

## **Attachment 3**

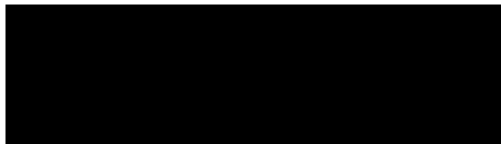
### **Environmental Summary Report (BES, 2015)**

**Pt LOTS 313 TO 316 MAIDMENT PARADE AND  
LOT 1 HAREWOODS ROAD, DALYELLUP**

**ENVIRONMENTAL SUMMARY REPORT**

**Prepared for**

**Mr Colin Piacentini**



Report No. J07013a  
24 February 2015

**BAYLEY ENVIRONMENTAL SERVICES**  
30 Thomas Street  
SOUTH FREMANTLE WA 6162



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## EXECUTIVE SUMMARY

This Environmental Summary Report (ESR) has been prepared in support of the Dalyellup South Local Structure Plan (the Structure Plan) to guide subdivision and development on Lots 313-316 Maidment Parade and Lot 1 Harewoods Road, Dalyellup (the subject land). The locality and layout of the subject land are shown on Figure 1. The structure plan for the proposed residential development is shown on Figure 2.

In order to permit the development, the current Urban Deferred zoning under the Greater Bunbury Region Scheme (GBRS) needs to be lifted to Urban. An amendment to the Shire of Capel Town Planning Scheme is also required to rezone the land from Rural to Development Zone. At the time of writing, the TPS Amendment was awaiting the signature of the Minister for Planning.

In its assessment of the GBRS, the EPA nominated remnant vegetation, fauna and ecological linkages as deferred factors to be addressed at the next stage of planning for the subject land.

In addition, the GBRS contains provisions enabling the responsible authority (the Shire or WAPC) to require management plans prior to subdivision to deal with:

- interface with adjacent Regional Open Space, wetlands, conservation areas, bushland or ecological linkages;
- urban water management;
- acid sulphate soil management; and
- biological surveys for regionally significant vegetation or native fauna.

These factors have been addressed as follows:

### *Remnant Vegetation*

- Vegetation surveys and searches for rare flora have been undertaken over the subject land on four occasions between 2001 and 2007 and are reported in this document.
- The vegetation complex affected by the development (Karrakatta Complex – Central and South) is well represented (66.7% of original remains) and well reserved (31.5% of original area) in the Greater Bunbury Region.
- A clearing approval for part of the subject land has been issued by the Department of Environmental Regulation (DER) for the purpose of sand extraction.

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### *Fauna*

- A general fauna survey and detailed searches for Western Ringtail Possums have been undertaken over the whole of the subject land.
- The possum surveys sighted one Western Ringtail Possum within the development area and another six in bushland to the east and west of the site. The surveys also found a few disused possum dreys (nests) and old scats (faecal pellets) within the site. Any Western Ringtail Possums within the development site are likely to be transient individuals between the better habitat areas to the east and west.
- Approvals for clearing and sand extraction on Lots 313 and 314 have been granted by the DER, the Shire of Capel and the Commonwealth Department of Environment, Water, Heritage and the Arts (DEWHA) in view of the probability that there is no extant population of Western Ringtail Possums on the site.
- Extensive planting of peppermint trees will be undertaken within and around the development area to enhance its habitat value for possums.
- Habitat enhancement for black cockatoos will also be undertaken, including erection of nest boxes and planting of food trees such as banksia, marri, sheoak and hakea.

### *Ecological Linkages*

- The EPA's requirement for retention of an ecological linkage from the coast to System 6 Area C71 will be met by the retention of the parts of Lots 313-316 west of Minnipup Road and a corridor within Lot 317 in Regional Open Space.
- Management Plans may be required by the responsible authority for the interface between the development area, the ecological linkage and other conservation areas.

### *Existing and Proposed Conservation Areas*

- The Structure Plan shows a road along the eastern boundary of the site between the development and the System 6 area. This will limit weed invasion and other edge effects.
- The responsible authority may require a management plan to be prepared to deal with the interface between the development and the System 6 area.

### *Urban Water Management*

- Stormwater will be managed in accordance with the principles set out in the *Stormwater Management Manual for Western Australia* (DoW, 2004).

- By incorporation of proven structural and non-structural controls, the developed urban area can achieve an overall rate of nutrient input and export that is significantly less than the current broadacre agriculture.
- A Local Water Management Strategy (LWMS) has been prepared in support of the Structure Plan. An Urban Water Management Plan (UWMP) may be required by the responsible authority prior to approval of a subdivision over the subject land.

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## **1.0 INTRODUCTION**

### **1.1 Overview**

This Environmental Summary Report (ESR) has been prepared in support of the Dalyellup South Local Structure Plan (the Structure Plan) to guide subdivision and development on Lots 313-316 Maidment Parade and Lot 1 Harewoods Road, Dalyellup (the subject land). The locality and layout of the subject land are shown on Figure 1. The structure plan for the proposed residential development is shown on Figure 2. The subject land has an area of about 89 hectares and includes the Maidment Parade road reserve, the parts of Lots 313 to 316 to its east, Lot 1 Harewoods Road and parts of Harewood Road.

The subject land is part of the South Dalyellup planning precinct and is currently zoned Urban Deferred under the draft Greater Bunbury Region Scheme (GBRS), which was enacted in December 2007. In order to permit the subdivision and development of the land, it is necessary to lift the Urban Deferred zoning to Urban. The subject land is currently zoned Rural under the Shire of Capel Town Planning Scheme. An amendment to the Town Planning Scheme will be necessary to permit urban development and to bring the Town Planning Scheme into line with the Region Scheme. At the time of writing, the TPS Amendment was awaiting the signature of the Minister for Planning.

The subject land is currently used for cattle and sheep grazing and sand extraction. The sand extraction operation is contained within Lots 313 and 314 (Figure 1) and is being carried out under an Extractive Industries Licence issued by the Shire of Capel in January 2007 (Appendix A) and a Clearing Permit issued by the Department of Environmental Regulation (DER) in June 2007 (Appendix B).

The sand extraction operation is expected to continue for about four years, after which the affected land will be recontoured, stabilised and developed as part of the proposed urban subdivision.

A Structure Plan has been prepared by LB Planning for the subject land. The remainder of the Piacentini landholding, totalling another 95ha and comprising Lot 317 to the south and those parts of Lots 313 to 316 west of the Maidment Parade road reserve, is zoned Regional Open Space under the GBRS.

This ESR was originally prepared and submitted to the EPA and WAPC in 2010 in support of the GBRS and TPS Amendments. It has been updated to reflect the current status of those Amendments and the Structure Plan, as well as other changes that have occurred since its original submission.

## **1.2 Environmental Review of the Greater Bunbury Region Scheme**

### **1.2.1 EPA Referral and Assessment**

The Greater Bunbury Region Scheme was referred to the EPA by the WAPC in August 1996 and was assessed on the basis of an Environmental Review submitted by the WAPC in 2000. In 2003 the EPA published Bulletin 1108, in which it recommended approval of the GBRS subject to certain conditions. Following public submissions and hearings, the Minister for the Environment published his “Statement that a Scheme may be Implemented” No. 000697 in October 2005.

### **1.2.2 Deferred Environmental Factors**

In its assessment of the Scheme, the EPA deferred a number of environmental factors until a later stage of assessment, either because of the broad scale of the assessment or because insufficient information was available at that stage of the planning process. These factors are subject to assessment by the EPA at the stage of future local government scheme amendments, subdivisions or development proposals.

The factors deferred by the EPA in relation to the subject land were remnant vegetation, fauna and ecological linkages. These factors are addressed in this report.

### **1.2.3 Environmental Conditions**

EPA Bulletin 1108 recommended a number of environmental conditions on the Scheme, based broadly on environmental management measures proposed by the WAPC in the Environmental Review. Following consultation with the public and between the WAPC and EPA, the final Scheme approved by the Minister for the Environment contained provisions to which subdivisions and developments under the Scheme will be subject. Those provisions relevant to the subject land are:

#### **1. Management Plans**

The following Environmental Management Plans may be required in accordance with the specifications set out in Attachment 1 in the Minister for the Environment’s “Statement that a Scheme may be Implemented” No. 000697 published on 31 October 2005, and shall be subsequently implemented in accordance with the provisions of the Management Plans, to the satisfaction of the Western Australian Planning Commission —

- (a) Environmental Management Plans for schemes, subdivisions and developments which impact on Regional Open Space in the scheme, Crown conservation or nature reserves, a National Park or bushland, waterways, wetlands or other land that may be part of an ecological linkage;

- (b) Environmental Management Plans for industrial development within the Kemerton Industrial Area and Special Control Area No. 2;
- (c) Drainage, Nutrient and Water Management Plans in areas where the Average Maximum Groundwater Level is less than 1.2 metres below the natural ground surface or where any proposed off-site drainage could lead to degradation of wetlands or waterways; and
- (d) Acid Sulphate Soil Management Plans where the presence of acid sulphate soils is confirmed or there is likely to be a significant risk of disturbing acid sulphate soils.

## 2. Biological Survey

As part of a scheme amendment or application to subdivide or develop land which has the potential to impact on regionally significant native remnant vegetation or native fauna, the Western Australian Planning Commission or local government, as the case requires, may require a biological survey, including a search for Declared Rare Flora and Fauna, Priority Flora, Threatened Flora Communities and Threatened Fauna, to be undertaken.

The biological survey shall be undertaken to the satisfaction of the Western Australian Planning Commission or local government, as the case requires, having due regard for advice from relevant government agencies, and shall be taken into account when considering the rezoning and subsequent subdivision and development applications.

The means by which these conditions will be satisfied in the subdivision and development of the subject land are detailed in this report.

### 1.2.4 EPA Recommendations for the Subject Land

EPA Bulletin 1108 contained the following recommendations in relation to the subject land:

- remnant vegetation on Lots 315, 316 and 317 should be conserved and appropriately managed either as a ROS reserve in the GBRS or as part of future zoning, subdivision and/or development on the lots;
- the extraction of sand and limestone from Lots 315, 316 and 317 is incompatible with the need to protect vegetation in this area; and
- immediate planning measures be implemented by the WAPC to manage and prevent any further development or change of land use on Lots 315, 316 and 317, until the GBRS has been proclaimed.



In response to the EPA recommendations, the WAPC initially proposed to return the eastern parts of Lots 315 to 317 to the Rural zone pending future reservation. However, following an appeal by the Shire of Capel against the EPA recommendation, the Minister for the Environment determined that an acceptable compromise would be the reservation of the parts of Lots 313 to 316 west of the Maidment Parade road reserve and all of Lot 317 in Regional Open Space, with the eastern parts of Lots 313 to 316 being kept as Urban Deferred. This decision is reflected in the current GBRS.

### 1.3 Purpose of this Report

This report has been prepared in support of the application for lifting of urban deferment, the lodgement of a structure plan for the subject land and a request for amendment of the Shire of Capel Town Planning Scheme in accordance with the Urban zoning under the GBRS.

The report has been prepared in part to satisfy the WAPC *Guidelines for the Lifting of Urban Deferment* (2000), which recommends that the following be addressed in regard to the natural environment:

- an accurate description of the land including the natural environment;
- description of the physical conditions of the land;
- identification of the means by which natural features (such as foreshores, wetlands, remnant vegetation) will be protected; and
- identification of any environmental issues which may impact on future development (such as noise, water catchment, contaminated land and air pollution).

Lifting of urban deferment does not constitute an amendment to the Region Scheme. Therefore, the proposal to lift the zoning to Urban does not require referral to the EPA. However, the amendment of the Shire of Capel Town Planning Scheme will require referral to the EPA, at which time the environmental factors deferred by the EPA in its assessment of the Region Scheme will be subject to assessment.

This report addresses:

- the requirements of the WAPC (2000) Guidelines;
- the factors identified as Deferred Factors by the EPA in its assessment of the Scheme;
- the EPA's specific recommendations for the subject land; and
- the EPA's general conditions attached to its recommendations for approval of the Scheme.

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## **2.0 ENVIRONMENTAL FACTORS**

### **2.1 Soils and Landforms**

#### **2.1.1 Overview**

The subject land lies across the crest and slopes of a north-south trending dune, with elevations ranging from about 10m AHD on the eastern and western boundaries to a high of 24m AHD at a number of high points in the centre of the site. The slopes range from about 1% in the east and in parts of the central ridge to about 10% on the lower western slopes.

The soils of the site have been mapped by Churchward and McArthur (1978) as being of the Spearwood Dune (S2a and S2c) landform system (Figure 3). The Spearwood dunes consist of deep, well drained, yellow-brown siliceous sands, in places containing stony plains and low ridges with deep yellow sands and brown siliceous sands with common limestone outcrops (Churchward and McArthur, 1978).

The Department of Agriculture (Wells, 1989) describes this soil type as having high capability for house and road construction.

#### **2.1.2 Acid Sulphate Soils**

The DPAW (2006) maps the subject land as having Low to Nil risk of containing actual or potential acid sulphate soils (ASS) (Figure 3). The wetland immediately west of the subject land is mapped as having high risk of ASS on account of its low elevation and peaty soils.

Given the elevation and soils of the subject land, it is highly unlikely that any ASS would be encountered at the depths to be reached by excavation for underground services such as sewers. If required, a preliminary investigation for acid sulphate soils will be undertaken following the cessation of sand extraction on Lots 313 and 314 and prior to approval of subdivision.

### **2.2 Hydrology**

#### **2.2.1 Surface Drainage**

There are no natural surface drainage channels on the site. Given the permeable sandy surface soils, most rainfall would infiltrate at-source and little runoff would occur in all but very heavy rainfall events, when surface runoff would enter the wetland to the west or the Five Mile Brook Diversion Drain to the east.

The Five Mile Brook Diversion Drain runs adjacent to the eastern boundary of the site. Land adjacent to the Diversion Drain is subject to flooding during high flow events.

### 2.2.2 Groundwater

The Bunbury Shallow Drilling Groundwater Investigation (Commander, 1982) describes the vicinity of the site as comprising a Superficial aquifer at an elevation of 5m AHD, which directly overlies the Yarragadee aquifer. Shallow groundwater flows generally in a westerly direction and discharges to the coastal swamps and the ocean. The average seasonal variation in the water table is less than one metre.

Groundwater from the Superficial aquifer is used in the surrounding area for domestic rural-residential uses, stock water supply in rural areas and irrigation of gardens and POS areas in the Dalyellup estates to the north.

Groundwater levels have been measured in up to nine bores within and around the development site in 2003, 2004, 2008 and 2013. Figure 4 shows the bore locations. Table 2.1 summarises all of the water level data collected at the site since 2003.

The table shows that the groundwater level sits at between 4m and 5m AHD across the site and varies little between summer and winter. Figure 4 shows estimated Average Annual Groundwater Level (AAMGL) contours derived from the bore data.

**Table 2.1 Groundwater Levels**

<i>Bore (Figure 4)</i>	<i>Easting</i>	<i>Northing</i>	<i>Water Level (m AHD)</i>					
			<i>21/11/02</i>	<i>5/05/03</i>	<i>7/08/03</i>	<i>30/01/04</i>	<i>1/07/08</i>	<i>30/10/13</i>
DoW 1623	372138	6301978					6.20	6.97
MB1	371135	6301968	4.56	4.19	4.43	4.52		
MB2	371176	6302258	4.48	4.15	4.34	4.46		
MB3	370932	6301917	4.38	4.01	4.40	4.21		
MB4	371253	6301523	4.89	4.44	4.69	4.89		
Stock Bore	371499	6302263	4.79	4.39	4.84	4.90		
G1	370850	6302186					4.44	4.82
G2	370870	6301774					4.31	
G3	370785	6301349					4.12	

### 2.2.3 Wetlands

A Multiple Use (MU) category wetland is located in Lot 1 in the north-east corner of the subject land (Figure 4). MU category wetlands are generally considered to have little or no natural value and hence are generally developable, provided that their hydrological (mainly drainage) functions are maintained or reproduced. Lot 1 is proposed as a future high school site under the Structure Plan.

A larger wetland mapped by the DPAW as Resource Enhancement Category (REW) is located on the western side of Lots 313 to 317, west of the Maidment Parade road

reserve. A part of the wetland is gazetted under the *Environmental Protection (Swan Coastal Plain Lakes) Policy 1992* (Figure 4).

The majority of this wetland is completely degraded, consisting of flat open paddocks dominated by pasture species and weeds with a minority of native wetland species including scattered sedges and isolated paperbarks. This part of the wetland is grazed and regularly slashed to control Bulrushes and improve pasture growth.

The western part of the wetland, close to the dunes, contains extensive beds of Asian Bulrush (*Typha orientalis*) and, in pockets closer to the dunes, paperbark (*Melaleuca raphiophylla*) woodland. These parts of the wetland are in good condition and support a range of waterbird species when inundated.

The eastern boundary of the wetland is poorly defined due to the very low slopes and absence of wetland vegetation. The western boundary is well defined by the abrupt slope change at the base of the Quindalup Dunes.

The REW was originally mapped as Conservation Category (CCW) by the DPAW. In 2011, in response to a wetland assessment report prepared by Bayley Environmental Services (2010), the DPAW agreed to amend the management category to Resource Enhancement and to modify the mapped western boundary of the wetland.

Resource Enhancement is the second tier on the three-tiered DPAW wetland management category scale. The DPAW's objective for REW wetlands is: "To manage, restore and protect towards improving their conservation value. These wetlands have the potential to be restored or rehabilitated to Conservation category focusing on wetland functions, structure and biodiversity value."

The EPA and DPAW generally apply a generic minimum 50m wetland buffer to Conservation Category wetlands. A more flexible approach is often adopted in the case of Resource Enhancement Category wetlands, providing that the values of the wetland are protected. In 2012, in response to a Wetland Buffer Definition Study prepared by Bayley Environmental Services in February 2012, the EPA and DPAW agreed to a buffer of between 24m and 88m between the mapped REW boundary and the edge of the road reserve. The agreed wetland buffer is shown on Figure 2. Letters from the EPA and DPAW (DEC) confirming the agreement are attached in Appendix C.

The proponent is committed to rehabilitation of the wetland west of the development area, focussing on weed eradication and re-establishment of native vegetation in the cleared eastern portion of the wetland. The rehabilitation program will be detailed in the Wetland Management Plan, which is expected to be a condition of WAPC subdivision approval. The wetland rehabilitation works will be undertaken by an experienced rehabilitation contractor following the commencement of lot sales in the estate.

## 2.3 Vegetation and Flora

### 2.3.1 Overview

The subject land has been used for grazing for a considerable period, with the result that the remaining vegetation consists largely of mature trees over pasture grasses.

Remnant vegetation was identified by the EPA as a Deferred Factor in relation to the subject land in its assessment of the Greater Bunbury Region Scheme, owing to the broad-scale nature of that assessment. Deferred Factors are subject to assessment by the EPA at a later stage, such as future scheme amendments or subdivision.

The vegetation and flora of Lots 313 to 317 have been surveyed on four occasions by McCutcheon (2001 and 2002), RPS Bowman Bishaw Gorham (2006) and Weston (2007). The vegetation descriptions that follow incorporate the findings of those four surveys.

During the February 2001 survey the area was inspected using the timed meander technique, which involved making ten traverses of the area in roughly an east-west direction and two in a north-south direction. During the second survey in September 2002, sixteen traverses in roughly an east-west direction were undertaken across the portion of the property to the east of Maidment Parade road reserve.

A further field survey of the area east of the Maidment Parade road reserve was undertaken in October 2007 by A.S. Weston. This survey was undertaken to confirm and refine descriptions and mapping of vegetation units there.

All species encountered were either identified in the field or collected for determination in the office. Locations of significant species were recorded by GPS and collected, and identifications of them were confirmed at the Western Australian Herbarium.

### 2.3.2 Regional Vegetation Description

Hedde *et al.* (1978) mapped the following vegetation complexes on the site (Figure 5):

- Vasse Complex – Typically consists of closed scrub of *Melaleuca* species fringing woodlands of *Eucalyptus rudis* – *Melaleuca* spp. and open forest of *Eucalyptus gomphocephala* – *E. marginata* – *Corymbia calophylla*. This complex is mapped on the western half of the site.
- Karrakatta Complex – Central and South is identified as consisting of predominantly open forest of *Eucalyptus gomphocephala*, *E. marginata*, *Corymbia calophylla* and *E. marginata* - *Banksia* species woodlands. This complex is mapped on the eastern half of the site.

The Heddle *et al.* (1978) mapping is broad-scale and generally follows the landform-soil boundaries mapped by Churchward and McArthur (1978). Closer examination of the vegetation on the site suggests that the vegetation of the majority of the subject land would be more properly mapped as Karrakatta Complex-Central and South, with the Vasse Complex restricted to the wetland west of the Maidment Parade road reserve and perhaps the lower adjacent slopes of the subject land.

### 2.3.3 Vegetation Type and Condition

The vegetation of the subject land consists of an Open Forest of *Eucalyptus gomphocephala* with *Eucalyptus marginata* and *Corymbia calophylla* over a Woodland of *Banksia attenuata* and *B. grandis* over scattered native understorey species including *Hibbertia cuneiformis*, *Jacksonia furcellata*, *Macrozamia reidleyi*, *Lepidosperma gladiatum* and *Pteridium esculentum* over pasture grasses and weeds including *Lagurus ovatus*, *Avena barbata*, *Bromus diandrus*, *Briza maxima* and *Lupinus cosentinii*.

Figure 5 shows a vegetation map of the subject land. Tuart (*Eucalyptus gomphocephala*) is the dominant tree in seven of the eight units shown on the map, and Peppermint (*Agonis flexuosa*) is a common tree in six of them. The two exceptions are relatively small: the completely degraded seasonal wetland in the cleared Lot 1 in the north-east corner of the subject land, with a few *Melaleuca raphiophylla* trees, and a strip of *Acacia saligna* and young tuart trees in the north-east next to the Harewoods Road Reserve.

The other six vegetation units are very similar and merge with each other. All have similar, very weedy understoreys. *Hibbertia cuneiformis*, a shrub under 2m tall, and *Lepidosperma gladiatum*, a large broad-leafed sedge, are the most common and widespread native species. *Trachyandra divaricata* and *Zantedeschia aethiopica* are conspicuous weeds.

The eight mapped vegetation units are:

- |              |                                                                                                                                                                                                                                                   |
|--------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <b>TPBJM</b> | Tuart ( <i>Eucalyptus gomphocephala</i> ) Woodland to Open Woodland over Peppermint ( <i>Agonis flexuosa</i> ) – <i>Banksia attenuata</i> – Jarrah ( <i>Eucalyptus marginata</i> ) Low Woodland, with Marri ( <i>Corymbia calophylla</i> ) trees. |
| <b>TPJ</b>   | Tuart ( <i>Eucalyptus gomphocephala</i> ) Open Woodland over Peppermint ( <i>Agonis flexuosa</i> ) – Jarrah ( <i>Eucalyptus marginata</i> ) Low Open Woodland.                                                                                    |
| <b>PBT</b>   | Peppermint ( <i>Agonis flexuosa</i> ) – <i>Banksia attenuata</i> Low Open Forest to Woodland, with Tuart tree(s).                                                                                                                                 |
| <b>TPF</b>   | Tuart ( <i>Eucalyptus gomphocephala</i> ) Open Forest over Peppermint ( <i>Agonis flexuosa</i> ) Low Open Forest.                                                                                                                                 |

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<b>TPW</b>	Tuart ( <i>Eucalyptus gomphocephala</i> ) Woodland over Peppermint ( <i>Agonis flexuosa</i> ) Low Woodland.
<b>TP</b>	Tuart ( <i>Eucalyptus gomphocephala</i> ) Open Woodland to Scattered Trees over Peppermint ( <i>Agonis flexuosa</i> ) Low Open Woodland to Scattered Trees.
<b>AT</b>	Tuart ( <i>Eucalyptus gomphocephala</i> ) Open to Low Open Woodland over <i>Acacia saligna</i> Closed Tall to Tall Open Scrub.
<b>M</b>	Paperbark ( <i>Melaleuca raphiophylla</i> ) Open Woodland.

The condition of all of the vegetation, with the possible exception of some parts of the *Acacia saligna* Closed Tall to Tall Open Scrub and small areas in the vegetation dominated by Tuart and Peppermint trees, is assessed as Completely Degraded based on the condition scale of Keighery (1994). The exceptions are assessed as Degraded or Degraded to Completely Degraded. Disturbance to the vegetation structure has been caused by partial clearing, grazing, weed invasion, tree deaths and disease.

#### 2.3.4 Flora

Sixty seven native plant species were recorded during a series of traverses conducted on the property. Fifty two were recorded during the February 2001 survey. Fifteen additional native species were recorded during the second vegetation and flora survey. A total of 30 weed species were recorded on site.

A list of all flora species found on the subject land is attached in Appendix D. The 67 native species recorded on the site are from 32 families. The 30 weed species are from 19 families, ten of which are not represented by native species.

A search of the *Environmental Protection and Biodiversity Conservation (EPBC) Act* database in August 2002 and July 2003 showed that three flora species listed under the EPBC Act may occur in the area. These species are *Verticordia densiflora* var. *pedunculata*, *Eleocharis keigheryi* and *Caladenia speciosa*. None of these species was recorded on the site during any of the vegetation and flora surveys.

Gibson *et al.* (1994) noted that the highest incidence of species endemic to the Swan Coastal Plain occurred on the heavy clay or iron enriched soils of the footslopes on the eastern edge of the Plain. The subject land is located approximately nine kilometres west of such areas.

Prior to the 2001, 2006 and 2007 field surveys, searches were made of the DPAW Threatened Flora Database, the Western Australian Herbarium database and the DPAW DRF and Priority Flora List for significant flora known within the region or that may be likely to occur on the subject land.

The results of the database searches found a total of 44 Rare and Priority Listed Flora species, many of which have been recorded within a ten kilometre radius of the subject land. Given the site characteristics of these species, nine were considered more likely than the others to occur on the subject land and it was considered possible, though less likely, that there might be habitat for twelve additional species.

These 21 species are listed in Table 2.2 below. A more complete description of the database search and its results is provided in Appendix E.

**Table 2.2**  
**Rare and Priority Listed Flora Within the Broader Vicinity**  
**of the Harewoods Road Property**

<i>More Likely Taxa</i>	<i>Code*</i>	<i>Less Likely Taxa</i>	<i>Code*</i>
<i>Lasiopetalum membranaceum</i>	P3 (2)	<i>Eleocharis keigheryi</i>	R
<i>Acacia semitrullata</i>	P3	<i>Verticordia densiflora</i> var. <i>pedunculata</i>	R
<i>Isopogon formosus</i> subsp. <i>dasylepis</i>	P3	<i>Caladenia huegelii</i>	R
<i>Jacksonia sericea</i>	P4 (3)	<i>Pterostylis turfosa</i>	- (P1)
<i>Verticordia attenuata</i>	P3	<i>Synaphea odocoileops</i>	P1
<i>Acacia flagelliformis</i>	P4	<i>Pithocarpa corymbulosa</i>	P2
<i>Caladenia speciosa</i> ms	P4	<i>Stylidium rigidifolium</i> (now <i>S. striatum</i> )	P4 (2)
<i>Drosera marchantii</i>		<i>Synaphea petiolaris</i> subsp. <i>simplex</i>	P2
subsp. <i>marchantii</i>	- (P4)	<i>Chordifex gracilior</i>	P3
<i>Jacksonia sparsa</i> ins	- (P4)	<i>Chamaescilla gibsonii</i> (Keighery) ms.	P3
		<i>Platysace ramosissima</i>	P3
		<i>Thysanotus glaucus</i>	- (P4)

\* Conservation status based upon DEC (2006) classifications for rare and priority taxa.

Spring flora searches of Lots 313 to 317 specifically targeting the possible presence of orchid species were undertaken by McCutcheon in 2001 and 2002. Further spring flora searches for all rare and priority species were undertaken by RPS Bowman Bishaw Gorham in November 2006 and Weston in October 2007. The Priority 3 species *Lasiopetalum membranaceum* was the only flora species of conservation significance found on the site. A population of 34 plants of this species was found on the southern boundary of Lot 317. This area is zoned Regional Open Space under the GBRS.

### 2.3.5 Floristic Community Types

The vegetation present on the subject land is inferred to belong to Floristic Community Type (FCT) 25: Southern *Eucalyptus gomphocephala* – *Agonis flexuosa* woodlands, with possibly some areas of FCT 21a: Central *Banksia attenuata* – *Eucalyptus marginata* woodlands. Given the heavy degradation of the vegetation and the depauperate species list, the occurrence and extent of these community types within the parkland cleared areas is only reflected in the remaining overstorey. It is not possible to accurately map the extent of each FCT on the site.



Community type 21a belongs to Gibson *et al.*'s Super Group 3, which is centred on, but not exclusive to, the Bassendean Dunes. There are also significant occurrences on the Pinjarra Plain and the Spearwood Dune System. Community type 21a is common to the Bassendean Central and South vegetation complex as well as the Karrakatta Central and South vegetation complex.

Community type 25 belongs to Gibson *et al.*'s Super Group 4, which is almost exclusively restricted to the Spearwood and Quindalup Dunes. Community type 25 is common to the Karrakatta Central and South vegetation complex.

The average species frequency for FCTs 21a and 25 is 53.7, while the average weed frequency is 8.55. The high incidence of weed species recorded on the subject land reflects the high level of previous disturbance to the site.

The characteristics of FCTs 21a and 25, as described by Gibson *et al.*, are presented in Table 2.3.

**Table 2.3**  
**Characteristics of Floristic Community**  
**Types of the Harewoods Road Property**

<i>Community Type</i>	<i>Description</i>	<i>Mean Species Frequency</i>	<i>Mean Weed Frequency</i>	<i>Vegetation Condition</i>	<i>Reservation Status</i>	<i>Conservation Status</i>
21a	Central <i>Banksia attenuata</i> - <i>Eucalyptus marginata</i> woodlands	54.6	4.2	2.5	Well reserved	Low risk
25	Southern <i>Eucalyptus gomphocephala</i> – <i>Agonis flexuosa</i> woodland	52.8	12.9	3.3	Poorly reserved	Susceptible

Although FCT25 is poorly reserved on the Swan Coastal Plain and is considered to have a “susceptible” conservation status, this FCT is not identified as a Threatened Ecological Community and is not subject to any statutory protection (Gibson *et al.* 1994). FCT 21a is considered to be well reserved and at low risk.

The DPAW database of known threatened ecological communities was searched in April 2003. The results of this search are listed in Table 2.4.

From the results of the database search and from a search of the EPBC database, it is concluded that the development of the subject land for urban use will not affect any known threatened ecological communities.

**Table 2.4**  
**Results of DPAW Database Search**  
**for Threatened Ecological Communities**

<i>TEC</i>	<i>Location relative to site</i>	<i>Description</i>	<i>Category</i>
HAY05	5.5km NNE	Shrublands on calcareous silts	Vulnerable
myHAY03	5.7km NNE	Shrublands on calcareous silts	Vulnerable
R116703	9km E	<i>Eucalyptus calophylla</i> woodlands on heavy soils	Vulnerable
mySwamp01	6km NE	Herb-rich saline shrublands in clay pans	Vulnerable
Swamp02	6km NE	Herb-rich saline shrublands in clay pans	Vulnerable
HAY01	6.3km NNE	Herb-rich shrublands in clay pans	Vulnerable
myHAY01	6.3km NNE	Herb-rich shrublands in clay pans	Vulnerable
myHAY02	6km NNE	Herb-rich shrublands in clay pans	Vulnerable
MANEA01	7km NE	Dense shrublands on clay flats	Vulnerable

### 2.3.6 Local and Regional Representation

Information from the Department of Environmental Protection document “*A Strategy for the EPA to identify regionally significant natural areas in its consideration of the Greater Bunbury Region Scheme (GBRS) portion of the Swan Coastal Plain*” states that the total remnant vegetation remaining on Spearwood dunes of the southern Swan Coastal Plain was 34%. Thirty percent of the Karrakatta Vegetation Complex-Central and South remains on the southern Swan Coastal Plain. It is estimated that 9% of this is in secure tenure. Within the GBRS area 52% of the Karrakatta Complex - Central and South remains, with 16% of this in secure tenure.

Vegetation remaining in the Marine (Estuarine and Lagoonal) Deposits on the southern Swan Coastal Plain is 40%. Twenty nine percent of the Vasse vegetation complex remains on the southern Swan Coastal Plain. It is estimated that 37% of this is in secure tenure.

Twenty three percent of the Vasse vegetation complex remains in the Greater Bunbury Region, of which 22% is within secure tenure.

Within a 15 kilometre radius of the property, approximately 3761 hectares is vegetated with the two vegetation complexes that occur on the subject land. Of this, 3284ha is Karrakatta Complex-Central and South and 477ha is Vasse Complex. About 63.5ha of the Karrakatta Complex-Central and South and 81ha of the Vasse Complex occur in either System Six areas or National Parks within 15km of the subject land.

Assuming that large-scale clearing in the region has not occurred since the photography in 2001, the vegetation on the subject land (approximately 77ha) represents 2% of the total remaining vegetation in the two vegetation complexes within a 15 kilometre radius.

### 2.3.7 Local and Regional Reservation

Figure 6 shows the locations of existing and proposed conservation areas within 15km of the subject land.

The Tuart Forest National Park is within 15km of the subject land and contains vegetation of the Karrakatta Complex–Central and South. The northern block of the Tuart Forest National Park, located approximately 7km south-west of the subject land, is mapped by Heddle *et al.* (1978) mostly as Karrakatta Complex-Central and South with a small amount of Vasse Complex.

The next block of Tuart Forest National Park is approximately 14km south and has been mapped as mostly Karrakatta Complex-Central and South with a small amount of Yoongarillup Complex on the western boundary.

System 6 areas are areas within the Darling System region that were recommended as conservation reserves by the Environmental Protection Authority in 1983. These recommendations have been progressively implemented since they were endorsed in 1983. In addition to Tuart Forest National Park, there are seven System 6 areas that occur within a 15 kilometre radius of the subject land (Figure 6). These are:

- C66 - Leschenault Inlet. The southern extent of Leschenault Inlet is located approximately 14.5km north of the subject land and consists of the Southern River Vegetation Complex.
- C67 - Brunswick, Collie and Wellesley Rivers. The Collie River is located approximately 14km north-east of the subject land and encompasses the Swan Complex in the east, some Karrakatta and then the Yoongarillup Complex before entering the Leschenault Inlet.
- C68 - Anglesea Island is located approximately 10km north of the subject land, and comprises the Quindalup and Vasse Complexes.
- C69 - Big Swamp, South of Bunbury, is located approximately 8km north of the subject land, and comprises the Quindalup and Vasse Complexes.
- C70 - South Bunbury Coastal Land is approximately 3km north of the subject land and comprises the Quindalup Complex.
- C71 - Reserve near Dalyellup is located adjacent to the eastern boundary of the subject land and comprises the Karrakatta Complex-Central and South.

- C86 - Dardanup Management Priority Area is located approximately 15km east of the subject land and comprises a number of vegetation complexes including Guildford, Preston, Mungardup and Kingia.

The subject land is located within a vegetation pocket that is isolated from all of these areas apart from C71.

Remnant vegetation encompassing the southern extension of the Karrakatta Complex and the Vasse Complex is located in Tuart Forest National Park. The Karrakatta Complex is represented also in the System 6 Area C71, while the Vasse Complex is represented in System 6 Areas C68 and C69. Although the species composition differs slightly between these sites and the subject land, the general species composition and structure are similar and are classified into the same vegetation complexes.

The limited diversity of taxa occurring on the subject land is well represented in these areas as well as other reserves, road reserves and other areas of remnant vegetation in the general region. These vegetation complexes are widespread over much of the Swan Coastal Plain. The Greater Bunbury Region Scheme has also proposed a number of areas to be zoned Regional Open Space, and it is likely that more areas of remnant vegetation will be protected in the general area in the future.

### 2.3.8 Vegetation Impacts and Management

The development of the subject land for urban use will result in the loss of approximately 50ha of parkland-cleared vegetation over and above the 25ha that is already approved for clearing in connection with the sand extraction operation.

The subdivision design for the subject land will incorporate the retention of mature trees within public open space and road reserves wherever this is practicable and compatible with necessary site earthworks and public safety.

The reservation of a vegetated corridor within Lot 317 in Regional Open Space will preserve a significant area of Tuart and Peppermint trees. There will be an opportunity for this vegetation to be enhanced by revegetation in the implementation of the Structure Plan.

## 2.4 **Fauna**

### 2.4.1 Fauna Species and Habitats

The EPA identified fauna as a deferred factor for the subject land in its Bulletin 1108 assessment of the GBRS, due to a lack of site-specific information.

A fauna assessment of Lots 313 to 317 was undertaken by Bamford and Wilcox in 2003 as part of investigations for the sand extraction proposal. The report of that survey is attached in Appendix F.

The survey found that, although the habitat is degraded, the site had potential to support a moderately rich fauna population, including some species of national and State conservation significance.

A search of the DPAW Threatened Fauna database in November 2006 indicated that the following threatened fauna could be present on or near the subject land:

- Western Ringtail Possum (*Pseudocheirus occidentalis*) – Schedule 1 Species
- Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*) – Schedule 1 Species
- Quokka (*Setonix brachyurus*) – Schedule 1 Species
- Bush Stone Curlew (*Burhinus grallarius*) – Priority 4 Species
- Quenda (*Isodon obesulus fusciventer*) – Priority 5 Species.

Other species listed in the database are unlikely to occur on the site due to the absence of suitable habitat and the degraded condition of the vegetation, especially in regard to the almost total lack of understorey.

#### Western Ringtail Possum (*Pseudocheirus occidentalis*)

An extensive survey for the Western Ringtail Possum within Lots 313 and 314 east of the Maidment Parade road reserve was conducted by S. Elscot of Green Iguana in March 2006. Further surveys of Lots 313 to 316 were carried out by G. Harewood in December 2007 and May 2012. The results of these surveys are detailed in Appendix G and summarised below.

The site's vegetation is suitable habitat for both the Western Ringtail Possum and the Common Brushtail Possum, and numerous hollows within the site's Tuart trees are suitable for use by both the species. However, the lack of canopy connectivity and native understorey greatly reduces the habitat value of the vegetation for Ringtails.

Three Western Ringtail Possum dreys (nests) were recorded in Lots 313 and 314, all in Peppermint trees in the north-eastern part of the site. One of the three dreys was obviously disused while the other two were intact. No scats were found during a thorough search of the ground beneath the drey trees and adjoining trees.

The 2007 search of Lots 315 and 316 found a further three disused and derelict dreys in the north-east of Lot 315, and two old scats (faecal pellets) in the north of Lot 315.

The majority of the Peppermint trees within the site had fully intact canopies and did not appear to be browsed. A few Peppermint trees had thinning canopies, however a careful search of the ground beneath these trees and others failed to locate any possum scats.

Spotlighting surveys to locate both Western Ringtail and Common Brushtail Possums were undertaken within Lots 313 and 314 over four consecutive nights during March 2006, in Lots 315 and 316 over two nights in December 2007, and over four nights in May 2012. The first two surveys found no Western Ringtail Possums (WRP), although seven sightings of Common Brushtail Possums were made in Lots 315 and 316. During the March 2006 daylight search an active fox den was located in the centre of the site. Because of the open nature of the vegetation on the site, possums would need to descend to ground level to move between tree stands or to access any water, making them highly susceptible to predation by foxes.

The 2012 survey produced one Western Ringtail Possum (WRP) sighting in Lot 314 within the development area, as well as six sightings in the western Regional Open Space and in the bushland to the east of the site.

The combined survey results suggest that ringtail possums use the development area at very low frequency and densities, probably in the form of transient individuals moving through the area between areas of better habitat to the east and west, or young animals moving out in search of new territories. The results confirm that the bushland to the east and west provides the better habitat and supports most of the WRP on the site.

Given the poor habitat value of the development area, due to its scattered canopy and open ground, it is unlikely that a population of ringtails could persist there in its present state.

Because it is possible that WRP may be present in the development area when clearing occurs, the following steps will be taken to ensure their protection:

- A spotlight survey will be undertaken of each stage within one week before clearing.
- Any WRP found will be trapped and relocated to bushland in the west of the property, if possible.
- Clearing will occur progressively from north to south, giving any WRP present the opportunity to escape into the Regional Open Space.
- Peppermint trees will be shaken before being felled, to encourage any animals present to evacuate.
- A fauna specialist will be on standby throughout clearing in case any WRP are found during the clearing.

The habitat value of the subject land and surroundings for Western Ringtail Possums will be enhanced by the planting of at least 1,500 peppermint trees across the Regional Open Space and within the urban landscape (streets and public open space). Practical experience in towns such as Dunsborough and Busselton has shown that WRP are able

to persist in urban areas provided that sufficient areas of interconnected peppermint canopies are maintained.

#### Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)

Carnaby's Black Cockatoo may be present within Lots 313 to 316 due to the presence of older Tuarts across the site that are likely to contain hollows and openings suitable for Carnaby's breeding habitat. However, it was not observed within the site during the fauna survey.

An intensive survey of potential black cockatoo food resources and nesting habitat was undertaken by Bamford (2012). The report of that survey is attached in Appendix G and summarised below.

Bamford (2012) found 54 potential cockatoo nesting trees (trees with hollows at least 100m in diameter) within the proposed development area. The locations of these trees have been recorded. When clearing is underway, each of these trees will be inspected and, if the hollows are confirmed to be suitable as black cockatoo breeding sites, they will be replaced with artificial nest boxes attached to existing trees on the ROS. The total number of nest boxes erected in the ROS will be at least equal to the number of confirmed suitable nesting hollows removed from the development area.

Carnaby's Black Cockatoo is a seasonal visitor to the Swan Coastal Plain over summer but breeds in the eastern hills and wheatbelt. They make extensive use of pine plantations but naturally feed on the seeds of banksias, dryandras, hakeas and eucalypts. Bamford (2012) found few of these species on the site. Plantings of black cockatoo food trees will be undertaken in public open space and regional open space to increase the potential food resource for black cockatoos. The species planted will include banksias, marri, hakeas, sheoaks and tuarts.

#### Quokka (*Setonix brachyurus*)

Sinclair & Hyder (2009) found evidence of quokkas (one carcass, one skull and fresh scats) in 2008 at Muddy Lake, about 2km south of the subject land. The researchers did not examine the land owned by Mr Piacentini at Lots 313-317. The evidence of quokkas was found in dense vegetation within and to the west of a wetland that had been protected from grazing for several years, where quokkas could find cover from foxes and other predators.

It is possible that quokkas also persist in other parts of the wetland chain, including the western side of Lots 313-317, although the heavier clearing and grazing in this area and particularly to the south makes this less likely (E. Sinclair, pers. comm.). Given the sparse ground cover present east of the Maidment Parade road reserve, it is very unlikely that quokkas are present there.

The available evidence points strongly to the fox as the major threat to the survival of quokkas on the mainland, with lesser threats from feral cats and dogs. The large and healthy quokka population on Rottnest Island (particularly around settled areas) clearly shows that quokkas are well able to survive and flourish in the presence of humans and urban development, provided that introduced predators are absent or controlled.

Urban development east of Maidment Parade is unlikely to significantly affect the populations of foxes or feral cats within or west of the wetland. The population of dogs in the urban area will increase but they are relatively controllable and can be excluded from the wetland.

The wetland rehabilitation proposed in Section 2.2 will markedly increase the area of dense wetland vegetation and will thereby increase the potential for quokkas to persist or re-establish in the local area. In undertaking the rehabilitation, the proponent will consult with recognised experts such as the WA Museum, the DPAW and the Botanic Gardens & Parks Authority on ways to maximise the value of the habitat thus created for quokkas.

Overall, it is expected that the development of the eastern part and the rehabilitation of the western part of the project area will be of benefit to quokkas.

#### Bush Stone Curlew (*Burhinus grallarius*)

The Bush Stone Curlew is scarce in the southern part of Australia and is mainly found near the north-eastern coast of Australia. It is considered unlikely that this bird would be present on the site as, given the low numbers at a regional level, any remaining individuals are likely to prefer habitat in better condition than occurs on the subject land.

#### Quenda (*Isoodon obesulus fusciventer*)

Quenda activity and diggings were observed around the dense vegetation next to the wetland located west of the site, however the lack of understorey in the subject land would deter Quenda from foraging or habituating there (Bamford and Wilcox, 2003).

#### 2.4.2 Fauna Impacts and Management

The development of the subject land for urban use will result in the loss of approximately 50ha of fauna habitat over and above the 25ha that is already approved for clearing in connection with the sand extraction operation. The habitat that will be lost is parkland cleared and of generally poor quality, although there is potential for some significant species to persist there.

The reservation of the parts of Lots 313 to 316 west of the Maidment Parade road reserve and a corridor through Lot 317 in Regional Open Space will preserve a significant area of habitat for a number of species that currently inhabit or may be reintroduced to the area. In particular:



- the best habitat for Quenda will all be retained around the wetland;
- rehabilitation of the wetland will increase its potential habitat value for Quokkas;
- a number of mature Tuarts with hollows suitable for nesting will be retained in Lot 317;
- plantings to increase the canopy density of peppermints in Lot 317 may enable the Western Ringtail Possum to successfully recolonise this area;
- planting of peppermints within Public Open Space, landscape areas and back yards may encourage Western Ringtail Possums to penetrate the urban area; and
- establishment of nesting boxes and planting of food tree species will increase the potential value of the site for black cockatoos.

## **2.5 Ecological Linkages**

### **2.5.1 Overview**

Ecological linkages were identified as a Deferred Factor for the subject land by the EPA in its Bulletin 1108 assessment of the GBRS.

The importance of maintaining or creating ecological linkages between coastal and inland areas in the Greater Bunbury Region was identified by the Department of Environment in its “*A Strategy for the EPA to identify regionally significant natural areas in its consideration of the Greater Bunbury Region Scheme Portion of the Swan Coastal Plain*” (2002). The potential to preserve an ecological linkage from Dalyellup via Gelorup to Crooked Brook was subsequently identified by the EPA in Appendix 4 to Bulletin 1108: *Ecological Linkages in the Greater Bunbury Region* (2003).

The EPA initially recommended, in Bulletin 1108, that all of Lots 315-317 and the western parts of Lots 313 and 314 should be preserved as part of the linkage. Following an appeal by the Shire of Capel, the Minister for the Environment determined that the linkage function in this area would be sufficiently served by reserving the western parts of Lots 313 to 316 and all of Lot 317. The Urban Deferred zoning currently shown in the GBRS reflects this decision.

### **2.5.2 Width of Ecological Linkages**

Ecological linkages and “green links” may fulfil a number of functions including:

- providing for genetic exchange between populations of fauna;
- permitting recolonisation of habitat following disturbance;
- providing additional habitat within the linkage; and
- providing an open space link for human movement.

The optimum and minimum widths of ecological linkages depend on a number of factors including the length of the linkage, the type of vegetation present, the fauna species inhabiting the area, the degree of disturbance likely to arise from surrounding areas and

the number and degree of interruptions to the linkage (gaps, roads etc.). Various researchers have proposed nominal widths for different types of linkage (e.g. regional, sub-regional, local) and/or methods for determining the optimum or minimum width. For example:

- The EPA and WAPC, in finalising the Greater Bunbury Region Scheme, defined a corridor between 150m and 500m wide through the Tuart Brook and College Grove estates for the Maidens-Preston River ecological linkage.
- Forestry South Australia (Horn, 2003) proposed a nominal minimum of 40m for corridors on farms.
- Redland Shire Council (Qld) (2003) recommended a 100m wildlife corridor for the Tingalpa Creek, including the waterway.
- The NSW Department of Environment and Conservation (2004) recommended widths ranging from over 500m for major regional corridors to less than 50m for local corridors.
- Bond (2003) and Bier & Low (1992) suggested that corridor design should be based on analysis of the home range sizes, movement, dispersal, and habitat use patterns of the target fauna species.
- The Queensland Department of Main Roads (199\_) suggested that determination of corridor width should be done on a case-by-case basis and should take into account:
  - the type and quality of the habitat;
  - the potential for edge effects;
  - animal mobility; and
  - predation and competition within the corridor.

In the case of the subject land, it is considered that the primary target species to be considered when determining an adequate corridor width is the Western Ringtail Possum. This species is present in high-quality peppermint woodland to the east and west of the site. An effective linkage through Lot 317 would enable populations to the east and west to be connected, although the effectiveness of any such linkage will be significantly reduced by the major barrier of Bussell Highway.

The habitat requirements of the Western Ringtail Possum can be summarised in part as follows:

- Primary habitat: Peppermint (*Agonis flexuosa*) and tuart/peppermint woodlands with a dense peppermint canopy.
- Range size: Varies from 0.5ha-1.5ha in dense peppermint woodland to 2.5ha in eucalyptus/peppermint forest; ranges overlap by up to 70%.
- Habit: Nocturnal, highly arboreal, rarely descending to ground.

- Diet: Predominantly peppermint leaves, plus some other eucalypts (e.g. Marri) and some garden species and fruits.
- Threats: Primarily loss of habitat and predation by foxes.

The minimum width and configuration of a corridor through Lot 317 can thus be estimated as follows:

- Assuming an individual possum has a roughly square home range of 1.5ha, a corridor width of 122m would accommodate one complete home range.
- Allowing for edge effects (due to weed invasion, human and domestic animal incursion etc.) extending 25m into the corridor on each side, a 122m corridor would contain a 72m wide core of relatively undisturbed habitat. Edge effects could be less significant for possums as the tree canopy would be little affected and ringtails have demonstrated the ability to persist in disturbed environments such as the urban areas of Busselton and Dunsborough, providing that the peppermint canopy is retained.
- To minimise predation, the corridor should possess, or be restored to, a near-continuous peppermint canopy to permit possums to move from end to end without descending to ground level.

From the above it can be concluded that a properly revegetated and managed corridor at least 122m wide through Lot 317 should provide adequate width for the movement of western ringtail possums through the site. Based on the vegetation surveys and aerial photography analysis, the southern part of Lot 317 appears to be the best suited for this purpose, as it possesses the densest existing peppermint canopy on the lot.

### 2.5.3 Management of Ecological Linkages

The reservations under the GBRS will create a continuous vegetated link from the coastal foreshore reserve through Lot 317 to System 6 area C71, located immediately east of the subject land (Figure 6). The opportunity exists for the government to extend this linkage further east through reservation of additional bushland within the rural zone east of Bussell Highway. The value of this link can be enhanced by appropriate revegetation within the corridor, including re-establishing native understorey species and increasing the canopy coverage of overstorey species such as Peppermints.

A management plan will be required at the subdivision stage of the subject land to ensure that the interface with the ecological linkage is properly managed and that edge effects, including weed invasion, physical disturbance and fire, are minimised. The value of the link for fauna may be maximised by fencing the link from the urban area to impede access for dogs and cats.

## **2.6 Existing and Proposed Conservation Areas**

System 6 Area C71 abuts the eastern boundary of the subject land (Figure 6). C71 consists of several small reserves on the western side of Bussell Highway. The area is mostly vegetated with Karrakatta Complex – Central and South.

The Structure Plan shows Public Open Space or subdivisional roads on all boundaries abutting conservation areas – the wetland to the west, the ecological linkage within Lot 317 to the South and System 6 Area C71 to the east. This configuration will assist in minimising edge effects such as weed invasion, litter and fire on these conservation areas. The boundaries between the development area and the conservation areas may be fenced to control access.

Management plans may be required by the responsible authority (Shire of Capel or WAPC) to deal with the interface of the development area with System 6 Area C71, the vegetation corridor in Lot 317 and the wetland reserve immediately west of the development. These management plans, if required, will deal primarily with management of edge effects as well as enhancement of the vegetation and habitats within the wetland and the vegetation corridor.

## 2.7 Urban Water Management

### 2.7.1 Overview

The subject land is located close to a number of wetlands, including the large one immediately to the west. Nutrients may be exported from the subject land to the wetland in groundwater discharge from grazed and fertilised pasture.

Development of the site for residential purposes has the potential to either increase or reduce the input of nutrients to the site, depending upon the degree to which best practice urban water management is implemented. The DoW and DEC (2006) *Peel-Harvey Water Quality Improvement Plan* found that unmanaged urban development can have higher phosphorus inputs than broadacre agriculture. On the other hand, modelling for projects including the Southern River Urban Water Management Strategy (JDA, 2002) and the Austin Cove Urban Water Management Strategy (BES & JDA, 2007) has found that implementation of recognised non-structural water-sensitive urban design (WSUD) measures can achieve reductions of more than 50% in phosphorus and nitrogen inputs compared to non-WSUD developments, resulting in post-development nutrient inputs well below those for broadacre agriculture.

### 2.7.2 Stormwater Management

Stormwater management will be consistent with DoW's current position on urban stormwater management, as described in the *Stormwater Management Manual for Western Australia* (DoW, 2004), which details the management objectives, principles and a stormwater delivery approach for WA.

Preliminary modelling of post-development stormwater flows and sizing of infiltration basins has been carried out by Wood & Grieve Engineers (2010). An excerpt from the engineer's report dealing with stormwater management is attached in Appendix H.

To manage the increased runoff expected from urban development, the drainage system will be designed to manage both minor and major events. The essential features of the drainage system will be as follows:

- The site will be divided into seven stormwater catchments.
- Runoff from all storms up to 1-year ARI will be retained and infiltrated within the development using a combination of shallow swales, soakwells and/or infiltration chambers (e.g. Stormtech) within the road reserves and infiltration basins within POS areas.
- Each catchment will contain a POS area incorporating a drainage basin (rain garden) designed to retain and infiltrate stormwater flows up to 1-year ARI from its catchment.

- In Catchments A, D and F, runoff from storms larger than 1-year ARI will overflow the rain gardens in a controlled and diffuse manner into a densely vegetated part of the wetland buffer via a diffusion swale along Maidment Parade.
- In the east of the site (Catchments B, C, E and G), in order to prevent surface discharge to the Five Mile Brook Diversion Drain, runoff from all storms up to 100-year ARI will be retained and infiltrated within the development site.
- Runoff in excess of 1-year ARI from Catchments B and C will overflow via pipes to a 100-year ARI basin incorporated within the large POS area in Catchment E. The 5-year ARI basin may be formed as an extension of the 1-year ARI rain garden, while the 100-year ARI basin may be formed as part of a sports ground (e.g. football oval) within the POS.
- In Catchment G, the 1-year ARI basin will be a linear swale within the road reserve on the eastern boundary. Excess runoff up to 100-year ARI will be captured in an infiltration basin in the south-east corner of the catchment.

### 2.7.3 Urban Water Management Plan

In accordance with Scheme Provision No. 1: Management Plans, an Urban Water Management Plan (UWMP) (formerly known as a Drainage and Nutrient Management Plan) may be required by the responsible authority (Shire of Capel or WAPC) prior to approval of a subdivision over the subject land. The UWMP may include, but is not limited to:

- a numerical model or other suitable analysis and forecasting techniques developed to determine the drainage management requirements of the site following development;
- an estimate of the existing water and nutrient balance of the site based on detailed on-site measurements;
- predicted post-development nutrient mass balance of the site based on the monitoring results of existing nutrient stripping ponds on other sites and other nutrient management measures proposed;
- establishing water quality performance criteria consistent with targets established for the catchment;
- a comparison of the results of the predicted mass and water balances with water quality performance criteria for the development; and
- the design and management planning (including mosquito control measures in the drainage system) that incorporate best management practices and principles of water sensitive design, monitoring to demonstrate compliance with water quality performance criteria, and reporting.

## **2.8 Aboriginal Heritage**

A search of the Department of Indigenous Affairs' online Register of Aboriginal Sites indicates that the site does not contain any recorded Aboriginal sites. An archaeological survey of the subject land by W. Glendinning in 2002 found no Aboriginal archaeological material on the site.

It is therefore considered that development of the subject land will not affect or be affected by any Aboriginal site.

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# Figures



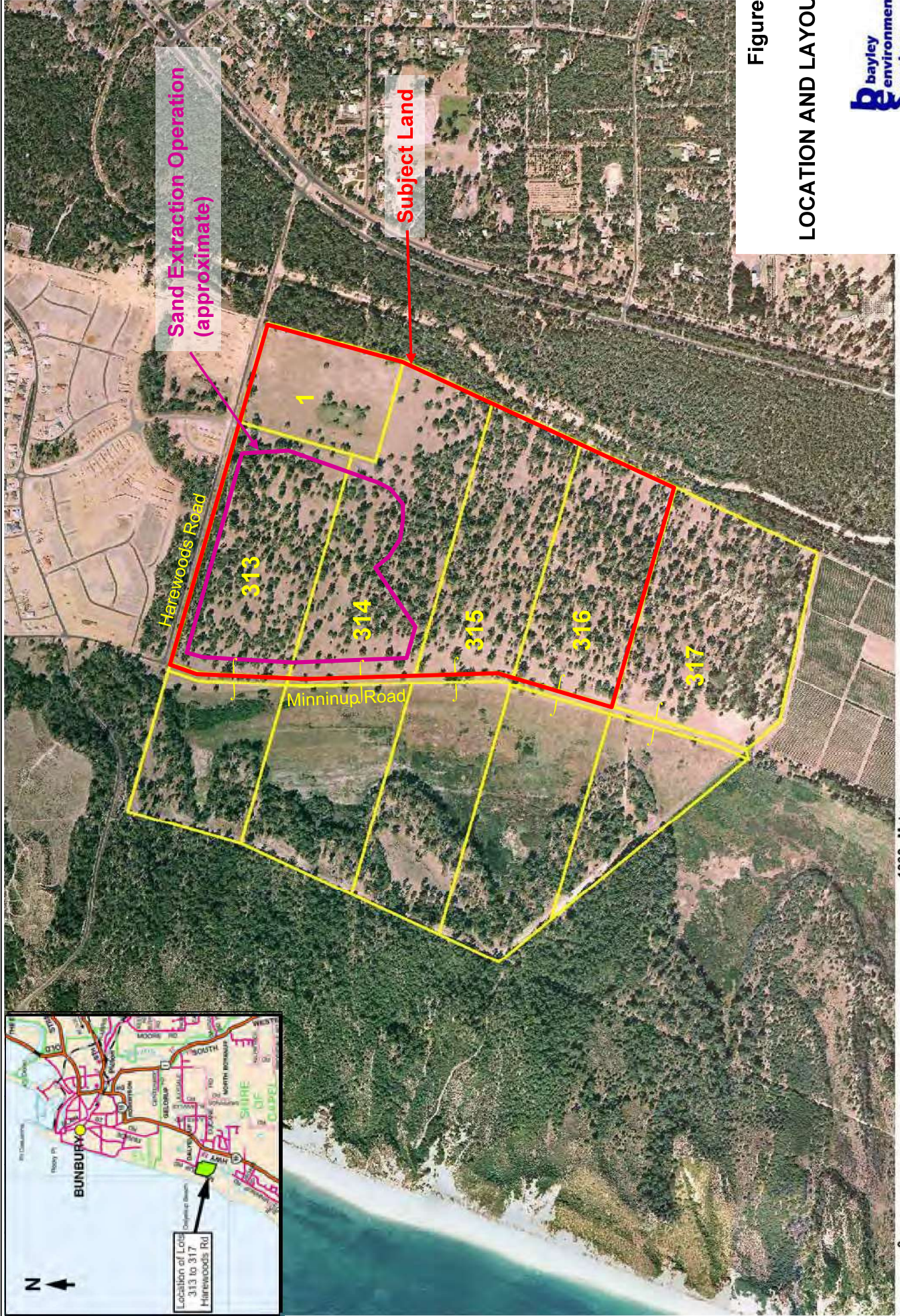


Figure 1

LOCATION AND LAYOUT



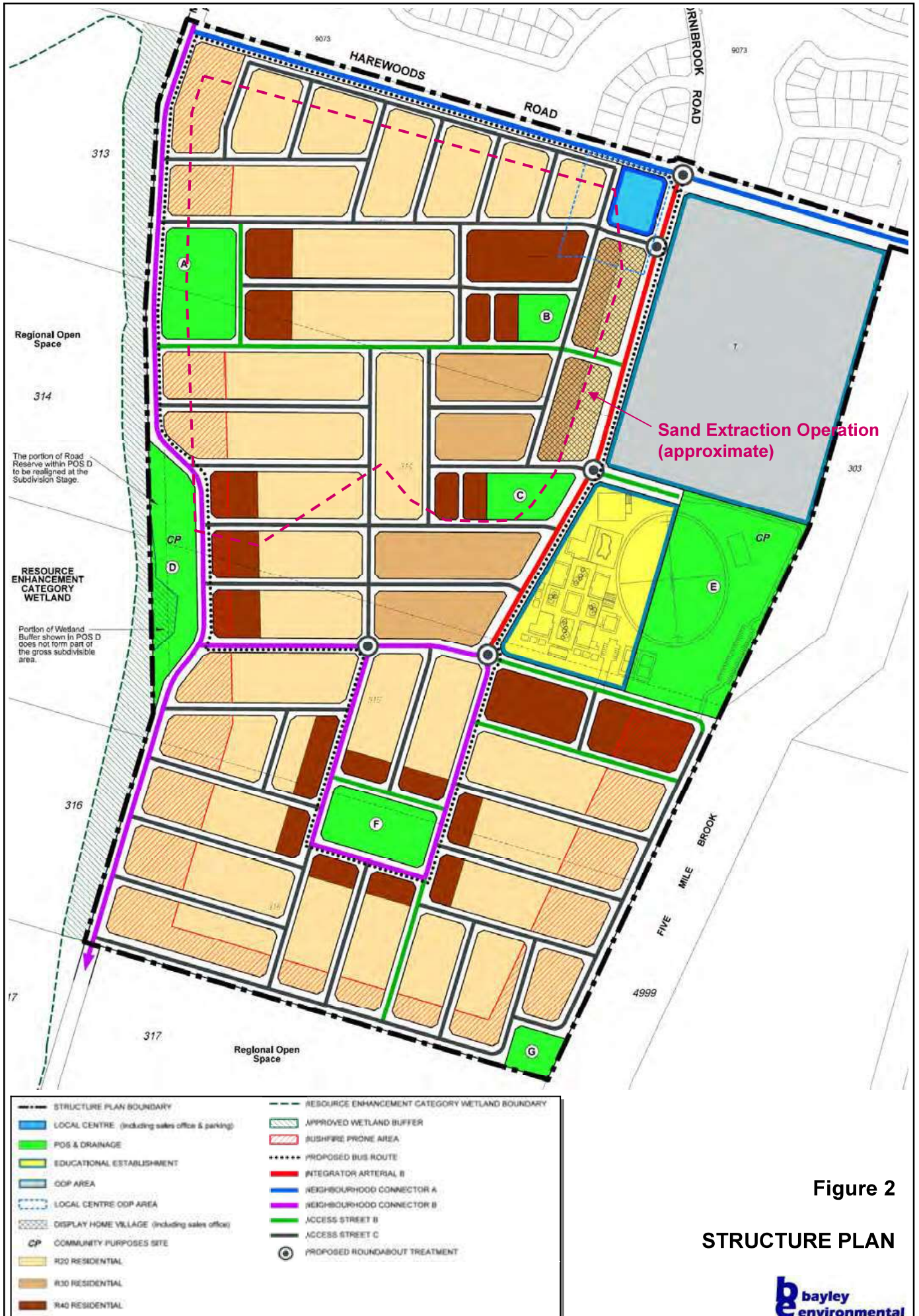
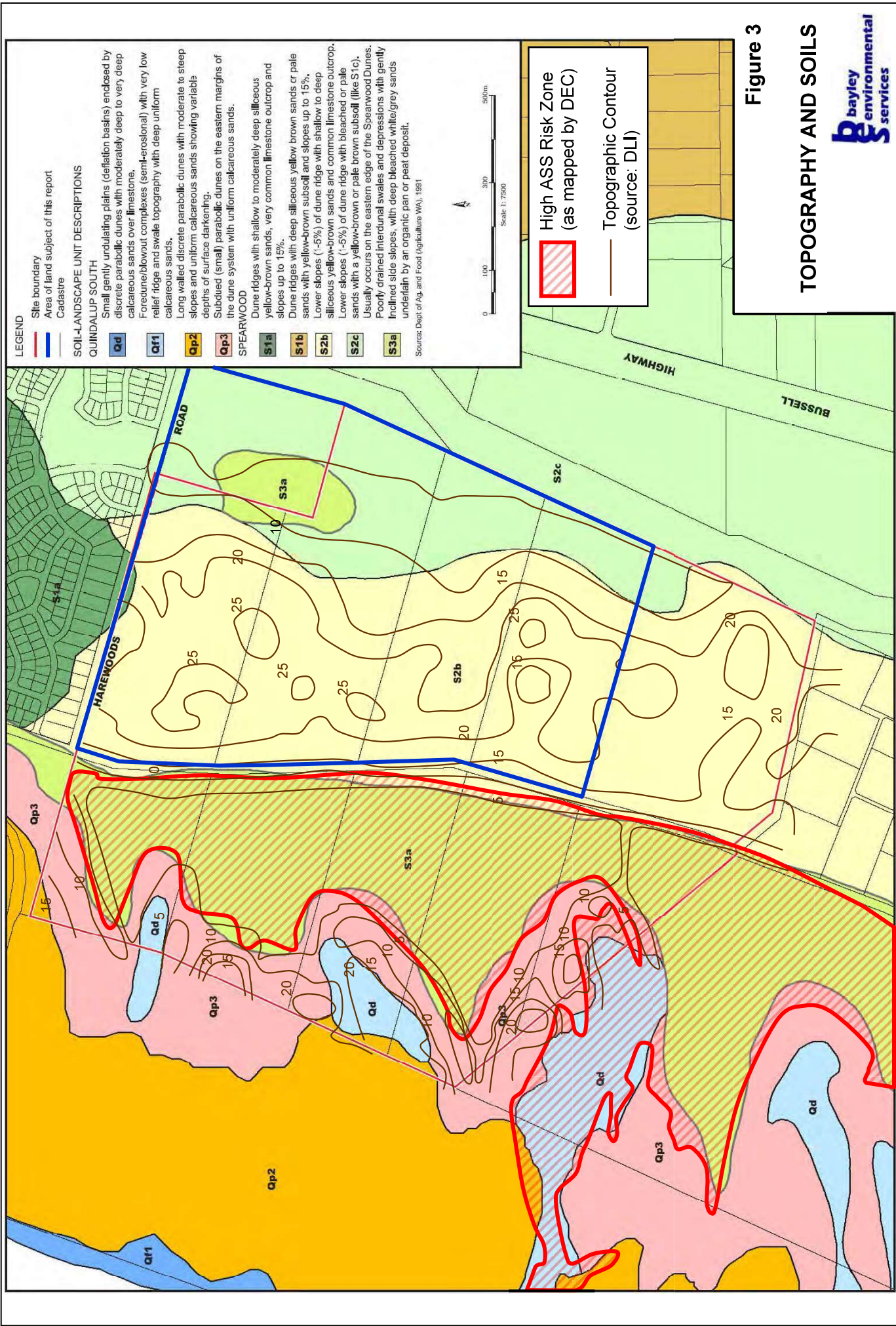


Figure 2  
STRUCTURE PLAN

Source: LB Planning, 2015





**LEGEND**

- Site boundary
- Area of land subject of this report
- Cadastral

**SOIL-LANDSCAPE UNIT DESCRIPTIONS**

**QUINDALUP SOUTH**

Small gently undulating plains (deflation basins) enclosed by discrete parabolic dunes with moderately deep to very deep calcareous sands over limestone.  
Foredune/blowout complexes (semi-horseshol) with very low relief ridge and swale topography with deep uniform calcareous sands.

Long walled discrete parabolic dunes with moderate to steep slopes and uniform calcareous sands showing variable depths of surface darkening.  
Subdued (small) parabolic dunes on the eastern margins of the dune system with uniform calcareous sands.

**SPEARWOOD**

Dune ridges with shallow to moderately deep siliceous yellow-brown sands, very common limestone outcrop and slopes up to 15%.

Dune ridges with deep siliceous yellow brown sands or pale sands with yellow-brown subsoil and slopes up to 15%.

Lower slopes (-5%) of dune ridge with shallow to deep siliceous yellow-brown sands and common limestone outcrop.

Lower slopes (-5%) of dune ridge with bleached or pale sands with a yellow-brown or pale brown subsoil (like S1c).

Usually occurs on the eastern edge of the Spearwood Dunes. Poorly drained interdunal swales and depressions with gently inclined side slopes, with deep bleached white/grey sands underlain by an organic pan or peat deposit.

Source: Dept of Ag. and Food (Agriculture WA), 1991



High ASS Risk Zone (as mapped by DEC)

Topographic Contour (source: DLI)

**Figure 3**

**TOPOGRAPHY AND SOILS**





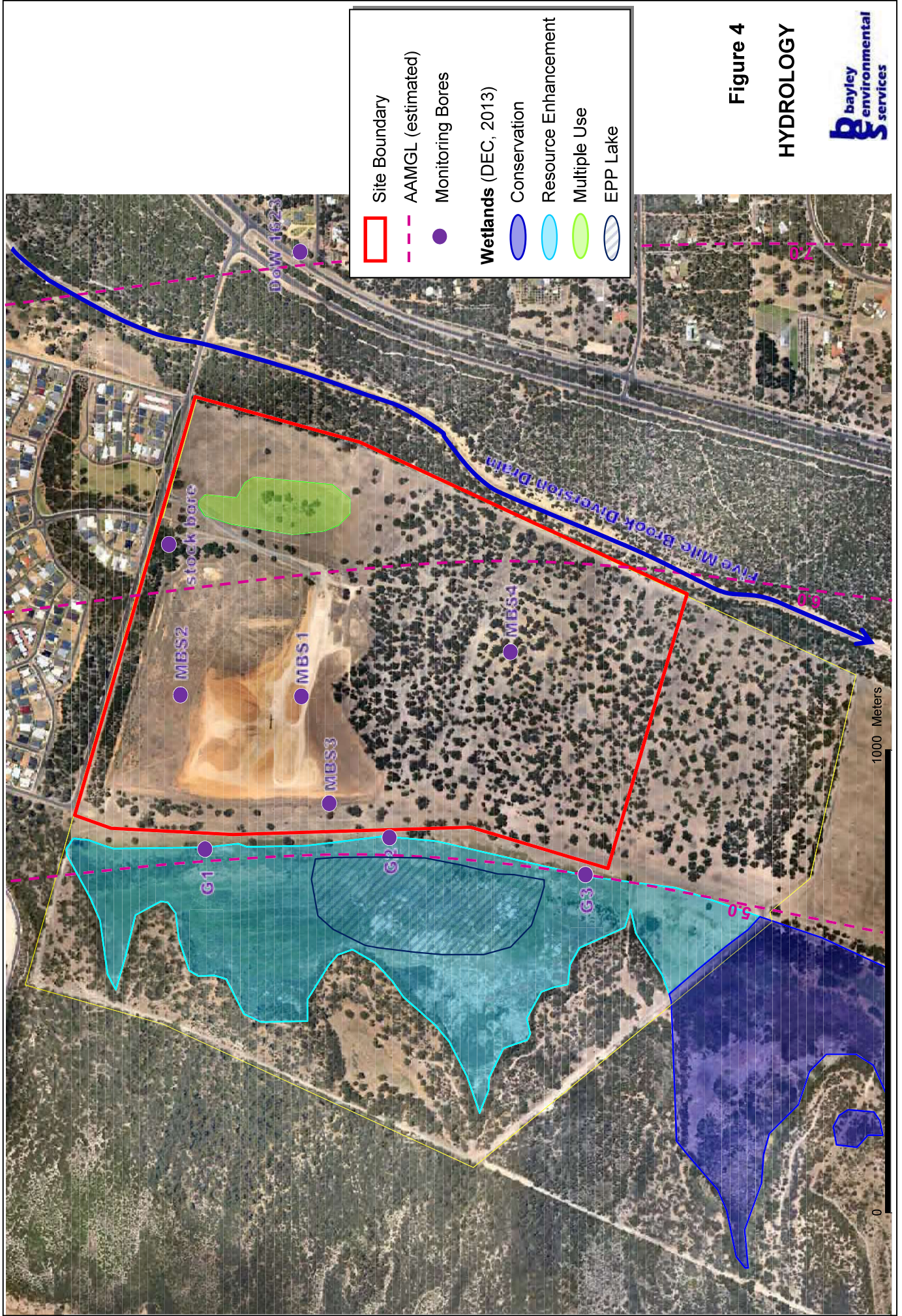
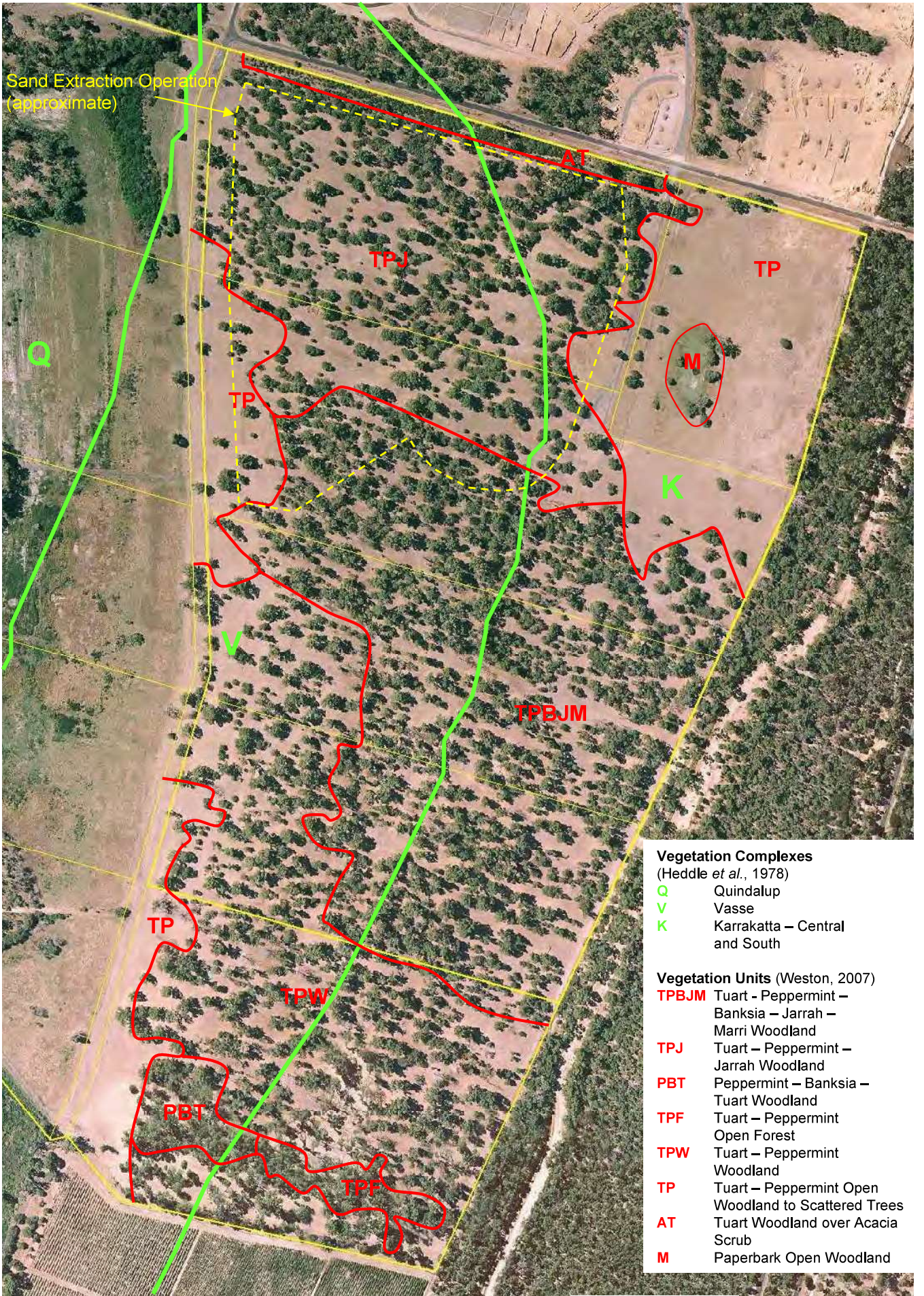


Figure 4

HYDROLOGY





**Vegetation Complexes**  
(Hedde *et al.*, 1978)

- Q** Quindalup
- V** Vasse
- K** Karrakatta – Central and South

**Vegetation Units** (Weston, 2007)

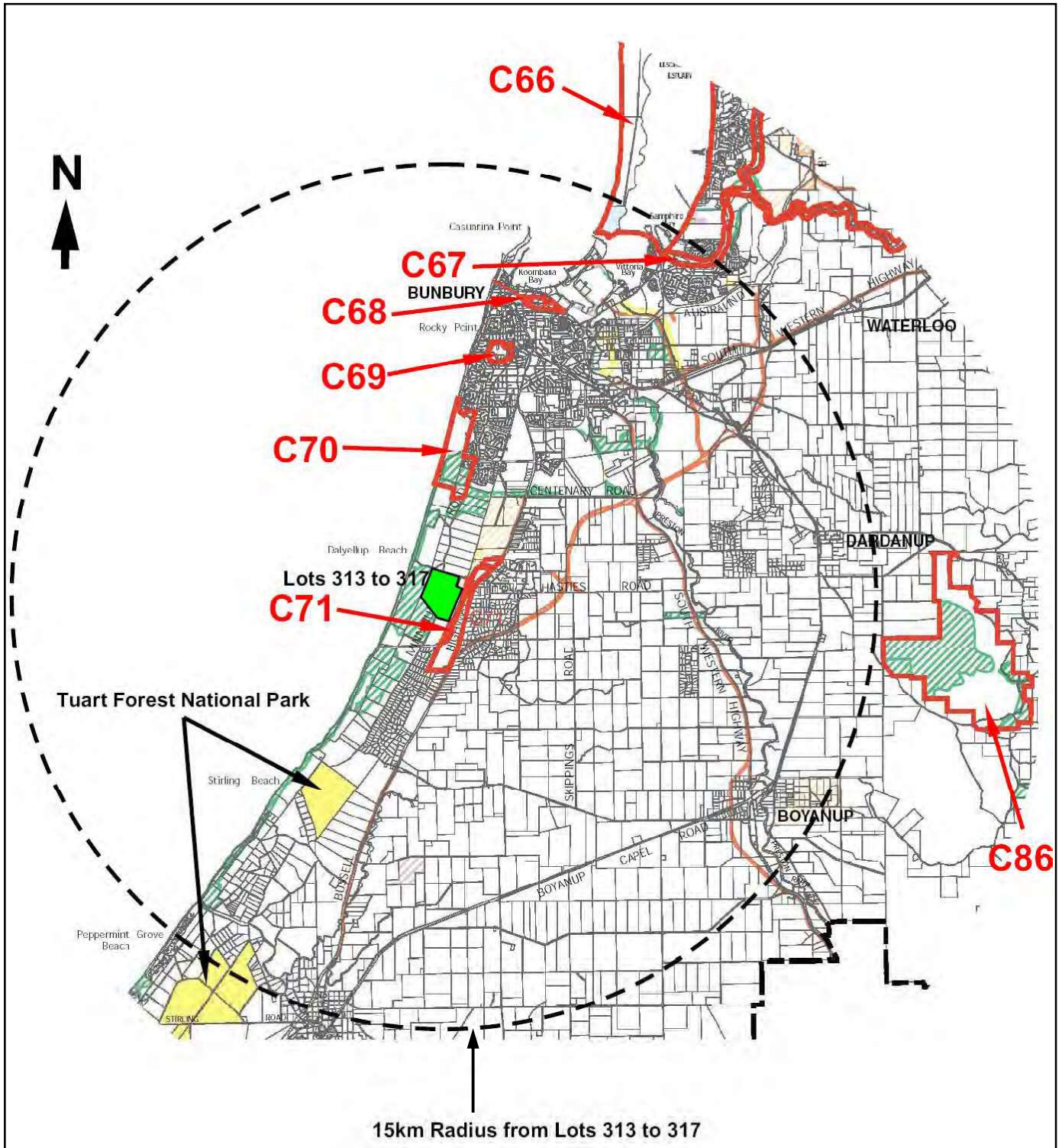
- TPBJM** Tuart - Peppermint – Banksia – Jarrah – Marri Woodland
- TPJ** Tuart – Peppermint – Jarrah Woodland
- PBT** Peppermint – Banksia – Tuart Woodland
- TPF** Tuart – Peppermint Open Forest
- TPW** Tuart – Peppermint Woodland
- TP** Tuart – Peppermint Open Woodland to Scattered Trees
- AT** Tuart Woodland over Acacia Scrub
- M** Paperbark Open Woodland


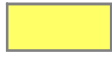

0 500 metres

**Figure 5**  
**VEGETATION**







-  Regional Open Space
-  National Park
-  **C86** System 6 Area

15km Radius from Lots 313 to 317

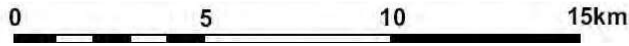


Figure 6

**EXISTING AND PROPOSED CONSERVATION AREAS**

# **Appendix A**

## **Extractive Industries Licence**



## ***EXTRACTIVE INDUSTRIES LICENCE***

Clause 3.1(3)(b)

Licensee: **PIACENTINI & SON PTY LTD**  
Address: PO Box 308 Bunbury WA 6231  
Land Description: Lots 313 and 314 Harewoods Road, Dalyellup  
Material to be Excavated: SAND  
Term of Licence: FOUR (4) YEARS  
Date of Expiry: 24 January 2011

This licence is issued in accordance with the Shire of Capel Extractive Industries Local Laws subject to the following conditions:

REFER ATTACHED CONDITIONS

Dated this 24<sup>th</sup> day of January 2007

P. F. Healy  
Chief Executive Officer  
SHIRE OF CAPEL

## EXTRACTIVE INDUSTRY LICENCE CONDITIONS

This licence is issued in accordance with the Shire of Capel Extractive Industry (EIL) Local Laws of 21 February 2001, subject to the following conditions:

*Clause 3.1 (3) (a)*

The Licence period expires on 24 January 2011

*Clause 3.1 (4) (a)*

The payment of an annual licence fee in accordance with Schedule 5 of the EIL Local Laws, prior to the commencement of sand extraction.

*Clause 3.1 (5)*

- (a) The extractive industry area shall be limited to the area and levels as detailed on the approved Development Plan dated 24 January 2007. For the purpose of this licence, the 'Extractive Industry' activity defined in the Development Plan includes vegetation clearing, excavation works, rehabilitation works, finished batters, topsoil stockpiles, access roads and bund walls.
- (b) Access to the site shall be via Harewoods Road. A sealed crossover is to be constructed and maintained by the licensee to the satisfaction of the Manager Operational Services. The internal haul road will be sealed for a minimum distance of 100 metres from the nearest point of Harewoods Road.
- (c) Material may be stockpiled on site up to a maximum of 1,000m<sup>3</sup> at any one time.
- (d) The hours of operation of the site shall be from 7.00a.m. to 6.00p.m. Monday to Friday; and 7.00am to 12.00 noon on Saturday. **No operations are permitted on Sundays or public holidays.**
- (e) Processing plant i.e.; screen plant, may only operate on the site as per the hours stipulated in (d) above.
- (g) Depth of excavation shall be limited to 11 metres AHD. **No over-excavation below agreed levels is permitted.**
- (h) Minimum setbacks for the industry are as follows:
  - Forty (40) metres from the Harewoods Road and Minninup Road reserve boundaries
  - Forty (40) metres from the Eastern boundary
  - Twenty (20) metres from the Southern boundary.
  - No operations are permitted within the setback areas. Vegetation is to be left undisturbed to screen the industry from the road and neighbouring properties.

- (i) Safety practices for persons employed or visiting shall be in accordance with Department of Minerals & Energy, Mines Safety & Inspection Act 1994 and Regulations 1995.
- (j) Precautions against wind blown material shall be made in accordance with the approved Dust Management Plan.
- (k) The existing vegetation buffer within the forty metre setback from Harewoods Road shall be maintained for the period of the licence.
- (l) Prevention of dieback spread in accordance with CALM guidelines shall be made.
- (m) No discharge of stormwater other than pre-development runoff in defined natural watercourses will be permitted.
- (n) Rehabilitation shall be in accordance with the rehabilitation plan contained within the licence application document dated December 2006.
- (o) Minimum batters of 1:10 shall be applied to all rehabilitated slopes.
- (p) A detailed survey of the EIL site shall be submitted to the Shire prior to 16 November each year to allow monitoring of excavation works, annual licence payments and rehabilitation bond adjustments by 31 December of each year.
- (q) Extraordinary expenses incurred by Shire of Capel in maintaining or repairing damage to thoroughfares in the district caused as a direct result of extraordinary traffic serving the extractive industry site shall be recoverable from the licensee.
- (r) Declared Rare Flora (DRF) shall be preserved, if identified. Refer to CALM guidelines for DRF preservation.
- (s)
  - (i) Access to the extractive industry site shall be available to authorised officers of the Shire of Capel at all times and without prior notice, for the purpose of inspection and monitoring of compliance with license conditions.
  - (ii) A Noise Management Plan shall be submitted for approval by Manager Operational Services prior to the commencement of any earthworks on the site.
  - (iii) Boundaries of the approved excavation area shall be marked with permanent metal markers at intervals of not less than 50 metres, or changes of direction, to clearly define the extent of the activity. The markers should be not less than 1.2 metres in height above ground level and be suitably painted or tagged for ease of identification. Certification from a licensed surveyor to confirm the placement of these markers shall be provided prior to commencement of works.
  - (iv) Appropriate markers to indicate the maximum permitted depth of excavation (11 metres AHD) shall be maintained at all times adjacent to the pit face in a position clearly visible to machine operators extracting material from the site.

*Clause 5 (1)*

Security for Restoration & Reinstatement

The lodgement of a secured amount of \$7,260/ha of disturbed land (or an amount as negotiated and adopted each year in Councils Annual Budget – Fees and Charges) is to be lodged prior to the commencement of extraction. This secured amount is to be reviewed annually in terms of Part 5 of the EIL Local Laws.

*Clause 6.2*

- (a) Securely fence the excavation to the satisfaction of the Manager Operational Services.
- (b) Erect warning signs at the gate and at intervals of not less than 200 metres around the perimeter of the site, bearing the words DANGER EXCAVATIONS KEEP OUT to the satisfaction of the Manager Operational Services.

*Clause 7.1*

A copy of a current public liability insurance policy for a sum of no less than \$10,000,000 in respect of any one claim relating to any of the excavation operations, is to be presented prior to the commencement of extraction. This policy is to remain current during the life of the EIL.

# **Appendix B**

## **Clearing Permit**





GOVERNMENT OF  
WESTERN AUSTRALIA

## CLEARING PERMIT

*Granted under section 51E of the Environmental Protection Act 1986*

### PERMIT DETAILS

Area Permit Number: 701 / 1

File Number: 20930

Duration of Permit: From 11 June 2007 to 11 June 2011

### PERMIT HOLDER

Colin Michael Piacentini

### LAND ON WHICH CLEARING IS TO BE DONE

LOT 314 ON PLAN 3097 (DALYELLUP 6230)

LOT 313 ON PLAN 3097 (DALYELLUP 6230)

### AUTHORISED ACTIVITY

1. Clearing of up to 25.33 hectares of native vegetation within the area cross-hatched yellow on attached Plan 701/1.

### CONDITIONS

#### 1. Weed Control

- (a) When undertaking any *clearing, rehabilitation*, or other activity pursuant to this Permit, the Permit Holder must take the following steps to minimise the risk of the introduction and spread of *weeds*:
  - (i) clean earth-moving machinery of soil and vegetation prior to entering and leaving the area to be cleared;
  - (ii) ensure that no weed-affected *road building materials, mulch, fill* or other material is brought into the area to be cleared; and
  - (iii) restrict the movement of machines and other vehicles to the limits of the areas to be cleared.
- (b) At least once in each 12 month period for the *term* of this Permit, the Permit Holder must remove or kill any *weeds* growing within areas cleared and rehabilitated under this Permit.

#### 2. Topsoil retention

The Permit Holder shall retain the vegetative material and topsoil removed by clearing in accordance with this Permit for use in rehabilitation.

#### 3. Cockatoo Nesting Habitat

- (a) The Permit Holder shall, in consultation with of an *environmental specialist* and the Curator of Ornithology of the Western Australian Museum:
  - (i) Identify twelve tree limbs with nesting hollows suitable for use by species from the *Calyptorhynchus* genus on trees permitted to be cleared for relocation;
  - (ii) Design and construct a minimum of six artificial nesting boxes suitable for use by species from the *Calyptorhynchus* genus;
  - (iii) Identify surrogate trees and locations for nesting boxes suitable for use by species from the *Calyptorhynchus* genus; and
  - (iv) Relocate and install nesting sites prior to 31 July 2007.
- (b) The Permit Holder must employ an *environmental specialist* to monitor the use of the cockatoo nesting habitat established under condition 3(a) by species from the *Calyptorhynchus* genus at least once during each cockatoo breeding season from June to November, for a minimum of two breeding seasons.



#### 4. Record Keeping

The Permit Holder must maintain the following records for activities done pursuant to this Permit:

- (a) In relation to the implementation of the establishment of cockatoo nesting habitat required under condition 3(a):
  - (i) The location of trees cleared under this permit which contain hollows, recorded using Geocentric Datum Australia 1994;
  - (ii) The location of trees containing nesting boxes and relocated tree limbs and trunks with hollows, recorded using Geocentric Datum Australia 1994;
  - (iii) The species of tree, height of nesting habitat (in metres) and type of nesting habitat for each tree at each location;
  - (iv) The dates that the activities were undertaken; and
  - (v) The persons who undertook the activities.
- (b) In relation to the implementation of the monitoring of additional cockatoo nesting habitat required under condition 3(b):
  - (i) The species, location, date and time of recorded cockatoo activity associated with nesting habitat established under condition 3(a); and
  - (ii) The persons who undertook the monitoring.

#### 5. Reporting

The Permit Holder must provide to the CEO on or before 30 June of each year, for the term of this permit, a written report of records requested under condition 4 for the period 1 January and 31 December of the preceding year.

#### 6. Definitions

The following meanings are given to terms used in this Permit:

**CEO** means the Chief Executive Officer of the Department responsible for the administration of the *Environmental Protection Act 1986*;

**environmental specialist** means a person who is engaged by the Permit Holder for the purpose of providing environmental advice, who holds a tertiary qualification in environmental science or equivalent, and has experience relevant to the type of environmental advice that an environmental specialist is required to provide under this Permit;

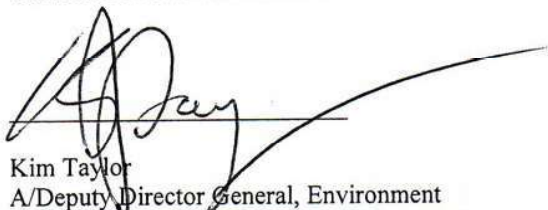
**fill** means material used to increase the ground level, or fill a hollow;

**mulch** means the use of organic matter, wood chips or rocks to slow the movement of water across the soil surface and to reduce evaporation;

**road building materials** means rock, gravel, soil, stone, timber, boulders and water;

**term** means the duration of this Permit, including as amended or renewed; and

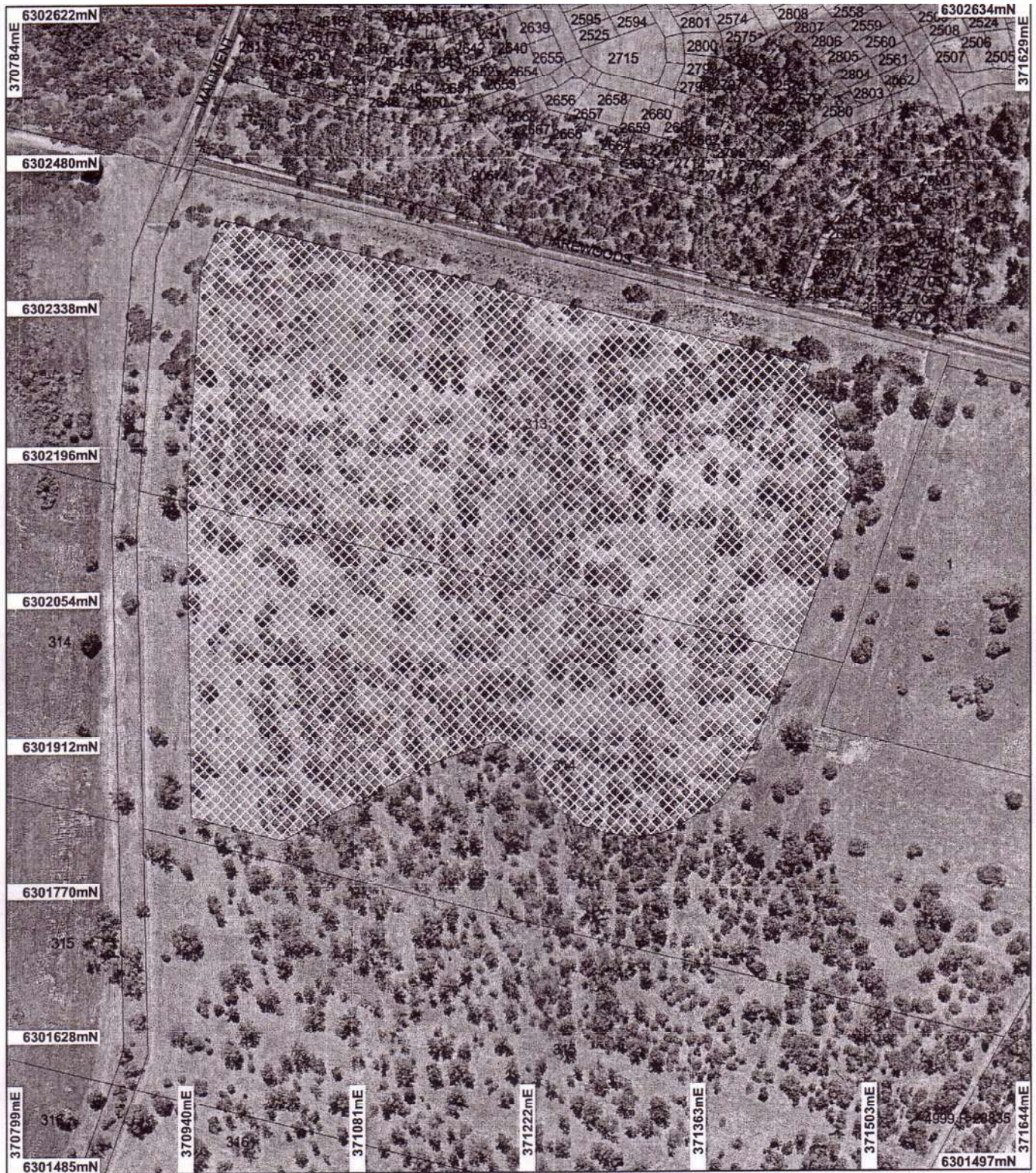
**weed** means a species listed in Appendix 3 of the "Environmental Weed Strategy" published by the Department of Conservation and Land Management (1999), and plants declared under section 37 of the *Agricultural and Related Resources Protection Act 1976*.







Kim Taylor  
A/Deputy Director General, Environment  
Department of Environment and Conservation  
Officer delegated under Section 20 of the *Environmental Protection Act 1986*

11 May 2007

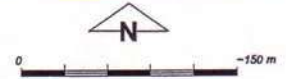




**LEGEND**

- Clearing Instruments**
-  Areas Subject to Conditions
  -  Areas Approved to Clear
  -  Road Centrelines - DLI 1/5/04
  -  Cadastre for labelling - DLI

Preston - Gellorup - Bunbury  
Townsite 20cm Orthomosaic -  
DLI04



Scale 1:5000  
(Approximate when reproduced at A4)

Geocentric Datum Australia 1994

Note: the data in this map have not been  
projected. This may result in geometric  
distortion or measurement inaccuracies.

*Kim Taylor* Date 11/9/07  
Kim Taylor

Officer with delegated authority under Section 20 of  
the Environmental Protection Act 1986

Information derived from this map should be  
confirmed with the data custodian acknowledged  
by the agency acronym in the legend.



# **Appendix C**

## **Letters from EPA and DEC**



# Environmental Protection Authority

The Atrium,  
Level 8, 168 St Georges Terrace,  
Perth, Western Australia 6000.  
Telephone: (08) 6467 5000.  
Facsimile: (08) 6467 5557.

Postal Address: Locked Bag 33,  
Cloisters Square, Perth, Western Australia 6850.  
Website: www.epa.wa.gov.au



Chief Executive Officer  
Shire of Capel  
PO Box 369  
CAPEL WA 6271

Our Ref     A384782  
Enquiries   Patrick Cavalli  
Phone       6467 5411

Attn: Glen Bishop

Dear Sir/Madam

## DECISION UNDER SECTION 48A(1)(a) *Environmental Protection Act 1986*

**SCHEME AMENDMENT TITLE:** Shire of Capel TPS 7 Amendment 51  
Rezoning from Special Use and Rural to  
Urban Development  
**LOCATION:** Lots 313, 314, 315 & 316 Maidment Parade  
**LOCALITY:** Dalyellup  
**RESPONSIBLE AUTHORITY:** Shire of Capel  
**DECISION:** Scheme Amendment Not Assessed –  
Advice Given (no appeals)

Thank you for referring the above scheme amendment to the Environmental Protection Authority (EPA).

After consideration of the information provided by you, the Environmental Protection Authority (EPA) considers that the proposed scheme amendment should not be assessed under Part IV Division 3 of the *Environmental Protection Act 1986* (EP Act) but nevertheless provides the following advice and recommendations.

### ADVICE AND RECOMMENDATIONS

#### 1. Environmental Issues

- Resource enhancement management category wetland
- Regional Open Space
- Significant Fauna Habitat

#### 2. Advice and recommendations regarding Environmental Issues

##### Resource enhancement management category wetland

A Resource enhancement management category wetland (REW) occurs directly west of the Minninup Road reserve (Wetland UFI 1004). Wetland UFI 1004



contains an EPP Lake and is part of a larger, continuous wetland system known as the Quindalup/Spearwood Interface Sumplands and the Muddy Lakes system. The Muddy Lakes system has been previously recognised as being regionally significant due to its sole representation of the Minninup Suite. The EPA understands that the wetland retains most of its wetland processes and habitat values. It has not been hydrologically altered and is ecologically linked both to the Conservation category wetland portion and intact terrestrial vegetation to the west.

#### *Wetland buffer*

The critical role of a buffer is to ensure that any proposed adjacent land uses do not impact on the conservation values of the wetland through edge effects such as the introduction of non-native animals, weeds and inappropriate land uses. The EPA understands the Wetland Buffer Study provided was carried out in accordance with the draft *Guideline for the Determination of Wetland Buffer Requirements* (WAPC, 2005). Table 9 in the draft *Guideline for the Determination of Wetland Buffer Requirements* (WAPC, 2005) recommends a 50m buffer for protection of avifauna habitat and from weed infestation.

The EPA understands from the Environmental Summary Report (ESR) and Wetland Buffer Study provided, that the Structure Plan for the proposed Dalyellup South development proposes a realignment of the Minninup Road reserve to increase the buffer between the proposed road and the mapped boundary of the REW to a range between 24 and 85 m. Based on a comparison of the information provided with DEC's dataset, the proposed REW buffer detailed in the Wetland Buffer Study only meets the 50m buffer distance for a length of approximately 200m of the approximate 1km length of the REW that is directly adjacent to the development area.

DEC Wetlands Section has advised the OEPA that the values of Wetland UFI 1004 are at the high end of the REW category, and that management measures addressing the degradation in vegetation condition due to the land use practices would regain the values commensurate with Conservation category. The EPA urges that all reasonable measures are taken to minimise the potential impacts on REWs and appropriate buffers.

In considering this portion of the Quindalup/Spearwood Interface Sumplands and the Muddy Lakes system has the potential to be restored to Conservation category, and the reduced buffer that is proposed, the EPA expects the proponent be required to rehabilitate the eastern part of the wetland with appropriate locally native species to the satisfaction of DEC, in addition to commitments made by the proponent regarding protection of fauna habitat, to mitigate potential impacts from the proposed Dalyellup South development on the Quindalup/Spearwood Interface Sumplands and the Muddy Lakes system. The EPA expects these requirements will be conditional with future development of the site.

#### *Proposed drainage into REW and its buffer*

Given the potential for the introduction of contaminants and excess nutrients from the development to the REW, the proponent's commitment to ensure that drainage basins are placed a minimum of 50m from the REW is supported. The EPA expects this commitment to be conditional with future development of the site, and the 50m will be measured from the REW boundary, as described in DEC's *Geomorphic Wetlands Swan Coastal Plain* dataset, so the water quality of the REW is not adversely affected by proposed development.

#### *Wetland boundary*

The REW shown in Figures within referral documentation and the Wetland Buffer Study provided appears to vary slightly from the current boundary in DEC's *Geomorphic Wetlands Swan Coastal Plain* dataset. Any buffer applied should be applied to the current REW boundary as per DEC's dataset. Prior to development the proponent should provide a clear map, at an appropriate scale, showing the current REW boundary and the agreed buffer, in consultation with DEC.

#### Regional Open Space

Ministerial Statement No. 697 relating to the Greater Bunbury Region Scheme states that Lot 317 Harewoods Road shall be reserved for conservation purposes to protect the integrity, function and environmental value of the bushland to the requirements of the WAPC on advice of the EPA, and shall only be used for conservation and complementary purposes.

#### *Urban interface*

The draft Dalyellup South Structure Plan currently proposes urban development directly adjacent to Lot 317, to be separated only by an access road.

Further consideration and assessment is required regarding the direct urban interface between the adjacent ROS of Lot 317 and urban development and the potential issues that may arise. This may ensure the regionally significant conservation values in the ROS are not impacted and that the reservation purpose outlined in Ministerial Statement No. 697 can be achieved and maintained.

#### *Drainage*

The EPA understands the proponent had previously proposed to use an area of Lot 317 for detention and infiltration of drainage and that flows were to be dispersed and used to facilitate rehabilitation of vegetation in this area. It is unclear from the information provided whether the proposed drainage use of Lot 317 would result in vegetation clearing or modification within Lot 317.

The use of 500 m<sup>2</sup> of Lot 317 for stormwater management as previously proposed has potential for long term impacts on the regionally significant values of Lot 317 and is therefore not supported. The EPA expressed to the proponent that drainage requirements should be incorporated within the development area, and the potential use of Lot 317 for stormwater management is inappropriate and not supported.

The EPA understands the proponent has made alterations to the draft Dalyellup South Structure Plan to remove all drainage infrastructures from Lot 317, and that all runoff will be retained and infiltrated within the development area, and not within Lot 317. The EPA expects this commitment to be conditional with development of the site.

#### Significant Fauna Habitat

The *Black Cockatoo and Western Ringtail Possum Habitat Assessment* (hereafter referred to as Habitat Assessment) (Bamford *et al.* 2011) provided found 128 potential breeding habitat trees for Black-Cockatoos (Carnaby's - *Calyptrorhynchus latirostris*, Baudin's - *C. baudinii* & Red-tailed - *C. banksii*)



within the proposed development area, and found 263 within the southern ROS (Lot 317). Neither the ROS or development area were found to contain extensive foraging habitat for Black-Cockatoos, however nearby areas were considered by the Habitat Assessment provided to contain foraging habitat likely to support birds breeding in the area into the future.

Although currently the trees are predominantly unused for breeding, when considering the suitability of tree hollows present in the development area and ROS, the loss of habitat within the species' breeding range and the expansion of the species' breeding range into coastal forests between Busselton and Perth, it is considered likely the species will utilise the habitat trees in the future, provided suitable habitat is still available.

The EPA considers the loss of breeding habitat that will occur as a result of this development, may potentially have a significant impact on Black-Cockatoo species. However retention and rehabilitation of Lot 317 may enhance its ecological habitat and linkage value. The following are considered suitable measures that may potentially offset the impact of the proposed development:

- the planting of foraging habitat for Black-Cockatoos (e.g. *Banksia grandis* & *B. sessilis*);
- revegetation of understorey plants for Western Ringtail Possum and other fauna (e.g. *Agonis flexuosa*); and
- use of appropriate weed-control techniques to remove weed species.

The EPA expects the long term retention of Lot 317 as ROS and that rehabilitation measures such as the above, will be conditional with development of the site and incorporated into proposed Regional Open Space and Wetland Management Plans, and carried out to the satisfaction of DEC.

### 3. General Advice

- For the purposes of Part IV of the EP Act, the scheme amendment is defined as an assessed scheme amendment. In relation to the implementation of the scheme amendment, please note the requirements of Part IV Division 4 of the EP Act.
- There is no appeal right in respect of the EPA's decision on the level of assessment of scheme amendments.
- A copy of this advice will be sent to relevant authorities and made available to the public on request.

Yours faithfully



Anthony Sutton  
Director  
Assessment and Compliance Division

23 April 2012





Mr Anthony Sutton  
Director, Assessment and Compliance Services  
Office of Environmental Protection Authority  
Locked Bag 33, Cloisters Square  
Perth Western Australia 6850

Att: Patrick Cavalli

Dear Mr Sutton

**RE: Shire of Capel Town Planning Scheme No. 7 Amendment 51- Wetland Buffer Study –Pt Lots 313-316 Harewoods Rd, Gelorup**

The Department of Environment and Conservation's (DEC) Wetlands Section has reviewed the "*Pt Lots 313 to 316 Harewoods Rd Gelorup Wetland Buffer Study*" (3 February 2012), as requested in your letter of 21 February 2012, and it provides the following advice to the Office of the Environmental Protection Authority.

*Wetland Buffer Study*

The Conservation Category wetland (CCW) boundary at the site was revised and the management category reassessed as being Resource Enhancement wetland (REW) by DEC in August 2011. Any buffer applied should be applied to the current REW boundary, as per the DEC's *Geomorphic Wetlands Swan Coastal Plain* dataset. The REW boundary shown in Figure 2 of the Wetland Buffer Study appears to vary slightly from the current boundary in the dataset. Prior to any development approval, DEC recommends that the proponent provide a clear map, at an appropriate scale, showing the current REW boundary and the agreed buffer to the proposed development.

The Wetland Buffer Study is not consistent with current government policy with respect to wetland conservation. In particular, the Wetland Buffer Study is not in accordance with the information outlined in Chapter B4 of the Environmental Protection Authority's (EPA) *Guidance Statement 33 - Environmental Guidance for Planning and Development* (EPA 2008). The EPA's Guidance Statement 33 states that REWs are priority wetlands and that the ultimate objective is to manage, restore and protect towards improving their conservation value. The EPA recommends protection of REWs. Guidance Statement 33 states that "*Wetlands to be protected require a minimum 50 metre buffer distance*" (p. 18, Chapter B4). The Wetland Buffer Study proposes a buffer of between 24 m and 88 m, although it is unclear whether this is measured from the current REW boundary, as per DEC's *Geomorphic Wetlands Swan Coastal Plain* dataset, because a map showing the buffer relative to the REW boundary was not included in the Wetland Buffer Study. Based on comparison of the information provided in Figure 4 with DEC's dataset, it appears that the proposed buffer as detailed in the Wetland Buffer Study only meets the minimum 50 m buffer distance for a length of approximately 200 m of the approximately 1 km length of wetland that is adjacent to the proposed development.

Section 2.4 - Wetland Function Area (pp. 5-6) quotes the *Guideline for the determination of wetland buffer requirements* (WAPC 2005). However, it selectively starts the quote mid sentence, stating "...the spatial



*boundary of the wetland. It normally would include the wetland itself and the wetland vegetation*". However, the omitted preceding sentence in the WAPC Guidelines (2005) states that "*The wetland function area is the area which needs to be protected to ensure the important functions and values of the wetland can be maintained*" (p. 2). Section 2.4 - Wetland Function Area only describes the current boundary of the wetland itself and not the wetland function area. There is no consideration of the function area of the wetland with respect to the protection of the values of the wetland, including fauna, flora and vegetation and the hydrological processes that support them.

A fauna study for the wetland in accordance with EPA Guidance Statement No. 56 (EPA 2004) has not been provided. Knowledge on the types of fauna in the wetland is important for determining appropriate management and in determining an appropriate wetland buffer. The Wetland Buffer Study states that the western part of the wetland provides "*seasonal nesting and feeding habitats for a range of waterbirds including ducks, grebes, herons and ibis*" (p. 4). One of the aims of the buffer is to ensure that the wetland's habitat values are not eroded by the adjacent development through "edge effects", including introduction of non-native animals, noise and inappropriate recreational uses. The Wetland Buffer Study does not consider buffering the habitat values of the wetland from the threats posed by the proposed development. Table 9 in the *Guideline for the Determination of Wetland Buffer Requirements* (WAPC 2005) recommends a separation distance for REWs of 50 m for protection of bird habitat.

The Wetland Buffer Study proposes management measures to reduce the impacts of the development on habitat values, rather than a 50 m buffer. These include installation of appropriate fencing and bollards to restrict inappropriate recreational activities and exclusion of dogs and horses through the use of fencing and signage. The report notes that cats are difficult to control and dismisses measures to control cats on the basis that "*it is likely that feral cats are already present*" (p. 10). Given the presence of nesting habitat for waterbirds on the western side of the wetland, measures to minimise the impact of domestic cats should be considered at this site. The City of Stirling implements a Cat Prohibited Area in proximity to Herdsman Lake through local laws and it is recommended that the implementation of a similar mechanism to exclude domestic cats from this development in proximity to the REW be investigated and implemented by the proponent, if practicable. If a reduced buffer is to be considered for this site, then the management measures to protect fauna habitat proposed in lieu of a 50 m buffer should be clearly committed to by the proponent and be made enforceable conditions of development approval.

Weeds are also a significant consideration. The Wetland Buffer Study states that "*because the wetland is heavily infested with weeds (almost totally, in the eastern part), there is no need to protect the eastern part of the wetland against weed invasion from the development.*" (p. 8). Although the development may reduce the risk of weeds common to agricultural lands, it creates a new risk associated with escape of garden plant species. Table 9 in the *Guideline for the Determination of Wetland Buffer Requirements* (WAPC 2005) recommends a 50 m separation with respect to threats from weed infestation for REWs. If a reduced buffer is to be considered at this site, then it is recommended that the proponent commit to rehabilitation of the eastern part of the wetland with appropriate locally native species, using locally native species for landscaping within the development area and encouraging residents within the development to use locally native species. These commitments should be made enforceable conditions of development approval.

The critical role of a buffer is to ensure that any proposed adjacent land uses do not impact on the conservation values of the wetland. Land uses such as firebreaks, fencelines, footpaths, stormwater and drainage infrastructure all should occur on the outside edge of a wetland buffer to ensure that the buffer is effective in maintaining the health and functioning of the wetland. The Wetland Buffer Study states that "*Pedestrian traffic can be regulated by provision of hardened footpaths around and possibly through the wetland*" (p. 10). The use of "*hardened footpaths*" through the wetland or buffer is not supported. The installation of a boardwalk or other environmentally sensitive structures within the buffer on the eastern side of the wetland, adjacent to the development, could be considered subject to submission of a more detailed proposal. However, no access or infrastructure should be constructed on the western side of the wetland to protect the habitat values in this area.

### *Drainage*

The Wetland Buffer Study notes that the proposed urban development will introduce a range of contaminants into the wetland, including nutrients, pesticides, hydrocarbons, heavy metals and suspended sediments (p. 8). The Local Waste Water Management Strategy (LWWMS) notes that the proponent proposes to manage this potential for contamination through infiltration basins within public open space designed to “*detain, treat and infiltrate*” (p. 24) surface discharge. The LWWMS indicates that a detailed Monitoring and Response Plan will be developed as part of the Urban Water Management Plan to be prepared at subdivision stage (p. 29, LWWMS). As a condition of any development approval, the agreed monitoring program, appropriate triggers and management actions for the REW should be implemented upon commencement of subdivision works. However, the proponent will need to ensure that there is adequate baseline data *prior* to commencement of subdivision works.

The *Decision process for stormwater management in WA* (Department of Water 2009) states that there “*shall be no new constructed stormwater infrastructure (e.g. no pipes or constructed channels) within ..... resource enhancement category wetlands and their buffers*”. The Wetland Buffer Study states that “*Apart from keeping all drainage basins at least 50 metres away from the wetland (as per the structure plan), no further separation is required for this factor*” (p. 9). Given the potential for the introduction of contaminants from the development to the wetland, as discussed above, the proponent’s commitment to ensure that drainage basins are at least 50 m from the wetland is supported. This commitment should form a condition of any development approval and the 50 m should be measured from the REW boundary, as described in DEC’s *Geomorphic Wetlands Swan Coastal Plain* dataset. If a reduced buffer is considered in relation to weed invasion and protection of fauna habitat due to the proponent committing to the implementation of other management measures to address these matters, the 50 m separation distance between the REW and drainage basins committed to in the Wetland Buffer Study should still be applied to ensure that water quality in the wetland is not adversely affected by the proposed development.

### *Conclusion*

Current government policy and guidelines recommend a minimum of 50 m separation distance for REWs. However, in this particular case, given that the higher conservation values are predominantly on the western side of the wetland, a reduced buffer could be considered on the eastern side of the wetland, adjacent to the proposed development. Any reduction in the agreed buffer would require the proponent’s management commitments to reduce the potential for weed invasion and impacts to fauna habitat, as described above, to be made conditions of the proposed development. The buffer should be applied to the REW, as described in the *Geomorphic Wetlands Swan Coastal Plain* dataset.

It is recommended that the proponent’s commitment to locate drainage basins at least 50 m from the REW also be made a condition of the proposed development.

Please contact Anthea Jones on 9219 8710 if you require additional information with respect to the above advice.

Yours sincerely,



Dr Michael Coote  
Principal Coordinator, Wetlands Section  
22 March 2012

cc: Phil Bayley, Bayley Environmental Services

# **Appendix D**

## **Flora Species List**

**Taxa Recorded at Lots 313 to 317 Harewoods Road, Gelorup  
During Field Surveys on 14 February 2001 and 18-19 September 2002**

**By G. S. McCutcheon**

(Species marked \* are introduced aliens)

<b>Family Code</b>	<b>Family Name</b>	<b>Taxon Name</b>	<b>Id</b>	<b>Notes</b>
<b>011C</b>	<b>Dennstaedtiaceae</b>		29a	
011C		Pteridium esculentum	30	
<b>016A</b>	<b>Zamiaceae</b>		95a	
016A		Macrozamia riedlei	96	
<b>031</b>	<b>Poaceae</b>		76aa	
031		'grass 1' undetermined	76b	
031		'sundry grasses' undetermined	76c	
031		* Avena sativa	77	
031		* Briza minor	78	
031		* Cynodon dactylon	79	
031		* Ehrharta longiflora	80	
031		* Lagurus ovatus	81	
<b>032</b>	<b>Cyperaceae</b>		19a	
032		Cyathochaeta avenacea	20	
032		Ficinia nodosa	22	=Isolepis nodosa
032		Gahnia ?trifida	21	
032		Lepidosperma ?gracile	25	
032		Lepidosperma ?longitudinale	26	
032		Lepidosperma ?tenuis	27	
032		Lepidosperma angustatum	23	
032		Lepidosperma gladiatum	24	
<b>035</b>	<b>Araceae</b>		07a	
035		* Zantedeschia aethiopica	08	
<b>039</b>	<b>Restionaceae</b>		85a	
039		? Desmocladus sp.	85b	=Loxocarya sp. GSM 3023
<b>052</b>	<b>Juncaceae</b>		51a	
052		Luzula meridionalis	52	
054F	<b>Anthericaceae</b>		01a	
<b>054G</b>	<b>Asphodelaceae</b>		09a	
<b>054J</b>	<b>Colchicaceae</b>		18a	
<b>054C</b>	<b>Dasypogonaceae</b>		27a	
<b>054D</b>	<b>Xanthorrhoeaceae</b>		93a	
054C		Acanthocarpus preissii	28	
054J		Burchardia congesta	19	=Burchardia umbellata
054F		Chamaescilla corymbosa	03	
054F		Corynotheca micrantha	04	
054F		Dichopogon preissii	02	=Arthropodium preissii
054C		Lomandra sp.	29	
054F		Sowerbaea laxiflora	05	
054G		* Trachyandra divaricata	10	
054D		Xanthorrhoea brunonis	94	
054D		Xanthorrhoea gracilis	95	
<b>055</b>	<b>Haemodoraceae</b>		46a	
055		Conostylis aculeata subsp. ?preissii	47	

055		Haemodorum spicatum	48	
<b>060</b>	<b>Iridaceae</b>		48a	
060		Orthrosanthus laxus	49	
060		Patersonia occidentalis	50	
060		* Romulea rosea	51	
<b>066</b>	<b>Orchidaceae</b>		62a	
066		Caladenia flava	62	
066		Caladenia hirta	63	
066		Caladenia latifolia	64	
066		Monadenia bracteata	65	=Monadenia bracteata
<b>090</b>	<b>Proteaceae</b>		81a	
090		Banksia attenuata	82	
090		Banksia grandis	83	
090		Persoonia longifolia	84	
<b>092</b>	<b>Santalaceae</b>		88a	
092		Exocarpos sparteus	89	
<b>105</b>	<b>Chenopodiaceae</b>		17a	
105		Rhagodia baccata subsp. baccata	18	
<b>106</b>	<b>Amaranthaceae</b>		0	
106		Ptilotus drummondii var. drummondii	01	
<b>113</b>	<b>Caryophyllaceae</b>		16a	
113		* Petrorhagia dubia	17	=Petrorhagia velutina
<b>119</b>	<b>Ranunculaceae</b>		84a	
119		Clematis pubescens	85	
<b>136</b>	<b>Fumariaceae</b>		41a	
136		* Fumaria capreolata	42	
<b>143</b>	<b>Droseraceae</b>		34a	
143		Drosera ?menziesii	36	
143		Drosera macrantha subsp. macrantha	35	
143		Drosera stolonifera	37	probably now D. porrecta
<b>149</b>	<b>Crassulaceae</b>		15a	
149		* Crassula glomerata	16	Not Caryophyllaceae
<b>163</b>	<b>Mimosaceae</b>		52a	
163		Acacia alata	53	
163		Acacia cochlearis	54	
163		Acacia pulchella	55	
163		Acacia rostellifera	56	
163		Acacia saligna	57	
<b>165</b>	<b>Papilionaceae</b>		68a	
165		Daviesia divaricata	69	
165		Hardenbergia comptoniana	72	
165		Hovea trisperma	73	
165		Jacksonia ?sternbergiana	70	
165		Jacksonia furcellata	74	
165		Kennedia prostrata	75	
165		* Lupinus ?cosentinii	76	
165		* Ornithopus sp.	71	
165		* Zz Genus undetermined	76a	
<b>167</b>	<b>Geraniaceae</b>		43a	
167		Geranium solanderi	44	
167		Pelargonium australe	45	
167		* Pelargonium capitatum	46	

<b>168</b>	<b>Oxalidaceae</b>		66a	
168		Oxalis corniculata	67	
168		Oxalis pes-caprae	68	
<b>185</b>	<b>Euphorbiaceae</b>		39a	
185		* Euphorbia peplus	40	
185		Phyllanthus calycinus	41	
<b>215</b>	<b>Rhamnaceae</b>		85a	
215		Spyridium globulosum	86	
<b>223</b>	<b>Sterculiaceae</b>		92a	
223		Lasiopetalum membranaceum	93	P2, GSM 3/020, 3021, 3022
<b>226</b>	<b>Dilleniaceae</b>		30a	
226		Hibbertia cuneiformis	31	
226		Hibbertia hypericoides	32	
226		Hibbertia racemosa	33	
<b>273</b>	<b>Myrtaceae</b>		57a	
273		Agonis flexuosa	58	
273		Corymbia calophylla	59	=Eucalyptus calophylla
273		Eucalyptus gomphocephala	60	
273		Eucalyptus marginata	61	
<b>281</b>	<b>Apiaceae</b>		05a	
281		Daucus glochidiatus	06	
281		Eryngium pinnatifidum subsp. ?pinnatifidum ms	07	
<b>288</b>	<b>Epacridaceae</b>		37a	
288		Conostephium preissii	38	
288		Leucopogon propinquus	39	
<b>303</b>	<b>Gentianaceae</b>		42a	
303		* Centaurium sp.	43	
<b>305</b>	<b>Asclepiadaceae</b>		8a	
305		* Gomphocarpus fruticosus	09	
<b>315</b>	<b>Solanaceae</b>		90a	
315		* Solanum linnaeanum	92	=Solanum sodomeum
315		* Solanum nigrum	91	
<b>316</b>	<b>Scrophulariaceae</b>		89a	
316		* Parentucellia ?viscosa	90	
<b>320</b>	<b>Orobanchaceae</b>		65a	
320		* Orobanche minor	66	
<b>331</b>	<b>Rubiaceae</b>		86a	
331		Opercularia vaginata	87	
331		Sherardia arvensis	88	
<b>336</b>	<b>Dipsacaceae</b>		33a	
336		*? Scabiosa atropurpurea	34	
<b>345</b>	<b>Asteraceae</b>		10a	
345		* Cotula turbinata	11	
345		Craspedia variabilis	12	=Craspedia glauca
345		* Hypochaeris glabra	13	
345		Lagenophora huegelii	14	
345		Senecio ?pinnatifolius	15	=Senecio ?lautus
400x	<b>Family Unknown</b>		97	
400x		Zz 'strap leaves'	98	

The names and classification in the table follow Max V3 (3.1.2.215).

ASW 17/10/2007

# **Appendix E**

## **Rare and Priority Flora**

## RARE FLORA WITH DISTRIBUTIONS AND HABITATS WHICH MAY INCLUDE LOTS 313 TO 317 HAREWOODS ROAD GELORUP

### Introduction

Table 1 lists 35 taxa (species, subspecies and varieties) of Declared Rare (R) and Priority (P) Flora recorded in the broader vicinity of Lots 313 to 317 survey area. The list was compiled from the results of searches of three databases carried out by the Threatened Flora Database Officer of the Species and Communities Branch, Department of Environment and Conservation (DEC), in July 2007. The table also provides information about conservation codes, distributions, locality records and flowering times; these were compiled from the results and from Atkins (2006).

Presumably similar database searches requested by McCutcheon in 2001 resulted in a total of 44 taxa. Consideration of the habitat preferences of these taxa allowed McCutcheon to reduce to nine the taxa most likely to occur in the study area and to eleven those taxa less likely to occur there. These 20 taxa and their current conservation codes (and, if different, their codes in 2001/2002) are:

<i>Most Likely Priority Taxa</i>	<i>Code</i>	<i>Less Likely Taxa</i>	<i>Code</i>
<i>Lasiopetalum membranaceum</i>	P3 (2)	<i>Eleocharis keigheryi</i>	R
<i>Acacia semitrullata</i>	P3	<i>Verticordia densiflora</i> var. <i>pedunculata</i>	R
<i>Isopogon formosus</i> subsp. <i>dasylepis</i>	P3	<i>Pterostylis turfosa</i>	-(P1)
<i>Jacksonia sericea</i>	P4 (3)	<i>Synaphea odocoileops</i>	P1
<i>Verticordia attenuata</i>	P3	<i>Pithocarpa corymbulosa</i>	P2
<i>Acacia flagelliformis</i>	P4	<i>Stylidium rigidifolium</i> (now <i>S. striatum</i> )	P4 (2)
<i>Caladenia speciosa</i> ms	P4	<i>Synaphea petiolaris</i> subsp. <i>simplex</i>	P2
<i>Drosera marchantii</i>		<i>Chordifex gracilior</i>	P3
subsp. <i>marchantii</i>	-(P4)	<i>Chamaescilla gibsonii</i> (Keighery) ms.	P3
<i>Jacksonia sparsa</i> ins	-(P4)	<i>Platysace ramosissima</i>	P3
		<i>Thysanotus glaucus</i>	-(P4)

Four of the these 20 taxa searched for by McCutcheon are no longer Priority listed, and three others are no longer mapped, in FloraBase, as occurring south of Mandurah, Yalgorup or Pinjarra. These three are *Jacksonia sericea*, *Pithocarpa corymbulosa* and *Platysace ramosissima*. Four others – the Less Likely Taxa *Chordifex gracilior*, *Synaphea odocoileops*, *Synaphea petiolaris* subsp. *simplex* and *Verticordia densiflora* var. *pedunculata* – are not listed in the results of the 2007 database searches.

The Table 1 list of taxa was compiled from the results of searches of three databases carried out by the Threatened Flora Database Officer of the Species and Communities Branch, DEC, in July 2007. These three DEC databases, and the symbols for them in Table A1, are *Threatened (Declared Rare) Flora* (Summary of Threatened Flora Data) [ThrFlor], *Declared Rare and Priority Flora List [D-P list]* and *Western Australian Herbarium Specimen* (WAHERB) [WA Herb]. The searches



were for Declared Rare and Priority Flora taxa recorded within 10km of the property. The parameters requested for the searches were:

- the *Declared Rare and Priority Flora List* database for the locations: Bunbury, Capel, Dalyellup, Minninup, Peppermint Grove,
- the *Western Australian Herbarium Specimen* database for records in the rectangle defined by the coordinates 33° 20' - 33° 30' S and 115° 30' - 115° 38' E,
- the *Threatened (Declared Rare) Flora* database for records in the rectangle defined by the coordinates 33° 20' - 33° 30' S and 115° 30' - 115° 38' E and

The printouts also provided some information about conservation codes, localities and distributions and flowering times. Additional information in the table was obtained from Atkins (2006).

Five of the taxa listed in Table A1 are R: Declared Rare Flora, but only two of them - *Caladenia huegelii* and *Eleocharis keigheryi* - were in the results of the database searches as having been recorded within 10 km of the Gelorup study area. One plant of *Caladenia huegelii* was recorded south to south-east of the study area, and *Eleocharis keigheryi* plants were recorded in a clay pan 9 km from Boyanup along the railway line from there to Capel. None of the habitats in the study area is suitable for either species.

### **Conservation Code Definitions**

Department of Conservation and Land Management definitions of the Conservation Codes (Atkins 2006) in Table 1 are:

- R: Declared Rare Flora – Extant Taxa  
Taxa which have been adequately searched for and are deemed to be in the wild either rare, in danger of extinction, or otherwise in need of special protection, and have been gazetted as such.
- 1: Priority One – Poorly Known Taxa  
Taxa which are known from one or a few (generally <5) populations which are under threat. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- 2: Priority Two – Poorly Known Taxa  
Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.
- 3: Priority Three – Poorly Known Taxa  
Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered). Such

taxa are under consideration for declaration as 'rare flora', but are in need of further survey.

4: Priority Four – Rare Taxa

Taxa which are considered to have been adequately surveyed and which, whilst being rare (in Australia), are not currently threatened by any identifiable factors. These taxa require monitoring every 5-10 years.

The need for further survey of poorly known taxa is prioritised into the Priority 1, 2 and 3 categories depending on the perceived urgency for determining the conservation status of those taxa, as indicated by the apparent degree of threat to the taxa based on current information.

**Table 1**  
**Declared Rare and Priority Flora Recorded in the Broader Vicinity of Lots 313**  
**To 317 Harewoods Road, Gelorup**

D-P list	Thr Flor	WA Herb	SPECIES / TAXON	FAM CODE	CONS CODE	DISTRIBUTION / LOCALITIES	Flowers
D	-	-	<i>Acacia flagelliformis</i>	163	4	Harvey, Eaton, Bunbury, Capel, Busselton, Donnybrook	Jul-Sep
-	-	2	<i>Acacia semitrullata</i>	163	3	Yallingup, Donnybrook, Harvey, Yarloop, Collie	Jun-Aug
D	-	-	<i>Amperea micrantha</i>	185	2	Mokine, Yoongarillup, Capel, Whicher Range, Ruabon NR	Sep-Oct
-	-	1	<i>Anthotium junciforme</i>	341	4	Wattle Grove, Midland, Bayswater, Serpentine, Upper Swan, Kenwick, Busselton, Scott River Plain, Albany	Dec-Mar
D	-	-	<i>Aponogeton hexatepalus</i>	025	4	Perth, Pinjarra, Capel, Bunbury, Boyanup, Nannup	Aug-Sep
D	-	-	<i>Boronia humifusa</i>	175	1	Capel, Tutunup, Kalamunda	Sep
D	-	-	<i>Boronia tetragona</i>	175	3	Capel, Busselton, Whicher Range, Cowaramup	Oct-Dec
D	-	-	<i>Caladenia busselliana</i>	066	R	Marybrook, Capel	Oct
D	1	-	<i>Caladenia huegelii</i>	066	R	Perth - Capel	Aug-Oct
D	1	9	<i>Caladenia speciosa</i>	066	4	Myalup, Eaton, Yarloop, Ludlow, Gingin, Capel	Sep-Oct
D	-	1	<i>Chamaescilla gibsonii</i>	054F	3	Muchea, Ellen Brook, Yule Brook, Drakesbrook, Capel	Jun
D	-	-	<i>Chamelaucium roycei</i> ms	273	R	Capel, Tutunup	Oct-Dec
-	1	-	<i>Conostylis pauciflora</i> subsp. <i>pauciflora</i>	055	4	Yarloop, Dawesville, Yalgorup NP	(Jun-) Aug-Oct
D	-	-	<i>Dryandra squarrosa</i> subsp. <i>argillacea</i>	090	R	Ruabon, Tutunup, Whicher Range, Upper Capel	Jul-Aug
-	-	1	<i>Eleocharis keigheryi</i>	032	R	Kenwick, Lesueur, Cataby, Wannamal, Ellenbrook, Boyanup, Waterloo, Julimar	-
D	-	-	<i>Eryngium ferox</i> ms	281	3	Collie, Pinjarra, Capel, Kulunilup NR	Oct, Nov
D	-	-	<i>Eryngium pinnatifidum</i> subsp. <i>palustre</i> ms	281	3	Arrowsmith-Capel Serpentine, Kenwick, Forrestdale, Bullsbrook	Oct-Nov
D	-	-	<i>Franklandia</i>	090	4	Capel, Tutunup,	Aug-

			triaristata			Jarraewood, Argyle	Oct
-	1	-	Hibbertia spicata subsp. leptotheca	226	3	Yalgorup, Lancelin, Burns Beach	Sep- Nov (Jul- Dec)
D	-	-	Isopogon formosus subsp. dasylepis	090	3	Capel, Ludlow, Busselton, Ruabon, Scott R, Yoongarillup	Jun, Sep- Dec
D	4	3	Lasiopetalum membranaceum	223	3	Capel, Dwellingup, Yandup, Australind, Dawesville, Yanchep	Sep- Dec
D	-	-	Logania wendyae	302	1	Capel, Dardanup	Oct
D	-	-	Mitreola minima	302	3	Woolbernup Hill, Walpole, Capel	Nov- Jan
-	1	-	Platysace ramosissima	281	3	Yalgorup, Lancelin, Boonanarring, Gingin, Bullsbrook NR	Oct- Nov
D	-	-	Pultenaea skinneri	165	4	Collie, Binningup, Boyanup, Whicher Ra., Bunbury, Nannup	Jul- Jan
D	-	-	Rhodanthe pyrethrum	345	3	Bullsbrook-Waterloo- Denmark, Capel, Kenwick, Forrestdale	Sep- Oct
-	1	1	Schoenus benthamii	032	3	Mogumber, Kenwick, Busselton, Manypeaks	-
D	-	-	Stylidium leeuwinense	343	3	Capel, Milyeannup, Scott R., , Shannon River, Walpole-Nornalup NP	Feb- May
D	-	-	Stylidium longitubum	343	3	Midland, Busselton, Arthur River, Jandakot	Nov
-	1	-	Stylidium maritimum	343	3	Yalgorup - Breton Bay, Cervantes, Nilgen, Bold Park, Drivers Cave NP	Sep- Dec
D	-	-	Stylidium striatum	343	4	Gooseberry Hill, Armadale, Flynn Block, Beverley, Capel, Boyanup	Oct- Nov
D	-	-	Synaphea hians	090	3	Busselton, Collie, Ludlow, Capel, Crooked Brook	Sep- Oct
D	-	-	Tetrateca parvifolia	182	3	Capel, East of Donnybrook, Collie	Oct
D	-	-	Verticordia attenuata	273	3	Capel, Ruabon – Tutunup (Busselton), Bunbury	Jan
-	-	1	Villarsia submersa	303A	4	Gunapin, Boyanup, Lake Muir, Denmark, Forrest- dale, Kenwick, Frankland River, Lane Poole	Sep- Oct

# **Appendix F**

## **Fauna Survey Reports**

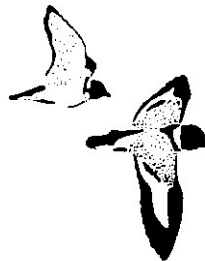
**HAREWOODS ROAD PROPOSED SAND PIT:  
Assessment of fauna values**

Prepared for: Piacentini & Son Pty Ltd.  
PO Box 308,  
Bunbury, WA, 6230

Prepared by: M.J. Bamford\* and J. Wilcox#

\* M.J. & A.R. Bamford,  
CONSULTING ECOLOGISTS.  
23 Plover Way,  
Kingsley, WA, 6026

# WESTERN WILDLIFE  
37A The Avenue,  
Nedlands, WA, 6009



27/04/'01

## INTRODUCTION

As part of the Environmental Impact Assessment of a proposed sand quarry located alongside Harewoods Road south of Bunbury, we have been asked to provide information on the value of the site for fauna. The main aims of this report are therefore to:

- produce a list of fauna observed or expected to occur on the site;
- identify significant or fragile fauna habitats on the site;
- determine the local and regional conservation significance of the fauna and the fauna habitats of the site and;
- provide recommendations for management of the site to minimise impacts upon fauna.

## METHODS AND SITE DESCRIPTION

In order to assess the value of the Harewoods Rd site for fauna, an inspection was carried out. The site was visited by Dr Mike Bamford of Bamford Consulting Ecologists on 1<sup>st</sup> April 2001 at the request of Piacentini & Son. The site inspection made it possible to observe some fauna on the site, but its purpose was mainly to allow for fauna habitats to be recognised so that general information on fauna in the region, based on available information, could be put into the local perspective. Records were made on fauna based on observations of conspicuous species such as birds, recognition of tracks and diggings and some searching under logs and debris.

Even with years of intensive work it is difficult to record all species present in an area. For example, working in Bold Park in Perth, How (1998) found that in each year of a seven year study, an average of only 79% of the total reptile fauna was recorded. Therefore, lists of vertebrate fauna likely to occur in the region have been developed on the basis of published and unpublished records. The main sources of information were records from the WA Museum, the personal records of Dr Mike Bamford and the CALM threatened fauna database. Information on birds likely to occur in the area was obtained from Blakers *et al.* (1984) and records from Birds Australia for the Bunbury region.

The site consists of a stabilised sandy ridge and the vegetation is a parkland with a Tuart *Eucalyptus gomphocephala*, Jarrah *E. marginata* and Marri *Corymbia calophylla* overstorey. Peppermint *Agonis flexuosa* and *Banksia* spp. form a mid-storey. The native understorey has been cleared at some time in the past, so the understorey now consists of grasses and other weeds, with some scattered native bushes such as *Jacksonia* spp. Some of the Tuarts and Marri are old trees, but many of the trees are regrowth. The site is adjacent to a wetland that lies immediately to the west and a community managed reserve that lies to the east.

Species are considered to be of national conservation significance if they are listed under the Commonwealth Environmental Protection and Biodiversity Conservation Act, the WA Wildlife Conservation Act, CALM's list of Priority species, Cogger *et al.* (1993), or are classed as near threatened or threatened in Garnett and Crowley (2000). See Appendix One for categories used by these authors. Species are

considered to be of local conservation significance if they are poorly represented in the general area or are at the limit of the species distribution in the region, but are not listed as being of national conservation significance.

Taxonomic orders and names used in this report generally follow Tyler *et al.* (1984) for amphibians, Storr *et al.* (1983, 1986, 1990 and 1999) for reptiles (common names for amphibians and reptiles from Bush *et al.* 1995), Strahan (1983) for mammals and Christidis and Boles (1994) for birds. Where recent taxonomic revisions have occurred, earlier names are given in parenthesis. This is particularly the case with reptiles, for which several recent revisions have been carried out but some new names have not been widely published or accepted.

## THE VERTEBRATE FAUNA OF THE HAREWOODS RD SITE

Tables 1, 2 and 3 lists species observed or expected at the Harewoods Rd site, and Table 4 lists species believed to be extinct in the region. The site may support 5 frog species (Table 1), 30 reptile species (Table 1), 80 bird species (Table 2) and 23 mammal species (Table 3). At least 5 species of mammals may be extinct on the site (Table 4).

### Amphibians

There are 5 species of frogs likely to occur on the Harewoods Rd site (Table 1). One of these, the Turtle Frog, breeds terrestrially, while the remaining species can be expected to breed in the adjacent wetland but will disperse through upland habitats to varying degrees. The Moaning Frog and the Pobblebonk in particular may be reliant on these upland habitats for much of the year.

None of these species are of national conservation significance, but the Turtle Frog is at the southern limit of its range. No species of frog are likely to have become extinct at the site. Conservation of the frogs depends upon protection of the adjacent wetland and retention of woodland with understorey vegetation.

### Reptiles

There are 33 reptile species expected to occur on the site (Table 1). While many of these species may be present, the lack of a native understorey means that the value of the site for reptiles is low. The 6 species most tolerant of degraded habitats are indicated on Table 1, but other species may be present where understorey persists and where dead, fallen trees provide cover. The long-necked Tortoise may be present in the adjacent wetland. Although primarily aquatic, it breeds on land and may lay eggs in the Harewoods Rd site.

The only species of National Conservation Significance that may be present is the South-West Carpet Python (Schedule 4 of the Wildlife Conservation Act, Vulnerable according to Cogger *et al.* 1993). In the Bunbury to Busselton area it has been reported from coastal heathlands and therefore the study area probably provides little



habitat for the species. The study area is, however, between patches of suitable habitat. The skink *Lerista lineata* is listed by Cogger *et al.* (1993) as Rare or Insufficiently Known but has been removed from lists under the WA Wildlife Conservation Act, as it appears to be more widespread and abundant than previously believed.

Conservation of the reptile species present on the site depends upon retention of the existing areas of native vegetation wherever possible. Although reptiles have been found to persist in small, isolated areas of native vegetation for decades, linkage with adjacent areas of vegetation will be beneficial. This is especially important for large species that occur at low population densities, such as the Carpet Python.

## Birds

Of the 80 bird species expected on the Harewoods Rd site, 9 were observed during the site inspection (Table 2). Due to the highly mobile nature of birds, almost any species that occurs in the region could occasionally occur on the site. Therefore, only those most likely to occur have been listed.

Of the waterbirds listed, the Australian Shelduck and Australian Wood Duck may nest in tree hollows on the site and walk their ducklings to nearby wetlands, while White-faced Herons may nest in large trees. Many other species may also utilise hollows in large trees for nesting, including the parrots, owls, frogmouth, pardalotes and Tree Martins. Note that waterbirds not likely to use the upland habitats have not been listed. The adjacent wetland has a dense cover of sedges and rushes and may therefore be utilised by species such as the Australasian Bittern (Vulnerable) and the Little Bittern (Near Threatened). These

Species such as Weebills, pardalotes and Purple-crowned Lorikeets are eucalypt specialists, and would forage in the Tuart and Jarrah on the site. Honeyeaters such as Red Wattlebirds and New Holland Honeyeaters are nomadic, moving seasonally to secure a nectar supply throughout the year. The Eucalypts and banksias on the site would be a valuable nectar resource when in flower.

The degraded nature of the site favours those species that make use of disturbed environments. Introduced species such as the Laughing Turtle-dove and native species such as the Yellow-rumped Thornbill, Australian Raven and Galah are good examples.

Four bird species of National Conservation Significance may occur at the Harewoods Rd site. They are: the Square-tailed Kite (Priority 4 according to CALM), Peregrine Falcon (Specially Protected under the Wildlife Conservation Act), Carnaby's Black-Cockatoo (Endangered in Garnett and Crowley 2000, under the Federal EPBC Act and under the WA Wildlife Conservation Act), and Masked Owl (listed as Near Threatened by Garnett and Crowley 2000).

The Square-tailed Kite is more common in the South-West in winter than in summer (Blakers *et al.* 1984), and individuals range widely. Therefore, the site could be utilised occasionally for part of the year by one or two kites, although it would be

significant if the birds nested on the site. Square-tailed Kites tend to forage over heathland but nest in tall trees. The Peregrine Falcon may similarly be present in small numbers and could nest in tall trees such as the Tuarts on the site.

Carnaby's Black-Cockatoo is a seasonal visitor to the Coastal Plain over summer but breeds in the wheatbelt. They make extensive use of pine plantations but naturally feed on the seeds of *Banksia* sp., *Dryandra* sp. *Hakea* sp. and eucalypts, so could utilise the banksia and eucalypts present on the site.

The Masked Owl has been reported occasionally from Tuart forest south of Bunbury and therefore has been included on the list because there is Tuart remaining on the site, and the site is adjacent to other stands of Tuart.

In general, the site is only of moderate value for birds because much of the degraded nature of the vegetation. However, the site has some values because of the presence of old trees, especially those bearing nesting hollows, it provides some foraging habitat for seasonal visitors such as honeyeaters and black-cockatoos, and it provides linkage between the reserve to the east and the wetland and native vegetation to the west.

## **Mammals**

The mammal fauna of the region and much of mainland Australia has declined catastrophically, which is why there is a significant list of regionally extinct mammal species (Table 4). This loss of species has been attributed to changes in fire regimes, habitat loss and predation by foxes and cats over large areas (Burbidge and McKenzie 1989, Paton 1991). In the South-West, such extinctions occurred in the first half of the Twentieth Century and there are few records of the extinct species in the region, making it difficult to predict which may have been present. Therefore, the extinct list is almost certainly conservative.

There are 24 mammal species expected to occur in the region (Table 3) of which 5 are of conservation significance. The species of conservation significance that may occur on the site are the: Quenda (Conservation Dependent), Chuditch (Schedule 1, Vulnerable), Western Ring-tailed Possum (Schedule 1, Vulnerable), Brush-tailed Phascogale (Priority 3) and Quokka (Schedule 1, Vulnerable).

The Quenda favours dense, low vegetation and the adjacent wetland may be important habitat. The characteristic diggings of the Quenda were located around the margins of this wetland. The Quokka may also be present in the dense vegetation of the adjacent wetland as this species is known to persist around some wetlands south of Bunbury. Both these species could forage on the project area.

The tall trees on the site may be suitable for Chuditch, Phascogale and Western Ring-tailed Possums. These species roost and breed in large trees such as the Tuarts found on the site. The Western Ring-tailed Possum favours Peppermint *Agonis flexuosa* that is also present on the site. Other mammals may also rely on the old trees for shelter, including the Brush-tailed Possum and the bat species, which may forage widely at

night but probably roost in hollow branches and under loose bark of large trees during the day.

Introduced species are well represented in the mammal fauna and most are likely to be widespread throughout native vegetation in the region. The Rabbit is common at the site due to its degraded nature. The Fox and the Cat can place pressure on populations of native species and are favoured by habitat fragmentation and degradation.

As for other fauna groups, the site provides some habitat for mammals and acts as a link between the reserve to the east and the wetland and native vegetation to the west. Note that in the event of a project affecting species of conservation significance in the Bunbury region, the Department of Conservation and Land Management sometimes undertakes translocation of specimens. At the Harewoods Road site, the most likely species for which translocation can be considered is the Ring-tailed Possum.

## CONCLUSIONS

Although the habitat is degraded, the Harewoods Rd site is likely to support a moderately rich fauna, including some species of national conservation significance. The main points with respect to potential impact of the proposed development upon this fauna are:

- Loss of habitat for fauna. While this is inevitable, it may be possible to retain some large trees, while future land-use of the site could incorporate rehabilitation or at least the use of local plant species along road verges. For species of national conservation significance such as the Ring-tailed Possum, the Department of Conservation and Land Management may request proponent-funded translocation.
- The site lies between a reserve and the adjacent wetland and large areas of native vegetation. Therefore, the site has a role in providing linkage for wildlife moving between these areas of high quality habitat. This linkage function can only be protected by retaining vegetation where possible, and can be restored to some extent by incorporating local plant species into any future land-uses of the site.
- Impact on adjacent wetland. The adjacent wetland supports the Quenda and may support the Quokka, and both of these species may forage on the site occasionally. The wetland may also support significant bird species such as the Australasian and Little Bitterns. Because of the importance of this wetland, any hydrological impacts resulting from sand extraction from the site needs to be minimised.

TABLE ONE. Frog and reptile species observed (+) and expected to occur on the Harewoods Rd site. Species of conservation significance are indicated in the 'comments' column. Details on the categories of conservation significance can be found in Appendix One.

Species	Observed on site	Comments
<b>FROGS</b>		
<b>Myobatrachidae</b> (ground frogs)		
Glauert's Froglet <i>Crinia glauerti</i>		adjacent wetland
Sandplain Froglet <i>Crinia insignifera</i>		adjacent wetland
Moaning Frog <i>Heleioporus eyrei</i>		
Pobblebonk <i>Limnodynastes dorsalis</i>		
Turtle Frog <i>Myobatrachus gouldii</i>		terrestrial
Guenther's Toadlet <i>Pseudophryne guentheri</i>		
<b>Hylidae</b> (tree frogs)		
Slender Tree Frog <i>Litoria adelaidensis</i>		adjacent wetland
Motorbike Frog <i>Litoria moorei</i>		
<b>REPTILES</b>		
<b>Chelidae</b> (side-neck tortoises)		
South-West Long-necked Tortoise <i>Chelodina oblonga</i>		may breed on site
<b>Gekkonidae</b> (geckoes)		
Marbled Gecko <i>Phyllodactylus marmoratus</i>		
<b>Pygopodidae</b> (legless-lizards)		
Sandplain Worm-Lizard <i>Aprasia repens</i>		
Burton's Legless-Lizard <i>Lialis burtonis</i>		
Common Scaleyfoot <i>Pygopus lepidopodus</i>		
<b>Agamidae</b> (dragon lizards)		
Bearded Dragon <i>Pogona minor</i>		
<b>Varanidae</b> (monitors or goannas)		
Gould's Sand Goanna <i>Varanus gouldii</i>		in degraded habitats
Rosenberg's Goanna <i>Varanus rosenbergi</i>		
<b>Scincidae</b> (skink lizards)		
Fence Skink <i>Acritoscincus (Bassiana) trilineatum</i>	+	in degraded habitats
<i>Cryptoblepharus plagiocephalus</i>		
<i>Ctenotus australis</i>		
<i>Ctenotus impar</i>		
King's Skink <i>Egernia kingii</i>		
Mourning Skink <i>Egernia luctuosa</i>		
Salmon-bellied Skink <i>Egernia napoleonis</i>		
<i>Glaphyromorphus gracilipes</i>		
<i>Glaphyromorphus</i> sp.		
<i>Hemiergis peronii</i>		
<i>Hemiergis quadrilineata</i>	in degraded habitats Rare or Insufficiently Known?	
<i>Lerista elegans</i>		
<i>Lerista lineata</i>		
Dwarf Skink <i>Menetia greyii</i>		in degraded habitats

TABLE TWO. Bird species observed (+) and expected to occur on the Harewoods Rd site. Species of conservation significance are indicated in the 'comments' column. Details on the categories of conservation significance can be found in Appendix One. Note that <sup>Int.</sup> indicates introduced species.

Species	Observed	Comments
<b>Phasianidae</b> (pheasants and quails)		
Brown Quail <i>Coturnix ypsilophora</i>		
Stubble Quail <i>Coturnix pectoralis</i>		
<b>Anatidae</b> (ducks, geese and swans)		
Australian Shelduck <i>Tadorna tadornoides</i>		Breed in hollows
Pacific Black Duck <i>Anas superciliosus</i>		Breed in hollows
Grey Teal <i>Anas gibberifrons</i>		Breed in hollows
Australian Wood Duck <i>Chenonetta jubata</i>		Breed in hollows
<b>Ardeidae</b> (herons and egrets)		
White-faced Heron <i>Egretta novaehollandiae</i>		
<b>Plataleidae</b> (ibis and spoonbills)		
Australian White Ibis <i>Threskiornis molucca</i>		
Straw-necked Ibis <i>Threskiornis spinicollis</i>		
<b>Accipitridae</b> (kites, hawks and eagles)		
Square-tailed Kite <i>Lophoictinia isura</i>		Priority 4 (Rare)
Black-shouldered Kite <i>Elanus axillaris</i>		
Whistling Kite <i>Haliastur sphenurus</i>		
Brown Goshawk <i>Accipiter fasciatus</i>		
Collared Sparrowhawk <i>Accipiter cirrhocephalus</i>		
Wedge-tailed Eagle <i>Aquila audax</i>		
Little Eagle <i>Hieraetus morphnoides</i>		
<b>Falconidae</b> (falcons)		
Peregrine Falcon <i>Falco peregrinus</i>		Specially Protected
Australian Hobby <i>Falco longipennis</i>		
Brown Falcon <i>Falco berigora</i>		
Nankeen Kestrel <i>Falco cenchroides</i>		
<b>Turnicidae</b> (button-quails)		
Painted Button-quail <i>Turnix varia</i>		
<b>Columbidae</b> (pigeons and doves)		
Laughing Turtle-Dove <i>Streptopelia senegalensis</i> <sup>Int.</sup>		
Common Bronzewing <i>Phaps chalcoptera</i>		
Crested Pigeon <i>Ocyphaps lophotes</i>		
<b>Cacatuidae</b> (cockatoos)		
Carnaby's Black-Cockatoo <i>Calyptorhynchus latirostris</i>		Endangered
Galah <i>Cacatua roseicapilla</i>		

Table 2 (cont.)

Species	Observed	Comments
<b>Psittacidae</b> (lorikeets and parrots)		
Purple-crowned Lorikeet <i>Glossopsitta porphyrocephala</i>		
Regent Parrot <i>Polytelis anthopephus</i>		
Red-capped Parrot <i>Purpureicephalus spurius</i>		
Western Rosella <i>Platycercus icterotis</i>	+	
Australian Ringneck <i>Barnardius zonarius</i>	+	
Elegant Parrot <i>Neophema elegans</i>		
<b>Cuculidae</b> (cuckoos)		
Pallid Cuckoo <i>Cuculus pallidus</i>		
Fan-tailed Cuckoo <i>Cuculus pyrrhophamus</i>		
Horsfield's Bronze-Cuckoo <i>Chrysococcyx basalis</i>		
Shining Bronze-Cuckoo <i>Chrysococcyx lucidus</i>		
<b>Strigidae</b> (hawk-owls)		
Southern Boobook Owl <i>Ninox novaeseelandiae</i>		
<b>Tytonidae</b> (barn owls)		
Masked Owl <i>Tyto novaehollandiae novaehollandiae</i>		Near Threatened
Barn Owl <i>Tyto alba</i>		
<b>Podargidae</b> (frogmouths)		
Tawny Frogmouth <i>Podargus strigoides</i>		
<b>Halcyonidae</b> (forest kingfishers)		
Laughing Kookaburra <i>Dacelo novaeguineae</i> <sup>Int.</sup>		
Sacred Kingfisher <i>Todiramphus sanctus</i>		
<b>Meropidae</b> (bee-eaters)		
Rainbow Bee-eater <i>Merops ornatus</i>		
<b>Maluridae</b> (fairy-wrens)		
Splendid Fairy-wren <i>Malurus splendens</i>	+	
<b>Pardalotidae</b> (pardalotes)		
Spotted Pardalote <i>Pardalotus punctatus</i>		
Striated Pardalote <i>Pardalotus striatus</i>	+	
White-browed Scrubwren <i>Sericornis frontalis</i>		
Weebill <i>Smicrornis brevirostris</i>	+	
Western Gerygone <i>Gerygone fusca</i>	+	
Inland Thornbill <i>Acanthiza apicalis</i>		
Western Thornbill <i>Acanthiza inornata</i>		
Yellow-rumped Thornbill <i>Acanthiza chrysorrhoa</i>		

Table 2 (cont.)

Species	Observed	Comments
<b>Meliphagidae</b> (honeyeaters)		
Red Wattlebird <i>Anthochaera carunculata</i>	+	
Western Wattlebird <i>Anthochaera lunulata</i>		
Brown-headed Honeyeater <i>Melithreptus brevirostris</i>		
White-naped Honeyeater <i>Melithreptus lunatus</i>		
Brown Honeyeater <i>Lichmera indistincta</i>	+	
New Holland Honeyeater <i>Phylidonyris novaehollandiae</i>	+	
White-cheeked Honeyeater <i>Phylidonyris nigra</i>		
Western Spinebill <i>Acanthorhynchus superciliosus</i>		
White-fronted Chat <i>Epthiamura albifrons</i>		
<b>Petroicidae</b> (Australian robins)		
Scarlet Robin <i>Petroica multicolor</i>		
<b>Neosittidae</b> (sittellas)		
Varied Sittella <i>Daphoenositta chrysoptera</i>		
<b>Pachycephalidae</b> (whistlers)		
Golden Whistler <i>Pachycephala pectoralis</i>		
Rufous Whistler <i>Pachycephala rufiventris</i>		
Grey Shrike-thrush <i>Colluricincla harmonica</i>		
<b>Dicruridae</b> (flycatchers)		
Magpie-lark <i>Grallina cyanoleuca</i>		
Grey Fantail <i>Rhipidura fuliginosa</i>		
Willie Wagtail <i>Rhipidura leucophrys</i>		
<b>Campephagidae</b> (cuckoo-shrikes)		
Black-faced Cuckoo-shrike <i>Coracina novaehollandiae</i>		
White-winged Triller <i>Lalage sueurii</i>		
<b>Artamidae</b> (woodswallows)		
Black-faced Woodswallow <i>Artamus cinereus</i>		
Dusky Woodswallow <i>Artamus cyanopterus</i>		
Grey Butcherbird <i>Cracticus torquatus</i>		
Australian Magpie <i>Gymnorhina tibicen</i>		
<b>Corvidae</b> (ravens and crows)		
Australian Raven <i>Corvus coronoides</i>		
<b>Motacillidae</b> (pipits and true wagtails)		
Richard's Pipit <i>Anthus novaeseelandiae</i>		
<b>Hirundinidae</b> (swallows)		
Welcome Swallow <i>Hirundo neoxena</i>		
Tree Martin <i>Hirundo nigricans</i>		
<b>Zosteropidae</b> (white-eyes)		
Silvereye <i>Zosterops lateralis</i>		
Number of bird species observed:	9	
Number of species expected:	80	

TABLE THREE. Mammal species observed (+) and expected to occur at the Harewoods Road Site. Species of conservation significance are indicated in the comments column. Details on the categories of conservation significance can be found in Appendix One. Note that <sup>Int</sup> indicates introduced species.

Species	Observed	Comments
<b>Tachyglossidae</b> (echidnas) Echidna <i>Tachyglossus aculeatus</i>		
<b>Dasyuridae</b> Chuditch <i>Dasyurus geoffroii</i>		Schedule 1; Vulnerable
Brush-tailed Phascogale <i>Phascogale tapoatafa</i>		Priority 3
<b>Peramelidae</b> (bandicoots) Quenda (Southern Brown Bandicoot) <i>Isoodon obesulus</i>	+	Priority 4
<b>Phalangeridae</b> (possums) Brush-tailed Possum <i>Trichosurus vulpecula</i>		
<b>Pseudocheiridae</b> (ring-tailed possums) Western Ring-tailed Possum <i>Pseudocheirus occidentalis</i>		Schedule 1; Vulnerable
<b>Macropodidae</b> (kangaroos and wallabies) Western Grey Kangaroo <i>Macropus fuliginosus</i> Quokka <i>Setonix brachyurus</i>	+	Schedule 1; Vulnerable
<b>Mollosidae</b> (mastiff bats) White-striped Bat <i>Nyctinomus australis</i> <i>Mormopterus planiceps</i>		
<b>Vespertilionidae</b> (vesper bats) Gould's Wattle Bat <i>Chalinolobus gouldii</i> Chocolate Wattle Bat <i>Chalinolobus morio</i> <i>Vespedalus (Eptesicus) regulus</i> <i>Falsistrellus mackenziei</i> Lesser Long-eared Bat <i>Nyctophilus geoffroyi</i> Gould's Long-eared Bat <i>Nyctophilus gouldii</i> Greater Long-eared Bat <i>Nyctophilus timoriensis</i>		
<b>Muridae</b> (rats and mice) Rakali or Water-Rat <i>Hydromys chrysogaster</i> House Mouse <i>Mus musculus</i> <sup>Int</sup> Black Rat <i>Rattus rattus</i> <sup>Int</sup>		
<b>Leporidae</b> (rabbits and hares) Rabbit <i>Oryctolagus cuniculus</i> <sup>Int</sup>	+	
<b>Canidae</b> (foxes and dogs) European Red Fox <i>Vulpes vulpes</i> <sup>Int</sup>	+	
<b>Felidae</b> (cats) Feral Cat <i>Felis catus</i> <sup>Int</sup>		
<b>Suidae</b> (pigs) Feral Pig <i>Sus scrofa</i> <sup>Int</sup>		
Number of species observed:	4	
Number of species observed or expected:	24	



TABLE FOUR. Species believed to have been present in the general region of the Harewoods Road site at the time of European settlement, but which are now locally extinct. Note that these species are included on the basis of general information.

Species		Status
<b>Potoroidae</b> (rat-kangaroos and allies)		
Woylie	<i>Bettongia penicillata</i>	Conservation dependent Schedule 1; Vulnerable
Boodie	<i>Bettongia lesueur</i>	
<b>Macropodidae</b> (kangaroos and wallabies)		
Tammar	<i>Macropus eugenii</i>	Priority 4
<b>Muridae</b> (rats and mice)		
Noodji or Ashy-grey Mouse	<i>Pseudomys albocinereus</i>	
<b>Canidae</b> (foxes and dogs)		
Dingo	<i>Canis lupus dingo</i>	

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**APPENDIX ONE.** Categories used in the recognition of conservation significance.

**WA Wildlife Conservation Act.**

Schedule 1. Fauna which is rare or likely to become extinct, including Conservation Dependent taxa.

Schedule 2. Fauna presumed to be extinct

Schedule 3. Birds protected under an international agreement

Schedule 4. Other specially protected fauna.

**WA Department of Conservation and Land Management** (species not listed under the Conservation Act, but for which there is some concern).

Priority 1. Taxa with few, poorly known populations on threatened lands.

Priority 2. Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.

Priority 3. Taxa with several, poorly known populations, some on conservation lands.

Priority 4. Taxa in need of monitoring.

**International Union for the Conservation of Nature and Natural Resources (IUCN)** Based on a 1994 review by Mace and Stuart (1994).

Extinct. Taxa not definitely located in the wild during the past 50 years.

Extinct in the Wild. Taxa known to survive only in captivity.

Critically Endangered. Taxa facing an extremely high risk of extinction in the wild in the immediate future.

Endangered. Taxa facing a very high risk of extinction in the wild in the near future.

Vulnerable. Taxa facing a high risk of extinction in the wild in the medium-term future.

Near Threatened. Taxa that risk becoming Vulnerable in the wild.

Conservation Dependent. Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.

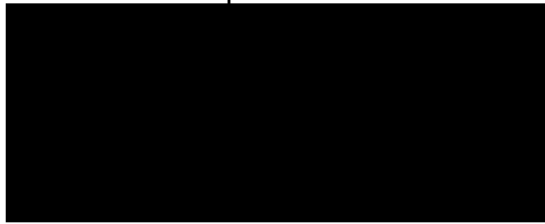
Data Deficient (Insufficiently Known). Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.

# **Appendix G**

## **Black Cockatoo and Possum Survey Reports**

**Survey for the Western Ringtail Possum  
*Pseudocheirus occidentalis* within a proposed  
extractive operation area, part Lots 313 and 314  
Harewoods Road, Gelorup, Western Australia.**

Prepared for:



Prepared by:

**Sue Elscot  
GREEN IGUANA  
PO Box 601  
DUNSBOROUGH WA 6281  
T/F: (08) 9755 2916  
M: 041 935 4484  
E: [green\\_iguana@bigpond.com](mailto:green_iguana@bigpond.com)**

**March 2006**

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## 1 Introduction

### 1.1 Background

Piacentini and Son Pty Ltd is seeking to clear remnant native vegetation from part of Lots 313 and 314 Harewoods Road, Gelorup, for the purpose of a proposed extractive operation. The site's vegetation contains a midstorey of Peppermint trees (*Agonis flexuosa*) so the area is potential habitat for the gazetted rare and specially protected Western Ringtail Possum (*Pseudocheirus occidentalis*). As a result, the Department of Environment requested that the area be surveyed to ascertain the status of the species within the site prior to the approval of an application for a clearing permit made under Section 51E of the Western Australian *Environmental Protection Act* (1986).

In March 2006, MBS Environmental commissioned Green Iguana to undertake a survey to provide detailed information on the abundance and distribution of the Western Ringtail Possum within the site. The method agreed for the survey included a thorough daylight search of the entire site and two replicates of spotlighting surveys (carried out over four nights) to cover the entire area to be cleared twice, together with a limited search of the surrounding bushland. This report presents the results of the survey for Western Ringtail Possums within the site, carried out during March 24-28, 2006.

### 1.2 Western Ringtail Possum – Legislative Framework

The Western Ringtail Possum is listed as a Schedule 1 species ('Fauna that is rare or likely to become extinct') under the Western Australian *Wildlife Conservation Act* (1950), and is a trigger species under the Commonwealth *Environment Protection and Biodiversity Conservation Act* (1999) ('the EPBC Act'), where it is listed as 'Vulnerable'.

The EPBC Act provides protection for matters of National Environmental Significance (NES), and as a listed nationally threatened species, the Western Ringtail Possum is defined as a matter of NES. Under the EPBC Act, any action that is likely to have a significant impact on a matter of NES requires assessment and approval by the Commonwealth Minister for the Environment. Guidelines for determining whether an action is likely to have a significant impact on a listed 'Vulnerable' species are provided in the '*EPBC Administrative Guidelines on Significance, July 2000*' (available online at the Federal Department of Environment and Heritage's (DEH) website at:

<http://www.deh.gov.au/epbc/assessmentsapprovals/guidelines/administrative/index.html> ).

Under the EPBC Act, it is the responsibility of the proponent to refer any proposal that may have a significant impact on a matter of NES to the Commonwealth Department of Environment and Heritage (DEH) for determination of the level of assessment required, although other agencies may also refer a proposal to DEH.

Under the Western Australian *Wildlife Conservation Act* (1950) all native fauna that is declared as Specially Protected is wholly protected throughout the State at all times, except to the extent that the Minister declares otherwise by notice in the Government Gazette. Section 15 of the Act allows for the Minister to '*issue such licences as are prescribed*', while Section 15(3a) of the Act allows the Minister to delegate any of the powers conferred upon them (with the exception of delegation) to the Executive Director of CALM or to any Wildlife Officer. Under Section 16 of the Act, the taking (killing or removal) of protected fauna is an offence under the Act, unless consent has been obtained under Section 15 of the Act.

### 1.3 Western Ringtail Possum - Biology

The Western Ringtail Possum (Ringtail Possum) is a small, arboreal browsing mammal. Ringtail Possums are closely associated with the Peppermint tree (*Agonis flexuosa*) that occurs as the dominant overstorey species in woodland and also as a co-dominant in mixed woodland of Tuart (*Eucalyptus gomphocephala*), Jarrah (*E. marginata*), Marri (*Corymbia calophylla*) and *Banksia* spp. in the Busselton area. The Ringtail Possum also lives within the suburbs of Busselton and travels via fences to individual Peppermint trees. Ringtail Possums

are nocturnal and usually shelter by day in dreys (bird-like nests) or in tree hollows in the Busselton area. Dreys are typically located in the crown of Peppermint trees, but may be constructed in other species, such as *Melaleuca* and *Banksia* trees. Ringtail Possums are territorial and have defined, overlapping home ranges of 0.5-1.5 ha that extend to about 60m from the nearest drey or rest tree. There may be a number of dreys or rest sites within one home range. The leaves of Peppermint trees are the primary food source of the species, but individuals in residential areas may feed on garden plants, fruit and vegetables in compost heaps. Jones *et al.* (1994 a & b) present detailed information on aspects of the biology of the Western Ringtail Possum.

## 2 The Site

### 2.1 The Development Proposal

Piacentini and Son Pty Ltd is seeking approval to clear part of Lots 313 and 314 Harewoods Road, Gelorup, for the purpose of a proposed extractive operation that will encompass an area of 27 ha. Under the current proposal all of the vegetation within the boundary of the proposed extraction area, shown over an aerial photograph in figure one, will be removed.

### 2.2 Site Description

Lots 313 and 314 Harewoods Road, Gelorup, are located on the western side of the Bussell Highway, approximately 10 km south of Bunbury (figure 1). Lots 313 and 314 are bisected by the road reserve for Mininup Road, which is currently unmade. The site of the proposed extractive operation ('the site') is located to the east of the road reserve, encompassing the yellow sands of the Spearwood land system. Low-lying wetland areas to the west of the road reserve are part of an extensive, north-south running interdunal wetland system which separates the Spearwood and Quindalup land systems. The wetland system, which is identified as a conservation wetland by the *Swan Coastal Plain Lakes Environmental Protection Policy* (1992), had no standing water at the time of this survey. The site is located approximately 1.5 km east of Dalyellup Beach.

The site has been used for livestock grazing, both sheep and cattle, for more than 30 years, and is currently stocked with low numbers of cattle. Livestock grazing and trampling has removed the native understorey vegetation over most of the area, and reduced the canopy cover to small stands of trees with canopy connectivity (approximate range 2 – 12 trees per stand) and patchy open areas with occasional isolated trees. The understorey is dominated by introduced pasture species and only a few native shrubs and herbs remain around the base of some of the trees. There is no regeneration of native vegetation currently occurring. No parts of the site are fenced from stock and therefore, all parts of the site have suffered and are degraded.

One vegetation unit is present across the entire site: an open forest of Tuart (*Eucalyptus gomphocephala*) with a midstorey of Peppermint (*Agonis flexuosa*), Jarrah (*Eucalyptus marginata*?), Candle Banksia (*Banksia attenuata*) with occasional Marri (*Corymbia calophylla*) and Bull Banksia (*B. grandis*) over *Acacia saligna*, *A. cyclops*?, Basket Bush (*Spyridium globulosum*), Cutleaf Hibbertia (*Hibbertia cuneiformis*), *Jacksonia furcellata*, Spiked Beard Heath (*Leucopogon australis*) and Berry Saltbush (*Rhagodia baccata*) over the cycad Zamia Palm (*Macrozamia reidlii*), Native Wisteria (*Hardenbergia comptoniana*), a sword sedge (*Lepidosperma* sp.) and a small fringed lily (*Thysanotus* sp.). Some of the Jarrah present within the site displayed a mallee habit and fruits present had caps with both three or four divisions, suggesting that it is possibly a Jarrah – Bullich (*E. megacarpa*) hybrid (Wheeler *et al.*, 2002).

The site's vegetation is suitable habitat for both the Western Ringtail Possum and the Common Brushtail Possum (*Trichosurus vulpecula*). Numerous hollows within the site's Tuart trees are suitable for use by both species however the lack of canopy connectivity and native understorey reduce the habitat value of the vegetation for Ringtail Possums.



### 3 Survey Method

To identify whether Western Ringtail Possums are present within the site and to estimate the density at which they occur, the survey, undertaken by Sue Elscot and Floyd Irvine (Green Iguana – Dunsborough), had two components:

- 1) A daylight search to identify Ringtail Possum dreys was focussed on the native vegetation within the site. A thorough search was made of the canopy of each Peppermint tree and all other suitable tree and understorey species within the site. To ensure that all of the vegetation within the site was searched, the search was conducted by following parallel transects 15 m apart, determined using a global positioning system (GPS). The exact location of every drey was recorded as a waypoint on the GPS and the tree or shrub species in which the drey occurred was also recorded. The ground around all trees within the stand in which the drey occurred was carefully searched for Ringtail Possum scat for at least 15 minutes. The daylight search, undertaken on Friday March 24, 2006, took a total of 8 hours of field time to complete.
- 2) A night-time spotlighting survey was undertaken over four consecutive evenings to enable all areas of native vegetation within the site to be searched twice. The spotlighting survey was carried out between Saturday March 25 and Tuesday March 28, 2005, for five hours each evening. The canopy of each overstorey tree, particularly Peppermint trees, and each suitable understorey species was thoroughly searched for possums using hand-held spotlights. To ensure that the vegetation within the site was thoroughly searched, the spotlighting survey was conducted by following parallel transects 15 m apart, determined using the GPS, as occurred during the daytime search. The night-time surveys were undertaken in good conditions, on clear, cool nights, with calm conditions on the first three evenings and fresh southeast winds on the fourth evening. The night-time spotlighting survey took a total of 20 hours of field time to complete.

### 4 Results and Discussion

#### 4.1 Daytime search for Western Ringtail Possum dreys and scat

A total of three Western Ringtail Possum dreys were recorded across the site, all within Peppermint trees in the north-eastern part of the site where the greatest density of Peppermint trees occur. One of the three dreys was obviously disused as it was found crushed within the lower limbs of a Peppermint tree on a branch which appeared to have fallen from the upper canopy some time ago. The other two dreys were intact and possibly active however no scat was found during a thorough search of the ground around the base of the drey trees and adjoining trees. Appendix one gives the coordinates of the three Ringtail Possum dreys located within the site.

Jones *et al.* (1994a) recorded a ratio three dreys per Ringtail Possum at the Locke Estate in Busselton where only Peppermint trees were present (ratio based on the number of occupied dreys compared to the total number of dreys recorded). At the Abba River, Jones *et al.* (1994a) found only two dreys, both located along the riverbank, which were being used by one male Ringtail Possum, while the numerous Tuart tree hollows were the main rest site for the remaining Ringtail Possums.

The majority of Peppermint trees within the site were observed to have fully intact canopies and did not appear to be browsed. However, there were a small number of trees that had areas of bare twigs in the upper canopy and a careful search for possum faecal pellets was focussed on the ground around these trees and others within the same stand. No possum faecal pellets were found during all searches.

A recent study comparing survey methods for arboreal possums in Jarrah forest found that scat-detection rates for the Ringtail Possum were strongly related to abundance derived by

spotlighting when the surveys were carried out at the end of the summer drought period, when moisture-driven scat decay rates are lowest (Wayne *et al.*, 2005). Wayne *et al.* (2005) suggested that scat surveys may therefore be a useful alternative measure of relative abundance for the Ringtail Possum. However, it was also noted that their use to compare data or calculate population estimates may be limited by variable defecation rates and scat decay rates which may also vary with habitat type.

## **4.2 Numbers of Western Ringtail Possums**

Spotlighting surveys to locate both Western Ringtail and Common Brushtail Possums were undertaken across the site over four consecutive nights, during March 25-28, 2006, for five hours each evening, to cover the entire site twice (i.e. two five hours nights to cover the entire site once). No possums of either species were recorded throughout the survey. No possum calls were heard either.

During the daylight search an active fox den was located within the centre of the site and fresh footprints were present following light rain the previous evening. Because of the open nature of the vegetation on the site, possums would need to descend to ground level to move between tree stands, making them susceptible to predation by the fox. Jones *et al.* (1994a) found that all extant populations of Ringtail Possums occurred in areas associated with water sources, either creeks, wetlands or drains. However, there is no water source with direct canopy connectivity to the site's vegetation and access to the wetland areas or stock watering points would require possums to travel up to hundreds of metres across ground with only a sparse covering of pasture grasses, making them very susceptible to predation. The lack of Western Ringtail Possum sightings together with the apparent absence of scat suggests that the Western Ringtail Possum is no longer present within the site.

In a recent comparison of possum survey methods in Jarrah forest, Wayne *et al.* (2005) found that spotlighting with 50W or 100W spotlights detected significantly more Western Ringtail Possums than did trapping, and concluded that, in Jarrah forest, repeated spotlighting provides similar or better detection rates than extensive trapping but requires substantially less effort. In contrast, the same study found that spotlighting detected, on average, less than 5% of the Common Brushtail Possum population 'known to be alive' by trapping. Therefore, the Common Brushtail Possum may be present at the site but remained undetected.

## **5 Summary**

Piacentini and Son Pty Ltd is seeking approval to clear remnant native vegetation from part of Lots 313 and 314 Harewoods Road, Gelorup, for the purpose of a proposed extractive operation that will require the removal of an area of 27 ha of remnant native vegetation (figure 1).

The site of the proposed extractive operation ('the site') has been used for livestock grazing for more than 30 years and is currently stocked with low numbers of cattle. Livestock grazing and trampling has removed the native understorey vegetation over most of the area, and reduced the canopy cover to small stands of trees with canopy connectivity and patchy open areas with occasional isolated trees. The understorey is dominated by introduced pasture species and only a few native shrubs and herbs remain around the base of some of the trees. There is no regeneration of native vegetation currently occurring.

One vegetation unit is present across the entire site: an open forest of Tuart (*Eucalyptus gomphocephala*) with a midstorey of Peppermint (*Agonis flexuosa*), Jarrah (*Eucalyptus marginata?*), and Candle Banksia (*Banksia attenuata*) with occasional Marri (*Corymbia calophylla*) and Bull Banksia (*B. grandis*). Some native understorey plants are present in low numbers. The site's vegetation is suitable habitat for both the Western Ringtail Possum and the Common Brushtail Possum and numerous hollows within the site's Tuart trees are suitable for use by both the species. However, the lack of canopy connectivity and native understorey reduce the habitat value of the vegetation for Ringtail Possums.

A total of three Western Ringtail Possum dreys were recorded across the site, all within Peppermint trees in the north-eastern part of the site. One of the three dreys was obviously disused while the other two dreys were intact. No scat was found during a thorough search of the ground around the base of the drey trees and adjoining trees.

The majority of the Peppermint trees within the site had fully intact canopies and did not appear to be browsed. A few Peppermint trees had thinning canopies however a careful search focussed on the ground around these trees and others failed to locate any possum faecal pellets.

Spotlighting surveys to locate both Western Ringtail and Common Brushtail Possums were undertaken across the site over four consecutive nights, during March 25-28, 2006, for five hours each evening, to cover the entire site twice (i.e. two five hours nights to cover the entire site once). No individuals of either species were recorded throughout the survey. No possum calls were heard either. During the daylight search an active fox den was located within the centre of the site. Because of the open nature of the vegetation on the site, possums would need to descend to ground level to move between tree stands or to access any water, making them susceptible to predation by the fox. The lack of Western Ringtail Possum sightings together with the apparent absence of scat suggests that the Western Ringtail Possum is no longer present within the site.

In a recent comparison of possum survey methods in Jarrah forest, Wayne *et al.* (2005) found that spotlighting (with 50-100W spotlights) is more effective for detecting Western Ringtail Possums than extensive trapping but requires substantially less effort. In contrast, the same study found that spotlighting detected, on average, less than 5% of the Common Brushtail Possum population 'known to be alive' by trapping. Therefore, the Common Brushtail Possum may be present at the site but remained undetected.

## 6 References

- Jones, B.A., How, R.A. and Kitchener, D.J. (1994a). A field study of *Pseudocheirus occidentalis* (Marsupialia: Petauridae). I. Distribution and habitat. *Wildlife Research* 21: 175-187.
- Jones, B.A., How, R.A. and Kitchener, D.J. (1994b). A field study of *Pseudocheirus occidentalis* (Marsupialia: Petauridae). II. Population studies. *Wildlife Research* 21: 175-187.
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Figure 11114. Aerial photograph showing the proposed extraction operation area.

**Appendix 1** Location of dreys within the area of the proposed extractive operation, Lots 313 and 314 Harewoods Road, Gelorup.

LOCATION (DATUM WGS84)	COMMENTS
33.41282 S 115.61727 E	1 large basket drey in Native Wisteria within the upper canopy of a medium sized Peppermint tree, in a stand of seven Peppermint trees and several small Marri.
33.41180 S 115.61446 E	1 old basket drey found crushed within the lower limbs of a Peppermint tree on a branch that appeared to have fallen from the upper canopy some time ago.
33.41181 S 115.61797 E	1 small basket drey within a Peppermint tree on the northeastern boundary of the site, within a small grove of dense Peppermint trees with some Cutleaf Hibbertia understorey.



## Assessment of habitat for Black-Cockatoos and Western Ringtail Possums at Harewoods Road, Gelorup.

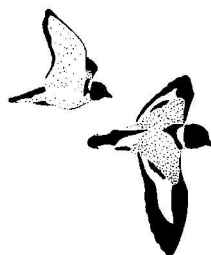


Western Ringtail Possum at Harewoods Road, Gelorup.

Prepared for: Bayley Environmental Services,  
30 Thomas St,  
South Fremantle, WA, 6162

Prepared by: **Gillian Basnett, Simon Cherriman and Mike Bamford**

**M.J. & A.R. BAMFORD**  
**CONSULTING ECOLOGISTS**  
23 Plover Way  
KINGSLEY WA 6026



3 February 2012

## EXECUTIVE SUMMARY

A field survey of Lots 1 and 313-317 Harewoods Road, Gelorup, involved measuring and assessing habitat trees with the potential to support nesting Black-Cockatoos, estimating Banksia density, searching for evidence of the Western Ringtail Possum, and assessing general vegetation present. This information was used to provide an ecological comparison between an area earmarked for development of a residential estate (RD) and that proposed as Regional Open Space (ROS).

Seven-hundred and twenty-nine habitat trees were assessed: 292 in the proposed RD area and 437 in the ROS. Of these, 161 trees (54 in the RD, 19%; 107 in the ROS, 24%) were identified as having hollows large enough to support nesting Black-Cockatoos currently, and a further 230 (74 in the RD, 25%; 156 in the ROS, 36%) contained small hollows which may be important future nest sites. Banksia density was very low in the area east of Minninup Road (5.8 trees per hectare) and Banksia trees were absent west of Minninup Road, compared with 150-200 per hectare around Perth.

One Western Ringtail Possum was located during a nocturnal spotlighting transect in the ROS area and eight dreys were found, though only one of these was active. One very old drey was found in the RD area but no possums were observed at this site.

The area east of Minninup Road (~118 ha) consisted of remnant Tuart woodland with a parkland-like structure, having almost no understorey plants and no fallen debris, the result of intense grazing pressure and clearing. About 90 ha of this Site is earmarked for the RD area, with the remainder (Lot 317, ~21 ha) to be incorporated into the ROS area. The size and age of remnant Tuart trees made the habitat suitable to support nesting Black-Cockatoos both now and in the future, though the low density of Banksia trees means food resources are limited. There are, however, bush remnants in the vicinity of Gelorup containing much higher densities of Banksia. The absence of understorey vegetation makes this habitat marginal for the Western Ringtail Possum which appears to be absent from the site, apart from occasional transient individuals utilising it as a corridor. Fox presence throughout the site would place high predation pressure on these animals.

The area west of Minninup Road (~73 ha) contained mostly cleared paddock and a large wetland occupying much of the site. Along with Lot 317, this is proposed to become ROS, which will have a total area of approximately 105 ha, of which ~50 ha contains remnant Tuart woodland. The western third of this area consists of relatively intact remnant Tuart woodland (~31 ha), with large trees and, in places, a dense understorey of various plants, including Peppermint. There were fewer habitat trees than east of Minninup Road and tree spacing was greater, but this habitat still is potentially suitable to support nesting Black-Cockatoos. The denser understorey and vegetation diversity makes it highly suitable to support the Western Ringtail Possum, and the sighting of one possum and the presence of dreys indicates the species is still present in low numbers. Again, the presence of Foxes would place pressure on remaining individuals.

The value of retaining the ROS as an offset for developing the RD area would depend upon not simply retaining the ROS, but on enhancing its value such as through the planting of foraging habitat for Black-Cockatoos, revegetation of understorey plants for the WRP and other fauna, installation of nest hollows, possibly the relocation of

natural hollows from the RD area, and community education about the value of the site in a regional context.

Connectivity of habitat is also important. The habitat value of the ROS area is high given that the surrounding native bush on the south, east and west sides is planned to also be zoned as Regional Open Space. The ROS area will not be large enough to provide adequate habitat for WRPs on their own, however the retention of Black-Cockatoo foraging habitat in other areas of ROS to the east and west of the site will help to improve the success of any breeding birds in the area.

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## 1 INTRODUCTION

### 1.1 Introduction

Mr Colin Piacentini is seeking to clear remnant native vegetation from parts of Lots 1, 313, 314, 315 and 316 Harewoods Road, Gelorup, for the purpose of a residential development (Figure 1). In this report, this area is referred to as 'Residential Development' (RD) - see Figure 2. Lots 313 and part of 314 have already been cleared as part of an existing quarry (Figures 1 and 2). The parts of Lots 313-316 west of Minninup Road and all of Lot 317 are reserved as Regional Open Space (ROS).

The large eucalypt trees present on both sites, as well as a mid-storey of Banksia on part of the ROS, may provide potential nesting and foraging habitat for Carnaby's (*Calyptorhynchus latirostris*) and Baudin's (*C. baudinii*) Black-Cockatoos. Carnaby's Black-Cockatoo is listed as Endangered and Baudin's Vulnerable under the Federal *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), and both species are listed as Endangered under the West Australian *Wildlife Conservation Act 1950*. Furthermore, these two species are listed in the Action Plan for Australian Birds: Carnaby's as Endangered and Baudin's as Near Threatened (Garnett and Crowley 2000). (See Appendix 1 for detail on EPBC and WA Wildlife Conservation Act listings, and Appendix 2 for information on Carnaby's Black-Cockatoo threats).

A mid-storey of Peppermint (*Agonis flexuosa*) trees may also provide potential habitat for the Western Ringtail Possum (WRP, *Pseudocheirus occidentalis*), which is listed as Vulnerable under both the EPBC and Wildlife Conservation Acts. Although previous studies conducted on part of the RD area at this location (Elscot 2006; Harewood 2007) did not detect the WRP, they did locate several possum dreys (nests made out of sticks). As the species is known from the region of Gelorup, and the site may still contain suitable habitat, it may be present.

Bamford Consulting Ecologists (BCE) was commissioned to assess the potential habitat for both Black-Cockatoos and the WRP, and search for any signs of these two species at the site. BCE was also required to provide an ecological comparison between the Residential Development (RD) and Regional Open Space (ROS) areas, and in doing so assess the suitability of the ROS as offset areas for the proposed Residential Development.

This report contains the results of a field survey conducted at on 16<sup>th</sup>, 17<sup>th</sup> and 19<sup>th</sup> August 2011.





Figure 1. Regional location and layout of Harewoods Road site, showing Minninup Road and existing quarry.

## 1.2 Study Objectives

The objectives of the fauna assessment were to broadly determine the habitat values of the Project Area for Black-Cockatoos and the WRP, and determine the suitability of the ROS as an offset area for the proposed development (Figure 2). This provides government agencies with the information needed to assess the significance of impacts under State and Commonwealth legislation. The key objectives of the fauna studies are listed below:

- identify and describe general vegetation (habitats) present;
- investigate the potential habitat for Black-Cockatoos;
- investigate the presence/absence of the WRP;
- identify the suitability of the ROS as an offset for the planned RD;
- provide recommendations to minimise impacts to fauna.

The assessment was not intended to produce a definitive answer as to whether Black-Cockatoos or the WRP are present or currently utilising the site, but rather the potential of the site to provide habitat for these species now and in the future.

## 1.3 Site Description

The survey area was south of Harewoods Road in Gelorup, approximately 10 km south of Bunbury, WA. For regional location details see Figure 1.



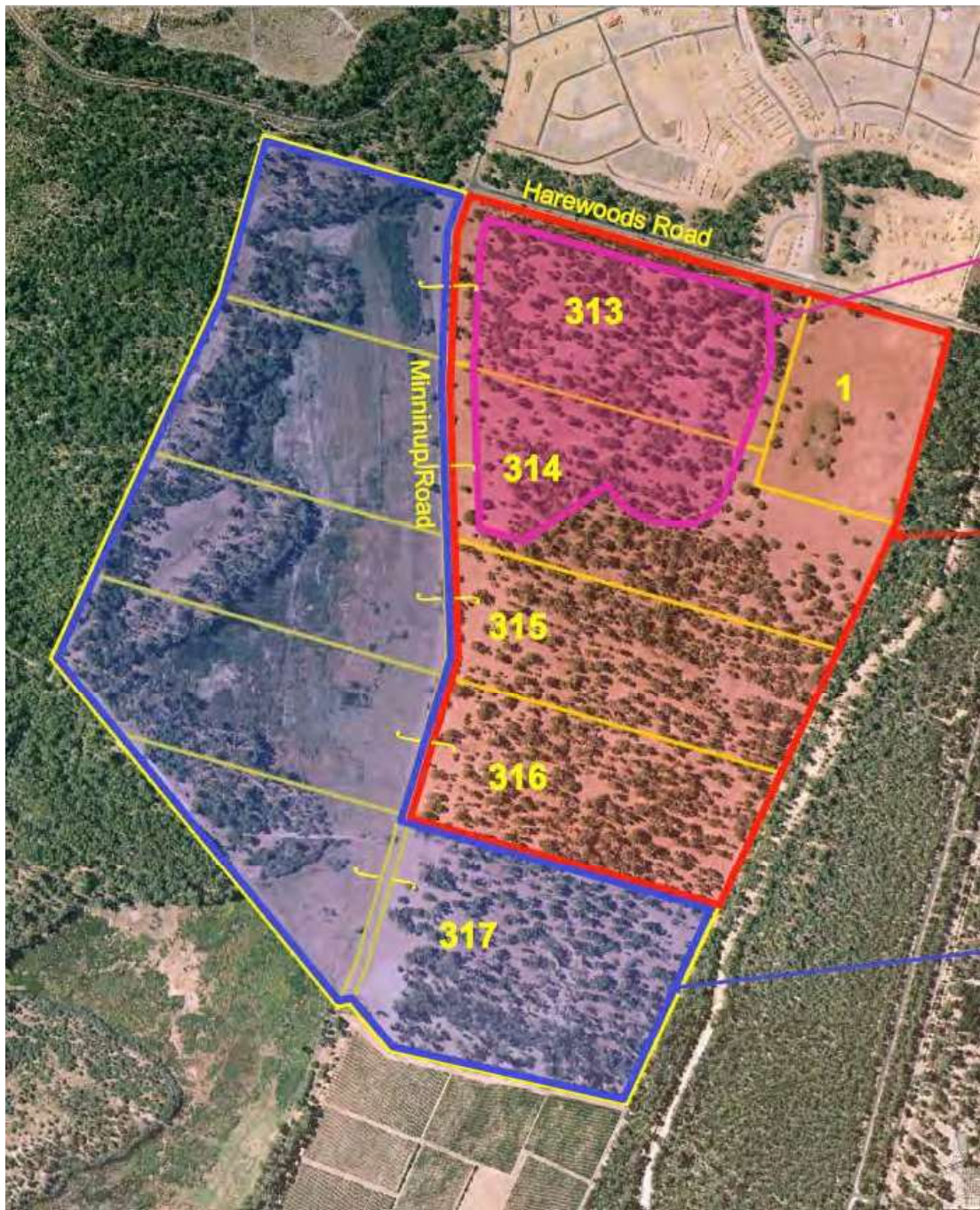


Figure 2. Location map of Harewoods Road site, showing proposed Residential Development (red), Regional Open Space (blue), and existing quarry (pink).

## 2 METHODS

### 2.1 Personnel

The following personnel were involved in the preparation of this report:

- Ms Gillian Basnett *BSc. (REM), MSc., MSc. (Res.)*
- Mr Simon Cherriman *BSc. Hons (Env. Biol.), MSc. submitted (Sci. Comm.)*
- Dr Mike Bamford *BSc. Hons (Biol.), PhD (Biol.)*

The field survey was undertaken by Simon Cherriman and Gillian Basnett and the report was prepared by Gillian Basnett, Simon Cherriman and Mike Bamford.

### 2.2 Licences and Permits

As the field assessment was observational in nature, no license or permit was required.

### 2.3 Nomenclature and Taxonomy

As per the recommendations of EPA (2004), the nomenclature and taxonomic order presented in this report are based largely upon the Western Australian Museum's *Checklist of the Vertebrates of Western Australia*. The authorities used for each vertebrate group are: amphibians and reptiles (Aplin and Smith 2001), birds (Christidis and Boles 2008), and mammals (How *et al.* 2001). English names (if available) are used in the text, with all Latin and English names presented on the first mention of the species and in Table 4.

### 2.4 Field Survey and Impact Assessment

A field survey was conducted on 16<sup>th</sup>, 17<sup>th</sup> and 19<sup>th</sup> August 2011. Weather conditions were typical for the time of year, being cool (daily maxima around 19.2°C) and damp after recent rain. Activities undertaken during the site inspection included:

- Description of general vegetation (habitats) present;
- Measurement and assessment of habitat trees with the potential for Black-Cockatoo nest sites;
- Measurement of Banksia density;
- Searching for evidence of the WRP, such as dreys, scats and possums; and
- Opportunistic observations on all other fauna.

All personnel involved in searching were familiar with the evidence of each species.

#### 2.4.1 Measurement and Assessment of Habitat Trees

This involved walking through the sites and measuring all trees with a Diameter at Breast Height (DBH) greater than 500 mm, and making an assessment of any hollows in those trees. For nest sites, all species of Black-Cockatoo require trees that have a DBH greater than 500 mm, and where the entrance to the hollow cavity is at least 100 mm in diameter (Whitford 2001).

Each tree recorded was placed into a category based on the number and size of hollows present. These categories were:



1. No Obvious Hollows – no hollows or dead or broken branches evident.
2. Small Hollows – one or more smaller hollows of entrance diameter <100 mm.
3. Hollow Top – Trees with a broken-off top forming one vertical hollow, entrance diameter >200 mm.
4. Several Large Hollows – One to three large hollows with entrance diameter at least 100 mm, and usually >200 mm.
5. Multiple Large Hollows – More than three hollows with entrance diameter at least 100 mm, and usually >200 mm.

Large tree hollows were observed through binoculars for any evidence of nesting cockatoos, such as chew-marks at the hollow's entrance.

The proposed RD and ROS areas were assessed separately to enable a comparison to be made between each. Due to quarry operations and time constraints, the trees within the fenced area around the sand quarry (see Figure 1) were not assessed during this survey.

#### 2.4.2 Measurement of Banksia Density

Banksias are an important food resource for Black-Cockatoos, particularly Carnaby's (Johnstone and Storr 1998). Banksia density was therefore estimated to determine the relative importance of the RD to foraging Black-Cockatoos. This was done by walking three 400 m transects and counting the number of Banksia trees within 50 m either side of each transect, giving three 100 x 400 m (4ha) samples of tree density (Figure 3). The numbers of Banksias in each sample were then averaged to give a total estimate of Banksia density.

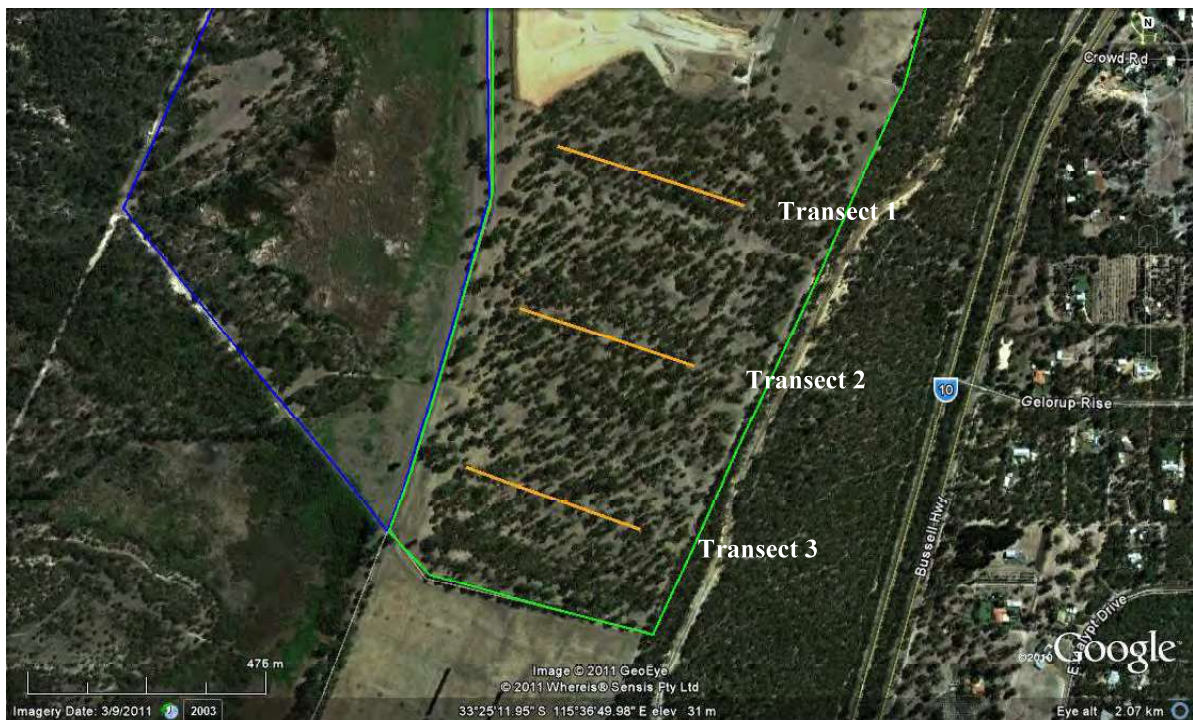


Figure 3. Banksia transects carried out on the 11<sup>th</sup> August 2011.

#### 2.4.3 Searching for Evidence of Western Ringtail Possums

While traversing the site, active searches were made for possum dreys and scats, with particular focus on dense stands of Peppermint and Banksia trees. All habitat trees

measured as potential Black-Cockatoo nest sites were searched for scratch marks likely to have been made by possums. A two hour spotlight transect (routes shown in Figure 4) was carried out on Tuesday 9<sup>th</sup> August between 7pm and 9pm, with one hour being spent at each site. Transects were driven at a very slow speed (<10 km/h); the transect on the eastern side of Minninup Road was driven in one direction only, whereas that on the western side was driven in both directions. Separate surveys were carried out on foot in areas of more dense vegetation, which included the southern end of Lot 317 and some dune swale areas of the ROS.

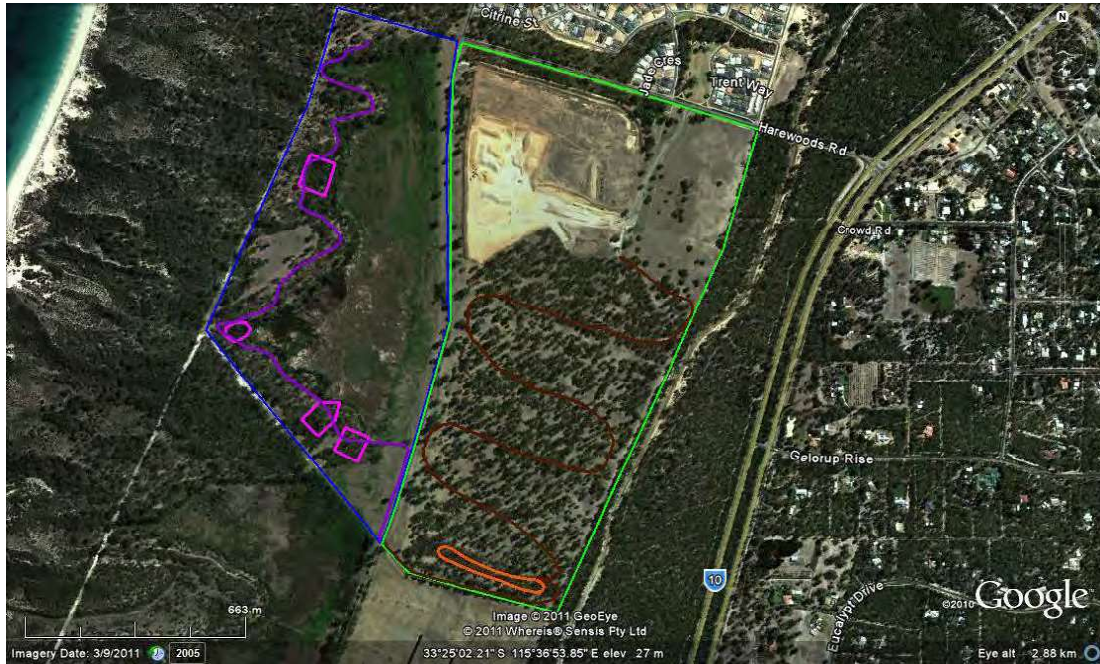


Figure 4. Nocturnal spotlight transects carried out on the 9<sup>th</sup> August 2011. Brown and purple lines indicate drive transects, orange and pink polygons show smaller walk transects.

#### 2.4.4 Opportunistic Observations.

Opportunistic observations on fauna were made at all times during the site survey.



### 3 RESULTS AND DISCUSSION

#### 3.1 General Vegetation

##### 3.1.1 East of Minninup Road

The vegetation of all blocks east of Minninup Road, which includes the RD area and Lot 317, consisted of a stabilised sandy ridge with a parkland-like vegetation structure. The over-storey was dominated by large Tuart (*Eucalyptus gomphocephala*) trees with occasional Jarrah (*E. marginata*) and Marri (*Corymbia calophylla*) also present (Figure 5). Scattered Peppermint (*Agonis flexuosa*) trees and *Banksia* spp. made up the sparse mid-storey. The native understorey had largely been cleared and extensively grazed, and consisted mainly of introduced grasses and weeds, with scattered natives such as *Jacksonia* sp. Much of the fallen logs, trunks and branches (and thus terrestrial microhabitats) had been removed, apparently from regular gathering and burning by the landowner (Piacentini and Son Pty Ltd. employee, pers. comm.).

The southern end of this area (Part Lot 317) consisted of similar dominant eucalypt species but had a much denser mid-storey of Peppermint trees (Figure 6). The understorey here was still predominantly a mix of weeds and introduced grasses. About ten artificial nest boxes designed for Black-Cockatoos had been installed into a number of trees in this part of the site.

A cleared paddock with introduced grasses and weeds adjacent to Harewoods Rd was situated in the north-east corner this site (Lot 1; see Figure 1). This contained one large Tuart tree in the centre of the paddock, as well as a small dampland area of Swamp Paperbark (*Melaleuca raphiophylla*).



Figure 5. Typical parkland-like habitat east of Minninup Road with dominant Tuart (*Eucalyptus gomphocephala*) trees.





Figure 6. Denser mid-storey of Peppermint (*Agonis flexuosa*) at Lot 317.

### 3.1.2 West of Minninup Road

This section comprised most of the ROS area and consisted mostly of low-lying cleared paddock and a large wetland, with about a third of the area having relatively intact, dense Tuart woodland (see Figures 1, 7). The latter grew on a sandy ridge 5-15 m higher than the adjacent wetland. Exotic grasses and weeds, especially Kikuyu Grass (*Pennisetum clandestinum*), dominated the cleared area (Figures 7, 8). The wetland was covered with beds of native Jointed Twig-rush (*Baumea articulata*; Figure 9), introduced Bulrush (*Typha orientalis*) and occasional exotic grasses. Surface water (Figure 9), which probably disappears in the summer months, was observed along the western edge.

The transition zone from wetland to woodland consisted of a meandering, sloping embankment running approximately north-south along the edge of the wetland (Figure 9). This area was generally in very good condition and contained a variety of plants growing in dense thickets, as well as dense Tuart saplings covered in creepers (Figure 10). Species noted included Orange Wattle (*Acacia saligna*), Swamp Paperbark, Spreading Sword-sedge (*Lepidosperma effusum*), *Trymalium* sp., *Gahnia* sp., *Hardenbergia comptoniana* and *Cassytha* sp. This area provided the most suitable habitat for WRPs anywhere on the Harewoods Road blocks.

The woodland section varied from having fairly open stands of Tuart to areas with a fairly dense mid-storey of Peppermint trees, and understorey including *Xanthorrhoea*, *Hibbertia* and *Macrozamia* species (Figure 11). No Banksias were present. Occasional dune swales contained dense thickets of Peppermint, Spreading Sword-sedge and/or *Trymalium* sp. (Figure 12). The dominant over-storey tree was Tuart, however tree spacing was greater than in the area East of Minninup Road. Weed species were less evident in the woodland area than elsewhere on the site.





Figure 7. ROS area facing north north-west, showing wetland and remnant Tuart Woodland.



Figure 8. ROS area facing east south-east, showing low-lying cleared area (foreground), wetland vegetation (middle) and existing sand quarry (behind).





Figure 9. Wetland vegetation of ROS area, showing beds of Jointed Twig-rush (*Baumea articulata*), dense transition zone and remnant Tuart woodland.



Figure 10. Thick vegetation of transition zone between wetland and Tuart woodland of ROS area.





Figure 11. Typical vegetation of ROS area showing Tuart trees and dense Peppermint mid-storey.



Figure 12. Dune swale in ROS area with dense Peppermint and Spreading Sword-sedge (foreground).

### 3.2 Measurement and Assessment of Habitat Trees

Two-hundred and ninety-two habitat trees with a DBH over 500 mm were identified in the proposed RD area, and 437 in the ROS. The trees were widespread east of Minninup Road except in the active sand quarry and cleared paddocks of Lot 1 (Figure 13), but were largely confined to west of the wetland on the opposite side of Minninup Road (Figure 14).

Figure 15 shows the size distribution of trees. In both the RD and ROS, the majority of trees measured had a DBH between 500 mm and 1 m; 186 trees (64%) in the RD and 279 trees (64%) in the ROS (Figure 15). Less than 13% of all trees had a DBH greater than 1.5 m, and less than 4% had a DBH greater than 2 m.

The number and percentage of trees in each category, according to the type of hollows present, is shown in Figures 16 and 17, respectively. Of the trees measured in the RD, the majority (164; 56%) had no obvious hollows (Figure 16 and 17). Small hollows were found in 74 (25%), and while these trees are not currently suitable for Black-Cockatoo nest sites, they may become important future nest sites in the next 50 years or so. Fifty-four trees (19%) were placed in the remaining categories having at least one large hollow. These formed the best current potential nest sites for Black-Cockatoos, with many trees having multiple large hollows with entrance diameter greater than 200 mm. Figure 18 shows a typical example of one of these trees which contained five hollows suitable for Black-Cockatoo nests.

In the ROS area, 156 trees (36%) had small hollows, while the majority 174 (40%) had no obvious hollows. One-hundred and seven trees (24%) had at least one large hollow, and as with the RD area, many of these had multiple large hollows suitable as current Black-Cockatoo nest sites.

While many suitable hollows were observed, none contained nesting Black-Cockatoos or any evidence of recent occupancy. No Black-Cockatoos were seen or heard, and no feeding debris (chewed Banksia or Eucalypt fruits) was observed.

Six of the trees measured had Cockatoo nest-boxes installed. Another four boxes occurred in trees that had a DBH of less than 500 mm. These occurred in the southern section of Lot 317. Boxes consisted of ~1 m lengths of black piping with a hollow top and wooden base, placed vertically in each tree and secured in place with chains. Each box also had two 'chewing blocks' placed at the edge of the hollow entrance, and a wire 'ladder' extending into the box enabling birds to climb inside easily. The chewing block on tree A435 (GPS location 371168E, 6300845N) had faded chew-marks suggesting it may have been utilised by Black-Cockatoos, but no fresh signs were evident.





Figure 13. Location of habitat trees with a DBH of more than 500 mm found east of Minnipup Road.



Figure 14. Location of habitat trees with a DBH of more than 500 mm found west of Minnipup Road.

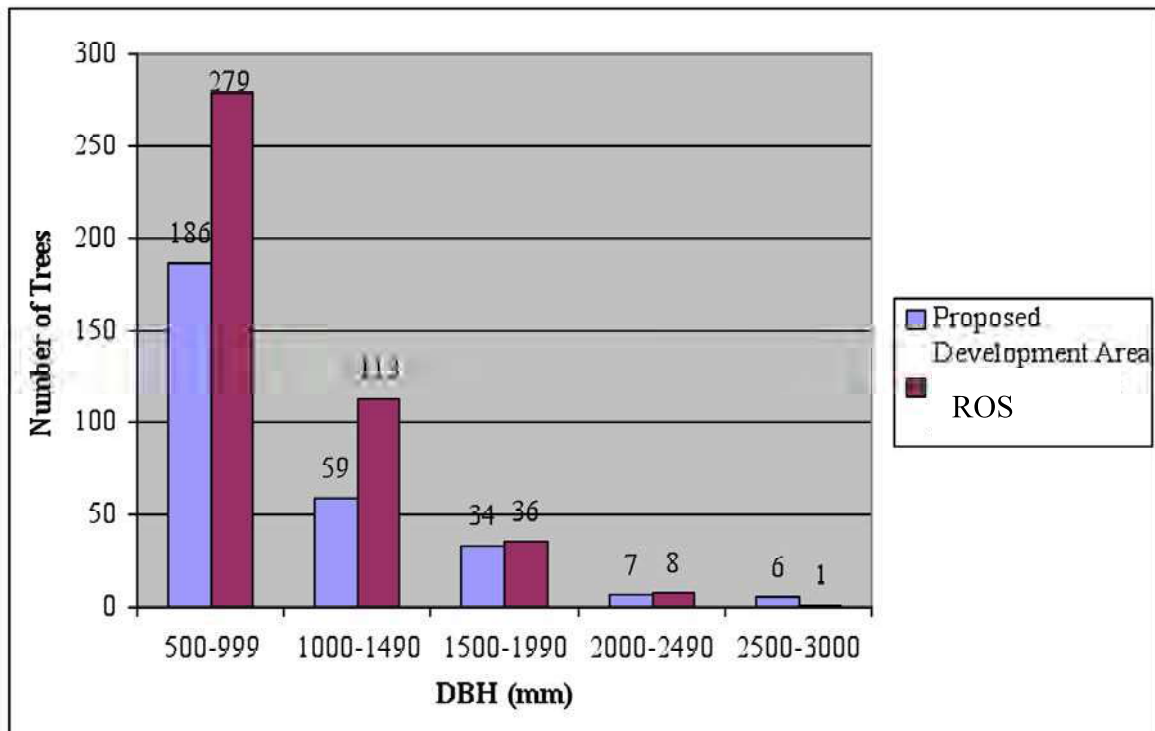


Figure 15. Size distribution, showing Diameter at Breast Height (DBH), of habitat trees at Harewoods Rd, Gelorup.

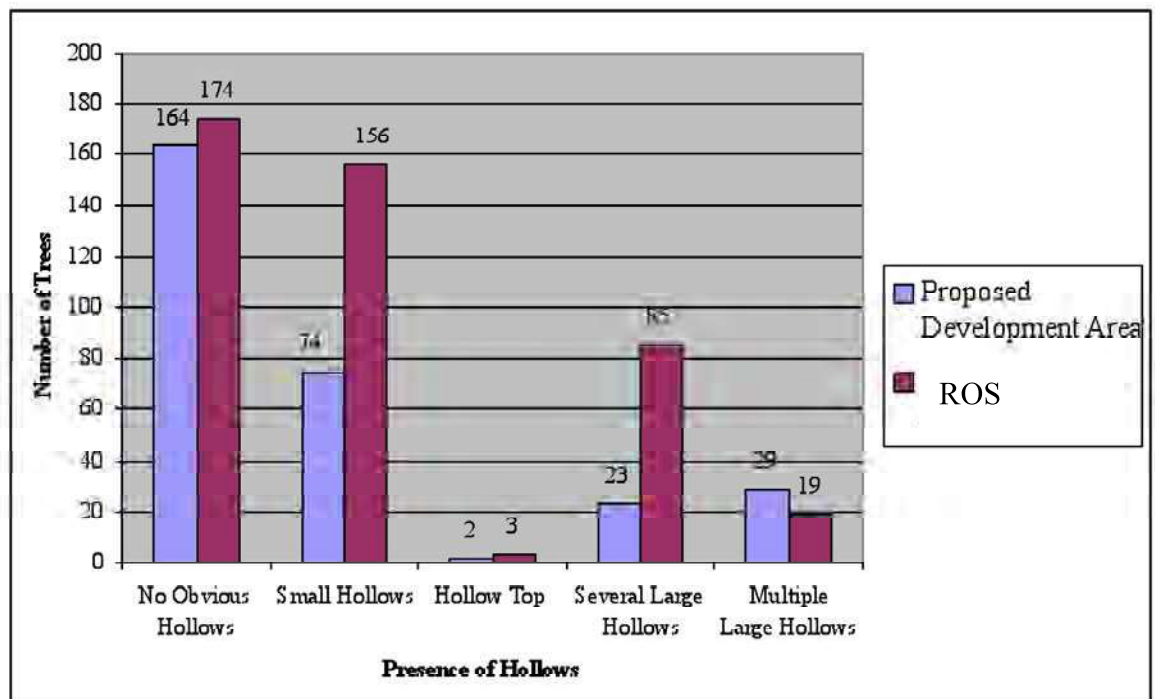


Figure 16. Number of trees in each category according to size of hollows at Harewoods Road, Gelorup.



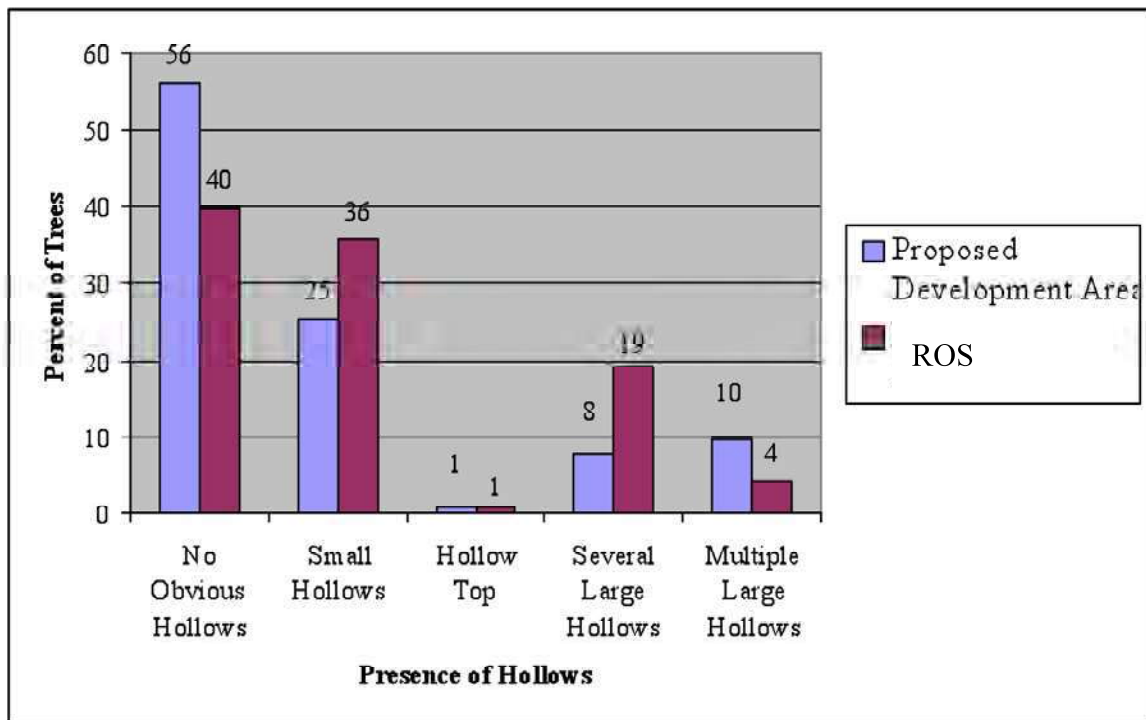


Figure 17. Proportion of trees in each category according to size of hollows at Harewoods Road, Gelorup.



Figure 18. Example of habitat tree from RD area containing multiple large hollows (indicated).

### 3.3 Measurement of Banksia Density

Banksias were sparse in the RD area and absent from the ROS, therefore density was only measured in the RD. Forty-four Banksias were counted along Transect 1, 18 along Transect 2 and eight along Transect 3 giving a total of 70 Banksias across all three transects (covering a total of 12ha). This equates to an average of 5.8 Banksias per hectare. This is much lower than the densities commonly found in healthy Banksia woodland around Perth, which are frequently around 150-200 trees/ha (M. Bamford unpubl. data). In contrast to the low Banksia densities on the site, there are other bush remnants in close proximity to Harewoods Road which have high densities of Banksias. This means that while the site provides limited foraging habitat, there are food sources nearby for Black-Cockatoos nesting in the region.

### 3.4 Evidence of Western Ringtail Possums

During the spotlight survey one WRP (Figure 19) was identified in a Swamp Paperbark thicket close to the wetland in the ROS area (Figure 20). No possums were observed in the RD area.



Figure 19. Western Ringtail Possum (*Pseudocheirus occidentalis*) observed in the ROS area during nocturnal spotlight survey on 16<sup>th</sup> August 2011, at Harewoods Road, Gelorup.

During the daytime habitat assessment, ten WRP dreys were found. None of the dreys identified contained possums at the time of the survey but one appeared to have been recently used. Maps showing the location of each drey are provided in Figures 20 and 21, and descriptions are provided below. The coordinates of each drey are shown in Table 3.

<b>Drey No.</b>	<b>Details:</b>
RTD01	Three metres up in large Tuart hollow. Highly deteriorated and inactive.
RTD02	Six metres up in Peppermint tree. Mostly intact but inactive.
RTD03	Five metres up in Banksia tree. Fully intact and recently used.
RTD04	Two metres above the ground in <i>Acacia/Cassutha</i> vine thicket. Mostly intact but not recently active.
RTD05	Three metres up in <i>Acacia</i> . Intact but not recently active.
RTD06	Five metres up in Tuart sapling. Deteriorated and inactive (Figure 21).
RTD07	Four metres up in Peppermint tree. Highly deteriorated and inactive.
RTD08	Four metres up in Peppermint tree, very close to RTD07. Only a few sticks remaining, inactive.
RTD09	Six metres up in hollow spout of Tuart. Partly deteriorated and inactive.
RTD10	Seven metres up in dense <i>Melaleuca</i> thicket over ephemeral water. Very old and inactive.

Based on descriptions of habitat and location, dreys were different to those discovered in previous surveys (Elsco 2006; Harewood 2007). Dreys found during previous surveys had almost certainly fully disintegrated by August 2011, as they were already in poor condition at the time of the earlier surveys. The one drey found in the RD area (RTD 01) was in very poor condition. Another drey (RTD03) was observed outside the fence in thicker vegetation along the eastern boundary of lot 317. This was the only drey that was in excellent condition and contained signs of recent use, even though no possums were present during its inspection. The rest of the dreys were found in the western ROS area (Figures 20 and 21, Table 3). The deteriorated condition of one of these dreys (RTD06), and a site photo showing the habitat in which it was observed, are shown in Figures 22 and 23, respectively.

No other evidence of the WRP was found in the RD area or Lot 317 and it appears there are currently none occupying this area. This is consistent with the findings of Elscot (2006) and Harewood (2007).

The proposed RD area probably still supports small numbers of Common Brushtail Possum (*Trichosurus vulpecula*). Scats belonging to this species were found along the eastern boundary of Lots 314-317, and a very old skull (Figure 24) was located beneath a large habitat tree at the southern end of Lot 317. No individuals were seen during the spotlighting at either site.

The ROS area appears to be a more suitable habitat than the RD area for WRPs, as the understorey is more dense with thicker areas of Peppermint trees. There was evidence that the WRP still utilises the western ROS area and almost none to indicate its presence in the proposed RD. The neighbouring property to the east of Lot 317 also had thick vegetation which contained a WRP drey and is more likely to support WRPs than the proposed RD area. Despite this, there may be some movement of possums (and other fauna) through the RD area.



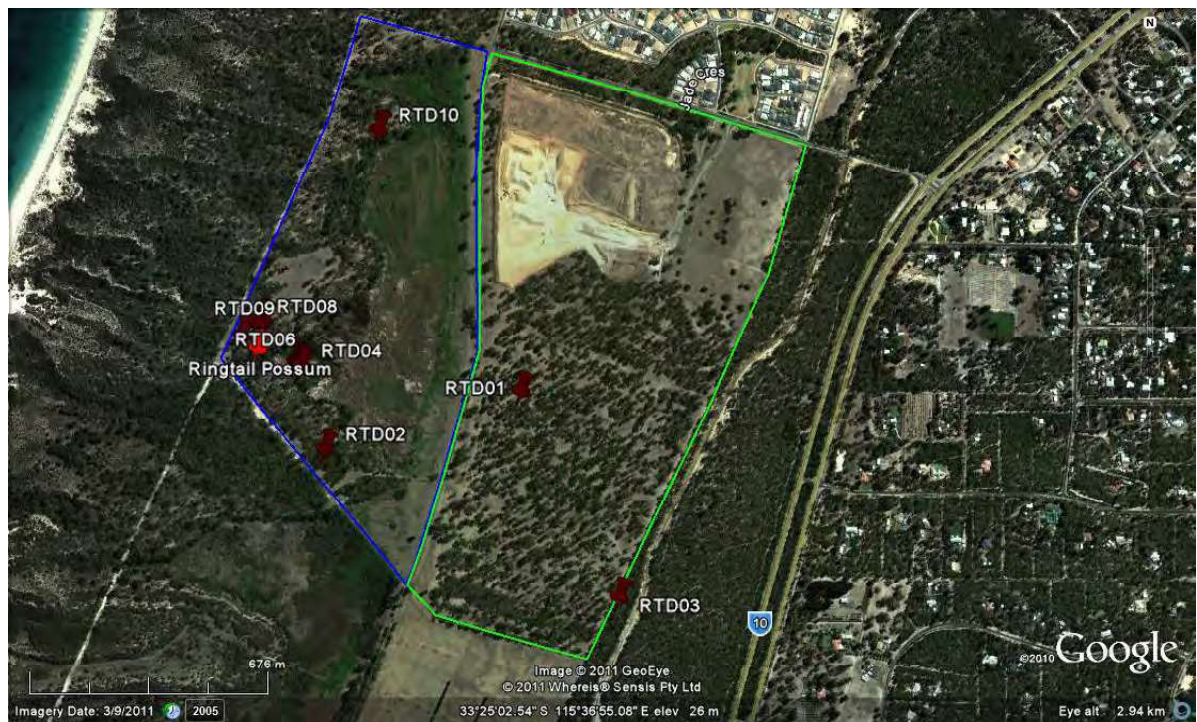


Figure 20. Western Ringtail Possum dreys (maroon) and possum (red) found during surveys carried out at Harewoods Road, Gelorup, during August 2011.



Figure 21. South west corner of the ROS showing location of Western Ringtail Possum dreys (maroon) and possum observed during spotlighting (red).





Figure 22. Photo of a deteriorated WRP drey (RTD06) at the ROS area at Harewoods Rd, Gelorup.

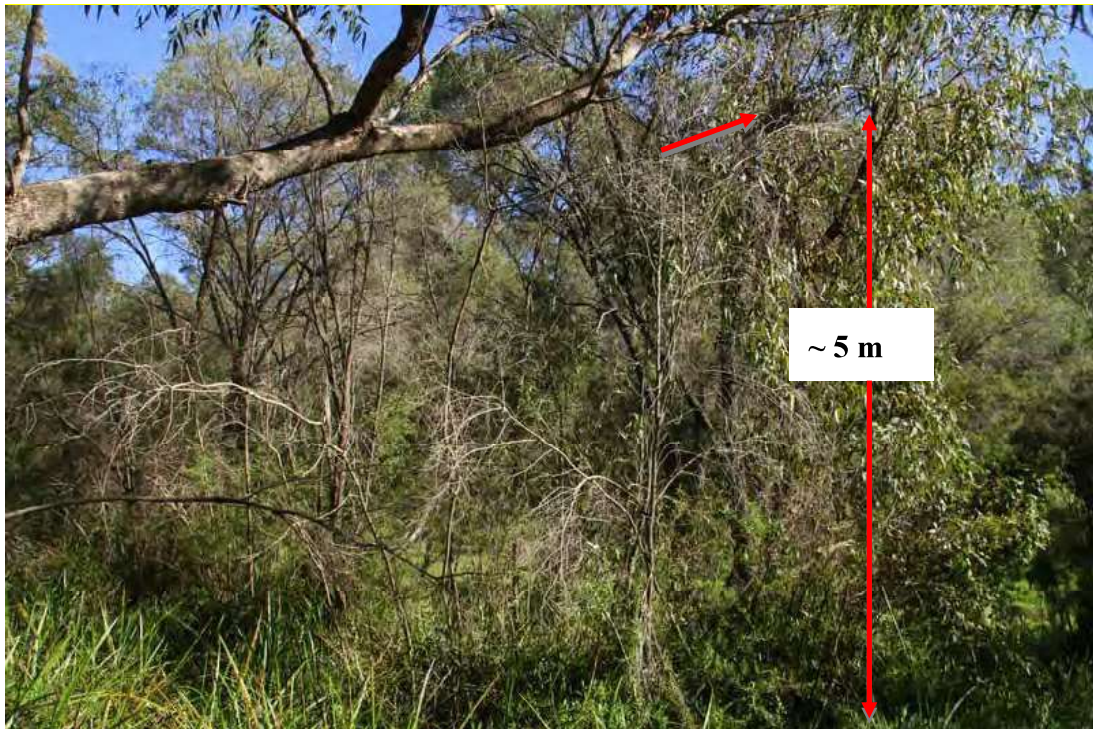


Figure 23. Site photo showing location of WRP drey (RTD06) at the ROS area at Harewoods Rd, Gelorup.





Figure 24. Skull of Common Brushtail Possum (*Trichosurus vulpecula*) located beneath habitat tree at Lot 317, Harewoods Road, Gelorup.

### 3.5 Opportunistic Observations

Although not part of the official survey, opportunistic sightings of fauna species were made while on site and a list of all other fauna detected is provided in Table 4. In the RD area, 36 species of birds and three species of mammals were observed. Sightings of 40 species of birds, four species of mammals, one species of reptile and five species of frog were made in the ROS. There did not appear to be a difference in the diversity of bird species between the two sites. The wetland in the ROS did result in the presence of a number of frog and waterbird species recorded. The areas which still have native vegetation in the ROS are in better condition than those in the RD area which has been grazed and the understorey and fallen timber cleared.

## 4 CONCLUSIONS AND RECOMMENDATIONS

Carnaby's Black-Cockatoo is known to nest in Tuart forest at Ludlow, approximately 15 km south-west of Gelorup (S. Cherriman pers. obs.). Given the suitability of tree hollows present at Harewoods Road, it is likely that the species could nest in habitat trees on the property in the future. This is especially applicable if habitat loss in its breeding range continues. In addition, the species is expanding its breeding range into coastal forests between Busselton and Perth (R.E. Johnstone, WA. Museum, pers. comm.), and therefore suitable but currently unused breeding habitat is likely to be occupied in the future.

The closest known record of Baudin's Black-Cockatoo nesting in the region is at Lowden, about 35 km east south-east of Gelorup (Johnstone and Storr, 1998). It is therefore possible this species could nest in the Harewoods Rd area in the future provided suitable habitat was available.

When considering only the number of current available nest sites, the proposed ROS appears to provide better nesting habitat for Black-Cockatoos, as there are more large trees present and more of these trees contain hollows suitable as nests. Black-Cockatoo habitat assessment does not just take into account present hollow trees but the potential of the area to provide nest hollows in the future, and the ROS contained both more current and more future habitat trees than the RD. Neither the ROS nor the RD had extensive foraging habitat for Black-Cockatoos, but nearby areas do provide foraging habitat that would support birds breeding in the area.

The Western Ringtail Possum was recorded only in the ROS, but it is possible that the species may occasionally utilise the RD area. The ROS has more suitable habitat for the Western Ring-tailed Possum, and probably more suitable habitat for a range of other fauna species, than the RD.

In terms of conservation value of the two Sites for Black-Cockatoos and the Western Ringtail Possum, clearing for the RD and retention of the ROS area would result in the loss of up to 128 potential breeding habitat trees for Black-Cockatoos (just under 50% of the total on the Piacentini landholding) but little loss of habitat for the possum. The impact of the development on the movement of possums between the western ROS and bushland to the east can be minimised by the retention of a vegetated corridor between the two areas through Lot 317.

The value of retaining the ROS as an offset for developing the RD area would depend upon not simply retaining the ROS, but on enhancing its value such as through the planting of foraging habitat for Black-Cockatoos, revegetation of understorey plants for the WRP and other fauna, installation of nest hollows, possibly the relocation of natural hollows from the RD area, and community education about the value of the site in a regional context.

Connectivity of habitat is also important. The habitat value of the ROS area is high given that the surrounding native bush on the south, east and west sides is planned to also be reserved as Regional Open Space. The proposed ROS area on the Harewoods Road block will not be large enough to provide adequate habitat for WRPs on their own, however retention of nearby Black-cockatoo foraging habitat in other ROS areas to the west and east of the site would help to improve the success of any breeding birds in the area.

In light of the above, the following recommendations for the ROS area are applicable:

- Enhance understorey for the WRP and Black-Cockatoos

This could be done by planting local native species (e.g. *Agonis flexuosa*) in areas which are degraded or have been affected by weeds or erosion to increase vegetation density. Planting of *Banksia grandis* and *Banksia sessilis* could provide food for Black-Cockatoos.

- Maintain habitat connectivity

Retain or create some habitat (perhaps within Lot 317) to allow for movement of possums between the ROS and bushland to the east. Note that both possum species will utilise narrow lines of trees and even gardens, although a wider belt of native vegetation would be more effective and support a greater range of species.

- Weed control

Use appropriate weed-control techniques to remove weed species taking over native vegetation (e.g. frog-friendly spraying of Kikuyu grass).

- Relocate potential nesting hollows from RD area.

Existing hollows can be removed from trees felled in the RD and placed in the ROS area either on the ground for terrestrial fauna, or have bases fitted and be hung in trees to provide ‘nest boxes’ for Black-Cockatoos.

- Community/resident education

Install signage and conduct community workshops/activities to educate the community of the rarity and importance of Tuart forest, and how they can help protect species utilising this habitat.

- Wetland rehabilitation

Conduct revegetation using local native wetland species (e.g. *Melaleuca rhapsiophylla*, *Baumea articulata*) to extend habitat around the eastern edge of the wetland, enhancing its value for the WRP.



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## 6 TABLES

Table 1. Information gathered from trees with a DBH measured over 50mm east of Minninup Road.

Tree Identification	Easting	Northing	Species	DBH (cm)	Hollows	No. of Stems (if more than 1)	Comments
A001	371441.789	6301795.358	Marri	162	Small Hollows		
A002	371441.361	6301813.54	Tuart	126	No Obvious Hollows		
A003	371456.697	6301821.285	Jarra	78	No Obvious Hollows		
A004	371464.475	6301809.855	Tuart	190	Several Large Hollows		
A005	371556.04	6301764.05	Jarra	124	No Obvious Hollows		
A006	371552.463	6301746.258	Tuart	194	No Obvious Hollows		
A007	371600.161	6301761.198	Jarra	87	No Obvious Hollows		
A008	371576.332	6301706.651	Tuart	114	No Obvious Hollows	3	
A009	371504.336	6301700.594	Marri	94	No Obvious Hollows		
A010	371508.279	6301690.887	Marri	112	Small Hollows		
A011	371446.356	6301682.634	Marri	141	Small Hollows		
A012	371416.412	6301717.391	Marri	112	Small Hollows		
A013	371430.929	6301730.781	Marri	80	No Obvious Hollows		
A014	371584.702	6301636.674	Marri	165	No Obvious Hollows		
A015	371554.531	6301604.556	Tuart	83	Small Hollows		
A016	371503.304	6301589.347	Marri	72	Small Hollows		
A017	371575.739	6301562.252	Marri	135	Small Hollows		
A018	371576.734	6301578.346	Tuart	72	No Obvious Hollows	9	
A019	371498.819	6301632.871	Marri	103	Small Hollows		
A020	371447.56	6301578.071	Jarra	172	No Obvious Hollows		
A021	371432.758	6301649.183	Tuart	86	Small Hollows		
A022	371411.532	6301650.786	Marri	100	Several Large Hollows		
A023	371320.576	6301615.863	Tuart	86	Small Hollows		
A024	371330.952	6301604.911	Tuart	67	No Obvious Hollows		
A025	371304.028	6301622.407	Tuart	55	No Obvious Hollows		
A026	371285.694	6301644.343	Tuart	86	No Obvious Hollows		
A027	371283.042	6301640.981	Tuart	64	No Obvious Hollows	2	
A028	371287.855	6301656.682	Tuart	83	Small Hollows		
A029	371290.079	6301685.213	Tuart	84	Small Hollows		
A030	371312.267	6301688.17	Tuart	90	No Obvious Hollows		
A031	371299.453	6301693.655	Tuart	58	No Obvious Hollows	5	
A032	371294.891	6301694.038	Tuart	69	No Obvious Hollows	10	
A033	371282.85	6301704.302	Tuart	91	Small Hollows		Dead
A034	371238.429	6301680.755	Tuart	170	Several Large Hollows		
A035	371235.039	6301655.979	Tuart	158	Multiple Large Hollows		
A036	371221.683	6301681.197	Tuart	272	Multiple Large Hollows		
A037	371196.725	6301704.708	Tuart	104	Small Hollows		
A038	371170.774	6301683.957	Tuart	198	Multiple Large Hollows		

Tree Identification	Easting	Northing	Species	DBH (cm)	Hollows	No. of Stems (if more than 1)	Comments
A039	371138.287	6301686.186	Tuart	186	Multiple Large Hollows		
A040	371133.282	6301663.939	Tuart	69	Small Hollows		Dead
A041	371133.572	6301656.18	Tuart	170	Multiple Large Hollows		
A042	371116.789	6301673.368	Tuart	174	Multiple Large Hollows		
A043	371105.834	6301685.864	Tuart	128	Small Hollows		
A044	371103.94	6301709.35	Tuart	100	Small Hollows		
A045	371093.001	6301720.627	Tuart	86	No Obvious Hollows		
A046	371081.781	6301773.931	Tuart	137	Several Large Hollows		
A047	371080.319	6301772.026	Tuart	287	Multiple Large Hollows		
A048	371030.297	6301764.04	Tuart	163	Several Large Hollows		
A049	371029.663	6301734.865	Tuart	108	No Obvious Hollows		
A050	371032.202	6301718.818	Tuart	153	Several Large Hollows		
A051	371006.781	6301728.128	Tuart	227	Several Large Hollows		
A052	370948.255	6301716.257	Tuart	152	No Obvious Hollows	14	
A053	370919.357	6301804.924	Tuart	169	Multiple Large Hollows		
A054	371025.974	6301690.677	Tuart	155	Multiple Large Hollows		
A055	371010.058	6301656.752	Tuart	164	Multiple Large Hollows		
A056	370999.391	6301626.777	Tuart	172	Multiple Large Hollows		
A057	371040.189	6301608.025	Tuart	78	No Obvious Hollows	2	
A058	371078.376	6301638.699	Tuart	231	Multiple Large Hollows		
A059	371106.021	6301595.04	Tuart	60	No Obvious Hollows		
A060	371124.016	6301591.62	Tuart	80	No Obvious Hollows		
A061	371165.134	6301590.726	Tuart	79	No Obvious Hollows		
A062	371169.116	6301591.999	Tuart	84	No Obvious Hollows		
A063	371171.255	6301592.027	Tuart	63	No Obvious Hollows		
A064	371208.747	6301591.085	Tuart	136	Several Large Hollows		
A065	371237.255	6301587.361	Tuart	63	No Obvious Hollows		
A066	371248.358	6301570.652	Tuart	94	No Obvious Hollows		
A067	371257.018	6301541.934	Tuart	163	Hollow Top		
A068	371268.055	6301558.161	Tuart	77	No Obvious Hollows		
A069	371275.756	6301552.497	Tuart	62	No Obvious Hollows	7	
A070	371292.822	6301534.98	Tuart	175	Several Large Hollows		
A071	371306.194	6301557.449	Tuart	100	Small Hollows		
A072	371330.404	6301555.22	Tuart	84	No Obvious Hollows	4	
A073	371334.574	6301549.398	Tuart	84	No Obvious Hollows		
A074	371367.272	6301559.26	Jarrah	82	No Obvious Hollows		
A075	371463.764	6301485.463	Tuart	160	No Obvious Hollows		
A076	371503.343	6301467.358	Tuart	68	No Obvious Hollows		
A077	371511.036	6301476.332	Tuart	55	No Obvious Hollows		
A078	371525.302	6301473.527	Tuart	86	No Obvious Hollows	5	Dead
A079	371501.489	6301452.916	Tuart	54	No Obvious Hollows		
A080	371381.261	6301465.402	Tuart	64	No Obvious Hollows		

Tree Identification	Easting	Northing	Species	DBH (cm)	Hollows	No. of Stems (if more than 1)	Comments
A081	371384.598	6301473.21	Tuart	63	No Obvious Hollows		
A082	371378.385	6301499.854	Tuart	99	No Obvious Hollows		
A083	371356.237	6301486.917	Tuart	78	Small Hollows		
A084	371343.21	6301480.422	Tuart	75	Small Hollows	3	
A085	371318.94	6301494.184	Tuart	204	Small Hollows		
A086	371298.567	6301501.676	Tuart	85	Small Hollows		
A087	371285.733	6301508.602	Tuart	64	Small Hollows	6	
A088	371252.602	6301517.366	Tuart	59	No Obvious Hollows		
A089	371236.659	6301520.37	Tuart	103	Several Large Hollows		
A090	371231.244	6301528.948	Tuart	157	Multiple Large Hollows		
A091	371242.377	6301496.048	Tuart	86	Small Hollows	4	
A092	371233.43	6301490.495	Tuart	56	No Obvious Hollows		
A093	371217.912	6301510.472	Tuart	80	No Obvious Hollows		
A094	371185.348	6301511.48	Tuart	103	No Obvious Hollows		Dead
A095	371165.281	6301495.908	Tuart	73	No Obvious Hollows		
A096	371154.424	6301501.087	Jarraah	62	No Obvious Hollows		
A097	371139.444	6301501.664	Tuart	72	Small Hollows		
A098	371128.945	6301535.792	Tuart	152	Small Hollows		
A099	371167.115	6301567.685	Tuart	78	No Obvious Hollows		
A100	371146.971	6301585.826	Tuart	66	No Obvious Hollows	4	
A101	371131.69	6301567.102	Tuart	74	No Obvious Hollows	2	
A102	371117.787	6301556.603	Tuart	63	No Obvious Hollows		
A103	371111.754	6301555.636	Tuart	72	No Obvious Hollows		
A104	371072.648	6301559.107	Tuart	251	Several Large Hollows		
A105	371023.167	6301566.432	Tuart	74	Small Hollows	5	
A106	371025.766	6301566.799	Tuart	58	No Obvious Hollows	4	
A107	371014.169	6301585.608	Tuart	72	No Obvious Hollows		Dead
A108	370993.73	6301556.169	Tuart	71	No Obvious Hollows		
A109	370999.903	6301525.643	Tuart	73	Small Hollows		
A110	370997.7	6301516.52	Tuart	110	No Obvious Hollows		
A111	370990.777	6301519.533	Tuart	53	No Obvious Hollows		
A112	370930.343	6301553.216	Tuart	104	Small Hollows	6	
A113	370925.168	6301564.681	Jarraah	64	No Obvious Hollows		
A114	370909.928	6301542.852	Tuart	140	Small Hollows		
A115	370957.007	6301513.426	Tuart	78	Small Hollows		
A116	370953.341	6301502.398	Tuart	77	Small Hollows		
A117	370956.22	6301474.822	Tuart	64	No Obvious Hollows	5	
A118	370929.333	6301461.599	Tuart	53	No Obvious Hollows		
A119	370893.126	6301456.902	Tuart	120	No Obvious Hollows		
A120	370890.2	6301446.216	Tuart	74	No Obvious Hollows		
A121	370901.389	6301437.05	Tuart	104	Small Hollows		Dead
A122	370970.006	6301445.285	Tuart	72	No Obvious Hollows	3	

<b>Tree Identification</b>	<b>Easting</b>	<b>Northing</b>	<b>Species</b>	<b>DBH (cm)</b>	<b>Hollows</b>	<b>No. of Stems (if more than 1)</b>	<b>Comments</b>
A123	370986.712	6301426.877	Tuart	171	Small Hollows		
A124	371002.96	6301463.802	Tuart	200	Multiple Large Hollows		
A125	371007.44	6301469.517	Tuart	55	No Obvious Hollows		
A126	371007.863	6301472.739	Tuart	68	No Obvious Hollows		
A127	371038.922	6301458.958	Tuart	134	Small Hollows		
A128	371030.691	6301448.534	Tuart	81	No Obvious Hollows	3	
A129	371007.254	6301427.705	Tuart	112	No Obvious Hollows	4	
A130	371028.739	6301420.562	Tuart	92	Small Hollows		
A131	371041.339	6301424.168	Tuart	96	Small Hollows		
A132	371056.552	6301420.156	Tuart	76	Small Hollows	2	
A133	371051.788	6301456.579	Tuart	73	No Obvious Hollows		
A134	371089.276	6301490.792	Tuart	148	Small Hollows		
A135	371089.988	6301507.104	Tuart	57	No Obvious Hollows	4	
A136	371101.303	6301481.526	Tuart	82	No Obvious Hollows		
A137	371121.609	6301472.148	Tuart	68	No Obvious Hollows		
A138	371121.611	6301472.037	Tuart	63	Small Hollows		
A139	371128.464	6301460.262	Jarra	78	No Obvious Hollows		
A140	371157.082	6301455.21	Jarra	195	Several Large Hollows		
A141	371160.624	6301447.605	Tuart	70	No Obvious Hollows		
A142	371157.646	6301447.787	Tuart	62	No Obvious Hollows		
A143	371152.087	6301432.187	Tuart	57	No Obvious Hollows		
A144	371151.009	6301429.4	Tuart	50	No Obvious Hollows		
A145	371148.677	6301429.923	Tuart	56	No Obvious Hollows		
A146	371148.767	6301430.146	Tuart	50	No Obvious Hollows		
A147	371140.685	6301429.484	Tuart	112	No Obvious Hollows		
A148	371184.037	6301428.398	Tuart	208	Several Large Hollows		
A149	371206.841	6301440.901	Tuart	81	Small Hollows		Dead
A150	371198.111	6301426.035	Jarra	66	No Obvious Hollows		
A151	371201.11	6301417.314	Tuart	63	No Obvious Hollows		
A152	371179.414	6301398.394	Tuart	60	No Obvious Hollows		
A153	371173.186	6301384.226	Tuart	61	No Obvious Hollows		
A154	371182.362	6301386.567	Tuart	140	Small Hollows		
A155	371195.303	6301364.559	Tuart	122	Small Hollows		
A156	371215.408	6301398.208	Tuart	204	Multiple Large Hollows		Dead
A157	371222.257	6301372.681	Tuart	180	Multiple Large Hollows		Dead
A158	371233.656	6301375.716	Tuart	70	No Obvious Hollows		Dead
A159	371248.62	6301390.332	Tuart	63	No Obvious Hollows	3	
A160	371251.002	6301400.012	Tuart	69	Small Hollows		
A161	371231.164	6301409.175	Tuart	140	Multiple Large Hollows		Corellas Nesting
A162	371234.104	6301432.836	Tuart	73	No Obvious Hollows		
A163	371244.05	6301433.19	Tuart	165	Several Large Hollows		
A164	371252.937	6301429.316	Tuart	75	No Obvious Hollows		Dead



<b>Tree Identification</b>	<b>Easting</b>	<b>Northing</b>	<b>Species</b>	<b>DBH (cm)</b>	<b>Hollows</b>	<b>No. of Stems (if more than 1)</b>	<b>Comments</b>
A165	371291.848	6301454.454	Tuart	69	No Obvious Hollows		
A166	371294.852	6301459.373	Tuart	96	No Obvious Hollows		
A167	371288.062	6301417.473	Tuart	72	No Obvious Hollows		
A168	371281.478	6301395.095	Tuart	69	Small Hollows		
A169	371268.639	6301381.505	Tuart	165	Small Hollows		
A170	371261.427	6301385.402	Tuart	76	Small Hollows		
A171	371243.931	6301358.331	Tuart	69	Small Hollows		
A172	371240.565	6301352.741	Tuart	58	No Obvious Hollows	3	
A173	371278.239	6301352.023	Tuart	55	No Obvious Hollows	4	
A174	371293.353	6301348.342	Tuart	66	No Obvious Hollows		
A175	371283.189	6301343.438	Tuart	67	Small Hollows		
A176	371279.772	6301334.632	Tuart	63	Small Hollows		
A177	371305.854	6301317.457	Tuart	176	Multiple Large Hollows		
A178	371327.441	6301330.608	Tuart	62	No Obvious Hollows		
A179	371310.239	6301379.286	Tuart	131	Multiple Large Hollows		
A180	371306.926	6301390.665	Tuart	67	No Obvious Hollows		
A181	371313.678	6301407.39	Tuart	73	Small Hollows		
A182	371329.233	6301377.654	Tuart	66	No Obvious Hollows		
A183	371340.364	6301365.825	Tuart	59	No Obvious Hollows		
A184	371375.821	6301343.007	Tuart	111	Small Hollows		
A185	371386.023	6301387.059	Tuart	128	Several Large Hollows		
A186	371395.172	6301370.435	Tuart	56	No Obvious Hollows		
A187	371396.593	6301368.458	Tuart	71	No Obvious Hollows	2	
A188	371474.183	6301345.313	Tuart	61	No Obvious Hollows	3	
A189	371436.838	6301377.2	Tuart	63	No Obvious Hollows		
A190	371287.695	6301284.389	Tuart	71	No Obvious Hollows	4	
A191	371300.408	6301300.416	Tuart	53	No Obvious Hollows	3	
A192	371278.652	6301313.989	Tuart	255	Large Hollow Top		
A193	371278.65	6301314.1	Tuart	62	Small Hollows		
A194	371262.85	6301292.486	Tuart	77	Small Hollows		
A195	371240.472	6301275.886	Tuart	83	Small Hollows		
A196	371234.141	6301269.48	Tuart	92	Small Hollows	2	
A197	371215.993	6301312.379	Tuart	250	Multiple Large Hollows		
A198	371238.538	6301316.339	Tuart	61	No Obvious Hollows		
A199	371245.791	6301323.422	Tuart	58	No Obvious Hollows		
A200	371241.654	6301326.805	Tuart	59	No Obvious Hollows		
A201	371259.355	6301324.49	Tuart	67	No Obvious Hollows	4	
A202	371200.813	6301348.885	Tuart	61	No Obvious Hollows		
A203	371194.204	6301328.391	Tuart	119	No Obvious Hollows		
A204	371193.137	6301303.757	Tuart	67	No Obvious Hollows	5	
A205	371183.141	6301293.199	Jarraah	66	No Obvious Hollows		
A206	371183.82	6301277.128	Tuart	131	Small Hollows		

<b>Tree Identification</b>	<b>Easting</b>	<b>Northing</b>	<b>Species</b>	<b>DBH (cm)</b>	<b>Hollows</b>	<b>No. of Stems (if more than 1)</b>	<b>Comments</b>
A207	371194.824	6301274.834	Tuart	65	No Obvious Hollows		
A208	371163.137	6301286.944	Tuart	50	No Obvious Hollows		
A209	371154.169	6301296.916	Tuart	86	No Obvious Hollows		
A210	371160.305	6301310.972	Tuart	105	Small Hollows		
A211	371160.262	6301335.147	Tuart	66	No Obvious Hollows		
A212	371136.479	6301305.442	Tuart	58	No Obvious Hollows		Dead
A213	371138.396	6301301.142	Tuart	69	No Obvious Hollows		
A214	371113.876	6301326.655	Tuart	210	Multiple Large Hollows		Dead
A215	371111.269	6301368.763	Tuart	59	No Obvious Hollows	2	
A216	371094.247	6301389.939	Tuart	66	No Obvious Hollows		
A217	371087.721	6301391.183	Tuart	64	No Obvious Hollows		
A218	371087.313	6301386.853	Tuart	64	No Obvious Hollows		
A219	371069.106	6301357.443	Tuart	67	No Obvious Hollows	2	
A220	371061.825	6301359.453	Tuart	107	Small Hollows		
A221	371051.983	6301372.186	Tuart	172	Multiple Large Hollows		
A222	371074.394	6301323.467	Tuart	66	No Obvious Hollows		
A223	371037.168	6301325.522	Tuart	55	Small Hollows		
A224	371026.244	6301335.69	Tuart	114	Several Large Hollows		
A225	371009.307	6301322.599	Tuart	54	No Obvious Hollows	6	
A226	370995.421	6301359.677	Jarraah	75	No Obvious Hollows	3	
A227	371013.307	6301371.338	Tuart	86	No Obvious Hollows		
A228	370982.258	6301370.369	Tuart	136	Multiple Large Hollows		
A229	370962.989	6301378.762	Tuart	64	No Obvious Hollows		
A230	370960.49	6301377.842	Tuart	92	Small Hollows		
A231	370942.299	6301375.048	Tuart	134	Multiple Large Hollows		
A232	370926.116	6301382.152	Tuart	63	No Obvious Hollows	4	
A233	370866.658	6301384.463	Tuart	116	No Obvious Hollows		
A234	370861.962	6301346.14	Tuart	94	No Obvious Hollows		
A235	370873.261	6301342.742	Tuart	64	No Obvious Hollows		
A236	370874.095	6301322.015	Jarraah	56	No Obvious Hollows		
A237	370864.483	6301317.561	Jarraah	52	No Obvious Hollows		
A238	370856.947	6301324.78	Tuart	105	No Obvious Hollows		
A239	370849.605	6301310.487	Tuart	112	No Obvious Hollows		
A240	370844.635	6301306.539	Tuart	84	No Obvious Hollows		
A241	370835.559	6301275.92	Tuart	68	No Obvious Hollows		
A242	370840.227	6301274.541	Tuart	83	No Obvious Hollows	2	Dead
A243	370860.754	6301262.505	Tuart	61	No Obvious Hollows	2	Dead
A244	370915.354	6301219.983	Tuart	135	Several Large Hollows		
A245	370916.485	6301239.738	Tuart	140	Several Large Hollows		
A246	370945.036	6301232.689	Tuart	78	No Obvious Hollows		
A247	370969.068	6301236.78	Tuart	182	Small Hollows		
A248	370937.996	6301251.559	Tuart	52	No Obvious Hollows		

<b>Tree Identification</b>	<b>Easting</b>	<b>Northing</b>	<b>Species</b>	<b>DBH (cm)</b>	<b>Hollows</b>	<b>No. of Stems (if more than 1)</b>	<b>Comments</b>
A249	370942.089	6301265.365	Tuart	56	No Obvious Hollows		
A250	370953.975	6301266.744	Tuart	160	Multiple Large Hollows		
A251	370931.895	6301276.652	Tuart	60	No Obvious Hollows		
A252	370940.727	6301297.73	Tuart	114	Several Large Hollows		
A253	370999.972	6301269.465	Tuart	101	Small Hollows		
A254	371004.113	6301244.9	Jarraah	63	No Obvious Hollows		
A255	370993.019	6301226.01	Tuart	73	No Obvious Hollows		
A256	371013.313	6301203.546	Tuart	78	No Obvious Hollows		
A257	371034.243	6301203.16	Tuart	65	No Obvious Hollows		
A258	371030.436	6301181.816	Tuart	143	Multiple Large Hollows		Dead
A259	371051.451	6301216.808	Tuart	171	Multiple Large Hollows		
A260	371063.352	6301258.887	Tuart	90	Small Hollows		
A261	371070.405	6301259.979	Tuart	88	No Obvious Hollows		
A262	371069.377	6301246.436	Tuart	57	Small Hollows		
A263	371079.609	6301246.239	Tuart	79	No Obvious Hollows		Ringneck Parrot Nesting
A264	371105.31	6301250.685	Tuart	140	Several Large Hollows		
A265	371120.116	6301284.153	Jarraah	69	No Obvious Hollows		
A266	371130.493	6301273.09	Tuart	124	Small Hollows		
A267	371095.639	6301222.72	Tuart	140	Small Hollows		
A268	371098.932	6301191.934	Tuart	72	No Obvious Hollows	4	
A269	371088.693	6301178.711	Tuart	145	Multiple Large Hollows		
A270	371098.165	6301179.725	Tuart	54	No Obvious Hollows		
A271	371148.141	6301211.887	Tuart	262	Small Hollows		
A272	371166.669	6301224.222	Tuart	84	Small Hollows		
A273	371183.563	6301240.527	Tuart	95	Small Hollows		
A274	371196.776	6301219.078	Tuart	92	No Obvious Hollows		
A275	371209.997	6301196.963	Tuart	75	No Obvious Hollows		
A276	371212.441	6301194.999	Tuart	67	No Obvious Hollows		Dead
A277	371213.752	6301180.378	Jarraah	165	Several Large Hollows		
A278	371223.097	6301169.967	Tuart	145	Multiple Large Hollows		
A279	371239.888	6301194.034	Marri	70	No Obvious Hollows		
A280	371252.774	6301183.115	Tuart	58	No Obvious Hollows	3	
A281	371279.763	6301174.603	Marri	73	No Obvious Hollows		
A282	371251.826	6301219.367	Jarraah	92	Small Hollows		
A283	371295.572	6301230.596	Tuart	62	No Obvious Hollows		
A284	371320.837	6301239.804	Tuart	130	Small Hollows		
A285	371318.17	6301223.577	Jarraah	83	No Obvious Hollows		
A286	371318.845	6301221.812	Tuart	64	No Obvious Hollows		
A287	371325.224	6301224.669	Tuart	80	No Obvious Hollows		
A288	371353.096	6301114.805	Tuart	133	Several Large Hollows		Dead
A289	371293.297	6301045.141	Tuart	140	Small Hollows		

Tree Identification	Easting	Northing	Species	DBH (cm)	Hollows	No. of Stems (if more than 1)	Comments
A290	371248.973	6301056.528	Tuart	83	No Obvious Hollows		Dead
A291	371221.712	6301071.469	Tuart	80	No Obvious Hollows		Dead
A292	371217.886	6301086.39	Tuart	110	No Obvious Hollows		
A293	371235.938	6301078.645	Tuart	92	No Obvious Hollows		
A294	371239.068	6301081.016	Tuart	52	No Obvious Hollows		
A295	371254.384	6301104.065	Tuart	138	Small Hollows		
A296	371191.65	6301066.3	Jarrah	120	Small Hollows		
A297	371166.915	6301080.166	Tuart	100	No Obvious Hollows		
A298	371157.429	6301087.137	Tuart	55	No Obvious Hollows		
A299	371143.925	6301088.62	Tuart	96	No Obvious Hollows		
A300	371144.266	6301104.927	Tuart	180	Several Large Hollows		
A301	371127.207	6301114.903	Tuart	110	Several Large Hollows		Dead
A302	371117.202	6301132.957	Tuart	200	Several Large Hollows		
A303	371119.659	6301150.956	Jarrah	63	No Obvious Hollows		
A304	371130.597	6301146.665	Tuart	62	No Obvious Hollows	3	
A305	371138.487	6301161.742	Tuart	72	No Obvious Hollows		Dead
A306	371164.262	6301132.697	Tuart	72	No Obvious Hollows		
A307	371179.445	6301144.766	Jarrah	128	No Obvious Hollows		
A308	371164.31	6301177.945	Jarrah	78	No Obvious Hollows		
A309	371086.039	6301147.624	Tuart	53	No Obvious Hollows		
A310	371079.229	6301142.21	Tuart	64	No Obvious Hollows		
A311	371082.359	6301137.594	Tuart	70	No Obvious Hollows		
A312	371083.252	6301133.392	Tuart	88	No Obvious Hollows	4	
A313	371097.437	6301115.726	Tuart	79	No Obvious Hollows		Dead
A314	371096.994	6301100.194	Tuart	61	Small Hollows		
A315	371081.87	6301055.743	Tuart	74	No Obvious Hollows	3	
A316	371089.242	6301053.845	Tuart	243	Hollow Top		
A317	371087.018	6301053.261	Tuart	66	No Obvious Hollows	2	
A318	371049.115	6301092.125	Tuart	82	No Obvious Hollows		
A319	371036.477	6301091.402	Tuart	55	No Obvious Hollows		
A320	371022.488	6301087.445	Tuart	83	No Obvious Hollows	3	
A321	371002.924	6301083.081	Tuart	80	No Obvious Hollows		
A322	371041.251	6301123.96	Tuart	78	No Obvious Hollows		
A323	371066.49	6301156.014	Jarrah	64	No Obvious Hollows		
A324	371040.72	6301149.792	Tuart	68	No Obvious Hollows		
A325	371033.743	6301143.045	Tuart	65	No Obvious Hollows		
A326	371010.233	6301148.609	Tuart	128	Several Large Hollows		
A327	370983.916	6301162.453	Tuart	130	Multiple Large Hollows		
A328	370967.787	6301158.578	Tuart	195	Multiple Large Hollows		
A329	370955.802	6301101.97	Tuart	95	Multiple Large Hollows	2	
A330	370954.092	6301083.76	Tuart	73	No Obvious Hollows		Dead
A331	370953.639	6301075.88	Tuart	66	No Obvious Hollows		

Tree Identification	Easting	Northing	Species	DBH (cm)	Hollows	No. of Stems (if more than 1)	Comments
A332	370952.141	6301076.636	Tuart	54	No Obvious Hollows		
A333	370947.383	6301077.793	Tuart	52	No Obvious Hollows		
A334	370941.385	6301074.275	Tuart	64	No Obvious Hollows		
A335	370924.087	6301081.252	Tuart	66	No Obvious Hollows	5	
A336	370932.172	6301123.502	Tuart	97	Several Large Hollows		
A337	370940.001	6301136.138	Tuart	130	Multiple Large Hollows		
A338	370939.4	6301146.333	Tuart	113	Multiple Large Hollows		
A339	370930.994	6301142.118	Tuart	122	Multiple Large Hollows		
A340	370901.058	6301141.385	Tuart	148	Multiple Large Hollows		
A341	370931.426	6301186.373	Tuart	147	Several Large Hollows		Dead
A342	370871.227	6301195.55	Tuart	155	Multiple Large Hollows		
A343	370844.964	6301198.415	Tuart	83	No Obvious Hollows		
A344	370845.402	6301193.431	Tuart	75	No Obvious Hollows		
A345	370845.202	6301152.728	Tuart	85	No Obvious Hollows		
A346	370852.497	6301128.76	Tuart	77	No Obvious Hollows		Dead
A347	370831.355	6301124.152	Tuart	74	No Obvious Hollows		
A348	370814.406	6301125.922	Tuart	63	No Obvious Hollows		
A349	370789.156	6301122.59	Tuart	110	No Obvious Hollows	3	
A350	370798.202	6301113.728	Tuart	57	No Obvious Hollows		
A351	370802.67	6301099.482	Tuart	105	No Obvious Hollows	6	
A352	370816.028	6301095.002	Tuart	95	No Obvious Hollows		
A353	370862.328	6301081.98	Tuart	103	No Obvious Hollows		
A354	370870.165	6301073.102	Tuart	57	No Obvious Hollows		
A355	370891.236	6301041.222	Tuart	140	Small Hollows		
A356	370900.455	6301026.374	Tuart	72	No Obvious Hollows		
A357	370896.749	6300997.49	Tuart	60	No Obvious Hollows		
A358	370906.481	6300992.962	Tuart	165	Several Large Hollows		Cocky Box
A359	370919.741	6301002.788	Tuart	70	Several Large Hollows		
A360	370919.261	6301003.89	Tuart	86	Several Large Hollows		
A361	370929.697	6301016.34	Tuart	71	No Obvious Hollows		
A362	370930.682	6301019.125	Tuart	88	No Obvious Hollows		
A363	370925.837	6301019.837	Tuart	66	No Obvious Hollows		
A364	370940.968	6301042.773	Tuart	114	Several Large Hollows		
A365	370944.139	6301035.164	Jarrah	55	Several Large Hollows		
A366	370957.189	6301025.911	Tuart	128	Several Large Hollows		
A367	370945.247	6301007.897	Tuart	205	Several Large Hollows		
A368	370936.948	6300974.738	Tuart	75	Small Hollows		
A369	370961.233	6300966.744	Tuart	88	No Obvious Hollows		
A370	370969.02	6300989.472	Tuart	144	Multiple Large Hollows		
A371	371003.075	6301009.001	Jarrah	90	No Obvious Hollows		
A372	371015.728	6301036.452	Tuart	212	Several Large Hollows		Dead
A373	371046.084	6301005.583	Tuart	76	No Obvious Hollows	2	Dead



Tree Identification	Easting	Northing	Species	DBH (cm)	Hollows	No. of Stems (if more than 1)	Comments
A374	371021.048	6300972.311	Tuart	90	No Obvious Hollows		
A375	371019.011	6300964.632	Jarraah	102	No Obvious Hollows		
A376	371005.068	6300943.264	Tuart	120	Small Hollows		Dead
A377	371039.116	6300935.401	Tuart	90	Small Hollows		
A378	371050.185	6300928.229	Tuart	72	No Obvious Hollows		Dead
A379	371059.097	6300943.319	Tuart	78	No Obvious Hollows		Dead
A380	371032.683	6300964.482	Tuart	93	Small Hollows		
A381	371086.338	6301013.55	Tuart	106	Small Hollows		
A382	371098.643	6300997.411	Tuart	183	Several Large Hollows		Dead
A383	371121.974	6300998.166	Tuart	76	No Obvious Hollows		
A384	371125.438	6300996.438	Tuart	70	No Obvious Hollows		
A385	371130.942	6300995.18	Tuart	66	No Obvious Hollows		
A386	371130.363	6301031.659	Tuart	67	No Obvious Hollows		
A387	371139	6301060.386	Tuart	97	Small Hollows		
A388	371125.106	6301070.182	Tuart	132	Small Hollows		
A389	371153.085	6301057.247	Tuart	92	No Obvious Hollows	2	
A390	371155.309	6301050.844	Tuart	60	No Obvious Hollows	2	
A391	371166.909	6301024.715	Tuart	186	Multiple Large Hollows		
A392	371169.633	6301008.782	Tuart	58	No Obvious Hollows		
A393	371169.664	6300999.467	Tuart	103	Several Large Hollows		Dead
A394	371166.399	6301000.2	Tuart	62	No Obvious Hollows		
A395	371168.761	6300990.472	Tuart	60	No Obvious Hollows		
A396	371162.296	6300994.045	Tuart	62	No Obvious Hollows		
A397	371153.753	6300993.155	Tuart	60	No Obvious Hollows		
A398	371150.478	6300973.704	Tuart	67	Small Hollows		
A399	371144.921	6300971.967	Tuart	68	No Obvious Hollows		
A400	371132.336	6300953.389	Tuart	163	Several Large Hollows		Dead
A401	371126.027	6300938.334	Tuart	82	Small Hollows	4	
A402	371124.322	6300933.653	Tuart	77	No Obvious Hollows		
A403	371145.554	6300931.496	Tuart	146	Several Large Hollows		
A404	371189.067	6300939.063	Tuart	69	No Obvious Hollows	2	
A405	371197.403	6300948.601	Tuart	110	Several Large Hollows		
A406	371207.645	6300975.575	Tuart	146	Several Large Hollows		
A407	371210.855	6300971.958	Tuart	54	No Obvious Hollows		
A408	371223.593	6300965.141	Tuart	92	Small Hollows		
A409	371232.914	6300984.451	Tuart	186	Small Hollows		
A410	371262.21	6300970.313	Tuart	100	No Obvious Hollows		Dead
A411	371295.577	6300964.658	Tuart	153	No Obvious Hollows		
A412	371277.516	6300910.298	Tuart	85	No Obvious Hollows		
A413	371259.043	6300928.794	Tuart	78	No Obvious Hollows		
A414	371264.093	6300947.603	Tuart	55	No Obvious Hollows	2	
A415	371217.881	6300912.276	Jarraah	62	No Obvious Hollows		

<b>Tree Identification</b>	<b>Easting</b>	<b>Northing</b>	<b>Species</b>	<b>DBH (cm)</b>	<b>Hollows</b>	<b>No. of Stems (if more than 1)</b>	<b>Comments</b>
A416	371210.245	6300885.115	Tuart	97	Small Hollows		
A417	371226.544	6300869.251	Marri	61	No Obvious Hollows		
A418	371242.669	6300880.445	Marri	95	No Obvious Hollows		
A419	371246.428	6300884.488	Tuart	60	No Obvious Hollows		
A420	371239.371	6300848.795	Tuart	67	Small Hollows		
A421	371223.348	6300836.937	Marri	76	No Obvious Hollows		Dead
A422	371220.187	6300822.921	Marri	57	No Obvious Hollows		
A423	371219.801	6300816.928	Jarra	52	No Obvious Hollows		
A424	371195.39	6300813.497	Jarra	62	Small Hollows		
A425	371164.403	6300821.956	Tuart	60	No Obvious Hollows		
A426	371167.715	6300824.662	Tuart	60	No Obvious Hollows		
A427	371162.355	6300829.138	Tuart	60	No Obvious Hollows		
A428	371142.678	6300819.338	Tuart	122	Several Large Hollows		Cocky Box
A429	371130.328	6300817.954	Tuart	80	Small Hollows		
A430	371124.389	6300830.961	Tuart	50	No Obvious Hollows		
A431	371123.719	6300832.393	Tuart	80	No Obvious Hollows		
A432	371136.704	6300828.02	Tuart	118	No Obvious Hollows		
A433	371143.914	6300845.194	Tuart	82	Small Hollows		
A434	371173.527	6300835.164	Tuart	56	No Obvious Hollows		Cocky Box, Block Chewed
A435	371168.001	6300845.072	Tuart	92	Small Hollows		
A436	371175.545	6300858.148	Tuart	75	Small Hollows		
A437	371171.677	6300862.31	Jarra	107	Small Hollows		Dead
A438	371127.96	6300891.005	Tuart	64	No Obvious Hollows		
A439	371127.23	6300889.886	Tuart	64	No Obvious Hollows		
A440	371126.053	6300866.582	Tuart	82	Small Hollows	2	
A441	371095.439	6300833.125	Tuart	82	Small Hollows	2	
A442	371091.013	6300823.307	Tuart	75	No Obvious Hollows		
A443	371078.824	6300830.797	Tuart	93	Small Hollows		
A444	371067.578	6300858.261	Tuart	119	Several Large Hollows		
A445	371068.68	6300873.247	Tuart	135	Multiple Large Hollows		
A446	371089.84	6300890.386	Tuart	170	Small Hollows		
A447	371080.76	6300908.785	Tuart	95	Small Hollows		Dead
A448	371059.246	6300897.298	Tuart	66	No Obvious Hollows		Dead
A449	371058.554	6300900.394	Tuart	68	No Obvious Hollows		Dead
A450	371029.562	6300870.84	Tuart	78	Small Hollows		Dead
A451	370999.953	6300887.524	Tuart	167	Small Hollows		Dead
A452	371017.701	6300895.524	Tuart	107	Several Large Hollows		
A453	370993.086	6300844.625	Tuart	205	Multiple Large Hollows		Cocky Box
A454	370998.629	6300847.36	Tuart	90	Small Hollows		
A455	370972.703	6300880.728	Tuart	200	Multiple Large Hollows		Dead
A456	370960.168	6300879.341	Tuart	60	No Obvious Hollows		

<b>Tree Identification</b>	<b>Easting</b>	<b>Northing</b>	<b>Species</b>	<b>DBH (cm)</b>	<b>Hollows</b>	<b>No. of Stems (if more than 1)</b>	<b>Comments</b>
A457	370946.843	6300888.257	Tuart	110	Several Large Hollows		
A458	370945.896	6300889.575	Tuart	122	Several Large Hollows		Cocky Box
A459	370964.553	6300913.113	Tuart	92	Small Hollows		
A460	370959.686	6300929.35	Tuart	50	No Obvious Hollows		
A461	370941.719	6300937.761	Tuart	80	No Obvious Hollows		
A462	370937.466	6300935.93	Tuart	64	Small Hollows	3	
A463	370907.567	6300967.359	Tuart	156	Multiple Large Hollows		
A464	370881.775	6300962.8	Tuart	60	No Obvious Hollows		
A465	370879.441	6300984.395	Tuart	165	Several Large Hollows		
A466	370869.314	6300976.718	Tuart	54	No Obvious Hollows		
A467	370865.994	6300981.553	Tuart	92	No Obvious Hollows		
A468	370848.638	6300958.143	Tuart	162	Several Large Hollows		Cocky Box
A469	370835.516	6300958.855	Tuart	67	No Obvious Hollows		
A470	370837.867	6300984.727	Tuart	122	Small Hollows		
A471	370831.563	6301011.148	Jarra	64	No Obvious Hollows		
A472	370820.016	6301040.16	Tuart	53	No Obvious Hollows		
A473	370849.209	6301054.634	Tuart	68	No Obvious Hollows	7	
A474	370813.95	6301013.907	Tuart	92	No Obvious Hollows		
A475	370812.259	6300994.255	Tuart	144	Small Hollows		
A476	370758.287	6300941.188	Tuart	75	No Obvious Hollows		
A477	370797.157	6300941.375	Tuart	70	Small Hollows	6	
A478	370800.647	6300937.651	Tuart	109	Small Hollows		
A479	370810.363	6300934.343	Tuart	175	Small Hollows		
A480	370832.418	6300933.196	Tuart	128	Several Large Hollows		
A481	370833.696	6300934.988	Tuart	105	Hollow Top		Dead
A482	370833.449	6300939.531	Tuart	175	Small Hollows		
A483	370870.496	6300902.098	Tuart	67	No Obvious Hollows		
A484	370877.325	6300892.097	Jarra	55	No Obvious Hollows		
A485	370902.169	6300870.138	Tuart	68	No Obvious Hollows		Dead
A486	370919.976	6300852.854	Tuart	193	Several Large Hollows		Dead
A487	370929.726	6300874.831	Tuart	120	Several Large Hollows		
A488	370914.217	6300894.143	Tuart	90	Small Hollows		
A489	370933.263	6300909.368	Tuart	172	Several Large Hollows		
A490	371624	6302050	Tuart	120	Several Large Hollows		
A491	371642	6302247	Tuart	110	Small Hollows		
A492	371670	6302257	Tuart	100	No Obvious Hollows		

Table 2. Information gathered from trees with a DBH measured over 50mm west of Minninup Road.

<b>Tree Identification</b>	<b>Easting</b>	<b>Northing</b>	<b>Species</b>	<b>DBH (cm)</b>	<b>Hollows</b>	<b>No. of Stems (if more than 1)</b>	<b>Comments</b>
<b>B1</b>	370592.366	6301262.244	Tuart	110	No Obvious Hollows		
<b>B2</b>	370568.253	6301340.66	Tuart	65	No Obvious Hollows	3	
<b>B3</b>	370530.66	6301321.415	Tuart	69	No Obvious Hollows		
<b>B4</b>	370529.269	6301321.064	Tuart	75	No Obvious Hollows	3	
<b>B5</b>	370522.929	6301336.172	Tuart	100	Small Hollows		
<b>B6</b>	370508.576	6301352.393	Tuart	115	Small Hollows		
<b>B7</b>	370489.978	6301338.393	Tuart	155	Several Large Hollows		
<b>B8</b>	370461.474	6301334.906	Tuart	145	Several Large Hollows		
<b>B9</b>	370460.666	6301325.801	Tuart	70	Small Hollows		
<b>B10</b>	370417.661	6301321.787	Tuart	73	Small Hollows	4	
<b>B11</b>	370421.323	6301353.886	Tuart	117	Small Hollows		
<b>B12</b>	370389.292	6301391.496	Tuart	100	Small Hollows		
<b>B13</b>	370372.303	6301403.134	Tuart	71	No Obvious Hollows		
<b>B14</b>	370401.686	6301431.253	Tuart	145	Small Hollows		
<b>B15</b>	370413.543	6301441.726	Tuart	68	Small Hollows		
<b>B16</b>	370440.354	6301453.619	Tuart	255	Small Hollows		
<b>B17</b>	370463.053	6301473.885	Tuart	135	Small Hollows		
<b>B18</b>	370466.069	6301457.069	Tuart	88	Small Hollows		
<b>B19</b>	370470.981	6301451.368	Tuart	60	No Obvious Hollows	5	
<b>B20</b>	370456.71	6301440.641	Tuart	115	No Obvious Hollows		
<b>B21</b>	370456.539	6301418.68	Tuart	154	Small Hollows		
<b>B22</b>	370462.734	6301386.602	Tuart	103	Small Hollows		
<b>B23</b>	370507.862	6301426.576	Tuart	84	Small Hollows	2	
<b>B24</b>	370510.6	6301423.508	Tuart	95	Small Hollows		
<b>B25</b>	370536.728	6301430.844	Tuart	97	Several Large Hollows		
<b>B26</b>	370533.208	6301422.812	Tuart	100	Several Large Hollows		
<b>B27</b>	370529.407	6301414.998	Tuart	80	Small Hollows		
<b>B28</b>	370522.628	6301407.255	Tuart	60	Small Hollows	3	
<b>B29</b>	370516.892	6301405.071	Tuart	110	Small Hollows		
<b>B30</b>	370504.269	6301410.115	Tuart	68	Small Hollows		
<b>B31</b>	370537.049	6301379.058	Tuart	73	Small Hollows		
<b>B32</b>	370538.851	6301383.407	Tuart	58	No Obvious Hollows		
<b>B33</b>	370539.04	6301383.188	Tuart	64	No Obvious Hollows		
<b>B34</b>	370548.782	6301377.884	Tuart	74	Small Hollows		
<b>B35</b>	370556.188	6301380.423	Tuart	88	Small Hollows		
<b>B36</b>	370563.962	6301383.3	Tuart	74	Hollow Top		
<b>B37</b>	370578.439	6301378.614	Tuart	120	Several Large Hollows		
<b>B38</b>	370400.65	6301522.511	Tuart	90	Small Hollows		
<b>B39</b>	370412.781	6301512.47	Tuart	107	Small Hollows		
<b>B40</b>	370386.355	6301534.296	Tuart	82	Several Large Hollows		
<b>B41</b>	370366.774	6301552	Tuart	57	No Obvious Hollows		

<b>B42</b>	370381.4	6301522.363	Tuart	152	Several Large Hollows	
<b>B43</b>	370357.424	6301521.044	Tuart	93	Small Hollows	2
<b>B44</b>	370313.816	6301506.486	Tuart	120	Several Large Hollows	
<b>B45</b>	370329.296	6301544.954	Tuart	75	No Obvious Hollows	
<b>B46</b>	370295.43	6301566.791	Tuart	105	Small Hollows	
<b>B47</b>	370285.862	6301572.873	Tuart	81	Small Hollows	
<b>B48</b>	370271.266	6301579.442	Tuart	66	Small Hollows	
<b>B49</b>	370261.148	6301598.825	Tuart	87	Small Hollows	
<b>B50</b>	370270.654	6301604.276	Tuart	82	Small Hollows	
<b>B51</b>	370293.582	6301600.591	Tuart	96	Small Hollows	
<b>B52</b>	370302.354	6301605.255	Tuart	75	Small Hollows	
<b>B53</b>	370322.455	6301625.154	Tuart	115	Small Hollows	2
<b>B54</b>	370331.478	6301618.067	Tuart	75	Small Hollows	
<b>B55</b>	370359.493	6301630.309	Tuart	96	Several Large Hollows	
<b>B56</b>	370402.364	6301658.276	Tuart	128	Several Large Hollows	
<b>B57</b>	370410.929	6301657.614	Tuart	90	Small Hollows	
<b>B58</b>	370411.483	6301657.954	Tuart	88	Small Hollows	
<b>B59</b>	370427.636	6301667.043	Tuart	95	Several Large Hollows	
<b>B60</b>	370429.03	6301667.172	Tuart	107	Small Hollows	
<b>B61</b>	370429.121	6301667.284	Tuart	52	Small Hollows	
<b>B62</b>	370448.981	6301670.434	Tuart	60	No Obvious Hollows	
<b>B63</b>	370473.073	6301690.94	Tuart	72	Small Hollows	
<b>B64</b>	370471.26	6301694.354	Tuart	75	Small Hollows	
<b>B65</b>	370461.985	6301720.291	Tuart	150	Several Large Hollows	
<b>B66</b>	370449.288	6301744.741	Tuart	58	Small Hollows	
<b>B67</b>	370415.743	6301749.504	Tuart	106	Several Large Hollows	
<b>B68</b>	370407.624	6301744.627	Tuart	180	Several Large Hollows	
<b>B69</b>	370396.027	6301721.737	Tuart	196	Several Large Hollows	
<b>B70</b>	370384.404	6301749.306	Tuart	62	No Obvious Hollows	
<b>B71</b>	370391.288	6301686.74	Tuart	80	No Obvious Hollows	6
<b>B72</b>	370360.838	6301647.96	Tuart	62	No Obvious Hollows	2
<b>B73</b>	370322.774	6301705.34	Tuart	70	No Obvious Hollows	
<b>B74</b>	370316.849	6301696.388	Tuart	71	Small Hollows	
<b>B75</b>	370280.194	6301662.626	Tuart	68	No Obvious Hollows	
<b>B76</b>	370239.643	6301655.872	Tuart	107	No Obvious Hollows	
<b>B77</b>	370239.677	6301653.322	Tuart	72	No Obvious Hollows	
<b>B78</b>	370218.266	6301647.933	Tuart	113	No Obvious Hollows	
<b>B79</b>	370217.854	6301623.197	Tuart	223	Several Large Hollows	
<b>B80</b>	370197.113	6301574.787	Tuart	68	No Obvious Hollows	
<b>B81</b>	370248.872	6301543.321	Tuart	134	Small Hollows	
<b>B82</b>	370248.683	6301543.54	Tuart	63	No Obvious Hollows	2
<b>B83</b>	370270.445	6301550.486	Tuart	87	Small Hollows	
<b>B84</b>	370271.284	6301550.386	Tuart	83	No Obvious Hollows	
<b>B85</b>	370274.496	6301553.535	Tuart	120	Small Hollows	
<b>B86</b>	370234.268	6301592.032	Tuart	130	Several Large Hollows	



<b>B87</b>	370455.697	6301793.956	Tuart	145	Several Large Hollows
<b>B88</b>	370450.041	6301778.798	Tuart	113	Several Large Hollows
<b>B89</b>	370456.65	6301750.607	Tuart	59	No Obvious Hollows
<b>B90</b>	370462.738	6301754.348	Tuart	66	No Obvious Hollows
<b>B91</b>	370473.082	6301745.836	Tuart	104	Small Hollows
<b>B92</b>	370496.37	6301722.194	Tuart	120	Several Large Hollows
<b>B93</b>	370506.885	6301728.767	Tuart	94	Several Large Hollows
<b>B94</b>	370533.746	6301750.863	Tuart	95	Several Large Hollows
<b>B95</b>	370524.923	6301756.844	Tuart	72	Small Hollows
<b>B96</b>	370530.355	6301754.033	Tuart	60	No Obvious Hollows
<b>B97</b>	370532.312	6301753.727	Tuart	79	Small Hollows
<b>B98</b>	370547.253	6301763.132	Tuart	62	No Obvious Hollows
<b>B99</b>	370546.202	6301765.225	Tuart	58	Small Hollows
<b>B100</b>	370549.818	6301766.049	Tuart	81	Small Hollows
<b>B101</b>	370562.77	6301778.089	Tuart	90	Small Hollows
<b>B102</b>	370566.371	6301780.023	Tuart	75	Small Hollows
<b>B103</b>	370568.616	6301786.041	Tuart	80	Small Hollows
<b>B104</b>	370565.124	6301796.752	Tuart	88	Small Hollows
<b>B105</b>	370569.165	6301807.563	Tuart	97	Small Hollows
<b>B106</b>	370582.631	6301836.799	Tuart	86	Small Hollows
<b>B107</b>	370595.735	6301809.693	Tuart	60	No Obvious Hollows
<b>B108</b>	370606.119	6301833.01	Tuart	68	Small Hollows
<b>B109</b>	370603.667	6301835.528	Tuart	71	No Obvious Hollows
<b>B110</b>	370605.962	6301837.777	Tuart	93	Small Hollows
<b>B111</b>	370612.394	6301843.63	Tuart	64	Small Hollows
<b>B112</b>	370613.393	6301845.418	Tuart	65	Small Hollows
<b>B113</b>	370618.799	6301858.465	Tuart	105	Several Large Hollows
<b>B114</b>	370619.02	6301876.656	Tuart	72	Small Hollows
<b>B115</b>	370618.506	6301880.309	Tuart	94	Small Hollows
<b>B116</b>	370617.777	6301886.177	Tuart	68	No Obvious Hollows
<b>B117</b>	370612.194	6301893.31	Tuart	82	Several Large Hollows
<b>B118</b>	370609.258	6301904.25	Tuart	93	Small Hollows
<b>B119</b>	370594.58	6301896.069	Tuart	84	No Obvious Hollows
<b>B120</b>	370585.197	6301895.278	Tuart	92	Small Hollows
<b>B121</b>	370581.968	6301886.363	Tuart	102	Several Large Hollows
<b>B122</b>	370579.535	6301873.577	Tuart	84	Small Hollows
<b>B123</b>	370576.709	6301862.338	Tuart	80	No Obvious Hollows
<b>B124</b>	370576.252	6301861.778	Tuart	115	Small Hollows
<b>B125</b>	370601.723	6301855.686	Tuart	94	Small Hollows
<b>B126</b>	370599.998	6301852.558	Tuart	85	Small Hollows
<b>B127</b>	370577.017	6301846.262	Tuart	91	Small Hollows
<b>B128</b>	370553.857	6301832.533	Tuart	160	Small Hollows
<b>B129</b>	370513.875	6301804.051	Tuart	81	Small Hollows
<b>B130</b>	370479.139	6301807.467	Tuart	136	Several Large Hollows
<b>B131</b>	370485.673	6301840.381	Tuart	71	No Obvious Hollows

<b>B132</b>	370489.375	6301876.473	Tuart	88	No Obvious Hollows	
<b>B133</b>	370528.757	6301887.314	Tuart	105	No Obvious Hollows	
<b>B134</b>	370484.809	6301932.75	Tuart	58	No Obvious Hollows	
<b>B135</b>	370495.448	6301943.871	Tuart	90	Small Hollows	
<b>B136</b>	370500.039	6301941.382	Tuart	104	Several Large Hollows	
<b>B137</b>	370497.407	6301943.454	Tuart	96	Several Large Hollows	
<b>B138</b>	370501.82	6301940.297	Tuart	88	Several Large Hollows	
<b>B139</b>	370521.319	6301907.953	Tuart	97	Several Large Hollows	
<b>B140</b>	370579.629	6301936.015	Tuart	90	Small Hollows	
<b>B141</b>	370566.808	6301941.943	Tuart	90	No Obvious Hollows	
<b>B142</b>	370554.547	6301947.768	Tuart	64	Small Hollows	
<b>B143</b>	370541.224	6301956.461	Tuart	90	Several Large Hollows	
<b>B144</b>	370533.763	6301958.025	Tuart	174	Several Large Hollows	
<b>B145</b>	370519.323	6301959.828	Tuart	56	No Obvious Hollows	
<b>B146</b>	370496.48	6301964.069	Tuart	66	No Obvious Hollows	
<b>B147</b>	370471.749	6301963.405	Tuart	67	Small Hollows	
<b>B148</b>	370470.53	6301964.165	Tuart	75	No Obvious Hollows	
<b>B149</b>	370471.596	6301974.826	Tuart	185	Small Hollows	
<b>B150</b>	370472.243	6301975.167	Tuart	62	Small Hollows	
<b>B151</b>	370473.345	6301976.18	Tuart	70	Small Hollows	
<b>B152</b>	370474.83	6301983.408	Tuart	82	Small Hollows	
<b>B153</b>	370482.633	6301991.054	Tuart	62	Small Hollows	
<b>B154</b>	370487.062	6302007.527	Tuart	92	Small Hollows	
<b>B155</b>	370494.705	6302027.147	Tuart	77	Small Hollows	
<b>B156</b>	370495.76	6302052.558	Tuart	101	Small Hollows	
<b>B157</b>	370479.828	6302054.673	Tuart	126	Several Large Hollows	
<b>B158</b>	370493.625	6302066.17	Tuart	135	Several Large Hollows	
<b>B159</b>	370492.378	6302082.899	Tuart	100	Several Large Hollows	Dead
<b>B160</b>	370465.011	6302084.64	Tuart	84	Small Hollows	
<b>B161</b>	370464.467	6302083.523	Tuart	155	Several Large Hollows	
<b>B162</b>	370461.429	6302053.429	Tuart	102	Small Hollows	
<b>B163</b>	370433.244	6302067.69	Tuart	140	Multiple Large Hollows	
<b>B164</b>	370416.084	6302043.395	Tuart	109	Several Large Hollows	
<b>B165</b>	370452.858	6302033.685	Tuart	96	Small Hollows	
<b>B166</b>	370410.565	6302004.062	Tuart	90	Small Hollows	
<b>B167</b>	370412.358	6302002.201	Tuart	82	Small Hollows	
<b>B168</b>	370414.044	6301980.487	Tuart	190	Multiple Large Hollows	
<b>B169</b>	370378.79	6301939.203	Tuart	87	Small Hollows	
<b>B170</b>	370498.358	6302108.597	Tuart	94	Small Hollows	
<b>B171</b>	370509.257	6302121.164	Tuart	108	Small Hollows	
<b>B172</b>	370501.511	6302144.017	Tuart	160	Small Hollows	
<b>B173</b>	370485.602	6302144.358	Tuart	90	Small Hollows	
<b>B174</b>	370480.161	6302154.821	Tuart	75	No Obvious Hollows	
<b>B175</b>	370473.701	6302185.786	Tuart	110	Small Hollows	
<b>B176</b>	370477.422	6302206.575	Tuart	140	Small Hollows	

<b>B177</b>	370507.724	6302180.142	Tuart	112	Several Large Hollows		
<b>B178</b>	370533.64	6302161.747	Tuart	81	Small Hollows		
<b>B179</b>	370540.082	6302152.961	Tuart	88	No Obvious Hollows		
<b>B180</b>	370561.14	6302157.014	Tuart	100	Small Hollows		
<b>B181</b>	370564.007	6302158.272	Tuart	102	No Obvious Hollows		
<b>B182</b>	370567.605	6302160.427	Tuart	55	Small Hollows		
<b>B183</b>	370567.334	6302152.882	Tuart	108	Several Large Hollows		
<b>B184</b>	370573.93	6302153.414	Tuart	51	Small Hollows		
<b>B185</b>	370579.276	6302157.035	Tuart	70	Small Hollows		
<b>B186</b>	370524.778	6302226.283	Tuart	178	Several Large Hollows		
<b>B187</b>	370537.013	6302215.468	Tuart	131	Several Large Hollows		
<b>B188</b>	370558.187	6302217.858	Tuart	82	No Obvious Hollows		
<b>B189</b>	370585.4	6302213.787	Tuart	104	Small Hollows		
<b>B190</b>	370597.863	6302213.731	Tuart	95	Multiple Large Hollows		
<b>B191</b>	370617.392	6302227.855	Tuart	76	No Obvious Hollows		
<b>B192</b>	370628.959	6302239.211	Tuart	64	No Obvious Hollows		
<b>B193</b>	370657.653	6302242.589	Tuart	87	Small Hollows		
<b>B194</b>	370694.147	6302239.972	Tuart	141	Small Hollows		
<b>B195</b>	370700.96	6302321.685	Tuart	80	No Obvious Hollows		Dead
<b>B196</b>	370676.463	6302331.339	Tuart	66	No Obvious Hollows	4	
<b>B197</b>	370633.487	6302345.736	Tuart	85	Several Large Hollows		
<b>B198</b>	370622.767	6302347.478	Tuart	66	No Obvious Hollows		
<b>B199</b>	370605.556	6302354.789	Tuart	58	No Obvious Hollows		
<b>B200</b>	370570.399	6302354.762	Tuart	145	Several Large Hollows		
<b>B201</b>	370555.647	6302365.987	Tuart	113	Several Large Hollows		
<b>B202</b>	370531.052	6302348.136	Tuart	90	Several Large Hollows		
<b>B203</b>	370550.289	6302342.405	Tuart	128	Several Large Hollows		
<b>B204</b>	370574.623	6302337.962	Tuart	97	No Obvious Hollows		
<b>B205</b>	370638.201	6302306.207	Tuart	130	Small Hollows		
<b>B206</b>	370664.13	6302286.814	Tuart	74	No Obvious Hollows		
<b>B207</b>	370628.72	6302243.2	Tuart	80	No Obvious Hollows		
<b>B208</b>	370596.594	6302239.111	Tuart	167	Several Large Hollows		
<b>B210</b>	370544.875	6302441.144	Tuart	102	Small Hollows		
<b>B211</b>	370595.948	6302495.947	Tuart	110	Small Hollows		
<b>B212</b>	370600.555	6302520.074	Tuart	134	Small Hollows		
<b>B213</b>	370617.668	6302485.369	Tuart	50	No Obvious Hollows		
<b>B214</b>	370618.151	6302484.045	Tuart	82	No Obvious Hollows		
<b>B215</b>	370608.785	6302481.923	Tuart	61	Small Hollows		
<b>B216</b>	370608.774	6302468.837	Tuart	72	No Obvious Hollows		
<b>B217</b>	370644.922	6302436.494	Tuart	94	No Obvious Hollows		
<b>B218</b>	370682.167	6302433.443	Tuart	88	Small Hollows		
<b>B219</b>	370699.213	6302431.564	Tuart	90	No Obvious Hollows		Dead
<b>B220</b>	370691.396	6302445.766	Tuart	145	Multiple Large Hollows		
<b>B221</b>	370686.919	6302481.526	Tuart	150	Small Hollows		
<b>B222</b>	370548.885	6302509.845	Tuart	90	Small Hollows		

<b>B223</b>	370333.087 6301948.904	Tuart	104	Small Hollows	2
<b>B224</b>	370332.139 6301929.484	Tuart	90	Small Hollows	2
<b>B225</b>	370336.384 6301924.994	Tuart	123	Small Hollows	
<b>B226</b>	370336.462, 6301884.517	Tuart	108	Several Large Hollows	
<b>B227</b>	370325.428 6301882.04	Tuart	130	Several Large Hollows	
<b>B228</b>	370274.704 6301822.36	Tuart	107	Several Large Hollows	
<b>B229</b>	370898.669 6302330.647	Tuart	117	Several Large Hollows	
<b>B230</b>	370905.903 6302318.212	Tuart	145	Small Hollows	
<b>B231</b>	370889.393 6302217.294	Tuart	240	Multiple Large Hollows	
<b>B232</b>	370860.415 6302005.31	Tuart	75	No Obvious Hollows	2
<b>B233</b>	370861.89 6301922.709	Tuart	165	No Obvious Hollows	
<b>B234</b>	370889.859 6301854.879	Tuart	170	Several Large Hollows	
<b>B235</b>	370897.541 6301676.543	Tuart	155	Several Large Hollows	
<b>B236</b>	370897.635 6301606.788	Tuart	132	Several Large Hollows	
<b>B237</b>	370873.41 6301519.63	Tuart	135	Small Hollows	
<b>B238</b>	370864.703 6301447.317	Jarrah	100	No Obvious Hollows	

Table 3. Coordinates of Western Ringtail Possum (RT) and Western Ringtail Possum Dreys (RTD) found at Harewoods Rd, Gelorup, August 2011.

<b>ID</b>	<b>Easting</b>	<b>Northing</b>
<b>RT01</b>	370263.753	6301584.886
<b>RTD01</b>	371013.059	6301473.585
<b>RTD02</b>	370458.386	6301301.594
<b>RTD03</b>	371298.824	6300895.388
<b>RTD04</b>	370386.417	6301536.626
<b>RTD05</b>	370370.638	6301548.17
<b>RTD06</b>	370277.518	6301668.025
<b>RTD07</b>	370264.627	6301651.438
<b>RTD08</b>	370259.656	6301661.464
<b>RTD09</b>	370219.181	6301621.329
<b>RTD10</b>	370597.969	6302205.859

Table 4. Opportunistic sightings of species in Harewoods Rd site. \* = introduced species

Species Name	RD	ROS	Evidence of presence
<b>BIRDS</b>			
Musk Duck		X	Seen and heard
Black Swan		X	Seen
Australian Shelduck	X	X	Seen and heard
Pacific Black Duck		X	Seen
Black-shouldered Kite		X	Seen
Square-tailed Kite		X	Seen
Whistling Kite	X	X	Seen and heard
Little Eagle	X		Seen
Wedge-tailed Eagle	X		Seen
Swamp Harrier		X	Seen
Nankeen Kestrel		X	Seen
Purple Swamphen		X	Seen and heard
Common Bronzewing		X	Seen
Galah	X		Seen
Western Corella	X		Seen
Regent Parrot	X	X	Seen and heard
Western Rosella		X	Seen and heard
Red-capped Parrot	X	X	Seen and heard
Australian Ringneck	X	X	Seen and heard
Elegant Parrot	X		Seen and heard
Fan-tailed Cuckoo	X	X	Seen and heard
Shining Bronze-Cuckoo	X	X	Seen and heard
Southern Boobook		X	Seen and heard
Tawny Frogmouth	X		Seen
*Laughing Kookaburra	X	X	Seen and heard
Splendid Fairy-wren		X	Seen and heard
Spotted Pardalote	X	X	Heard
Striated Pardalote	X	X	Heard
White-browed Scrubwren		X	Heard
Western Gerygone	X	X	Seen and heard
Inland Thornbill	X	X	Seen and heard
Yellow-rumped Thornbill	X		Seen and heard
Weebill	X	X	Seen and heard
Red Wattlebird	X	X	Seen and heard
White-naped Honeyeater	X		Seen and heard
Brown Honeyeater		X	Heard
Scarlet Robin	X	X	Seen and heard
Varied Sittella	X	X	Seen and heard
Golden Whistler	X	X	Seen and heard
Rufous Whistler	X		Heard
Grey Shrike-thrush	X		Heard
Grey Fantail	X	X	Seen and heard
Willie Wagtail		X	Seen and heard
Black-faced Cuckoo-shrike	X	X	Seen and heard
Dusky Woodswallow	X		Seen and heard
Grey Butcherbird	X	X	Seen and heard
Magpie-lark	X	X	Seen
Australian Magpie	X	X	Seen and heard
Australian Raven	X	X	Seen and heard
Tree Martin	X		Seen and heard
Little Grassbird		X	Heard
Silvereye	X	X	Seen and heard
<b>Total Species</b>	<b>36</b>	<b>40</b>	



<b><u>MAMMALS</u></b>				
Western Ringtail Possum	<i>Pseudocheirus occidentalis</i>		X	Seen, dreys located
Common Brushtail Possum	<i>Trichosurus vulpecula</i>	X		Skull and scats
* Fox	<i>Vulpes vulpes</i>	X	X	Scats, tracks, diggings & seen in ROS.
* European Rabbit	<i>Oryctolagus cuniculus</i>	X	X	Scats, tracks, diggings
* Dog	<i>Canis lupus</i>		X	Tracks
<b>Total Species</b>		<b>3</b>	<b>4</b>	
<b><u>REPTILES</u></b>				
Fence Skink	<i>Cryptoblepharus buechananii</i>		X	Seen
<b>Total Species</b>		<b>0</b>	<b>1</b>	
<b><u>AMPHIBIANS</u></b>				
Motorbike Frog	<i>Litoria moorei</i>		X	Heard
Slender Tree Frog	<i>Litoria adelaidensis</i>		X	Heard
Clicking Froglet	<i>Crinia glauerti</i>		X	Heard
Lea's Froglet	<i>Geocrinia leai</i>		X	Heard
Banjo Frog	<i>Limnodynastes dorsalis</i>		X	Heard
<b>Total Species</b>		<b>0</b>	<b>5</b>	

## 7 APPENDICES

### 7.1 Appendix 1. Categories used in the assessment of conservation status.

**Environment Protection and Biodiversity Conservation (EPBC) Act and the WA Wildlife Conservation Act** [categories from IUCN, based on review by Mace and Stuart (1994)].

Extinct	Taxa not definitely located in the wild during the past 50 years.
Extinct in the wild	Taxa known to survive only in captivity.
Critically Endangered	Taxa facing an extremely high risk of extinction in the wild in the immediate future.
Endangered	Taxa facing a very high risk of extinction in the wild in the near future.
Vulnerable	Taxa facing a very high risk of extinction in the wild in the medium-term future.
Near Threatened	Taxa that risk becoming Vulnerable in the wild.
Conservation Dependent	Taxa whose survival depends upon ongoing conservation measures. Without these measures, a conservation dependent taxon would be classed as Vulnerable or more severely threatened.
Data Deficient	Taxa suspected of being Rare, Vulnerable or Endangered, but whose true status cannot be determined without more information.
Least Concern	Taxa that are not Threatened.

**WA Department of Conservation and Land Management Priority species**  
(species not listed under the Conservation Act, but for which there is some concern).

Schedule 1 (S1)	Fauna that is Rare or Likely to Become Extinct
Schedule 2 (S2)	Fauna that is Presumed to be Extinct
Schedule 3 (S3)	Migratory Birds Protected under an International Agreement
Schedule 4 (S4)	Other Specially Protected Fauna
Priority 1.	Taxa with few, poorly known populations on threatened lands.
Priority 2.	Taxa with few, poorly known populations on conservation lands; or taxa with several, poorly known populations not on conservation lands.
Priority 3.	Taxa with several, poorly known populations, some on conservation lands.
Priority 4.	Taxa in need of monitoring.
Priority 5.	Conservation dependent species.

# WESTERN RINGTAIL POSSUM ASSESSMENT SURVEY

LOTS 315 AND 316  
HAREWOOD'S ROAD

DALYELLUP

DECEMBER 2007

*On behalf of:*



*Prepared by:*

Greg Harewood B.Sc. (Zoology)

A.B.N. 95 536 627 336

PO Box 755

BUNBURY WA 6231

Mobile: 0402 141 197

Telephone (08) 9725 0982 Facsimile (08) 9725 0982

Email: gharewood@iinet.net.au



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## **FIGURES**

Figure 1: Proposal Area and Surrounds

Figure 3: Diurnal Inspection Results – 8<sup>th</sup> December 2007

## **PLATES**

Plate 1: View of vegetation near north east corner of study area.

Plate 2: View of vegetation near north west corner of study area.

Plate 3: View of vegetation near south west corner of study area.

Plate 4: View of vegetation near south east corner of study area.





## **STATEMENT OF LIMITATIONS**

### **Scope of Services**

This environmental site assessment report (“the report”) has been prepared in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Greg Harewood (the Author). In some circumstances the scope of services may have been limited by a range of factors such as time, budget, access and/or site disturbance constraints.

### **Reliance on Data**

In preparing the report, the Author has relied upon data, surveys, analyses, designs, plans and other information provided by the Client and other individuals and organisations, most of which are referred to in the report (“the data”). Except as otherwise stated in the report, the Author has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report (“conclusions”) are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. The Author will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to the Author.

### **Environmental Conclusions**

In accordance with the scope of services, the Author has relied upon the data and has conducted environmental field monitoring and/or testing in the preparation of the report. The nature and extent of monitoring and/or testing conducted is described in the report.

Within the limitations imposed by the scope of services, the monitoring, testing, sampling and preparation of this report have been undertaken and performed in a professional manner, in accordance with generally accepted practices and using a degree of skill and care ordinarily exercised by reputable environmental consultants under similar circumstances. No other warranty, expressed or implied, is made.

### **Report for Benefit of Client**

The report has been prepared for the benefit of the Client and no other party. The Author assumes no responsibility and will not be liable to any other person or organisation for or in relation to any matter dealt with or conclusions expressed in the report, or for any loss or damage suffered by any other person or organisation arising from matters dealt with or conclusions expressed in the report (including without limitation matters arising from any negligent act or omission of The Author or for any loss or damage suffered by any other party relying upon the matters dealt with or conclusions expressed in the report). Other parties should not rely upon the report or the accuracy or completeness of any conclusions and should make their own enquiries and obtain independent advice in relation to such matters.



### **Other Limitations**

The Author will not be liable to update or revise the report to take into account any events or emergent circumstances or facts occurring or becoming apparent after the date of the report.

The scope of services did not include any assessment of the title to or ownership of the properties, buildings and structures referred to in the report nor the application or interpretation of laws in the jurisdiction in which those properties, buildings and structures are located.



## EXECUTIVE SUMMARY

This report has been prepared in response to an invitation from the Piacentini & Sons to carry out a Western Ringtail Possum assessment survey over the eastern most sections of Lots 315 & 316 Harewood's Road, Dalyellup. The study area has a total area of about 34ha.

It is understood that the property is being investigated for the purposes of continuing a sand/limestone extraction project which is currently being carried out on adjacent properties to the north. The results of this assessment will be used to facilitate the controlled and guided development of the site with the principal aim of minimising impacts/potential impacts (if any) on WRPs.

The assessment has included a daytime and two night time surveys for WRP dreys (nests made of vegetation, generally located in trees), tree hollows, scats (droppings) and individuals both within the bounds of the study area.

The vegetation within the study area was found to consist of a park land cleared, very open forest/woodland comprised of Tuart (*Eucalyptus gomphocephala*), Jarrah (*E. marginata*), Marri (*Corymbia calophylla*), Peppermint (*Agonis flexuosa*) and Banksia species over a range of introduced grass species.

Canopy connectivity, a significant component of good WRP habitat, is very poor across the study area. There is no continuous canopy connection across the site with most trees being in very small "groves" or as lone individuals separated by substantial areas (<10m) of grassland or bare sand. Despite the presence of Peppermints, a tree favoured by WRPs in coastal areas of the south west, the lack of canopy connection and any groundcover whatsoever makes the site very marginal as WRP habitat as individuals would need to cross extensive areas of open ground to move into and through the site. This makes individuals utilising the site very prone to predation by, in this area, feral predators such as cats or foxes.

Three WRP dreys, all in a deteriorating condition (i.e. not recently maintain and in the process of falling apart) were observed during the course of a daytime survey of the study area. Forty two trees (mainly tuarts, some dead) were identified as potentially containing hollows suitable for WRPs to use as daytime refuges. It should also be noted that other factors that determined the suitability of a hollow for use by WRPs has not been assessed. For example a large percentage of the trees had no connectivity with any other trees or groups of trees making them very unlikely to be used by WRPs, except possibly on very rare occasions by transient individuals.

WRP scats were found to be very rare and those observed were confined two old (several months) scats under one Peppermint tree near the central section of the northern boundary of the study area.



Two night time surveys were been conducted on foot over the study area using a head torch along close spaced traverses. No WRPs were observed during the course of either nocturnal survey. Three Brushtail Possums were observed within the study area during the first survey and four during the second.

The results of the survey work suggest that the study area is not being utilised on a continuous basis by a population or individuals of a population of WRPs. The small number of deteriorating dreys, the lack of fresh scats and the failure to observe any WRP individuals during nocturnal survey work suggest that WRPs only utilise the site rarely, most likely in the form of transient individuals moving out of more suitable habitat located to the east of the study area. The sites function as a corridor for WRP movement between habitat areas is low given its degraded nature and the lack of any actual connectivity with bush remnants to the west.

In the event that the proposal is approved, standard clearing protocols should be observed to ensure that WRPs, if encountered, are not injured or killed during clearing of the site while facilitating their relocation to retained trees or nearby habitat.

It is the Authors opinion that no DEW referral with respect to WRPs is required for this proposal.



# 1. INTRODUCTION

This report has been prepared in response to an invitation from the Piacentini & Sons to carry out a Western Ringtail Possum (WRP - *Pseudocheirus occidentalis*) assessment survey over the eastern most sections of Lots 315 & 316 Harewood's Road, Dalyellup (the study area - Figure 1). The study area is centred on approximately 33.419558 °S and 115.613390 °E (GDA94) and has a total area of about 34ha. The study area is zoned urban deferred under the recently enacted Greater Bunbury Region Scheme. Currently the site is used to graze sheep.

As the general area is known to be utilised by WRPs, a series of targeted surveys have been carried out with the ultimate aim of formulating a DEC approved WRP management plan, if required, prior to any development proceeding.

It is understood that the property is being investigated for the purposes of continuing a sand/limestone extraction project which is currently being carried out on adjacent properties to the north. The results of this assessment will be used to facilitate the controlled and guided development of the site with the principal aim of minimising impacts/potential impacts (if any) on WRPs.

The assessment has included a daytime and two night time surveys for WRP dreys (nests made of vegetation, generally located in trees), tree hollows, scats (droppings) and individuals both within the bounds of the study area. The amount and quality of WRP habitat within and adjacent to the proposed development site is documented. The value of the site to other fauna has not been assessed.

Western Ringtail Possums are listed as specially protected (Schedule 1 - Fauna that is rare or is likely to become extinct) under the Western Australian Wildlife Conservation Act (1950) and as threatened (vulnerable) under the federal Environmental Protection and Biodiversity Conservation Act (1999). The species distribution has reduced dramatically since European settlement for a number of reasons. Currently, in the general south west area, destruction of habitat is the main threatening process. The management strategies adopted to help maintain the existing populations in the region are aimed at minimising the impact of all types of land development on WRP populations.





## 2. WESTERN RINGTAIL POSSUM ASSESSMENT

### 2.1 WESTERN RINGTAIL POSSUM HABITAT

The Western Ringtail Possum was once located in a variety of habitats including Coastal Peppermint, Coastal Peppermint-Tuart, Jarrah-Marri associations, Sheoak woodland, and eucalypt woodland and mallee. Currently the largest known populations mostly inhabit Peppermint-Eucalypt and Peppermint-Banksia associations from Dawesville to east of Albany, both in natural settings and urban environments. Inland, the largest known populations occur in the Upper Warren area east of Manjimup (Wayne *et al* 2005). In this area the Peppermint tree is naturally absent and jarrah and marri foliage constitutes the species staple diet (Jones *et al* 1994b).

There are two habitat types in the Southern Swan Coastal Plain Region that are particularly important for the Western Ringtail Possum:

Coastal Peppermint (*Agonis flexuosa*) – Peppermint-dominated communities on sand with perched/shallow fresh groundwater that are generally within one kilometre of the coast, including areas where this community occurs as remnants. This habitat type:

- has the highest known density populations, and these populations are necessary for the long term survival and recovery of the species;
- supports western ringtail foraging, breeding, and dispersal to the extent that the area has the highest known western ringtail possum fecundity; and
- includes some habitat where the Common Brushtail Possum (*Trichosurus vulpecula*) does not co-occur with the western ringtail possum.

Myrtaceous / other communities – Communities with mosaic of eucalypt woodlands and forest with varying Peppermint presence, including occasional Peppermint-dominated gullies / sheltered / wet / sandy sites. This habitat type:

- supports western ringtail possum breeding, foraging, dispersal, and genetic exchange between breeding habitats; and
- includes some habitat where the Common Brushtail Possum (*Trichosurus vulpecula*) co-occurs with the western ringtail possum.

The Western Ringtail Possum is distributed where these habitats are intact, and in vegetation remnants where these habitat types occurred. Areas where the



remaining vegetation occurs as isolated remnants or paddock trees can play an important role in connecting larger patches of remaining habitat (DEW 2007).

The Western Ringtail Possum is highly arboreal, feeding, resting and socialising in the canopy, rarely venturing to the ground. In coastal areas, where Peppermints are dominant, hollow bearing trees are relatively rare and dreys, constructed in any suitable tree or bush, are the usual daytime rest site. However, when present, hollows within eucalypts or peppermints are favoured (Jones *et al.* 1994a).

Other daytime refuges known to be used included Balga Bush (grasstrees), rabbit warrens (when concealed by thick ground cover) and dense ground cover such as Coastal Sword Sedge (*Lepidosperma gladiatum*). Within urban areas, almost any large shrub or tree with sufficiently dense foliage (or hollows) has the potential to be utilised for daytime refuge and drey construction. WRPs will also utilise suitable man made structures such as roof cavities and broad, flat support beams in sheds for day time refuges (G. Harewood pers. obs.).

WRPs maintain a relatively small and stable home range. In dense, coastal Peppermint forest, home ranges vary from about 0.5 hectares to 1.5 hectares (for a circular home range this translates to a 40m to 70m radius from a central point) and in Tuart dominated eucalypt forests about 2.5 hectares (about a 90m radius from a central point). In contrast, in the northern jarrah forests, home ranges are larger and have been recorded to at least 5.6 hectares (about a 135m radius from a central point). Regardless of forest type, individuals have been observed to use three to eight different nest sites (dreys or hollow trees) in the course of a year. Adjacent home ranges can overlap as much as 70 per cent (Jones 1995).

Social activity occurs at night, primarily by investigation of scent trails on tree limbs (marked with urine) and males may visit adjacent female home ranges. In some populations, most young disperse to home ranges adjacent to the natal range but in high-density groups, young can travel across several home ranges (Jones 1995).

Peppermint (*Agonis flexuosa*) leaves form the basis of the WRP diet in coastal areas, but when unavailable, the dominant myrtaceous species are eaten. In the inland forest, Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) are the main food source (Jones 1994a). Within urban areas a range of non-endemic and exotic plant species are also eaten (Greg Harewood pers. obs.).

### 2.1.1 WRP Habitats within Development Site

The vegetation within the project area was examined on the 8<sup>th</sup> of December, 2007. The vegetation within the study area was found to consist of a park land



cleared, very open forest/woodland comprised of Tuart (*Eucalyptus gomphocephala*), Jarrah (*E. marginata*), Marri (*Corymbia calophylla*), Peppermint (*Agonis flexuosa*) and Banksia species over a range of introduced grass species. The vegetation is an example of highly degraded Karrakatta complex. Tuarts are most common in the western three quarters of the property on the slope and crest of the dunal feature that runs north/south across the study area. Banksia, Peppermint, Jarrah and Marri, are more dominant in lower areas in the eastern third of the study area.

Canopy connectivity, a significant component of good WRP habitat, is very poor across the study area. There is no continuous canopy connection across the site with most trees being in very small "groves" or as lone individuals separated by substantial areas (<10m) of grassland or bare sand. Despite the presence of Peppermints, a tree favoured by WRPs in coastal areas of the south west, the lack of canopy connection and any groundcover whatsoever makes the site very marginal as WRP habitat as individuals would need to cross extensive areas of open ground to move into and through the site. This makes individuals utilising the site very prone to predation by, in this area, feral predators such as cats or foxes. Even in areas where canopy connection is continuous feral cats are known to have a substantial impact of WRPs (e.g. Leschenault Peninsula)

Plates 1 to 4 illustrate the nature of vegetation remaining on the site.

### 2.1.2 WRP Habitats adjacent to Development Site

Suitable habitat for WRPs is known to be present in several areas in close proximity to the study area including bush remnants at Dalyellup and College Grove to the north, Gelorup to the east and Stratham to the south (Greg Harewood pers. obs.).

The closest area of known WRP habitat is the System 6 Reserve (C71) that adjoins the study area to the east and extends from north of Harewood's Road, south to Lakes Road. The area consists of a *Banksia attenuata* Woodland with emergent Jarrah and Marri with a Peppermint midstorey. The Author does not have access to specific data relating to WRP population numbers in this area but it is understood that DEC PhD students are carrying out regular monitoring of WRPs within this bush remnant. Population densities are however relatively low compared to some other nearby area and are less than one individual per hectare (Barbara Jones pers. obs.).

The bush remnants in the general study area have been identified as part of the Dalyellup/Gelorup/Crooked Brook Ecological Linkage (WAPC 2000) and a conceptual corridor exists between the System 6 Reserve and wetland and coast vegetation west of the study area.



## 2.2 DIURNAL SITE INSPECTION

A daytime survey was conducted on foot over the study area on December 8<sup>th</sup>, 2007. The aim of the survey was to document the presence of dreys, hollows, scats and individual WRPs. Figure 2 shows the results of the daytime site inspection.

Three dreys, all in a deteriorating condition (i.e. not recently maintain and in the process of falling apart) were observed within the study area.

Fourty two trees (mainly tuarts, some dead) were identified as potentially containing hollows suitable for WRPs to use as daytime refuges. It should also be noted that other factors that determined the suitability of a hollow for use by WRPs has not been assessed. For example a large percentage of the trees had no connectivity with any other trees or groups of trees making them very unlikely to be used by WRPs, except possibly on very rare occasions by transient individuals.

WRP scats were found to be very rare and those observed were confined two old (several months) scats under one Peppermint tree near the central section of the northern boundary of the study area.

## 2.3 NOCTURNAL COUNTS

Two night time surveys were conducted on foot over the study area on December 8<sup>th</sup> and 21<sup>st</sup>, 2007 using a head torch along close spaced traverses. The aim of the survey work was to document the distribution and abundance of WRPs within the study area.

No WRPs were observed during the course of either nocturnal survey. Three Brushtail Possums were observed within the study area during the first survey and four during the second.



### **3. POTENTIAL IMPACT AND MANAGEMENT OPTIONS**

#### **3.1 HABITAT IMPACT**

The results of the survey work suggest that the study area is not being utilised on a continuous basis by a population or individuals of a population of WRPs. The small number of deteriorating dreys, the lack of fresh scats and the failure to observe any WRP individuals during nocturnal survey work suggest that WRPs only utilise the site rarely, most likely in the form of transient individuals moving out of more suitable habitat located to the east of the study area.

These observations are consistent with previous surveys carried out in similar remnant vegetation units directly north of the study area (Lots 313 and 314).

The habitat within the study area must also be regarded as very marginal given the generally wide spacing between trees making it necessary for WRPs to cross extensive areas of bare ground to move into and around the site. Any WRPs that do move into the site would have a high risk of predation by introduced feral predators which undoubtedly inhabit the general area. The value of the site as a corridor for WRP movement is also low given the abovementioned facts and also because there is no actual direct linkage with vegetation to the west, the direction of the conceptual Dalyellup/Gelorup/Crooked Brook Ecological Linkage.

#### **3.2 MANAGEMENT OPTIONS**

Given that WRPs are not likely to be utilising the site on a continuous basis no specific WRP management plan is proposed. When clearing is undertaken standard DEC protocols should be followed. These are typically set as conditions with the permit to clear and require the presence of a qualified "fauna spotter" to supervise activities with the aim of reducing the chances of significant native fauna of any kind being injured or killed during clearing. If WRPs are by chance encountered they should either be herded to retained vegetation on site or captured and released into the adjoining reserve to the east.





## 4. LEGISLATIVE OBLIGATIONS

### 4.1 ENVIRONMENTAL PROTECTION ACT 1986

The purpose of the Environmental Protection Act (1986) is “...to provide for an Environmental Protection Authority, for the prevention, control and abatement of pollution and environmental harm, for the conservation, preservation, protection enhancement and management of the environment and for matters incidental to or connected with the foregoing”.

The powers of the Environmental Protection Act 1986 are administered by the Department of Environment and Conservation (DEC), which in relevant cases advises the Environmental Protection Authority (EPA). The jurisdiction of the DEC comprises the protection of environmental systems, pollution prevention and waste management. In particular, the DEC manages and protects rivers, streams, creeks, estuaries, drains, wetlands and groundwater, but not marine waters, of Western Australia (WA).

New legislation proclaimed on 8 July 2004 now protects all native vegetation in WA. Under the new law, clearing native vegetation is prohibited, unless a clearing permit is granted by the DEC, or the clearing is for an exempt purpose. These exemptions ensure that low impact day to day activities involving clearing can be undertaken. People that wish to clear are required to submit an application if an exemption does not apply. There are two types of clearing permits – an area permit and a purpose permit. In respect to the proposal in an area permit will be required and there the project will be assessed against the ten clearing principles below relating to native vegetation in the EP Act. These principles provide a guide for when native vegetation should not be cleared. The DEC must consider these principles in making a decision on whether or not to issue a clearing permit.

Native vegetation should not be cleared if:

- (a) it comprises a high level of biological diversity;
- (b) it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia;
- (c) it includes, or is necessary for the continued existence of, rare flora;
- (d) it comprises the whole or a part of, or is necessary for the maintenance of a threatened ecological community;
- (e) it is significant as a remnant of native vegetation in an area that has been extensively cleared;



- (f) it is growing in, or in association with, an environment associated with a watercourse or wetland;
- (g) the clearing of the vegetation is likely to cause appreciable land degradation;
- (h) the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area;
- (i) the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water; or
- (j) clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.

One purpose of the Western Ringtail Possum Survey reported on here is to provide information relevant to principle (b). Based on the survey results it is the author's opinion that the site doesn't constitute the whole or a part of, or is necessary for the maintenance of, a significant habitat for the Western Ringtail Possum in the area. This opinion is based on the fact that the site appears to only be used rarely by WRPs in the form of transient individuals, the very marginal quality of the habitat and the lack of functionality as a corridor for WRP movement between bush remnants in the area.

#### **4.2 COMMONWEALTH ENVIRONMENTAL PROTECTION & BIODIVERSITY CONSERVATION ACT 1999**

Western Ringtail Possums are listed as vulnerable under the federal *Environmental Protection and Biodiversity Conservation Act* (1999). The objective of the EPBC Act is to provide for the protection of the environment, especially those aspects that are of national significance, promote ecologically sustainable development, the conservation of biodiversity and a cooperative approach to the protection and management of the environment.

If an action (i.e. the proposed development) is deemed to have a potential significant impact on listed species a referral to the Department of the Environment and Water Resources (DEW, formerly the DEH) is required.

Taking into consideration the EPBC Act "Principal Significant impact Guidelines 1.1" (DEH 2006 – Significant Impact Criteria, Vulnerable Species, page 12) it is considered by the Author that any proposed development of the site will not result in a significant impact (as defined in the abovementioned document) to the Western Ringtail Possum population principally because the site is only rarely used by WRPs and it can not be considered of significance to them. It is therefore considered that the referral of the proposal to the DEW is not required.



It should also be noted that the Significant Impact Guidelines have recently undergone a review and new draft policy guidelines exist though not officially released/enacted. Within this document the definition of “significant impact” has been redefined and having regards to the current understanding of Western Ringtail Possum (WRP) ecology the Australian Government believes that an action is likely to have a significant impact on the WRP in the Southern Swan Coastal Plain Region if it:

- reduces the ability of the region to support the persistence of the western ringtail possum;
- modifies, destroys, removes or isolates important remnant habitat patches, or decreases the availability or quality of remnant habitat patches;
- adversely affects connections between important areas; or
- interferes substantially with the ability of the area to effectively contribute to the recovery of the species.

The revised guidelines have categorised certain areas between Bunbury and Dunsborough as “Core Habitat”, “Supporting Habitat” or “Primary Corridors”. The study area falls within an area defined as “Core Habitat” (also referred to as Area 1). As defined in the revised guidelines a significant impact on WRPs is deemed as “likely” if there is a real chance or possibility that an action within in the defined in Area 1 will result in:

- any clearing of a remnant habitat patch greater than 0.5 hectares in size;
- the clearing of more than 50% of a remnant habitat patch that is between 0.1 and 0.5 hectares in size;
- the fragmentation of any existing habitat linkages; or

Within the draft guidelines document an “important remnant habitat patch” is defined as:

“an area of native vegetation used or occupied by the Western Ringtail Possum that is greater than 0.1 hectares in size in core habitat areas and primary corridors or 0.2 hectares in size in supporting habitat areas. A patch is an area with more than 30% Peppermint tree canopy cover that is disjunct”.

The study area falls within the highest ranked Core Habitat area. Significant impact in this area is defined as possibly occurring when any area of potential WRP habitat greater than or equal to 0.5ha is to be cleared. For smaller areas between 0.1 and 0.5 ha in size, significant impact is defined as possible if greater than 50% of the area is to be cleared.



While the clearing required for the proposal to proceed will far exceed 0.5 hectares the vegetation on site is already parkland cleared and no one section of vegetation within the study area would appear to qualify as an “important remnant habitat patch” as canopy connectivity is very fragmented over the entire site and the minimum 0.1ha threshold is therefore not reached in any case. In addition the very marginal quality of the habitat and the lack of direct connectivity with other potential significant WRP habitat means that clearing at any level will not sever any existing WRP habitat linkages.

It is therefore concluded that, if the abovementioned criteria are applied to the project proposal area, in the Authors opinion, a significant impact to WRPs is not “likely” mainly given that the defined thresholds required to trigger referral are not exceeded.

### **4.3 WILDLIFE CONSERVATION ACT 1950**

The objective of the *Wildlife Conservation Act 1950* is to provide for the protection of wildlife. The Act is administered by the Executive Director of the Department of Conservation and Land Management, under the direction and control of the Minister for the Environment. Under section 14, “Protection of fauna”, of this Act, all fauna is wholly protected throughout the State at all times, unless declared by the Minister by notice in the Government Gazette. Under section 14(2)(ba) of The Act, Fauna Notices are made by the Minister for the Environment listing specially protected fauna.

Disturbance or destruction of any native fauna over and above that reasonably required for construction works and access is considered an offence under the Act and the developer should take the necessary steps to inform construction personal of this fact.



## 5. CONCLUSION

The results of this WRP assessment over the study area indicate that the site does not represent significant habitat for WRPs mainly due to the parkland cleared nature of the site (wide spacing between trees and lack of understorey or groundcover). Observations made in the field suggest the site is probably only used rarely by transient individuals which originate from the nearby reserve to the east where WRPs are known to exist at low population densities. The site's function as a corridor for WRP movement between habitat areas is also low given its degraded nature and the lack of any actual connectivity with bush remnants to the west.

In the event that the proposal is approved, standard clearing protocols should be observed to ensure that WRPs, if encountered, are not injured or killed during clearing of the site while facilitating their relocation to retained trees or nearby habitat.

It is the Authors' opinion that no DEW referral with respect to WRPs is required for this proposal.



## 6. REFERENCES

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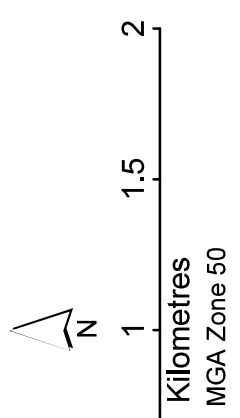


# FIGURES





	<b>WRP Assessment</b> DRAWN: G. Harewood DATE: Dec 2007 SCALE: 1:25,000
	<b>Lot 315 and 316</b> <b>Harewood's Road, Dalyellup</b> <b>Proposal Area and Surrounds</b>







- Legend**
-  Cadastral Boundaries (Existing)
  -  Study Area





**Legend**

-  Cadastral Boundaries (Existing)
-  Study Area
-  Tree with Potential Hollows
-  WRP Drey (all in deteriorating condition)



	WRP Assessment
DRAWN/G: Harewood	
DATE: Dec 2007	
SCALE: 1:5,000	

Lot 315 and 316  
 Harewood's Road, Dalyellup  
**Diurnal Inspection Results**  
**8th Dec 2007**



# PLATES





Plate 1: View of vegetation near north east corner of study area.



Plate 2: View of vegetation near north west corner of study area.







Plate 3: View of vegetation near south west corner of study area.



Plate 4: View of vegetation near south west corner of study area.



# **Appendix H**

## **Stormwater Management (Excerpt from Engineer's Report)**

### ***Sewer Reticulation Summary***

The subject site falls within a Water Corporation servicing area;

The Overall Sewer Catchment, incorporating post development flows from the subject site and external catchments, requires the construction of 2 x Wastewater Pumping stations. Flow from both pumping stations (Catchments 1 and 2) will discharge into Catchment 3, which comprises a gravity system;

Preliminary design indicates that the Pump Stations required for the subject site will be sized as a Type 40;

Catchment 3 (incorporating flows from Catchments 1 and 2) will then discharge (via gravity) into an existing Water Corporation system located in Sherwood Drive ( at intersection with Harewoods Road ) at Invert Level 7.40m AHD;

The subject site is capable of being serviced with sewer reticulation, subject to detailed design and Water Corporation approval.

## **7.2 Roadworks**

Based on the Local Structure Plan, a conceptual internal road layout has been prepared as shown on the Wood and Grieve Engineers', Road Plans (Ref: 19433-BUC-C/R1/R2), included as Appendix F.

The plan shows an overall layout and proposed pavement widths, these would be subject to detailed design and formal approval by the Shire of Capel.

Discussions with Traffic Engineers, Shawmac Pty Ltd Consulting Engineers indicate that the proposed subdivision will increase the traffic flow on Harewoods Road to approximately 8,000 vehicles per day (VPD). Based on this predicted increase in traffic volume a detailed analysis regarding the capacity and safety of the Harewoods Road, Bussell Highway intersection will be undertaken at detailed design stage.

The construction of Harewoods Road to Shire of Capel standards will be required where it abuts the subject site.

## **7.3 Stormwater**

The main areas of focus for investigations into proposed stormwater drainage treatment for the subject site were as follows:

- To review sizes of the basins required to confirm that they could be accommodated in the Public Open Space areas, as shown on RPS' Local Structure Plan, refer Appendix A;
- To review the locations of the Public Open Space areas to confirm that adequate spacing and logical positioning of basins were workable within the constraints of the earthworks design.
- Confirm that adequate flood routing of large storm events could be achieved, considering the size, spacing and locations of the Public Open Space areas.
- To demonstrate that a water management system has been planned and proposed to be adopted for development.
- To minimise urban impact on the landscape and improve management of the urban water cycle.
- To calculate the area of storage required in each catchment for the 1 year ARI event. These areas are used by the Local Authority to determine active and passive percentages and POS contributions by the developer.



In order to provide a size estimate of the proposed infiltration/detention basins the subject site has been divided into seven (7) catchment areas as shown on the Wood and Grieve Engineers', Post Development Stormwater Catchment Plan (Ref: 19433-BUC-C-R3) included as Appendix G. The catchments are based on public open designations as shown on the RPS' Local Structure Plan, refer to Appendix A.

Key principles of the drainage management for this development will include:

- Protect natural hydrological systems
- Integrate stormwater treatment into the landscape
- Protect water quality
- Manage peak run-off flows
- Add value whilst minimising development and future infrastructure costs

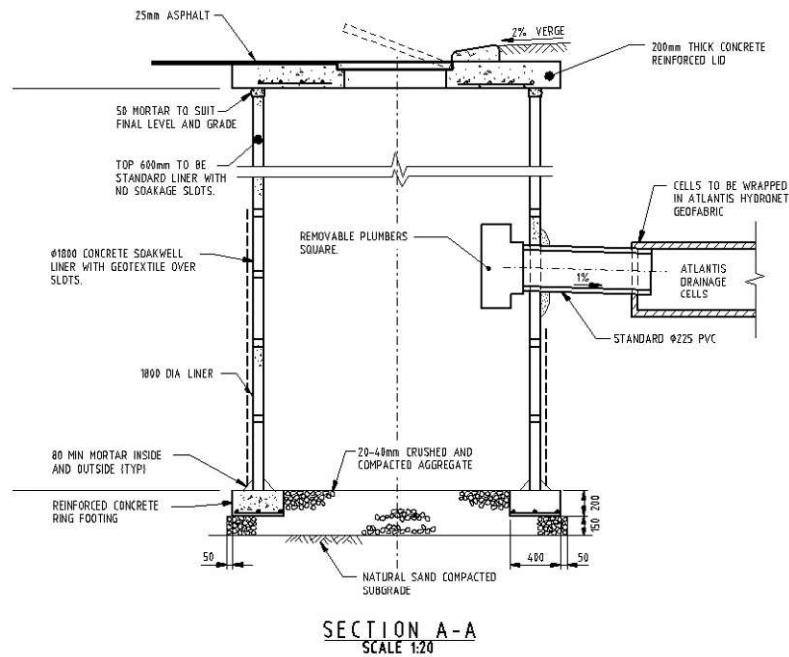
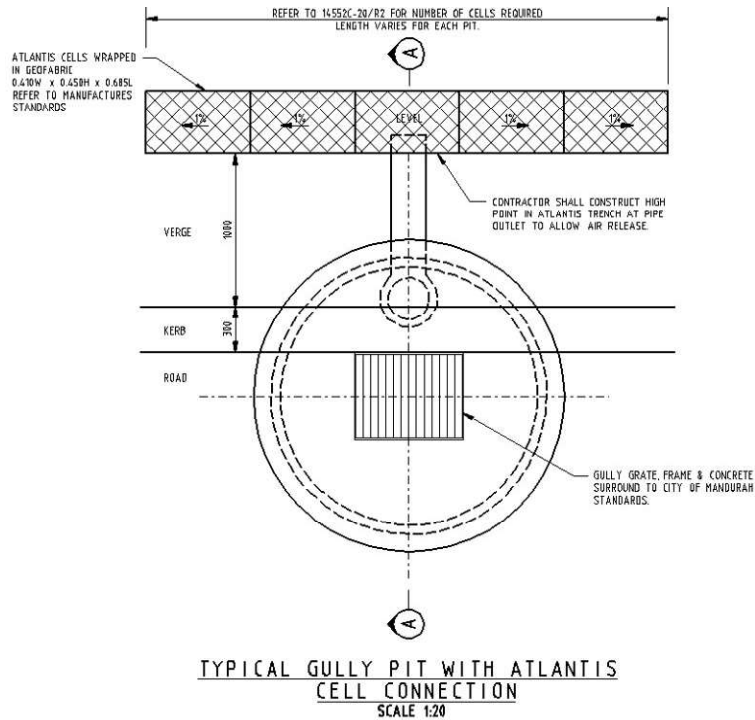
Through discussions with the Project Team and Shire of Capel, a concept has been adopted that will allow retention and infiltration of the 1 year ARI storm event at source to enable heavy metals present within the water to be captured and stored in areas away from public and recreation areas. This concept has been agreed in principle with the Shire of Capel and Client due to the permeable nature of the in-situ soils and adequate clearance to groundwater.

Retention of the 1 year ARI event upstream will allow the development to provide seasonally dry basins that will allow for major stormwater retention and blend well with the surrounding eco-systems throughout the Estate.

This above concept has been adopted throughout developments by Wood and Grieve and has been accepted as good stormwater management by the City of Mandurah.

Details following show general arrangement of the structural components of the concept.



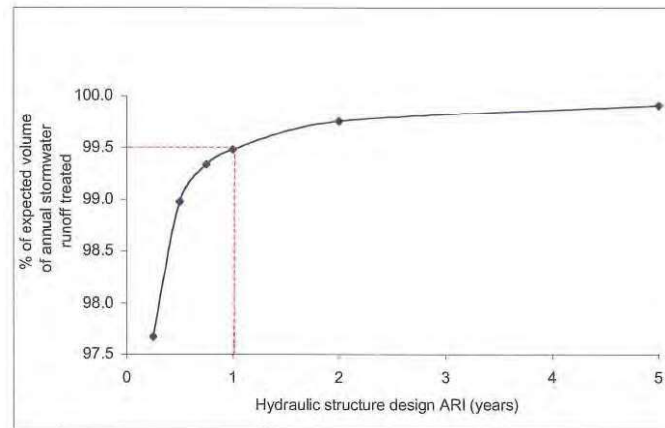


NOTES : CONTRACTOR SHALL ENSURE COMPACTION OF BASE AND BACKFILL MATERIAL TO LINER IS IN ACCORDANCE WITH THE SPECIFICATION AND UNIFORM.



The ability to retain stormwater events up to a 1 year ARI effectively enables infiltration of approximately 99.5% of the annual stormwater runoff. Refer Table 6.

Table 6. Treatment efficiency of stormwater hydraulic structures for Perth, Western Australia (adapted from Wong, 1999)



Design rainfall intensity data has been calculated in accordance with Australian Rainfall and Run-off for Bunbury (33.3 South 115.63 East). The post development stormwater hydrology is summarised in Table 7 below.

Detailed design of stormwater pipe drainage systems will be undertaken at subdivision design stage.

Table 7: Post Development Catchment Information

Catchment	Road Reserve Area (ha)	Flow Length (m)	Fall (m)
A	4.2702	575	16.2
B	3.7621	500	14.6
C	3.3776	500	1.0
D	5.6280	754	9.2
E	1.9740	613	2.2
F	2.0859	331	7.4
G	1.7639	467	4.4



The volume required to store and infiltrate the major storm events in each catchment have been estimated using a saturated infiltration rate of 3m/day. The necessary storage volume is sensitive to the assumed infiltration rate and detailed percolation testing should be undertaken at a later stage of the design process to confirm the infiltration capacity of the sand. A factor of safety to account for long term sedimentation should also be included in future designs.

The seasonally dry basins which allow for additional runoff from the 1 year ARI events are shown in Table 8 below. These requirements are used by the Local Authority to determine active and passive areas of POS drainage contributions and are sized to store up to a depth of 300mm.

Table 8: Preliminary 1 Year AYI Basin Sizing

Catchment ID	1 Year ARI		
	Infiltration Volume (m <sup>3</sup> )	Base Area (m <sup>2</sup> )	Top Area (m <sup>2</sup> )
A	175	510	664
B	74	205	307
C	182	540	698
D	160	465	613
E	48	125	207
F	85	235	343
G	0	0	0
TOTAL	724	2080	2832

The basin areas required to infiltrate the 10 and 100 year ARI storm events up to and including the 72hr duration are provided within Table 9 below. The basin areas are based on limiting the depth of water in the basins to 1.2m. Side slopes of 1 (V) to 6 (H) have been adopted to estimate the top area.

Table 9: Preliminary Infiltration Basin Sizing.

Catchment ID	10 Year ARI			100 Year ARI		
	Infiltration Volume (m <sup>3</sup> )	Base Area (m <sup>2</sup> )	Top Area (m <sup>2</sup> )	Infiltration Volume (m <sup>3</sup> )	Base Area (m <sup>2</sup> )	Top Area (m <sup>2</sup> )
A	863	1056	1732	2214	1066	2215
B	676	866	1484	1427	870	2090
C	620	1005	1666	1439	822	1855
D	1064	1415	2118	2162	1490	2810
E	391	412	874	802	407	1195
F	420	450	941	873	460	1285
G	350	347	808	696	347	1090



### **Stormwater Drainage Summary**

- Stormwater drainage will be carried via concrete pipe and channel drainage systems for roads wider than 6.0m to detention basins located in Public Open Space Areas. Pipes will carry up to the 1 in 5 year storm event;
- For 6.0m wide roads and smaller a combination of soakwells and atlantis cells will be used to store the 1 year ARI storm events where possible;
- Access chambers will be constructed with soakage under-lays, as per Shire of Capel standards.
- Basins located within Public Open Space areas will retain and infiltrate the 10 year average recurrence interval (ARI) storm event for all durations up to and including the 72 hour event;
- Run-off for events up to and including the design 100 year ARI event as overland flow within road reserves and Public Open Space areas;
- Run-off from events greater than the 10 year ARI events and up to and including the 1 in 100 year ARI design storm shall be detained on site.
- Preliminary sizing of the drainage basin requirements for the 1 in 10 year and 1 in 100 year storms has been undertaken, the results are tabled above and shown graphically on drawing No. 19433-BUS-C/R3, refer Appendix G. Graphical representation of the basins is shown to scale, however, location and final shape may vary subject to detailed design and incorporation of landscaping considerations;
- Design depth of basins is 0.8m and 1.2m for the 1 in 10 and 1 in 100 year storm events, respectively;
- Current Public Open Space locations and sizes as shown on the RPS' Local Structure Plan have adequate size and are strategically located to cater for stormwater run-off for the proposed development.

## **7.4 Water Supply**

Our investigations have found that servicing of the subject site will be via a connection to the existing 200mm diameter main located within the Minninup Road / Maidment Parade road reserve.

We have undertaken preliminary layout and sizing design based on the above connection point, refer to Water Reticulation Plan, Appendix H.

REV.	DESCRIPTION	DWN	UPD'D	APPROVED
A	ISSUE FOR PERMIT			
B	REVISED P.O.S. LAYOUT			
C	REVISED PLANNING LAYOUT, CATCHMENTS SHOWN			

NOTES

- 1. POST DEVELOPMENT DRAINAGE CATCHMENTS ARE BASED ON PRELIMINARY ROAD WORKS AND EARTHWORKS DEMANDS (THESE ARE NOT SHOWN ON THE PLAN).
- 2. DRAINAGE AREAS ARE BASED ON PRELIMINARY ACCEPTED CONCEPTS OF THE WORK, UNLESS SHOWN OTHERWISE IN PARALLEL AREAS TO CONTAIN THE ACHIEVED, AND ASSOCIATED VOLUMES.

LEGEND

- CATCHMENT BOUNDARY
- DIRECTION OF DRAINAGE PLAN (LONG ROADS BASED ON PRELIMINARY ROAD LEVEL DESIGN)
- ⓐ CATCHMENT DESIGNATION

CATCHMENT	P.O.S. AREA (ha)	1 IN 1 YEAR BASIN TOP AREA (m <sup>2</sup> )	1 IN 100 YEAR BASIN TOP AREA (m <sup>2</sup> )
A	0.8886	664	2215
B	0.2614	307	2090
C	0.6231	698	1855
D	1.0100	613	2810
E	3.8800	207	1195
F	1.2600	343	1285
G	0	N/A	N/A

CATCHMENT	ROAD RESERVE AREA (ha)	TOTAL LOT AREA (ha)	P.O.S. AREA (ha)	TOTAL CATCHMENT AREA (ha)
A	4.2702	7.4870	0.8886	12.6458
B	3.7621	6.7310	0.2614	10.7545
C	3.3776	6.1457	0.6231	10.1464
D	5.6208	12.2428	1.0100	18.8808
E	1.9740	3.0558	3.8800	8.9098
F	2.0859	2.5146	1.2600	5.8605
G	1.7639	5.4019	-	7.1658



**WOOD & ORIENTE ENGINEERING**  
 10000 101ST AVE. S.W.  
 SUITE 1000  
 BURNABY, B.C. V5A 4E4  
 TEL: 604-291-0844  
 FAX: 604-291-0845  
 WWW.WOODORIENTE.COM

CLIENT: PIACENTINI & SON PTY LTD  
 PROJECT: LOT 313-316 MINNIPUP ROAD, GELORUP  
 TITLE: POST DEVELOPMENT STORMWATER CATCHMENT PLAN

DESIGNER: K. GORHAM  
 DRAWN: K. GORHAM  
 APPROVED: K. GORHAM  
 DATE: 10/10/2019

SCALE: 1:5000 (B) / 1:10000 (A) / 1:15000 (C)

PLAN  
 SCALE 1:5000 (B) / 1:10000 (A) / 1:15000 (C)

LOT 31

EXISTING WETLAND