weed control implemented	X		
Monitoring program start-up	X		
Habitat creation completed		X	
Revegetation completed		X	
Meeting of completion criteria for rehabilitation success		X	
Independent environmental audit	X	X	X
Conservation covenant has been placed	(By 16 July 2015 as		

MILESTONE	TIMING		
on the Woodland Habitat Offset Area.	per Condition 3)		

1.4 RELEVANT GUIDELINES

The following guidelines and documents are relevant to the development of this Rehabilitation Management Plan:

- Guidance Statement 6 - Rehabilitation of Terrestrial Ecosystems (EPA, 2006);
- “Artificial Hollows for Carnaby’s Cockatoo, How to Design a Hollow”. Information Sheet a joint initiative of Birds Australia, the Western Australian Museum and the Department of Environment and Conservation (DEC, 2011a, Appendix B);
- “Artificial Hollows for Carnaby’s Cockatoo, How to Monitor and Maintain”. Information Sheet a joint initiative of Birds Australia, the Western Australian Museum and the Department of Environment and Conservation (DEC,2011b, Appendix C); and
- Black Cockatoos on the Swan Coastal Plain. Report for the Department of Planning Western Australia (Johnstone and Kirby, 2007). This report provides valuable information regarding the distribution, status, breeding, food, movements and historical changes to Carnaby’s Cockatoo, Baudin’s Cockatoo and the Forest Red-tailed Black Cockatoo on the Swan Coastal Plain.
- Forest Black Cockatoo (Baudin’s Cockatoo *Calyptorhynchus baudinii* and Forest Red tailed Black Cockatoo *Calyptorhynchus banksia naso*) Recovery Plan (DEC and the Australian Government 2008).
- Cale B., in press. Carnaby’s Black Cockatoo Recovery Plan 2000-2009.

Birds Australia (WA) is leading a recovery program that assists rural communities in the management of breeding populations of Carnaby’s Black-Cockatoo and implementing suitable recovery actions. These recovery actions include protection of existing breeding and feeding sites, revegetation, the development of corridors between breeding and feeding sites, repair of old and damaged hollows and control of competitor species, such as feral bees.

Through fencing and excluding stock from the WHROA, protection of the WHROA (a known foraging site), revegetation around existing foraging habitat within the WHROA and control of competitor species, Doral is undertaking suitable recovery actions as outlined by Birds Australia WA and therefore contributing to the recovery of this species and other Black Cockatoo species.

2 EXISTING ENVIRONMENT

2.1 LOCATION

The WHROA is located to the west of Simpson Road and to the north of Guimelli Road in Lot 107 Simpson Road directly adjacent to the area of impact on Doral owned land (Figure 1). The location of the WHROA was selected due to:

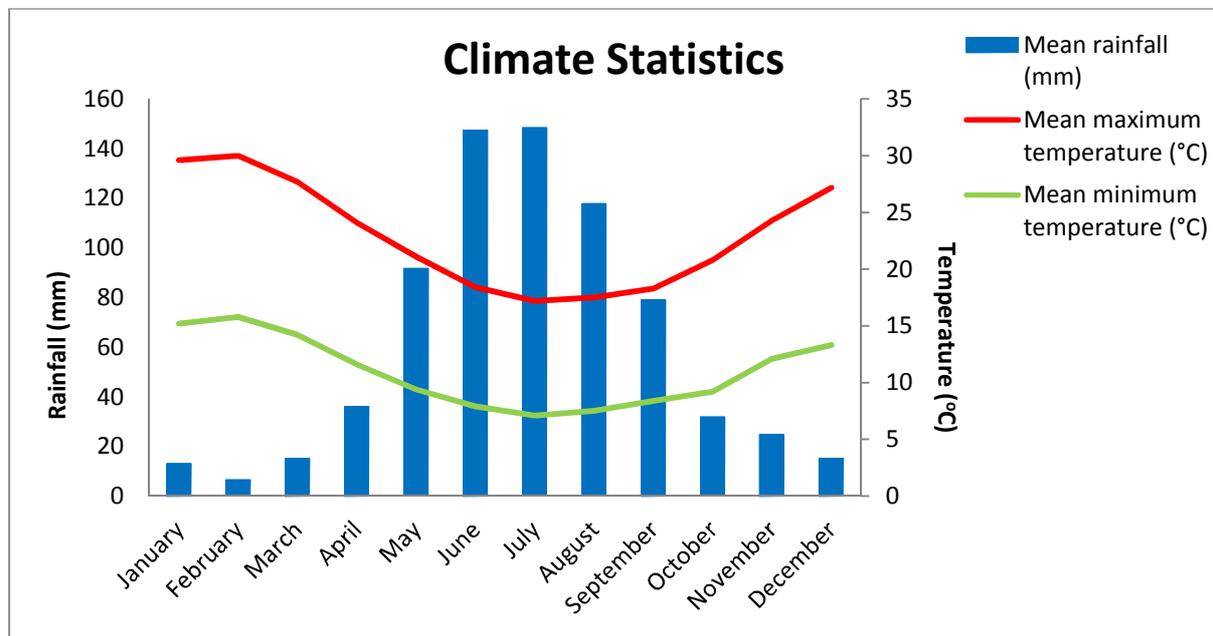
- Its potential ecological value. The existing degraded vegetation within the WHROA provides some Black Cockatoo foraging habitat and potential breeding habitat. Approximately 40% of the large hollows located within the DSE Project area are within the WHROA;
- Its proximity to the project area and accessibility for management by Doral; and
- To enable a “like for like” offset area targeting the protection, restoration and creation of habitat for Black Cockatoos.

2.2 CLIMATE

The climate is Mediterranean and experiences cool wet winters and dry hot summers. Climate statistics from 1995 to 2011 for the Bunbury Site (Site Number: 009965) which is approximately 18km from the site are shown in Chart 1.

CHART 1

CLIMATE STATISTICS FOR BUNBURY SITE (SITE NUMBER: 009965)



(Source: Bureau of Meteorology, 2011)

The highest average maximum temperature is 30.0°C and highest average minimum temperature is 15.8°C, both of which occur in February. July records the lowest temperatures with the lowest average maximum and minimum of 17.2°C and 7.1°C. Rainfall is mainly from April to September with 586.4mm of the total rainfall of 728.5mm (approximately 80% of the total), with 142.1mm falling in the summer months (October to March).

2.3 TOPOGRAPHY

Topography of the WHROA is gently undulating with an upward slope from approximately 55m AHD on the western boundary to 70m AHD on the eastern boundary.

2.4 GEOLOGY

The soils assessment report by Coffey Geotechnics (2011) indicates that the general subsurface profile across the DSE project area is most likely to comprise a transition of colluvium and some eluvial soils to sands and clays of the Yoganup Formation to sandy clay of the Guildford Formation and indicates that the WHROA is primarily within the Yoganup Formation (Figure 2).

Yoganup Formation

The Yoganup Formation typically comprises well graded, fine to coarse grained sands with gravels of laterite and water rounded quartz, overlying sandy clay and clayey sands. The formation is interspersed with laterised beds/iron-cemented ferricrete, generally recovered as laterite gravel bands within the boreholes.

The sand grades from pale grey at the surface, through to yellow, orange and brown with increasing depth. Very fine grained ilmenite mineral was observed throughout the formation.

2.5 SOILS AND SOIL PROFILES

Coffey Geotechnics (2011) separated the DSE site into five generalised subsurface profiles termed Profile A-E. The five subsurface profiles generally conform to the geological and topographic setting of the site, with the distribution of the subsurface profiles typically extending parallel to the toe of the Darling and Whicher Scarps (i.e. northeast-southwest), intersected by drainage features traversing the DSE site towards the western coastline.

The approximate extent and location of the generalised subsurface profiles across the site is shown in Figure 3. The profile boundaries are inferred from the results of the Coffey Geotechnics (2011) investigation, exploration drilling data (provided by Doral), aerial photography and published mapping.

The WHROA is predominately located within Soil Profile D, with the exception of the southeast corner (mapped as Soil Profile E). These Profiles are summarised below.

Profile D

The generalised subsurface profile of 'Profile D' is shown in Table 2. Profile D encompasses the Forrestfield CSs, CSw and F5 Phase soil landscape units with the surface soils of Profile D deposited on the clayey soils, typically of the Yoganup Formation.

The typical depth to the clayey sand of Unit D4 and thickness of overlying sand of Unit D1 and Unit D2 increases towards the south of the Profile D.

The surface soils typically have greater than 90% sand content with the majority of the fines fraction (<75µm) comprising of silt. The soils are typically non-sodic, non-saline and have a moderately acidic pH throughout the soil profile.

TABLE 2

GENERALISED SUBSURFACE PROFILE: 'PROFILE D'

UNIT	SOIL TYPE	TYPICAL DEPTH TO TOP OF LAYER (M)	TYPICAL LAYER THICKNESS (M)	DESCRIPTION/REMARKS
D1	Sand/Silty Sand	Surface	0.1 to 0.3	Fine to coarse grained, dark grey/black to grey (with trace to some laterite gravel BH02 and BH07)
D2	Sand	0.1 to 0.3	1.0 to 2.9	Fine to coarse grained, grey to pale yellow brown/pale grey/pale yellow grey; trace to some clay
D3	Clayey sandy gravel	0.5 to 1.0	0.5 to 2.0	Fine to medium grained laterite gravel; grey mottled orange/orange brown/red brown. Sand, fine to coarse grained, pale grey. (Gravelly sand encountered in BH07)
D4	Clayey sand/sandy clay	1.0 to 3.0	>depth of 3.0	(Generally Yoganup Formation) Fine to coarse grained, pale blue grey mottled orange; with some fine to coarse laterite and quartz gravel. Quartz gravel content increasing to the south of the site. Occasional very coarse quartz sand deposits. Very fine grained ilmenite mineral was observed throughout the formation.

Profile E

The generalised subsurface profile of 'Profile E' is shown in Table 3. Profile E encompasses the Whicher gentle slopes Phase soil landscape unit and a minor portion of the Forrestfield CSs Phase to the west of the distribution.

The typical thickness of the sandy soils of Unit E1 and Unit E2 is significantly greater in the northern part of the profile distribution.

The surface soil layers exhibit clear boundaries into each other, with the topsoil typically non-sodic becoming moderately sodic in the underlying subsoil of Unit E2.

The soils are non-saline with the topsoil having a moderately acidic pH becoming slightly acidic pH in the Unit E2 subsoil.

TABLE 3
GENERALISED SUBSURFACE PROFILE 'PROFILE E'

UNIT	SOIL TYPE	TYPICAL DEPTH TO TOP OF LAYER (M)	TYPICAL LAYER THICKNESS (M)	DESCRIPTION/REMARKS
E1	Sand	Surface	0.1 to 0.7	Fine to medium grained; dark grey/grey/brown; with some gravel.
E2	Sandy Gravel/Gravelly Sand	0.1 to 0.7	0.2 to 1.5 >3.0 depth	Fine to medium grained laterite gravel; orange/orange brown/red brown. Sand, fine to coarse grained; pale orange; trace to some clay. Laterite gravel likely to be interspersed laterised beds/iron-cemented ferricrete.
E3	Clayey gravelly Sand	0.8 to 1.0	>3.0 depth	(Yoganup Formation) Fine to medium grained; pale orange to yellow; fine to medium grained gravel of laterite.

2.6 HYDROLOGY

2.6.1 Surface Water

The DSE project is located between two river basins, the Preston River (south) and the Collie River (north). There are numerous creeks that pass through the project area which are:

- Henty Brook;
- Paradise Creek; and
- Six unnamed creeks between Paradise Creek and Henty Brook (PB, 2012).

A 0.5ha creek area occurs just north of the WHROA, on the northern boundary of Lot 107, adjacent to Simpson Road (Plate 1).

PLATE 1

CREEKLINE CROSSING SIMPSON ROAD

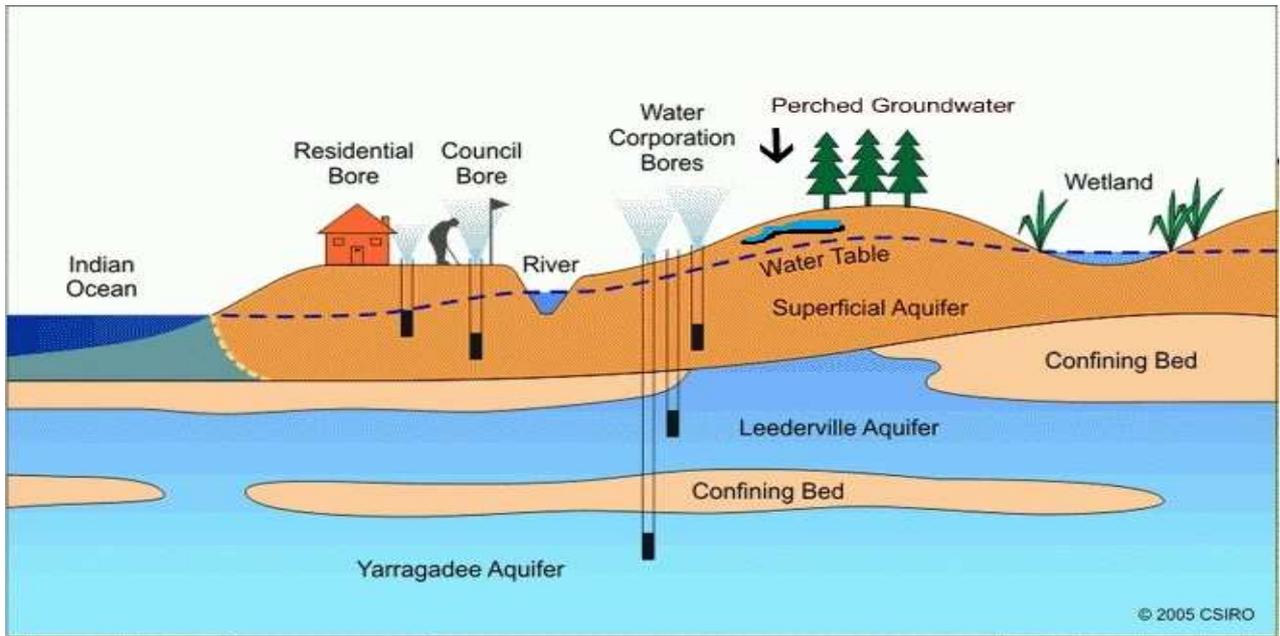


2.6.2 Groundwater

Groundwater in the DSE area comprises perched, Superficial and Leederville aquifers. These systems are shown diagrammatically in Plate 2 and described in Table 4. A cross section of the DSE, diagrammatically showing confining clay layers is shown in Chart 2.

One GDE occurs within the WHROA: ErMp (open Woodland of *Eucalyptus rudis* and *Melaleuca preissiana* over pasture grasses). Soil profiles for this area indicate there is a perched groundwater table within the confining layer between the ground surface and 4mBGL. The perched groundwater is recharged directly by rainfall and is not likely to be influenced by dewatering and subsequent drawdown of the underlying Superficial Aquifer, thereby reducing the risk to this GDE.

PLATE 2
GROUNDWATER IN THE DARDANUP AREA

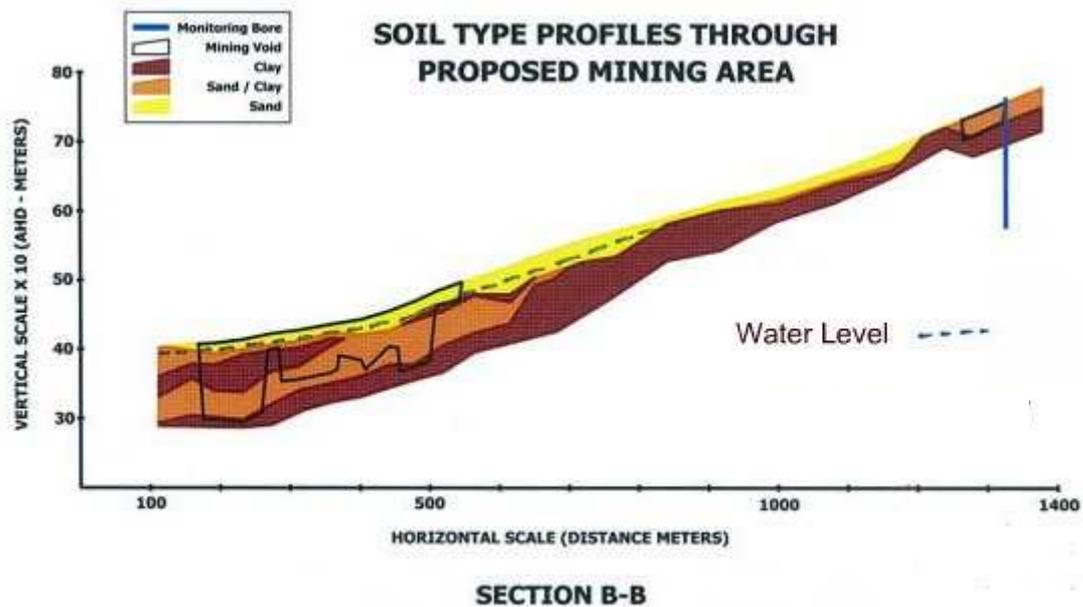


Source: CSIRO 2005

TABLE 4
GROUNDWATER CHARACTERISATION IN THE DARDANUP AREA

AQUIFER NAME	DESCRIPTION
Perched	Perched groundwater is unconfined and occurs above impervious layers such as clays and silts which form an unsaturated zone. Perched groundwater is generally separate from the underlying Superficial Aquifer. In the DSE, perched groundwater occurs between 1 to 4m BGL depending on the nature of the impervious clay layer.
Superficial	The Superficial Aquifer in the Dardanup area typically consists of Bassendean Sands, Guildford formation and Alluvium (west near Bunbury). The Superficial Aquifer is thin (5–15mBGL) to absent across the sub-area, thinning towards the east and overlying the Leederville Aquifer. There is very little fresh groundwater in this aquifer with the water quality is mostly marginal to brackish (500–2000 mg/L TDS), especially towards the coast. In the DSE, the average thickness of the Superficial Aquifer is between 10-12m with thicker portions in the west. The aquifer is thinner in the east of the DSE.
Leederville	The Leederville Aquifer in this area is made up of the Upper and Lower Vasse member. The aquifer thickness ranges between 100–300m, with depth ranging from 15–300mBGL. Generally groundwater salinity is >500 mg/L TDS, increasing with depth. In the DSE, the Leederville Aquifer starts where the Superficial Aquifer ends (vertically) and can be up to 30-50m thick.

CHART 2
SOIL PROFILE CROSS SECTION – DSE



2.7 FLORA AND VEGETATION

2.7.1 Flora

Several flora and vegetation surveys have been undertaken in the DSE project area. A total of 160 vascular plant taxa from 87 plant genera and 37 plant families have been recorded.

No Threatened or Priority species pursuant to the [Western Australian] *Wildlife Conservation Act 1950* or the *EPBC Act 1999* were recorded within the DSE project area (Mattiske, 2011).

Included in the taxa were 67 weed (introduced) species (Appendix D). Cotton Bush (*Gomphocarpus fruticosus*) and Apple of Sodom (*Solanum linnaeanum*) are currently listed as Declared Plant species pursuant to section 37 of the [Western Australian] *Agricultural and Related Resources Protection Act 1976* and have been recorded in the DSE.

2.7.2 Vegetation Complexes

The remnant vegetation in the DSE mostly consists of vegetation from the Guildford Complex (Hedde *et al.*, 1980). The Guildford complex is defined as:

- A mixture of open forest to tall open forest of *Corymbia calophylla*-*Eucalyptus wandoo*-*Eucalyptus marginata* and woodland of *Eucalyptus wandoo*. Minor components include *Eucalyptus rudis*- *Melaleuca raphiophylla*.

Thirty five vegetation communities have been defined and mapped in the DSE project area (Figure 4). The number of communities is related to the lack of native species and the various combinations of a few dominant species. In the WHROA, three vegetation communities were mapped by Mattiske Consulting (2011), these are:

- **CcEmXp** - Tall Open Woodland of *Corymbia calophylla*/*Eucalyptus marginata* var. *marginata* over *Xanthorrhoea preissii* over **Arctotheca calendula*;

- **ErMp** - Open Woodland of *Eucalyptus rudis* and *Melaleuca preissiana* over pasture grasses;
- **XoAg** - Low Open Woodland dominated by *Xylomelum occidentale* and *Agonis flexuosa* over *Xanthorrhoea preissii* over **Cynodon dactylon* and **Romulea rosea*; and
- **CcNfAgMp** - (Tall Open Forest of *Corymbia calophylla* over *Nuytsia floribunda*/*Agonis flexuosa*/*Melaleuca preissiana* over *Juncus pallidus* and **Cynodon dactylon*).

2.7.3 Vegetation Condition

Mattiske Consulting (2011) mapped the approximately 13ha of the WHROA as being Degraded (Plate 3) and the remaining 6ha as Completely Degraded (Plates 4 and 5) according to the condition scale of Keighery (1994) as outlined in Table 5 and shown in Figure 4.

TABLE 5
VEGETATION CONDITION RATING SCALE

Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These are often described as 'parkland cleared' with the flora comprising weed or crop species with isolated native trees or shrubs.

Source: Government of Western Australia, 2000.

PLATE 3
DEGRADED AREAS WITHIN THE WHROA



PLATE 4

COMPLETELY DEGRADED AREAS WITHIN THE WHROA



PLATE 5
COMPLETELY DEGRADED AREA (FOREGROUND) AND DEGRADED AREA (TO THE BACK) WITHIN THE
WHROA



2.8 FAUNA

Coffey Environments (2011) have undertaken studies for fauna habitats for the DSE. Five fauna habitats were recorded in the DSE project area including:

- Pasture with mature trees (P);
- Woodland (W);
- Open Woodland with *Xanthorrhoea* (OWX);
- Linear Remnant Vegetation (LRV); and
- Riparian Vegetation (RP).

A high proportion of the DSE was considered to be in highly degraded condition. Due to its condition and the fragmented nature of the remaining habitat, Coffey Environments determined that the DSE project area had low faunal values.

The WHROA has been mapped as “Open Woodland with *Xanthorrhoea*” with a Fauna Condition rating of “Disturbed” (Coffey Environments, 2011). Although conservation significant fauna may utilise the Woodland habitat (see below), it is unlikely to contain a unique fauna assemblage at a local scale or in a regional context (Coffey Environments, 2011).

The following species of conservation significance are known to occur in the general area and may possibly utilise the WHROA:

- WRPs (*Pseudocheirus occidentalis*), listed as Schedule 1 under the *Wildlife Conservation Act 1950* and as Vulnerable under the *EPBC Act 1999*;
- Southern Brush-tailed Phascogale (*Phascogale tapoatafa*), listed as Schedule 1 under the *Wildlife Conservation Act 1950*;
- Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) - listed as Schedule 1 under the *Wildlife Conservation Act 1950* and as Vulnerable under the *EPBC Act 1999*;
- Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) - listed as Schedule 1 under the *Wildlife Conservation Act 1950* and as Vulnerable under the *EPBC Act 1999*; and
- Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) - listed as Schedule 1 under the *Wildlife Conservation Act 1950* and as Endangered under the *EPBC Act 1999*.

The WHROA contains plants which are known to provide foraging value to the three Black Cockatoo species. Approximately 40% of the 23 trees that have large hollows (>20cm) in the DSE project area that were determined to be potentially suitable for breeding by Black Cockatoos (Coffey Environments, 2011; Harewood, 2012) are located in the WHROA. However no evidence of past or current black cockatoo breeding was found when these hollows were investigated by a qualified zoologist.

2.9 PHYTOPHTHORA DIEBACK

NPC (2010) conducted a *Phytophthora* dieback assessment for the DSE using tissue and soil sampling. The assessment concluded that there are no protectable areas within the DSE project area. Therefore, no specific hygiene or dieback management is necessary (NPC, 2010).

3 REHABILITATION MANAGEMENT

The WHROA has been divided into two Management Areas in accordance with current vegetation condition, proposed revegetation strategy and future management (Table 6, Figure 1).

TABLE 6
DESCRIPTION OF MANAGEMENT AREAS FOR THE WHROA

AREA	#ha	CURRENT ENVIRONMENT (Refer to Section 2.7.2 For Vegetation Community Descriptions)	CURRENT CONDITION**	MANAGEMENT STRATEGIES
Management Area 1	6	This area is dominated by a Low Open Woodland of XoAg (much of this is cleared pasture), CcEmXp and ErMp	Completely Degraded / highly degraded Unaffected by mining activities	Fencing Weed and Pest control Soil Preparation Revegetation Creation of fauna habitat (placement of logs) Conservation covenant
Management Area 2	13	This area is dominated by a Tall Open Woodland CcEmXp. Smaller areas of Open Woodland of ErMp over pasture grasses and vegetation community XoAg also occur.	Degraded / Disturbed Unaffected by mining activities	Fencing Weed and Pest control Vegetation enhancement (through revegetation) Creation of fauna habitat (installation of artificial nesting boxes and dreys) Conservation covenant

** As described by Mattiske (2011) / Coffey Environments (2011)

3.1 SITE PREPARATION

3.1.1 Fencing

The 19ha WHROA will be fenced to exclude stock and pests. A 1.5m high boundary fence will be constructed from 1.8m high cyclone mesh with a combination of treated pine and steel posts spaced approximately every six metres. The additional 30cm of mesh will be turned out against the ground, to minimise the intrusion by foxes, rabbits and kangaroos. Prior to fencing, the area will be de-stocked, kangaroos excluded and unnecessary fencing removed.

3.1.2 Pest Control

Foxes

Baiting with 1080 poison-impregnated egg and/or meat baits will be undertaken for two to four weeks in March and September annually until Autumn 2016. Baits will be checked at least every three days, with fresh baits laid if required. The location of baits will be determined when a risk assessment to surrounding residents has been undertaken.

Rabbits

Evidence of rabbit activity has been observed within the WHROA. This has the potential to compromise proposed revegetation efforts. As such tree guards will be installed at the time of planting.

Oat baits impregnated with 1080 poison will be laid once or twice, depending on weather conditions and rabbit activity. The baits will be laid in and around active areas during February-March when alternative food sources are at their lowest and (weather permitting) in spring (October-November).

Activity post-baiting will initially be monitored monthly. Once existing populations have substantially declined, monitoring frequency will reduce to quarterly with baiting repeated as necessary.

Kangaroos

A 1.5m high boundary fence will be constructed from 1.8m high cyclone mesh with a combination of treated pine and steel posts spaced approximately every six metres. Prior to finalising the fencing Kangaroos will be excluded from the WHROA (herded out) as they can impact revegetation efforts by grazing on newly planted seedlings and juvenile plants. In the event that excluding kangaroos from the WHROA increases pressure on adjacent areas, Doral will work collaboratively with surrounding land owners (subject to DEC approvals) where necessary to manage kangaroo numbers at a sustainable level.

Grasshoppers

Grasshopper numbers fluctuate from year to year depending on seasonal conditions. Numbers will be monitored close to planting/seeding time; baits will be laid if necessary. Baiting is undertaken for between two and four weeks in both March and September of each year.

3.1.3 Weed Control

Weed coverage in the WHROA is estimated to range from approximately 80-100% and as such weed control measures outlined below will be applied biannually (weather permitting and where required) until Autumn 2016.

Many of the weeds in the 19ha WHROA include broadleaf species that can be controlled using a 'frog friendly' Glyphosate-based herbicide such as Roundup Biactive® or similar. Herbicides will be applied twice a year just after the break of season (April to May) and in late winter to early spring.

Bulbs and corm species of the Iridaceae family including *Romulea rosea* (Guildford grass), *Watsonia* and *Gladiolus* species are present in the WHROA. These species are not as effectively controlled by Glyphosate. A bulb-specific herbicide containing metsulfuron-methyl will be applied within the WHROA prior to any application of Glyphosate. Spraying will be undertaken approximately six to eight weeks after shoots have emerged, when the old bulb/corm is exhausted and the new bulb/corm is developing. This will permit enough chemical to be absorbed by the new bulb/corm to kill it.

The central part of the WHROA (Management Area 2, Figure 1) has vegetation comprising of scattered trees and shrubs. Some areas within Management Area 2 have limited access for

machinery. In these areas weeds will be sprayed by hand using backpack sprayers or equivalent delivery system to ensure that only weeds are impacted by the spray. The remainder of the WHROA (Management Area 1, Figure 1) contains mostly pasture species. These are able to be accessed by a ute mounted or tractor pulled spraying units. This will be undertaken during suitable weather conditions (i.e. very little air movement blowing away from existing vegetation) to ensure adjacent vegetation in the road reserves will not be impacted by spray drift.

Couch grass (*Cynodon dactylon*) and kikuyu (*Pennisetum clandestinum*) have been recorded in the DSE and occurs in the wetter parts of the site. A grass selective herbicide will be used.

Cotton Bush (*Gomphocarpus fruticosus*) and Apple of Sodom (*Solanum linnaeanum*) occur at low densities in the WHROA. These are currently being removed by hand and will continue to be controlled using a combination of physical removal and chemical control prior to revegetation.

3.1.4 Soil Preparation

Deep ripping is highly effective as it breaks apart a compaction layer which forms at approximately 150mm depth from continual grazing and traffic associated with agricultural practices at 10 to 40cm depth (Gilkes and Hunt, 1992).

Ripping and furrowing will be undertaken where possible which will generally be in Management Area 1. The soil will be ripped where possible to 50 to 80cm depth in late summer/early autumn, as this is when the soil compaction layer will shatter. Any areas with compacted clay may be treated with gypsum prior to ripping. Rip lines will follow contours and will be kept outside the foliage line of remnant vegetation to minimise disturbance to the root system of the existing vegetation. Prior to planting, rip lines will be furrowed where possible. Furrows collect water, directing it to the root-zone and also help to remove hydrophobic soils if present. Furrow spoil will be hilled on the down-slope side to better trap and retain water.

In Management Area 2 planting will be done in soil that will be dug by manual means.

3.1.5 Habitat Creation

Large logs have been collected from around the entire Dardanup Mine site area over recent years and stockpiled. These logs will be strategically placed where practicable throughout Management Area 1 to provide niche habitats and decrease wind erosion potential. To avoid creating sites for future rabbit warrens or fox dens, logs will not be piled or stacked but rather placed individually through the site.

No Black Cockatoo breeding has been recorded to date within the WHROA. However, as the area contains a number of suitable breeding hollows, and is in close proximity to existing and future foraging habitat it is proposed six artificial or salvaged hollows are placed within the WHROA and monitored for use (Figure 1). It is proposed that hollows from trees within mining pit SS3 are salvaged (Figure 1) and their use as breeding hollows evaluated for use within the WHROA. All other hollows will be designed and installed in the WHROA in accordance with the DEC Information Sheet "Artificial Hollows for Carnaby's Cockatoo, How to Design a Hollow" (DEC 2011a, Appendix B).

Monitoring and Maintenance of Artificial Hollows will be in accordance with DEC Information Sheet "Artificial Hollows for Carnaby's Cockatoo, How to Monitor and Maintain" (DEC 2011b, Appendix C). Refer to Section 6.0.

4 REVEGETATION

4.1.1 Species and Densities

Species lists and densities for the WHROA are outlined in Tables 7 and 8. In the Completely Degraded Areas (Management Area 1, Figure 1) trees will be planted at a density of 260 stems/ha (a total of 1,552 trees) (Table 7). In the remaining WHROA (Management Area 2, Figure 1) trees will be planted at a density of 57 stems/ha (approximately 744 trees) (Table 8). Trees within Management Area 2 will be planted amongst the existing vegetation where there are areas that are greater than 20m² that do not have a tree present.

The species list has been compiled to ensure the resultant vegetation is suited to the soil type and hydrology of each management area and is compatible with the surrounding vegetation.

TABLE 7
SPECIES LISTS AND DENSITIES FOR THE WHROA MANAGEMENT AREA 1

MANAGEMENT AREA 1: COMPLETELY DEGRADED VEGETATION				
Trees/Shrubs	Species Planted	# Stems	Area (ha)	Density (stems per ha)
Trees (Cockatoo Habitat)	<i>Corymbia calophylla</i>	867	5.97	145
	<i>Eucalyptus marginata</i> var. <i>marginata</i>	533	5.97	89
	<i>Banksia grandis</i>	80	5.97	13
Trees (WRP Habitat)	<i>Agonis flexuosa</i>	80	5.97	13
Shrubs	<i>Hakea trifurcata</i>	150	5.97	25
	<i>Hakea amplexicaulis</i>	150	5.97	25
	<i>Xylomelum occidentale</i>	30	5.97	5
	<i>Kunzea glabrescens</i>	150	5.97	25
	<i>Xanthorrhoea preissii</i>	25	5.97	4
Understorey	<i>Patersonia occidentalis</i>	290	5.97	49
	<i>Kennedia prostrata</i>	290	5.97	49

TABLE 8
SPECIES LISTS AND DENSITIES FOR THE WHROA MANAGEMENT AREA 2

MANAGEMENT AREA 2: DEGRADED VEGETATION				
Trees/Shrubs	Species Planted	# Stems	Area (ha)	Density (stems per ha)
Trees (Cockatoo Habitat)	<i>Corymbia calophylla</i>	470	13.06	36
	<i>Eucalyptus marginata</i> var. <i>marginata</i>	210	13.06	16
	<i>Banksia grandis</i>	70	13.06	5
Shrubs	<i>Hakea trifurcata</i>	65	13.06	5
	<i>Hakea amplexicaulis</i>	65	13.06	5
	<i>Xylomelum occidentale</i>	15	13.06	1
	<i>Kunzea glabrescens</i>	65	13.06	5
Understorey	<i>Patersonia occidentalis</i>	125	13.06	10
	<i>Kennedia prostrata</i>	125	13.06	10

4.1.2 Planting

The WHROA will be planted in a semi-random manner to ensure the final vegetation appears as natural as possible. Tubestock will be used in all cases, however if weed control is successful in the first two years some seed may be spread over areas to enhance the rehabilitated area to a natural looking bushland.

Planting will be initially undertaken in 2013 after one round of weed control has been completed and following the installation of fences. Rehabilitation will be conducted progressively over a three year period. Approximately one third of the area will be planted out each year. In addition to balancing resource and labour demands over the project timeframe, this will enable effective management of risks which may arise from species unavailability, abnormally dry, late or otherwise difficult seasons, and other such risks. Spreading the project over multiple years allows contingencies to be planned that can address any threats to or impacts on project success.

4.1.3 Source

Seed will be sourced locally wherever possible. Consistent with previous rehabilitation projects, existing Doral offsets areas will be harvested for seed as will the neighbouring bushland outside of Doral landholdings where available. Reconnaissance visits will be made to bushland for which Doral has permission to harvest seed to determine the species diversity and seed quantity that can be sourced in time for orders to be placed with local seed merchants or nurseries for the planting seasons as required. It is Doral's intention to engage volunteer seed collectors associated with local

community groups where possible in order to develop the skills and experience of group members and support the local community. Support or donations or a combination of both will be used to remunerate groups who assist with this aspect of the project.

Seed collected will be given to the Leschenault Community Nursery where plant stock will be grown specifically for this project. Any species not able to be supplied by collecting seed or this nursery will be sourced from other nearby suppliers. Tubestock for the 2013 planting season will be sourced from local suppliers.

Xanthorrhoea preissii is proposed to be planted in Management Area 1 (Refer to Table 7). Where possible, transplantation of *Xanthorrhoea preissii* from areas to be cleared from Lot 107 Simpson Road will be used in the rehabilitation planting.

5 PERFORMANCE AND COMPLETION CRITERIA

Completion criteria for the WHROA are broken into two key areas:

- Rehabilitation Performance Criteria; and
- Completion Criteria.

These criteria will be used to assess the success of the rehabilitation management and revegetation in order to meet commitments and conditions.

5.1.1 Rehabilitation Performance Criteria

The following targets will be used to assess the performance of the rehabilitation and identify areas that require additional planting and/or weed treatment:

- 75% survival of overstorey seedlings (a total surviving tree count of 1,720 (1,600 Black Cockatoo habitat trees);
- 75% survival of understorey seedlings;
- Species representation (acceptable survival of at least 75% of species planted in each area); and
- Presence of weeds (a 40% reduction in weed cover over 2 years and 50% reduction within 3 years compared to the current weed cover (80-100%).

If these performance criteria are not met then remedial action including supplementary planting and weed control will be undertaken as required so that the targets can be satisfied. Compliance with these targets will be recorded during the quarterly monitoring and reported annually.

5.1.2 Completion Criteria

The completion criteria provided below will be used to assess the success of offset in relation to commitments and conditions outlined in Section 1.2.

1. Habitat available to black cockatoos is created and enhanced by meeting rehabilitation targets.
2. The following has been provided:
 - Fencing to exclude grazing stock and pests;
 - Destocking of the Offset Area;
 - Removal of unnecessary fences;
 - Pest control has been undertaken; and
 - Artificial Habitat has been created.
3. A conservation covenant has been placed on the area that:
 - Restricts or prohibits activities on the land that could degrade the conservation value of the land, in particular to black cockatoos;

- Is a legally binding document, and is registered on the Certificate of Title of the property;
- Is flexible as to suit both the conservation values of the land and the landowner; and
- Can be modified if the nature conservation values of the covenanted land are not compromised.

6 MONITORING AND MAINTENANCE

6.1 MONITORING

The objectives of monitoring are to:

- Determine whether rehabilitation performance criteria have been met;
- Evaluate the effectiveness of management measures and determine if additional work is required;
- To monitor the improvement of black cockatoo habitat over time; and
- Assess whether completion criteria have been met.

Monitoring will be undertaken by a qualified ecologist or a suitably experienced environmental scientist.

Table 9 lists the methods of assessment to monitor rehabilitation success in accordance with the rehabilitation performance criteria in Section 5.0.

TABLE 9
MONITORING REHABILITATION SUCCESS

ASSESSMENT PARAMETER	ASSESSMENT METHOD	PERFORMANCE CRITERIA
Seedling survival of overstorey species	Quadrats (Refer to Section 6.1.1) Requiring seedling health to be measured (% survival in each quadrat)	75% survival of overstorey seedlings
Seedling survival of understorey species	Quadrats (Refer to Section 6.1.1) Requiring seedling health to be measured (% survival in each quadrat)	75% survival of understorey seedlings
Height	Quadrats (Refer to Section 6.1.1) Height of trees to be estimated (within each quadrat)	Trees are to show consistent growth during monitoring and based on this either be a minimum of 3m in height after 3 years or show that they will attain that height in the short-term future without the need for remedial action.
Species diversity	Quadrats (Refer to Section 6.1.1) Number and species of plants counted in each quadrat	Survival of at least 75% of species planted in each area
Presence of Weeds	(Refer to Section 6.1.1) Identification of any declared plants	A reduced number of weeds compared to surrounding

ASSESSMENT PARAMETER	ASSESSMENT METHOD	PERFORMANCE CRITERIA
	<p>and significant environmental weed species within the rehabilitated areas</p> <p>Weed Cover within Quadrats</p>	<p>comparable areas</p> <p>Criteria to be used:</p> <ul style="list-style-type: none"> • No declared weeds within the rehabilitated area 2 years after implementation. • Reduction of 40% weed cover within 2 years after implementation and 50% reduction in weed cover after 3 years of implementation (compared to current weed cover of 80-100%).
Overall success of plant establishment	<p>Subjective measure based on a visual assessment of species composition, plant density and plant condition within the rehabilitated areas. Five categories used (Excellent, Good, Satisfactory, Poor and Unacceptable). Photographic record of plant growth in each rehabilitated area Section 6.1.3). Overall assessment of the ability of the revegetated area to attain a final required vegetation structure and composition (e.g. a habitat area might not contain 30% canopy cover but is growing well and will attain that in a few years without the need for remedial action).</p>	<p>Species composition and projected plant growth likely to achieve overstorey foliage target (A total surviving tree count of 1,720 (1,600 Black Cockatoo habitat trees)</p>

Monitoring results will be compared to the targets in Section 5.0. These will be reviewed annually with any immediate actions required communicated to the Mine Manager.

6.1.1 Quadrats

Monitoring of quadrats will be undertaken on a quarterly basis during each season. Vegetation monitoring will start on completion of the first round of planting and continue for three years post completion of rehabilitation. Three 10m x 10m quadrats will be established in each management unit in order to allow for quantitative assessments of revegetation success to be undertaken. Quadrat locations will be chosen randomly.

Seedling survival, diversity, weed cover and tree height will be monitored in the monitoring program. Quadrat corners will be marked with steel droppers and tagged with flagging tape, and all are orientated such that diagonals are aligned northwest-southeast and southwest-northeast.

Coordinates for the southeast and northwest corners will be recorded and all quadrat photographs will be taken from the southeast corner. Two photographs will be taken for each quadrat, one at approximately 40cm height to illustrate vegetation structure, the other at standing height to illustrate vegetation cover and condition.

6.1.2 Visual Monitoring

Visual monitoring will be undertaken on a quarterly basis during each season. Visual monitoring will start on completion of planting and continue for three years post completion of the rehabilitation. The visual assessment will include:

- Condition of fences;
- Condition of artificial habitat (i.e. hollows);
- Any signs of pest activities including diggings, burrows, scat or damage to leaf material;
- The presence of grass weeds, bulbs/corms and or woody declared weeds;
- Soil condition including observations of compacting, waterlogging or water repellent soils;
- Signs of native fauna, particularly Black Cockatoos and Western Ringtail Possums;
- Overall success of plant establishment (see Table 9)
- Presence of any regeneration of native species within the rehabilitated area;
- Nearby vegetation that could provide seed source; and
- Condition of firebreaks.

Observations from the monitoring will be recorded and compared to the targets in Section 3.9. These will be reviewed annually with any immediate actions required communicated to the Mine Manager.

6.1.3 Photo-points

Ten photo-points will be established in the WHROA to allow a visual comparison of changes in vegetation structure and composition over time which will aid in monitoring revegetation success as well as the rate of natural regeneration in remnant areas. Photo-points will be established prior to undertaking any works onsite so that a true baseline condition picture can be recorded. Monitoring of photo-points will continue for three years post completion of rehabilitation.

Six of the ten photo-points will be established within monitoring quadrats (see method in Section 6.1.1). The remaining four photo-points will be marked with white-tipped timber surveying pegs which are flagged with pink tape and labelled on the side from which the photograph is taken. GPS coordinates and compass bearings shall be recorded for each photo-point. Photo-points will be visited on an annual basis in Spring. Photos will be taken from behind the photo-point, from as far back as necessary to include the peg in the centre and bottom 20% of the photo. Photos will be taken from a standing position, with the camera held in front of the photographer's face, without zooming.

6.1.4 Artificial Habitats

It is proposed that at least two visits are undertaken during peak breeding season (that is, between September and December). Two or more of following monitoring techniques will be used:

- Observing and recording the presence of Black Cockatoos in the region;
- Observing behaviour of adults around hollow;
- Listening for chicks;
- Looking for evidence of chewing;
- Observing nest for signs of activity;
- Breeding behaviour of adults around hollow or evidence of chewing;
- Noises from chicks in hollow; and

6.1.5 Independent Environmental Audit

In accordance with Condition 12 (decision made under sections 130 (1) and 133 of the EPBC Act 1999) an independent environmental audit of the offsets component of the DSE will be conducted to review the adequacy of the rehabilitation and management of the WHROA and recommend measures to improve the environmental performance of the project in order to meet the completion criteria where required. The audit will be undertaken within two years of approval of this plan and every three years until mine closure. Results of the audit will be documented in Doral's Annual Environmental Report (AER).

6.2 MAINTENANCE

6.2.1 Weed Control

Weed control will be determined by site weed inspections undertaken quarterly as per 6.1.2. Each management area will be assessed individually for the presence and severity of weed re-establishment. Weed species will be removed by hand or treated with herbicide as required based on observations during site inspections.

The aim of the weed control program is to prevent weed seed set; therefore the site weed inspection schedule will be continually audited to determine whether an increase or decrease in the frequency of inspections is necessary in order to achieve this aim.

6.2.2 Pest Control

Activity post-baiting will be monitored as required and quarterly as per 6.1.2. Once existing populations have substantially declined, monitoring frequency may be reduced according to site based evidence of digging, burrows and scats.

Baiting will occur when necessary, as per Section 3.1.2

6.2.3 Dieback Management

There are no protectable areas and therefore no requirements on hygiene and management of dieback within the rehabilitated areas. If susceptible species are affected in the rehabilitated areas in the first two years the species composition will be adjusted to avoid using dieback sensitive species.

6.2.4 Fire Management

A firebreak will be maintained around the perimeter of the WHROA.

6.2.5 Artificial Habitat

Maintenance will be undertaken annually between July and January (before the breeding season) to assess and maintain the following where required (as a minimum):

- Condition of chewing posts;
- Condition of the attachment points;
- Condition of the hollow bases;
- Stability of tree or pole used to mount the artificial hollow; and
- Ensure that feral bees or other feral animals are not utilising the hollows.

7 TIMING

A schedule of works is provided in Table 10. The schedule of works is for 3 years. If, after 3 years (Autumn 2016), rehabilitation targets and completion criteria have not been met then the WHROA Plan (this plan) will be revised to extend management and monitoring of the WHROA until all rehabilitation targets and completion criteria have been met.

**TABLE 10
SCHEDULE OF WORKS**

SEASON	FENCING	PEST CONTROL				WEED CONTROL		SOIL PREPARATION		HABITAT CREATION	REVEGETATION		FIREBREAKS	MONITORING and AUDITING	REPORTING
		Kangaroos	Foxes	Rabbits	Grasshoppers	Metsulfuron-methyl	Glyphosate	Ripping	Gypsum Application		Planting	Seed Collection			
Autumn 2013	WHROA to be destocked, unnecessary fencing removed and fencing installed around Woodland Habitat Rehabilitation Area	Kangaroos to be removed just prior to completion of fencing	Baiting in March	Baiting in March	Baiting in March (if required)	Spray in April to May in suitable weather	Spray in April to May in suitable weather	Management Area 2 only (following weed control)	If required		Reconnaissance and Seed Collection			Submission of AER to DSEWPaC AER to be published on Doral's website by the 1 of March in accordance with Condition 9.*	
Winter 2013					6 to 8 weeks after emergence					Placement of logs and hollows	Plant one third of plants (Management Area 2) Salvage and planting of <i>Xanthorrhoea pressii</i>		Photopoint monitoring Quadrat monitoring to start in Management Area 2		
Spring 2013			Baiting in September	Baiting in October (weather permitting)			Weed Control Where required					Maintenance of Firebreaks	Quadrats and Photo-point Observation of Artificial Hollows		
Summer 2013							Weed Control Where required	Late Summer after spraying is effective			Seed Collection		Quadrats and Photo-point Observation of Artificial Hollows		
Autumn 2014			Baiting in March	Baiting in March	Baiting in March (if required)		Spray in April to May in suitable weather						Quadrats and Photo-point	Submission of AER to DSEWPaC. AER to be published on Doral's website by the 1 of March in accordance with Condition 9.*	

SEASON	FENCING		PEST CONTROL			WEED CONTROL		SOIL PREPARATION		HABITAT CREATION	REVEGETATION		FIREBREAKS	MONITORING and AUDITING	REPORTING
Winter 2014						6 to 8 weeks after emergence					Plant one third of plants (Management Area 1)			Quadrats and Photo-point Maintenance of Artificial Hollows	
Spring 2014			Baiting in September	Baiting in October (weather permitting)			Weed Control Where required						Maintenance of Firebreaks	Quadrats and Photo-point Observation of Artificial Hollows	
Summer 2014							Weed Control Where required	Late Summer if required				Seed Collection		Quadrats and Photo-point Observation of Artificial Hollows INDEPENDENT AUDIT	
Autumn 2015			Baiting in March	Baiting in March	Baiting in March (if required)		Spray in April to May in suitable weather							Quadrats and Photo-point	Submission of AER to DSEWPac. AER to be published on Doral's website by the 1 of March in accordance with Condition 9.*
Winter 2015						6 to 8 weeks after emergence					Plant one third of plants (Management Area 1)			Quadrats and Photo-point Visual Inspections to start. Maintenance of Artificial Hollows	
Spring 2015			Baiting in September	Baiting in October (weather permitting)			Weed Control Where required						Maintenance of Firebreaks	Visual Inspection, quadrats and Photo-point Observation of Artificial Hollows	

SEASON	FENCING		PEST CONTROL			WEED CONTROL		SOIL PREPARATION		HABITAT CREATION	REVEGETATION		FIREBREAKS	MONITORING and AUDITING	REPORTING
Summer 2015							Weed Control Where required							Visual Inspection, quadrats and Photo-point Observation of Artificial Hollows	
Autumn 2016			Baiting in March	Baiting	Baiting in March (if required)		Spray in April to May							Visual Inspection, quadrats and Photo-point	Submission of AER to DSEWPac AER to be published on Doral's website by the 1 of March in accordance with Condition 9.* Independent Audit

- Condition 9 (decision made under sections 130 (1) and 133 of the EPBC Act 1999) requiring that any non-compliance is reported to department as well as publishing AER by the 1of March each year.

8 RESPONSIBILITIES

Doral's Occupational Health, Safety and Environment Superintendent will be responsible for the implementation of this WHROA Rehabilitation Plan.

9 RISKS AND CONTINGENCY MEASURES

Potential risks to the successful management and rehabilitation within the WHROA and management measures to mitigate these risks are described in Table 11 below.

TABLE 11
CONTINGENCY MEASURES

RISK	MANAGEMENT ACTION	SECTION OF THIS PLAN
Revegetation efforts hampered by rabbits	1. Tubestock to be planted with protective barrier 2. Baiting for rabbits 3. Infill planting	3.1.2
Revegetation efforts hampered by kangaroos	4. WHROA is to be fenced following removal of kangaroos from offset area 5. Fence will be maintained 6. Infill planting	3.1.2
Revegetation efforts hampered by dry conditions	7. Seedlings will be planted at the start of winter. 8. Infill planting	4.0
Revegetation efforts hampered by weeds	9. Weed control plan	3.1.3
Revegetation efforts hampered by grasshoppers	10. Implement grasshopper control program	3.1.2
Fire	11. A firebreak will be maintained around the perimeter of the WHROA.	6.2.4
Feral Bees or other introduced species invading hollows	12. Hollows will be checked during annual maintenance.	6.2.5

10 REPORTING

Doral's AER will be provided to DSEWPaC annually. As a minimum the AER will include:

- A description of management actions completed within the WHROA;
- Milestones achieved;
- Results of monitoring and compliance with rehabilitation performance criteria and completion criteria;
- Results of independent audit (every two years only); and
- Identification of any adaptive management actions required in order to meet rehabilitation and completion criteria.

Final documentation reporting on completion criteria and future management of the Offset Area will be documented in Doral's Dardanup Mineral Sands Mine Closure Plan.

10.1 COMMUNICATION/PROMOTION OF RESULTS

Doral is committed to communicating and sharing knowledge of its rehabilitation activities for the DSE project. Doral will also involve the local community with implementation of the rehabilitation and celebrations of success where possible. To realise this, a variety of communication methods are currently used, including:

- Newspaper and newsletter articles as significant milestones or other events worthy of celebration are reached (these will include the Dardanup District Times, South Western Times and others as appropriate);
- Poster and / or other displays at local events such as the Doral sponsored Dardanup Bull and Barrel Festival;
- Field days based around learning events, such as seed picking or planting workshops;
- Articles in other media avenues such as Farm Weekly and local radio; and
- Stories and articles on the Doral company website (Howe and Strang, 2010).

These communications will include news about the rehabilitation site in the DSE project area.

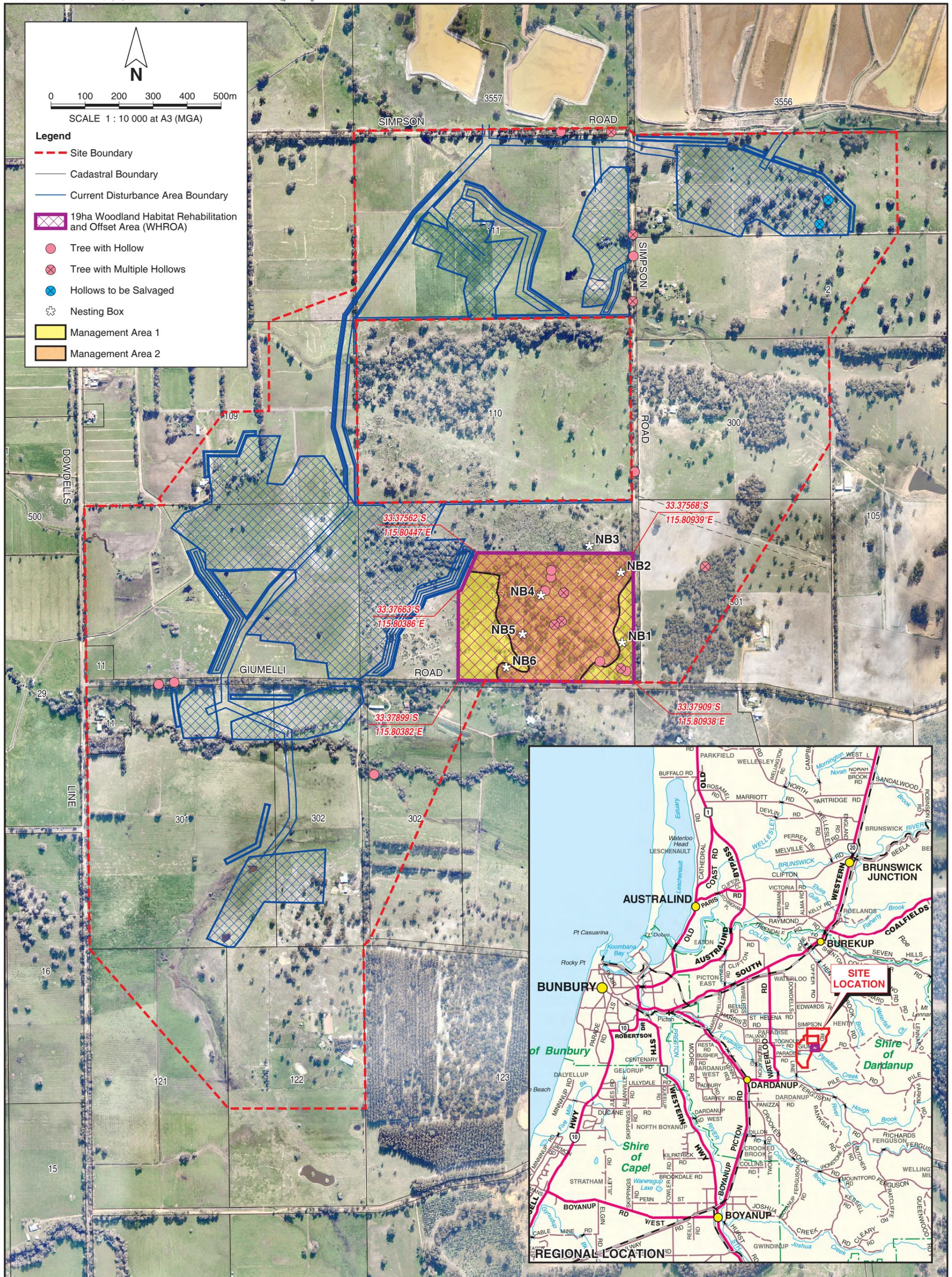
11 REFERENCES

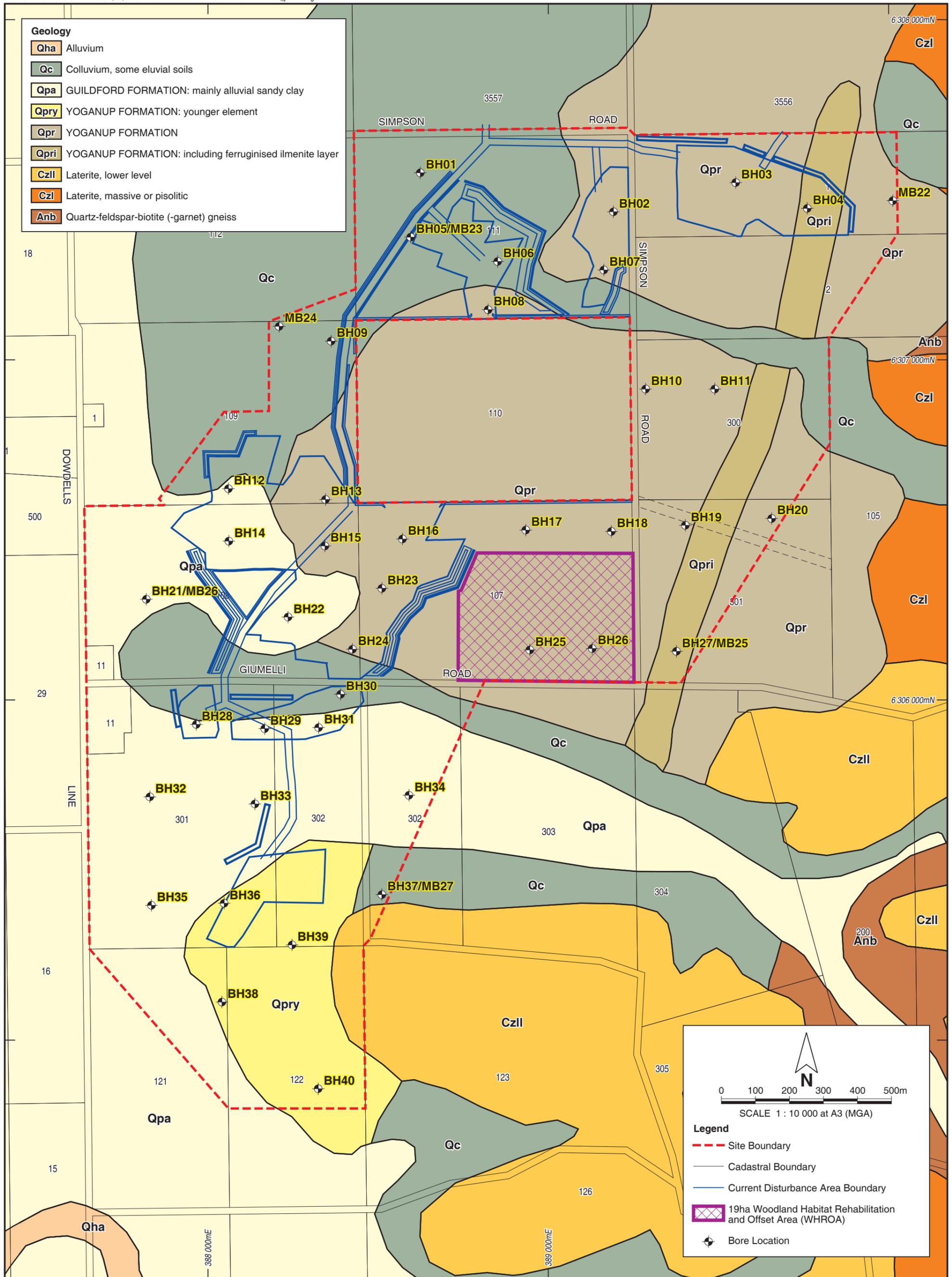
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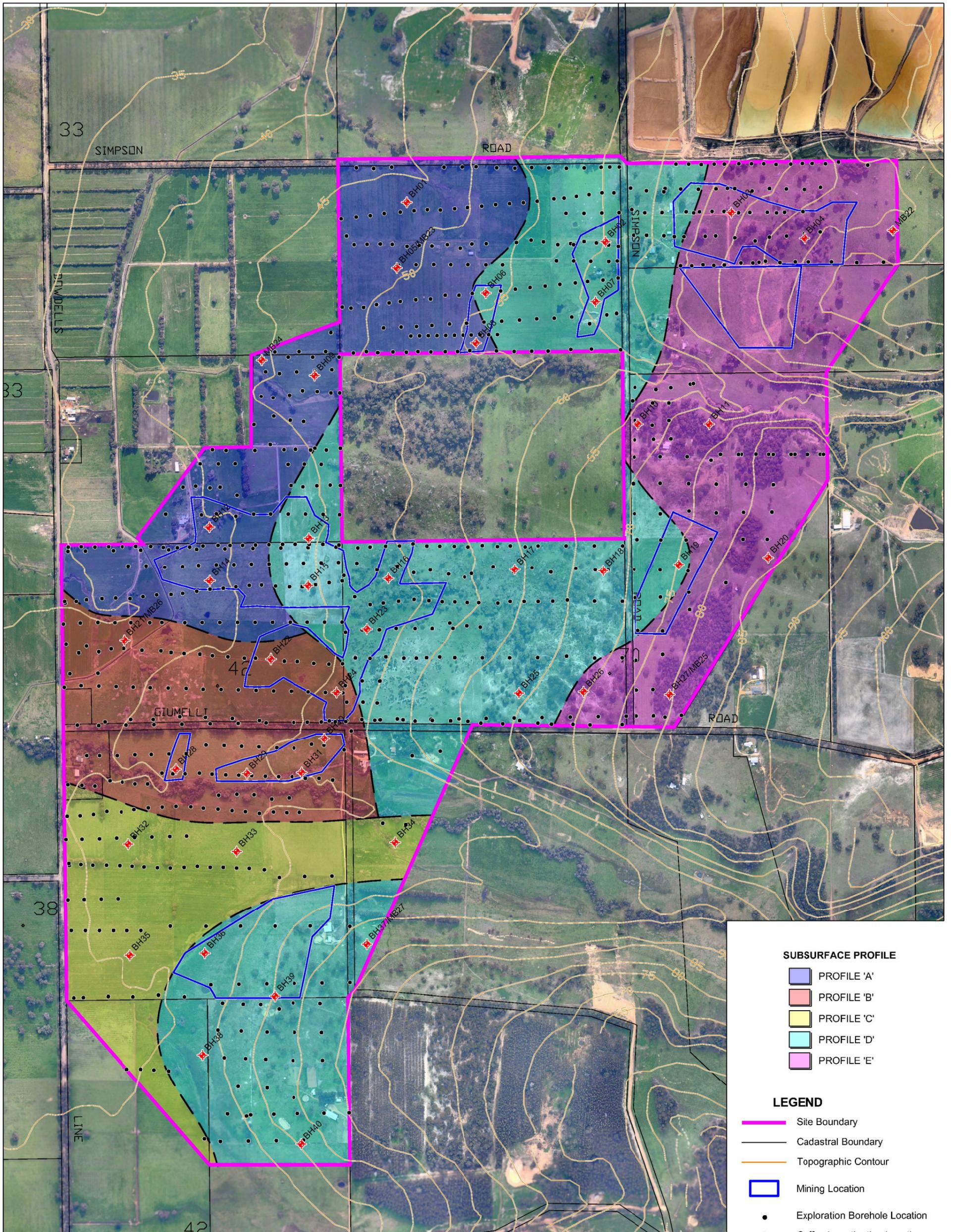
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FIGURES

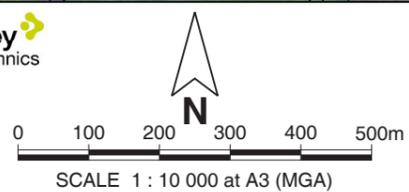






- SUBSURFACE PROFILE**
- PROFILE 'A'
 - PROFILE 'B'
 - PROFILE 'C'
 - PROFILE 'D'
 - PROFILE 'E'

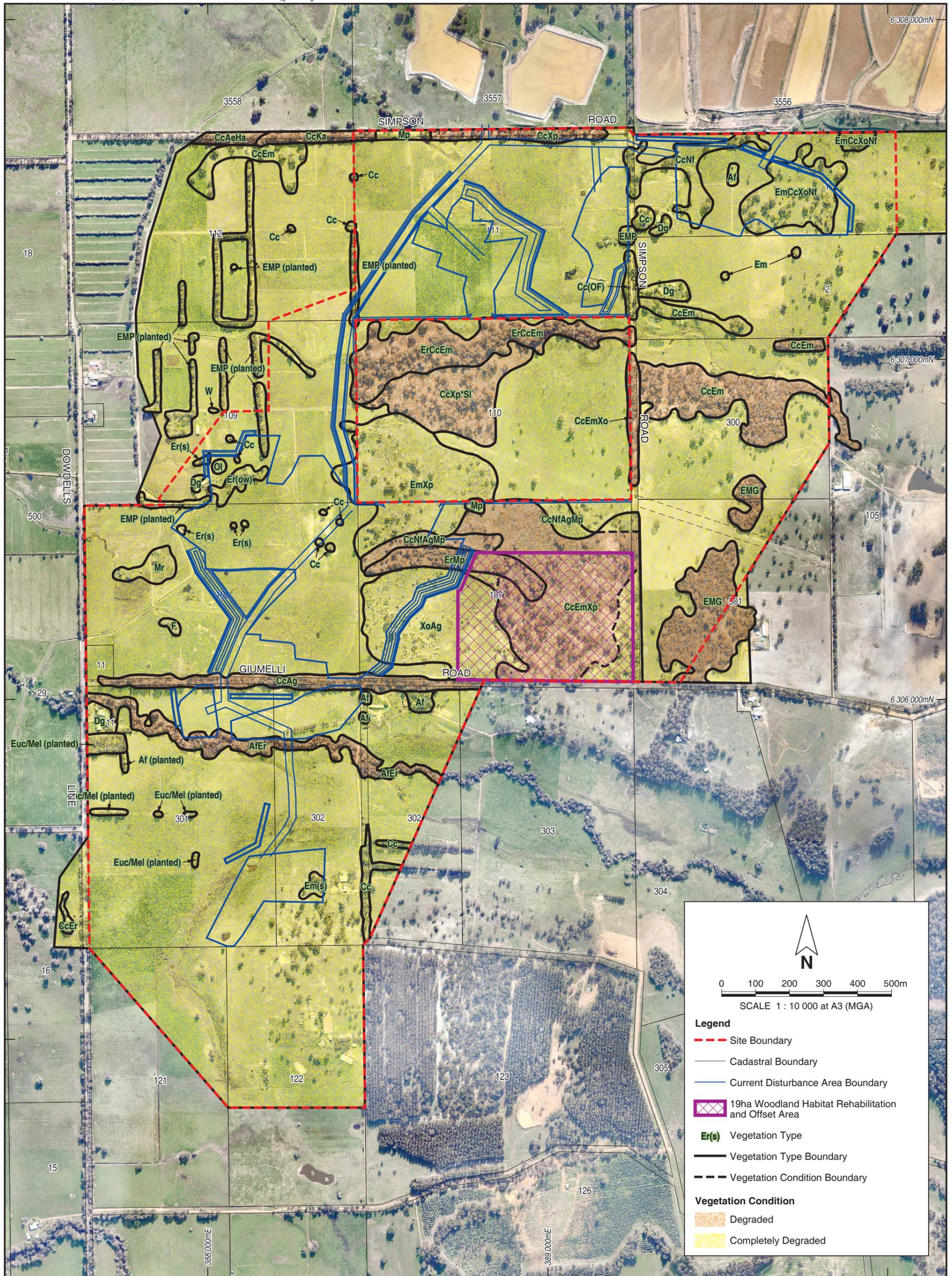
- LEGEND**
- Site Boundary
 - Cadastral Boundary
 - Topographic Contour
 - Mining Location
 - Exploration Borehole Location
 - Coffey Investigation Location



Doral
WOODLAND HABITAT REHABILITATION PLAN
SOUTHERN EXTENSION TO THE DARDANUP MINERAL SANDS PROJECT

SUBSURFACE PROFILE DISTRIBUTION PLAN

Figure 3



N

0 100 200 300 400 500m

SCALE 1 : 10 000 at A3 (MGA)

Legend

- - - Site Boundary
- Cadastral Boundary
- Current Disturbance Area Boundary
- 19ha Woodland Habitat Rehabilitation and Offset Area
- Er(s) Vegetation Type
- Vegetation Type Boundary
- Vegetation Condition Boundary

Vegetation Condition

- Degraded
- Completely Degraded

APPENDIX A

EPBC 2011/6087 Approval Conditions



Australian Government

Department of Sustainability, Environment, Water, Population and Communities

Approval

Dardanup Mine Expansion Southern Extension, Henty, WA (EPBC 2011/6087)

This decision is made under sections 130(1) and 133 of the *Environment Protection and Biodiversity Conservation Act 1999*.

Proposed action

person to whom the approval is granted Doral Mineral Sands Pty Ltd

proponent's ACN (if applicable) ACN: 096 342 451

proposed action The proposed action is the Dardanup mine expansion at Henty, 15 km east of Bunbury, Western Australia. The proposal involves new open-cut pits to mine a heavy mineral deposit (see EPBC Act referral 2011/6087).

Approval decision

Controlling Provision	Decision
Listed threatened species and communities (sections 18 & 18A)	Approved

conditions of approval

This approval is subject to the conditions specified below.

expiry date of approval

This approval has effect until 30 June 2017

Decision-maker

name and position David Calvert
A/g Assistant Secretary
Environment Assessment Branch

signature

date of decision 16 /07/2012

Conditions attached to the approval

1. Within 30 days of the **commencement of construction** of the action, the person taking the action must advise the **department** in writing of the actual date of commencement.
2. The person taking the action must not clear:
 - a) more than 13.7 ha of **black cockatoo** foraging habitat. Area to be cleared includes two identified potential breeding trees (H1 and H2 as identified in Appendix A).
 - b) **potential breeding trees** known to contain hollows suitable for breeding as identified in Appendix A, other than the two identified in condition 2a). These **potential breeding trees** must be **avoided** during **construction** and **operation**.
 - c) **native vegetation** in the areas identified as the Woodland Habitat Rehabilitation and Offset Area (WHROA) as defined in Appendix B.
3. Within three years of the date of this approval the person taking the action must register a legally binding conservation covenant over the Woodland Habitat Rehabilitation and Offset Area (WHROA) identified in the map at Appendix B. The conservation covenant must provide enduring protection and rehabilitation of no less than 19 ha including the establishment of 1600 **black cockatoo** habitat trees.
4. To offset the impacts to **black cockatoos**, within 60 days of **commencement of construction**, the person taking the action must submit to the **Minister** for approval a Woodland Habitat Rehabilitation Plan (WHRP). This plan must be used to establish and maintain the WHROA in accordance with the Offset Management Plan (2012) provided in the Preliminary Documentation.

The WHRP must include, but not be limited to the following:

- a) milestones and objectives of the WHROA
- b) a description and map to clearly define the location and boundaries of all of the offset areas. This must be accompanied by the **offset attributes** and a **shapefile**
- c) details of management actions to protect and enhance the extent and condition of habitat values of the offset areas including but not limited to rehabilitation, weed control and feral animal control
- d) details of the location and type of habitat creation (including but not limited to artificial nesting boxes and relocated logs)
- e) the timing, responsibilities, performance criteria and corrective actions, to be implemented if performance criteria are not met with in specified timeframes, for management actions
- f) a monitoring plan, including timing and methods for assessment of rehabilitation success to be undertaken by a qualified ecologist or suitably experienced environmental scientist to assess the success of the management actions against identified milestones and objectives
- g) a process to report to the **department**, the management actions undertaken in the offset areas and the outcome of those actions, including identification of any need for adapting management actions
- h) a description of the potential risks to successful management and rehabilitation in the offset areas, and a description of the contingency measures that would be implemented to mitigate these risks
- i) details of parties responsible for management, monitoring and implementing the plan, including their position or status as a separate contractor

The approved WHRP must be implemented.

5. Prior to undertaking **clearance of native vegetation**, the person taking the action must undertake pre-clearance surveys. The surveys must:
 - a) Be undertaken by a qualified ecologist with previous experience in surveys of the above listed species;
 - b) Be conducted in accordance with DSEWPaC Survey guidelines for Australia's threatened bird species (2010) and DSEWPaC Survey Guidelines for Australia's threatened mammal species (2011)
 - c) Be undertaken during likely breeding season for black cockatoos (August to November)
 - d) If fauna are located within the disturbance area during pre-clearance surveys then the **department** would be notified in writing and individuals will be removed from danger by a specialist ecologist and relocated to adjacent habitat in consultation with **DEC**.
 - e) Any black cockatoo breeding/nest trees identified must not be cleared without written approval from the **department**;
6. The person taking the action must develop a Perched Groundwater and Tree Health Monitoring Program (the program) to be conducted for the life of the project, including the rehabilitation phase, to ensure mining excavations do not reduce water availability. The program, including trigger values and contingency measures, must be developed in consultation with local **DEC** officers. The program must be provided to the **department** within 60 days of establishment of the program.
7. The Flora and Vegetation Management Plan (DMS-EMP-11.1)(June 2012) for the Dardanup mine must include the **DSE** and be submitted to the **department** for approval prior to **commencement of construction**. The EMP will include clearing procedures and avoidance techniques for identified potential breeding trees or habitat (see Appendix A). The approved DMS-EMP-11.1 must be implemented.
8. The Mine Closure Plan (DMS-EMP-6.3)(June 2012) and Rehabilitation Management Plan (DMS-EMP-6.1) (June 2012) must include the **DSE** and be submitted to the **department** for approval within 90 days of the **commencement of construction**. The approved DMS-EMP-6.3 and DMS-EMP-6.1 must be implemented.
9. The person taking the action must publish an Annual Environmental Report (AER) on their website to be made freely available to the public by the first of March each year. This AER must address compliance with each of the conditions of this approval, including implementation of any **management plans** as specified in the conditions. Documentary evidence providing proof of the date of publication, and details of any non-compliance with any of the conditions of this approval, must be provided to the **department** at the same time as the compliance report is published.
10. Unless otherwise agreed to in writing by the **Minister**, the person taking the action must publish all **management plans** referred to in these conditions of approval on their website to be made freely available to the public. Each **management plan** must be published on the website within 1 month of being approved.
11. The person taking the action must maintain accurate records substantiating all activities associated with or relevant to the conditions of approval, including measures taken to implement the **management plans** required by this approval, and make them available upon request to the **department**. Such records may be subject to audit by the **department** or an independent auditor in accordance with section 458 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), or used to verify compliance with the

conditions of approval. Summaries of audits will be posted on the **department's** website. The results of audits may also be publicised through the general media.

12. Upon the direction of the **Minister**, the person taking the action must ensure that an independent audit of compliance with the conditions of approval is conducted and a report submitted to the **Minister**. The independent auditor must be approved by the **Minister** prior to the commencement of the audit. Audit criteria must be agreed to by the **Minister** and the audit report must address the criteria to the satisfaction of the **Minister**.
13. If the person taking the action wishes to carry out any activity otherwise than in accordance with the **management plans**, as specified in the conditions, the person taking the action must submit to the **department** for the **Minister's** written approval a revised version of those **management plans**. The varied activity shall not commence until the **Minister** has approved the varied **management plans** in writing. The **Minister** will not approve a varied **management plan** unless the revised **management plan** would result in an equivalent or improved environmental outcome over time. If the **Minister** approves the revised **management plan** that management plan must be implemented in place of the **management plan** originally approved.
14. If the **Minister** believes that it is necessary or convenient for the better protection of listed threatened species and communities (s18 & s18A) to do so, the **Minister** may request that the person taking the action make specified revisions to the **management plans** specified in these conditions and submit the revised **management plans** for the **Minister's** written approval. The person taking the action must comply with any such request. The revised approved **management plans** must be implemented. Unless the **Minister** has approved the revised **management plans**, then the person taking the action must continue to implement the **management plans** originally approved, as specified in these conditions.
15. If, at any time after two years from the date of this approval, the person taking the action has not substantially commenced the action, then the person taking the action must not substantially commence the action without the written agreement of the **Minister**.

Definitions:

- a) **Avoided** means there will be no direct or indirect impacts to the tree being avoided or any other tree within a 5 meter radius.
- b) **Black cockatoo** means Carnaby's cockatoo (*Calyptorhynchus latirostris*), Baudin's cockatoo (*Calyptorhynchus baudinii*) or forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*).
- c) **Clearance of native vegetation** means the cutting down, felling, thinning, logging, removing, killing, destroying, poisoning, ringbarking, uprooting or burning of native vegetation.
- d) **Commencement of construction** Includes any preparatory works required to be undertaken including clearing vegetation, the erection of any onsite temporary structures and the use of heavy duty equipment for the purpose of breaking ground for buildings or infrastructure.
- e) **Department** The Australian Government department administering the *Environment Protection and Biodiversity Conservation Act 1999*.
- f) **DEC** is the Western Australian Government's of Environment and Conservation (or equivalent agency).
- g) **DSE** is the Dardanup Southern Extension (proposal mining footprint).
- h) **Foraging habitat** for black cockatoo's is any vegetation community that is known to provide foraging resources for black cockatoo's.
- i) **Listed threatened species** Species listed under the EPBC Act including Carnaby's cockatoo (*Calyptorhynchus latirostris*), Baudin's cockatoo (*Calyptorhynchus baudinii*) and Forest red-tailed black cockatoo (*Calyptorhynchus banksii naso*)
- j) **Management plans** include:
 - a. Flora and Vegetation Management Plan – DMS-EMP-11.1
 - b. Offset Management Plan - OMP
 - c. Woodland Habitat Rehabilitation Plan - WHRP
 - d. Perched Groundwater and Tree Health Monitoring Program – the program
 - e. Closure and Decommissioning Plan - DMS-EMP-6.3
 - f. Rehabilitation Management Plan - DMS-EMP-6.1
- k) **Minister** The Minister administering the *Environment Protection and Biodiversity Conservation Act 1999* and includes a delegate of the Minister.
- l) **Native vegetation** means indigenous vegetation including trees, plants and groundcover.
- m) **Offset attributes** means an '.xls' file capturing relevant attributes of the Offset Area, including the EPBC reference ID number, the physical address of the offset site, coordinates of the boundary points in decimal degrees, the EPBC protected matters that the offset compensates for, any additional EPBC matters that are benefiting from the offset, and the size of the offset in hectares.
- n) **Operation** includes any activity undertaken in association with the proposed action
- o) **Potential breeding habitat** for black cockatoo's includes any known tree of a species known to be used by the black cockatoo's for breeding that are greater than 500mm diameter-at-breast-height. In mapping and calculating areas, the **department** considers potential breeding habitat to be any 0.5ha patch of native vegetation that contains three or more trees that are greater than 500mm diameter-at-breast-height. In the project area known species include Marri (*Corymbia calophylla*), Jarrah (*Eucalyptus marginata*) and Flooded Gum (*Eucalyptus rudis*).
- p) **Shapefile** means an ESRI Shapefile containing '.shp', '.shx', and '.dbf' files and other files capturing attributes on the Offset Area, including the shape, EPBC reference ID number and EPBC protected matters present at the relevant site. Attributes should also be captured in '.xls' format.

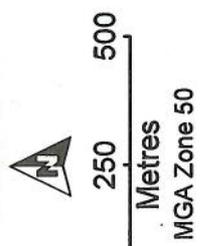
APPENDIX A



Doral Mineral Sands Pty Ltd
Southern Mine Extension

Habitat Trees with Possible Large Hollows

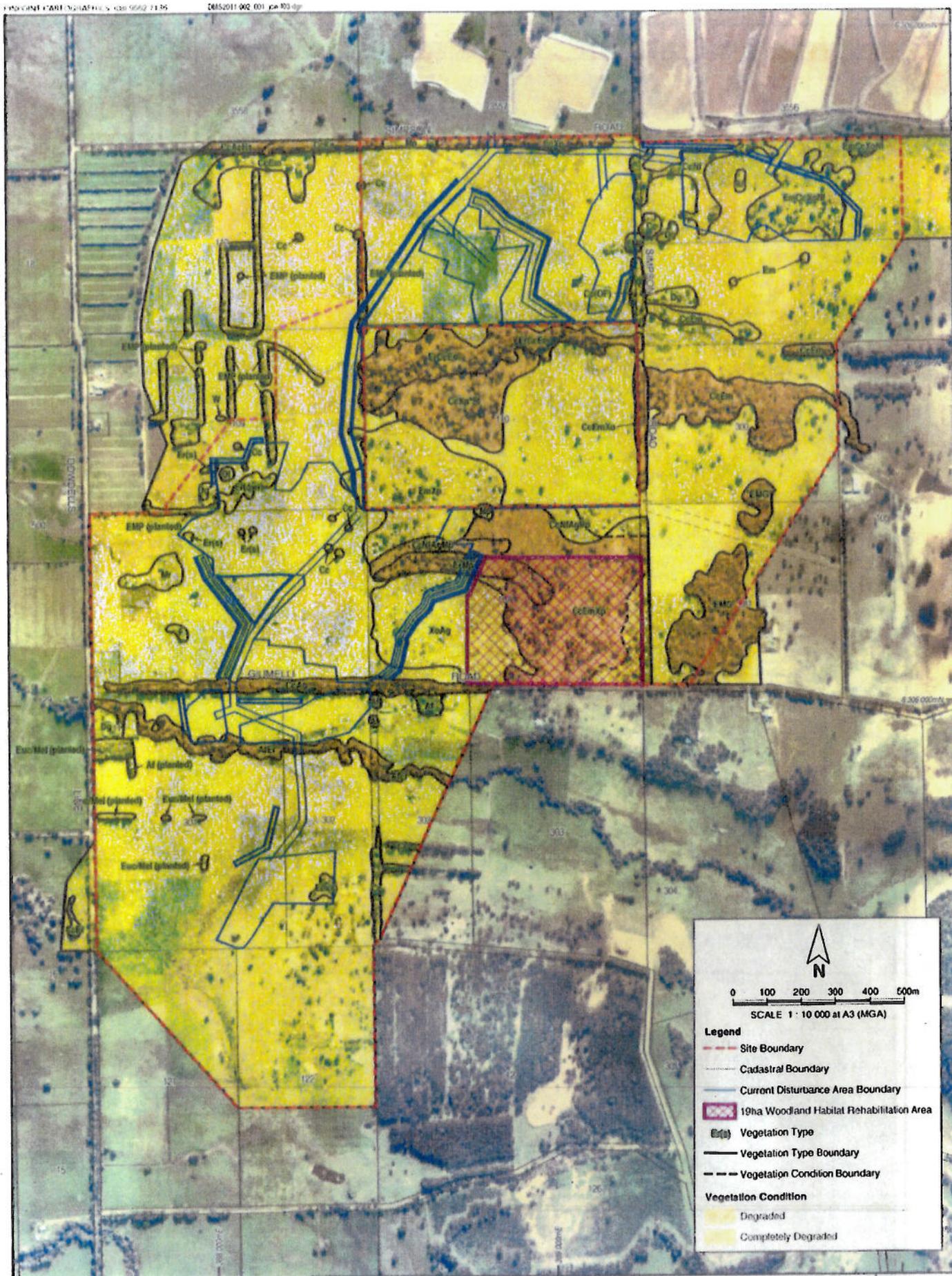
DRAWN: G Harewood
DATE: Dec 2011
SCALE: 1:14,000



- Legend**
- Trees potentially containing medium to large hollows
- C1 to C21 = Coffey 2011, H1 to H5 = Aurora 2011

Figure: 1

APPENDIX B



CADASTRAL SOURCE: Landgate, January 2012
 VEGETATION SOURCE: Munkse Consulting 2011
 AERIAL PHOTOGRAPH SOURCE: NearMap, Nov 2011



Drawn: J. Vishar Date: 31 Mar 2012

Date: EPBC ACT REFERRAL (EPBC 2011/0387) CONSOLIDATED PRELIMINARY DOCUMENTATION
 SOUTHERN EXTENSION TO THE DRYCREEK MINERAL SANDS PROJECT

WOODLAND HABITAT REHABILITATION AREA

Figure 3

J44 DMS/21/02

APPENDIX B

Artificial Hollows for Carnaby's Cockatoo, How to Design a Hollow

Artificial hollows for Carnaby's cockatoo



How to design a hollow



Department of
Environment and Conservation



Information sheet

How to design and place artificial hollows for Carnaby's cockatoo

Artificial hollows can be used to help conserve the threatened Carnaby's cockatoo by enabling the cockatoos to breed in areas where natural hollows are limited.

A wide variety of artificial hollow designs have been used with mixed success. Evidence suggests that, while the hollow must meet some basic requirements, other factors such as proximity to existing breeding areas may be more important when determining the success of artificial hollows.

This information sheet contains broad guidelines for the design and placement of artificial hollows for Carnaby's cockatoo. (Also see information sheet, *When to use artificial hollows for Carnaby's cockatoo.*)

Walls

The walls of the artificial hollow need to be constructed from a material that is:

- durable enough to withstand exposure to elements for an extended period of time (that is, 20+ years)
- able to simulate the thermal properties of a natural tree hollow not less than 300 millimetres in internal diameter
- between 0.5 and 2.5 metres long.

Successful artificial hollows have been constructed from sections of salvaged natural hollow, black industrial pipe recycled from the mining industry and, in captivity, white PVC pipe. When using non-natural materials care must be taken to ensure there are no toxic residues and that the materials are safe to ingest.

Base

The base of the artificial hollow must be:

- able to support the bird and chicks
- durable enough to last the life of the nest
- free draining
- at least 300 millimetres in diameter
- covered with 100–150 millimetres of dry, free draining material such as charcoal, hardwood woodchips or wood debris (do not use saw dust or fibre products that will retain moisture).

Example materials that could be used for artificial hollow bases include heavy duty stainless steel, galvanised or treated metal (for example Zincalume®), thick hardwood timber slab or marine ply (not chipboard or MDF). The base material must be cut to fit internally, with sharp or rough edges ground away or curled inwards and fixed securely to the walls.



Carnaby's cockatoo chicks in artificial hollow. Photo by Christine Groom

Entrance

The entrance of the artificial hollow:

- must have a diameter of at least 100 millimetres (preferably 200–300 millimetres)
- should preferably be top-entry to minimise use by non-target species.

A lid or cap would partly weatherproof the hollow, but is not necessary. Top-entry hollows are unattractive to nest competitors such as feral bees, galahs and corellas. Side-entry hollows have been successful in areas where feral bees are not a problem and where galahs and corellas are deterred.

Ladder

For artificial hollows made of non-natural materials, or of processed boards, it is necessary to provide a ladder to enable the birds to easily climb in and out of the hollow.



Bottom of artificial hollow showing ladder fixed to wall and chewed sacrificial posts. Photo by Christine Groom

The ladder must:

- be securely mounted to the inside of the hollow
- be made from an open heavy wire mesh such as WeldMesh™ with mesh size of 30–50 millimetres, or heavy chain
- not be made of a material that the birds can chew
- not be galvanised because the birds may grip or chew the ladder and ingest harmful compounds.

If using mesh for the ladder, the width will depend on the curvature of the nest walls. A minimum width of about 60–100 millimetres is recommended.

Sacrificial chewing posts

For artificial hollows made of non-natural materials, or of processed boards, it is necessary to provide sacrificial chewing posts. The birds chew material to prepare a dry base on which to lay their egg(s). Without this material, the artificial hollow is unlikely to be used by a cockatoo.

The sacrificial chewing posts must:

- be made of untreated hardwood such as jarrah, marri or wandoo
- be thick enough to satisfy the birds needs between maintenance visits
- extend beyond the top of the hollow as an aid to see whether the nest is being used
- be placed on the inside of the hollow
- be attached in such a way that they are easy to replace (for example, can hook over the top of hollow or can slide in/out of a pair of U bolts fitted to the side of the hollow).

It is recommended that at least two posts are provided. Posts 70 by 50 millimetres have been used but require replacing at least every second breeding season when the nest is active. Birds do vary in their chewing habits and therefore the frequency at which the chewing posts require replacement will also vary.

Mountings

The artificial hollow must be mounted such that:

- the fixings used will last the duration of the nest, for example galvanised bracket or chain fixed with galvanised coach screws
- it is secured by more than one anchor for security and stability
- it is positioned vertically or near vertically.

Placement

Sites should be chosen within current breeding areas and where they can be monitored, but are preferably not conspicuous to the general public. It is important that

artificial hollows are placed where they will be accessible for future monitoring and maintenance. For more detail refer to the separate information sheet, *When to use artificial hollows for Carnaby's cockatoo*.

The height at which artificial hollows should be placed is variable. The average height of natural hollows in dominant tree species in the area is a good guide. Natural hollows used by Carnaby's have been recorded as low as two metres above the ground. If located on private property, the hollows can be placed lower to the ground so they are accessible by ladder or a rope and pulley system can be used. Where public access is possible artificial hollows should be placed at least seven metres high (that is, higher than most ladders) and on the side of the tree away from public view to reduce the chance of interference or poaching.

Carnaby's cockatoos show no preference for aspect of natural hollows. However, it may still be beneficial to place artificial hollows facing away from prevailing weather.

Artificial hollows to be placed in trees require:

- accessibility of the tree for a vehicle, elevated work platform or cherry picker
- a section of trunk two-to-three metres long suitable for attaching the hollow.

Artificial hollows to be placed on poles require:

- a hinge at the bottom of the pole that can be secured when the pole is in the upright position
- access for a vehicle to assist raising the pole.



*Example fixing for artificial hollow.
Photo by Christine Groom*



Carnaby's cockatoo chicks. Photo by Christine Groom

Maintenance and monitoring

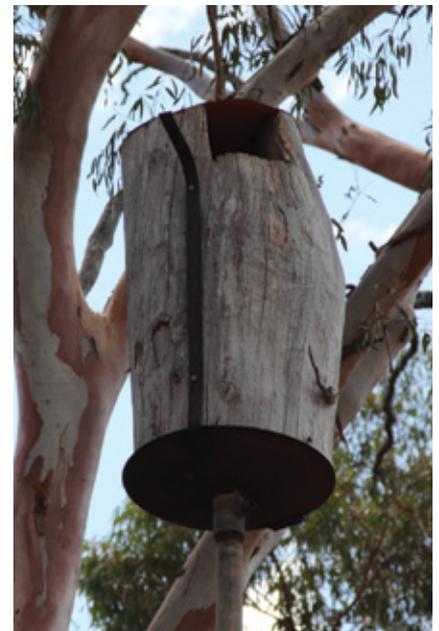
Once artificial hollows have been placed they require monitoring and maintenance to ensure they continue to be useful for nesting by Carnaby's cockatoos. It is important to monitor artificial hollows to determine use by the cockatoos, other native species and pest species. By undertaking monitoring, the success of the design and placement of artificial hollows can be determined and areas for improvement identified for future placement of artificial hollows.

Monitoring can also assess whether any maintenance is required. Without regular maintenance artificial hollows are unlikely to achieve their objective (that is, they will fail to provide nesting opportunities for threatened cockatoos). Therefore, it is important to continue a regime of regular maintenance while the artificial hollow is required. It may be several (too many) decades until a natural replacement hollow is available.

For further advice on monitoring and maintenance of artificial hollows please refer to the separate information sheet *How to monitor and maintain artificial hollows for Carnaby's cockatoo*.

Safety

Take care when placing artificial hollows. Artificial hollows are heavy and require lifting and manoeuvring into position several metres above the ground. Consider your safety at all times.



Examples of successful artificial hollows. Note signs of fresh chewing on hollow entrance (right) and chewing posts (left). Photos by Christine Groom

Acknowledgements

This information sheet is a joint initiative of Birds Australia, the Western Australian Museum and the Department of Environment and Conservation. Many individuals have contributed to its preparation. Special acknowledgment is made for the contributions of Ron Johnstone from the WA Museum and Alan Elliott from the Serpentine-Jarrahdale Landcare Centre. The final version was completed by Christine Groom (Department of Environment and Conservation).

APPENDIX C

Artificial Hollows for Carnaby's Cockatoo, How to Monitor and Maintain

Artificial hollows for Carnaby's cockatoo



How to monitor and maintain



Department of
Environment and Conservation



Information sheet

How to monitor and maintain artificial hollows for Carnaby's cockatoo

It is important to monitor and maintain artificial hollows after they have been placed. Monitoring ensures that the effectiveness of the artificial hollow can be determined. It also means that problems with pest species or any maintenance requirements can be identified and resolved.

Without regular maintenance, artificial hollows are likely to fail to achieve their objective (that is, they will fail to provide nesting opportunities for threatened cockatoos). Therefore, it is important to continue a regime of regular maintenance while the artificial hollow is required. It may be several (to many) decades until a natural replacement hollow is available.

Monitoring should be undertaken in order to detect:

- use by Carnaby's cockatoo
- maintenance requirements
- use by other native species
- use by pest species (for example feral bees and corellas).

How do I monitor artificial hollows?

Before undertaking monitoring of artificial hollows, it is recommended that you seek advice from Birds Australia, the WA Museum or the Department of Environment and Conservation (DEC). It is also important to contact DEC to determine if a licence is required (wildlifelicensing@dec.wa.gov.au).

Monitoring artificial hollows requires keen observation and naturalist skills. It is often not possible to directly observe evidence of breeding (that is, chicks or eggs) and inferences must be made based on observation. There are many techniques available to monitor artificial hollows. A combination of several is likely to achieve the best results.

Looking for signs of use

Cobwebs covering the entrance to the hollow will indicate that the hollow has not been used recently. This would also apply to other light debris that may have fallen to partially cover the opening. Signs of recent use or interest in the hollow include evidence of chewing.



*Artificial hollow with fresh evidence of chewing on posts.
Photo by Christine Groom*

Observing parent behaviour around the nest

The behaviour of parent birds around a nest will indicate an approximate age of young in the nest (Table 1).

Table 1 Parent behaviour around nests and approximate age of young.

Parent behaviour	Approximate age/stage of young
Prospecting for hollow	Unborn
Male only seen out of hollow	Egg or very young chick (< 3–4 weeks)
Both parents seen entering/exiting the hollow	Young have hatched (> 3–4 weeks)

Observing feeding flocks

Flocks of all male birds indicate that the females are sitting on eggs. When flocks are mixed it suggests the birds have either not yet laid or that the chicks have hatched and no longer require brooding (more than three-to-four weeks old).

Tapping

When hens are sitting on eggs they will usually respond to tapping at the base of their tree (or pole) by appearing at the entrance or flying from the hollow opening. This is not a guarantee of breeding activity but an indication that it is possibly occurring in the hollow.

Observing insect activity around nest

The faecal matter produced by chicks in a nest attracts insects, especially flies and ants. The type and number of these insects will help indicate how old any chicks present may be. Factors such as temperature and humidity will also affect insect activity, so observations of insect activity should only be used as supporting evidence for other indications of age/use. Blowflies around a nest usually indicate that a death has occurred.

Listening for chicks

With experience, it is possible to determine if one or two chicks are present and a broad estimate of age based on the type and loudness of noises they make.

Looking inside the nest

This can be achieved either with the aid of a telescopic pole and camera or mirror, or with the use of a ladder or other climbing equipment. This method can obtain the most detailed monitoring information for artificial hollows. However, it is also the most time-consuming and difficult to organise. Special equipment is likely to be needed depending on the height and positioning of artificial hollows. There are also safety issues associated with ladder or rope climbing options.

How often should I monitor artificial hollows?

The minimum frequency of monitoring and the techniques used will be determined by the aims of the monitoring and the resources available (Table 2). It is important to limit disturbance to breeding birds and this should be considered when determining the techniques used and frequency.

Table 2 Monitoring of artificial hollows.

Monitoring aim	Frequency of visits	Monitoring techniques
To determine possible use by Carnaby's cockatoo	At least once during peak breeding season (that is, between September and December).	<ul style="list-style-type: none">• Observing behaviour of adults around hollow.• Tapping to see if female will flush from hollow (best undertaken between 10am and 3pm when females most likely to be sitting).• Listening for chicks.• Looking for evidence of chewing.• Looking inside nest.
To confirm use by Carnaby's cockatoo	At least two visits during peak breeding season (that is, between September and December).	To observe at least two of the following: <ul style="list-style-type: none">• breeding behaviour of adults around hollow or evidence of chewing• female flushed from hollow• noises from chicks in hollow. Or to observe: <ul style="list-style-type: none">• chicks or eggs in nest.
To determine nesting success by Carnaby's cockatoo	The more visits, the better. Preferably fortnightly visits between July and December. As a minimum, at least three visits spread throughout breeding season.	<ul style="list-style-type: none">• Looking inside nest to observe eggs or chicks.
To determine use by any species	As often as possible.	<ul style="list-style-type: none">• Inspection from ground as a minimum.• Looking inside nest for detailed observations.
To determine maintenance requirements	At least every two years and preferably annually if hollow fitted with sacrificial chewing posts; can be longer if without.	<ul style="list-style-type: none">• A basic maintenance check can be undertaken from the ground. A ladder or elevated work platform will be required for a comprehensive check and to replace sacrificial chewing posts.

How do I maintain artificial hollows?

Artificial hollows require maintenance to ensure they continue to have the greatest chance of being used by Carnaby's cockatoos. Periodic maintenance checks should be undertaken at least every two years, preferably annually. These checks should be undertaken before the breeding season, which is between July and January with breeding occurring later in this period in southern areas. It is important to maintain a regime of regular maintenance while the artificial hollow is required.

Maintenance checks should assess the following as a minimum:

- condition of chewing posts (if present)
- condition of attachment points
- condition of hollow bases
- stability of tree or pole used to mount the artificial hollow.

Any problems identified during maintenance checks should be addressed as soon as possible. If breeding is currently occurring, maintenance may need to be delayed if it is likely to disturb the parents or chick. Likely maintenance needs include replacement of chewing posts (frequently) or nest bases (occasionally) and repairing of any cracks (infrequently). Maintenance concerns about the security of attachment points or the stability of the tree or pole should be addressed as a priority for safety reasons.

Spare chewing posts should be taken into the field when undertaking maintenance checks on hollows known to be used.



*Artificial hollow base requiring maintenance.
Photo by Christine Groom*



Artificial hollow in fallen tree. Photo by Christine Groom

Acknowledgements

This information sheet is a joint initiative of Birds Australia, the Western Australian Museum and the Department of Environment and Conservation. Many individuals have contributed to its preparation. The final version was completed by Christine Groom (Department of Environment and Conservation).

APPENDIX D
Vascular Flora

**APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED IN THE PROPOSED
DARDANUP SOUTHERN EXPANSION**

Note: * denotes introduced species; P1, P2, P3 and P4 denote Priority Flora Species (DEC, 2010G)

FAMILY	SPECIES	Mattiske 2010	Coffey 2008
PINACEAE	* <i>Pinus</i> sp.		X
ZAMIACEAE	<i>Macrozamia riedlei</i>	X	X
POACEAE	* <i>Avena fatua</i>	X	X
	<i>Austrodanthonia caespitosa</i>	X	
	<i>Austrostipa camylachne</i>		X
	* <i>Briza maxima</i>	X	X
	* <i>Briza minor</i>		X
	* <i>Bromus diandrus</i>	X	X
	* <i>Bromus hordeaceus</i>		X
	* <i>Cynodon dactylon</i>	X	X
	* <i>Ehrharta calycina</i>	X	X
	* <i>Ehrharta longiflora</i>		X
	* <i>Eragrostis curvula</i>	X	
	* <i>Holcus lanatus</i>	X	
	* <i>Holcus setiger</i>		X
	* <i>Hordeum glaucum</i>	X	
	* <i>Hordeum leporinum</i>		X
	* <i>Lolium perenne</i>	X	X
	* <i>Lolium rigidum</i>		X
	* <i>Lolium</i> sp.	X	
	* <i>Pennisetum clandestinum</i>	X	X
	* <i>Sporobolus indicus</i>		X
	* <i>Vulpia myuros</i>	X	
CYPERACEAE	<i>Baumea juncea</i>		X
	<i>Baumea preesii</i>		X
	<i>Cyathochaeta avenacea</i>	X	
	* <i>Cyperus tenellus</i>		X
	<i>Isolepis cyperoides</i>	X	
	<i>Isolepis oldfieldiana</i>	X	
	* <i>Isolepis prolifera</i>		X
	<i>Lepidosperma gracile</i>		X
	<i>Lepidosperma squamatum</i>	X	
	<i>Mesomelaena tetragona</i>	X	X
	<i>Tetraria octandra</i>	X	
ARACEAE	<i>Lemna disperma</i>	X	
	* <i>Zantedeschia aethiopica</i>		X

**APPENDIX C: SUMMARY OF VASCULAR PLANT SPECIES RECORDED IN THE PROPOSED
DARDANUP SOUTHERN EXPANSION**

Note: * denotes introduced species; P1, P2, P3 and P4 denote Priority Flora Species (DEC, 2010G)

FAMILY	SPECIES	Mattiske 2010	Coffey 2008
RESTIONACEAE	<i>Desmocladius fasciculatus</i>	x	
	<i>Hypolaena exsulca</i>	x	
	<i>Hypolaena pubescens</i>		x
JUNCACEAE	* <i>Juncus articulatus</i>		x
	<i>Juncus kraussii</i>		x
	<i>Juncus kraussii</i> subsp. <i>australiensis</i>	x	
	* <i>Juncus microcephalus</i>	x	
	<i>Juncus pallidus</i>	x	x
ASPARAGACEAE	* <i>Asparagus asparagoides</i>		x
	<i>Lomandra hermaphrodita</i>	x	
	<i>Lomandra puppurea</i>		
	<i>Lomandra sonderi</i>	x	
	<i>Lomandra</i> sp.	x	
	<i>Sowerbaea laxifolia</i>		x
DASYPOGONACEAE	<i>Dasypogon bromeliifolius</i>	x	x
	<i>Kingia australis</i>	x	x
XANTHORRHOEACEAE	<i>Xanthorrhoea gracilis</i>	x	x
	<i>Xanthorrhoea preissii</i>	x	x
COLCHICACEAE	<i>Burchardia congesta</i>		x
HEMEROCALLIDACEAE	<i>Caesia occidentalis</i>		x
	<i>Dianella revoluta</i>	x	
	<i>Tricoryne elatior</i>	x	
HAEMODORACEAE	<i>Conostylis aculeata</i>		x
	<i>Haemodorum</i> sp.	x	
	<i>Phlebocarya ciliata</i>	x	
IRIDACEAE	* <i>Gladiolus</i> sp.	x	x
	<i>Patersonia occidentalis</i>	x	
	<i>Patersonia umbrosa</i> var. <i>xanthina</i>		x
	* <i>Romulea rosea</i>	x	x
	* <i>Watsonia meriana</i>	x	
	* <i>Watsonia meriana</i> var. <i>bulbillifera</i>		x
ORCHIDACEAE	<i>Caladenia latifolia</i>		x
	* <i>Disa bracteata</i>		x
	<i>Thelymitra macrophylla</i>		x

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FAMILY	SPECIES	Mattiske 2010	Coffey 2008
CASUARINACEAE	<i>Allocasuarina humilis</i>	x	x
SALICACEAE	* <i>Salix babylonica</i>		x
MORACEAE	* <i>Ficus carica</i>	x	x
PROTEACEAE	<i>Adenanthos meisneri</i>	x	x
	<i>Banksia dallanneyi</i> var. <i>dallanneyi</i>	x	x
	<i>Banksia grandis</i>	x	x
	<i>Hakea amplexicaulis</i>		x
	<i>Hakea ruscifolia</i>	x	
	<i>Hakea trifurcata</i>		x
	<i>Stirlingia latifolia</i>	x	
	<i>Synaphea obtusata</i>		x
	<i>Xylomelum occidentale</i>	x	x
LORANTHACEAE	<i>Nuytsia floribunda</i>	x	x
POLYGONACEAE	* <i>Acetosella vulgaris</i>	x	
	* <i>Rumex crispus</i>	x	x
AIZOACEAE	* <i>Carpobrotus edulis</i>	x	
CARYOPHYLLACEAE	* <i>Petrorhagia dubia</i>	x	
	* <i>Petrorhagia velutina</i>		x
PAPAVERACEAE	* <i>Fumaria</i> sp.	x	
DROSERACEAE	<i>Drosera</i> sp.	x	
CRASSULACEAE	<i>Crassula colorata</i>	x	
FABACEAE	<i>Acacia extensa</i>	x	x
	<i>Acacia myrtifolia</i>		x
	<i>Acacia pulchella</i>	x	x
	<i>Acacia pulchella</i> var. <i>pulchella</i>	x	
	<i>Acacia saligna</i>		x
	<i>Acacia stenoptera</i>	x	
	<i>Bossiaea aquifolium</i> subsp. <i>aquifolium</i>		x
	<i>Bossiaea ornata</i>	x	
	* <i>Chamaecytisus palmensis</i>		x
	* <i>Dipogon lignosus</i>	x	x

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FAMILY	SPECIES	Mattiske 2010	Coffey 2008
FABACEAE	* <i>Erythrina x sykesii</i>		X
(continued)	<i>Gastrolobium spinosum</i>	X	
	<i>Gompholobium tomentosum</i>	X	
	<i>Hovea chorizemifolia</i>	X	
	<i>Jacksonia furcellata</i>	X	X
	<i>Kennedia coccinea</i>		X
	<i>Kennedia prostrata</i>	X	
	* <i>Lotus angustissimus</i>		X
	* <i>Lotus subbiflorus</i>	X	
	* <i>Trifolium repens</i> var. <i>repens</i>	X	
	* <i>Trifolium</i> sp.		
	* <i>Vicia sativa</i>		X
GERANIACEAE	* <i>Geranium molle</i>	X	
	<i>Erodium cygnorum</i>	X	
OXALIDACEAE	* <i>Oxalis corniculata</i>	X	
	* <i>Oxalis pes-caprae</i>		X
EUPHORBIACEAE	* <i>Euphorbia terracina</i>	X	
	<i>Phyllanthus calycinus</i>		X
CELASTRACEAE	<i>Stackhousia scoparia</i>	X	
DILLENIACEAE	<i>Hibbertia hypericoides</i>	X	X
LYTHRACEAE	* <i>Lythrum hyssopifolia</i>	X	
MYRTACEAE	<i>Agonis flexuosa</i>	X	X
	<i>Calothamnus quadrifidus</i>		X
	<i>Calothamnus sanguineus</i>	X	
	<i>Corymbia calophylla</i>	X	X
	<i>Darwinia citriodora</i>		X
	<i>Eucalyptus marginata</i>	X	X
	<i>Eucalyptus rudis</i>	X	X
	<i>Hypocalymma angustifolium</i>		X
	<i>Hypocalymma robustum</i>	X	
	<i>Kunzea glabrescens</i>		X
	<i>Kunzea recurva</i>	X	
	<i>Melaleuca preissiana</i>	X	X
	<i>Melaleuca raphiophylla</i>		X
	<i>Taxandria linearifolia</i>		X

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FAMILY	SPECIES	Mattiske 2010	Coffey 2008
APIACEAE	* <i>Foeniculum vulgare</i>		X
ERICACEAE	<i>Astroloma ciliatum</i>		X
	<i>Leucopogon propinquus</i>	X	
OLEACEAE	* <i>Olea europaea</i>		X
APOCYNACEAE	* <i>Gomphocarpus fruticosus</i>	X	
SOLANACEAE	* <i>Solanum laciniatum</i>		X
	* <i>Solanum linnaeanum</i>	X	
	<i>Solanum nigrum</i>	X	X
OROBANCHACEAE	* <i>Orobanche minor</i>		X
RUBIACEAE	<i>Opercularia apiciflora</i>	X	
GOODENIACEAE	<i>Dampiera linearis</i>	X	
	<i>Lechenaultia biloba</i>		X
	<i>Scaevola calliptera</i>	X	X
STYLIDIACEAE	<i>Stylidium piliferum</i>	X	
ASTERACEAE	* <i>Arctotheca calendula</i>	X	X
	* <i>Cirsium vulgare</i>	X	
	* <i>Cotula coronopifolia</i>	X	
	* <i>Cotula turbinata</i>		X
	<i>Hyalosperma cotula</i>	X	
	* <i>Hypochoeris glabra</i>	X	
	* <i>Hypochoeris</i> sp.		X
	* <i>Hypochoeris radicata</i>	X	
	* <i>Taraxacum officinale</i>		X
	* <i>Ursinia anthemoides</i>	X	X