Flora, Vegetation, Fauna and Wetland Assessment Mandogalup

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Cardno BSD Pty Ltd

EXECUTIVE SUMMARY

In 2005, Mandogalup Land Development Company (MLDC) acquired a large land holding within the locality of Mandogalup. The land is identified within the Draft Jandakot Structure Plan as being suitable for future urban development.

The land is generally bound by the Kwinana Freeway to the east, Mandogalup Road to the west, Rowley Road to the north, and Anketell Road to the south (shown on **Figure 1**). This survey report provides more detailed and site specific information to progress planning for the subject area and to support future structure planning and rezoning processes. The advice and recommendations contained within this survey report refer to the subject area and the developer's intention to develop the parcels into medium density residential lots.

The Mandogalup site is largely degraded due to historic and current agricultural land uses of market gardening and grazing. The vegetation onsite varies from "Very Degraded" to "Excellent" condition. The northeast corner of the site retains "Excellent" condition vegetation.

During the survey no Declared Rare, Priority or significant flora species were located within the site pursuant to the *Wildlife Conservation Act 1950 or the Environmental Protection* and *Biodiversity Conservation Act 1999*. No TEC's were located during the time of the survey and none are thought to occur within a 5km radius of the site

The Mandogalup study site contains a variety of fauna habitats and a number of fauna species of conservation significance were identified as utilising or potentially utilising the site. Development of the site also has the potential to restrict the movement of some fauna species as the area forms part of an identified ecological linkage and wildlife corridor. Future planning for the Mandogalup site should aim to retain remnant vegetation with the aim on maintaining and enhancing linkages between areas of remnant vegetation both within the site and adjoining areas.

The ecological linkage value of the site was acknowledged in the Bush Forever document. (Bush Forever, 2000), and contiguous corridors or greenways of bushlands and wetlands are proposed to the west of Kwinana Freeway from Rockingham to Murdoch joining Thomson, Yangebup, Bibra and North lakes, which passes through the Mandogalup site. (shown on **Figure 6**). Greenways are natural corridors proposed as linkages between declared public open space such as local regional or national parks, stream reserves, wetlands and beaches.

The Town of Kwinana has indicated that 10% of land within the subject area should be retained as POS, with 2% to be allocated for community and recreation, The further 8% will be allocated to the most significant vegetation with less significant areas of vegetation to be retained within road reserves and similar areas.

Development of the site has the potential to restrict the movement of some fauna species as the area forms part of an identified ecological linkage and wildlife corridor. Future planning for the Mandogalup site is likely to require consideration of retention of some of these linkage functions.

All of the wetlands recorded on site are degraded but still retain wetland dependant vegetation and important hydrological functions. It is recommended that the five identifies wetlands retain their current management categories, however there appears opportunity to reclassify the current wetland boundaries for each. There also exists some opportunity for incorporation of these areas into future planning for POS or similar land retention.

It is not recommended to alter the current boundaries of the five identified wetland boundaries, as it will not affect the structure plan. Multiple Use and Resource Enhancement wetlands do not require preservation, however it is important restore and retain hydrological function and wetland vegetation where possible.

It is believed that the development of the site would not pose a significant or unacceptable impact on flora, vegetation, fauna or wetlands, However Cardno BSD provide the following recommendations:

- Where possible retain "Good" to "Excellent" vegetation within areas of POS, and this should be discussed further with the City of Kwinana;
- A native corridor should be maintained in the north east corner to maintain native fauna movement and preserve fauna habitat;
- Current wetland management categories are appropriate; and
- There is potential for the inclusion of a number of wetlands areas within future planning as areas of Public Open Space (POS).

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1. INTRODUCTION

1.1 BACKGROUND

In 2005, Mandogalup Land Development Company (MLDC) acquired a large land holding within the locality of Mandogalup. The land is identified within the Draft Jandakot Structure Plan as being suitable for future urban development. MLDC intend to secure the appropriate zoning over the land to facilitate this and ultimately subdivide the land for residential and associated purposes.

These parcels, totalling approximately 167 hectares, include the following titles:

- Lot 669 on Plan 202618, Vol 1910, Folio 829;
- Lot 16 on Plan 9780, Vol 533, Folio 188A;
- Lot 664 on Plan 202790, Vol 1228, Folio 688 (104 Mandogalup Road);
- Lot 791 on Plan 202790, Vol 1259, Folio 344 (10 Norkett Road);
- Lot 663 on Plan 202790, Vol 1798, Folio 681 (40 Norkett Road);
- Lot 682 on Plan 3475, Vol 2005, Folio 989 (Lot 682 Rowley Road); and
- Lot 668 on Plan 202618, Vol 45, Folio 321A (20 Mandogalup Road).

The land detailed above is referred to herein as the "subject area" and is generally bound by the Kwinana Freeway to the east, Mandogalup Road to the west, Rowley Road to the north, and Anketell Road to the south (shown on **Figure 1**). The subject area is included within the JSP and environmental issues and constraints for the entire JSP have been summarised in the associated JSP report. This survey report provides more detailed and site specific information to progress planning for the subject area and to support future structure planning and rezoning processes.

The advice and recommendations contained within this survey report refer to the subject area and the developer's intention to develop the parcels into medium density residential lots.

1.2 PURPOSE OF THIS REPORT

For the rezoning process to progress for the subject area a review of any environmental constraints that may impact upon the proposed future development and a biological survey of fauna, vegetation and flora is generally required. The purpose of this environmental assessment is to investigate remnant vegetation, flora, fauna, wetlands and ecological links that may be present and confirm or otherwise that any issues can be accommodated during the subsequent planning process. Other environmental considerations are not discussed within this document and will be the subject of future work.

This report has been prepared to document the significant environment factors that are likely to be raised and/or queried during rezoning processes, particularly in relation to the overall ecological significance of the site

In summary this report provides:

- A review of existing flora and vegetation information including Declared Rare Flora (DRF), Threatened Ecological Communities (TEC), Bush Forever, and information held by the Local Government (local biodiversity initiatives);
- A review of threatened fauna information (provided by CALM) in light of existing vegetation information; and
- A summary of the existing wetland information including Hill et al. (1986), the draft Environmental Protection (Swan Coastal Wetlands) Policy (EPP 2004) and the most recent DoE geomorphic wetland series mapping;
- Details regarding the comprehensive Flora and Vegetation field survey that was undertaken between 6th and 8th September, 2005;
- Details regrading the preliminary fauna field survey that was undertaken on the 7th September 2005;
- Details regarding the comprehensive wetlands survey that was undertaken between 6th and 8th
 September, 2005; and
- A summary of recommendations regarding likely management requirements for the areas of wetlands and vegetation within the subject area.

2. EXISTING ENVIRONMENT

2.1 SOILS AND LANDFORMS

The Swan Coastal Plain is generally flat, approximately 20 – 30kms wide and consists of a series of geomorphic entities running parallel to the coastline. The northern part of the Plain is formed from either fluviatile or aeolian depositional material. The coastal plain itself is low lying, often swampy with sandhills and therefore the soils predominately consist of recent sands or swampy deposits (Beard, 1990). The Swan Coastal Plain consists of the Pinjarra Plain and three dune systems (Quindalup, Spearwood and Bassendean) of differing ages of deposition whose soils are at different stages of leaching and formation.

The site is specifically part of the Bassendean dune system consisting of Bassendean Sands and Silty Sands, with low permeability and low-medium corrosion potential. The site predominately consist of areas of high water tables prone to flooding, some area are well drained when dry and heavily vegetated (Geological Survey WA, 1978)

2.2 CLIMATE

The Swan Coastal Plain has a Mediterranean climate with hot dry summers and mild wet winters. Winter precipitation varies between 600-1000 mm per year with five to six dry months per year (Beard 1990).

3. FLORA AND VEGETATION

3.1 REGIONAL CONTENT

The survey area lies on the Swan Coastal Plain Subregion of the Drummond Botanical Subdistrict within the southwest Botanical Province as described by Beard (1990). Flora composition of the Swan Coastal Plain Subregion has been described by Beard (1990) as predominantly consisting of *Banksia* Low Woodlands on leached sands with *Melaleuca* swamps where ill drained and Woodlands of *Eucalyptus* spp. on less leached soils.

Previous soil-based vegetation mapping for the region by Heddle *et al.* (1980) describes the vegetation of the subject area as a transition between the Cottesloe Complex (Central and South) and the Karrakatta Complex (Central and South). Heddle *et al.* (1980) describes the vegetation of the Cottesloe Central and South Vegetation Complex as mosaic of woodlands of *Eucalyptus gomphocephala*, and open forests of *E.gomphocephala*, *Eucalyptus marginata*, *Corymbia calophylla*, and describes the vegetation of the Karrakatta Central and South Complex as predominantly open forests of *Eucalyptus gomphocephala Eucalyptus marginata*, *Corymbia calophylla* and woodlands of *Eucalyptus marginata and Banksia sp*.

3.2 **VEGETATION SURVEY METHODS**

A botanist from Cardno BSD undertook a site assessment on 6th and 7th September 2005. The area was surveyed for flora, wetlands and vegetation communities and condition. A Declared Rare Flora and Priority Listed Flora survey was undertaken in 15 metre sweeps in a general east-west orientation over the entire subject area. Quadrats (10 metres by 10 metres) were assembled in each vegetation type or variations found within the site to quantitatively determine vegetation communities and condition.

A total of 18 quadrats were assembled in the subject area, with none of the quadrats being permanently assembled due to the assumption that the quadrats will not need to be revisited.

The use of a standard data collection form ensured the data was collected in a systematic and consistent manner. At each change in vegetation the following records were taken:

- Vegetation Condition and signs of disturbance;
- Topography;
- Soils;
- Outcropping rocks and their type; and
- Flora species and vegetation types.

At each quadrat data was recorded on vegetation communities and condition. Aerial photography was used to extrapolate and map plant communities in combination with running notes made during the course of the survey.

Quadrats were assembled in each different vegetation unit. Locations were chosen while undertaking transects throughout the area. Eighteen quadrats were recorded within the site. Quadrat locations are shown on **Figure 4** and the quadrat data is contained in **Appendix B**

All plant specimens collected during the field survey were dried, pressed and then sorted in accordance with the requirements of the Western Australian State Herbarium. Identification of specimens occurred through comparison with named material and through the use of taxonomic keys. Nomenclature of species used in this report follows current usage (Western Australia Herbarium 1998-2003).

3.3 SIGNIFICANT FLORA SPECIES

3.3.1 Declared Rare and Priority Listed Flora

Species of flora acquire "Declared Rare" or "Priority" conservation status where populations are restricted geographically or threatened by local processes. CALM recognise these threats and subsequently applies regulations towards population protection and species conservation. CALM enforce regulations under the *Western Australian Wildlife Conservation Act 1950* (WAWC) to conserve Declared Rare Flora species and protect significant populations. Priority Flora species are potentially rare or threatened and are classified in order of threat. Declared Rare and Priority Flora category definitions are listed in **Table 1**.

Declared Rare Flora species are gazetted under subsection 2 of section 23F of the Wildlife Conservation Act 1950 and therefore it is an offence to "take" or damage rare flora without Ministerial approval. Section 23F of the Act defines "to take" as "... to gather, pick, cut, pull up, destroy, dig up, remove or injure the flora to cause or permit the same to be done by any means".

Conservation	Category		
Loae			
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.		
Х	Declared Rare Flora – Presumed Extinct Taxa		
	Taxa which have not been collected, or otherwise verified, over the past 50 years despite		
	thorough searching, or of which all known wild populations have been destroyed more		
	recently, and have been gazetted as such.		
P1	Priority One – Poorly Known Taxa		
	Taxa which are known from one or a few (generally <5) populations which are under threat,		
	either due to small population size, or being on lands under immediate threat eg road verges,		
	urban areas, farmland, active mineral leases etc, or the plants are under threat, eg from		
	disease, grazing by feral animals etc. May include taxa with threatened populations on		
	protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in		
	urgent need of further survey.		
P2	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 urgently need further survey.		
P3	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), either due to the number of known		
	populations (generally >5), or known populations being large, and either widespread or		
	protected. Such taxa are under consideration for declaration as 'rare flora' but need further		
	survey.		
P4	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.		

Table 1: Definition of Rare and Priority Flora Species (CALM 2003)

A search of CALM's Threatened Species database identified one Priority 4 (P4) taxa and one Rare (R) taxa that potentially occur within the subject site. Species descriptions were taken from the Western Australian Herbarium (1998-2003).

Drakaea elastica (R) is a tuberous perennial herb, which grows between 0.12-0.3 m high. It flowers from October-November and is commonly found on white or grey sand and in low-lying situations

adjoining winter-wet swamps. Its range extends through the south west coast along the Swan Coastal Plain.

Dodonaea hackettiana (P4) is an erect shrub or tree, growing to approximately 1–5 m high. It flowers from July to October. This species usually occurs in sand and on outcropping limestone.

3.3.2 Environment Protection and Biodiversity Conservation Act (1999) (EPBC) – Species Level Significance

The EPBC promotes the conservation of biodiversity by providing strong protection for plants at a species level. Section 178 and 179 provides the lists and categories of threatened species under the Act and is presented in **Table 2** below.

Table 2: Categories of Threatened Species (EPBC Act, Section 179, 1999)

Extinct
Taxa which is known only to survive in cultivation, in captivity or as a naturalised population, well outside its
past range; or it has not been recorded in its known and/or expected habitat, at appropriate seasons, anywhere in
its past range, despite exhaustive surveys over a time frame appropriate to its life cycle and form.
Critically Endangered
Taxa which is facing a very high risk of extinction in the wild in the immediate or near future, as determined in
accordance with the prescribed criteria
Endangered Taxa which are not critically endangered and is facing a very high risk of extinction in the wild in
the near future, as determined in accordance with the prescribed criteria.
Vulnerable
Taxa which is not endangered and is facing a high risk of extinction in the wild in the medium-term future, as
determined in accordance with the prescribed criteria
Conservation Dependant

A species that is the focus of a specific conservation program; the cessation of which would result in the species becoming vulnerable, endangered or critically endangered within a period of 5 years.

Drakaea elastica is listed as "Endangered" under the EPBC Act and is considered a matter of national environmental significance.

3.4 SIGNIFICANT VEGETATION COMMUNITIES

3.4.1 CALM Listed Threatened Ecological Communities (TEC)

Currently there is a total of 69 TEC's in Western Australia that are endorsed by the Minister of Environment, and 16 of these are listed under the Commonwealth EPBC Act

Swan Coastal Plain (SCP) 26a *Melaleuca huegelii-Melalueca acerosa* (currently *Melaleuca systena*) shrublands on limestone ridges is listed on the Department of Conservation and Land Management's (CALM) TEC Database, which is endorsed by the Minister for the Environment. This TEC is listed as occurring within approximately 5km radius of the subject area.

8			
CALM Conservation	Community description	CALM Status	EPBC Status
Code			
SCP 26a	Melaleuca huegelii-Melalueca acerosa	Endangered	Not Listed
	(currently Melaleuca systena)		
	shrublands on limestone ridges		

 Table 3: CALM Threatened Ecological Communities list

3.4.2 EPBC Act Threatened Ecological Communities (TEC)

The EPBC Act provides for the protection of plant communities, or Threatened Ecological Communities (TEC's), which are listed under section 181 of the Act and are described as 'Critically Endangered', 'Endangered' or 'Vulnerable' under section 182.

There are no known TEC's occurring within the site however there are occurrences of TEC's nearby (within approximately 5 kilometre radius), which are summarised below in **Table 3**. Detailed descriptions of each of the listed communities can be found in "A Floristic Survey of the Southern Swan Coastal Plain" (Gibson et al, 1994). The TEC is not protected under the Commonwealth EPBC Act.

EPBC Act TECs are based on the same nomenclature values as State-based Floristic Community Type (FCT) but not all WA listed TECs are scheduled under the EPBC Act.

3.5 VEGETATION SURVEY RESULTS

A total of 83 taxa, comprising 32 families and 68 genera were recorded on site as shown in **Appendix A**. Species representation was greatest among the Myrtaceae (Myrtles), Papilionaceae (Peas) and Proteaceae (Proteas) families, typical of the Swan Coastal Plain Subdistrict (Beard 1981). Thirteen introduced (weed) species were collected. Weeds were present in the Poaceae (grasses) and Asteraceae (daisies) families.

3.5.1 Declared Rare and Priority Flora

No species of DRF or Priority Flora, pursuant to subsection 2 of Section 23F of the WAWC Act and listed by CALM were located during the time of the survey. However it is acknowledged that these may occur in this area therefore their potential occurrence on the site cannot be ruled out.

The Mandogalup site provides a suitable environment for one of the CALM listed species - DRF *Drakea elastica*, however due to the nature of the site, it is unlikely that *Drakea elastica* will occur in vegetation in "Degraded" – "Completely Degraded" condition. Although the vegetation survey was undertaken during the appropriate time to intercept the flowering of this species, it was not recorded. This may be due to a number of environmental factors, such as the climate. It is also unlikely that the CALM listed Priority four species *Dodonaea hackettiana* would occur within the subject area, as it usually grows in association with limestone outcrops, which were not recorded on site.

3.5.2 Local Vegetation Communities

Five vegetation communities are represented on the site at a local level. Photographic representations of the vegetation communities are shown in **Plates 1-5**. Vegetation Community 1 is the dominant vegetation community on the site. Community 1 is the most "Degraded" area, however also retains some scattered trees. The dominant remnant vegetation type is best described as Open Banksia Woodlands with scattered Melaleucas and Jarrahs. This vegetation type slightly changes with transitions to other vegetation communities. The Vegetation Types are described below in **Table 4**. Vegetation communities are shown on **Figure 2**

Community Descriptions		
Vegetation Community 1 – Parkland Cleared		
aded understorey of various weed species with scattered trees of Eucalyptus		
hocephala (Turat) Eucalyptus rudis (Flooded gum) and Melaleuca preissiana		
Vegetation Community- 2 Banksia woodland		
Banksia woodlands of Banksia ilicifolia, Banksia menezesii, Banksia attenuata		
yptus marginata, over Xanthorhorrea preissii, Hibbertia hypericoides, Hypocalymma		
tifolium		
Vegetation Community 3 – Flooded gum woodland		
ed gum, Melaleuca preissiana, Jarrah, understorey dominated by weed species of		
lily, *Hypochaeris glabra and Pteridium esculentum		
Vegetation Community 4 – Melaleuca/Eucalyptus rudis woodland		
euca viminea, Melaleuca preissiana, Flooded gum Xanthorhorrea preissii, understorey		
ated by Acacia pulchela, Xanthorhorrea preissii and Dasypogon bromeliifolius		
Vegetation Community 5 – Melaleuca woodland		
euca viminea thickets with a common understorey of Dasypogon bromelijfolius.		
stylis setigera and Pigface		

Table 4: Local Vegetation Communities Recorded at Mandogalup, September 2005

3.5.3 Regional Vegetation Communities

Species recorded within each vegetation community were compared with species occurring in the Gibson et al. (1994) database of vegetation communities on the southern Swan Coastal Plain using the vegetation significance methodology described below. The inferred FCT is based on the number of species matches and is recorded in **Table 5** below.

Vegetation Community Code	Floristic Community Type
1	6
2	23a
3	11
4	11/4
5	4

 Table 5: Inferred Gibson et al. Floristic Community Type

Five 'Gibson et al'. FCTs have been recorded on site. One of the communities represented seems to be a mixture of two types, which may be due to the level of degradation in the area and the historical impact of fire on the vegetation. Descriptions of each of the FCT recorded are presented below.

FCT 4 is described as Melaleuca preissiana damplands and appear throughout the southern Swan Coastal Plain. FCT 4 has been recorded along the coastal plain from Perth to Capel and the Gibson et al. site descriptions reflect the vegetation occurring on site. FCT site 4 is a well-reserved community type with a low risk conservation status (Gibson et al, 1994).

FCT 6 is described as weed dominated wetlands on heavy soils and appears throughout the southern Swan Coastal Plain. FCT 6 (Gibson et al). site descriptions reflect the vegetation occurring on site. FCT6 is a well-reserved community type with a low risk conservation status (Gibson et al, 1994).

FCT 11 is described as Wet forests and woodlands and appear throughout the southern Swan Coastal Plain. FCT 11 has been recorded along the coastal plain from Gingin to Capel and the Gibson et al. site descriptions reflect the vegetation occurring on site. FCT site 11 is a well-reserved community type with a low risk conservation status (Gibson et al, 1994).

FCT 23a is described as Central Banksia attenuata-Banksia menziesii Woodlands and appear throughout the Swan Coastal Plain. FCT 23a has been recorded along the coastal plain from Perth to Fremantle and the Gibson et al. site descriptions reflect the vegetation occurring on site. FCT site 23a is well-reserved community type with a low risk conservation status (Gibson et al, 1994).

All of the FCT's described above are recognised as well reserved and are at a low risk based on TEC listings by English & Blyth (1997). None of the FCT's are currently listed under the Commonwealth *EPBC Act 1999*, or the CALM's TEC Database, which is endorsed by the Minister for the Environment.

The Vegetation Condition was rated according to the Vegetation Condition Scale commonly used in the Perth Metropolitan Region (Government of WA 2000). Photographic records of the vegetation conditions are shown in **Plates 6-10.** The definitions are described in **Table 6** below.

Vegetation Condition	Definition				
Pristine (1)	Pristine or nearly so, no obvious signs of disturbance.				
Excellent (2)	Vegetation structure intact, disturbance affecting individual species and weeds are				
	non-aggressive species.				
Very Good (3)	Vegetation structure altered, obvious signs of disturbance. For example				
	disturbance to vegetation structure caused by repeated fires, the presence of some				
	more aggressive weeds, dieback, logging and grazing				
Good (4)	Vegetation structure significantly altered by very obvious signs of multip				
	disturbances. Retains basic vegetation structure or ability to regenerate it. For				
	example, disturbance to vegetation structure caused by very frequent fires, the				
	presence of some very aggressive weeds at high density, partial clearing, dieback				
	and grazing.				
Degraded (5)	Basic vegetation structure severely impacted by disturbance. Scope for				
	regeneration but not to a state approaching good condition without intensive				
	management. For example, disturbance to vegetation structure caused by very				
	frequent fires, the presence of very aggressive weeds, partial clearing, dieback and				
	grazing.				
Completely Degraded (6)	The structure of the vegetation is no longer intact and the area is completely or				
	almost completely without native species. These areas are often described as				
	'parkland cleared' with the flora comprising weed or crop species with isolated				
	native trees or shrubs.				

 Table 6: Vegetation Condition Scale (Taken from Bush Forever (Government of WA 2000))

In general, the vegetation condition ranged from "Completely Degraded" to "Excellent". Tracks and fence lines on the site have a higher percentage of weeds but still act as a buffer to the rest of the area, which in some areas has "Excellent" vegetation condition. The Vegetation Condition mapped over the subject area are shown in **Figure 3**.

Disturbance was associated mostly with tracks and boundaries. The edges of the subject area had a higher presence of weeds, and fire had caused some species to become dominant in the understorey and caused some larger trees to die.

3.5.4 Introduced Species

The majority of the Vegetation Communities had a number of invasive weed species present, which were associated mostly with tracks and boundaries. Thirteen introduced flora species were recorded on the site. Introduced species (weeds) were recorded in the Poaceae (grass) and Asteraceae (daisy) families. This represents approximately 15% of the total flora recorded on site.

None of the weed species collected are declared species (Department of Agriculture) but a highly invasive grass species, **Ehrharta calycina* was found on the outer areas, along tracks and in lower numbers within native vegetation.

3.6 FLORA AND VEGETATION SUMMARY

The vegetation recorded within the subject area was consistent with that found commonly on the Swan Coastal Plain. The dominant remnant vegetation type is best described as Open Banksia Woodlands with scattered Melaleucas and Jarrahs.

Species representation was greatest among the Myrtaceae (Myrtles), Papilionaceae (Peas) and Proteaceae (Proteas). In general, the vegetation condition ranged from "Completely Degraded" to "Excellent". Tracks and fence lines on the site has a higher percentage of weeds present but acts as a buffer to the rest of the area, which in some areas has "Excellent" vegetation.

None of the weed species collected are declared species (Department of Agriculture) but a highly invasive grass species, **Ehrharta calycina*, was found on the outer areas, along tracks and in lower numbers within native vegetation. No species of Declared Rare Flora (DRF) or Priority Flora (PF) were located during the time of the survey. No State or Commonwealth TECs were identified within the subject area, and vegetation communities are generally considered to be well represented and well reserved.

4. FAUNA

A habitat assessment was carried out by a qualified zoologist, specifically targeting the likely habitats of listed (under the relevant Federal and State Acts) threatened vertebrate species potentially occurring in the subject area. The aim of the habitat assessment was to determine if it was likely that any threatened species would be utilising the area. The assessment involved the review of available

information on the habitats of the threatened species possibly occurring in the region. During the field survey all potential habitat areas within the subject area were assessed to determine potential to be hosting any of the listed threatened species in addition to aiding in the compilation of a potential fauna list based on available habitats and opportunistic observations.

During the course of the reconnaissance fieldwork non-systematic opportunistic observations of fauna species were made and recorded. Secondary evidence of fauna such as tracks, diggings and scats were also noted. Some active searching was undertaken in specific areas with the aim of locating the more elusive frog and reptile species that may inhabit the site.

4.1 METHODOLOGY

A list of all vertebrate fauna potentially occurring within the study area was compiled from searches undertaken on the WA Museum Database, CALM's Threatened Fauna Database, the Department of Environment and Heritage Environment Protection and Biodiversity Conservation Database, Birds Australia's 'birdata', published and unpublished reports and specialist books detailing fauna of the general area.

Species observed during fieldwork have also been included. The results of the habitat assessment also provided information on the potential fauna assemblage. Taxonomy and nomenclature for fauna species used in this report generally follow Aplin and Smith (2001) for amphibians and reptiles, How et al. (2001) for mammals and Johnstone (2001) for birds. Some names, including common names recommended for national and international use by Christidis and Boles (1994) for birds are also used. Common names for reptiles and amphibians come from a variety of sources and are not necessarily generally accepted. Sources include Tyler et al. (2000) and Glauret (1961). All species are listed in **Appendix C**

4.2 FAUNA HABITAT ASSESSMENT

Based on the fauna habitat assessment undertaken, the following broad habitat types were observed and correspond with the vegetation community mapping referred to in **Section 3** of this report

Parkland Cleared

Cleared farmland with a dominant understorey of introduced species. This vegetation type is dominant on the site. Some areas of the cleared pastures are inundated during winter and provide foraging habitat for birds of prey, waterbird species and breeding grounds for frogs. This area also contains scattered trees of *Eucalytpus gomphocephala*, *E. rudis, Melaleuca preissiana* and various exotic species. While the trees are scattered and limited in numbers, they provide roosting, foraging and breeding opportunities for fauna.

Banksia Woodland

Low woodlands of *Banksia attenuata* make up the majority of the remnant vegetation at Mandogalup and are typically confined to the drier upper sandy slopes and ridges. Associated tree species vary with emergent *Eucalyptus marginata* being present in the northern areas, while in the southwest corner *E. gomphocephala* (Tuart) is dominant. The amount of ground cover, understorey and leaf litter varies considerably from area to area and ranges from non-existent to dense. The best quality and most expansive areas exist in the north west corner of the study area. Evidence of Quenda's (*Isoodon obesulus fusciventer*) and a sighting of the Western Brush Wallaby (*Macropus irma*) occurred here. Significant sized fallen logs were very rare in the subject area. Hollows were relatively common within the Eucalypts in the subject area, with some significant sized hollows being present. The Banksia species are likely to be utilised as a food source for White-tailed Black Cockatoos that pass through the area.

Flooded Gum Woodland

Flooded gums (*Eucalyptus rudis*) are typically found in the lower lying areas of the site, forming a fringe around areas subject to inundation. Melaleuca species replace the Flooded Gum in areas subject to more lengthy periods of inundation. As with other areas of the study site the amount of ground cover, understorey and leaf litter varies considerably from area to area and ranges from non-existent to dense. These areas have been subject to considerable historical disturbance with the most common ground cover observed being introduced species. Despite its weed status the dense ground cover provides potential habitat for some fauna species such as Quendas that require refuge from predators. Hollows within the Flooded Gums were not common.

Melaleuca/Eucalytpus rudis Woodland

Several small areas of paperbark woodland occur within the study area. The vegetation provides important roosting and refuge habitat for waterbirds, owls, raptors and breeding grounds for frogs. The extent of inundated areas with the paperbark was limited to the two areas of Melaleuca and Flooded Gum along the eastern boundary of the study area. Other areas were dry at the time of the survey.

Melaleuca Shrubland

A generally dense Melaleuca shrubland is present in the north east of the study site. The composition changes to the south with shrub density reducing and Banksia species becoming more prevalent.

4.3 SIGNIFICANT FAUNA

The conservation status of fauna species in Western Australia is assessed under the EPBC Act and the State administered WAWC Act. Under the EPBC Act threatened fauna may be listed in any one of the following categories as defined in Section 179 of the Act:

- Extinct;
- Extinct in the wild;
- Critically endangered;
- Endangered;
- Vulnerable; and
- Conservation dependant.

"Extinct in the wild", "Critically endangered", "Endangered", and "Vulnerable" are matters of National Environmental Significance under the EPBC Act.

The *Western Australian Wildlife Conservation Act (1950)* uses a set of schedules (see **Table 7 & 8**) in addition to utilising the categories defined by the EPBC Act.

Table 7: Western Australian Threatened Fauna	Categories	Category	Code	Description
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Category	Code	Description		
Schedule 1	S1	Fauna which is rare or likely to become extinct		
Schedule 2	S2	Fauna which is presumed extinct		
Schedule 3	S3	Birds which are subject to an agreement between the governments of Australia and		
		Japan (JAMBA) relating to the protection of migratory birds and birds in danger of		
		extinction		
Schedule 4	S4	Fauna that is otherwise in need of special protection In Western Australia, the		
		Department of Conservation and Land Management (CALM) also produce a		
		supplementary list of priority fauna. The species listed are not considered		
		threatened under the WAWC Act, but due to lack of knowledge or where species		
		are poorly represented in secure conservation reserves some concern for there long		
		term survival exists		

Table 8: CALM Priority Fauna Categories Category Code Description

Category	Code	Description		
Priority 1	P1	Taxa with few, poorly know populations on threatened lands.		
Priority 2	P2	Taxa with few, poorly known populations on Conservation lands		
Priority 3	P3	Taxa with several, poorly known populations, some on conservation lands.		
Priority 4	P4	Taxa in need of monitoring (Not currently threatened or in need of special protection, but could be if present circumstances change)		
Priority 5	P5	Taxa in need of monitoring (Not considered threatened but are subject to a specific conservation program, the cessation of which would result in the species becoming threatened within five years)		

A search of EPBC Act's Threatened Fauna list, CALM's Threatened Fauna Database and Priority List and scientific publications identified 13 specially protected, priority or migratory fauna species as potentially occurring in the general study area. A brief account of these species with details on their distribution and habitat preference are given below.

Lerisita lineata (Perth Lined Lerista)

- *Status and Distribution*: Listed as Priority 3 by CALM. Found in the lower west coast from Perth to Mandurah. It has also been found at Busselton, Rottnest Island and Garden Island (Storr et al, 1999) and at the Spectacles, just south of the study site (Government of Western Australia 2000b).
- *Habitat*: This small species of skink inhabits white sands (Storr et al, 1999) under areas of shrubs and heath where it inhabits loose soil and leaf litter at the base of shrubs (Nevill 2005).
- *Likely presence in study area*: Records of this species at Spectacles suggest it may be present within Banksia woodland at Mandogalup.

Neelaps calonotos (Black-striped Snake)

- *Status and Distribution*: Listed as Priority 3 by CALM. Found in the lower west coast from Lancelin to Mandurah. It is locally abundant but is under threat due to land clearing (Storr et al, 1999).
- *Habitat:* This species of snake favours sandy soils supporting heath and Banksia/Eucalypt woodland (Nevill 2005).
- *Likely presence in study area*: Given the presence of suitable good quality habitat it is likely to be present in the study area.

Ardea alba (Great Egret)

- *Status and Distribution*: This species of egret is listed as migratory under the EPBC Act (1999) and under international agreements to which Australia is a signatory. The Great Egret is common and very widespread in any suitable permanent or temporary habitat (Morcombe, 2003).
- *Habitat:* Wetlands, flooded pasture, dams, estuarine mudflats, mangroves and reefs (Morcombe, 2003).
- *Likely presence in study area*: Likely to commonly visit the area in low numbers, particularly in winter when areas of pasture are flooded.

Ardea ibis (Cattle Egret)

• Status and Distribution: This species of egret is listed as migratory under the EPBC Act and under international agreements to which Australia is a signatory. The Cattle Egret is

common in the north sections of its range but is an irregular visitor to the better watered parts of the State (Johnstone and Storr 1998). The population is expanding (Morcombe, 2003).

- *Habitat*: Moist pastures with tall grasses, shallow open wetlands and margins, mudflats (Morcombe, 2003).
- *Likely presence in study area:* Potentially an infrequent visitor to the general area. This species was not recorded in the project area during the most recent Birds Australia Atlas survey (Barrett, 2003) and there are also no W.A. Museum records in the region.

Haliaeetus leucogaster (White-bellied Sea Eagle)

- *Status and Distribution*: This species is listed as migratory under the EPBC Act and under international agreements to which Australia is a signatory. White-bellied Sea Eagles are common in coastal and near coastal areas of Australia and are also found in New Guinea, Indonesia, China, southeast Asia and India.
- *Habitat:* They nest and forage mainly near the coast but will also live near large rivers and inland lakes, often moving on a seasonal basis. White-bellied Sea- Eagles build large stick nests, which may be used for many seasons in succession.
- *Likely presence in study area*: The species may occasionally fly over the study site but is unlikely to specifically target the area for foraging or nesting.

Falco perigrinus (Peregrine Falcon)

- Status and Distribution: This species is listed as Schedule 3 under the WAWC Act. Individuals of this species are uncommon/rare but wide ranging across Australia. Moderately common at higher levels of the Stirling Range, uncommon in hilly, north west Kimberley, Hamersley and Darling Ranges; rare or scarce elsewhere (Johnstone and Storr 1998).
- *Habitat:* Diverse from rainforest to arid shrublands, from coastal heath to alpine (Morcombe, 2003). Mainly about cliffs along coasts, rivers and ranges and about wooded watercourses and lakes (Johnstone and Storr 1998). The species utilises the ledges, cliff faces and large hollows/broken spouts of trees for nesting. It will also occasionally use the abandoned nests of other birds of prey.
- *Likely presence in study area*: The species potentially utilises some sections of the study area as part of a much larger home range. No evidence of this species nesting within the study area was found.

Calyptorhynchus latirostris (Carnaby's Black- Cockatoo)

• *Status and Distribution*: Carnaby's Black Cockatoo is listed as Schedule 1 under the WAWC Act and "Endangered" under the EPBC Act. Confined to the south-west of Western

Australia, north to the lower Murchison River and east to Nabawa, Wilroy, Waddi Forest, Nugadong, Manmanning, Durokoppin, Noongar (Moorine Rock), Lake Cronin, Ravensthorpe Range, head of Oldfield River, 20 km ESE of Condingup and Cape Arid; also casual on Rottnest Island (Johnstone and Storr 1998).

- *Habitat*: Forests, woodlands, heathlands, farms; feeds on banksia, hakeas, dryandras and Marri. Breeding occurs in winter/spring mainly in eastern forest and wheatbelt where they can find mature hollow bearing trees to nest in (Morcombe, 2003).
- *Likely presence in study area*: This species is likely to visit the area during non-breeding season as suitable foraging and roosting habitat exists. Unlikely to breed in the area.

Calyptorhynchus baudinii (Baudin's Black- Cockatoo)

- *Status and Distribution*: Listed as Schedule 1 under the WAWC Act and "Endangered" under the EPBC Act. Confined to the south-west of Western Australia, north to Gidgegannup, east to Mt Helena, Wandering, Quindanning, Kojonup, Frankland and King River and west to the eastern strip of the Swan Coastal Plain including West Midland, Byford, Nth Dandalup, Yarloop, Wokalup and Bunbury (Johnstone and Storr 1998).
- *Habitat:* Mainly Eucalypt forests where it feeds primarily on the Marri seeds, (Morcombe, 2003), Banksia, Hakeas and Erodium sp. Also strips bark from trees in search of beetle larvae (Johnstone and Storr 1998).
- *Likely presence in study area*: This species is likely to visit the area during non-breeding season as suitable foraging and roosting habitat exists. Unlikely to breed in the area.

Apus pacificus (Fork-tailed Swift)

- *Status and Distribution:* The Fork-tailed Swift is listed as migratory under the EPBC Act and under international agreements to which Australia is a signatory. It is a summer migrant (Oct-Apr) to Australia (Morcombe, 2003).
- *Habitat:* Low to very high airspace over varied habitat from rainforest to semi desert (Morcombe, 2003).
- *Likely presence in study area*: It is potentially an occasional summer visitor to the study area but is entirely aerial and largely independent of terrestrial habitats.

Merops ornatus (Rainbow Bee-eater)

• *Status and Distribution*: This species is listed as migratory under the EPBC Act and under international agreements to which Australia is a signatory. The Rainbow Bee-eater is a common summer migrant to southern Australia but in the north they are resident (Morcombe, 2003).

- *Habitat:* Open Country, of woodlands, open forest, semi arid scrub, grasslands, clearings in heavier forest, farmlands (Morcombe, 2003). Breeds underground in areas of suitable soft soil firm enough to support tunnel building.
- *Likely presence in study area*: A potential visitor to the general area. Potentially breeds in general area.

Phascogale tapoatafa tapoatafa (Southern Brush-tailed Phascogale)

- *Status and Distribution*: Listed as Priority 4 by CALM. Present range is believed to have been reduced to approximately 50 per cent of its former range. Now known from Perth and south to Albany, west of Albany Highway. Occurs at low densities in the northern Jarrah forest. Highest densities occur in the Perup/Kingston area, Collie River valley, and near Margaret River and Busselton (CALM information pamphlet (Web, 2005)). Records are less common from wetter forests.
- *Habitat*: This subspecies has been observed in dry sclerophyll forests and open woodlands that contain hollow-bearing trees but a sparse ground cover. A nocturnal carnivore relying on tree hollows as nest sites. The home range for a female Brush-tailed Phascogale is estimated at between 20 and 70 ha, whilst that for males is given as twice that of females. In addition, they tend to utilise a large number (approximately 20) of different nest sites throughout their range (Soderquist, 1995).
- *Likely presence in study area*: Potentially present as suitable hollows exist in Eucalypts found across the study site, though there appears to be no recent records from adjacent bushland areas that have been subject to more detailed surveys (i.e. Spectacles, Thomsons Lake Nature Reserve)

Isoodon obesulus fusciventer (Quenda)

- Status and Distribution: Listed as Priority 5 by CALM. Widely distributed in the south west from near Cervantes north of Perth to east of Esperance, patchy distribution through the Jarrah and Karri forest and on the Swan Coastal Plain, and inland as far as Hyden. Has been translocated to Julimar State Forest, Hills Forest Mundaring, Tutanning Nature Reserve, Boyagin Nature Reserve, Dongolocking Nature Reserve, Leschenault Conservation Park, and Karakamia and Paruna Sanctuaries (CALM information pamphlet) and most recently Nambung National Park (CALM pers. Coms, March 2005.)
- *Habitat:* Dense scrubby, often swampy, vegetation with dense cover up to one metre high, often feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. Populations inhabiting Jarrah and Wandoo forests are usually associated with watercourses. Quendas will thrive in more open habitat subject to exotic predator control (CALM information pamphlet (Web, 2005)).

• *Likely presence in study area*: A dead male Quenda was found in the far northwest corner of the study site. Diggings of this species were found to be relatively common throughout the vegetated north west corner of the study site. May also be present in the other smaller pockets of remnant vegetation in the study area.

Macropus irma (Brush Wallaby)

- *Status and Distribution*: Listed as Priority 4 by CALM. The Western Brush Wallaby is distributed across the south-west of Western Australia from north of Kalbarri to Cape Arid. Known populations exist in adjacent bushland areas (Government of Western Australia 2000b).
- *Habitat:* The species optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets. It is also found in some areas of mallee and heathland, and is uncommon in karri forest (CALM information pamphlet).
- *Likely presence in study area*: A single individual was sighted by K. Del Fante (Botanist) during the course of fieldwork. This species is likely to be present in small numbers, moving between adjacent bushland areas.

4.4.1 Other Species of Significance

A number of other species not listed in official lists can also be considered of regional conservation significance. These include species that have a restricted range, those that occur in breeding colonies and those at the limit of their range. While not classified as rare, threatened or vulnerable under any State or Commonwealth legislation, a number of bird species have been listed as of significance on the Swan Coastal portion of the Perth Metropolitan Region (Bush Forever - Government of Western Australia 1998 and 2000).

4.4 VALUE OF THE STUDY AREA AS A WILDLIFE CORRIDOR

Linkage with adjacent bushland areas is a natural attribute of high priority in the assessment of any sites significance. Within the Beeliar Regional Park Draft Management Plan (CALM 2000) and Bush Forever Volume 1 document (Figure 6 - Government of Western Australia 2000a) the Mandogalup area was specifically identified as part of a Greenway corridor between the Thompsons Lake Nature Reserve and the Spectacles.

The identified linkage extends from the Spectacles in the south, along the western boundary of the study site (in adjacent bushland), into the remnant bushland in the north west corner of the study area and into Frankland Park. Within the Beeliar Regional Park Draft Management Plan it is stated that it is

important to maintain and improve Greenway corridors and other links between and within Beeliar Regional Park to adjoin areas of ecological significance. This is necessary to help maintain the diversity and vigour of the Park's ecological systems and to help integrate the Park within the broader urban and industrial landscapes.

The Draft Jandakot Structure Plan has proposed narrow and elongated urban corridors both east and west of the freeway. The elongated north to south urban corridor is also punctuated by east to west aligned greenways linking environmental features both within and beyond the urban form, this provides the opportunity for fauna movement and to provide strong landscape edges to the residential areas, in the northern urban cells (Mandogalup and Wandi). Where possible, greenway concepts should be incorporated into future planning proposals as part of the development of best practice planning and design solutions (Government of Western Australia 2000a).

The linkage value of the site was acknowledged in the Bush Forever document. (Bush Forever, 2000). Contiguous corridors of bushlands and wetlands are proposed to the west of Kwinana Freeway from Rockingham to Murdoch joining Thomson, Yangebup, Bibra and North lakes, which passes through the Mandogalup site, Shown on **Figure 6**.

4.5 SUMMARY OF FAUNA VALUES

The Mandogalup study site contains a variety of fauna habitats and a number of fauna species of conservation significance were identified as utilising or potentially utilising the site. Sections of the site form part of an identified Greenway corridor. Any proposed development of the site is likely to require the clearing of remnant vegetation and consequently the loss or degradation of potential fauna habitat.

The impact on specific fauna species will vary depending on population densities and the quantity and quality of potential foraging and breeding sites, both within the area of impact and adjacent areas. Development of the site also has the potential to restrict the movement of some fauna species as the area forms part of an identified ecological linkage and wildlife corridor. Future planning for the Mandogalup site should aim to retain remnant vegetation with the aim on maintaining and enhancing linkages between areas of remnant vegetation both within the site and adjoining areas.

5. WETLANDS

Much of the Swan Coastal Plain is categorised by wetland environments. Conservation and management of these wetland areas have required classification systems to be developed in order to group and describe the variations in wetland types. One recognised system is that of Semeniuk (1987)

based on geomorphic setting and hydrological processes. The resultant classification allocates individual wetlands with shared characteristics to wetland suites.

Large variations in the condition of wetlands has added further classification systems, such as that detailed in Hill et al, (DEP/WRC, 1996), which is based on a range of characteristics of individual wetlands including size, condition, physical, hydrological and biological functions, and human use attributes.

Wetland areas classified as being in the 'Multiple Use' Management Category are totally or mostly cleared, and are used for agricultural purposes. These wetlands still serve hydrological functions, such as groundwater recharge and flood mitigation. The wetlands that are designated 'Resource Enhancement' have some native vegetation remaining, but are also often used for grazing or agistment of horses or other stock. They can be considered to have hydrological functions but limited biological significance. Only the wetlands in the 'Conservation' Management Category support relatively intact vegetation and have a range of natural attributes that render them significant. The wetland management categories as set out in Hill et al, (DEP/WRC 1996) are defined in **Table 9** below.

Management	Description of Wetland	Management Objectives		
Category				
Conservation (C)	Wetlands, which support high levels of attributes and functions.	To preserve wetland attributes and functions through reservation in national parks, crown reserves, state owned land and protection under environmental protection policies		
Resource Enhancement (R)	Wetlands, which have been partly modified but still support substantial functions and attributes.	To restore wetlands through maintenance and enhancement of wetland functions and attributes by protection in crown reserves, state or local government owned land and by environmental protection policies, or in private property by sustainable management		
Multiple Use (M)	Wetlands with few attributes, which still provide important wetland functions.	Use, development and management should be considered in the context of water, town and environmental planning through Landcare		

Table 9: Wetland management categories and management objectives

The Department of Environment (DoE) maintains a geomorphic wetland dataset, which categorise individual wetlands into specific management categories as described in **Table 9** above. It is important to understand the significance of each wetland based on hydrological, biological and human use features, which are the key components for the classification of management categories. The dynamic dataset is continually updated with site-specific wetland surveys providing new and relevant information.

5.1 WETLAND ASSESSMENT

The project area contains five wetlands as identified in current DoE mapping. Wetland 6719 is a 'Resource Enhancement Wetland', and 6716, 6717, 6530 and 6538 are 'Multiple Use Wetlands' The aerial photography of the area shows the location of the wetlands in the context of the overall area data has been taken from the DoE 2004 Geomorphic Dataset to determine the current boundaries and wetland classifications as shown in **Figure 5**. The details of the wetlands are given in **Table 10**, below.

Wetland	Area	Consanguineous	Geomorphic	Wetland	Current	Local Gov Authority
Id No.	(ha)	Suite	Classification	Туре	M'mnt	
					Category	
6530 2	215 4	B.3	Basin	Dampland	MUW	Town of Kwinana
	213.4	Jandakot				
6538	20.1	B.3	Basin	Dampland	MUW	Town of Kwinana
		Jandakot				
6716	0.3	B.3	Basin	Sumpland	MUW	Town of Kwinana
		Jandakot				
6717	0.6	B.3	Basin	Sumpland	MUW	Town of Kwinana
		Jandakot				
6719	1.2	B.3	Basin	Sumpland	REW	Town of Kwinana
		Jandakot				

 Table 10: Wetland classification

This site has historically been used for market gardens and grazing and in some areas the market gardens are still actively operating. The wetlands on the site are either Dampland or Sumpland Wetlands, (WRC, 1996) which are seasonally waterlogged. The soil complex is described as Bassendean Dunes (Semeniuk, 1998).

All the wetlands are described as being within the Bassendean Dunes, occurring in the Jandakot consanguineous wetland suite. The Jandakot suite occurs on the transition between Bassendean Dunes and Pinjarra Plain. The underlying stratigraphy is a complex of sands, clays, calcrete and laterite. Wetlands lie along depressions at the distributary ends of the creeks or adjacent to intermittent disconnected drainage channels (Semeniuk, 1998).

Wetland 6716 consists of Melaleuca woodland/ Banksia woodland, with typical wetland dependant vegetation and a degraded understorey. The vegetation is currently rated as being in "Good" condition. The wetland still retains vegetation structure and hydrological functions. Wetland 6716 is currently categorised as a MUW.

Wetland 6719 consists of Melaleuca woodland/Banksia woodland, with typical wetland dependant vegetation the vegetation is currently rated as being in "Good" condition. The wetland still retains vegetation structure and hydrological functions. Wetland 6719 is currently categorised as a REW.

Wetland 6717 consists of Melaleuca woodland, with typical wetland dependant vegetation and a dense understorey of native species with a buffer of Banksia woodland. The vegetation is currently rated as being in "Very Good" condition. The wetland still retains vegetation structure and hydrological functions. Wetland 6717 is currently categorised as a MUW.

Wetland 6530 consists of Melelaueca/*Eucalytpus rudis* woodland, with various vegetation types and conditions. Wetland 6530 is predominately "Completely Degraded" with scattered areas of "Good" condition. The wetland still retains hydrological functions. Wetland 6530 is currently categorised as a MUW.

Wetland 6538 consists of Melaleuca preissiana woodland. Wetland 6538 is predominately "Degraded" to "Completely Degraded". The wetland still retains hydrological functions. Wetland 6530 is currently categorised as a MUW.

5.2 WETLAND RECOMMENDATIONS

All of the wetlands recorded on site are degraded but still retain wetland dependant vegetation and important hydrological functions. Photographic records of the wetlands are shown in **Plates 11-15.** Photographic records are taken of the best quality vegetation within each of the five identified wetlands. Therefore the photographs are not a true representation of the entire wetland but an area of the best rated vegetation condition.

There is opportunity to reclassify the current wetland boundaries for each of the five wetlands, however based on existing Wetland Management Categories this is not recommended, as it will not affect the structure plan. Multiple Use and Resource Enhancement wetlands do not require preservation, however it is important restore and retain hydrological function and wetland vegetation where possible. Specific areas of Cardno BSD surveyed wetlands are shown on **Figure 5**, these areas are recommended for retention where possible

The current wetland management categories indicate that the areas of wetlands do not support significant values that would necessitate their conservation. Based on the findings of the site inspection, it is suggested that there are parts of these systems that retain some hydrological and ecological values. The best examples of these areas are shown on **Figure 5**, outlined as Cardno BSD surveyed wetlands. As such it is recommended that these wetland areas be retained wherever possible

within multiple use drainage and recreation corridors. The wetlands with the best vegetation condition are shown on **Figure 5** as the recommended wetland retention areas, and are areas recommended to be retained due to their quality of vegetation and hydrological functions.

6. CONCLUSIONS AND RECOMMENDATIONS

From an ecological value point of view the Mandogalup site has been predominately degraded due to historic and current agricultural land uses (market gardens and grazing). Remnant vegetation varies from "Very Degraded" to "Excellent" condition. The northeast corner of the site retains excellent remnant condition. This area may provide natural corridors for native fauna and linkages between adjacent bushland and Bush Forever sites. The site is adjacent to three Bush Forever sites, to the east (Site no. 268), to the south (Site no 269) and to the west (Site no 347).

During the survey no Declared Rare, priority or significant flora species were located within the site pursuant to the *Wildlife Conservation Act 1950 or the Environmental Protection* and *Biodiversity Conservation Act 1999*. No TEC's were located during the time of the survey and are not thought to occur within a 5km radius of the site

The Draft Jandakot Structure Plan has proposed narrow and elongated urban corridors both east and west of the freeway. The elongated north to south urban corridor is also punctuated by east to west aligned greenways linking environmental features both within and beyond the urban form, this provides the opportunity for fauna movement and to provide strong landscape edges to the residential areas. In the northern urban cells (Mandogalup and Wandi) these links coincide with infrastructure corridors, which protect the Dampier to Bunbury (below ground) Natural Gas Pipeline and a number of Western Power Transmission Line Easements

Greenways are natural corridors proposed as linkages between declared public open space such as local regional or national parks, stream reserves, wetlands and beaches. The linkage value of the site was acknowledged in the Bush Forever document. (Bush Forever, 2000). Contiguous corridors of bushlands and wetlands are proposed to the west of Kwinana Freeway form Rockingham to Murdoch joining Thomson, Yangebup, Bibra and North lakes, which passes through the Mandogalup site, Shown on **Figure 6**.

Development of the site has the potential to restrict the movement of some fauna species as the area forms part of an identified ecological linkage and wildlife corridor. Future planning for the Mandogalup site should aim to retain remnant vegetation as described in the Draft Jandakot Structure Plan, with the aim on maintaining and enhancing linkages between areas of remnant vegetation both within the site and adjoining areas.

All of the wetlands recorded on site are degraded but still retain wetland dependant vegetation and important hydrological functions. It is recommended that the five wetlands currently on site retain their current management categories.

There is opportunity to reclassify the current wetland boundaries for each of the five wetlands, however based on existing Wetland Management Categories this is not recommended, as it will not affect the structure plan. Multiple Use and Resource Enhancement wetlands do not require preservation, however it is important restore and retain hydrological function and wetland vegetation where possible.

It is believed that the development of the site would not pose a significant or unacceptable impact on flora, vegetation, fauna or wetlands, However Cardno BSD provide the following recommendations:

- Where possible retain "Good" to "Excellent" vegetation within areas of POS, and this should be discussed further with the City of Kwinana;
- A native corridor should be maintained in the north east corner to maintain native fauna movement and preserve fauna habitat;
- The Bush Forever greenway should be considered in the structure plan;
- Current wetland management categories area appropriate; and
- There is potential for the inclusion of a number of wetlands areas within future planning as an area of Public Open Space (POS).

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FIGURES