TRANSMITTAL

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Name, Company and Address: Department of Water and Environmental Regulation
Native Vegetation Branch
Locked Bag 33, CLOISTERS SQUARE
PERTH WA 6850

Date: Thursday, 16 November 2017

Our Ref: EEL11266.005

From: John Halleen

Subject: Cleaning Permit Application – Lot 600 Lakes Road, Stake Hill

☒ For Your Information ☒ As Requested

Description	Qty
Hardcopy	1

☐ Courier ☒ Post ☐ Hand Delivered ☐ Collected

Remarks

It is the responsibility of the recipient to either destroy or mark as superseded any superseded versions of the accompanying documents.

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Our Ref: EEL11266.005
Date: 8 November 2017

E-mail: giles.glasson@rpsgroup.com.au
Direct Dial: (08) 9288 0834

Department of Water and Environment Regulation
Locked Bag 33
Cloisters Square
PERTH WA 6850

Dear Sir / Madam

Re: Clearing Permit Application – Lot 600 Lakes Road, Stake Hill

Please find attached a purpose permit clearing application to clear a total of approximately 3.34 hectares (ha) of native vegetation within Lot 600 Lakes Road, Stake Hill (the site) to facilitate an earthworks program (Appendix 1).

Background

The site is located approximately 50 kilometres (km) south-east of the Perth Central Business District within the Shire of Murray (Figure 1). The site has been used for cattle grazing, with most of the native vegetative understory being historically cleared to create paddocks and dams to facilitate this agricultural land use.

Supporting the above purpose permit clearing application, the following figures and documents have been provided:

- Figure 1: Site Location and Clearing Application Area
- Figure 2: Proposed Subdivision and Staging Plan
- Figure 3: Vegetation Type and Condition
- Appendix 1: Application for a Clearing Permit (Purpose Permit) and Form C3
- Appendix 2: Environmental Assessment Report, Lot 600 Lakes Road, Stake Hill – Local Structure Plan
- Appendix 3: Certificate of Title
- Shapefile Data – Compact Disc.

The owner of the site (LandCorp) is proposing to implement an earthworks program, prior to receiving subdivision approval from the Western Australian Planning Commission (WAPC), which will result in the clearing of remnant native trees.

A summary of the purpose permit clearing application is provided below in Table 1.

Table 1: Clearing Proposal Summary

Location	Portion of Lot 600 Lakes Road, Nambeelup
Application Area	26.73 ha
Vegetation Extent	3.34 ha
Timing	Clearing will occur as one action (including Stages 1A and 2A and portions of Stages 3 and 4) during the 2018 calendar year (Figure 2)
Clearing Method	The native vegetation will be cleared mechanically
Purpose of Clearing	To facilitate an earthworks program
Vegetation Proposed to be Cleared	■ Approximately 3.04 ha containing Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *M. preissiana* to 12 metres (m) with occasional *Banksia littoralis* over grassland / herbland / sedgeland to scattered grasses / herbs / sedges dominated by weed species in "Degraded" condition (Figure 3) ■ Approximately 0.30 ha containing Scattered Trees of *M. rhaphiophylla* and *M. preissiana* to 12 m over pasture species with scattered patches of *Juncus pallidus* 1.3 m in "Completely Degraded" condition (Figure 3)

Planning Context

The site is the first stage of LandCorp's Peel Business Park industrial development for which significant planning and environmental assessment has been undertaken.

A District Structure Plan (DSP) for the Nambeelup Industrial Area was prepared and endorsed by the WAPC in April 2016. Under the DSP, the site is designated "Industrial", "Open Space" (the wetland area) and "Roads".

The site was rezoned by the Peel Region Scheme Minor Amendment 043-57 from "Rural" to "Industrial". In accordance with Section 48A of the *Environmental Protection Act 1986*, the proposed rezoning of the site was referred to the Environmental Protection Authority (EPA) on 01 December 2016. The Chairman of the EPA determined: Referral Examined, Preliminary Investigations and Inquiries Conducted. Scheme Amendment Not to be Assessed Under Part IV of EP Act. No Advice Given. (Not Appealable) on 17 December 2016.

Amendment No. 301 to rezone the site under the Shire of Murray's (SoM) Town Planning Scheme No. 4 is currently "in-action", with the SoM Council voting unanimously to support the amendment on 27 April 2017.

An Environmental Assessment Report (EAR) was prepared to inform and underpin the proposed Local Structure Plan (LSP) for site (Appendix 2). The proposed LSP and associated supporting documentation, including the EAR, is currently being advertised for public comment by the SoM.

As part of the preparation of the LSP, consultation was undertaken with the SoM, Department of Parks and Wildlife (DPaW) and Office of the Environmental Protection Authority (OEPA) to confirm the spatial extent of the wetland buffers required to protect the existing environmental values of the two Resource Enhancement Wetlands (REWs) within the site. The SoM, as the long-term manager of the REWs and open space areas, supported a 30 m wetland buffer and proposed management measures to protect the environmental values of the two REWs. DPaW advised that the department would defer to the SoM to advise on an acceptable buffer width, whilst the OEPA considered that a 30 m wetland buffer to be adequate. Details of the consultation process and copies of the DPaW and OEPA correspondence are provided within Appendix 2.

To kick start the Peel Business Park industrial development, LandCorp is proposing to implement an earthworks program within Stages 1A and 2A and portions of Stages 3 and 4 (Figure 2). The implementation of the earthworks program will be subject to the SoM's approval of a Development Application for the works. A Development Application for the earthworks program has been prepared and is currently pending approval with the SoM.

Clearing of native vegetation is generally not assessed by local government authorities as part of their assessment and approval process for Development Applications. Therefore this clearing permit application has been prepared to facilitate the clearing of native trees by the earthworks program within the SoM approved development area[1].

Vegetation and Flora

Coffey Environments undertook a Level 2 flora and vegetation survey undertaken for Lots 91[2], 92 and 604, Nambeelup[3], which is consistent with the EPA's Guidance Statement No. 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia*.

The findings of the survey are summarised as follows:

- No Threatened flora species listed under the *Wildlife Conservation Act 1950* (WC Act) or Priority listed flora species or any species protected under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) were recorded within the site.
- The vegetation units described and mapped within the site were
  - Open Forest to Open Woodland of *E. rudis* subsp. *rudis*, *M. rhaphiophylla* and *M. preissiana* to 12 m with occasional *B. littoralis* over grassland / herbland / sedgeland to scattered grasses / herbs / sedges dominated by weed species
  - Scattered Trees of *M. rhaphiophylla* and *M. preissiana* to 12 m over pasture species with scattered patches of *J. pallidus* 1.3 m.
- The vegetation condition within the site ranged from "Degraded" to "Completely Degraded".
- No Threatened Ecological Communities (TECs) or Priority Ecological Communities (PECs) were recorded within the site.

Assessment Against the 10 Clearing Principles

Table 2 below provides an assessment of the proposed clearing activities against the "10 Clearing Principles" as outlined in Schedule 5 of the Environmental Protection (Clearing of Native Vegetation) Regulations 2004 to determine whether the proposed clearing is at variance to the Principles.

---

[1] The area subject to the Development Application has been identified in Figures 1 and 3 as the Clearing Application Area.
[2] Lot 91 Nambeelup is now known as Lot 600 Lakes Road, Stake Hill.
[3] This report is included as Appendix 3 in Environmental Assessment Report, Lot 600 Lakes Road, Stake Hill – Local Structure Plan (Appendix 2).

Table 2: Assessment of the Site against the 10 Clearing Principles

Principle	Assessment	Outcome
Native vegetation should not be cleared if it comprises a high level of biological diversity	The majority of the clearing application area has been previously cleared to facilitate cattle grazing and the remaining native vegetation is in "Degraded" to "Completely Degraded" condition (Appendix 2).	The proposal is not at variance with the Principle
Native vegetation should not be cleared if it comprises the whole or part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous Western Australia	The clearing application area is not considered to represent significant habitat for native fauna species (Appendix 2).	The proposal is not at variance with the Principle
Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No Threatened flora species listed under the WC Act or Priority listed flora species or any species protected under the EPBC Act were recorded within the clearing application area (Appendix 2).	The proposal is not at variance with the Principle
Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community	No TECs or PECs were recorded within the clearing application area (Appendix 2).	The proposal is not at variance with the Principle
Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared	The native vegetation unit is identified as belonging to Heddle's Bassendean Complex – Central and South complex. This vegetation community has approximately 27.7% of its Pre-European extent remaining on the Swan Coastal Plain[4]. Given that the vegetation within the clearing application area has been previously cleared to facilitate cattle grazing, and that the remaining native vegetation is in "Degraded" to "Completely Degraded" condition, it is not considered to be of conservation significance.	The proposal is not at variance with the Principle
Native vegetation should not be cleared if it is growing in or in association with a watercourse or wetland.	The clearing application area is not within the mapped extent of the REWs or their agreed buffers.	The proposal is not at variance with the Principle
Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	Due to the degraded to completely degraded condition of the native vegetation within the site, it is no considered that the clearing of the native trees within the clearing application area would cause appreciable land degradation.	The proposal is not at variance with the Principle
Native vegetation should not be cleared if the clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	The clearing application area is not adjacent to or nearby a conservation area.	The proposal is not at variance with the Principle

[4] Perth Biodiversity Project. 2013. 2013 Native Vegetation extent by Vegetation complexes on the Swan Coastal Plain south of Moore River. Accessed 25 August 2017 http://pbp.walga.asn.au/Portals/1/Templates/docs/SCP%202013%20remnant%20veg.pdf

Principle	Assessment	Outcome
Native vegetation should not be cleared if the clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water	No natural surface water features exist within the site. A Local Water Management Strategy has been prepared to support the LPS to maintain the quality of groundwater so that its environmental values are protected. An Urban Water Management Plan will subsequently be prepared at subdivision stage.	The proposal is not at variance with the Principle
Native vegetation should not be cleared if the clearing of the vegetation is likely to cause, or exacerbate, the intensity of flooding.	A Local Water Management Strategy has been prepared to support the LPS to maintain the hydrological regimes so that environmental values are protected. An Urban Water Management Plan will subsequently be prepared at subdivision stage.	The proposal is not at variance with the Principle

Concluding Remarks

The clearing application area has been historically impacted. The majority of the native vegetation has been previously cleared to create paddocks and dams to facilitate cattle grazing. The native vegetation proposed to be cleared primarily comprises of isolated native trees.

The implementation of the earthworks program will be subject to the SoM's approval of a Development Application for the works. A Development Application for the earthworks program has been prepared and is currently pending approval with the SoM.

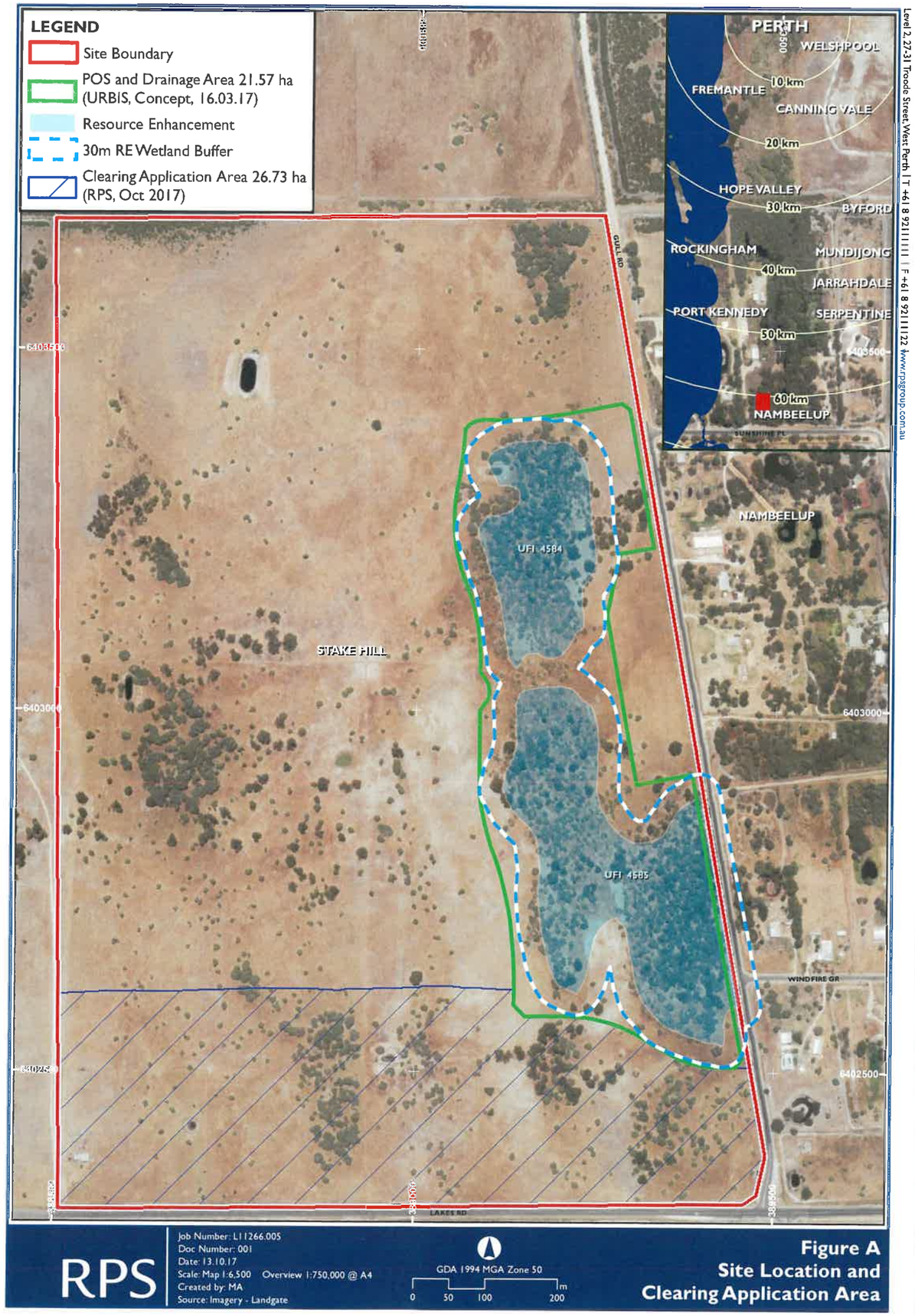
We trust this information is sufficient for your purposes, however should you require further details or clarification, please do not hesitate to contact the writer by telephone.

Yours sincerely
RPS

Giles Glasson
Managing Scientist

enc: Figures
Appendix 1 Application for a Clearing Permit (Purpose Permit) and Form C3
Appendix 2 Environmental Assessment Report, Lot 600 Lakes Road, Stake Hill – Local Structure Plan
Appendix 3 Certificate of Title

Figures



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LEGEND:

- SUBJECT SITE
- AGRI-INNOVATION PRECINCT
- INDUSTRIAL
- COMMERCIAL

READHEADS ROAD

GULL ROAD

LAKES ROAD

46.97HA

Stage 1B

Stage 2B

2.43HA

Stage 4

0.40HA 0.40HA 0.40HA 0.40HA 0.40HA 0.69HA

0.54HA 0.51HA

0.54HA 0.51HA

0.56HA 0.56HA

0.96HA

0.46HA

0.41HA

0.42HA

1.05HA

Stage 3

0.92HA

115

90

2

1.04HA

1

2.08HA

3

1.04HA

0.73HA 0.54HA

0.56HA 0.52HA

92.5

55

6 0.51HA

7 0.51HA

5 0.51HA

8 0.51HA

4 1.03HA

9 1.05HA

10

2.03HA

122.5

160

1.62HA

1.49HA

1.84HA

Stage 2A

Stage 1A

0.27HA 0.27HA 0.27HA 0.27HA 0.27HA 0.27HA 0.27HA 0.27HA

2.02HA

1.34HA

RPS

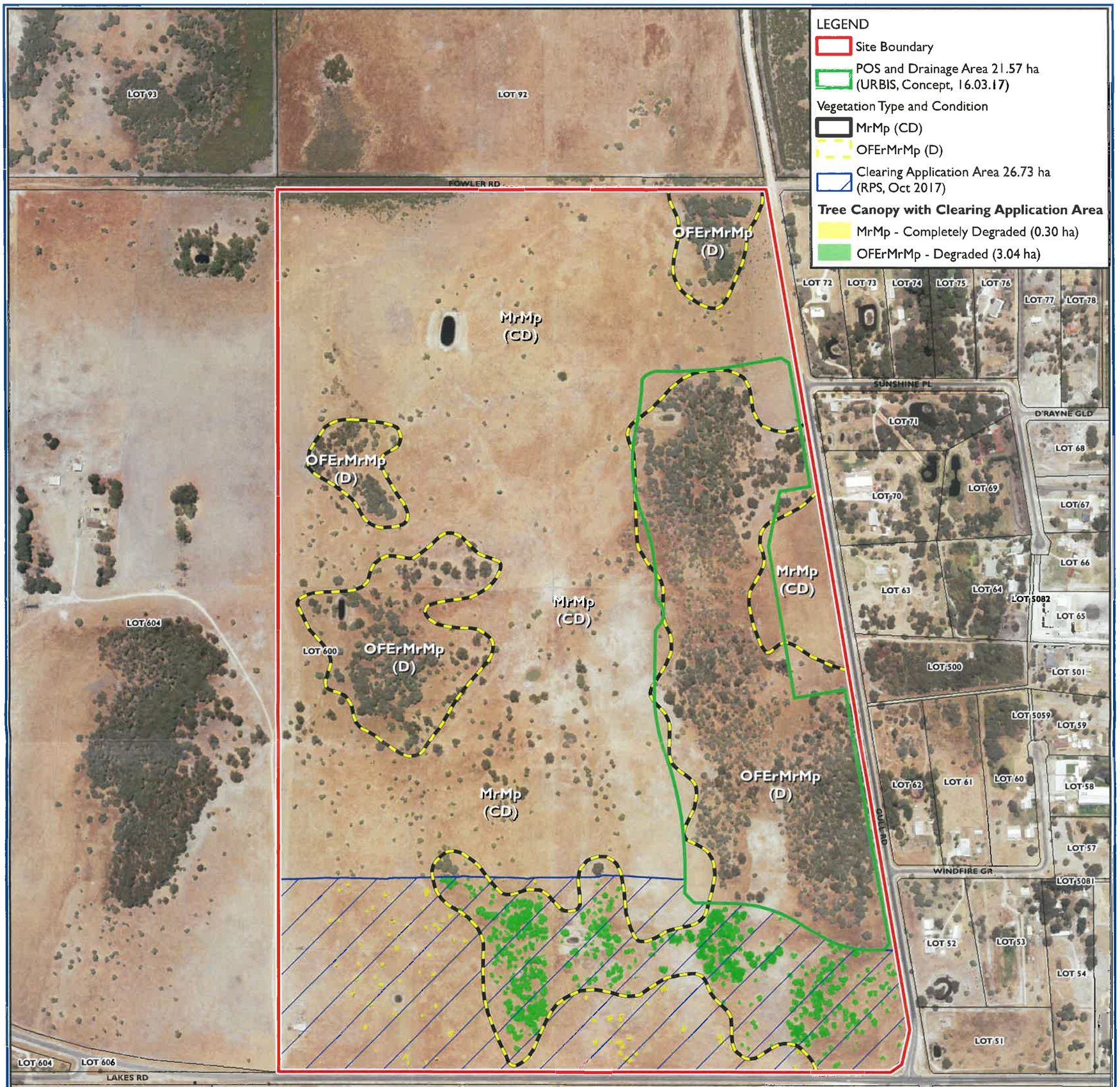
Job Number: L11266.005
Doc Number: 002
Date: 22.08.17
Scale: 1: 5,000 @ A3
Created by: MA
Source: Subdivision Concept (PA1332 20 Rev2) - URBIS, 17.05.17.

GDA 1994 MGA Zone 50

0 125 250 m

Figure B

Proposed Subdivision and Staging Plan



VEGETATION CONDITION LEGEND (SOURCE: *BUSH FOREVER* Govt. of W.A., 2000)

P - Pristine
Pristine or nearly so, no obvious signs of disturbance.

E - Excellent
Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.

VG - 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.

G - Good
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

D - 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.

CD - 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.

Vegetation Type

OFErMrMp
Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12m with occasional *Banksia littoralis* over Grassland/Herbland/Sedgeland to Scattered Grasses/Herbs/Sedges dominated by weed species.

MrMp
Scattered Trees of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12m over pasture species with scattered patches of *Juncus pallidus* to 1.3m.

RPS

Job Number: L11266.005
Doc No: 003
Date: 07.11.17
Scale: 1:6,000 @ A3
Drafted by: MA
Source: Cadastre, & Orthophoto - Landgate, 2017. Vegetation Mapping - Coffey 2009.

0 25 50 100 150 200 m

Figure C

Vegetation Type and Condition

Appendix 1

Application for a Clearing Permit (Purpose Permit) and Form C3

GOVERNMENT OF WESTERN AUSTRALIA

Department of Water and Environmental Regulation – Department of Mines, Industry Regulation and Safety

Application for a clearing permit (purpose permit)

Environmental Protection Act 1986 s 51E

FORM C2

Clearing of native vegetation is prohibited in Western Australia except where a clearing permit has been granted or an exemption applies. A person who causes or allows unauthorised clearing commits an offence.

CPS No.

Date stamp

Part 1 Assessment under the EPBC bilateral agreement

The native vegetation clearing processes under Part V of the *Environmental Protection Act 1986* (EP Act) have been accredited by the Commonwealth of Australia under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and can be assessed under an assessment bilateral agreement.

To be assessed under the assessment bilateral agreement, the proposed clearing action must be referred to the Commonwealth under the EPBC Act prior to submitting this application form and Annex C7 must also be completed.

For further information see Annex C7 and *A guide to native vegetation clearing processes under the assessment bilateral agreement* available at www.dwer.wa.gov.au.

Do you want your proposed clearing action assessed in accordance with, or under, an EPBC Act Accredited Process such as the assessment bilateral agreement?

☐ Yes ☒ No Proceed to Part 2

Has the proposed clearing action been referred to the Commonwealth of Australia under the EPBC Act?

☐ Yes EPBC Number

☐ No It cannot be assessed under an Accredited Process until it has been referred to the Commonwealth. Proceed to Part 2.

Has a decision been made under the EPBC Act as to whether or not the proposed clearing action is a controlled action?

☐ Yes ☐ No Proceed to Part 2

Is the proposed clearing action a controlled action under the EPBC Act?

☐ No It cannot be assessed under an Accredited Process, proceed to Part 2

☐ Yes Complete and attach the requirements of Annex C7 to this completed form

List the controlling provisions identified in the notification of the controlled action decision

☐ Annex C7 is complete and the required supporting information is attached

Part 2 Land details

The location of the land where clearing is proposed must be accurately described.

FILE REFERENCE

Land description: volume and folio number, lot or location number(s), Crown lease or reserve number, pastoral lease number or mining tenement number of all properties.

Lot 600 On Deposited Plan 57701

Local government area

Shire of Murray

Part 3 Proposal

An aerial photograph or map with a north arrow must be attached, clearly marking the area proposed to be cleared

or

if you have the facilities, a digital map on CDROM of the area to clear as an ESRI shapefile with the following properties:

- Geometry type: polygon shape
- Coordinate system: GDA 1994 (Geographic latitude/longitude)
- Datum: GDA 1994 (Geocentric Datum of Australia 1994).

Total area of clearing proposed (hectares)

3.34 ha

Proposed method of clearing or final land use

The native vegetation will be cleared mechanically

Period within which clearing is proposed to be undertaken, e.g. May 2018– June 2023

Clearing will occur as one action (including Stages 1A and 2A and portions of Stages 3 and 4) during the 2018 calendar year

Purpose of clearing

To facilitate an earthworks program

Has this clearing application or any related matter been referred to the Environmental Protection Authority (EPA) [X] Yes [ ] No

Part 4 Applicant

To apply for a permit you must either be:
- the landowner
  or
- have the authority of the landowner to access the land and undertake the clearing.

Are you applying as an individual, a company or an incorporated body? Enter details for one only (please print).

Western Australian Land Authority trading as LandCorp

Ownership of land

A landowner can be:
- a person who holds the certificate of title
- a person who is the lessee of Crown land
  or
- a public authority that is responsible for care of the land.

Form of ownership:

- [X] Certificate of title (please attach a copy of the certificate and all associated encumbrances with the application, available from the Western Australian Land Information Authority – Landgate)
- [ ] Pastoral lease (please attach a copy of the lease and all associated encumbrances with the application)
- [ ] Mining lease
- [ ] Public authority that has care, control or management of the land
- [ ] Other form of lease, land tenure or specific arrangement. Please state:

Authority to access land

Please specify the applicant's authority to access land to be cleared. For example, a letter from Department of Planning, a statutory power or letter of authority from the landowner.

Note: the letter of authority must explicitly state the applicant has authority to clear on the said land.

State nature of authority to access land (please attach copy of authority)

Owner

Proposed permit holder details

*If applying as a company or incorporated body, please also supply the registered business office address.

Given names, family name and title (Mr, Mrs, Ms, etc.)

Brenton Pham

Position title/Company

Development Manager/LandCorp

Postal/Business address* (for future correspondence)

Level 6, 40 The Esplanade
PERTH WA 6000

Fixed telephone number

(08) 9482 7818

Mobile telephone number

0422 702 329

Fax number

(08) 9481 0861

Email address

Brenton.Pham@landcorp.com.au

Contact details

[X] Contact details are the same as above **or:**

Person with whom the Department of Water and Environmental Regulation or Department of Mines, Industry Regulation and Safety should liaise concerning the clearing application.

*If applying as a company or incorporated body, please also supply the registered business office address.

Given names, family name and title (Mr, Mrs, Ms, etc.): Mr Giles Glasson

Position title/Company: Managing Scientist/RPS

Postal/Business address*: Level 2, 27-33 Troode Street
WEST PERTH WA 6005

Fixed telephone number: (08) 9288 0834

Mobile telephone number: 0487 444 094

Fax number: (08) 9211 1122

Email address: giles.glasson@rpsgroup.com.au

Part 5 Declaration and signature

For your application to be accepted, it must be signed either on behalf of the company or as an individual.

By signing this form you are declaring that the statements on this form are true and correct.

The department in accepting this form accepts you are a person duly authorised to sign for and on behalf of the body corporate in applying for and in holding a permit.

Knowingly providing false or misleading information is an offence under section 112 of the *Environmental Protection Act 1986* and may incur a penalty of up to $50,000.

Please indicate if you are signing as an individual or a company:

[ ] **An individual**. If an individual landowner is applying, **all landowners** must sign this form.

[X] **A company**. A person duly authorised to sign for and on behalf of the body corporate must sign this form. A company must be a legal entity and provide an Australian Company Number (ACN). Please note Australian Business Number (ABN) is not sufficient.

[ ] **Other entity formed at law**. Provide details:

Signature(s): (1) Brenton Pham

(2)

Date: 15/11/2017

Print name(s): (1) BRENTON PHAM

(2)

Common seal (if used)

Position (e.g. director, CEO etc.): (1) DEVELOPMENT MANAGER

(2)

Company name/ACN or other entity (incorporation etc.): WESTERN AUSTRALIAN LAND AUTHORITY
ABN 34 868 192 835

Part 6 Prescribed fee

Make cheques or money orders payable to:

Department of Water and Environmental Regulation
(for all clearing purposes other than mining and petroleum activities)
or
Department of Mines, Industry Regulation and Safety
(for mining and petroleum clearing activities under the Mining Act, various Petroleum Acts or State Agreement Acts).

To make payment with a credit card, please complete Form C3 and attach to this form.

Do not send cash in the mail.

A **$200** fee is required for all purpose permit applications.

OFFICE USE ONLY

Payment method (tick applicable box):

[ ] Cheque [ ] Money order [X] Credit card (please complete Form C3 and attach)

Part 7 Application checklist and documentation summary

Additional information to assist in the assessment of your proposal may be attached to this application—e.g. reports on salinity, fauna or flora studies or other environmental reports conducted for the site could be included in electronic format and submitted on CDROM.

Please ensure you have included the following as part of your application:

REQUIRED

- [X] A completed application form that is signed and dated by all landowners, or the applicant acting on behalf of or likely to become the landowner.
- [X] Payment.
- [X] An aerial photograph or map with a north arrow clearly identifying the areas of vegetation proposed to be cleared or ESRI shapefile. An ERSI shapefile must be provided if the application requires an assessment under an EPBC Act Accredited process.
- [X] Written authority from the landowner to access the land and undertake the clearing.
- [X] I have read and understood the 'Confidential or commercially sensitive information' section at the bottom of this form.

REQUIRED IF APPLICABLE

- [X] Copy of the certificate of title or pastoral lease.
- [X] Form C3 if fee is to be paid by credit card.
- [ ] Annex C7 if the clearing applied for is also to be assessed under an EPBC Act Accredited Process.

Please provide a summary of all attached documentation.

Cover letter inclusive of this form, EAR and Certificate of Title
Shapefiles of clearing application area

Part 8 Lodgement

Send by email or post original applications for all clearing purposes (other than mining and petroleum activities) to:

Department of Water and Environmental Regulation
Locked Bag 33, CLOISTERS SQUARE
PERTH WA 6850
Email: info-der@dwer.wa.gov.au

Telephone: 6364 7000

For more information: www.dwer.wa.gov.au

Send original applications related to mining and petroleum clearing activities (under delegation) to:

Department of Mines, Industry Regulation and Safety
Environment Division
Mineral House
100 Plain St
EAST PERTH WA 6004

Telephone: 9222 3333

For more information: www.dmp.wa.gov.au

Please retain a copy of this form for your records.
Incomplete applications will be declined in accordance with section 51E (3) of the *Environmental Protection Act 1986*.

CONFIDENTIAL OR COMMERCIALLY SENSITIVE INFORMATION

Information submitted as part of this application may be made publicly available. If you wish to submit information that you believe to be commercially sensitive or otherwise confidential, then you should submit that information in an appendix to this application, with a written statement of reasons why you request that each item of information be kept confidential. The department will take reasonable steps to protect confidential or commercially sensitive information. Please note in particular that all submitted information may be the subject of an application for release under the *Freedom of Information Act 1992*. If you have any enquiries regarding the provision of relevant information as part of this application contact either the Department of Water and Environmental Regulation or the Department of Mines, Industry Regulation and Safety.

If there is insufficient space on any part of this form, please continue on a separate sheet of paper and attach to this form.

Part 2 Lodgement

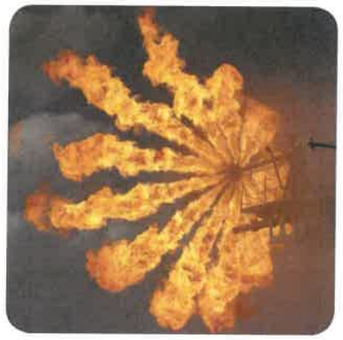
Please attach Form C3 to any relevant clearing permit application form and send by email or post original applications for all clearing purposes (other than mining and petroleum activities) to: **Department of Water and Environmental Regulation** Locked Bag 33, CLOISTERS SQUARE, PERTH WA 6850 Email: info-der@dwer.wa.gov.au Telephone: 6364 7000 For more information: www.dwer.wa.gov.au	Please attach Form C3 to any relevant clearing permit application form and send original applications related to mining and petroleum clearing activities (under delegation) to: **Department of Mines, Industry Regulation and Safety** Environment Division Mineral House 100 Plain St EAST PERTH WA 6004 Telephone: 9222 3333 For more information: www.dmp.wa.gov.au

Appendix 2

Environmental Assessment Report Lot 600 Lakes Road Stake Hill – Local Structure Plan

ENVIRONMENTAL ASSESSMENT REPORT

Lot 600 Lakes Road, Stake Hill – Local Structure Plan



ENVIRONMENTAL ASSESSMENT REPORT

Lot 600 Lakes Road, Stake Hill – Local Structure Plan

Prepared by:

RPS

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WEST PERTH WA 6005
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Prepared for:

LANDCORP

Level 6 Wesfarmers House
40 The Esplanade
PERTH WA 6000

Report No: EEL11266.003:2
Version/Date: Rev 0, March 2017

Document Status

Version	Purpose of Document	Orig	Review	Review Date	Format Review	RPS Release Approval	Issue Date
Draft A	Draft for Client Review	GilGla	JohHal	09.02.17	SN 24.02.17		
Rev 0	Final for Issue	GilGla	JohHal	20.03.17	DC 20.03.17	J. Halleen	21.03.17

Disclaimer

SUMMARY

Background

RPS Australia West Pty Ltd (RPS) was commissioned to provide an Environmental Assessment Report (EAR) to support the Local Structure Plan (LSP) for Lot 600 Lakes Road, Stake Hill (the site). The site is 119 hectares (ha) and is located approximately 50 kilometres (km) south-east of the Perth Central Business District, within the Shire of Murray (Figure 1).

Planning Context

The site is located in the Nambeelup Industrial Area (NIA), which is a modern industrial estate comprising of approximately 1,000 ha of industrial land, situated approximately 9 km north-east of Mandurah and 14 km north-west of Pinjarra (Figure 2).

Peel Region Scheme

The land is presently zoned "Rural" under the Peel Region Scheme (PRS). The PRS Amendment for Lot 600 (currently being assessed by the Department of Planning) seeks to rezone Lot 600 from "Rural" to "Industrial" under the PRS, to provide for planned industrial subdivision and development. This approach is consistent with land located to the south of Lakes Road, directly opposite the site.

Shire of Murray Town Planning Scheme No. 4

Lot 600 is zoned "Rural" under the Shire of Murray's (SoM) Town Planning Scheme No. 4 (TPS 4). Industrial development is not aligned with the objectives of the "Rural" zone.

To facilitate industrial land use and development, a request to amend TPS 4 from "Rural" to "Industrial Development" for Lot 600 has been submitted to the SoM (so that TPS No. 4 is consistent with the PRS).

Nambeelup Industrial Area District Structure Plan (DSP)

A District Structure Plan (DSP) for the NIA was prepared and endorsed by the Western Australian Planning Commission (WAPC) in April 2016 and is the primary mechanism for the PRS and SoM's TPS 4 rezoning proposals.

The Nambeelup DSP sets out the zoning and general development requirements to guide the coordinated approach to the planning and development of the NIA. The intention of the DSP is to implement broad land use zones with the delineation of more comprehensive zoning occurring at future planning stages. Under the DSP, the site is designated "Industrial", "Open Space" (the wetland area) and "Roads".

RPS notes the DSP shows a central road traversing through the Resource Enhancement Wetland (REW) within the site, as illustrated in Figures A and 2.

Figure A: Nambeelup DSP

Directions 2031 and Beyond

Directions 2031 and Beyond (Directions 2031) provides a high-level spatial framework for development and future growth within the Perth and Peel regions. This document provides a framework to guide the detailed planning and delivery of housing, infrastructure and services necessary to accommodate the forecasted additional 45,000 residents in Peel by 2031. Directions 2031 recognises that maintaining a strong and regionally dispersed network of industrial centres is critical to the Perth and Peel region's continued economic growth.

Directions 2031 identifies Nambeelup as a "Regional Industrial Centre" consistent with the DSP.

Perth and Peel@3.5million

In May 2015, the Draft Perth and Peel@3.5million was released for public comment. This is an overarching document that builds upon the vision laid down in Directions 2031 and beyond and provides a link across the four sub-regional planning frameworks (the South Metropolitan Peel Subregional Planning Framework being one of these) that define the spatial plan of the Perth and Peel regions for the next 35 to 40 years in order to accommodate a population of 3.5 million people. Perth and Peel@3.5million is yet to be finalised.

Draft Perth and Peel Green Growth Plan

The Draft Perth and Peel Green Growth Plan for 3.5 million (PPGGP) was also released in December 2015 by the state government. At the centre of the Draft PPGGP is the Strategic Conservation Plan, which sets out the conservation outcomes and objectives that will be achieved across several Action Plans (e.g. Draft Action Plan A: Urban and Industrial) over a 30 year lifespan.

While not a formal statutory document, it is intended the Draft PPGGP will secure upfront Commonwealth approvals and streamline state environmental approvals.

On review of the Draft PPGGP the site was identified as containing areas mapped as "Broad Commitments and Values". These areas generally correspond with the mapping of two REWs vegetation (UFI 4584 and UFI 4585).

The Draft PPGGP acknowledges that several "Broad Commitments and Values" areas need to be refined further before the PPGGP mapping is finalised, and/or through individual approval processes on a site-by-site basis. The site is mapped as an area designated for "Industrial Development" (Draft Action Plan A: Urban and Industrial) in the Draft PPGGP. The Lot 600 LSP corresponds closely with the environmental mapping in the Draft PPGGP and the DSP.

Lot 600 LSP

TPS 4 requires a LSP to be prepared and adopted for land zoned "Industrial Development" prior to subdivision or development of the land.

The proposed LSP defines the areas of industrial land use, drainage, public open space and infrastructure requirements consistent with the planning objectives and design outlined in the NIA DSP. The proposed LSP has responded to environmental assessment(s) undertaken for the DSP by incorporating the two REWs (UFI 4584) and UFI 4585) into a proposed future local Public Open Space (POS) and incorporating best practice stormwater management design.

The key characteristics of the proposed LSP are outlined in Table 1.

Table 1: Key Characteristics of the Proposed LSP

Key Characteristics	Proposed LSP
Project location	Lot 600 Lakes Road, Stake Hill
Indicative project time frame	▪ Peel Region Scheme Amendment 2017, and subsequent SoM TPS Amendment ▪ Structure Planning 2017–2018 and Subdivision 2018 and Construction 2018–2019
Project area	119 ha
Area of Industrial (inclusive of road widening and all roads)	89.32 ha
Resource Enhancement Wetlands (REW) area	11.71 ha

Key Characteristics	Proposed LSP
Additional wetland area from the removal of the neighbourhood connector road	0.54 ha
Wetland buffer and open space area	21.64 ha
Dedicated drainage areas	8.04 ha

Environmental Assessment Report

This EAR describes the relevant environmental characteristics of the site and presents management and mitigation strategies in response to potential environmental impacts. These management and mitigation strategies aim to minimise the potential impact on the environmental values within the site.

Key Environmental Issues

The following were considered the key environmental factors within the site that required further consideration and management as part of the proposed LSP and subdivision process:

- terrestrial environmental quality
- hydrology
- inland waters environmental quality
- flora and vegetation
- terrestrial fauna
- human health.

To prepare this EAR, a desktop assessment, a site inspection and a tree survey of the site was undertaken by RPS. LandCorp commissioned the following additional scope of services to assist in assessing the natural environment of the site:

- Coffey Geotechnics to undertake a geotechnical investigation
- JDA Consulting Hydrologists to undertake monitoring of the groundwater levels on a monthly basis and groundwater quality sampling on a quarterly basis to inform the preparation of a Local Water Management Strategy (LWMS)
- Coffey Environments Level 2 flora and vegetation survey and Level 1 fauna assessment.

Key Findings

- The site investigation undertaken by RPS on 2 September 2011 and Coffey Environments (2009) identifies the native vegetation within the site is considered to be in a "Degraded" to "Completely Degraded" condition.

- Coffey Environments (2009) identifies that no Threatened or Priority Flora, Threatened or Priority Ecological Communities protected under federal or state legislation were recorded upon site.

- Coffey Environments (2009) identified that no Threatened or Priority Fauna protected under Federal or State legislation were recorded upon the site.

- Coffey Environments (2009) identified the survey area contains habitat that is generally in a degraded condition due to significant impacts by previous land uses and would generally be assessed as either Disturbed Fauna Habitat or Highly Degraded Fauna Habitat that is unlikely to contain a unique fauna assemblage.

- The site does not contain habitat which would be considered to be significant breeding or foraging habitat for either the Carnaby's Black-Cockatoo or the forest red-tailed black cockatoo.

- There have been no significant changes to the existing environment within the site over the past 40 years. The site has been used for cattle grazing consistent with the "Rural" land use zoning.

Management of Impacts

A summary of the management measures which will underpin the proposed LSP for the site is provided in Table 2. The implementation of these management measures will ensure that potential impacts to key environmental factors are managed to ensure that the development of the site meets the objectives of the Environmental Protection Authority (EPA) and the SoM, who are the long-term manager of the REW and open space areas.

Conclusion

This environmental assessment demonstrates that the potential environmental impacts associated with the proposed future development of Lot 600 Lakes Road, Stake Hill can be appropriately managed in accordance with the objectives of the EPA to prevent significant impacts to the environment at the site.

The environmental outcomes from the PRS environmental investigations and information in the NIA DSP and Draft PPGGP have been incorporated into the development of the LSP.

A summary the environmental management objectives are provided below:

- Removal of the road dissecting the two REWs (promoted in the DSP). The area of 0.54 ha will be rehabilitated and consolidated in the surrounding wetlands. This increases the core wetland area to 12.25 ha.

- provide for the long-term conservation and management of the wetlands

- provide best quality groundwater and surface water quality management through the implementation of water sensitive urban design and best drainage management practices

- reduction of nutrient input into the Peel Inlet–Harvey Estuary system.

Table 2: Summary of the Key Environmental Factors and Management Measures

Environmental Factor	EPA Objective	Applicable Guidance and/or Legislation	Potential Impacts	Environmental Investigations	Management Recommendations and Timing
Terrestrial Environmental Quality	To maintain the quality of land and soils so that environmental values are protected.	▪ Environmental Factor Guideline: Terrestrial Environmental Quality (EPA 2016a). ▪ Acid Sulfate Soils-Planning Guidelines (WAPC 2008a). ▪ Planning Bulletin 64/2009-Acid Sulfate Soils (WAPC 2009). ▪ Identification and Investigation of Acid Sulfate Soils and Acidic Landscapes (Department of Environment Regulation (DER) 2015a). ▪ Treatment and Management of Soils and Water in Acid Sulfate Soil Landscapes (DER 2015b).	Potential for oxidation of excavated or in situ Potential Acid Sulfate Soils (ASS) generating acidic conditions, and possibly releasing metals into groundwater.	Desktop assessment.	▪ Preliminary ASS investigation to confirm the presence or absence of ASS prior to any site earth works. ▪ ASS and Dewatering Management Plan to be prepared, if required, to the satisfaction of DER at subdivision approval stage.
Hydrological Processes	To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.	▪ Environmental Factor Guideline: Hydrological Processes (EPA 2016b). ▪ Better Urban Water Management (WAPC 2008b)	▪ Groundwater level changes can occur as a result of a change in land use. ▪ Removal of vegetation and installation of impervious surfaces can lead to an increase in run-off during rainfall events. ▪ Industrialisation will result in an increase in the potential for industrial generated pollutants such as hydrocarbons, metals and sediment being discharged via run-off and influencing the soil profile and ultimately into the groundwater. ▪ Nutrient loading to the groundwater and surface water can occur. ▪ Stormwater drainage can facilitate the transportation of nutrients (through surface run-off) and potential contaminants (e.g. litter) through the site.	▪ Groundwater monitoring undertaken by JDA Consulting Hydrologists to determine groundwater levels and quality. ▪ Local Water Management Strategy prepared by JDA Consulting Hydrologist	Urban Water Management Plan(s) (UWMP) will be finalised to the satisfaction of the SoM and Department of Water (DoW) at subdivision approval stage.

Environmental Factor	EPA Objective	Applicable Guidance and/or Legislation	Potential Impacts	Environmental Investigations	Management Recommendations and Timing
Inland Waters Environmental Quality	To maintain the quality of groundwater and surface water so that environmental values are protected.	▪ Environmental Factor Guideline: Inland Waters Environmental Quality (EPA 2016c). ▪ Better Urban Water Management (WAPC 2008b) ▪ Environmental Protection (Peel Inlet–Harvey Estuary) Policy 1992 ▪ State Planning Policy 2.1 Peel–Harvey Coastal Plain Catchment	▪ Alterations to flow regimes. ▪ Land use conflict. ▪ Development will result in an increase in the potential for industrial generated pollutants such as hydrocarbons, metals and sediment being discharged via run-off and can influence the water chemistry of the two REWs. ▪ Stormwater drainage can facilitate the transportation of potential contaminants (e.g. litter) through to the two REWs.	▪ Site inspection undertaken by RPS. ▪ Assessment of the wetland values undertaken by Coffee Environments and RPS ▪ Local Water Management Strategy prepared by JDA Consulting Hydrologist	▪ Removal of road dissecting the two REWs. Adding an addition 0.54 ha to the core wetland area. ▪ Wetland Management Plan (WMP) to be prepared to the satisfaction of SoM and DPaW at subdivision approval stage which includes: - provision of a buffer from the mapped edge of the wetland, primarily to retain the Melaleuca trees - maintaining the ecological water requirements of the *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* trees by incorporating the infiltration of surface waters within the wetland buffer - revegetation of the core wetland area where the road was proposed in the DSP

Environmental Factor	EPA Objective	Applicable Guidance and/or Legislation	Potential Impacts	Environmental Investigations	Management Recommendations and Timing
					- surface water retention swales, batters from roads / paths within or adjacent to the wetland buffer planted using endemic species - interface treatments between conservation areas and recreation areas. ▪ UWMP(s) will be finalised to the satisfaction of the SoM and DoW at subdivision approval stage.
Flora and Vegetation	To protect flora and vegetation so that biological diversity and ecological integrity are maintained.	▪ Environmental Factor Guideline: Flora and Vegetation (EPA 2016d). ▪ Technical Guidance: Flora and Vegetation Surveys for Environmental Impact Assessment (EPA 2016e). ▪ *Wildlife Conservation Act 1950* ▪ *Environmental Protection and Biodiversity Act 1999*	▪ Removal of vegetation within the site with the exception of those areas proposed to be retained. ▪ Degradation of retained vegetation through uncontrolled access and weed invasion.	▪ Site Inspection undertaken by RPS. ▪ Level 2 Flora and Vegetation Survey undertaken by Coffey Environments.	WMP to be prepared to the satisfaction of SoM and DPaW at subdivision approval stage.

Environmental Factor	EPA Objective	Applicable Guidance and/or Legislation	Potential Impacts	Environmental Investigations	Management Recommendations and Timing
Terrestrial Fauna	To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.	▪ Environmental Factor Guideline: Terrestrial Fauna (EPA 2016f). ▪ Technical Guidance: Sampling Methods for Terrestrial Vertebrate Fauna (EPA 2016g). ▪ Technical Guidance: Terrestrial Fauna Surveys (EPA 2016h). ▪ *Wildlife Conservation Act 1950* ▪ *Environmental Protection and Biodiversity Act 1999*	▪ Loss of habitat through clearing. ▪ Habitat fragmentation (including obstructions to fauna movement through roads, fencing, etc.). ▪ Land clearing and vehicle movement may result in death or injury of fauna as a result of collisions. ▪ Species interactions, including predation and competition. ▪ Disturbance of fauna from noise and human disturbance.	▪ Site Inspection and Tree Survey undertaken by RPS. ▪ Level 1 Fauna Survey undertaken by Coffey Environments.	WMP to be prepared to the satisfaction of SoM and DPaW at subdivision approval stage.
Human Health	To protect human health from significant harm.	▪ Environmental Factor Guideline: Human Health (EPA 2016i). ▪ Assessment and Management of Contaminated Sites (DER 2014). ▪ Identification, Reporting and Classification of Contaminated Sites in Western Australia (DER 2015c). ▪ National Environment Protection (Assessment of Site Contamination) Measure (National Environment Protection Council 2013).	Potential for contaminated soils or groundwater to be unearthed during development activities.	Desktop assessment	A Preliminary Site Investigation is recommended to be undertaken to determine if any actions to manage potential contamination are required to be implemented during construction.

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APPENDICES

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1.0 INTRODUCTION

1.1 Background

RPS Australia West Pty Ltd (RPS) was commissioned by LandCorp to provide an Environmental Assessment Report (EAR) to support the Local Structure Plan (LSP) for Lot 600 Lakes Road, Stake Hill (the site). The site is 119 hectares (ha) and is located approximately 55 kilometres (km) south-east of the Perth Central Business District and within the Shire of Murray (Figure 1).

The present land use within Lot 600 is principally cattle grazing. Most of the native vegetative understory has been cleared to create paddocks and dams to facilitate this agricultural land use. Analysis of historical imagery indicates the historic land uses for the site has changed little since 1974.

1.2 Objective

This EAR describes the relevant environmental characteristics of the site and presents management and mitigation strategies in response to potential environmental impacts. These management and mitigation strategies aim to minimise the potential impact on the environmental values within the site.

In order to deliver this report, RPS undertook the following approach:

- described the existing natural environment of the site
- identified the key environmental constraints to the LSP
- identified management actions required to facilitate future industrial development.

1.3 Methodology and Scope

This EAR addresses the following environmental factors:

- terrestrial environmental quality
- hydrology
- inland waters environmental quality
- flora and vegetation
- terrestrial fauna
- human health.

The environmental factors identified have been validated and refined through:

- desktop assessments
- site visits.

LandCorp commissioned the following scope of services to assist in assessing the natural environment of the site:

- Coffey Environments to undertake a Level 2 terrestrial flora and vegetation survey and Level 1 fauna assessment
- Coffey Geotechnics to undertake a geotechnical study
- JDA Consulting Hydrologists to undertake monitoring of the groundwater levels on a monthly basis and groundwater quality sampling on a quarterly basis to inform the preparation of a Local Water Management Strategy (LWMS).

The above investigations were primarily completed from 2009 to 2012, as LandCorp originally intended to initiate a Peel Region Scheme (PRS) Amendment in 2012. This was placed on hold however while the state government prepared the District Structure Plan (DSP) for the entire Nambeelup Industrial Area (NIA). The DSP was finalised and approved by the Western Australian Planning Commission (WAPC) in April 2016.

Within Lot 600 there have been no land use changes or changes to the existing environment identified since these investigations were undertaken that would influence the outcomes or management actions discussed herein. The site has been used for cattle grazing for the past 10 years.

1.4 Abbreviations and Acronyms

Table 3 identifies the abbreviations and acronyms that are used within this report for reference.

Table 3: Abbreviations and Acronyms

Abbreviation/Acronym	In Full
ASS	Acid Sulfate Soil
CCW	Conservation Category Wetland
DAA	Department of Aboriginal Affairs
DER	Department of Environment Regulation
DPaW	Department of Parks and Wildlife
DSP	District Structure Plan
EAR	Environmental Assessment Report
EPA	Environmental Protection Authority
EPBC Act	*Environmental Protection and Biodiversity Conservation Act 1999*
ha	hectare
km	kilometres
LWMS	Local Water Management Strategy

Abbreviation/Acronym	In Full
PRS	Peel Regional Scheme
MUW	Multiple Use Wetland
m	metres
mm	millimetres
NIA	Nambeelup Industrial Area
PASS	Potential Acid Sulfate Soil
ODP	Outline Development Plan
RPS	RPS Australia West Pty Ltd
TECs	Threatened Ecological Communities
the guidelines	EPBC Act draft referral guidelines for three threatened black cockatoo species: Carnaby's Black-Cockatoo *Calyptorhynchus latirostris*, Baudin's black cockatoo *Calyptorhynchus baudinii* and forest red-tailed black cockatoo *Calyptorhynchus banksii naso*
PPGGP	Draft Perth and Peel Green Growth Plan
REW	Resource Enhancement Wetland
RPS	RPS Australia West Pty Ltd
SoM	Shire of Murray
the site	Lot 600 Lakes Road, Stake Hill
the survey area	Lots 91, 92 and 604, Nambeelup
TPS No. 4	Shire of Murray Town Planning Scheme No. 4
UWMP	Urban Water Management Plan
WAPC	Western Australian Planning Commission
WMP	Wetland Management Plan
WSUD	Water Sensitive Urban Design

1.5 Environmental Aspects of Local Structure Plan Design

From an environmental perspective the key influences of the LSP were:

- Resource Enhancement Wetlands (REW)
- water management.

The following values have been accounted for as part of the LSP design:

- maintaining wetland, fauna habitat values within the defined open space area (e.g. retaining existing trees within the open space area).

1.5.1 Hydrological and Engineering Philosophy

The groundwater management strategy in the NIA District Water Management Strategy (JDA Consulting Hydrologists 2012) proposes to utilise a combination of such measures as subsoil drainage systems for controlling the groundwater level, filling of land to achieve adequate separation to groundwater and also suitable building foundation designs.

In this context, the LSP has been designed to meet the following key environmental objectives:

- Department of Water (DoW) no longer sets minimum separation distances to groundwater requirements for lots. Fill levels are dependent on the most critical of several design criteria and generally, a separation distance of one to 1.5 metres (m) would be required to meet these criteria
- meet Better Urban Water Management (WAPC 2008b) stormwater design and water quality objectives
- incorporating and protecting the REWs within the LSP design
- managing Acid Sulfate Soil (ASS) in accordance with the Department of Environment Regulation (DER) ASS guidelines.

2.0 PLANNING CONTEXT

2.1 Planning Background

2.1.1 Nambeelup Industrial Area District Structure Plan

The site is located in the NIA, which is a modern industrial estate comprising of approximately 1,000 ha of industrial land, situated approximately 9 km north-east of Mandurah and 14 km north-west of Pinjarra.

The Nambeelup NIA has a long history of planning investigations and in June 2011, the Department of Planning assigned a high priority action to formulate a DSP to ensure orderly planning and development of the NIA. The NIA consists of the core industrial land identified in Department of Planning and Infrastructure (2005) and additional surrounding land parcels (Figure 2).

In order to facilitate a coordinated approach to the planning and development of the NIA, and to protect areas determined to be of environmental significance within the NIA, a DSP was prepared and endorsed by the Western Australian Planning Commission (WAPC) in December 2015.

The DSP was endorsed by the WAPC following more than 10 years of planning, environmental, drainage and infrastructure servicing investigations, as well as separate public consultation periods for an initial Draft DSP in 2012 and a revised Draft DSP in 2014. The NIA DSP is the primary mechanism for future rezoning proposals under the PRS and the SoM's Town Planning Scheme (TPS) No. 4.

The Nambeelup DSP sets out the zoning and general development requirements to guide the coordinated approach to the planning and development of the NIA. The intention of the DSP is to implement broad land use zones with the delineation of more comprehensive zoning occurring at future planning stages. Under the DSP, the site is designated "Industrial", "Open Space" (the wetland area) and "Roads".

RPS notes the DSP shows a central road traversing through the two REWs, as illustrated in Figures A and 2.

Areas identified as a "Regionally Significant Natural Area", "Conservation Category Wetland (CCW)" and "REW", which retain their ecological value, are to be protected within areas identified as "Open Space" as identified in the DSP.

The DSP proposes a 'stepping-stone" local ecological linkage utilising open space areas (containing remnant vegetation) on the eastern boundary of Lot 109 Gull Road, the proposed major drainage areas in the centre of Lot 109, and further to the north abutting Gull Road. These defined stepping-stones areas are located outside of Lot 600.

The LSP for Lot 600 defines areas for industrial development, public open space (POS), roads and drainage areas, consistent with the DSP (Figure 3).

2.1.2 Peel Region Scheme

Under the Peel Region Scheme (PRS), Lot 600 is zoned "Rural".

The PRS Amendment for Lot 600 is currently being assessed by the Department of Planning and the WAPC. This Amendment seeks to rezone Lot 600 from "Rural" to "Industrial" under the PRS, to provide for planned industrial subdivision and development. This approach is consistent with land located to the south of Lakes Road, directly opposite the subject land.

2.1.3 Shire of Murray Town Planning Scheme No. 4

Under the SoM's TPS No. 4, Lot 600 is zoned "Industrial Development". The adjacent existing kennel estates, abattoir site and Murrayfield Airpark are zoned "Special Use". The proposed industrial development is not aligned with the objectives of the "Rural" zone.

To facilitate industrial land use and development, a request to amend TPS No. 4 from "Rural" to "Industrial Development" for Lot 600 has been submitted to the SoM (so that TPS No. 4 is consistent with the PRS).

TPS 4 requires a LSP to be prepared and adopted for land zoned "Industrial Development" prior to subdivision or development of the land.

2.1.4 Draft Perth and Peel Green Growth Plan

The Draft Perth and Peel Green Growth Plan for 3.5 million (PPGGP) was also released in December 2015 by the state government. At the centre of the Draft PPGGP is the Strategic Conservation Plan, which sets out the conservation outcomes and objectives that will be achieved across several Action Plans (e.g. Draft Action Plan A: Urban and Industrial) over a 30 year lifespan.

While not a formal statutory document, it is intended the PPGGP (when finalised) will secure upfront Commonwealth approvals and streamline state environmental approvals.

The site contains areas mapped as "Broad Commitments and Values" which generally corresponds with the mapping of two REWs vegetation (UFI 4584 and UFI 4585).

The Draft PPGGP acknowledges that several "Broad Commitments and Values" areas need to be refined further before the Draft PPGGP mapping is finalised, and/or through individual approval processes on a site-by-site basis.

The site is mapped as an area designated for "Industrial Development" (Draft Action Plan A: Urban and Industrial) in the Draft PPGGP. The proposed LSP corresponds closely with the environmental mapping in the Draft PPGGP and the DSP.

2.2 Statutory Planning

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

The objective of the Environmental Protection (Peel Inlet–Harvey Estuary) Policy 1992 (EPA 1992) is to reduce the input of nutrients, particularly phosphorus, into the Peel Inlet–Harvey Estuary system through a number of means which includes appropriate land management by landowners in the policy area.

The site is located within the catchment area of the Peel Inlet–Harvey Estuary system, which has a history of poor water quality.

The objectives of this policy are:

- to set out environmental quality objectives for the Peel Inlet and Harvey Estuary System which if achieved will rehabilitate the water bodies and protect them from further degradation
- to outline the means by which the environmental quality objectives for the water bodies are to be achieved and maintained.

2.2.2 State Planning Policy 2.1 Peel–Harvey Coastal Plain Catchment 1992

The State Planning Policy 2.1 Peel–Harvey Coastal Plain Catchment (WAPC 2003a) was prepared in 1992 to support the Environmental Protection (Peel Inlet–Harvey Estuary) Policy 1992 by restricting changes in land use that could be environmentally detrimental to the Peel Inlet–Harvey Estuary system.

The objectives of this planning policy are to:

- Improve the social, economic, ecological, aesthetic, and recreational potential of the Peel–Harvey coastal plain catchment.
- Ensure that changes to land use within the catchment to the Peel–Harvey estuarine system are controlled so as to avoid and minimise environmental damage.
- Balance environmental protection with the economic viability of the primary sector.
- Increase high water using vegetation cover within the Peel–Harvey coastal plain catchment.

- Reflect the environmental objectives in the Environmental Protection (Peel Inlet–Harvey Estuary) Policy 1992.

- Prevent land uses likely to result in excessive nutrient export into the drainage system.

2.2.3 State Planning Policy No. 4.1: State Industrial Buffer Policy

The purpose of the State Planning Policy No. 4.1 – State Industrial Buffer Policy (SPP 4.1) is to provide a consistent approach to the protection and security of industrial zones, transport terminals, ports, other utilities and special use zones. SPP 4.1 also considers the safety and amenity of surrounding land uses, while having regard to the rights of landowners who may be affected by residual emissions and risk.

Section 1.1 of SPP 4.1 states that in the case of light / service industry or technology parks the impacts can usually be retained on site, which is a normal requirement for these types of industry, where building setbacks combined with suitable landscaping in effect from the buffer area. Other types of industry such as hazardous, noxious, resource processing, general industry and infrastructure (including power generation facilities, effluent treatment plants and ports) often require buffer areas which may extend off site on to surrounding properties. The NIA will provide for light / service and general industrial land uses. All proposed industrial uses within the area would be assessed for compliance with Guidance Statement No. 3: *Separation Distance between Industrial and Sensitive Land Uses* at the development application stage, as this is when detailed information becomes available.

2.3 Strategic Planning

The LSP considers the following key strategic environmental and planning documents.

2.3.1 South Metropolitan Peel Sub-regional Planning Framework

The Draft South Metropolitan Peel Sub-regional Planning Framework was one of four subregional planning frameworks that were released for public comment in May 2015. These planning frameworks, when finalised as sub-regional structure plans, will put in place an integrated long-term planning framework for land use and infrastructure for the Perth and Peel regions.

These strategic documents recognise the importance of a "whole of government approach" and use a planning horizon linked to a whole-of-Perth-Peel population of 3.5 million people. Depending upon matters such as migration policy and fertility rates, it is expected that a population of 3.5 million will be reached during the period 2046–2050. The Draft South Metropolitan Peel Sub-regional Planning Framework reflected the proposed industrial area and associated regional road network shown on the NIA DSP. The WAPC, as explained in Section 5.2, concluded that the NIA DSP could be finalised prior to the finalisation of the sub-regional structure planning process.

2.3.2 Water Quality Improvement Plan for the Rivers and Estuary of the Peel–Harvey System – Phosphorus Management

The Water Quality Improvement Plan for the Rivers and Estuary of the Peel–Harvey System – Phosphorus Management was released by the EPA in November 2008 (EPA 2008a). The objective of the Water Quality Improvement Plan for the Rivers and Estuary of the Peel–Harvey System – Phosphorus Management is to limit the level of phosphorus reaching the Peel–Harvey waterways to 75 tonnes per year.

The LWMS for Lot 600 outlines best practice water and nutrient management for the site to be implementing in future UWMPs.

2.3.3 Swan Bioplan – Peel Sector, Peel Regionally Significant Natural Areas

The Swan Bioplan – Peel Regionally Significant Natural Areas (RSNAs) has been endorsed by the EPA to guide strategic land use and conservation planning in the Peel Sector of the Swan Coastal Plain (EPA 2010).

As part of the Swan Bioplan Project, landscape, habitat, vegetation and flora values have been identified and this information was used to delineate regionally significant natural areas (EPA 2010).

The Peel RSNAs should be considered during strategic planning and in highly cleared landscapes as these areas represent a range of landscapes, habitats, vegetation and flora originally found in the area (EPA 2010).

Any developments in the Peel Sector area will be considered on their merits. Those impacting upon RSNAs will be subject to a higher level of scrutiny and every effort should be made to locate any proposed development in cleared areas in preference to uncleared areas (EPA 2010).

It is noted there are no Peel RSNAs within Lot 600.

Any development proposals and planning scheme amendments that impact upon the RSNAs will require detailed investigations of their natural values consistent with:

- Environmental Factor Guideline: Flora and Vegetation (EPA 2016a)
- Environmental Factor Guideline: Terrestrial Fauna (EPA 2016d).

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3.0 EXISTING ENVIRONMENT

3.1 Site Context

The site is located within the Shire of Murray, approximately 55 km south-east of the Perth Central Business District (Figure 1). The total area of the site is approximately 119 ha.

The majority of the site has been previously used for cattle grazing and has undergone substantial clearing. There are limited areas of remnant vegetation remaining within Lot 600 with introduced weed species as an understorey (Plates 1 and 2).

Analysis of historical imagery indicates the historic land uses for the site has changed little since 1974. The extent of vegetation displays very little variation from the 1974 image to the present day.

Plate 1: Cattle upon the Site

Plate 2: Constructed Dam

3.1.1 Surrounding Land Uses

The site is bound on three sides by the local road network, which comprises of Fowler Road to the north, Gull Road to the east and Lakes Road to the south.

The land uses surrounding the site consist of large rural lots to the north and west. East of the Lot 600 is the kennel zone. The kennel area, located east of Gull Road and north of Lakes Road, comprised of 32 properties each of which is approximately two hectares in size. The estate is zoned "Special Use – Kennels" under TPS No. 4. It is envisaged the current kennel activities will remain in the short to medium term.

Murrayfield Airpark is located on Lot 11 Lakes Road and Lot 4 Nambeelup Road. It is a small aircraft aerodrome operated by the Royal Aero Club. The Royal Aero Club proposes to operate the aerodrome for the foreseeable future. A small portion of Lot 600 (along the southern boundary) is within the 20 ANEF noise contours. Industrial and commercial land uses are considered compatible with these levels of aircraft noise exposure.

Land to the east has been divided into smaller rural lifestyle landholdings. The land directly to the south has recently been zoned "Industrial" in the PRS.

3.2 Topography

The topography of the site is low in relief and varies slightly in slope from below five metres Australian Height Datum (m AHD) in the lowest points to the west to above 6 m AHD in the east (Figure 4).

The major landform unit underlying the site is the Bassendean Dune system. This dune system is located around the centre of the Swan Coastal Plain, and is the oldest of the three aeolian derived dune systems (Bolland 1998).

3.3 Geology

The main soil association that underlies the site are the Bassendean Sands (Figure 4). The Qpb/Qpa duplex soil association is comprised of a thin layer of Bassendean Sands of very light grey, medium-grained sand at the surface with brown silty and slightly sandy clays of the Guildford Formation (McPherson and Jones 2011).

To the north of the Bassendean Sands, sand deposits lie the S8 Sands which intersect the site. The S8 Sands are comprised of very light grey sand at the surface, with yellow sand at depth. The sand is fine to medium grained, sub-rounded moderately sorted quartz of aeolian origin (Department of Industry and Resources 1999).

Coffey Geotechnics (2009) completed a geotechnical investigation of the site and identified the following generalised subsurface profile as occurring upon the site:

- Topsoil (0.1 m) – sandy topsoil organic and generally shallow
- Sands (2.0 m thick) – sand medium dense to dense with coffee rock
- Clayey Sands (0.5 m) – Clayey sand, firm dark grey–green
- Sands (unknown) – Sand dense to very dense course grained.

3.3.1 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring soils, sediments and peats that contain fine-grained metal sulfides, typically pyrite, which are formed under saturated, anoxic/reducing conditions (MPL Laboratories 2010). In an undisturbed state below the water table, these soils are benign and non-acidic. However, if the soils are exposed to the atmosphere by drainage, excavation or lowering of the water table, the sulfides may react with oxygen to form sulfuric acid. Where these materials have oxidised, they commonly have a mottled appearance (orange–red or buttery yellow discolouration) due to the presence of oxidised iron minerals (MPL Laboratories 2010).

ASS that have already oxidised and display existing acidity are termed Actual ASS. ASS which have not oxidised are referred to as Potential ASS (PASS).

The WAPC, in consultation with the DER, has compiled ASS risk maps that are based on surface geology mapping and provide a broad scale indication of the risk of occurrence of ASS. The ASS risk mapping indicates that the entire extent of the site is mapped as "moderate to low risk" of ASS occurring at depths of greater than 3 m (Figure 5).

3.4 Hydrology

3.4.1 Groundwater

3.4.1.1 Regional Groundwater

Recharge to the superficial aquifer is mostly from direct rainfall. Groundwater flows in the superficial aquifer is driven by gravity and generally flow from east to west towards the Serpentine River. Peak groundwater levels generally occur in September (JDA Consulting Hydrologists 2012).

3.4.1.2 Local Groundwater

JDA Consulting Hydrologists undertook monitoring of the groundwater levels on a monthly basis and groundwater quality sampling on a quarterly basis in order to inform the preparation of a LWMS.

JDA Consulting Hydrologists (2012) found:

- Peak groundwater levels occurred in August–September and minimum ground water levels occurred in March.
- Water levels showed a maximum groundwater gradient of 0.003 m/m from east to west across the centre of the site during maximum levels in August 2011.
- Water was not found to break above the natural surface in the wetlands.

Further details on groundwater levels and the proposed surface and groundwater management are available in the Lot 600 LWMS.

3.4.2 Surface Water

Low-lying areas on the site are exposed to water logging in late winter and early spring.

3.4.3 Wetlands Context

3.4.3.1 Classification of Wetlands

Semeniuk (1987) proposed a landform / geomorphic and water / wetness approach to the assessment of wetlands in the Darling System. Using this methodology, the then Water and Rivers Commission and Department of Environmental Protection classified natural wetlands as being one of seven basic types based on water regime and cross sectional shape. Table 4 shows the formal wetland classification.

Table 4: Wetland Classification

Water Longevity	Landform		
	Basin	Channel	Flat
Permanent inundation	Lake	River	
Seasonal inundation	Sumpland	Creek	Flood plain
Seasonally waterlogged	Dampland	Trough	Palusplain

Source: Hill et al. (1996)

3.4.3.2 Evaluation of Wetlands

Typically, wetland evaluations use ecological criteria and attach non-economic values to sites where both value judgements and comparisons are made.

Realistically, the protection of every wetland is not achievable if development is to occur. In the environmental planning process, environmental values are balanced with social and economic considerations.

The Department of Parks and Wildlife (DPaW) employs a tiered approach for evaluating wetlands. This approach is widely used to identify highly valuable wetlands that should receive the greatest protection, moderately valuable wetlands that need rehabilitation and the least valuable wetlands where alterations may be allowed, perhaps with some conditions

This tiered approach resulted in the creation of three evaluation/management categories for wetlands: CCW, REW and Multiple Use Wetland (MUW) (Table 5).

Table 5: Management Objectives of the Wetland Categories

Management Category	General Description	Management Objectives
CCW	Wetlands support a high level of ecological attributes and functions	Highest priority wetlands. Objective is preservation of wetland attributes and functions through various mechanisms including: ▪ reservation in national parks, Crown reserves and state-owned land ▪ wetland covenanting by landowners. These are the most valuable wetlands and the Commission will oppose any activity that may lead to the further loss or degradation. No development.
REW	Wetlands which may have been partially modified but still support substantial ecological attributes and functions	Priority wetlands. Ultimate objective is for management, restoration and protection towards improving their conservation value. These wetlands have the potential to be restored to conservation category. This can be achieved by restoring wetland structure, function and biodiversity. Protection is recommended through a number of mechanisms.
MUW	Wetlands with few important ecological attributes and functions remaining	Use, development and management should be considered in the context of ecologically sustainable development and best management practice catchment planning through land care. Should be considered in strategic planning.

Source: Water and River Commission (2001)

3.4.4 Nambeelup Industrial Area Wetland Context

Approximately 70% of the NIA is mapped by DPaW's Geomorphic Wetlands Swan Coastal Plain dataset as MUWs. The wetlands within the NIA DSP area are illustrated in Table 6.

According to the Geomorphic Wetlands Swan Coastal Plain dataset, there are 10 CCWs and 19 REWs (which are not inclusive of the REWs that occur within Lot 600), within the NIA. Some of the wetlands have been identified as RSNAs (Figure 6).

Table 6: Wetlands within the NIA DSP

Classification	ID Number	Wetland Type	Wetland Protection Status
CCW	UFI 13906	Sumpland	Peel RSNA
CCW	UFI 4835	Sumpland	Peel RSNA
CCW	UFI 5032	Sumpland	Peel RSNA
CCW	UFI 13305	Palusplain	Peel RSNA
CCW	UFI 5033	Sumpland	Peel RSNA
CCW	UFI 5034	Palusplain	
CCW	UFI 5029	Palusplain	Peel RSNA
CCW	UFI 14424	Sumpland	
CCW	UFI 5129	Palusplain	Peel RSNA
CCW	UFI 5182	Palusplain	
REW	UFI 14652	Sumpland	
REW	UFI 15373	Palusplain	
REW	UFI 15377	Palusplain	
REW	UFI 15379	Sumpland	
REW	UFI 14592	Palusplain	
REW	UFI 14598	Dampland	
REW	UFI 4287	Sumpland	
REW	UFI 15374	Dampland	
REW	UFI 15381	Sumpland	Partially enclosed within Peel RSNA
REW	UFI 13898	Sumpland	Partially enclosed within Peel RSNA
REW	UFI 15378	Sumpland	
REW	UFI 4883	Dampland	Peel RSNA
REW	UFI 5175	Palusplain	
REW	UFI 13892	Sumpland	
REW	UFI 4834	Sumpland	Peel RSNA
REW	UFI 14438	Dampland	
REW	UFI 15236	Palusplain	Peel RSNA
REW	UFI 5128	Sumpland	Partially enclosed within Peel RSNA
REW	UFI 5127	Sumpland	

Sources: Coterra Environment (2012) and WA Atlas (2012)

3.4.5 Site Wetland Context

The two distinct management categories of geomorphic wetlands in Lot 600 are REW and MUW (Figure B).

3.4.5.1 Multiple Use

MUW (UFI 15802) is mapped for a significant portion of the site. This wetland is an extensive palusplain wetland which has been subject to various impacts associated with past and current land uses across its extent (Figure B).

Extents of two other MUWs (UFI 14609 and UFI 15785) have also been identified within the site (Figure B).

3.4.5.2 Resource Enhancement

The two REWs (UFI 4584 and UFI 4585), are located in the east and south-east of the site (Figures B and 7).

Figure 6 highlights the environmental values of the wetlands contained within the site, and the wider NIA. The extent of CCWs within the NIA DSP area is 129.38 ha and the total extent of REWs (not inclusive of the REWs within Lot 600) is 249.63 ha.

The two REWs within the subject land comprise approximately 11.71 ha (or approximately 4.5%) extent of the total extent of REWs within the NIA.

Figure B: Multiple Use and REWs within Lot 600

The vegetation of REWs (UFI 4584 and UFI 4585) is broadly described of consisting of an "Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12 m with occasional *Banksia littoralis* over grassland / herbland / sedgeland to scattered grasses / herbs / sedges dominated by weed species". The condition of these vegetated extents within the wetlands is "Degraded".

Within REWs (UFI 4584 and UFI 4585) one quadrat (10 m × 10 m) for each wetland was described by Coffey Environments (2009). Within REW (UFI 4584) the vegetation was specifically described as consisting of an "Open Forest to Woodland of *Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* to 12 m over Open grassland / herbland of **Lolium perenne** and **Lotus subbiflorus* to 0.2 m" (Plates 3 and 4).

Source: Coffey Environments (2009)

Plate 3: Degraded Vegetation within REW (UFI 4584)

Coffey Environments (2009) specifically identifies the species that were recorded within REW (UFI 4584) (Table 7).

** Denotes that the species is a not a native species.

Table 7: Species recorded within REW (UFI 4584)

Species Recorded	Cover %	Height (m)
**Arctotheca calendula*	<1	0.1
**Cotula coronopifolia*	<1	0.2
**Cynodon dactylon*	<1	0.1
Eucalyptus rudis subsp. *rudis*	15	12
Isolepiscernua var. *setiformis*	<1	0.1
**Lolium perenne*	15	0.2
**Lotus subbiflorus*	10	0.1
**Lythrum hyssopifolia*	<1	0.1
Melaleuca rhaphiophylla	30	10
**Poa annua*	<1	0.1
**Ranunculus muricatus*	<1	0.1
**Sonchus oleraceus*	<1	0.1
**Trifolium hybridum* var. *hybridum*	<1	0.1

Table 7 shows that the diversity of species within REW (UFI 4584) is low with 13 species being recorded in Site 91-1 (Coffey Environments 2009). Of the 13 species identified only two species are native, *Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla*. These two overstorey species comprise an estimated 45% of the canopy cover of REW (UFI 4584).

Within REW (UFI 4585) the vegetation was specifically described as consisting of an "Open Forest of *Melaleuca rhaphiophylla* to 9 m with occasional *Banksia littoralis* and *Melaleuca preissiana* to 8 m over grassland of *Lolium perenne* to 0.4 m" (Plate 4).

Coffey Environments (2009) specifically identifies the species that were recorded within REW (UFI 4585) (Table 8).

Table 8: Species Recorded within REW (UFI 4585)

Species recorded	Cover %	Height (m)
Banksia littoralis	3	8
**Hypochaeris glabra*	< 1	Groundcover
**Lolium perenne*	65	0.4
**Lotus subbiflorus*	< 1–1	0.1
Melaleuca rhaphiophylla	50	9
**Ranunculus muricatus*	< 1	0.2
**Rumex crispus*	< 1	0.2
**Sonchus oleraceus*	< 1	0.1
**Trifolium hybridum* var. *hybridum*	< 1	0.1

Tables 7 and 8 shows that the diversity of species within REW (UFI 4585) is lower than in REW (UFI 4584) with nine species being recorded in Site 91-2 (Coffey Environments 2009). Of the nine species identified only two species are native, *Banksia littoralis* and *Melaleuca rhaphiophylla*. These two overstorey species comprise an estimated 53% of the canopy cover of REW (UFI 4585).

Plate 4: Degraded Vegetation within REW (UFI 4585)

3.5 Assessment of Wetlands

The Geomorphic Wetlands Swan Coastal Plain dataset is used to illustrate the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain.

- Three vegetation types occur within the site, though only one unit is present within the wetland area subject of this assessment ("Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12 m with occasional *Banksia littoralis* over grassland / herbland / sedgeland to scattered grasses / herbs / sedges dominated by weed species").

- The vegetation condition associated with REWs (UFI 4584 and UFI 4585) was determined to be "Degraded" (Figure 8).

- The wetland vegetation has been highly modified with no understorey vegetation remaining.
- No Threatened or Priority Flora (listed under the DPaW database of Threatened and Priority Flora Species) was recorded during the vegetation and flora survey.
- Agricultural infrastructure (dams) within the wetland buffer.

3.5.1 Proposed REW Open Space and Buffer

The NIA DSP advocates positioning a "Neighbourhood Connector" road through the two REWs (UFI 4584 and 4585). The total area between the REWs is 0.54 ha (Figure 7). The Lot 600 LSP removes the road and therefore the impacts from construction and operation of the road on the two REWs.

It is proposed to relocate the road to the west of the wetland buffer and revegetate the area between the two REWs, therefore increasing the core wetland area by 0.54 ha to a total core REW area of 12.25 ha (11.71 ha the existing REW area and 0.54 ha).

The Lot 600 LSP has been designed with a 30m buffer provided to the core of the two REWs (UFI 4584 and 4585) to protect the remaining environmental value of these wetlands.

3.5.1.1 Stakeholder Consultation

Consultation was undertaken with the SoM, (as the long-term manager of the REW and open space areas) regarding the long-term management of the REWs within Lot 600. The SoM supported a 30 m wetland buffer and the following management measures to protect the environmental values of the two REWs:

- provision of a buffer from the mapped edge of the wetland, primarily to retain the Melaleuca trees
- maintaining the ecological water requirements of the *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* trees
- revegetation of the core wetland area where the road was proposed in the DSP and agricultural dams
- surface water retention swales, batters from roads / paths within or adjacent to the wetland buffer planted using endemic species
- interface treatments between conservation areas and recreation areas.

Consultation was also undertaken with DPaW and Office of the Environmental Protection Authority (OEPA) regarding the wetland buffer arrangements provided for in the LSP.

DPaW stated as the SoM will be the future manager of the REW and open space areas, and given the resource enhancement wetland area is part of a larger palusplain wetland, the department will defer to the SoM to advise on an acceptable buffer width (Appendix 1).

The OEPA considered a 30m buffer for the two REWs (UFI 4584 and 4585) to be adequate, given the significant management measures negotiated with the SoM, to protect the remaining environmental values of the wetlands (Appendix 1).

3.5.1.2 Negotiated Wetland Buffer

Given the findings of the detailed wetland assessment (Section 3.5), and informed by the outcomes of the stakeholder consultation, it is considered that a 30 metre buffer for the two REWs (UFI 4584 and 4585) is appropriate and when coupled with the proposed management measures a net environmental benefit will be realised for the two REWs within Lot 600.

The LSP design and proposed management measures responds to the SoM, DPaW and OEPA supported outcome.

3.6 Flora and Vegetation

3.6.1 Desktop Assessment

According to Heddle et al. (1980) the vegetation unit within the site belongs to the Bassendean Complex – Central and South, which is associated with underlying Bassendean Sands and S8 Sands (Figure 9).

The Bassendean Complex – Central and South vegetation unit is described as ranging from woodland of *Eucalyptus marginata – Casuarina fraseriana – Banksia* spp. to a low woodland of *Melaleuca* species, and sedgelands on the moister sites (Swan Catchment Council 2004).

3.6.1.1 Threatened and Priority Flora

A search was undertaken on 29 August 2011 of the then Department of Environment and Conservation's Threatened Flora database, Declared Rare and Priority Flora List and the Western Australian Herbarium Specimen database for priority species opportunistically collected within a 5 km radius of the site.

There was one species of Threatened Flora (*Drakaea elastica*) and 10 species of Priority Flora identified as occurring within the search area (Table 9). The spatial information for the known distribution of Threatened and Priority flora species that occurs in close proximity to the site is presented in Figure 9.

Table 9: Threatened and Priority Flora Species

Species / Taxon	Conservation Code
Drakaea elastica	Threatened
Acacia benthamii	Priority 2
Acacia lasiocarpa var.*bracteolata long peduncle variant* (G.J. Keighery 5026)	Priority 1
Boronia capitata subsp. *gracilis*	Priority 2
Caladenia speciosa	Priority 4
Dillwynia dillwynioides	Priority 3
Eryngium pinnatifidum subsp. *palustre*	Priority 3
Eucalyptus rudis subsp. *cratyantha*	Priority 4
Jacksonia sericea	Priority 4
Johnsonia pubescens subsp. *cygnorum*	Priority 2
Parsonsia diaphanophleba	Priority 4

3.6.1.2 Threatened and Priority Ecological Communities

A search of DPaW's Threatened Ecological Communities (TEC) database within a 5 km radius of the site. There were no known occurrences of TECs recorded for this search. Two Priority 3 Ecological Communities were recorded as occurring within two km of the search area. These communities are identified as:

- "Priority 3" ecological community – Northern Spearwood shrublands and woodlands (SCP24)
- "Priority 3" ecological community – Southern *Eucalyptus gomphocephala–Agonis flexuosa* woodlands (SCP25).

3.6.1.3 Flora and Ecological Communities Protected Under the EPBC Act

The EPBC Act Protected Matters Search Tool identifies critically endangered and endangered plant species that may be present upon the site and surrounding areas. It is only designed to provide an indication of species that may be present in an area.

No federally listed TECs are identified as occurring within the search area (Appendix 2).

3.6.2 Site Inspection

A site inspection of the site was undertaken in 2011 by RPS. The site inspection comprised of a visual analysis of the vegetation present upon the site, a bushland condition assessment and targeted search for any Threatened and Priority Flora listed in Table 9.

3.6.2.1 Visual Analysis

The visual analysis identified three distinct areas of remnant vegetation, which are dominated by overstorey tree species. The extent of the three distinct areas is defined by the boundary of two REWs (UFI 4584 and UFI 4585) and one MUW (UFI 14609).

Using descriptions developed by Beard (1990) of plant communities based on the structural forms of Australian vegetation the three distinct areas are described as being comprised of Woodland to Open Woodland of *Eucalyptus rudis* subsp. *rudis* over Open Low Forest to Closed Low Forest of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* over introduced pasture species, dominated by agricultural weed species (Plates 3 and 4).

Plate 5: ***Eucalyptus rudis* subsp. *rudis* Fringing the Edge of MUW (UFI 14609) with Understory of Introduced Pasture Species**

Plate 6: ***Melaleuca* sp. Fringing the REW (UFI 4584) with an Understory of Introduced Pasture Species**

Outside of these identified areas the remaining vegetation is described as comprising of an Open Low Woodland of *Melaleuca* sp. and *Eucalyptus rudis* subsp. *rudis* over an understory consisting of introduced pasture species, dominated by agricultural weed species (Plates 5 and 6).

Table 10 identifies the native flora species recorded as occurring upon the site during the site inspection.

Table 10: Native Flora Species

Species	Status
Astartea scoparia, *Astartea scoparia*	Not threatened
Pale rush, *Juncus pallidus*	Not threatened
Swamp banksia, *Banksia littoralis*	Not threatened
Moonah, *Melaleuca preissiana*	Not threatened
Swamp paper bark, *Melaleuca rhaphiophylla*	Not threatened
Marri, *Corymbia calophylla*	Not threatened
Flooded gum, *Eucalyptus rudis* subsp. *rudis*	Not threatened
Pimpernel sundew, *Drosera glanduligera*	Not threatened

3.6.2.2 Vegetation Condition Assessment

Using the vegetation condition scale used in Bush Forever (Government of Western Australia 2000), the condition of the vegetation across the site is classified as "Degraded" within the REWs and MUW (UFI 14609) and in areas described as Open Woodland of *Eucalyptus rudis* subsp. *rudis* over Open Low Forest to Closed Low Forest of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* over introduced pasture species, dominated by agricultural weed species to "Completely Degraded" over the majority of the remaining extent of MUW (UFI 15802).

3.6.3 Level 2 Flora and Vegetation Survey

Coffey Environments undertook a Level 2 flora and vegetation survey undertaken for Lots 91†, 92 and 604, Nambeelup, which is consistent with the EPA's Guidance Statement No. 51 – *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004a).

Coffey Environments undertook:

- a desktop assessment
- field surveys on 30 September to 1 October and 11 December 2008.

The report Flora and Fauna Assessments, Lots 91, 92 and 604, Nambeelup Industrial Study Area (Coffey Environments 2009) is provided in Appendix 3.

The results of the Level 2 flora and vegetation survey is mapped on Figure 8 and summarised below:

- Two distinct vegetation complexes were identified as occurring upon the site
  - Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12 m with occasional *Banksia littoralis* over grassland / herbland / sedgeland to scattered grasses / herbs / sedges dominated by weed species
  - Scattered Trees of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12 m over pasture species with scattered patches of *Juncus pallidus* 1.3 m.
- Using the vegetation condition scale used in Bush Forever (Government of Western Australia 2000), the site is identified as being in "Degraded" to "Completely Degraded" condition.
- There were no TECs or Priority Ecological Communities recorded within the survey area.

† Lot 91 Nambeelup is now known as Lot 600 Lakes Road, Stake Hill.

- There were no Threatened or Priority Flora species recorded within the survey area.

- The report notes the majority of the annual and ephemeral flora species, including the Threatened orchid species (*Caladenia huegelli*, *Diuris drummondii*, *Diuris micrantha* and *Drakea elastica*) would have been identifiable during the Level 2 flora and vegetation survey.

- The report notes the vegetation within the survey area is too degraded with minimal understorey for *Drakea elastica* to survive.

3.6.4 Conclusions

The results of the desktop assessments, site investigation and Level 2 flora and vegetation survey provide the following key findings:

- The native vegetation within the site is considered to be in a "Degraded" to "Completely Degraded" condition using the Bush Forever vegetation condition scale (Government of Western Australia 2000).

- There is a very high occurrence of agricultural weeds / pasture species within the site.

- No Threatened or Priority Flora, Threatened or Priority Ecological Communities protected under federal or state legislation were recorded upon site.

3.7 Terrestrial Fauna

Consistent with the EPA's Guidance Statement No. 56 – *Terrestrial Fauna Survey for Environmental Impact Assessment in Western Australia* (EPA 2004b), Coffey Environments undertook a Level 1 fauna survey for Lots 91, 92 and 604, Nambeelup.

Coffey Environments undertook a:

- desktop assessment
- field investigation on 28 November 2008.

The report *Flora and Fauna Assessments, Lots 91, 92 and 604, Nambeelup Industrial Study Area* (Coffey Environments 2009) is provided in Appendix 3.

3.7.1 Habitat Types

Coffey Environments (2009) recorded the following fauna habitats within the survey area:

1. Open paddock.
2. Paddock with dispersed Melaleuca.
3. Melaleuca thicket.
4. Paddock with Eucalyptus.
5. Paddock with *Juncus*.

3.7.2 Protected Fauna

DPaW's Threatened Fauna and Priority Fauna database search results (from a five km radius of the site) are listed below in Table 11.

Table 11: Threatened and Priority Fauna Species

Species	Common Name	Likelihood of Occurrence on Site
Schedule 1 – Fauna that is rare or is likely to become extinct		
Calyptorhynchus banksii naso	Forest red-tailed black cockatoo	The forest red-tailed black cockatoo occurs in a range of forests and woodlands, however prefer jarrah–marri forests and nests in hollows of trees such as marri, jarrah and karri. Coffey Environments (2009) identifies that forest red-tailed black cockatoo was recorded during the site visit of the survey area and that the likely location or specific habitat for the forest red-tailed black cockatoo are the marri trees located on Lot 604.
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	The Carnaby's Black-Cockatoo prefers Eucalypt woodlands containing salmon gum, wandoo, hakea, banksia and grevillea. Remnant vegetation upon the site may potentially provide limited habitat Carnaby's Black-Cockatoo, however is not considered significant habitat. Coffey Environments (2009) identifies that it is likely Carnaby's Black-Cockatoo would occasionally utilise the marri trees in Lot 604 for foraging.
Dasyurus geoffroii	Western quoll	The western quoll occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors. It currently survives only in south-western Western Australia, in areas dominated by eucalypt forest or woodland and mallee shrubland and also persists amongst rocky outcrops. Coffey Environments (2009) identifies that it is considered highly unlikely to occur within the survey area due to the degraded nature of the site and lack of records in recent surveys nearby and in similar habitats.
Myrmecobius fasciatus	Numbat	Current populations of numbat are known to inhabit upland jarrah forest, open eucalypt woodland, Banksia woodland and tall closed shrubland. There is no vegetation present upon the site which would provide habitat for the numbat. Coffey Environments (2009) identifies that it is considered highly unlikely to occur within the survey area.

Species	Common Name	Likelihood of Occurrence on Site
Priority 4 – Taxa in need of monitoring		
Numenius madagascariensis	Eastern curlew	The eastern curlew is widespread in coastal regions in the north east and south of Western Australia and is rarely seen inland. The eastern curlew is found on intertidal mudflats and sandflats, often with beds of seagrass, on sheltered coasts, especially estuaries, mangrove swamps, bays, harbours and lagoons. Coffey Environments (2009) identifies that it is considered unlikely the eastern curlew would utilise the survey area because no suitable habitat exists for the species.
Priority 5 – Taxa in need of monitoring (conservation dependent)		
Isoodon obesulus fusciventer	Southern brown bandicoot	The southern brown bandicoot prefers dense, scrubby, often swampy, vegetation with very dense cover. Coffey Environments (2009) identifies that it is considered likely that the densely vegetated wetland areas on Lot 92 to contains high quality habitat for this species.

The EPBC Act Protected Matters Search Tool identifies a range of endangered and vulnerable species that have potential to utilise the site and surrounding areas. It is only designed to provide an indication of species that may be present in an area. Table 12 identifies the fauna species that have the potential to utilise the site.

Table 12: Fauna Species that have Potential to Utilise the Site

Species	Common Name	Conservation Status	Likelihood of Occurrence
Birds			
Botaurus poiciloptilus	Australasian bittern	Endangered	The Australasian bittern's preferred habitat is comprised of permanent and seasonal freshwater habitats. It may potentially utilise the wetlands on the site, however the environment in the surrounding areas would be more preferential habitat for the species.
Calyptorhynchus banksia naso	Forest red-tailed black cockatoo	Vulnerable	The forest red-tailed black cockatoo occurs in a range of forests and woodlands, however prefer jarrah-marri forests and nests in hollows of trees such as marri, jarrah and karri. Coffey Environments (2009) identifies that forest red-tailed black cockatoo was recorded during the site visit of the survey area and that the likely location or specific habitat for the forest red-tailed black cockatoo are the marri trees located on Lot 604.
Calyptorhynchus baudinii	Baudin's black cockatoo	Vulnerable	Baudin's black cockatoo occurs in the deep south-west of Western Australia. Birds generally breed in the karri, marri and wandoo forests in the southern parts of the species" range and move north to the Darling Range and Swan Coastal Plain during autumn and winter (non-breeding period). Baudin's black cockatoo is most common in heavily

Species	Common Name	Conservation Status	Likelihood of Occurrence
			forested areas dominated eucalyptus sp. such as karri and jarrah. Coffey Environments (2009) identifies that Baudin's black cockatoo is unlikely to occur in the survey area.
Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	Endangered	The Carnaby's Black-Cockatoo prefers eucalypt woodlands containing salmon gum, wandoo, hakea, banksia and grevillea. Remnant vegetation upon the site may potentially provide limited habitat Carnaby's Black-Cockatoo, however is not considered significant habitat. Coffey Environments (2009) identifies that it is likely Carnaby's Black-Cockatoo would occasionally utilise the marri trees in Lot 604 for foraging.
Stenula nereis nereis	Fairy tern (Australian)	Vulnerable	The fairy terns utilise a variety of habitats including offshore, estuarine or lake islands, wetlands, beaches and splits. It may potentially utilise the wetlands on the site, however the environment in the surrounding areas would be more preferential habitat for the species.
Apus pacificus	Fork-tailed swift	Migratory	The fork-tailed swift mostly occurs over dry or open habitats and are also found in settled areas. It may potentially utilise the open areas of the site, however the environment in the surrounding areas would be more preferential habitat for the species.
Ardea alba	Great egret	Migratory	The white egret occurs in a wide range of wetland habitats and although unlikely to occur on the site, may potentially utilise the wetlands. Coffey Environments (2009) identifies that this species may occur in the survey area but it is unlikely to rely on the habitat for survival.
Ardea ibis	Cattle egret	Migratory	The cattle egret typically occurs in temperate and tropical grasslands, wooded areas and terrestrial wetlands. Coffey Environments (2009) identifies that it could possibly occur within the survey area but it is unlikely to rely on the habitat for survival.
Haliaeetus leucogaster	White bellied sea eagle	Migratory	The white bellied sea eagle prefers habitats characterised by the presence of large areas of open water and is found in coastal habitats and around wetlands. Coffey Environments (2009) identifies that the white bellied sea eagle is known to utilise vegetation on Lot 604 as breeding habitat.

Species	Common Name	Conservation Status	Likelihood of Occurrence
Mammals			
Dasyurus geoffroii	Western quoll	Vulnerable	The western quoll occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors. It currently survives only in south-western Western Australia, in areas dominated by eucalypt forest or woodland and mallee shrubland and also persists amongst rocky outcrops. Coffey Environments (2009) identifies that it is considered highly unlikely to occur within the survey area due to the degraded nature of the site and lack of records in recent surveys nearby and in similar habitats.
Phascogale calura	Red-tailed Phascogale	Endangered	Red-tailed phascogale are restricted to remnants of native vegetation throughout the wheat belt of south-western Western Australia. Due to its restricted distribution it is considered unlikely that the red-tailed phascogale occurs upon the site.
Setonix brachyurus	Quokka	Vulnerable	The quokka prefers dense riparian vegetation, however is also found in heaths and shrublands of the coast. Due to its restricted distribution it is considered unlikely it is considered unlikely that quokkas occur on the site or in the immediate vicinity.

3.7.2.1 Black Cockatoos

Carnaby's Black-Cockatoo, *Calyptorhynchus latirostris,* is listed as "Endangered" under the EPBC Act due to population decline and limited geographical distribution. The estimated number of mature individuals is considered to be extremely low (Commonwealth Department of Environment and Energy 2011).

Baudin's black cockatoo, *Calyptorhynchus baudinii,* and the forest red-tailed black cockatoo, *Calyptorhynchus banksii naso,* are listed as "Vulnerable" under the EPBC Act due to population decline and limited geographical distribution. The estimated number of mature individuals was considered to be extremely low (Commonwealth Department of the Environment 2011).

The Commonwealth Department of the Environment and Energy (DEE) released EPBC Act Draft Referral Guidelines for all three of these threatened black cockatoo species in July 2011 (the guidelines) (Commonwealth of Australia 2011). The guidelines are intended to assist proponents in determining whether a particular action, for instance the removal of native vegetation from a landholding, needs to be referred to the DEE (Commonwealth of Australia 2011) for its consideration.

DPaW prepared a species list of plants which are used by Carnaby's Black-Cockatoo for foraging, nesting and roosting (DPaW 2011) (Appendix 4). The Commonwealth DEE considers any established tree which may offer roosting, nesting and/or foraging within the identified species range should be regarded as potential habitat for the black cockatoo species.

Nesting Habitat Assessment

Coffey Environments (2009) identifies there are no suitable breeding hollows within the site.

Foraging Habitat Assessment

The site investigation, undertaken by RPS on 2 September 2011, indicates there are very limited black cockatoos foraging habitat within the site. However, the following tree species are identified as occurring upon the site with the potential to provide foraging and roosting habitat (DPaW 2011):

- *Banksia littoralis* (swamp banksia)
- *Eucalyptus rudis* subsp. *rudis* (flooded gum)
- *Corymbia calophylla* (marri).

The site investigation undertaken by RPS, found no evidence of black cockatoos utilising the fruit of the *Banksia littoralis* trees or the one *Corymbia calophylla* tree as a food source.

Coffey Environments (2009) recorded the forest red-tailed black cockatoo as occurring within the survey area during the site visit and that the forest red-tailed black cockatoo occasionally utilise the marri trees located in Lot 604 for foraging.

Roosting Habitat Assessment

Anecdotal evidence suggests that Carnaby's Black-Cockatoo return to the same roost sites from year to year with roost sites primarily being tall eucalypt trees with dense canopies (Shah 2006). There are no known Carnaby's Black-Cockatoo or forest red-tailed black cockatoo roost sites within the site.

3.7.2.2 Tree Survey

A site visit was undertaken in 2011 by RPS to identify if any potential Carnaby's Black-Cockatoo nesting trees occur on the site.

RPS recorded a number of *Eucalyptus rudis* subsp. *rudis* trees as having a Diameter at Breast Height (DBH) of greater than 500 millimetres (mm). None of the recorded trees had evidence of any hollows deemed suitable as current nest sites for Carnaby's Black-Cockatoo. Opportunistic searches below the *Eucalyptus rudis* subsp. *rudis* trees identified

no evidence of Carnaby's Black-Cockatoo feeding activity. No black cockatoos were observed utilising the site.

Eighty *Eucalyptus rudis* subsp. *rudis* trees meet the Commonwealth's DEE 2011 definition for breeding habitat for the Carnaby's Black-Cockatoo. The site is, however, outside of the defined breeding range indicated in the guidelines.

In accordance with the Commonwealth's definition, specifically the following:

> habitat that meets the definition set out here, but is outside of the predicted breeding range, is considered breeding habitat unless proven otherwise.

RPS notes:

- The site is outside of the predicted breeding range of the Carnaby's Black-Cockatoo.
- Coffey Environments (2009) states that no breeding hollows for black cockatoos were observed during the site visit.
- None of the trees recorded by RPS' tree survey had hollows deemed suitable as current nest sites for Carnaby's Black-Cockatoo.
- Coffey Environments (2009) identifies the likely location or specific habitat for Carnaby's Black-Cockatoo within the study area is Lot 604 and they may occasionally use the few available marri trees in Lot 604 for foraging.

Given this information, RPS considers the site does not contain habitat considered to be significant breeding or foraging habitat for either the Carnaby's Black-Cockatoo or forest red-tailed black cockatoo.

3.7.3 Conclusions

- No Protected Fauna were recorded by Coffey Environments (2009) upon the site.
- Coffey Environments (2009) identified the survey area contains habitat that is generally degraded due to significant impact by previous land uses. The habitat would generally be assessed as either Disturbed Fauna Habitat or Highly Degraded Fauna Habitat and is unlikely to contain a unique fauna assemblage.
- The site does not contain habitat considered to be significant breeding or foraging habitat for either the Carnaby's Black-Cockatoo or the forest red-tailed black cockatoo.

- The Nambeelup DSP has allocated approximately 24 hectares of the western portion of Lot 604, which contains vegetation, (excluded from the proposed industrial area) based upon further investigations undertaken by the Department of Planning. Although this vegetation is not identified as a RSNA in the Swan Bioplan, this vegetation is considered important to be protected, given the broader strategic planning considerations relating to the protection of black cockatoo potential foraging, roosting and/or breeding habitat within the DSP area. This area of vegetation has been included as "Open Space" area on the DSP.

3.8 Human Health

The contaminated sites legislation in Western Australia has been formulated to protect the health of the local population and safe guard the natural environment from serious harm. Under the *Contaminated Sites Act 2003*, polluted sites may need to be investigated and ameliorated, if required, to protect the interests of the owners and occupiers of the specific landholding.

A search of the DER's Contaminated Sites Database was undertaken on 9 June 2016. No matches were recorded for the site, however Lots 109 on Plan 741 and 230 Gull Road, Nambeelup, which are located adjacent to the site in a north-easterly direction, are both listed as "Contaminated – restricted use" (Appendix 5). Contaminated Sites 18729 and 18730 are located diagonally adjacent to the site (Figure 10).

The Basic Summary of Records Search Response identifies that at the time of classification, 19 March 2010, the potential contaminants of concern appear to be contained on the sites such that human and environmental receptor exposure is restricted. Periodic monitoring of soil and ground water quality at the sites is required in accordance with licence conditions, to assess if there is any movement of contaminants in groundwater at the sites.

There are elevated concentrations of ammonia present in groundwater beneath the sites. The land use of the sites is restricted to the current rural industrial / intensive agricultural land use and similar rural uses.

From analysis of the historical imagery contained upon the Landgate Map Viewer the land use of the keeping of cattle upon the site appears to be the only historical factor with the potential to cause soil and groundwater contamination. This is due to the potential for historical applications of fertilisers, pesticides or herbicides to be above manufacturer's current recommendations for a specific item and therefore, there is a possibility these contaminants may be present in elevated concentrations upon the site.

3.9 Social Surroundings

3.9.1 Aboriginal Heritage

An Aboriginal Heritage assessment has been undertaken for Lot 600 inclusive of engagement with the Department of Aboriginal Affairs and Tradition Owner groups. This report is provided as part of the LSP planning documentation and confirms that there are no significant Aboriginal Heritage concerns.

3.9.2 European Heritage

A search of the Heritage Council of Western Australia's Places Database was undertaken on 9 June 2016 and no matches were found for the site. The Places Database allows members of the general public to search for places or sites listed on the State Register of Heritage Places. The State Register of Heritage Places is managed by the Heritage Council of Western Australia (Government of Western Australia 2011).

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4.0 POTENTIAL ENVIRONMENTAL IMPACTS AND MANAGEMENT MEASURES

4.1 Terrestrial Environmental Quality

4.1.1 EPA Objective

To maintain the quality of land and soils so that environmental values are protected.

4.1.2 Potential Impacts

Due to the low-lying nature of the region and high groundwater levels the potential impacts relate to the potential for oxidation of excavated or in-situ PASS generating acidic conditions, and possibly releasing metals into the groundwater.

4.1.3 Environmental Management Measures

A preliminary ASS investigation will need to be conducted to confirm the presence or absence of ASS prior to any site earthworks.

ASS and Dewatering Management Plan to be prepared, if required, to the satisfaction of DER at subdivision approval stage.

4.1.4 Proposed/Predicted Outcome

Through the implementation of the ASS and Dewatering Management Plan, outlined above, to mitigate potential adverse effects on the natural environment of the site posed by potential ASS the future subdivision can be implemented in accordance with the objectives of the EPA and DER.

4.2 Hydrological Processes

4.2.1 EPA Objectives

To maintain the hydrological regimes of groundwater and surface water so that environmental values are protected.

4.2.2 Potential Impacts

Surface and groundwater of the site have the potential to be impacted by a variety of activities including:

- Groundwater level changes can occur as a result of a change in land use.

- Removal of vegetation and installation of impervious surfaces can lead to an increase in run-off during rainfall events.
- Future development may lead to industrial generated pollutants such as hydrocarbons, metals and sediment being discharged via run-off and influencing the soil profile and ultimately, the groundwater quality.
- Nutrient loading to the groundwater and surface water can occur.
- Stormwater drainage can facilitate the transportation of potential contaminants and litter through the site.

Additionally, the proposed development of the site will lead to an improvement in the quality of drainage water through the cessation of cattle grazing in and around drainage lines, and treatment of drainage water prior to its movement across the site.

4.2.3 Environmental Management Measures

To ensure that the quantity and quality of surface water and ground water within the site, and to the Peel Inlet–Harvey Estuary system, is not adversely impacted by the proposed LSP a carefully designed water sensitive approach to management the total water cycle will be delivered by the LWMS and Urban Water Management Plan(s) (UWMP).

The LWMS has been prepared by JDA Consultant Hydrologists to support the proposed LSP. The principles of total water cycle management as outlined in *Better Urban Water Management* (WAPC 2008b) will be used here. These principles are:

1. Consideration of all water resources, including wastewater, in water planning.
2. The sustainable and equitable use of all water sources, having consideration of the needs of all water users, including the community, industry and the environment.
3. Integration of human water use and natural water processes.
4. A whole-of-catchment integration of natural resource use and management.

Water Sensitive Urban Design (WSUD) principles from *Peel–Harvey WSUD Local Planning Policy* developed by the Peel Development Commission (PDC 2006) will also been used. These principles in order of priority are as follows:

1 Provide protection to life and property from flooding that would occur in a 100-year Average Recurrence Interval flood event.

2 Manage rainfall events to minimise run-off as high in the catchment as possible and maximise infiltration.

3 Retain and restore existing elements of the natural drainage system.

4 Maximise water use efficiency, reduce potable water demand and maximise the re-use of water harvested.

5 Minimise pollutant inputs through implementation of appropriate non-structural source controls and structural controls.

General objectives of WSUD from WAPC (2008b), as adapted from the *Stormwater Management Manual for WA*, Department of Water 2004–2007, are:

1. To manage a water regime:
   - Maintain appropriate aquifer levels, recharge and surface water characteristics in accordance with assigned beneficial uses.
   - Manage groundwater recharge sustainably.
   - Prevent flood damage in developed areas.
   - Prevent excessive erosion of waterways, slopes and banks.
2. To maintain and, where possible, enhance water quality:
   - Minimise waterborne sediment loading.
   - Protect riparian vegetation.
   - Minimise the export of pollutants such as phosphorus and nitrogen to surface or groundwater.
   - Prevent groundwater acidification processes.
   - Minimise the export and impact of pollution from sewerage.
3. To encourage water conservation:
   - Minimise the import and use of scheme water.
   - Promote the sustainable use of rainwater.
   - Promote the sustainable re-use and recycling of wastewater.
   - Reduce irrigation requirements.
   - Promote opportunities for localised supply.

4. To maintain and, where possible, enhance water-related environmental values.

5. To enhance water-related recreational and cultural values.

Principles of stormwater management as a component of water sensitive urban design from WAPC (2008b), as adapted from the *Stormwater Management Manual for WA*, Department of Water 2004–2007, are to:

- Protect natural systems – protect and enhance natural water systems and their hydrological regimes in urban developments.
- Integrate stormwater treatment into the landscape – use stormwater in the landscape by incorporating multi-use corridors that maximise the visual and recreational amenity of developments.
- Protect water quality – protect from draining from urban development and minimise outputs of phosphorous, nitrogen and other pollutants.
- Manage run-off and peak flows – reduce peak flows from urban developments by using local detention measures and minimising impervious areas.
- Add value while minimising development costs – minimise the drainage infrastructure cost of development.

4.2.4 Proposed/Predicted Outcomes

The dedicated drainage area and roadside swales will replicate the pre-development hydrological regime of rainfall collection and infiltration at source. The roadside swales will facilitate the function of removing pollutants, for example nutrients and gross particles, from the surface water run-off within the site thereby assisting in reducing nutrient input into the Peel Inlet-Harvey Estuary system.

Through the preparation of a LWMS and future UWMP(s), outlined in the above Sections, to mitigate potential adverse impacts to the local water cycle within the site, the proposed LSP and future subdivision can be implemented in accordance with the objectives of the EPA.

4.3 Inland Waters Environmental Quality

4.3.1 EPA Objectives

To maintain the quality of groundwater and surface water so that environmental values are protected.

4.3.2 Potential Impacts

Wetlands can be impacted by a variety of activities:

- alterations to flow regimes
- land use conflict
- future development may lead to industrial generated pollutants, such as nutrients, hydrocarbons, metals and sediment, being discharged via run-off and influencing the water chemistry of the wetlands retained on site
- stormwater drainage can facilitate the transportation of potential contaminants (e.g. litter) through to the two RE wetlands.

4.3.2.1 Multiple Use Wetlands

The impacts to the MUWs within the site are minimal as these wetlands are in a "Completely Degraded" condition and are considered suitable for development.

4.3.2.2 Resource Enhancement Wetlands

The two REWs will be retained and protected within the LSP design and it is anticipated that impacts to the wetland will be minimal. However, potential impacts to this wetland due to the proposed surrounding development include:

- accidental clearing of wetland vegetation
- erosion and sedimentation as a result of earthworks
- ASS impacts resulting from earthworks or dewatering
- changes to hydrology through changes in surface water flows and subsoil drains.

4.3.3 Environmental Management Measures

The LSP increases the core wetland habitat area by 0.54 ha. The two REWs which currently cover an area of approximately 11.71 ha with an additional 0.54 ha incorporated into the core wetland area.

The wetland management measures will include:

- preparation of a Wetland Management Plan (WMP) to the satisfaction of SoM and DPaW at subdivision approval stage
- preparation of UWMP(s) to the satisfaction of the SoM and DoW at subdivision approval stage.

4.3.3.1 REW Rehabilitation

It is proposed to relocate the road current defined in the DSP to the west of the wetland buffer and revegetate the area between the two REWs, therefore increasing the core wetland area by 0.54 ha to a total core REW area of 12.25 ha (11.71 ha the existing REW area and 0.54 ha). The revegetation works will be detailed in a WMP and it will include the following:

- revegetation of the 0.54 ha core wetland area where the road was proposed in the DSP and agricultural dams
- revegetation of the key surface water management areas (e.g. bio-retention swales) using endemic plant species.

4.3.3.2 Integration with Surrounding Development

It is proposed the two REWs buffer and associated open space will accommodate the following uses:

- re-vegetation
- bio-retention swales
- paths.

Interface treatments proposed for protection of the REW will be detailed in a WMP and a landscape plan.

4.3.4 Proposed/Predicted Outcome

The NIA DSP advocates positioning a "Neighbourhood Connector" road through the two REWs (UFI 4584 and 4585). The total area between the REWs is 0.54 ha (Figure 7). The Lot 600 LSP removes the road and therefore the impacts from construction and operation of the road on the two REWs.

It is proposed to relocate the road to the west of the wetland buffer and revegetate the area between the two REWs, therefore increasing the core wetland area by 0.54 ha to a total core REW area of 12.25 ha (11.71 ha the existing REW area and 0.54 ha).

Consultation has been undertaken with the SoM, DPaW and the OEPA with the following management measures to protect the environmental values of the two REWs agreed to:

- provision of a buffer from the mapped edge of the wetland, primarily to retain the Melaleuca trees

- maintaining the ecological water requirements of the *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* trees by incorporating the infiltration of surface waters within the wetland buffer
- revegetation of the core wetland area where the road was proposed in the DSP
- surface water retention swales, batters from roads / paths within or adjacent to the wetland buffer planted using endemic species
- interface treatments between conservation areas and recreation areas.

4.4 Flora and Vegetation

4.4.1 EPA Objectives

To protect flora and vegetation so that biological diversity and ecological integrity are maintained.

4.4.2 Potential Impacts

The potential impacts to native vegetation within the site from the LSP include:

- removal of vegetation within the site with the exception of those areas proposed to be retained
- degradation of retained vegetation through uncontrolled access.

4.4.3 Management Measures

The environmental management measures will include the preparation of a WMP to the satisfaction of SoM and DPaW at subdivision approval stage.

4.4.4 Proposed/Predicted Outcome

The retained REWs will be protected and have long-term management plans invoked to ensure their attributes and functions are conserved, thereby protecting the associated flora and fauna.

Through the implementation of the WMP, outlined above, to mitigate potential adverse impacts to the flora and vegetation at site, the proposed LSP and future subdivision can be implemented in accordance with the objectives of the EPA.

4.5 Terrestrial Fauna

4.5.1 EPA Objectives

To protect terrestrial fauna so that biological diversity and ecological integrity are maintained.

4.5.2 Potential Impacts

The threatening process in general to fauna and habitat relevant to the site include:

- loss of habitat through clearing
- land clearing and vehicle movement may result in death or injury of fauna as a result of collisions
- species interactions, including predation and competition
- disturbance of fauna from noise and human disturbance.

4.5.3 Management Measures

The environmental management measures will include the preparation of a WMP to the satisfaction of SoM and DPaW at subdivision approval stage.

4.5.4 Proposed/Predicted Outcome

The retained wetlands will be protected and have long-term management plans invoked to ensure their attributes and functions are conserved for perpetuity.

Through the implementation of the WMP, outlined above, to mitigate potential adverse impacts to the fauna with the site, the proposed LSP and future subdivision(s) can be implemented in accordance with the objectives of the EPA.

4.6 Human Health

4.6.1 EPA Objective

To protect human health from significant harm.

4.6.2 Potential Impacts

The potential impacts relate to the potential for contaminated soils or groundwater to be unearthed during development activities.

The redevelopment of the site for industrial purposes will result in the reduction and removal of many potentially contaminating activities and land uses. Reduced agricultural activities will substantially reduce levels of nutrients, trace metals and pesticides entering soils and groundwater, and in turn, the Peel–Harvey System.

4.6.3 Management Measures

A Preliminary Site Investigation is recommended be undertaken across the site according to the methodology detailed in the Contaminated Sites Guidelines (DER 2014) prior to construction.

4.6.4 Proposed/Predicted Outcome

Through the implementation of a PSI, outlined above, to mitigate potential adverse effects on the natural environment of the site posed by potential contamination the proposed LSP can be implemented in accordance with the objectives of the EPA.

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5.0 CONCLUSIONS

The proposed LSP for Lot 600 recognises the importance of the key environmental and landscape attributes of the area, and incorporates these in an urban form to create an environmentally responsive urban development which meets the EPA and SoM's environmental requirements. Consequently, the environmental outcomes of the proposed LSP are considerable and include:

- providing an improvement in groundwater and surface water quality through the development and implementation of water sensitive urban design and best stormwater drainage management practices
- incorporation of REWs within the LSP to protect the environmental attributes of these wetlands
- landscaping and enhancing the existing vegetation within the two REWs
- consistency with the NIA DSP and the Draft Perth and Peel Green Growth Plan.

Table 2 outlines the key environmental factors, the environmental objectives which relate to the proposal and presents the proposed management measures that will be invoked to manage the environmental values of the site in accordance with the objectives of the EPA.

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Job Number: L1619901
Doc Number: 001
Date: 27.10.16
Scale: Map 1:15,000 Overview 1:750,000 @ A4
Created by: MA
Source: Imagery - Landgate

GDA 1994 MGA Zone 50
0 125 250 500 m

Figure 1

Site Location

Linear open space to contain a drainage 'spillway' and fixed drainage alignment. Also forms part of a buffer for a resource enhancement wetland on Lot 93 Readheads Road.

Resource enhancement wetland and the associated 50 metre buffer contained in open space.

Proposed important neighbourhood connector and public tranport route traverses between two resource enhancement wetlands.

The exact size and location of the commercial support centre site will be determined at the local structure planning stage.

Approximately 24 hectares of remnant vegetation included in open space as it is considered an important potential Black Cockatoo foraging, roosting, and/or breeding habitat.

Potential to identify specific areas along Lakes and Paterson Roads for service commercial or light industry at the local planning stage.

Drainage areas shown in approved local structure plan for Lot 530 Lakes Road.

Remnant vegetation on Lot 212 Lakelands Road identified as being of regional significance contained in open space.

Lot 89 is known to provide habitat for avifauna species protected under Environmental Protection and Biodiversity Conservation Act (1999) and may be subject to further assessment. Consultation with EPA will be required in regard to potential impacts to avifauna and fauna survey requirements at rezoning stage.

'Stepping stone' north-south ecological corridor utilising proposed open space and potential drainage areas. To be investigated as part of the local structure planning stage.

Resource Enhancement category wetland and associated 50 metre buffer included within open space.

Major infrastructure services to and from a future Water Corporation facility on Lot 88 Nambeelup Road expected to be accommodated in the ultimate road reserve for Readheads Road.

Depending upon the findings of further transport modelling, it may be determined that a section of Nambeelup Road may only need to be constructed as an Integrator B road (two lanes).

North-south open space area through Lot 221 Lakes Road contains conservation category and resource enhancement wetlands and an area of remnant vegetation. Portion of this open space is also to be used for drainage.

50 metre wide foreshore reserve proposed along most of the length of Nambeelup Brook.

Small rural area retained north of Nambeelup Brook which contains two existing residences.

Notes

1: Identified local and regional ecological linkages to be investigated in further detail at local structure planning stage, taking into account the guiding principles outlined in South West Regional Ecological Linkages – Technical Report (2009).

2: Any rezoning, local structure planning and/or development proposals prior to finalisation of the SAPPR within areas identified for industrial purposes may be subject to referrals under the EPBC Act 1999.

Site Boundary

N

0 250 500

Metres

Map shown @ Scale 1:20,000 for A3 Size Paper

Produced by:
Mapping & GeoSpatial Data Branch
Department of Planning, WA
On behalf of:
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Nts-man\Gis\ArcGIS\PRS GIS Data\
Gis Project Data Storage\Project Workspace\
NambeelupIndustrialDistrictStructurePlan\
MXD\Final\MXDs\A3_Final\MXD\
Figure2_NambeelupIndustrialDSP

Base information supplied by:
Western Australian Land Information Authority
LI 782-2015-1

District arterial drainage information supplied by:
JDA Consulting Hydrologists

Legend

Nambeelup District Structure Plan

- Industrial
- Potential Commercial Support Centre (Note: Location indicative only.)
- Service Commercial/ Light Industry
- Open Space
- Regional Ecological Linkage
- Local Ecological Linkage
- Airpark and Related Landuses
- Rural
- Drainage
- Possible local drainage storage area. Location and size illustrative only. The location and size to be determined at the local structure planning stage.
- Primary Regional Roads
- Integrator A
- Integrator B
- Important Neighbourhood Connector
- Controlled Intersection
- Possible Public Transport Route

District Arterial Drainage

- Fixed Alignment
- Flexible Alignment
- Retained Natural Flow Path
- Cadastre
- Project Area Boundary

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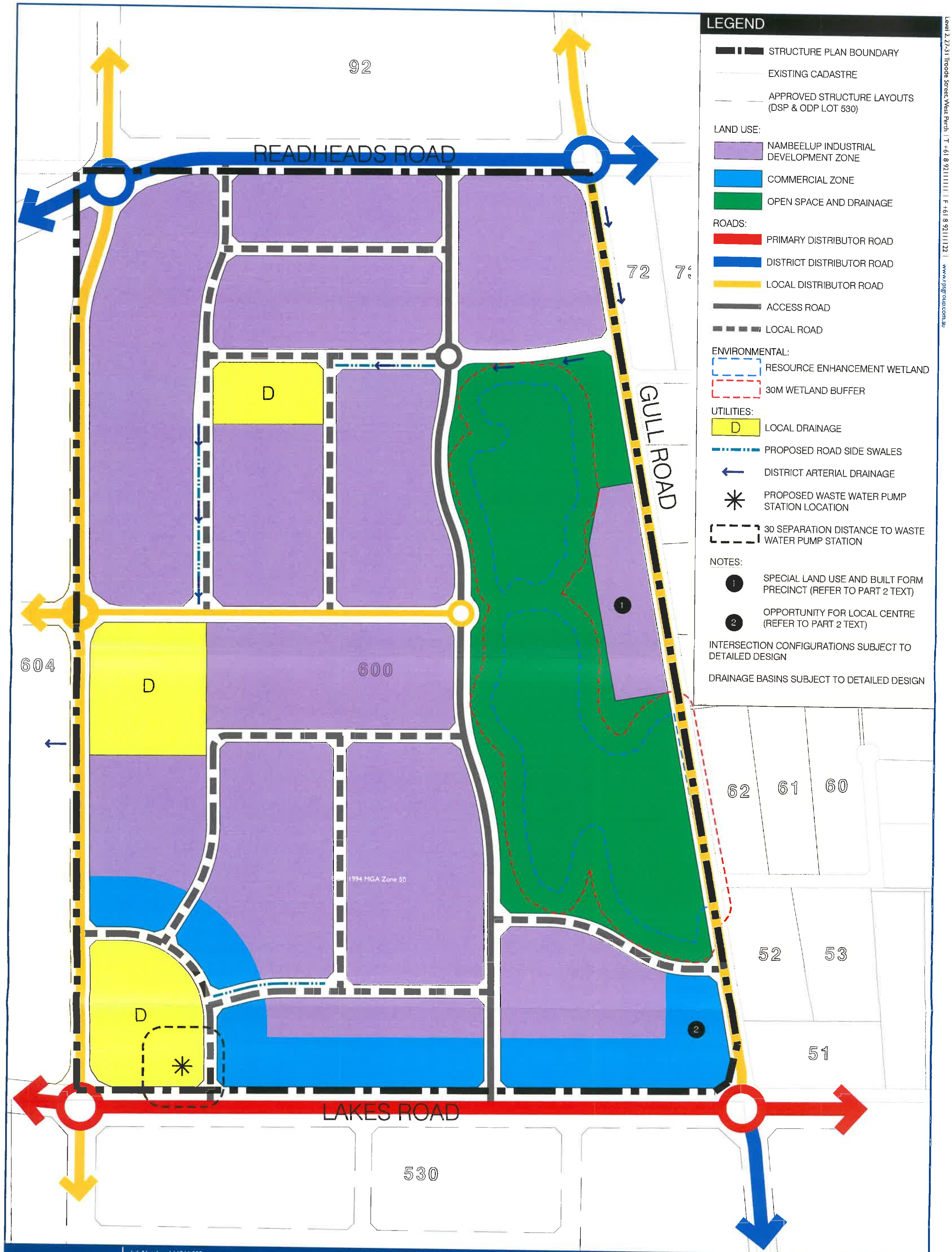
Job Number: L1126603
Doc Number: 002
Date: 10.06.16
Scale: NTS @ A3
Created By: MR
Source: Nambeelup District Structure Plan - April 2016

Figure 2

District Structure Plan



LEGEND
STRUCTURE PLAN BOUNDARY
EXISTING CADASTRE
APPROVED STRUCTURE LAYOUTS (DSP & ODP LOT 530)
LAND USE:
NAMBEELUP INDUSTRIAL DEVELOPMENT ZONE
COMMERCIAL ZONE
OPEN SPACE AND DRAINAGE
ROADS:
PRIMARY DISTRIBUTOR ROAD
DISTRICT DISTRIBUTOR ROAD
LOCAL DISTRIBUTOR ROAD
ACCESS ROAD
LOCAL ROAD
ENVIRONMENTAL:
RESOURCE ENHANCEMENT WETLAND
30M WETLAND BUFFER
UTILITIES:
D LOCAL DRAINAGE
PROPOSED ROAD SIDE SWALES
DISTRICT ARTERIAL DRAINAGE
PROPOSED WASTE WATER PUMP STATION LOCATION
30 SEPARATION DISTANCE TO WASTE WATER PUMP STATION
NOTES:
1 SPECIAL LAND USE AND BUILT FORM PRECINCT (REFER TO PART 2 TEXT)
2 OPPORTUNITY FOR LOCAL CENTRE (REFER TO PART 2 TEXT)
INTERSECTION CONFIGURATIONS SUBJECT TO DETAILED DESIGN
DRAINAGE BASINS SUBJECT TO DETAILED DESIGN
READHEADS ROAD
GULL ROAD
LAKES ROAD
92
72
604
600
62
61
60
52
53
51
530
D
1994 MGA Zone 50
GDA 1994 MGA Zone 50
0
125
250
m

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Job Number: L11266.003
Doc Number: 003
Date: 21.03.17
Scale: 1:5,000 @ A3
Created by: MA
Source: Preferred Concept (PA1332 13 Rev) - URBIS, 16.03.17.

Figure 3

Local Structure Plan

LEGEND
Site Boundary
Cadastre
Contour (mAHD)

FOWLER RD
READHEADS RD
SUNSHINE PL
GUEL RD
WINDFIRE GR
LAKES RD

LOT 92
LOT 109
LOT 606
LOT 604
LOT 600
LOT 500
LOT 501
LOT 71
LOT 72
LOT 73
LOT 74
LOT 75
LOT 76
LOT 69
LOT 70
LOT 63
LOT 64
LOT 60
LOT 61
LOT 62
LOT 52
LOT 53
LOT 51

S8
Cp
Cps
Qpb
Qpb/Qpa
Qhw

Environmental Geology (DoIR, 1999)

- Cp - PEATY CLAY - mid to dark gray, soft, water saturated clay with variable organic content, of alluvial origin
- Cps - PEATY CLAY - dark grey and black, soft, variable organic content, some quartz sand in places, of lacustrine origin
- Qhw - Swamp Deposits
- Qpb - BASSENDEAN SAND
- Qpb/Qpa - BASSENDEAN SAND - thin veneer over Guildford Formation
- S8 - SAND - SAND - very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin as relatively thin veneer over C2, M4 and Mc2

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Job Number: L1126603
Doc Number: 004
Date: 17.01.17
Scale: 1:5,000 @ A3
Drafted by: MA
Source: Cadastre Relief & Orthophoto - Landgate, 2016. Environmental Geology - DoIR 1999.

GDA 1994 MGA Zone 50

0 25 50 100 150 200 m

Figure 4
Topography and Environmental Geology

LEGEND

Site Boundary

Cadastre

Acid Sulfate Soil Risk Mapping (DER, 22.09.2014)

High to Moderate Risk

Moderate to Low Risk

LOT 92

LOT 109

FOWLER RD

READHEADS RD

LOT 72

LOT 73

LOT 74

LOT 75

LOT 76

LOT 77

SUNSHINE PL

LOT 71

LOT 68

LOT 70

LOT 69

LOT 63

LOT 64

LOT 65

LOT 604

LOT 600

LOT 500

LOT 501

LOT 59

LOT 5059

LOT 62

LOT 61

LOT 60

GULL RD

WINDFIRE GR

LOT 52

LOT 53

LOT 51

LOT 606

LAKES RD

LOT 602

LOT 530

PATERSON RD

LOT 221

RPS

Job Number: L1126603
Doc Number: 005
Date: 27.01.17
Scale: 1:5,000 @ A3
Drafted by: MA
Source: Cadastre & Orthophoto - Landgate, 2016.

GDA 1994 MGA Zone 50

0 25 50 100 150 200 m

Figure 5

Acid Sulfate Soils Risk Mapping

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LEGEND

- Site Boundary
- Cadastre
- Nambeelup Industrial Area District Structure Plan Boundary
- Peel Regionally Significant Natural Areas

Geomorphic Wetlands (DPaW, 14.01.2016)

- Conservation
- Resource Enhancement

Serpentine River Bushland
Lakes Rd West Bushland
Lakes Rd South Wetland
Serpentine River Bushland
Barragup Bushland
Black Lake Bushland
Black Lake Bushland
Nambeelup Bushland
Nambeelup Bushland
Nambeelup Bushland
Nambeelup South Bushland
Nambeelup Brook Natural Area

UFI 6436, UFI 14652, UFI 15373, UFI 3991, UFI 14588, UFI 15379, UFI 15377, UFI 15856, UFI 15853, UFI 15849, UFI 15857, UFI 15895, UFI 14592, UFI 14598, UFI 3941, UFI 4287, UFI 15381, UFI 13906, UFI 15374, UFI 4883, UFI 5032, UFI 4584, UFI 3694, UFI 3843, UFI 4585, UFI 13898, UFI 15378, UFI 5175, UFI 5182, UFI 13305, UFI 3944, UFI 4289, UFI 4288, UFI 4834, UFI 4835, UFI 13892, UFI 5033, UFI 5129, UFI 14424, UFI 5034, UFI 14438, UFI 5127, UFI 5029, UFI 5128, UFI 15236, UFI 3998, UFI 3547, UFI 4287, UFI 4286, UFI 4832, UFI 14608, UFI 4535, UFI 3842

LOWLER RD, READHEADS RD, LAKELANDS RD, PATERSON RD, NAMBEELUP RD, GREYHOUND RT, BUSH RT, SCOTT RD

Job Number: L1126603
Doc Number: 006
Date: 27.01.17
Scale: 1:20,000 @ A3
Drafted by: MA
Source: Cadastre & Orthophoto - Landgate, 2016.

GDA 1994 MGA Zone 50

0 125 250 500 750 1,000 m

Figure 6

Nambeelup Industrial Area Wetland Context

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Job Number: L1126603
Doc No: 007
Date: 27.01.17
Scale: 1:5,000 @ A3
Drawn by: MA
Source: Cadastre, 2011 Orthophoto - Landgate, Aug2016. DSP - DoP, April 2016 Wetlands - DPaW, 2016

GDA 1994 MGA Zone 50

0 25 50 100 150 200 m

Figure 7
Resource Enhancement Wetlands with District Structure Plan Road Layout

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VEGETATION CONDITION LEGEND (SOURCE: BUSH FOREVER Govt. of W.A., 2000)

P - Pristine
Pristine or nearly so, no obvious signs of disturbance.

E - Excellent
Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.

VG - 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.

G - Good
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

D - 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.

CD - 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.

Vegetation Type

OFErMrMp
Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12m with occasional *Banksia littoralis* over Grassland/Herbland/Sedgeland to Scattered Grasses/Herbs/Sedges dominated by weed species.

MrMp
Scattered Trees of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12m over pasture species with scattered patches of *Juncus pallidus* to 1.3m.

LEGEND
- Site Boundary
- Cadastre

Vegetation Type and Condition
- MrMp (CD)
- OFErMrMp (D)

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Job Number: L1126603
Doc No: 008
Date: 10.06.16
Scale: 1:6,000 @ A3
Drafted by: MA
Source: Cadastre, & Orthophoto - Landgate, 2016. Vegetation Mapping - Coffey 2009.

0 25 50 100 150 200 metres

Figure 8

Vegetation Type and Condition

RPS

Job Number: L1126603
Doc No: 009
Date: 27.01.17
Scale: 1:15,000 @ A3
Drafted by: MA
Source: Cadastre, & Orthophoto - Landgate, 2011.
Vegetation, Threatened Flora/Fauna - DEC 1980, 2011.

Figure 9

Heddle Vegetation Complex and Threatened and Priority Flora

LEGEND

- Site Boundary
- Cadastre
- DER Contaminated Sites

LOT 4157
LOT 93
LOT 92
LOT 109
LOT 89
FOWLER RD
PEARHEADS RD
LOT 82
LOT 83
LOT 604
LOT 50
LOT 604
LOT 907
LOT 604
LOT 600
LOT 71
LOT 70
LOT 68
LOT 67
LOT 66
LOT 65
LOT 500
LOT 501
LOT 59
LOT 58
LOT 57
LOT 2
LOT 1
LOT 11
LOT 51
LAKES RD
LOT 329
LOT 602
LOT 603
LOT 530
LOT 221
LAKELANDS RD
LOT 2
LOT 20
LOT 58
LOT 341
LOT 1
LOT 4776
LOT 28
LOT 1
LOT 212
LOT 224
KWINANA FWY
LOT 51
LOT 534
LOT 534
LOT 210
PATERSON RD
HOUGHAM RD

RPS

Job Number: L1126603
Doc Number: 010
Date: 27.01.17
Scale: 1:20,000 @ A3
Drafted by: MA
Source: Cadastre & Orthophoto - Landgate, 2016.

GDA 1994 MGA Zone 50

0 100 200 400 600 800 m

Figure 10

DER Contaminated Sites

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APPENDIX I

Stakeholder Correspondence

From: Mutter, Lyndon <Lyndon.Mutter@DPaW.wa.gov.au>
Sent: Monday, 20 February 2017 10:15 AM
To: Giles Glasson
Subject: RE: Local Structure Plan for Lot 600 Lakes Road, Stake Hill

Hi Giles,

The Department of Parks and Wildlife supports the Environmental Protection Authority's guidance that wetlands that are to be protected should have a minimum 50 metre buffer. However in this instance, as the Shire of Murray will be the future reserve manager, and given the resource enhancement wetland area is part of a larger palusplain wetland, the department will defer to the Shire to advise on an acceptable buffer width. If a buffer less than 50 metres is accepted, it is even more important that the buffer be fully revegetated.

As outlined in the 2016 DoW *Decision process for stormwater management in WA: draft for consultation,* stormwater drainage infrastructure should not be located in the wetland buffer.

Regards,

Lyndon Mutter

Senior Landuse Planner | Swan Region
P: 9442 0342 | M: 0408 920 985

Department of
Parks and Wildlife

www.dpaw.wa.gov.au

From: Giles Glasson [mailto:Giles.Glasson@rpsgroup.com.au]
Sent: Monday, 13 February 2017 3:20 PM
To: Mutter, Lyndon
Cc: John Halleen; Steve Rolls
Subject: Local Structure Plan for Lot 600 Lakes Road, Stake Hill

Thanks for the quick chat phone today Lyndon.

We are currently assisting LandCorp and its project team to prepare an industrial Local Structure Plan (LSP) for Lot 600 Lakes Road in Stake Hill, which is within the Nambeelup Industrial Area District Structure Plan (NIA DSP) area.

To provide you with a brief overview, the site is has been historically cleared and used for cattle grazing. This previous use has essentially reduced the native vegetation within the site to remnant tree species. The site contains the extents of two mapped REWs (UFI 4584 and 4585), primarily comprised of mature *Melaleuca* sp. with pasture understorey. The vegetation within the REWs has been assessed to be in 'Degraded' condition. Please find attached wetland mapping and the proposed LSP for your information.

DPaW previously provided general advice to the WAPC that all wetlands in the NIA DSP should have a 50m buffer (noting that CCWs occur on other sites), however this was "blanket" advice rather than assessing each proposal on its environmental merits.

The NIA DSP advocates positioning a 'Neighbourhood Connector' road in between the two REWs. However, the LSP proposes to relocate the road to the west of the wetlands and revegetate the area between the two REWs, therefore increasing the core wetland area by 0.54 ha to a total core REW area of 12.25 ha (11.71 ha the existing REW area + 0.54 ha).

In this case, with the wetland buffers proposed in the LSP, this equates to a large POS/wetland conservation area with an overall size of 21.64 ha, which is a considerable management responsibility within an industrial estate.

A meeting was held with representatives from the Shire of Murray and the Department of Planning last Friday to review the proposed LSP. The Shire of Murray, as the long term manager of the REWs and open space areas, supported the 30m wetland buffers incorporated into the LSP and along with management measures to protect the remaining values of the two REWs. The Department of Planning representatives identified that DPaW should also be consulted with regard to the proposed outcomes presented in the LSP.

In essence, we are now seeking DPaWs written support for the 21.64 ha POS/wetland conservation area, which incorporates buffers ranging from a minimum of 30m but generally considerably larger, shown in the attached LSP (termed the Preferred Concept Layout).

To achieve this outcome we request a meeting with yourself as well as any representative(s) from the Wetland Branch to review the proposed buffers and management of the two REWs. Ideally, it would be our strong preference to meet out at the site so that our discussions can be informed in the context of the site's existing environmental values.

If you could please identify a time in the next week that we could meet that would be appreciated. At this stage, we are available any day from Tuesday to Friday next week (if that assists). Steve Rolls from our office will also attend.

Please feel free to get in touch to discuss as required.

Best regards,

Giles

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Giles Glasson
Managing Scientist
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Email: Giles.Glasson@rpsgroup.com.au
www: http://rpsgroup.com.au

Doris Clarke

From: Liesl Rohl <Liesl.Rohl@epa.wa.gov.au>
Sent: Thursday, 9 March 2017 3:26 PM
To: Giles Glasson
Cc: Stephen Pavey
Subject: RE: Lot 600 Lakes Road Local Structure Plan and Wetland Buffer

Hi Giles
Thank you for your email with attached maps.

From the information provided, where the following management measures to protect the environmental values of the two REWs can be achieved:

- provision of a buffer from the mapped edge of the wetland, primarily to retain the *Melaleuca* trees
- maintaining the ecological water requirements of the *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* trees
- revegetation of the core wetland area where the road was proposed in the DSP and agricultural dams
- surface water retention swales, batters from roads / paths within or adjacent to the wetland buffer planted using endemic species
- interface treatments between conservation areas and recreation areas.

The OEPA would consider that a 30 m buffer would be sufficient. It is recommended that the 30 m buffer be 'squared/rounded' off to reduce edge effect and management requirements. It is also recommended that hard edges around this area be considered to reduce negative human impacts on the POS and wetlands.

Liesl

Liesl Rohl
Manager
Environmental Planning Branch

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direct: 08 6145 0858 reception: 08 6145 0800 fax: 08 6145 0895
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www: http://rpsgroup.com.au

UDIA 2016 AWARDS FOR EXCELLENCE WINNERS
- Alkimos Beach - EnviroDevelopment Chairman's Choice Award
- Eliza Ponds - Residential Development under 250 lots
- The Playground at Coolbellup - Urban Renewal
- New North Project - Urban Renewal
- Annie's Landing Ellenbrook - Residential Development over 250 lots

UDIA 2015 AWARDS FOR EXCELLENCE WINNERS
- Elements - Russel Perry Award for Urban Development Excellence & Affordable Development
- Eliza Ponds - Urban Water Excellence & Urban Renewal
- The Primary at Coolbellup - Residential Development under 250 lots

UDIA 2014 AWARDS FOR EXCELLENCE WINNERS
- Frasers Landing - National Environmental Excellence
- Eliza Ponds - Rising Star Award

From: Giles Glasson [mailto:giles.glasson@rpsgroup.com.au]
Sent: Thursday, 2 March 2017 2:50 PM
To: liesl.rohl@epa.wa.gov.au
Subject: Lot 600 Lakes Road Local Structure Plan and Wetland Buffer

Thanks for the quick chat today Liesl.

As discussed, we are currently assisting LandCorp and its project team to prepare an industrial Local Structure Plan (LSP) for Lot 600 Lakes Road in Stake Hill, which is within the Nambeelup Industrial Area District Structure Plan (NIA DSP) area (See attached NIA DSP). I also understand the Peel Region Scheme Amendment to rezone Lot 600 from 'Rural' to 'Industrial' was recently assessed by the EPA.

Planning Advice and Status

In summary, the majority of the site is has been historically cleared and used for cattle grazing. This previous use has essentially reduced the native vegetation within the site to remnant tree species. The site contains the extents of two mapped REWs (UFI 4584 and 4585), primarily comprised of mature *Melaleuca* sp. with pasture understorey.

The vegetation within the REWs has been assessed to be in 'Degraded' condition (See attached Figure 6).

It was noted in both the DPaW general advice and in the NIA DSP that CCW and RE wetlands should have a 50m buffer (noting that CCWs occur on other sites), however this was "blanket" advice rather than assessing each proposal on its environmental merits.

In finalising the LSP LandCorp and the project planners (Urbis) collaborated with the Shire of Murray (SoM) regarding the long-term management of the REWs within Lot 600. The SoM, as the long term manager of the RE wetland preference was for a 30 m buffer to the RE wetland and supported the removal of the neighbourhood connector road through the two mapped REWs (UFI 4584 and 4585). The SoM supports the proposed Concept Plan (attached), which incorporates buffers ranging from a minimum of 30 m but generally considerably larger, and the following management measures to protect the environmental values of the two REWs:

- provision of a buffer from the mapped edge of the wetland, primarily to retain the *Melaleuca* trees
- maintaining the ecological water requirements of the *Eucalyptus rudis* subsp. *rudis*, *Melaleuca rhaphiophylla* and *Melaleuca preissiana* trees
- revegetation of the core wetland area where the road was proposed in the DSP and agricultural dams
- surface water retention swales, batters from roads / paths within or adjacent to the wetland buffer planted using endemic species
- interface treatments between conservation areas and recreation areas.

<u>DPaW Advice</u>

We've recently contacted Lyndon Mutter from DPaW with regard to this general advice and with respect to Lot 600, he's noted that as the Shire of Murray will be the future reserve manager, and given the RE wetland area is part of a larger palusplain wetland, the Department will defer to the Shire to advise on an acceptable buffer width (see attached DPaWs correspondence).

Wetland Management Outcome

Please also note that the NIA DSP advocates positioning a 'Neighbourhood Connector' road in between the two REWs. However, proposed Concept Plan proposes to relocate the road to the west of the wetlands and revegetate the area between the two REWs, therefore increasing the core wetland area by 0.54 ha to a total core REW area of 12.25 ha (11.71 ha the existing REW area + 0.54 ha). (See attached Figure 7). Figure 7 also presents the extent of the POS reservation proposed by the NIA DSP within Lot 600.

We've also been in consultation with Lilia Palermo from the Department of Planning, who has noted detailed consultation was also undertaken with OEPA and Green Growth team in relation to wetland and remnant vegetation protection during finalisation of the NIA DSP.

Given that the potential impacts to the hydrological values of the REWs will be managed to the satisfaction of the Department of Water as part of their endorsement of the Local Water Management Strategy, and noting the SoM and DPaW's support for the buffer requirements identified in the proposed Concept Plan, we are now seeking the OEPA's position on the proposed 21.64 ha POS/wetland conservation area, which incorporates buffers ranging from a minimum of 30 m but generally considerably larger, shown in the proposed Concept Plan prior to submission to the Department of Planning for endorsement as part of the LSP documentation.

The Department of Planning is particularly keen to ensure all key agency stakeholders have been engaged prior to any consideration by the WAPC.

Please feel free to get in touch to discuss as required.

Best regards,

Giles Glasson

Managing Scientist

Environment - Land & Infrastructure

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www: http://rpsgroup.com.au

Files attached to this message

Filename	Size	Checksum (SHA1)
Nambeelup Industrial Area DSP (April 2016).pdf	5.34 MB	5794107973cabdf2c408f96b85fa6bf60ab07616
L1126603_G_Fig 6_Geomorphic Wetlands_MR_Rev0_160610.pdf	455 KB	11f28bb8c34577c95c0d01d6c360ab796f85d77b
PA1332 Lot 600 Lakes Road Nambeelup Preferred Layout (A3P 5000 @A3) REV ....pdf	6.29 MB	34b13a00bb25ba522d6b59ee456d387a6d547a3b
RE Local Structure Plan for Lot 600 Lakes Road Stake Hill .msg	89.5 KB	b22a672bf7e49f43201ea88309aa2eb9fe514df1
L1126603_G_007_Fig7 RE Wetland with DPS Layout_170127.pdf	1.25 MB	291c12ef782f49f0f884d4ba8df929a3b4cd4d84

Please click on the following link to download the attachments:
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This email or download link can be forwarded to anyone.

The attachments are available until: **Thursday, 16 March.**

RPS

APPENDIX 2

EPBC Act Protected Matters Search Tool

Australian Government
Department of the Environment

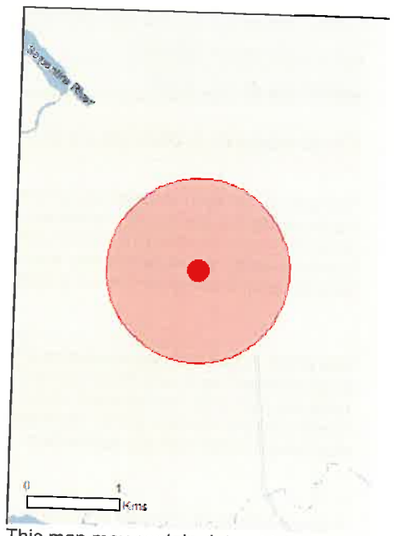
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 09/06/16 15:47:35



Coordinates
Buffer: 1.0Km

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	1
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	15
Listed Migratory Species:	7

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	10
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	None
Regional Forest Agreements:	None
Invasive Species:	35
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar)	[Resource Information]
Name	Proximity
Peel-yalgorup system	Within 10km of Ramsar

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat may occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat may occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Baudin's Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat may occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat likely to occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Vulnerable	Species or species habitat likely to occur within area
Plants		
Andersonia gracilis Slender Andersonia [14470]	Endangered	Species or species habitat may occur within area
Caladenia huegelii King Spider-orchid, Grand Spider-orchid, Rusty Spider-orchid [7309]	Endangered	Species or species habitat may occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat likely to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species

Name	Status	Type of Presence
		habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat likely to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Synaphea sp. Fairbridge Farm (D.Papenfus 696) Selena's Synaphea [82881]	Critically Endangered	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Breeding known to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat may occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat likely to occur within area

Extra Information

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Acridotheres tristis Common Myna, Indian Myna [387]		Species or species habitat likely to occur within area
Anas platyrhynchos Mallard [974]		Species or species habitat likely to occur within area
Carduelis carduelis European Goldfinch [403]		Species or species habitat likely to occur within area
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Streptopelia senegalensis Laughing Turtle-dove, Laughing Dove [781]		Species or species habitat likely to occur within area
Sturnus vulgaris Common Starling [389]		Species or species habitat likely to occur within area
Turdus merula Common Blackbird, Eurasian Blackbird [596]		Species or species habitat likely to occur within area
Mammals		
Bos taurus Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris Domestic Dog [82654]		Species or species habitat likely to occur within area
Felis catus Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Feral deer Feral deer species in Australia [85733]		Species or species habitat likely to occur within area
Funambulus pennantii Northern Palm Squirrel, Five-striped Palm Squirrel [129]		Species or species habitat likely to occur within area
Mus musculus House Mouse [120]		Species or species habitat likely to occur within area
Oryctolagus cuniculus Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus norvegicus Brown Rat, Norway Rat [83]		Species or species habitat likely to occur within area
Rattus rattus Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa Pig [6]		Species or species habitat likely to occur within area
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within

Name	Status	Type of Presence area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species habitat may occur within area
Chrysanthemoides monilifera Bitou Bush, Boneseed [18983]		Species or species habitat may occur within area
Chrysanthemoides monilifera subsp. monilifera Boneseed [16905]		Species or species habitat likely to occur within area
Genista sp. X Genista monspessulana Broom [67538]		Species or species habitat may occur within area
Lantana camara Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Salix spp. except S.babylonica, S.x calodendron & S.x reichardtii Willows except Weeping Willow, Pussy Willow and Sterile Pussy Willow [68497]		Species or species habitat likely to occur within area
Salvinia molesta Salvinia, Giant Salvinia, Aquarium Watermoss, Kariba Weed [13665]		Species or species habitat likely to occur within area
Tamarix aphylla Athel Pine, Athel Tree, Tamarisk, Athel Tamarisk, Athel Tamarix, Desert Tamarisk, Flowering Cypress, Salt Cedar [16018]		Species or species habitat likely to occur within area
Reptiles		
Hemidactylus frenatus Asian House Gecko [1708]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

For species where the distributions are well known, maps are digitised from sources such as recovery plans and detailed habitat studies. Where appropriate, core breeding, foraging and roosting areas are indicated under 'type of presence'. For species whose distributions are less well known, point locations are collated from government wildlife authorities, museums, and non-government organisations; bioclimatic distribution models are generated and these validated by experts. In some cases, the distribution maps are based solely on expert knowledge.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-32.50417 115.81775

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Parks and Wildlife Commission NT, Northern Territory Government
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Atherton and Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

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APPENDIX 3

**Flora and Fauna Assessments,
Lots 91, 92 and 604, Nambeelup
Industrial Study Area**

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

FLORA AND FAUNA ASSESSMENTS, LOTS 91, 92 AND 604, NAMBEELUP INDUSTRIAL STUDY AREA

Prepared for:

Landcorp
Level 3 Wesfarmers House
40 The Esplanade
PERTH WA 6000

Tony Gardner Commercial Pty Ltd
267 St Georges Terrace
PERTH WA 6100

Report Date: 12 June 2009
Project Ref: EP2009/014 V2

Written/Submitted by:

Clinton Van Den Bergh
Environmental Scientist
(Botany)

Written/Submitted by:

Graeme Finlayson
Environmental Scientist
(Zoology)

Reviewed/Approved by:

Paul van der Moezel
Principal

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ENVIPERT00597AA_Flora & Fauna_001_cvdb_V2

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

12 June 2009

Landcorp
Level 3 Wesfarmers House
40 The Esplanade
PERTH WA 6000

Tony Gardner Commercial Pty Ltd
267 St Georges Terrace
PERTH WA 6100

Attention: Tristan Cribb and Tony Gardner

Dear Tristan and Tony

RE: Flora and Fauna Assessments, Lots 91, 92 and 604

Please find enclosed Coffey Environments Report No. EP2009/014, V2, *Flora and Fauna Assessments, Lots 91, 92 and 604.*

Please see dot points below with regards to some of the comments you provided in the draft report:

- (Section 1.2, 3, 3.2 and 6.1) The difference between flora and vegetation is flora is the study of the individual flora species and vegetation is the study of the community(s) of flora species. We report on both because an individual species may be significant but a community may not. They may also have different objectives and outcomes (i.e. retention of one flora species compared to a community); and
- (Section 5.6) A statement addressing the ecological functional value at the ecosystem level needs to be included in the assessment to address the requirements of the EPA Position Statement No. 3 (EPA, 2002).

If you have any further queries, please do not hesitate to call myself or Paul van der Moezel on 9355 7100.

For and on behalf of Coffey Environments Pty Ltd

Clinton Van Den Bergh
Environmental Scientist (Botanist)

Attachment A: Coffey Environments Report No. 2009/014, V2

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1	ENVIPERT00597AA_Flora and Fauna_001_cvdb_V1	V2	12 June 2009	Coffey Environments Pty Ltd	CVDB

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1 INTRODUCTION

1.1 Background

Lots 91, 92 and 604 are located in Nambeelup, approximately 8km from Mandurah city centre and are strategically situated within the area being considered for the Nambeelup Industrial Estate. LandCorp and Tony Gardner Commercial are considering submitting a rezoning application under the Peel Region Scheme for Lots 91, 92 and 604 Nambeelup from 'Rural' to 'Industrial'. As the three lots contain some remnant native vegetation, this flora and fauna assessment has been undertaken as part of the rezoning application.

The total size of the study area is approximately 444.2ha (Lot 91 is 120ha; Lot 92 is 118.5ha; and Lot 604 is 205.7ha).

1.2 Scope of Works

Flora and Vegetation

Based on the potential scale of clearing for future industrial purposes a Level 2 flora and vegetation survey of the study area was undertaken. The scope of works for this report is:

- A review of DEC's threatened species database;
- A review of all the previous surveys (including Nicole Siemon and Associates PL, 2005) conducted within and in the immediate vicinity of the study area;
- A description and map of vegetation types and condition;
- A list of all native and non-native flora species recorded from the study area;
- A list of significant species recorded on the DEC's database as occurring in the vicinity of the study area;
- A description of any Threatened (TEC) and Priority Ecological Communities (PEC) occurring within the study area;
- A review of any biodiversity implications for the area through the removal of vegetation associated with the future industrial development; and
- Recommendations on floristic communities considered worthy of rehabilitation and/or collection of propagating material and future replanting.

Fauna

Based on the potential scale of clearing for future industrial purposes a Level 1 Fauna Assessment was considered sufficient for assessment of the study area. The objectives of the Level 1 Fauna assessment were to provide the following:

- A review of the Western Australian Museum database (FaunaBase) to identify potential vertebrate fauna within the area;
- A search of the Department of Environment and Conservation's Threatened and Priority Species database to identify potential scheduled and threatened species within the region;
- A review of the Birds Australia on line database;
- A search of the Commonwealth government's database of fauna of national environmental significance to identify species potentially occurring within the area that are protected under the *Environment Protection and Biodiversity Conservation Act 1999* or international migratory bird agreements (JAMBA/CAMBA);

- A review of previous fauna surveys (if any) conducted on site and for the region;
- A review of all trees contained within the study area to determine the significance of the habitat for breeding and feeding potential for Black Cockatoos;
- A review of the significance of the site for Black Cockatoos in a local and regional context;
- Advice on project requirements to satisfy the Commonwealth *EPBC Act 1999* and State Legislation.
- A description of the fauna habitats on site, identifying any areas of high conservation value for fauna; and
- Recommendations on appropriate methodologies for any follow-up comprehensive fauna surveys necessary to identify species of conservation significance or faunal assemblages that are important and likely to be impacted with the construction work.

2 EXISTING ENVIRONMENT

2.1 Location

The Study area is located over three lots (Lot 91, 92 and 604) on the border of the Nambeelup and Stakehill suburbs. The study area is approximately 8km to the east-north-east of Mandurah City and approximately 65km south of the Perth Central Business District (Figure 1).

The study area is bordered by Lakes Road to the south, Paterson Road to the east, Fowler Road and the Kwinana Freeway extension to the west and private property to the north. The Serpentine River is located to the west of the study area and at its shortest distance the Serpentine River is approximately 20m to the west of the study area.

2.2 Existing Land Use

The study area is currently used for cattle and horse grazing with some old farm infrastructure located within Lot 91, 92 and an occupied dwelling in the north-eastern portion of Lot 604.

Recently, Lot 604 was divided into three separate lots for the construction of the Kwinana Freeway extension. The Kwinana Freeway extension passes over the Serpentine River along the south-western boundary of Lot 604. The bridge crossing has subsequently separated Fowler Road into two sections. The northern section is accessed via an off ramp from the Kwinana Freeway extension which joins Lakes Road near Lot 91 and Fowler Road to the north. The southern section is still accessed via Lakes Road, however, access to the study area is available from Fowler Road.

2.3 Geological and Physiographic Context of the Study Area

2.3.1 Climate

The climate on the Swan Coastal Plain is Mediterranean with cool wet winters and warm dry summers. The study area receives the majority of its rain during the months of June, July and August. The nearest weather station to the study area is located at the Mandurah Weather Station. The Mandurah Weather Station has an average annual rainfall of 882.2mm with a mean of 82.3 days of rain greater than or equal to 1mm. Data recorded from the Mandurah Weather Station indicate that during the hottest three months (January, February and March) the temperature ranges from a minimum of 16.5℃ to a maximum of 28.8℃ and during the coldes t three months (June, July and August) the temperature ranges from a minimum of 8.9℃ to a max imum of 17.7℃ (Bureau of Meteorology, 2008).

2.3.2 Topography

The study area is generally flat at around 2m to 8m Australian Height Datum (AHD) over the majority of the study area. The highest point within the study area of 8m AHD was recorded over the majority of Lot 92. The lowest point within the study area of 2m AHD was recorded from in the north-west and south of Lot 604.

2.3.3 Drainage and Groundwater

The groundwater of the study area was monitored by Parsons Brinckerhoff over 12 months during August 2007 and July 2008 (Parsons Brinkerhoff, 2008). The groundwater monitoring was conducted over the entire Nambeelup Strategic Study Area. The study area is located in the central-west of the strategic study area.

The monitoring indicated that the groundwater showed typical seasonal variations with lower groundwater levels recorded in Autumn and higher groundwater levels recorded in Winter (Parsons Brinckerhoff, 2008). The average depth to the groundwater over the 12 month monitoring period for the

strategic study area was 1.84 metres below ground level (mbgl). The average water level variation between the Autumn and the Winter months was 1.09m.

The maximum depth of the groundwater level according to mapping by Parsons Brinckerhoff (2008) is approximately between 0 mbgl and 4 mbgl. The minimum depth of the groundwater level is approximately between 0 mbgl and 2 mbgl.

The groundwater at the study area flows predominantly to the west and it can be inferred the groundwater finally discharges in the Serpentine River (Parsons Brinckerhoff, 2008).

2.3.4 Geology and Soils

The geology and soils of the study area are mapped as comprising a thin layer of Bassendean Sands over the Guildford Formation (Qpa/Qpb) (Gozzard, 1983). The Geological unit that comprise the study area is described below:

- **S_{10}** – SAND – as S_8 (SAND – very light grey at surface, yellow at depth, fine to medium-grained, sub-rounded quartz, moderately well sorted, of eolian origin) as relatively thin veneer over C_2, M_4 and Mc_2). S_{10} is of variable thickness with the sands physical properties influenced by the underlying material. Generally S_{10} occurs in areas with a high water table that are prone to flooding in part.

The landforms and soil of the study area are of Aeolian Deposits and belong to the Bassendean System (Churchward and McArthur, 1978). The Bassendean System is characterised by gently undulating sandplains with low to very low relief sand dunes and the occasional intervening sandy and clayey swamps.

2.3.5 Wetlands

There are 13 wetlands mapped as occurring within the study area according to the DEC's *Geomorphic Wetlands Swan Coastal Plain* dataset. The 13 wetlands are mapped as either Multiple Use (MU) or Resource Enhancement (RE). No Conservation category (CC) wetlands were identified as occurring within the study area. The 13 wetlands within their respective lots are described below and mapped in Figure 2:

Lot 92

- Multiple Use (Unique Feature Identifier (UFI) 6594) Sumpland – Located in the north of Lot 92.
- Multiple Use (UFI 14014) Palusplain – Located all over Lot 92 except in the north where UFI 6594 is and along the south-eastern boundary where UFI 13895 and 13903 are.
- Multiple Use (UFI 13895) Sumpland – Located in the south-east of the lot.
- Resource Enhancement (UFI 13897) Palusplain – Located at the centre of the western boundary.
- Resource Enhancement (UFI 13903) Sumpland – Located along the eastern boundary in the south of the lot.

Lot 91

- Multiple Use (UFI 4583) Sumpland – Located in the north-east corner of Lot 91.
- Multiple Use (UFI 14043) Palusplain – Located over the majority of Lot 91 and half of Lot 604 in the east.
- Resource Enhancement (UFI 4584) Palusplain – Located in the east of the Lot 91.
- Resource Enhancement (UFI 4585) Palusplain – Located in the east of the study area just to the south of UFI 4584.

Lot 604

- Multiple Use (UFI 14043) Palusplain – Located in the eastern half of Lot 604 and continuing into the majority of Lot 91.
- Multiple Use (UFI 13894) Sumpland – Located in the southern portion of Lot 604.
- Resource Enhancement (UFI 4287) Sumpland – Located in the north of Lot 604.
- Resource Enhancement (UFI 4139) Dampland – Located in the north-west corner of the lot and extending north across Fowler Road.
- Resource Enhancement (UFI 4238) Dampland – Located in the north-west corner with only a small portion extending into Lot 604.

The definition of Sumpland, Dampland and Palusplain has been described by Hill *et al.* (1996). The definitions are described below:

- Sumpland – A seasonally inundated basin of variable size and shape;
- Dampland – A seasonally waterlogged (damp) basin of variable size and shape; and
- Palusplain – A seasonally waterlogged flat.

The management categories and objectives for wetlands as described by Hill *et al.* (1996) are outlined below in Table 1.

Table 1

Wetland Management Categories and Objectives

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

* Source – *Wetlands of the Swan Coastal Plain Volume 2b* (Hill *et al.*, 1996)

Several CC wetlands are located to the west of the study area. UFI 3992 is described as a Floodplain and occurs along the eastern side of the Serpentine River. UFI3992 is the closest CC wetland to the study area, which is within 10m of the study area in the south-west corner of Lot 604. UFI 3941 and UFI 6447 are described as Rivers and they make up the Serpentine River within the portion that located in close vicinity to the study area. The Serpentine River ranges from approximately 20m (in the south) and 130m (in the north) to the west of the Study Area.

2.4 Biological Context of the Study Area

2.4.1 Bioregional Context

Western Australia supports 53 biogeographical subregions. The Nambeelup Industrial Study area is located in the Perth Subregion of the Swan Coastal Plain. The Swan Coastal Plain Bioregion is a low-lying coastal plain, mainly covered with woodlands. It is dominated by Banksia (*Banksia* sp.) or

Tuart (*Eucalyptus gomphocephala*) on sandy soils, Swamp Sheoak (*Casuarina obesa*) on outwash plains and Paperbark (*Melaleuca* sp.) in swampy areas.

The Perth Subregion is composed of colluvial and Aeolian sands, alluvial river flats and coastal limestone. The vegetation is dominated by heath and/or Tuart (*Eucalyptus gomphocephala*) woodlands on limestone, Banksia (*Banksia* sp.) and Jarrah (*Eucalyptus marginata*) woodlands on quaternary marine dunes of various ages and Marri (*Corymbia calophylla*) on colluvials and alluvials.

The Perth Subregion includes a complex series of seasonal wetlands and also includes the many islands found offshore from Perth. The subregional area is 1,333,901ha in size (McKenzie *et al.*, 2002).

2.4.2 Beard Mapping

According to Beard (1990) the vegetation of the study area is located within the Drummond Botanical Subdistrict of the Swan Coastal Plain Subregion. The Drummond Botanical Subdistrict is mainly comprised of *Banksia* sp. low woodland on leached sands with Melaleuca (*Melaleuca* sp.) swamps where ill-drained; woodland of Tuart (*Eucalyptus gomphocephala*), Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) on less leached soils.

2.4.3 Vegetation Complexes

According to mapping by Heddle *et al.* (1980) the vegetation of the study area and surrounding areas is considered to be representative of the Bassendean Complex-Central and South. The vegetation complex is described below and mapped in Figure 2:

- **Bassendean Complex-Central and South** – Ranges from woodland of Jarrah (*Eucalyptus marginata*)-Sheoak (*Allocasuarina fraseriana*)-*Banksia* species on the sand dunes, to a low woodland of *Melaleuca* species, and sedgelands on the low-lying depressions and swamps. Other plants include Spearwood (*Kunzea ericifolia*), White Myrtle (*Hypocalymma angustifolium*), Basket Flower (*Adenanthos obovatus*) and *Verticordia* species.

There is approximately 23635ha (27%) of the pre-European extent of the Bassendean Complex-Central and South remaining on the Southern Swan Coastal Plain (Table 3b of Appendix 3 in EPA, 2003).

2.4.4 Previous Biological Assessments

There have previously been a number of flora, vegetation and fauna assessments conducted around the Nambeelup region in similar vegetation communities to those occurring within the study area. Data from these surveys have been utilised for this assessment.

3 FLORA AND VEGETATION

3.1 Methodology

3.1.1 Field Survey

Based on the scale of potential clearing as a result of the proposed industrial development, a Level 2 flora and vegetation survey of the project was conducted. The flora and vegetation survey of the study area was undertaken by Clinton Van Den Bergh, a botanist from Coffey Environments with survey experience in the South-West Botanical Province, with help from a field assistant. The study area was sampled over two survey seasons (i.e. two phases). Phase 1 was conducted over two days on 30 September 2008 and 1 October 2008, totalling approximately 20 hours of survey time. Phase 2 was conducted over one day on 11 December 2008, totalling approximately 10 hours of survey time. The time spent surveying the study area is considered appropriate considering the sparse highly degraded vegetation recorded over the entire study area and ease of access in the majority of the study area.

3.1.2 Survey Description

The survey was undertaken to provide a description of the dominant vegetation types, vegetation condition and provide a list of all the flora species present at the time of the surveys. Additionally, the survey determined whether any of the significant flora species identified on the DEC Declared Rare and Priority Flora list for the area actually occur or are likely to occur within the study area. This was based on a combination of sampling within permanent quadrats of 10m x 10m dimensions located in representative vegetation types, as well as intensively traversing the entire site (i.e. Releve) to opportunistically record all plant species that were not recorded from the quadrats. Vegetation types were described according to the vegetation structural classes adapted from Muir (1977) and Aplin (1979) (Table 2).

Table 2

Vegetation Structural Classes

Stratum	Canopy Cover			
	70-100%	30-70%	10-30%	2-10%
Trees over 30m	Tall Closed Forest	Tall Open Forest	Tall Woodland	Tall Open Woodland
Trees 10-30m	Closed Forest	Open Forest	Woodland	Open Woodland
Trees under 10m	Low Closed Forest	Low Open Forest	Low Woodland	Low Open Woodland
Shrubs over 2m Shrubs 1-2m	Tall Closed Scrub Closed Heath	Tall Open Scrub Open Heath	Tall Shrubland Shrubland	Tall Open Shrubland Low Shrubland
Shrubs under 1m	Low Closed Heath	Low Open Heath	Low Shrubland	Low Open Shrubland
Grasses	Closed Grassland	Grassland	Open Grassland	Very Open Grassland
Herbs and Sedges	Closed Herbland/ Sedgeland	Herbland/ Sedgeland	Open Herbland/ Sedgeland	Very Open Herbland/ Sedgeland

(Adapted from Muir (1977) and Aplin (1979))

The survey methodology complies with Coffey Environments interpretation of the EPA's guidelines for flora surveys as outlined in Guidance Statement No. 51, *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004a) and Position Statement No. 3, *Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA, 2002). The EPA states in Guidance Statement No. 51, that a level 2 survey must involve sampling of flora over two seasons (i.e. two phases). For the study area, the surveys were conducted in Spring (September and October) and early Summer (December). Early summer was considered appropriate given that the area contains many wetlands which dry out in the summer months.

The optimal time for conducting flora and vegetation surveys for the South-West Botanical Province, as outlined by Guidance Statement No. 51, is Spring. Therefore the timing of the survey is considered to be appropriate for the identification of the majority of the annual and ephemeral species, including any orchid species (including the DRF orchid species that are known to occur within the area) that may be present during the survey of the study area.

The two phases undertaken with the survey of the Study area were appropriate for the identification of the DRF orchid species, the Grand Spider Orchid (*Caladenia huegelii*), Tall Donkey Orchid (*Diuris drummondii*), Dwarf Bee Orchid (*Diuris micrantha*) and the Glossy-leaved Hammer Orchid (*Drakaea elastica*). The Grand Spider Orchid, Dwarf Bee Orchid and the Glossy-leaved Hammer Orchid flower in Spring and would have been identifiable during the Phase 1 survey. The Tall Donkey Orchid flowers in Summer and would have been identifiable during the Phase 2 survey.

Access was not considered to be a limiting factor to the flora and vegetation survey of the study area. Access into the study area was from Paterson Road, Fowler Road and Lakes Road along the eastern, western and southern boundaries. The majority of the site was accessed on foot, which was not considered to be difficult because of the highly degraded vegetation and large open spaces (paddocks). The gates leading into the study area were locked at the time of each survey (Phase 1 and Phase 2). The major vegetation types occurring on site were identified and delineated using recent colour aerial photography and confirmed by field surveys to ground-truth.

Common species that were well known to the survey botanists were identified in the field, while the specimens of all the other species were collected, assigned a unique number to facilitate tracking and pressed during that day. These specimens were then identified by comparing them against specimens at the Western Australian Herbarium (WAHERB), taxonomic keys and with the help from the WAHERB employees and volunteers. Conservation significant species, geographic range extensions and unique/unusual specimens were retained for future vouchering.

Quadrat dimensions are dependant on the region in which the survey is being undertaken. For the Swan Coastal Plain it was appropriate to use quadrats of 10m x 10m (EPA, 2004a; Gibson *et al.*, 1994). The following information was recorded for each of the 11 permanent 10m x 10m quadrats:

- **Location** - MGA coordinates (equivalent of WGS84) were taken from each corner of the 10m x 10m quadrat using a handheld Magellan GPS to an accuracy of 2m. All four posts of the quadrat have been left in the field to aid any re-surveying that may be required in the future;
- **Vegetation Description** - The vegetation types were described and mapped using the vegetation structural classes adapted from Muir (1977) and Aplin (1979) and described in Bush Forever (Government of Western Australia, 2000b);
- **Disturbance Details** - Vegetation condition was assessed using the condition rating scale adapted from Bush Forever (Government of Western Australia, (2000b);
- **Percentage Foliage Cover and Height** - Cover and Height was estimated visually for each species recorded within each quadrat. Estimates were made to the nearest percentage and tenth of a metre (i.e. 0.1m) where possible;
- **Habitat** - Habitat was described based on aspect and slope within and around the surrounding area of the quadrat; and
- **Soil** - Colour and soil texture within each quadrat was recorded.

3.1.3 Department of Environment and Conservation Database Search

Prior to conducting the field survey, a search of the DEC Declared Rare and Priority Listed Flora database was undertaken to identify any significant flora that could potentially occur within the study area. This investigation encompassed a review of the following databases:

- The Department's '*Threatened (Declared Rare) Flora*' database;
- The '*Western Australian Herbarium Specimen*' database; and
- The Department's '*Declared Rare and Priority Flora List*', which contains species that are Declared Rare (Conservation Codes R or X for those presumed extinct), poorly known (Conservation Codes 1, 2 and 3) or require monitoring (Conservation Code 4).

The results of the DEC database search are presented below in Table 3. No known DRF or Priority Listed flora have been previously recorded from within the study area. However, the DRF, *Drakaea elastica*, was recorded from within the Kwinana Freeway extension alignment (Lot 907) in vegetation located along the south-west boundary of Lot 604 (Figure 2).

Table 3

Threatened Flora Recorded in the Vicinity of the Study Area

Species	Conservation Code	Site Characteristics	Flowering Period
Caladenia huegelii	R	Grey or brown sand, clay loam	Sep-Oct
Diuris drummondii	R	Low-lying depressions, swamps	Nov-Jan
Diuris micrantha	R	Brown loamy clay. Winter-wet swamps, in shallow water	Sep-Oct
Drakaea elastica	R	White or grey sand. Low-lying situations adjoining winter-wet swamps	Oct-Nov
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	R	Sandy with lateritic pebbles. Near winter-wet flats, in low woodland with weedy grasses	Oct
Synaphea sp. Pinjarra (R. Davis 6578)	R	Grey clayey sand. Swamp	Sep
Synaphea stenoloba	R	Sandy or sandy clay soils. Winter-wet flats, granite	Aug-Oct
Acacia lasiocarpa var. bracteolata long peduncle variant (G.J. Keighery 5026)	1	Grey or black sand over clay. Swampy areas, winter wet lowlands	May/Aug
Stachystemon sp. Keysbrook (R. Archer 17/11/99)	1	-	-
Synaphea sp. Pinjarra Plain (A.S. George 17182)	1	Grey sandy loam or clay, grey-brown clayey sand, brown clayey loam, laterite. Flats, seasonally wet areas, railroad reserves often with wet depressions or drains	Sep-Oct
Acacia benthamii	2	Sand. Typically on limestone breakaways	Aug-Sep
Cardamine paucijuga	2	In moist to dry habitats	Sep-Oct
Grevillea manglesii subsp. *ornithopoda*	2	Amongst medium trees, or low trees, or tall (sclerophyll) shrubland, or low (sclerophyll) shrubland; in gravelly soil, or sand, or clay; occupying along creek beds	Sep-Nov
Johnsonia pubescens subsp. *cygnorum*	2	Grey-white-yellow sand. Flats, seasonally-wet sites	Sep
Chamaescilla gibsonii	3	Clay to sandy clay. Winter-wet flats, shallow water-filled claypans	Sep
Cyathochaeta teretifolia	3	Grey sand, sandy clay. Swamps, creek edges	-
Dillwynia dillwynioides	3	Sandy soils. Winter-wet depressions	Aug-Dec
Eryngium pinnatifidum subsp. *palustre* ms	3	Clay, sandy clay. Claypans, seasonally wet flats	Oct-Nov
Lasiopetalum membranaceum	3	Sand over limestone	Sep-Dec
Stylidium longitubum	3	Sandy clay, clay. Seasonal wetlands	Oct-Dec
Stylidium maritimum	3	Sand over limestone. Dune slopes and flats. Coastal heath and shrubland, open Banksia woodland	Sep-Nov
Anthotium junciforme	4	Sandy clay, clay. Winter-wet depressions, drainage lines	Nov-Mar
Caladenia speciosa	4	White, grey or black sand	Sep-Oct
Conostylis pauciflora Hopper subsp. *pauciflora*	4	Grey sand, limestone. Hillslopes, consolidated dunes	Aug-Oct

Species	Conservation Code	Site Characteristics	Flowering Period
Eucalyptus rudis subsp. *cratyantha*	4	Loam. Flats, hillsides	Jul-Sep
Jacksonia sericea	4	Calcareous & sandy soils	Dec-Feb
Parsonsia diaphanophleba	4	Alluvial soils. Along rivers	Jan-Jun/Sep
Villarsia submersa	4	In freshwater 0.05-0.6 m deep. Pools, lakes, swamps, winter-wet depressions, claypans	Aug-Nov

(Site Characteristics and Flowering Period were obtained from Florabase®)

The Commonwealths Department of the Environment, Heritage, Water and the Arts (DEHWA) also assigns an additional level of conservation significance to the states DRF levels (presumed extinct and extant) under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. Table 4 shows the additional Commonwealth categories along with the states categories for DRF flora identified from the DEC database search.

Table 4

Commonwealth Threatened Flora Species (*EPBC Act 1999*) Recorded in the Vicinity of the Study Area

Species	Conservation Code	Status under Commonwealth *EPBC Act 1999*
Caladenia huegelii	R	Endangered
Drakaea elastica	R	Endangered
Diuris drummondii	R	Vulnerable
Diuris micrantha	R	Vulnerable
Synaphea sp. Fairbridge Farm (D. Papenfus 696)	R	-
Synaphea sp. Pinjarra (R. Davis 6578)	R	-
Synaphea stenoloba	R	-

A search of the DEC's Threatened (TEC) and Priority Ecological Communities (PEC) database was also conducted for the study area prior to the commencement of the field work. No TECs were recorded from within or in the vicinity of the study area.

3.1.4 Botanical Survey Limitations

The potential botanical survey limitations of the Level 2 flora and vegetation survey of the study area are presented below in Table 5.

Table 5

Statement of Botanical Survey Limitations

Potential Limitations	Constraints (Yes/No); Significant, Moderate or No Constraint	Comment
Competency/experience of the consultant conducting the survey	No constraint	The Coffey Environments botanists has more than adequate survey experience in the region and taxonomic skills
Proportion of the flora identified	No constraint	three days or approximately 30 hours spent on site with an estimated 95% + of the flora species from the study area identified
Sources of information (historic/recent or new data)	No constraint	Relatively well documented, with recent and historic work undertaken in the study area
Proportion of the task achieved and further work that may need to be undertaken	No constraint	Entire area was surveyed and no further work is considered necessary for the current tourist development plans

Potential Limitations	Constraints (Yes/No); Significant, Moderate or No Constraint	Comment
Timing/Weather/Season/Cycle	No constraint	The timing was considered adequate with consistent rainfall during the survey period
Intensity of Survey (e.g. in retrospect was the intensity of the survey adequate)	No constraint	The proposed disturbance area was mapped and searched comprehensively, with the majority of the area traversed on foot
Completeness (e.g. was relevant area fully surveyed)	No constraint	The entire study area was traversed and sampled adequately
Resources (e.g. degree of expertise available for plant identification)	No constraint	Botanist undertook plant identifications at the WAHERB with the assistance of staff and volunteers.
Remoteness and/or access problems	No constraint	Vehicle access was not considered to be a limiting factor with access via Paterson Road, Lakes Road and Fowler Road.
Availability of contextual (e.g. bioregional) information for the survey area	No constraint	McKenzie *et al.* (2002); Beard (1990); Gibson *et a.* (1994); and Heddle *et al.* (1980)

Fungi and non-vascular (e.g. alga, mosses and liverworts) were not specifically surveyed for during this survey.

No numerical analysis (i.e. PATN) of the floristic sample data collected from the survey was conducted for this study. However, floristic data collected from the survey was compared on a presence/absence basis with the complete dataset from the *Floristic Survey of the Southern Swan Coastal Plain* (Gibson *et al.*, 1994) to ensure that the Floristic Community Type (FCT) determination could be strongly inferred.

3.2 Flora and Vegetation Survey Results

3.2.1 Vegetation Types

Based on the results of the Level 2 flora and vegetation survey of the study area, a total of seven vegetation types were identified and delineated from Lots 91, 92 and 604. The seven vegetation types are described below along with the corresponding quadrats from Appendix A. The quadrat locations are shown on Figure 3:

- **OFEm**

Open Forest to Woodland of *Eucalyptus marginata* (Jarrah) to 14m over Tall Open Scrub to Tall Open Shrubland of *Kunzea glabrescens* (Spearwood) to 7m over Scattered Shrubs of *Dasypogon bromeliifolius, Hibbertia hypericoides* and *Daviesia physodes* to 1.5m over Scattered Herbland/Sedgeland on grey/black Bassendean sands.

This vegetation type was recorded from Lot 604 in Quadrats 604-2 and 604-3. The vegetation type covered approximately 3% of the study area.

- **OFEr**

Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis* (Flooded Gum) to 12m over Low Woodland to Scattered Low Woodland of *Melaleuca rhaphiophylla* (Swamp Paperbark) and *Melaleuca preissiana* (Moonah) to 8m with occasional *Kunzea glabrescens* (Spearwood) over Tall Closed Scrub to Tall Open Scrub of *Astartea scoparia* to 4m over Scattered Grasses/Herbs dominated by weed species on waterlogged black organic sandy clay.

This vegetation type was recorded from Lot 92 in Quadrats 92-1, 92-2 and 92-3. The vegetation type covered approximately 5% of the study area.

- **OFErMrMp**

Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis* (Flooded Gum), *Melaleuca rhaphiophylla* (Swamp Paperbark) and *Melaleuca preissiana* (Moonah) to 12m with occasional *Banksia littoralis* (Swamp Banksia) over Grassland/Herbland/Sedgeland to Scattered Grasses/Herbs/Sedges dominated by weed species on waterlogged black organic sandy clay.

This vegetation type was recorded from Lots 91 and 604 in Quadrats 91-1, 91-2 and 604-6. The vegetation type covered approximately 12% of the study area.

- **OFMrMp**

Open Forest to Open Woodland of *Melaleuca rhaphiophylla* (Swamp Paperbark) and *Melaleuca preissiana* (Moonah) to 11m over occasional patches of Tall Shrubs of *Kunzea glabrescens* (Spearwood) to 8m over Open Grassland/Herbland/Sedgeland to Scattered Grassland/Herbland/Sedgeland dominated by weed species on waterlogged black organic sandy clay.

This vegetation type was recorded from Lot 604 in Quadrats 604-4 and 604-5. The vegetation type covered approximately 5% of the study area.

- **EmCc**

Scattered Trees of *Eucalyptus marginata* (Jarrah) and *Corymbia calophylla* (Marri) to 28m over Grassland to Very Open Grassland of *Ehrharta calycina* to 1.2m on grey Bassendean sands.

This vegetation type was recorded from Lot 604 and covered approximately 15% of the study area. No quadrats were sampled in this vegetation type because of the highly degraded nature of the vegetation. Releves and flora samples were taken opportunistically from random points from within Lot 604.

- **MrMp**

Scattered Trees of *Melaleuca rhaphiophylla* (Swamp Paperbark) and *Melaleuca preissiana* (Moonah) to 12m over pasture species with scattered patches of *Juncus pallidus* to 1.3m on waterlogged black organic sandy clay.

This vegetation type was recorded from Lot 91, 92 and 604 and covered approximately 55% of the study area. No quadrats were sampled in this vegetation type because of the highly degraded nature of the paddock**s**. Releves and samples were opportunistically taken from random points from within the paddocks.

- **TWEm**

Tall Woodland to Scattered Trees of *Eucalyptus marginata* (Jarrah) to 15m with occasional *Corymbia calophylla* (Marri) over Scattered Low Woodland of *Xylomelum occidentale* (Woody Pear), *Nuytsia floribunda* (W.A. Christmas Tree) and *Allocasuarina fraseriana* (Sheoak) to 9m over Scattered Tall Shrubs of *Kunzea glabrescens* (Spearwood) to 4m over Scattered Shrubs of *Acacia pulchella* var. *glaberrima* and *Hibbertia hypericoides* to 1.4m over Grassland to Very Open Grassland of *Ehrharta calycina* to 0.9m on grey Bassendean sands.

This vegetation type was recorded from Lot 604 in Quadrat 604-1. The vegetation type covered

approximately 5% of the study area.

3.2.2 Vegetation Condition

The condition of the vegetation was assessed using the condition rating scale of Keighery (1994) published in Bush Forever (Government of Western Australia, 2000b). Keighery's condition rating scale ranges from Pristine (where the vegetation exhibits no visible signs of disturbance) to Completely Degraded (where the vegetation structure is no longer intact and without native plant species) (Table 6).

Table 6

Vegetation Condition Rating Scale

Vegetation Condition Rating Scale (Government of Western Australia, 2000b)	
P	Pristine Pristine or nearly so, no obvious signs of disturbance
Ex	Excellent Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species
VG	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
*G	Good Vegetation structure significantly altered by very obvious signs of multiple disturbances. Retains basic vegetation structure or ability to regenerate. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing
*Deg	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
*CD	Completely Degraded The structure of the vegetation is no longer intact and the area is completely or almost completely without native species. These areas are often referred to as parkland cleared with the flora composing weed or crop species with isolated native trees or shrubs

* - Denotes conditions applicable to the study area

The vegetation condition of the study area ranged from Good to Completely Degraded (Figure 4) according to the vegetation condition rating scale published in Bush Forever (Government of Western Australia, 2000b). The majority of the study area (approximately 95%) was in a Degraded to Completely Degraded condition due to land clearing, grazing from cattle and horses and high densities of very aggressive weed species (for example **Ehrharta calycina, *Lotus subbiflorus *Lolium perenne* and **Lolium rigidum*). The areas of Good vegetation were recorded from Lot 604 in the Jarrah (*Eucalyptus marginata*) Open Forest/Woodlands and the north of Lot 92 in the Flooded Gum (*Eucalyptus rudis* subsp. *rudis*) Open Forest/Woodlands.

3.2.3 Conservation Significance of Vegetation

An ecological community is described as a naturally occurring biological assemblage that occurs in a particular type of habitat. A Threatened Ecological Community (TEC) is one which is found to fit into one of the following categories; *"presumed totally destroyed", "critically endangered", "endangered'* or *'vulnerable"*. Possible TECs that do not meet survey criteria are added to DEC's Priority Ecological Community (PEC) Lists under Priorities 1, 2 and 3. Ecological Communities that are adequately known, are rare but not threatened, or meet criteria for Near Threatened, or that have been recently removed from the threatened list, are placed in Priority 4. These ecological communities require regular monitoring. Conservation Dependent ecological communities are placed in Priority 5.

A search of the DEC's Threatened and Priority Ecological Communities database was conducted for the study are prior to undertaking the field survey. No TECs or PECs were identified from within or in the vicinity of the study area.

The Floristic Community Types were determined based on a presence/absence comparison with the complete dataset from the *Floristic Survey of the Southern Swan Coastal Plain* (Gibson *et al.*, 1994) and the flora data obtained from each of the eleven quadrats and the vegetation types recorded from the flora and vegetation assessment of the study area. Based on the comparison it was found that the vegetation located within the study area most closely resembles Floristic Community Types (FCT) 11 and 21a. FCT11 and FCT21a are described below:

- FCT11 – *Wet Forests and Woodlands*; and
- FCT21a – *Central Banksia attenuata – Eucalyptus marginata Woodlands*.

FCT11 and FCT21a are not classified as TECs or PECs by the DEC. The FCTs are not listed as a TEC by the Department of Environment, Water, Heritage and the Arts (DEHWA), under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. Gibson *et al.* (1994) considers FCT11 and FCT21a to be well reserved on the Swan Coastal Plain and low risk conservation status.

According to vegetation mapping by Heddle *et al.* (1980) the vegetation within the study area is considered to be representative of the Bassendean Complex-Central and South. Currently, there is 27% (or 23635ha) of the original pre-European extent remaining on the Southern Swan Coastal Plain. Of the original area (87626ha) on the Southern Swan Coastal Plain, approximately 0.7% or 572ha is in secure tenures (Table 3b of Appendix 3 in EPA, 2003).

As a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in the Comprehensive, Adequate and Representative (CAR) reserve system (Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee, 1997). There is approximately 27% of the Bassendean Complex-Central and South remaining on the Southern Swan Coastal Plain, this is above the general criterion of 15% and therefore is not considered to be regionally significant. The vegetation representative of the Bassendean Complex-Central and South is in a Good to Degraded condition and therefore is not a good example of this vegetation complex.

There are examples of better quality vegetation that is similar to the study area which are protected within three Bush Forever Sites located approximately 7km to the north of the study area (Government of Western Australia, 2000a). Bush Forever Sites 379 (Anstey Swamp, Karnup), 394 (Lake Amarillo, Serpentine River and Adjacent Bushland, Karnup) and 395 (Paganoni Swamp and Adjacent Bushland, Karnup) are located within close proximity to the Serpentine River and are within the same landforms and soils and/or vegetation complex as the study area.

The study area does not provide any ecological linkage value within and outside the study area. The vegetation is patchy with isolated areas of trees that display no connectivity with any other areas of remnant vegetation located outside of the study area.

The tall (greater than 10m in height) Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Flooded Gum (*Eucalyptus rudis* subsp. *rudis*), Swamp Paperbark (*Melaleuca rhaphiophylla*) and Moonah (*Melaleuca preissiana*) trees support some ecological value. The trees provide feeding, roosting and nesting sites for locally common bird species (including conservation significant bird species like the Forest Red-Tailed Black Cockatoo and White Bellied Sea Eagle). The tall trees also provide aesthetic values to the people that live around and pass by the study area.

3.2.4 Vegetation and Wetland Conservation

The Serpentine River and associated floodplains and wetlands are located between approximately 10m and 100m to the west-north-west of the study area. The Serpentine River and associated flood plains and wetlands are considered to be Conservation Category (CC) Wetlands (numerous UFI numbers).

While none of the CC Wetlands occur within the boundary of the study area, the EPA's Guidance Statement No. 33, *Environmental Guidance for Planning and Development*, states that for permanently inundated rivers (the Serpentine River) a minimum generic buffer distance of 50m is required for any development (EPA, 2008). The majority of the study area falls outside the generic buffer, except the south-west corner of Lot 604 where the Serpentine River at its closest point to the study area is only 20m to the west. The vegetation in this section of the study area is considered Good to Degraded with some areas of scattered Jarrah (*Eucalyptus marginata*) and Marri (*Corymbia calophylla*) trees. Consideration should be given to retaining the vegetation within the Serpentine River generic buffer zone.

Some of the stands of vegetation located within the study area are associated with Resource Enhancement (RE) wetlands. There are also other similar stands that occur within areas mapped as Multiple Use. However, MU wetlands are not considered a priority for retention according to the EPA.

RE wetlands are wetlands that are degraded but could be rehabilitated to a Conservation Category. Coffey Environments believes that the areas mapped as RE are so degraded that they are unlikely to be able to be rehabilitated to a Conservation Category. However, given the high amount of clearing in the Nambeelup area and the local fauna, aesthetic and other wetland values, it is Coffey Environments opinion that areas of Open Forest within RE wetlands should be retained where possible and managed with the aim of improving the wetlands ecological values. There are also some other areas of Open Forest located in the area mapped as MU wetlands which should also be considered for retention for the same reason as above.

3.2.5 Flora

A total of 115 flora species from 38 families were identified from the study area during the October and December flora and vegetation assessment. This includes 77 (67% of the total species) native species and 38 (33% of the total species) introduced (weed) species.

A total of 38 introduced (weed) species were recorded from the study area with the majority recorded from the Multiple Use wetland areas of Lot 91, 92 and 604. One of the introduced species (**Asparagus asparagoides*) is listed as a Declared Weed by the Department for Agriculture and Food Western Australia (DAFWA) under section 37 of the *Agricultural and Related Resources Protection Act 1976* (WA). **Asparagus asparagoides* or commonly referred to as Bridal Creeper, is categorised as a P1 (Prevention), which prohibits the movement of plants or their seeds within the state. This also prohibits the movement of contaminated machinery and produce (including livestock and fodder). Bridal Creeper was recorded from Quadrat 92-3 and surrounding vegetation along the western boundary of Lot 92.

During any proposed clearing of the study area, the plants of Bridal Creeper will need to be disposed off in an appropriate manner which does not transport seeds and/or allows vegetative material to strike (from roots) and colonise a new area, including waste disposal sites. The machinery involved in the clearing of the Bridal Creeper plants will need to be cleaned appropriately, so the seeds and/or vegetative material is not transported across the study area.

The dominant families from within the study area are shown in Table 7 and the dominant genera were *Lomandra* (4 taxa), *Melaleuca* (4 taxa), *Banksia* (3 taxa), *Caladenia* (3 taxa) and *Daviesia* (3 taxa).

Table 7

Dominant Families Recorded from within the Study Area

Family	Total Species	
	Native Species	*Introduced Species
Papilionaceae (Pea Family)	12	*5
Poaceae (Grass Family)	-	*15
Orchidaceae (Orchid Family)	9	*1
Myrtaceae (Eucalypt Family)	9	-
Asteraceae (Daisy Family)	1	*5
Anthericaceae (Lily Family)	5	-
Dasypogonaceae (Dasypogon Family)	5	-

A comprehensive list of the entire flora species recorded during the October and December 2008 flora survey of the study area is provided in Appendix B. The floristic data collected from each of the 11 quadrats and one Releve is provided in Appendix A, while the locations of each of the quadrats sampled are shown on Figure 2.

Nicole Siemon and Associates PL (2005) recorded 256 flora species (including 45 introduced species) from the proposed Nambeelup Industrial Area which included Lots 91, 92 and 604, as well as surrounding lots which supported a different array of vegetation types, some of which was in very good condition.

Coffey Environments are in the process of completing a report on the flora and vegetation of Keralup (formerly Amarillo), which is located approximately 1km to the north of the study area. The flora and vegetation survey was conducted in spring and early summer 2008 and recorded 302 plant species (including 207 native species and 95 introduced species). The vegetation types and landforms between the study area and Keralup are similar with paddocks dominated by scattered Swamp Paperbarks (*Melaleuca rhaphiophylla*), Moonah (*Melaleuca preissiana*) and Flooded Gums (*Eucalyptus rudis*), open woodlands dominated by Jarrah (*Eucalyptus marginata*) and stands of *Juncus pallidus*. The Keralup study area is significantly larger than Lots 91, 92 and 604 (Keralup is approximately 4,000ha in size compared to approximately 444ha in size for Lots 91, 92 and 604) and also the Keralup survey sampled the riparian vegetation along the Serpentine River. The Keralup report and data is not yet available to the public.

3.2.6 Conservation Significance of Flora

While all native flora species are protected under the *Wildlife Conservation Act 1950-1979*, a number of plant species are assigned an additional level of conservation significance based on the limited number of known populations and the perceived threats to these populations (Appendix C). Species of the highest conservation significance are designated Declared Rare Flora (DRF), either extant or presumed extinct. Species that appear to be rare or threatened, but for which there is insufficient information to properly evaluate their conservation significance, are assigned to one of four Priority flora categories. Conservation Codes 1, 2 and 3 are considered to be poorly known and Conservation Code 4 is considered to be rare taxa that require monitoring.

The search of the DEC's Threatened (Declared Rare) and Priority Flora database and the WAHERB Specimen database was commissioned for the study area identified 7 DRF and 21 Priority Listed flora species that have been previously recorded from within and/or around the vicinity of the study area (Table 3).

No DRF or Priority Listed flora species were recorded from the level 2 flora and vegetation survey of the study area. The majority of the annual and ephemeral flora species, including the DRF orchid species (*Caladenia huegelii, Diuris drummondii, Diuris micrantha* and *Drakaea elastica*) that are protected under the *EPBC Act 1999*, would have been identifiable during the Level 2 flora and vegetation survey of the study area.

The majority of the study area was wetlands and does not match the habitat descriptions required for the *Caladenia huegelii*. The only area it may be located would be in the south-west corner of Lot 604 were the vegetation is dominated by Jarrah (*Eucalyptus marginata*). However this vegetation type was in a Good to Degraded condition with minimal understorey.

The majority of the wetlands identified within the study area are in a Degraded condition due to heavy grazing and clearing. The wetlands also do not support native sedges or any significant understorey to support populations of *Diuris drummondii* and *Diuris micrantha*. *Diuris drummondii* flowers from November to January so the Phase 2 survey would have identified this species if it was present within the study area.

Several populations of *Drakaea elastica* have been recorded just outside the south-west corner of the study area, within the Kwinana Freeway extension (Figure 2). The vegetation of the study area is different to the known locations of *Drakaea elastica*. The vegetation is also too degraded with minimal understorey for *Drakaea elastica* too survive within the study area.

The Keralup Survey recorded two significant flora species, the DRF *Diuris drummondii* and the P3 *Stylidium longitubum*. One plant of the *Diuris drummondii* and several plants of *Stylidium longitubum* were recorded along the Serpentine River in similar vegetation to the Study Area. The Level 2 flora and vegetation survey would have recorded both species if they were located within the study area. The Serpentine River is located to the west of study area and not within the study area like the Keralup survey area.

4 FAUNA

4.1 Methodology

4.1.1 Database Search and Literature Review

A desktop search of the Western Australian Museum database and the Terrestrial Ecosystem fauna database, was used to develop a list of potential bird, reptile, mammal and amphibians in the general study area. The search area was for the area surrounding the study area with a 20km buffer area with a linear search area along the Swan Coastal Plain. This search area was used to eliminate results from the Scarp and to maximise the similarity in fauna habitats encompassed by the search area. Other more general texts were also used to provide supplementary information including Tyler *et al.* (2000) for frogs; Storr *et al.* (1983, 1990, 1999, 2002) for reptiles; Johnstone and Storr (1998; 2004) and Storr and Johnstone (2003) for birds; Strahan (2000) for mammals and consultant staff's personal experience. In addition, a number of published and unpublished reports (see references below and Appendix C) for fauna surveys on the Swan Coastal Plain have been used to provide a regional context for the small vertebrate assemblages sampled in the study area.

Collectively these sources of information were used to create lists of species expected to utilise the study area. It should be noted that these lists include species that have been recorded in the general region, but are vagrants, and are generally not found in the area because of a lack of suitable habitat. Vagrants can be recorded almost anywhere. In addition, because the data provided by the museum is based on historic records, it can include species that are now locally extinct. For the metropolitan area, it also includes species that are exotics or held in captivity and died. Many of the bird, mammal, reptile and amphibian species have specific habitat requirements that may be present in the general area but not in the specific study area (e.g. marine species). Also, the ecology of many of these species is often not well understood and it can sometimes be difficult to indicate those species whose specific habitat requirements are not present in the study area. As a consequence some species will be included in the list produced from these database searches but will not be present in the actual study area. Any such species have been removed from the list.

A search of the Department of Environment and Conservation's Threatened and Priority Fauna database was undertaken to identify potential scheduled and threatened species in the region (Appendix E). A search of the Commonwealth *Environment Protection and Biodiversity Conservation (EPBC) Act 1999* online database was also undertaken for the area to identify species of conservation interest to the Commonwealth Government.

Taxonomy and nomenclature for fauna species used in this report generally follow that provided in WAM (2008) which we presume is based on Aplin and Smith (2001) for amphibians and reptiles, How *et al.* (2001) for mammals and Johnstone (2001) and Christidis L and Boles W E (2008) for birds.

4.2 Site Reconnaissance

Graeme Finlayson (Coffey Environments) and Dr Graham Thompson (Terrestrial Ecosystems) visited and inspected the study area on 28 November 2008. This visit included an inspection of the major fauna habitats/land systems within the study area and the adjacent areas. The primary purpose of this reconnaissance survey was to identify fauna habitats and assess the potential for conservation significant species to be in the study area.

4.3 Limitations

A comprehensive terrestrial and avian survey has not been undertaken for this assessment. Conclusions and management recommendations have therefore been made based on data collated from various surveys and reports for adjacent areas and the bioregion. It is acknowledged that repeated surveys at multiple sites over several years are necessary to describe the spatial and temporal

variations in the faunal assemblage for a particular site. However, in this circumstance it is Coffey Environments' opinion that given the limited amount of intact remnant vegetation available and previous anthropogenic activity on site, adequate data have been collected to assess any potential impact on the terrestrial vertebrate fauna.

This assessment was undertaken in accordance with a Level 1 assessment as suggested in the Environmental Protection Authority (EPA) *Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA, 2002), Coffey Environments' interpretation of the EPA *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (EPA, 2004) and industry best practice as described in the literature (Thompson, 2007).

The EPA *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (EPA, 2004) suggests that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 8.

TABLE 8

FAUNA ASSESSMENT LIMITATIONS AND CONSTRAINTS

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out the survey	No	Zoologists that undertook this survey have appropriate training and experience in conducting Level 1 vertebrate fauna assessments.
Scope	No	All components required for a Level 1 fauna assessment have been completed.
Proportion of fauna identified, recorded and/or collected	Yes Negligible	An on site terrestrial fauna survey has not been undertaken within the study area; however, a large proportion of the site is degraded pastoral habitat and also a number of fauna surveys have been previously conducted in the surrounding area. Numerous terrestrial fauna surveys have been undertaken in the bioregion which include habitat similar to that on site. While the terrestrial fauna in the study area has not been directly surveyed, there is sufficient data to assess the impact of development on the likely faunal assemblage.
Sources of information	No	Vertebrate fauna information was available from appropriate database searches and both published and unpublished reports.
Proportion of the task achieved	No	The assessment fulfils all of the objectives.
Timing/weather/season/ cycle	No	The reconnaissance site visit was undertaken in weather conditions which were appropriate for this type of assessment.
Disturbances which affected results of the survey	No	A large portion of the site is predominantly disturbed or cleared pastoral vegetation. This impact has been taken into account in this assessment.
Intensity of survey effort	No	The intensity of the assessment is sufficient for a Level 1 assessment.
Completeness	No	All major habitat types were visited.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	There were no access problems.
Availability of contextual information for the region	No	WA Museum database, Terrestrial Ecosystems fauna database, DEC Threatened and Priority species lists, EPBC Act Protected Matters Search and results of previous surveys in both the surrounding area and the bioregion were available to provide comparison at both a local and regional level.

Negligible – less than 20%; Moderate – 20-60%; significant – greater than 60%

5 RESULTS

5.1 Fauna Habitat in the Study Area

When assessing the fauna habitat quality a number of factors are taken into consideration including, the size of the habitat, the level of habitat connectivity, availability of specific resources (e.g. tree hollows) and overall vegetation quality. The following is a summary of ratings that Coffey Environments consider applicable for assessing fauna habitat quality.

High quality fauna habitat (5) – These areas closely approximate the vegetation mix and quality that would have been in the area prior to any disturbance. The habitat has connectivity with other habitats and is likely to contain the most natural vertebrate fauna assemblage.

Very good fauna habitat (4) - These areas show minimal signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) and generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be minimally effected by disturbance.

Good fauna habitat (3) – These areas showed signs of disturbance (e.g. grazing, clearing, fragmentation, weeds) but generally retain many of the characteristics of the habitat if it had not been disturbed. The habitat has connectivity with other habitats and fauna assemblages in these areas are likely to be affected by disturbance.

Disturbed fauna habitat (2) – These areas showed signs of significant disturbance. Many of the trees, shrubs and undergrowth are cleared. These areas may be in the early succession and regeneration stages. Areas may show signs of significant grazing, contain weeds or have been damaged by vehicle or machinery. Habitats are fragmented or have limited connectivity with other fauna habitats. Fauna assemblages in these areas are likely to differ significantly from what might be expected in the area had the disturbance not occurred.

Highly degraded fauna habitat (1) – These areas often have a significant loss of vegetation, an abundance of weeds, and a large number of vehicle tracks or are completely cleared. Limited or no fauna habitat connectivity. Faunal assemblages in these areas are likely to be significantly different to what might have been in the area pre-disturbance.

Fauna habitats recorded within the Nambeelup Industrial study area (Plates 1 – 5) included:

1. Open paddock;
2. Paddock with dispersed *Melaleuca*;
3. *Melaleuca* thicket;
4. Paddock with *Eucalyptus*; and
5. Paddock with *Juncus*.

In general the quality of habitat located within the study area was either disturbed (2) or good (3) quality as there was evidence of disturbance, habitat fragmentation and limited connectivity between good quality fauna habitat. The good quality habitat contained trees that were suitable for roosting birds (e.g. Plate 7) or potential foraging habitat (Plate 6).

5.2 Potential Vertebrate Fauna in the Study Area

Appendix D shows the lists of species recorded in fauna surveys undertaken in the general area. Fauna that are of conservation significance and might be found in the study area are listed and discussed below.

5.3 Short-range Endemic (SRE) Invertebrates

Although no specific SRE investigations were undertaken, none of the habitats within the study area are unique or locally uncommon and are therefore unlikely to support SRE fauna that are not found elsewhere in the immediate vicinity.

5.4 Significant Fauna Species Predicted to Occur in the Study Area

Numerous species of birds were identified as having national environmental significance under the *EPBC Act 1999* within the search grid co-ordinates. However, the vast majority of these are marine or coastal species that are likely to inhabit the marine environment to the west of the study area, and are unlikely to breed or forage on site. These birds have not been considered. The remaining species that may be found in the area are listed in Table 9. The only species of conservation interest under the *EPBC Act* likely to be found in the area are Carnaby's Black-Cockatoo, the White-bellied Sea Eagle and the Rainbow Bee-eater. The Chuditch, although recorded in the region is unlikely to inhabit the site due to a lack of suitable habitat and lack of recent records.

In Western Australia, all native fauna species are protected under the *Wildlife Conservation Act 1950-1979*. Fauna species that are considered rare, threatened with extinction or have a high conservation value are specially protected under the Act. In addition, some species of fauna are covered under the 1991 ANZECC convention, while certain birds are listed under the Japan and Australian Migratory Bird Agreement (JAMBA) and the China and Australian Migratory Bird Agreement (CAMBA). In addition to the above classification, the Department of Environment and Conservation (DEC) also classify fauna under five different Priority codes and rare and endangered fauna are classified under the *Wildlife Conservation (Specially Protected Fauna) Notice 2008* into four schedules of taxa. These are:

Schedule 1 – Fauna which are rare or likely to become extinct and are declared to be fauna in need of special protection.

Schedule 2 – Fauna which are presumed to be extinct and are declared to be fauna in need of special protection.

Schedule 3 – Birds which are subject to an agreement between the governments of Australia and Japan relating to the protection of migratory birds and birds in danger of extinction which are declared to be fauna in need of special protection.

Schedule 4 – Fauna that are in need of special protection, otherwise than for the reasons mentioned in Schedule 1, 2 or 3.

In addition to the above classification, the DEC also classifies fauna under five different priority codes:

Priority 1 – *Taxa with few, poorly known populations on threatened lands.* Taxa which are known from few specimens or sight records from one of a few localities on lands not managed for conservation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened species.

Priority 2 – *Taxa with few, poorly known populations on conservation lands, or taxa with several, poorly known populations not on conservation lands.* Taxa which are known from few specimens or sight records from one or a few localities on lands not under immediate threat of habitat destruction or degradation. The taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 3 – *Taxa with several, poorly known populations, some on conservation lands.* Taxa which are known from few specimens or sight records from several localities, some of which are on lands not under immediate threat of habitat destruction or degradation. The

taxon needs urgent survey and evaluation of conservation status before consideration can be given to declaration as threatened fauna.

Priority 4 and 5 – 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 if present circumstances change. These taxa are usually represented on conservation lands. Taxa which are declining significantly but are not yet threatened.

Threatened and Priority species listed under the *Wildlife Conservation Act*, DEC's database and the *EPBC* Act that may potentially occur in the region are listed in Table 9. The likelihood of species listed under government legislation or conservation programs being found in the study area are discussed below. These are also shown in Appendix D.

TABLE 9

SPECIES LISTED AS BEING SIGNIFICANT VERTEBRATE BY THE COMMONWEALTH OR STATE GOVERNMENTS AND PREDICTED TO OCCUR IN THE NAMBEELUP AREA

Species	Status under Wildlife Conservation Act Schedule (S) / Priority (P)	Status under Commonwealth Environment Protection and Biodiversity Act	Potential to be found in the study area	Likely Location or Specific Habitat
Chuditch, Western Quoll (*Dasyurus geoffroii*)	Schedule 1	Vulnerable	*Highly unlikely* to occur within area	N/A
Numbat, Walpurti (*Myrmecobius fasciatus*)	Schedule 1		*Highly unlikely* to occur within area	N/A
Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)	Schedule 1		*Occurs* within the study area	Lot 604
Carnaby's Black-Cockatoo, (*Calyptorhynchus latirostris*)	Schedule 1	Endangered	*Likely* to occasionally occur within area	Lot 604
Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)	Schedule 1	Vulnerable	*Possibly* but *unlikely* to occur within the study area	N/A
Graceful Sunmoth (*Synemon gratiosa*)	Schedule 1	Endangered	*Unlikely to* occur in the study area	N/A
Black-striped Snake (*Neelaps calonotus*)	Priority 3		*May* occur within the study area	Dense leaf litter
Lined Skink (*Lerista lineata*)	Priority 3		*May* occur within the study area	Dense leaf litter
Water Rat (*Hydromys chrysogaster*)	Priority 4		*Highly unlikely* to occur within the study area	N/A
Hooded Plover (*Charadrius rubicollis rubicollis*)	Priority 4		*Highly unlikely* to occur within the study area	N/A
Eastern Curlew (*Numenius madagascariensis*)	Priority 4		*Unlikely* to occur within the study area	N/A
Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)	Priority 5		*Likely* to occur within the study area	Densely vegetated wetland areas: Lot 92
White-bellied Sea-Eagle (*Haliaeetus leucogaster*)		Migratory	*Occurs* within the study area	Lot 604 – breeding habitat
Rainbow Bee-eater (*Merops ornatus*)		Migratory	*Likely* to occur in the study area	All areas

Species	Status under Wildlife Conservation Act Schedule (S) / Priority (P)	Status under Commonwealth Environment Protection and Biodiversity Act	Potential to be found in the study area	Likely Location or Specific Habitat
Great Egret (*Ardea alba*)		Migratory	*Possibly* occurs within the study area	Flying over and wetland areas
Cattle Egret (*Ardea ibis*)		Migratory	*Possibly* occurs within the study area	Flying over and wetland areas
Sharp-tailed Sandpiper (*Calidris acuminata*)		Migratory	*Unlikely* to occur within the study area	N/A
Curlew Sandpiper (*Calidris ferruginea*)		Migratory	*Unlikely* to occur within the study area	N/A
Red-necked Stint (*Calidris ruficollis*)		Migratory	*Unlikely* to occur within the study area	N/A
Grey Plover(*Pluvialis squatarola*)		Migratory	*Unlikely* to occur within the study area	N/A
Common Greenshank (*Tringa nebularia*)		Migratory	*Unlikely* to occur within the study area	N/A
Marsh Sandpiper (*Tringa stagnatilis*)		Migratory	*Unlikely* to occur within the study area	N/A

Below is a brief description of the preferred habitat of species listed in Table 9 and our assessment of the likelihood of these species being found on the study area.

Chuditch, Western Quoll (*Dasyurus geoffroi*)

The Chuditch was originally found in over 70% of Australian woodlands; however, since European settlement its range has diminished to a patchy distribution throughout the Jarrah forest and mixed Karri - Marri - Jarrah forest of south-west WA. They have been known to occupy a wide range of habitats including woodlands, dry sclerophyll forests, riparian vegetation, beaches and deserts. The Chuditch creates dens in hollow logs or burrows and have also been recorded in tree hollows and cavities. They are opportunistic feeders, and forage on the ground at night, feeding on invertebrates, small mammals, birds and reptiles.

Coffey Environments believes that it is unlikely the Chuditch occurs within the study area due to the degraded nature of the site and lack of records in recent surveys nearby and in similar habitat types.

Numbat, Walpurti (*Myrmecobius fasciatus*)

The Numbat was originally widespread across southern semi-arid and arid Australia, from western NSW through SA and southern NT to the south-west of WA (Maxwell *et al.*, 1996). There are currently two remnant native populations at Dryandra and Perup, WA and several reintroduced populations including Boyagin Nature Reserve, Tutanning Nature Reserve, Batalling block and Karroun Hill Nature Reserve (Friend and Thomas, 1995). DEC Threatened species database records this species being seen at Ida Hill mine in 1918.

There are no recent records of this species in the general area; as a consequence, Coffey Environments' assessment is that it is unlikely to occur within the study area.

Forest Red-tailed Black-Cockatoo (*Calptorhynchus banksii naso*) – Forest Red-tailed Black-Cockatoos frequent the humid to subhumid south-west feeding on a variety of *Eucalyptus* species, from Gingin in the north, Albany in the south and west to Cape Leeuwin and Bunbury. Nesting occurs in hollows with a depth of 1-5m predominately in Marri (*C. calophylla*), Jarrah (*E. marginata*) and Karri (*E. diversicolor*). Forest Red-tailed Black-Cockatoos were formerly common but are now uncommon and patchily distributed.

The Red-Tailed Black Cockatoo was recorded during the site visit and it is Coffey Environments' view that Forest Red-tailed Black-Cockatoos utilise the study area for occasional feeding purposes on Marri trees in Lot 604.

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)

Carnaby's Black-Cockatoo inhabits the south-west of Western Australia. Its preferred habitat is the woodland where it preferentially feeds on plants of the Proteaceae family. Preferred nesting trees include the smooth-barked Salmon Gum (*Eucalyptus salmonophloia)* and Wandoo (*E. wandoo*), which contain deep hollows. Nesting also occurs in Marri (*Corymbia calophylla)* and Tuart (*E. gomphocephala*). Carnaby's Black-Cockatoo forages in woodland and kwongan heath that is dominated by proteaceous species. Its main foods are the seeds of Hakeas, Grevilleas, Banksias, Eucalypts and introduced Pines.

There were no suitable breeding hollows identified within the study area. It is Coffey Environments' view that Carnaby's Black Cockatoos would occasionally utilise the study area for foraging in the few available Marri trees in Lot 604.

Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)

This species is most common in the far south-west of Western Australia where it breeds. It is known to breed from the southern forests north to Collie and east to near Kojonup. Baudin's Cockatoo is typically found in vagrant flocks and utilises the taller, more open Jarrah and Marri woodlands, where it feeds mainly on Marri seeds and various Proteaceous species. Whilst they are seasonally present on the Swan Coastal Plain, Baudin's Black-Cockatoos are more likely to occur in the eastern region of the coastal plain.

Coffey Environments' view is that Baudin's Black Cockatoos are unlikely to occur in the study area.

Graceful Sunmoth (*Synemon gratiosa*)

This species has brightly coloured orange hind-wings, and is similar in appearance to a butterfly. The breeding season is during March, during which time adults are active during the day and thought to breed exclusively on *Lomandra* species, in particular *L. hermaphrodita*. It occurs along the Swan Coastal Plain between Wanneroo and Mandurah and is under threat due to damage to habitat for four-wheel driving and the vulnerability of larvae and juveniles to fire.

Coffey Environments believes that this species is unlikely to occur in the study area, as there were no records of *L. hermaphrodita* within the study area and very little intact understorey.

Black-striped Snake (*Neelaps calonotus*)

This species occurs on dunes and sand-plains vegetated with heaths and eucalypt/banksia woodlands. It feeds largely on skinks and its distribution is restricted and threatened by urban development.

Coffey Environments believes that this species is unlikely to be found within the study area due to a lack of suitable habitat.

Lined Skink (*Lerista lineata*)

This species is found in coastal heaths and shrublands on the lower west coast between Perth and Mandurah and including Rottnest Island, with isolated populations on the mid-west coast and Busselton.

Coffey Environments believes that this species may be found in the study area but would not be dependant on habitat found on site for its overall survival.

Water Rat (*Hydromys chrysogaster*)

The water rat is found mainly near permanent bodies of freshwater, occasionally at temporary waterholes.

Coffey Environments believes that it is highly unlikely to be found in the study area due to a lack of suitable habitat.

Hooded Plover (*Charadrius rubricollis*)

This species frequents the margins and shallows of salt lakes, also along coastal beaches, where it forages for invertebrates along the water's edge.

Coffey Environments believes that it is highly unlikely to be found in the study area due to a lack of suitable habitat.

Eastern Curlew (*Numenius madagascariensis*)

This species breeds on open mossy or transitional bogs, moss-lichen bogs and wet meadows, and on the swampy shores of small lakes. In the non-breeding season it is essentially coastal, occurring at estuaries, mangrove swamps, saltmarshes and intertidal flats, particularly those with extensive seagrass meadows.

Coffey Environments is of the opinion that this species is unlikely to be recorded in the study area due to a lack of suitable habitat.

Southern Brown Bandicoot (*Isoodon obesulus fusciventer*)

Southern Brown Bandicoots prefer dense scrub (up to one metre high), with swampy vegetation. They will often feed in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and crop land lying close to dense cover. This species has been recorded in the area on multiple occasions in densely vegetated habitat.

It is Coffey Environments opinion that this species is likely to be recorded within the study area due to nearby wetlands that contain high quality habitat for this species and also the presence of some good quality habitat on site, particularly in Lot 92. Areas of remnant vegetation should be incorporated into the development as areas of Public Open Space to minimise the likelihood of impacting this species in the clearing process.

White-bellied Sea Eagle (*Haliaeetus leucogaster*)

This species is the second largest bird of prey found in Australia and is mostly seen along shore lines and off-shore islands.

Coffey Environments staff observed a White-bellied Sea Eagle flying over a nest site during the site visit in Lot 604 (387369E, 6403385N) and therefore recognise that this species uses the study area for nesting. Effort should be made to incorporate large trees (i.e. Jarrah and Marri trees greater than 10m in height) into retained remnant vegetation within the structure plan to avoid removing potential nesting trees for this species.

Rainbow Bee-eater (*Merops ornatus*)

The Rainbow Bee-eater is found throughout mainland Australia, as well as eastern Indonesia, New Guinea and, rarely, the Solomon Islands. In Australia it is widespread, except in desert areas, and breeds throughout most of its range, although southern birds move north to breed. The Rainbow Bee-eater is most often found in open forests, woodlands and shrublands, and cleared areas, usually near water. It will use disturbed sites such as pastureland, quarries, cuttings and mines to build its nesting tunnels. Rainbow Bee-eaters eat insects, mainly catching bees and wasps, as well as dragonflies, beetles, butterflies and moths. It is possible this species occurs within the study area.

Coffey Environments believes that although this species may be recorded within the study area, the loss of degraded habitat in the study area is unlikely to impact significantly on this species in a regional context.

Great Egret (*Ardea alba*)

This species is one of the largest Australian Egrets and is typically found near water, salt or fresh, and feeds in wetlands, streams, ponds and tidal flats. It nests in trees near water.

It is Coffey Environments view that this species may occur in the study area but is unlikely to rely on the habitat for survival.

Cattle Egret (*Ardea ibis*)

This species is a relatively small egret found in grasslands, woodlands and wetlands. Cattle Egret pairs are monogamous for the breeding season, and they breed in colonies, usually with other waterbirds.

It is Coffey Environments' opinion that although this species may be occassionally seen in the study area, it is unlikely to rely on the study area for survival.

Sharp-tailed Sandpiper (*Calidris alba*)

This species inhabits a variety of habitats including tidal sandbars and mudflats also estuaries, swamps, inland lakes and shorelines.

Coffey Environments believes that this species is unlikely to occur within the study area due to a lack of suitable habitat.

Curlew Sandpiper (*Calidris ferruginea*)

It occurs at coastal lagoons, mudflats and sandy beaches.

Coffey Environments' view is that this species is unlikely to be seen within the study area due to the lak of suitable habitat.

Red-necked Stint (*Calidris ruficollis*)

The Red-necked Stint is a wader that prefers saline sand bars or tidal mudflats, along the coast and as a result is unlikely to be recorded within the study area.

It is Coffey Environments opinion that this species does not occur in the study area due to a lack of suitable habitat.

Grey Plover (*Pluvialis squatarola*)

The Grey Plover prefers coastal areas and salt lakes.

Coffey Environments believes that it is most unlikely to be seen in the study area due to a lack of suitable habitat.

Common Greenshank (*Tringa nebularia*)

This species is a large wader, inhabiting fresh or saline mudflats, swamps and sandbars.

Coffey Environments believes that It is unlikely to be found in the study area due to a lack of suitable habitat.

Marsh Sandpiper (*Tringa stagnatilis*)

This species prefers coastal swamps and waterways.

Coffey Environments believes that it is unlikely to be seen in the study area due to a lack of habitat.

5.5 Biodiversity value

The EPA's (2002) *Terrestrial Biological Surveys as an Element of Biodiversity Protection Position Statement No. 3* indicated an ecological assessment of a site must consider its biodiversity value at the genetic, species and ecosystem levels; and its ecological functional value at the ecosystem level.

It is Coffey Environments' view that species of mammals, reptiles, birds and amphibians likely to visit or utilise the habitats within the study area would also be present or visit other similarly vegetated areas in the region. Species of conservation interest have been addressed above. The potential presence of conservation significant species addressed above is an important consideration for the proposed development and any potential impacts to these species should be minimised.

It is not possible to assess the biodiversity value at a genetic level based on the information available, however due to the degraded nature of the site and the lack of large isolated high quality habitat, it is Coffey Environments view that biodiversity value at the genetic level would not be impacted as a result of development within the study area.

It is Coffey Environments' view that species of mammals, reptiles, birds and amphibians likely to be present or to visit the habitats within the study area would also be present or visit many of the other similarly vegetated areas in region. Therefore small scale clearing of vegetation associated with this development will not have a significant impact on the biodiversity value at the genetic, species, and ecosystem levels in this region.

The retention of all large trees on the western side of the study area in both Lot 92 and Lot 604 will help reduce the impact of land clearing within the study area on species of conservation significance that may occur on site. The retention of these trees is also important when considering the two large nests located in Lot 604 that were being used by a White-bellied Sea Eagle (387369E, 6403385N) and an Osprey (386681E, 6402919N).

5.6 Ecological functional value at the ecosystem level

Sites that have a low biodiversity value normally would have a low ecological functional value unless they contain conservation significant species or the habitat is rare and therefore important. In this case, the study area may contain a number of vertebrates that are of conservation significance, but this presence is likely to be limited by the quality of habitat within the site. These species are unlikely to be significantly impacted by vegetation clearing in degraded areas. No areas of high quality habitat occurred within the study area and it is Coffey Environments' view that land clearing within the majority of the study area will not have a significant impact on an ecosystem of high functional value or that is important in a regional context.

5.7 Risk Assessment

Fauna surveys to support EIA are part of the environmental risk assessment undertaken to consider the potential impact that a development might have on the biodiversity at the site and the region. Table 10 is a summary of the risk assessment associated with this study based on the available data.

Based on the risk assessment, the clearing of vegetation of degraded areas within the study area will have a low risk of significantly impacting on fauna species of conservation significance, threatened or conservation significant fauna assemblages, or fauna habitat that have high ecological value. Coffey Environments recommends that clearing of remnant vegetation within the study area be kept as minimal as possible, particularly large trees (i.e. Marri and Jarrah trees greater than 10m tall) that are useful for nesting by species such as White-bellied Sea Eagles and Ospreys and feeding by Black Cockatoo species, and that habitat connectivity in the area be addressed in the design process.

TABLE 10

FAUNA IMPACT RISK ASSESSMENT DESCRIPTORS

Any risk assessment is a product of the likelihood of an event or impact occurring and the consequences of that event or impact. Likelihood and consequences are categorised and described below. The assessed risk level (likelihood x consequences) is then calculated as the overall risk for the development. This is followed by an assessment of the acceptability of the risk associated with each of the events or impacts (Table 12). Disturbances and vegetation clearing have an impact on the fauna at multiple scales – site, local, landscape and regional. Each of these is considered in the risk assessment. This assessment should be considered in the context of the summary in Table 11.

Likelihood		
Level	**Description**	**Criteria**
1	Rare	The environmental event may occur in exceptional circumstances.
2	Unlikely	The environmental event could occur at sometime.
3	Moderate	The environmental event should occur at sometime.
4	Likely	The environmental event will probably occur in most circumstances.
5	Almost certain	The environmental event is expected to occur in most circumstances.
Consequences		
Level	**Description**	**Criteria**
1	Insignificant	Insignificant impact on fauna of conservation significance or regional biodiversity, and the loss of individuals will be insignificant in the context of the availability of similar fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the study area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or an impact on species of conservation significance in the study area.
4	Major	Significant impact on conservation significant fauna or their habitat in the study area and/or regional biodiversity and/or a significant loss in the biodiversity at the landscape scale.
5	Catastrophic	Loss of species at the regional scale and/or a significant loss of species categorised as 'vulnerable' or 'critical' under the *EPBC Act 1999* at the local or regional scale.

Acceptability of Risk	
Level of risk	**Management of Risk**
1-4	Acceptable, no action required.
5-6	Moderate, avoid if possible, routine management with internal audit and review of monitoring results annually
7-8	High, externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes with annually.
9-10	Extreme, unacceptable, project should be redesigned or not proceed.

TABLE 11
LEVEL OF ACCEPTABLE RISK

		Likelihood				
		1 **Rare or very low** May occur in exceptional circumstances	2 **Unlikely or low** Could occur at sometime	3 **Moderate** Should occur at sometime	4 **Likely** Will probably occur in most circumstances	5 **Almost certain** Is expected to occur in most circumstances
Consequences	**1 – Insignificant** Insignificant impact on fauna species of conservation significance or regional biodiversity and the loss of species will be insignificant in the context of the availability of similar fauna assemblages in the area.	2	3	4	5	6
	2 – Minor Short term and no significant impact on species of conservation significance in the study area, but nature will redress this issue. Loss of species at the local scale.	3	4	5	6	7
	3 – Moderate An appreciable loss of fauna in a regional context or an impact on species of conservation significance in the study area.	4	5	6	7	8
	4 – Major Significant impact on conservation significant fauna or their habitat in the study area and/or regional biodiversity and/or a significant loss in the biodiversity at the landscape scale.	5	6	7	8	9
	5 – Catastrophic Loss of species at the regional scale and/or a significant loss of species categorised as 'vulnerable' or 'critical' under the *EPBC Act 1999* at the local or regional scale.	6	7	8	9	10

TABLE 12

FAUNA IMPACT RISK ASSESSMENT

Nambeelup Industrial study area			Before Management					With Management			
			Inherent Risk					Residual Risk			
Risk Issue	Aspect or Issue	Impact	Likelihood	Consequence	Level of Risk	Significance	Risk Controls	Likelihood	Consequence	Level of Risk	Significance
Fauna assessment	Inadequate data for analysis	Unknown impact on fauna assemblage and conservation significant species	2	2	4	Acceptable					
	Inadequate regional data for contextual purposes	Incomplete analysis of data and appreciation of impact on biodiversity values in a regional context	2	2	4	Acceptable					
Clearing vegetation of fauna assemblages	Removal of habitat – site scale	Almost complete loss of terrestrial fauna in cleared areas, severe impact on local communities	5	1	6	Moderate	Avoid clearing good quality habitat, large potential habitat trees and fragmenting habitat. Fauna Management Plan.	2	2	4	Acceptable
	Significant reduction of habitats – local scale	Loss of good habitat and some impact on local fauna and faunal communities	1	1	2	Acceptable					
	Significant reduction of habitats – landscape scale	Minimal impact on fauna and faunal communities	1	1	2	Acceptable					
	Significant reduction of habitats – regional scale	Minimal impact on fauna and faunal communities	1	1	2	Acceptable					

Nambeelup Industrial study area			Before Management					With Management			
			Inherent Risk					Residual Risk			
Risk Issue	Aspect or Issue	Impact	Likelihood	Consequence	Level of Risk	Significance	Risk Controls	Likelihood	Consequence	Level of Risk	Significance
Death or loss of conservation species	Resident terrestrial species	Death of conservation significant species (e.g. Southern Brown Bandicoots)	1	4	5	Moderate	Minimise the areas of remnant vegetation to be cleared and retain wetland areas with a well-vegetated understorey as areas of Public Open Space	1	3	4	Acceptable
	Resident avian species	Loss of conservation significant species	1	4	5	Moderate	Retain large trees	1	3	4	Acceptable
	Migratory avian species	Loss of conservation significant species	1	3	4	Moderate	Retain large trees	1	3	4	Acceptable

Based on this risk assessment, the clearing of vegetation of degraded areas within the study area will have a low risk of significantly impacting on species of conservation significance, threatened or conservation significant fauna assemblages, or fauna habitat that have high ecological value. Coffey Environments recommends that clearing of land within the study area be kept as minimal and conducted in areas that are already cleared of dense vegetation. We also recommend that all large trees (i.e. Jarrah and Marri trees >10m in height) be avoided to retain habitat connectivity in the area and potential nesting locations for migratory birds that may visit the study area.

5.8 Environmental impacts

5.8.1 Significant Habitat for Fauna Indigenous to Western Australia

The habitat within the Nambeelup study area is mostly degraded pasture with some patches of isolated good quality habitat. Of the species of conservation significance that may potentially be present within the study area, Red-tailed Black Cockatoos, Carnaby's Cockatoos, Rainbow Bee eaters, Quenda and White-bellied Sea Eagle occur or are likely to occur in the area. No breeding hollows for Black Cockatoos were observed during the site investigation, however the area provided some foraging opportunities for these bird species and also a nest site for the migratory species, the White-bellied Sea Eagle.

Clearing of vegetation within the study area will result in the loss of terrestrial species in specific locations. This impact, in most cases, is unavoidable unless a trapping program is instigated to catch and translocate species. Such action does not seem necessary as terrestrial species likely to be present will also be abundant in adjacent areas.

Little is known of the short range endemic invertebrates to make useful comment. However, as the fauna habitats within the study area are not restricted or isolated, it would be reasonable to presume that invertebrates present on the site are also present in the adjacent habitat.

Coffey Environments is of the opinion that habitats within the study area do not have high fauna biodiversity or ecosystem functional value.

5.8.2 Threatened Ecological Communities

Previous fauna surveys in the region suggest that there are unlikely to be any characteristics of the reptile, bird and mammal assemblages that are of particular conservation significance in the region.

5.8.3 Loss or Degradation of Fauna Habitat

Land clearing will result in the loss of fauna habitat at a local scale. However, these habitats are replicated in the adjacent areas. Although the loss of any fauna habitat should be minimised, the loss of habitat in the study area is unlikely to significantly impact on any species of conservation significance, especially given the degraded nature of the majority of habitats within the study area.

5.8.4 Feral Fauna

A number of introduced and feral animals have been recorded in the region (Appendix D). Mice (*Mus musculus*), cats (*Felis catus*) and foxes (*Vulpes vulpes*) are all likely to be present. Development in the study area could potentially lead to an increase in the presence and abundance of feral fauna in the region through the presence of rubbish and more available water. Every effort should be made to manage the presence of foxes and feral cats once development commences.

The above issues should be addressed as a section in the Contractor Management Plan which should be written prior to the commencement of works and should be used to conduct best practise environmental procedures during clearing and development.

6 CONCLUSIONS

6.1 Flora and Vegetation

6.1.1 Conclusions

Based on the results of the Level 2 flora and vegetation assessment undertaken within Lots 91, 92 and 604 Nambeelup Industrial Study Area, the following conclusions have been made:

- Seven vegetation types were identified from within the study area, ranging in condition from Good to Completely Degraded (Bush Forever condition rating scale). The majority of the study area was considered to be in a Very Poor to Completely Degraded condition. The south-west corner of Lot 604 and the north-west corner of Lot 92 were considered to be in the best condition (Good);
- Based on a presence/absence comparison basis with the flora data recorded from the level 2 survey and the complete dataset of *A Floristic Survey of the Southern Swan Coastal Plain* (Gibson *et al.*, 1994), the vegetation was determined to most closely resemble FCT11 and FCT21a. FCT11 and FCT21a are not considered to be TECs or PECs according to the DEC or DEHWA under the *EPBC Act 1999*;
- According to mapping undertaken by Heddle *et al.* (1980) the vegetation within the study area is considered to be representative of the Bassendean Complex-Central and South Vegetation Complex. Currently there is 27% (or 23635ha) of the original pre-European extent remaining on the Southern Swan Coastal Plain. Of the 27% remaining on the Southern Swan Coastal Plain approximately 0.7% or 572ha is in secure tenures;
- As a general criterion, 15% of the pre-1750 distribution of each forest ecosystem should be protected in the Comprehensive, Adequate and Representative (CAR) reserve system (Joint ANZECC/MCFFA National Forest Policy Statement Implementation Sub-committee, 1997). There is approximately 27% of the Bassendean Complex-Central and South remaining on the Southern Swan Coastal Plain, this is above the general criterion of 15% and therefore is not considered to be regionally significant. The vegetation is also in a Good to Very Poor condition and does not adequately represent the Bassendean Complex-Central and South;
- Coffey Environments believes that the wetland areas mapped as Resource Enhancement and Multiple Use are so degraded that they are unlikely to be able to be rehabilitated to a Conservation Category without intensive rehabilitation and management;
- A total of 115 flora species were identified from within the study area during the Level 2 flora and vegetation survey. This included 77 native species and 38 introduced (weed) species. The majority of the weed species were pasture species and were located throughout the study area; and
- No DRF or Priority Listed flora species were recorded from the study area during the Level 2 flora and vegetation survey. The Level 2 flora and vegetation survey would have recorded the majority of the annual and ephemeral flora species, including the DRF orchid species (*Caladenia huegelii, Diuris drummondii, Diuris micrantha* and *Drakaea elastica*) that are protected under the *EPBC Act 1999*, if they occurred within the study area.

6.2 Fauna

6.2.1 Conclusions

Based on the results of the Level 1 fauna assessment undertaken within Lots 91, 92 and 604 Nambeelup Industrial Study Area, the following conclusions have been made:

The Level 1 fauna assessment adequately satisfies the Environmental Protection Authority (EPA) Position Statement No. 3 Terrestrial Biological Surveys as an Element of Biodiversity Protection (EPA, 2002), Coffey Environments' interpretation of the EPA Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56 (EPA, 2004) and industry best practice as described in the literature (Thompson, 2007).

The site contains habitat that is generally in a degraded condition due to significant impact by previous anthropogenic activities and would generally be assessed as either Disturbed Fauna Habitat or Highly Degraded Fauna Habitat that is unlikely to contain a unique fauna assemblage at both a local scale and in a regional context.

A search of both the DEC's threatened fauna species database and the Commonwealth's online database for Protected Matters identified a number of conservation significant species that may be recorded in the region however given the condition of habitat observed during the site visit, the impact of further disturbance to the majority of habitats within the site is likely to be low on any resident conservation significant fauna, should the management recommendations below be followed.

7 RECOMMENDATIONS

Based on the conclusions of the Level 2 flora and vegetation survey and the Level 1 Fauna Assessment of the study area, Coffey Environments recommends the following:

- Land clearing should be minimised to areas of lowest quality with the retention of as many of the tall (greater than 10m in height) Jarrah (*Eucalyptus marginata*), Marri (*Corymbia calophylla*), Flooded Gum (*Eucalyptus rudis* subsp. *rudis*), Swamp Paperbark (*Melaleuca rhaphiophylla*) and Moonah (*Melaleuca preissiana*) trees as possible. These tall trees provide valuable feeding, roosting and nesting sites for locally common bird species (including conservation significant birds like Forest Red-Tailed Black Cockatoos and White Bellied Sea Eagles) and aesthetic values for the public;
- Any proposed clearing of the P1 Declared Weed, Bridal Creeper (**Asparagus asparagoides*) along the western boundary of Lot 92 will need to be undertaken in an appropriate manner which does not spread the seeds and/or vegetative material from its current location. The plants will need to be disposed of in an appropriate manner off site;
- Consideration should be given to minimising the clearing of vegetation within the generic buffer zone of 50m of Serpentine River and associated Conservation Category wetlands in the south-west of Lot 604;
- Given the high amount of clearing in the Nambeelup area and the local fauna, aesthetic and other wetland values, it is Coffey Environments opinion that areas of Open Forest within Resource Enhancement wetlands should be retained where possible and managed with the aim of improving the wetlands ecological values. Consideration should be given to retaining areas of Open Forest in Multiple Use wetlands for the same reasons above; and
- Prior to the commencement of works and as part of an onsite Construction Management Plan, the following issues should be addressed to promote best practise environmental management during development:
    - Feral animals;
    - Southern Brown Bandicoots;
    - Kangaroos;
    - Waste management;
    - Drainage and groundwater management; and
    - Weed control.

Management of the above issues should also be incorporated into site induction programs so that all staff and contractors associated with construction are aware of environmental issues on site.

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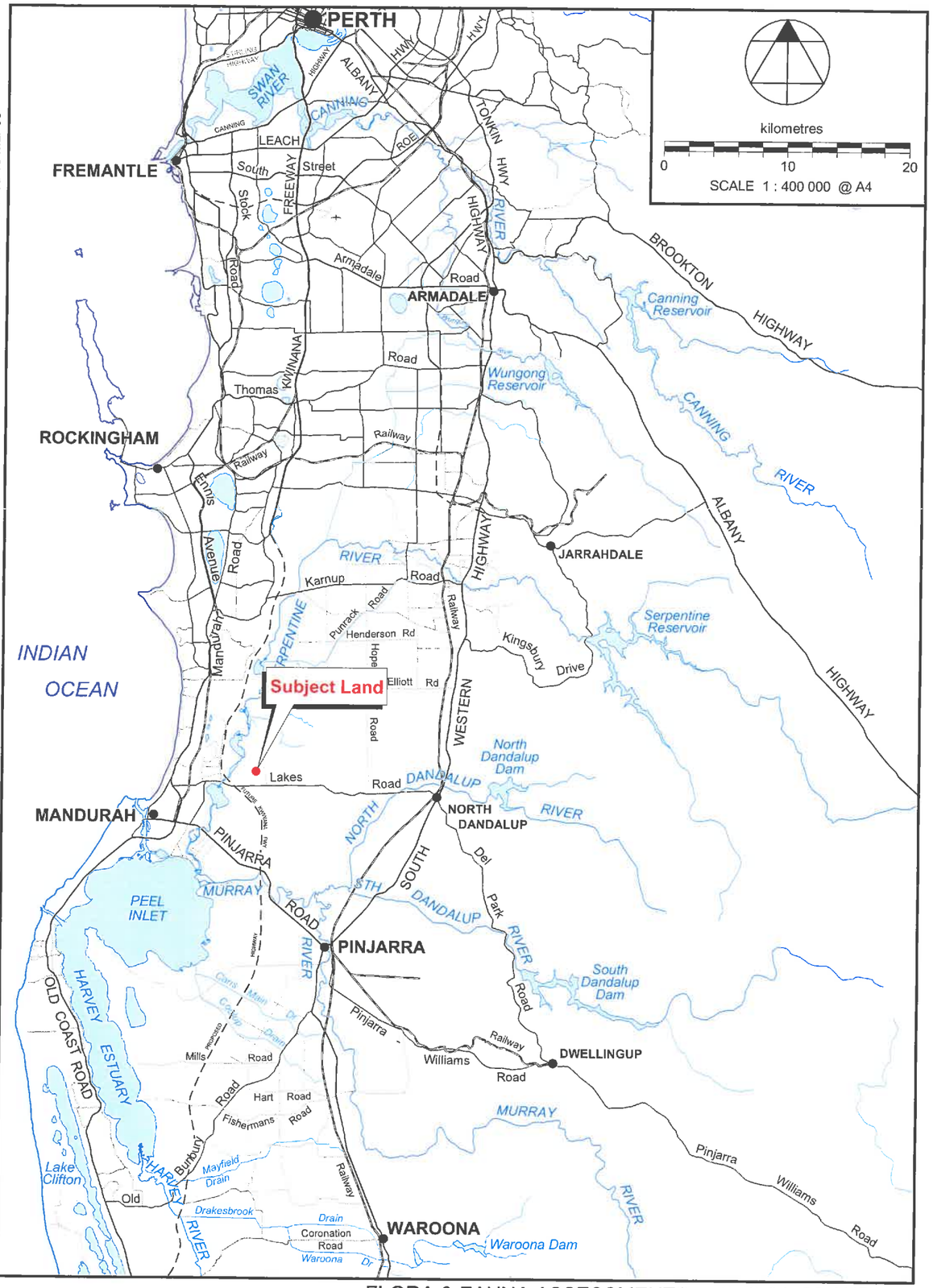
Figures

Flora and Fauna Assessments
Lot 91, 92 & 604



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FLORA & FAUNA ASSESSMENTS - LOTS 91, 92 AND 604
NAMBEELUP INDUSTRIAL STUDY AREA

REGIONAL LOCATION

FIGURE 1

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

PRINTED: Wed 10 Jun 09

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DATUM: MGA zn50

ENV\PERT\00597AA\Flora Assessment\EP2009-014F02.dgn

metres

0 100 200 300 400 500

SCALE 1 : 12 500 @ A3

LEGEND

- Cadastral Boundary
- Topographic Contour
- Zoned Rural
- Zoned Industrial
- 92-3 Quadrat Location (10m x 10m)
- Threatened Flora Location
- Heddle Vegetation Complexes

WETLANDS

- Conservation Category Wetland
- Multiple Use Wetland
- Resource Enhancement Wetland

92-1 92-2 92-3 604-1 604-2 604-3 604-4 604-5 604-6 91-1 91-2

Caladenia speciosa

Drakaea elastica

Herdsman Complex

Yoongarillup Complex

Bassendean Complex-Central And South

PATERSON

ROAD

FOWLER

LAKES

WETLANDS SOURCE: DEC, Feb 2007.
BASE SOURCE: McMullen Nolan, dwg No. 95815-002, 05-05-2009.
AERIAL PHOTOGRAPH SOURCE: Landgate, flown December 2008.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

FLORA & FAUNA ASSESSMENTS - LOTS 91, 92 AND 604
NAMBEELUP INDUSTRIAL STUDY AREA

WETLAND MAPPING, VEGETATION COMPLEXES AND KNOWN THREATENED FLORA LOCATIONS

FIGURE 2

Vegetation Types Legend

OFEm
Open Forest to Woodland of *Eucalyptus marginata* to 14m over Tall Open Scrub to Tall Open Shrubland of *Kunzea glabrescens* to 7m over Scattered Shrubs of *Dasypogon bromeliifolius*, *Hibbertia hypericoides* and *Daviesia physodes* to 1.5m over Scattered Herbland/Sedgeland.

OFEr
Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis* to 12m over Low Woodland to Scattered Low Woodland of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 8m with occasional *Kunzea glabrescens* over Tall Closed Scrub to Tall Open Scrub of *Astartea scoparia* to 4m over Scattered Grasses/Herbs dominated by weed species.

OFErMrMp
Open Forest to Open Woodland of *Eucalyptus rudis* subsp. *rudis, Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12m with occasional *Banksia littoralis* over Grassland/Herbland/Sedgeland to Scattered Grasses/Herbs/Sedges dominated by weed species.

OFMrMp
Open Forest to Open Woodland of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 11m over occasional patches of Tall Shrubs of *Kunzea glabrescens* to 8m over Open Grassland/Herbland/Sedgeland to Scattered Grassland/Herbland/Sedgeland dominated by weed species.

EmCc
Scattered Tress of *Eucalyptus marginata* and *Corymbia calophylla* to 28m over Grassland to Very Open Grassland of *Ehrharta calycina* to 1.2m.

MrMp
Scattered Trees of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 12m over pasture species with scattered patches of *Juncus pallidus* to 1.3m.

TWEm
Tall Open Woodland to Scattered Trees of *Eucalyptus marginata* to 15m over Scattered Low Woodland of *Xylomelum occidentale, Nuytsia floribunda* and *Allocasuarina fraseriana* to 9m over Scattered Tall Shrubs of *Kunzea glabrescens* to 4m over Scattered Shrubs of *Acacia pulchella* var. *glaberrima* and *Hibbertia hypericoides* to 1.4m over Grassland to Very Open Grassland of *Ehrharta calycina* to 0.9m.

metres
0 100 200 300 400 500
SCALE 1 : 12 500 @ A3

LEGEND
- Cadastral Boundary
- Topographic Contour
- Zoned Rural
- Zoned Industrial
- 92-3 Quadrat Location (10m x 10m)
- OFEr Vegetation Type
- Vegetation Type Boundary

BASE SOURCE: McMullen Nolan, dwg No. 95815-002, 05-05-2009.
AERIAL PHOTOGRAPH SOURCE: Landgate, flown December 2008.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

FLORA & FAUNA ASSESSMENTS - LOTS 91, 92 AND 604
NAMBEELUP INDUSTRIAL STUDY AREA

QUADRAT LOCATIONS AND VEGETATION TYPES

FIGURE 3

PRINTED: Wed 10 Jun 09
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DRAWN: CR 10-06-09
DATUM: MGA zn50
ENV//PERT/00597AA/Flora Assessment/EP2009-014F03.dgn

VEGETATION CONDITION LEGEND (SOURCE: BUSH FOREVER Govt. of W.A., 2000)

P - Pristine
Pristine or nearly so, no obvious signs of disturbance.

E - Excellent
Vegetation structure intact, disturbance affecting individual species and weeds are non aggressive species.

VG - 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.

G - Good
Vegetation structure significantly altered by very obvious signs of multiple disturbance. Retains basic vegetation structure or ability to regenerate it. For example, disturbance to vegetation structure caused by very frequent fires, the presence of some very aggressive weeds at high density, partial clearing, dieback and grazing.

D - 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.

CD - 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.

metres
0 100 200 300 400 500
SCALE 1 : 12 500 @ A3

LEGEND
- Cadastral Boundary
- Topographic Contour
- Zoned Rural
- Zoned Industrial
- 92-3 Quadrat Location (10m x 10m)
- G-Deg Vegetation Condition
- Vegetation Condition Boundary

BASE SOURCE: McMullen Nolan, dwg No. 95815-002, 05-05-2009.
AERIAL PHOTOGRAPH SOURCE: Landgate, flown December 2008.

coffey environments
SPECIALISTS IN LIVING AND WORKING PLACES

FLORA & FAUNA ASSESSMENTS - LOTS 91, 92 AND 604
NAMBEELUP INDUSTRIAL STUDY AREA

QUADRAT LOCATIONS AND VEGETATION CONDITION

FIGURE 4

PRINTED: Wed 10 Jun 09
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Plates

Flora and Fauna Assessments
Lot 91, 92 & 604

Plate 1. Paddock with dispersed *Melaleuca*

Plate 2. *Melaleuca* thicket

Plate 3. Paddock with *Juncus*

Plate 4. Open Paddock

Plate 5. Paddock with *Eucalyts*

Plate 6. Red-tailed Black Cockatoos observed during the site visit

Plate 7. Osprey Nest located in Lot 604, Nambeelup Industrial Study Site (386681E, 6402919N)

Plate 8. White-bellied Sea Eagle nest located on site (387369E, 6403385N)

Appendix A
Quadrat Data

Flora and Fauna Assessments
Lot 91, 92 & 604

Appendix A
Quadrat Data

Site: 91-1

Described: CVDB **Date:** 30/09/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 91, eastern edge in the centre

MGA Zone: 50 389149mE; 6403269mN
Habitat: Low lying
Soil: Very moist black organic sandy clay
Rock Type: None exposed
Vegetation: Open Forest to Woodland of *Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* to 12m over Open Grassland/Herbland of **Lolium perenne* and **Lotus subbiflorus* to 0.2m
Condition: Degraded
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Arctotheca calendula	<1	0.1
Cotula coronopifolia	<1	0.2
Cynodon dactylon	<1	0.1
Eucalyptus rudis subsp. *rudis*	15	12
Isolepis cernua var. *setiformis*	<1	0.1
Lolium perenne	15	0.2
Lotus subbiflorus	10	0.1
Lythrum hyssopifolia	<1	0.1
Melaleuca rhaphiophylla	30	10
Poa annua	<1	0.1
Ranunculus muricatus	<1	0.1
Sonchus oleraceus	<1	0.1
Trifolium hybridum var. *hybridum*	<1	0.1

Site: 91-2

Described: CVDB **Date:** 30/09/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 91, south-eastern corner

MGA Zone: 50 389336mE; 6402632mN
Habitat: Low lying
Soil: Very moist black organic sandy clay
Rock Type: None exposed
Vegetation: Low Open Forest of *Melaleuca rhaphiophylla* to 9m with occasional *Banksia littoralis* and *Melaleuca preissiana* to 8m over Grassland of **Lolium perenne* to 0.4m
Condition: Degraded
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Banksia littoralis	3	8
Hypochaeris glabra	<1	Groundcover
Lolium perenne	65	0.4
Lotus subbiflorus	<1-1	0.1
Melaleuca rhaphiophylla	50	9
Ranunculus muricatus	<1	0.2
Rumex crispus	<1	0.2
Sonchus oleraceus	<1	0.1
Trifolium hybridum var. *hybridum*	<1	0.1

Site: 92-1

Described: CVDB **Date:** 30/09/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 92, north-western edge

MGA Zone: 50 388746mE; 6405287mN
Habitat: Low lying
Soil: Very moist black organic sandy clay with scattered leaf litter
Rock Type: None exposed
Vegetation: Open Forest to Woodland of *Eucalyptus rudis* subsp. *rudis* to 11m over Closed Tall Scrub to Open Tall Scrub of *Astartea scoparia* to 2.2m over Scattered Weeds.
Condition: Good to Degraded
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Anthoxanthum odoratum	<1	0.2
Astartea scoparia	70	2.2
Briza minor	<1-1	0.2
Cassytha sp. *glabella/racemosa*	<1	Creeper
Eucalyptus rudis subsp. *rudis*	30	11
Hypochaeris glabra	<1	Groundcover
Juncus pallidus	<1-1	1.1
Lolium rigidum	<1	0.2
Lotus subbiflorus	<1-1	0.2
Microtis media	<1	0.1
Ornithopus pinnatus	<1	0.2
Oxalis sp.	<1	0.1
Vulpia myuros var. *megalura*	<1-	0.2

Site: 92-2

Described: CVDB **Date:** 30/09/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 92, north-western corner

MGA Zone: 50 388540mE; 6405376mN
Habitat: Low lying
Soil: Very moist black organic sandy clay with scattered leaf litter
Rock Type: None exposed
Vegetation: Low Woodland to Low Open Woodland of *Eucalyptus rudis* subsp. *rudis* to 7m over Tall Open Scrub of *Kunzea glabrescens* and *Astartea scoparia* to 8m over Scattered Weeds.
Condition: Good
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Anthoxanthum odoratum	<1	0.2
Astartea scoparia	30	3
Briza minor	<1	0.3
Caladenia sp.	<1	0.05
Cassytha sp. *glabella/racemosa*	<1	Creeper
Disa bracteata	<1	0.1
Eucalyptus rudis subsp. *rudis*	10	7
Hypochaeris glabra	<1	Groundcover
Juncus pallidus	<1	0.4
Kunzea glabrescens	5	8
Lolium rigidum	<1	0.3
Lotus subbiflorus	<1	0.3
Melaleuca preissiana	<1	2.4
Pterostylis pyramidalis	<1	0.2
Trifolium hybridum var. *hybridum*	<1	0.3
Vulpia myuros var. *megalura*	<1-1	0.1

Site: 92-3

Described: CVDB **Date:** 30/09/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 92, south-western corner

MGA Zone: 50 388534mE; 6404641mN
Habitat: Low lying
Soil: Very moist black organic sandy clay
Rock Type: None exposed
Vegetation: Woodland of *Eucalyptus rudis* subsp. *rudis* to 12m over Tall Closed Scrub of *Astartea scoparia* to 4m over Scattered Herbland of **Hypochaeris glabra*, **Lotus subbiflorus*, **Acetosella vulgaris* and **Ranunculus muricatus* to 0.3m
Condition: Good to Degraded
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Acetosella vulgaris	<1-1	0.4
Anthoxanthum odoratum	<1	0.2
Asparagus asparagoides	<1	Creeper
Astartea scoparia	80	4
Eucalyptus rudis subsp. *rudis*	20	12
Hordeum leporinum	<1	0.3
Hypochaeris glabra	<1-1	Groundcover
Juncus pallidus	<1	1.4
Lolium rigidum	<1	0.2
Lotus subbiflorus	<1-1	0.2
Microtis media	<1	0.3
Oxalis sp.	<1	0.1
Pterostylis pyramidalis	<1	0.2
Ranunculus muricatus	<1-1	0.3
Rumex crispus	<1	0.2
Sonchus oleraceus	<1	0.2

Site: 604-1

Described: CVDB **Date:** 30/09/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 604, near Fowler Road

MGA Zone: 50 386959mE; 6403056mN
Habitat: Relatively flat
Soil: Grey Bassendean Sands
Rock Type: None exposed
Vegetation: Tall Woodland of *Eucalyptus marginata* to 15m over Scattered Tall Shrubs of *Xylomelum occidentale* to 8m over Scattered Shrubs of *Acacia pulchella* var. *glaberrima* to 1.4m over Very Open Grassland of *Ehrharta calycina* to 0.9m.
Condition: Good to Degraded
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Acacia huegelii	<1	0.2
Acacia pulchella var. *glaberrima*	2	1.4
Burchardia congesta	<1	0.4
Caladenia flava subsp. *flava*	<1	0.1
Conostylis aculeata subsp. *aculeata*	<1	0.2
Desmocladus asper	<1	0.1
Desmocladus fasciculatus	<1	0.1
Drosera stolonifera	<1	0.2
Ehrharta calycina	5	0.9
Eucalyptus marginata	25	15
Gompholobium tomentosum	<1	0.3
Hibbertia hypericoides	<1	0.4
Hypochaeris glabra	<1	0.1
Isotropis cuneifolia subsp. *cuneifolia*	<1	0.3
Kennedia prostrata	<1	Creeper
Leucopogon propinquus	<1	0.2

Ornithopus compressus	<1	0.1
Patersonia occidentalis var. *?angustifolia*	<1	0.5
Romulea rosea	<1	0.1
Sowerbaea laxiflora	<1	0.4
Tricoryne tenella	<1	0.3
Trifolium dubium	<1	0.1
Trifolium hybridum var. *hybridum*	<1	0.2
Ursinia anthemoides	<1	0.1
Xylomelum occidentale	<1-1	8

Site: 604-2

Described: CVDB **Date:** 1/10/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 604, near Fowler Road

MGA Zone: 50 386890mE; 6402672mN
Habitat: Relatively flat upland
Soil: Grey/black Bassendean Sands
Rock Type: None exposed
Vegetation: Open Forest to Woodland of *Eucalyptus marginata* to 11m over Tall Open Scrub of *Kunzea glabrescens* to 5m over Scattered Herbland/Sedgeland
Condition: Good
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Acacia pulchella var. *glaberrima*	<1	1
Anthericaceae sp. (*Caesia/Sowerbaea*)	<1	0.2
Banksia menziesii	<1	0.1
Bossiaea eriocarpa	<1	0.3
Briza maxima	<1	0.1
Caladenia flava subsp. *flava*	<1	0.1
Conostylis aculeata subsp. *aculeata*	<1	0.1
Conostylis juncea	<1	0.2
Corynotheca ?micrantha	<1	0.3
Daviesia triflora	<1	0.5
Desmocladus fasciculatus	<1	0.2
Disa bracteata	<1	0.2
Drosera erythrorhiza	<1	Groundcover
Drosera stolonifera	<1	0.2
Ehrharta calycina	<1	0.6
Eucalyptus marginata	35	11
Gastrolobium capitatum	<1	0.4

Gompholobium tomentosum	<1	0.4
Hardenbergia comptoniana	<1	Creeper
Hypochaeris glabra	<1	0.1
Isotropis cuneifolia subsp. *cuneifolia*	<1	0.2
Kennedia prostrata	<1	Creeper
Kunzea glabrescens	45	5
Lepidosperma pubisquameum	<1	0.3
Leucopogon propinquus	<1	0.3
Lomandra caespitosa	<1	0.2
Lomandra integra	<1	0.3
Patersonia occidentalis var. *?angustifolia*	<1	0.3
Pterostylis sp.	<1	0.3
Stylidium sp.	<1	0.1
Ursinia anthemoides	<1	0.1

Site: 604-3

Described: CVDB **Date:** 1/10/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 604, near Fowler Road

MGA Zone: 50 387030mE; 6402593mN
Habitat: Localised micro-undulations, relatively flat
Soil: Grey/black Bassendean Sands
Rock Type: None exposed
Vegetation: Open Forest to Woodland of *Eucalyptus marginata* to 14m over Tall Open Scrub of *Kunzea glabrescens* to 7m over Scattered Herbland/Sedgeland
Condition: Good
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Bossiaea eriocarpa	<1	0.2
Caladenia flava subsp. *flava*	<1	0.2
Conostephium pendulum	<1	0.2
Conostylis juncea	<1	0.5
Dasypogon bromeliifolius	<1	0.3
Daviesia physodes	<1	0.2
Desmocladus fasciculatus	<1	0.2
Disa bracteata	<1	0.1
Drosera erythrorhiza	<1	Groundcover
Ehrharta calycina	<1	1
Eucalyptus marginata	35	14
Gastrolobium capitatum	<1	0.3
Gompholobium tomentosum	<1	0.3
Hardenbergia comptoniana	<1	Creeper
Hibbertia hypericoides	<1	0.1
Hypochaeris glabra	<1	0.1
Isotropis cuneifolia subsp. *cuneifolia*	<1	0.3

Kennedia prostrata	<1	Creeper
Kunzea glabrescens	40	7
Leporella fimbriata	<1	Groundcover
Lomandra nigricans	<1	0.3
Lomandra sp.	<1	0.3
Opercularia echinocephala	<1	0.4
Ornithopus compressus	<1	0.05
Patersonia occidentalis var. *?angustifolia*	<1	0.1
Poranthera microphylla	<1	0.1
Pyrorchis nigricans	<1	Groundcover
Stylidium sp.	<1	0.1
Ursinia anthemoides	<1	0.3

Site: 604-4

Described: CVDB **Date:** 1/10/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 604, northern end near Fowler Road

MGA Zone: 50 387776mE; 6403420mN
Habitat: Low lying swamp
Soil: Very moist black organic sandy clay (peat?)
Rock Type: None exposed
Vegetation: Open Forest of *Melaleuca rhaphiophylla* and *Melaleuca preissiana* to 11m over Tall Open Shrubland of *Kunzea glabrescens* to 8m over weed species.
Condition: Degraded
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Anagallis arvensis var. *caerulea*	<1	0.1
Arctotheca calendula	<1	Groundcover
Briza maxima	<1	0.1
Briza minor	<1	0.1
Centella asiatica	<1	0.1
Chamaescilla corymbosa var. *corymbosa*	<1	0.3
Cotula coronopifolia	<1	0.05
Eutaxia virgata	<1	0.8
Hydrocotyle sp.	<1	0.05
Hypochaeris glabra	<1	Groundcover
Kunzea glabrescens	5	8
Lotus subbiflorus	<1	0.1
Lythrum hyssopifolia	<1	0.2
Melaleuca preissiana	40	10
Melaleuca rhaphiophylla	20	11
Ornithopus pinnatus	<1	0.1
Poa annua	<1	0.2

Pterostylis pyramidalis	<1	0.2
Ranunculus muricatus	<1	0.1
Romulea rosea	<1	0.3
Schoenus sp.	<1	0.7
Solanum nigrum	<1	0.4

Site: 604-5

Described: CVDB **Date:** 1/10/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 604, northern end near Fowler Road

MGA Zone: 50 387457mE; 6403618mN
Habitat: Low lying swamp
Soil: Very moist black organic sandy clay
Rock Type: None exposed
Vegetation: Open Woodland to Scattered *Melaleuca preissiana* to 10m over Low Open Forest of *Melaleuca rhaphiophylla* to 7m over Scattered Herbland/Sedgeland/Grassland.
Condition: Degraded
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Briza maxima	<1	0.2
Cotula coronopifolia	<1	0.1
Ehrharta longiflora	<1-1	0.2
Hypochaeris glabra	<1	Groundcover
Juncus pallidus	<1	0.3
Lolium rigidum	<1	0.3
Lotus subbiflorus	<1-1	0.1
Lythrum hyssopifolia	<1	0.2
Melaleuca preissiana	5	10
Melaleuca rhaphiophylla	50	7
Romulea rosea	<1-1	0.3
Solanum nigrum	<1	0.5
Sonchus oleraceus	<1	0.3

Site: 604-6

Described: CVDB **Date:** 1/10/2008 **Type:** Quadrat (10m x 10m) **Season:** Excellent

Location: Lot 604, near boundary of Lot 91

MGA Zone: 50388303mE; 6402681mN
Habitat: Low lying swamp
Soil: Very moist black organic sandy clay
Rock Type: None exposed
Vegetation: Low Open Forest of *Eucalyptus rudis* subsp. *rudis* and *Melaleuca rhaphiophylla* to 9m over Very Open Grassland of *Lolium perenne* to 0.7m over Scattered Herbland/Sedgeland
Condition: Degraded
Fire Age: >5 years

Species List:

Name	Cover (%)	Height (m)
Briza minor	<1	0.1
Cassytha sp. *glabella/racemosa*	<1	Creeper
Cotula coronopifolia	<1	0.1
Eucalyptus rudis subsp. *rudis*	25	9
Hypochaeris glabra	<1-1	Groundcover
Isolepis cernua var. *setiformis*	<1	0.05
Lolium perenne	3	0.7
Lolium rigidum	<1-1	0.3
Lotus subbiflorus	<1	0.1
Lythrum hyssopifolia	<1	0.1
Melaleuca rhaphiophylla	15	9
Microtis media	<1	0.3
Rumex crispus	<1	0.1
Sonchus oleraceus	<1	0.05
Trifolium hybridum var. *hybridum*	<1	0.1

Site: Pasture

Described: CVDB **Date:** 30/09/2008 **Type:** Releve **Season:** Excellent

Location: Pastures in Lots 91, 92 and 604

MGA Zone: No GPS points taken
Habitat: Low lying
Soil: Very moist organic black sandy clay
Rock Type: None exposed
Vegetation: Paddocks dominated by weed and pasture species
Condition: Completely Degraded
Fire Age: >5 years

Species List:

Name
Acetosella vulgaris
Anthoxanthum odoratum
Arctotheca calendula
Avena barbata
Disa bracteata
Juncus pallidus
Lolium perenne
Orobanche minor
Pennisetum clandestinum
Romulea rosea
Rumex crispus
Ursinia anthemoides
Vellereophyton dealbatum

Appendix B
Comprehensive Flora List

Flora and Fauna Assessments
Lot 91, 92 & 604

Appendix B
Comprehensive Flora List
Lots 91, 92 & 604 Nambeelup

		# Records
031	**POACEAE**	
*	*Anthoxanthum odoratum*	5
*	*Avena barbata*	1
*	*Briza maxima*	3
*	*Briza minor*	4
*	*Cynodon dactylon*	2
*	*Ehrharta calycina*	3
*	*Ehrharta longiflora*	1
*	*Hordeum leporinum*	1
*	*Lolium perenne*	4
*	*Lolium rigidum*	5
*	*Paspalum dilatatum*	1
*	*Pennisetum clandestinum*	1
*	*Poa annua*	2
*	*Stenotaphrum secundatum*	1
*	*Vulpia myuros* var. *megalura*	2
032	**CYPERACEAE**	
	Isolepis cernua var. *setiformis*	2
	Lepidosperma pubisquameum	1
	Schoenus sp.	1
039	**RESTIONACEAE**	
	Desmocladus asper	1
	Desmocladus fasciculatus	3
	Hypolaena exsulca	1
	Lyginia imberbis	1
052	**JUNCACEAE**	
	Juncus pallidus	5
054B	**ASPARAGACEAE**	
*	*Asparagus asparagoides*	1
054C	**DASYPOGONACEAE**	
	Dasypogon bromeliifolius	1
	Lomandra caespitosa	1
	Lomandra integra	1
	Lomandra nigricans	1
	Lomandra sp.	1
054F	**ANTHERICACEAE**	
	Anthericaceae sp. (*Caesia/Sowerbaea*)	1
	Chamaescilla corymbosa var. *corymbosa*	1
	Corynotheca ?micrantha	1
	Sowerbaea laxiflora	1
	Tricoryne tenella	1
054J	**COLCHICACEAE**	
	Burchardia congesta	2
055	**HAEMODORACEAE**	
	Conostylis aculeata subsp. *aculeata*	2
	Conostylis juncea	2

060	**IRIDACEAE**	
	Patersonia occidentalis var. *?angustifolia*	3
*	*Romulea rosea*	5
066	**ORCHIDACEAE**	
	Caladenia flava subsp. *flava*	3
	Caladenia latifolia	1
	Caladenia sp.	1
*	*Disa bracteata*	4
	Elythranthera brunonis	1
	Leporella fimbriata	1
	Microtis media	3
	Pterostylis pyramidalis	3
	Pterostylis sp.	1
	Pyrorchis nigricans	2
070	**CASUARINACEAE**	
	Allocasuarina fraseriana	1
090	**PROTEACEAE**	
	Banksia ilicifolia	1
	Banksia littoralis	1
	Banksia menziesii	1
	Xylomelum occidentale	1
097	**LORANTHACEAE**	
	Nuytsia floribunda	1
103	**POLYGONACEAE**	
*	*Acetosella vulgaris*	2
*	*Rumex crispus*	4
113	**CARYOPHYLLACEAE**	
*	*Petrorhagia dubia*	1
119	**RANUNCULACEAE**	
*	*Ranunculus muricatus*	4
131	**LAURACEAE**	
	Cassytha sp. *glabella/racemosa*	3
143	**DROSERACEAE**	
	Drosera erythrorhiza	2
	Drosera stolonifera	2
163	**MIMOSACEAE**	
	Acacia huegelii	1
	Acacia pulchella var. *glaberrima*	2
165	**PAPILIONACEAE**	
	Bossiaea eriocarpa	2
	Daviesia incrassata subsp. *incrassata*	1
	Daviesia physodes	1
	Daviesia triflora	1
	Eutaxia virgata	1
	Gastrolobium capitatum	2
	Gompholobium tomentosum	3
	Hardenbergia comptoniana	2
	Isotropis cuneifolia subsp. *cuneifolia*	3
	Jacksonia sternbergiana	1
	Kennedia prostrata	3
*	*Lotus subbiflorus*	8

* *Lupinus angustifolius*	1
* *Ornithopus compressus*	2
* *Ornithopus pinnatus*	2
* *Trifolium dubium*	1
* *Trifolium hybridum* var. *hybridum*	5
167 GERANIACEAE	
* *Erodium botrys*	1
168 OXALIDACEAE	
Oxalis sp.	2
185 EUPHORBIACEAE	
Poranthera microphylla	1
226 DILLENIACEAE	
Hibbertia hypericoides	2
265 LYTHRACEAE	
* *Lythrum hyssopifolia*	5
273 MYRTACEAE	
Astartea scoparia	3
Corymbia calophylla	1
Eucalyptus marginata	3
Eucalyptus rudis subsp. *rudis*	5
Kunzea glabrescens	4
Melaleuca preissiana	3
Melaleuca rhaphiophylla	5
Melaleuca teretifolia	1
Melaleuca thymoides	1
281 APIACEAE	
Centella asiatica	1
Hydrocotyle sp.	1
288 EPACRIDACEAE	
Astroloma pallidum	1
Conostephium pendulum	1
Leucopogon propinquus	2
293 PRIMULACEAE	
* *Anagallis arvensis* var. *caerulea*	1
313 LAMIACEAE	
Hemiandra pungens	1
315 SOLANACEAE	
* *Solanum nigrum*	2
320 OROBANCHACEAE	
* *Orobanche minor*	1
331 RUBIACEAE	
Opercularia echinocephala	1
340 LOBELIACEAE	
Lobelia tenuior	1
341 GOODENIACEAE	
Goodenia pulchella subsp. Coastal Plain A (M. Hislop 634)	1

343	**STYLIDIACEAE**	
	Stylidium schoenoides	1
	Stylidium sp.	2
345	**ASTERACEAE**	
*	*Arctotheca calendula*	3
	Cotula coronopifolia	4
*	*Hypochaeris glabra*	10
*	*Sonchus oleraceus*	5
*	*Ursinia anthemoides*	4
*	*Vellereophyton dealbatum*	2

Native Species	77
Introduced Species	38
TOTAL SPECIES	**115**

* - Denotes Introduced (Weed) Species

Appendix C
The Department of Environment and Conservation Declared Rare and Priority Flora List Conservation Codes for Western Australia

Flora and Fauna Assessments
Lot 91, 92 & 604

THE DEPARTMENT OF ENVIRONMENT AND CONSERVATION

DECLARED RARE AND PRIORITY FLORA LIST

for Western Australia

CONSERVATION CODES

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.

X: Declared Rare Flora - Presumed Extinct Taxa

Taxa which have not been collected, or otherwise verified, over the past 50 years despite thorough searching, or of which all known wild populations have been destroyed more recently, and have been gazetted as such.

1: Priority One - Poorly known Taxa

Taxa which are known from one or a few (generally <5) populations which are under threat, either due to small population size, or being on lands under immediate threat, e.g. road verges, urban areas, farmland, active mineral leases, etc., or the plants are under threat, e.g. from disease, grazing by feral animals, etc. May include taxa with threatened populations on protected lands. Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

2: Priority Two - Poorly Known Taxa

Taxa which are known from one or a few (generally <5) populations, at least some of which are not believed to be under immediate threat (i.e. not currently endangered). Such taxa are under consideration for declaration as 'rare flora', but are in urgent need of further survey.

3: Priority Three - Poorly Known Taxa

Taxa which are known from several populations, and the taxa are not believed to be under immediate threat (i.e. not currently endangered), either due to the number of known populations (generally >5), or known populations being large, and either widespread or protected. Such taxa are under consideration for declaration as 'rare flora' but 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.

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

Appendix D
Vertebrate Fauna Species Recorded Within the Study Region

Flora and Fauna Assessments
Lot 91, 92 & 604

Appendix D: Vertebrate Fauna Species Recorded within the Project Region

(Search area includes surveys between the Swan River and Australind on the Swan Coastal Plain)

Conservation Status	Family	Species	Common Name	Armadale Brookdale ATA Environmental 2005				Barnes Ave Australind Ecologia 2001				Turpin 1990	Preston Beach Western Wildlife 2007					
				Site 1	Site 2	Site 3	Unknown	Forest	Riparian	Scrub	Woodland	Unknown	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
	Hylidae	*Litoria adelaidensis*	Slender Tree Frog	7	4	10					X							
		Litoria dorsalis										6						
		Litoria moorei	Motorbike Frog	8	36	9												
	Limnodynastidae	*Heleioporus eyrei*	Moaning Frog	518	81						X							
		Heleioporus inornatus	Whooping Frog															
		Heleioporus psammophilus	Sand Frog															
		Limnodynastes dorsalis	Western Banjo Frog	1	2													
		Neobatrachus pelobatoides	Humming Frog															
	Myobatrachidae	*Crinia georgiana*	Quacking Frog	158				X										
		Crinia glauerti	Clicking Frog	11	1	4												
		Crinia insignifera	Squelching Froglet	2380				X		X								
		Crinia pseudinsignifera	Bleating Froglet															
		Crinia sp.																
		Geocrinia leai	Ticking Frog															
		Myobatrachus gouldii	Turtle Frog															
		Pseudophryne douglasi	Gorge Toadlet															
		Pseudophryne guentheri	Crawling Toadlet															
	Accipitridae	*Accipiter cirrhocephalus*	Collared Sparrowhawk									X						
		Accipiter fasciatus	Brown Goshawk									X						
		Aquila audax	Wedge-tailed Eagle															
		Circus approximans	Swamp Harrier															
		Elanus axillaris	Black-shouldered Kite									X						
		Haliastur sphenurus	Whistling Kite				2											
		Hieraaetus morphnoides	Little Eagle															
		Lophoictinia isura	Square-tailed Kite							X								
		Pandion haliaetus	Osprey						X									
	Anatidae	*Anas gracilis*	Grey Teal				8											
		Anas rhynchotis	Australasian Shoveler															
		Anas superciliosa	Pacific Black Duck				26		X									
		Aythya australis	Hardhead				2											
		Chenonetta jubata	Australian Wood Duck				59											
		Cygnus atratus	Black Swan				1											
		Tadorna tadornoides	Australian Shelduck				25											
	Podargidae	*Podargus strigoides*	Tawny Frogmouth				1											
	Casuariidae	*Dromaius novaehollandiae*	Emu															
		Charadrius ruficapillus	Red-capped Plover															X
		Elseyornis melanops	Black-fronted Dotterel															
		Erythrogonys cinctus	Red-kneed Dotterel						X									
P4		*Thinornis rubricollis*	Hooded Plover															
	Laridae	*Chroicocephalus novaehollandiae*	Silver Gull															
		Hydroprogne caspia	Caspian Tern															
		Thalasseus bergii	Crested Tern															
	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt															
	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper															
		Calidris ruficollis	Red-necked Stint															
		Tringa nebularia	Common Greenshank						X									
	Turnicidae	*Turnix varius*	Painted Button-quail															
	Ardeidae	*Ardea alba*	Great Egret						X									
		Ardea pacifica	White-necked Heron				3											
		Egretta novaehollandiae	White-faced Heron				31											
		Nycticorax caledonicus	Nankeen Night Heron				1											
	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican				1		X									
	Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill															
		Threskiornis molucca	Australian White Ibis				28		X									
		Threskiornis spinicollis	Straw-necked Ibis				238											
	Columbidae	*Columba livia*	Rock Dove															
		Ocyphaps lophotes	Crested Pigeon				8											
		Phaps chalcoptera	Common Bronzewing				15				X							
		Streptopelia chinensis	Spotted Dove				7					X				X	X	
		Streptopelia senegalensis	Laughing Dove				24											

Conservation Status	Family	Species	Common Name	Armadale Brookdale ATA Environmental 2005				Barnes Ave Australind Ecologia 2001				Turpin 1990	Preston Beach Western Wildlife 2007					
				Site 1	Site 2	Site 3	Unknown	Forest	Riparian	Scrub	Woodland	Unknown	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
	Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra				6			X	X		X	X	X	X		X
		Todiramphus sanctus	Sacred Kingfisher				7											
	Meropidae	*Merops ornatus*	Rainbow Bee-eater				34	X										
	Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo				1											
		Chalcites basalis	Horsfield's Bronze-Cuckoo				1				X							
		Chalcites lucidus	Shining Bronze-Cuckoo				11											
	Falconidae	*Falco berigora*	Brown Falcon				1											
		Falco cenchroides	Nankeen Kestrel				21											
		Falco longipennis	Australian Hobby															
	Phasianidae	*Coturnix ypsilophora*	Brown Quail				1											
	Rallidae	*Fulica atra*	Eurasian Coot				20											
		Gallinula tenebrosa	Dusky Moorhen						X									
		Gallirallus philippensis	Buff-banded Rail															
		Porphyrio porphyrio	Purple Swamphen				9											
		Porzana fluminea	Australian Spotted Crake															
	Acanthizidae	*Acanthiza apicalis*	Inland Thornbill				14						X	X	X	X	X	X
		Acanthiza chrysorrhoa	Yellow-rumped Thornbill				169	X		X								
		Acanthiza inornata	Western Thornbill															
		Gerygone fusca	Western Gerygone				42	X		X	X		X	X		X		X
		Sericornis frontalis	White-browed Scrubwren				3						X	X	X	X	X	X
		Smicrornis brevirostris	Weebill				3							X	X			X
	Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler															
		Megalurus gramineus	Little Grassbird															
	Artamidae	*Artamus cinereus*	Black-faced Woodswallow															
		Artamus cyanopterus	Dusky Woodswallow															
		Cracticus tibicen	Australian Magpie				155							X			X	X
		Cracticus torquatus	Grey Butcherbird				21							X	X	X	X	
	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike				29				X	X						
		Lalage sueurii	White-winged Triller				4											
	Corvidae	*Corvus coronoides*	Australian Raven				198	X		X	X		X	X	X	X	X	X
	Estrildidae	*Stagonopleura oculata*	Red-eared Firetail															
	Hirundinidae	*Hirundo neoxena*	Welcome Swallow				26					X						
		Petrochelidon ariel	Fairy Martin															
		Petrochelidon nigricans	Tree Martin				25	X		X	X							
	Maluridae	*Malurus splendens*	Splendid Fairy-wren				173						X	X	X	X	X	
	Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill															
		Anthochaera carunculata	Red Wattlebird				70				X							
		Anthochaera chrysoptera	Little Wattlebird															
		Anthochaera lunulata	Western Wattlebird				3											
		Epthianura albifrons	White-fronted Chat															
		Glyciphila melanops	Tawny-crowned Honeyeater															
		Lichenostomus ornatus	Yellow-plumed Honeyeater															
		Lichenostomus virescens	Singing Honeyeater				29								X	X	X	
		Lichmera indistincta	Brown Honeyeater				120	X										X
		Melithreptus lunatus	White-naped Honeyeater															
		Phylidonyris niger	White-cheeked Honeyeater															
		Phylidonyris novaehollandiae	New Holland Honeyeater				63	X										
		Grallina cyanoleuca	Magpie-Lark				94											
	Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit				16											
	Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird				1											
	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella															
	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush				8						X					X
		Pachycephala pectoralis	Golden Whistler											X	X			X
		Pachycephala rufiventris	Rufous Whistler				32	X		X	X	X	X			X		X
	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote					X					X		X			X
		Pardalotus striatus	Striated Pardalote				11	X		X	X			X	X			X
	Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin											X				X
		Petroica goodenovii	Red-capped Robin								X							
		Petroica multicolor	Pacific Robin				2											
	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail															
		Rhipidura fuliginosa	New Zealand Fantail				67	X		X	X		X	X	X		X	X
		Rhipidura leucophrys	Willie Wagtail				53					X						
	Timaliidae	*Zosterops lateralis*	Silvereye				293	X			X		X	X	X	X	X	X
	Anhingidae	*Anhinga melanogaster*	Australasian Darter						X									
	Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant				5		X									
		Phalacrocorax carbo	Great Cormorant															

Conservation Status	Family	Species	Common Name	Armadale Brookdale ATA Environmental 2005				Barnes Ave Australind Ecologia 2001				Turpin 1990	Preston Beach Western Wildlife 2007					
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		Phalacrocorax sulcirostris	Little Black Cormorant				2											
	Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe															
		Tachybaptus novaehollandiae	Australasian Grebe				2											
	Cacatuidae	*Cacatua sanguinea*	Little Corella				6											
		Calyptorhynchus banksii	Red-tailed Black-Cockatoo				26											
VU, Sc1		*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo															X
EN, Sc1		*Calyptorhynchus baudinii*	Baudin's Black-Cockatoo															
EN, Sc1		*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo				2					X						
		Eolophus roseicapillus	Galah				85								X			X
	Psittacidae	*Barnardius zonarius*	Australian Ringneck				60	X		X	X	X	X	X	X	X	X	X
		Glossopsitta porphyrocephala	Purple-crowned Lorikeet														X	
		Neophema elegans	Elegant Parrot				6											
		Polytelis anthopeplus	Regent Parrot				14											
		Purpureicephalus spurius	Red-capped Parrot				52				X							
		Trichoglossus haematodus	Rainbow Lorikeet				56											
	Strigidae	*Ninox novaeseelandiae*	Southern Boobook				2											
	Tytonidae	*Tyto alba*	Barn Owl				1											
	Bovidae	*Bos taurus*	Cow															
	Suidae	*Sus scrofa*	Pig															
	Canidae	*Vulpes vulpes*	Red Fox	1	1						X							
	Felidae	*Felis catus*	House Cat	1	1													
	Molossidae	*Nyctinomus australis*	White-striped Freetail Bat															
	Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox															
	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	1														
		Chalinolobus morio	Chocolate Wattled Bat								X							
P4		*Falsistrellus mackenziei*	Western Falsistrelle															
		Nyctophilus geoffroyi	Lesser Longeared Bat															
		Nyctophilus timoriensis timoriensis																
		Vespadelus regulus	Southern Forest Bat															
	Dasyuridae	*Antechinus flavipes leucogaster*																
VU, Sc1		*Dasyurus geoffroii*	Western Quoll															
VU		*Phascogale tapoatafa tapoatafa*	Brush-tailed Phascogale															
		Sminthopsis gilberti	Gilbert's Dunnart															
		Sminthopsis g. griseoventer	Grey-bellied Dunnart															
VU, Sc1	Myrmecobiidae	*Myrmecobius fasciatus*	Numbat															
P5	Macropodidae	*Macropus eugenii derbianus*	Tammar Wallaby															
		Macropus fuliginosus	Western Grey Kangaroo					X			X							
P4		*Macropus irma*	Western Brush Wallaby															
VU, Sc1		*Setonix brachyurus*	Quokka															
	Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum	18						X			1					
VU, Sc1	Pseudocheiridae	*Pseudocheirus occidentalis*	Western Ringtail Possum															
	Tarsipedidae	*Tarsipes rostratus*	Honey Possum															
	Leporidae	*Oryctolagus cuniculus*	European Rabbit		4													
	Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna															
P5	Peramelidae	*Isoodon obesulus fusciventer*	Southern Brown Bandicoot		25													
	Equidae	*Equus caballus*	Domestic Horse															
P4	Muridae	*Hydromys chrysogaster*	Water Rat															
		Mus musculus	House Mouse	26	23			X			X	23	1		1	3	11	2
		Rattus fuscipes	Bush Rat	1														
		Rattus norvegicus	Brown Rat															
		Rattus rattus	Black Rat		5			X			X							
	Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon															
		Ctenophorus a. adelaidensis																
		Ctenophorus a. chapmani																
		Ctenophorus ornatus	Ornate Crevice Dragon															
		Pogona minor										4						
		Pogona minor minor													1	1		
	Boidae	*Antaresia stimsoni stimsoni*																
Sc4, P4		*Morelia spilota imbricata*																
	Carphodactylidae	*Nephrurus milii*	Barking Gecko															
	Colubridae	*Dendrelaphis punctulata*	Green Tree Snake															
	Diplodactylidae	*Diplodactylus polyophthalmus*																
		Strophurus spinigerus																
		Strophurus spinigerus inornatus																
		Strophurus spinigerus spinigerus																
		Strophurus strophurus											1			2	1	

Conservation Status	Family	Species	Common Name	Armadale Brookdale ATA Environmental 2005				Barnes Ave Australind Ecologia 2001				Turpin 1990	Preston Beach Western Wildlife 2007					
				Site 1	Site 2	Site 3	Unknown	Forest	Riparian	Scrub	Woodland	Unknown	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
P3	Elapidae	*Acanthophis antarcticus*	Southern Death Adder															
		Brachyurophis fasciolata fasciolata																
		Brachyurophis semifasciata																
		Demansia psammophis	Yellow-faced Whipsnake															
		Demansia psammophis reticulata											1					
		Echiopsis curta	Bardick															
		Elapognathus coronatus	Crowned Snake															
		Neelaps bimaculatus	Black-naped Snake															
P3		*Neelaps calonotos*	Black-striped Snake															
		Notechis scutatus	Tiger Snake	3	2													
		Parasuta gouldii																
		Parasuta nigriceps																
		Pseudechis australis	Mulga Snake															
		Pseudonaja affinis	Dugite															
		Pseudonaja affinis affinis		2	1													
		Pseudonaja modesta	Ringed Brown Snake															
		Pseudonaja nuchalis	Gwardar															
		Simoselaps bertholdi	Jan's Banded Snake															
		Simoselaps littoralis	West Coast Banded Snake															
	Gekkonidae	*Christinus marmoratus*	Marbled Gecko	1				X				1		1				1
		Diplodactylus g. granariensis																
		Gehyra variegata																
		Hemidactylus frenatus	Asian House Gecko															
		Heteronotia binoei	Bynoe's Gecko															
		Lucasium alboguttatum										2						
		Oedura gracilis										2						
	Pygopodidae	*Aclys concinna concinna*																
		Aprasia pulchella																
		Aprasia repens		2														
		Delma fraseri																
		Delma grayii															1	
		Lialis burtonis		5								1				1	1	
		Pletholax gracilis	Keeled Legless Lizard															
		Pletholax gracilis gracilis																
		Pygopus lepidopodus	Common Scaly Foot															
	Scincidae	*Acritoscincus trilineatum*		30	2			X						2				
		Cryptoblepharus buchananii		36	3	9					X							
		Cryptoblepharus plagiocephalus																
		Ctenotus australis			13							2		1		1		
P4		*Ctenotus delli*																
		Ctenotus fallens										2						
P3		*Ctenotus gemmula*	(Swan Coastal plain)															
		Ctenotus impar																
		Ctenotus labillardieri																
		Cyclodomorphus celatus																
		Egernia kingii	King's Skink					X										
		Egernia luctuosa	Western Swamp Skink													1		
		Egernia napoleonis											1					
		Hemiergis initialis initialis																
		Hemiergis peronii																
		Hemiergis peronii tridactyla																
		Hemiergis quadrilineata						X		X	X	6	1			2		
		Lerista christinae																
		Lerista distinguenda																
		Lerista elegans		11	9					X	X	8		2	1	1		
P3		*Lerista lineata*																
		Lerista lineopunctulata																
		Lerista praepedita																
		Menetia greyii		14	3	1				X		4	1	3				3
		Morethia lineoocellata			1			X			X		2	16	3	1	1	6
		Morethia obscura		4														
		Tiliqua occipitalis	Western Bluetongue															
		Tiliqua rugosa		3	3							1						
		Tiliqua rugosa rugosa																
	Typhlopidae	*Ramphotyphlops australis*		2							X						1	
		Ramphotyphlops bituberculatus																

Conservation Status	Family	Species	Common Name	Armadale Brookdale ATA Environmental 2005				Barnes Ave Australind Ecologia 2001				Turpin 1990	Preston Beach Western Wildlife 2007					
				Site 1	Site 2	Site 3	Unknown	Forest	Riparian	Scrub	Woodland	Unknown	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
		Ramphotyphlops braminus																
		Ramphotyphlops pinguis																
		Ramphotyphlops waitii																
	Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor		3													
		Varanus rosenbergi	Heath Monitor	1														
		Varanus tristis	Racehorse Monitor															
		Varanus tristis tristis																

(cont)

Conservation Status	Family	Species	Common Name	Preston Beach Western Wildlife 2007				Perth Remnants How and Dell 2000			Perth Remnants How *et al.* 1996					
				Site 7	Site 8	Site 9		Site 10	Harfield Park	Norman Road	Rushton Road	Jandakot Airport 1	Jandakot Airport 2	Mount Henry bushland 1	Mount Henry bushland 2	Perth Airport 6
	Hylidae	*Litoria adelaidensis*	Slender Tree Frog													
		Litoria dorsalis														
		Litoria moorei	Motorbike Frog													
	Limnodynastidae	*Heleioporus eyrei*	Moaning Frog					X	X	X		2	1		32	
		Heleioporus inornatus	Whooping Frog													
		Heleioporus psammophilus	Sand Frog													
		Limnodynastes dorsalis	Western Banjo Frog						X	X	6	1			3	
		Neobatrachus pelobatoides	Humming Frog													
	Myobatrachidae	*Crinia georgiana*	Quacking Frog					X	X	X						
		Crinia glauerti	Clicking Frog							X						
		Crinia insignifera	Squelching Froglet					X	X	X	X				11	
		Crinia pseudinsignifera	Bleating Froglet													
		Crinia sp.														
		Geocrinia leai	Ticking Frog													
		Myobatrachus gouldii	Turtle Frog									1	1	3		
		Pseudophryne douglasi	Gorge Toadlet							X						
		Pseudophryne guentheri	Crawling Toadlet					X							7	
	Accipitridae	*Accipiter cirrhocephalus*	Collared Sparrowhawk													
		Accipiter fasciatus	Brown Goshawk								1	2	4		1	
		Aquila audax	Wedge-tailed Eagle			X										
		Circus approximans	Swamp Harrier													
		Elanus axillaris	Black-shouldered Kite										1	X	1	
		Haliastur sphenurus	Whistling Kite											X		
		Hieraaetus morphnoides	Little Eagle									7	3	3	3	
		Lophoictinia isura	Square-tailed Kite													
		Pandion haliaetus	Osprey										1	5		
	Anatidae	*Anas gracilis*	Grey Teal													
		Anas rhynchotis	Australasian Shoveler													
		Anas superciliosa	Pacific Black Duck													
		Aythya australis	Hardhead													
		Chenonetta jubata	Australian Wood Duck													
		Cygnus atratus	Black Swan												1	
		Tadorna tadornoides	Australian Shelduck													
	Podargidae	*Podargus strigoides*	Tawny Frogmouth													
	Casuariidae	*Dromaius novaehollandiae*	Emu													
		Charadrius ruficapillus	Red-capped Plover										6	13		
		Elseyornis melanops	Black-fronted Dotterel										1	2		
		Erythrogonys cinctus	Red-kneed Dotterel													
P4		*Thinornis rubricollis*	Hooded Plover													
	Laridae	*Chroicocephalus novaehollandiae*	Silver Gull													
		Hydroprogne caspia	Caspian Tern													
		Thalasseus bergii	Crested Tern													
	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt													
	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper													
		Calidris ruficollis	Red-necked Stint													
		Tringa nebularia	Common Greenshank													
	Turnicidae	*Turnix varius*	Painted Button-quail													
	Ardeidae	*Ardea alba*	Great Egret													
		Ardea pacifica	White-necked Heron													
		Egretta novaehollandiae	White-faced Heron													
		Nycticorax caledonicus	Nankeen Night Heron													
	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican										2	2		
	Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill													
		Threskiornis molucca	Australian White Ibis										3	3		
		Threskiornis spinicollis	Straw-necked Ibis													
	Columbidae	*Columba livia*	Rock Dove													
		Ocyphaps lophotes	Crested Pigeon													X
		Phaps chalcoptera	Common Bronzewing	X		X										
		Streptopelia chinensis	Spotted Dove										1	1	2	
		Streptopelia senegalensis	Laughing Dove								14		33	6	14	
	Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra													
		Todiramphus sanctus	Sacred Kingfisher								2			1		
	Meropidae	*Merops ornatus*	Rainbow Bee-eater								3	1	31	7	8	
	Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo													

Conservation Status	Family	Species	Common Name	Preston Beach Western Wildlife 2007				Perth Remnants How and Dell 2000			Perth Remnants How *et al.* 1996					
				Site 7	Site 8	Site 9		Site 10	Harfield Park	Norman Road	Rushton Road	Jandakot Airport 1	Jandakot Airport 2	Mount Henry bushland 1	Mount Henry bushland 2	Perth Airport 6
		Chalcites basalis	Horsfield's Bronze-Cuckoo													
		Chalcites lucidus	Shining Bronze-Cuckoo													
	Falconidae	*Falco berigora*	Brown Falcon													
		Falco cenchroides	Nankeen Kestrel													
		Falco longipennis	Australian Hobby												2	
	Phasianidae	*Coturnix ypsilophora*	Brown Quail											1		
	Rallidae	*Fulica atra*	Eurasian Coot													
		Gallinula tenebrosa	Dusky Moorhen													
		Gallirallus philippensis	Buff-banded Rail													
		Porphyrio porphyrio	Purple Swamphen													
		Porzana fluminea	Australian Spotted Crake													
	Acanthizidae	*Acanthiza apicalis*	Inland Thornbill		X	X										
		Acanthiza chrysorrhoa	Yellow-rumped Thornbill	X		X										
		Acanthiza inornata	Western Thornbill													X
		Gerygone fusca	Western Gerygone	X	X	X					2	7		1		X
		Sericornis frontalis	White-browed Scrubwren	X	X		X									X
	Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler													
		Megalurus gramineus	Little Grassbird													
	Artamidae	*Artamus cinereus*	Black-faced Woodswallow													
		Artamus cyanopterus	Dusky Woodswallow												1	
		Cracticus tibicen	Australian Magpie		X		X				13	6	5	1	2	
		Cracticus torquatus	Grey Butcherbird	X							1	2				X
	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike								3	2	6	7		
		Lalage sueurii	White-winged Triller												2	
	Corvidae	*Corvus coronoides*	Australian Raven	X	X	X	X				42	26	18	22	8	X
	Estrildidae	*Stagonopleura oculata*	Red-eared Firetail													
	Hirundinidae	*Hirundo neoxena*	Welcome Swallow								4	1	6	8	1	
		Petrochelidon ariel	Fairy Martin													
		Petrochelidon nigricans	Tree Martin								42	9	6	12	1	
	Maluridae	*Malurus splendens*	Splendid Fairy-wren	X	X		X				9	9				X
	Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill								15	3			3	
		Anthochaera carunculata	Red Wattlebird	X		X					35	3	7	5	1	X
		Anthochaera chrysoptera	Little Wattlebird								2					
		Anthochaera lunulata	Western Wattlebird													
		Epthianura albifrons	White-fronted Chat													
		Glyciphila melanops	Tawny-crowned Honeyeater												3	
		Lichenostomus ornatus	Yellow-plumed Honeyeater													
		Lichenostomus virescens	Singing Honeyeater		X	X	X				36	23	49	33	25	
		Lichmera indistincta	Brown Honeyeater								43	35	37	14	53	
		Melithreptus lunatus	White-naped Honeyeater													
		Phylidonyris niger	White-cheeked Honeyeater								11	1	46	45	52	
		Phylidonyris novaehollandiae	New Holland Honeyeater								35	10				
		Grallina cyanoleuca	Magpie-Lark								8					
	Motacillidae	*Anthus novaeseelandiae*	Australasian Pipit													
	Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird													
	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella								2	2				
	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush		X		X					6				
		Pachycephala pectoralis	Golden Whistler		X	X							1			
		Pachycephala rufiventris	Rufous Whistler	X							28	27	1	1	5	X
	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote		X	X										
		Pardalotus striatus	Striated Pardalote		X						10	4	2	7		
	Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin	X												X
		Petroica goodenovii	Red-capped Robin													
		Petroica multicolor	Pacific Robin													
	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail													
		Rhipidura fuliginosa	New Zealand Fantail	X	X	X	X				7					X
		Rhipidura leucophrys	Willie Wagtail								24	1	4		5	
	Timaliidae	*Zosterops lateralis*	Silvereye	X	X	X	X				7	3	2	1	7	X
	Anhingidae	*Anhinga melanogaster*	Australasian Darter													
	Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant										1	10		
		Phalacrocorax carbo	Great Cormorant											1		
		Phalacrocorax sulcirostris	Little Black Cormorant											2		
	Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe													
		Tachybaptus novaehollandiae	Australasian Grebe													

Conservation Status	Family	Species	Common Name	Preston Beach Western Wildlife 2007				Perth Remnants How and Dell 2000			Perth Remnants How *et al.* 1996					
				Site 7	Site 8	Site 9		Site 10	Harfield Park	Norman Road	Rushton Road	Jandakot Airport 1	Jandakot Airport 2	Mount Henry bushland 1	Mount Henry bushland 2	Perth Airport 6
	Cacatuidae	*Cacatua sanguinea*	Little Corella													
		Calyptorhynchus banksii	Red-tailed Black-Cockatoo													
VU, Sc1		*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo													
EN, Sc1		*Calyptorhynchus baudinii*	Baudin's Black-Cockatoo										5	2		
EN, Sc1		*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo													
		Eolophus roseicapillus	Galah													
	Psittacidae	*Barnardius zonarius*	Australian Ringneck		X						1					
		Glossopsitta porphyrocephala	Purple-crowned Lorikeet													
		Neophema elegans	Elegant Parrot										5	2		
		Polytelis anthopeplus	Regent Parrot													
		Purpureicephalus spurius	Red-capped Parrot								4	1	1			
		Trichoglossus haematodus	Rainbow Lorikeet										2			
	Strigidae	*Ninox novaeseelandiae*	Southern Boobook													
	Tytonidae	*Tyto alba*	Barn Owl													
	Bovidae	*Bos taurus*	Cow													
	Suidae	*Sus scrofa*	Pig													
	Canidae	*Vulpes vulpes*	Red Fox													
	Felidae	*Felis catus*	House Cat													
	Molossidae	*Nyctinomus australis*	White-striped Freetail Bat													
	Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox													
	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat													
		Chalinolobus morio	Chocolate Wattled Bat													
P4		*Falsistrellus mackenziei*	Western Falsistrelle													
		Nyctophilus geoffroyi	Lesser Longeared Bat													
		Nyctophilus timoriensis timoriensis														
		Vespadelus regulus	Southern Forest Bat													
	Dasyuridae	*Antechinus flavipes leucogaster*														
VU, Sc1		*Dasyurus geoffroii*	Western Quoll													
VU		*Phascogale tapoatafa tapoatafa*	Brush-tailed Phascogale													
		Sminthopsis gilberti	Gilbert's Dunnart													
		Sminthopsis g. griseoventer	Grey-bellied Dunnart													
VU, Sc1	Myrmecobiidae	*Myrmecobius fasciatus*	Numbat													
P5	Macropodidae	*Macropus eugenii derbianus*	Tammar Wallaby													
		Macropus fuliginosus	Western Grey Kangaroo													
P4		*Macropus irma*	Western Brush Wallaby													
VU, Sc1		*Setonix brachyurus*	Quokka													
	Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum													
VU, Sc1	Pseudocheiridae	*Pseudocheirus occidentalis*	Western Ringtail Possum													
	Tarsipedidae	*Tarsipes rostratus*	Honey Possum													
	Leporidae	*Oryctolagus cuniculus*	European Rabbit													
	Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna													
P5	Peramelidae	*Isoodon obesulus fusciventer*	Southern Brown Bandicoot													
	Equidae	*Equus caballus*	Domestic Horse													
P4	Muridae	*Hydromys chrysogaster*	Water Rat													4
		Mus musculus	House Mouse	4	3	4	9									
		Rattus fuscipes	Bush Rat													
		Rattus norvegicus	Brown Rat													
		Rattus rattus	Black Rat													1
	Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon	1			1									
		Ctenophorus a. adelaidensis														
		Ctenophorus a. chapmani														
		Ctenophorus ornatus	Ornate Crevice Dragon					X	X	X	2		17	5	6	
		Pogona minor														3
		Pogona minor minor		3		1										
	Boidae	*Antaresia stimsoni stimsoni*														
Sc4, P4		*Morelia spilota imbricata*														
	Carphodactylidae	*Nephrurus milii*	Barking Gecko													
	Colubridae	*Dendrelaphis punctulata*	Green Tree Snake													
	Diplodactylidae	*Diplodactylus polyophthalmus*														
		Strophurus spinigerus						X		X						
		Strophurus spinigerus inornatus														
		Strophurus spinigerus spinigerus														
		Strophurus strophurus			1		1									
P3	Elapidae	*Acanthophis antarcticus*	Southern Death Adder													
		Brachyurophis fasciolata fasciolata														

Conservation Status	Family	Species	Common Name	Preston Beach Western Wildlife 2007				Perth Remnants How and Dell 2000			Perth Remnants How *et al.* 1996					
				Site 7	Site 8	Site 9		Site 10	Harfield Park	Norman Road	Rushton Road	Jandakot Airport 1	Jandakot Airport 2	Mount Henry bushland 1	Mount Henry bushland 2	Perth Airport 6
		Brachyurophis semifasciata								X						
		Demansia psammophis	Yellow-faced Whipsnake													
		Demansia psammophis reticulata														
		Echiopsis curta	Bardick													
		Elapognathus coronatus	Crowned Snake												1	
		Neelaps bimaculatus	Black-naped Snake													
P3		*Neelaps calonotos*	Black-striped Snake													
		Notechis scutatus	Tiger Snake													
		Parasuta gouldii										1				
		Parasuta nigriceps														
		Pseudechis australis	Mulga Snake													
		Pseudonaja affinis	Dugite			1			X			1			X	
		Pseudonaja affinis affinis														
		Pseudonaja modesta	Ringed Brown Snake													
		Pseudonaja nuchalis	Gwardar													
		Simoselaps bertholdi	Jan's Banded Snake													
		Simoselaps littoralis	West Coast Banded Snake													
	Gekkonidae	*Christinus marmoratus*	Marbled Gecko										2	1		
		Diplodactylus g. granariensis														
		Gehyra variegata														
		Hemidactylus frenatus	Asian House Gecko													
		Heteronotia binoei	Bynoe's Gecko													
		Lucasium alboguttatum														
		Oedura gracilis						X								
	Pygopodidae	*Aclys concinna concinna*														
		Aprasia pulchella														
		Aprasia repens							X							
		Delma fraseri									2	3	2	4		
		Delma grayii								X						
		Lialis burtonis								X		2	7	4	2	
		Pletholax gracilis	Keeled Legless Lizard							X		2				
		Pletholax gracilis gracilis														
		Pygopus lepidopodus	Common Scaly Foot													
	Scincidae	*Acritoscincus trilineatum*		5		1		X							1	5
		Cryptoblepharus buchananii						X	X							
		Cryptoblepharus plagiocephalus									2	5	4	3	1	
		Ctenotus australis		1	4		1	X		X	1	4	11	16	4	1
P4		*Ctenotus delli*														
		Ctenotus fallens						X	X	X					5	
P3		*Ctenotus gemmula*	(Swan Coastal plain)													
		Ctenotus impar							X							
		Ctenotus labillardieri														
		Cyclodomorphus celatus														
		Egernia kingii	King's Skink													
		Egernia luctuosa	Western Swamp Skink													
		Egernia napoleonis														
		Hemiergis initialis initialis														
		Hemiergis peronii														
		Hemiergis peronii tridactyla														
		Hemiergis quadrilineata		3						X			5	9	4	3
		Lerista christinae														
		Lerista distinguenda														
		Lerista elegans					2	X	X	X	12	14			3	
P3		*Lerista lineata*									1	8	5	1		
		Lerista lineopunctulata														
		Lerista praepedita														
		Menetia greyii						X	X	X	12	28	10	4	1	
		Morethia lineoocellata			1	5	1									
		Morethia obscura							X	X						
		Tiliqua occipitalis	Western Bluetongue													
		Tiliqua rugosa						X	X	X	2	3	1	2		
		Tiliqua rugosa rugosa														
	Typhlopidae	*Ramphotyphlops australis*						X	X	X	1		1	4		
		Ramphotyphlops bituberculatus														
		Ramphotyphlops braminus														

Conservation Status	Family	Species	Common Name	Preston Beach Western Wildlife 2007				Perth Remnants How and Dell 2000			Perth Remnants How *et al.* 1996					
				Site 7	Site 8	Site 9		Site 10	Harfield Park	Norman Road	Rushton Road	Jandakot Airport 1	Jandakot Airport 2	Mount Henry bushland 1	Mount Henry bushland 2	Perth Airport 6
		Ramphotyphlops pinguis														
		Ramphotyphlops waitii														
	Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor						X						2	
		Varanus rosenbergi	Heath Monitor													
		Varanus tristis	Racehorse Monitor							X						
		Varanus tristis tristis														

(cont)

Conservation Status	Family	Species	Common Name	Perth Remnants How *et al.* 1996							Perth birds Gole 2003				
				Perth Airport 7	Perth Airport 8	Tuart Hill Bushland	Tuart Hill Bushland 1	Woodman Point Reserve 1	Woodman Point Reserve 2	Woodman Point Reserve 3	Ern Stapleton Reserve	Harry Sandon Park	Hume Road Wildlife Reserve	Jerrat Drive Foreshore	Ken Hurst Park
	Hylidae	*Litoria adelaidensis*	Slender Tree Frog	X											
		Litoria dorsalis													
		Litoria moorei	Motorbike Frog												
	Limnodynastidae	*Heleioporus eyrei*	Moaning Frog	7	63										
		Heleioporus inornatus	Whooping Frog												
		Heleioporus psammophilus	Sand Frog												
		Limnodynastes dorsalis	Western Banjo Frog				6	1	1	1					
		Neobatrachus pelobatoides	Humming Frog												
	Myobatrachidae	*Crinia georgiana*	Quacking Frog												
		Crinia glauerti	Clicking Frog												
		Crinia insignifera	Squelching Froglet	16	4										
		Crinia pseudinsignifera	Bleating Froglet												
		Crinia sp.													
		Geocrinia leai	Ticking Frog												
		Myobatrachus gouldii	Turtle Frog				1								
		Pseudophryne douglasi	Gorge Toadlet												
		Pseudophryne guentheri	Crawling Toadlet	X											
	Accipitridae	*Accipiter cirrhocephalus*	Collared Sparrowhawk												
		Accipiter fasciatus	Brown Goshawk						1	5					X
		Aquila audax	Wedge-tailed Eagle												
		Circus approximans	Swamp Harrier												
		Elanus axillaris	Black-shouldered Kite					1						X	
		Haliastur sphenurus	Whistling Kite												
		Hieraaetus morphnoides	Little Eagle	1	1	1				2					
		Lophoictinia isura	Square-tailed Kite												
		Pandion haliaetus	Osprey												X
	Anatidae	*Anas gracilis*	Grey Teal												
		Anas rhynchotis	Australasian Shoveler											X	
		Anas superciliosa	Pacific Black Duck												
		Aythya australis	Hardhead											X	
		Chenonetta jubata	Australian Wood Duck												
		Cygnus atratus	Black Swan											X	
		Tadorna tadornoides	Australian Shelduck			1									
	Podargidae	*Podargus strigoides*	Tawny Frogmouth												
	Casuariidae	*Dromaius novaehollandiae*	Emu												
		Charadrius ruficapillus	Red-capped Plover												
		Elseyornis melanops	Black-fronted Dotterel												
		Erythrogonys cinctus	Red-kneed Dotterel												
P4		*Thinornis rubricollis*	Hooded Plover												
	Laridae	*Chroicocephalus novaehollandiae*	Silver Gull											X	
		Hydroprogne caspia	Caspian Tern											X	
		Thalasseus bergii	Crested Tern												
	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt												
	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper											X	
		Calidris ruficollis	Red-necked Stint												
		Tringa nebularia	Common Greenshank												
	Turnicidae	*Turnix varius*	Painted Button-quail												
	Ardeidae	*Ardea alba*	Great Egret												
		Ardea pacifica	White-necked Heron												
		Egretta novaehollandiae	White-faced Heron											X	
		Nycticorax caledonicus	Nankeen Night Heron											X	
	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican												
	Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill												
		Threskiornis molucca	Australian White Ibis									X			
		Threskiornis spinicollis	Straw-necked Ibis												
	Columbidae	*Columba livia*	Rock Dove			1									X
		Ocyphaps lophotes	Crested Pigeon												
		Phaps chalcoptera	Common Bronzewing							1					X
		Streptopelia chinensis	Spotted Dove	2		2					X	X			X
		Streptopelia senegalensis	Laughing Dove		5	3		11	13	14	X	X		X	X
	Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra			7				5		X		X	
		Todiramphus sanctus	Sacred Kingfisher		1					1					
	Meropidae	*Merops ornatus*	Rainbow Bee-eater		4	12		2		11		X			X

Conservation Status	Family	Species	Common Name	Perth Remnants How *et al.* 1996							Perth birds Gole 2003				
				Perth Airport 7	Perth Airport 8	Tuart Hill Bushland	Tuart Hill Bushland 1	Woodman Point Reserve 1	Woodman Point Reserve 2	Woodman Point Reserve 3	Ern Stapleton Reserve	Harry Sandon Park	Hume Road Wildlife Reserve	Jerrat Drive Foreshore	Ken Hurst Park
	Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo							1					
		Chalcites basalis	Horsfield's Bronze-Cuckoo							1					
		Chalcites lucidus	Shining Bronze-Cuckoo					2	3	15					
	Falconidae	*Falco berigora*	Brown Falcon												
		Falco cenchroides	Nankeen Kestrel		4	2									
		Falco longipennis	Australian Hobby												X
	Phasianidae	*Coturnix ypsilophora*	Brown Quail												
	Rallidae	*Fulica atra*	Eurasian Coot												
		Gallinula tenebrosa	Dusky Moorhen												
		Gallirallus philippensis	Buff-banded Rail												
		Porphyrio porphyrio	Purple Swamphen												
		Porzana fluminea	Australian Spotted Crake												
	Acanthizidae	*Acanthiza apicalis*	Inland Thornbill					32	24	29					
		Acanthiza chrysorrhoa	Yellow-rumped Thornbill	8				1		2					
		Acanthiza inornata	Western Thornbill												
		Gerygone fusca	Western Gerygone					11	9	50					X
		Sericornis frontalis	White-browed Scrubwren					10	6	22					
		Smicrornis brevirostris	Weebill							5					
	Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler												
		Megalurus gramineus	Little Grassbird												
	Artamidae	*Artamus cinereus*	Black-faced Woodswallow												
		Artamus cyanopterus	Dusky Woodswallow												
		Cracticus tibicen	Australian Magpie			37		1		3	X	X	X	X	X
		Cracticus torquatus	Grey Butcherbird	1	1	18		3	3	34	X		X	X	X
	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike		4	2				2		X	X	X	X
		Lalage sueurii	White-winged Triller												
	Corvidae	*Corvus coronoides*	Australian Raven		1	17		1		13	X	X	X	X	X
	Estrildidae	*Stagonopleura oculata*	Red-eared Firetail												
	Hirundinidae	*Hirundo neoxena*	Welcome Swallow		2	16		7	5	1				X	X
		Petrochelidon ariel	Fairy Martin		1										
		Petrochelidon nigricans	Tree Martin		1	7		3	2	1	X				
	Maluridae	*Malurus splendens*	Splendid Fairy-wren	X				3	6	29					X
	Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill		2	8									X
		Anthochaera carunculata	Red Wattlebird	1		1				2	X	X	X	X	X
		Anthochaera chrysoptera	Little Wattlebird	6								X			X
		Anthochaera lunulata	Western Wattlebird												
		Epthianura albifrons	White-fronted Chat						1						
		Glyciphila melanops	Tawny-crowned Honeyeater												
		Lichenostomus ornatus	Yellow-plumed Honeyeater												
		Lichenostomus virescens	Singing Honeyeater	1	30	41			1	10	X	X	X	X	X
		Lichmera indistincta	Brown Honeyeater	19	25	23				18	X	X	X	X	X
		Melithreptus lunatus	White-naped Honeyeater												
		Phylidonyris niger	White-cheeked Honeyeater		13							X			X
		Phylidonyris novaehollandiae	New Holland Honeyeater											X	X
		Grallina cyanoleuca	Magpie-Lark		1	9		1		2		X	X	X	X
	Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit												
	Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird			1									
	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella		1										X
	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush							1					X
		Pachycephala pectoralis	Golden Whistler							1					
		Pachycephala rufiventris	Rufous Whistler	7	13			5	1	46			X		X
	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote												
		Pardalotus striatus	Striated Pardalote	2		14				5	X		X	X	X
	Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin												
		Petroica goodenovii	Red-capped Robin												
		Petroica multicolor	Pacific Robin												X
	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail												X
		Rhipidura fuliginosa	New Zealand Fantail					2	15	42					
		Rhipidura leucophrys	Willie Wagtail			1				1		X		X	X
	Timaliidae	*Zosterops lateralis*	Silvereye	6	2			34	34	35		X	X		X
	Anhingidae	*Anhinga melanogaster*	Australasian Darter											X	
	Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant											X	
		Phalacrocorax carbo	Great Cormorant											X	
		Phalacrocorax sulcirostris	Little Black Cormorant											X	

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	Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe												
		Tachybaptus novaehollandiae	Australasian Grebe												
	Cacatuidae	*Cacatua sanguinea*	Little Corella			2								X	
		Calyptorhynchus banksii	Red-tailed Black-Cockatoo												
VU, Sc1		*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo												
EN, Sc1		*Calyptorhynchus baudinii*	Baudin's Black-Cockatoo												
EN, Sc1		*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo			5						X		X	X
		Eolophus roseicapillus	Galah			11		1		2		X	X		X
	Psittacidae	*Barnardius zonarius*	Australian Ringneck			30				7	X	X	X		X
		Glossopsitta porphyrocephala	Purple-crowned Lorikeet												
		Neophema elegans	Elegant Parrot			5									
		Polytelis anthopeplus	Regent Parrot												
		Purpureicephalus spurius	Red-capped Parrot	1						6	X				X
		Trichoglossus haematodus	Rainbow Lorikeet			12					X	X	X	X	X
	Strigidae	*Ninox novaeseelandiae*	Southern Boobook												
	Tytonidae	*Tyto alba*	Barn Owl												
	Bovidae	*Bos taurus*	Cow												
	Suidae	*Sus scrofa*	Pig												
	Canidae	*Vulpes vulpes*	Red Fox												
	Felidae	*Felis catus*	House Cat												
	Molossidae	*Nyctinomus australis*	White-striped Freetail Bat												
	Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox												
	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat												
		Chalinolobus morio	Chocolate Wattled Bat												
P4		*Falsistrellus mackenziei*	Western Falsistrelle												
		Nyctophilus geoffroyi	Lesser Longeared Bat												
		Nyctophilus timoriensis timoriensis													
		Vespadelus regulus	Southern Forest Bat												
	Dasyuridae	*Antechinus flavipes leucogaster*													
VU, Sc1		*Dasyurus geoffroii*	Western Quoll												
VU		*Phascogale tapoatafa tapoatafa*	Brush-tailed Phascogale												
		Sminthopsis gilberti	Gilbert's Dunnart												
		Sminthopsis g. griseoventer	Grey-bellied Dunnart												
VU, Sc1	Myrmecobiidae	*Myrmecobius fasciatus*	Numbat												
P5	Macropodidae	*Macropus eugenii derbianus*	Tammar Wallaby												
		Macropus fuliginosus	Western Grey Kangaroo												
P4		*Macropus irma*	Western Brush Wallaby												
VU, Sc1		*Setonix brachyurus*	Quokka												
	Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum												
VU, Sc1	Pseudocheiridae	*Pseudocheirus occidentalis*	Western Ringtail Possum												
	Tarsipedidae	*Tarsipes rostratus*	Honey Possum												
	Leporidae	*Oryctolagus cuniculus*	European Rabbit												
	Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna												
P5	Peramelidae	*Isoodon obesulus fusciventer*	Southern Brown Bandicoot												
	Equidae	*Equus caballus*	Domestic Horse												
P4	Muridae	*Hydromys chrysogaster*	Water Rat												
		Mus musculus	House Mouse												
		Rattus fuscipes	Bush Rat												
		Rattus norvegicus	Brown Rat												
		Rattus rattus	Black Rat												
	Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon					1							
		Ctenophorus a. adelaidensis													
		Ctenophorus a. chapmani													
		Ctenophorus ornatus	Ornate Crevice Dragon												
		Pogona minor		X	9		2		2						
		Pogona minor minor													
	Boidae	*Antaresia stimsoni stimsoni*													
Sc4, P4		*Morelia spilota imbricata*													
	Carphodactylidae	*Nephrurus milii*	Barking Gecko												
	Colubridae	*Dendrelaphis punctulata*	Green Tree Snake												
	Diplodactylidae	*Diplodactylus polyophthalmus*													
		Strophurus spinigerus						7	3						
		Strophurus spinigerus inornatus													
		Strophurus spinigerus spinigerus													

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		Strophurus strophurus													
P3	Elapidae	*Acanthophis antarcticus*	Southern Death Adder												
		Brachyurophis fasciolata fasciolata													
		Brachyurophis semifasciata													
		Demansia psammophis	Yellow-faced Whipsnake												
		Demansia psammophis reticulata													
		Echiopsis curta	Bardick												
		Elapognathus coronatus	Crowned Snake		1										
		Neelaps bimaculatus	Black-naped Snake												
P3		*Neelaps calonotos*	Black-striped Snake												
		Notechis scutatus	Tiger Snake												
		Parasuta gouldii													
		Parasuta nigriceps													
		Pseudechis australis	Mulga Snake												
		Pseudonaja affinis	Dugite		X			X	X						
		Pseudonaja affinis affinis													
		Pseudonaja modesta	Ringed Brown Snake												
		Pseudonaja nuchalis	Gwardar												
		Simoselaps bertholdi	Jan's Banded Snake												
		Simoselaps littoralis	West Coast Banded Snake												
	Gekkonidae	*Christinus marmoratus*	Marbled Gecko												
		Diplodactylus g. granariensis													
		Gehyra variegata													
		Hemidactylus frenatus	Asian House Gecko												
		Heteronotia binoei	Bynoe's Gecko												
		Lucasium alboguttatum													
		Oedura gracilis													
	Pygopodidae	*Aclys concinna concinna*													
		Aprasia pulchella													
		Aprasia repens					2			1					
		Delma fraseri													
		Delma grayii			1										
		Lialis burtonis		1	1					1					
		Pletholax gracilis	Keeled Legless Lizard		1		2								
		Pletholax gracilis gracilis													
		Pygopus lepidopodus	Common Scaly Foot												
	Scincidae	*Acritoscincus trilineatum*		4	4										
		Cryptoblepharus buchananii													
		Cryptoblepharus plagiocephalus		X			1	3		3					
		Ctenotus australis			1		6	6	4						
P4		*Ctenotus delli*													
		Ctenotus fallens		X	5		13	9	10	2					
P3		*Ctenotus gemmula*	(Swan Coastal plain)												
		Ctenotus impar													
		Ctenotus labillardieri													
		Cyclodomorphus celatus													
		Egernia kingii	King's Skink												
		Egernia luctuosa	Western Swamp Skink												
		Egernia napoleonis													
		Hemiergis initialis initialis													
		Hemiergis peronii													
		Hemiergis peronii tridactyla													
		Hemiergis quadrilineata			X		5	7	2	11					
		Lerista christinae													
		Lerista distinguenda													
		Lerista elegans			20		12								
P3		*Lerista lineata*						25	46	18					
		Lerista lineopunctulata													
		Lerista praepedita					1								
		Menetia greyii		X	3		10	42	22	41					
		Morethia lineoocellata					X								
		Morethia obscura					10								
		Tiliqua occipitalis	Western Bluetongue												
		Tiliqua rugosa		X	X		1	1	4	X					

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		Tiliqua rugosa rugosa													
	Typhlopidae	*Ramphotyphlops australis*													
		Ramphotyphlops bituberculatus													
		Ramphotyphlops braminus													
		Ramphotyphlops pinguis													
		Ramphotyphlops waitii													
	Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor												
		Varanus rosenbergi	Heath Monitor												
		Varanus tristis	Racehorse Monitor						2	X					
		Varanus tristis tristis													

(cont)

Conservation Status	Family	Species	Common Name	Perth birds, Gole 2003								
				Locke Crescent Nature Reserve	Manjedal Brook	Maylands Peninsula	Piney Lake Reserve	Richard Lewis Park	Rushton Rd	Shreeve Road Wetland Reserve	Wal Hughes Reserve	Wireless Hill Park
	Hylidae	*Litoria adelaidensis*	Slender Tree Frog									
		Litoria dorsalis										
		Litoria moorei	Motorbike Frog									
	Limnodynastidae	*Heleioporus eyrei*	Moaning Frog									
		Heleioporus inornatus	Whooping Frog									
		Heleioporus psammophilus	Sand Frog									
		Limnodynastes dorsalis	Western Banjo Frog									
		Neobatrachus pelobatoides	Humming Frog									
	Myobatrachidae	*Crinia georgiana*	Quacking Frog									
		Crinia glauerti	Clicking Frog									
		Crinia insignifera	Squelching Froglet									
		Crinia pseudinsignifera	Bleating Froglet									
		Crinia sp.										
		Geocrinia leai	Ticking Frog									
		Myobatrachus gouldii	Turtle Frog									
		Pseudophryne douglasi	Gorge Toadlet									
		Pseudophryne guentheri	Crawling Toadlet									
	Accipitridae	*Accipiter cirrhocephalus*	Collared Sparrowhawk		X	X						
		Accipiter fasciatus	Brown Goshawk		X		X					
		Aquila audax	Wedge-tailed Eagle						X			
		Circus approximans	Swamp Harrier									
		Elanus axillaris	Black-shouldered Kite	X		X				X		
		Haliastur sphenurus	Whistling Kite				X					
		Hieraaetus morphnoides	Little Eagle									
		Lophoictinia isura	Square-tailed Kite									
		Pandion haliaetus	Osprey									
	Anatidae	*Anas gracilis*	Grey Teal			X	X			X		
		Anas rhynchotis	Australasian Shoveler				X					
		Anas superciliosa	Pacific Black Duck		X	X	X			X		
		Aythya australis	Hardhead				X					
		Chenonetta jubata	Australian Wood Duck		X					X		
		Cygnus atratus	Black Swan			X	X					
		Tadorna tadornoides	Australian Shelduck			X				X		
	Podargidae	*Podargus strigoides*	Tawny Frogmouth									
	Casuariidae	*Dromaius novaehollandiae*	Emu									
		Charadrius ruficapillus	Red-capped Plover									
		Elseyornis melanops	Black-fronted Dotterel				X			X		
		Erythrogonys cinctus	Red-kneed Dotterel									
P4		*Thinornis rubricollis*	Hooded Plover									
	Laridae	*Chroicocephalus novaehollandiae*	Silver Gull			X	X					X
		Hydroprogne caspia	Caspian Tern			X						
		Thalasseus bergii	Crested Tern			X						
	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt			X	X			X		
	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper									
		Calidris ruficollis	Red-necked Stint									
		Tringa nebularia	Common Greenshank				X					
	Turnicidae	*Turnix varius*	Painted Button-quail									X
	Ardeidae	*Ardea alba*	Great Egret			X	X			X		
		Ardea pacifica	White-necked Heron		X							
		Egretta novaehollandiae	White-faced Heron		X	X	X			X		
		Nycticorax caledonicus	Nankeen Night Heron									
	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican			X	X					
	Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill			X	X					
		Threskiornis molucca	Australian White Ibis			X	X			X		
		Threskiornis spinicollis	Straw-necked Ibis							X		
	Columbidae	*Columba livia*	Rock Dove		X							X
		Ocyphaps lophotes	Crested Pigeon									
		Phaps chalcoptera	Common Bronzewing		X				X	X		X
		Streptopelia chinensis	Spotted Dove	X		X	X	X	X		X	X
		Streptopelia senegalensis	Laughing Dove	X	X	X	X	X	X		X	X
	Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra	X	X				X	X		X
		Todiramphus sanctus	Sacred Kingfisher		X							
	Meropidae	*Merops ornatus*	Rainbow Bee-eater		X		X	X				X
	Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo									

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				Locke Crescent Nature Reserve	Manjedal Brook	Maylands Peninsula	Piney Lake Reserve	Richard Lewis Park	Rushton Rd	Shreeve Road Wetland Reserve	Wal Hughes Reserve	Wireless Hill Park
		Chalcites basalis	Horsfield's Bronze-Cuckoo		X							
		Chalcites lucidus	Shining Bronze-Cuckoo		X							
	Falconidae	*Falco berigora*	Brown Falcon									
		Falco cenchroides	Nankeen Kestrel									
		Falco longipennis	Australian Hobby									
	Phasianidae	*Coturnix ypsilophora*	Brown Quail									
	Rallidae	*Fulica atra*	Eurasian Coot			X	X			X		
		Gallinula tenebrosa	Dusky Moorhen							X		
		Gallirallus philippensis	Buff-banded Rail			X						
		Porphyrio porphyrio	Purple Swamphen			X				X		
		Porzana fluminea	Australian Spotted Crake							X		
	Acanthizidae	*Acanthiza apicalis*	Inland Thornbill		X					X		X
		Acanthiza chrysorrhoa	Yellow-rumped Thornbill		X		X	X	X	X		
		Acanthiza inornata	Western Thornbill		X		X		X			
		Gerygone fusca	Western Gerygone		X		X		X	X		X
		Sericornis frontalis	White-browed Scrubwren		X		X	X	X	X		
		Smicrornis brevirostris	Weebill		X			X	X			
	Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler				X			X		
		Megalurus gramineus	Little Grassbird			X						
	Artamidae	*Artamus cinereus*	Black-faced Woodswallow							X		
		Artamus cyanopterus	Dusky Woodswallow		X							
		Cracticus tibicen	Australian Magpie	X	X	X	X	X	X	X	X	X
		Cracticus torquatus	Grey Butcherbird	X	X				X		X	X
	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike		X	X	X	X	X	X		X
		Lalage sueurii	White-winged Triller		X		X					
	Corvidae	*Corvus coronoides*	Australian Raven	X	X	X		X	X	X	X	X
	Estrildidae	*Stagonopleura oculata*	Red-eared Firetail						X			
	Hirundinidae	*Hirundo neoxena*	Welcome Swallow	X	X		X			X		
		Petrochelidon ariel	Fairy Martin									
		Petrochelidon nigricans	Tree Martin		X		X	X	X	X		X
	Maluridae	*Malurus splendens*	Splendid Fairy-wren		X		X	X	X	X		
	Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill				X					X
		Anthochaera carunculata	Red Wattlebird	X	X	X	X	X	X	X	X	X
		Anthochaera chrysoptera	Little Wattlebird				X	X	X			X
		Anthochaera lunulata	Western Wattlebird									
		Epthianura albifrons	White-fronted Chat									
		Glyciphila melanops	Tawny-crowned Honeyeater									X
		Lichenostomus ornatus	Yellow-plumed Honeyeater		X							
		Lichenostomus virescens	Singing Honeyeater	X	X	X	X	X	X	X	X	X
		Lichmera indistincta	Brown Honeyeater	X	X	X	X	X	X	X	X	X
		Melithreptus lunatus	White-naped Honeyeater		X							
		Phylidonyris niger	White-cheeked Honeyeater	X	X	X	X	X	X			X
		Phylidonyris novaehollandiae	New Holland Honeyeater	X	X		X	X	X	X		X
		Grallina cyanoleuca	Magpie-Lark	X	X	X	X	X		X		X
	Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit									
	Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird		X	X			X			
	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella		X				X			X
	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush						X			
		Pachycephala pectoralis	Golden Whistler		X							
		Pachycephala rufiventris	Rufous Whistler		X		X	X	X	X		X
	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote		X				X			
		Pardalotus striatus	Striated Pardalote		X			X	X	X	X	
	Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin									
		Petroica goodenovii	Red-capped Robin		X							
		Petroica multicolor	Pacific Robin		X				X			
	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail		X			X	X	X		
		Rhipidura fuliginosa	New Zealand Fantail									
		Rhipidura leucophrys	Willie Wagtail	X	X	X	X	X	X	X		X
	Timaliidae	*Zosterops lateralis*	Silvereye		X	X	X	X	X	X		X
	Anhingidae	*Anhinga melanogaster*	Australasian Darter			X						
	Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant			X	X			X		
		Phalacrocorax carbo	Great Cormorant			X						
		Phalacrocorax sulcirostris	Little Black Cormorant			X	X			X		
	Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe			X	X					
		Tachybaptus novaehollandiae	Australasian Grebe				X			X		

Conservation Status	Family	Species	Common Name	Perth birds, Gole 2003								
				Locke Crescent Nature Reserve	Manjedal Brook	Maylands Peninsula	Piney Lake Reserve	Richard Lewis Park	Rushton Rd	Shreeve Road Wetland Reserve	Wal Hughes Reserve	Wireless Hill Park
	Cacatuidae	*Cacatua sanguinea*	Little Corella	X	X							
		Calyptorhynchus banksii	Red-tailed Black-Cockatoo									
VU, Sc1		*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo		X							
EN, Sc1		*Calyptorhynchus baudinii*	Baudin's Black-Cockatoo									
EN, Sc1		*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo		X		X		X		X	X
		Eolophus roseicapillus	Galah	X	X		X		X	X	X	X
	Psittacidae	*Barnardius zonarius*	Australian Ringneck	X	X	X	X		X	X	X	X
		Glossopsitta porphyrocephala	Purple-crowned Lorikeet									
		Neophema elegans	Elegant Parrot									
		Polytelis anthopeplus	Regent Parrot		X							
		Purpureicephalus spurius	Red-capped Parrot		X		X	X	X	X	X	X
		Trichoglossus haematodus	Rainbow Lorikeet	X		X	X	X			X	X
	Strigidae	*Ninox novaeseelandiae*	Southern Boobook									
	Tytonidae	*Tyto alba*	Barn Owl									
	Bovidae	*Bos taurus*	Cow									
	Suidae	*Sus scrofa*	Pig									
	Canidae	*Vulpes vulpes*	Red Fox									
	Felidae	*Felis catus*	House Cat									
	Molossidae	*Nyctinomus australis*	White-striped Freetail Bat									
	Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox									
	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat									
		Chalinolobus morio	Chocolate Wattled Bat									
P4		*Falsistrellus mackenziei*	Western Falsistrelle									
		Nyctophilus geoffroyi	Lesser Longeared Bat									
		Nyctophilus timoriensis timoriensis										
		Vespadelus regulus	Southern Forest Bat									
	Dasyuridae	*Antechinus flavipes leucogaster*										
VU, Sc1		*Dasyurus geoffroii*	Western Quoll									
VU		*Phascogale tapoatafa tapoatafa*	Brush-tailed Phascogale									
		Sminthopsis gilberti	Gilbert's Dunnart									
		Sminthopsis g. griseoventer	Grey-bellied Dunnart									
VU, Sc1	Myrmecobiidae	*Myrmecobius fasciatus*	Numbat									
P5	Macropodidae	*Macropus eugenii derbianus*	Tammar Wallaby									
		Macropus fuliginosus	Western Grey Kangaroo									
P4		*Macropus irma*	Western Brush Wallaby									
VU, Sc1		*Setonix brachyurus*	Quokka									
	Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum									
VU, Sc1	Pseudocheiridae	*Pseudocheirus occidentalis*	Western Ringtail Possum									
	Tarsipedidae	*Tarsipes rostratus*	Honey Possum									
	Leporidae	*Oryctolagus cuniculus*	European Rabbit									
	Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna									
P5	Peramelidae	*Isoodon obesulus fusciventer*	Southern Brown Bandicoot									
	Equidae	*Equus caballus*	Domestic Horse									
P4	Muridae	*Hydromys chrysogaster*	Water Rat									
		Mus musculus	House Mouse									
		Rattus fuscipes	Bush Rat									
		Rattus norvegicus	Brown Rat									
		Rattus rattus	Black Rat									
	Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon									
		Ctenophorus a. adelaidensis										
		Ctenophorus a. chapmani										
		Ctenophorus ornatus	Ornate Crevice Dragon									
		Pogona minor										
		Pogona minor minor										
	Boidae	*Antaresia stimsoni stimsoni*										
Sc4, P4		*Morelia spilota imbricata*										
	Carphodactylidae	*Nephrurus milii*	Barking Gecko									
	Colubridae	*Dendrelaphis punctulata*	Green Tree Snake									
	Diplodactylidae	*Diplodactylus polyophthalmus*										
		Strophurus spinigerus										
		Strophurus spinigerus inornatus										
		Strophurus spinigerus spinigerus										
		Strophurus strophurus										
P3	Elapidae	*Acanthophis antarcticus*	Southern Death Adder									
		Brachyurophis fasciolata fasciolata										

Conservation Status	Family	Species	Common Name	Perth birds, Gole 2003								
				Locke Crescent Nature Reserve	Manjedal Brook	Maylands Peninsula	Piney Lake Reserve	Richard Lewis Park	Rushton Rd	Shreeve Road Wetland Reserve	Wal Hughes Reserve	Wireless Hill Park
		Brachyurophis semifasciata										
		Demansia psammophis	Yellow-faced Whipsnake									
		Demansia psammophis reticulata										
		Echiopsis curta	Bardick									
		Elapognathus coronatus	Crowned Snake									
		Neelaps bimaculatus	Black-naped Snake									
P3		*Neelaps calonotos*	Black-striped Snake									
		Notechis scutatus	Tiger Snake									
		Parasuta gouldii										
		Parasuta nigriceps										
		Pseudechis australis	Mulga Snake									
		Pseudonaja affinis	Dugite									
		Pseudonaja affinis affinis										
		Pseudonaja modesta	Ringed Brown Snake									
		Pseudonaja nuchalis	Gwardar									
		Simoselaps bertholdi	Jan's Banded Snake									
		Simoselaps littoralis	West Coast Banded Snake									
	Gekkonidae	*Christinus marmoratus*	Marbled Gecko									
		Diplodactylus g. granariensis										
		Gehyra variegata										
		Hemidactylus frenatus	Asian House Gecko									
		Heteronotia binoei	Bynoe's Gecko									
		Lucasium alboguttatum										
		Oedura gracilis										
	Pygopodidae	*Aclys concinna concinna*										
		Aprasia pulchella										
		Aprasia repens										
		Delma fraseri										
		Delma grayii										
		Lialis burtonis										
		Pletholax gracilis	Keeled Legless Lizard									
		Pletholax gracilis gracilis										
		Pygopus lepidopodus	Common Scaly Foot									
	Scincidae	*Acritoscincus trilineatum*										
		Cryptoblepharus buchananii										
		Cryptoblepharus plagiocephalus										
		Ctenotus australis										
P4		*Ctenotus delli*										
		Ctenotus fallens										
P3		*Ctenotus gemmula*	(Swan Coastal plain)									
		Ctenotus impar										
		Ctenotus labillardieri										
		Cyclodomorphus celatus										
		Egernia kingii	King's Skink									
		Egernia luctuosa	Western Swamp Skink									
		Egernia napoleonis										
		Hemiergis initialis initialis										
		Hemiergis peronii										
		Hemiergis peronii tridactyla										
		Hemiergis quadrilineata										
		Lerista christinae										
		Lerista distinguenda										
		Lerista elegans										
P3		*Lerista lineata*										
		Lerista lineopunctulata										
		Lerista praepedita										
		Menetia greyii										
		Morethia lineoocellata										
		Morethia obscura										
		Tiliqua occipitalis	Western Bluetongue									
		Tiliqua rugosa										
		Tiliqua rugosa rugosa										
	Typhlopidae	*Ramphotyphlops australis*										
		Ramphotyphlops bituberculatus										
		Ramphotyphlops braminus										

Conservation Status	Family	Species	Common Name	Perth birds, Gole 2003								
				Locke Crescent Nature Reserve	Manjedal Brook	Maylands Peninsula	Piney Lake Reserve	Richard Lewis Park	Rushton Rd	Shreeve Road Wetland Reserve	Wal Hughes Reserve	Wireless Hill Park
		Ramphotyphlops pinguis										
		Ramphotyphlops waitii										
	Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor									
		Varanus rosenbergi	Heath Monitor									
		Varanus tristis	Racehorse Monitor									
		Varanus tristis tristis										

(cont)

Conservation Status	Family	Species	Common Name	Perth-Bunbury Freeway Extension 2006	Preston Beach North ATA Environmental 2007						
				Unknown	Coastal Pepp North	Coastal Pepp South	Lake Preston	Melaleuca Heath North	Melaleuca Heath South	Unknown	Wetland
	Hylidae	*Litoria adelaidensis*	Slender Tree Frog								
		Litoria dorsalis									
		Litoria moorei	Motorbike Frog								
	Limnodynastidae	*Heleioporus eyrei*	Moaning Frog		21	6		10	22		
		Heleioporus inornatus	Whooping Frog								
		Heleioporus psammophilus	Sand Frog		4			2	2		
		Limnodynastes dorsalis	Western Banjo Frog			1		2	1		
		Neobatrachus pelobatoides	Humming Frog								
	Myobatrachidae	*Crinia georgiana*	Quacking Frog				1				1
		Crinia glauerti	Clicking Frog								
		Crinia insignifera	Squelching Froglet								
		Crinia pseudinsignifera	Bleating Froglet								
		Crinia sp.									
		Geocrinia leai	Ticking Frog								4
		Myobatrachus gouldii	Turtle Frog								
		Pseudophryne douglasi	Gorge Toadlet								
		Pseudophryne guentheri	Crawling Toadlet								
	Accipitridae	*Accipiter cirrhocephalus*	Collared Sparrowhawk								
		Accipiter fasciatus	Brown Goshawk								
		Aquila audax	Wedge-tailed Eagle							1	
		Circus approximans	Swamp Harrier							2	
		Elanus axillaris	Black-shouldered Kite							2	
		Haliastur sphenurus	Whistling Kite								
		Hieraaetus morphnoides	Little Eagle							1	
		Lophoictinia isura	Square-tailed Kite								
		Pandion haliaetus	Osprey							1	
	Anatidae	*Anas gracilis*	Grey Teal							1	
		Anas rhynchotis	Australasian Shoveler								
		Anas superciliosa	Pacific Black Duck							54	
		Aythya australis	Hardhead								
		Chenonetta jubata	Australian Wood Duck							2	
		Cygnus atratus	Black Swan								
		Tadorna tadornoides	Australian Shelduck								
	Podargidae	*Podargus strigoides*	Tawny Frogmouth								
	Casuariidae	*Dromaius novaehollandiae*	Emu							3	
		Charadrius ruficapillus	Red-capped Plover							6	
		Elseyornis melanops	Black-fronted Dotterel								
		Erythrogonys cinctus	Red-kneed Dotterel								
P4		*Thinornis rubricollis*	Hooded Plover							76	
	Laridae	*Chroicocephalus novaehollandiae*	Silver Gull								
		Hydroprogne caspia	Caspian Tern								
		Thalasseus bergii	Crested Tern								
	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt								
	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper								
		Calidris ruficollis	Red-necked Stint							15	
		Tringa nebularia	Common Greenshank								
	Turnicidae	*Turnix varius*	Painted Button-quail							2	
	Ardeidae	*Ardea alba*	Great Egret								
		Ardea pacifica	White-necked Heron								
		Egretta novaehollandiae	White-faced Heron								
		Nycticorax caledonicus	Nankeen Night Heron								
	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican								
	Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill								
		Threskiornis molucca	Australian White Ibis								
		Threskiornis spinicollis	Straw-necked Ibis								
	Columbidae	*Columba livia*	Rock Dove								
		Ocyphaps lophotes	Crested Pigeon								
		Phaps chalcoptera	Common Bronzewing							13	
		Streptopelia chinensis	Spotted Dove								
		Streptopelia senegalensis	Laughing Dove								
	Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra							21	
		Todiramphus sanctus	Sacred Kingfisher								

Conservation Status	Family	Species	Common Name	Perth-Bunbury Freeway Extension 2006	Preston Beach North ATA Environmental 2007						
				Unknown	Coastal Pepp North	Coastal Pepp South	Lake Preston	Melaleuca Heath North	Melaleuca Heath South	Unknown	Wetland
	Meropidae	*Merops ornatus*	Rainbow Bee-eater							39	
	Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo								
		Chalcites basalis	Horsfield's Bronze-Cuckoo							3	
		Chalcites lucidus	Shining Bronze-Cuckoo								
	Falconidae	*Falco berigora*	Brown Falcon								
		Falco cenchroides	Nankeen Kestrel								
		Falco longipennis	Australian Hobby								
	Phasianidae	*Coturnix ypsilophora*	Brown Quail								
	Rallidae	*Fulica atra*	Eurasian Coot								
		Gallinula tenebrosa	Dusky Moorhen								
		Gallirallus philippensis	Buff-banded Rail								
		Porphyrio porphyrio	Purple Swamphen							1	
		Porzana fluminea	Australian Spotted Crake								
	Acanthizidae	*Acanthiza apicalis*	Inland Thornbill							67	
		Acanthiza chrysorrhoa	Yellow-rumped Thornbill							61	
		Acanthiza inornata	Western Thornbill							19	
		Gerygone fusca	Western Gerygone							22	
		Sericornis frontalis	White-browed Scrubwren							67	
		Smicrornis brevirostris	Weebill							9	
	Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler								
		Megalurus gramineus	Little Grassbird								
	Artamidae	*Artamus cinereus*	Black-faced Woodswallow							2	
		Artamus cyanopterus	Dusky Woodswallow								
		Cracticus tibicen	Australian Magpie							71	
		Cracticus torquatus	Grey Butcherbird							21	
	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike							8	
		Lalage sueurii	White-winged Triller								
	Corvidae	*Corvus coronoides*	Australian Raven							29	
	Estrildidae	*Stagonopleura oculata*	Red-eared Firetail								
	Hirundinidae	*Hirundo neoxena*	Welcome Swallow							2	
		Petrochelidon ariel	Fairy Martin								
		Petrochelidon nigricans	Tree Martin							4	
	Maluridae	*Malurus splendens*	Splendid Fairy-wren							347	
	Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill								
		Anthochaera carunculata	Red Wattlebird							9	
		Anthochaera chrysoptera	Little Wattlebird								
		Anthochaera lunulata	Western Wattlebird								
		Epthianura albifrons	White-fronted Chat							3	
		Glyciphila melanops	Tawny-crowned Honeyeater								
		Lichenostomus ornatus	Yellow-plumed Honeyeater								
		Lichenostomus virescens	Singing Honeyeater								
		Lichmera indistincta	Brown Honeyeater								
		Melithreptus lunatus	White-naped Honeyeater								
		Phylidonyris niger	White-cheeked Honeyeater								
		Phylidonyris novaehollandiae	New Holland Honeyeater							14	
		Grallina cyanoleuca	Magpie-Lark							6	
	Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit							17	
	Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird								
	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella								
	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush							30	
		Pachycephala pectoralis	Golden Whistler								
		Pachycephala rufiventris	Rufous Whistler							19	
	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote								
		Pardalotus striatus	Striated Pardalote							5	
	Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin								
		Petroica goodenovii	Red-capped Robin								
		Petroica multicolor	Pacific Robin							10	
	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail								
		Rhipidura fuliginosa	New Zealand Fantail							104	
		Rhipidura leucophrys	Willie Wagtail							4	
	Timaliidae	*Zosterops lateralis*	Silvereye							540	
	Anhingidae	*Anhinga melanogaster*	Australasian Darter								
	Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant								
		Phalacrocorax carbo	Great Cormorant								

Conservation Status	Family	Species	Common Name	Perth-Bunbury Freeway Extension 2006	Preston Beach North ATA Environmental 2007						
				Unknown	Coastal Pepp North	Coastal Pepp South	Lake Preston	Melaleuca Heath North	Melaleuca Heath South	Unknown	Wetland
		Phalacrocorax sulcirostris	Little Black Cormorant								
	Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe								
		Tachybaptus novaehollandiae	Australasian Grebe								
	Cacatuidae	*Cacatua sanguinea*	Little Corella								
		Calyptorhynchus banksii	Red-tailed Black-Cockatoo	16							
VU, Sc1		*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo								
EN, Sc1		*Calyptorhynchus baudinii*	Baudin's Black-Cockatoo	1							
EN, Sc1		*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo	20							
		Eolophus roseicapillus	Galah							3	
	Psittacidae	*Barnardius zonarius*	Australian Ringneck							109	
		Glossopsitta porphyrocephala	Purple-crowned Lorikeet								
		Neophema elegans	Elegant Parrot							16	
		Polytelis anthopeplus	Regent Parrot								
		Purpureicephalus spurius	Red-capped Parrot							21	
		Trichoglossus haematodus	Rainbow Lorikeet								
	Strigidae	*Ninox novaeseelandiae*	Southern Boobook								
	Tytonidae	*Tyto alba*	Barn Owl								
	Bovidae	*Bos taurus*	Cow								
	Suidae	*Sus scrofa*	Pig								
	Canidae	*Vulpes vulpes*	Red Fox								
	Felidae	*Felis catus*	House Cat								
	Molossidae	*Nyctinomus australis*	White-striped Freetail Bat								
	Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox								
	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat								
		Chalinolobus morio	Chocolate Wattled Bat								
P4		*Falsistrellus mackenziei*	Western Falsistrelle								
		Nyctophilus geoffroyi	Lesser Longeared Bat								
		Nyctophilus timoriensis timoriensis									
		Vespadelus regulus	Southern Forest Bat								
	Dasyuridae	*Antechinus flavipes leucogaster*									
VU, Sc1		*Dasyurus geoffroii*	Western Quoll								
VU		*Phascogale tapoatafa tapoatafa*	Brush-tailed Phascogale								
		Sminthopsis gilberti	Gilbert's Dunnart								
		Sminthopsis g. griseoventer	Grey-bellied Dunnart								
VU, Sc1	Myrmecobiidae	*Myrmecobius fasciatus*	Numbat								
P5	Macropodidae	*Macropus eugenii derbianus*	Tammar Wallaby								
		Macropus fuliginosus	Western Grey Kangaroo								
P4		*Macropus irma*	Western Brush Wallaby								
VU, Sc1		*Setonix brachyurus*	Quokka								
	Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum			2					
VU, Sc1	Pseudocheiridae	*Pseudocheirus occidentalis*	Western Ringtail Possum	1							
	Tarsipedidae	*Tarsipes rostratus*	Honey Possum								
	Leporidae	*Oryctolagus cuniculus*	European Rabbit								
	Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna								
P5	Peramelidae	*Isoodon obesulus fusciventer*	Southern Brown Bandicoot								
	Equidae	*Equus caballus*	Domestic Horse								
P4	Muridae	*Hydromys chrysogaster*	Water Rat								
		Mus musculus	House Mouse			10	4				10
		Rattus fuscipes	Bush Rat								
		Rattus norvegicus	Brown Rat								
		Rattus rattus	Black Rat								
	Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon		2						
		Ctenophorus a. adelaidensis									
		Ctenophorus a. chapmani									
		Ctenophorus ornatus	Ornate Crevice Dragon								
		Pogona minor			1		1		2		
		Pogona minor minor									
	Boidae	*Antaresia stimsoni stimsoni*									
Sc4, P4		*Morelia spilota imbricata*									
	Carphodactylidae	*Nephrurus milii*	Barking Gecko								
	Colubridae	*Dendrelaphis punctulata*	Green Tree Snake								
	Diplodactylidae	*Diplodactylus polyophthalmus*									
		Strophurus spinigerus			1	10		2	9		
		Strophurus spinigerus inornatus									

Conservation Status	Family	Species	Common Name	Perth-Bunbury Freeway Extension 2006	Preston Beach North ATA Environmental 2007						
				Unknown	Coastal Pepp North	Coastal Pepp South	Lake Preston	Melaleuca Heath North	Melaleuca Heath South	Unknown	Wetland
		Strophurus spinigerus spinigerus									
		Strophurus strophurus									
P3	Elapidae	*Acanthophis antarcticus*	Southern Death Adder								
		Brachyurophis fasciolata fasciolata									
		Brachyurophis semifasciata									
		Demansia psammophis	Yellow-faced Whipsnake		1				1		
		Demansia psammophis reticulata									
		Echiopsis curta	Bardick			2					
		Elapognathus coronatus	Crowned Snake								
		Neelaps bimaculatus	Black-naped Snake			1					
P3		*Neelaps calonotos*	Black-striped Snake								
		Notechis scutatus	Tiger Snake			1					
		Parasuta gouldii									
		Parasuta nigriceps									
		Pseudechis australis	Mulga Snake								
		Pseudonaja affinis	Dugite		1	2		1	1		
		Pseudonaja affinis affinis									
		Pseudonaja modesta	Ringed Brown Snake								
		Pseudonaja nuchalis	Gwardar						1		
		Simoselaps bertholdi	Jan's Banded Snake								
		Simoselaps littoralis	West Coast Banded Snake								
	Gekkonidae	*Christinus marmoratus*	Marbled Gecko								
		Diplodactylus g. granariensis									
		Gehyra variegata									
		Hemidactylus frenatus	Asian House Gecko								
		Heteronotia binoei	Bynoe's Gecko								
		Lucasium alboguttatum									
		Oedura gracilis									
	Pygopodidae	*Aclys concinna concinna*									
		Aprasia pulchella									
		Aprasia repens									
		Delma fraseri							1		
		Delma grayii				2		1	1		
		Lialis burtonis									
		Pletholax gracilis	Keeled Legless Lizard								
		Pletholax gracilis gracilis									
		Pygopus lepidopodus	Common Scaly Foot								
	Scincidae	*Acritoscincus trilineatum*				2	6	1			
		Cryptoblepharus buchananii				3	1				5
		Cryptoblepharus plagiocephalus									
		Ctenotus australis			2	1		1	1		
P4		*Ctenotus delli*									
		Ctenotus fallens									
P3		*Ctenotus gemmula*	(Swan Coastal plain)								
		Ctenotus impar									
		Ctenotus labillardieri									
		Cyclodomorphus celatus									
		Egernia kingii	King's Skink								
		Egernia luctuosa	Western Swamp Skink								
		Egernia napoleonis					1				
		Hemiergis initialis initialis									
		Hemiergis peronii									
		Hemiergis peronii tridactyla									
		Hemiergis quadrilineata			1	15	7	5	11		1
		Lerista christinae									
		Lerista distinguenda									
		Lerista elegans									
P3		*Lerista lineata*									
		Lerista lineopunctulata									
		Lerista praepedita									
		Menetia greyii			1			5	3		
		Morethia lineoocellata									
		Morethia obscura									
		Tiliqua occipitalis	Western Bluetongue								

Conservation Status	Family	Species	Common Name	Perth-Bunbury Freeway Extension 2006	Preston Beach North ATA Environmental 2007						
				Unknown	Coastal Pepp North	Coastal Pepp South	Lake Preston	Melaleuca Heath North	Melaleuca Heath South	Unknown	Wetland
		Tiliqua rugosa				1			1		
		Tiliqua rugosa rugosa									
	Typhlopidae	*Ramphotyphlops australis*						1			
		Ramphotyphlops bituberculatus									
		Ramphotyphlops braminus									
		Ramphotyphlops pinguis									
		Ramphotyphlops waitii									
	Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor								
		Varanus rosenbergi	Heath Monitor								
		Varanus tristis	Racehorse Monitor								
		Varanus tristis tristis									

(cont)

Conservation Status	Family	Species	Common Name	Rockingham IP14				WAM
				Site 1	Site 2	Site 3	Site 4	Unknown
	Hylidae	*Litoria adelaidensis*	Slender Tree Frog					55
		Litoria dorsalis						
		Litoria moorei	Motorbike Frog					82
	Limnodynastidae	*Heleioporus eyrei*	Moaning Frog					365
		Heleioporus inornatus	Whooping Frog					1
		Heleioporus psammophilus	Sand Frog					5
		Limnodynastes dorsalis	Western Banjo Frog					98
		Neobatrachus pelobatoides	Humming Frog					5
	Myobatrachidae	*Crinia georgiana*	Quacking Frog					122
		Crinia glauerti	Clicking Frog					330
		Crinia insignifera	Squelching Froglet					492
		Crinia pseudinsignifera	Bleating Froglet					7
		Crinia sp.						
		Geocrinia leai	Ticking Frog					9
		Myobatrachus gouldii	Turtle Frog					60
		Pseudophryne douglasi	Gorge Toadlet					
		Pseudophryne guentheri	Crawling Toadlet					35
	Accipitridae	*Accipiter cirrhocephalus*	Collared Sparrowhawk					
		Accipiter fasciatus	Brown Goshawk					
		Aquila audax	Wedge-tailed Eagle					
		Circus approximans	Swamp Harrier					
		Elanus axillaris	Black-shouldered Kite					
		Haliastur sphenurus	Whistling Kite					
		Hieraaetus morphnoides	Little Eagle					
		Lophoictinia isura	Square-tailed Kite					
		Pandion haliaetus	Osprey					
	Anatidae	*Anas gracilis*	Grey Teal					
		Anas rhynchotis	Australasian Shoveler					
		Anas superciliosa	Pacific Black Duck					
		Aythya australis	Hardhead					
		Chenonetta jubata	Australian Wood Duck					
		Cygnus atratus	Black Swan					
		Tadorna tadornoides	Australian Shelduck					
	Podargidae	*Podargus strigoides*	Tawny Frogmouth					
	Casuariidae	*Dromaius novaehollandiae*	Emu					
		Charadrius ruficapillus	Red-capped Plover					
		Elseyornis melanops	Black-fronted Dotterel					
		Erythrogonys cinctus	Red-kneed Dotterel					
P4		*Thinornis rubricollis*	Hooded Plover					
	Laridae	*Chroicocephalus novaehollandiae*	Silver Gull					
		Hydroprogne caspia	Caspian Tern					
		Thalasseus bergii	Crested Tern					
	Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt					
	Scolopacidae	*Actitis hypoleucos*	Common Sandpiper					
		Calidris ruficollis	Red-necked Stint					
		Tringa nebularia	Common Greenshank					
	Turnicidae	*Turnix varius*	Painted Button-quail					
	Ardeidae	*Ardea alba*	Great Egret					
		Ardea pacifica	White-necked Heron					
		Egretta novaehollandiae	White-faced Heron					
		Nycticorax caledonicus	Nankeen Night Heron					
	Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican					
	Threskiornithidae	*Platalea flavipes*	Yellow-billed Spoonbill					
		Threskiornis molucca	Australian White Ibis					
		Threskiornis spinicollis	Straw-necked Ibis					
	Columbidae	*Columba livia*	Rock Dove					
		Ocyphaps lophotes	Crested Pigeon					
		Phaps chalcoptera	Common Bronzewing					
		Streptopelia chinensis	Spotted Dove					
		Streptopelia senegalensis	Laughing Dove					
	Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra					
		Todiramphus sanctus	Sacred Kingfisher					
	Meropidae	*Merops ornatus*	Rainbow Bee-eater					
	Cuculidae	*Cacomantis flabelliformis*	Fan-tailed Cuckoo					
		Chalcites basalis	Horsfield's Bronze-Cuckoo					

Conservation Status	Family	Species	Common Name	Rockingham IP14				WAM
				Site 1	Site 2	Site 3	Site 4	Unknown
		Chalcites lucidus	Shining Bronze-Cuckoo					
	Falconidae	*Falco berigora*	Brown Falcon					
		Falco cenchroides	Nankeen Kestrel					
		Falco longipennis	Australian Hobby					
	Phasianidae	*Coturnix ypsilophora*	Brown Quail					
	Rallidae	*Fulica atra*	Eurasian Coot					
		Gallinula tenebrosa	Dusky Moorhen					
		Gallirallus philippensis	Buff-banded Rail					
		Porphyrio porphyrio	Purple Swamphen					
		Porzana fluminea	Australian Spotted Crake					
	Acanthizidae	*Acanthiza apicalis*	Inland Thornbill					
		Acanthiza chrysorrhoa	Yellow-rumped Thornbill					
		Acanthiza inornata	Western Thornbill					
		Gerygone fusca	Western Gerygone					
		Sericornis frontalis	White-browed Scrubwren					
		Smicrornis brevirostris	Weebill					
	Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler					
		Megalurus gramineus	Little Grassbird					
	Artamidae	*Artamus cinereus*	Black-faced Woodswallow					
		Artamus cyanopterus	Dusky Woodswallow					
		Cracticus tibicen	Australian Magpie					
		Cracticus torquatus	Grey Butcherbird					
	Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike					
		Lalage sueurii	White-winged Triller					
	Corvidae	*Corvus coronoides*	Australian Raven					
	Estrildidae	*Stagonopleura oculata*	Red-eared Firetail					
	Hirundinidae	*Hirundo neoxena*	Welcome Swallow					
		Petrochelidon ariel	Fairy Martin					
		Petrochelidon nigricans	Tree Martin					
	Maluridae	*Malurus splendens*	Splendid Fairy-wren					
	Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill					
		Anthochaera carunculata	Red Wattlebird					
		Anthochaera chrysoptera	Little Wattlebird					
		Anthochaera lunulata	Western Wattlebird					
		Epthianura albifrons	White-fronted Chat					
		Glyciphila melanops	Tawny-crowned Honeyeater					
		Lichenostomus ornatus	Yellow-plumed Honeyeater					
		Lichenostomus virescens	Singing Honeyeater					
		Lichmera indistincta	Brown Honeyeater					
		Melithreptus lunatus	White-naped Honeyeater					
		Phylidonyris niger	White-cheeked Honeyeater					
		Phylidonyris novaehollandiae	New Holland Honeyeater					
		Grallina cyanoleuca	Magpie-Lark					
	Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit					
	Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird					
	Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella					
	Pachycephalidae	*Colluricincla harmonica*	Grey Shrike-thrush					
		Pachycephala pectoralis	Golden Whistler					
		Pachycephala rufiventris	Rufous Whistler					
	Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote					
		Pardalotus striatus	Striated Pardalote					
	Petroicidae	*Eopsaltria griseogularis*	Western Yellow Robin					
		Petroica goodenovii	Red-capped Robin					
		Petroica multicolor	Pacific Robin					
	Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail					
		Rhipidura fuliginosa	New Zealand Fantail					
		Rhipidura leucophrys	Willie Wagtail					
	Timaliidae	*Zosterops lateralis*	Silvereye					
	Anhingidae	*Anhinga melanogaster*	Australasian Darter					
	Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant					
		Phalacrocorax carbo	Great Cormorant					
		Phalacrocorax sulcirostris	Little Black Cormorant					
	Podicipedidae	*Poliocephalus poliocephalus*	Hoary-headed Grebe					
		Tachybaptus novaehollandiae	Australasian Grebe					
	Cacatuidae	*Cacatua sanguinea*	Little Corella					
		Calyptorhynchus banksii	Red-tailed Black-Cockatoo					

Conservation Status	Family	Species	Common Name	Rockingham IP14				WAM
				Site 1	Site 2	Site 3	Site 4	Unknown
VU, Sc1		*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo					
EN, Sc1		*Calyptorhynchus baudinii*	Baudin's Black-Cockatoo					
EN, Sc1		*Calyptorhynchus latirostris*	Carnaby's Black-Cockatoo					
		Eolophus roseicapillus	Galah					
	Psittacidae	*Barnardius zonarius*	Australian Ringneck					
		Glossopsitta porphyrocephala	Purple-crowned Lorikeet					
		Neophema elegans	Elegant Parrot					
		Polytelis anthopeplus	Regent Parrot					
		Purpureicephalus spurius	Red-capped Parrot					
		Trichoglossus haematodus	Rainbow Lorikeet					
	Strigidae	*Ninox novaeseeiandiae*	Southern Boobook					
	Tytonidae	*Tyto alba*	Barn Owl					
	Bovidae	*Bos taurus*	Cow					1
	Suidae	*Sus scrofa*	Pig					5
	Canidae	*Vulpes vulpes*	Red Fox					1
	Felidae	*Felis catus*	House Cat					8
	Molossidae	*Nyctinomus australis*	White-striped Freetail Bat					1
	Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox					1
	Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat					12
		Chalinolobus morio	Chocolate Wattled Bat					1
P4		*Falsistrellus mackenziei*	Western Falsistrelle					9
		Nyctophilus geoffroyi	Lesser Longeared Bat					4
		Nyctophilus timoriensis timoriensis						2
		Vespadelus regulus	Southern Forest Bat					13
	Dasyuridae	*Antechinus flavipes leucogaster*						14
VU, Sc1		*Dasyurus geoffroii*	Western Quoll					18
VU		*Phascogale tapoatafa tapoatafa*	Brush-tailed Phascogale					34
		Sminthopsis gilberti	Gilbert's Dunnart					2
		Sminthopsis g. griseoventer	Grey-bellied Dunnart					1
VU, Sc1	Myrmecobiidae	*Myrmecobius fasciatus*	Numbat					4
P5	Macropodidae	*Macropus eugenii derbianus*	Tammar Wallaby					1
		Macropus fuliginosus	Western Grey Kangaroo					2
P4		*Macropus irma*	Western Brush Wallaby					15
VU, Sc1		*Setonix brachyurus*	Quokka					9
	Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum					69
VU, Sc1	Pseudocheiridae	*Pseudocheirus occidentalis*	Western Ringtail Possum					
	Tarsipedidae	*Tarsipes rostratus*	Honey Possum					21
	Leporidae	*Oryctolagus cuniculus*	European Rabbit					3
	Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna					4
P5	Peramelidae	*Isoodon obesulus fusciventer*	Southern Brown Bandicoot	1	1	1	1	101
	Equidae	*Equus caballus*	Domestic Horse					1
P4	Muridae	*Hydromys chrysogaster*	Water Rat					10
		Mus musculus	House Mouse	69	52	35	88	42
		Rattus fuscipes	Bush Rat					
		Rattus norvegicus	Brown Rat					5
		Rattus rattus	Black Rat	2	1	1	1	55
	Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon					
		Ctenophorus a. adelaidensis						26
		Ctenophorus a. chapmani		1	5	1	2	
		Ctenophorus ornatus	Ornate Crevice Dragon					26
		Pogona minor						
		Pogona minor minor		5	2	1	1	83
	Boidae	*Antaresia stimsoni stimsoni*						1
Sc4, P4		*Morelia spilota imbricata*						8
	Carphodactylidae	*Nephrurus milii*	Barking Gecko					10
	Colubridae	*Dendrelaphis punctulata*	Green Tree Snake					1
	Diplodactylidae	*Diplodactylus polyophthalmus*						14
		Strophurus spinigerus		15	3	8	6	
		Strophurus spinigerus inornatus						4
		Strophurus spinigerus spinigerus						13
		Strophurus strophurus						
P3	Elapidae	*Acanthophis antarcticus*	Southern Death Adder					8
		Brachyurophis fasciolata fasciolata						2
		Brachyurophis semifasciata						37
		Demansia psammophis	Yellow-faced Whipsnake					
		Demansia psammophis reticulata		1	1	1	1	19

Conservation Status	Family	Species	Common Name	Rockingham IP14				WAM
				Site 1	Site 2	Site 3	Site 4	Unknown
		Echiopsis curta	Bardick					8
		Elapognathus coronatus	Crowned Snake					26
		Neelaps bimaculatus	Black-naped Snake					32
P3		*Neelaps calonotos*	Black-striped Snake					16
		Notechis scutatus	Tiger Snake					83
		Parasuta gouldii						51
		Parasuta nigriceps						6
		Pseudechis australis	Mulga Snake					5
		Pseudonaja affinis	Dugite					
		Pseudonaja affinis affinis		1	1	1	1	423
		Pseudonaja modesta	Ringed Brown Snake					1
		Pseudonaja nuchalis	Gwardar					8
		Simoselaps bertholdi	Jan's Banded Snake					68
		Simoselaps littoralis	West Coast Banded Snake					1
	Gekkonidae	*Christinus marmoratus*	Marbled Gecko					69
		Diplodactylus g. granariensis						1
		Gehyra variegata		1	1	1	1	2
		Hemidactylus frenatus	Asian House Gecko					2
		Heteronotia binoei	Bynoe's Gecko					1
		Lucasium alboguttatum						1
		Oedura gracilis						
	Pygopodidae	*Aclys concinna concinna*		1	1	1	1	
		Aprasia pulchella						6
		Aprasia repens						76
		Delma fraseri						41
		Delma grayii		1	1	1	1	12
		Lialis burtonis		1	1	3	1	173
		Pletholax gracilis	Keeled Legless Lizard					
		Pletholax gracilis gracilis						48
		Pygopus lepidopodus	Common Scaly Foot					26
	Scincidae	*Acritoscincus trilineatum*		1	1	1	1	59
		Cryptoblepharus buchananii						
		Cryptoblepharus plagiocephalus		2	3	5	1	142
		Ctenotus australis		3	8	9	3	124
P4		*Ctenotus delli*						2
		Ctenotus fallens		14	16	10	14	43
P3		*Ctenotus gemmula*	(Swan Coastal plain)					33
		Ctenotus impar						60
		Ctenotus labillardieri						19
		Cyclodomorphus celatus						1
		Egernia kingii	King's Skink					17
		Egernia luctuosa	Western Swamp Skink					
		Egernia napoleonis		1	1	2	1	10
		Hemiergis initialis initialis		2	8	9	3	11
		Hemiergis peronii						3
		Hemiergis peronii tridactyla		1	1	1	1	
		Hemiergis quadrilineata		1	3	1	1	146
		Lerista christinae						1
		Lerista distinguenda						14
		Lerista elegans						372
P3		*Lerista lineata*						196
		Lerista lineopunctulata						5
		Lerista praepedita						4
		Menetia greyii		1	1	1	1	147
		Morethia lineoocellata						39
		Morethia obscura		2	13	3	6	20
		Tiliqua occipitalis	Western Bluetongue					16
		Tiliqua rugosa		1	6	3	4	
		Tiliqua rugosa rugosa						20
	Typhlopidae	*Ramphotyphlops australis*		1	1	1	1	89
		Ramphotyphlops bituberculatus						1
		Ramphotyphlops braminus						1
		Ramphotyphlops pinguis						7
		Ramphotyphlops waitii						9
	Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor	1	1	1	1	17
		Varanus rosenbergi	Heath Monitor					10

Conservation Status	Family	Species	Common Name	Rockingham IP14				WAM
				Site 1	Site 2	Site 3	Site 4	Unknown
		Varanus tristis	Racehorse Monitor	1	1	1	1	
		Varanus tristis tristis						8
	Cheluidae	*Chelodina oblonga*	Oblong Turtle					37

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Ecologia Environmental Consultants 2001 Part Lot 211 Barnes Avenue, Australind Fauna Survey. Unpublished report for Marist Brothers Community, Perth.

Gole CA (2004) Bird surveys in selected metropolitan reserves: Rounds 1 and 2 survey report. Birds Australia WA, Perth and Perth Biodiversity Project, WA Local Government Association, Perth.

How R A and Dell J (2000) Ground vertebrate fauna of Perth's vegetation remnants: impact of 170 years of urbanization. Pacific Conservation Biology 6: 198-217.

How R.A., Harvey M.S., Dell J, and Waldock J.M. (1996) *Ground Fauna of the Urban Bushland Remnants in Perth, Report to the Australian Heritage Commission NEP Grant N93/04*. Unpublished report, Perth.

Turpin M C (1990) Ecological appraisal of an islotaed Banksia woodland reserve No. 3694 south of the Swan River. Western Australian Naturalist 18: 131-138.

WAM – WA Museum database

Western Wildlife 2007 Lot 801 and Lot 4 Preston Beach Fauna Survey 2007. Unpublished report for RPS Bowman Bishaw Gorham; Perth

En – Endangered

Vu – Vulnerable

Sc1 – Schedule 1

Sc4 – Schedule 4

P1 - Priority 1

P2 - Priority 2

P3 - Priority 3

P4 - Priority 4

P5 - Priority 5

Appendix E
DEC Threatened and Priority Fauna Database Search Results

Flora and Fauna Assessments
Lot 91, 92 & 604

32.406 °S 115.6983 °E / 32.6 °S 115.891 °E Nambeelup area (plus~10km buffer)

*	Date	Certainty	Seen	Location Name	Method

Schedule 1 - Fauna that is rare or is likely to become extinct

Dasyurus geoffroii — Chuditch — *3 records*

This carnivorous marsupial occupies large home ranges, is highly mobile and appears able to utilise bush remnants and corridors.

1992	1	1	CORIO SWAMP SYSTEM	Day sighting
1995	1	1	BARRAGUP	Day sighting
1999	2	1	South Yunderup	Day sighting

Myrmecobius fasciatus — Numbat, Walpurti — *1 records*

This diurnal marsupial feeds almost exclusively on termites and is very vulnerable to predation by foxes and cats. It occurs in a variety of habitats including woodland and shrubland where it shelters in hollow logs, tree hollows and burrows.

2002	2	1	Barragup	Day sighting

Calyptorhynchus banksii naso — Forest Red-tailed Black-Cockatoo — *1 records*

This subspecies of the Red-tailed Black Cockatoo is restricted to the forests of the south-west. It requires tree hollows to nest and breed and is totally dependent on jarrah-marri forest.

2004	1	20	Goegrup Lake Nature Reserve	Day sighting

Synemon gratiosa — Graceful Sunmoth — *1 records*

This species has been recorded in a few locations from Wanneroo to Mandurah and is under great pressure from land development.

1984	1	1	Mandurah	Caught or trapped

Priority Three: Taxa with several, poorly known populations, some on conservation lands

Neelaps calonotos — Black-striped Snake — *2 records*

1967	1	1	Madora	Caught or trapped
1977	1	1	Singleton	Caught or trapped

Lerista lineata — Lined Skink — *3 records*

A small, slender skink that inhabits white sands.

1977	1	2	Singleton	Caught or trapped
1980	1	1	Mandurah	Caught or trapped
2001	1	2	Karnup	Caught or trapped

Priority Four: Taxa in need of monitoring

Hydromys chrysogaster — Water-rat, Rakali — *1 records*

This species occurs in waterways and wetlands that support its main prey items such as molluscs and crustaceans.

	1	1	South Yundurup	

Charadrius rubricollis — Hooded Plover — *1 records*

This species frequents the margins and shallows of salt lakes, also along coastal beaches, where it forages for invertebrates along the water's edge.

2000	1	2	Peel Inlet	

32.406 °S 115.6983 °E / 32.6 °S 115.891 °E Nambeelup area (plus~10km buffer)

*	Date	Certainty	Seen	Location Name	Method

Numenius madagascariensis **Eastern Curlew** *7 records*

This species is a migratory visitor and has been observed on reef flats and sandy beaches along the West Australian coast and in coastal estuaries.

1928	1	1	Peel Inlet	Day sighting
1959	1	1	Mandurah	Day sighting
1992	1	16	Mandurah	Day sighting
1995	1	3	Peel Inlet	Day sighting
1997	1	5	Mandurah	Day sighting
1998	1	5	Peel Inlet	Day sighting
2000	1	7	Peel Inlet	

Priority Five: Taxa in need of monitoring (conservation dependent)

Isoodon obesulus fusciventer **Quenda** *8 records*

This species prefers areas with dense understorey vegetation, particularly around swamps and along watercourses, that provides ample protection from predators.

1997	1	1	Keysbrook	
1997	1	1	Keysbrook	
1997	1	1	Keysbrook	
2004	1	1	Barragup/Ravenswood	Day sighting
2005	1	2	Singleton	Night sighting
2005	1	2	Singleton	Night sighting
2005	1	2	Singleton	Night sighting
2006	3	0	Greenfields	Definite signs

* Information relating to any records provided for listed species:-
Date: date of recorded observation
Certainty (of correct species identification): 1=Very certain; 2=Moderately certain; and 3=Not sure.
Seen: Number of individuals observed.
Location Name: Name of reserve or nearest locality where observation was made
Method: Method or type of observation

RPS

APPENDIX 4

Plants Used by Carnaby's Black-Cockatoo

Plants Used by Carnaby's Black Cockatoo

Department of Environment and Conservation

List prepared by Christine Groom, Department of Environment and Conservation 15 April 2011

For more information on plant selection or references used to produce this list please visit the Plants for Carnaby's Search Tool webpage at www.dec.wa.gov.au/plantsforcarnabys

Our environment, our future

Species	Used for: Feeding	Used for: Nesting	Used for: Roosting	Priority for planting for Carnaby's	Growth form	Flower colour	Soil type: Clayey	Soil type: Gravelly	Soil type: Loamy	Soil type: Sandy	Sun exposure	Soil drainage: Well drained	Soil drainage: Poorly drained	Soil drainage: Waterlogged	Soil drainage: Salt affected	Origin
Acacia baileyana (Cootamundra wattle)*				Low	Tree	Yellow					○ ◗					Australian native
Acacia pentadenia (Karri Wattle)				Low	Tree	Cream					○ ◗ ◗					WA native
Acacia saligna (Orange Wattle)				Low	Tree	Yellow					○ ◗					WA native
Agonis flexuosa (Peppermint Tree)				Low	Tree	White					○ ◗ ◗					WA native
Araucaria heterophylla (Norfolk Island Pine)				Low	Tree	Green					○ ◗ ◗					Exotic to Australia
Banksia ashbyi (Ashby's Banksia)				Medium	Tree or Tall shrub	Yellow, Orange					○ ◗					WA native
Banksia attenuata (Slender Banksia)				High	Tree	Yellow					○ ◗					WA native
Banksia baxteri (Baxter's Banksia)				Medium	Tall shrub	Yellow					○ ◗					WA native
Banksia carlinoides (Pink Dryandra)				Medium	Medium or small shrub	White, cream, pink					○ ◗					WA native
Banksia coccinea (Scarlet Banksia)				Medium	Tree	Red					○ ◗					WA native
Banksia dallanneyi (Couch Honeypot Dryandra)				Low	Medium or small shrub	Orange, brown					○					WA native
Banksia ericifolia (Heath-leaved Banksia)				Medium	Tall shrub	Orange					○					Australian native
Banksia fraseri (Dryandra)				Medium	Medium or small shrub	Orange					○ ◗					WA native
Banksia gardneri (Prostrate Banksia)				Low	Medium or small shrub	Orange					○ ◗					WA native
Banksia grandis (Bull Banksia)				High	Tree	Yellow					○ ◗					WA native
Banksia hookeriana (Hooker's Banksia)				Medium	Tall shrub	Orange					○ ◗					WA native
Banksia ilicifolia (Holly Banksia)				High	Tree	Cream					○ ◗					WA native
Banksia kippistiana (Dryandra)				Medium	Medium or small shrub	Yellow					○ ◗					WA native
Banksia leptophylla				Low	Medium or small shrub	Yellow					○ ◗					WA native
Banksia littoralis (Swamp Banksia)				High	Tree	Yellow					○ ◗					WA native
Banksia menziesii (Firewood or Menzie's Banksia)				High	Tree	Yellow, pink, red					○ ◗					WA native
Banksia mucronulata (Swordfish Dryandra)				Medium	Medium or small shrub	Yellow					○ ◗					WA native
Banksia nivea (Honeypot Dryandra)				High	Medium or small shrub	Orange					○ ◗					WA native
Banksia nobilis (Golden Dryandra)				Medium	Tall shrub	Orange					○					WA native
Banksia praemorsa (Cut-leaf Banksia)				Medium	Tall shrub	Red, yellow, green					○					WA native
Banksia prionotes (Acorn Banksia)				High	Tree	Orange					○					WA native

Species	Used for			Priority for planting for Carnaby's	Growth form	Flower colour	Soil type				Sun exposure			Soil drainage				Origin
	Feeding	Nesting	Roosting				Clayey	Gravelly	Loamy	Sandy	○	◔	◕	Well drained	Poorly drained	Waterlogged	Salt affected	
Banksia quercifolia (Oak-leaved Banksia)	■			Medium	Tall shrub	Brown				■	○						■	WA native
Banksia sessilis (Parrot Bush)	■			High	Tree	Cream		■		■	○	◔		■				WA native
Banksia speciosa (Showy Banksia)	■			High	Tree	Yellow	■			■	○	◔		■				WA native
Banksia squarrosa (Pingle)	■			High	Tall shrub	Yellow	■	■	■	■	○			■				WA native
Banksia tricuspis (Lesueur Banskia or Pine Banksia)	■			Medium	Tree	Orange				■	○	◔		■				WA native
Banksia undata (Urchin or Cut-leaf Dryandra)	■			High	Tall shrub	Yellow	■	■	■	■	○	◔		■				WA native
Banksia verticillata (Granite Banksia)	■			Low	Tree	Yellow			■	■	○	◔		■				WA native
Brassica campestris (Canola, Rape)**	■			Low	Herb	Yellow			■	■	○	◔	●	■				Exotic to Australia
Callistemon viminalis (Captain Cook Bottlebrush)	■			Medium	Tall shrub	Red	■	■	■	■	○			■				Australian native
Callitris sp.	■			Medium	Tree		■		■	■	○			■				WA native
Carya illnoinensis (Pecan)	■			Low	Tree	Yellow			■	■	○	◔		■				Exotic to Australia
Casuarina cunninghamiana (River Sheoak)*	■			Low	Tree	Red	■	■	■	■	○			■	■	■		Australian native
Citrullus lanatus (Pie or Afghan Melon)*	■			Low	Scrambler, climber or percher	Yellow	■	■	■	■	○			■				Exotic to Australia
Corymbia calophylla (Marri)	■	■	■	High	Tree	Cream	■	■	■	■	○	◔		■	■			WA native
Corymbia ficifolia (Red Flowering Gum)	■			Medium	Tree	Red		■	■	■	○			■				WA native
Corymbia haematoxylon (Mountain Marri)	■			Medium	Tree	White				■	○			■				WA native
Corymbia maculata (Spotted Gum)			■	Low	Tree	White		■			○			■				Australian native
Darwinia citriodora (Lemon-scented Darwinia)	■			Low	Medium or small shrub	Red, orange, yellow		■			○	◔		■				WA native
Diospyros sp. (Sweet Persimmon)	■			Low	Tree				■	■	○			■				Exotic to Australia
Eremophila glabra (Tarbush)	■			Low	Tall shrub	Various	■	■	■	■	○	◔		■				WA native
Erodium aureum (Corkscrew Grass or Storksbill)*	■			Low	Herb	Pink			■	■	○			■				Exotic to Australia
Erodium botrys (Corkscrew Grass or Storksbill)*	■			Low	Herb	Purple			■		○			■				Exotic to Australia
Eucalyptus caesia (Silver Princess)	■			Medium	Tree	Pink			■		○			■				WA native
Eucalyptus camaldulensis (River Red Gum)			■	Low	Tree	Cream, yellow	■				○				■	■	■	Australian native
Eucalyptus citriodora (Lemon Scented Gum)	■		■	Medium	Tree	Red		■	■		○			■				Australian native
Eucalyptus diversicolor (Karri)		■		Low	Tree	Cream			■	■	○			■				WA native
Eucalyptus globulus (Tasmaniam Blue Gum)			■	Low	Tree	White	■	■	■		○			■				Australian native
Eucalyptus gomphocephala (Tuart)	■	■	■	High	Tree	White			■	■	○			■				WA native
Eucalyptus grandis (Flooded Gum, Rose Gum)			■	Low	Tree	White, cream	■		■	■	○			■				Australian native
Eucalyptus longicornis (Red Morrell)		■		Low	Tree	White	■		■		○			■				WA native
Eucalyptus loxophleba (York Gum)	■	■		Low	Tree	White		■	■	■	○			■				WA native
Eucalyptus marginata (Jarrah)	■		■	Medium	Tree	White	■	■	■	■	○			■				WA native
Eucalyptus occidentalis (Swamp Yate)		■		Low	Tree	Cream	■		■		○				■	■		WA native
Eucalyptus patens (Blackbutt)	■		■	Medium	Tree	White	■	■	■	■	○			■				WA native
Eucalyptus pleurocarpa (Tallerack)	■			Medium	Tree	White				■	○			■				WA native

Species	Used for			Priority for planting for Carnaby's	Growth form	Flower colour	Soil type				Sun exposure	Soil drainage				Origin
	Feeding	Nesting	Roosting				Clayey	Gravelly	Loamy	Sandy		Well drained	Poorly drained	Waterlogged	Salt affected	
Eucalyptus preissiana (Bell-fruited Mallee)				Medium	Tree	Yellow					○					WA native
Eucalyptus robusta (Swamp Mahogany)				Medium	Tree	White					○					Australian native
Eucalyptus rudis (Flooded Gum)				Low	Tree	White					○					WA native
Eucalyptus salmonophloia (Salmon Gum)				High	Tree	White					○					WA native
Eucalyptus salubris (Gimlet)				Medium	Tree	White, cream					○					WA native
Eucalyptus todtiana (Coastal Blackbutt or Prickley Bark)				Medium	Tree	White					○					WA native
Eucalyptus wandoo (Wandoo)				High	Tree	White					○					WA native
Ficus sp. (Fig)				Low	Tree						○					Australian native
Grevillea armigera (Prickly Toothbrushes)				Medium	Tall shrub	Green, yellow, black					○					WA native
Grevillea bipinnatifida (Fuschia Grevillea)				Medium	Medium or small shrub	Red					○					WA native
Grevillea hookeriana (Red Toothbrushes)				Medium	Tall shrub	Red					○					WA native
Grevillea hookeriana subsp. apiciloba (Black Toothbrushes)				Medium	Medium or small shrub	Black					○					WA native
Grevillea paniculata (Kerosene Bush)				Medium	Tall shrub	White					○					WA native
Grevillea paradoxa (Bottlebrush Grevillea)				Medium	Medium or small shrub	Cream, pink					○					WA native
Grevillea petrophiloides (Pink Poker)				Medium	Tall shrub	Pink					○					WA native
Grevillea robusta (Silky Oak)				Medium	Tree	Orange					○					Australian native
Hakea auriculata				Medium	Tall shrub	White					○					WA native
Hakea candolleana				Medium	Medium or small shrub	White					○					WA native
Hakea circumalata (Coastal Hakea)				Medium	Medium or small shrub	White, pink					○					WA native
Hakea commutata				Medium	Medium or small shrub						○					WA native
Hakea conchifolia				Medium	Medium or small shrub	White, cream, pink					○					WA native
Hakea costata (Ribbed Hakea)				Medium	Medium or small shrub	White					○					WA native
Hakea cristata (Snail Hakea)				Medium	Medium or small shrub	White					○					WA native
Hakea cucullata (Snail Hakea)				Medium	Tall shrub	Pink					○					WA native
Hakea cyclocarpa (Ramshorn)				Medium	Medium or small shrub	White					○					WA native
Hakea eneabba				Medium	Medium or small shrub	Yellow					○					WA native
Hakea erinacea (Hedgehog Hakea)				Medium	Medium or small shrub	Cream					○					WA native
Hakea falcata (Sickle Hakea)				Medium	Tall shrub	White					○					WA native
Hakea flabellifolia (Fan-leaved Hakea)				Medium	Medium or small shrub	Brown					○					WA native
Hakea gilbertii				Medium	Medium or small shrub	White					○					WA native
Hakea incrassata (Golfball or Marble Hakea)				Medium	Medium or small shrub	Cream					○					WA native
Hakea lasiantha (Woolly Flowered Hakea)				Medium	Tall shrub	White					○					WA native
Hakea lasianthoides				Medium	Tall shrub	White										WA native
Hakea laurina (Pin-cushion hakea)				Medium	Tree	Red					○					WA native
Hakea lissocarpha (Honeybush)				Medium	Medium or small shrub	White					○					WA native

Species	Used for			Priority for planting for Carnaby's	Growth form	Flower colour	Soil type				Sun exposure			Soil drainage				Origin
	Feeding	Nesting	Roosting				Clayey	Gravelly	Loamy	Sandy				Well drained	Poorly drained	Waterlogged	Salt affected	
Hakea megalosperma (Lesueur Hakea)				Medium	Medium or small shrub	White, cream, pink, red					○							WA native
Hakea multilineata (Grass Leaf Hakea)				Medium	Tall shrub	Pink					○	◗						WA native
Hakea obliqua (Needles and Corks)				Medium	Tall shrub	White					○							WA native
Hakea oleifolia (Dungyn or Olive-leaved Hakea)				Medium	Tree	White					○							WA native
Hakea pandanicarpa subsp. crassifolia (Thick-leaved Hakea)				Medium	Tall shrub	Cream					○	◗						WA native
Hakea polyanthema				Medium	Medium or small shrub	White					○							WA native
Hakea petiolaris (Sea Urchin Hakea)				Medium	Tall to medium shrub	Cream, pink					○	◗						WA native
Hakea preissii (Needle Tree)				Medium	Tall shrub	Yellow					○							WA native
Hakea prostrata (Harsh Hakea)				High	Tall to mediumshrub	White					○							WA native
Hakea psilorrhyncha				Medium	Tall shrub	Cream					○							WA native
Hakea ruscifolia (Candle Hakea)				Medium	Tall shrub	White					○	◗						WA native
Hakea scoparia (Kangaroo Bush)				Medium	Tall shrub	Cream					○	◗						WA native
Hakea smilacifolia				Medium	Medium or small shrub	White					○							WA native
Hakea spathulata				Medium	Medium or small shrub	Red					○							WA native
Hakea stenocarpa (Narrow-fruited Hakea)				Medium	Medium or small shrub	White					○	◗						WA native
Hakea sulcata (Furrowed Hakea)				Medium	Medium or small shrub	White					○	◗						WA native
Hakea trifurcata (Two-leaved Hakea)				High	Tall shrub	White					○	◗	◗					WA native
Hakea undulata (Wavy-leaved Hakea)				High	Tall shrub	White					○	◗						WA native
Hakea varia (Variable-leaved Hakea)				Medium	Tall shrub	White					○	◗						WA native
Helianthus annuus (Sunflower)*				Low	Herb	Yellow					○							Exotic to Australia
Hibiscus sp. (Hibiscus)				Low	Tall shrub	Various					○	◗	◗					Exotic to Australia
Isopogon scabriusculus				Medium	Medium or small shrub	Pink					○							WA native
Jacaranda mimosifolia (Jacaranda)				Low	Tree	Blue, purple					○	◗						Exotic to Australia
Jacksonia furcellata (Grey Stinkwood)				Medium	Tall shrub	Orange					○	◗						WA native
Lambertia inermis (Chittick)				Medium	Tree	Red, orange, yellow					○	◗						WA native
Lambertia multiflora (Many-flowered Honeysuckle)				Medium	Medium or small shrub	Orange, yellow					○							WA native
Liquidamber styraciflua (Liquid Amber)				Medium	Tree	Green					○	◗						Exotic to Australia
Lupinus sp. (Lupin)*				Low	Herb	Yellow, blue					○							Exotic to Australia
Macadamia integrifolia (Macadamia)				Medium	Tree	White					○							Australian native
Malus domestica (Apple)				Low	Tree	White					○							Exotic to Australia
Melaleuca leuropoma				Medium	Medium or small shrub	Cream, purple, yellow					○							WA native
Melia azedarach (Cape Lilac or White Cedar)**				Low	Tree	Purple					○	◗						Exotic to Australia
Mesomeleana sp.				Medium	Grassy or strappy						○							WA native
Protea repens				Medium	Tree or medium to small shrub	White, cream, pink					○	◗						Exotic to Australia
Protea 'Pink Ice'				Medium	Tree or medium to small shrub	White, cream, pink					○	◗						Exotic to Australia

Species	Used for			Priority for planting for Carnaby's	Growth form	Flower colour	Soil type				Sun exposure	Soil drainage				Origin
	Feeding	Nesting	Roosting				Clayey	Gravelly	Loamy	Sandy		Well drained	Poorly drained	Waterlogged	Salt affected	
Pinus canariensis (Canary Island Pine)				Low	Tree	Brown					O					Exotic to Australia
Pinus caribea (Caribbean Pine)				Low	Tree	Brown					O					Exotic to Australia
Pinus pinaster (Pinaster or Maritime Pine)**				Medium	Tree	Brown					O					Exotic to Australia
Pinus radiata (Radiata Pine)**				Medium	Tree	Brown					O					Exotic to Australia
Prunus amygdalus (Almond Tree)				Medium	Tree						O					Exotic to Australia
Raphanus raphanistrum (Wild Radish)*				Low	Herb	Various					O					Exotic to Australia
Tipuana tipu (Tipu or Rosewood Tree)**				Low	Tree	Yellow					O					Exotic to Australia
Xanthorrhoea preissii (Grass Tree)				Medium	Grassy or strappy	Cream					O					WA native

* Weed

** Potential weed

RPS

APPENDIX 5

Contaminated Sites Basic Summary of Records

Government of **Western Australia**
Department of **Environment Regulation**

Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 2:31:36PM, 09/06/2016

Search Results

This response relates to a search request received for:

Lot 109 On Plan 741
Nambeelup WA 6207

This parcel belongs to a site that contains 2 parcel(s).

According to Department of Environment Regulation records, this land has been reported as a known or suspected contaminated site.

Address	Lot 109 On Plan 741 Nambeelup WA 6207
Lot on Plan Address	Lot 109 On Plan 741
Parcel Status	**Classification:** *19/03/2010 - Contaminated - restricted use* **Nature and Extent of Contamination:** Elevated concentrations of ammonia are present in groundwater beneath the Site. **Restrictions on Use:** The land use of the Site is restricted to the current rural industrial/intensive agricultural land use and similar rural uses. Further assessment of soil and groundwater contamination is required before the land use of the site is changed to a more sensitive land use (e.g. residential development, child care centres). **Reason for Classification:** This Site was reported to the Department of Environment and Conservation (DEC) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003', which commenced on 1 December 2006. The Site classification is based on information submitted to DEC by February 2010. This Site is used as a piggery, compost manufacturing and waste management facility, land uses that have the potential to cause contamination, as specified in the guideline 'Potentially Contaminating Activities, Industries and Landuses' (Department of Environment, 2004). Operations at the facility are regulated under a licence issued under Part V of the 'Environmental Protection Act 1986'. The groundwater and soil beneath the Site have been monitored since 2005, as required by the licence conditions for the Site. The soil investigations found elevated levels of nutrients

Government of **Western Australia**
Department of **Environment Regulation**

Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report Generated at: 2:31:36PM, 09/06/2016

	in the soils on the Site. The groundwater investigations found ammonia concentrations above trigger values for slightly disturbed ecosystems in south west Australia, as published in the 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000). The ammonia concentration at the down gradient boundary of the Site (where groundwater flows from the Site) is substantially lower than near the wastewater treatment plants on the Site, where contamination levels are highest. This suggests natural processes are restricting the migration of contamination and are likely to be decreasing the overall concentration of ammonia on the Site. At the time of classification, the potential contaminants of concern appear to be contained on the Site such that human and environmental receptor exposure is restricted. Periodic monitoring of soil and groundwater quality at the Site is required in accordance with the licence conditions, to assess if there is any movement of contaminants in groundwater at the Site. Based on the available information, the Site appears suitable for continued rural industrial/intensive agricultural land uses, but may not be suitable for sensitive land uses (such as residential development, child care centres). As the Site is suitable for the current landuse, but may not be suitable for a more sensitive landuse, the Site has been classified as 'contaminated - restricted use'. A memorial stating the Site's classification has been placed on the Certificate of Title, and will trigger the need for further investigations and risk assessment should the Site be proposed for a more sensitive land use. DEC, in consultation with Department of Health, has classified this Site based on the information available to DEC at the time of classification. It is acknowledged that the contamination status of the Site may have changed since the information was collated and/or submitted to DEC, and as such, the usefulness of this information may be limited. In accordance with Department of Health advice, if groundwater is being or is proposed to be abstracted, DEC recommends that analytical testing should be carried out to determine whether the groundwater is suitable for its intended use. Under the Contaminated Sites Act 2003, this Site has been classified as "Contaminated - restricted use". For further information on the contamination status of this Site, please contact the Contaminated Sites section of the Department of Environment & Conservation.
Certificate of Title Memorial	
Current Regulatory Notice Issued	**Type of Regulatory Notice:** Nil **Date Issued:** Nil

Government of **Western Australia**
Department of **Environment Regulation**

Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report Generated at: 2:31:36PM, 09/06/2016

General

No other information relating to this parcel.

Government of **Western Australia**
Department of **Environment Regulation**

Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report Generated at: 2:30:49PM, 09/06/2016

Search Results

This response relates to a search request received for:

230 Gull Rd
Nambeelup WA 6207

This parcel belongs to a site that contains 2 parcel(s).

According to Department of Environment Regulation records, this land has been reported as a known or suspected contaminated site.

Address	230 Gull Rd Nambeelup WA 6207
Lot on Plan Address	Lot 89 On Plan 741
Parcel Status	**Classification:** *19/03/2010 - Contaminated - restricted use* **Nature and Extent of Contamination:** Elevated concentrations of ammonia are present in groundwater beneath the Site. **Restrictions on Use:** The land use of the Site is restricted to the current rural industrial/intensive agricultural land use and similar rural uses. Further assessment of soil and groundwater contamination is required before the land use of the site is changed to a more sensitive land use (e.g. residential development, child care centres). **Reason for Classification:** This Site was reported to the Department of Environment and Conservation (DEC) as per reporting obligations under section 11 of the 'Contaminated Sites Act 2003', which commenced on 1 December 2006. The Site classification is based on information submitted to DEC by February 2010. This Site is used as a piggery, compost manufacturing and waste management facility, land uses that have the potential to cause contamination, as specified in the guideline 'Potentially Contaminating Activities, Industries and Landuses' (Department of Environment, 2004). Operations at the facility are regulated under a licence issued under Part V of the 'Environmental Protection Act 1986'. The groundwater and soil beneath the Site have been monitored since 2005, as required by the licence conditions for the Site. The soil investigations found elevated levels of nutrients

Government of Western Australia
Department of Environment Regulation

Contaminated Sites Act 2003
Basic Summary of Records Search Response

Report Generated at: 2:30:49PM, 09/06/2016

in the soils on the Site. The groundwater investigations found ammonia concentrations above trigger values for slightly disturbed ecosystems in south west Australia, as published in the 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality (ANZECC, 2000). The ammonia concentration at the down gradient boundary of the Site (where groundwater flows from the Site) is substantially lower than near the wastewater treatment plants on the Site, where contamination levels are highest. This suggests natural processes are restricting the migration of contamination and are likely to be decreasing the overall concentration of ammonia on the Site.

At the time of classification, the potential contaminants of concern appear to be contained on the Site such that human and environmental receptor exposure is restricted. Periodic monitoring of soil and groundwater quality at the Site is required in accordance with the licence conditions, to assess if there is any movement of contaminants in groundwater at the Site.

Based on the available information, the Site appears suitable for continued rural industrial/intensive agricultural land uses, but may not be suitable for sensitive land uses (such as residential development, child care centres). As the Site is suitable for the current landuse, but may not be suitable for a more sensitive landuse, the Site has been classified as 'contaminated - restricted use'.

A memorial stating the Site's classification has been placed on the Certificate of Title, and will trigger the need for further investigations and risk assessment should the Site be proposed for a more sensitive land use.

DEC, in consultation with Department of Health, has classified this Site based on the information available to DEC at the time of classification. It is acknowledged that the contamination status of the Site may have changed since the information was collated and/or submitted to DEC, and as such, the usefulness of this information may be limited.

In accordance with Department of Health advice, if groundwater is being or is proposed to be abstracted, DEC recommends that analytical testing should be carried out to determine whether the groundwater is suitable for its intended use.

Certificate of Title Memorial

Under the Contaminated Sites Act 2003, this Site has been classified as "Contaminated - restricted use". For further information on the contamination status of this Site, please contact the Contaminated Sites section of the Department of Environment & Conservation.

Current Regulatory Notice Issued

Type of Regulatory Notice: Nil

Date Issued: Nil

Government of **Western Australia**
Department of **Environment Regulation**

Contaminated Sites Act 2003

Basic Summary of Records Search Response

Report Generated at: 2:30:49PM, 09/06/2016

General

No other information relating to this parcel.

RPS

Appendix 3

Certificate of Title

WESTERN AUSTRALIA

REGISTER NUMBER	
600/DP57701	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
1	18/10/2010

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

VOLUME 2753 FOLIO 559

The person described in the first schedule is the registered proprietor of an estate in fee simple in the land described below subject to the reservations, conditions and depth limit contained in the original grant (if a grant issued) and to the limitations, interests, encumbrances and notifications shown in the second schedule.

REGISTRAR OF TITLES

REGISTRAR OF TITLES WESTERN AUSTRALIA

LAND DESCRIPTION:

LOT 600 ON DEPOSITED PLAN 57701

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

WESTERN AUSTRALIAN LAND AUTHORITY OF LEVEL 3, 40 THE ESPLANADE, PERTH
(AF L452034) REGISTERED 13 OCTOBER 2010

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

Warning: A current search of the sketch of the land should be obtained where detail of position, dimensions or area of the lot is required.
* Any entries preceded by an asterisk may not appear on the current edition of the duplicate certificate of title.
Lot as described in the land description may be a lot or location.

----------END OF CERTIFICATE OF TITLE----------

STATEMENTS:

The statements set out below are not intended to be nor should they be relied on as substitutes for inspection of the land and the relevant documents or for local government, legal, surveying or other professional advice.

SKETCH OF LAND:	DP57701 [SHEET 1].
PREVIOUS TITLE:	1142-24.
PROPERTY STREET ADDRESS:	NO STREET ADDRESS INFORMATION AVAILABLE.
LOCAL GOVERNMENT AREA:	SHIRE OF MURRAY.
RESPONSIBLE AGENCY:	WESTERN AUSTRALIAN LAND AUTHORITY.

VER.	AMENDMENT	AUTHORISED BY	DATE
2	AUDIT REQUIREMENTS	FUGRO	8/10/2008

ENLARGEMENT
SCALE 1:1500

INTERESTS AND NOTIFICATIONS

SUBJECT	PURPOSE	STATUTORY REFERENCE	ORIGIN	LAND BURDENED	BENEFIT TO	COMMENTS

TYPE FREEHOLD

PURPOSE SUBDIVISION

PLAN OF

LOT 600 AND
ROAD WIDENING

DP 57701 (01)

SSA NO

DISTRICT COCKBURN SOUND DPI FILE

TOWNSITE

LOCALITY STAKE HILL

LOCAL AUTHORITY SHIRE OF MURRAY

FORMER TENURE	ON	FIELD BOOK
LOT 91 ON P 741(3) C/T 1142-24	INDEX BG33(10) 03.01	104347

SCALE: 1:7500 AT A3 SIZE
ALL DISTANCES ARE IN METRES
0 100 200 300 400 500

SURVEYOR'S CERTIFICATE - Reg 54
N. A. BARLETT
I hereby certify that this plan is accurate and is a correct representation of the -
(a) * survey, and/or (* delete if applicable)
(b) * calculations from measurements,
undertaken for the purposes of this plan and that it complies with the relevant written law(s) in relation to which it is lodged.
Licensed Surveyor 05/09/2008 Date

SURVEYOR'S CERTIFICATE - Compiled
I
hereby certify that this compiled plan
(a) is a correct and accurate representation of the survey(s) of the subject land, and
(b) is in accordance with the relevant law in relation to which it is lodged.
Licensed Surveyor Date

LODGED
DATE 8-Sep-08
FEE PAID
$251.00
ASSESS No.
4273272

TYPE OF VALIDATION
FULL AUDIT
LEGAL COMPONENT RF
DOCKET 01678-2005/05
CERTIFIED CORRECT 10.10.08
LS.C.
F.S.C.

FUGRO SPATIAL SOLUTIONS Pty. Ltd.
19 PROWSE STREET
WEST PERTH, W.A., 6005
TEL. (08) 9322 4955
FAX. (08) 9322 1775
PLAN No. 67/18961-1 Rev 1

IN ORDER FOR DEALINGS
SUBJECT TO
Sec 168(3) of the P&D Act

APPROVED BY
WESTERN AUSTRALIAN PLANNING COMMISSION
FILE 135967
DELEGATED UNDER S16 P & D ACT 2005
DATE 14/10/2008

17-10-08
FOR INSPECTOR OF PLANS & SURVEYS AUTHORISED LAND OFFICER DATE

APPROVED
13-10-2010
INSPECTOR OF PLANS & SURVEYS AUTHORISED LAND OFFICER DATE

Landgate
Western Australian Land Information Authority

DEPOSITED PLAN
57701
ORIGINAL
SHEET 1 OF 1
VERSION 2