CASTLEMERE PTY LTD

PT LOT 200 WANJEEP ST, COODANUP FLORA, VEGETATION AND FAUNA ASSESSMENT

VERSION 2

FEBRUARY 2003

REPORT NO: 2003/10

ATA Environmental
environmental scientists

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Limitations Section ?
Didn't consider effectively in reg. or local context.

Didn't look at linkage value except 16 ref scattered in Discussion.

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1. INTRODUCTION

1.1 Background and Purpose

A residential subdivision has been proposed for the land comprising Pt Lot 200 Wanjeep St, Coodanup, an undeveloped block of 110ha of native vegetation located approximately 3.5km east of Mandurah. The Lot is bounded by the Serpentine River to the east, Wanjeep Street to the west, an existing subdivision to the south and vacant land to the north. The Lot is zoned Residential and Local Recreation reservation under the City of Mandurah Town Planning Scheme No. 3. The portion of the Lot that is the subject of this assessment is shown Urban in the Peel Region Scheme (WAPC, 1999)

ATA Environmental was commissioned to prepare this report to assist the City of Mandurah in its consideration of the proposed subdivision development for the site and to determine the potential environmental impacts that the development will have. The City of Mandurah requested that a vegetation, flora and fauna assessment of the site be undertaken. Bamford Consulting Ecologists undertook the fauna component of the assessment.

2. STUDY AREA DESCRIPTION

2.1 Soils and Landform

Pt Lot 200 Wanjeep St, Coodanup is located on the Spearwood Dunes of the Swan Coastal Plain, and comprises soils of the Yoongarillup unit over Pleistocene Tamala Limestone. The Yoongarillup unit generally comprises shallow yellow and brown sands developed on fossiliferous limestone.

2.2 Flora and Vegetation

2.2.1 Assessment Methodology

The flora and vegetation component of this assessment included a survey of the site undertaken by ATA Environmental on 21 January 2003. The survey was conducted by a combination of traversing the site on foot and 4WD. In addition to mapping of the vegetation types occurring within the study area, vegetation condition was assessed using the condition scale published in Bush Forever (Government of WA, 2000). The vegetation community(s) associated with the site was also determined. The process of accurately determining vegetation communities (or Floristic Community Types) is time-consuming and requires analysis of a comprehensive dataset collected from several site visits at optimal times of the year. Due to time constraints a less onerous methodology was undertaken for this assessment. This involved sampling 10m x 10m plots on one occasion only and inferring the actual vegetation community (more accurately termed Floristic Community Type) on the basis of the limited data. The identification of vegetation communities at this level is important as it is at this level that the conservation status of vegetation has been determined on a State as well as a Federal level.

Although the timing of the survey was not optimal for maximising the identification of all flora species within the study area, the majority of the perennial plant species were able to be identified.

Accordingly, the following tasks were undertaken:

1. a search of CALM's threatened flora database to identify any significant species known from the site or nearby;

2. a site visit to record all plant species (native and introduced) occurring on the lot at the time of the survey (ie January);

3. assess the significance of the individual plant species on the lot;

4. describe and map the population size for any significant plant species recorded on the lot;

5. assess the likelihood of any significant species occurring on site that might not have been detectable given the season of survey;

6. record the plant species in several 10m x 10m plots;

7. infer the Floristic Community Types present on site on the basis of the plot data; and

8. assess the significance of the Floristic Community Types on the site using CALM's Threatened Ecological Community database and the Commonwealth Threatened Communities list.

2.2.2 Vegetation Complexes and Types

The vegetation of the site is representative of the Yoongarillup Vegetation Complex which is characterised by Tall Woodlands of Tuart (*Eucalyptus gomphocephala*) and Open Forests of Tuart-Jarrah (*Eucalyptus marginata*)-Marri (*Corymbia calophylla*). The Yoongarillup Vegetation Complex has strong affinities with the Karrakatta Central and South Vegetation Complex in the Spearwood Dune System.

The survey identified that the vegetation of Pt Lot 200 can be broadly classified into one vegetation unit, a Mixed Eucalypt/Banksia woodland, based on the floristic composition and structural characteristics of the vegetation. This unit has been previously logged of Jarrah and Tuart, and consists mostly of Banksia woodland with scattered *Eucalyptus* sp. regrowth. A more detailed inspection reveals that this unit can be further divided into six vegetation types that are described below and mapped in Figure 2:

EmBAf Jarrah (*Eucalyptus marginata*), *Banksia attenuata, B. menziesii* and Sheoak (*Allocasuarina fraseriana*) Low Open Forest over a mixed understorey (Plate 1). Prominant understorey species include *Hibbertia hypericoides, Persoonia saccata, Hypolaena exsulca, Macrozamia fraseri, Leucopogon propinquus, Xanthorrhoea preissii* and introduced grasses.

EmB Jarrah (*Eucalyptus marginata*), *Banksia attenuata* and *B. menziesii* Open Woodland over degraded, predominantly cleared understorey.

Eg Tuart (*Eucalyptus gomphocephala)* Tall Open Woodland (Parkland cleared), with occasional scattered Jarrah (Plate 2). Understorey dominated by pasture grasses with scattered *Acacia saligna.*

EmAf Jarrah (*Eucalyptus marginata*)/Sheoak (*Allocasuarina fraseriana*) Woodland over a mixed understorey.

CcEr Marri (*Corymbia calophylla*)/Flooded Gum (*Eucalyptus rudis*) Open Woodland.

Cc Marri (*Corymbia calophylla*) Woodland.

A small stand of Christmas Trees (*Nuytsia floribunda*), adjacent to the foreshore reserve, were previously recommended for protection in the structure plan for the site.

2.2.3 Vegetation Communities

The vegetation communities occurring on the site were determined by recording all vascular plants found within four 10m x 10m quadrats. All non-permanent quadrats were situated within the Jarrah (*Eucalyptus marginata*), *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Open Forest that dominated the southern two thirds of the study area. The list of flora species recorded from the quadrats was further supplemented by species recorded from elsewhere within the site.

Vegetation communities or Floristic Community Types (FCTs) are distinctive assemblages of flora first described by Gibson *et al.,* in 1994 that are derived from the vegetation complexes of the Swan Coastal Plain (SCP). Thirty floristic community types have been defined for the SCP. Comparison of the data obtained from the quadrats and supplementary recordings within the study area and species groupings associated with the FCTs found that the study area vegetation community was analogous with one of the FCTs:

Floristic Community Type 21a: Central *Banksia attenuata-E. marginata* Woodlands

Community type 21a is primarily *Eucalyptus marginata-Banksia attenuata* woodlands, *Eucalyptus marginata-Corymbia calophylla-Banksia attenuata* woodlands or *B. attenuata* woodlands. This community commonly occurs in the central portion of the Swan Coastal Plain between Perth and Capel. It is considered to be well reserved within the community reservation system and its conservation status is classed as low risk (Gibson *et., al.,* 1994). FTC 21a is not on CALM's Threatened Ecological Community database or the Commonwealths list of Threatened Communities and as a consequence is not considered conservation significant.

2.2.4 Vegetation Condition

The condition of the vegetation of the site was assessed using the condition scale published in Bush Forever (Government of WA, 2000) (Table 1). The majority of the bushland on the site is in the very good to excellent condition with few non-invasive weeds and minimal disturbance to the vegetation structure, particularly within the core of the site (Figure 2). Several access tracks and firebreaks traverse the perimeter and interior of the site and some heavy infestations of invasive weed species such as Veldtgrass (*Ehrharta calycina*) and Wild Oats (*Avena fatua*) were often associated with these tracks. Some potential areas of dieback infection was also observed from Banksia trees occurring along the edges of some of the internal tracks. Weed infestations associated with the dumping of garden refuse was also noted in vegetation adjacent to residences along the southern boundary of the site.

The natural vegetation in the northern portion of the site has largely been parkland cleared or disturbed by past land use activities including grazing. As a consequence, only the overstorey vegetation remains, which includes Tuart (*Eucalyptus gomphocephala*), Marri (*Corymbia calophylla*) and Jarrah (*E. marginata*) with scattered Banksia species (*Banksia attenuata, B. menziesii, B. grandis*).

TABLE 1
VEGETATION CONDITION SCALE RATING
(From Bush Forever, 2000)

Vegetation Condition Rating Bush Forever (2000)	
Pristine	Pristine or nearly so, no obvious signs of disturbance
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.
Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate. Fore example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.
Degraded	Basic vegetation structure severely impacted by disturbance. Scope for regeneration but not to a state approaching good condition without intensive management. For example, disturbance to vegetation structure caused by very frequent fires, the presence of very aggressive weeds, partial clearing, dieback and grazing.
Completely Degraded	The structure of the vegetation is no longer intact and the areas is completely or almost completely without native species. These areas are often described as 'parkland cleared' with the flora composing weed or crop species with isolated native trees or shrubs.

2.2.5 Flora

A total of 79 species of vascular flora, including 66 native and 13 introduced species, were recorded during the January 2003 survey (Appendix 1). The families with the highest representation are Proteaceae (Banksia family, 13 native species), Papilionaceae (Pea Family, 10 native and 2 introduced species) and Myrtaceae (Eucalyptus family, 7 native species). The number of species recorded from the site was not comprehensive due to the timing of the survey. The timing of the survey was not optimal for the identification and recording of a significant number of ephemeral and annual species, including genera such as *Drosera*, *Stylidium* and species in the Orchid and Grass Families. Additionally due to the absence of flowering material at the time the survey was undertaken., a number of taxa could be identified to genus level only.

A search of the Department of Conservation and Land Management Declared Rare and Priority Flora database was undertaken prior to the flora survey. The search revealed that four priority listed species had previously been recorded from the vicinity of site. These are listed in Table 2. Only one of these species, the Priority 3 taxa *Jacksonia sericea,* was recorded during ATA Environmental's survey of the site. Several scattered *Jacksonia sericea* plants were recorded through the central and northern portions of the site during the survey. Priority 3 flora species are not protected under Section 23F of the *Wildlife Conservation Act, 1950.*

TABLE 2
*SIGNIFICANT FLORA RECORDED IN THE VICINITY OF Pt LOT 200 WANJEEP RD, COODANUP

(* Only *Jacksonia sericea* was recorded during the survey of the site)

Species	Conservation Code	Location
Dillwynia dillwynioides	3	Mandurah-North Yunderup
Eucalyptus rudis ssp. cratyantha	4	Yallingup, Eagle Bay, Mandurah
Jacksonia sericea	3	Mandurah to Wanneroo
Lasiopetalum membranaceum	3	Lake Clifton

3. FAUNA

3.1 Assessment Methodology

The significance of the vertebrate fauna habitat from Pt Lot 200 Wanjeep St, Coodanup was assessed by Bamford Consulting Ecologists through a combined desktop assessment and on-site inspections undertaken on January 27 and February 1, 2003. The two primary aims of the fauna assessment were:

- to identify significant habitat trees, specifically those supporting nests of birds of prey or hollows that could be utilised by fauna; and
- to identify the fauna likely to be utilising the site, with particular reference to specially protected and priority fauna and fauna of local or regional significance.

The site investigation also sought to identify and mark significant fauna habitat trees within the site. Trees were identified as significant if they were large and had conspicuous hollows, crevices or bird nests. They were not considered significant if they were large but had no other important features. Locations of significant trees were determined and recorded using a hand-held GPS.

All vertebrate fauna species observed during the site visits or expected to occur on the site are presented in Appendix 2.

Taxonomic orders and names used in this report generally follow Tyler *et al.* (1984) for amphibians, Storr *et al.* (1983, 1990, 1999, 2000 and 2002) for reptiles, Menkhorst and Knight (2001) for mammals and Christidis and Boles (1994) for birds, except where recent taxanomic revisions have occurred (earlier names are given in parenthesis). This is particularly the case with reptiles, where current WA Museum printouts contain many recent revisions.

Fauna records obtained from all sources were vetted on the basis of Bamford Consulting Ecologists experience and in the light of habitats found in the project area. Therefore, some species recorded in the region were considered to be very unlikely to occur in the project area and were deleted from species lists.

3.2 Fauna Habitats

The majority of the vegetation and fauna habitat of Pt Lot 200 Wanjeep St, Coodanup remains in excellent condition. Aside from previous intermittent logging of Jarrah and edge effects associated with access tracks, there has been minimal disturbance to the vegetation structure through the southern two thirds of the site. However, the northern third of the site has been highly modified as a result of past land uses including grazing and logging.

Twenty fauna habitat trees from the site were identified as significant (Figure 2). These habitats were primarily hollows that are mostly suitable for parrots, possums and bats. Hollows were not large enough to be utilised by ducks. The most significant

habitat trees were two active raptor nests identified from the eastern (Plate 3) and northern portions of the site (Figure 2). Neither of these species are considered to be conservation significant. A description and location of these trees is provided in Table 3.

TABLE 3
SIGNIFICANT HABITAT TREES IN THE LOT 200, WANJEEP RD

Tree Species	AMG Co-ordinates	Reason for inclusion
Jarrah.	50 382 933 E, 6 397 580 N	Hollows
Jarrah.	50 382 934 E, 6 397 599 N	Hollows
Marri	50 382 912 E, 6 397 677 N	Hollows
Tuart	50 382 984 E, 6 397 762 N	Nest; Australian Raven?
Tuart	50 382 998 E, 6 397 867 N	Hollows
Jarrah	50 382 950 E, 6 397 811 N	Hollows
eucalypt; dead	50 383 055 E, 6 398 004 N	Osprey nest with chick (see Plate 3)
Tuart	50 383 093 E, 6 398 389 N	Hollows
Jarrah	50 382 736 E, 6 397 903 N	Hollows
Jarrah & Tuart	50 383 116 E, 6 398 404 N	Both trees with hollows
Tuart	50 383 125 E, 6 398 439 N	Whistling Kite nest (active) & hollows
Jarrah	50 383 142 E, 6 398 469 N	Hollows
Tuart	50 382 911 E, 6 398 550 N	Hollows
Jarrah	50 382 774 E, 6 398 226 N	Hollows
Jarrah	50 382 788 E, 6 398 228 N	Hollows
Jarrah	50 382 801 E, 6 398 212 N	Hollows
Tuart	50 382 938 E, 6 398 140 N	Hollows in partly dead tree
Jarrah	50 382 608 E, 6 397 758 N	Hollows
Jarrah	50 382 445 E, 6 397 712 N	Hollows
Jarrah	50 382 625 E, 6 397 575 N	Hollows

3.3 Vertebrate Fauna

On the basis of the species recorded from the site, the habitats present and published distribution information, a total of 195 vertebrate fauna species may occur in the area. This includes eight frogs, 39 reptiles, 122 birds, 21 native mammals and 5 introduced mammals. A further three bird species and six mammal species probably occurred in the area historically, but are now expected to be locally, regionally or entirely extinct (Appendix 2).

3.3.1 Amphibians and Reptiles

A total of eight frogs and 39 reptile species were identified as potentially occurring within the study area (Appendix 2). This includes one frog and five reptile species that are of conservation significance. However, most of these species are either at the edge of their distribution or have restricted populations on the Swan Coastal Plain.

3.3.2 Birds

A total of 122 bird species may occur in the study area, with 14 of these being considered to be conservation significant (Appendix 2). This high number is a result of the highly mobile nature of many of the birds. Seven species are listed under the

Commonwealth *Environmental Protection and Biodiversity Conservation Act* (EPBC) (1999) and the *Wildlife Conservation Act 1950*, including the Peregrine Falcon *Falco peregrinus*, four migratory wader species, Carnaby's Black-Cockatoo (*Calyptorynchus latirostris*) and Baudin's Black-Cockatoo (*Calyptorynchus baudinii*). Three taxa, the Forest Red-tailed Cockatoo (*Calyptorynchus banksii naso*), Barking Owl (*Ninox connivens*) and the Masked Owl (*Tyto novaehollandiae*), are listed on the Department of Conservation and Land Management's (CALM's) Priority fauna list. The remaining four conservation significant bird species are considered to either be at the edge of their distribution, or have restricted populations on the Swan Coastal Plain.

Several of the conservation significant species, including the migratory waders and the cockatoos, are only expected to utilise the site for food resources on a seasonal basis. The waders would occur along the Serpentine River, particularly the seasonal pools on adjacent salt marshes. Carnaby's Black-Cockatoo in particular may be a regular visitor to forage on the seeds of Banksias. The two owl species may use the site on a more regular basis as part of their home range.

3.3.3 Mammals

A total of 26 mammal species may occur in the study area, comprising of 21 native species and five introduced species (Appendix 2). Of the 21 native species, 10 are considered to be of conservation significance. Two of these species, the Chuditch (*Dasyurus geoffroii*) and the Western Ringtail Possum (*Pseudochierus occidentalis*), are listed as being threatened under both the EPBC and *Wildlife Conservation Act 1950*. However, given the lack of Native Peppermint (*Agonis flexuosa*) on the site, a species favoured by the Western Ringtail Possum as a refuge, it is unlikely that the species occurs on the site. The Chuditch is increasing in abundance in the region through implementation of fox control and reintroduction programs within the south-west, and though it may visit the site the site for foraging purposes on an opportunistic basis it is highly unlikely that the species is reliant on the vegetation on the site.

A further five species are listed as under the Department of CALM's Priority fauna list, including the Quenda (*Isoodon obesulus*) (which was recorded from the study area, near the Serpentine River), Brush-tailed Phascogale (*Phascogale tapoatafa*), Brush or Black-gloved Wallaby (*Macropus irma*), Western False Pipistrelle (*Falsistrellus mackenziei*) and Rakali or Water-Rat (*Hydromys chrysogaster*). The remaining three species, the Honey Possum (*Tarsipes rostratus*), Brush-tailed Possum (*Trichosurus vulpecula*) and the Western Pygmy Possum (*Cercartetus concinnus*), are all thought to have restricted populations on the Swan Coastal Plain.

Whilst some of these species may occur throughout the study area, others are expected to be restricted to certain areas. The Quenda is expected to occur predominantly in or near dense riparian vegetation adjacent to the Serpentine River, whilst the Rakali may occur anywhere along the river. The Western False Pipistrelle may only use the study area for food resources on an irregular basis.

4. DISCUSSION

The Yoongarillup Vegetation Complex, which is associated with Pt Lot 200 Wanjeep St, Coodanup, is currently well reserved within the Swan Coastal Plain with more than 14% of the original extent of the complex remaining within the conservation estate (WAPC, 1999). The vegetation and flora assessment revealed that the dominant vegetation type on the site is a Jarrah/Banksia/Sheoak Low Open Forest, of which the majority is in excellent condition. The northern third of the site has been highly modified by grazing and human activities and is in a degraded to completely degraded condition. The vegetation community analogous with the site is associated with Floristic Community Type 21a: Central *Banksia attenuata-E. marginata* Woodlands. This community is primarily a *Eucalyptus marginata-Banksia attenuata* woodlands, *Eucalyptus marginata-Corymbia calophylla-Banksia attenuata* woodlands or *B. attenuata* woodland. This community is considered to be well reserved its conservation status is classed as low risk. As a consequence, it is not classified as a Threatened Ecological Community.

The flora survey recorded 79 vascular plant species. This number was lower than expected as the survey was undertaken at a time that was not conducive to maximising the identification of the flora species occurring on the site. One Priority listed flora, *Jacksonia sericea* (P3), was recorded from several locations within the site. Priority 3 flora species are not protected under Section 23F of the *Wildlife Conservation Act, 1950.*

Twenty fauna habitat trees were identified from the site that either supported active nests of birds of prey or contained hollows that could be potentially utilised by fauna. The most significant habitat trees identified are two trees containing the nests of birds of prey, which are located adjacent to the foreshore reserve and near the northern boundary of the site (Figure 2).

A total of 195 vertebrate fauna species may potentially occur on the site. This includes several conservation significant bird and mammals species that may use the site for food resources on a seasonal basis (ie birds) or may visit to site for opportunistic foraging purposes. The Western Ringtail Possum is unlikely to occur on the site due to lack of specific foraging habitat, while the Chuditch may visit the site on an opportunistic basis. Both mammals are listed as threatened under the Commonwealth EPBC Act and the WA Wildlife Conservation Act. The Priority 3 listed Quenda was recorded from the study area, within riparian zone of the Serpentine River.

The Public Open Space (POS) proposed in the preliminary structure plan for the site, which features a linear green corridor linking Wandjeep St (to the immediate south of Coodanup High School) with the Serpentine River, is likely to meet the general objectives of the City of Mandurah's environmental objectives. However, from an ecological perspective, the small areas of POS that comprised this corridor are likely to become parkland cleared following development of the site, with a subsequent loss of ecological values. Ideally, it would be preferable that the POS for the development should also encompass a corridor along the river, which would include the site of the Osprey nest and a stand of Christmas trees (*Nuytsia floribunda*) adjacent to the foreshore reserve that were identified for protection in the structure plan. This should include a buffer zone of upland native vegetation acting as a corridor to allow the

regional movement of terrestrial fauna species through the area. The wider this buffer zone, the more effective it will be for the movement of fauna along the vegetated river corridor and the more resistant it will be to weed invasion.

5. RECOMMENDATIONS

The following provides recommendations on how the issues identified in this assessment area could be resolved sensitively.

1. While consideration should be given to retaining the Priority 3 *Jacksonia sericea* plants identified during this assessment within an area of POS, under the *Wildlife Conservation Act 1950* there is no obligation to do so. Greater priority should be given to the retention of a vegetated corridor that includes upland vegetation which of suitable width to allow for the regional movement of fauna, in addition to the existing foreshore reserve.

2. Where possible, all trees identified as significant habitat trees should be retained (see Table 3). Special priority should be given to the retention of trees containing the active Osprey and Whistling kite nests.

3. In addition to the areas of POS proposed in the preliminary structure plan for the site, it is recommend that an additional area of POS be added to the existing foreshore reserve to create a vegetated corridor that would allow for the regional movement of fauna through the area. A corridor of at least 30m in width (including the foreshore reserve) is recommended. It is also recommended that the stand of Tuart and Jarrah trees with hollows and the Whistling kite nest that are adjacent to the northern boundary of the site, be retained, either within the road reserve or as POS for the proposed development.

4. Restrictions should be placed on the movement of domestic pets (e.g. cats and dogs) within the development, thereby reducing their predation on native fauna species, particularly those moving along the corridor of riverine vegetation. This may included a cat exclusion zone around the river and/or a curfew on the hours when cats are allowed outdoors. Guidelines relating to these measures could be provided in a public information brochure.

5. It is recommended that locally endemic plant species be planted throughout the POS and road reserves of the proposed subdivision to allow for the movement of bird species through the area.

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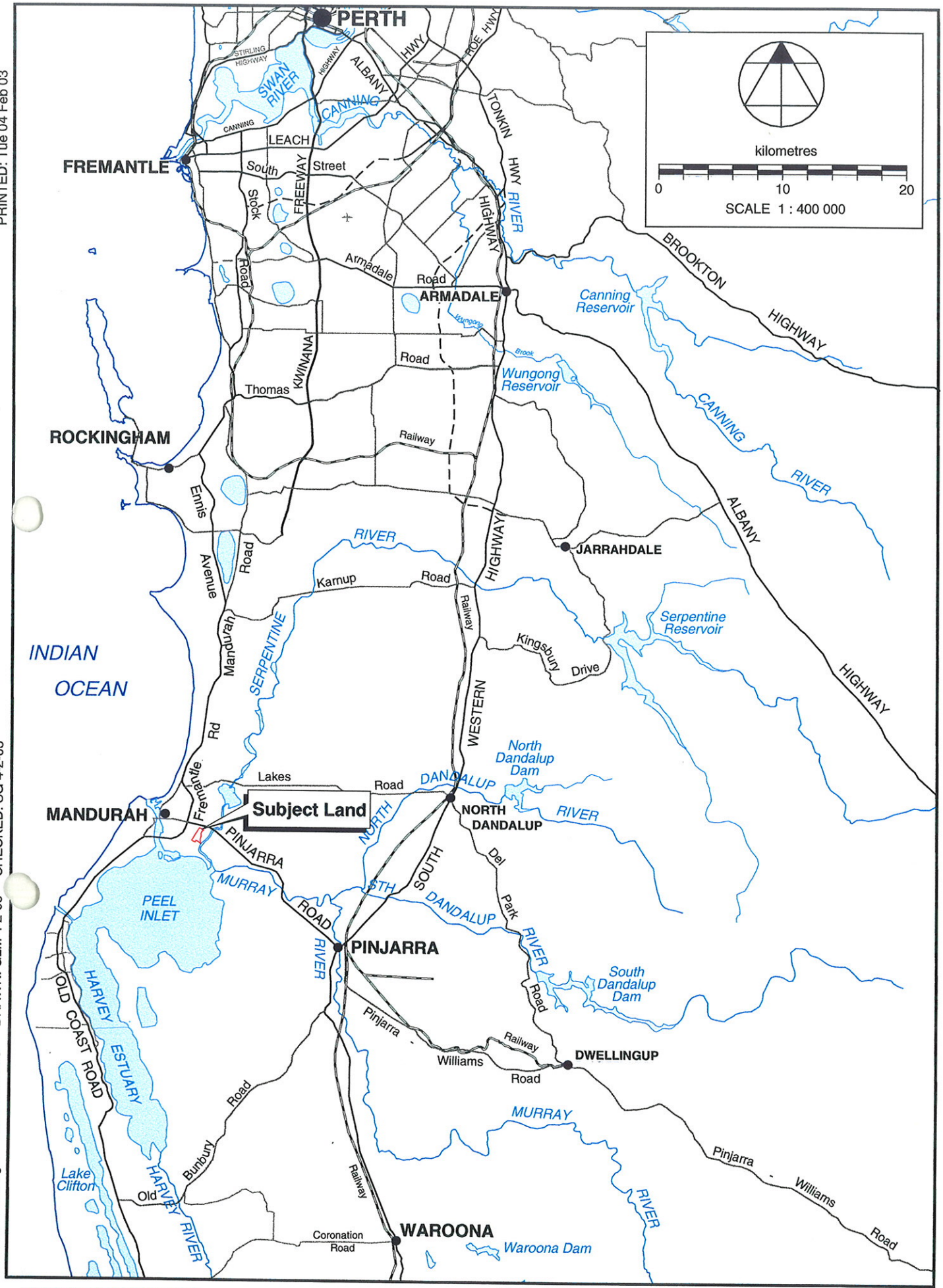
FIGURES



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PT LOT 200 WANJEEP STREET, COODANUP
VEGETATION, FLORA & FAUNA ASSESSMENT

REGIONAL LOCATION

FIGURE 1

PRINTED: Wed 05 Feb 03

LEGEND

- Boundary of Subject Land
- 200 — Cadastral Boundary of Lot 200
- 113 — Cadastral Boundary and Lot Number
- 4 — Topographic Contour (mAHD)
- Vegetation Type Boundary

metres
0 50 100 150 200 250
SCALE 1 : 5 000

VEGETATION TYPES

EmBAf	Jarrah (*Eucalyptus marginata*), *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana* Low Open Forest
EmB	Jarrah (*Eucalyptus marginata*), *Banksia attenuata,* and *B. menziesii* Open Woodland
Eg	Tuart (*Eucalyptus gomphocephala*) Tall Open Woodland (Parkland cleared) with occassional Scattered Jarrah
EmAf	Jarrah (*Eucalyptus marginata*)/*Allocasuarina fraseriana* Woodland
CcEr	Marri (*Corymbia calophylla*)/Flooded Gum (*Eucalyptus rudis*) Open Woodland
Cc	Marri (*Corymbia calophylla*) Woodland
Nf	Christmas Tree (*Nuytsia floribunda*) Low Woodland

VEGETATION CONDITION (SOURCE: Bush Forever, Govt. of W.A.) See text for full description

Not Applicable	Pristine
E	Excellent
VG	Very Good
G	Good
D	Degraded
CD	Completely Degraded

SIGNIFICANT FAUNA HABITAT TREES (Location and Tree Species)

×	Location of Tree with Hollows
J	Jarrah
M	Marri
T	Tuart
D	Dead Eucalypt

ATA Environmental
environmental scientists

PT LOT200 WANJEEP STREET, COODANUP
VEGETATION, FLORA & FAUNA ASSESSMENT

VEGETATION TYPES AND CONDITION AND SIGNIFICANT FAUNA HABITAT TREES

FIGURE 2

23006/23_10f2.dgn DATUM: MGA DRAWN BY: GLM 5-2-03 CHECKED BY: SG 5-2-03

BASE SOURCE: GRAY & LEWIS, 4-7-02

degraded edge

PLATES

Plate 1 Jarrah/Banksia/Sheoak Low Open Forest

Plate 2 Tuart Tall Open Woodland

ATA Environmental
environmental scientists

Plate 3 Osprey and Nest

APPENDICES

APPENDIX 1

PT LOT 200 WANJEEP STREET, COODANUP
FLORA LIST

APPENDIX 1
PT LOT 200WANJEEP STREET, COODANUP FLORA LIST

CYCADS	
ZAMIACEAE	*Macrozamia fraseri*
MONOCOTYLEDONS	
ANTHERICACEAE	*Thysanotus manglesianus*
	Thysanotus multiflorus
CYPERACEAE	*Lepidosperma longitudinale*
	Mesomelaena tetragona
	Mesomelaena pseudostygia
	Tetraria octandra
DASYPOGONACEAE	*Acanthocarpus preissii*
	Dasypogon bromeliifolius
HAEMODORACEAE	*Conostylis aculeata*
	Conostylis setigera
	Conostylis juncea
PHORMIACEAE	*Dianella revoluta*
POACEAE	**Avena fatua*
	**Briza maxima*
	** Cynodon dactylon*
	**Ehrharta calycina*
	**Ehrharta longifolia*
	**Eragrostis curvula*
	**Pennisetum clandestinum*
	Austrodanthonia sp
RESTIONACEAE	*Desmocladus flexuosus*
	Hypolaena exsulca
	Leptocarpus sp.
	Lyginia barbata
	Themeda triandra
XANTHORRHOEACEAE	*Xanthorrhoea gracilis*
	Xanthorrhoea preissii
DYCOTYLEDONS	
AIZOACEAE	**Carpobrotus edulis*
ASTERACEAE	**Conyza albida*
	**Hypochaeris glabra*
	**Ursinia anthemoides*

CASUARINACEAE	✓	*Allocasuarina fraseriana*
DILLENIACEAE		*Hibbertia huegelii*
	✓	*Hibbertia hypericoides*
EPACRIDACEAE		*Conostephium pendulum*
		Leucopogon conostephioides
		Leucopogon propinquus
		Lysinema ciliatum
EUPHORBIACEAE	✓	*Phyllanthus calycinus*
GOODENIACEAE		*Dampiera linearis*
	✓	*Scaevola* sp.
LAURACEAE		*Cassytha racemosa*
LORANTHACEAE	✓	*Nuytsia floribunda*
MIMOSACEAE	✓	*Acacia pulchella*
		**Acacia pycnantha*
	✓	*Acacia saligna*
MYRTACEAE	✓	*Corymbia calophylla*
		Kunzea ericifolia
		Eucalyptus gomphocephala
	✓	*Eucalyptus marginata* ssp. *marginata*
		Eucalyptus rudis
		Melaleuca cuticularis
		Melaleuca rhaphiophylla
PAPILIONACEAE		*Bossiaea eriocarpa*
		Bossiaea ornata
		Daviesia decurrens
	✓	*Gompholobium tomentosum*
	✓	*Hardenbergia comptoniana*
		Jacksonia furcellata
		Jacksonia sternbergiana
		Jacksonia sericea (P3)
		**Lupinus* sp.
		Nemcia capitatum
		Nemcia reticulatum
		**Trifolium campestre*
PROTEACEAE	✓	*Banksia attenuata*
	✓	*Banksia grandis*
	✓	*Banksia ilicifolia*
	✓	*Banksia menziesii*

Kennedia prostrata
delicate blue flower.

	Dryandra lindleyana
	Hakea amplexicaulis
✓	*Hakea ruscifolia*
✓	*Persoonia saccata*
✓	*Petrophile linearis*
	Stirlingia latifolia
	Synaphea petiolaris
	Synaphea spinulosa
✓	*Xylomelum occidentale*
SOLANACEAE	* *Solanum linnaeanum*
Total Species:	**79**
Native:	66
Introduced:	13
Note: * denotes introduced species	
(P3) Priority Listed Taxa	

APPENDIX 2

VERTEBRATE SPECIES LIST FOR PT LOT 200 WANJEEP ROAD, COODANUP

APPENDIX 2
VERTEBRATE SPECIES LIST FOR PT LOT 200 WANJEEP ROAD, COODANUP

Species		Observed	Status	Comments
AMPHIBIANS				
Myobatrachidae (ground frogs)				
Glauert's Froglet	*Crinia glauerti*	WAM		
Squelching Frog	*Crinia insignifera*	WAM		
Moaning Frog	*Heleioporus eyrei*	WAM		
Pobblebonk	*Limnodynastes dorsalis*	WAM		
Turtle Frog	*Myobatrachus gouldii*		**CS3**	
Guenther's Toadlet	*Pseudophryne guentherii*	WAM		
Hylidae (tree frogs)				
Motorbike Frog	*Litoria moorei*	WAM		
Slender Tree Frog	*Litoria adelaidensis*			
Number of frog species expected		8		

Species		Observed	Status	Comments
REPTILES				
Chelidae (freshwater tortoises)				
Long-necked Tortoise	*Chelodina oblonga*			
Gekkonidae (geckoes)				
Marbled Gecko	*Christinus(Phyllodactylus) marmoratus*	WAM		
Spiny-tailed Gecko	*Strophurus spinigerus*			
Barking Gecko	*Underwoodisaurus milli*	WAM	CS3	
Pygopodidae (legless lizards)				
Sandplain Worm Lizard	*Aprasia repens*	WAM		
Fraser's Legless Lizard	*Delma fraseri*			
Grey's Legless Lizard	*Delma greyii*			
Burton's Legless Lizard	*Lialis burtonis*	WAM		
Common Scaleyfoot	*Pygopus lepidopodus*			
Agamidae (dragon lizards)				
Western Bearded Dragon	*Pogona minor*	WAM		
Varanidae (monitors or goannas)				
Gould's Sand Goanna	*Varanus gouldii*			
Rosenberg's Goanna	*Varanus rosenbergi*			
Scincidae (skink lizards)				
South-West Cool Skink	*Acritoscincus trilineatum*	WAM		
Fence Skink	*Cryptoblepharus plagiocephalus*	WAM		
Western Ctenotus	*Ctenotus australis*	WAM		
South-west Odd-striped Ctenotus	*Ctenotus impar*	WAM		
Red-legged Skink	*Ctenotus labillardieri*		CS3	
King's Skink	*Egernia kingii*	WAM		
Western Swamp Egernia	*Egernia luctuosa*			
Salmon-bellied Skink	*Egernia napoleonis*	WAM		
Two-toed Earless Skink	*Hemiergis quadrilineata*	WAM		
South-western Four-toed Lerista	*Lerista distinguenda*			
West Coast Four-toed Lerista	*Lerista elegans*	WAM		
Perth Lined Lerista	*Lerista lineata*		CS3	
Dwarf Skink	*Menetia greyii*	WAM		

Species	Observed	Status	Comments
Western pale-flecked Morethia *Morethia lineoocellata*	WAM		
Southern pale-flecked Morethia *Morethia obscura*			
Bobtail *Tiliqua rugosa*	WAM		
Typhlopidae (blind snakes)			
Southern Blind Snake *Ramphotyphlops australis*	WAM		
Boidae (pythons)			
South-West Carpet Python *Morelia spilota imbricata*	?	CS1	
Elapidae (front-fanged snakes)			
Bardick *Echiopsis curta*	WAM		
Crowned Snake *Elapognathus coronata*	WAM		
Black-naped Snake *Neelaps bimaculatus*	WAM		
Black-striped Snake *Neelaps calanotus*			
Tiger Snake *Notechis scutatus*	WAM		
Dugite *Pseudonaja affinis*	WAM		
Gould's Snake *Parasuta(Rhinoplocephalus) gouldii*	WAM		
Jan's Bandy-Bandy *Simoselaps(Vermicella) bertholdi*	WAM		
Black-naped Snake *Simoselaps(Vermicella) bimaculata*		CS3	
Number of reptile species expected:	39		

Species	Observed	Status	Comments
BIRDS			
Phasianidae (pheasants and quails)			
Brown Quail *Coturnix ypsilophora*			
Stubble Quail *Coturnix pectoralis*			
Anatidae (ducks, geese and swans)			
Black Swan *Cygnus atratus*			
Grey Teal *Anas gracilis*			
Pacific Black Duck *Anas superciliosa*	X		
Australian Shelduck *Tadorna tadornoides*			
Australian Wood Duck *Chenonetta jubata*			
Podicipediae (grebes)			
Hoary-headed Grebe *Poliocephalus poliocephalus*	WAM		
Great Crested Grebe *Podiceps cristatus*	WAM		
Anhingidae (darters)			
Darter *Anhinga melanogaster*	WAM X		
Phalacrocoracidae (cormorants)			
Great Cormorant *Phalacrocorax carbo*	WAM X		
Little Pied Cormorant *Phalacrocorax melanoleucos*	WAM		
Little Black Cormorant *Phalacrocorax sulcirostris*			
Pied Cormorant *Phalacrocorax varius*			
Pelecanidae (pelicans)			
Australian Pelican *Pelecanus conspicillatus*	WAM X		
Ardeidae (herons and egrets)			
White-faced Heron *Egretta novaehollandiae*	X		
Little Egret *Egretta garzetta*			
White-necked Heron *Ardea pacifica*			
Great Egret *Ardea alba*	X		
Nankeen Night Heron *Nycticorax caledonicus*			
Threskiornithidae (ibis)			
Australian White Ibis *Theskiornis molucca*			
Straw-necked Ibis *Threskiornis spinicollis*	X		

4 = wide ranging redb distrib SCP
3 = habitat specialists redb pop SCP

Species	Observed	Status	Comments
Yellow-billed Spoonbill *Platalea flavipes*			
Accipitridae (kites, hawks and eagles)			
Osprey *Pandion haliaetus*	X X		Nesting
Black-shouldered Kite *Elanus notatus*			
Square-tailed Kite *Lophoictinia isura*			
Whistling Kite *Haliastur sphenurus*	X, WAM X	4	Nesting
Swamp Harrier *Circus approximans*			
Brown Goshawk *Accipiter fasciatus*			
Collared Sparrowhawk *Accipiter cirrhocephalus*			
Wedge-tailed Eagle *Aquila audax*			
Little Eagle *Hieraaetus morphnoides*			
Falconidae (falcons)			
Peregrine Falcon *Falco peregrinus*	WAM	CS1	
Australian Hobby *Falco longipennis*			
Brown Falcon *Falco berigora*			
Nankeen Kestrel *Falco cenchroides*			
Rallidae (rails and crakes)			
Buff-banded Rail *Gallirallus philippensis*	X		
Baillon's Crake *Porzana pusilla*			
Australian Spotted Crake *Porzana fluminea*			
Spotless Crake *Porzana tabuensis*			
Purple Swamphen *Porphyrio porphyrio*			
Eurasian Coot *Fulica atra*			
Turnicidae (button-quails)			
Painted Button-quail *Turnix varia*			
Scolopacidae (stints, sandpipers and curlews)			
Common Greenshank *Tringa nebularia*	WAM	CS1	
Red-necked Stint *Calidris ruficollis*		CS1	
Sharp-tailed Sandpiper *Calidris acuminata*		CS1	
Curlew Sandpiper *Calidris ferruginea*		CS1	
Recurvirostridae (stilts and avocets)			
Black-winged Stilt *Himantopus himantopus*			
Banded Stilt *Cladorhynchus leucocephalus*			
Red-necked Avocet *Recurvirostra novaehollandiae*			
Charadriidae (lapwings and plovers)			
Red-capped Plover *Charadrius ruficapillus*			
Black-fronted Dotterel *Elseyornis melanops*			
Laridae (gulls and terns)			
Silver Gull *Larus novaehollandiae*			
Columbidae (pigeons and doves)			
Laughing Turtle-Dove *Streptopelia senegalensis*			
Common Bronzewing *Phaps chalcoptera*	X	3	
Crested Pigeon *Ocyphaps lophotes*			
Cacatuidae (cockatoos)			
Red-tailed Black-Cockatoo *Calyptorhynchus banksii*	WAM	CS2	
Short-billed Black-Cockatoo *Calyptorhynchus latirostris*	WAM	CS1	
Long-billed Black-Cockatoo *Calyptorhynchus baudinii*		CS1	
Galah *Cacatua roseicapilla*	X		
Psittacidae (lorikeets and parrots)			

Species		Observed	Status	Comments
Purple-crowned Lorikeet	*Glossopsitta porphyrocephala*			
Regent Parrot	*Polytelis anthopeplus*	WAM		
Red-capped Parrot	*Purpureicephalus spurius*	X, WAMX		
Western Rosella	*Platycercus icterotis*	WAM ?		
Australian Ringneck	*Barnardius zonarius*	X, WAMX		
Elegant Parrot	*Neophema elegans*			
Cuculidae (cuckoos)				
Pallid Cuckoo	*Cuculus pallidus*			
Fan-tailed Cuckoo	*Cuculus pyrrhophanus*			
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*	WAM		
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*			
Strigidae (hawk-owls)				
Barking Owl	*Ninox connivens*		CS2	
Southern Boobook Owl	*Ninox novaeseelandiae*	WAM		
Tytonidae (barn owls)				
Masked Owl	*Tyto novaehollandiae*		CS2	
Barn Owl	*Tyto alba*	WAM		
Podargidae (frogmouths)				
Tawny Frogmouth	*Podargus strigoides*			
Apodidae (swifts)				
Fork-tailed Swift	*Apodus pacificus*	WAM		
Halcyonidae (forest kingfishers)				
Laughing Kookaburra	*Dacelo novaeguineae*	X, WAMX		
Sacred Kingfisher	*Todiramphus sanctus*	WAM X		
Meropidae (bee-eaters)				
Rainbow Bee-eater	*Merops ornatus*			
Maluridae (fairy-wrens)				
Splendid Fairy-wren	*Malurus splendens*	X, WAM	3	
Pardalotidae (pardalotes and thornbills)				
Spotted Pardalote	*Pardalotus punctatus*		CS3	
Striated Pardalote	*Pardalotus striatus*	WAM X	C	
White-browed Scrubwren	*Sericornis frontalis*	X	3	
Western Gerygone	*Gerygone fusca*	X, WAMX		
Weebill	*Smicrornis brevirostris*	X, WAMX	3	
Inland Thornbill	*Acanthiza apicalis*	WAM		
Western Thornbill	*Acanthiza inornata*	X, WAM	3	
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	WAM		
Meliphagidae (honeyeaters)				
Red Wattlebird	*Anthochaera carunculata*	X, WAM X		
Western Wattlebird	*Anthochaera lunulata*	WAM		
Singing Honeyeater	*Lichenostomus virescens*	X, WAM		
White-naped Honeyeater	*Melithreptus lunatus*	WAM		
Brown-headed Honeyeater	*Melithreptus brevirostris*			
Brown Honeyeater	*Lichmera indistincta*	X, WAM		
New Holland Honeyeater	*Phylidonyris novaehollandiae*	X, WAM	4	
White-cheeked Honeyeater	*Phylidonyris nigra*			
Tawny-crowned Honeyeater	*Phylidonyris melanops*			
Western Spinebill	*Acanthorhynchus superciliosus*	X		
White-fronted Chat	*Epthianura albifrons*			

Species	Observed	Status	Comments
Petroicidae (Australian robins)			
Scarlet Robin *Petroica multicolor*	WAM		
Neosittidae (sittellas)			
Varied Sittella *Daphoenositta chrysoptera*	WAM		
Pachycephalidae (whistlers)			
Golden Whistler *Pachycephala pectoralis*	WAM	CS3	
Rufous Whistler *Pachycephala rufiventris*	X		
Grey Shrike-thrush *Colluricincla harmonica*	WAM X	S	
Dicruridae (flycatchers)			
Magpie-lark *Grallina cyanoleuca*			
Restless Flycatcher *Myiagra inquieta*		CS3	
Grey Fantail *Rhipidura fuliginosa*	X, WAM X		
Willie Wagtail *Rhipidura leucophrys*	WAM		
Campephagidae (cuckoo-shrikes)			
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	X		
White-winged Triller *Lalage tricolor*	WAM		
Artamidae (woodswallows)			
Black-faced Woodswallow *Artamus cinereus*			
Dusky Woodswallow *Artamus cyanopterus*			
Grey Butcherbird *Cracticus torquatus*	X		
Australian Magpie *Gymnorhina tibicen*	X, WAM X		
Grey Currawong *Strepera versicolor*		CS3	
Corvidae (ravens and crows)			
Australian Raven *Corvus coronoides*	X X		
Motacillidae (pipits and true wagtails)			
Richard's Pipit *Anthus novaeseelandiae*			
Dicaeidae (mistletoebird)			
Mistletoebird *Dicaeum hirundinaceum*			
Hirundinidae (swallows)			
Welcome Swallow *Hirundo neoxena*	X		
Tree Martin *Hirundo nigricans*			
Sylviidae (grassbirds)			
Little Grassbird *Megalurus gramineus*	WAM		
Zosteropidae (white-eyes)			
Silvereye *Zosterops lateralis*	X, WAM		
Number of bird species expected:	122		
Number of bird species observed: (not including WA Museum records) BHC	22 24 + 14		

Total 36

BHC got 14 not got by consultants

Mammal Species Possibly Occurring

Species		Observed	Status
MAMMALS			
Tachyglossidae (echidnas)			
Echidna	*Tachyglossus aculeatus*		
Dasyuridae (dunnarts and allies)			
Brush-tailed Phascogale	*Phascogale tapoatafa*	?, WAM	CS2
Chuditch	*Dasyurus geoffroii*	?	CS1
Peramelidae (bandicoots)			
Quenda or Southern Brown Bandicoot	*Isoodon obesulus*	X, WAM	CS2
Tarsipedidae (honey possum)			
Honey Possum	*Tarsipes rostratus*	?	CS3
Phalangeridae (possums)			
Brush-tailed Possum	*Trichosurus vulpecula*	seen nearby?	CS3
Pseudocheiridae (ring-tailed possums)			
Western Ring-tailed Possum	*Pseudochierus occidentalis*	?	CS1
Burramyidae (pygmy possums)			
Western Pygmy Possum	*Cercartetus concinnus*	WAM	CS3
Macropodidae (kangaroos and wallabies)			
Western Grey Kangaroo	*Macropus fuliginosus*	X	
Brush or Black-gloved Wallaby	*Macropus irma*	?, WAM	CS2
Mollosidae (mastiff bats)			
White-striped Bat	*Tadarida australis*	X	
Western Freetail Bat	*Mormopterus planiceps*		
Vespertilionidae (vesper bats)			
Gould's Wattled Bat	*Chalinolobus gouldii*		
Chocolate Wattled Bat	*Chalinolobus morio*		
Western False Pipistrelle	*Falsistrellus mackenziei*		CS2
Southern Forest Bat	*Vespadelus (Eptesicus) regulus*	WAM	
Lesser Long-eared Bat	*Nyctophilus geoffroyi*		
Gould's Long-eared Bat	*Nyctophilus gouldii*		
Greater Long-eared Bat	*Nyctophilus timoriensis*		
Muridae (rats and mice)			
Rakali or Water-Rat	*Hydromys chrysogaster*	WAM	CS2
Moodit or Southern Bush Rat	*Rattus fuscipes*	?, WAM	
House Mouse	*Mus musculus*	WAM	
Black Rat	*Rattus rattus*	WAM	
Leporidae (rabbits and hares)			
Rabbit	*Oryctolagus cuniculus*	X	
Canidae (foxes and dogs)			
European Red Fox	*Vulpes vulpes*	X	
Felidae (cats)			
Feral Cat	*Felis catus*		
Number of mammal species expected:		26	
Number of mammal species observed:		5	

Species Extinct

Species	Status under WA Act
Petroicidae (Australian robins)	
White-breasted Robin *Eopsaltria georgiana*	
Western Yellow Robin *Eopsaltria griseogularis*	
Passeridae (finches)	
Red-eared Firetail *Stagonopleura oculata*	
Dasyuridae (dunnarts and allies)	
dunnart *Sminthopsis gilberti*	
Potoroidae (potoroos)	
Woylie *Bettongia penicillata*	Conservation Dependent
Boodie *Bettongia lesueur*	Schedule 1 (Extinct on mainland)
Macropodidae (kangaroos and wallabies)	
Tammar *Macropus eugeni*	Conservation Dependent
Quokka *Setonix brachyurus*	Schedule 1 (Vulnerable)
Muridae (rats and mice)	
Noodji *Pseudomys albocinereus*	

NOTE:

X - Species observed during a site visit.

WAM - Species recorded on the Western Australian Museum Fauna Base in the area cornered by 32.5° S, 115.7° E and 32.6° S and 115.8° S. This may include historic records for species that no longer occur in the area.

? - Species probably locally extinct in the area.

Conservation Significance (CS)

CS 1. Species listed under EPBC or WA Wildlife Conservation Act. Includes migratory bird species.

CS 2. Species listed as Priority, or in published lists such as Garnett and Crowley. These are not "officially" significant under legislation, but concern for them is sufficient for publication.

CS3. Regional significance, based on species at the limit of their distribution

* may be vagrants in area.

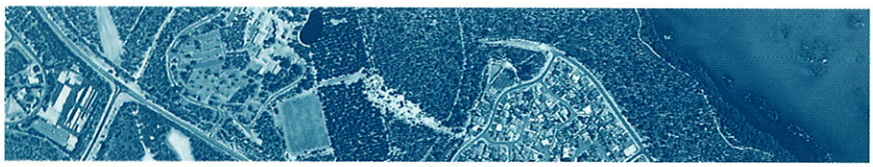
NB. The waterbirds recorded were largely recorded from adjacent to the Serpentine River.

Tabled at meeting 2/12/05 S. Reilly, K. Chow, O. Drescher, D. Cole, Maxine Dawson

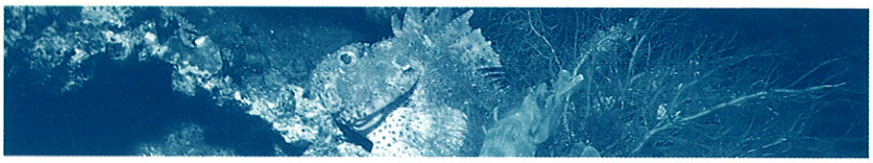
Also large format report

RPS Bowman Bishaw Gorham

ENVIRONMENTAL MANAGEMENT CONSULTANTS



ENVIRONMENTAL ASSESSMENT REPORT
LOT 440 WANJEEP STREET, COODANUP
CITY OF MANDURAH



ENVIRONMENTAL ASSESSMENT REPORT
LOT 440 WANJEEP STREET, COODANUP
CITY OF MANDURAH

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Report No: L05597
October 2005

Report Status

Revision/Version	Purpose of Document	Prepared By	Reviewed By	Date Approved
1	Client Review	KAC/KC/SR	SR	27/10/05
2	Environmental Assessment Report For ODP	KC	Client	31/10/05

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Appendix A **Vegetation and Flora Assessment Report**
(RPS Bowman Bishaw Gorham, October 2005)

Appendix B **Fauna and Habitat Assessment Report**
(Bamford Consulting Ecologists, October 2005)

1.0 INTRODUCTION

1.1 Background

Lots 440 and 442 Wanjeep Street are located within the suburb of Coodanup within the City of Mandurah. The two land holdings are large and total approximately 190ha.

The overall landholding is divided into two zonings.

A portion of Lot 440 is bounded in the west by Wanjeep Street, east by the Serpentine River and the Peel Regional Park, south by Birchley Road, and in the north by private land (Figure 1). This portion of Lot 440 is zoned Urban under the Peel Region Scheme (PRS). This area is shown in the City of Mandurah's Town Planning Scheme No. 3 (TPS), as predominantly Residential R12.5/R20 and Local Recreation. This area is approximately 52ha.

A second larger title, Lot 442, is also owned by Frasers Mandurah Pty Ltd and includes the riverine floodplain, and Serpentine River itself up to and including part of Geogrup Lake. This component is reserved as Parks and Recreation under the Peel Region Scheme (PRS), although still in private ownership, and has an area of approximately 138ha (Figure 2).

The Parks and Recreation components of both landholdings (Lot 442) is not considered for development as part of this proposal, and consequently this Environmental Assessment Report responds to a development proposal for the Urban zoned land only on Lot 440 Wanjeep Street. This land is termed "the site".

However notwithstanding that Lot 442 is not proposed for development, it remains relevant to consider this land in the context of its proximity and biological connectivity to the urban zoned land.

A more thorough description of planning issues relevant to the site and project is provided in the Outline Development Plan report (RobertsDay, 2005).

1.2 Previous Environmental Assessment

The residential zoned portion of Lot 440 Wanjeep Street was zoned under the City of Mandurah's Town Planning Scheme in the mid 1980s. When the Peel Region Scheme was proposed for the Mandurah region, current residential zonings under the local planning schemes were zoned as Urban under the PRS. Consequently as part of the implementation of the Peel Region Scheme (PRS), the site was zoned Urban under the PRS. The remaining area east of the site was reserved Parks and Recreation under the PRS.

The PRS was formally assessed by the EPA under Section 48A of the *Environmental Protection Act, 1986*. However, the scope of the EPA's assessment focused on "new zones" where the zoning shown in the PRS differed from that shown in the existing local town planning scheme, which represented a "real" change in land use that had the potential for adverse environmental impacts.

Further, a subdivision application for the site was previously lodged with the regulatory authorities by previous proponents. A preliminary review of the plan indicates that the proposed design did not sufficiently respond to the environmental attributes of the site, and the proposal did not proceed.

Future development proposals or subdivision applications for the site can be referred to the EPA for consideration and assessment under Section 38 of the *Environmental Protection Act, 1986*.

1.3 Outline Development Plan

An Outline Development Plan (ODP) has been prepared for the site (Urban zoned area), which is described in detail in the ODP Report prepared by the extensive project team. An ODP is a broad but definitive planning framework that provides guidance and context for future development over suitably zoned land.

The urban zoned site contains a large area of native vegetation in good condition, and the challenge for this ODP process, which has involved regulatory authority and community input from the outset (Planning Design Forum), has been to find a balance between development, conservation, and economic and environmental viability.

Further, there is a need to supply a built form product that is both acceptable to an environmentally conscious community, but at the same time demonstrably marketable and commercially valid.

The Frasers Mandurah ODP is based on a planning concept conceived at a Planning Design Forum organised and facilitated by RobertsDay Town Planning + Design. The Forum was conducted over two and a half days between 21st and 23rd September, 2005 at the Meadow Springs Golf Course Clubhouse, Mandurah.

The Design Forum enabled a concept plan to be prepared in collaboration with the City of Mandurah, Department for Planning and Infrastructure, local community representatives, other key stakeholders, and the Frasers Mandurah project team.

Delegates were invited to participate in the Design Forum program, which included:

- an opening presentation of traditional neighbourhood planning and design principles, environmental, landscape, and engineering issues;
- a site inspection (terrestrial and aquatic);
- an issues identification session divided into key interest groups;
- technical presentations by members of the project team;
- a community representatives forum; and
- presentation of the outcomes of the forum in the form of a preliminary concept plan.

The Design Forum program and a list of delegates that participated are provided in the ODP Report.

Importantly, the resultant ODP is based on design principles and techniques for sustainable development and it is a holistic response to issues discovered through the Design Forum and extensive site familiarisation and survey. The environmental issues that were raised through the Design Forum, as a result of the direct transfer of knowledge concerning the natural and cultural heritage of the Coodanup locality and the aspirations of its residents, is highlighted in Section 4.1 of this document.

The site is predominantly well vegetated by native species, and the protection of native vegetation was one of the key issues that were raised by the participants at the Design Forum. Subsequently, significant effort has been expended to map the vegetation of the urban component of the site from both biological and landscape perspectives.

This was manifested in establishing a Core Conservation Reserve as a key design element within the ODP area, with due consideration of location, condition, representativeness and connectivity of the reserve. However, retention of vegetation was not limited to the CCR, and is also proposed in the built environment.

In brief, the ODP components include (Figure 3):

- A substantial Core Conservation Reserve (approximately 23% of the site);
- Managed public access to the foreshore environment (currently private);
- "Hamlet" style development precincts with vegetation protection as landscape features;
- Apartment style development precincts, where density development is considered an equitable trade-off for a reduced development "footprint" and hence increased vegetation retention;
- A "Keyhole Inlet" that provides a publicly available water feature and focus within the ODP area that is not physically connected to the adjacent river;
- A Wanjeep commercial node; and
- Open space areas

The implementation of the ODP footprint has been used as the basis for this assessment, and is discussed further in the following sections.

2.0 EXISTING ENVIRONMENT

2.1 Topography

The Urban component of the site gently grades in an easterly direction and varies from a high point of 6mAHD in the south west of the site to 2m AHD along the foreshore of the Serpentine River. This riverside elevation reflects the relatively steep banks that occur in this location.

2.2 Geology and Soils

The site is characterised by sand over Tamala (Coastal) Limestone (Archer *et al.*, 1978). The soil type has been mapped as Spearwood Dune and Plain System (S4). (Wells and Hesp, 1981) (Figure 4). S4 is characterised as gently to moderately incline low hills and gently undulating plan located west of the Bassendean System and associated with Pleistocene, Tamala Limestone. S4 is flat to gently undulating sand plain with deep, pale and sometimes bleached, sands with yellow brown subsoils, shallow to moderately deep siliceous yellow brown and grey brown sands with minor limestone outcrop.

This regional description is generally supported by on-site investigations (see Engineering Report).

2.2.1 Acid Sulfate Soils

The WAPC (2003) has undertaken regional-scale mapping of the site and surrounds with respect to the potential for acid sulfate soils (Figure 5).

The western section of the Urban component of the site has been mapped as Moderate to Low risk of Actual Acid Sulfate Soil (AASS) and Potential Acid Sulfate Soil (PASS) occurring generally at depths of >3m. The central section of the site is mapped as Moderate risk for AASS and PASS. The eastern margin of the site is mapped as High potential for AASS and PASS.

The preliminary management options for this issue are discussed further in Section 4.7 of this report.

2.3 Surface Hydrology and Wetlands

The site is located on the western shore of the Serpentine River, within the water catchment of the Peel-Harvey Estuary, which is a regionally and internationally significant environmental feature and conservation reserve.

The adjacent Serpentine River and floodplain are mapped by the Department of Environment (DoE) as Conservation management category wetlands; the highest management category (Figure 6). These areas are not proposed for development, and buffers to development of varying widths are proposed.

Lot 440 is not located within the Serpentine River floodway or floodplain, however the site boundary does abut the extent of the 1 in 100 year floodplain (Figure 7).

2.4 Groundwater

Depth to groundwater varies from approximately 5 metres below ground level in the west and north west of the site, to 0m towards the eastern edge of the site adjacent to the river. Groundwater flow in the area would generally be towards the Serpentine River.

2.5 Vegetation and Flora

2.5.1 Vegetation Complexes

The site is predominantly vegetated with native plant species. Approximately 45ha of vegetation within Lot 440 consists of the Yoongarillup Complex, which is described at a regional scale as woodland to tall woodland of tuart (*E.gomphocephela*) with Peppermint (*Agonis flexuosa*) in the second storey. Less consistently an open forest of tuart-jarrah-marri (*E. gomphocephela-E.marginata- Corymbia calophylla*).

Approximately 4ha of vegetation in the south east of the Urban zoned land is mapped as Vasse Complex, described at regional scale as a mixture of closed scrub of *Melaleuca* spp., fringing woodland of river gum and paperbark (*E.rudis-Melaleuca* spp.) and open forest of tuart-jarrah-marri.

The very northern portion of the site has been parkland cleared, and areas of degradation due to uncontrolled access are apparent adjacent to the river.

The ODP area only includes the Yoongarillup Vegetation Complex. In terms of regional representation of this complexes, within the Peel Region Scheme (PRS) area approximately 4,587ha (36%) of Yoongarillup Complex remains within the PRS area, and 28% (or 3,610ha) of this complex is located within the Peel Regional Park (State of Western Australia, 1999) (Figure 9), which is preserved in perpetuity.

There is approximately 3,028ha (40%) of the Vasse Complex remaining in the Peel Region Scheme area. The percentage of this complex reserved as Parks and Recreation under the PRS is currently unknown. However, within the System 6/part System1 area approximately 37% is in secure tenure (EPA, 2003). This vegetation complex is not proposed for development in the ODP.

The EPA is currently reviewing vegetation complex representation in the Peel Region Scheme area.

2.5.2 Vegetation Types

Survey not complete only

A Level 2 Vegetation and Flora Survey, in accordance with the requirements of the EPA's Guidance Statement No. 51 (EPA, 2004) has commenced for the site, with spring surveys conducted in September, 2005. A second vegetation and flora survey is scheduled for November, 2005. The full Vegetation and Flora Assessment report is included as Appendix A.

Specific survey indicates that the Urban component of the site contains native vegetation predominantly in Good to Excellent condition using Bush Forever criteria (Govt of Western Australia, 2000), with some peripheral but generally limited weed infestation.

Six vegetation units have been recorded from the site in this assessment, however the dominant unit is Jarrah-Banksia-Sheoak low open forest. The units are:

JBS - *Eucalyptus marginata, Banksia attenuata, B. menziesii, Allocasuarina fraseriana* Low Open Forest. (Good-Excellent)

Cc - *Corymbia calophylla* Open Forest (Completely Degraded)

EgJ - *Eucalyptus gomphocephela, E. marginata* Open Forest/Open Woodland (Completely Degraded)

CeJX - *Corymbia calophylla, Eucalyptus marginata* Low Closed Forest over *Xylomelum occidentale* Tall Open Shrubland. (Degraded-Completely Degraded)

JTBS- *Eucalyptus gomphocephela* Scattered Trees over *Eucalyptus marginata, Banksia attenuata, B. menziesii, Allocasuarina fraseriana* Low Closed Forest. (Very Good)

CcTBS- *Eucalyptus gomphocephela* Scattererd Trees over *Corymbia calophylla, Banksia attenuata, B. menziesii, Allocasuarina fraseriana Low Closed Forest* (Very Good)

The representation of vegetation units is presented in Figure 10.

The September 2005 survey of Lot 440 resulted in 101 flora species identified from the quadrats established (Appendix A).

2.5.3 Floristic Community Types

The most accurate way to determine which Floristic Community Types are in a metropolitan region Swan Coastal Plain study area is to select, sample and analyse 10 m by 10 m quadrats using the techniques described by Gibson *et al.* (1994) and Keighery (1994). An essential component of these techniques is the compilation of a complete list of species for each quadrat based upon correctly identified plant specimens. This often requires sampling the quadrat more than once.

The floristic community approach to vegetation classification and description gives equal weight to all vascular plant species in plant community sampling quadrats (or plots). These plots are, in the case of Swan Coastal Plain floristic surveys, 10m by 10m squares. The presence or absence of individual species in the quadrats is, with the aid of computerised multivariate analysis techniques (specifically, PATN software), used to define floristic community types (FCTs; or other groupings), which are based on shared species and groups of species having high frequencies of co-occurrence, and on absence of species. An essential prerequisite of this method is a complete list of correctly identified species for each plot.

As the survey work for this site has not been completed, no computer analysis has been carried out. However, comparison with descriptions of Floristic Community Types in Gibson *et al* (1994) shows the vegetation at Lot 440 Wanjeep St to most probably belong in FCT 21a – Central *Banksia attenuata – Eucalyptus marginata* Woodlands. This FCT is considered to be well reserved and at low risk. FCT 21a does not appear on CALM's Threatened Ecological Community Database or listed under the Commonwealth *Environmental Protection and Biodiversity Conservation* Act 1999.

However, in accordance with the requirements of the EPA's Guidance Statement No. 51 for Level 2 vegetation and flora surveys, further flora surveying is proposed to be undertaken in early summer this year to confirm whether this or any other FCTs and/or TECs occur within the site.

However, the outcomes derived from the initial survey are not expected to change.

2.5.4 Significant Flora

A Declared Rare and Priority Flora survey was also undertaken in September 2005. No Declare Rare or Priority Flora was recorded within the site.

The City of Mandurah (Jane O'Malley) provided information that the DRF orchid *Caladenia huegelii* may be present in the very southwest corner of the site. Dr Arthur Weston (Consultant Botanist) attended a site visit with a community representative to search for the species. Some orchids had been grazed, and Dr Weston considered that habitat may exist for the species in this location. However no specimens of *Caladenia huegelii* could be located.

2.6 Fauna

2.6.1 Site Description and Fauna Habitats

The site is located between the Serpentine River and Wanjeep Street, with urban development to the south and west, and largely degraded land to the north as far as Pinjarra Road. The vegetation of the site consists largely of banksia/eucalypt woodland on sand, with the understorey in good condition except in the north, which has been parkland cleared, leaving only scattered large eucalypts, mostly Tuarts *Eucalyptus gomphocephela*.

There is riparian vegetation along the Serpentine River and several areas of marshland that are seasonally inundated. The site is traversed by several vehicular tracks with some localise degradation of vegetation and weed invasion. As in most areas of urban bushland, household and garden rubbish from neighbouring properties has been dumped along the tracks through the site.

2.6.2 Field Survey

The good quality vegetation at the site and proximity to the Serpentine River environment results in a range of fauna habitats. A Level 2 Fauna Survey was undertaken by Bamford Consulting Ecologists (2005) for Lot 440 from 26 September to 3 October 2005, in accordance with the EPA's Guidance Statement No. 51 (EPA, 2004a). The Fauna Assessment Report is provided as Appendix B.

A summary of the survey results are as follows:

- The only invertebrate species of significance listed for the Mandurah area is the Graceful Sun-Moth. The Graceful Sun-Moth is listed as Priority 1 under the *WA Wildlife Conservation Act*. Its habitat requirements are unknown but it occurs in Banksia woodland so may be present on the site.

- The frog fauna is considered to potentially include eight species of which five were recorded. The distribution of captures indicates a concentration of frogs such as the Moaning Frog and Pobblebonk in upland areas with understorey vegetation in good condition.

- The reptile fauna is considered to potentially include 39 species; eight were recorded. Several of the reptile species are of local significance, but the only very significant reptile, the Carpet Python, is probably locally extinct. The reptiles are reliant largely upon terrestrial habitats, especially where understorey vegetation is in good condition. The distribution of captures across the sampling sites indicates that there is a concentration of reptile fauna close to the Serpentine River.

- The bird fauna is considered to potentially include 123 species; 48 have been recorded. Most important features of the avifauna are the migratory waterbirds that use the Serpentine River and adjacent wetlands, nesting by birds of prey such as the White-bellied Sea-Eagle, foraging by black-cockatoos, and the presence of a suite of small insectivores (fairy-wrens and thornbills).

- The mammal fauna is expected to be poor with only 21 species; of which five are introduced. Nine of the 16 native species are bats. The only species recorded during the September survey were the Black Rat and House Mouse, although results of bat echolocation surveys are not yet available. The Quenda has previously been recorded in the area while the Rakali is very likely to be present. Both these species are of conservation significance and are likely to occur along the Serpentine River.

2.7 Heritage

2.7.1 Aboriginal Heritage

The Department of Indigenous Affairs, Aboriginal Sites database was searched for registered sites. No Aboriginal sites are registered within Lot 440, however, there are two registered sites located near the site. These include:

- Peel Inlet (coordinates -32.5752S, 115.7763E)
- Coodanup Camps (coordinates -32.5752S, 115.7763E) (DIA, 2005).

2.7.2 European Heritage

The Heritage Council of Western Australia and the National Trust of Australia (WA) databases were searched and there are no registered sites within the study area (Heritage Council of WA, 2005). There are two sites registered on the Heritage Council of Western Australia database, which are located outside but near the study area, these are:

- Barragup House and Buildings (Pinjarra Road, Coodanup); and
- Nairn Farmhouse (Lot 167 Beacham St, Coodanup).

2.7.3 Natural Heritage

The register of National Estate was searched, and no sites are registered within the study area (Australian Heritage Council, 2005). The nearest registered place is the Peel Harvey Estuarine System, Mandurah.

2.8 Surrounding Land Uses

North of the site is the Mandurah Gardens Estate Caravan Park while residential development is located west and south of the site. The sites' eastern boundary abuts the Peel Region Park (Figure 2) and Serpentine River flood plain.

3.0 ENVIRONMENTAL POLICIES

3.1 Environmental Protection (Peel Inlet–Harvey Estuary) Policy 1992

3.1.1 Overview

The subject site is located within the Swan Coastal Plain Catchment of the Peel-Harvey Estuary, which has a history of poor water quality. The objective of the *Environmental Protection (Peel Inlet – Harvey Estuary) Policy 1992* is to reduce the input of nutrients, particularly phosphorus, into the Peel-Harvey Estuary through a number of means, which includes appropriate land management by landowners in the policy area.

3.1.2 Implications

Any future development of the site will ensure that the change of land use to urban development will meet the objectives of this policy. This may require the preparation of a nutrient budget or appropriate management plans for proposed land uses.

Existing drainage patterns, land use and nutrient export will be examined as the basis for evaluating the impacts of changing land use, and possible management techniques for nutrient control and engineering solutions for stormwater disposal following development will be derived.

Section 4.5 of this report, discusses nutrient management in further detail and the specific principles that will be applied to urban drainage design in order to ensure that future development will be managed to limit the impact of the development upon the surrounding catchment.

3.2 Draft Guidance Statement No. 33 Environmental Guidance for Planning and Development

3.2.1 Overview

In June 2005, the EPA released the draft Guidance Statement No. 33 Environmental Guidance for Planning and Development. This statement provides information and

advice to assist participants in land use planning and development processes to protect, conserve and enhance the environment. It also provides public advice on the environmental management which the EPA recommends.

3.2.2 Implications

The guidance statement provides a list of EPA's broad principles for the protection of native vegetation and flora. These are:

- Avoid clearing
- Maintain biodiversity at sustainable levels
- Conserve biodiversity in situ (retaining significant vegetation and flora, retain or create ecological linkages)
- Prevent loss of biodiversity (an ecological community that is at 10% or less of the original extent in a region is considered to be critically endangered.

In regards to fauna, broad principles include protection and management of adequate natural areas, adoption of an ecosystem approach and environmentally sound management practices, and development should not result in species extinction.

3.3 Perth Biodiversity Planning Guidelines

3.3.1 Overview

The Perth Biodiversity Project (PBP) has developed Ecological Criteria to identify locally significant natural areas (that are not included in a Bush Forever area). This criteria assists in identifying natural areas that are of greatest value for biodiversity conservation.

The ecological criteria have been designated a level of priority, either Essential or Desirable criteria. These ecological criteria (to identify locally significant natural areas[1]) are an adaptation of the Bush Forever criteria and the local significance criteria proposed in the Urban Bushland Strategy.

Overall the ecological criteria for local biodiversity planning are grouped under the following themes:

- Representation of ecological communities.
- Diversity.
- Rarity.
- Maintaining ecological processes of natural systems- connectivity.
- Protect wetlands, streamlines and estuarine fringing vegetation and coastal vegetation (WALGA, 2004).

The protection of Locally Significant Natural Areas (LSNAs) is considered to be important to:

1. maintain a basic level of natural diversity;
2. buffer and provide connectivity between protection regionally significant natural areas; and
3. benefit the local community (including passive recreation, sense of place, amenity and local environmental services).

3.3.2 Implications

The Biodiversity Planning Guidelines aim to achieve the similar principles as the SPP No. 2.8. These guidelines are aimed to assist Local Government in the development of Local Biodiversity Strategies. It is possible that Local Governments could use the ecological criteria to assess development proposals.

Therefore, these important criteria have been considered in the formulation of the ODP and were considered as a guide in determining the size, shape and location of the proposed core conservation reserve within the ODP. Section 4.2.1 of this report discusses this in further detail.

[1] Local Natural Areas are national areas that exist outside CLAM managed estate, regional parks and Bush Forever. Local Natural Areas likely to meet one or more ecological criteria are for local significance.

4.0 ODP RESPONSE, ENVIRONMENTAL IMPACTS AND MANAGEMENT

4.1 Environmental Design Principles of the ODP

In the formulation of the ODP the design team has been cognisant of the requirement to reflect the outcomes of the Design Forum where practicable.

The key environmental outcomes from the Design Forum can be summarised as follows:

- Significance of river and remnant bushland acknowledged
- Biodiversity protection required as a foundation project philosophy
- Riparian vegetation important
- North/south river corridor required for river protection, vegetation and fauna
- Capture east/west diversity sequence in open space
- Create core conservation area – not fragmented, respond to environmental elements
- Firm agreement on tradeoff – smaller project footprint for increased building density
- Shape of conservation area important for viability - length to area ratio
- Tree retention within development area too
- Foreshore degraded in parts (variable setback)
- Access to island? – should be limited
- Possible inlet/keyhole "inlet" could be considered to take pressure off river
- Aboriginal sites to be incorporated/acknowledged (eg, fish traps, walktrail, celebration)

Consequently, a fundamental and underlying principle of the ODP design is protection of the existing environment. It is the basis on which the project has progressed, and was reflected strongly in the Design Forum. These key design elements are discussed in the following sections.

4.2 Vegetation Protection and Integration

The protection of native vegetation is a key design element of the ODP, and significant effort has been expended to map the vegetation from both biological and landscape perspectives.

This is integral in the consideration of:

- establishing a Core Conservation Reserve within the ODP area, with particular emphasis being placed on its location, representativeness and connectivity with the foreshore and the Peel Regional Park; and

- retention of vegetation in the built environment.

4.2.1 Proposed Core Conservation Reserve

In establishing a reserve within the ODP area, the following ecological criteria for local biodiversity planning from the Perth Biodiversity Project (WALGA, 2004) are considered relevant and useful.

- Representation of ecological communities.
- Diversity.
- Rarity.
- Maintaining ecological processes of natural systems- connectivity.
- Protect wetlands, streamlines and estuarine fringing vegetation and coastal vegetation.

Additionally, the criteria adopted in the assessment of regional and local significance of urban bushland part of the Environmental Review for the Peel Region Scheme is presented in Table 1. These criteria were also considered relevant and useful in establishing a reserve within the ODP area.

TABLE 1
Criteria for Regional and Local Significance of Urban Bushland

Regionally Significant	Locally Significant
*[ii]Example of a regional vegetation type which is threatened or poorly reserved or a site with special value for flora or fauna conservation.	One of the better of a local vegetation type.
*Has considerable biodiversity or supports a population of Declared Rare Flora, priority listed flora, or threatened flora.	Has biodiversity value but unlikely to include Declared Rare Flora. May include geographically significant species at the limit of their range.
*Vegetation in good or better.	Threatened vegetation types may be regionally significant even it in poor condition.
Vegetation may be in poor condition but if poor, capable of regeneration.	Usually greater then 20 hectares but may be smaller in the case of threatened or poorly reserved vegetation types, or areas with special significance for other purposes.
Ideally greater then 4 ha but smaller areas may be of significance depending on how much remains in the locality.	Suitable for passive recreation by people from both within and beyond the locality. Suitable for passive recreation by the local community.
Region wide use or potential for scientific or educational study.	Use or potential use by local schools.
Having cultural heritage values of a regional or greater significance.	Having local heritage value.
Regular shape is desirable unless the area functions as a significant corridor linkage other remnants.	Shape not critical but remnant should be capable of ongoing management.

Source: Reproduced from Urban Bushland Strategy (1995)

[ii] * Essential criteria for bushland to be regarded as regionally significant.

The above criteria have subsequently been considered as a guide in determining the size, shape and location of the proposed core conservation reserve within the ODP. The key attributes defined in the Design Forum as being important components in determining the proposed conservation reserve (Section 4.1), have also been carefully considered.

Figure 3 presents the location and dimensions of the Core Conservation Reserve. The reserve is triangular in shape and has an area of approximately 11.9ha (or 23%) of the ODP area.

It is represented as one contiguous parcel with relatively long (500m) boundaries, and abuts the Serpentine River and Peel Regional Park without separation by roads or other development.

Importantly, the proposed Core Conservation Reserve:

- captures three different vegetation units in Good to Excellent condition;
- provides for a transition in vegetation and habitats from the upland vegetation in the west of the ODP area east to the wetland and foreshore area, and beyond; and
- creates a north/south corridor along part of the river foreshore, which has been identified as a key environmental area (this corridor will be further continued as a foreshore reserve in the north of the site as part of the Peel Regional Park).

Table 2 provides a description of vegetation communities captured in the proposed Core Conservation Reserve.

Additionally, the proposed Core Conservation Reserve captures seven (of twenty) trees identified as being of significant habitat (nesting or hollows) and/or landscape value (see Landscape Architecture Report). The remainder will be preserved within the built form area of the ODP where practicable.

The Core Conservation Reserve will remain intact (including understorey) and is currently in excellent biological condition, with the exception of limited peripheral weed invasion.

TABLE 2
Vegetation Communities Captured within the Proposed Core Conservation Reserve

Vegetation Communities	Vegetation Condition[iii]	Vegetation Communities Preserved within Core Conservation Reserve
Eucalyptus marginata, Banksia attenuata, B. menziesii, Allocasuarina fraseriana Low Open Forest. (JBS)	Good- Excellent	√
Eucalyptus gomphocephela, E. marginata Open Forest/Open Woodland (EgJ)	Completely Degraded	X
Corymbia calophylla Open Forest (CC)	Completely degraded	X
Eucalyptus gomphocephela, E. marginata Open Forest/Open Woodland (CcJX)	Degraded- Completely degraded	X
Eucalyptus gomphocephela Scattered Trees over *Eucalyptus marginata, Banksia attenuata, B. menziesii, Allocasuarina fraseriana* Low Closed Forest (JTBS)	Very Good	√
Eucalyptus gomphocephela Scattered Trees over *Corymbia calophylla, Banksia attenuata, B. menziesii, Allocasuarina fraseriana* Low Closed Forest (CcTBS)	Very Good	√

4.2.2 Core Conservation Reserve Viability

The viability criteria (guidelines) identified in the Perth Biodiversity Project include the following elements; size, shape, perimeter to area ratio, condition and connectivity. These criteria have subsequently been considered as a guide in determining the size, shape and location of the proposed conservation reserve.

[iii] In accordance with Condition Scale presented in Bush Forever (2000)

Table 3 compares the characteristics of the proposed ODP Core Conservation Reserve with the criteria in the Perth Biodiversity Project (WALGA, 2004).

TABLE 3
Viability of Proposed Core Conservation Reserve

Criteria	Proposed Core Conservation Reserve
Reserve Size	~11.9ha – exceeds minimum recommended size (4ha). Average major boundary of reserve ~500m – exceeds minimal length. High viability with low management costs.
Shape of Reserve	Generally regular shape medium to high viability
Perimeter to Area Ratio	Ratio value of 0.016 Medium to high viability
Vegetation Condition	Contains vegetation in Good to Excellent Condition

Preliminary analysis suggests that the proposed Core Conservation Reserve has a High to Medium viability, which reflects the reserves good long-term potential for 'survival' within an urban development context.

In this respect, it is also relevant to reiterate that the Core Conservation Reserve immediately abuts and adjoins the proposed Peel Region Park reservation within the proponent's current landholdings (Figure 2).

No development is proposed between the reserve and the Regional Open Space, and consequently the combined contiguous landholding in conservation reservation will exceed 149ha, which will have very high long term viability and value.

4.2.3 Core Conservation Reserve Management

To ensure the reserves' long-term success a Core Conservation Reserve Management Plan will be developed and implemented as part of the subdivision process. The management plan may include (but not limited to):

- Existing features (including significance landscape trees and habitat trees, vegetation, fauna and Hydrological Regime).

- Address the feasibility of working with adjacent owners and authorities to rehabilitate areas within the proposed reserve to provide for a continuous east-west linkage.

- Management of the remnant bushland area (including revegetation, edge effects, weed control, fire management, access, signage, fauna movement, habitat protection).

- Funding opportunities.

- Implementation, timing, reporting and responsibility.

The Management Plan would be submitted to the Local Government and DoE for comment and approval.

4.2.4 Vegetation Integration within the Built Environment

The clearing of vegetation within the built form is proposed to be minimised, with significant tree retention throughout the ODP area. A fundamental design philosophy is to eliminate or limit "cut to fill" and to "nestle" buildings within a forest setting.

The practical application of this intent is graphically represented in Figure 11, which depicts how both the Core Conservation Reserve and vegetation within the built environment can achieve vegetation retention objectives.

A significant landscape tree and habitat tree survey has been undertaken by landscape architects, Arbor vitae. Where practicable, significant trees identified within the urban portion of the ODP will be retained and incorporated into the urban fabric.

This approach requires the cooperation of the regulatory authorities, and in particular local government. Initial discussions with City of Mandurah officers indicate they are particularly supportive and responsive to innovation in this regard.

4.3 Fauna

A fauna and habitat assessment for the study area was undertaken by Bamford Consulting Ecologists (2005). A summary of the assessments key conclusions are discussed below.

4.3.1 Fauna Persistence

The fauna of the site is likely to be rich because of the high quality of the vegetation, the sequence from riverine and riparian vegetation to upland woodland, and the site is large enough to support a wide range of species. Summary comments on each major taxonomic group appear below (Bamford Consulting Ecologists, 2005).

Invertebrates were not well surveyed but at least one species of conservation significance may be present in banksia woodland. There may also be species with restricted distributions, notably millipedes and isopods (slaters). The upland margins of riparian vegetation and upland vegetation with good quality understorey may be most important for these species.

Frogs are likely to be concentrated along the Serpentine River where freshwater accumulates in winter, but upland habitats are important for some species.

Most of the reptiles are dependent upon upland vegetation and some species require a large area of habitat to support a viable population. Reduction of habitat area will therefore likely lead to some local extinction. The majority of species, however, persist in small areas of habitat.

The bird assemblage is likely to be very rich, with most important features of the avifauna being migratory waterbirds that use the Serpentine River and adjacent wetlands, nesting by birds of prey such as the Osprey and White-bellied Sea-Eagle, foraging by black-cockatoos, and the presence of a suite of small insectivores that disappear during urbanisation (particularly fairy-wrens and thornbills). Habitat area, habitat condition and the presence of banksias and net trees are therefore important for the avifauna.

The mammal fauna is expected to be poor, but significant species present or likely to be present are the Quenda and Rakali (Water-Rat), and possibly also the Western False Pipistrelle. Respectively, these rely on dense understorey and riparian vegetation, wetland habitats and trees with hollows/crevices.

4.3.2 Fauna Habitats

From the above comments, key features of the site for fauna can be summarised as follows (Bamford Consulting Ecologists, 2005):

- the riparian vegetation and areas of seasonal inundation (specific fauna, linkage along the Serpentine River);
- the generally good condition of understorey vegetation (supports wide range of fauna see below);
- scattered habitat trees, being large and providing shelter and nest sites, including hollows (including Tuarts in otherwise degraded northern area);
- the largest tract of native vegetation remaining in the general area, making it a local refuge for fauna;
- the site supports a sequence of fauna habitats from wetland through to riparian vegetation to upland vegetation; and
- weak linkage to fauna habitats in Creery Nature Reserve and the area is isolated for non-flying fauna by the Serpentine River.

4.3.3 Fauna Conservation and Management

With respect to the proposed development, key actions for fauna conservation are as follows (Bamford Consulting Ecologists, 2005):

- Retain representative vegetation so that the catenary of vegetation and habitat types from shoreline of the Serpentine River to the highest point in the local landscape is protected.
- Protected habitat should be compact in shape to minimise edge effects.

- Riparian vegetation along the Serpentine River should be protected as this secures a wildlife corridor along the river, and serves to protect the river. Public Open Space is already indicated along the river, but protection of habitat needs to be emphasised. Public access to the river should be restricted to small nodes, preferably at locations where the vegetation is already degraded.

- Identify and retain specific habitat trees, including nest trees such as that used by the Osprey and White-bellied Sea-Eagle.

- Retain elements of native vegetation, such as trees, during clearing, so that these can be incorporated into the urban design where possible.

- Given that the intention is to retain large areas for landscape and wildlife conservation, a reasonable cat policy is needed. At the least, this should consist of a commitment to keep cats in at night.

The proposed Core Conservation Reserve provides for the protection and enhancement of the site's most significant environmental values by providing a sequence in fauna habitats, ranging from representative wetland vegetation through to riparian vegetation and upland vegetation in the south eastern portion of the site. The provision of this ecological link between wetland vegetation and upland vegetation will ensure that native fauna within or near the site is adequately protected.

Further to this, the proposed Core Conservation Reserve contains vegetation in good to excellent condition and captures seven (of twenty) trees identified on site as being of significant habitat and/or landscape value, which will aid in supporting a wide range in fauna.

The Core Conservation Reserve Management Plan discussed in Section 4.2.3 will address issues such as fauna movement, fauna habitats as well as management of introduced species, such as cats.

As stated previously, a fundamental design philosophy of the ODP is to eliminate or limit "cut to fill" and to "nestle" buildings within a forest setting (Figure 11). Therefore, the clearing of vegetation is proposed to be minimised and where practicable, significant trees identified within the urban portion of the ODP will be retained and incorporated into the urban fabric

4.4 Riverine Protection and Management

4.4.1 Riverine Protection

The riverine floodplain and Serpentine River, which is included within the original site boundary has been reserved as Parks and Reservation under the Peel Regional Scheme, and is also part of the Peel Regional Park (Figure 2). This extensive area forms an underlying basis for further conservation within the ODP area, and constitutes approximately 138ha of land under the ownership of the proponent.

The ODP proposes to incorporate a road and associated development adjacent to the river foreshore in the north-eastern section of the site. This will assist in controlled access to and along the foreshore, compared to the current situation where there is uncontrolled access, which is evidence by foreshore degradation, weed invasion and erosion.

A "Keyhole Inlet" is proposed as an important component of the ODP, to provide a focal point adjacent to the river. Due to the reported seasonally poor water quality of the Serpentine River, the keyhole inlet will be lined and impermeable, with the potential to act as a reservoir for irrigation water for use in the ODP area.

The keyhole inlet will be disconnected from the Serpentine River through the provision of a weir to prevent water from the river entering the inlet, but still allow overflow from the inlet to the Serpentine River, which is in accordance with current DoE guidelines for stormwater management and discharge into waterways and wetlands.

There is also potential to harvest roof run-off to a dedicated pipe system for discharge to the keyhole inlet for irrigation, as a sustainability initiative. This aspect will be considered at the detailed design stage of the project.

There will be a requirement to undertake modelling for the stormwater catchment area in order to determine the volume of water that will be required for irrigation purposes and the final size of the keyhole inlet. However, this can be undertaken at a later stage of the planning process (i.e. during subdivision) when there will be further detail provided on the various design components for future development.

4.4.2 Riverine Management

To mitigate for potential direct and indirect impacts from future urban use on the adjacent foreshore and wetland areas, rehabilitation and restoration of the degraded areas is proposed to protect and enhance the adjacent wetlands and vegetation values.

The final configuration and treatments between future development and the foreshore and wetland areas will be addressed in a Foreshore and Wetland Management Plan, which will be developed and implemented as part of the subdivision process.

The management plan will include the final design and rehabilitation of the foreshore and small wetland area, with the following key components:

- protect and enhance the buffer to the wetland adjacent to the site;
- detail replanting areas and species selection;
- detail management of access, fencing and weeds for the adjacent wetland area and Public Open Space areas;
- detail management of passive recreation space adjacent to the site;
- set out final design of the stormwater management contiguous with the CCW, including stormwater treatment; and
- develop a program, with a timetable, outlining the tasks and responsibilities for weed control, revegetation and maintenance program for the adjacent wetland areas.

4.5 Nutrient Management

The primary aim for stormwater management within the site is for minimised collection, and on-site retention and infiltration of both stormwater and entrained contaminants. On-site retention and infiltration of stormwater will help to limit the impact of the development upon the surrounding catchment, and will ensure compliance with current DoE Stormwater Management Principles.

The stormwater management hierarchy applied in Western Australia is as follows:

- Retain and restore natural drainage lines – retain and restore existing valuable elements of the natural drainage system;

- Implement 'at source' controls – planning, organisation and behavioural techniques to minimise the amount of pollution entering the drainage system;

- Maximise local infiltration – infiltration of rainfall as high in the catchment as possible, to minimise runoff; and

- Limit use of 'in-system' management measures – collection/treatment of runoff, where limitation to local infiltration is not practicable due to local hydrologic conditions.

Specific principles of the Statement applying to urban drainage design are:

- Rainfall from a 1:1 year ARI event should be retained and infiltrated on-site, unless it can be clearly demonstrated that achievement of this objective is impractical due to the hydrologic conditions of the site.

- Runoff from all impervious areas, i.e. roads and buildings, should be directed to soakwells or other infiltration structures which are able to accommodate a 1:1 year ARI event prior to overflow.

- Controls which incorporate vegetation are generally considered an effective water quality management measure. These should be used both as single management measures (eg. Swales and filter strips) and as links between infiltration measures.

- Large and infrequent storm events, such as 1:5 and 1:10 year ARI events, can be mitigated through the use of "soft engineered" retention or detention areas, that may be integrated within public open space/linear multiple use corridors.

These principals are preliminarily addressed in the Engineering Report; however a more detailed Drainage and Nutrient Management Plan for the site would be prepared incorporating and addressing the issues discussed above and their management measures to ensure compliance with relevant Policies and the sustainability design philosophies of the project. This plan would be submitted to the City of Mandurah and DoE for comment and approval prior to implementation.

4.6 Mosquito Management

Within any area of surface water and surrounds, mosquitoes may potentially cause nuisance as a pest and as a vector of pathogens. They require a body of water for the development of their immature stages (larvae and pupae), although the nature of the habitat and the duration of the association may vary and are often characteristic of the species. Furthermore, different species can occupy different environmental niches within a single wetland.

The EPA encourages the adoption of mosquito control measures which maintain healthy wetland ecosystems, and minimises the physical alteration of foreshore areas or wetlands. The use of Water Sensitive Urban Design principles is also encouraged to ensure appropriate management of stormwater run-off (EPA, 2000).

Management of mosquito populations can be addressed through the careful design and management of the drainage treatment systems, and the following aspects should be considered in the proposed design:

- minimise potential areas of winter water stagnation through suitable design of water inflow and outflow points (no water proposed in summer);
- runnelling of shallow areas to facilitate flushing of mosquito breeding habitat and improve access for predators of mosquito larvae during construction; and
- removing accumulations of debris and dead vegetation.

However in this case breeding habitat also occurs adjacent to the site. Consequently the key to mosquito management will be to:

- partner with the City of Mandurah in both monitoring and control programs;
- educate residents regarding appropriate protection measures; and
- provide a built form that responds to this environmental parameter.

This is the case for existing Coodanup residents, and for residents near estuarine or other waterbodies within the municipality.

4.7 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils and sediments that contain sulphide minerals, predominately pyrite (an iron sulphide). In an undisturbed state below the watertable, these soils are benign and non acidic. However, if the soils are drained, excavated or exposed by lowering of the water table, the sulphides can react with oxygen to form sulphuric acid.

Developments in ASS risk areas that involve excavation, lowering the water table, compacting saturated soils or disturbing previously saturated sediments, may result in soil, groundwater and surface water acidity and the release of metals and precipitates (DoE, 2003 ASS Guideline Series). Appropriate management of ASS by landowners or developers is required under the *Environmental Protection Act 1986* to avoid environmental harm.

As discussed in Section 2.1, the western section of the site has been identified Moderate to Low risk of Actual Acid Sulfate Soil (AASS) and Potential Acid Sulfate Soil (PASS) occurring generally at depths of >3m, while the central section of the site is mapped as moderate risk. On the eastern margin of the site a high AASS and PASS risk area has been mapped (WAPC, 2003a) (Figure 3).

In accordance with DoE (2003) ASS Investigation guidelines, any dewatering or soil disturbance, compaction or lateral displacement in the ASS risk areas identified above will require a preliminary site assessment and investigation to determine whether or not ASS is present.

Depending on the results of the investigation, an ASS Management Plan (ASSMP) may be required in accordance with DoE guidelines. The ASSMP would identify management and/or treatment options for any disturbed ASS.

5.0 SUMMARY AND KEY CONCLUSIONS

- A portion of Lot 440 Wanjeep Street, Coodanup is zoned Urban under the Peel Region Scheme and Residential R12.5/R20 under the City of Mandurah town planning scheme.

- The site has an area of approximately 52ha, and is adjacent to approximately 138ha of Regional Open Space (Peel Regional Park) under the same private ownership.

- The site is characterised by deep sand over Tamala (Coastal) Limestone.

- Approximately 45ha of vegetation on site belongs to the Yoongarillup Complex, of which 28% of the original extent is located within the Peel Regional Park, and the Vasse Complex. The percentage of this complex reserved as Parks and Recreation under the PRS is currently unknown, however, this complex is not proposed for development.

- Specific survey indicates that the site contains six different native vegetation units, mainly consisting of Jarrah-Banksia-Sheoak low open forest, which is predominantly in Good to Excellent condition with some peripheral weed infestation.

- Based on the flora and vegetation survey undertaken to date, Floristic Community Type (FCT) 21a – Central *Banksia attenuata – E. marginata* Woodlands may be represented within the site. This FCT is not listed on the Department of Conservation and Land Management's Threatened Ecological Community database or the Commonwealth's list of Threatened Ecological Communities.

- No Declare Rare or Priority Flora was recorded within the site.

- The good quality vegetation at the site and proximity to the Serpentine River environment results in a range of fauna habitats. A fauna survey was undertaken and the following fauna were recorded: five frog fauna, eight reptile fauna, 48 bird fauna and five introduced mammal fauna.

- The site is located on within the water catchment of the Peel-Harvey Estuary and is adjacent to the Serpentine River and floodplain, which are mapped as Conservation management category wetlands. These areas are not proposed for development. The site boundary does abut the extent of the 1 in 100 year floodplain.

- The urban zoned site contains a large area of native vegetation in good condition, and the challenge for this ODP process, which has involved regulatory authority and community input from the outset (Planning Design Forum), has been to find a balance between development, conservation, and economic and environmental viability. Further, there is a need to supply a built form product that is both acceptable to an environmentally conscious community, but at the same time demonstrably marketable and commercially valid.

- A fundamental and underlying principle of the ODP design is protection of the existing environment. In particular, the two key design elements of the ODP are the establishment of a conservation reserve within the ODP area and the retention of vegetation in the built environment.

- Key outcomes of the Design Forum have been acknowledged and incorporated into the ODP.

- A Core Conservation Reserve is proposed. The reserve is triangular in shape and has an area of approximately 11.9ha, or 23% of the ODP area. It is represented as one contiguous parcel with relatively long (500m) boundaries, and abuts the Serpentine River and Peel Regional Park without separation by roads or other development.

- The Core Conservation Reserve captures three different vegetation units in Good to Excellent condition, seven trees identified as being of significant habitat and/or landscape value, and provides for a transition in vegetation and fauna habitats from the upland vegetation in the west to the wetland and foreshore area in the east and beyond.

- The proposed Core Conservation Reserve will provide for the protection and enhancement of the site's most significant environmental values by increasing the amount of vegetation being conserved as well as provide for a greater viability and management costs.

- No development is proposed between the reserve and the Regional Open Space, and consequently the combined contiguous landholding in conservation reservation will exceed 149ha, which will have very high long term viability and value.

- To ensure the reserves' long-term success a Core Conservation Reserve Management Plan will be development and implemented as part of the subdivision process.

- Where practicable, significant trees identified within the urban portion of the ODP will be retained and incorporated into the urban fabric.

- To assist in controlled access to and along the foreshore the ODP proposes to incorporate a road and associated development adjacent to the river foreshore in the north-eastern sector of the site.

- A "Keyhole Inlet" is proposed as an important component of the ODP, to provide a focal point adjacent to the river and potentially act as a reservoir for irrigation water to be used in the ODP area. Due to the seasonally poor water quality of the Serpentine River, the keyhole inlet will be lined and disconnected from the Serpentine River, but still allow overflow from the lake to the river.

- The final configuration and treatments between future development and the foreshore and wetland areas will be addressed in a Foreshore and Wetland Management Plan, which will be developed and implemented as part of the subdivision process.

- The primary aim for stormwater management within the site is for minimised collection, and on-site retention and infiltration of both stormwater and entrained contaminants. A Drainage and Nutrient Management Plan for the site would be prepared to ensure compliance with relevant Policies and the sustainability design philosophies of the project.

- Management of mosquito populations can be adequately addressed through the careful design and management of the stormwater treatment systems. However in this case breeding habitat also occurs adjacent to the site. Consequently the key to mosquito management will be to partner with the City of Mandurah in both monitoring and control programs, educate residents regarding appropriate protection measures; and provide a built form that responds to this environmental parameter.

This is the case for existing Coodanup residents, and for residents near estuarine or other waterbodies within the municipality.

- The western section of the site mapped at regional scale as Moderate to Low risk of Actual Acid Sulfate Soil (AASS) and Potential Acid Sulfate Soil (PASS) occurring generally at depths of >3m, while the central section of the site is mapped as Moderate risk. On the eastern margin of the site a High AASS and PASS risk area has been mapped.

- Any dewatering or soil disturbance, compaction or lateral displacement in the ASS risk areas identified above will require a preliminary site assessment and investigation to determine whether or not ASS is present. Depending on the results of the investigation, an ASS Management Plan (ASSMP) may be required in accordance with DoE guidelines. The ASSMP would identify management and/or treatment options for any disturbed ASS.

- No Aboriginal site are registered within the site, however, there are two registered sites located near the site. Land to the north is acknowledged as important, with historical significance (fish monger).

- There are two sites registered on the Heritage Council of Western Australia database, which are located outside but near the study area.

    - No National Estate sites are registered within the study area. The nearest registered place is the Peel Harvey Estuarine System, Mandurah.

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FIGURES

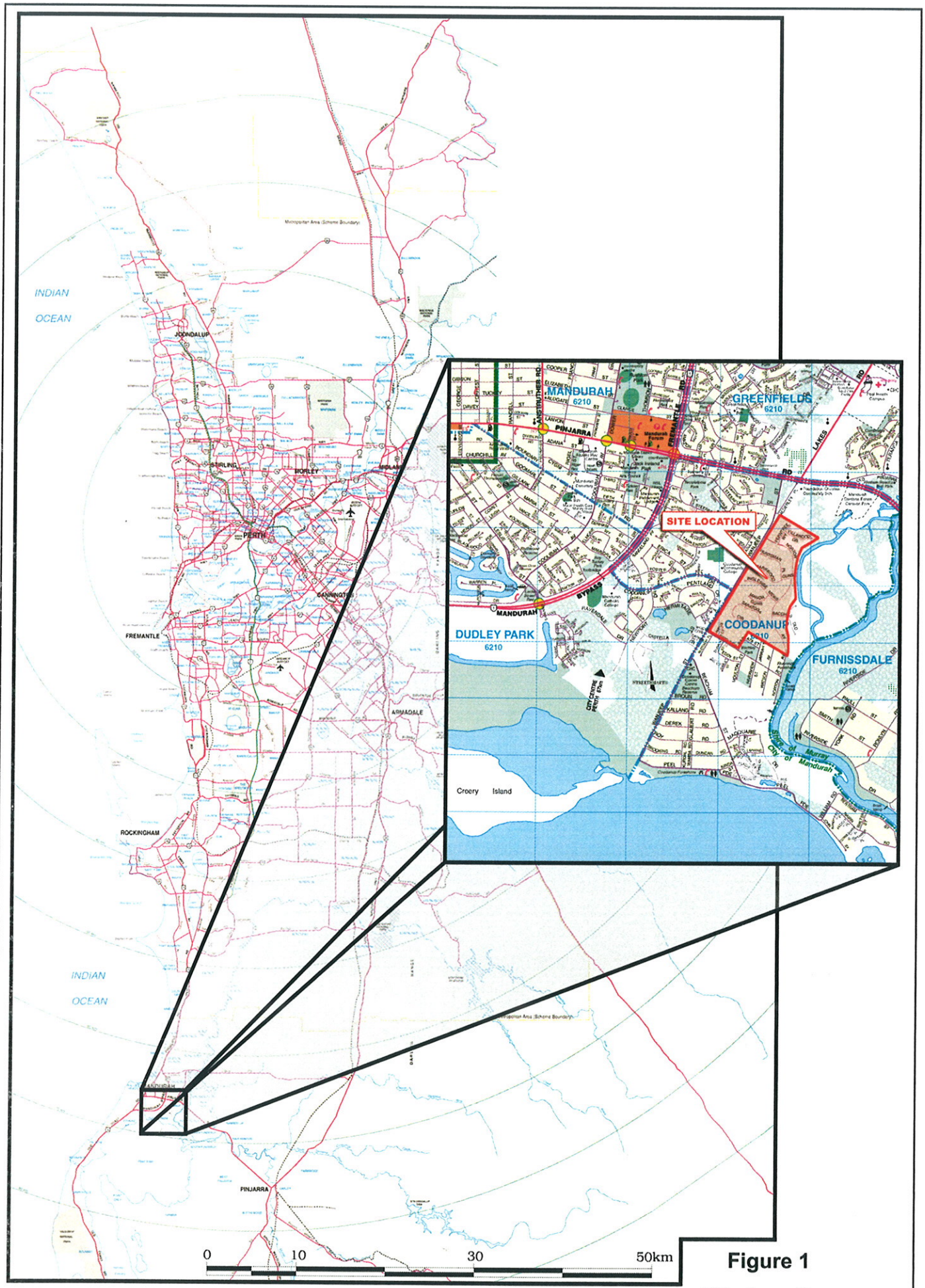


Figure 1

Site Location

Source: DOLA, 2002

L05597 13.09.05

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

Source: WAPC, April 2003

N

0 200 600 1000m

Scale 1:15000

L05145 01.07.05

Figure 2

Peel Regional Park

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

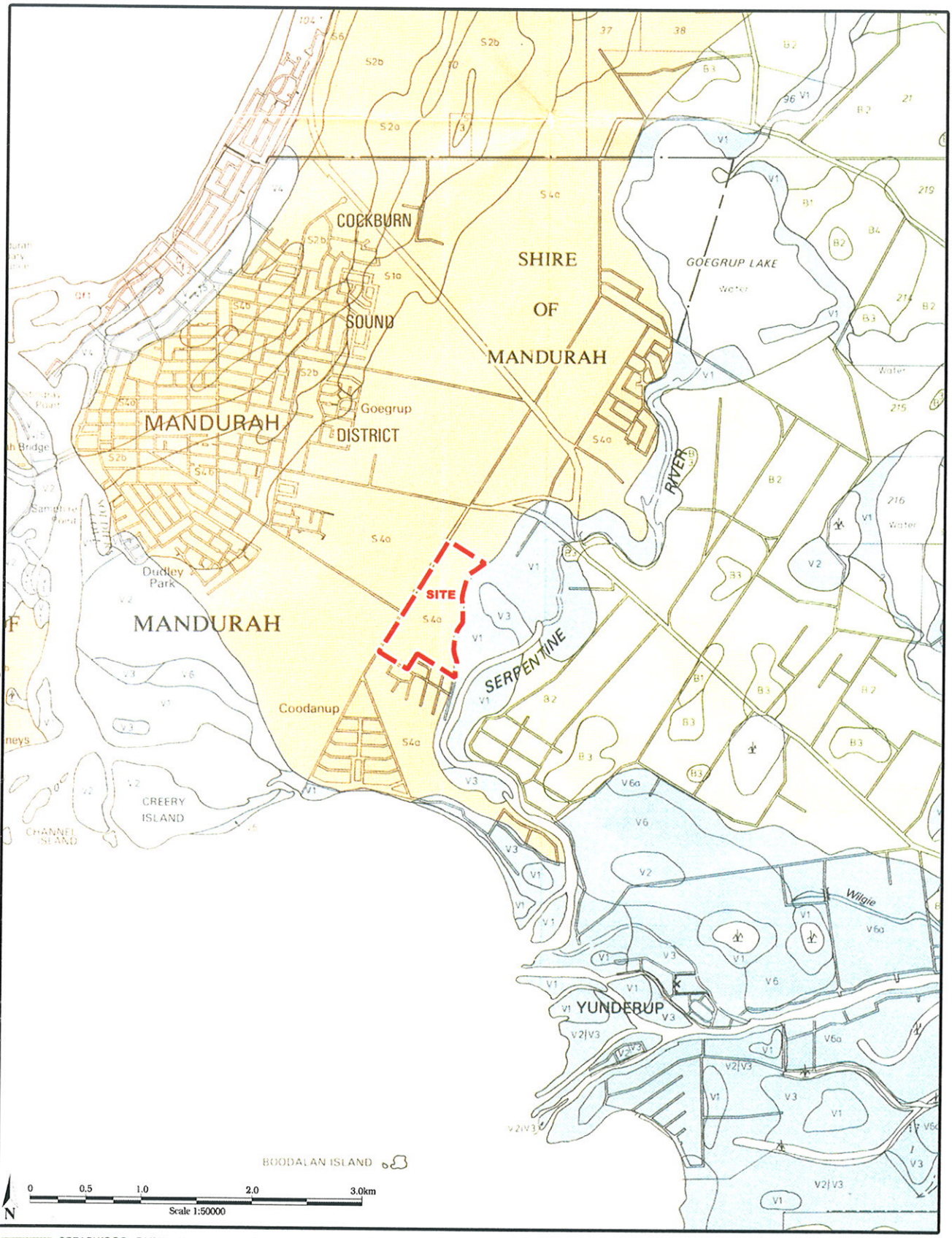
Source: RobertsDay, October 2005

L05597 27.10.05

Figure 3

Outline Development Plan

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS



Source: Division of Resource Management Western Australian Department of Agriculture

S SPEARWOOD DUNE AND PLAIN SYSTEM—Gently to moderately inclined low hills and gently undulating plain located west of the Bassendean System and associated with Pleistocene, Tamala Limestone. Hills consist of a core of friable aeolianite, capped by secondary calcite and overlain by variable depths of rapidly drained siliceous yellow brown sands. The gently undulating plain is the surface expression of the consolidated marine limestone component of the Tamala Limestone.

S4 Flat to gently undulating sand plain with:

(a) deep, pale and sometimes bleached, sands with yellow brown subsoils.

(b) shallow to moderately deep siliceous yellow brown and grey brown sands with minor limestone outcrop.

V VASSE ESTUARINE AND LAGOONAL SYSTEM—Low lying poorly drained terraces, flats and beach ridges fringing Peel Inlet, Harvey Estuary, the coastal lake system and major river mouths. Soils are extremely variable, being formed on unconsolidated Holocene estuarine alluvium and lagoonal deposits, and are often highly saline and subject to periodic inundation.

V1 Saline tidal flats composed of grey, black and brown foetid muds and humic sandy clays with locally common shell and limestone fragments.

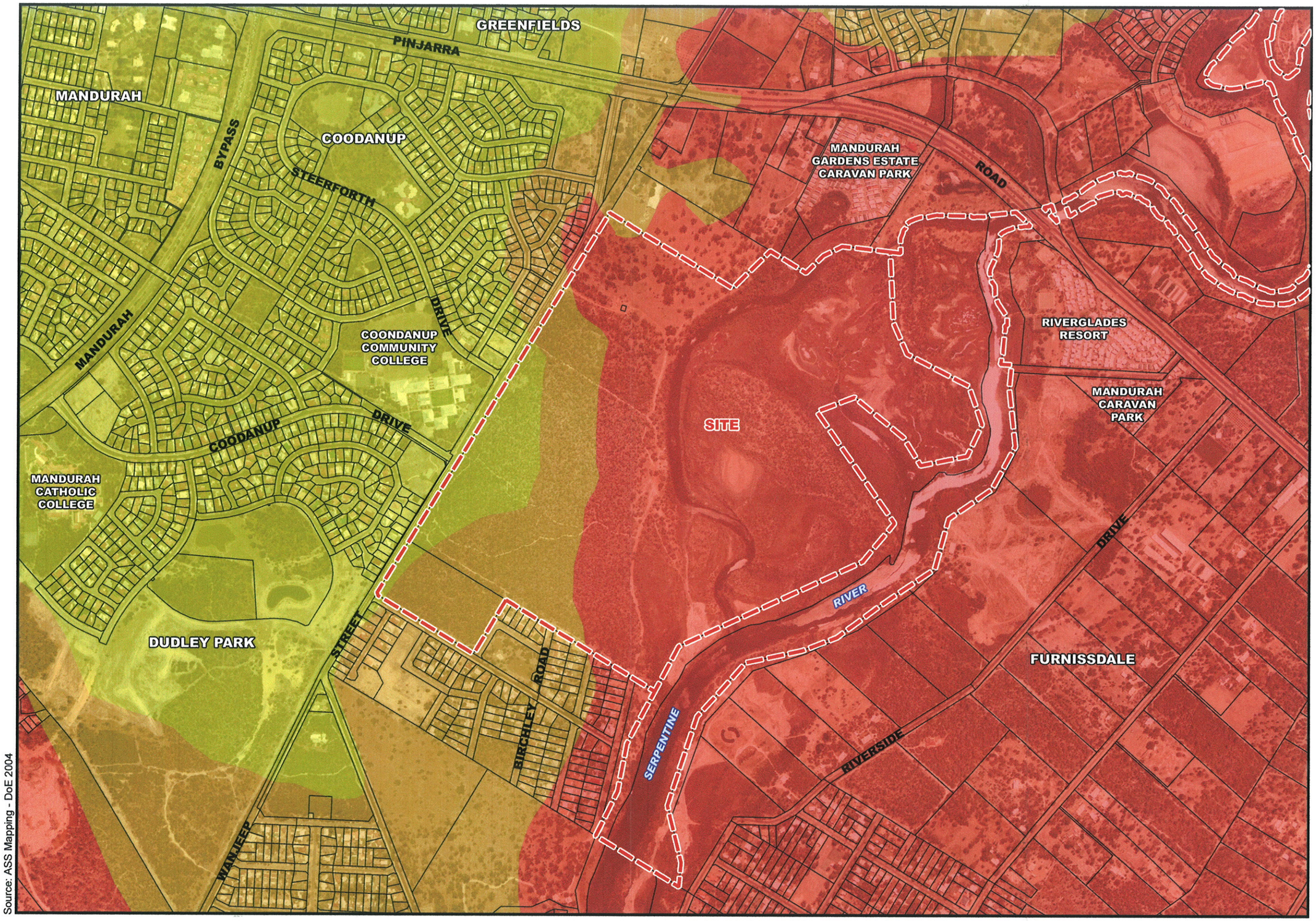
V3 Sand flats similar to V2 but marginally higher and commonly supporting stands of *Melaleuca* spp.

Figure 4

Soils

L05597 13.09.05

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS



Source: ASS Mapping - DoE 2004

LEGEND

- Site Boundary
- Cadastre
- Moderate to high risk of ASS or PASS occurring <3 m from soil surface.
- Moderate to low risk of ASS or PASS occurring >3 m from soil surface; no risk occurrence <3m from soil surface.
- Low to nil risk of ASS or PASS occurring >3 m from soil surface; no risk of <3m from soil surface.

N

0 100 300 500 700m

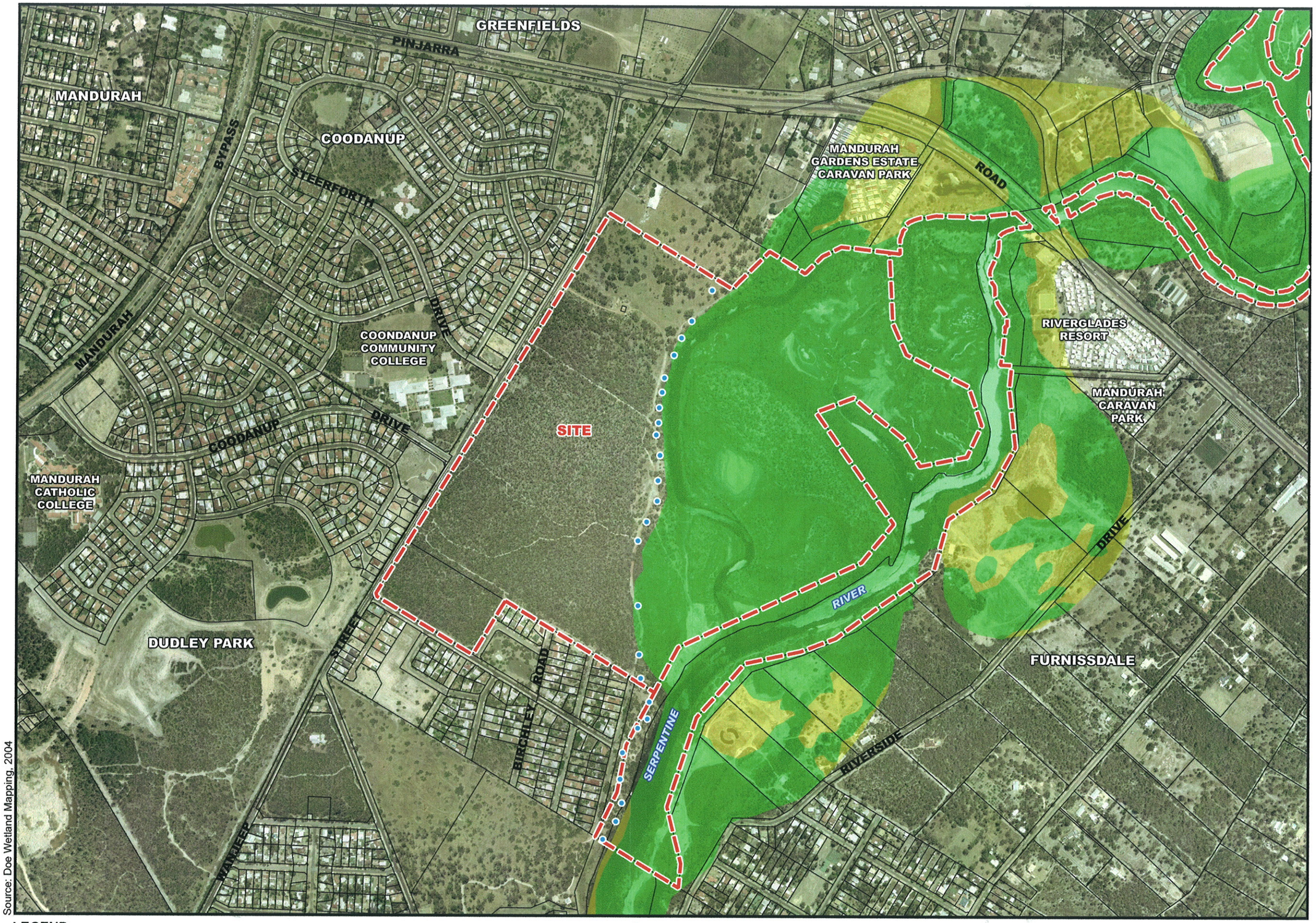
Scale 1:10000

Figure 5

Acid Sulfate Soils

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

L05145 01.07.05



Source: Doe Wetland Mapping, 2004

LEGEND

- Site Boundary
- Cadastre
- Wetland Boundary Verification Points
- Conservation Category Wetland
- Multiple Use Category Wetland

N

0 100 300 500 700m

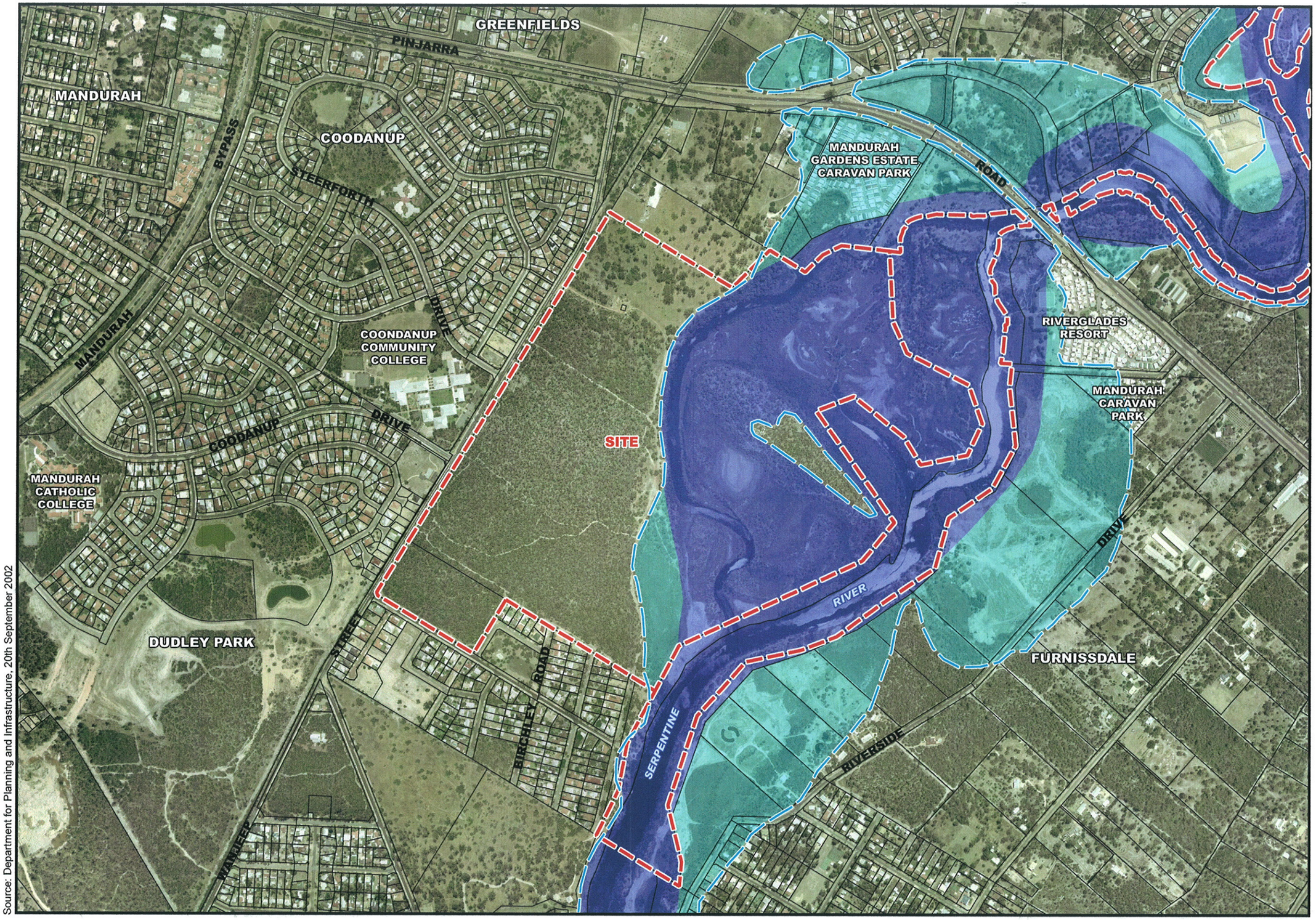
Scale 1:10000

Figure 6

DoE Wetland Mapping

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

L05145 01.07.05



Source: Department for Planning and Infrastructure, 20th September 2002

LEGEND

- Site Boundary
- Cadastre
- Extent of 1 in 100 Year Floodplains
- Floodway
- Flood Fringe

N

0 100 300 500 700m

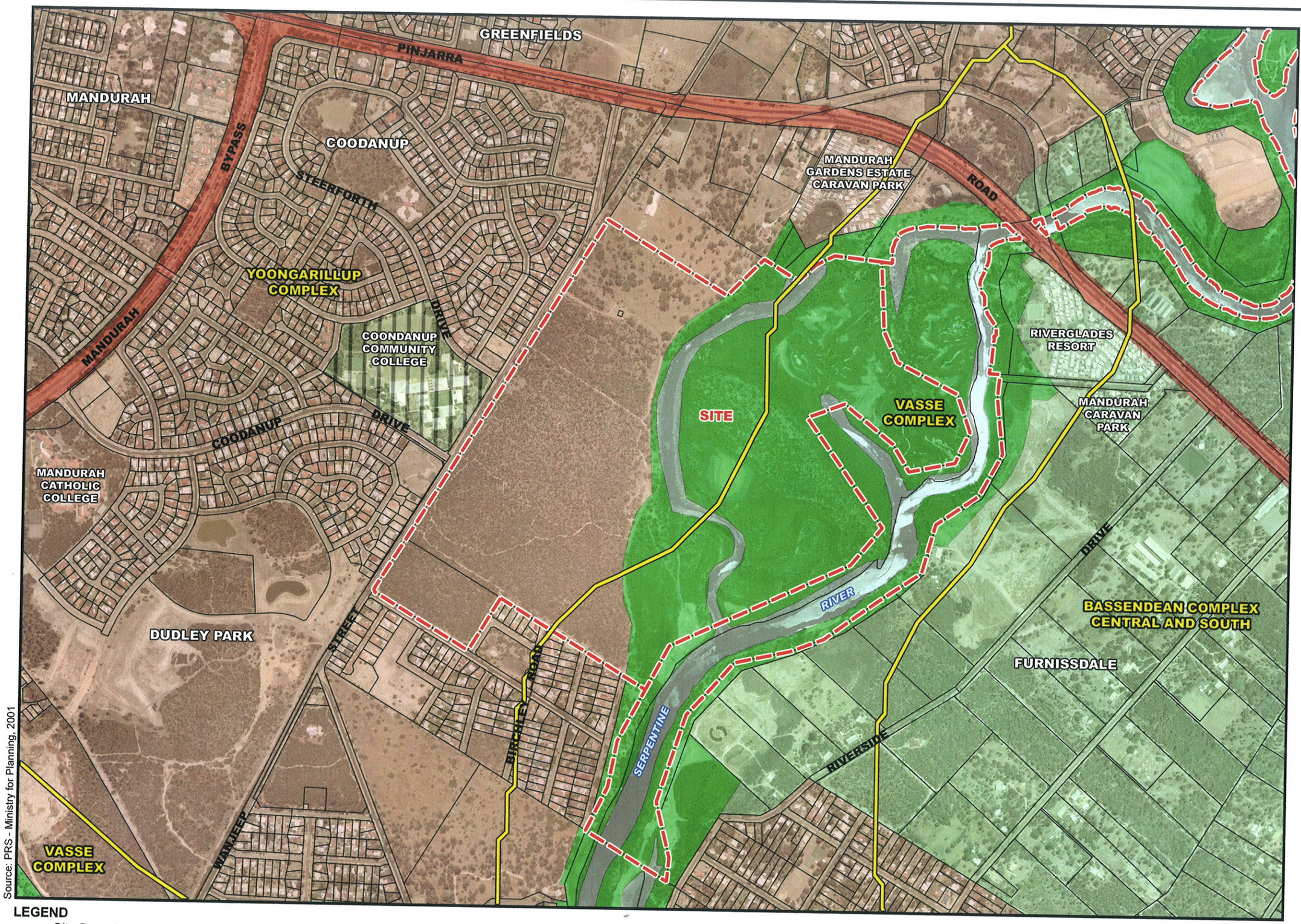
Scale 1:10000

Figure 7

Floodplain Mapping

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

L05145 01.07.05



Source: PRS - Ministry for Planning, 2001

LEGEND

- Site Boundary
- Cadastre
- Vegetation Complex Boundary

PEEL REGION SCHEME

- Urban
- Rural
- Primary Regional Roads
- Waterways
- Regional Open Space
- Public Purposes (High School)

N

0 100 300 500 700m

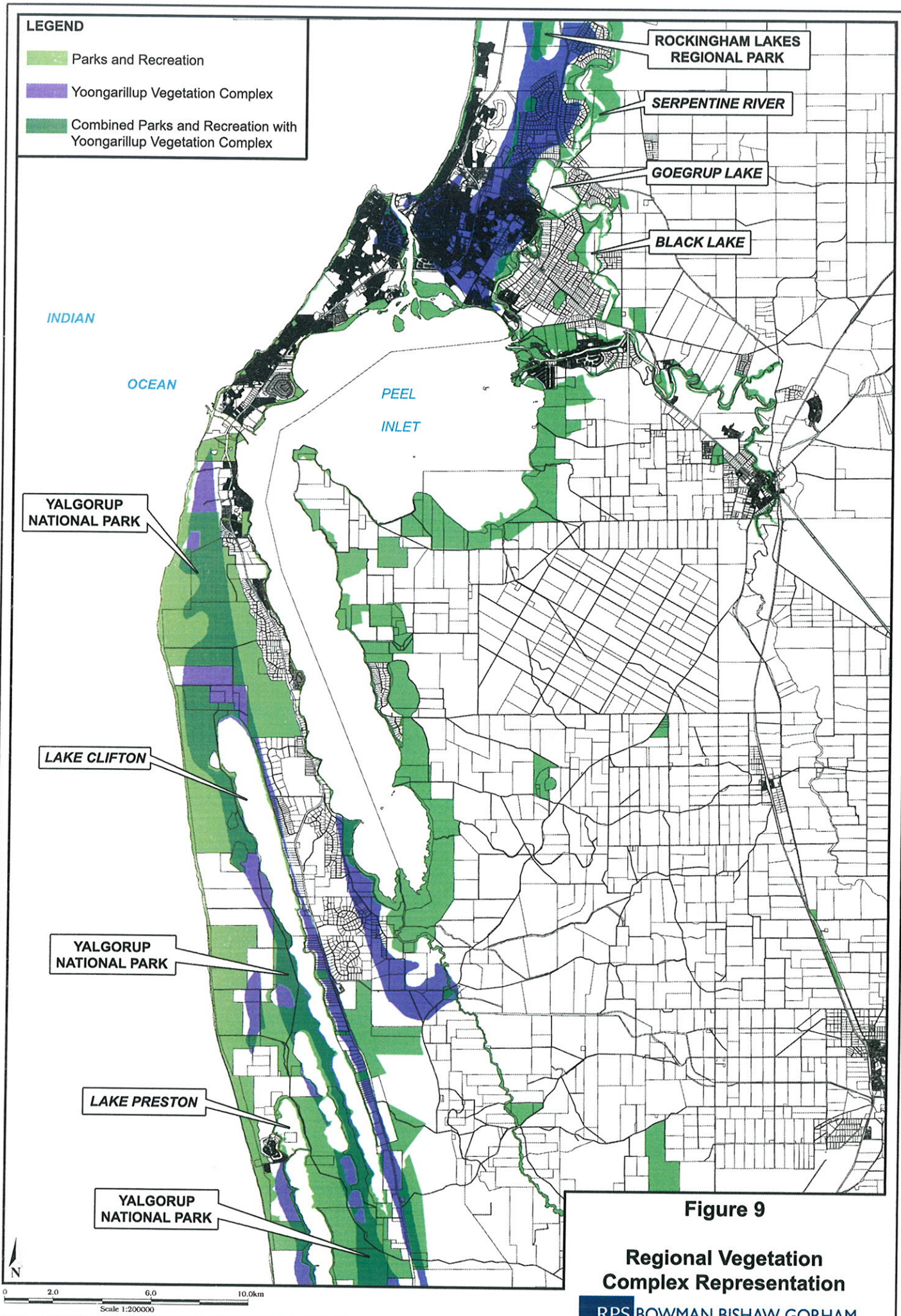
Scale 1:10000

Figure 8

Vegetation Complexes

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

L05597 01.07.05



L05597 13.09.05

Figure 9

Regional Vegetation Complex Representation

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

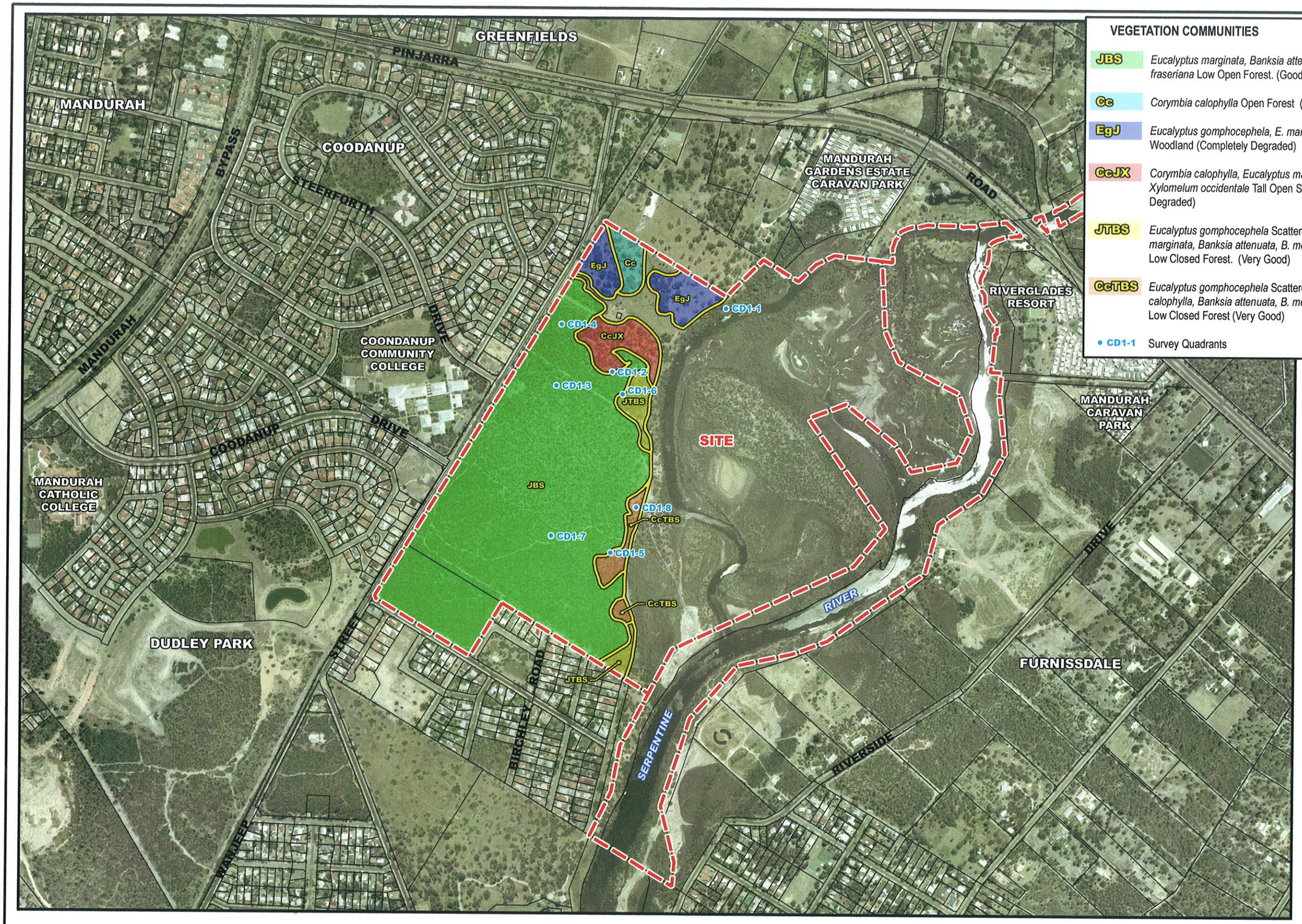


Figure 10

Vegetation Communities and Condition

L05597 01.07.05

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Figure 11

Vegetation Retention Within the ODP

Source: RobertsDay

L05597 13.09.05

RPS BOWMAN BISHAW GORHAM
ENVIRONMENTAL MANAGEMENT CONSULTANTS

APPENDIX A

Vegetation and Flora Assessment Report

RPS Bowman Bishaw Gorham, October 2005

PART LOT 440 WANJEEP ST, COODANUP

VEGETATION AND FLORA SURVEY

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Our Ref: L05314
October 2005

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Appendix C Condition Codes and Vegetation Structure Table
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1.0 INTRODUCTION

1.1 Objectives

The specific objectives of this interim report are to detail the first phase of flora and vegetation survey undertaken for Lot 440 Wanjeep Street, Coodanup and to:

- Provide accurate descriptions of flora, floristic community types and vegetation units, and their condition.

- Determine the presence of Declared Rare Flora (DRF), endangered, priority and other significant species, Threatened Ecological Communities (TEC) and other significant vegetation units.

- Provide a vegetation map of the area showing vegetation communities and their condition, any DRF flora and any TECs or other significant vegetation.

A final report will be provided after completion of the second phase of the vegetation survey.

1.2 Location

The site, at Lot 440 Wanjeep Street, Coodanup, is located approximately 2.5 kilometres east of the intersection of Fremantle Road and the Mandurah Bypass and lies on the eastern side of Wanjeep Street. The Urban zoned portion (under the Peel Region Scheme) covers an area of approximately 52 ha, bounded on the eastern side by the Serpentine River, residential and other development on its northern and southern boundaries and Wanjeep Street to the west.

Botanically, it is located in the Drummond Botanical Subdistrict of Beard (1980), which is more or less equivalent to the Swan Coastal Plain. This division is also consistent with the Swan Coastal Plain IBRA (Interim Biogeographic Regionalisation for Australia) of Thackway and Cresswell (1995).

2.0 METHODS

The survey was undertaken in four stages:

- Preparation for field work, including consultations, the gathering and collation of available information and interpretation of aerial photography,
- Undertaking field work to record and collect flora, to establish vegetation monitoring plots, to determine condition and distributions of vegetation units and to search for significant flora,
- Pressing, drying and identification of plants recorded and collected during field work, and
- Report preparation.

2.1 Field Preparation

Preparation for field work included:

- Reviewing existing vegetation descriptions and maps and flora lists for the study area and the general area,
- Reviewing lists of and familiarising at state herbarium with DRF or Priority taxa for the area provided by CALM Database searches,
- Selection of sites for field work through inspection of available aerial photography.

Provisional understanding of vegetation of the study area was based primarily upon interpretation of aerial photography and the review of various publications and maps, including a previous study of the site (ATA Environmental, 2003). Aerial photography of the site was also examined to estimate the number of vegetation communities and plan the survey.

2.2 Field Work

2.2.1 Vegetation

In all, eight permanent 10m x 10m quadrats were established over the site, sampling each of the vegetation communities defined within the site. Each quadrat was described and specimens of all species present were collected, or referred to a collection number from an earlier plot. In this way a comprehensive list of flora present at the time of survey was compiled.

The classification system used for recording plant communities and the six-point scale for assessing vegetation condition are described in *Bush Forever* (Government of Western Australia 2000, Volume 2, pp. 492-494). *Bush Forever* tables summarising the system and the scale are reproduced in Appendix C.

The vegetation survey is based on descriptions of vegetation recorded in representative vegetation plots established throughout the site and from releves in areas of degraded vegetation.

2.2.2 DRF and Priority Flora

After the initial establishment of vegetation plots prior to the start of Spring (mid August 2005), the site was again visited at a later date (mid September 2005) and searched for Declared Rare and Priority Flora listed as potentially present in the CALM Database Searches.

Transects were walked through the site in an East-West direction at a distance of fifteen to twenty metres apart, and vegetation searched for the presence of any species of interest. This distance was chosen due to the open nature of a large part of the vegetation on the site, but in areas where the vegetation was thicker, for example in parts burnt in the last two years, the distance between transects was reduced to ensure consistency of coverage in the survey.

2.3 After Field Work

Plant specimens collected during the field work were pressed, then dried in the Western Australian Herbarium in South Perth. The specimens were identified by checking them against a variety of keys and descriptions in floras and taxonomic works, only some of which are referred to in this report, by consulting other botanists and, after fumigation, by comparing them with specimens in Herbarium collections.

Following the process of identification, the names of the plants identified were checked against the tables in Appendix E and other lists of significant flora, including the *Bush Forever* list of significant flora of the Perth Metropolitan Area (Government of Western Australia 2000, Volume 2, Table 13) and Atkins (2005). A site and species table was compiled and used, along with multivariate analysis of similar areas, to infer floristic community types represented in the study area.

The provisional vegetation descriptions and boundaries were revised, refined and finalised, and the significance of vegetation units, vegetation complexes and floristic community types in the study area were assessed in terms of conservation and reservation status.

A vegetation map was drawn to show vegetation communities in the study area and the location of the releves where sampling occurred.

2.4 Limitations of this report

This survey was carried out in mid-late August 2005, prior to the official start of Spring. While a large proportion of the species present were in flower or otherwise identifiable, not all annual species were readily identifiable or maybe even present.

As a result of the timing it is possible that ephemeral species that do not appear until later in the year were missed, and the survey biased towards perennial species. However, a number of annual species (for example *Trachymene pilosa*) appear on the list despite being recorded as having later flowering times (CALM, 2005).

This report describes the methods and results of the first part of the Level 2 (EPA 2004) survey, and as such is incomplete. There is a requirement to revisit the site and quadrats

in late spring/early summer. Once the second visit has been made then computer analysis of the results will be possible, and the species list will be more complete than in this interim report.

3.0 RESULTS

3.1 Landform and Soils

Lot 440 Wanjeep Street is located on the Spearwood Dunes of the Swan Coastal Plain. The Spearwood Dunes consist of a core of limestone overlain by a yellow sand showing various levels of wind erosion, but on the site this has been further developed by marine or estuarine deposits. Two soil units are present; the Yoongarillup unit has shallow brown and yellow sands over limestone and the Vasse unit which consists of mixed layers of recent estuarine deposits. Each soil unit supports a vegetation complex of the same name, with the Vasse Complex lying to the east of the Yoongarillup Complex along the Serpentine River.

3.2 Flora

3.2.1 Native Flora

One hundred and eleven flowering plants were recorded in Phase 1 of the flora survey. Of these, ninety-six are native, and fifteen are introduced. These numbers may change after the second site visit. Forty-nine are monocotyledons, six of which are aliens, and sixty-two are dicotyledons of which nine are alien.

Of the 96 native angiosperms recorded, 41 are monocotyledons from 10 different families and 55 are dicotyledons from 22 different families. The Families with greatest representation are: Monocotyledons; Cyperaceae (9), Orchidaceae (8), and Anthericaceae (7). Of the Dicotyledons; the Papilionaceae (9) were the best represented. The absence or low representation of some Families (for example Haemodoraceae) may be due to the timing of the survey.

3.2.2 Introduced Flora

The Papilionaceae and Asteraceae were the families with the greatest number of exotic species (3 in each). The most common exotic taxa were, however, **Romulea rosea* and *Romulea flava* var. *minor* (Iridaceae) and **Ehrharta calycina* (Poaceae) which were each found in a total of 3 sites. These sites are scattered throughout Lot 440.

3.2.3 DRF and Priority Flora

No DRF were located during the survey of the site, and only one potential priority species *?Comesperma acerosum* was recorded in the quadrats. The specimen was not in an ideal condition for identification, so this determination should be regarded as provisional until the survey quadrats are revisited.

Comesperma acerosum is a Priority 3 species, and if it's presence is confirmed this will be the first record for the site. No record of this taxon was shown on the CALM database searches.

The Priority 3 species *Dillwynia dillwynioides* was found at the edge of the wetland adjacent to the south-eastern corner of the site. As this wetland is outside the development area no further search of it was made.

Determination of the locations of specimens reported in the WAHERB Specimen Database showed that none were collected on Lot 440 Wanjeep Street Coodanup. Anecdotally, *Caladenia huegelii* (DRF) and *Drakaea elastica* (DRF) have been seen on Lot 440, (by Allison Dixon, from the City of Mandurah's Environmental Committee), but a site visit by Dr A. Weston and Ms Dixon on 2/10/05 failed to find any specimens of either in flower.

At the time of the original DRF and Priority Flora survey, *Drakaea elastica* was not flowering, although its basal leaf may have been present.

3.3 Vegetation

3.3.1 Vegetation Communities in the Study Area

The vegetation in the study area is falls into the Yoongarillup Complex of Heddle *et al.* Broadly, this complex contains the only extensive Tuart (*Eucalyptus gomphocephela*) woodlands on the Swan Coastal Plain. Understorey species include Banksia (*Banksia attenuata* and *B. menziesii*), *Hibbertia hypericoides* and *Macrozamia reidlii*.

Approximately 28% of the original Yoongarillup Complex is reserved within the Peel Regional Park, with approximately 36% remaining within the Peel Regional Scheme area.

The area of Yoongarillup Complex is less within the Perth Metropolitan Region, although 72% of the original remains (Government of Western Australia, 2000). Of the 664 ha , 401 ha are proposed for protection, with 379 ha of these having some existing protection.

Guidance 10

Six vegetation communities were described and mapped during the survey and photos of each are shown below. The greatest proportion of the site was represented by vegetation community JBS (Plate 1).

Plate 1 **JBS: *Eucalyptus marginata, Banksia attenuata, B. menzieii, Allocasuarina fraseriana* Low Open Forest**
(Good-Excellent)

Cc (no photograph): *Corymbia calophylla* Open Forest
(Completely Degraded)

Plate 2 **EgJ: *Eucalyptus gomphocephela, E. marginata* Open Forest/Open Woodland**
(Completely Degraded) Overstory intact CD-D

Plate 3 **CcJX: *Corymbia calophylla, Eucalyptus marginata* Low Closed Forest over *Xylomelum occidentale* Tall Open Shrubland**
(Degraded-Completely Degraded) CD-D
Overstory intact

Plate 4 **JTBS: *Eucalyptus gomphocephela* Scattered Trees over *Eucalyptus marginata, Banksia attenuata, B. menziesii, Allocasuarina fraseriana* Low Closed Forest**

(Very Good)

Plate 5 **CcTBS: *Eucalyptus gomphocephela* Scattered Trees over *Corymbia calophylla, Banksia attenuata, B. menziesii, Allocasuarina fraseriana* Low Closed Forest**

(Very Good)

3.3.2 Floristic Community Types

The most accurate way to determine which floristic community types are in a metropolitan region Swan Coastal Plain study area is to select, sample and analyse 10 m by 10 m quadrats using the techniques described by Gibson *et al.* (1994) and Keighery (1994). An essential component of these techniques is the compilation of a complete list of species for each quadrat based upon correctly identified plant specimens. This often requires sampling the quadrat more than once.

It should be possible, however, according to *Bush Forever* (Government of Western Australia 2000, Volume 2, p. 487), to infer which floristic community types, at least of the original 43 described by Gibson *et al.* (1994), occur in a study area. Inferences of which FCTs occur in particular Bush Forever sites have been made from "information on the floristics of the area and the area's geographic location" (Government of Western Australia 2000, Volume 2, p. 487).

The floristic community approach to vegetation classification and description gives equal weight to all vascular plant species in plant community sampling quadrats (or plots). These plots are, in the case of Swan Coastal Plain floristic surveys, 10m by 10m squares. The presence or absence of individual species in the quadrats is, with the aid of computerised multivariate analysis techniques (specifically, PATN software), used to define floristic community types (FCTs; or other groupings), which are based on shared species and groups of species having high frequencies of co-occurrence, and on absence of species. An essential prerequisite of this method is a complete list of correctly identified species for each plot.

As these analyses only use presence/absence data, they do not take vegetation structure or abundance into account and can only be viewed as definitive on a broader scale (see Trudgen (1999) in his discussion of vegetation analysis).

Gibson *et al.* (1994) used analyses of 509 southern Swan Coastal Plain survey quadrats to define 43 FCTs. Subsequent analyses of 613 other quadrats led to 23 additional FCTs being defined, mainly in the Perth Metropolitan Region (Keighery, 1997).

As the survey work for this site has not been completed, no computer analysis has been carried out. However, comparison with descriptions of Floristic Community Types in Gibson *et al* (1994) shows the vegetation at Lot 440 Wanjeep St to most probably

belong in FCT 21a – Central *Banksia attenuata – Eucalyptus marginata* Woodlands. This FCT is considered to be well reserved and at low risk. FCT 21a does not appear on CALM's Threatened Ecological Community Database or listed under the Commonwealth *Environmental Protection and Biodiversity Conservation* Act 1999.

Plot CDI-1 ?FCT 1?
21a is VERY variable
[illegible]

4.0 DISCUSSION

As the survey work is incomplete at the time of writing, any conclusions drawn here may be changed once the second phase of vegetation survey work is completed.

The vegetation on Lot 440 Wanjeep St, Coodanup, represents a Vegetation Complex and Floristic Community Type that appears to be well reserved. It is perhaps unusual in its high proportion of vegetation in good to excellent condition, considering the proximity of residential development and previous clearing on part of the Lot.

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APPENDIX A

Quadrat Data for Study Area

CD1

GPS: NW Corner. GDA94 Datum.
50H 0383392, UTM 6398533

Veg Description.
Eucalyptus gomphocephela, E. rudis Scattered Trees over *Casuarina obesa, Melaleuca cuticularis, M. rhaphiophylla* Low Open Forest over *Ghania trifida, Juncus ?pallidus, Baumea juncea* Closed Sedgeland over **Cynodon dactylon* Grassland.

Condition: Very Good-Excellent

Soil: Black sandy loam.

Aspect/Slope: Flat

Species List

Melaleuca cuticularis	1-1
*Rumex crispus	1-10
Lobelia alata	1-11
Centella asiatica	1-13
Threlkeldia diffusa	1-14
Eucalyptus rudis	1-15
Lepidosperma longitudinale	1-17a
Juncus ?kraussii	1-17b
*Romulea flava var. minor	1-18
Comesperma ?ciliatum	1-19 (1-16)
Baumea juncea	1-2
Baumea juncea	1-2(2nd coll)
Samolus repens	1-12
Gahnia trifida	1-4
Juncus ?pallidus	1-5
Sarcocornia quinqueflora	1-6
*Cynodon dactylon	1-7
?Triglochin sp	1-8
*Ehrharta sp	1-9
Apium prostratum ssp prostratum	1-9
Eucalyptus gomphocephela	
Casuarina obesa	
Melaleuca rhaphiophylla	1-3

Banksia menziesii	2-4
Sowerbaea laxiflora	2-40
Lepidosperma pubisquameum	2-41
Desmocladus fasciculatus	2-42
Drosera pallida	2-43
Xanthosia huegelii	2-44
Trachymene pilosa	2-45
Lomandra drummondii	2-46
*Romulea flava var. minor	2-49
Allocasuarina fraseriana	2-5
*Ornithopus sativus	2-50
Dryandra/Banksia	2-52
Acacia pulchella var glaberrima	2-6
Leucopogon propinquus	2-7
Hibbertia hypericoides	2-8
Xylomelum occidentale	2-AW01
Corymbia calophylla	2-AW01

CD1

GPS: NW Corner. GDA94 Datum.
50H 0383392, UTM 6398533

Veg Description.
Eucalyptus gomphocephela, E. rudis Scattered Trees over *Casuarina obesa, Melaleuca cuticularis, M. rhaphiophylla* Low Open Forest over *Ghania trifida, Juncus ?pallidus, Baumea juncea* Closed Sedgeland over **Cynodon dactylon* Grassland.

Condition: Very Good-Excellent

Soil: Black sandy loam.

Aspect/Slope: Flat

Species List

Melaleuca cuticularis	1-1
*Rumex crispus	1-10
Lobelia alata	1-11
Centella asiatica	1-13
Threlkeldia diffusa	1-14
Eucalyptus rudis	1-15
Lepidosperma longitudinale	1-17a
Juncus ?kraussii	1-17b
*Romulea flava var. minor	1-18
Comesperma ?ciliatum	1-19 (1-16)
Baumea juncea	1-2
Baumea juncea	1-2(2nd coll)
Samolus repens	1-12
Gahnia trifida	1-4
Juncus ?pallidus	1-5
Sarcocornia quinqueflora	1-6
*Cynodon dactylon	1-7
?Triglochin sp	1-8
*Ehrharta sp	1-9
Apium prostratum ssp prostratum	1-9
Eucalyptus gomphocephela	
Casuarina obesa	
Melaleuca rhaphiophylla	1-3

CD2

GPS: NW Corner, GDA94 Datum.
50H 0383085, UTM 6398360

Vegetation Description:
Eucalyptus marginata Scattered Trees over *Allocasuarina fraseriana, Banksia attenuata, B. menziesii, Xylomelum occidentale* Low Open Forest over *Acacia pulchella, Leucopogon propinquus* Shrubland/Open Shrubland over *Hibbertia hypericoides, Conostephium pendulum* Low Shrubland over *Chamaescilla corymbosa, Lomandra ?caespitosa, Lepidosperma pubisquameum, *Hypochaeris glabra* Herbland/Sedgeland.

Condition: Good

Soil: Grey sand

Aspect/Slope: Flat

Species List

Dichopogon/Caesia sp	2-?
Gompholobium tomentosum	2-10
Bossiaea eriocarpa	2-11
Hovea trisperma	2-12
Boronia ramosa ssp anethifolia	2-13
?Tricoryne elatior	2-14
Dichopogon capillipes	2-15
Chamaescilla corymbosa	2-16
Burchardia umbellata	2-17
Hardenbergia comptoniana	2-18
Eucalyptus marginata	2-2
Pyrorchis nigricans	2-20
Caladenia ?flava ssp flava	2-21
*Ehrharta calycina	2-22
*Hypochaeris glabra	2-23
Chamaescilla corymbosa	2-24
Chamaescilla corymbosa	2-25
Hovea trisperma	2-26
*Romulea ?rosea	2-28
Poaceae sp	2-29
Banksia attenuata	2-3
Drosera ?erythrorhiza	2-30
Astroloma pallidum	2-32
*Ursinia anthemoides	2-33
Lagenophora huegelii	2-34
Lomandra ?caespitosa	2-35
Caladenia ?flava ssp flava	2-36
Tetraria octandra	2-37
Phyllanthus calycinus	2-38
Desmocladus flexuosus	2-39

Banksia menziesii	2-4
Sowerbaea laxiflora	2-40
Lepidosperma pubisquameum	2-41
Desmocladus fasciculatus	2-42
Drosera pallida	2-43
Xanthosia huegelii	2-44
Trachymene pilosa	2-45
Lomandra drummondii	2-46
*Romulea flava var. minor	2-49
Allocasuarina fraseriana	2-5
*Ornithopus sativus	2-50
Dryandra/Banksia	2-52
Acacia pulchella var glaberrima	2-6
Leucopogon propinquus	2-7
Hibbertia hypericoides	2-8
Xylomelum occidentale	2-AW01
Corymbia calophylla	2-AW01

CD3

GPS: NW Corner. GDA94 Datum
50H 0382935, UTM 6398332

Vegetation Description:
Eucalyptus marginata Scattered Trees over *Banksia attenuata, B. menziesii, Allocasuarina fraseriana, Xylomelum occidentale* Low Open Forest over *Acacia pulchella* Open Shrubland over *Hibbertia hypericoides, Philotheca spicata, Bossiaea eriocarpa* Low Open Heath over *Dianella revoluta, Burchardia umbellata* Open Herbland.

Condition: Excellent

Soil: Loamy Grey Sand

Aspect/Slope: Flat

Litter: Leaves, twigs 4%.

Species List

Burchardia umbellata	3-1
Conostylis aculeata ssp aculeata	3-10
Conostylis aculeata ssp aculeata	3-10
Synaphea spinulosa ssp spinulosa	3-11
Hibbertia racemosa	3-12
Lepidosperma pubisquameum	3-13
Caladenia ?flava ssp flava	3-14
Conostylis juncea	3-15
Hovea trisperma	
Scaevola repens var repens	3-16
Poaceae sp	3-17
Daviesia incrassata ssp incrassata	3-18
Austrodanthonia sp	3-19
Gompholobium tomentosum	3-2
Isotropis cuneifolia	3-20
Chamaescilla corymbosa	3-21
Caesia ?micrantha	3-22
Thysanotus multiflorus	3-23
Drosera ?stolonifera	3-25
Eriochilus dilatatus ssp multiflorus	3-26
Sowerbaea laxiflora	3-29
Conostephium pendulum	3-3
Xanthosia huegelii	3-4
Desmocladus fasciculatus	3-5
Stylidium piliferum ssp piliferum	3-6
*Hypochaeris glabra	3-7
Trachymene pilosa	3-8
Acacia stenoptera	3-9

Allocasuarina fraseriana	
Eucalyptus marginata	
Banksia attenuata	
Banksia ilicifolia	
Banksia menziesii	
Xylomelum occidentale	
Acacia pulchella	
Hibbertia hypericoides	
Philotheca spicata	
Bossiaea eriocarpa	
Dianella revoluta	
Hovea trisperma	
Lagenophera huegelii	
Drosera ?erythrorhiza	
Lomandra sericea	
Romulea rosea	
Petrophile linearis	
Desmocladus flexuosus	
Burchardia umbellata	3-1
Astroloma pallidum	
Briza minor	
Ursinia anthemoides	

CD4

GPS: NW Corner, GDA94 Datum
50H 0382948, UTM 6398487.

Vegetation Description:
Corymbia calophylla, Allocasuarina fraseriana Open Forest over *Banksia attenuata (Banksia menziesii)* Scattered Low Trees over *Hibbertia hypericoides* Low Shrubland over *Tetraria octandra, Desmocladus flexuosus* Open Sedgeland over *Drosera ?erythrorhiza* Herbland.

Condition: Very Good

Soil: Very sandy grey loam

Aspect/Slope: Flat

Species List

*Allium sp	4-10
Caladenia ?flava ssp flava	4-11
Desmocladus fasciculatus	4-12
Eriochilus dilatatus ssp multiflorus	4-13
Lagenophora huegelii	4-14
Astroloma pallidum	4-15
Hovea trisperma	4-16
Tetraria octandra	4-2
Caesia ?micrantha	4-20
*Hypochaeris glabra	4-21
Pterostylis vittata	4-22
Bossiaea eriocarpa	4-23
*Ehrharta sp	4-24
Lomandra preissii	4-25
Lepidosperma pubisquameum	4-26
Dianella revoluta var. divaricata	4-27
Trachymene pilosa	4-28
Pyrorchis nigricans	4-29
Lepidosperma ?pubisquameum	4-3
Desmocladus flexuosus	4-3
Sonchus sp	4-30
Papilionaceae sp	4-31
Drosera ?erythrorhiza	4-4
Lomandra sericea	4-5
Poaceae sp	4-7
Conostephium pendulum	4-9
Hovea trisperma	4-1
Corymbia calophylla	
Banksia attenuata	
Allocasuarina fraseriana	
Hibbertia hypericoides	

*Ehrharta calycina
Philotheca spicatus
Banksia menziesii
Burchardia umbellata
Acacia pulchella
Kennedia prostrata
Briza maxima
Isotropis cuneifolia
Drosera stolonifera
Gompholobium tomentosum
Petrophile linearis
Romulea rosea

CD5

GPS: NW Corner, GDA94 Datum
50H 0383085, UTM 6397875

Vegetation Description:
Eucalyptus gomphocephela Scattered Trees over *Allocasuarina fraseriana, Banksia menziesii, B. attenuata* Low Open Forest over *Acacia pulchella* Open Heath over *Hibbertia hypericoides, Conostephium pendulum* Open Low Heath over *Tetraria octandra, Burchardia umbellata* Open Sedgeland over *Ehrharta calycina, Ehrharta ?longiflora* Grassland.

Condition: Very Good

Soil: Grey loamy sand

Aspect/Slope: Flat

Species List

Eucalyptus gomphocephela	
Banksia attenuata	
Banksia menziesii	
Allocasuarina fraseriana	
Acacia saligna	
Acacia pulchella	
Hibbertia hypericoides	
Dianella revoluta	
Burchardia umbellata	
Philotheca spicata	
*Oxalis pes-caprae	
Lomandra sericea	
Bossiaea eriocarpa	
*Briza maxima	
Isotropis cuneifolia	
*Romulea rosea	
*Ursinia anthemoides	
Conostephium pendulum	
Phyllanthus calycinus	
Gompholobium tomentosum	
Sowerbaea laxiflora	5-1
Chamaescilla corymbosa	5-10
Tricoryne ?elatior	5-11
Caladenia ?flava ssp flava	5-13
Drosera pallida	5-15
Eriochilus ?helonomas	5-16
Desmocladus fasciculatus	5-17
Amphipogon debilis	5-18
Pterostylis vittata	5-19
Poaceae sp	5-2

Stylidium piliferum ssp piliferum	5-20
?Rhodanthe citrina	5-21
Poranthera drummondii	5-22
Schoenus grandiflorus	5-23
Lomandra preissii	5-24
Trifolium ?dubium	5-25
Synaphea spinulosa ssp spinulosa	5-3
Tetraria octandra	5-6
Thysanotus pat/mang	5-7
Conostylis aculeata ssp aculeata	5-8
Lomandra suaveolens	5-9

CD6

GPS: NW Corner, GDA94 Datum
50H 0383123, UTM 6398226

Vegetation Description:
Eucalyptus gomphocephela, E. marginata Open Forest over *Xylomelum occidentale, Banksia attenuata, B. menziesii* Low Forest over *Kunzea glabrescens* Scattered Tall Shrubs over *Hibbertia hypericoides* Low Open Shrubland over

Condition: Very Good

Soil: Grey Loamy sand

Slope/Aspect: Flat

Species List

Sowerbaea laxiflora	6-1
*Hypochaeris glabra	6-10
Hovea trisperma	6-11
Boronia ramosa ssp anethifolia	6-12
?Tricoryne elatior	6-13
Pterostylis vittata	6-14
Dichopogon/Caesia sp	6-15
*Romulea ?rosea	6-16
Desmocladus fasciculatus	6-17
*Romulea flava var. minor	6-18
Chamaescilla corymbosa	6-2
Kunzea glabrescens	6-20
Caladenia ?flava ssp flava	6-21
Caladenia ?flava ssp flava	6-22
*Anagallis arvensis	6-23
*Ursinia anthemoides	6-24
Isotropis cuneifolia	6-25
Pterostylis aff nana	6-26
*Sonchus sp	6-27
Desmocladus flexuosus	6-28
Stylidium schoenoides	6-29
Drosera ?erythrorhiza	6-3
Eriochilus dilatatus ssp multiflorus	6-31
Stylidium piliferum ssp piliferum	6-32
Allocasuarina fraseriana	6-33
Dichopogon/Caesia sp	6-34
Burchardia umbellata	6-4
Conostylis aculeata ssp aculeata	6-5
*Ehrharta calycina	6-6
Pyrorchis nigricans	6-7
Trachymene pilosa	6-8
Schoenus grandiflorus	6-9

Gompholobium tomentosum	6-9
Eucalyptus gomphocephela	
Xylomelum occidentale	
Banksia attenuata	
Banksia menziesii	
Hibbertia hypericoides	
Xanthorrhoea preissii	
Phyllanthus calycinus	
Acacia pulchella	

CD7

GPS: NW Corner, GDA94 Datum
50H 0382923, UTM 6397920

Vegetation Description:
Eucalyptus marginata Scattered Trees over *Banksia attenuata, B. menziesii, Allocasuarina fraseriana* Low Open Forest over *Acacia pulchella* Shrubland over *Hibbertia hypericoides, Petrophile linearis, Daviesia incrassata, Philotheca spicata* Open Low Heath over *Lomandra sericea* Open Sedgeland

Condition: Excellent – Pristine

Soil: Grey loamy sand.

Slope/Aspect: Flat.

Species List

Daviesia physodes	7-1
Stylidium piliferum ssp piliferum	7-11
Drosera ?erythrorhiza	7-12
Persoonia saccata	7-13
Acacia pulchella var glaberrima	7-14
Monocot sp	7-15
Desmocladus flexuosus	7-16
Dasypogon bromeliifolius	7-18
?Caladenia sp.	7-19
Schoenus grandiflorus	7-2
Astroloma pallidum	7-20
Lomandra ?caespitosa	7-21
Acacia huegelii	7-22
Chamaescilla corymbosa	7-23
Synaphea spinulosa ssp spinulosa	7-24
Hypolaena exsulca	7-25
Hemiandra glabra ssp chimaera ms	7-26
Trifolium ?dubium	7-27
?Comesperma acerosum	7-27
Thysanotus pat/mang	7-28
Lepidosperma ?pubisquameum	7-3
Boronia ramosa ssp anethifolia	7-4
Lomandra sericea	7-5
Poaceae sp	7-6
Hovea trisperma	7-6
Pterostylis vittata	7-7
Scaevola repens var repens	7-7
Lepidosperma pubisquameum	7-8
Allocasuarina fraseriana	
Banksia attenuata	
Banksia menziesii	

Eucalyptus marginata	
Gomphplobium tomentosum	3-2
Philotheca spicata	
Hibbertia hypericoides	
Lomandra sericea	4-5
Petrophile linearis	
Conostylis aculeata ssp aculeata	3-10
Conostylis setigera	3-15
Conostephium pendulum	3-3
Daviesia incrassata ssp incrassata	3-18
Desmocladus fasciculatus	4-12
Burchardia umbellata	3-1
Xanthosia huegelii	3-4
Bossiaea eriocarpa	4-23
Isotropis cuneifolia	3-20
Pyrorchis nigricans	4-29

CD8

GPS: NW Corner, GDA94 Datum
50H 0383153, UTM 6397997

Vegetation Description:
Nuytsia floribunda, Eucalyptus marginata, Allocasuarina fraseriana Low Open Forest/Open Forest over *Acacia pulchella* Scattered Shrubs over *Lupinus consentinius, *Oxalis pes-caprae, *Ehrharta calycina* Closed Herbland/Grassland.

Condition: Degraded – Completely Degraded

Soil: Grey/Black Loamy sand.

Slope/Aspect: Flat

Species List

Conostylis aculeata ssp aculeata	8-1
*Trifolium ?dubium	8-2a
*Trifolium ?hirtum	8-2b
*Allium sp	8-3
Poaceae sp	8-5
*Hypochaeris glabra	8-4
Dicot sp	8-6
Eucalyptus marginata	
Allocasuarina fraseriana	
Nuytsia floribunda	
Stirlingia latifolia	
Acacia pulchella	
Hardenbergia comptoniana	
*Lupinus consentinius	
*Oxalis pes-caprae	
*Ehrharta calycina	
Gompholobium tomentosum	
*Ursinia anthemoides	
*Ehrharta longiflora	
*Romulea flava var. minor	

APPENDIX B

CALM Conservation and Priority Codes

CONSERVATION CODES

A Summary of Department of Conservation and Land Management Definitions of Their Declared Rare and Priority Flora List Conservation Codes (Atkins 2004).

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, . . . 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, . . . 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.

SIGNIFICANCE CODES

A summary of *Bush Forever* (2000, Volume 2, pp. 51-55, Table 13) definitions of the Significance Codes used in Table A2 is given below. Some other taxa are listed in Bush Forever Site descriptions of Significant Flora, some of which are "typical of Tamala Limestone taxa" ('limestone taxon', 'lt'). Others are just 'significant'.

P2, P3 Priority 2 and 3: Poorly Known Taxa
e taxa endemic to the Swan Coastal Plain
p considered to be poorly reserved
r populations at the northern or southern limit of their known geographic range
s significant populations
X considered lost in the Perth Metropolitan Region

APPENDIX C

Condition Codes and Vegetation Structure Table

VEGETATION STRUCTURE CLASSES AND CONDITION SCALE

TABLES

Vegetation Structure Classes (Layers)

These vegetation structure classes are the ones defined and used in Bush Forever (2000, Volume 2, Table 11 and p. 493) to describe vegetation in Bush Forever sites, (except that [1] a bracketed name refers to a dominant that has fewer plants and provides significantly less cover than others, and that [2] 'scattered' refers to trees, low trees, tall shrubs and low shrubs that have <2% cover). 'Sedges' are in Table 11 but not on p. 493.

Life Form/ Height Class	Canopy Cover (percentage)			
	100% - 70%	70% - 30%	30% - 10%	10% - 2%
Trees 10-30m Trees < 10m	Closed Forest Low Closed Forest	Open Forest Low Open Forest	Woodland Low Woodland	Open Woodland Low Open Woodland
Shrub Mallee	Closed Shrub Mallee	Shrub Mallee	Open Shrub Mallee	Very Open Shrub Mallee
Shrubs > 2m Shrubs 1-2m Shrubs <1m	Closed Tall Scrub Closed Heath Closed Low Heath	Tall Open Scrub Open Heath Open Low Heath	Tall Shrubland Shrubland Low Shrubland	Tall Open Shrubland Open Shrubland Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs	Closed Herbland	Herbland	Open Herbland	Very Open Herbland
Sedges	Closed Sedgeland	Sedgeland	Open Sedgeland	Very Open Sedgeland

Vegetation Condition Scale

This condition scale is the one used in *Bush Forever* (2000, Volume 2, Table 12 and p. 494) to describe condition of vegetation in Bush Forever sites.
Assessment of condition is at least as much of understorey strata as of overstorey.

P	Pristine	No obvious signs of disturbance
E	Excellent	Vegetation structure intact, disturbance affecting individual species [plants?]; weeds are non-aggressive species
V	Very Good	Vegetation structure altered; obvious signs of disturbance
G	Good	Vegetation structure significantly altered by very obvious signs of multiple disturbance; basic vegetation structure or ability to regenerate it is retained
D	Degraded	Basic vegetation structure severely impacted by disturbance; scope for regeneration but not to a state approaching good (sic) condition without intensive management
C	Completely Degraded	Vegetation structure not intact; the area completely or almost completely without native species ('parkland cleared').

APPENDIX D

CALM Database Search Results

WAHERB SPECIMEN DATABASE
GENERAL ENQUIRY

Caladenia huegelii
Rchb.f. (Orchidaceae)
CONSERVATION STATUS:R
Coll.: C.A. Gardner 890 Date: 16 10 1920 (PERTH 870374)
LOCALITY Ravenswood WA
LAT 32 Deg 35 Min Sec S LONG 115 Deg 49 Min Sec E
Previous det.: Caladenia huegelii Rchb.f.

Dillwynia dillwynioides
(Meisn.) Druce (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: P. Foreman & J. Kelly GLO 53 Date: 10 2001 (PERTH 06084370)
LOCALITY Goegrup Lake, N end of Caponi Road WA
LAT 32 Deg 31 Min 42.000 Sec S LONG 115 Deg 46 Min 41.000 Sec E
Erect shrub 2 m high. Flowers yellow and orange, crowded in a short terminal raceme.
Swamp and estuarine wetland deposits during Holocene Period. Moderate litter
cover less than 5%. Black sandy loam over aeolian and marine deposits.
Salt marsh vegetation with fringing estuarine forest. Sarcacornia quinqueflora,
Casuarina obesa, Melaleuca rhaphiophylla, Eucalyptus rudis.
Previous det.: Dillwynia dillwynioides (Meisn.)Druce
Frequency:common in the wet area.

Dillwynia dillwynioides
(Meisn.) Druce (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: G.J. Keighery 16135 Date: 16 11 2000 (PERTH 06097340)
LOCALITY Jeegarnyeejip Island, Murray River Delta WA
LAT 32 Deg 34 Min 43.600 Sec S LONG 115 Deg 45 Min 52.400 Sec E
Slender erect shrub 1.5 m high. Flowers orange-yellow, wings-keel red. Largely post flowering. Winter damp. Black sandy clay. Melaleuca preissiana, Mel. viminea low woodland over tall shrubland.
Frequency:rare.

Dillwynia dillwynioides
(Meisn.) Druce (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: P. Foreman & J. Kelly GLO 53 Date: 09 2001 (PERTH 05890608)
LOCALITY Goegrup Lake, N end of Caponi Road, WA
LAT 32 Deg 31 Min 42.000 Sec S LONG 115 Deg 46 Min 41.000 Sec E
Erect shrub 1 m high. Swamp and estuarine wetland deposits during Holocene period. Moderate litter
cover less than 5%. Black sandy loam over aeolian and marine deposits.
Salt marsh vegetation with fringing estuarine forest. Sarcacornia quinqueflora,
Casuarina obesa, Melaleuca rhaphiophylla, Eucalyptus rudis.
Frequency:occasional.

Dillwynia dillwynioides
(Meisn.) Druce (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: A.R. Fairall 1698 Date: 03 10 1965 (PERTH 00720801)
LOCALITY Mandurah - North Yunderup WA
LAT 32 Deg 33 Min 11.000 Sec S LONG 115 Deg 44 Min 27.000 Sec E
Slender shrub up to 4 ft. Flowers orange, red. Swampy roadside.
Previous det.: Dillwynia dillwynioides (Meisn.)Druce

Dillwynia dillwynioides
(Meisn.) Druce (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: P. Foreman & J. Kelly GLO 53 Date: 10 2001 (PERTH 06146813)
LOCALITY Goegrup Lake, N end of Caponi Road WA
LAT 32 Deg 31 Min 42.000 Sec S LONG 115 Deg 46 Min 40.800 Sec E
Erect shrub, 2 m high. Flowers yellow and orange, crowded in a short terminal raceme.
Swamp and estuarine wetland deposits during Holocene Period. Moderate litter
cover, less than 5%. Black sandy loam over aeolian and marine deposits.
Salt marsh vegetation with fringing estuarine forest. Sarcocornia quinqueflora,
with Casuarina obesa, Melaleuca rhapiophylla, Eucalyptus rudis.
Frequency:common in the wet area.

Dillwynia dillwynioides
(Meisn.) Druce (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: C.F. Davies 565 Date: 12 1965 (PERTH 720798)
LOCALITY Yunderup WA
LAT 32 Deg 35 Min Sec S LONG 115 Deg 46 Min Sec E

Dillwynia dillwynioides
(Meisn.) Druce (Papilionaceae)
CONSERVATION STATUS:P3
Coll.: C.F. Davies 565 Date: 12 1965 (PERTH 720771)
LOCALITY Yunderup WA
LAT 32 Deg 35 Min Sec S LONG 115 Deg 46 Min Sec E

DEPARTMENT OF CONSERVATION AND LAND MANAGEMENT
DECLARED RARE AND PRIORITY FLORA LIST
22 February 2005

SPECIES / TAXON	CONS CODE	CALM REGION	DISTRIBUTION	FLOWER PERIOD
Eucalyptus rudis subsp. cratyantha	4	CF	Yallingup, Eagle Bay, Mandurah, Cape Naturaliste, Meelup, Busselton	-
Jacksonia sericea	4	SW	Wanneroo, Trigg, Perth, Karrinyup, Mandurah-Pinjarra, Neerabup NPk, Ardross	Dec-Feb

APPENDIX B

Fauna and Habitat Assessment Report

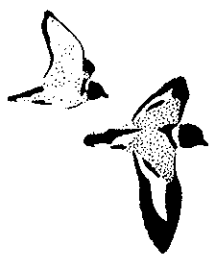
Bamford Consulting Ecologists, October 2005

Lot 440 Wanjeep Road, Coodanup:

assessment of fauna and fauna habitats

Prepared for: RPS Bowman Bishaw Gorham,
PO Box 465,
Subiaco, WA, 6904

Prepared by: M.J. & A.R. Bamford,
CONSULTING ECOLOGISTS.
23 Plover Way,
Kingsley, WA, 6026



21st October 2005

INTRODUCTION

As part of the environmental assessment of Lot 440 Wanjeep Road, Coodanup, Bamford Consulting Ecologists was commissioned to undertake an investigation into the fauna of the site. The aims of this investigation were:

- List species likely to occur on the site;
- List and discuss significant species likely to occur on the site;
- Identify significant habitats on the site; and
- Provide recommendations for fauna conservation with respect to the proposed development of part of the site.

These investigations built upon previous studies, carried out at the site in January 2003, to identify significant trees (Bamford 2003).

METHODS

Level of assessment and limitations

Investigations at Lot 440 Wanjeep Road constituted a Level 2 assessment under Guidance Statement No. 56 (EPA 2004). This is an assessment that incorporates a literature review, reconnaissance survey and detailed trapping survey. The project area lies within a region where the vertebrate fauna at least is well known, making it possible to predict the species present with a fair degree of accuracy. Personal experience with the fauna and habitats is important in this process. The timing of the trapping survey (26th September to 3rd October 2005) was determined by the client's reporting requirements and was not ideal for sampling fauna groups such as reptiles. However, general information on fauna in the region and personal experience offset this limitation. Furthermore, the purpose of trapping is not primarily to generate a complete confirmed species list, as that takes many years of field-work, but to get information on the presence, distribution and abundance of at least some species, and particularly species of conservation significance.

Desktop review

Lists of fauna expected to occur in the study area were produced using information from a number of sources. These included publications that provide information on general patterns of distribution of frogs (Tyler *et al.* 2000), reptiles (Storr *et al.* 1983, 1990, 1999 and 2002, Bush *et al.* 1995), birds (Barrett *et al.* 2003; Johnstone and Storr 1998), and mammals (Menkhorst and Knight 2001; Strahan 1995). In addition, records for the Mandurah area were sought from databases managed by the WA Museum (faunabase), the Department of Conservation and Land Management (threatened fauna database), Birds Australia (Atlas II Database) and the Department of the Environment and Heritage (EPBC Protected Matters database). The search area for databases was 32° 20' to 32° 40'S, and 115° 45' to 116° 05'E except for the Atlas II database, for which the search area was 32° 00' to 33° 00'S and 115° 00' to 116° 00'E. Personal records (M. Bamford) from work carried out in the region since the mid 1980s were also used in the desktop review. This included data from monthly bird surveys conducted along the Serpentine

River from January to September 2002, and from an earlier survey of the site in January 2003 (Bamford 2003).

These sources of information were used to create lists of species expected to occur at the site. As far as possible, expected species are those that are likely to utilise the project area, and such lists exclude species that have been recorded in the general region as vagrants or for which suitable habitat is absent. Particularly among the birds, for example, vagrants can be recorded almost anywhere.

Taxonomy and nomenclature for fauna species used in this report generally follow the WA Museum (2001) for amphibians, reptiles and mammals, and Christidis and Boles (1994) for birds, with WA Museum names for birds provided in parentheses where appropriate.

Field survey

The field survey took place from 26th September to 3rd October 2005. Weather conditions during the survey were generally cool and windy with persistent showers, which was unfavourable for trapping and bird surveys.

For sampling frogs, reptiles and small mammals, seven sampling sites were established, each consisting of a transect of traps (see Figure 1). Traplines 1, 2, 4, 5 and 6, which passed through woodland areas, with lines 4 and 6 in degraded woodland but lines 1, 2 and 5 in woodland in good condition. Traplines 3 and 7a and 7b ran through riparian vegetation close to the Serpentine River. Trapline 7 (a and b) had only cage and Elliott traps as they were designed to target the Quenda or Brown Bandicoot and the Rakali or Water Rat. Other traplines had assisted pitfall traps and funnel traps well as cage and Elliott traps. Details of trapping effort are presented in Table 1. The traps on each trapline were open for 5 nights.

Table 1. Deployment of traps in each trapline at Lot 440 Wanjeep Road, Coodanup, 26th September to 3rd October 2005.

Trapline	N pitfalls	N funnels	N cage traps	N Elliott traps
1	15	15	1	5
2	10	10	1	5
3	15	15	15	15
4	10	10	1	5
5	10	10	1	5
6	10	10	1	5
7a	-	-	9	10
7b	-	-	8	10
Total	70	70	37	60
N trapnights	350	350	185	300

Figure 1: Sampling Sites and Traplines

In addition to trapping, bird observations were made opportunistically on 26th September and were supplemented by observations from January 2003 (Bamford 2003) and from monthly surveys (January to September 2002) carried out along the Serpentine River and adjacent habitat (M. Bamford, personal database). Some hand-searching for reptiles were carried out at all sites, and night observations were made on the evening of 28th September 2005, including hand-spotlighting for nocturnal fauna and echo-location recording for bats. Final results from the echo-location recording are not available, but preliminary results suggested no species of significance were present at the time.

Personnel
The desktop survey was carried out by Dr Mike Bamford. Field work was carried out under instruction from Dr Bamford by Jason Fraser, with assistance from Brenden Metcalf (site establishment and bat surveys), Jenny Goldberg and Adam Ashby (site establishment). Report preparation by Mike Bamford.

Assessment of conservation significance
The conservation status of fauna species is assessed under Commonwealth and State Acts such as the *Commonwealth Environment Protection and Biodiversity Conservation Act* (EPBC Act) 1999 and the *Western Australian Wildlife Conservation Act* 1950. The significance levels for fauna used in the EPBC Act are those recommended by the International Union for the Conservation of Nature and Natural Resources (IUCN 2001). The *WA Wildlife Conservation Act* 1950 uses a set of Schedules but also classifies species using some of the IUCN categories. These categories and Schedules are described in Appendix 1.

The EPBC Act also has lists of migratory species that are recognised under international treaties such as the China Australia Migratory Bird Agreement (CAMBA), the Japan Australia Migratory Bird Agreement (JAMBA) and the Bonn Convention (The Convention on the Conservation of Migratory Species of Wild Animals). The list of migratory species under the EPBC Act has been revised to include species only, thus excluding family listings (DEH, pers comm.). Those species listed in JAMBA are also protected under Schedule 3 of the *WA Wildlife Conservation Act*. There is a separate list of marine species under the EPBC Act, but this only applies to land and waters under Commonwealth management. Therefore, marine listings are not included in this report.

The Department of the Environment and Heritage (DEH, formerly Environment Australia) has also supported the publication of reports on the conservation status of most vertebrate fauna species: reptiles (Cogger *et al.* 1993), birds (Garnett and Crowley 2000), monotremes and marsupials (Maxwell *et al.* 1996), rodents (Lee 1995) and bats (Duncan *et al.* 1999). The Threatened Species and Communities Section of Environment Australia has also produced a list of Threatened Australian Fauna (Environment Australia 1999), although this list is effectively a precursor to the list produced under the EPBC Act. These publications also use the IUCN categories, although those used by Cogger *et al.* (1993) differ in some respects because this report pre-dates categories reviewed by Mace and Stuart (1994) and revisited since by IUCN (2001).

In Western Australia, the Department of Conservation and Land Management (CALM) has produced a supplementary list of Priority Fauna, being species that are not considered Threatened under the WA Act but for which the Department feels there is cause for concern. Some Priority species, however, are also assigned to the IUCN Conservation Dependent category. Levels of Priority are described in Appendix 1.

Fauna species included under conservation acts and/or agreements are formally recognised as of conservation significance under state or federal legislation. Species listed only as Priority by CALM, or that are included in publications such as Garnett and Crowley (2000) and Cogger *et al.* (1993), but not in State or Commonwealth Acts, are also of recognised conservation significance. In addition, species that are at the limit of their distribution, those that have a very restricted range and those that occur in breeding colonies, such as some waterbirds, can be considered of conservation significance, although this level of significance has no legislative or published recognition and is based on interpretation of distribution information. The WA Department of Environmental Protection (2000) used this sort of interpretation to identify significant bird species in the Perth metropolitan area as part of Perth Bushplan (DEP 2000).

On the basis of the above comments, three levels of conservation significance are recognised in this report:

- *Conservation Significance (CS) 1*: Species listed under State or Commonwealth Acts.
- *Conservation Significance (CS) 2*: Species not listed under State or Commonwealth Acts, but listed in publications on threatened fauna or as Priority species by CALM.
- *Conservation Significance (CS) 3*: Species not listed under Acts or in publications, but considered of at least local significance because of their pattern of distribution.

RESULTS

Site description and fauna habitats

The site lies between the Serpentine River and Wanjeep Road, with urban development to the south and west, and largely degraded land to the north as far as Pinjarra Road. The vegetation of the site consists largely of banksia/eucalypt woodland on sand, with the understorey in good condition except in the north, which has been parkland cleared, leaving only scattered large eucalypts, mostly Tuarts *Eucalyptus gomphocephala*. There is riparian vegetation along the Serpentine River and several areas of marshland that are seasonally inundated. The site is traversed by several vehicular tracks with some localise degradation of vegetation and weed invasion. As in most areas of urban bushland, household and garden rubbish from neighbouring properties has been dumped along the tracks through the site.

Invertebrates
The only information on invertebrate fauna is for threatened species listed in the Threatened Fauna Database maintained by CALM. The only species listed for the Mandurah area is the Graceful Sun-Moth *Synemon gratiosa* (Castniidae). This is noted as occurring in few locations from Wanneroo to Mandurah and to be threatened by land clearing. The Graceful Sun-Moth is listed as Priority 1 under the *WA Wildlife Conservation Act.* Its habitat requirements are unknown but it occurs in Banksia woodland so may be present on the site.

Frogs
The frog fauna is considered to include eight species, of which five were recorded (Table 2). One of the frog species not recorded, the Turtle Frog, is of some conservation interest as it is close to the southern edge of its range in the area. This is an entirely terrestrial species, but all other frogs are likely to breed in freshwater on the margins of the Serpentine River. Despite this, species such as the Moaning Frog and the Pobblebonk make extensive use of terrestrial habitats. The distribution of captures (see Table 7) indicates a concentration of frogs such as the Moaning Frog and Pobblebonk in upland areas with understorey vegetation in good condition (eg. Sites 1 and 2).

Reptiles
The reptile fauna is considered to include 39 species, of which only eight were recorded, a reflection of the time of year when the survey was undertaken (Table 2). Several of the reptile species are of some conservation significance, but the only species of very significant reptile (CS1), the Carpet Python, is probably locally extinct. The other species of conservation significance (CS2 or CS3) are likely to be present. The reptiles are reliant largely upon terrestrial habitats, especially where understorey vegetation is in good condition. The distribution of captures across the sampling sites indicates little except for the concentration of the skink *Hemiergis quadrilineata* in site 3, close to the Serpentine River. This species often favours sites with high soil moisture content (M. Bamford pers. obs.).

Conservation Significance Level 1
The Carpet Python is listed as 'other specially protected fauna' under the Wildlife Conservation Act, as Priority 4 by CALM and as vulnerable by Cogger *et al.* (1993). The Carpet Python is known from the Mandurah area (M. Bamford, pers. obs), although the likelihood that it persists in the project area is low.

Conservation Significance Level 2
The Black-striped Snake is listed as Priority 3 by CALM. This species is restricted to the west coast region from Lancelin to Mandurah and although locally common in some habitats on the Swan Coastal Plain, its future persistence is threatened by continuing loss of habitat due to increasing urban development pressures throughout its range (Storr *et al.* 2002).

The Perth Lined Lerista is listed as Priority 3 by CALM. This species is found in the southern areas of Perth and is restricted to sandplain areas particularly shrublands and

Banksia woodlands (Bush *et al.* 1995). This species has a very restricted geographic range and is threatened by urban development (Bush *et al.* 1995).

Conservation Significance Level 3
The Barking Gecko, Red-legged Skink and black-naped Snake are locally significant, as they are at the limit of their range in the area. The Red-legged Skink is of further interest as the taxonomic status of the coastal plain population around Mandurah has been questioned (J.N. Dunlop pers. com.).

Birds
The bird fauna is considered to include 123 species, of which 48 have been recorded. The low number of species recorded in September 2005 was due to inclement weather rather than to a reduction in the number of species in the site. Most important features of the avifauna are the migratory waterbirds that use the Serpentine River and adjacent wetlands, nesting by birds of prey such as the Osprey and White-bellied Sea-Eagle, foraging by black-cockatoos, and the presence of a suite of small insectivores that disappear during urbanisation (particularly fairy-wrens and thornbills). Bamford (2003) carried out a survey of significant trees on the site, with emphasis on trees with hollows that might be used for nesting by birds, and these are listed in Table 4.

Conservation Significance 1
The Short-billed (Carnaby's) Black-Cockatoo is listed as endangered under the EPBC Act, the Wildlife Conservation Act and by Garnett and Crowley (2000). Carnaby's Black-Cockatoo has declined due to loss of breeding habitat in the wheatbelt and of non-breeding habitat along the west coast, partly due to urban expansion. While small areas of foraging habitat around the metropolitan area support only small numbers of birds for short periods of time, the progressive loss of such small areas is an ongoing concern for this species. The site, especially banksias, provides such feeding habitat. Furthermore, Carnaby's Black-Cockatoo has been recorded breeding in a Tuart tree within 5km of the site (M Bamford pers. obs.) and potentially may nest in large tree hollows on the site.

The Long-billed (Baudin's) Black-Cockatoo is listed as vulnerable under both the EPBC Act and Wildlife Conservation Act and as 'near threatened' by Garnett and Crowley (2000). It may be an infrequent visitor to the site.

The Red-tailed Black-Cockatoo (forest race) is listed as Schedule 1 under the Wildlife Conservation Act and was observed at the site in September 2005. It is probably a regular foraging visitor but there are no records of breeding in the Mandurah area.

The Peregrine Falcon is listed as 'other specially protected fauna' under the Wildlife Conservation Act. The Peregrine Falcon is a wide-ranging bird of prey that may be an occasional visitor to the site. There was no evidence that they breed there.

Ten bird species present or expected to occur on the site are listed as migratory under the EPBC Act (see Table 3). Most are waterbirds that will utilise the Serpentine River and

adjacent wetlands. A nest being used by Ospreys in 2003 (see Table 4) appeared to be in use White-bellied Sea-Eagles in September 2005.

Conservation Significance 2
The Barking Owl is listed as Priority 2 by the CALM and as 'near threatened' by Garnett and Crowley (2000). It is very rarely observed on the Coastal Plain south of Perth, so is unlikely to be present on the site regularly.

The Masked Owl is listed as Priority 3 by the CALM and as 'near threatened' by Garnett and Crowley (2000). A Masked Owl was recently recorded just to the south of Mandurah (Lake Mealup Preservation Society 2001), and it may occur in the project area, possibly roosting and even nesting in large tree hollows such as amongst the Tuarts at the northern end of the site.

Conservation Significance Level 3
Thirteen bird species are of CS3, being species listed as having declined in the Perth area due to urbanization (Department of Environmental Protection 2000). These species are well-represented on the site, with eight of them recorded. This reflects the large area of good quality woodland habitat available.

Mammals
The mammal fauna is expected to be poor with only 21 species, of which five are introduced. Nine of the 16 native species are bats. The only species caught during the September survey were the Black Rat and House Mouse. Results of bat echolocation surveys are not yet available, but inclement weather probably resulted in no species being recorded. The White-striped Bat is included as present as it was heard nearby in September 2005, and is very common in urban areas. Targeted trapping for the Quenda and Rakali was unsuccessful, but the Quenda has previously been recorded in the area while the Rakali is very likely to be present and can be hard to catch. Both these species are of conservation significance (see below) and are likely to occur along the Serpentine River. Also of conservation significance is the Bat *F. mackenziei* which, like other bats, my roost in tree hollows and under loose bark, and forage over woodland at night. Trapping intensity was probably sufficient for the Honey Possum to have been caught if it was present, although these species varies in abundance greatly both seasonally and annually. Trapping results (Table 7) indicate that the only two mammal species caught, the introduced House Mouse and Black Rat, are most abundant close to the Serpentine River.

Conservation Significance 2
The Quenda is listed as Priority 4 by CALM and as lower risk (near threatened) by Maxwell *et al.* (1996). Diggings were common in dense vegetation close to the Serpentine River so the species is present even though no specimens were caught. It has previously been recorded in the area (M. Bamford pers. obs.).

The Brush Wallaby is listed as Priority 4 by CALM and as lower risk (near threatened) by Maxwell *et al.* (1996). It may be locally extinct on the site and the area is probably too small to support the species even if some specimens persist.

The Western False Pipistrelle is listed as Priority 4 by CALM and as lower risk (near threatened) by Duncan *et al.* (1999). It is known from areas of Jarrah, Tuart and banksia on the coastal plain and on the site is likely to shelter in hollows and crevices in trees.

The Water Rat (Rakali) is listed as Priority 4 by CALM and although not trapped, is very likely to occur along the Serpentine River.

Table 2. Frogs and reptiles likely to occur at the Coodanup site, indicating numbers caught during the survey in September 2005. An asterisk indicates a species recorded opportunistically but not trapped. See Appendix 1 for explanation of status.

Species		Sept 2005	Status
FROGS			
Myobatrachidae (ground frogs)			
Glauert's Froglet	*Crinia glauerti*	1	
Squelching Frog	*Crinia insignifera*	*	
Moaning Frog	*Heleioporus eyrei*	23	
Pobblebonk	*Limnodynastes dorsalis*	4	
Turtle Frog	*Myobatrachus gouldii*		CS3
Guenther's Toadlet	*Pseudophryne guentherii*		
Hylidae (tree frogs)			
Motorbike Frog	*Litoria moorei*		
Slender Tree Frog	*Litoria adelaidensis*	*	
REPTILES			
Chelidae (freshwater tortoises)			
Long-necked Tortoise	*Chelodina oblonga*		
Gekkonidae (geckoes)			
Marbled Gecko	*Christinus(Phyllodactylus) marmoratus*		
Spiny-tailed Gecko	*Strophurus spinigerus*		
Barking Gecko	*Underwoodisaurus milli*		**CS3**
Pygopodidae (legless lizards)			
Sandplain Worm Lizard	*Aprasia repens*		
Fraser's Legless Lizard	*Delma fraseri*		
Grey's Legless Lizard	*Delma grayii*		
Burton's Legless Lizard	*Lialis burtonis*		
Common Scaleyfoot	*Pygopus lepidopodus*		
Agamidae (dragon lizards)			
Western Bearded Dragon	*Pogona minor*		
Varanidae (monitors or goannas)			
Gould's Sand Goanna	*Varanus gouldii*		
Rosenberg's Goanna	*Varanus rosenbergi*		
Scincidae (skink lizards)			
South-West Cool Skink	*Acritoscincus trilineatum*		
Fence Skink	*Cryptoblepharus plagiocephalus*		
Western Ctenotus	*Ctenotus australis*	1	
South-west Odd-striped Ctenotus	*Ctenotus impar*		
Red-legged Skink	*Ctenotus labillardieri*		CS3
King's Skink	*Egernia kingii*		
Western Swamp Egernia	*Egernia luctuosa*		
Salmon-bellied Skink	*Egernia napoleonis*		
Two-toed Earless Skink	*Hemiergis quadrilineata*	17	
South-western Four-toed Lerista	*Lerista distinguenda*	3	
West Coast Four-toed Lerista	*Lerista elegans*		
Perth Lined Lerista	*Lerista lineata*		CS2

Table 2 (cont.)

Species		Sept 2005	Status
Dwarf Skink	*Menetia greyii*	3	
Western pale-flecked Morethia	*Morethia lineoocellata*		
Southern pale-flecked Morethia	*Morethia obscura*	3	
Bobtail	*Tiliqua rugosa*	5	
Typhlopidae (blind snakes)			
Southern Blind Snake	*Ramphotyphlops australis*		
Boidae (pythons)			
South-West Carpet Python	*Morelia spilota imbricata*		CS1
Elapidae (front-fanged snakes)			
Bardick	*Echiopsis curta*		
Crowned Snake	*Elapognathus coronata*		
Black-naped Snake	*Neelaps bimaculatus*		
Black-striped Snake	*Neelaps calonotus*		CS2
Tiger Snake	*Notechis scutatus*	1	
Dugite	*Pseudonaja affinis*		
Gould's Snake	*Parasuta(Rhinoplocephalus) gouldii*	1	
Jan's Bandy-Bandy	*Simoselaps(Vermicella) bertholdi*		
Black-naped Snake	*Simoselaps(Vermicella) bimaculata*		CS3

Table 3. Birds likely to occur at the Coodanup site, indicating species observed in 2002, January 2003 and during the survey in September 2005. See Appendix 1 for explanation of status. Species designated as "CS1 m" are listed as migratory under the EPBC Act.

Species	2002	Jan 03	Sep 05	Status
Phasianidae (pheasants and quails)				
Brown Quail *Coturnix ypsilophora*				
Stubble Quail *Coturnix pectoralis*				
Anatidae (ducks, geese and swans)				
Black Swan *Cygnus atratus*				
Grey Teal *Anas gracilis*	X			
Pacific Black Duck *Anas superciliosa*	X		X	
Australian Shelduck *Tadorna tadornoides*	X			
Australian Wood Duck *Chenonetta jubata*				
Podicipediae (grebes)				
Hoary-headed Grebe *Poliocephalus poliocephalus*				
Anhingidae (darters)				
Darter *Anhinga melanogaster*	X		X	
Phalacrocoracidae (cormorants)				
Great Cormorant *Phalacrocorax carbo*				
Little Pied Cormorant *Phalacrocorax melanoleucos*	X			
Little Black Cormorant *Phalacrocorax sulcirostris*				
Pied Cormorant *Phalacrocorax varius*				
Pelecanidae (pelicans)				
Australian Pelican *Pelecanus conspicillatus*				
Ardeidae (herons and egrets)				
White-faced Heron *Egretta novaehollandiae*	X			
White-necked Heron *Ardea pacifica*				
Little Egret			X	
Great Egret *Ardea alba*	X			CS1 m
Nankeen Night Heron *Nycticorax caledonicus*				
Threskiornithidae (ibis)				
Australian White Ibis *Theskiornis molucca*			X	
Straw-necked Ibis *Threskiornis spinicollis*				
Yellow-billed Spoonbill *Platalea flavipes*				
Accipitridae (kites, hawks and eagles)				
Osprey *Pandion haliaetus*	X	X		CS1 m
Black-shouldered Kite *Elanus notatus*				
Square-tailed Kite *Lophoictinia isura*				
Whistling Kite *Haliastur sphenurus*		X nest		
White-bellied Sea-Eagle *Haliaeetus leucogaster*			X nest	CS1 m
Swamp Harrier *Circus approximans*				
Brown Goshawk *Accipiter fasciatus*				
Collared Sparrowhawk *Accipiter cirrhocephalus*				
Wedge-tailed Eagle *Aquila audax*				
Little Eagle *Hieraaetus morphnoides*				

Table 3 (cont)

Species	2002	Jan 03	Sep 05	Status
Falconidae (falcons)				
Peregrine Falcon *Falco peregrinus*				CS1
Australian Hobby *Falco longipennis*				
Brown Falcon *Falco berigora*				
Nankeen Kestrel *Falco cenchroides*				
Rallidae (rails and crakes)				
Buff-banded Rail *Gallirallus philippensis*				
Baillon's Crake *Porzana pusilla*				
Australian Spotted Crake *Porzana fluminea*				
Spotless Crake *Porzana tabuensis*				
Purple Swamphen *Porphyrio porphyrio*				
Eurasian Coot *Fulica atra*				
Turnicidae (button-quails)				
Painted Button-quail *Turnix varia*				CS3
Scolopacidae (stints, sandpipers and curlews)				
Common Greenshank *Tringa nebularia*				CS1 m
Common Sandpiper *Tringa hypoleucos*				CS1 m
Red-necked Stint *Calidris ruficollis*				CS1 m
Sharp-tailed Sandpiper *Calidris acuminata*				CS1 m
Curlew Sandpiper *Calidris ferruginea*				CS1 m
Recurvirostridae (stilts and avocets)				
Black-winged Stilt *Himantopus himantopus*				
Banded Stilt *Cladorhynchus leucocephalus*				
Red-necked Avocet *Recurvirostra novaehollandiae*	X			
Charadriidae (lapwings and plovers)				
Red-capped Plover *Charadrius ruficapillus*				
Black-fronted Dotterel *Elseyornis melanops*	X			
Laridae (gulls and terns)				
Silver Gull *Larus novaehollandiae*				
Columbidae (pigeons and doves)				
Laughing Turtle-Dove *Streptopelia senegalensis*				introd.
Common Bronzewing *Phaps chalcoptera*	X	X	X	
Crested Pigeon *Ocyphaps lophotes*				
Cacatuidae (cockatoos)				
Red-tailed Black-Cockatoo *Calyptorhynchus banksii*			X	CS1
Short-billed Black-Cockatoo *Calyptorhynchus latirostris*				CS1
Long-billed Black-Cockatoo *Calyptorhynchus baudinii*				CS1
Galah *Cacatua roseicapilla*	X			
Sulphur-crested Cockatoo *Cacatua galerita*			X	Introd
Psittacidae (lorikeets and parrots)				
Purple-crowned Lorikeet *Glossopsitta porphyrocephala*				
Regent Parrot *Polytelis anthopeplus*				
Red-capped Parrot *Purpureicephalus spurius*		X	X	
Western Rosella *Platycercus icterotis*				

Table 3 (cont.)

Species		2002	Jan 03	Sep 05	Status
Australian Ringneck	*Barnardius zonarius*	X	X	X	
Elegant Parrot	*Neophema elegans*				
Cuculidae (cuckoos)					
Pallid Cuckoo	*Cuculus pallidus*				
Fan-tailed Cuckoo	*Cuculus pyrrhophanus*				
Horsfield's Bronze-Cuckoo	*Chrysococcyx basalis*				
Shining Bronze-Cuckoo	*Chrysococcyx lucidus*				
Strigidae (hawk-owls)					
Barking Owl	*Ninox connivens*				CS2
Southern Boobook Owl	*Ninox novaeseelandiae*				
Tytonidae (barn owls)					
Masked Owl	*Tyto novaehollandiae*				CS2
Barn Owl	*Tyto alba*				
Podargidae (frogmouths)					
Tawny Frogmouth	*Podargus strigoides*				
Apodidae (swifts)					
Fork-tailed Swift	*Apodus pacificus*				CS1 m
Halcyonidae (forest kingfishers)					
Laughing Kookaburra	*Dacelo novaeguineae*		X	X	
Sacred Kingfisher	*Todiramphus sanctus*	X			
Meropidae (bee-eaters)					
Rainbow Bee-eater	*Merops ornatus*	X			CS1 m
Maluridae (fairy-wrens)					
Splendid Fairy-wren	*Malurus splendens*	X	X	X	CS3
Pardalotidae (pardalotes and thornbills)					
Spotted Pardalote	*Pardalotus punctatus*				CS3
Striated Pardalote	*Pardalotus striatus*	X			
White-browed Scrubwren	*Sericornis frontalis*	X			CS3
Western Gerygone	*Gerygone fusca*	X	X		
Weebill	*Smicrornis brevirostris*		X		CS3
Inland Thornbill	*Acanthiza apicalis*	X			CS3
Western Thornbill	*Acanthiza inornata*	X	X		CS3
Yellow-rumped Thornbill	*Acanthiza chrysorrhoa*	X			CS3
Meliphagidae (honeyeaters)					
Red Wattlebird	*Anthochaera carunculata*	X	X		
Western Wattlebird	*Anthochaera lunulata*	X			
Singing Honeyeater	*Lichenostomus virescens*		X		
White-naped Honeyeater	*Melithreptus lunatus*				
Brown-headed Honeyeater	*Melithreptus brevirostris*				
Brown Honeyeater	*Lichmera indistincta*	X	X	X	
New Holland Honeyeater	*Phylidonyris novaehollandiae*	X	X		CS3
White-cheeked Honeyeater	*Phylidonyris nigra*				CS3
Tawny-crowned Honeyeater	*Phylidonyris melanops*				
Western Spinebill	*Acanthorhynchus superciliosus*	X	X		
White-fronted Chat	*Epthianura albifrons*	X			

Table 3 (cont.)

Species	2002	Jan 03	Sep 05	Status
Petroicidae (Australian robins)				
Scarlet Robin *Petroica multicolor*				
Neosittidae (sittellas)				
Varied Sittella *Daphoenositta chrysoptera*				
Pachycephalidae (whistlers)				
Golden Whistler *Pachycephala pectoralis*				CS3
Rufous Whistler *Pachycephala rufiventris*	X	X		
Grey Shrike-thrush *Colluricincla harmonica*				
Dicruridae (flycatchers)				
Magpie-lark *Grallina cyanoleuca*				
Restless Flycatcher *Myiagra inquieta*				CS3
Grey Fantail *Rhipidura fuliginosa*	X	X		
Willie Wagtail *Rhipidura leucophrys*	X			
Campephagidae (cuckoo-shrikes)				
Black-faced Cuckoo-shrike *Coracina novaehollandiae*	X			
White-winged Triller *Lalage tricolor*				
Artamidae (woodswallows)				
Black-faced Woodswallow *Artamus cinereus*				
Dusky Woodswallow *Artamus cyanopterus*				
Grey Butcherbird *Cracticus torquatus*	X	X		
Australian Magpie *Gymnorhina tibicen*	X	X	X	
Grey Currawong *Strepera versicolor*			X	CS3
Corvidae (ravens and crows)				
Australian Raven *Corvus coronoides*	X	X	X	
Motacillidae (pipits and true wagtails)				
Richard's Pipit *Anthus novaeseelandiae*				
Dicaeidae (mistletoebird)				
Mistletoebird *Dicaeum hirundinaceum*				
Hirundinidae (swallows)				
Welcome Swallow *Hirundo neoxena*	X			
Tree Martin *Hirundo nigricans*	X			
Zosteropidae (white-eyes)				
Silvereye *Zosterops lateralis*	X	X		
Number of species:	38	21	15	

Table 4. Locations (UTM, WGS 84) of significant trees in the study area, taken from Bamford (2003).

Species	easting and northing	Reason for inclusion
Jarrah.	50 382 933 E, 6 397 580 N	Hollows
Jarrah.	50 382 934 E, 6 397 599 N	Hollows
Marri	50 382 912 E, 6 397 677 N	Hollows
Tuart	50 382 984 E, 6 397 762 N	Nest; Australian Raven?
Tuart	50 382 998 E, 6 397 867 N	Hollows
Jarrah	50 382 950 E, 6 397 811 N	Hollows
eucalypt; dead	50 383 055 E, 6 398 004 N	Osprey nest with chick
Tuart	50 383 093 E, 6 398 389 N	Hollows
Jarrah	50 382 736 E, 6 397 903 N	Hollows
Jarrah & Tuart	50 383 116 E, 6 398 404 N	Both trees with hollows
Tuart	50 383 125 E, 6 398 439 N	Whistling Kite nest (active) & hollows
Jarrah	50 383 142 E, 6 398 469 N	Hollows
Tuart	50 382 911 E, 6 398 550 N	Hollows
Jarrah	50 382 774 E, 6 398 226 N	Hollows
Jarrah	50 382 788 E, 6 398 228 N	Hollows
Jarrah	50 382 801 E, 6 398 212 N	Hollows
Tuart	50 382 938 E, 6 398 140 N	Hollows in partly dead tree
Jarrah	50 382 608 E, 6 397 758 N	Hollows
Jarrah	50 382 445 E, 6 397 712 N	Hollows
Jarrah	50 382 625 E, 6 397 575 N	Hollows

Table 5. Mammals likely to occur at the Coodanup site, indicating numbers caught during the survey in September 2005. See Appendix 1 for explanation of status. Int indicates introduced species.

Species		Sept 2005	Status
Tachyglossidae (echidnas)			
Echidna	*Tachyglossus aculeatus*		
Peramelidae (bandicoots)			
Quenda or Southern Brown Bandicoot	*Isoodon obesulus*	X	CS1
Tarsipedidae (honey possum)			
Honey Possum	*Tarsipes rostratus*		CS3
Phalangeridae (possums)			
Brush-tailed Possum	*Trichosurus vulpecula*		
Macropodidae (kangaroos and wallabies)			
Western Grey Kangaroo	*Macropus fuliginosus*	X	
Brush or Black-gloved Wallaby	*Macropus irma*		CS2
Mollosidae (mastiff bats)			
White-striped Bat	*Tadarida australis*	X	
	Mormopterus planiceps		
Vespertilionidae (vesper bats)			
Gould's Wattled Bat	*Chalinolobus gouldii*		
Chocolate Wattled Bat	*Chalinolobus morio*		
	Falsistrellus mackenziei		CS3
Southern Forest Bat	*Vespadelus (Eptesicus) regulus*		
Lesser Long-eared Bat	*Nyctophilus geoffroyi*		
Gould's Long-eared Bat	*Nyctophilus gouldii*		
Greater Long-eared Bat	*Nyctophilus timoriensis*		
Muridae (rats and mice)			
Rakali or Water-Rat	*Hydromys chrysogaster*		CS2
House Mouse	*Mus musculus*	35	Int
Black Rat	*Rattus rattus*	14	Int
Leporidae (rabbits and hares)			
Rabbit	*Oryctolagus cuniculus*	X	Int
Canidae (foxes and dogs)			
European Red Fox	*Vulpes vulpes*	X	Int
Felidae (cats)			
Feral Cat	*Felis catus*		Int

Table 6. Species believed to be extinct in the area.

Species		Status
Petroicidae (Australian robins)		
White-breasted Robin	*Eopsaltria georgiana*	CS3
Passeridae (finches)		
Red-eared Firetail	*Stagonopleura oculata*	CS3
Dasyuridae (dunnarts and allies)		
Brush-tailed Phascogale	*Phascogale tapoatafa*	CS2
Chuditch	*Dasyurus geoffroii*	CS1
dunnart	*Sminthopsis gilberti*	CS3
Pseudocheiridae (ring-tailed possums)		
Western Ring-tailed Possum	*Pseudochierus occidentalis*	CS1
Burramyidae (pygmy possums)		
Western Pygmy Possum	*Cercartetus concinnus*	CS3
Potoroidae (potoroos)		
Woylie	*Bettongia penicillata*	CS2
Boodie	*Bettongia lesueur*	CS1
Macropodidae (kangaroos and wallabies)		
Tammar	*Macropus eugeni*	CS1
Quokka	*Setonix brachyurus*	CS1
Muridae (rats and mice)		
Moodit or Southern Bush Rat	*Rattus fuscipes*	CS3
Noodji	*Pseudomys albocinereus*	CS3

Table 7. Numbers of captures on each trapping site, September/October 2005.

Species	1	2	3	4	5	6	7
Heleioporus eyrei	11	5	-	1	3	3	-
Limnodynastes dorsalis	-	2	1	-	-	1	-
Crinia sp.	-	-	1	-	-	-	-
Ctenotus australis	-	-	-	-	1	-	-
Hemiergis quadrilineata	1	1	13	1	1	-	-
Lerista distinguenda	-	-	1	1	-	-	-
Menetia greyii	2	-	1	-	-	-	-
Morethia obscura	-	-	-	-	-	2	-
Tiliqua rugosa	1	-	-	-	1	-	-
Parasuta gouldii	1	-	-	-	-	-	-
Mus musculus	-	6	4	3	10	3	7
Rattus rattus	-	-	6	-	-	-	8

DISCUSSION AND CONCLUSIONS

Although the September 2005 field survey confirmed the presence of only a small number of species, previous work in the area and the results of the desktop review make it possible to produce a list of fauna that occurs on the site with a fair degree of confidence. Familiarity with the fauna and the site also makes it possible to comment on significant features of the site, potential impacts and management strategies for fauna conservation.

The fauna of the site is likely to be rich because of the high quality of the vegetation, the sequence from riverine and riparian vegetation to upland woodland, and the site is large enough to support a wide range of species. Summary comments on each major taxonomic group appear below.

Invertebrates were not well surveyed but at least one species of conservation significance may be present in banksia woodland. There may also be species with restricted distributions, notably millipedes and isopods (slaters). The upland margins of riparian vegetation and upland vegetation with good quality understorey may be most important for these species.

Frogs are likely to be concentrated along the Serpentine River where freshwater accumulates in winter, but upland habitats are important for some species.

Most of the reptiles are dependent upon upland vegetation and some species require a large area of habitat to support a viable population. Reduction of habitat area will therefore lead to some local extinctions. The majority of species, however, persist in small areas of habitat.

The bird assemblage is likely to be very rich, with most important features of the avifauna being migratory waterbirds that use the Serpentine River and adjacent wetlands, nesting by birds of prey such as the Osprey and White-bellied Sea-Eagle, foraging by black-cockatoos, and the presence of a suite of small insectivores that disappear during urbanisation (particularly fairy-wrens and thornbills). Habitat area, habitat condition and the presence of banksias and net trees are therefore important for the avifauna.

The mammal fauna is expected to be poor, but significant species present or likely to be present are the Quenda and Rakali (Water-Rat), and possibly also the Western False Pipistrelle. Respectively, these rely on dense understorey and riparian vegetation, wetland habitats and trees with hollows/crevices.

From the above comments, key features of the site for fauna can be summarised as follows:

- the riparian vegetation and areas of seasonal inundation (specific fauna, linkage along the Serpentine River);
- generally good condition of understorey vegetation (supports wide range of fauna see below);

- scattered habitat trees, being large and providing shelter and nest sites, including hollows (including Tuarts in otherwise degraded northern area);
- the largest tract of native vegetation remaining in the general area, making it a local refuge for fauna;
- the site supports a sequence of fauna habitats from wetland through riparian vegetation to upland vegetation.
- weak linkage to fauna habitats in Creery Nature Reserve and the area is isolated for non-flying fauna by the Serpentine River.

With respect to the proposed development, key actions for fauna conservation are:

- Retain representative vegetation so that the catenary of vegetation and habitat types from shoreline of the Serpentine River to the highest point in the local landscape is protected.
- Protected habitat should be compact in shape to minimise edge effects.
- Riparian vegetation along the Serpentine River should be protected as this secures a wildlife corridor along the river, and serves to protect the river. Public Open Space is already indicated along the river, but protection of habitat needs to be emphasised. Public access to river should be restricted to small nodes, preferably at locations where the vegetation is already degraded.
- Identify and retain specific habitat trees, including nest trees such as that used by the Osprey and White-bellied Sea-Eagle.
- Retain elements of native vegetation, such as trees, during clearing, so that these can be incorporated into the urban design where possible.
- Given that the intention is to retain large areas for landscape and wildlife conservation, a reasonable cat policy is needed. At the least, this should consist of a commitment to keep cats in at night.

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Appendix 1.

Categories used in the assessment of conservation status.

IUCN categories (based on review by Mace and Stuart 1994) **as used for the Environmental Protection and Biodiversity Conservation (EPBC) Act and the WA Wildlife Conservation Act.**

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.

Least Concern. Taxa that are not Threatened.

Schedules used in the WA Wildlife Conservation Act.

Schedule 1. Rare and Likely to become Extinct.
Schedule 2. Extinct.
Schedule 3. Migratory species listed under international treaties.
Schedule 4. Other Specially Protected Fauna.

WA Department of Conservation and Land Management Priority species (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. Taxa which are considered to have been adequately surveyed, or for which sufficient knowledge is available, and which are considered not currently threatened or in need of special protection, but could be if present circumstances change.

Priority 5. Taxa in need of monitoring. Taxa which are 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 (IUCN Conservation Dependent).

TERRESTRIAL ECOSYSTEMS BRANCH
POLICY AND COORDINATION DIVISION
Memorandum

ATTENTION:	Glen McLeod-Thorpe
FROM:	Bridget Hyder/John Dell/Mark Brundrett
DATE:	7 March 2006
SUBJECT:	ODP Lot 440 Wanjeep Street Coodanup
FILE NO.:	

This whole site is regionally significant for flora, vegetation and fauna and provides the only opportunity to conserve a substantial area of upland vegetation in the City of Mandurah.

Flora and vegetation

- The upland vegetation on the site is more characteristic of Karrakatta Central and South rather than the Yoongarillup Vegetation Complex as identified in Heddle *et al.* (1980) and the report. Only 2.5% of the Karrakatta Central and South vegetation complex is protected on the Swan Coastal Plain making this site regionally significant. This fits with the criteria for representation of Ecological Communities as identified in Guidance 10. The Vegetation Complex mapping shown in Figure 8 was not expected to be accurate at such a fine scale.
- Only results of a preliminary flora survey were presented and limitations to this survey are clearly stated in the survey report. In particular, it was recommended that further surveys to identify late flowering species, such as annuals and rare flora be undertaken. The Vegetation and Flora Survey Report was also recommended that statistical analysis of flora data be undertaken once comprehensive plot-based data was obtained after revisiting sites. It is not clear if follow up survey occurred and the data analysis required to assign vegetation to floristic communities was not presented.
- Note that only 29% of Karrakatta Central and South vegetation complex remains which is below the 30% retention target. *Bush Forever* was unable to protect 10% of Karrakatta Central and South and stated that additional areas would be identified and protected outside the Metropolitan region.
- The site is approximately 52 hectares and represents the largest piece of upland bushland remaining in the Mandurah area and is contiguous with extensive wetland and riparian environments in the Peel Regional Park. It represents an important refuge for native fauna. The site has particular value having both wetland and upland vegetation. Size is of key importance in the long-term viability of the site it is therefore important to retain the current extent of the bushland. This also meets the criteria for the representation of ecological communities in Guidance 10.
- Only two upland remnants of any size are protected on the Serpentine River (Paganoni Swamp and Lowlands). None are protected in Mandurah. Consequently this area has very high conservation significance in this local area and should be considered as the local equivalent of Kings Park.
- Vegetation condition of the area is very good overall. There also are areas of high weed cover, but it is probably inappropriate to label them as completely degraded as the tree canopy appears to be intact. This provides an excellent opportunity to conserve bushland that can be sustainably managed with minimal restoration inputs.
- It is possible that the site supports two DRF species *Caladenia huegelii* and *Drakaea elastica.* The timing of the survey was inappropriate for determining the presence of *Drakaea elastica. Caladenia huegelii* was found on the site previously but was not found in flower during the survey. We recommend that CALM staff with expertise identifying rare orchids attend subsequent surveys. It should be noted that *Drakaea elastica* has a unique leaf that can be accurately identified even on non-flowering plants.

- The Area should also be considered to have scientific and educational value due to its location close to schools and a community college.

Fauna

- Most of the reptile species present or likely to be present on the site are dependent on upland vegetation and some species require a large area of habitat to support a viable population. Reduction of the upland habitat will therefore lead to some local extinctions as identified in the fauna report.
- Some of the reptiles recorded by Bamford, e.g. *Parasuta gouldii*, *Lerista distinguenda* are regionally significant for coastal parts of the Swan Coastal Plain. Other species suggested by Bamford as likely to be present, e.g. *Varanus rosenbergi, Ctenotus labillardieri, Lerista lineata* and *Neelaps calanotus* would also be regionally significant. Two species (*Lerista lineata* and *Neelaps calanotus*) are also listed by CALM as Priority 3 species which are conservation significant species with limited distributions confined to the Coastal Plain.
- The site meets the Rarity criteria because of its important feeding habitat for threatened Carnaby's Cockatoo and at least eight bird species which are listed in Bush Forever as conservation significant species on the Coastal Plain. Upland areas are especially important in this regard.
- The Banksia woodland on the site provides the largest remaining area of Carnaby's Cockatoo (endangered under the EPBC Act) feeding habitat close to Mandurah. The Schedule 1 Threatened Forest Red-tailed Black Cockatoo has been recorded breeding within 5kms of the site and may potentially breed in the large tree hollows on the site.
- The site is likely to support 13 species of birds that were identified in *Bush Forever* as declining on the Swan Coastal Plain, of these 8 were recorded during the fauna survey (during weather that was unfavourable for bird survey). This reflects the large area of upland woodland, which is predominantly low open forest (of *Eucalyptus marginata*, *Banksia attenuata, B. menziesii* and *Allocasuarina fraseriana*) in good to excellent condition.
- On the basis of the limited survey for fauna the site is likely to meet the Diversity Criteria for regional significance.
- The site is part of a north south regional ecological linkage along the Serpentine River.
- In addition the City of Mandurah have identified this site as the highest priority site for conservation, from a community perspective and landscape value within the City of Mandurah.

It is understood that a Western Ringtail Possum was reported recently from bushland with relatively close vicinity of this site. If this is correct the potential exists for this area to support the northern-most population of Western Ringtail Possum which is listed as Vulnerable under the EPBC Act.

* % KC+S Peel Region Scheme URBAN Area.

* Check KC+S Hills Head - Research two letting go as Urban

* GIS output Peel Region Scheme
  - KC+S Original / Current / ~~Protected Extent~~ ('What is upzoned')
  - Urban Zone
  - What lost in last 3 years. overlain against upzoned

For

Lot numbers and Heddle Vegetation complex Mandurah north of Peel Inlet

GENERAL LEGEND

Land Owner Type and Lot Numbers

0 700 1400 2100 Meters

(Approximate when reproduced at A4)

Datum: GDA 1994 - Projection MGA Zone 50
Note: the data in this map have not been projected, this may result in geometric distortion or measurement inaccuracies.

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

TERRESTRIAL ECOSYSTEMS BRANCH
POLICY AND COORDINATION DIVISION
Memorandum

ATTENTION:	Gary Whisson
FROM:	Bridget Hyder
DATE:	3 March 2006
SUBJECT:	ODP Lot 440 Wanjeep Street Coodanup
FILE NO.:	

This whole site is regionally significant.

- The upland vegetation on the site is more characteristic of Karrakatta Central and South rather than the Yoongarillup Vegetation Complex as identified in Heddle *et al.* (1980) and the report. Only 2.5% of the Karrakatta Central and South vegetation complex is protected on the Swan Coastal Plain making this site regionally significant. This fits with the criteria for representation of Ecological Communities as identified in Guidance 10.
- Note that only 29% of Karrakatta Central and South vegetation complex remains which is below the 30% retention target. *Bush Forever* was unable to protect 10% of Karrakatta Central and South and stated that additional areas would be identified and protected outside the Metropolitan region.
- The site is approximately 52 hectares and represents the largest piece of upland bushland remaining in the Mandurah area. It represents an important refuge for native fauna. The site has particular value having both wetland and upland vegetation. Size is of key importance in the long term viability of the site it is therefore important to retain the current extent of the bushland. This also meets the criteria for the representation of ecological communities in Guidance 10.
- It is possible that the site supports two DRF species *Caladenia huegelii* and *Drakaea elastica.* The timing of the survey was inappropriate for determining the presence of *Drakaea elastica*. *Caladenia huegelii* was found on the site previously but was not found in flower during the survey.
- Only two upland remnants of any size are protected on the Serpentine River (Paganoni Swamp and Lowlands). None are protected in Mandurah.
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Banksia attenuata, B.menziesii and *Allocasuarina fraseriana*) in good to excellent condition.

- The site meets the Rarity criteria because of its important feeding habitat for threatened Carnaby's Cockatoo and at least eight bird species which are listed in Bush Forever as conservation significant species on the Coastal Plain.
- On the basis of the limited survey for fauna the site is likely to meet the Diversity Criteria for regional significance.
- The site is part of a north south regional ecological linkage along the Serpentine River.
- In addition the City of Mandurah have identified this site as the highest priority site for conservation, from a community perspective and landscape value within the City of Mandurah.

TERRESTRIAL ECOSYSTEMS BRANCH
POLICY AND COORDINATION DIVISION
Memorandum

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- The site is approximately 52 hectares and represents the largest piece of upland bushland remaining in the Mandurah area. It represents an important refuge for native fauna. The site has particular value having both wetland and upland vegetation. Size is of key importance in the long-term viability of the site it is therefore important to retain the current extent of the bushland. This also meets the criteria for the representation of ecological communities in Guidance 10.
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COODANUP ODP

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- Only two upland remnants of any size are protected on the Serpentine River (Paganoni Swamp and Lowlands) Non are protected in Mandurah.
- Most of the reptile species are dependent on upland vegetation and some species require a large area of habitat to support a viable population. Reduction of the upland habitat will therefore lead to some local extinctions as identified in the fauna report.
- Some of the reptiles recorded by Bamford eg *Parasuta gouldii*, *Lerista distinguenda* are regionally significant for coastal parts of the Swan Coastal Plain. Other species suggested by Bamford as likely to be present eg. *Varanus rosenbergi, Ctenotus labillardieri, Lerista lineata* and *Neelaps calanotus* would also be regionally significant.
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- The site is likely to support 13 species of birds that were identified in *Bush Forever* as declining on the Swan Coastal Plain, of these 8 were recorded during the fauna survey (during weather that was unfavourable for bird survey). This reflects the large area of upland woodland, which is predominantly low open forest (of Eucalyptus marginata, Banksia attenuata, B. menziesii and Allocasuarina fraseriana) in good to excellent condition.
- The site meets the Rarity criteria because of its important feeding habitat for threatened Carnaby's Cockatoo and at least eight bird species which are listed in Bush Forever as conservation significant species on the Coastal Plain.

- On the basis of the limited survey for fauna the site is likely to meet the Diversity Criteria for regional significance.
- The site is part of a north south regional ecological linkage along the Serpentine River.
- In addition the City of Mandurah have identified this site as the highest priority site for conservation, from a community perspective and landscape value within the City of Mandurah.

- EIA Advice
- Coodanup ODP Mandurah

TERRESTRIAL ECOSYSTEMS BRANCH
POLICY AND COORDINATION DIVISION
Memorandum

ATTENTION:	Gary Whisson Glen McLeod-Thorpe
FROM:	Bridget Hyder
DATE:	3 March 2006
SUBJECT:	ODP Lot 440 Wanjeep Street Coodanup
FILE NO.:	

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- The Banksia woodland on the site provides the largest remaining area of Carnaby's Cockatoo (endangered under the EPBC Act) feeding habitat close to Mandurah. Carnaby's Cockatoo has been recorded breeding within 5kms of the site and may potentially breed in the large tree hollows on the site.
- The site is likely to support 13 species of birds that were identified in *Bush Forever* as declining on the Swan Coastal Plain, of these 8 were recorded during the fauna survey (during weather that was unfavourable for bird survey). This reflects the large area of upland woodland, which is predominantly low open forest (of Eucalyptus marginata, Banksia attenuata, B.menziesii and Allocasuarina fraseriana) in good to excellent condition.
- The site meets the Rarity criteria because of its important feeding habitat for threatened Carnaby's Cockatoo and at least eight bird species which are listed in Bush Forever as conservation significant species on the Coastal Plain.

Vegetation condition · very good overall. even areas with weeds have good overstorey

- On the basis of the limited survey for fauna the site is likely to meet the Diversity Criteria for regional significance.
- The site is part of a north south regional ecological linkage along the Serpentine River.
- In addition the City of Mandurah have identified this site as the highest priority site for conservation, from a community perspective and landscape value within the City of Mandurah.

- The Area should also be considered to have scientific and educational value du to its location close to schools and a community college.

Fauna

- Most of the reptile species present or likely to be present on the site are dependent on upland vegetation and some species require a large area of habitat to support a viable population. Reduction of the upland habitat will therefore lead to some local extinctions as identified in the fauna report.
- Some of the reptiles recorded by Bamford, e.g. *Parasuta gouldii*, *Lerista distinguenda* are regionally significant for coastal parts of the Swan Coastal Plain. Other species suggested by Bamford as likely to be present, e.g. *Varanus rosenbergi, Ctenotus labillardieri, Lerista lineata* and *Neelaps calanotus* would also be regionally significant. Two species (*Lerista lineata* and *Neelaps calanotus*) are also listed by CALM as Priority 3 species which are conservation significant species with limited distributions confined to the Coastal Plain.
- The Banksia woodland on the site provides the largest remaining area of Carnaby's Cockatoo (endangered under the EPBC Act) feeding habitat close to Mandurah. The Schedule 1 Threatened Forest Red-tailed Black Cockatoo has been recorded breeding within 5kms of the site and may potentially breed in the large tree hollows on the site.
- The site is likely to support 13 species of birds that were identified in *Bush Forever* as declining on the Swan Coastal Plain, of these 8 were recorded during the fauna survey (during weather that was unfavourable for bird survey). This reflects the large area of upland woodland, which is predominantly low open forest (of *Eucalyptus marginata, Banksia attenuata, B.menziesii* and *Allocasuarina fraseriana*) in good to excellent condition.
- The site meets the Rarity criteria because of its important feeding habitat for threatened Carnaby's Cockatoo and at least eight bird species which are listed in Bush Forever as conservation significant species on the Coastal Plain. Upland areas are especially important in this regard.
- On the basis of the limited survey for fauna the site is likely to meet the Diversity Criteria for regional significance.
- The site is part of a north south regional ecological linkage along the Serpentine River.
- In addition the City of Mandurah have identified this site as the highest priority site for conservation, from a community perspective and landscape value within the City of Mandurah.

· It is understood (~~Pers Com City of Mandurah~~) that a Ringtail Possum was relatively recorded recently from bushland with relatively close vicinity of this site. (If this is correct) the potential exist for this area to support the northernmost population of Western Ringtail Possum (Vulnerable under the EPBC Act)