Amendment No. 5

to the

Barfield Road Local Structure Plan (SPN/0467)

The Amendment to the Barfield Road Local Structure Plan (SPN/0467) has been prepared under the provisions of the City of Cockburn Town Planning Scheme No. 3

The Amendment has been prepared by RobertsDay on behalf of the landowners, care of Richard Noble & Company.

Prepared: June 2019

RobertsDay planning·design·place

RICHARDNOBLE PROPERTY INTEGRITY COMMUNITY

Endorsement Page

It is certified that Amendment No. 5 to the Barfield Road Local Structure Plan was approved by resolution of the Western Australian Planning Commission on:

_____

Date

Signed for and on behalf of the Western Australian Planning Commission

_____

an Officer of the Commission duly authorised by the Commission pursuant to Section 16 of the *Planning and Development Act 2005* for that purpose.

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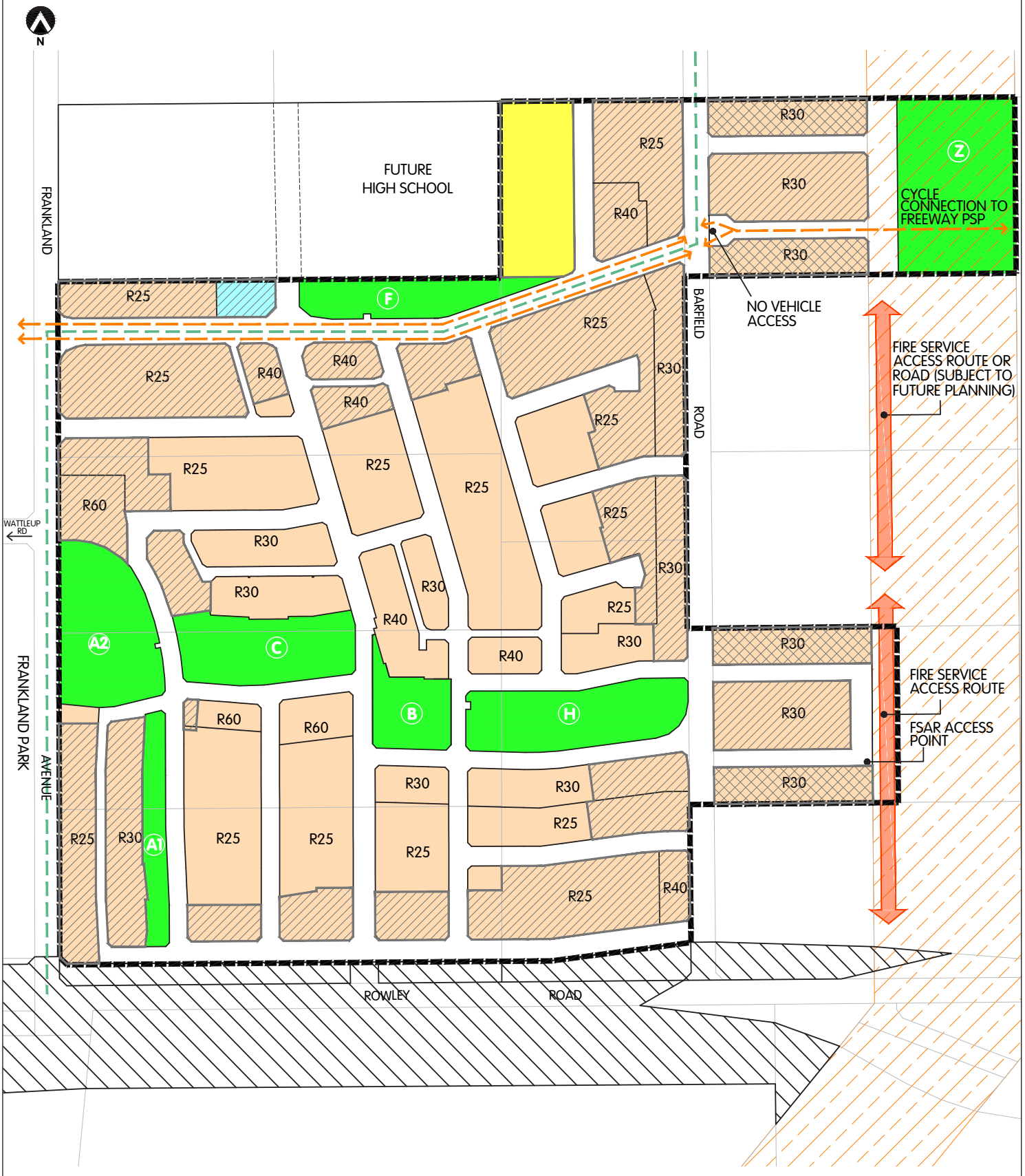
01 Proposed Changes

Amendment No. 5 to the Barfield Road Local Structure Plan

The City of Cockburn, pursuant to its Town Planning Scheme No. 3, hereby amends the above Structure Plan by:

PART	SECTION	PROPOSED MODIFICATION
PART ONE	Heading	Update heading to replace 'Statutory Section' with 'Implementation'
	2.0 Structure Plan Content	Update third dot point to replace 'Statutory Section' with 'Implementation'
	5.0 Relationship with Local Planning Scheme	Delete provision (a)
	7.1.1 Notifications on Title	Update sentence to include reference to latest Bushfire Management Plan
	7.2.1.iii Detailed Area Plans	Update paragraph to include refence to latest Bushfire Management Plan
	Plan 1	Update Plan 1 to reflect modified Structure Plan map, including following specific modifications: 1. Change density code from 'R30' to 'R60' for small residential cell south of POS C 2. Change Structure Plan boundary to the extend east of Barfield Road, to include Lot 15 for Residential development and Lot 37 for Parks and Recreation 3. Change to design layout for Lot 18, including the addition of a portion of Lot 40 for Fire Service Access Route 4. Removal of hatching for land no longer subject to 'Flame Zone' classification
PART TWO	1.1 Introduction and Purpose	Update first paragraph to include all lots now subject to Structure Plan
	1.2.2 Area and land use	Update to include new total area for Structure Plan area, including additions made in this amendment
	Figure 1 Location Plan	Update to reflect revised subject area made in this amendment
	Figure 2 Context Plan	Update to reflect revised subject area made in this amendment

PART	SECTION	PROPOSED MODIFICATION
	Table 1 Lot Details and Ownership Summary	Update to reflect lot additions made in this amendment
	Figure 3 Site Plan	Update to reflect lot additions made in this amendment
	Figure 4 MRS Zoning	Update to reflect revised subject area made in this amendment
	Figure 5 TPS Zoning	Update to reflect revised subject area made in this amendment
	Figure 6 Vegetation Condition	Update to reflect revised subject area made in this amendment
	Figure 7 Contour Plan	Update to reflect revised subject area made in this amendment
	2.5.1 Western Power Easement	Update paragraph to reflect current context of Western Power easement in relation to proposed LSP design made in the amendment
	Figure 8 Context and Constraints Plan	Update to reflect revised subject area made in this amendment
	Figure 9 Local Structure Plan	Update to reflect modified LSP map
	Table 2 Local Structure Plan Summary Table	Update proposed figures to reflect changes made in this amendment
	Figure 10 Residential Density Plan	Update to reflect density changes made in this amendment
	Table 3 Density Target Summary	Update proposed figures for both Directions 2031 and Liveable Neighbourhoods
	Figure 11 Movement Network Plan	Update to reflect movement network changes made in this amendment
	Figure 13 Cycle/ Footpath and Public Transport Plan	Update to reflect changes made in this amendment
	3.5 Open Space	Update paragraph 4 to reflect proposed POS figures made in this amendment
	Table 5 Public Open Space Calculations	Update POS figures to reflect changes made in this amendment
	Table 6 Public Open Space Schedule	Update POS figures to reflect changes made in this amendment
	Figure 14 Public Open Space	Update to reflect changes made in this amendment
	Figure 15 Staging Plan	Update to reflect changes made in this amendment
	4.1 Staging	Update paragraph to replace 'Figure 16' with 'Figure 15'



LEGEND

STRUCTURE PLAN BOUNDARY

ZONES
- RESIDENTIAL
- LOCAL CENTRE

RESERVES
- PARKS AND RECREATION
- PUBLIC PURPOSE

OTHER ELEMENTS THAT INFORM THE LSP
- R25 RESIDENTIAL DENSITY CODE
- PROPOSED BUS ROUTE
- DISTRICT CYCLE CONNECTION
- WESTERN POWER EASEMENT
- PLANNING CONTROL AREA No. 112
- LAND WITHIN FLAME ZONE NOT CAPABLE OF BEING DEVELOPED UNTIL ADJOINING BUSH FIRE HAZARD REMOVED
- DEVELOPMENT SUBJECT TO DWELLING CONSTRUCTION UNDER AS3959-2009

CADASTRAL INFORMATION
SOURCE: McMULLEN NOLAN
YYMMDD: 140501
DWG REF: 96236
PROJECTION: PCG 94

AERIAL PHOTOGRAPHY
SOURCE: NA
YYMMDD: NA

great places

0 metres 30 60 90 120 150

SIZE A3_ 1:3000

REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
K	NOTE WESTERN POWER	190619	SB	EH
J	UPDATE PER RD1 150D	190510	SB	ED
I	STRUCTURE PLAN UPDATE	190417	HH	EH
H	MINOR BOUNDARY ADJUST	181001	ED	-
G	ALIGN R30	180927	ED	-

BARFIELD ROAD STRUCTURE PLAN
Lots 13-14, 18 & 47-51 Hammond park
City of Cockburn

REF NO.	DRAW NO.	REV.
RIC HAM	**RD1 045**	**K**

PLAN 1: UPDATED LSP MAP

DISCLAIMER: ISSUED FOR DESIGN INTENT ONLY. ALL AREAS AND DIMENSIONS ARE SUBJECT TO DETAIL DESIGN AND SURVEY

02 Explanatory Report

2.1 BACKGROUND

RobertsDay acts on behalf of Gold Estates Holdings Pty Ltd c/- Richard Noble & Company in submitting this application to modify the approved Barfield Road Local Structure Plan (SPN/0467). The Barfield Road LSP establishes the planning framework for the Vivente Residential Estate, which is being developed by our Client.

The Barfield Road LSP was first approved by Council on 14 November 2013 (prior to the introduction of the Deemed Provisions to Local Planning Schemes) and has since been subject to four minor amendments, as outlined below:

1. 16 October 2014 – change to location of Local Centre zone and tweaks to road layout.
2. 16 October 2015 – removal of unnecessary road connection to Wattleup Road
3. 9 March 2017 – upcoding of grouped housing site in west from R25 to R60
4. 29 June 2018 – updates to density codes and tweaks to road layout (cul-de-sacing two east-west streets)

The purpose of this application is to propose a fifth minor amendment to the Barfield Road LSP. The proposed amendment seeks to modify the Barfield Road LSP in accordance with the enclosed Comparison Plan (Drawing Ref: RIC HAM RD1 045J) and relates to four key areas.

2.2 PROPOSAL CONTEXT

On this occasion, the trigger for an amendment to the Barfield Road LSP comes from our Client's acquisition of new landholdings, Lots 15 and 37. A design has been prepared for the new landholdings, and in doing so it was timely to also review the design of the remaining unconstructed stages of the LSP area.

This amendment to modify the Barfield Road LSP has been prepared with consideration of:

- Optimising design from a land efficiency point of view
- Striking a balance between housing diversity and market preference for freehold lots over strata
- Market performance of the earlier stages of Vivente Residential Estate

The change to the expected dwelling yield compared to previous amendments is negligible and as such will not have a material impact on the objectives of the Structure Plan.

2.3 MODIFICATIONS

2.3.1 Modification 1

Modification 1 is a simple density code change from R30 to R60 for a small residential cell fronting Parco Glade and POS C. The cell being modified was previously planned as a grouped housing site. The proposed upcoding achieves the following outcomes:

- Responding to the decline in investor activity around grouped housing sites
- Introducing additional compact freehold lots that cater to the needs of smaller household structures (i.e. single persons, couples with no children, single parents)
- Providing housing choice and diversity

2.3.2 Modification 2 & 3

It is proposed to introduce new landholdings into the Barfield Road Structure Plan area. These new landholdings include, Lot 15, Lot 37 and a portion of Lot 40.

It is also proposed to modify the design over an existing portion of the Barfield Road Structure Plan area east of Barfield Road (Lot 18).

The designs and density codes as they relate to proposed modification 2 and 3 are consistent with the overall design of the broader Barfield Road LSP area.

2.3.3 Modification 4

Modification 4 is a simple change brought about by the commencement of construction for the high school abutting the northern boundary of the Barfield Road LSP. Land within the Structure Plan area was previously classified as Flame Zone due to the bushfire hazard posed by the vegetation abutting the site. Since the commencement of construction of the high school, the vegetation has been cleared and the bushfire threat removed. As such, the Flame Zone classification can be removed.

2.4 WESTERN POWER EASEMENT

There is a Western Power high-voltage power line, and associated easement, that runs in a north-south direction through the eastern portion of the Barfield Road LSP area. In accordance with land use restrictions associated with power infrastructure easements, the only uses proposed within the affected land are Parks and Recreation reserve (for which we will not be seeking a POS credit) and a fire emergency services access route.

2.5 PUBLIC OPEN SPACE

The latest approved version of the Barfield Road LSP provides 3.9076ha of public open space (POS), equating to 11.5% of the total gross subdivisible area. This represents an over provision on 0.746ha when assessed against the requirement for 10% POS.

The proposed modifications to the Barfield Road LSP involve an additional 3.8872ha of total net site area (Lots 15, 37 and a portion Lot 40) being added to the Structure Plan area. The classification of 2.0222ha of this land as a deduction from the gross subdivisible area due to land use constraints associated with a Western Power easement, and the original aforementioned POS over provision, mean that the modified Barfield Road LSP is still able to achieve the 10% POS requirement.

The proposed modification to the Barfield Road LSP identifies a new area of Parks and Recreation, POS Z, within Lot 37. It is noted that this area of Parks and Recreation is constrained by the Western Power easement for high-voltage power lines and as such we will not be seeking a POS credit for this portion of open space.

The table enclosed under Appendix 4 details revised POS calculations as they relate to the proposed modification to the Barfield Road LSP.

2.6 DISTRICT CYCLE CONNECTION

The addition of Lots 15 and 37 into the Barfield Road LSP area provides an opportunity to complete an extension of Whadjuk Drive to the Kwinana Freeway. Whadjuk Drive, including its on-road cycle lanes to the Principal Share Path (PSP) along the Kwinana Freeway, is becoming an important east-west connection for the broader district catchment.

The extension of Whadjuk Drive to Kwinana Freeway will plug a gap in the district cycle network by providing an additional east-west link to the PSP, logically located half way between two existing access points, being Gaebler Road 700m to the north and Rowley Road 600m to the south.

The opportunity to complete the Whadjuk Drive cycle link extension to the Kwinana Freeway PSP would benefit not only the planned and constructed dwellings of the Barfield Road LSP, but also the almost 2,300 dwellings in the East Wattleup Primary School catchment plus the Hammond Park High School, which is currently being constructed directly west of the proposed connection.

2.7 OVERALL DWELLING YIELD

The original approved dwelling yield estimate for the approved Barfield Road LSP is 479 dwellings. With the changes outlined above, our design estimates indicated that the overall yield will not be materially impacted by the proposed amendment. Although some yield may be lost by the removal of some grouped housing sites, additional yield has been gained through design efficiencies and density changes for freehold lots.

It is anticipated that final dwelling yields for the estate will be in the range of 470 – 490 dwellings.

2.8 OTHER CONSIDERATIONS

We have reviewed the supporting documents in preparing this application and submit:

- Given the overall dwelling yield generally accords with the original design, this is amendment is not expected to materially impact the way in which traffic flows perform and will not have any undue impact on the external road network. A revised Transport Impact Assessment, authored by KCTT (June 2019), has been prepared to capture the revised design.
- The Bushfire Management Plan has been revised to incorporate the latest Barfield Road LSP design, including the new LSP areas and amended design over existing LSP areas.
- Strategen have prepared a detailed report with a Native Vegetation Clearing Permit and supporting documentation for Lot 15.

None of the other technical documents contained within the original Barfield Road LSP warrant updating as a result of these proposed minor amendment.

2.9 SUMMARY

This proposal to modify the Barfield Road LSP warrants support from the City of Cockburn and the Department of Planning, Lands and Heritage for the following reasons:

1. The inclusion of additional landholdings within the Barfield Road LSP will ensure orderly and proper planning for a greater portion of land within the Hammond Park area.
2. The proposed modification is able to achieve the requirement for 10% POS provision
3. The proposed design of the additional and modified areas is in keeping with the planned and constructed portions of the existing Barfield Road LSP.
4. The proposed modifications will not have a material impact on the overall dwelling yield for the estate.

03 Attachments

Supporting Attachments

Attachment 1_ Barfield Road Updated LSP map

Attachment 2_ LSP Comparison Map

Attachment 3_ Illustrative Masterplan

Attachment 4_Public Open Space Calculations Table

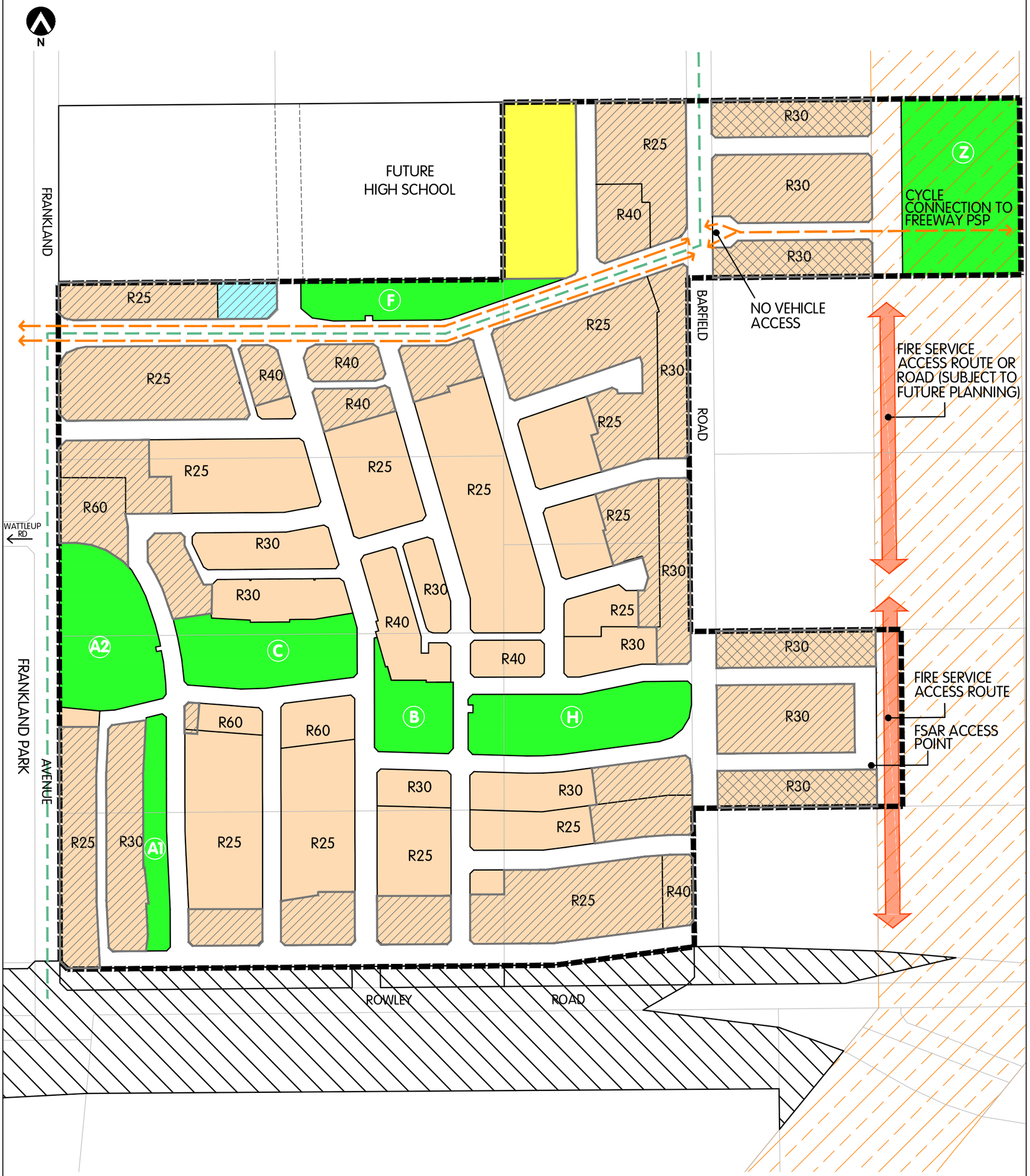
Attachment 5_ Addendum to Bushfire Management Plan

Attachment 6_ Revised Transport Impact Assessment

Attachment 7_ Lot 15 Native Vegetation Clearing Permit

Attachment

01 Barfield Road Updated LSP map



LEGEND

STRUCTURE PLAN BOUNDARY

ZONES
- RESIDENTIAL
- LOCAL CENTRE

RESERVES
- PARKS AND RECREATION
- PUBLIC PURPOSE

OTHER ELEMENTS THAT INFORM THE LSP
- R25 RESIDENTIAL DENSITY CODE
- PROPOSED BUS ROUTE
- DISTRICT CYCLE CONNECTION
- WESTERN POWER EASEMENT
- PLANNING CONTROL AREA No. 112
- LAND WITHIN FLAME ZONE NOT CAPABLE OF BEING DEVELOPED UNTIL ADJOINING BUSH FIRE HAZARD REMOVED
- DEVELOPMENT SUBJECT TO DWELLING CONSTRUCTION UNDER AS3959-2009

CADASTRAL INFORMATION
SOURCE: McMULLEN NOLAN
YYMMDD: 140501
DWG REF: 96236
PROJECTION: PCG 94

AERIAL PHOTOGRAPHY
SOURCE: NA
YYMMDD: NA

RD great places

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REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
K	NOTE WESTERN POWER	190619	SB	EH
J	UPDATE PER RD1 150D	190510	SB	ED
I	STRUCTURE PLAN UPDATE	190417	HH	EH
H	MINOR BOUNDARY ADJUST	181001	ED	-
G	ALIGN R30	180927	ED	-

BARFIELD ROAD STRUCTURE PLAN
Lots 13-14, 18 & 47-51 Hammond park
City of Cockburn

REF NO.	DRAW NO.	REV.
RIC HAM	**RD1 045**	**K**

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Attachment

02 LSP Comparison Map





ENDORSED LOCAL STRUCTURE PLAN

LEGEND

STRUCTURE PLAN BOUNDARY

ZONES
- RESIDENTIAL
- LOCAL CENTRE

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- PUBLIC PURPOSE

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- R25 RESIDENTIAL DENSITY CODE
- PROPOSED BUS ROUTE
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- PLANNING CONTROL AREA No. 112
- LAND WITHIN FLAME ZONE NOT CAPABLE OF BEING DEVELOPED UNTIL ADJOINING BUSH FIRE HAZARD REMOVED
- DEVELOPMENT SUBJECT TO DWELLING CONSTRUCTION UNDER AS3959-2009

MODIFIED LOCAL STRUCTURE PLAN

STRUCTURE PLAN MODIFICATIONS

1. CHANGE FROM R30 TO R60
2. ADD IN LOT 15 FOR RESIDENTIAL DEVELOPMENT; ADD IN LOT 37 FOR PARKS AND RECREATION
3. CHANGE TO DESIGN LAYOUT OF LOT 18; ADD IN PORTION OF LOT 40 FOR FSAR
4. LAND NO LONGER SUBJECT TO FLAME ZONE

CADASTRAL INFORMATION
SOURCE: McMULLEN NOLAN
YYMMDD: 140501
DWG REF: 96236
PROJECTION: PCG 94

AERIAL PHOTOGRAPHY
SOURCE: NA
YYMMDD: NA

great places

SIZE A3_ 1:5000

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REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
K	NOTE WESTERN POWER	190619	SB	EH
J	UPDATE PER RD1 150D	190510	SB	ED
I	STRUCTURE PLAN UPDATE	190417	HH	EH
H	MINOR BOUNDARY ADJUST	181001	ED	-
G	ALIGN R30	180927	ED	-

EXISTING AND MODIFIED LOCAL STRUCTURE PLAN COMPARISON

Lots 13-14, 18 & 47-51 Hammond park

City of Cockburn

REF NO.	DRAW NO.	REV.
RIC HAM	**RD1 045**	**K**

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Attachment

03 Illustrative Masterplan

N



great places

SIZE A3_ 1:4000

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REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
A	BASE PLAN	190624	SB	-

BARFIELD ROAD ILLUSTRATIVE MASTERPLAN

Lots 13-14, 18 & 47-51 Hammond Park

City of Cockburn

REF NO.	DRAW NO.	REV.
RIC HAM	**RD3 030**	**A**

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Attachment

04 Public Open Space Calculations Table

Public Open Space Calculations Table

Total Net Site Area				**37.4036**
Deductions				
Land use / Reserves				
Rowley Road Planning Control Area	0.9320			
Local Centre	0.1511			
High School Site	0.9081			
Western Power high voltage line easement (Lot 37 & portion Lot 40)	2.0222			
sub-total		4.0134		
Infrastructure / drainage				
POS C (1in1yr event)	0.0830			
POS F (1in1yr event)	0.1134			
POS H (1in1yr event)	0.0606			
sub-total		0.2570		
Total Deductions			**4.2704**	
Gross Subdivisible Area (total area minus deductions)				**33.1332**
Required POS				
May comprise max 20% restricted POS			0.6627	
May comprise min 80% unrestricted POS			2.6507	
10% POS Requirement				**3.3133**
Breakdown of POS Provided		**(top of water drainage calculations)**		
Public Open Space and Function	**Total**	**1in1yr (Deduction)**	**1in5yr - 1in1yr (Restricted)**	**POS contribution**
POS A1	0.3509			0.3509
POS A2	0.9897			0.9897
POS B	0.3983			0.3983
POS C	0.7743	0.0830	0.0716	0.6197
POS F	0.5379	0.1134	0.0460	0.3785
POS H	0.8829	0.0606	0.0442	0.7781
sub-total	3.9340	0.2570	0.1618	3.5152
Total restricted POS				0.1618
Total unrestricted POS				3.3534
Total Public Open Space Provision				**3.5152**
Total Public Open Space Provision (%)				**10.6%**

Attachment

05 Addendum to Bushfire Management Plan

FPA AUSTRALIA | Fire Protection Association Australia | Life. Property. Environment.

BPAD Bushfire Planning & Design

Bushfire Management Plan Coversheet

This Coversheet and accompanying Bushfire Management Plan has been prepared and issued by a person accredited by Fire Protection Association Australia under the Bushfire Planning and Design (BPAD) Accreditation Scheme.

Bushfire Management Plan and Site Details

Site Address / Plan Reference: Vivente Estate Structure Plan Amendment, including Stages 9 & 10

Suburb: Hammond Park **State:** WA **P/code:** 6164

Local government area: City of Cockburn

Description of the planning proposal: Structure Plan Amendment

BMP Plan / Reference Number: RDP19149.01 **Version:** R001 Rev 0 **Date of Issue:** 20/06/2019

Client / Business Name: Gold Estates Holdings Pty Ltd

Reason for referral to DFES	Yes	No
Has the BAL been calculated by a method other than method 1 as outlined in AS3959 (tick no if AS3959 method 1 has been used to calculate the BAL)?	☐	☒
Have any of the bushfire protection criteria elements been addressed through the use of a performance principle (tick no if only acceptable solutions have been used to address all of the BPC elements)?	☐	☒
Is the proposal any of the following special development types (see SPP 3.7 for definitions)?		
Unavoidable development (in BAL-40 or BAL-FZ)	☐	☒
Strategic planning proposal (including rezoning applications)	☒	☐
Minor development (in BAL-40 or BAL-FZ)	☐	☒
High risk land-use	☐	☒
Vulnerable land-use	☐	☒

If the development is a special development type as listed above, explain why the proposal is considered to be one of the above listed classifications (E.g. considered vulnerable land-use as the development is for accommodation of the elderly, etc.)?

Structure Plan Amendment

Note: The decision maker (e.g. local government or the WAPC) should only refer the proposal to DFES for comment if one (or more) of the above answers are ticked "Yes".

BPAD Accredited Practitioner Details and Declaration

Name
Zac Cockerill

Accreditation Level
Level 2

Accreditation No.
BPAD 37803

Accreditation Expiry
31/08/2019

Company
Strategen Environmental

Contact No.
(08) 9792 4797

I declare that the information provided within this bushfire management plan is to the best of my knowledge true and correct

Signature of Practitioner

Date 20/06/2019



intelligent outcomes | respected experience

Bushfire Management Plan

Vivente Estate Structure Plan Amendment, including Stages 9 and 10

Prepared for
Gold Estates Holdings Pty Ltd
by Strategen

June 2019

BPAD Bushfire Planning & Design Accredited Practitioner Level 2

strategen ENVIRONMENTAL

Bushfire Management Plan

Vivente Estate Structure Plan Amendment, including Stages 9 and 10

Strategen is a trading name of
Strategen Environmental Consultants Pty Ltd
Level 1, 50 Subiaco Square Road Subiaco WA 6008
ACN: 056 190 419

June 2019

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consultants Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

Document control

Client: Gold Estates Holdings Pty Ltd

Report Version	Revision No.	Purpose	Strategen author	Strategen reviewer	Submitted to Client	
					Form	Date
Draft Report	Rev A	For client review	Louisa Robertson (BPAD 36748, Level 1)	Zac Cockerill (BPAD 37803, Level 2)	Electronic (email)	12/06/2019
Final Report	**Rev 0**	**For client review**	**Louisa Robertson (BPAD 36748, Level 1)**	**Zac Cockerill (BPAD 37803, Level 2)**	**Electronic (email)**	**20/06/2019**

Filename: RDP19149_01 R001 Rev 0 - 20 June 2019

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1. Proposal details

1.1 Background

Roberts Day, on behalf of Gold Estates Holdings Pty Ltd, is seeking to lodge a Structure Plan amendment to the endorsed Structure Plan over the Barfield Road area in Hammond Park, known as Vivente Estate. The Structure Plan amendment is primarily associated with Stages 9 and 10 of the development situated east of Barfield Road; however, administrative changes are also proposed for three additional development cells located west of Barfield Road. The administrative changes to these cells do not involve modification of development boundaries or an increase in bushfire risk in comparison to the endorsed Structure Plan.

Designs for the endorsed Structure Plan and proposed amendment are compared in Figure 1 and identify five cells that are the subject of the proposed amendment (the project area). The proposed amendments are explained as follows:

- the proposed layout of development within Lot 18/Stage 9 has been revised and a portion of adjacent Lot 40 has also been included within this stage to accommodate a fire service access route (FSAR) or future road
- Stage 10 has been added to the Structure Plan area which includes proposed development of Lot 15 and proposed POS within adjacent Lot 37 for the purposes of Parks and Recreation (along with proposed clearing and earthworks within Lot 37)
- the existing carpark central to the site is proposed to be changed from R30 to R60
- the BAL-FZ ratings applicable to two development cells in the northwest of the Structure Plan area have now been removed through clearing carried out to facilitate residential development to the north of the project area and for the development of the school site (lots within these cells have already been created under approved subdivision WAPC Ref No. 1429269 dated 17 December 2014).

The project area is located within the municipality of the City of Cockburn.

1.2 Site description

The overall Vivente Estate site is bound to the south by Rowley Road; to the west by Frankland Avenue; to the north by future residential development and a school site; and to the west by fully-vegetated lots situated east of Barfield Road.

The five cells which make up the project area, and the surrounding environment are depicted in Figure 2.

The three cells located within the existing Vivente Estate area to the west of Barfield Road are predominantly surrounded by existing residential development, land cleared and managed in a low threat state for future residential development and a school site, low threat landscaping, and Public Open Space (POS) managed in accordance with the adopted Bushfire Management Plan prepared to support the original Structure Plan (Strategen 2015).

The Stage 9 and 10 cells, situated east of Barfield Road, are currently bordered to the north, east and south by banksia—sheoak low woodland vegetation. A Western Power high voltage powerline corridor runs parallel to the eastern boundaries of Lots 15 and 18, being partially incorporated into Stage 9 to accommodate the FSAR/road, and into Stage 10 to accommodate the Parks and Recreation Reserve.

The potential FSAR has been included within Stage 9 as part of a future design where the FSAR will connect within the public road network within Stage 10, or alternatively, a public road will be constructed south from Rowley Road, through Lots 41, 49, 39 and 38 to join with the Stage 10 area (Lot 37).

The project area is designated as bushfire prone on the *Map of Bush Fire Prone Areas* (DFES 2019; see Plate 1).

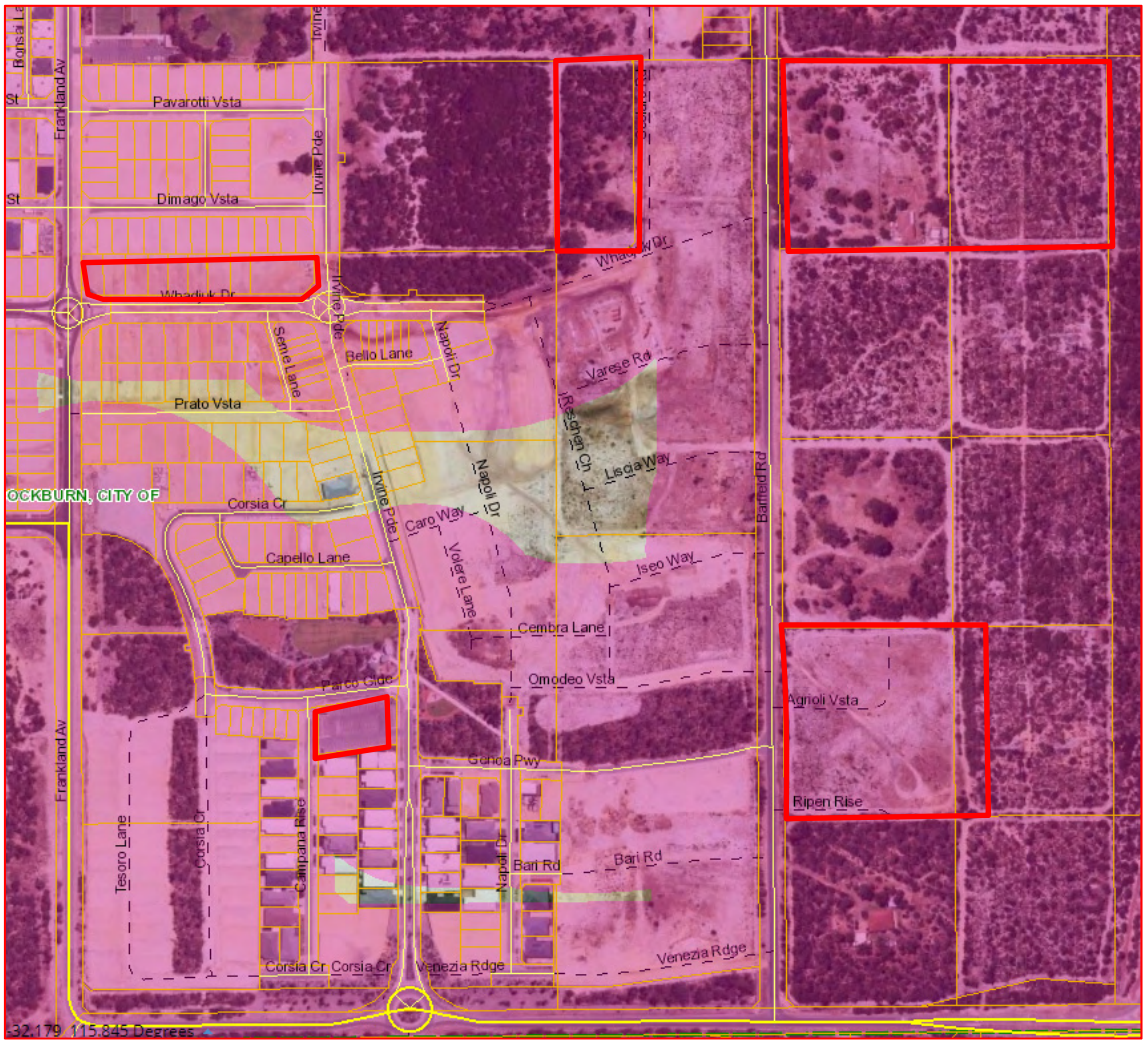


Plate 1: Map of Bush Fire Prone Areas (DFES 2019)

1.3 Purpose

This Bushfire Management Plan (BMP) has been prepared to address requirements under Policy Measure 6.3 of *State Planning Policy 3.7 Planning in Bushfire-Prone Areas* (SPP 3.7; WAPC 2015) and *Guidelines for Planning in Bushfire-Prone Areas* (the Guidelines; WAPC 2017).

1.4 Other plans/reports

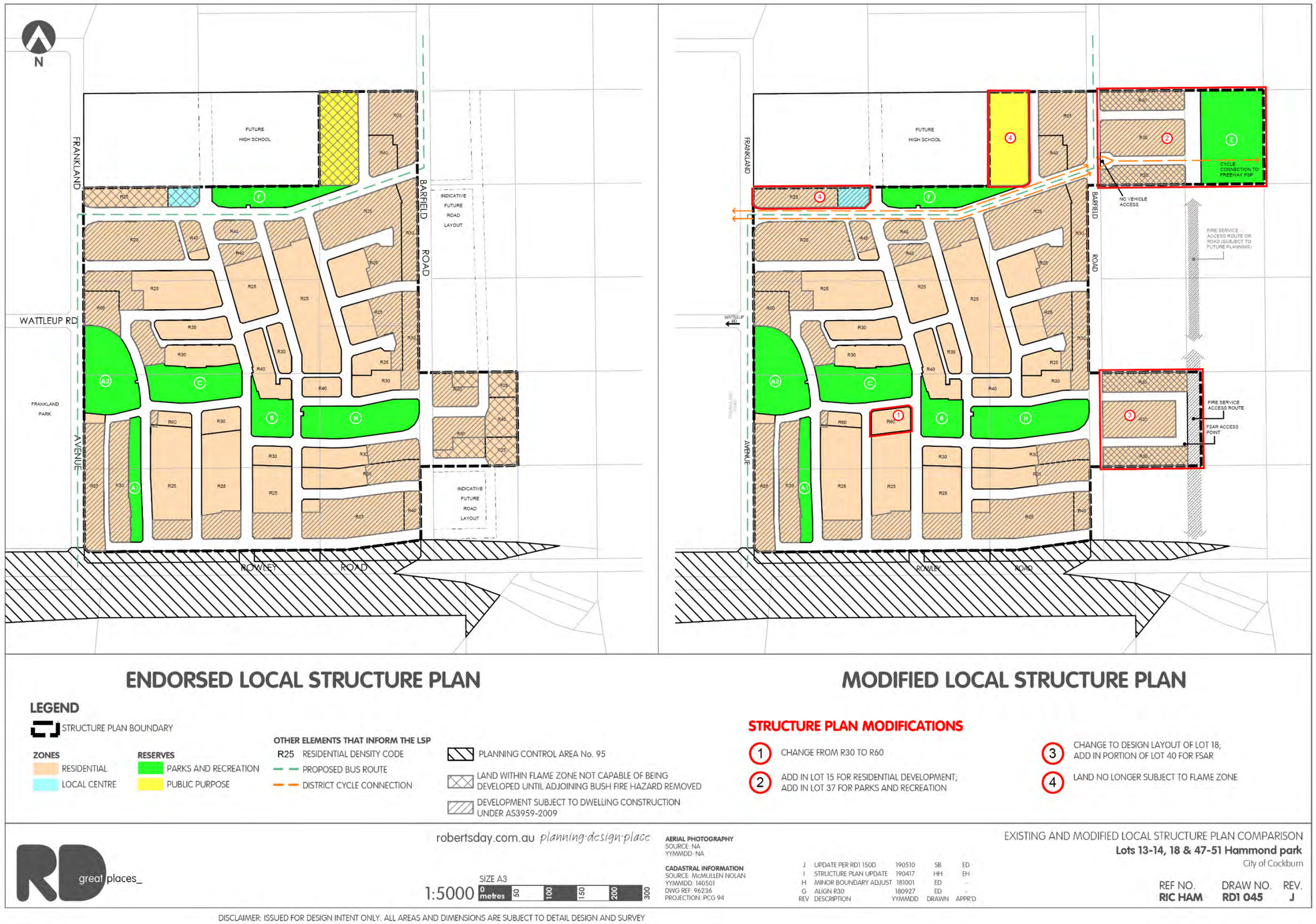
Fire Management Plan, Barfield Road Local Structure Plan (Strategen, 2015)

The 2015 Fire Management Plan (FMP) was prepared to support the original Local Structure Plan (LSP) over Vivente Estate and has been subsequently used to support various subdivision applications within the LSP area.

In consultation and agreement with City of Cockburn and DFES officers, the FMP excluded all vegetation within the central east-west POS corridor as low threat vegetation in acknowledgement of the fragmented, small pockets of low fuel carrying banksia that would not warrant full BAL application in accordance with AS 3959 Method 1. This approach was further supported by commitments outlined in the FMP regarding ongoing management of the vegetation in a low fuel state and application of precautionary BAL-12.5 ratings on a number of lots with direct frontage to the POS cells. This strategy was deemed adequate in terms of addressing bushfire risk to future dwellings and supported by the relevant decision makers at the time the Structure Plan was endorsed. To achieve consistency with this approach, and in acknowledgement that the amendments to the previously endorsed Structure Plan in these areas are largely administrative, this current BMP aims to align with the previously endorsed bushfire management strategies applicable to the approved Structure Plan area.

Clearing Permit Decision Report (DWER, 2018)

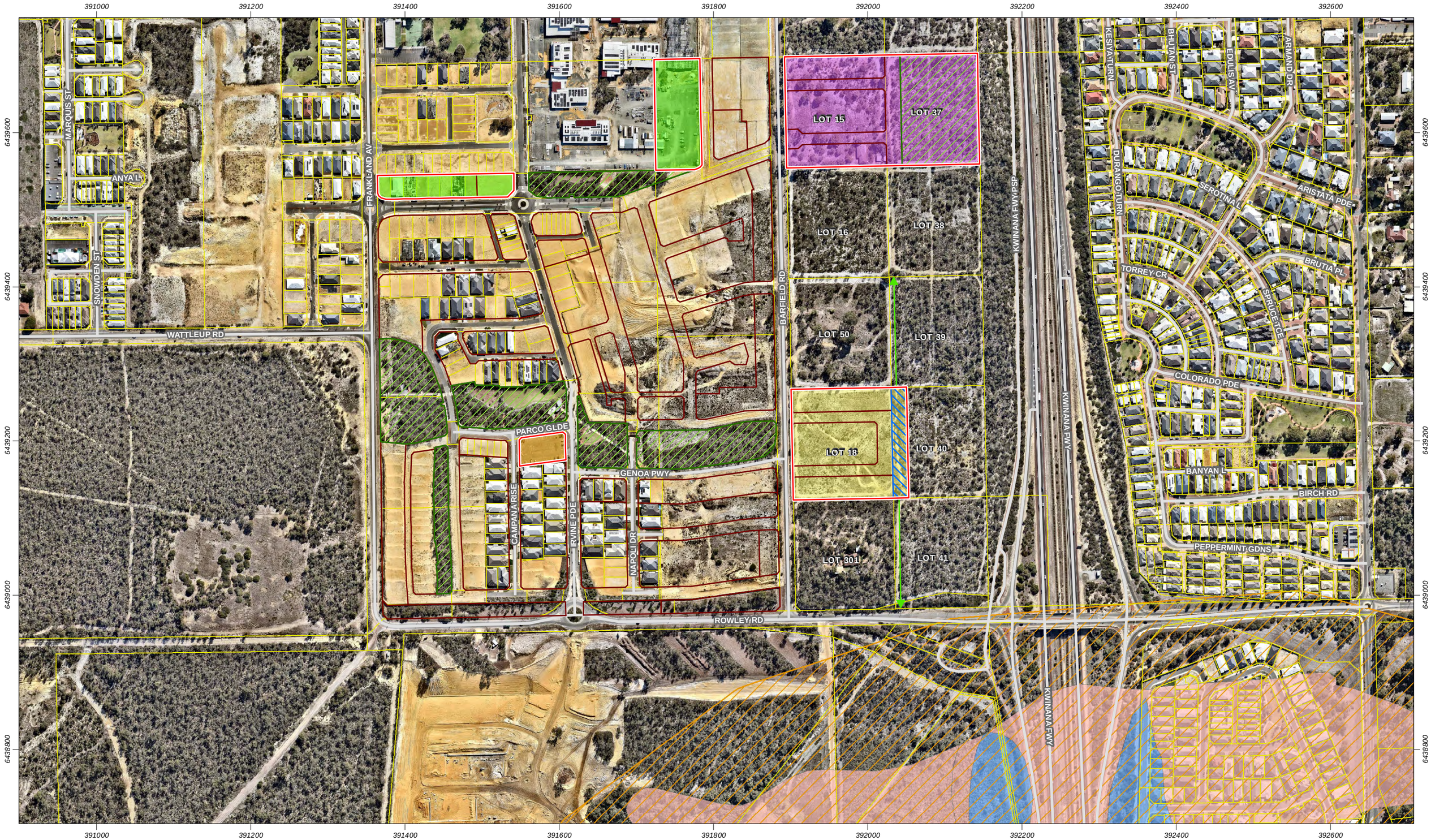
A clearing permit has been obtained from the Department of Water and Environmental Regulation (DWER) to clear up to 1.5 ha of native vegetation within Lot 37 for the purpose of bulk earthworks. This area encapsulates the majority of Lot 37, aside from a 10 m wide strip around the southern and eastern boundaries which are largely already cleared for firebreaks.



Source: Roberts Day, RD1 045, Rev J

Figure 1: Existing and modified Local Structure Plan comparison

Figure 2: Site overview



N

Scale 1:4,500 at A3

0 50 100 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 6/06/2019

Legend

- Project area
- POS
- FSAR/future road
- Future FSAR/road linkage
- Modified LSP layout
- Roads
- Change from R30 to R60
- Land no longer subject to BAL-FZ
- Stage 9
- Stage 10
- Existing cadastre
- ESA
- Multiple Use Wetland
- Resource Enhancement Wetland

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Data source: Nearmap: Aerial image, flown 05/2019. Landgate: Cadastre, 02/2019. DBCA: Wetlands, 2019. DER: ESA, 2018. Client: Roberts Day . Development layout, 05/2019. Created by: jcrute

2. Environmental considerations

2.1 Native vegetation – modification and clearing

Aside from Lot 18 (east of Barfield Road), all land within the previously approved Structure Plan area (refer to Figure 1) has been previously cleared/modified to facilitate urban development of the site. Strategen understands that all necessary environmental approvals have been obtained in regard to clearing/modification of this land.

Lot 15 (Stage 10) and Lot 18 (Stage 9) situated east of Barfield Road have not been previously cleared as part of the endorsed Structure Plan development. These lots currently contain a combination of remnant banksia woodland and scrub amongst substantial areas of grassland, indicating that the lots have been subject to previous clearing/disturbances. Environmental impacts resulting from proposed clearing within Stages 9 and 10 will need to be addressed under standard State and Federal environmental assessment and referral requirements under the *Environmental Protection Act 1986* and *Environment Protection and Biodiversity Conservation Act 1999* where appropriate.

Table 1 provides a summary of a search of publicly available environmental information relevant to the project area cells.

Table 1: Summary of environmental values

Environmental value	Present within or adjacent to project area	Description
Environmentally Sensitive Area	Adjacent	The nearest ESA is located to the south of Rowley Road (refer to Figure 2).
Swan Bioplan Regionally Significant Natural Area	No	N/A
Wetlands	Adjacent	The nearest wetlands include Resource Enhancement and Multiple Use wetlands to the south of Rowley Road (refer to Figure 2).
Waterways	No	N/A
Ecological Linkages	Within and adjacent	The western portion of the overall Structure Plan area is mapped as being within the Perth Regional Ecological Linkage
Threatened Ecological Communities listed under the EPBC Act	Possibly	The endangered banksia woodlands of the Swan Coastal Plain TEC is mapped as having potential to occur within the project area. The clearing permit obtained from DWER acknowledges that proposed clearing within Lot 37 will impact on a small, degraded area of this TEC but that the impacts to the TEC in the local area are negligible (DWER 2018).
Threatened and priority flora	No	There are no previous records of threatened and priority flora within the project area cells or within 1.5 km.
Fauna habitat listed under the EPBC Act	Yes	A portion of Lot 18 is mapped as being a potential feeding area for endangered Carnaby's Black Cockatoo (CBC). Adjacent land to the east of Barfield Road and a large portion of the overall structure plan area are also mapped as potential feeding areas for CBC. The project area and a large proportion of surrounding land is also mapped as a confirmed roosting area (buffered) for CBC. A portion of Lots 15 and 18 and a large portion of the overall Structure Plan area is mapped as being potential Quenda habitat.
Threatened and priority fauna	Yes	Observations of Priority fauna have been recorded within the south of the overall Structure Plan, however, this land has now been predominantly cleared. Observations of threatened and priority fauna have been recorded to the north of the Structure Plan area.
Bush Forever Site	No	N/A

Environmental value	Present within or adjacent to project area	Description
DBCA managed lands and lands and waters (includes legislated lands and waters and lands of interest)	No	N/A
Conservation covenants	No	N/A

2.2 Revegetation / Landscape Plans

The three project area cells to the west of Barfield Road are already cleared to facilitate development of urban lots and the school site. Any landscaping works within these cells will constitute low threat vegetation in accordance with AS 3959 Clause 2.2.3.2 (f) (e.g. cultivated gardens and maintained lawns).

The full extent of native vegetation to be retained within Stages 9 and 10 (likely to be focussed within Lot 37/Stage 10) will be determined at future planning stages through the allocation of POS and the development of a Landscape Plan. Strategen has assumed vegetation will be retained within Lot 37 as part of the Parks and Recreation Reserve (aside from the future road provision).

Based on the proposed Structure Plan amendment (Figure 1), Strategen expects that the full extent of Lots 15/Part Lot 37 (Stage 10) and Lots 18/Part Lot 40 (Stage 9) will be cleared to facilitate urban residential development and associated FSAR/future road. Any vegetation retained for streetscaping/visual amenity will comprise low threat vegetation in accordance with AS 3959 Clause 2.2.3.2 (f).

3. Bushfire assessment results

3.1 Assessment inputs

3.1.1 Vegetation classification

Strategen assessed classified vegetation and exclusions within 150 m of the project area cells through on-ground verification on 15 May 2019 in accordance with *AS 3959—2018 Construction of Buildings in Bushfire-Prone Areas* ([AS 3959]; SA 2018) and the *Visual Guide for Bushfire Risk Assessment in Western Australia* (DoP 2016). Georeferenced site photos and a description of the vegetation classifications and exclusions are contained in Appendix 1. The vegetation/exclusion plots identified are summarised in Table 2 and depicted in Figure 3.

3.1.2 Effective slope

Strategen assessed effective slope under classified vegetation through on-ground verification on 15 May 2019 in accordance with AS 3959. Results were cross-referenced with DPIRD 2 m contour data and are depicted in Table 2 and Figure 3.

Site observations indicate that the surrounding land is predominantly flat or upslope in relation to the five development cells.

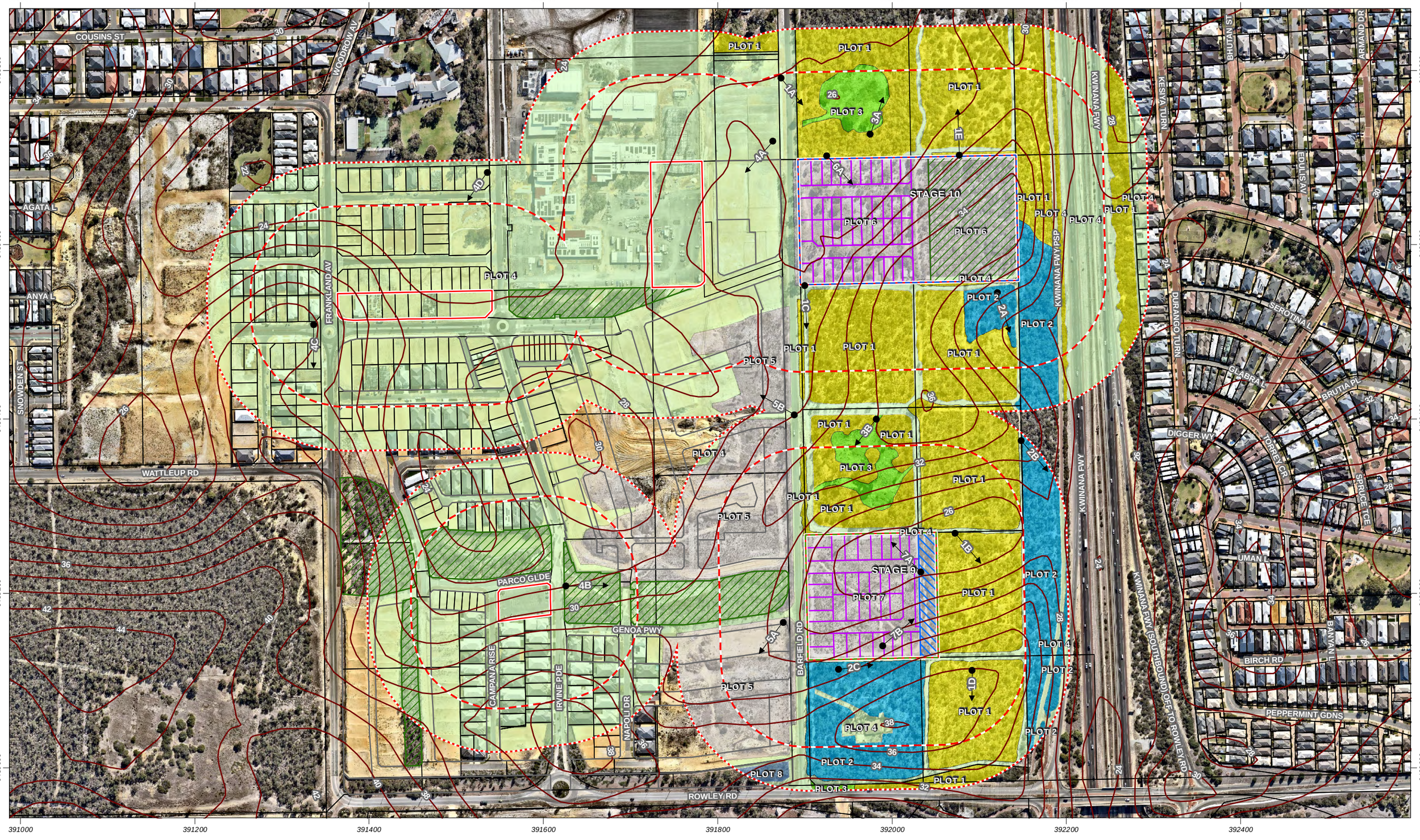
3.1.3 Summary of inputs

Figure 3 illustrates the anticipated post-development vegetation classifications and exclusions following completion of subdivision works and implementation of low threat landscaping throughout the project area. The post-development vegetation classifications/exclusions and effective slope are summarised in Table 2

Table 2: Summary of post-development vegetation classifications/exclusions and effective slope

Vegetation plot	Vegetation classification	Effective slope	Comments
1	Class D Scrub	Flat/upslope (0°)	Low banksia scrub (2–6 m)
2	Class B Woodland	Flat/upslope (0°)	Tall banksia-sheoak woodland (>6 m)
3	Class G Grassland	Flat/upslope (0°)	Unmanaged grassland within vacant lots
4	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	All existing low threat and non-vegetated land within 150 m of the project area cells (includes existing POS within Vivente Estate)
5	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	Land to be modified to low threat state within the existing development portion of Vivente Estate in accordance with previous Structure Plan/subdivision approvals
6	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	Land to be modified to low threat state within Stage 10
7	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	Land to be modified to low threat state within Stage 9

Figure 3: Post-development vegetation classification and effective slope



Legend

- Project area
- 100m assessment area
- 150m assessment area
- Photo point and direction
- Surface elevation (mAHD)
- Stage 9 boundary
- Stage 10 boundary
- POS
- FSAR/future road
- Indicative lot layout
- Modified LSP layout
- Existing cadastre

Vegetation class

- Class B Woodland
- Class D Scrub
- Class G Grassland
- To be modified to a low threat state
- Excluded under Clause 2.2.3.2 (d)
- Excluded under Clauses 2.2.3.2 (e) and (f)

N

Scale 1:4,000 at A3

0 50 100 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 18/06/2019

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3.2 Assessment outputs

3.2.1 Bushfire Attack Level (BAL) contour assessment

Indicative subdivision concepts show a proposed lot layout for Stages 9 and 10; therefore, Strategen has undertaken a BAL contour assessment in accordance with Method 1 of AS 3959 for the project area cells (Figure 4). The Method 1 procedure incorporates the following factors:

- state-adopted FDI 80 rating
- post-development vegetation classification
- effective slope
- distance maintained between proposed development areas and the classified vegetation.

The BAL rating gives an indication of the level of bushfire attack (i.e. the radiant heat flux) that may be received by proposed future development and subsequently informs the standard of building construction and/or setbacks required for proposed habitable development to potentially withstand such impacts.

Results of the BAL contour assessment for each project area cell are detailed in Table 3 (three cells to west of Barfield Road), Table 4 (Stage 9) and Table 5 (Stage 10) and illustrated in Figure 4.

The highest BAL applicable to the external boundary of the proposed lots for each cell are as follows:

- three cells to the west of Barfield Road: BAL-LOW
- Stage 9: BAL-FZ
- Stage 10: BAL-FZ.

In order to ensure that all habitable development will occur within areas subject to a maximum of BAL-29, all lots subject to BAL-40/FZ will be temporarily quarantined from development until the classified vegetation within adjacent landholdings is permanently removed and managed in a non-vegetated or low threat state as part of future development. 18 lots are to be temporarily excluded from development within Stage 9 and 22 lots are to be temporarily excluded from development within Stage 10. These temporarily quarantined lots are identified in Figure 4.

Table 3: BAL contour assessment results – three cells to west of Barfield Road

Method 1 BAL determination					
Plot	Vegetation classification	Effective slope	Separation distance	Highest BAL (to lot boundary)	Modified BAL (with building setbacks)
1	Class D Scrub	Flat/upslope (0°)	>100 m	BAL–Low	N/A
2	Class B Woodland	Flat/upslope (0°)	>100 m	BAL–Low	N/A
3	Class G Grassland	Flat/upslope (0°)	>100 m	BAL–Low	N/A
4	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low	N/A
5	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low	N/A
6	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low	N/A
7	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low	N/A
8	Excluded – Clause 2.2.3.2 [d]	N/A	N/A	BAL–Low	N/A
				Highest BAL	BAL-LOW

Table 4: BAL contour assessment results - Stage 9

Plot	Vegetation classification	Effective slope	Separation distance	Highest BAL (to lot boundary)
1	Class D Scrub	Flat/upslope (0°)	0 m	BAL-FZ*
2	Class B Woodland	Flat/upslope (0°)	3 m	BAL-FZ*
3	Class G Grassland	Flat/upslope (0°)	27 m	BAL–12.5
4	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
5	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
6	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
7	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
8	Excluded – Clause 2.2.3.2 [d]	N/A	N/A	BAL–Low
			Highest BAL	BAL-FZ
			Highest BAL with BAL-FZ lots excluded via temporary quarantining	BAL-29

*BAL-FZ applies to lots bordering the northern and southern boundaries of the Stage 9 cell only. All BAL-FZ lots are to be excluded from development until adjacent temporary bushfire hazards are removed as part of future development. All remaining lots will achieve BAL-29 or lower (which may be further reduced through the future occurrence of adjacent development).

Table 5: BAL contour assessment results - Stage 10

Plot	Vegetation classification	Effective slope	Separation distance	Highest BAL (to lot boundary)
1	Class D Scrub	Flat/upslope (0°)	0 m	BAL-FZ*
2	Class B Woodland	Flat/upslope (0°)	58 m	BAL–12.5
3	Class G Grassland	Flat/upslope (0°)	29 m	BAL–12.5
4	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
5	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
6	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
7	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])	N/A	N/A	BAL–Low
8	Excluded – Clause 2.2.3.2 [d]	N/A	N/A	BAL–Low
			Highest BAL	BAL-FZ
			Highest BAL with BAL-FZ lots excluded via temporary quarantining	BAL-12.5

*BAL-FZ applies to lots bordering the northern and southern boundaries of the Stage 10 cell only. All BAL-FZ lots are to be excluded from development until adjacent temporary bushfire hazards are removed as part of future development. All remaining lots will achieve BAL-12.5 (which may be further reduced through the future occurrence of adjacent development).

391000 391200 391400 391600 391800 392000 392200 392400

6439800 6439600 6439400 6439200 6439000

COUSINS ST
WOODROW AV
MARQUIS ST
AGATA L
ANYA L
SNOWDEN ST
WATTLEUP RD
FRANKLAND AV
BARFIELD RD
KWINANA FWY
KWINANA FWY PSP
KESIYA TURN
BHUTAN ST
ARMAND DR
EDDIS AV
DURANGO TURN
SEROTINA L
BRUTIA PL
TORREY CR
SPRUCE TCE
COLORADO PDE
LATTERI TURN
BANYAN L
BIRCH RD
PEPPERMINT GDNS
KWINANA FWY (SOUTHBOUND) OFF TO ROWLEY RD
PARCO GLDE
CAMPANA RISE
IRVINE PDE
NAPOLI DR
GENOA PWY
ROWLEY RD

STAGE 10
STAGE 9

PLOT 1
PLOT 2
PLOT 3
PLOT 4
PLOT 5
PLOT 6
PLOT 7
PLOT 8

391000 391200 391400 391600 391800 392000 392200 392400

Figure 4: BAL contour map and bushfire management measures

N

Scale 1:4,000 at A3

0 50 100 m

Coordinate System: GDA 1994 MGA Zone 50

Date: 18/06/2019

Legend

- Project area
- 100m assessment area
- 150m assessment area
- Lots subject to BAL-40/FZ to be quarantined until adjacent temporary bushfire hazards permanently removed/managed in a low threat state
- Stage 9 boundary
- Stage 10 boundary
- POS
- FSAR/future road
- Indicative lot layout
- Modified LSP layout
- Existing cadastre
- Classified vegetation
- Existing fire hydrants

BAL contours

- BAL FZ
- BAL 40
- BAL 29
- BAL 19
- BAL 12.5
- BAL Low

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Data source: Nearmap: Aerial image, flown 05/2019. Landgate: Cadastre, 02/2019. Water Corporation: Existing hydrants, 2018. Client: Roberts Day . Development layout, 05/2019. Created by: jcrute

4. Identification of bushfire hazard issues

4.1 Bushfire context

The three development cells within the existing Vivente Estate subdivision area, west of Barfield Road, are cleared (some partially constructed) and surrounded by land that has already been cleared/modified as part of approved subdivision areas of Vivente Estate and adjacent development areas of Hammond Park. Banksia woodland vegetation within Frankland Park, west of Frankland Avenue, poses the greatest threat to the development cells; however, there is substantial separation (greater than 150 m) provided by Frankland Avenue and existing developed areas within Vivente Estate, meaning these cells would not be subject to significant bushfire impacts. Vegetated land to the south of Rowley Road is currently in the process of being cleared as part of a separate, staged development (Apsley Estate), and will therefore not pose a bushfire threat to the development cells in the long term.

The Vivente Estate approved Structure Plan and subdivision design includes a vegetated corridor extending through the centre of the site in an east-west direction. As part of a management measure written into the BMP prepared to support these previous planning applications (Strategen 2015), the vegetation will be managed in a low fuel state and is unlikely to pose a significant bushfire threat to adjacent development. The Strategen (2015) BMP does however cater for precautionary BAL-12.5 application on a number of lots located adjacent to the POS cells to provide for an additional level of safety for these dwellings in terms of ember protection.

The Stage 9 and 10 development cells are bordered to the west by Barfield Road and the existing Vivente Estate development area, which, as discussed above, comprises land cleared and partially developed along with the managed POS corridor. The bushfire threat from the west is therefore considered to be extremely limited. The development cells, however, are subject to potential bushfire impacts from surrounding banksia vegetation, which has been predominantly classified as Class D Scrub based on a fairly continuous horizontal and vertical fuel structure less than 6 m in height. This vegetation forms a narrow band of approximately 300 m width between Kwinana Freeway and Barfield Road and extends a length of approximately 900 m north from Rowley Road. This vegetation has a direct interface with the Stage 9 and 10 development cells, resulting in BAL-40/FZ impacts on lots proposed at the perimeter of these cells. However, as the surrounding land is expected to be cleared and developed in the future, these lots will be temporarily quarantined, excluding them from development until such a time as the temporary vegetation hazards adjacent to the cells are permanently removed and developed/managed in a low threat state. In addition, clearing within Lot 27 to facilitate bulk earthworks will reduce impacts on Stage 10 from the east. Strategen considers that the bushfire risk to Stages 9 and 10 posed by these hazards can be managed via standard staging mechanisms and application of acceptable solutions under the Guidelines, as well as through a direct bushfire suppression response if required. Bushfire mitigation strategies applicable to the proposed development are addressed in Section 5 of this BMP.

4.2 Bushfire hazard issues

Strategen does not consider there to be any bushfire hazard issues for the three development cells situated west of Barfield Road, since these are subject to BAL-Low and already meet all compliance requirements of the Guidelines. As such, these cells are not considered further within this section.

The key bushfire hazard issues for the remaining development cells (i.e. Stages 9 and 10, east of Barfield Road) that are likely to require management and/or consideration at future planning stages from a bushfire management perspective include:

1. Temporary quarantining of lots within the Stage 9 and 10 development cells currently subject to BAL-40/FZ until such a time that adjacent temporary bushfire hazards are permanently removed and/or managed in a low threat state.
2. Provision of two access/egress routes on completion of development as well as during staging.
3. Provision of a compliant cul-de-sac and turnaround area within the Stage 10 development cell on completion of development.

4. Provisions for temporary emergency access from the Stage 10 cul-de-sac onto Barfield Road or staging of development until a compliant cul-de-sac can be provided through the construction of a future road linkage south to Rowley Road.
5. Provision of a suitable bushfire fighting water supply and associated infrastructure to support the scale of the proposed development.

The above potential bushfire hazard issues are considered further in Section 5.

Based on the above, Strategen considers the bushfire hazards within and adjacent to project area and the associated bushfire risks are readily manageable through standard management responses outlined in the Guidelines and AS 3959. These responses will be factored into proposed development as early as possible at all stages of the planning process to ensure a suitable and effective bushfire management outcome is achieved for protection of future life, property and environmental assets.

5. Assessment against the bushfire protection criteria

5.1 Compliance table

An acceptable solutions assessment against the bushfire protection criteria is provided in Table 6.

Table 6: Compliance with the bushfire protection criteria of the Guidelines

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies
Element 1: Location	A1.1 Development location	The BAL contour assessment identifies that through compliance with the 2015 Strategen BMP (in terms of site earthworks/clearing, establishment and maintenance of staging buffers and management of the POS corridor), the three development cells located within the existing Vivente Estate development (west of Barfield Road) are subject to BAL-Low (refer to Table 3 and Figure 4). The BAL contour assessment identifies that the Stage 9 and 10 development cells contain proposed lots currently subject to BAL-40/FZ (refer to Table 4, Table 5 and Figure 4). The identified lots are to be temporarily quarantined until the adjacent temporary bushfire hazards are permanently removed and/or managed in a low threat state. This will ensure that all future habitable development has the ability to achieve BAL-29 or lower.
Element 2: Siting and design	A2.1 Asset Protection Zone	On completion of development, all developable lots will be cleared and developed with residential dwellings along with cultivated gardens and managed lawns. As all proposed lots will be subject to a maximum BAL of 29, no separate APZs are considered to be required on completion of development. Prior to being developed with residential dwellings, all vacant lots are to be established and maintained by the developer in a low threat state as temporary APZs in accordance with Schedule 1 of the Guidelines (Appendix 2) and the City of Cockburn Fire Control Order (Firebreak Notice; Appendix 3). As the proposed residential lots will be <4,047 m^2 in area, they will be subject to Firebreak Notice requirements, including slashing of grass and weeds to <50 mm until the lots are sold, when responsibilities will be handed over to the individual land owner. During staging of development, all balance land (including lots excluded from development through temporary quarantining) are to be cleared and managed in a low threat state by the developer as a temporary APZ. Balance lots <4,047 m^2 in area are to have grasses and weeds maintained at <50 mm in accordance with the Firebreak Notice. Balance lots >4,047 m^2 are to are to have grasses and weeds maintained at <100 mm in accordance with Schedule 1 of the Guidelines.

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies
Element 3: Vehicular access	A3.1 Two access routes.	The three cells within the existing Vivente Estate development (to the west of Barfield Road) are currently provided with more than two access routes, comprising three access routes to Frankland Avenue in the west, one access route to Rowley Road in the south and one access route to Barfield Road in the east. On completion of staged development, the cells will be provided five additional access points onto Barfield Road. Kwinana Freeway being located within 300 m east of Barfield Road and the surrounding public road network provides access to and egress from the site in all directions. The Stage 9 development cell will be provided with an internal loop road which will achieve two access points onto Barfield Road. Barfield Road provides access to the north (through Harmonie Estate), south to Rowley Road and west (through Vivente Estate); therefore, two access routes in two different directions are achieved/exceeded for this cell. The modified LSP (Figure 1) makes provisions for a FSAR or a road extending from Rowley Road in the south to the Stage 10 development cell. If this corridor is constructed as a public road, access options will be further enhanced for the Stage 9 development cell. The Stage 10 development cell will be provided with a single access route (i.e. compliant cul-de-sac) onto Barfield Road. As discussed above, Barfield Road provides access to the north, south and west which meets compliance with A3.1. If constructed as a public road, the future north-south road Linking Stage 10 to Rowley Road will provide additional access options for the Stage 10 development cell. Two access routes are to be provided during staging of development, which is considered to be achievable based on the above information.
	A3.2 Public road	All proposed public roads are to be constructed to relevant technical requirements under the Guidelines (see Appendix 4).
	A3.3 Cul-de-sac (including a dead-end-road)	Cul-de-sacs within the existing Vivente Estate development (to the west of Barfield Road) have either been constructed, or approved, under previous subdivision applications and are therefore not considered further within this assessment. The Stage 10 development cell includes a cul-de-sac which has been included in the development design at the request of the City. The justification for this cul-de-sac is that a through connection onto Barfield Road at this point would conflict with the connection already approved on the opposite (western) side of Barfield Road . In this regard, inclusion of the cul-de-sac is considered to be unavoidable and at the City's request. The cul-de-sac will be provided a compliant turn around head (e.g. minimum 17.5 m diameter; refer to Appendix 4) however, the length of the road (as measured from the Barfield Road intersection) will exceed 200 m. The non-compliant length is, however, considered to be a temporary arrangement if a public road is constructed south to Rowley Road (and potentially north to service future adjacent development). In this regard, it is likely that the cul-de-sac will have a maximum length of 130 m on completion of development and will require interim staging mechanisms to ensure non-compliances are avoided. The cul-de-sac arrangement is discussed further in Section 5.2.2.
	A3.4 Battle-axe	N/A – no battle-axe lots are proposed as part of the development and the project area is not serviced by an existing battle-axe.
	A3.5 Private driveway longer than 50 m	N/A – the proposed lots are of size where all future habitable development will be located within 50 m of a public road.
	A3.6 Emergency access way	No emergency access ways (EAW) are proposed as part of the development.

Bushfire protection criteria	Method of compliance Acceptable solutions	Proposed bushfire management strategies
	A3.7 Fire service access routes (perimeter roads)	The modified Structure Plan (Figure 1) makes provisions for either a FSAR or public road bordering the eastern boundary of the Stage 9 cell, extending south to Rowley Road and north to the Stage 10 cell. If the FSAR option is pursued, the FSAR is to be constructed to relevant technical requirements under the Guidelines (see Appendix 4) and will need to be signposted. Gates may be locked with a common key. Following establishment, the City will responsible for maintaining the FSAR. The FSAR is to be no further than 600 m from a public road at any single point. The alignment of the potential FSAR will be determined at future planning stages.
	A3.8 Firebreak width	Each stage of development is required to comply with the requirements of Acceptable Solution A3.8 and the annual City Firebreak Notice as amended (refer to Appendix 3). On completion of development, firebreaks would not be required for the residential cells which will be less than <4,047 m^2 in area. Three metre wide, 4 m high internal perimeter firebreaks would be required for the Parks and Recreation Reserve within the Stage 10 development cell. During staged development, all balance land >4,047 m^2 in area will also require 3 m wide by 4 m high internal perimeter firebreaks.
Element 4: Water	A4.1 Reticulated areas	The proposed development will be connected to reticulated water supply via surrounding development in accordance with Water Corporations Design Standard 63 requirements (refer to Appendix 5). Existing firefighting hydrants are depicted in Figure 4.
	A4.2 Non-reticulated areas	N/A – the project area is located within an existing reticulated area.
	A4.3 Individual lots within non-reticulated areas	N/A – the project area is located within an existing reticulated area.

5.2 Additional management measures

5.2.1 Temporary quarantining of lots subject to BAL-40/FZ

The 18 lots within the Stage 9 development cells and 22 lots within the Stage 10 development cell impacted by BAL-FZ/40 will be subject to temporary quarantining (see Figure 4) until the temporary vegetation extents within adjacent lots to the north and south of these cells are permanently removed or managed to deliver a compliant rating of BAL-29 or lower for all proposed development. This exclusion area will be enforced via application of the following condition of subdivision:

> *The 18 lots within Stage 9 and 22 lots within Stage 10, highlighted on the attached subdivision plan, are not to be created until it can be adequately demonstrated, via a suitably qualified bushfire consultant, that the lots are not impacted by a Bushfire Attack Level of 40 or Flame Zone. (Western Australian Planning Commission).*

5.2.2 Vehicular access during staging

As discussed in Table 6 (under Acceptable Solution A3.3), the proposed public road within the Stage 10 development cell will comprise an approximately 330 m long cul-de-sac. This non-compliant road arrangement is expected to be temporary in nature and would be resolved through the following strategies:

- A temporary emergency access connection will be provided from the cul-de-sac head onto Barfield Road which will resolve the dead-end road. The connection will be provided by way of landscaping treatments, subject to approval from the City, with the design being confirmed at the subdivision stage.
- Once the proposed north-south aligned public road, to the east of the Stage 10 development cell, is connected through to adjacent development to the north and/or south, the cul-de-sac length will be measured from this road, as opposed to Barfield Road, and will have a length of approximately 130 m. Therefore, the cul-de-sac will achieve compliance with Acceptable Solution A3.3 once planned future road connections have been constructed. The temporary emergency access connection onto Barfield Road would then be decommissioned.

It should be noted that the design of the Stage 10 development cell is very similar to the Stage 9 development cell, with the main difference being that the internal road network within Stage 10 is unable to be provided with a permanent second connection to Barfield Road due to the opposite intersection on the western side of Barfield Road. The actual risk to the road network within the Stage 10 cell is considered to be lower than the Stage 9 cell, due to the proposed clearing within the Parks and Recreation reserve to the east. In this regard, Strategen considers that the temporary emergency access connection for the Stage 10 cul-de-sac will provide an access outcome comparable to that of Stage 9.

5.2.3 Management of staging buffers

Ongoing management of POS cells will continue to be in accordance with the approved Strategen (2015) BMP. This is also the case with the provision of 100 m wide low threat staging buffers, which are to be established where possible and maintained around each stage of development to mitigate unnecessary bushfire risk during rollout of development stages.

The developer and City are to ensure that all fuel management commitments are being met in accordance with the 2015 FMP.

6. Responsibilities for implementation and management of the bushfire measures

This BMP has been prepared as a strategic guide to demonstrate how development compliance will be delivered at future planning stages in accordance with the Guidelines. Aside from the preparation of future BMPs to accompany future subdivision and development applications where appropriate, there are no further items to implement, enforce or review at this strategic stage of the planning process.

Future BMPs prepared for subsequent subdivision and development applications are to meet the relevant commitments outlined in this strategic level BMP, address the relevant requirements of SPP 3.7 (i.e. Policy Measures 6.4 and 6.5 respectively) and demonstrate in detail how the proposed development will incorporate the relevant acceptable solutions or meet the performance requirements of the Guidelines. Future BMPs are to include the following detailed information:

- confirmed lot layout, including any proposed public open space (POS)
- detailed landscaping design/plans in regard to proposed POS, consistent with the provisions of this BMP
- post development classified vegetation extent and effective slope
- BAL contour map demonstrating that proposed development areas will achieve BAL–29 or lower
- width and alignment of compliant APZs/setbacks where applicable
- confirmation of how bushfire management will be addressed during development staging, particularly with regards to temporary quarantining of lots, delayed/staged development, provision of low threat staging buffers/vegetation modification or clearing in advance, vehicular access staging requirements, etc
- proposed approach to fuel management or AS 3959 application in response to any on-site POS
- vehicular access provisions, including demonstration that a minimum of two access routes will be achieved for each stage of development in accordance with Acceptable Solution A3.1
- compliance with any specific vehicular access technical requirements (e.g. public roads, cul-de-sacs, EAWs, etc)
- water supply provisions with regards to reticulated water
- provisions for notification on Title for any future lots with a rating of BAL–12.5 or greater as a condition of subdivision
- compliance requirements with the current City annual firebreak notice
- construction of Class 1, 2, 3 or associated 10a buildings in accordance with AS 3959 to the assessed BAL rating
- requirements for BMP/BAL compliance reports as conditions of subdivision
- compliance with acceptable solutions of the bushfire protection criteria
- proposed implementation and audit program outlining all measures requiring implementation and the appropriate timing and responsibilities for implementation.

On the basis of the information contained in this BMP, Strategen considers the bushfire hazards within and adjacent to the project area and the associated bushfire risks are readily manageable through standard management responses outlined in the Guidelines and AS 3959.

7. References

Department of Fire and Emergency Services (DFES) 2019, *Map of Bush Fire Prone Areas*, [Online], Government of Western Australia, available from: *https://maps.slip.wa.gov.au/landgate/bushfireprone/*, [28/05/2019].

Department of Planning (DoP) 2016, *Visual guide for bushfire risk assessment in Western Australia*, Department of Planning, Perth.

Department of Water and Environmental Regulation (DWER), 2018, *Clearing Permit Decision Report*, Government of Western Australia, Perth.

Standards Australia (SA) 2018, *Australian Standard AS 3959–2018 Construction of Buildings in Bushfire-prone Areas*, Standards Australia, Sydney.

Strategen, 2015, *Fire Management Plan: Barfield Road Local Structure Plan*, Strategen, Perth.

Western Australian Planning Commission (WAPC) 2015, *State Planning Policy 3.7 Planning in Bushfire Prone Areas*, Western Australian Planning Commission, Perth.

Western Australian Planning Commission (WAPC) 2017, *Guidelines for Planning in Bushfire Prone Areas*, Version 1.3 August 2017, Western Australian Planning Commission, Perth.

Appendix 1
Vegetation plot photos and description



Photo ID: 1a



Photo ID: 1b



Photo ID: 1c



Photo ID: 1d



Photo ID: 1e

Plot number		Plot 1
Vegetation classification	**Pre-development**	Class D Scrub
	Post-development	Class D Scrub
Description / justification		Shrubs greater than 2 m high at maturity (but generally less than 6 m), dominated by Banksia.

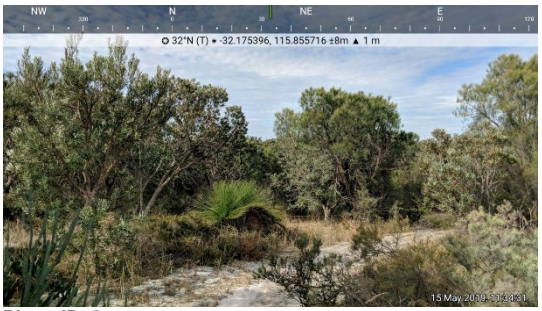


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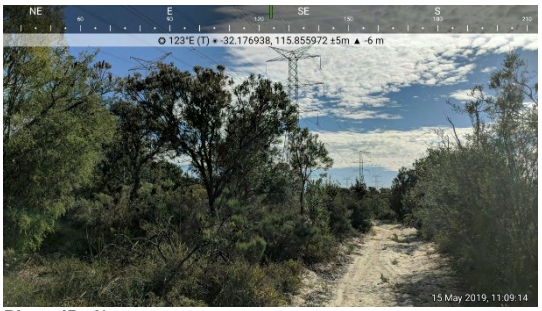


Photo ID: 2b



Photo ID: 2c

Plot number		Plot 2
Vegetation classification	**Pre-development**	Class B Woodland
	Post-development	Class B Woodland
Description / justification		Trees/shrubs generally greater than 6 m high at maturity, dominated by Banksia.



Photo ID: 3a

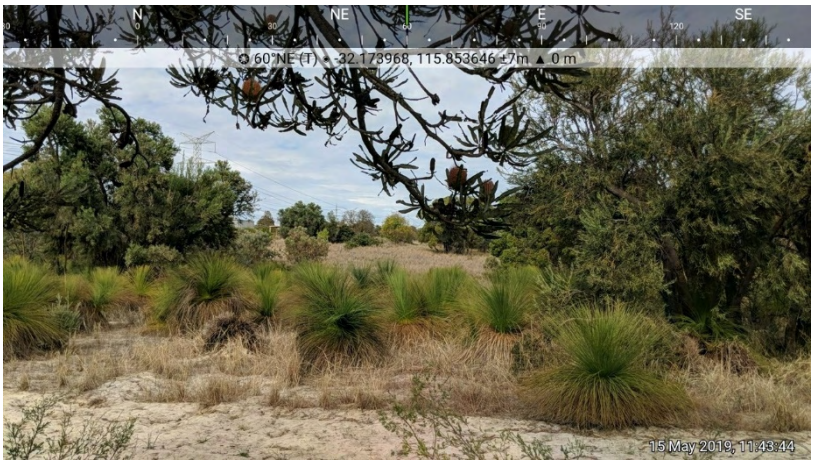


Photo ID: 3b

Plot number		Plot 3
Vegetation classification	**Pre-development**	Class G Grassland
	Post-development	Class G Grassland
Description / justification		Grassland greater than 100 mm in height within centre of Lots 50 and 28 (former house sites)



Photo ID: 4a



Photo ID: 4b



Photo ID: 4c



Photo ID: 4d

Plot number		Plot 4
Vegetation classification	**Pre-development**	Excluded – Non-vegetated & Low threat (Clauses 2.2.3.2 [e] and [f])
	Post-development	Modified to non-vegetated (exclusion 2.2.3.2 [e]) and/or low threat (exclusion 2.2.3.2 [f]) state
Description / justification		Portion of Vivente Estate to the west of Barfield Road, which has been cleared for urban development. Areas of POS excluded as low threat vegetation in accordance with 2015 FMP (refer to Section 5.2.3).



Photo ID: 5a

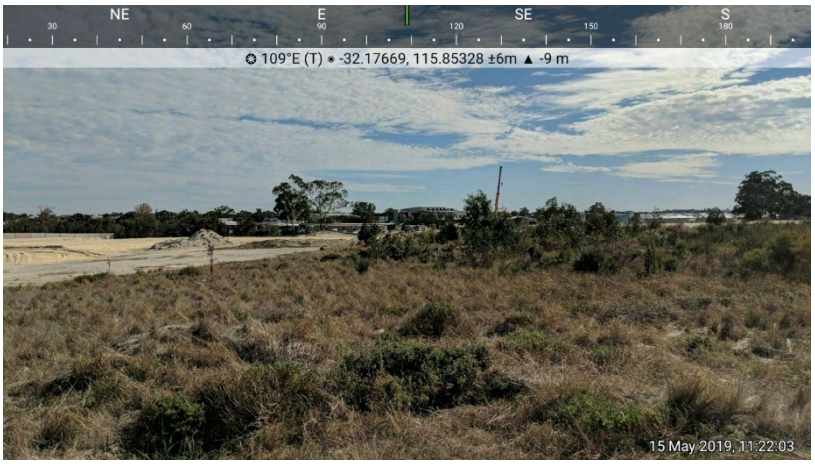


Photo ID: 5b

Plot number		Plot 5
Vegetation classification	**Pre-development**	Class G Grassland, Class D Scrub
	Post-development	Modified to non-vegetated (exclusion 2.2.3.2 [e]) and/or low threat (exclusion 2.2.3.2 [f]) state
Description / justification		Currently undeveloped portions of Vivente Estate to be modified to non-vegetated or low threat state as part of staging buffers in accordance with previously endorsed FMP (refer to Section 5.2.3). On completion of development, this land will be fully developed with residential lots and roads.

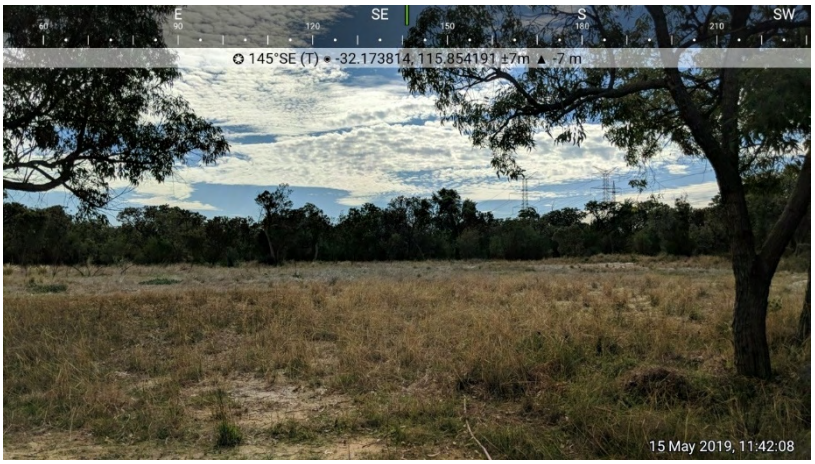


Photo ID: 6a

Plot number		Plot 6
Vegetation classification	**Pre-development**	Class G Grassland, Class D Scrub
	Post-development	Modified to non-vegetated (exclusion 2.2.3.2 [e]) and/or low threat (exclusion 2.2.3.2 [f]) state
Description / justification		Current vegetation comprises grassland >100 mm in height with regenerating banksias (Class D Scrub). Proposed Stage 10 development cell will comprise residential lots with cultivated gardens and reticulated lawns, roads and streetscaping.



Photo ID: 7a



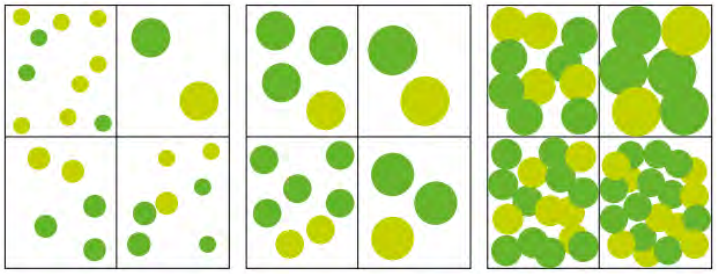
Photo ID: 7b

Plot number		Plot 7
Vegetation classification	**Pre-development**	Class G Grassland, Class D Scrub
	Post-development	Modified to non-vegetated (exclusion 2.2.3.2 [e]) and/or low threat (exclusion 2.2.3.2 [f]) state
Description / justification		Current vegetation comprises grassland >100 mm in height with regenerating banksias (Class D Scrub). Proposed Stage 9 development cell will comprise residential lots with cultivated gardens and reticulated lawns, roads and streetscaping and a limestone base FSAR or road.

Appendix 2
APZ standards (Schedule 1 of the Guidelines)

Schedule 1: Standards for Asset Protection Zones

- **Fences:** within the APZ are constructed from non-combustible materials (e.g. iron, brick, limestone, metal post and wire). It is recommended that solid or slatted non-combustible perimeter fences are used.
- **Objects:** within 10 metres of a building, combustible objects must not be located close to the vulnerable parts of the building i.e. windows and doors.
- **Fine Fuel load:** combustible dead vegetation matter less than 6 millimetres in thickness reduced to and maintained at an average of two tonnes per hectare.
- **Trees (> 5 metres in height):** trunks at maturity should be a minimum distance of 6 metres from all elevations of the building, branches at maturity should not touch or overhang the building, lower branches should be removed to a height of 2 metres above the ground and or surface vegetation, canopy cover should be less than 15% with tree canopies at maturity well spread to at least 5 metres apart as to not form a continuous canopy.



- **Shrubs (0.5 metres to 5 metres in height):** should not be located under trees or within 3 metres of buildings, should not be planted in clumps greater than 5m^2 in area, clumps of shrubs should be separated from each other and any exposed window or door by at least 10 metres. Shrubs greater than 5 metres in height are to be treated as trees.
- **Ground covers (<0.5 metres in height):** can be planted under trees but must be properly maintained to remove dead plant material and any parts within 2 metres of a structure, but 3 metres from windows or doors if greater than 100 millimetres in height. Ground covers greater than 0.5 metres in height are to be treated as shrubs.
- **Grass:** should be managed to maintain a height of 100 millimetres or less.

Appendix 3
City of Cockburn Fire Control Order
(2018-2019)

City of Cockburn Fire Control Order

Effective from 10 May 2018

First and Final Notice



Pursuant to *Section 33 of the Bush Fires Act 1954* owners or occupiers of land situated within the City of Cockburn are required by law to comply with the prescribed Fire Control Order here within.

Definitions	
Authorised Officer	A person appointed by the City of Cockburn Chief Executive Officer as an authorised person/officer to exercise the powers and duties set out in the Local Government Act 1995, Bush Fires Act 1954 and Local Law(s).
Flammable Material	Any dead or dry grass, vegetation, substance, object, thing or material (except living flora including live and/ or habitat standing trees) that may or is likely to catch fire and burn or any other thing deemed by an Authorised Officer to be capable of combustion.
Maintained Grass	Soil covered land, planted with grasses or other durable plants, maintained green and less than 50mm in height.
Prohibited Burning Time	The time of each year where it is unlawful to set fire to the bush at any time. This time is normally from 1 December of each year until and including 31 March of the following year. This time may be amended, subject to prevailing seasonal conditions.
Restricted Burning Time	The time of each year where it is unlawful to set fire to the bush without a valid Permit to Set Fire To The Bush issued by an Authorised Officer. This period normally is from 1 April until and including 31 May and from 1 October until and including 30 November of any year. This time may be amended, subject to the prevailing seasonal conditions.
Unrestricted Burning Time	The time of each year where it is lawful to set fire to the bush at any time, in areas zoned rural under the Metropolitan Region Scheme. This time normally is from 1 June until and including 30 September. This time may be amended, subject to the prevailing seasonal conditions.
Firebreak Time	The time of each year where fire hazard reduction works must be maintained as specified in this Fire Control Order. This time is 1 November of each year until and including 15 April of the following year.
Structure	A building, as defined in the Building Codes of Australia (BCA) may be made up of a number of classes if it has a mixed use.

1. All property (vacant or developed) – less than 4,047m²

To reduce the fire hazard on your land and to comply with the requirements of this Fire Control Order you are required to;

1.1 Have all flammable materials such as dry grass and weeds slashed, mown or trimmed down by other means to a maximum height of 50mm across the entire property for the duration of this Firebreak Time; and

1.2 Remove all dead vegetation.

2. All property (vacant or developed) – 4,047m² or greater

To reduce the fire hazard on your land and to comply with the requirements of this Fire Control Order you are required to;

2.1 Construct a firebreak (as defined within section 3 of this order) immediately inside all external property boundaries, this includes those adjacent to roads, drains, rail reserves and any public open space reserves; and

2.2 Remove all dead vegetation surrounding and over all habitable structures to a radius of 3 metres except living trees, shrubs, maintained grass and gardens under cultivation.

3. Firebreak Specifications

A firebreak is an area of land cleared of flammable material, installed to minimise the spread or extension of a fire and to provide suitable access for fire fighting vehicles. The standards of a compliant firebreak are as follows;

3.1 A firebreak must be constructed of bare earth, stone, or sealed surfaces and be clear of all flammable materials to create a 3 metre wide trafficable surface;

3.2 Maintained grass may occupy a firebreak;

3.3 Overhanging branches must be pruned to provide a 4 metre vertical clearance above the full width of the 3 metre firebreak surface; and

3.4 A firebreak must be a continuous trafficable surface for a fire fighting vehicle, clear of any obstructions and must not terminate in a cul-de-sac (dead end).

4. Additional Works

Regardless of land size and location, the City of Cockburn or its Authorised Officer(s) may require you to undertake additional work(s) on your property to improve access and/or undertake further works where in the opinion of that Authorised Officer(s), these works would be conducive to preventing the outbreak and/or the spread or extension of a fire.

5. Fire Control Order Variations

A variation will be considered where the owner and/or occupiers believe it is impractical to meet the compliance requirements of this Fire Control Order.

Approved structure's occupying a firebreak will not require a variation approval. However, a firebreak will be required to be installed as close as practical around the approved structure.

If approved, variations will be valid in perpetuity, unless a new variation has been approved or the property changes ownership.

The City of Cockburn reserves the right to review, amend or revoke an existing variation in writing at any time. Should a request to vary the Fire Control Order requirements on your property not be approved in writing, this Fire Control Order must be complied with as applicable in its entirety.

6. Burning

During the declared Prohibited Burning Time owners and/or occupiers must not undertake any bush or garden refuse burning activities.

During the declared Restricted Burning Time only, owners and/or occupiers may:

6.1 Apply for a permit to burn the bush for bush fire risk mitigation purposes, by following the conditions imposed on a permit to burn as issued by an Authorised Officer.

6.2 In areas zoned rural by the Metropolitan Region Scheme you may undertake burning of leaves, tree branches, and other dry vegetation in piles no larger than 1m³ in size, without a permit to burn, subject to the following conditions:

6.2.1 No flammable material (other than that being burned) is to be within 5m of the fire at any time while the fire is burning;

6.2.2 The fire is lit between 6pm and 11pm and is completely extinguished before midnight on the same day;

6.2.3 At least one person is present at the site of the fire at all times until it is completely extinguished; and

6.2.4 When the fire is no longer required, the person ensures that the fire is completely extinguished by the application of water or earth.

During the Unrestricted Burning Time, owners and/or occupiers in areas zoned rural under the Metropolitan Region Scheme may burn garden refuse and set fire to bush on their land without a permit 'To Set Fire To The Bush'. Burning of the bush must be in accordance with all relevant State legislative requirements.

Burning of garden refuse in areas not zoned rural shall not be undertaken within the City of Cockburn, unless approved by an Authorised Officer.

Burning of household waste is prohibited in all areas of the City of Cockburn.

7. Penalties

Failing to comply with this Fire Control Order will result in a penalty of up to $5,000. A person in default is also liable whether prosecuted or not to pay the costs of performing the work directed by a City's Authorised Officer.

Any owner and/or occupier who engages a contractor to undertake works on their behalf is responsible to ensure that the works completed meet the requirements of this Fire Control Order.

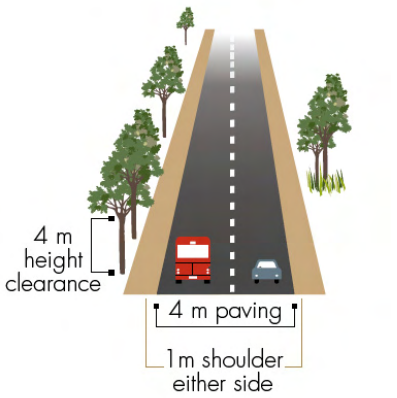
Any Fire Control Order previously published by the City of Cockburn in the Government Gazette or in any Western Australian newsprint is hereby revoked.

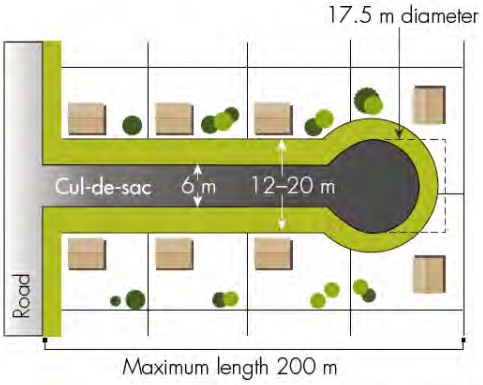
By Order of Council

The City of Cockburn Fire Control Order is available in Chinese, Portuguese, Italian and Croatian by contacting the City on 08 9411 3444.

Document Set ID: 7874932
Version: 1, Version Date: 12/10/2018

Appendix 4
Vehicular access technical standards of the Guidelines

Public roads	
Acceptable solution A3.2	A public road is to meet the requirements in Table 1, Column 1.
Explanatory note E3.2	Trafficable surface: Widths quoted for access routes refer to the width of the trafficable surface. A six metre trafficable surface does not necessarily mean paving width. It could, for example, include four metre wide paving one metre wide constructed road shoulders. In special circumstances, where eight lots or less are being serviced, a public road with a minimum trafficable surface of four metres for a maximum distance of 90 metres may be provided subject to the approval of both the local government and Department of Fire and Emergency Services. Public road design: All roads should allow for two-way traffic to allow conventional two-wheel drive vehicles and fire appliances to travel safely on them. 

Cul-de-sac (including a dead-end road)	
Acceptable solution A3.3	A cul-de-sac and/ or a dead end road should be avoided in bushfire prone areas. Where no alternative exists (i.e. the lot layout already exists and/ or will need to be demonstrated by the proponent), the following requirements are to be achieved: • Requirements in Table 1, Column 2 • Maximum length: 200 metres (if public emergency access is provided between cul-de-sac heads maximum length can be increased to 600 metres provided no more than eight lots are serviced and the emergency access way is no more than 600 metres) • Turn-around area requirements, including a minimum 17.5 metre diameter head.
Explanatory note E3.3	In bushfire prone areas, a cul-de-sac subdivision layout is not favoured because they do not provide access in different directions for residents. In some instances it may be possible to provide an emergency access way between cul-de-sac heads to a maximum distance of 600 metres, so as to achieve two-way access. Such links must be provided as right of ways or public access easements in gross to ensure accessibility to the public and fire services during an emergency. A cul-de-sac in a bushfire prone area is to connect to a public road that allows for travel in two directions in order to address Acceptable Solution A3.1. 

Fire service access routes (perimeter roads)	
Acceptable solution A3.7	Fire service access routes are to be established to provide access within and around the edge of the subdivision and related development to provide direct access to bushfire prone areas for fire fighters and link between public road networks for firefighting purposes. Fire service access routes are to meet the following requirements: • Requirements in Table 1, Column 5 • Provided as right of ways or public access easements in gross to ensure accessibility to the public and fire services during an emergency • Surface: all-weather (i.e. compacted gravel, limestone or sealed) • Dead end roads are not permitted • Turn-around areas designed to accommodate type 3.4 appliances and to enable them to turn around safely every 500 metres (i.e. kerb to kerb 17.5 metres) • No further than 600 metres from a public road • Allow for two-way traffic • Must be signposted.
Explanatory note E3.7	Fire service access routes should be established to separate bushfire prone areas from developed areas, and to provide access within and around the edge of subdivisions and related development. Fire service access is used during bushfire suppression operations but can also be used for fire prevention work. Fire service access routes should: • Link up with the road network at regular intervals - the development and road network forms part of the fire service access system • Be adequately signposted • Allow for two-way traffic - that is, two fire appliances must be able to safely pass each other • Have an all-weather surface (i.e. compacted gravel, limestone or sealed) • Have erosion control measures in place. Driveways may be used as part of the designated fire service access system, provided they meet the minimum standard for fire service access routes. It is beneficial to link the fire service access routes with individual driveways to allow quick access to properties and houses during fire emergencies. Where gates are used, these should be wide enough to accommodate type 3.4 fire appliances (minimum width of 3.6m) with the design and construction to be approved by the relevant local government. Gates on fire service access routes may be locked to restrict access provided that a common key system is used and such keys are made available for fire appliances and designated fire officers within the local government area and/or surrounding district. Gates should be installed where fences cross fire service access routes. Management and access arrangements should be in place to ensure that the maintenance of fire service access routes will occur in the long term after an area has been subdivided. A number of options can be used to achieve this, including but not limited to: • Individual property owners being responsible for maintaining fire service access routes where these fall on their property • Providing such access as a right-of-way or easement in gross to ensure accessibility to fire services during an emergency; and/or • A levy system administered by local government to cover the cost of maintaining fire service access routes. Such arrangements should be documented in the relevant planning application (such as a structure plan, subdivision plan or development plan) and should be agreed to by local government.

Table 1: Vehicular access technical requirements

Technical requirement	1	2	3	4	5
	Public road	Cul-de-sac	Private driveway longer than 50 m	Emergency access way	Fire service access routes
Minimum trafficable surface (m)	6*	6	4	6*	6*
Horizontal distance (m)	6	6	6	6	6
Vertical clearance (m)	4.5	N/A	4.5	4.5	4.5
Maximum grade <50 m	1 in 10	1 in 10	1 in 10	1 in 10	1 in 10
Minimum weight capacity (t)	15	15	15	15	15
Maximum crossfall	1 in 33	1 in 33	1 in 33	1 in 33	1 in 33
Curves minimum inner radius	8.5	8.5	8.5	8.5	8.5

* Refer to E3.2 Public roads: Trafficable surface

Appendix 5
Water technical standards (the Guidelines, WAPC 2017)

Reticulated areas	
Acceptable solution A4.1	The subdivision, development or land use is provided with a reticulated water supply in accordance with the specifications of the relevant water supply authority and Department of Fire and Emergency Services.
Explanatory note E4.1	Water supply authorities in Western Australia include the Water Corporation, Aqwest and the Busselton Water Board. The Water Corporation's 'No. 63 Water Reticulation Standard' is deemed to be the baseline criterion for developments and should be applied unless local water supply authorities' conditions apply.

Attachment

06 Revised Transport Impact Assessment

TRANSPORT IMPACT ASSESSMENT

Barfield Road Structure Plan

Hammond Park

June 2019

Rev A

kctt

HISTORY AND STATUS OF THE DOCUMENT

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Appendices

Appendix 1 - The layout of the proposed development
Appendix 2 - Transport Planning and Traffic Plans

1. Executive Summary

Site Context

- Barfield Road Structure Plan is located within Hammond Park suburb, City of Cockburn.
- The Structure Plan area is fronting Frankland Avenue to the east, Barfield Road to the west and Rowley Road to the south.
- The previously approved Barfield Road Structure Plan is being amended/updated, and following changes are the focus of this report:
    - Addition of Lots 15 and 37 to the Structure plan
    - Redesign of Lot 18
    - The Local Centre land use is changed to a Child Care Centre
    - Minor changes in R-Code densities.

Technical Findings

- The entire Barfield Road Structure Plan area is expected to generate up to 3,497 VPD, 421 VPH in AM peak and 416 VPH in PM peak in total. The additional traffic generated by Lot 15 and Child Care Centre is 629 VPD, 72 VPH in AM peak and 67 VPH in the PM Peak. KCTT believe that the well-planned road network will successfully absorb the additional traffic. Six major routes will be available for accessing the Structure Plan area:
    - Via Rowley Road towards east (Kwinana Freeway)
    - Via Barfield Road towards north
    - Via Frankland Avenue and Hammond Road towards north
    - Via Wattleup Road towards west
    - Via Proposed Scolaro Road towards north (proposed High School)
    - Via Irvine Parade towards north (proposed Primary School)

Relationship with Policies

- The predominant use is residential and to comply with the R-Codes, it is expected that all residences will provide a garage for each dwelling. KCTT believe that by having a garage for the owner, visitors are likely to park in the driveway space in front of the garage.
- According to City of Cockburn Town Planning Scheme No. 3, the childcare centre will require 21 bays. The approved Childcare Centre located on Lot 9 Irvine Parade will have 21 parking spaces as per the plan included in MSWJDAP/180, therefore meeting the requirements.
- It is expected that delivery and service vehicles (such as waste removal vehicles) servicing the area will not require designated parking spaces given that they can operate safely within the road reserve.

Other

- The following intersection controls are proposed:
    - Frankland Avenue / Whadjuk Drive - Roundabout – constructed
    - Irvine Parade / Whadjuk Drive - Roundabout – constructed
    - Rowley Road / Irvine Parade - Roundabout - constructed as an interim solution. When Rowley Road is upgraded and under MRWA jurisdiction, it is expected that this roundabout and intersection with Barfield Road will be terminated. The exact timeframes for these changes are unknown currently.

- Road 02 - Barfield Road - No vehicle access, only cycling. There is potential for a Left-in only, however this will be assessed at a more detailed stage of planning.
- All other intersections - Give-way/Yield

2. Transport Impact Assessment

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2.1. Location

Structure Plan	Barfield Road Structure Plan
Lot Numbers	Lots 13-14, 15,18, 37 & 47-51 Hammond Park
Road Name(s)	Barfield Road, Rowley Road, Frankland Avenue
Suburb	Hammond Park
Description of Site	Barfield Road LSP area is located in Hammond Park, City of Cockburn. Previously approved Barfield Road Structure Plan is being amended/updated, and following changes are the main subjects of this report: • Addition of Lots 15 and 37 to the Structure plan • Redesign of Lot 18 • The Local Centre land use is changed to a Child Care Centre • Minor changes in R-Code densities.

2.2. Technical Literature Used

Local Government Authority	City of Cockburn
Type of Development	Residential
Are the R-Codes referenced?	YES
If YES, nominate which:	State Planning Policy 3.1 Residential Design Codes 2018 R-Codes (incorporating amendments gazetted on 2/8/2013, 23/10/15 and 2/3/2018)
Are other State Planning Policies referenced?	NO
Is the NSW RTA Guide to Traffic Generating Developments Version 2.2 October 2002 (referenced to determine trip generation / attraction rates for various land uses) referenced?	YES
Which WAPC Transport Impact Assessment Guideline should be referenced?	Volume 2 - Planning Schemes, Structure Plans & Activity Centre Plans Volume 5 - Technical Guidance

Are there applicable LGA schemes for this type of development?	YES
Name Number of Scheme	City of Cockburn Town Planning Scheme No. 3
Are Austroads documents referenced?	YES
Is the Perth Transport Plan for 3.5 million and Beyond referenced?	YES

2.3. Land Uses

Are there any existing Land Uses within the Structure Plan Area?	YES
If YES, nominate:	Approximately 70 dwellings (part of Barfield Road Structure Plan)

Proposed Land Uses

How many types of land uses are proposed?	Three
Nominate land use type and yield	Residential (436 dwellings + 44 additional to the LSP area = a total of 480 dwellings), Child Care Centre (77 children and 13 staff members), POS
Are the proposed land uses complimentary with the surrounding land-uses?	YES

2.4. Local Road Network Information

How many existing roads are there within the Structure Plan Area?

Name of Roads within the Structure Plan Area / Road Classification and Description:

Road 1

Road Name	Barfield Road
Number of Lanes	two way, one lane each direction, undivided
Road Reservation Width	20m
Road Pavement Width	6.2m
Classification	Significant Urban Local Road / Local Distributor
Speed Limit	70kph
Bus Route	YES (North of Gaebler Road)
If YES Nominate Bus Routes	536
On-street parking	NO

Road 2

Road Name	Frankland Avenue
Number of Lanes	two way, one lane each direction, undivided
Road Reservation Width	20m
Road Pavement Width	7.3m
Classification	Urban Local Road / Access Road; Significant Urban Local Road / Regional Distributor
Speed Limit	50kph or State Limit; 70kph

Bus Route	NO
On-street parking	NO

Road 3

Road Name	Irvine Parade
Number of Lanes	two way, one lane (no linemarking), undivided
Road Reservation Width	20m
Road Pavement Width	7.2m
Classification	Significant Urban Local Road / Local Distributor ; Urban Local Road / Access Road
Speed Limit	50kph or State Limit
Bus Route	NO
On-street parking	NO

Name of Other Roads within 2km radius of site, or roads likely to take increased traffic due to the development:

Road 1

Road Name	Wattleup Road
Number of Lanes	two way, one lane each direction, undivided
Road Reservation Width	20m
Road Pavement Width	6.5m
Classification	Significant Urban Local Road / Regional Distributor
Speed Limit	80kph
Bus Route	NO
If YES Nominate Bus Routes	
On-street parking	NO

Road 2

Road Name	Rowley Road
Number of Lanes	two way, one lane each direction, undivided
Road Reservation Width	20m
Road Pavement Width	7.5
Classification	Rural Local Road / Regional Distributor
Speed Limit	70kph
Bus Route	NO
If YES Nominate Bus Routes	
On-street parking	NO

Road 3

Road Name	Kwinana Freeway
Number of Lanes	two way, two lanes per direction, divided
Road Reservation Width	130m
Road Pavement Width	14.4m (7.2m each direction)
Classification	Rural Highway / Primary Distributor
Speed Limit	100kph
Bus Route	YES

If YES Nominate Bus Routes

On-street parking NO

2.5. Traffic Volumes

Road Name	Location of Traffic Count	Vehicles Per Day (VPD)	Vehicles per Peak Hour (VPH)		Heavy Vehicle %	Year	
			AM Peak Time - AM Peak VPH	PM Peak Time - PM Peak VPH	*If HV count is Not Available, are HV likely to be in higher volumes than generally expected?*	Date of Traffic Count	*If older than 3 years multiply with a growth rate to the current year*
Barfield Road	650m north of Rowley Road*	3,112	N/A	N/A	4.6%	Nov 2016	3,401 (3% annual growth rate)
	75m north of Ironbark Terrace*	2,050	N/A	N/A	7.8%	Nov 2016	2,240 (3% annual growth rate)
Frankland Avenue	60m south of Woodrow Avenue*	1,311	08:00 - 159	15:00 - 166	7.1%	Mar 2017	–
	160m south of Wattleup Road*	5,113	N/A	N/A	20.4%	Feb 2016	5,587 (3% annual growth rate)
Gibbs Road	East of Kwinana Freeway	18,076	07:45 – 1,426	16:45 – 1,852	N/A	2017/ 2018	–
Hammond Road	North of Russell Road	10,386	07:30 – 1,055	15:30 – 1,081	7.8%	2016/ 2017	–
Irvine Parade	180m south of Gaebler Road*	1,426	N/A	N/A	4.8%	May 2016	1,558 (3% annual growth rate)
Kwinana Freeway	Northbound - South of Armadale Road	47,121	05:15 - 3,634	14:15 – 3,134	N/A	2017/ 2018	–
	Southbound - South of Armadale Road	55,643	06:45 – 3,554	15:15 – 4,619			–
	Northbound at Bridge Under Russell Road	38,593	05:15 – 3,037	14:15 – 2,549	18.9%	2017/ 2018	–
	Southbound at Bridge Under Russell Road	43,331	07:00 – 2,765	14:45 – 3,448	13.7%		–
	Northbound - South of Russell Road	41,610	05:15 – 3,204	14:15 – 2,750	13.3%	2017/ 2018	–

	Southbound - South of Russell Road	46,591	07:15 – 3,043	14:45 – 3,738	13.2%		–
	Northbound - South of Rowley Road	40,773	05:15 - 3,132	14:45 - 2,619	21.6%	2017/ 2018	–
	Southbound - South of Rowley Road	43,399	07:00 - 2,928	16:15 - 3,226	13.0%		–
Rowley Road	East of Kwinana Freeway	11.892	07:15 – 1,018	16:30 – 972	7.9%		–
	West of Kwinana Freeway	7,853	06:30 – 724	15:00 – 670	14.9%	2017/ 2018	–
Russell Road	West of Brushfoot Boulevard	15,111	07:30 – 1,298	16:30 – 1,423	12.3%	2014/ 2015	–
Russell Road on to Kwinana Freeway	Northbound - North of Russell Road	6,990	10:45 – 483	14:45 – 566	12.7%	2014/ 2015	–
Wattleup Road	300m west of Frankland Avenue*	4,742	06:00 - 494	16:00 - 419	25.8%	Sep 2017	–

Note - These traffic counts have been obtained from the City of Cockburn's Intramaps*

2.6. Vehicular Crash Information

Is Crash Data Available on Main Roads WA website?	YES
If YES, nominate important survey locations:	
Location 1	Rowley Road [SLK 0.00 - 0.80]
Location 2	Frankland Avenue [SLK 1.94 - 2.74] – no crashes
Location 3	Barfield Road [SLK 1.01-2.36]
Location 4	Barfield Road & Rowley Road
Location 5	Frankland Avenue & Rowley Road – no crashes
Period of crash data collection	01/01/2014 - 31/12/2018

Road / Intersection Name	SLK	Functional Classification	Road Hierarchy	Speed Limit	Crash Statistics			
					No of KSI Crashes	No of Medical Attention Crashes	No of PDO Major Crashes	No of PDO Minor Crashes
Rowley Road	0.00 - 0.80	Rural Local Road	Regional Distributor	70kph	0	0	2	0
No of MVKT Travelled at Location				approximately 7,500 VPD * 365 * 5 years * 0.8 km = 10.95 MVKT				
KSI Crash Rate				0 KSI crashes / 10.95 MVKT = 0 KSI crashes/MVKT				
All Crash Rate				2 crashes / 10.95 MVKT = 0.18 crashes/MVKT				
Comparison with Crash Density and Crash Rate Statistics				The average of 0.18 crashes/MVKT is lower than the network average of 0.81 crashes/MVKT.				
Barfield Road	1.01-2.36	Significant Urban Local Road	Local Distributor	70kph	0	0	1	0
No of MVKT Travelled at Location				approximately 3,000 VPD * 365 * 5 years * 1.35 km = 1.48 MVKT				
KSI Crash Rate				0 KSI crashes / 1.48 MVKT = 0 KSI crashes/MVKT				
All Crash Rate				1 crashes / 1.48 MVKT = 0.67 crashes/MVKT				
Comparison with Crash Density and Crash Rate Statistics				The average of 0.18 crashes/MVKT is lower than the network average of 0.81 crashes/MVKT.				
Barfield Road & Rowley Road	N/A	Significant Urban Local Road / Rural Local Road	Local Distributor / Regional Distributor	70kph / 70kph	0	0	2	0
No of MVKT Travelled at Location				approximately 10,000 VPD * 365 * 5 years * 0.3 km = 5.48 MVKT				
KSI Crash Rate				0 KSI crashes / 5.48 MVKT = 0 KSI crashes/MVKT				
All Crash Rate				2 crashes / 5.48 MVKT = 0.37 crashes/MVKT				
Comparison with Crash Density and Crash Rate Statistics				The average of 0.37 crashes/MVKT is lower than the network average of 1.73 crashes/MVKT.				

The following table shows the Crash Density and Crash Rates on Metropolitan Local Roads as obtained from Main Roads WA on the 14th May 2018 by email request: -

Crash Density and Crash Rate on Metropolitan Local Roads Network only

	All Crashes		Serious Injury Crashes (Fatal+Hospital)	
	Average Annual Crash Density (All Crashes/KM)	Average Annual Crash Rate (All Crashes/MVKT)	Average Annual Crash Density (Ser. Inj. Crashes/KM)	Average Annual Crash Rate (Ser. Inj. Crashes/MVKT)
Metro Local Road - Midblock	2.99	0.81	0.13	0.03
Metro Local Road - All	6.41	1.73	0.26	0.07

Note: Based on 5-years data for the period 2013 to 2017.

2.7. Public Transport Accessibility

How many bus routes are within 400 metres of the subject site? None

How many bus routes are within 800 metres of the subject site? Three (3)

Bus / Rail Route	Description	Peak Frequency	Off-Peak Frequency
535	Aubin Grove Station - Hammond Park West via Macquarie Boulevard	20 minutes	60 minutes
536	Aubin Grove Station - Hammond Park East via Barfield Road	20 minutes	60 minutes
537	Aubin Grove Station - Wandi via Lyon Road	10 minutes	60 minutes

Walk Score Rating for Accessibility to Public Transport.

25-49 | Some Transit. A few nearby public transportation options.

Is the development in a Greenfields area? NO

2.8. Pedestrian Infrastructure

Describe existing local pedestrian infrastructure within a 400m radius of the site:

Classification	**Road Name**
" Principal Shared Path"	Kwinana Freeway
" Other Shared Path (Shared by Pedestrians and Cyclists)"	Along Inverson Boulevard
Does the site have existing pedestrian facilities	YES
Does the site propose to improve pedestrian facilities?	YES

If YES, describe the measures proposed.

Refer to Section 2.19 Proposed Internal Road Network for roads with the proposed pedestrian paths.

What is the Walk Score Rating?

0-24 | Car-Dependent. Almost all errands require a car.

2.9. Cyclist Infrastructure

Are there any PBN Routes within an 800m radius of the subject site?	YES

If YES, describe:

Classification	Road Name
" Principal Shared Path"	Kwinana Freeway
" Other Shared Path (Shared by Pedestrians and Cyclists)"	Along Inverson Boulevard, Kesiya Turn, Macquarie Boulevard, Botany Parade, Durango Turn
" Good Road Riding Environment"	Irvine Parade, Gaebler Road, Lyon Road, Kesiya Turn, Macquarie Boulevard, Botany Parade, Ironbark Terrace, Durango Turn
" Perth Bicycle Network - Continuous Signed Routes"	SW18 - Wattleup Road, Rowley Road; SE41 - Barfield Road

Are there any PBN Routes within a 400m radius of the subject site?	YES

If YES, describe:

Classification	Road Name
" Principal Shared Path"	Kwinana Freeway
" Other Shared Path (Shared by Pedestrians and Cyclists)"	Along Inverson Boulevard, Kesiya Turn
" Good Road Riding Environment"	Irvine Parade, Kesiya Turn
" Perth Bicycle Network - Continuous Signed Routes"	SW18 - Wattleup Road, Rowley Road; SE41 - Barfield Road

Does the site have existing cyclist facilities?	YES
Does the site propose to improve cyclist facilities?	YES

If YES, describe the measures proposed.

Refer to Section 2.19 Proposed Internal Road Network for roads with the proposed pedestrian paths.

2.10. Vehicular Parking

Local Government	City of Cockburn
Local Government Document Utilised	Town Planning Scheme No. 3 State Planning Policy 3.1 - R-Codes

Description of Parking Requirements in accordance with Scheme:

City of Cockburn - Town Planning Scheme No. 3

" Dwelling - As prescribed in the Residential Design Codes

Child Care Premises:

- *1:1 employee Plus*
- *1:10 children"*

R-Codes:

" The following minimum number of on-site car parking spaces is to be provided for each single house, grouped dwelling and special purpose dwelling comprising the following number of bedrooms:

- *1-bedroom dwellings – Location B – 1 bay per dwelling*
- *2+ bedroom dwellings – Location B – 2 bays per dwelling"*

Justification

Predominant use is residential and to comply with the R-Codes, it is expected that all residences will provide a garage for each dwelling. KCTT believe that by having a garage for the owner, visitors are likely to park in the driveway space in front of the garage. Access Street "C" can accommodate on-street parking to provide additional

bays but also to visually narrow the street and improve safety in the pedestrian environment. Neighbourhood Connector B roads are expected to have parking on both sides of the road.

The approved Childcare Centre located on Lot 9 Irvine Parade will have 21 parking spaces as per the plan included in MSWJDAP/180.

Have Vehicle Swept Paths been checked for Parking?	NO

2.11. Bicycle Parking

Local Government	City of Cockburn
Reference Document Utilised	Town Planning Scheme No. 3
	State Planning Policy 3.1 - R-Codes

Description of Parking Requirements in accordance with Scheme:

City of Cockburn - Town Planning Scheme No. 3

" Dwelling - For Grouped and Multiple Dwellings.

- *1:4 units for residents*
- *1:16 units for visitors"*

Justification

It is expected that any grouped and multiple dwellings would provide bicycle parking as outlined by the City of Cockburn Town Planning Scheme No. 3.

The approved Childcare Centre located on Lot 9 Irvine Parade will have 1 bicycle rack as per the plan included in MSWJDAP/180.

2.12. ACROD Parking

Class of Building	Class 1a - a single dwelling Class 2 - a building containing 2 or more sole-occupancy units each being a separate dwelling
Does this building class require specific provision of ACROD Parking?	NO
Reference Document Utilised	Building Code of Australia

Justification

The approved Childcare Centre located on Lot 9 Irvine Parade will have 1 accessible car parking bay as per the plan included in MSWJDAP/180.

2.13. Delivery and Service Vehicles

Guideline Document used as reference	NSW RTA Guide to Traffic Generating Developments

Requirements

Residential flat buildings (> 200 flats or home Units) - 4 + 1 per 100 units over 200 plus 1 space per 1,000 m2 of public area set aside for bar, tavern, lounge and restaurant

Justification

It is expected that delivery and service vehicles (such as waste removal vehicles) servicing the area will not require designated parking spaces given that they can operate safely within the road reserve.

2.14. Calculation of Development Generated / Attracted Trips

What are the likely hours of operation?	For residential land uses, the hours of operation are not applicable. Child Care Centre 06:30 - 18:30
What are the likely peak hours of operation?	AM 08:00 - 09:00 PM 17:00 - 18:00
Do the development generated peaks coincide with existing road network peaks?	YES
If YES, Which:	Partially, AM peak only
Guideline Document Used	**WAPC Transport Assessment Guidelines for Developments**
Rates from above document:	**Residential** – 0.8 vehicle trips per dwelling for the AM and PM peak hours. A 25% IN / 75% OUT split has been adopted for the AM peak and a 67% IN / 33% OUT split for the PM peak hour; **Schools** - The rates are based on data from the PARTS surveys that indicate that around 65% - 70% of children are driven to primary school, with an average occupancy of around 1.4 - 1.5 children per car. This equates to 0.5 trips per child to school and 0.5 trips per child from school in each of the AM and PM peak hours. For secondary schools the PARTS data indicate that the proportion driven to school is generally a little lower but, to simplify the process of determining the level of assessment required and for the broad assessment of structure plans, it is suggested that the above primary school rates be used for all schools.
Guideline Document Used	**NSW RTA Guide to Traffic Generating Developments**
Rates from above document:	The NSW RTA Guide to Traffic Generating Developments suggest residential developments of this type in Sydney tend to generate between 4 and 5 vehicular trips per dwelling. In Perth, the Department of Planning and Infrastructure conducted a series of studies in the late 1990's / early 2000's which showed that higher density dwellings tended to average closer to 6.7 vehicle movements per day. KCTT propose using an average VPD of 6.7 vehicular trips per day per residence for R30 and below and an average VPD of 5.5 vehicular trips per day per residence for R40 and above (these rates were used in the previously approved TIA for the Barfield Road Structure Plan).
Guideline Document Used	**ITE Trip Generation Report (9th Edition)**
Rates from above document:	**Elementary School** *Students: 1.29 vehicular trips per day per student*

Child care centres vehicular daily trips can be assumed to be a maximum of 4 VPD per child and 2 VPD per employee. Each parent generates 2 vehicular trips when dropping off the child to the day care centre and 2 vehicular trips when picking the child up. Employees generate 1 vehicular trip arriving at work, and another

vehicular trip when leaving work. It is a conservative assumption based on the idea that every child in the centre is driven to the premises and that there are no siblings in the centre.

	Land Use Type	Rate above	Yield	Daily Traffic Generation	AM Peak	PM Peak
Previously approved Barfield Road Local Structure Plan	*Residential (R25-R30)*	*6.7 vehicle trips per day* *0.8 vehicle trips per peak hour*	392 dwellings	**2,626**	**314**	**314**
	Residential (R40-R60)	*5.5 vehicle trips per day* *0.8 vehicle trips per peak hour*	44 dwellings	**242**	**35**	**35**
Amendments to Barfield Road Local Structure Plan	*Residential (R30)*	*6.7 vehicle trips per day* *0.8 vehicle trips per peak hour*	44 dwellings	295	35	35
	Approved Child Care Centre	*4 vehicle trips per child* *2 vehicle trips per staff member* **Peak hour traffic generation was adopted from the TIS report for the proposed child care centre prepared by Cirqa - November 2018*	77 children 13 staff members	334	37*	32*
			Total LSP Traffic - (A):	**3,497**	**421**	**416**
Land Uses Outside of the LSP Area	*Primary School*	**Assume up to 60% of all children are driven to school* *1.2 vehicle trips per child per day* *0.5 vehicle trips per child per peak hour*	*Assume up to 300 children and up to 30 staff members*	360	150	150
	High School	**Assume up to 30% of all children are driven to school* *0.6 vehicle trips per child per day* *0.3 vehicle trips per child per peak hour*	*Assume up to 1,000 children and up to 50 staff members*	600	300	300
			Total **(B)**:	**4,457**	**871**	**866**

Justification

Does the site have existing trip generation / attraction?	YES

No of Daily Trips	Approximately 70 dwellings (according to the latest aerial imagery) 70 * 6.7 VPD = 469 VPD **(C)**
No of AM Peak Hour Trips	70 * 0.8 = 56 VPH
No of PM Peak Hour Trips	70 * 0.8 = 56 VPH
What is the total impact of the new proposed development?	**A - C** = 3,028 VPD; AM 365 VPH; PM 360 VPH The impact of the proposed development on the surrounding road network is high according to WAPC guidelines.

2.15. Trip Purposes

Land Use	Employment	Shopping	Education	Social / Recreational
Residential	40%	17.5%	25%	17.5%

2.16. Expected Origin / Destination

Name the closest existing major residential generators and non-residential attractors of traffic and the distance from the boundaries of the Structure Plan Area.

Residential — Employment (profile.id)

The majority of employment trips is expected to be external to the proposed Structure Plan Area. The ID website on the City of Cockburn's webpage suggests the following breakdown for employment destinations for residents of the City of Cockburn:

- Cockburn (C) - 28.1%
- Melville (C) - 11.1%
- Perth (C) - 10.8%
- Fremantle (C) - 9.6%
- Canning (C) - 5.8%
- No Fixed Address (WA) - 4.4%
- Belmont (C) - 2.6%
- Stirling (C) - 2.4%
- Kwinana (C) - 2.3%
- Rockingham (C) - 2.2%
- Victoria Park (T) - 2.2%
- Gosnells (C) - 1.8%
- Armadale (C) - 1.4%
- Subiaco (C) - 1.4%
- Swan (C) - 1.3%
- Vincent (C) - 1.1%
- South Perth (C) - 1.1%
- Ashburton (S) - 1.1%
- Nedlands (C) - 1.0%
- Others – less than 1.0% each

The City Cockburn i.d. site shows that up to 71.6% of all work trips are undertaken using a vehicle (i.e. vehicle as driver plus vehicle as passenger).

Given the predominant transport mode and distribution of destinations, which excluding working from home, shows that

	there is no source of employment within the structure plan area, the following roads in KCTT's opinion will be predominantly used for access/egress to the site: - • Rowley Road • Frankland Avenue • Barfield Road
Shopping	Shopping centre is not proposed within the structure plan area. The nearest shopping centres are: • Aubin Grove Local Centre located 1km to the north-east • The Park Hive located 1.6km to the north • Harvest Lakes Shopping centre 2km to the north-east
Education	There are no schools proposed within the structure plan area, however a Childcare Centre has been approved on Lot 9 Irvine Parade. Several schools are located in close vicinity: • Hammond Park Catholic Primary School is adjacent to the structure plan area to the north • Future high school is currently being constructed adjacent to the structure plan area to the north • Hammond Park Primary School is located 800m to the north-west • Aubin Grove Primary School is located 800m to the east
Social / Recreational	It is deemed that a minimum of 80% of the trips for social and recreational purpose will be external.

2.17. Traffic Flow Distribution onto External Road Networks

How many routes are available for access / egress to the site?	6
Route 1	
Provide details for Route No 1	**Via Rowley Road towards east (Kwinana Freeway)**
Percentage of Vehicular Movements via Route No 1	24% = 1,070 VPD / AM 209 VPH / PM 208 VPH
Route 2	
Provide details for Route No 2	**Via Barfield Road towards north**
Percentage of Vehicular Movements via Route No 2	17% = 758 VPD / AM 148 VPH / PM 147 VPH
Route 3	
Provide details for Route No 3	**Via Frankland Avenue and Hammond Road towards north**
Percentage of Vehicular Movements via Route No 3	34% = 1,515 VPD / AM 296 VPH / PM 294 VPH
Route 4	
Provide details for Route No 4	**Via Wattleup Road towards west**
Percentage of Vehicular Movements via Route No 4	13% = 579 VPD / AM 113 VPH / PM 113 VPH
Route 5	
Provide details for Route No 5	**Via Proposed Scolaro Road towards north (proposed High School)**
Percentage of Vehicular Movements via Route No 5	7% = 312 VPD / AM 61 VPH / PM 61 VPH
Route 6	

Provide details for Route No 6	**Via Irvine Parade towards north (proposed Primary School)**
Percentage of Vehicular Movements via Route No 6	5% = 223 VPD / AM 44 VPH / PM 43 VPH

**Note - To and from Rowley Road will only be permitted until construction of the land identified in the WAPC application 149269 has been completed and all Lots developed contained therein being sold to prospective purchasers. Once the construction and sale of these lots has been completed, access to and from Rowley Road for Irvine Parade will be removed at the full cost of the developer / applicant / original landowner and reconfigured to a T-intersection. No access will be permitted to or from Rowley Road for Irvine Parade once the above criteria have been met.*

***Note - Access to and from Rowley Road for Barfield Road will be either a cul-de-sac or an underpass as communicated in Main Roads response to the WAPC application 149269. In the short-term only a cul-de-sac will be permitted.*

2.18. Road Safety

Are sight distances adequate at proposed intersections?	YES

Justification

Liveable Neighbourhoods guidelines state that junction spacing for access streets or laneway junctions are not to be located closer than 20m. The proposed road network complies with this requirement.

2.19. Proposed Internal Road Network

Guideline Document used as reference	Liveable Neighbourhoods
How many proposed roads are there within the Structure Plan Area?	total of 27 roads, 10 of which are partly or completely constructed

The classification below is reflective of minimal traffic requirements. The road reservation widths can be expanded and re-organised to satisfy different types of requirements (e.g. civil engineering, environmental, conservational, urban design etc.), therefore roads that have lower order hierarchy according to traffic engineering requirements might have wider road reservations if required.

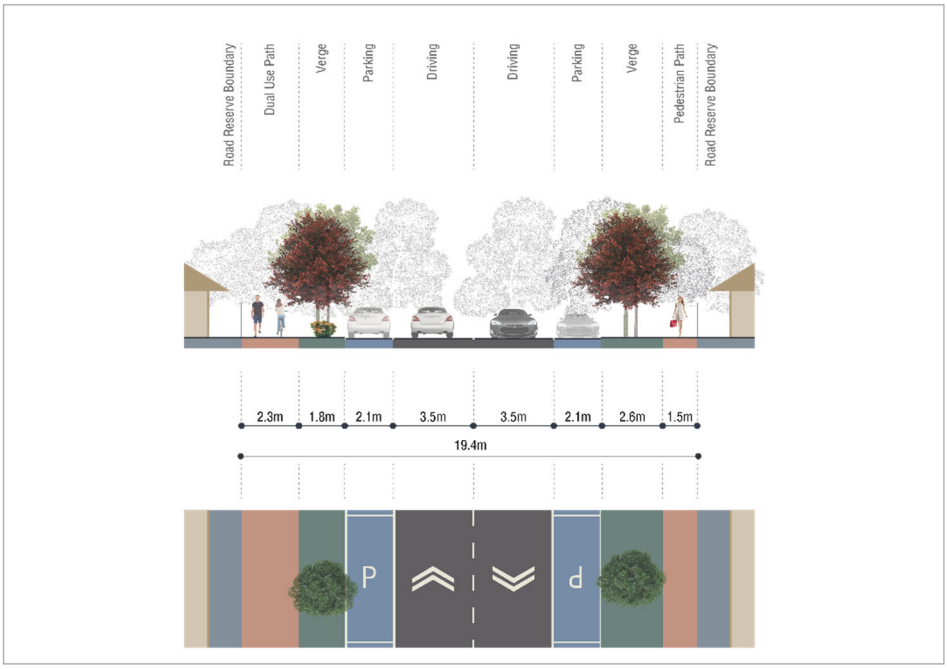
Name of Roads within the Structure Plan Area / Road Classification and Description:

Road 1-2

Name of Roads	Whadjuk Drive, Barfield Road (north of Road 02) *Note - It is expected that Whadjuk Drive (east of Frankland Avenue) will have 3,200 VPD in 2031. However, KCTT believe that traffic will not grow further, and therefore there will be no for upgrading this road section to NC A
Projected Traffic Volumes	< 3,000 VPD
Proposed Number of Lanes	one lane per direction
Proposed Road Reservation Width	19.4m
Proposed Road Pavement Width	7.0m
Proposed Median Width	-
Proposed Pedestrian / Cyclist / Shared Path Width	2.1-2.3m shared path on at least one side of the road reservation
Proposed Classification	Neighborhood Connector “B”
Proposed Speed Limit	50 km/h

Proposed Bus Route Extension / Introduction	YES
If YES Nominate Bus Routes	Bus route is planned along Barfield Road and Whadjuk Drive to a location near Rowley Road.
Proposed On-street parking	YES – 2.1m parallel parking

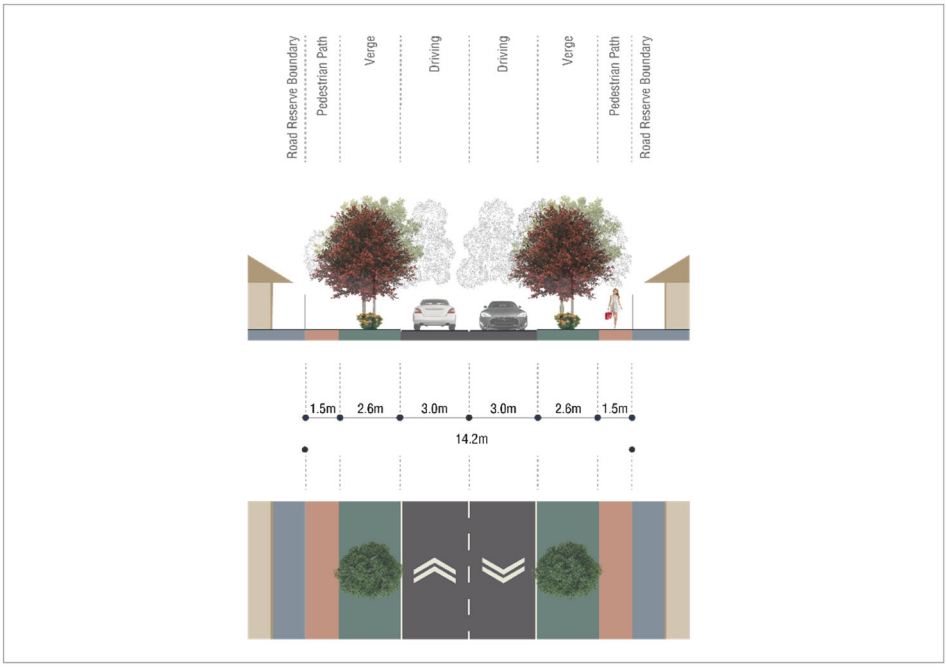
Provide graphics of the proposed internal road cross section within the Structure Plan Area



Road 3 - 19

Name	Road 01, Road 03, Road 04, Scolaro Road, Irvine Parade, Rechen Chase, Prato Vista, Corsia Crescent, Varese Road, Liscia Way, Caro Way, Iseo Way, Campana Rise, Napoli Drive, Bari Road, Venezia Ridge *Note - It is expected that Irvine Parade (south of Whadjuk Drive) will have 1,070 - 1,080 VPD. However, given this is an internal road, KCTT believe that traffic will not grow further, and therefore there will be no for upgrading this road section to NC B.
Projected Traffic Volumes	<1,000 VPD
Proposed Number of Lanes	one lane per direction
Proposed Road Reservation Width	14.2m
Proposed Road Pavement Width	6.0m
Proposed Median Width	-
Proposed Pedestrian / Cyclist / Shared Path Width	1.5m pedestrian path on at least one side of the road reservation
Proposed Classification	Neighborhood Connector “B”
Proposed Speed Limit	40 km/h
Proposed Bus Route Extension / Introduction	NO
Proposed On-street parking	NO

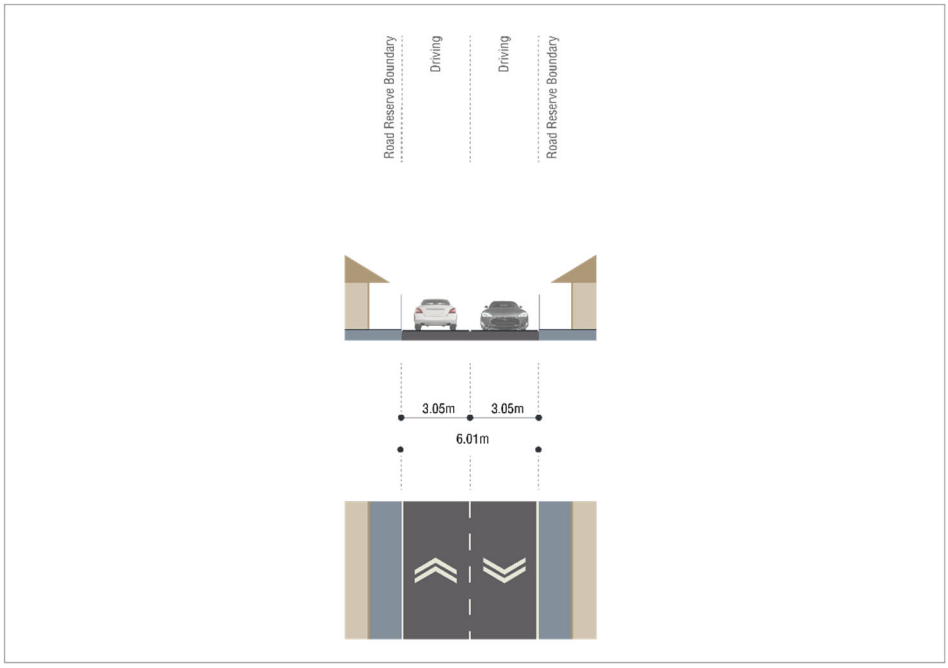
Provide graphics of the proposed internal road cross section within the Structure Plan Area



Road 20 - 26

Name	Seme Lane, Bello Lane, Capello Lane, Volere Lane, Cembra Lane, Tesoro Lane
Projected Traffic Volumes	<100 VPD
Proposed Number of Lanes	one lane per direction
Proposed Road Reservation Width	6.01m
Proposed Road Pavement Width	6.01m
Proposed Median Width	-
Proposed Pedestrian / Cyclist / Shared Path Width	-
Proposed Classification	Laneway
Proposed Speed Limit	15 km/h
Proposed Bus Route Extension / Introduction	NO
Proposed On-street parking	NO

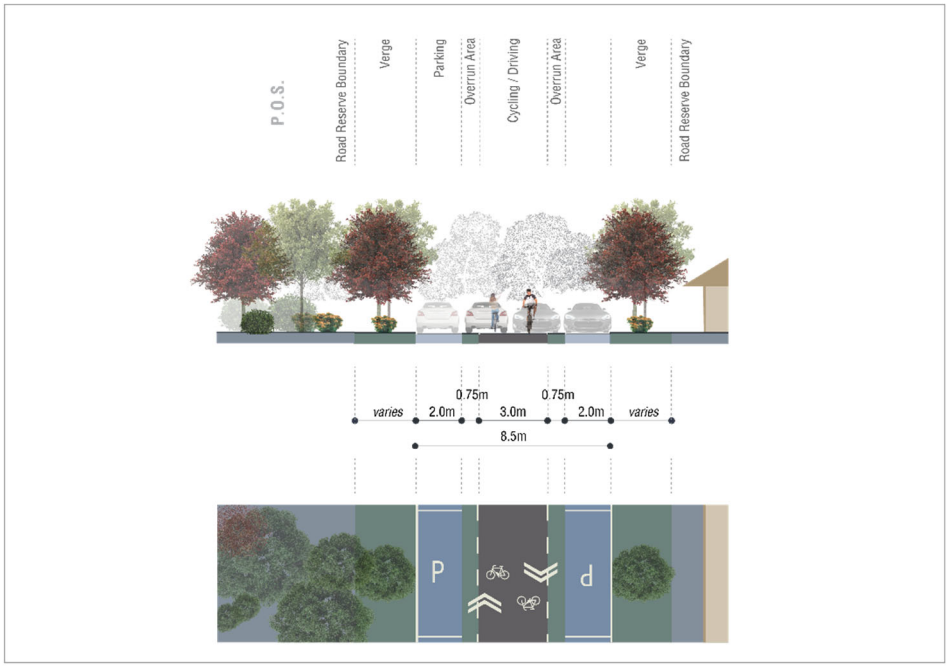
Provide graphics of the proposed internal road cross section within the Structure Plan Area



Road 27

Name	Road 02
Projected Traffic Volumes	<100 VPD
Proposed Number of Lanes	one lane per direction
Proposed Road Reservation Width	varies
Proposed Road Pavement Width	3.0
Proposed Median Width	-
Proposed Pedestrian / Cyclist / Shared Path Width	3.0m shared space
Proposed Classification	Safe Active Street *It should be noted that SAS can take up many forms, the one presented below is one of the examples.*
Proposed Speed Limit	15 km/h
Proposed Bus Route Extension / Introduction	NO
Proposed On-street parking	YES - 2.0m parallel parking

Provide graphics of the proposed internal road cross section within the Structure Plan Area


P.O.S.
Road Reserve Boundary
Verge
Parking
Overrun Area
Cycling / Driving
Overrun Area
Verge
Road Reserve Boundary
varies
2.0m
0.75m
3.0m
0.75m
2.0m
varies
8.5m
P
d

2.20. Proposed Intersection Controls

How many proposed intersections have been analysed?

Name of Intersections within the Structure Plan Area / Road Classification and Description:

Intersection 1	
Name	Frankland Avenue / Whadjuk Drive
Proposed Intersection Control	Roundabout – constructed
Intersection 2	
Name	Irvine Parade / Whadjuk Drive
Proposed Intersection Control	Roundabout – constructed
Intersection 3	
Name	Irvine Parade / Rowley Road
Proposed Intersection Control	Roundabout – constructed as an interim solution; When Rowley Road is upgraded, most likely the roundabout will be terminated. Timeframe is unknown currently.
Intersection 4	
Name	Road 02 - Barfield Road
Proposed Intersection Control	No vehicle access, only cycling. There is potential for a Left-in only, however this will be assessed at a more detailed stage of planning.
All other intersections	
Name	All other intersections
Proposed Intersection Control	Give-way/Yield *

*Note - Intersection with Irvine Parade north of Rowley Road might have Left-in/Left-out only configuration until the roundabout is closed. After roundabout closure, this intersection might be configured to a full movement T-intersection.

Name additional recommendations

Liveable Neighbourhoods suggest 6.0 metres kerb radii for access street intersections in order to discourage reckless driving therefore it would be prudent to allow for 6.0 metres curb radii for Access Street D intersections and laneways internal to the LSP area.

2.21. Proposed Internal Transport Networks

Are there any changes / additions to the existing road network?

- 28 proposed roads, some of them are already constructed or under construction as part of the approved structure plan area.
- The existing Rowley Road / Irvine Parade roundabout will serve as an interim solution. It is expected that this roundabout will be closed when Rowley Road is upgraded. However, the exact timeframe for this is unknown. Similarly, the intersection of Barfield Road and Rowley Road is expected to be terminated in the future.

Were there any discussions / agreements with MRWA regarding intersections with, or direct access onto roads under their jurisdiction?	YES
If YES, nominate:	The proposed access/egress arrangements to Rowley Road are short to medium term only and are subject to rationalisation in the future when MRWA constructs new Rowley Road geometry.
Are there any pedestrian / cycle networks and crossing facilities proposed for the roads within the Structure Plan Area?	YES
If YES, nominate:	• Proposed pedestrian path on one side of all proposed streets within the subject area • Proposed shared path on one side of Road 01 and Road 02 • Proposed shared path on Serpentine Road, connecting the existing PSP path along Kwinana Freeway to the good road environment on Baldivis Road.
Were there any discussions / agreements with the local authority over local road networks and pedestrian and cycle facilities?	NO
Were there any discussions / agreements with PTA / Transperth on new bus services or extensions / alterations to existing bus services to serve the Structure Plan Area?	YES
If YES, nominate:	• Bus route 525 is planned to service the Structure Plan Area with a network to be confirmed along Barfield Road to a location near Rowley Road. • Bus route 526 is planned to service the western portion of the Structure Plan Area with a network to be confirmed along the future Hammond Road and / or Frankland Road.

2.22. Changes to External Transport Networks

Are there any proposed changes of the road network?	YES: • Rowley Road has been identified as a primary freight route to the Naval Base / Kwinana Beach industrial areas. It will be constructed to four lanes and divided in accordance with Main Roads WA standards. However, timing for these upgrades are unknown at this stage (Perth and Peel @3.5 million - Road Network Plan). • Hammond Road extension south to Rowley Road, with the connection ultimately extending to Anketell Road.
Are there any proposed changes of the intersection controls?	YES • There are plans for grade separation on the intersection of Hammond Park and Rowley Road Extension, however this is yet to be confirmed at a more detailed planning stage.
Are there any proposed changes of the pedestrian / cycle networks and crossing facilities?	YES • Several new pedestrian and cycling facilities are planned as part of the adjoining structure plans areas in Hammond Park, Wattelup and Mandogalup.

Are there any proposed changes of the public transport services?	YES: • Bus route 525 is planned to service the Structure Plan Area with a network to be confirmed along Barfield Road to a location near Rowley Road. • Bus route 526 is planned to service the western portion of the Structure Plan Area with a network to be confirmed along the future Hammond Road and / or Frankland Road.

These changes could be those committed or proposed by others, MRWA or local authority, or by the proponent as part of the structure plan.

2.23. Integration with Surrounding Area

Are there any existing major residential generators of traffic within a minimum of 800 metres from the boundaries of the Structure Plan Area?	YES:
If YES, nominate:	• Hammond Park residential area north of the subject site • Aubin Grove residential area west of the subject site
Are there any existing major non-residential attractors of traffic within a minimum of 800 metres from the boundaries of the Structure Plan Area?	YES
If YES, nominate:	• Aubin Grove Local Centre located 1km to the north-east • The Park Hive located 1.6km to the north • Harvest Lakes Shopping centre 2km to the north-east • Hammond Park Catholic Primary School is adjacent to the structure plan area to the north • Future high school is currently being constructed adjacent to the structure plan area to the north • Hammond Park Primary School is located 800m to the north-west • Aubin Grove Primary School is located 800m to the east
Identify any proposals for major changes to the land uses within 800 metres of the boundaries of the Structure Plan Area.	• A large residential area is planned south of the subject site as part of the Mandogalup East LSP and Mandogalup West LSP with R-codes ranging from 30 to 80. Additionally, the plans outline a primary school and local centre site. • Southern Suburbs District Structure Plan for the area north and west of the subject site outline medium to high residential densities with mixed business, schools and local centres. Parts of this area are already constructed or under construction.
What are the main desire lines between the structure plan land uses and these external attractors / generators?	• Barfield Road • Hammond Road/Frankland Avenue • Rowley Road • Kwinana Freeway • Lyon Road
Will the existing transport networks, plus any proposed changes, adequately match these desire lines, particularly for pedestrians, cyclist and public transport users?	• Structure Plan Area is well connected to the metropolitan road network with connectivity to Rowley Road and Kwinana Freeway for major external trips, Frankland Avenue / Future Hammond Road alignment for external trips to the west and

Barfield Road for localised travel between the existing Hammond Park area and the Structure Plan Area.

Propose remedial measures to address these deficiencies.

The area is well planned, when all infrastructure is completed, it is expected that the network will function without any major issues.

2.24. Analysis of Transport Networks

Determine the year(s) for assessment and the time period(s) for the traffic flow analysis.

2025 and 2031

Determine structure plan generated traffic.

Refer Sections 2.14. and 2.17.

Road Name		Existing Traffic Volumes	Date	Forecasted Traffic Volumes in 2025	Forecasted Traffic Volumes in 2031
Barfield Road	Northern Boundary of Structure Plan Area	3,112	2016	2,280	2,480
Frankland Avenue	North of Wattleup Road	1,311	2017	2,430	2,080
	North of Rowley Road	5,113	2016	6,270	2,990
Rowley Road	East of Barfield Rd	7,853	2018	8,900	9,550
Irvine Parade	North of Whadjuk Drive	N/A	N/A	300	300
	South of Whadjuk Drive	N/A	N/A	1,070	1,080
	North of Rowley Road	N/A	N/A	310	310
Whadjuk Drive	East of Frankland Avenue	N/A	N/A	3,000	3,200
	West of Barfield Road	N/A	N/A	1,950	2,150
Prato Vista	East of Frankland Avenue	N/A	N/A	730	730
Parko Glade	West of Irvine Parade	N/A	N/A	260	260
Napoli Drive	South of Whadjuk Drive	N/A	N/A	350	350
	North of Venezia Ridge	N/A	N/A	50	50
Rechen Chase	South of Whadjuk Drive	N/A	N/A	300	300
Corsia Crescent	West of Irvine Parade	N/A	N/A	490	490
Liscia Way	West of Barfield Road	N/A	N/A	300	300
Genoa Parkway	West of Barfield Road	N/A	N/A	110	110
Venezia Ridge	West of Barfield Road	N/A	N/A	110	110
Road 01	East of Barfield Road	N/A	N/A	100	100
Road 02	East of Barfield Road	N/A	N/A	100	100
Road 03	East of Barfield Road	N/A	N/A	300	300
Road 04	Between Road 02 and Road 03	N/A	N/A	200	200

Identify all schools within the structure plan area and those within 800 metres of the structure plan area.

There are no schools proposed within the structure plan area, however a Childcare Centre has been approved on Lot 9 Irvine Parade.

	Several schools are located in vicinity: • Hammond Park Catholic Primary School is adjacent to the structure plan area to the north • Future high school is currently being constructed adjacent to the structure plan area to the north • Hammond Park Primary School is located 800m to the north-west • Aubin Grove Primary School is located 800m to the east
Identify the most likely walk and cycle routes to each school from the catchment areas.	It is expected that all proposed roads will have pedestrian paths in their road reserves. The main collector roads will be Irvine Parade, Napoli Drive and Rechen Chase and further via or across Whadjuk Drive to Irvine Parade (the proposed Primary School) or Scolaro Road (the proposed High School).

2.25. Site-Specific Issues and Proposed Remedial Measures

How many site-specific issues need to be discussed?	One (1)
Site Specific Issue No 1	**Traffic Impact of the proposed changes to the Local Structure Plan**
Remedial Measure / Response	The proposed changes will provide approximately 600 VPD (approximately 70 VPH in peak hours) in addition to the original Structure Plan. Since this additional traffic will be spread throughout the internal and external network with traffic distribution as described in Section 2.17, these amendments will not have a significant impact on the road network and its performance. KCTT believe that the proposed road network will successfully absorb the traffic generated by the proposed LSP area.

Appendix 1

The Layout of the Proposed Development



LEGEND

STRUCTURE PLAN BOUNDARY

ZONES
- RESIDENTIAL
- LOCAL CENTRE

RESERVES
- PARKS AND RECREATION
- PUBLIC PURPOSE

OTHER ELEMENTS THAT INFORM THE LSP
- R25 RESIDENTIAL DENSITY CODE
- PROPOSED BUS ROUTE
- DISTRICT CYCLE CONNECTION
- PLANNING CONTROL AREA No. 95
- LAND WITHIN FLAMEZONE NOT CAPABLE OF BEING DEVELOPED UNTIL ADJOINING BUSH FIRE HAZARD REMOVED
- DEVELOPMENT SUBJECT TO DWELLING CONSTRUCTION UNDER AS3959-2009

great places_
robertsday.com.au
planning·design·place

CADASTRAL INFORMATION
SOURCE: McMULLEN NOLAN
YYMMDD: 140501
DWG REF: 96236
PROJECTION: PCG 94

SIZE A3
1:3000
0 metres 30 60 90 120 150

REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
J	UPDATE PER RD1 150D	190510	SB	ED
I	STRUCTURE PLAN UPDATE	190417	HH	EH
H	MINOR BOUNDARY ADJUST	181001	ED	-
G	ALIGN R30	180927	ED	-

BARFIELD ROAD STRUCTURE PLAN
Lots 13-14, 18 & 47-51 Hammond park
City of Cockburn

REF NO. **RIC HAM**
DRAW NO. **RD1 045**
REV. **J**

DISCLAIMER: ISSUED FOR DESIGN INTENT ONLY. ALL AREAS AND DIMENSIONS ARE SUBJECT TO DETAIL DESIGN AND SURVEY

N

Lot 28

20

Dual Use Path Only - 2.1m

BARFIELD ROAD

14.2m ROAD RESERVE

20m Entire Road Reserve in Lot 37

HIGH VOLTAGE POWER LINE

Lot 37 POS

Possible Left in only Traffic option

Raised plateau to give cyclist priority

Indicative Connection to Freeway PSP

14.2m ROAD RESERVE

Dept. of Transport Safe Active Street Concept

Approx. Location of Power Pylon

100m OFFSET

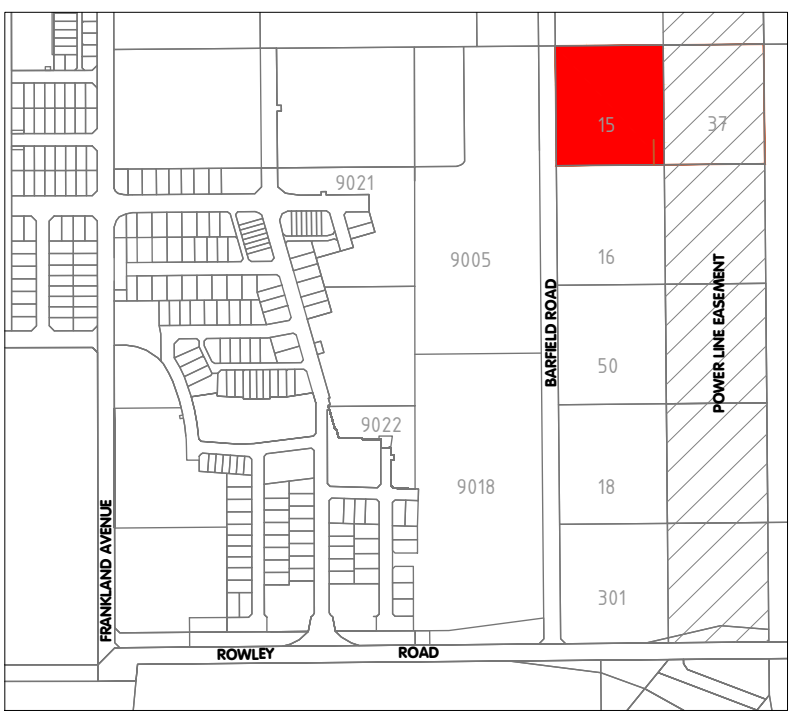
50m OFFSET

CENTRELINE

100

50

Lot 16



LOCATION PLAN EXISTING LOTS

SUBJECT LOT

LOT SUMMARY	
NUMBER OF LOTS	44
TOTAL AREA OF LOTS	14736m²
AVERAGE AREA OF LOTS	334m²
MINIMUM LOT AREA	268m²
MAXIMUM LOT AREA	433m²

LEGEND

- PROPOSED SUBDIVISION - SUBJECT LOTS
- EXISTING LOT
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARIES
- EXISTING LOT BOUNDARIES TO BE REMOVED
- 19 EXISTING CONTOURS
- 1012 EXISTING LOT NUMBERS
- INDICATIVE FUTURE LOT BOUNDARIES

Department of Transport Safe Active Streets Concept



GOLD ESTATES
RICHARDNOBLE
PROPERTY INTEGRITY COMMUNITY

CADASTRAL INFORMATION
SOURCE: MNG
YYMMDD: 180727
DWG REF: 96326pr-010ai.dwg
PROJECTION: PCG Conversion

AERIAL PHOTOGRAPHY
SOURCE:
YYMMDD:

RD great places

SIZE A3_1:1000

0 metres 10 20 30 40 50

REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
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B	LOT MODS. ADD PATH	190327	SB	ED
A	BASE PLAN RD1 111B	190326	SB	ED

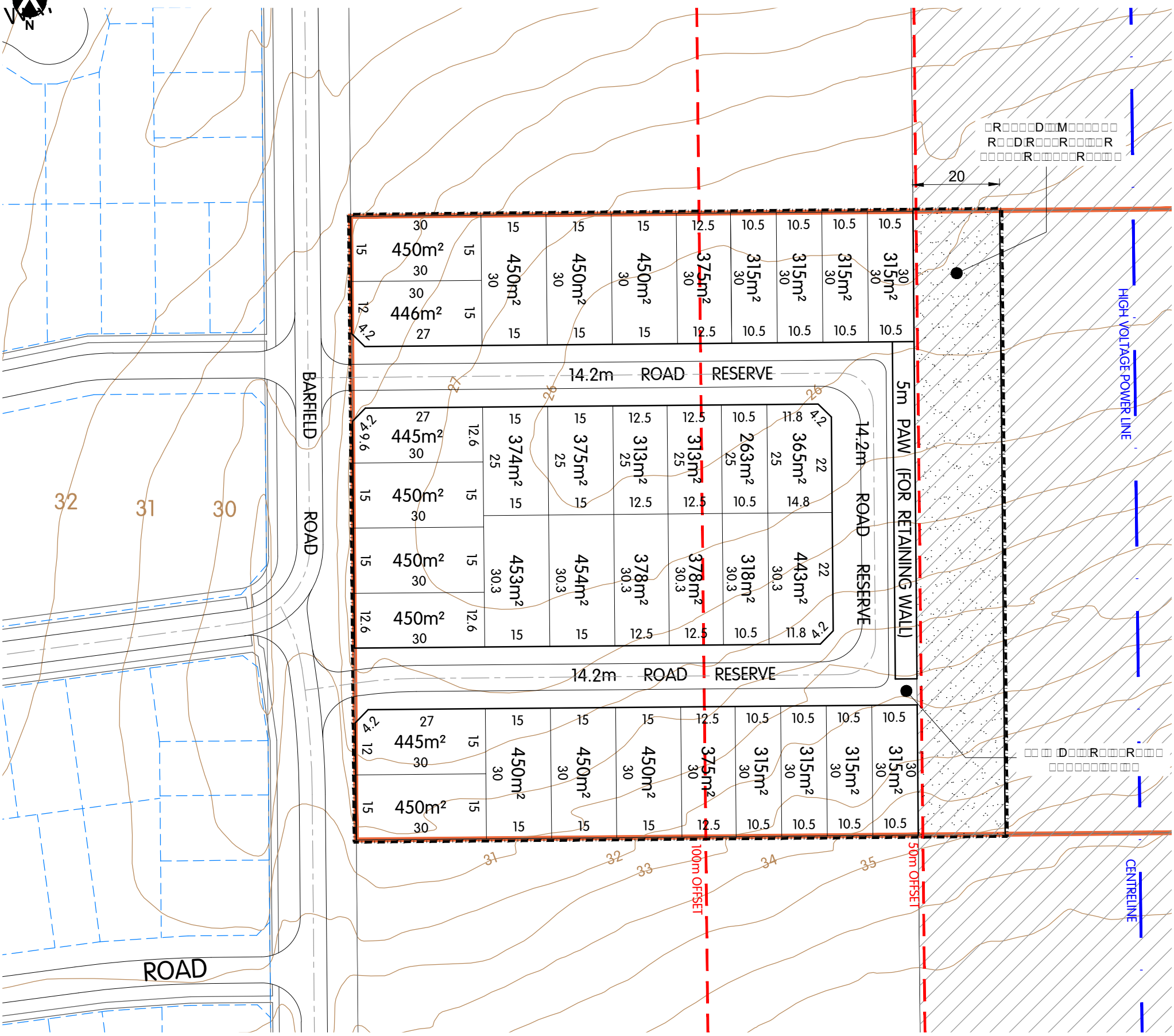
SUBDIVISION CONCEPT STUDY PLAN - ALTERNATIVE DESIGN

Vivente Estate (Barfield Road SP)

City of Cockburn

REF NO. **RIC HAM**
DRAW NO. **RD1 112**
REV. **C**

DISCLAIMER: ISSUED FOR DESIGN INTENT ONLY. ALL AREAS AND DIMENSIONS ARE SUBJECT TO DETAIL DESIGN AND SURVEY





LOCATION PLAN EXISTING LOTS

SUBJECT LOTS

36 LOTS

LEGEND

- PROPOSED SUBDIVISION - SUBJECT LOTS
- EXISTING LOT
- PROPOSED LOT BOUNDARY
- EXISTING LOT BOUNDARIES
- EXISTING LOT BOUNDARIES TO BE REMOVED
- 19 EXISTING CONTOURS
- 1012 EXISTING LOT NUMBERS
- INDICATIVE FUTURE LOT BOUNDARIES
- HIGH VOLTAGE POWER LINE

GOLD ESTATES
RICHARDNOBLE
PROPERTY INTEGRITY COMMUNITY

CADASTRAL INFORMATION
SOURCE: MNG
YYMMDD: 180727
DWG REF: 96326pr-010ai.dwg
PROJECTION: PCG Conversion

AERIAL PHOTOGRAPHY
SOURCE:
YYMMDD:

RD great places

SIZE A3_1:1000

0 metres 10 20 30 40 50

REV	DESCRIPTION	YYMMDD	DRAWN	APPR'D
C	ENGINEERING FEEDBACK	190502	ED	-
B	CUL-DE-SAC DESIGN	190424	SB	ED
A	BASE PLAN RD1 112C	190418	HH	ED

SUBDIVISION CONCEPT STUDY PLAN STAGE 9 (LOT 18)

Vivente Estate (Barfield Road SP)

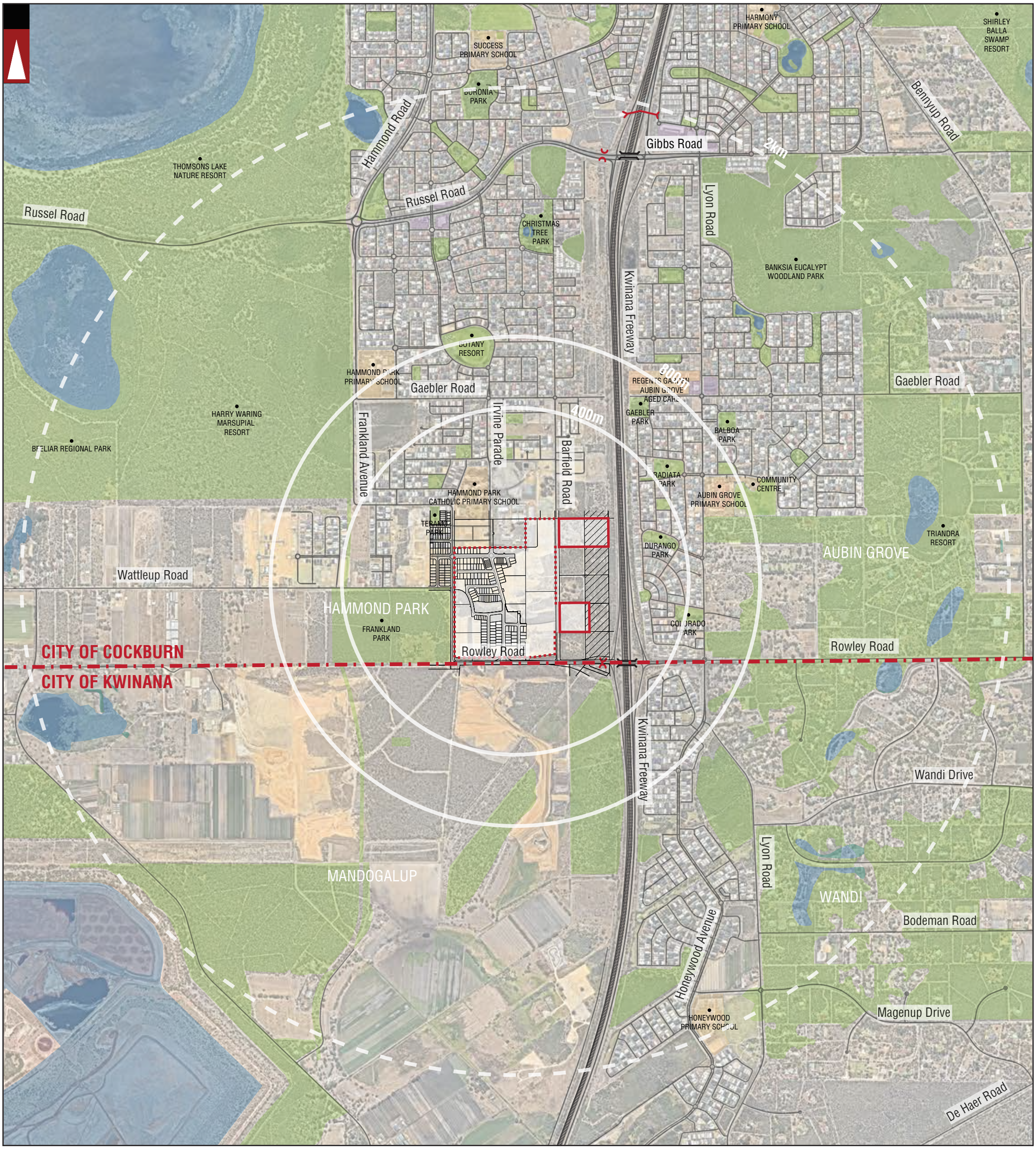
City of Cockburn

REF NO. **RIC HAM**
DRAW NO. **RD1 150**
REV. **C**

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Appendix 2

Transport Planning and Traffic Plans



PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
SHOPPING AREA
ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE, FOOT BRIDGE UNDERPASS
APPROVED STRUCTURE PLAN BOUNDARY
PROPOSED ADDITIONS TO STRUCTURE PLAN
DISTANCE FROM LOCATION
CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB

LEGEND

Certified System Quality ISO 9001 SAI GLOBAL

No	DATE	AMENDMENT
A	10-05-2019	ISSUED FOR REVIEW

PROJECT: BARFIELD ROAD, HAMMOND PARK

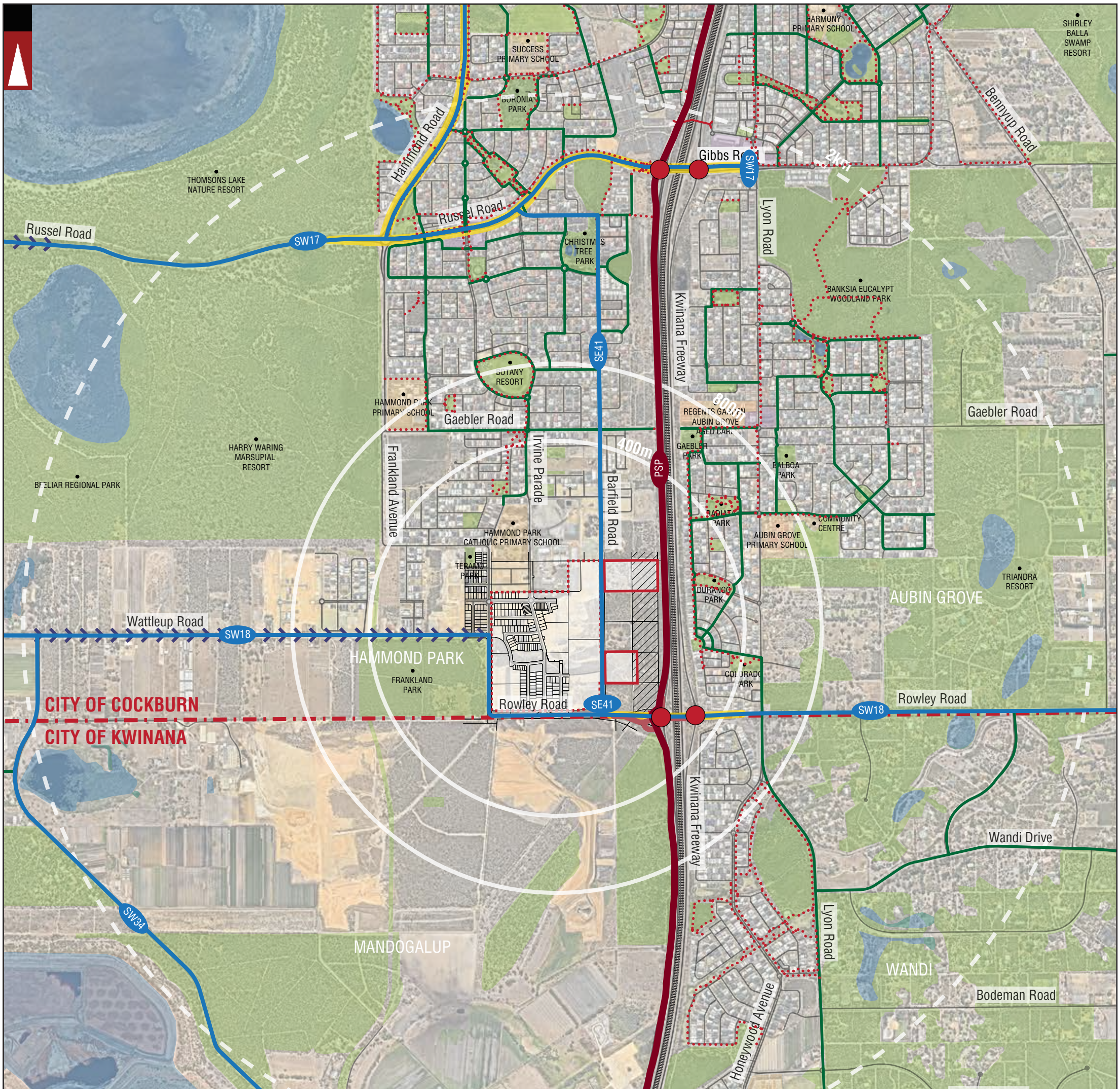
TITLE: LOCALITY PLAN - 2KM RADIUS

DRAWING NUMBER: KC00050.000_ S01

DRAWN BY: A.N.

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PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
SHOPPING AREA

ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE, FOOT BRIDGE UNDERPASS
APPROVED STRUCTURE PLAN BOUNDARY

PROPOSED ADDITIONS TO STRUCTURE PLAN
DISTANCE FROM LOCATION
CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB

PSP PRINCIPAL SHARED PATH (PSP)
HIGH QUALITY SHARED PATH
OTHER SHARED PATH (SHARED BY PEDESTRIANS & CYCLISTS)
GOOD ROAD RIDING ENVIRONMENT
NW12 PERTH BICYCLE NETWORK (PBN) - CONTINUOUS SIGNED ROUTES

BICYCLE LANES OR SEALED SHOULDER EITHER SIDE
GRADIENT ARROW
TRAFFIC LIGHT

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LEGEND

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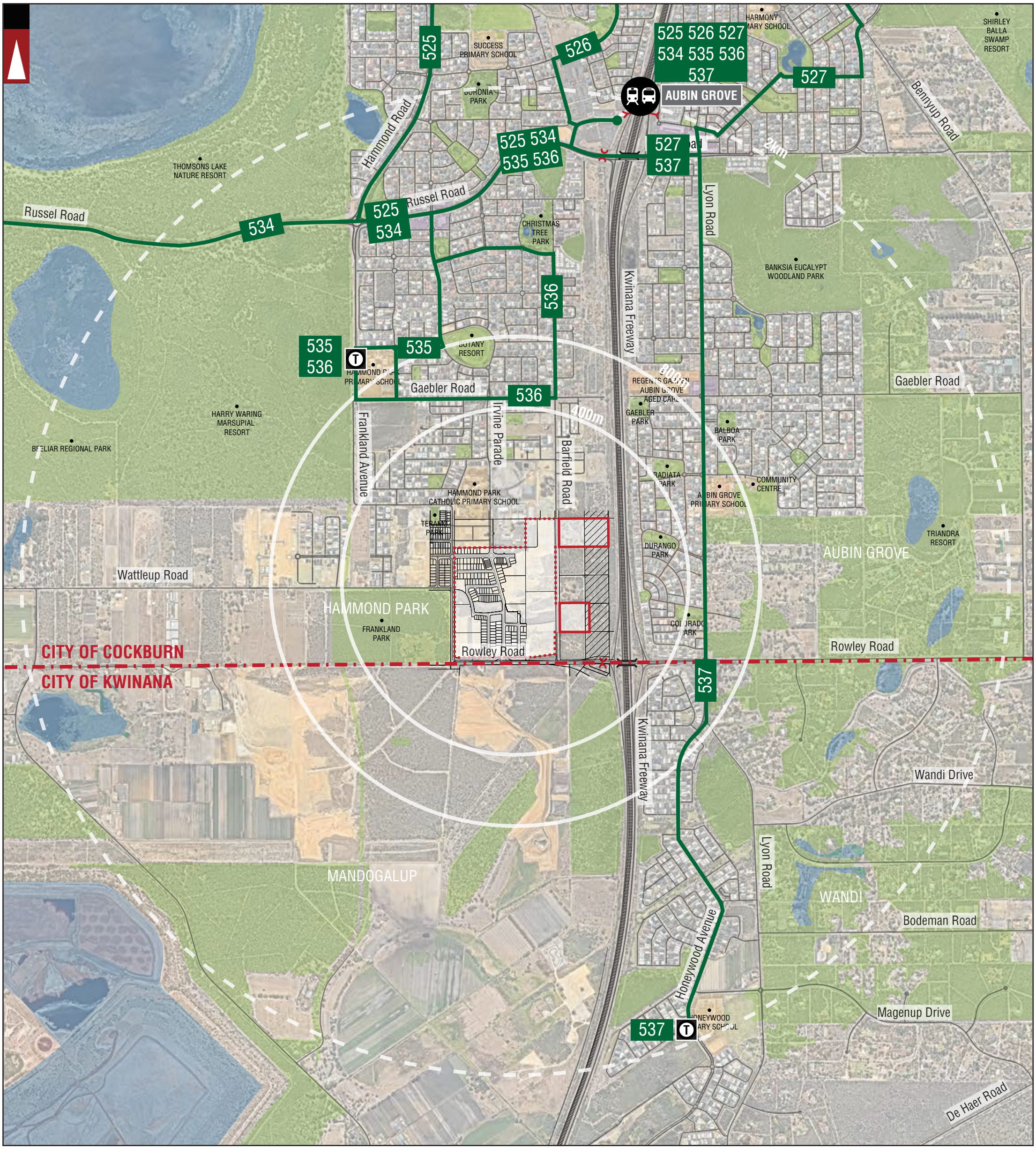
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TITLE: BICYCLE NETWORK PLAN - 2KM RADIUS

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PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
SHOPPING AREA

ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE, FOOT BRIDGE UNDERPASS
APPROVED STRUCTURE PLAN BOUNDARY

PROPOSED ADDITIONS TO STRUCTURE PLAN
DISTANCE FROM LOCATION
CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB

BUS ROUTES
103 BUS ROUTE NUMBER
TRAIN AND BUS TRANSFER
BUS TERMINUS

NOTE : FOR MORE INFORMATION REGARDING THE DESCRIPTION OF BUS ROUTES AND THEIR INDICATIVE PEAK AND OFF-PEAK FREQUENCIES REFER TO TIA REPORT

LEGEND

No	DATE	AMENDMENT
A	10-05-2019	ISSUED FOR REVIEW

PROJECT: BARFIELD ROAD, HAMMOND PARK

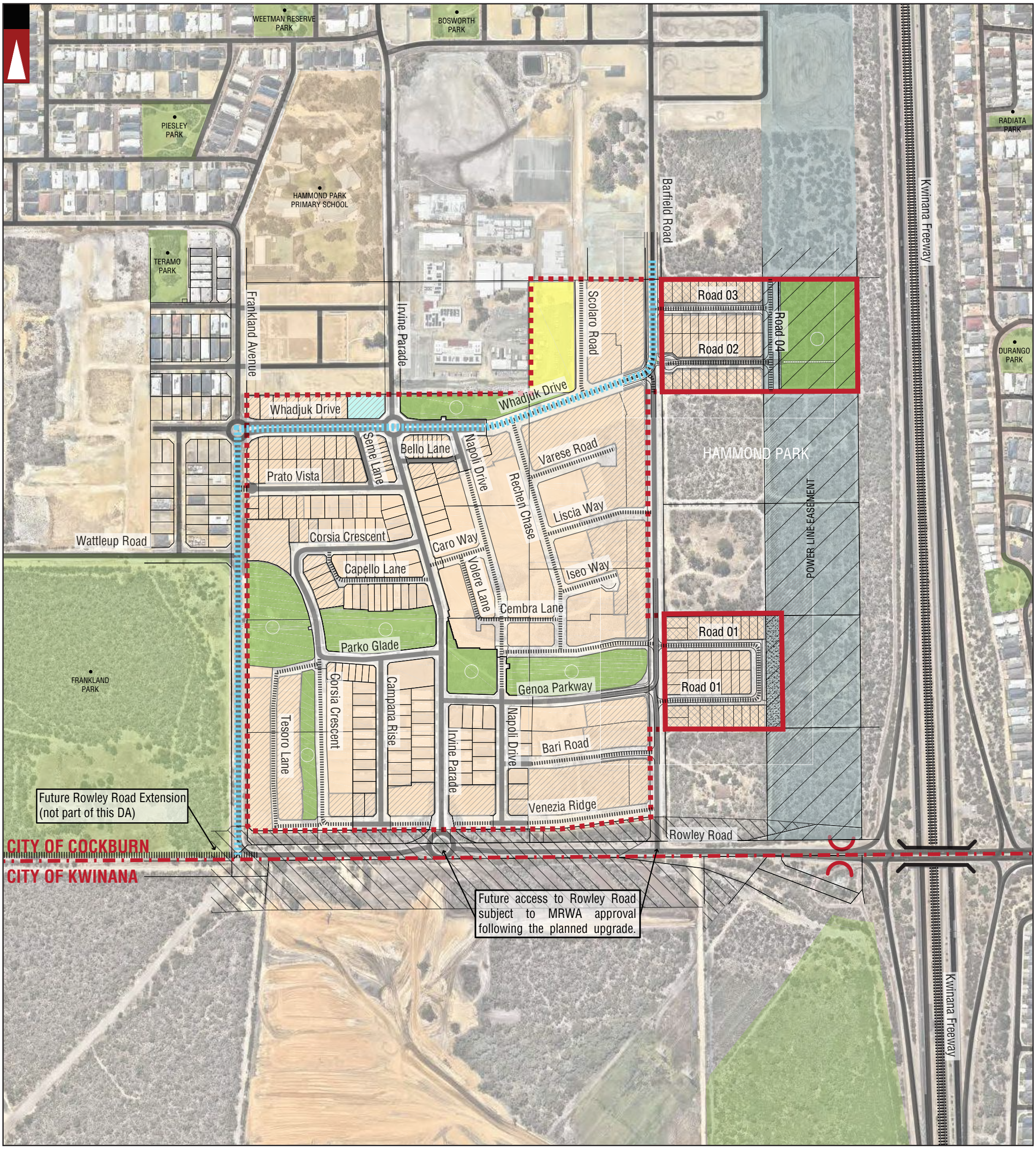
TITLE: PUBLIC TRANSPORT PLAN - 2KM RADIUS

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PARKS AND RECREATION
PUBLIC PURPOSE
EXISTING ROAD
PROPOSED ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE, UNDERPASS
STRUCTURE PLAN BOUNDARY
PROPOSED ADDITIONS TO STRUCTURE PLAN
CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB
PROPOSED BUS ROUTE

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LEGEND

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A	16-05-2019	ISSUED FOR REVIEW

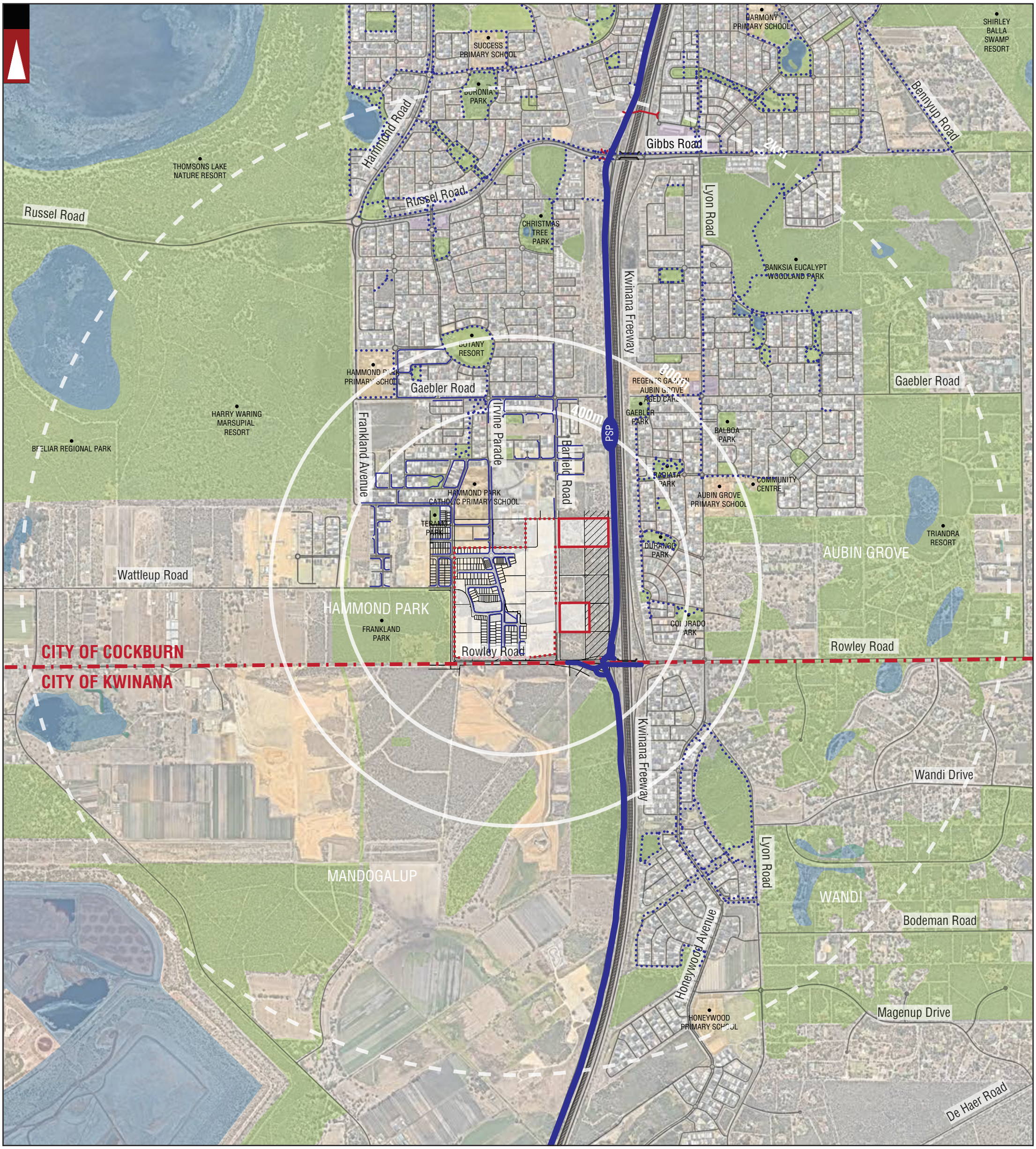
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TITLE: PROPOSED BUS ROUTES

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PARKS AND RECREATION
WATERWAYS
PUBLIC PURPOSE
SHOPPING AREA

ROAD
Hay Street STREET NAME
RAILWAY
ROAD BRIDGE, FOOT BRIDGE UNDERPASS
APPROVED STRUCTURE PLAN BOUNDARY

PROPOSED ADDITIONS TO STRUCTURE PLAN
DISTANCE FROM LOCATION
CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB

PSP PRINCIPAL SHARED PATH
HIGH QUALITY SHARED PATH
OTHER SHARED PATH (SHARED BY PEDESTRIANS & CYCLISTS)
PEDESTRIAN PATH

LEGEND

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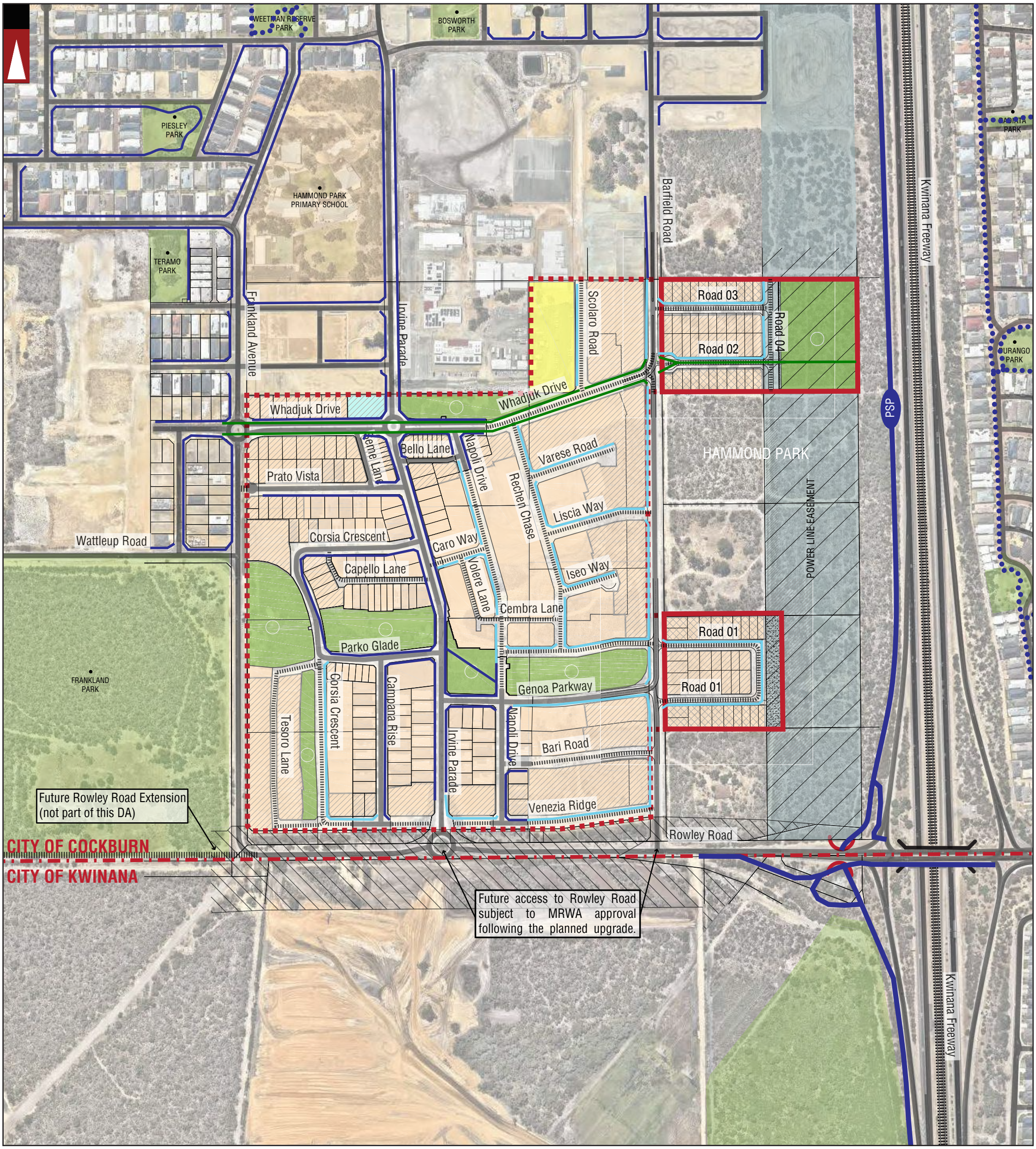
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TITLE: PEDESTRIAN PATHS PLAN - 2KM RADIUS

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PARKS AND RECREATION
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EXISTING ROAD
PROPOSED ROAD
Hay Street STREET NAME
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CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB

PSP PRINCIPAL SHARED PATH
HIGH QUALITY SHARED PATH
OTHER SHARED PATH (SHARED BY PEDESTRIANS & CYCLISTS)
PEDESTRIAN PATH

PROPOSED PEDESTRIAN PATH
PROPOSED CYCLING CONNECTION TO KWINANA FREEWAY PSP

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LEGEND

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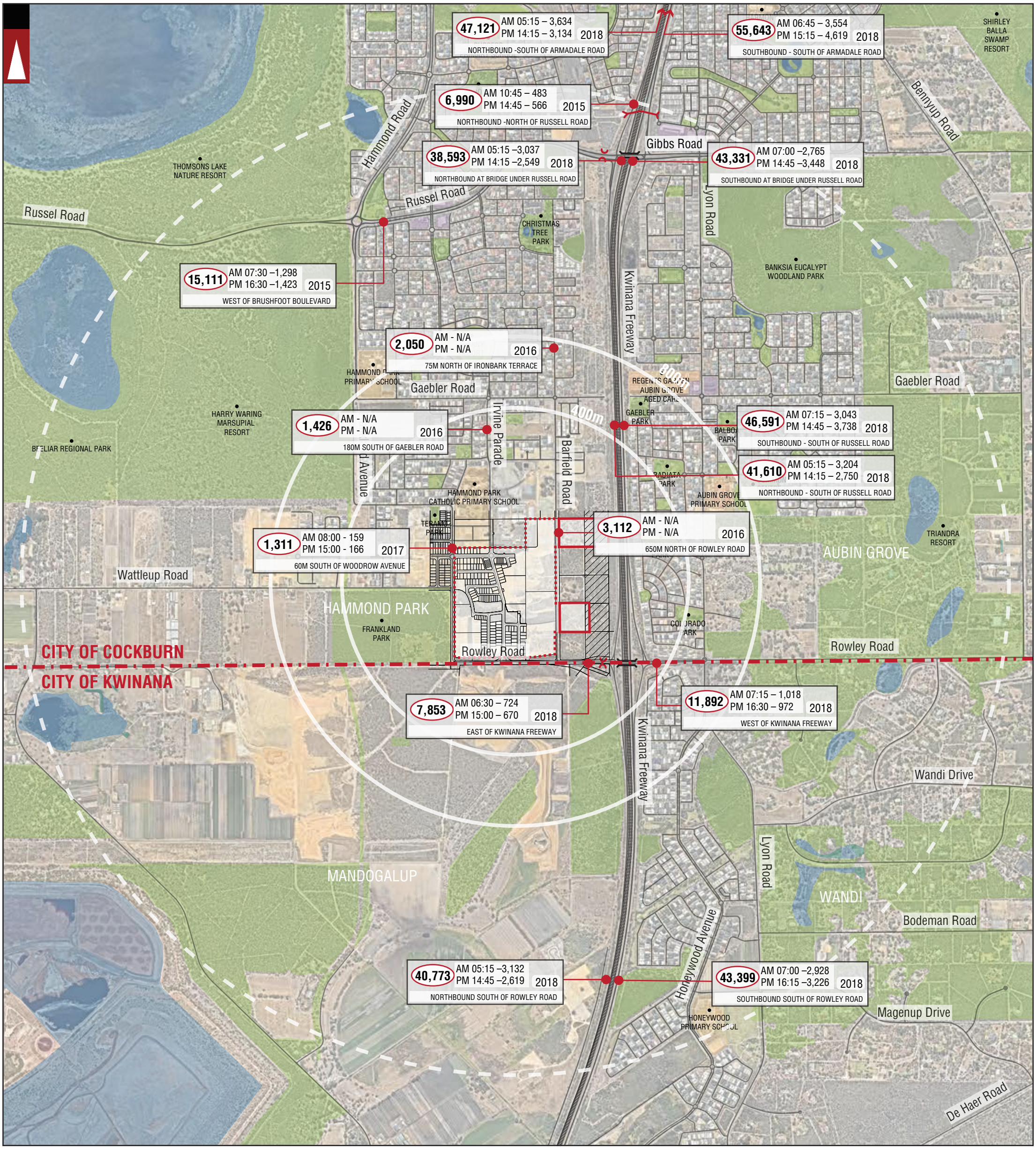
PROJECT: BARFIELD ROAD, HAMMOND PARK

TITLE: PROPOSED PEDESTRIAN AND SHARED PATHS PLAN

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PARKS AND RECREATION
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ROAD
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APPROVED STRUCTURE PLAN BOUNDARY
PROPOSED ADDITIONS TO STRUCTURE PLAN
DISTANCE FROM LOCATION
CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB
5,512 NUMBER OF VEHICLES PER DAY
AM 1145 – 381 PM 1630 – 480 NUMBER OF VEHICLES PER AM PEAK HOUR / NUMBER OF VEHICLES PER PM PEAK HOUR
2014 YEAR
EAST OF HARLOW ROAD LOCATION

LEGEND

No	DATE	AMENDMENT
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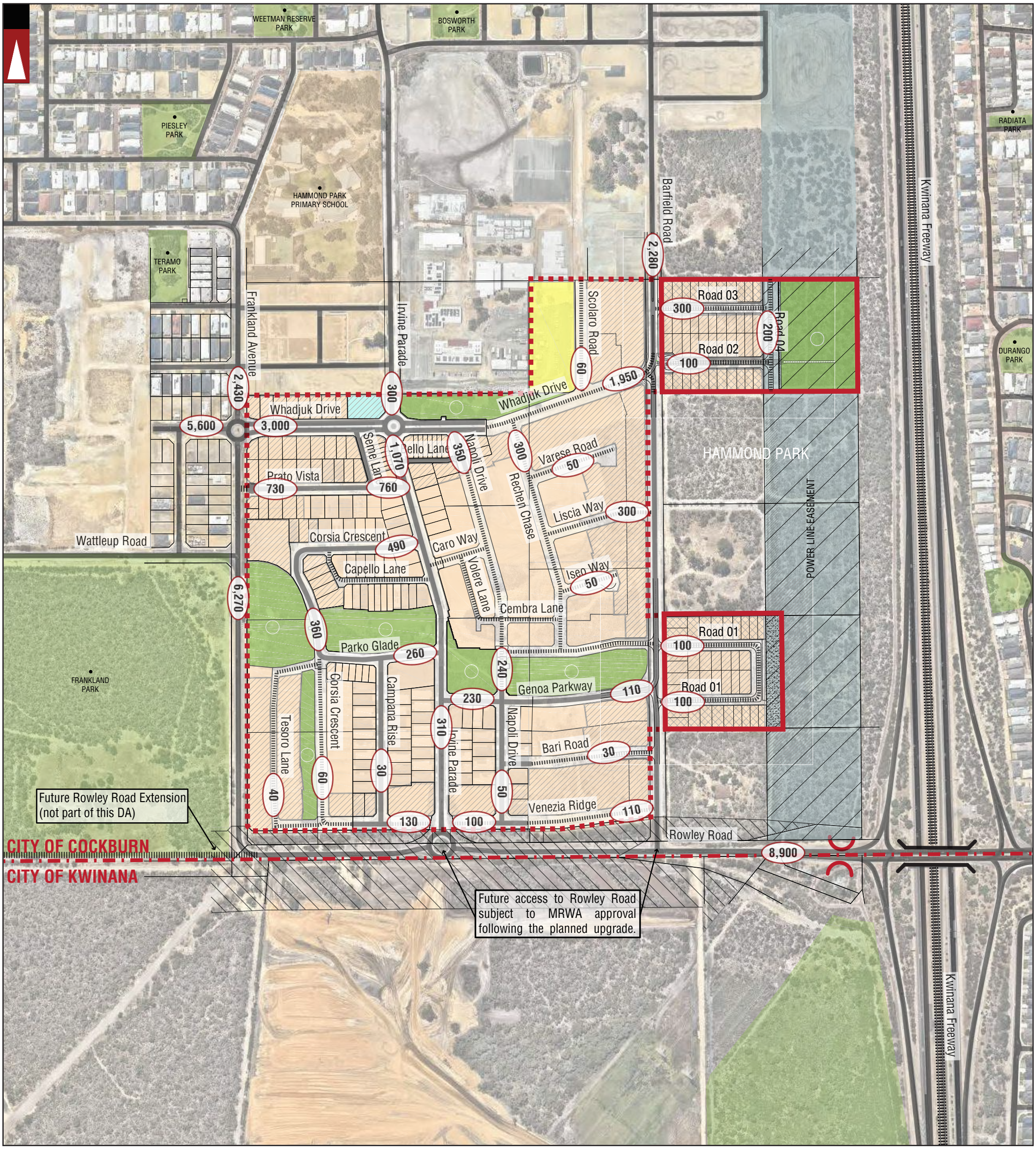
PROJECT: BARFIELD ROAD, HAMMOND PARK

TITLE: EXISTING TRAFFIC COUNTS

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PARKS AND RECREATION
PUBLIC PURPOSE
EXISTING ROAD
PROPOSED ROAD
Hay Street — STREET NAME
RAILWAY

ROAD BRIDGE, UNDERPASS
STRUCTURE PLAN BOUNDARY
PROPOSED ADDITIONS TO STRUCTURE PLAN
CITY OF COCKBURN — LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK — SUBURB

7,418 — FORECASTED TRAFFIC VOLUMES

Certified System Quality ISO 9001 SAI GLOBAL

LEGEND

No	DATE	AMENDMENT
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PROJECT: BARFIELD ROAD, HAMMOND PARK

TITLE: DAILY TRAFFIC VOLUMES - YEAR 2025

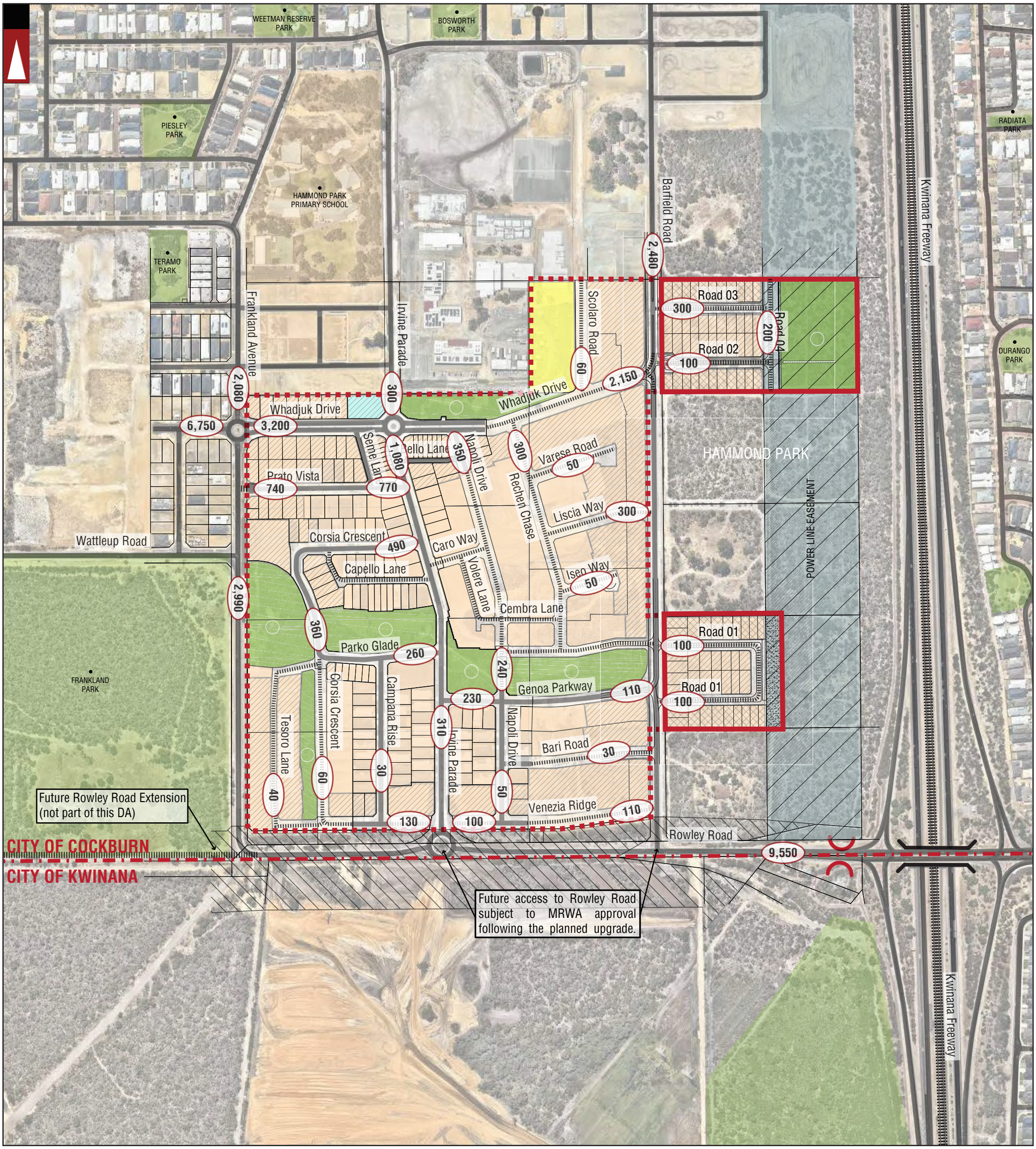
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PARKS AND RECREATION
PUBLIC PURPOSE
EXISTING ROAD
PROPOSED ROAD
Hay Street — STREET NAME
RAILWAY

ROAD BRIDGE, UNDERPASS
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PROPOSED ADDITIONS TO STRUCTURE PLAN
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HAMMOND PARK — SUBURB

7,418 — FORECASTED TRAFFIC VOLUMES

LEGEND

No	DATE	AMENDMENT
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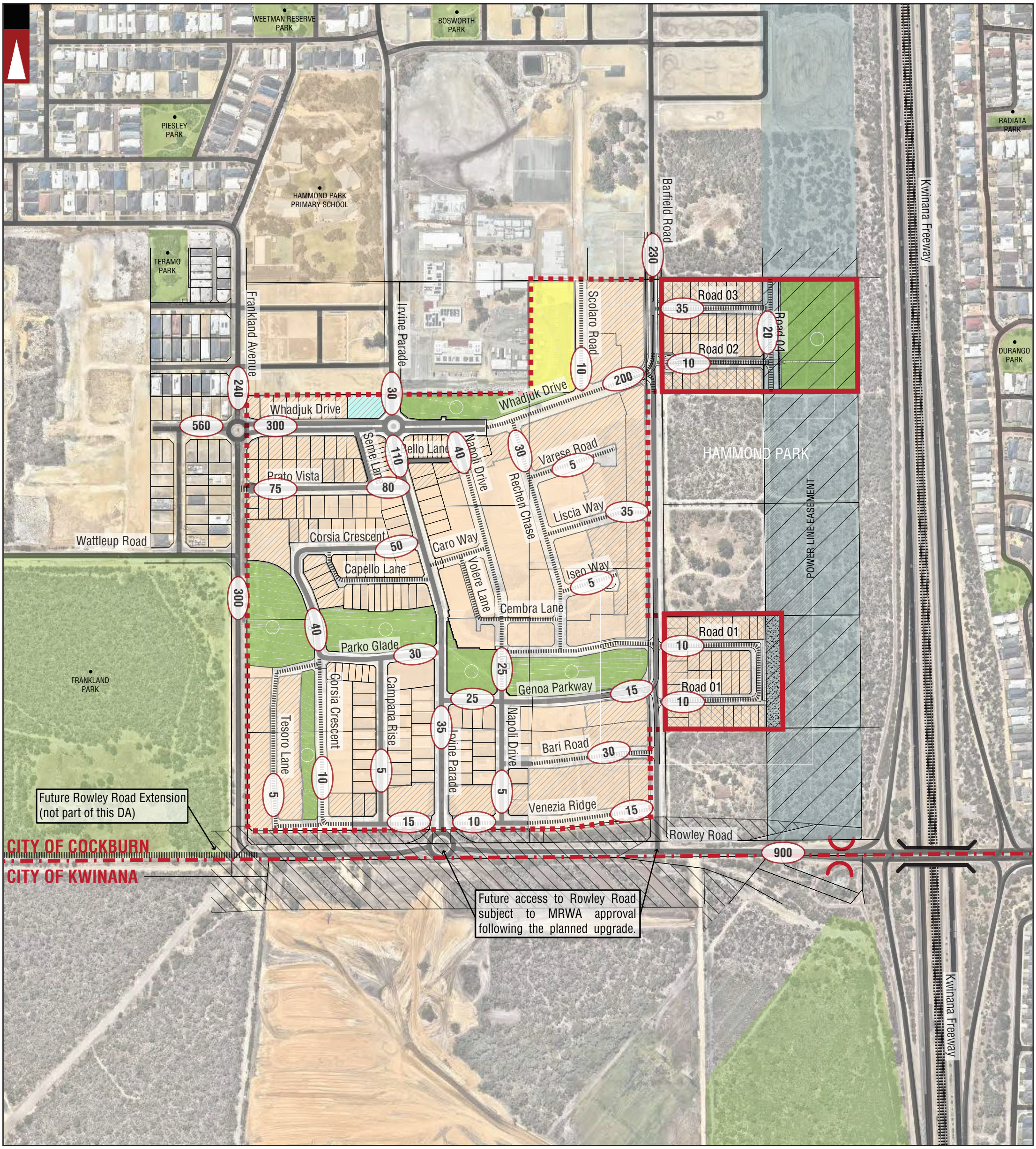
PROJECT: BARFIELD ROAD, HAMMOND PARK

TITLE: DAILY TRAFFIC VOLUMES - YEAR 2031

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CITY OF COCKBURN — LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK — SUBURB
7,418 — FORECASTED TRAFFIC VOLUMES - PEAK

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LEGEND

No	DATE	AMENDMENT
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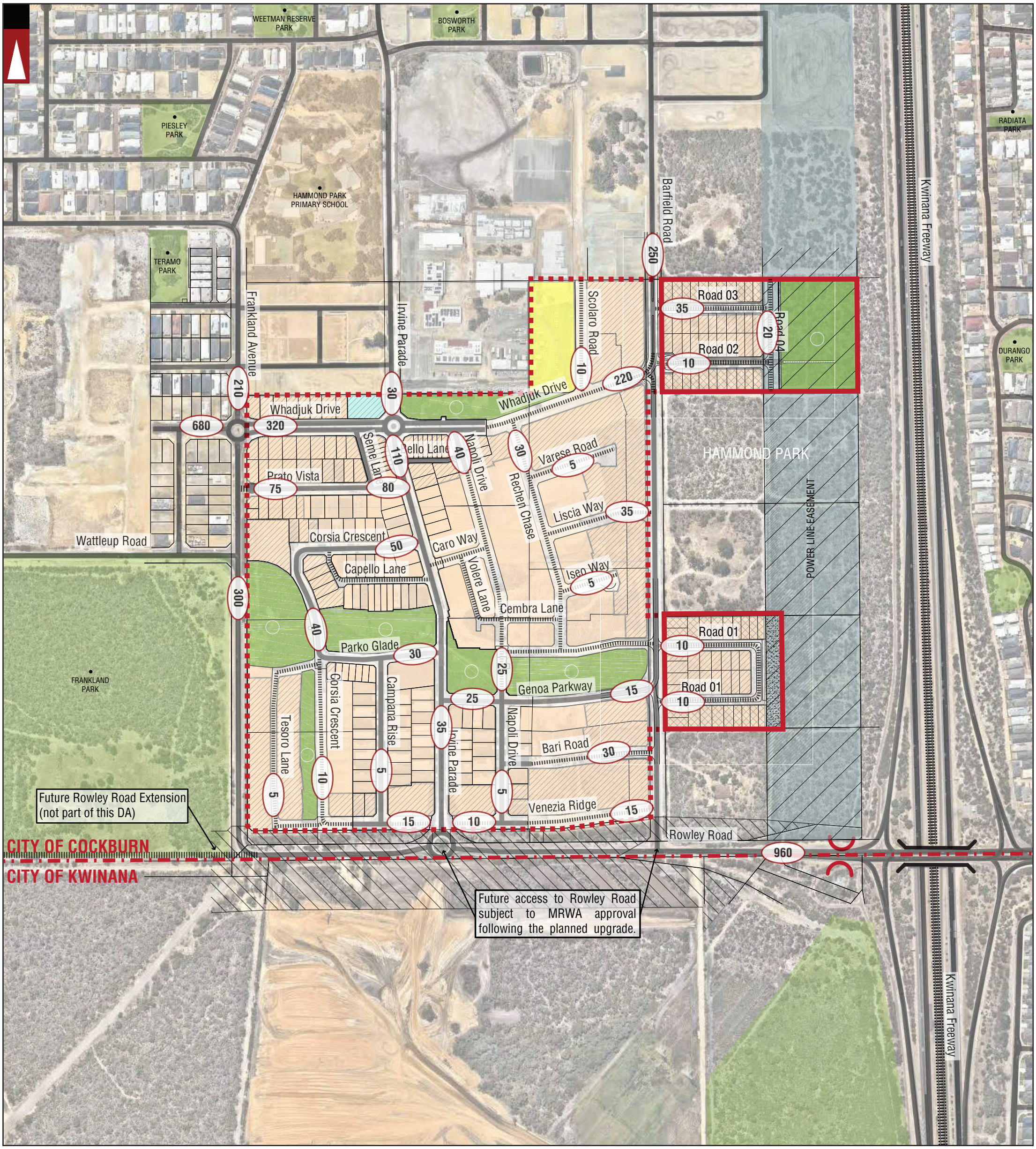
PROJECT: BARFIELD ROAD, HAMMOND PARK

TITLE: PEAK TRAFFIC VOLUMES - YEAR 2025

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PARKS AND RECREATION
PUBLIC PURPOSE
EXISTING ROAD
PROPOSED ROAD
Hay Street STREET NAME
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CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB

7,418 FORECASTED TRAFFIC VOLUMES - PEAK

Certified System Quality ISO 9001 SAI GLOBAL

LEGEND

No	DATE	AMENDMENT
A	16-05-2019	ISSUED FOR REVIEW

PROJECT: BARFIELD ROAD, HAMMOND PARK

TITLE: PEAK TRAFFIC VOLUMES - YEAR 2031

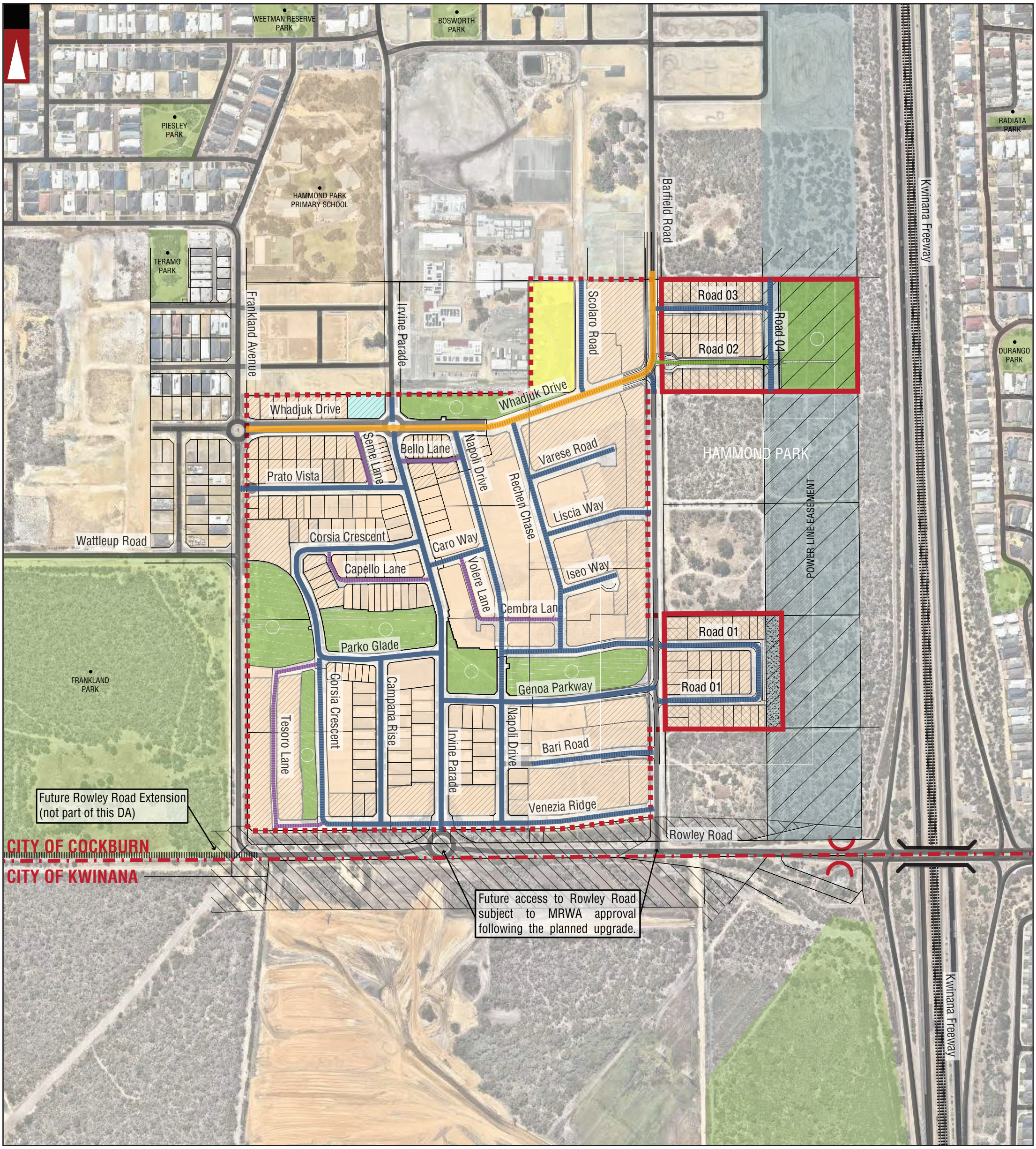
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PARKS AND RECREATION
PUBLIC PURPOSE
EXISTING ROAD
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ROAD BRIDGE, UNDERPASS
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PROPOSED ADDITIONS TO STRUCTURE PLAN
CITY OF COCKBURN LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK SUBURB

NEIGHBOURHOOD CONNECTOR "B"
AACCESS STREET "D"
LANEWAY
SAFE ACTIVE STREET

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LEGEND

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PROJECT: BARFIELD ROAD, HAMMOND PARK

TITLE: ROAD HIERARCHIES PLAN

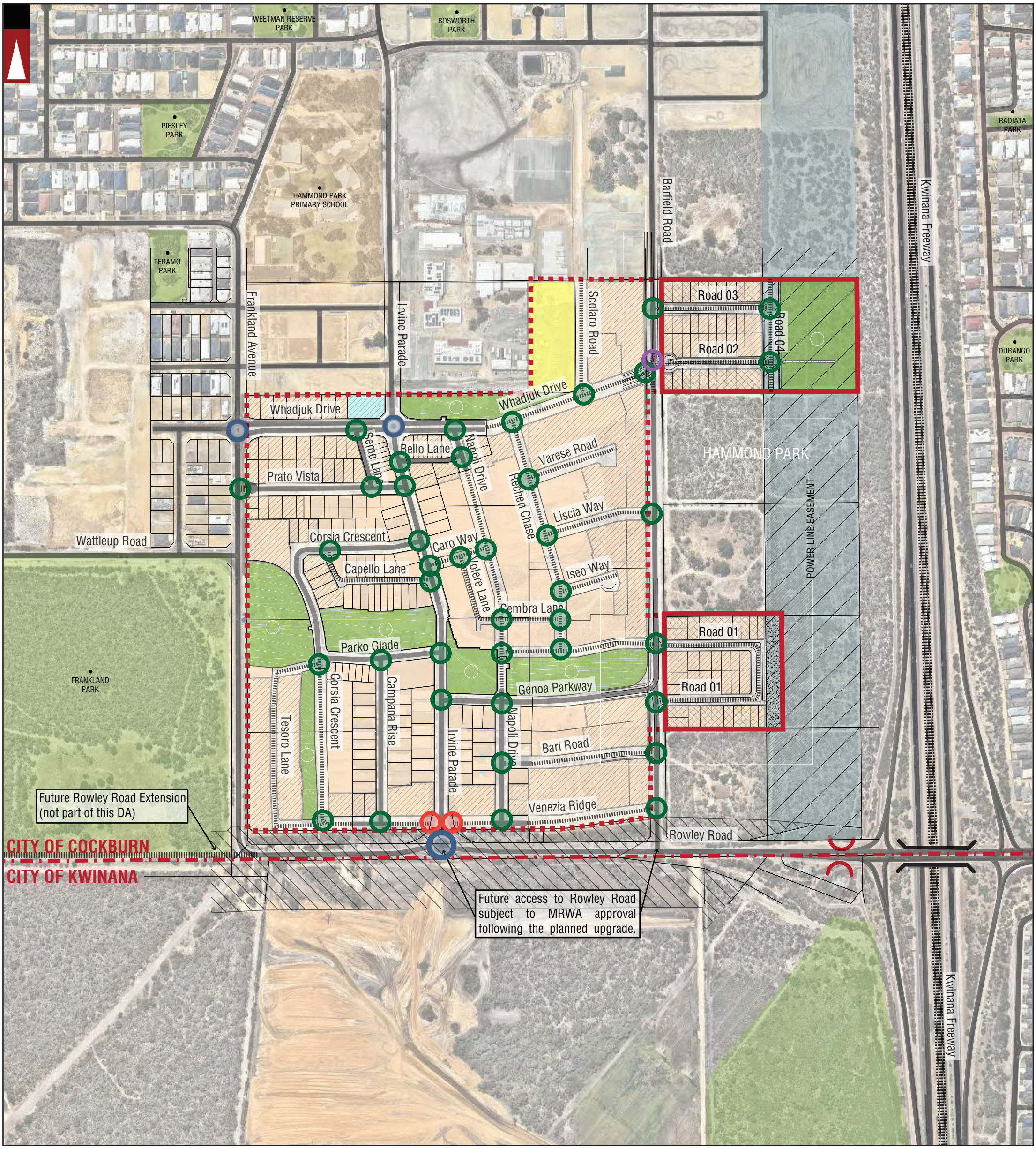
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PUBLIC PURPOSE
EXISTING ROAD
PROPOSED ROAD
Hay Street — STREET NAME
RAILWAY

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STRUCTURE PLAN BOUNDARY
PROPOSED ADDITIONS TO STRUCTURE PLAN
CITY OF COCKBURN — LOCAL GOVERNMENT NAME
LOCAL AUTHORITY BOUNDARY
HAMMOND PARK — SUBURB

ROUNDABOUT
SIGN CONTROLLED / YIELD
CYCLING ACCESS ONLY (POSSIBLE LEFT IN ONLY FOR VEHICULAR TRAFFIC)
LEFT-IN/LEFT-OUT (FULL MOVEMENT CAN BE CONSIDERED IF IRVINE PARADE LOSES ACCESS TO ROWLEY ROAD)

LEGEND

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PROJECT: BARFIELD ROAD, HAMMOND PARK

TITLE: Proposed Intersection Configurations

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Attachment

07 Lot 15 Native Vegetation Clearing Permit



intelligent outcomes | respected experience

Lot 15 Barfield Road, Hammond Park

Native Vegetation Clearing Permit supporting documentation

FINAL

Prepared for
Richard Noble
by Strategen

April 2019

strategen
ENVIRONMENTAL

Lot 15 Barfield Road, Hammond Park

Native Vegetation Clearing Permit supporting documentation

FINAL

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ACN: 056 190 419

April 2019

Limitations

Scope of services

This report ("the report") has been prepared by Strategen Environmental Consultants Pty Ltd (Strategen) in accordance with the scope of services set out in the contract, or as otherwise agreed, between the Client and Strategen. In some circumstances, a range of factors such as time, budget, access and/or site disturbance constraints may have limited the scope of services. This report is strictly limited to the matters stated in it and is not to be read as extending, by implication, to any other matter in connection with the matters addressed in it.

Reliance on data

In preparing the report, Strategen has relied upon data and other information provided by the Client and other individuals and organisations, most of which are referred to in the report ("the data"). Except as otherwise expressly stated in the report, Strategen has not verified the accuracy or completeness of the data. To the extent that the statements, opinions, facts, information, conclusions and/or recommendations in the report ("conclusions") are based in whole or part on the data, those conclusions are contingent upon the accuracy and completeness of the data. Strategen has also not attempted to determine whether any material matter has been omitted from the data. Strategen will not be liable in relation to incorrect conclusions should any data, information or condition be incorrect or have been concealed, withheld, misrepresented or otherwise not fully disclosed to Strategen. The making of any assumption does not imply that Strategen has made any enquiry to verify the correctness of that assumption.

The report is based on conditions encountered and information received at the time of preparation of this report or the time that site investigations were carried out. Strategen disclaims responsibility for any changes that may have occurred after this time. This report and any legal issues arising from it are governed by and construed in accordance with the law of Western Australia as at the date of this report.

Environmental conclusions

Within the limitations imposed by the scope of services, the preparation of this report has been undertaken and performed in a professional manner, in accordance with generally accepted environmental consulting practices. No other warranty, whether express or implied, is made.

Client: Richard Noble

Report Version	Revision No.	Purpose	Strategen author/reviewer	Submitted to Client	
				Form	Date
Draft Report	A	Client review	A Dalton / D Walsh	Electronic	10/04/19
Final Report	0	Regulator submission	T Sleigh / D Walsh	Electronic	10/04/19

Filename: RNO19156.01 R001 Rev 0 - 10 April 2019

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Appendix 4 Fauna Management and Relocation Plan
Appendix 5 Desktop assessment results (Parks and Wildlife 2007-, DEE 2019b)
Appendix 6 Black cockatoo distribution maps

1. Introduction

Gold Estates Holdings Pty Ltdare proposing to develop Lot 15 Barfield Road, Hammond Park (proposed clearing area). The proposed clearing area is located approximately 28 km from the Perth Central Business District, within the City of Cockburn (Figure 1).

The proposed clearing will enable a consolidation of their bulk earthworks strategy to facilitate residential development consistent with the local planning framework. This will necessitate the clearing of a small area of native vegetation (0.96 ha) within the proposed clearing area (Figure 1). Clearing of this vegetation will require a Native Vegetation Clearing Permit (NVCP) to facilitate lawful clearing of native vegetation. The area permit application form (form C1) is provided in Appendix 1.

This supporting document has been prepared to support the granting of a NVCP under s 51 E of the *Environmental Protection Act 1986* (EP Act). The supporting document includes the following information:

- an overview of the existing environmental conditions of the site
- an evaluation of potential impacts of the vegetation clearing
- an evaluation of compliance of the proposed clearing against the ten clearing principles listed under Schedule 5 of the EP Act
- environmental approvals and management requirements.

The information provided within this supporting document is based on surveys conducted in the proposed clearing area as documented in:

- *Lot 15 Barfield Road, Hammond Park Flora and Vegetation Survey* (PVG Environmental 2018, see Appendix 2)
- *Level 1 Fauna Risk Assessment and Black Cockatoo Habitat Assessment for Lot 15 Barfield Road, Hammond Park* (Terrestrial Ecosystems 2016, see appendix 3)

An Ecologist from Strategen attended the site in March 2019 to confirm the environmental values previously identified in the surveys (Strategen survey).

1.1 Location, ownership and tenure

The proposed clearing area is located at Lot 15 Barfield Road, Hammond Park. Site identification details for the proposed clearing area are provided in Table 1.

The current zoning under the current Local Planning Scheme, Developemtn, reflects the degraded nature of the proposed clearing area with historic partial clearing evident. As such, a large proportion of the site is cleared.

Table 1: Site identification details

Subject	Detail
Lot address	Lot 15 on Deposited Plan 30747
Street address	171 Barfield Rd, Hammond Park 6164
Current site owner	Gold Estates Holdings Pty Ltd
Local Government Authority	City of Cockburn
Current MRS zoning	Urban



Figure 1: Proposed clearing area

N

Scale 1:1,500 at A4

0 25 50 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 5/04/2019

Legend

- Proposed clearing area
- Cadastre (No Attributes) (LGATE-001)
- Roads

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Q:\Consult\2019\RNO\RNO19156\01_GIS_documents\ArcMap_documents\RNO19156_G001_RevA.mxd

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2. Overview of existing environment

2.1 Topography

The proposed clearing area slopes gently from a high around 35 m Australian Height Datum (AHD) in the south-east corner down to 28m AHD in the flatter north-west part (WALGA 2018).

2.2 Landform and Geology

The proposed clearing area is located within the Swan Coastal Plain bioregion (SWA2 – Swan Coastal Plain subregion) of Western Australia (Mitchell et al. 2002). The Swan Coastal Plain comprises five major geomorphologic systems that lie parallel to the coast, namely (from west to east) the Quindalup Dunes, Spearwood Dunes, Bassendean Dunes, Pinjarra Plain and Ridge Hill Shelf (Churchward & McArthur 1980; Gibson *et al.* 1994). Each major system is composed of further subdivisions in the form of detailed geomorphologic units (Churchward & McArthur 1980; Semeniuk 1990; Gibson *et al.*1994). Beard (1990) describes the Swan Coastal Plain as a low-lying coastal plain, often swampy, with sandhills also containing dissected country rising to the duricrusted Dandaragan plateau on Mesozoic, mainly sandy, yellow soils. The proposed clearing area is situated within the Bassendean Dunes formation.

2.3 Soils

Regional geological mapping identified one geological unit within the proposed clearing area; namely, Bassendean Sand (Qdcb) which is characterised by 'basal conglomerate overlain by dune quartz sand with heavy mineral concentrations' (Geoscience Australia 2008).

2.4 Acid Sulfate Soils

Acid Sulfate Soils (ASS) are naturally occurring, iron-sulphide rich soils, sediments or organic substrates, formed under waterlogged conditions. If exposed to air, these sulphides can oxidise and release sulphuric acid and heavy metals. This process can occur due to drainage, dewatering or excavation.

A search of the Swan Coastal Plain ASS risk mapping (WALGA 2017) indicates that there is a 'moderate to low' potential of soil within the proposed clearing area containing ASS.

2.5 Hydrology

2.5.1 Surface water

No surface water features have been identified within the proposed clearing area. The flora and vegetation survey undertaken by PVG Environmental confirmed the absence of wetlands in the proposed clearing area.

The Geomorphic Wetlands, Swan Coastal Plain mapping (DBCA 2015) identifies one Conservation Category Wetland (CCW) within 1 km of the proposed clearing area; namely UFI14104, approximately 1 km to the northwest of the proposed clearing area.

2.5.2 Groundwater

Groundwater contours within the proposed clearing area indicate that depth to groundwater across the proposed clearing area is estimated at 5 – 12 m below ground level (WALGA 2018).

2.6 Vegetation and flora

PGV undertook a flora and vegetation assessment of the proposed clearing area in September 2014. Subsequent to this assessment, an Ecologist from Strategen Environmental undertook a site visit in March 2019 to confirm the flora and vegetation values outlined by PGV Environmental (Strategen survey). The results of the assessments are detailed under the following sub-sections and a copy of the report is provided in Appendix 2.

2.6.1 Regional vegetation

Vegetation occurring within the region was initially mapped at a broad scale (1: 1 000 000) by Beard during the 1970s. This dataset has formed the basis of several regional mapping systems, including physiographic regions defined by Beard (1981); System 6 Vegetation Complex mapping undertaken by Heddle et al. (1980); the biogeographical region dataset (Interim Biogeographic Regionalisation for Australia) for Western Australia (DEE 2019a).

The proposed clearing area is situated within vegetation association Bassendean 1001 – Medium very sparse woodland; jarrah, with low woodland*; Banksia & Casuarina* (Beard 1990).

Based on regional vegetation complex mapping (Heddle et al. 1980) the proposed clearing area contains the Bassendean Central and South vegetation complex, described as ranging from woodland of *Eucalyptus marginata - Allocasuarina fraseriana - Banksia* species to low woodland of *Melaleuca* species, and sedgelands on the moister sites, and includes the transition of *Eucalyptus marginata* to *Eucalyptus todtiana* near Perth.

Vegetation statistics for the above vegetation system association and complex are displayed in Table 2. The proposed clearing area contains 0.28 ha of remnant vegetation in Good condition and 0.12 ha of vegetation in Degraded condition which is potentially representative of Pre-European vegetation associations and complexes.

Table 2: Pre-European and current extent vegetation system association and complexes (Government of Western Australia 2017; 2016)

Vegetation system association/ complex	Pre-European extent (ha)	Current extent (ha)	% remaining	% Current Extent Protected for Conservation
1001	57 410	12 704	22.13	2.8
Bassendean Central and South	87 476	23 533	26.9	1.86

2.6.2 Native flora

A total of 43 native vascular plant taxa from 23 plant families were recorded within the proposed clearing area. The majority of taxa were recorded within the Fabaceae and Asparagaceae families (see Appendix 2).

2.6.3 Threatened and Priority flora

The desktop assessment conducted by PGV Environmental (2014) (Appendix 2) identified four Threatened flora and 11 Priority flora species that have been recorded in the regional area. NatureMap (Parks and Wildlife 2019) and EPBC Protected Matters Tool (PMST) (DEE 2019b) searches were also undertaken in April 2019 By Strategen to inform other possible Threatened or Priority flora species occurring in the proposed clearing area. These searches identified a further three Threatened flora and three Priority flora species that have subsequently been recorded in the regional area.

One species, *Eremaea asterocarpa* subsp. *brachyclada* was identified by PGV Environmental (2014) as possibly occurring, however this species is no longer listed as a conservation significant species (Western Australian Herbarium 1998-).

Table 3 presents the combined results of the Threatened and Priority flora potentially occurring within the proposed clearing area, based on the desktop assessment.

Based on site observations, it was determined that preferred or potential habitat for the following Threatened and Priority flora taxa is potentially present:

- *Caladenia huegelii* (T, Endangered)
- *Dodonaea hackettiana* (P4)
- *Thysanotus glaucus* (P4).

As the flora survey was undertaken in September, the timing of the survey was within the usual flowering period for these *Caladenia huegelii* and *Dodonaea hackettiana*.

While outside the usual flowering period for *Thysanotus glaucus,* this species would be identifiable throughout the year, even without reproductive characteristics (flowers or fruit) present, and none were recorded within the proposed clearing area during the survey.

Preferred habitat for *C. huegelii* is mixed woodland of *Eucalyptus marginata, Banksia attenuata* and other *Banksia* species with scattered *Allocasuarina fraseriana* and *Corymbia calophylla* over a dense understorey, which was not present within the proposed clearing area. Remnant vegetation types, containing potential habitat in the proposed clearing area, are likely to be too degraded for this species to be present given the species tends to favour vegetation with dense undergrowth (DEC 2009).

No flora species listed as Threatened under the *Biodiversity and Conservation Act 2016* (BC Act) or Priority Flora species as listed by the DBCA were recorded during the field survey.

Table 3: Threatened and Priority flora potentially occurring within the proposed clearing area

Species	Conservation status		Description	Potential to occur
	BC Act / DBCA listing	EPBC Act		
Andersonia gracilis	T	Endangered	Slender erect or open straggly shrub, 0.1 to 0.5 m high. Flowers are white, pink or purple. Flowers from September to November. Occurs on white/grey sand, sandy clay, gravelly loam on winter-wet areas, near swamps (Western Australian Herbarium 1998-).	**Unlikely** due to the absence of preferred habitat.
Caladenia huegelii	T	Endangered	A slender orchid 30 to 50 cm tall. One or two striking flowers characterised by a greenish-cream lower petal with a maroon tip. Other petals are cream with red or pink suffusions. Habitat for this species occurs within well-drained, deep sandy soils in low mixed Banksia, Allocasuarina and Jarrah woodlands (Western Australian Herbarium 1998-, DEE 2018b).	**Possible** due to the presence of potential habitat.
Diuris micrantha	T	Vulnerable	A slender orchid to 60 cm tall. Flowers are yellow with reddish-brown markings and visible from September to October. Habitat for this species occurs within clay-loam substrates in winter-wet depressions or swamps (DEE 2018b).	**Unlikely** due to absence of preferred habitat.
Diuris purdiei	T	Endangered	A slender orchid to 0.35 m tall. Flowers are yellow and visible from September to October. Habitat for this species is grey-black sand substrates in winter-wet swamps which have high moisture (Western Australian Herbarium 1998-). Diuris purdiei occurs from Perth south to near the Whicher Range, within the Swan (Western Australia) Natural Resource Management Region. It grows on sand to sandy clay soils, in areas subject to winter inundation, and amongst native sedges and dense heath with scattered emergent *Melaleuca preissiana*, *Corymbia calophylla*, *E. marginata* and *Nuytsia floribunda* (DEE 2018b).	**Unlikely** due to absence of preferred habitat.
Drakaea elastica	T	Endangered	A slender orchid to 30 cm tall with a prostrate, round to heart shaped leaf. Singular, bright green, glossy flower. Habitat for this species is within bare patches of white sand over dark sandy loams on damp areas mostly in *Kunzea glabrescens* thickets (DotE 2015d).	**Unlikely** due to absence of preferred habitat.

Species	Conservation status		Description	Potential to occur
	BC Act / DBCA listing	EPBC Act		
Eleocharis keigheryi	T	Vulnerable	A rhizomatous, clumped perennial grass-like herb to 40 cm tall. Flowers are green and visible from August to November. Habitat for this species occurs in clay or sandy loam in freshwater creeks and claypans (Western Australian Herbarium 1998-).	**Unlikely** due to absence of preferred habitat.
Lepidosperma rostratum	T	Endangered	A rhizomatous, tufted perennial, grass-like or herb (sedge), 50 cm tall. Flowers are brown and flowering occurs from May to June. Habitat for this species occurs in peaty sand or clay and within seasonally wet swamps (Western Australian Herbarium 1998-, DotE 2015d).	**Unlikely** due to absence of preferred habitat.
Poranthera moorokatta	P2	-	Monoecious, erect annual. Flowering and fruit recorded for later September to early November. Known only from two populations at Kings Park and Ellenbrook in Banksia woodland, dampland (Barret 2012)	**Unlikely** due to absence of preferred habitat.
Cyathochaeta teretifolia	P3	-	Rhizomatous, clumped, robust perennial, grass-like or herb (sedge, to 2 m high to 1 m wide. Flowers are brown. Habitat for this species includes grey sand, sandy clay, preferring swamps and creek edges (Western Australian Herbarium 1998-).	**Unlikely** due to the absence of preferred habitat.
Eryngium pinnatifidum subsp. *palustre*	P3	-	An erect perennial, herb, 0.15 to 0.5 m high. Flowers are white and blue, flowering from October to November. Habitat for this species includes clay, sandy clay soils. It occurs on claypans, seasonally wet flats (Western Australian Herbarium 1998-).	**Unlikely** due to absence of preferred habitat
Jacksonia gracillima	P3	-	A decumbent shrub, to 0.20 m high and 0.50 m wide. Flowers are orange, yellow. Occurs on winter-wet flats (Western Australian Herbarium 1998-).	**Unlikely** due to absence of preferred habitat
Pimelea calcicola	P3	-	Erect to spreading shrub, 0.2 to 1 m high. Flowers are pink, flowering from September to November. Preferred habitat includes coastal limestone ridges on sand (Western Australian Herbarium 1998-).	**Unlikely** due to absence of preferred habitat
Pithocarpa corymbulosa	P3	-	Erect to scrambling perennial herb, 0.5 to 1 m high. Flowers are white, flowering from January to April. Occurs on gravelly or sandy loam, amongst granite outcrops.	**Unlikely** due to absence of suitable habitat

Species	Conservation status		Description	Potential to occur
	BC Act / DBCA listing	EPBC Act		
Stylidium paludicola	P3	-	Reed-like perennial, herb 0.35 m to 1 m high. Leaves are tufted, linear or subulate or narrowly oblanceolate. Flowers are pink, flowering from October to December. Peaty sand over clay, winter wet habitat. Marri and Melaleuca woodland, Melaleuca shrubland (Western Australian Herbarium 1998-).	**Unlikely** due to absence of suitable habitat
Dodonaea hackettiana	P4	-	An erect shrub or tree, 100 to 500 cm tall. Flowers are yellow to green/red and occur mainly from July to October. Habitat for this species occurs in sand and outcropping limestone (Western Australian Herbarium 1998-).	**Possible** due to presence of potential habitat.
Kennedia beckxiana	P4	-	Prostrate or twining shrub or climber. Flowers are red, flowering from September to December. Occurs on sand, loam on granite hills and outcrops (Western Australian Herbarium 1998-).	**Unlikely** due to absence of suitable habitat
Ornduffia submersa	P4	-	Aquatic species, occurring in wetland areas (Western Australian Herbarium 1998-).	**Unlikely** due to absence of suitable habitat
Thysanotus glaucus	P4	-	Caespitose, glaucose perennial, herb, 0.1 to 0.2 m high, Flowers are purple, flowering from October to December or January to March. Occurs on white, grey or yellow sand, sandy, sandy gravel (Western Australian Herbarium 1998-).	**Possible** due to presence of potential habitat.
Tripterococcus sp. Brachylobus (A.S George 14234)	P4	-	Grey, black or peaty sand. Winter-wet flats.	**Unlikely** due to absence of suitable habitat.
Verticordia lindleyi subsp. *lindleyi*	P4	-	An erect shrub, 0.2 m to 0.75 m high. Flowers are pink, flowering in May or November to December or January. Occurs in winter-wet depressions on sand, sandy clay (Western Australian Herbarium 1998-).	**Unlikely** due to absence of suitable habitat.

2.6.4 Vegetation types

Three vegetation types were recorded within the proposed clearing area (Table 4; Figure 2). The dominant native vegetation type was 'EmBaBm' which can be described as *Eucalyptus marginata, Banksia attenuata* and *Banksia menziesii* low woodland over weeds. This vegetation type completely lacks native understorey.

Table 4: Vegetation type within proposed clearing area

Vegetation type	Description	Area (ha)	Percentage of proposed clearing area
BaBm	*Banksia attenuata, B. menziesii* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland.	0.28	15%
Xp	*Xanthorrhoea preissii* Open Shrubland	0.12	6%
EmBaBm	*Eucalyptus marginata, B. attenuata, B. menziesii* Low Woodland over weeds	0.46	25%
CL	Cleared areas including tracks / firebreaks	0.99	54%
Total			



Figure 2: Vegetation types

N

Scale 1:800 at A4

0 10 20 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 10/04/2019

Legend

- Proposed clearing area
- Banksia Woodlands of the Swan Coastal Plain TEC'
- Roads

Vegetation type

- BaBm (0.28 ha)
- Cleared (0.998 ha)
- EmBaBm (0.462 ha)
- XP (0.122 ha)

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2.6.5 Vegetation condition

Vegetation condition was rated using the scale of Keighery (1994) for the South West Botanical Province (Table 5). The proposed clearing area has been subject to historical disturbance including clearing. As such, the majority of the site is in Completely Degraded condition (1.38 ha; 74%). The remainder of the vegetation was rated as Degraded to Good (Table 6, Figure 3).

Table 5: Vegetation condition scale (Keighery 1994)

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

Table 6: Vegetation condition within proposed clearing area

Condition	Area (ha)	Percentage of proposed clearing area
Good	0.28	15%
Degraded	0.12	6%
Completely Degraded	1.47	79%
Total	**1.87**	**100**



Figure 3: Vegetation condition

N

Scale 1:800 at A4

0 10 20 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 10/04/2019

Legend

- Proposed clearing area
- Roads

Vegetation condition

- Good (0.28 ha)
- Degraded (0.122 ha)
- Completely degraded (1.46 ha)

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2.6.6 Threatened and Priority Ecological Communities

Banksia woodland TEC

FCT analysis conducted by PVG Environmental (2014) identified that the small area of Banksia woodland (BmBa) in the north-east corner of the proposed clearing area is representative of the FCT 21a – Central *Banksia attenuata -Eucalyptus marginata* woodlands, which forms part of the *Banksia Woodlands of the Swan Coastal Plain* federally listed Threatened Ecological Community (Banksia Woodland TEC). This FCT is also a state listed (P3) Priority Ecological Community (PEC).

The EPBC PMST search identified the Banksia woodland TEC as potentially occurring in the proposed clearing area.

Vegetation within BmBa (0.28 ha) has retained Banksia woodland structure, but with limited native understorey (PGV Environmental 2014), which was confirmed by the Strategen survey. TSSC (2016) states that to be considered a part of the Banksia Woodlands TEC, a patch should be in at least 'Good' condition, 2 ha in size or above. As such, on its own, this patch would not meet the requirements due to its small size and condition. However, as this VT forms part of a broader area of Banksia woodland vegetation (within the private lots to the north), this small area of vegetation should be considered to form part of the Banksia woodland TEC, listed as Endangered under the EPBC Act.

Vegetation within EmBaBm is completely lacking native understory vegetation and is in 'Completely Degraded' condition. TSSC (2016) states that to be considered a part of the Banksia Woodlands TEC, the structure of the patch should include a highly species rich understorey. As such, EmBaBm has not been considered to form part of the Banksia woodland TEC.

No other PECs or TECs were considered to be represented by the vegetation within the proposed clearing area.

An assessment of BmBa against the diagnostic criteria provided in the approved conservation advice for the Banksia woodland TEC is shown in Table 7.

Table 7: Characteristics of the Banksia woodland within the proposed clearing area compared to the key diagnostic criteria as per TSSC (2016)

Key diagnostic criteria (TSSC 2016)	Banksia woodlands within the proposed clearing area
Location: Occurs in the Swan Coastal Plain or Jarrah Forest IBRA bioregions.	Yes. Banksia woodlands within the proposed clearing area occur on the Swan Coastal Plain.
Soils and landform: Occurs on: • well drained, low nutrient soils on sandplain landforms, particularly deep Bassendean and Spearwood sands and occasionally on Quindalup sands • sandy colluviums and aeolian sands of the Ridge Hill Shelf, Whicher Scarp and Dandaragan Plateau • transitional substrates and sandflats.	Yes. Banksia woodlands within BmBa occur on Bassendean sands.
Structure: Low woodland to forest with: • a distinctive upper sclerophyllous layer of low trees (occasionally large shrubs more than 2 m tall), typically dominated or co-dominated by one or more of the banksia species identified below • emergent trees of medium or tall (>10 m) height. *Eucalyptus* or *Allocasuarina* species may sometimes be present above the banksia canopy • an often highly species-rich understorey.	Yes. Banksia woodland in BmBa represents a low woodland-woodland structure.

Key diagnostic criteria (TSSC 2016)	Banksia woodlands within the proposed clearing area
Composition: Contains at least one of the following species: • *Banksia attenuata* • *Banksia menziesii* • *Banksia prionotes* • *Banksia ilicifolia*.	Yes. Banksia woodlands within BmBa contain *Banksia attenuata* and *B. menziesii*.
Condition (Keighery 1994): 'Pristine': no minimum patch size 'Excellent': 0.5 ha 'Very Good': 1 ha 'Good': 2 ha.	Banksia woodlands in BmBa covering 0.28 ha within the proposed clearing area in Good condition does not meet the patch size and condition criteria. However, the patch is contiguous with a broader patch of Banksia woodland directly to the north and east of the proposed clearing area, which would bring the overall patch size to >2 ha.

2.7 Terrestrial fauna

Terrestrial Ecology (2016) undertook a Level 1 fauna assessment of the proposed clearing area consisting of a desktop investigation and a 'targeted' reconnaissance field survey for conservation significant fauna and fauna habitat. The results of the assessment are detailed under the following sub-sections and a copy of the reports is provided in Appendix 3.

Subsequent to this assessment, an Ecologist from Strategen Environmental undertook a site visit in March 2019 to confirm the fauna values outlined by PGV Environmental (Strategen survey).

A Fauna Management and Relocation Plan was also prepared in consultation with the City of Cockburn and Department of Biodiversity Conservation and Attractions (DBCA) by Endplan Environmental (2016) (Appendix 4). The purpose of the plan was to identify the potential direct and indirect impacts of the proposed clearing of the site on vertebrate fauna.

2.7.1 Desktop assessment

Database searches of *NatureMap* and the DEE Protected Matters Database were undertaken as part of the fauna habitat survey undertaken by Terrestrial Ecosystems (2016) with a 10 km buffer of the proposed clearing area. These databases were used in conjunction with the vegetation and consequently the habitat present to determine the likelihood of any Threatened or Priority fauna species occurring in the proposed clearing area and in the nearby surrounds (where habitat is similar) (Appendix 3).

Fauna habitat present in the proposed clearing area has been mapped by Terrestrial Ecosystems (2016) as being either highly degraded or disturbed and therefore of very low value for fauna, particularly for conservation significant species.

It is important to note that the databases returned fauna species that are unlikely to occur in the proposed clearing area or nearby because of the following:

- specific habitat is not present within the proposed clearing area such as the ocean for marine mammals, or coastal shore habitat for shorebirds and wading birds or wetlands for waterbirds
- some species have a limited or patchy distribution
- species that have become locally extinct, or
- species that have been erroneously identified in previous surveys.

The database searches were examined and species were excluded if they met the above criteria, because they are then not expected to occur in the proposed clearing area.

Below provides a summary of species excluded from the conservation significant fauna records.

Waterbirds

Several shorebirds and wetland bird species were returned in the database searches. Wetland birds such as Egrets and wading birds including Plovers, Stints and Sandpipers inhabit estuaries, mudflats, saltmarshes, sandflats and beaches, where they feed on invertebrates such as worms, molluscs, insects and crustaceans (Garnett *et al.* 2011). There is no wetland in the proposed clearing area and therefore no habitat for these species. The wading birds returned from the database searches are excluded from any further discussion in this report.

Several coastal birds were returned from the database searches. Coastal birds such as White-bellied Sea-eagle and Osprey require coasts and near-coastal wetland habitat, where they feed mainly on fish, sea snakes and nesting seabirds (Johnstone & Storr 1998). There is no such habitat present in the proposed clearing area. As such, these species have also been excluded from any further discussion in this report.

Now Regionally Extinct

Several species returned in the database searches are also known to be historical records of species now regionally/locally extinct, for example the Malleefowl, Numbat and Western Ringtail Possum. These species have been excluded from any further discussion in this report.

Database Errors and Anomalies

Occasionally species appear in only the EPBC database searches, for example the Grey Wagtail and the Fork-tailed Swift. This database also considers broader information, for example bioclimatic distribution models, so can be less accurate at the local level. These species have also been omitted from any further discussion.

In addition, many fauna species are not distributed evenly across the landscape, are more abundant in some places than others are, and consequently more detectable (Currie 2007). Furthermore, some small, common ground-dwelling reptile and mammal species tend to be habitat specific, and many bird species can occur as regular migrants, occasional visitors or vagrants.

Conservation significant fauna

The likelihood of conservation significant species occurring in the proposed clearing area is outlined below in Table 9 and is based on the following criteria:

- Recorded: Recorded during the field survey or site reconnaissance
- Likely: Suitable habitat is present in the proposed clearing area and the proposed clearing area is in the species' known distribution
- Possible: Limited or no suitable habitat is present in proposed clearing area, but is nearby. The species has good dispersal abilities and is known from the general area
- Unlikely: No suitable habitat is present in proposed clearing area but is nearby, the species has poor dispersal abilities but is known from the general area or suitable habitat is present, however, the proposed clearing area is outside of the species' known distribution.

A total of eight conservation significant species (including Priority species) identified by the database searches have been considered here, with that being based on database records and suitable habitat in the proposed clearing area. These eight species are comprised of three reptile species, four birds and one mammal species.

Table 8: Threatened and priority fauna potentially occurring within the proposed clearing area

Species	Conservation status		Relevant Ecology	Likelihood of Occurrence
	BC Act / DBCA listing	EPBC Act		
Calyptorhynchus banksii naso (Forest Red-tailed Black-Cockatoo [FRTBC])	T	Vulnerable	This species is relatively common in the Perth metropolitan area. The FRTBC feeds primarily on Marri and Jarrah fruit, but also Tuart and to a lesser extent on Blackbutt (*Eucalyptus patens*), Albany Blackbutt (*E. staeri*), Karri (*Eucalyptus diversicolor*), Sheoak (*Allocasuarina fraseriana*) and Snottygobble (*Persoonia longifolia*) (Johnstone et al. 2013). The FRTBC can obtain energy faster when feeding on Marri and Jarrah than other food sources (Cooper et al. 2002), and these two-plant species make up most of their diet (Johnstone et al. 2013). The proposed clearing area has none of the FRTBC foraging species present.	**Likely**
Calyptorhynchus baudinii (Baudin's Black Cockatoo)	T	Endangered	This species occurs in the humid and sub-humid forests of Western Australia. Its range extends from Gidgegannup and Clackline in the north to about 50 km east of Albany and all the forest to the south-west coast (Chapman 2007).	**Possible**
Calyptorhynchus latirostris (Carnaby's Cockatoo)	T	Endangered	This species as with the FTRBC is relatively common in the Perth metropolitan area. Carnaby's Cockatoos feed on seeds, nuts and flowers of a variety of native and exotic plants. Food plants include a variety of Banksia species, for example the Slender Banksia (*Banksia attenuata*) and Firewood Banksia (*Banksia menziesii*), Eucalyptus species, such as Marri, Jarrah, Blackbutt, Coastal Blackbutt, Salmon Gum (*Eucalyptus salmonophloia*), as well as Pine trees (*Pinus sp.*), Grevillea, Allocasuarina, and Hakea species (Shah 2006, Johnstone et al. 2011). The seeds from a variety of Banksia species and the cones of Pine trees provide the highest energetic yield (Cooper et al. 2002). The proposed clearing area has food items such as the Slender Banksia, Firewood Banksia and Coastal Blackbutt that Carnaby's Cockatoo is known to eat.	**Likely**
Merops ornatus (Rainbow Bee-eater)	T	Marine	The Rainbow Bee-eater is often seen in the Perth metropolitan area. This species is one of the most common and widespread birds in Australia with a distribution that covers the majority of Australia (Barrett et al. 2003). The Rainbow Bee-eater is also a common and widespread species in WA, except the drier interior of the State and the far south-west. It occurs in lightly wooded, often sandy country, preferring areas near water. It feeds on airborne insects and nests throughout its range in WA in burrows excavated in sandy ground or banks, often at the margins of roads and tracks (Johnstone & Storr 1998). In WA, this bird can occur as a 'resident, breeding visitor, postnuptial nomad, passage migrant and winter visitor' (Johnstone & Storr 1998).	**Possible**

Species	Conservation status		Relevant Ecology	Likelihood of Occurrence
	BC Act / DBCA listing	EPBC Act		
Ctenotus gemmula (Jewelled South-west Ctenotus)	P3		There are three geographic populations for this species. One is on the sand plain north of Perth, one is on the sand plain around the greater metropolitan area and the largest geographic distribution is along the south coast of Western Australia. Its habitat includes white sand plains, mainly in semi-arid and sub-humid zones (Storr et al. 1999)	**Possible**
Neelaps calonotos (Black-striped Snake)	P3		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 by urban development. In its natural state, the proposed clearing area would have been typical habitat for the Black-striped snake, but not since the proposed clearing area has been historically cleared.	**Possible**
Lerista lineata (Lined Skink)	P3		This species is restricted to the south of the Swan River, where it inhabits sandy coastal heath and shrubland, this includes Banksia / Eucalypt woodlands (Wilson and Swan 2017). The proposed clearing area does have habitat that would be considered suitable for this species i.e. Banksia Woodland, however, the site has previously been cleared. The species is also likely to have poor dispersal ability.	**Possible**
Isoodon obesulus fusciventer (Quenda, Southwestern Brown Bandicoot)	P4		This species occurs from Guilderton southwards on the SCP, including the Perth Metropolitan area, in Jarrah and Karri forests and adjacent coastal vegetation complexes. The species inhabits scrubby, often swampy, vegetation with dense cover up to about 1 m high. It feeds in adjacent forest and woodland that is burnt on a regular basis and in areas of pasture and cropland lying close to dense cover. The Southern Brown Bandicoot is patchily distributed in suitable habitat, with populations inhabiting Jarrah and Wandoo forests usually associated with watercourses. On the Swan Coastal Plain it is often associated with wetlands with dense vegetation where they feed on fruit, seeds, insects and fungi (Woinarski et al. 2012). The proposed clearing area has some limited suitable habitat in the form of relatively dense vegetation cover in the understory.	**Possible**

2.7.2 Black Cockatoo habitat

Foraging habitat

There is limited suitable habitat for Black Cockatoo species (Carnaby's Cockatoo, FRTBC and Baudin's Black Cockatoo) that have known distributions that include the proposed clearing area (Appendix 6).

There are species present in the proposed clearing area that are known to be dietary items for Carnaby's Cockatoo, such as the Slender Banksia, Firewood Banksia and Jarrah (Shah 2006, Johnstone et al. 2011). However, these species are found relatively sparsely throughout the proposed clearing area in BmBa (0.28 ha) and EmBaBm (0.46 ha) (Figure 4).

The FRTBC feeds primarily on Marri and Jarrah fruit, but also Tuart and to a lesser extent on Blackbutt, Albany Blackbutt, Karri, Sheoak and Snottygobble (Johnstone et al. 2013). The proposed clearing area has a small patch of vegetation containing sparse Jarrah, therefore there is very limited foraging habitat for the FRTBC.

Johnstone and Kirkby (2008) reported Baudin's Black Cockatoo feeding primarily on the seeds of Marri, Jarrah and mixed *Banksia* spp. (including *B. grandis, B. littoralis* and *B. ilicifolia*). The Baudin's Black Cockatoo may infrequently be seen foraging in the vicinity of the proposed clearing area, but it is mostly seen on the Swan Coastal Plain, closer to the Darling Scarp.

Breeding habitat

There are no tree species in the proposed clearing area that are known to be used by Carnaby's Cockatoo or FRTBC for nesting. A total of seven Jarrah trees with a diameter at breast height (DBH) of ≥ 500 mm, to be considered potential breeding trees (DSEWPaC 2012) were identified within and directly adjacent to the potential clearing area (Figure 4). Only two of these trees occur within the proposed clearing area, the remaining five are located within the road reserve along Barfield Road. These five trees will be retained and will not be impacted by the proposed clearing.

None of the potential breeding trees identified had suitable hollows to be used for breeding by Black Cockatoos.

Given the limited extent of Carnaby's Cockatoo foraging habitat and the limited potential breeding habitat in the proposed clearing area, the site is considered to contain low quality habitat for Carnaby's Cockatoo.



Figure 4: Black Cockatoo habitat

N

Scale 1:800 at A4

0 10 20 m

Coordinate System:
GDA 1994 MGA Zone 50

Date: 10/04/2019

Legend

- Proposed clearing area
- Roads

Black Cockatoo habitat
- Low foraging value (0.28 ha)
- Very low foraging value (1.582 ha)

Potential Black Cockatoo breeding trees
- Within proposed clearing area
- Outside proposed clearing area

strategen ENVIRONMENTAL

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info@strategen.com.au | www.strategen.com.au

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Service Layer Credits: Nearmap: Aerial image, flown 02/2019. Client: Roberts Day. Site data 1/2019. Created by: c.thatcher

3. Assessment against the ten clearing principles

An assessment of the proposed clearing against the ten clearing principles is provided in Table 9. The ten clearing principles are outlined in Schedule 5 of the EP Act and assessment is in accordance with Department of Water and Environmental Regulation guidelines (DER 2014).

This assessment demonstrates that the proposed removal of 0.86 ha of native vegetation is not at variance with the any of the clearing principles.

Table 9: Assessment of native vegetation clearing in accordance with the ten clearing principles

Clearing principle	Assessment	Outcome
(a) Native vegetation should not be cleared if it comprises a high level of biological diversity.	A total of 43 native vascular plant taxa from 23 plant families were recorded within the proposed clearing area (PGV Environmental 2014). The relatively low number of taxa recorded was attributed to the small size and the degraded nature of the proposed clearing area. No flora species listed as Threatened under the BC Act or Priority Flora species as listed by the DBCA were recorded during the field survey. However, the surveyed identified the potential for *Caladenia huegelii* (T) and, *Dodonaea hackettiana* (P3) and *Thysanotus glaucus* (P4) based on preferred habitat and survey timing. Most of the vegetation within the proposed clearing area is not considered representative of any PECs or TECs. BmBa appeared to be a remnant of the Banksia woodlands of the Swan Coastal Plain TEC. Minimal native understorey was present within this vegetation type. The Pre-European vegetation system association and complexes within which the proposed clearing area is mapped, each have above 20% remaining which is above the 10% threshold for 'constrained areas'. Given the information above, vegetation within the proposed clearing area is not considered to comprises a high level of biological diversity and as such clearing is not expected to be at variance to this principle.	Not at variance.
b) Native vegetation should not be cleared if it comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	The proposed clearing area is not considered to represent or be necessary for the maintenance of significant habitat critical for fauna species. Two potential breeding trees for Black Cockatoos were recorded within the proposed clearing area, none of these trees contained any potential breeding hollows. Five potential breeding trees will be retained along the road reserve adjacent to the proposed clearing area. Foraging habitat quality in the proposed clearing area was rated as very poor. Additionally, vegetation retained within the road reserve adjacent to the proposed clearing area along Barfield Road will maintain habitat connectivity between areas of vegetation to the north and south. Therefore, clearing of 0.86 ha of vegetation is unlikely to be at variance to this principle.	Not at variance.
c) Native vegetation should not be cleared if it includes, or is necessary for the continued existence of, rare flora.	No Threatened or Priority flora species were recorded in the proposed clearing area during the flora and vegetation assessment (PGV Environmental 2014). The field survey was undertaken within the usual flowering period of *Caladenia huegelii* (T; flowers September to October) and *Dodonaea hackettiana* (P4; flowers July to October). During the field survey, no *Dodonaea* species were observed, and vegetation within the proposed clearing area was considered to be too degraded to constitute suitable habitat for *C. huegelii*. While the survey was undertaken outside the usual flowering period for *Thysanotus glaucus* (P4; flowers October to December or January to March), this species would still be identifiable throughout the year and therefore at the time of the survey. Given that the clearing area is small and unlikely to provide favourable habitat for Threatened or Priority flora, and that no Threatened or Priority flora were recorded during the field survey or have previously been recorded in the proposed clearing area, the proposed clearing is unlikely to be at variance with this principal.	Not at variance.

Clearing principle	Assessment	Outcome
d) 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.	While vegetation in BmBa is aligned with the Banksia woodlands of the Swan Coastal Plain TEC listed under the EPBC Act, this vegetation type has been heavily disturbed by historical clearing and weeds. Banksia woodland vegetation currently exists directly north of the proposed clearing area. For the above reasons, clearing of this area of vegetation would have limited impact on the maintenance of the overall TEC. As a result, the proposed clearing will not be at variance with this principle.	Not at variance.
e) Native vegetation should not be cleared if it is significant as a remnant of native vegetation in an area that has been extensively cleared.	A total 0.86 ha of remnant vegetation will be cleared to facilitate the consolidation of their bulk earthworks. This vegetation is not considered to be a significant remnant. The Pre-European vegetation system association and complexes within which the proposed clearing area is mapped, each have above 20% remaining which is above the above the 10% threshold for 'constrained areas'. The proposed clearing is not expected to result in a significant impact at the local or regional scale due to the small scale of clearing, with larger areas of vegetation protected in the broader region, including three nature reserves / Bush Forever sites within a 2 km radius (Thomsons Lake Reserve, Harry Waring Nature Reserve, and Banksia Eucalypt Woodland Park). Furthermore, the proposed clearing area encompasses previously disturbed areas, further reducing impacts on intact native vegetation. Given the above, the proposed clearing is not expected to be at variance to this principle.	Not at variance.
f) Native vegetation should not be cleared if it is growing in, or in association with, an environment associated with a watercourse or wetland.	The proposed clearing will not occur within or immediately adjacent to a watercourse or wetland. The closest wetland is located approximately 1 km to the northwest of the proposed clearing area. Therefore, the proposed clearing is not considered at variance to this principle.	Not at variance.
g) Native vegetation should not be cleared if the clearing of the vegetation is likely to cause appreciable land degradation.	The proposed clearing will be limited to a small area of vegetation (0.95 ha) in a broader area of existing urban development. In consideration of the above, the clearing is not likely to cause appreciable land degradation due to: • the small area of total proposed clearing • the large extent of vegetation that would remain within the local and regional areas • general construction environmental management measures being implemented. For the above reasons, the proposed clearing is unlikely to be at variance with this principle.	Not at variance.
h) 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 proposed clearing area occurs across a very small component of vegetation in the local area, does not occur within a conservation area and is isolated from any conservation areas. The nearest conservation areas are Thomsons Lake Nature Reserve (Bush Forever site 391), Harry Waring Marsupial Reserve (Bush Forever site 392) to the west, both of which are separated from the proposed clearing area by urban residential areas, and Banksia Eucalypt Woodland Park (Bush Forever site 492) to the east, which is separated from the proposed clearing area by residential areas and the Kwinana Freeway. Given the above information, the proposed clearing of vegetation within the proposed clearing area is unlikely to impact on the environmental values of any of these nearby conservation areas or be at variance to this principle.	Not at variance.

Clearing principle	Assessment	Outcome
i) 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 surface water features have been identified within the proposed clearing area, and stormwater readily filtrates through the porous, sandy soils of the Bassendean Sands. Earthworks within the proposed clearing area will not intersect with the water table and, as such, no disruption to the hydrological regime are expected within the proposed clearing area or in adjacent vegetation. Additionally, the vegetation proposed to be cleared is minimal (0.86 ha of vegetation). As such, the proposed clearing is not expected to affect surface water or groundwater quality given the remaining areas of intact native vegetation in the local area. Given the above information, the proposed clearing is not expected to be at variance to this principle.	Not at variance.
j) Native vegetation should not be cleared if clearing the vegetation is likely to cause, or exacerbate, the incidence of flooding.	Depth to groundwater across the proposed clearing area is estimated at 5 – 12 m below ground level. Given the porous, sandy nature of the soils within the proposed clearing area, stormwater readily infiltrates. In addition to the stormwater and groundwater characteristics above, the small scale of the proposed clearing, is highly unlikely to cause, or exacerbate, the incidence of flooding and therefore is not considered to be at variance to this principle.	Not at variance.

4. Environmental approval and management

4.1 Environmental approvals

The key approvals identified as being required and/or potentially required to support the proposed clearing include the following:

- Native Vegetation Clearing Permit (NVCP) under s 51 E of the EP Act

4.2 Environmental mitigation and management

To manage potential impacts associated with the proposed clearing, the following actions will be undertaken:

- general construction environmental management measures will be implemented, including but not limited to clear demarcation of the clearing boundary as to not impact upon adjacent vegetation, and site inductions for all contractors to inform of construction environmental management measures
- A fauna trapping and relocation program will be conducted by a suitably qualified and experienced fauna specialist prior to clearing and commencement to avoid fauna death and injury.

5. References

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Appendix 1
DWER Form C1 and Certificate of Title

GOVERNMENT OF WESTERN AUSTRALIA

Department of Water and Environmental Regulation (DWER)
Department of Mines, Industry Regulation and Safety (DMIRS)

Application for a clearing permit (area permit)

Environmental Protection Act 1986, section 51E

FORM C1

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 bilateral agreement

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

To be assessed in this manner, the proposed clearing action must be referred to the Commonwealth under the EPBC Act and deemed a 'controlled action' prior to submitting this application form.

For further information see *Form Annex C7* and *A guide to native vegetation clearing processes under the assessment bilateral agreement* available at www.der.wa.gov.au/our-work/clearing-permits.

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 EPBC Number

☒ No Proceed to Part 2

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

☐ *Form 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.

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 15 on Deposited Plan 30747

FILE REFERENCE

Street address	171 Barfield Rd, Hammond Park 6164
Local government area	City of Cockburn
Land zoning, e.g. rural, residential, industrial	Urban

Part 3: Applicant details

Applicant details

If granted, the permit will be granted in the name(s) of (all) landowner(s).

Include the Australian Company Number (ACN) if the proposed permit holder is a body corporate or other entity formed at law.

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

An individual	Title	Mr	☐	Mrs	☐	Ms	☐	Other:
	Name/s							
OR								
A body corporate or other entity formed at law (include ACN)		Gold Estates Holdings Pty Ltd ACN: 097 065 944						

Applicant contact details

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

DWER and DMIRS prefer to send all correspondence electronically via email.

We request that you consent to receiving all correspondence relating to instruments and notices under Part V of the EP Act ("Part V documents") electronically via email by indicating your consent in this section of the application form.

Where 'yes' is selected, all correspondence from DWER or DMIRS (as applicable) will be sent to you via email, to the email address provided in this section.

Where 'no' has been selected, Part V documents will be posted to you in hard copy to the postal/business address you have provided in this section. Other general correspondence may still be sent to you via email.

Provide contact details for the above individual or body corporate.

Contact person and position (if applicable)	Peter Dockett		
Company name (if applicable)	Richard Noble and Company (Gold Estates Holdings Pty Ltd)		
Postal / business address	Level 1, 189 Hay Street Subiaco WA 6008		
Phone (fixed line)	08 9380 9800	Phone (mobile)	
Email address	pdockett@rnoble.com.au		

	Yes	No
I consent to all written correspondence between myself (the applicant) and DWER/DMIRS (as applicable) regarding the subject of this application being exclusively via email, using the email address I have provided above.	☒	☐

Relationship to landowner

To apply for an area permit you must either be:

- the landowner;
- acting on the landowner's behalf;

  or
- likely to become the landowner.

"I am…" (mark the applicable box)

☒	the owner of the land.
☐	acting on behalf of the owner and have attached an agent's authority, expressly authorising me to act on behalf of the landowner. *[Attach a copy of the authorisation.]*
☐	likely to become the owner of the land. (If granted, the clearing permit will only be issued once the applicant becomes the land owner). *[Attach evidence of the pending transfer of ownership, contract of sale ('offer and acceptance'), or letter from current landowner.]*

Part 3: Applicant details

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:

☒	Certificate of title. *[Attach a copy of the certificate and all associated encumbrances with the application – available from Landgate]*
☐	Pastoral lease. *[Attach a copy of the lease and all associated encumbrances]*
☐	Mining lease.
☐	Public authority that has care, control, or management of the land.
☐	Other form of lease, land tenure, or specific arrangement. Please state:

Contact details for enquiries

If different from the applicant's contact details, enter the contact details of a person with whom DWER or DMIRS should liaise with concerning this clearing application.

Where contact details differ to those of the applicant, complete the below section:

Contact person (and position, if applicable)	Tristan Sleigh – Associate		
Company name (if applicable)	Strategen Environmental		
Postal / business address	Level 1, 50 Subiaco Square Road, Subiaco		
Phone (fixed line)	08 9380 3100	Phone (mobile)	0423 385 847
Email address	t.sleigh@strategen.com.au		

Part 4: Proposed clearing

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 a suitable portable digital storage device 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).

An ESRI shapefile must be provided if the application requires an assessment under an EPBC Act accredited process.

Total **area** of clearing proposed (hectares)	0.86 ha
and/or	
number of individual **trees** to be removed	

Proposed method of clearing

Mechanical

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

From July 2019 to July 2021

Purpose of clearing

Bulk earth works

Final land use:

Part 4: Proposed clearing					
You must provide evidence that avoidance and mitigation options have been pursued to eliminate, reduce, or otherwise mitigate the need for, and scale of, the proposed clearing of native vegetation.	Have alternatives that would avoid or minimise the need for clearing been considered and applied?	☒	Yes	☐	No
	If yes, provide details:				
	The proposed clearing represents the minimum area required to enable the clearing purpose.				
Refer to DWER's *Clearing of native vegetation offsets procedure* guideline available on the DWER website, and the Environmental Protection Authority's (EPA) *WA Environmental Offsets Policy and Guidelines* on the EPA website for further information.	Do you want to submit a clearing permit offset proposal with your application?	☐	Yes	☒	No
	If yes, provide details, and complete and attach Appendix A of the *Clearing of native vegetation offsets procedure* guideline.				

Part 5: Other DWER approvals	
INSTRUCTIONS: • **If your application is to be submitted to DMIRS, complete Section A and then skip to Part 6 of this form.** • **If your application is to be submitted to DWER, complete Section A and B.**	
Section A: Environmental Impact Assessment	
Environmental Impact Assessment (Part IV of the EP Act)	
Has this clearing application or any related matter been referred to the EPA?	☐ Yes – provide details [ ] ☒ No
Do you intend to refer the proposal to the EPA? Section 37B(1) of the EP Act defines a 'significant proposal' as *"a proposal likely, if implemented, to have a significant effect on the environment"*. If a decision-making authority (e.g. DWER or DMIRS) considers that the proposal in this application is likely to constitute a 'significant proposal', they are required under section 38(5) of the EP Act to refer the proposal to the EPA for assessment under Part IV, if such a referral has not already been made. If a relevant Ministerial Statement already exists, please provide the MS number in the space provided.	☐ Yes – intend to refer (proposal is a 'significant proposal') ☐ Yes – intend to refer (proposal will require a section 45C amendment to the current Ministerial Statement): MS [ ] ☐ No – a current valid Ministerial Statement applies: MS [ ] ☒ No – not a 'significant proposal'
Section B: Other approvals	
Pre-application scoping	
Have you had any pre-application / pre-referral / scoping meetings with DWER regarding any planned applications?	☒ No ☐ Yes – provide details: [ ]
Works approval / licence / registration (Part V Division 3 of the EP Act)	
Have you applied or do you intend to apply for a works approval, licence, registration, or an amendment to any of the above, under Part V Division 3 of the EP Act? It is an offence to perform any action that would cause a premises to become a prescribed premises of a type listed in Schedule 1 of the *Environmental Protection Regulations 1987*, unless that action is done in accordance with a works approval, licence, or registration. For further guidance, refer to *Guidance Statement: Decision Making*.	☐ Yes – application reference (if known): [ ] ☐ No – a valid works approval applies: [ ] ☐ No – a valid licence applies: [ ] ☐ No – a valid registration applies: [ ] ☒ No – not required

Part 5: Other DWER approvals

Water licences and permits (*Rights in Water and Irrigation Act 1914*)

Have you applied or do you intend to apply for: **1. a licence or amendment to a licence to take water (surface water or groundwater); or** **2. a licence or amendment to a licence to construct wells (including bores and soaks); or** **3. a permit or amendment to a permit to interfere with the bed and banks of a watercourse?**	☐ Yes – application reference (if known): [ ] ☐ No – a current valid licence applies: [ ] ☒ N/A

Part 6: Index of Biodiversity Surveys for Assessments (IBSA)

Biodiversity surveys submitted to support this application must meet the requirements of the EPA's *Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA)*. If these requirements are not met, DWER / DMIRS will decline to deal with the application.	☒	All biodiversity surveys submitted with this application meet the requirements of the EPA's *Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA).*

Part 7: Prescribed fee

Make cheques or money orders payable to:

Department of Water and Environmental Regulation for all clearing purposes other than mineral and petroleum activities

or

Department of Mines, Industry Regulation and Safety for mineral and petroleum clearing activities under the *Mining Act 1978*, various Petroleum Acts, or State Agreement Acts.

For credit card payments to:

- DWER, pay via BPoint, accessible online at: https://dwer.wa.gov.au/make-a-payment
- DMIRS, complete *Form C3* and attach it to this form.

Do not send cash in the mail.

Please indicate the clearing permit application fee that you are paying:

☒	**$50** for an area of less than one hectare
☐	**$100** for an area between one hectare and 10 hectares
☐	**$200** for an area of more than 10 hectares

Payment method (mark the applicable box):

☐	Cheque / Money Order
☒	*(DWER)* Secure EFT payment *(see https://dwer.wa.gov.au/make-a-payment for payment details)*
☐	*(DWER)* Secure credit card payment through BPoint Receipt number: Date of payment:
☐	*(DMIRS)* Credit card – complete and attach *Form C3*

OFFICE USE ONLY

Part 8: Application checklist			
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 suitable portable digital storage device.	Please ensure you have included the following as part of your application:		
	REQUIRED	☒	Payment.
		☒	An aerial photograph or map with a north arrow clearly identifying the areas of vegetation proposed to be cleared or ESRI shapefile.
		☒	Copy of the certificate of title or pastoral lease.
		☒	An index of all documentation attached to this application.
	AS REQUIRED	☐	Copy of written authority to act on behalf of the landowner.
		☐	Evidence of the pending transfer of land ownership, such as the offer and acceptance, or written notice from the current landowner.
		☐	*Form C3 – Credit card payment for DMIRS clearing applications*, if the fee is to be paid to DMIRS by credit card.
		☐	*Form Annex C7 – Assessment bilateral agreement*, if the clearing is also to be assessed under an EPBC Act accredited process.
		☐	Appendix A of the *Clearing of native vegetation offsets procedure* guideline, if the application includes a proposal for clearing permit offsets.
	ADDITIONAL SUPPORTING INFORMATION	☐	Photos of the application area.
		☒	Biodiversity surveys, submitted in accordance with the requirements of the EPA's *Instructions for the preparation of data packages for the Index of Biodiversity Surveys for Assessments (IBSA).*

Part 9: Commercially sensitive or confidential information		
Information submitted as part of this application will be made publicly available. If you wish to submit commercially sensitive or confidential information, please identify the information in Attachment 1, and include a written statement of reasons why you request each item of information be kept confidential. Information submitted later in the application process may also be made publicly available at the discretion of the relevant Department. For any commercially sensitive or confidential information, please follow the same process as described above. DWER and DMIRS 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* (WA).		
All information which you would propose to be exempt from public disclosure has been separately placed in **Attachment 1** (located at the end of this form). Grounds for claiming exemption in accordance with Schedule 1 to the *Freedom of Information Act 1992* must be specified.	**Attached** ☐	**N/A** ☐

Part 10: Submission of application	
Check one of the boxes below to nominate how you will submit your application. Files larger than 50MB cannot be received via email by DWER. Files larger than 45MB cannot be received via email by DMIRS. Larger files can be sent via File Transfer. Alternatively, email DWER or DMIRS (as applicable) to make other arrangements. If you have any enquiries regarding the provision of relevant information as part of this application, contact either DWER or DMIRS (as applicable), on the details below.	
A signed, electronic copy of the application form, including all attachments, has been submitted via the applicable email address specified below; **OR**	☐
A signed, electronic copy of the application form has been submitted via the applicable email address specified below, and attachments have been submitted via File Transfer, or electronically by other means as arranged with the relevant Department; **OR**	☐
A full, signed hard copy has been sent to the applicable postal address specified below.	☐
Email or post applications for all clearing purposes (other than mining and petroleum activities) to: Email: info@dwer.wa.gov.au **Department of Water and Environmental Regulation** Locked Bag 10 Joondalup DC WA 6919 Telephone: 6364 7000 For more information: www.dwer.wa.gov.au	Email or post applications related to mining and petroleum clearing activities (under delegation) to: Email: nvab@dmirs.wa.gov.au **Department of Mines, Industry Regulation and Safety** Resource and Environmental Compliance Division Mineral House 100 Plain St EAST PERTH WA 6004 Telephone: 9222 3333 For more information: www.dmirs.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*.	
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 11: Declaration and signature

General

I/We confirm and acknowledge that:

- the information contained in this application is true and correct and I/we acknowledge that knowingly providing information which is false or misleading in a material particular constitutes an offence under section 112 of the *Environmental Protection Act 1986* (WA) and may incur a penalty of up to $50,000;
- I/We have legal authority to sign on behalf of the applicant (where authorisation provided);
- I/We have not altered the requirements and instructions set out in this application form;
- I/We have provided a valid email address in Part 3 for receipt of correspondence electronically via email from DWER or DMIRS (as applicable) in relation to this application;
- I/We acknowledge that successful delivery to my/our server constitutes receipt of correspondence sent electronically via email from DWER or DMIRS (as applicable) in relation to this application; and
- I/We have provided a valid postal and/or business address in Part 3 for the service of all Part V documents.

Publication

I/We confirm and acknowledge:

- this application (including all attachments, apart from the sections identified in Attachment 1) is a public document and may be published;
- biodiversity surveys provided in accordance with Part 6 will be published and used, for the purposes of the IBSA project, in accordance with your declaration made in the *Metadata and Licensing Statement*;
- all necessary consents for the publication of information have been obtained from third parties;
- information considered exempt from public disclosure has been placed in Attachment 1 with reasons as to why the information should be exempt in accordance with the grounds specified in Schedule 1 to the *Freedom of Information Act 1992* (WA);
- subsequent information provided in relation to this application will be a public document and may be published unless written notice has been given to DWER or DMIRS (as applicable) by the applicant, at the time the information is provided, claiming that the information is considered exempt from public disclosure; and
- the decision to not publish information will be at the discretion of the CEO of DWER or DMIRS (as applicable) and will be made consistently with the provisions of the *Freedom of Information Act 1992* (WA).

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.

☒ **A company.** **Company name:** **Gold Estates Holding Pty** **ACN:** **097 065 944**

A person expressly authorised or authorised to execute on behalf of a body corporate must sign this form. A company must be a legal entity and provide an ACN. Please note an Australian Business Number is not sufficient.

☐ **Other entity formed at law.** Provide details:

Signature _____ Date 8/4/19

Name ALEX GREGG

Position DIRECTOR

Signature _____ Date 8/4/19

Name GREGORY JAMES ADAMS

Position COMPANY SECRETARY

ATTACHMENT 1 – Confidential or commercially sensitive information

Request for exemption from publication	
Information which you consider should not be published, on the grounds of a relevant exemption found in Schedule 1 to the *Freedom of Information Act 1992* (WA), must be specified in this Attachment.	
NOT FOR PUBLICATION IF GROUNDS FOR EXEMPTION ARE DETERMINED	
Specify section:	Ground for claiming exemption:
Specify section:	Ground for claiming exemption:

WESTERN AUSTRALIA

REGISTER NUMBER	
15/D30747	
DUPLICATE EDITION	DATE DUPLICATE ISSUED
2	9/7/2014

VOLUME 1913 FOLIO 170

RECORD OF CERTIFICATE OF TITLE

UNDER THE TRANSFER OF LAND ACT 1893

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 15 ON DIAGRAM 30747

REGISTERED PROPRIETOR:
(FIRST SCHEDULE)

GOLD ESTATES HOLDINGS PTY LTD OF PO BOX 8210, SUBIACO EAST

(T M697586) REGISTERED 7/7/2014

LIMITATIONS, INTERESTS, ENCUMBRANCES AND NOTIFICATIONS:
(SECOND SCHEDULE)

1. THE LAND THE SUBJECT OF THIS CERTIFICATE OF TITLE EXCLUDES ALL PORTIONS OF THE LOT DESCRIBED ABOVE EXCEPT THAT PORTION SHOWN IN THE SKETCH OF THE SUPERSEDED PAPER VERSION OF THIS TITLE. VOL 1913 FOL 170.

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:	1913-170 (15/D30747)
PREVIOUS TITLE:	1351-673
PROPERTY STREET ADDRESS:	171 BARFIELD RD, HAMMOND PARK.
LOCAL GOVERNMENT AUTHORITY:	CITY OF COCKBURN

LANDGATE COPY OF ORIGINAL NOT TO SCALE Mon Apr 8 16:04:35 2019 JOB 59045045

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Appendix 2
Flora and vegetation assessment

LOT 15 BARFIELD ROAD, HAMMOND PARK

FLORA AND VEGETATION SURVEY

Prepared for:	Richard Noble
Report Date:	9 December 2014
Version:	1
Report No.	2014-185

pgv ENVIRONMENTAL

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Appendix 1: DPaW Database Searches

Appendix 2: Species List

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1. INTRODUCTION

1.1 Purpose

The owners of Lot 15 Barfield Road, Hammond Park (the site), Richard Noble, plan to develop the site for residential purposes in accordance with its zoning. The site is approximately 1.8ha in size and located in the City of Cockburn, approximately 24km south of the Perth CBD.

The site has previously been cleared and contained two houses, one of which is no longer occupied. Native vegetation has regenerated on the site in some areas. As a result, Richard Noble commissioned PGV Environmental to undertake a Level 2 spring flora and vegetation survey of the site.

1.2 Scope of Works

The Level 2 Spring Flora and Vegetation Survey was undertaken in accordance with Guidance Statement 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004) and included the following:

- Desktop search and review of DPaW's Declared Rare and Priority Flora database and Threatened Ecological Communities database;
- Examination of recent aerial photography and contour maps to provisionally identify vegetation types and condition;
- Field survey in spring using quadrats to record native and introduced species as well as a thorough site walkover of any areas of native vegetation;
- Recording of any significant plant species using a hand-held GPS;
- Description and mapping of vegetation types and vegetation condition; and
- Compilation of a flora list.

2. EXISTING ENVIRONMENT

2.1 Land Use

The site has previously been cleared as evidence by the 1974 aerial photograph (Landgate, 2014) (Plate 1). The site regenerated to some extent until houses were constructed firstly in the south-east corner in the early 1980s and then along Barfield Road in the 1990s. Only the house in the south-east corner is currently occupied.

Plate 1. 1974 Historic Aerial Photograph



2.2 Topography

The site slopes gently from a high of around 35m AHD in the south-east corner down to 28m AHD in the flatter north-west part (DAFWA, 2014).

2.3 Geology and Soils

The site is located on the Swan Coastal Plain on the Bassendean Dune System.

One soil unit is located on the site as follows (DAFWA, 2014):

- Bassendean B1 Phase (212Bs_B1) consisting of extremely low to very low relief dunes, undulating sandplain and discrete sand rises. Deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2m.

2.4 Hydrology

The Perth Groundwater Atlas indicates that groundwater under the site in May 2003 was around 21m AHD and flowing in a westerly direction. The historical maximum groundwater was around 23m AHD. The depth to the historic maximum watertable ranges from 5-12m under the site.

2.5 Wetlands

There are no wetlands located on the site as mapped in the *Geomorphic Wetlands of the Swan Coastal Plain* Database (Landgate, 2014). The site investigations for the flora and vegetation survey confirmed the absence of wetlands on the site.

3. FLORA AND VEGETATION

3.1 Methodology

A flora and vegetation survey of the site was conducted by Dr Paul van der Moezel on 26 September2014. The survey included sampling from three non-permanent 10m x 10m quadrats as well as a thorough walk through the site. Site coverage was high due to the very small site, and high degree of disturbance enabling easy access on foot through the understorey.

3.2 Desktop Searches

A search of the Department of Parks and Wildlife's (DPaW's) Threatened Flora Database, the WA Herbarium database and the Declared Rare and Priority Flora Species List (Appendix 1) identified four Threatened (Declared Rare) plant species that have been recorded within 5km of the site (Appendix 1). A further 11 Priority listed species were also recorded.

Table 1: List of Flora Species Identified from Database Searches within 5km of the Site.

Species	Common Name	Status Under Wildlife Conservation Act 1950	Status Under EPBC Act 1999
Caladenia huegelii	Grand Spider Orchid	Threatened	Endangered
Diuris micrantha	Dwarf Bee-orchid	Threatened	Vulnerable
Drakaea elastica	Glossy-leaved Hammer Orchid	Threatened	Endangered
Lepidosperma rostratum	Beaked Lepidosperma	Threatened	Endangered
Eremaea asterocarpa subsp. *brachyclada*		Priority 1	
Cyathochaeta teretifolia		Priority 3	
Eryngium pinnatifidum subsp. *palustre*		Priority 3	
Jacksonia gracillima		Priority 3	
Pimelea calcicola		Priority 3	
Stylidium paludicola		Priority 3	
Dodonaea hackettiana	Hackett's Hopbush	Priority 4	
Ornduffia submersa		Priority 4	
Thysanotus glaucus		Priority 4	
Tripterococcus paniculatus		Priority 4	
Verticordia lindleyi subsp. lindleyi		Priority 4	

The likelihood of each species occurring on the site is discussed in Table 2. One Threatened and four Priority species could potentially occur in the sandy soils on the site.

Table 2: Likelihood of Identified Significant Flora Species occurring on the Site

Scientific Name	Preferred Habitat	Likelihood of Presence on site
Caladenia huegelii	Sand or clay loam. Does not survive in disturbed areas.	Possible
Diuris micrantha	Brown loamy clay. Winter-wet swamps, in shallow water	No
Drakaea elastica	Low-lying situations adjoining winter-wet swamps. Does not survive in disturbed areas	No
Lepidosperma rostratum	Peaty and clay soils	No
Eremaea asterocarpa subsp. *brachyclada*	Deep grey sand	Possible
Cyathochaeta teretifolia	Grey sand, sandy clay. Swamps, creek edges	No
Eryngium pinnatifidum subsp. *palustre*	Winter-wet areas	No
Jacksonia gracillima	Grey and brown well-drained sand	Possible
Pimelea calcicola	Sand. Coastal limestone ridges	Unlikely
Stylidium paludicola	Swampy areas	No
Dodonaea hackettiana	Sand. Outcropping limestone	Possible
Ornduffia submersa	Wetland areas	No
Thysanotus glaucus	White, grey or yellow sand, sandy gravel	Possible
Tripterococcus paniculatus	Grey, black or peaty sand. Winter-wet flats	No
Verticordia lindleyi subsp. lindleyi	Grey, black or peaty sand. Winter-wet depressions	No

*sourced from Florabase (DPaW, 2014b)

A search of the DPaW Threatened and Priority Ecological Community database identified one Threatened and three Priority Ecological Communities have been recorded within 5km of the site as follows:

- SCP 26a - Melaleuca huegelii - Melaleuca acerosa (currently M. systena) shrublands on limestone ridges (Threatened – Endangered)
- SCP 24 - Northern Spearwood shrublands and woodlands (Priority 3)
- SCP 21c - Low lying Banksia attenuata woodlands or shrublands (Priority 3)
- SCP 22 – Banksia ilicifolia woodlands (Priority 3)

3.3 Survey Conditions

The conditions that the survey was undertaken in are presented in Table 4 in order to assess the adequacy of the survey. In summary, there were no constraints to the survey.

Table 4: Statement of Botanical Survey Conditions

ISSUE	CONSTRAINTS (YES/NO); SIGNIFICANT, MODERATE OR NEGLIGIBLE	COMMENT
Competency/experience of the consultant conducting the survey	No constraints	Dr Paul van der Moezel has extensive survey experience on the Swan Coastal Plain.
Proportion of the flora identified	No constraints	The timing of the survey in early October should have identified most of the native species on the site.
Sources of information (historic/recent or new data)	No constraints	The flora of the Swan Coastal Plain is relatively well documented.
Proportion of the task achieved and further work that may need to be undertaken	No constraints	No follow-up survey required.
Timing/weather/season/cycle	No constraints	Generally slightly below average rainfall in winter 2014. Late September survey ideal for identifying rare orchids and maximising flowering of most species.
Intensity of survey (e.g. In retrospect was the intensity adequate)	No constraints	The open understorey made access and coverage easy. Approximately 4 hours spent on site.
Completeness (e.g. was relevant area fully surveyed)	No constraints	
Resources (e.g. degree of expertise available for plant identification)	No constraints	Experienced botanist undertook plant identifications on site.
Remoteness and/or access problems	No constraints	Easily accessible sites traversed entirely on foot.
Availability of contextual (e.g. bioregional) information for the study area.	No constraints	Heddle *et al.* (1980), Government of Western Australia (2000), Gibson *et al*. (1994).

Fungi and nonvascular flora (e.g. algae, mosses and liverworts) were not specifically surveyed for during the survey.

3.4 Results

3.4.1 Flora

A combined total of 62 species were recorded from the site (Appendix 2). The total included 43 native and 19 (31%) introduced species. The low number of native species, even for a small 1.8ha site, and the high percentage of introduced species reflects the high degree of disturbance to the native vegetation on the site.

The highest number of species recorded in the three quadrats was 26 in the Banksia woodland in Good condition in the north-east corner (Appendix 3). The other two quadrats recorded contained

vegetation in Degraded to Completely Degraded condition and had species richness numbers of 8 and 16 with a high proportion of introduced species.

None of the species recorded is a Threatened (Declared Rare) or Priority listed species. The survey was undertaken at a time when the Threatened orchid species *Caladenia huegelii* would have been flowering.

3.4.2 Vegetation

Vegetation Complexes

The vegetation belongs to the Bassendean – Central and South vegetation complex as mapped by Heddle *et al*. (1980).

Vegetation Types

Three vegetation types were mapped (Figure 3) and described for the site based on the structure and composition of the dominant layers.

BmBa ***Banksia attenuata/B. menziesii* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland**

This vegetation type occurred in the north-east corner of the site. The Banksia trees were up to 4m high and in low densities. *Xanthorrhoea preissii* was the most dominant native understorey species at around 1m high and 10% cover. All other native species had very low coverage. *Gladiolus caryophyllaceus, Ursinia anthemoides* and Flat Weed (*Hypochaeris glabra*) were the most prevalent weed species. The soil was grey-brown sand. Quadrat B1 is representative of this vegetation type.

Xp ***Xanthorrhoea preissii* Open Shrubland**

A small section of *Xanthorrhoea preissii* shrubland occurred in the north central part of the site. The *Xanthorrhoea* shrubs were up to 1.2m high and 20% density. Very few native species were recorded in this vegetation type and no trees except several WA Christmas Trees (*Nuytsia floribunda*). Presumably the Banksia and possibly Jarrah trees that occurred previously in this area did not regenerate after clearing in the early 1970s. Introduced species were common, particularly *Ursinia anthemoides,* Veltdgrass (*Ehrharta longiflora*) and Flat Weed. The soil was grey sand. Quadrat B2 is representative of this vegetation type.

Em ***Eucalyptus marginata/ Banksia attenuata/B. menziesii* Low Woodland over weeds**

Two stands of this vegetation type occurred, one in the north-west corner and the other in the south-west corner. Jarrah (*Eucalyptus marginata*) was the most common tree species up to 6m high and varying in density while *Banksia attenuata* and *B. menziesii* also occurred but in very low numbers. Few native understorey species were present while introduced species such as Veldtgrass and Ursinia were common. The soil was light grey sand. Quadrat B3 is representative of this vegetation type.

Floristic Community Types

Floristic Community Types (FCT) are based on the whole floristic composition of the vegetation rather than being determined by soil type and geomorphology (Vegetation Complex) or the nature of the dominant species (Vegetation Types). The FCT level of vegetation is required to identify whether any of the vegetation on the site is a Threatened or Priority Ecological Community.

Most of the vegetation on the site is too degraded to assign a FCT.

Analysis of the FCT for the Banksia woodland quadrat B1 was undertaken by comparing the species in each quadrat to the species-Community type table 12 in Gibson *et al*. (1994). The analysis produced a strong correlation for the Banksia woodland vegetation with FCT 28 'Spearwood *Banksia attenuata* woodlands or *Banksia attenuata* – *Eucalyptus* woodland' with high similarities to FCT 21a 'Central *Banksia attenuata* – *Eucalyptus marginata* woodlands' and 23a 'Central *Banksia attenuata* – *B. menziesii* woodlands'. FCT 28, however, occurs on Spearwood sands on Cottesloe and Karrakatta soil types and was not recorded by Gibson *et al.* (1994) on Bassendean Sands. The vegetation is therefore most likely to be FCT21a which occurs on Bassendean soil types. While FCT23a also occurs on Bassendean Soils this FCT rarely contain Jarrah (*Eucalyptus marginata*) which is common on the site.

As a comparison, Bayley Environmental Services (2011) considered the regrowth Banksia woodland on Lots 42-44 Frankland Avenue, Hammond Park was either FCT 21a or 23a. Coffey Environments (2008) considered that the Banksia woodland on Lot 46 Frankland Avenue, Hammond Park was likely to be FCT 23a. PGV Environmental (2011) considered the Banksia woodland on Lot 3 Norkett Road, Mandogalup was most likely to be FCT21a. All three sites are within 2km of Lot 15.

3.4.3 Vegetation Condition

The vegetation condition over the site was assessed using the condition scale adopted in Bush Forever (Table 6). The native vegetation on most of the site is either Completely Degraded or Degraded with remnant trees or shrubs in a weed dominated understorey. The Banksia woodland vegetation in the north-east corner was considered to be in Good condition as the understorey contained a reasonable number of native plant species and life forms (shrubs, herbs, orchids, sedges) but was partially cleared and contained an abundance of aggressive weeds.

No presence of dieback was noted.

Table 6. Vegetation Condition Rating Scale.

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

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

Source: Government of Western Australia, 2000.

3.4.4 Conservation Significance of Flora and Vegetation

Flora

None of the species recorded is a Threatened (Declared Rare) or Priority listed species or is listed in Bush Forever as a significant species.

Vegetation

The vegetation on most of the site is considered too degraded to have values for protection of vegetation.

The small area of Good condition Banksia woodland in the north-east corner of the site is considered to be representative of the Bassendean - Central and South Vegetation Complex as well as Floristic Community Type 21a.

The current extent of the Bassendean - Central and South Vegetation Complex remaining in the Swan Coastal Plain portion of the Perth Metropolitan Region is 10,919ha (24% of the original extent) of which 5,883ha or 13% has some existing or proposed protection. These percentages are above the Bush Forever targets of protecting at least 400ha or 10% of each vegetation complex in the Perth Metropolitan Region.

FCT21a occurs in the central part of the Swan Coastal Plain from Perth to Capel and is considered well reserved and a low conservation risk (Gibson *et al.* 1994). Accordingly FCT21a is not a Threatened or Priority Ecological Community.

Vegetation from the Bassendean-Central and South Vegetation Complex and FCT21a is protected in the nearby Bush Forever site 392 'Harry Waring Marsupial Reserve' (271.6ha including open water) located 1km west of Lot 15.

The vegetation on the site does not form any part of a local or regional linkage and has very limited values for fauna.

4. CONCLUSIONS AND SUMMARY

The Level 2 Flora and Vegetation Survey of Lot 15 Barfield Rod, Hammond resulted in the following findings:

- A total of 62 plant species including 43 native and 19 introduced species was recorded from the site. The low total of native species and high percentage of introduced species (31%) is indicative of not only small size of the site but the high degree of disturbance;
- No Threatened (Declared Rare) flora were recorded from either lot;
- Three vegetation types were recorded on the sandy soil types on the site, a Banksia woodland, a Jarrah/Banksia woodland and a Xanthorrhoea preissii Shrubland;
- The condition of the vegetation was mostly rated as Completely Degraded due to the past clearing on the site, low number of understorey species and prevalence of weeds. The Banksia woodland in the north-east corner of the site was rated as Good due to the higher number of native species in the understorey;
- The vegetation belongs to the Bassendean – Central and South vegetation complex which is well reserved on the southern Swan Coastal Plain;
- Most of the vegetation on the site was too degraded to assign a Floristic Community Type. The Banksia woodland vegetation type was considered to be representative of FCT 21a 'Central *Banksia attenuata* – *Eucalyptus marginata* woodlands' which is not a Threatened or Priority Ecological Community; and
- The vegetation on the site does not form part of any regional or local ecological linkage and has very limited values for fauna.

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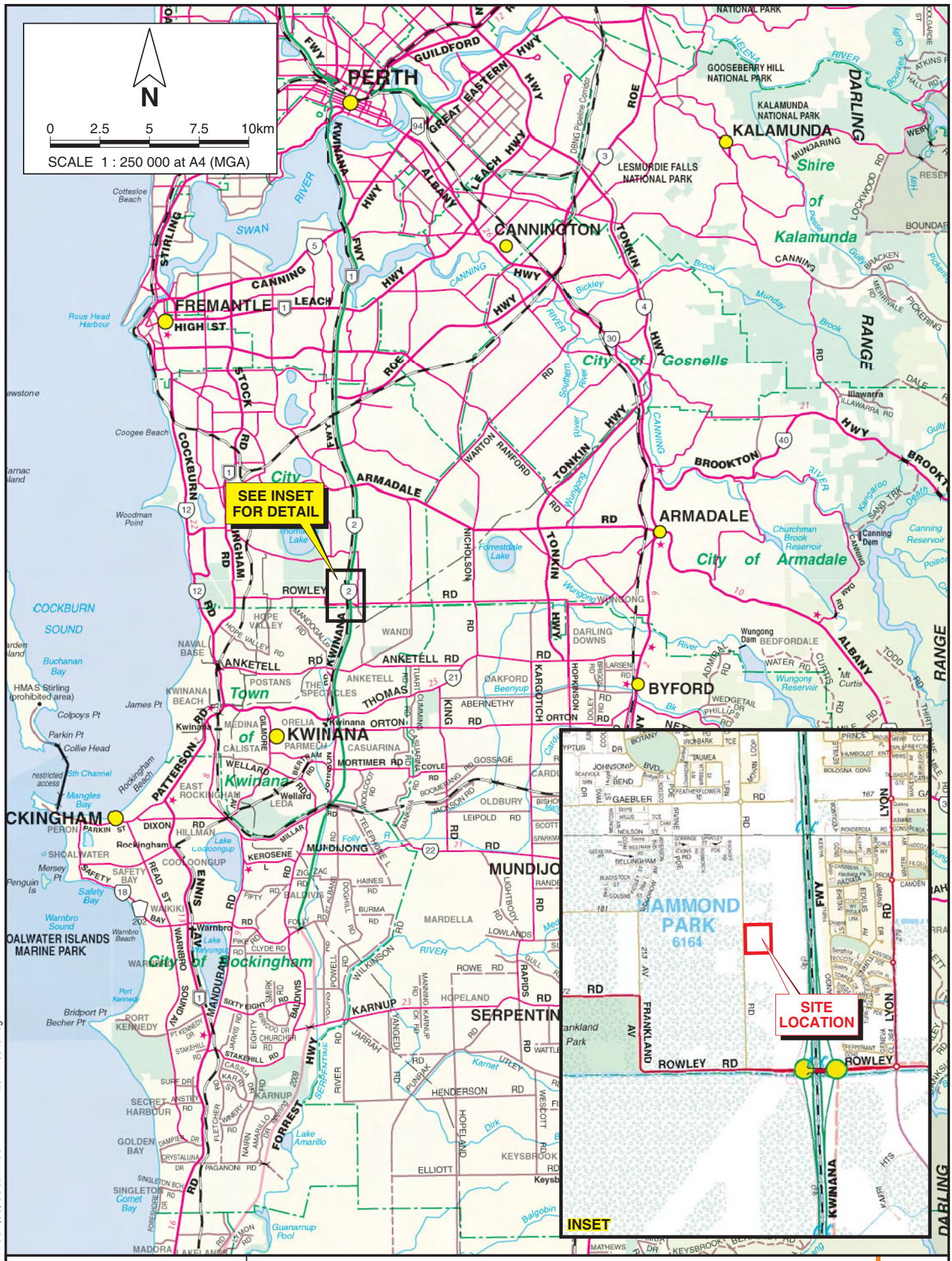
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FIGURES



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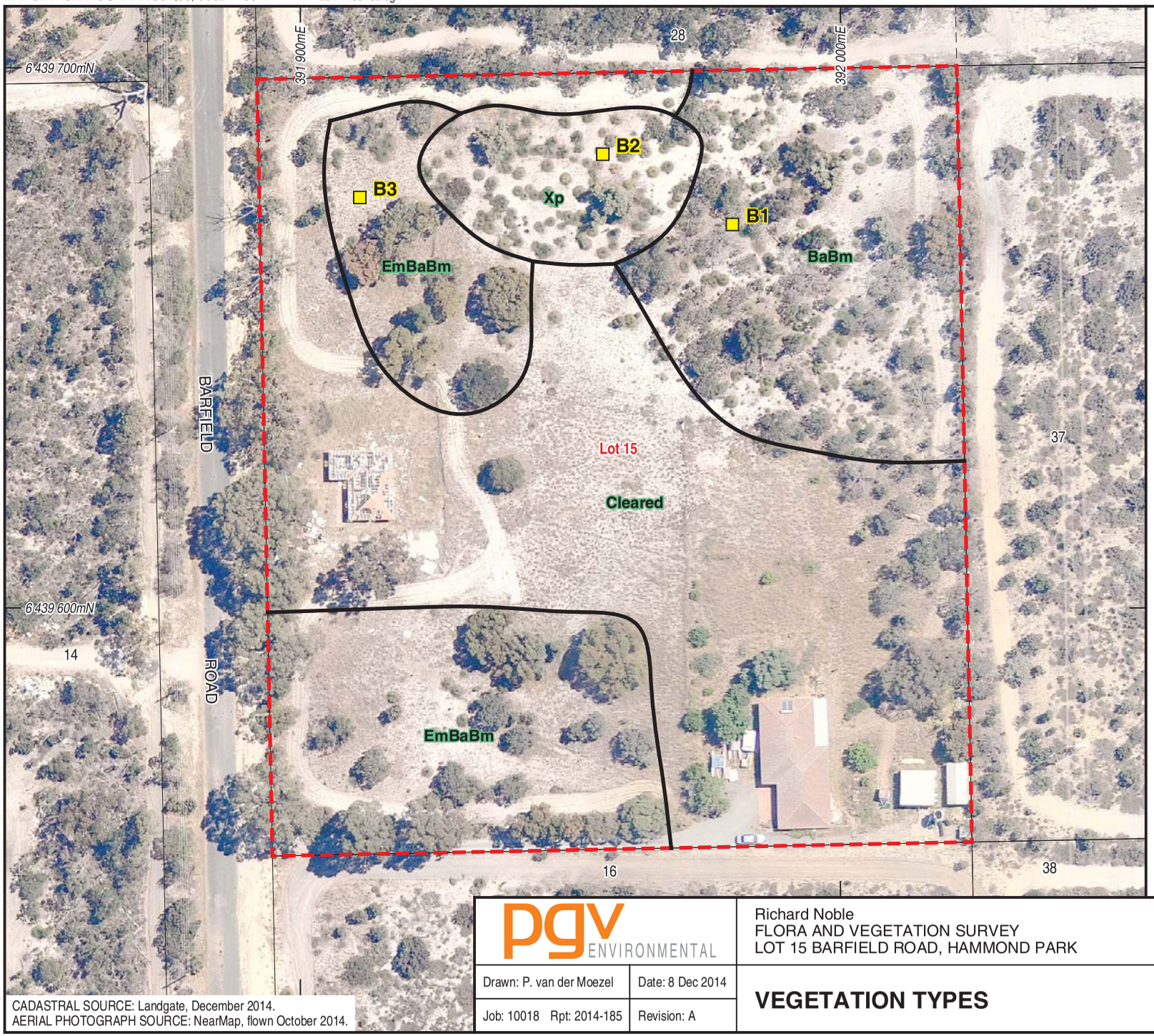
Richard Noble
FLORA AND VEGETATION SURVEY
LOT 15 BARFIELD ROAD, HAMMOND PARK

Drawn: P. van der Moezel	Date: 8 Dec 2014
Job: 10018 Rpt: 2014-185	Revision: A

SITE LOCATION

Figure 1

PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-185-f02.dgn



N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A4 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Quadrat Location
- Vegetation Type Boundary
- Xp Vegetation Type

Vegetation Types

BmBa *Banksia attenuata/B. menziesii* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland

Xp *Xanthorrhoea preissii* Open Shrubland

Em *Eucalyptus marginata/ Banksia attenuata/B. menziesii* Low Woodland over weeds

CADASTRAL SOURCE: Landgate, December 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2014.

pgv ENVIRONMENTAL

Drawn: P. van der Moezel | Date: 8 Dec 2014

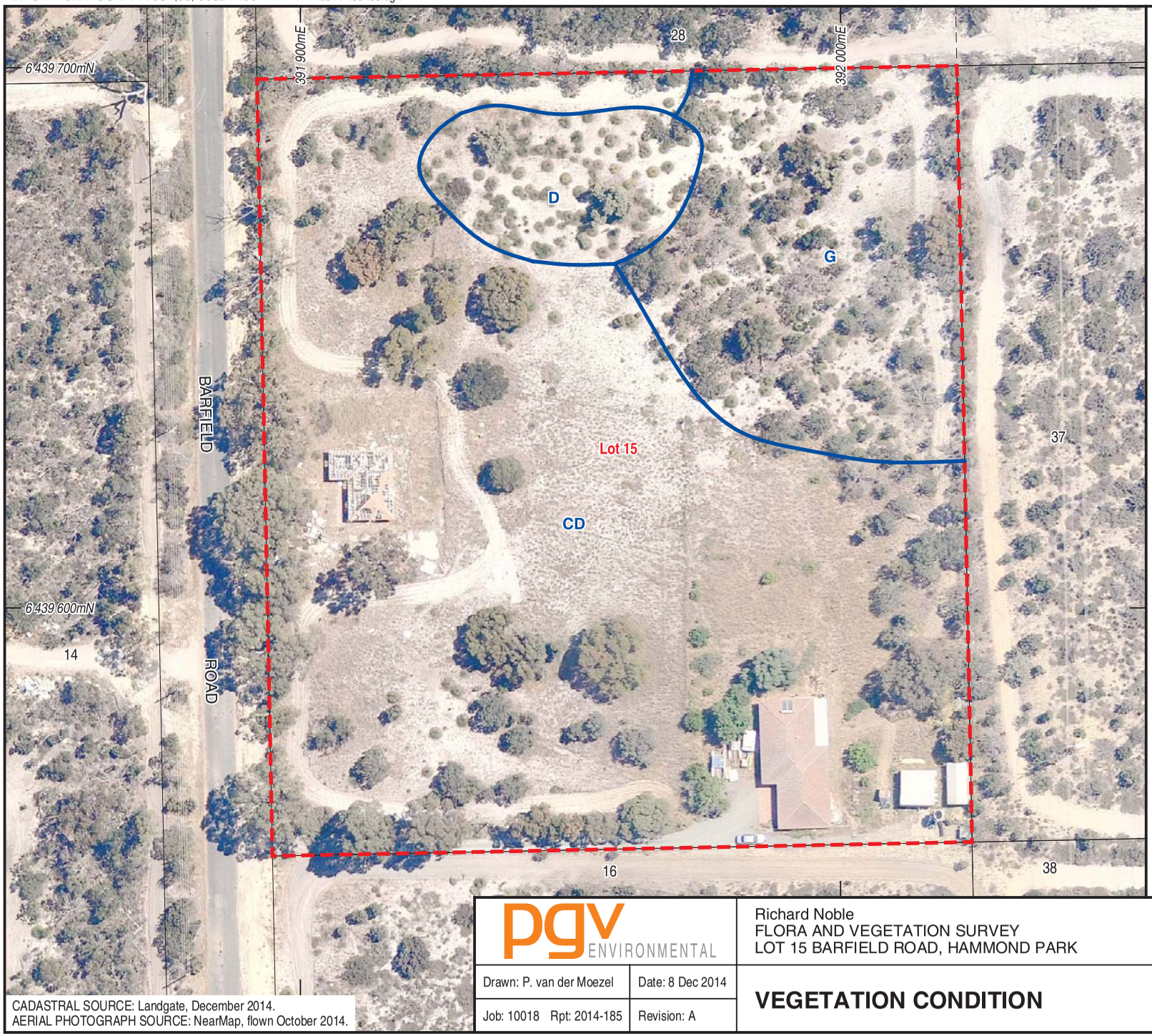
Job: 10018 Rpt: 2014-185 | Revision: A

Richard Noble
FLORA AND VEGETATION SURVEY
LOT 15 BARFIELD ROAD, HAMMOND PARK

VEGETATION TYPES

Figure 2

PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-185-f03.dgn



N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A4 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Vegetation Condition Boundary
- G Vegetation Condition

Vegetation Condition
(SOURCE: Bush Forever, Govt. of W.A., 2000)

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 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.

Cl - Cleared
No native vegetation remaining.

CADASTRAL SOURCE: Landgate, December 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2014.

pgv ENVIRONMENTAL

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FLORA AND VEGETATION SURVEY
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VEGETATION CONDITION

Figure 3

APPENDIX 1

DPaW Database Searches

PopId	Nameid	Taxon	ConsStatus	WARank	PopNumber	SubPopCode	PopStatus	Location	District	Vesting	Purpose1	Purpose2	AreaOccupi
97306	1596	Caladenia huegelii	T	CR	59	A		The north western boundary of Wandi Nature Reserve (Reserve No. 36110), within the Town of Kwinana. Approximately 100m NE of 30 Blackboy Grove, Wandi.	SWAN COASTAL	CC	CFF		
97307	1596	Caladenia huegelii	T	CR	59	B		Wandi Nature Reserve (Reserve No. 36110), from 30 Blackboy Grove, Wandi head south along Wandi NR boundary fence for ca. 150m, then east ca. 200m (ca. 130m NW of the southern boundary fence).	SWAN COASTAL	CC	CFF		
97308	1596	Caladenia huegelii	T	CR	59	C		Western boundary of Wandi Nature Reserve (Reserve No. 36110). Halfway down track along W boundary. Approx 320m in from De Haer Rd. ~5m E of track. Town of Kwinana.	SWAN COASTAL	CC	CFF		
97309	1596	Caladenia huegelii	T	CR	59	D		The southern boundary of Wandi Nature Reserve (Reserve No. 36110). Approx 440m SW down De Haer Rd from E corner of Reserve, approx 40m in from Road verge. Within the Town of Kwinana.	SWAN COASTAL	CC	CFF		
97310	1596	Caladenia huegelii	T	CR	59	E		Approx 150m SW down De Haer Rd from E corner of Wandi Nature Reserve (Reserve No. 36110). Approx 10m in from Road verge. Within the Town of Kwinana.	SWAN COASTAL	CC	CFF		
97312	1596	Caladenia huegelii	T	CR	60	A		Private Property, 36 (Lot 149) Stefanelli Road, Wandi.	SWAN COASTAL	PRI			
97313	1596	Caladenia huegelii	T	CR	60	B		Private Property, Lot 51 (previously part of Lot 137 which was sudivided) Rowley Road, Wandi, scattered in bush in southern half of block.	SWAN COASTAL	PRI			
97314	1596	Caladenia huegelii	T	CR	60	C		Private Property, Lot 1 (previously pasrt of Lot 132) Wandi Road, Wandi, scattered in bush in northern half of block.	SWAN COASTAL	PRI			
106221	1596	Caladenia huegelii	T	CR	60	D		Private Property, Lot 52 (previously part of Lot 137 which was sudivided) Rowley Road, Wandi, scattered in bush in southern half of block.	SWAN COASTAL	PRI			
84954	1596	Caladenia huegelii	T	CR	61			Private Property 384 Bartram Street, Banjup, remnant at back of property.	SWAN COASTAL	PRI			
84955	1596	Caladenia huegelii	T	CR	62			Western edge of Denis De Young Reserve Banjup.	SWAN COASTAL	LGA	REC		
84960	1596	Caladenia huegelii	T	CR	67			Unvested Reserve No. 41438, east of Shirley Balla Swamp, Banjup.	SWAN COASTAL	NON	GVT		
84964	1596	Caladenia huegelii	T	CR	72			Private Property, Lot 3 (54 Oxley Road), Banjup. Ca. 20m S of water tank.	SWAN COASTAL	PRI			

84968	1596	Caladenia huegelii	T	CR	76			Private property. 22 Robinson Rd (Lot 31), Wandi. Remnant bush/garden bed close to house within 1m of driveway. Town of Kwinana.	SWAN COASTAL	PRI				
106981	1596	Caladenia huegelii	T	CR	78	A		Private Property Lot 674 Lyon Road, Wandi. Site is 720m north of Anketell Road. Plant is on the disturbed edge of the eastern firebreak that runs parallel to Lyon Road.	SWAN COASTAL	PRI				1
107683	1596	Caladenia huegelii	T	CR	78	B		Private Property Lot 52 Lyon Road, Wandi. Site is 430m north of Anketell Road. Plants are on the disturbed edge of the eastern firebreak that runs parallel to Lyon Road and approx 20m in the bushland.	SWAN COASTAL	PRI				
93196	16245	Cyathochaeta teretifolia	3		12			Private Property. Lot 100, Treeby Rd. Anketell. Kwinana.	SWAN COASTAL	PRI				
99184	4763	Dodonaea hackettiana	4		4	B		N verge of Wedge Rd, along the S edge of Kogolup Lake, Yangebup.	SWAN COASTAL	LGA	VER			
99185	4763	Dodonaea hackettiana	4		4	C		N edge of Thomsons Lake. W end of Haring Rd, Success.	SWAN COASTAL	NON	OTH			
99186	4763	Dodonaea hackettiana	4		4	D		NW edge of Thomsons Lake. 0.6 km W of Wedge Rd and 0.5 km E of Lorimer Rd.	SWAN COASTAL	NON	OTH			
99189	4763	Dodonaea hackettiana	4		5	A		Russell Rd, Wattleup. From Pearse Rd, E for approx 0.6 km.	SWAN COASTAL	LGA	VER			
99190	4763	Dodonaea hackettiana	4		5	B		S side of Russell Rd, Wattleup. NW corner of Harry Waring Marsupial Reserve.	SWAN COASTAL	CC	CFF	OTH		
99191	4763	Dodonaea hackettiana	4		5	C		S edge of Thomsons Lake. From 0.5 to 1.5 km E of Pearse Rd.	SWAN COASTAL	LGA	NRE	CFA		
99192	4763	Dodonaea hackettiana	4		5	D		Harry Waring Marsupial Reserve. W edges of Banganup (Toodjabubup) Lake.	SWAN COASTAL	CC	CFF	OTH		
99193	4763	Dodonaea hackettiana	4		5	E		Harry Waring Marsupial Reserve. E side of Banganup (Toodjabubup) Lake. 375 m S of Russell Rd.	SWAN COASTAL	CC	CFF	OTH		
99194	4763	Dodonaea hackettiana	4		5	F		WSW edge of Banganup (Toodjabubup) Lake. 0.5 km SE of the intersection of Russell and Pearse Rds,	SWAN COASTAL	PRI				
87256	4763	Dodonaea hackettiana	4		15			Near the Spectacles, Peel Estate. W side of Johnson Rd, 1 km N of Thomas Rd.	SWAN COASTAL	PRI				
97391	1639	Drakaea elastica	T	CR	2	A	X	**Extinct - Cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 33.	SWAN COASTAL	PRI				
97392	1639	Drakaea elastica	T	CR	2	B	X	**Extinct - cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 34.	SWAN COASTAL	PRI				
97393	1639	Drakaea elastica	T	CR	2	C	X	**Extinct - cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 35.	SWAN COASTAL	PRI				
85074	1639	Drakaea elastica	T	CR	31			Private Property, Lot 129 Bodeman Road, Wandi. Plants scattered in bush in rear of block near western boundary. Shire of Kwinana.	SWAN COASTAL	PRI				

91803	14097	Eremaea asterocarpa subsp. brachyclada	1	1	Lot 147 Stefannelli Cl, Wandi; bushland S of driveway	SWAN COASTAL	PRI		
91804	14097	Eremaea asterocarpa subsp. brachyclada	1	2	Lot 137 Rowley Rd, Wandi; plants scattered in bushland in southern half of block	SWAN COASTAL	PRI		
91805	14097	Eremaea asterocarpa subsp. brachyclada	1	3	Lot 132 Wandi Dr, Wandi; bushland in eastern half of block	SWAN COASTAL	PRI		
91806	14097	Eremaea asterocarpa subsp. brachyclada	1	4	Lot 152 Stefanelli Cl, Wandi; bushland in S half of block	SWAN COASTAL	PRI		
91807	14097	Eremaea asterocarpa subsp. brachyclada	1	5	Lot 129 Bodeman Rd, Wandi; bushland to the west, north, south, and NE of house	SWAN COASTAL	PRI		
91808	14097	Eremaea asterocarpa subsp. brachyclada	1	6	Lot 130 Bodeman Rd, Wandi; bushland to the west, south, and SW of house	SWAN COASTAL	PRI		
93725	16998	Tripterococcus paniculatus	4	6	Reserve 41438 (Location 418), cnr of Liddlow & Gibbs Rds,Banjup.	SWAN COASTAL	NON	GVT	
92664	14714	Verticordia lindleyi subsp. lindleyi	4	22	Denis De Young Reserve, Banjup. East side of Liddelow Rd, ca. 475 m north of the junction with Oxley Rd.	SWAN COASTAL	LGA	REC	

Taxon	Status	Rank	IUCNCriteria	EPBC	DECRegion	DECDistrict	Distribution	FloweringPeriod
Dodonaea hackettiana	4				SWAN	SWAN COASTAL	Wattleup, Thompson Lake, Kings Park, Jandakot, Bibra Lake-The Spectacles, Gingin, Peron, Baldivis, Beeliar, Baldivis, Harry Waring Marsupial Reserve	Jul-Oct
Eremaea asterocarpa subsp. brachyclada	1				SWAN	SWAN COASTAL	Base of Darling Scarp, Wandi	
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459) PN	3				SWAN	SWAN COASTAL	Serpentine, Kenwick, Upper Swan, Gingin, Forrestdale, Bullsbrook, Mandurah, Arrowsmith, Capel	-
Jacksonia gracillima	3				SWAN,SWST	SWAN COASTAL,BLACKWOOD	Mundijong, Forrestdale, Capel, Elgin, Modong N.R., Forrestfield, Ambergate	Oct-Nov
Lepidosperma rostratum	T	EN	B1ab(iii)+2ab(iii)	EN	SWAN	SWAN COASTAL	Cannington, Kenwick, Forrestdale Lake NR	Aug
Ornduffia submersa	4				SCST,SWAN,SWST,WARR	PERTH HILLS,SWAN COASTAL,WELLINGTON,DONNELLY,FRANKLAND,ALBANY	Gunapin, Boyanup, Lake Muir, Denmark, Forrestdale, Kenwick, Frankland River, Lane Poole	Sep-Oct
Stylidium paludicola MS	3				SWAN,SWST	SWAN COASTAL,BLACKWOOD,WELLINGTON	Bullsbrook, Ruabon, Mandogalup, Lake Clifton, Cookernup, Capel, Dardanup	
Thysanotus glaucus	4				MWST,SCST,SWAN,SWST,WHTB	PERTH HILLS,SWAN COASTAL,BLACKWOOD,ALBANY,ESPERANCE,MOORA,GREAT SOUTHERN	Regans Ford, Forrestdale, Busselton, Lake King, West Mt Barren, Lesueur NPk	Nov-Feb
Tripterococcus paniculatus	4				SWAN,SWST	SWAN COASTAL,BLACKWOOD	Cannington, Armadale, Leeming, Forrestfield, Upper Swan, Willeton, Forrestdale, Busselton	Nov
Verticordia lindleyi subsp. lindleyi	4				MWST,SWAN	PERTH HILLS,SWAN COASTAL,MOORA	Gillingarra-Forrestdale, Cannington, Guildford, Muchea, Gingin, Murray River, Moore River, Serpentine	Nov-Jan

Taxon	Cons_ code	Site	Vegetation	Locality	Geocode_ me	Prec
Cyathochaeta teretifolia	3			In or adjacent to Emma Treeby Reserve, S Armadale Road, Banjup	MAN	3
Diuris micrantha	T	Swamp. Black peaty soil.	Miscellaneous rushes and sedges.	Mandogolup, Johnsons Road, Darling District	UNK	3
Dodonaea hackettiana	4			Thomson's Lake Reserve, Jandakot	MAN	3
Dodonaea hackettiana	4	Sand with outcropping limestone.	Tall danse Banksia forest.	24 km S of Perth, S of Thompson's Lake on Russell road	MAN	3
Dodonaea hackettiana	4			Russell Road (S side of Reserve) between Thomsons Lake and Marsupial Reserves, Wattleup	AUTO	2
Drakaea elastica	T	In deep grey sand on gradual slopes in undulating plain.	Low woodland of Banksia attenuata, B. menziesii, B. ilicifolia, and Jarrah over scrub of Adenanthos cygnorum and Kunzea over herbs.	Mandogalup, S of Perth, 0.8 km S of Hope Valley Road, along Treeby Road	MAN	3
Jacksonia gracillima	3	Flat, well-drained but adjacent to winter-wet swamp; pale grey sand.	Banksia woodland.	Bushland near Shirley Balla Swamp, north of Gibbs Rd, Banjup	GPS	1
Pimelea calcicola	3	Brown sand and protruding limestone.	Melaleuca/Acacia rostellifera patches. Associated vegetation: Dryandra sessilis, Phyllanthus calycinus, Hibbertia hypericoides, Ehrharta calycina.	ca 75 m N of Retta Street on E side of Cockburn Road, Mount Brown (Beeliar) Regional Park,	MAN	0
Stylidium paludicola	3	Near edge of swamp.	Amongst Juncus.	Jandakot Marsupial Breeding Station at Banganup Lake	MAN	0
Stylidium paludicola	3	Gentle slope, south aspect, surface soil is dark grey loamy sand and sub surface soil is very dark grey brown sandy loam, drainage is poor and wet during winter and spring only.	Melaleuca preissiana, Kunzea glabrescens low open forest over Astartea scoparia, Hypocalymma angustifolium open shrubland over Lepidosperma longitudinale open sedgeland. Vegetation is in a pristine to excellent condition with some rabbit diggings and pot	Robinson Road, Wandi	GPS	1
Tripterococcus paniculatus	4	Winter wet flats, peaty sand over clay.	Hypocalymma angustifolium low heath.	Gazetted Reserve 418 [Reserve No. 41438], Bartrum Road swamp, Jandakot	MAN	3

OBJECTID	OCC_UNIQUE	COM_ID	COM_NAME	CT_DESC	S_ID_COUNT	FIRST_S_ID	LAST_S_ID	BUFFER	BDY_ID	Shape_Leng	Shape_Area
209	1877	Limestone ridges (SCP 26a)	Melaleuca huegelii - Melaleuca acerosa (currently M. systena) shrublands on limestone ridges (Gibson et al. 1994 type 26a)	Endangered	1	ANKETELL01		500	318	0.03923105991	0.00011516805
1179	2650	SCP24	Northern Spearwood shrublands and woodlands	Priority 3	1	THOM02		500	1488	0.04065425830	0.00012864193
14416	3084	SCP22	Banksia ilicifolia woodlands	Priority 3	1	DEJONG01		500	0	0.03086091885	0.00007506911
14417	3156	SCP21c	Low lying Banksia attenuata woodlands or shrublands	Priority 3	1	DEJONG02		500	0	0.03086111380	0.00007507000
14869	3188	SCP21c	Low lying Banksia attenuata woodlands or shrublands	Priority 3	1	BAS34		200	0	0.01234285024	0.00001200577
14871	3190	SCP21c	Low lying Banksia attenuata woodlands or shrublands	Priority 3	1	BAS36		200	0	0.01234220938	0.00001200460
14873	3194	SCP21c	Low lying Banksia attenuata woodlands or shrublands	Priority 3	1	BAS40		200	0	0.01234716656	0.00001201365
14886	2981	SCP22	Banksia ilicifolia woodlands	Priority 3	1	BIW15		900	0	0.05554702582	0.00024321731
14887	2982	SCP22	Banksia ilicifolia woodlands	Priority 3	1	BIW16		200	0	0.01234601897	0.00001201155
14888	2983	SCP22	Banksia ilicifolia woodlands	Priority 3	1	BIW17		200	0	0.01234716664	0.00001201365

APPENDIX 2

Species List

SPECIES LIST – Lot 15 Barfield Road, Hammond

* = Introduced species

MONOCOTYLEDONS

ANARTHRIACEAE
Lyginia barbata

ASPARAGACEAE
Laxmannia squarrosa
Lomandra hermaphrodita
Lomandra preissii
Sowerbaea laxiflora
Thysanotus thyrsoideus

ASPHODELACEAE
**Trachyandra divaricata*

COLCHICACEAE
Burchardia congesta

CYPERACEAE
Schoenus lanatus

DASYPOGONACEAE
Dasypogon bromeliifolius

HAEMODORACEAE
Anigozanthos humilis
Anigozanthos manglesii
Conostylis aculeata

IRIDACEAE
**Freesia alba x leichtlinii*
**Gladiolus caryophyllaceus*
Patersonia occidentalis
**Romulea rosea*

ORCHIDACEAE
Caladenia flava
Caladenia longicauda subsp. *calcigena*
Microtis media subsp. *densiflora*

POACEAE
Amphipogon turbinatus
**Ehrharta longiflora*
**Pennisetum setaceum*

RESTIONACEAE
Desmocladus flexuosus

XANTHORRHOEACEAE
Xanthorrhoea preissii

DICOTYLEDONS

APIACEAE
Trachymene pilosa

ASTERACEAE
**Arctotheca calendula*
**Hypochaeris glabra*
**Podotheca angustifolia*
**Ursinia anthemoides*

CAMPANULACEAE
**Wahlenbergia capensis*

CARYOPHYLLACEAE
**Petrorhagia dubia*

CASUARINACEAE
Allocasuarina fraseriana

ERICACEAE
Leucopogon polymorphus
Lysinema ciliatum

EUPHORBIACEAE
**Euphorbia terracina*

FABACEAE
Acacia pulchella
Acacia stenoptera
Bossiaea eriocarpa
Daviesia triflora
Gompholobium tomentosum

Jacksonia furcellata
**Lupinus cosentinii*
**Trifolium arvense* var. *arvense*
**Trifolium campestre*

GERANIACEAE
**Pelargonium capitatum*

GOODENIACEAE
Lechenaultia floribunda

LAMIACEAE
Hemiandra pungens

LOGANIACEAE
Phyllangium paradoxum

LORANTHACEAE
Nuytsia floribunda

MOLLUGINACEAE
Macarthuria australis

MYRTACEAE
Eremaea pauciflora
Eucalyptus marginata
Scholtzia involucrata

PRIMULACEAE
**Lysimachia arvensis*

PROTEACEAE
Adenanthos cygnorum
Banksia attenuata
Banksia menziesii
Petrophile linearis

SCROPHULARIACEAE
**Dischisma capitatum*

STYLIDIACEAE
Stylidium brunonianum
Stylidium piliferum

APPENDIX 3

Quadrat Data

QUADRAT B1

50 391980 E 6439671 N

Vegetation: *Banksia menziesii/B. attenuata* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland

Condition: Good

Soil Type: Grey-brown sand

Landform: Very gentle slope



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Banksia menziesii	4	10
Banksia attenuata	4	5
Xanthorrhoea preissii	1.1	10
Jacksonia furcellata	1	<1
**Gladiolus caryophyllaceus*	0.6	1
Gompholobium tomentosum	0.5	<1
Patersonia occidentalis	0.5	<1
Burchardia congesta	0.5	<1
**Ehrharta longiflora*	0.4	1
Leucopogon polymorphus	0.4	<1
Conostylis aculeata	0.4	<1
Lyginia barbata	0.4	<1
Microtis media subsp. *densiflora*	0.4	<1
Stylidium brunonianum	0.4	<1
**Ursinia anthemoides*	0.3	5
Daviesia triflora	0.3	1
Dasypogon bromeliifolius	0.3	<1
Caladenia longicauda subsp. *calcigena*	0.3	<1
Anigozanthos humilis	0.3	<1
Scholtzia involucrata	0.2	1

SPECIES	HEIGHT (m)	COVER (%)
Amphipogon turbinatus	0.2	<1
Trachymene pilosa	0.1	2
Phyllangium paradoxum	0.1	1
Laxmannia squarrosa	0.1	<1
**Podotheca angustifolia*	0.1	<1
**Hypochaeris glabra*	Flat	5

* introduced species

QUADRAT B2

50 391956 E 6439684 N

Vegetation: *Xanthorrhoea preissii* Open Shrubland
Condition: Degraded
Soil Type: Grey sand
Landform: Flat



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Xanthorrhoea preissii	1.2	20
**Ehrharta longiflora*	1	2
**Gladiolus caryophyllaceus*	0.6	1
**Petrorhagia dubia*	0.4	<1
**Ursinia anthemoides*	0.1	10
Laxmannia squarrosa	0.1	<1
**Podotheca angustifolia*	0.1	<1
**Hypochaeris glabra*	Flat	2

* introduced species

QUADRAT B3

50 391911 E 6439676 N

Vegetation: *Eucalyptus marginata* Low Woodland over weeds
Condition: Completely Degraded
Soil Type: Light grey sand
Landform: Flat



Quadrat (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Eucalyptus marginata	6	20
Banksia attenuata	3	2
Xanthorrhoea preissii	1	1
Acacia pulchella	0.8	<1
**Ehrharta longiflora*	0.6	20
**Gladiolus caryophyllaceus*	0.6	2
Burchardia congesta	0.4	<1
Lyginia barbata	0.4	<1
Allocasuarina fraseriana	0.4	<1
Gompholobium tomentosum	0.3	<1
Conostylis aculeata	0.3	<1
**Ursinia anthemoides*	0.2	4
**Petrorhagia dubia*	0.2	<1
**Triflium campestre*	0.1	<1
**Dischisma capitatum*	0.1	<1
**Hypochaeris glabra*	Flat	<1

* introduced species

Appendix 3
Level 1 Fauna and Black Cockatoo habitat assessment

Level 1 fauna risk assessment and Black-Cockatoo habitat assessment for Lot 15 Barfield Road, Hammond Park



Version 2. April 2016

Prepared for:

Gold Estates Holdings Pty Ltd
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Subiaco WA 6008

By:

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Front Cover: Burton's Legless Lizard (*Lialis burtonis*)

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EXECUTIVE SUMMARY

Gold Estates Holdings Pty Ltd proposes to clear and develop Lot 15 Barfield Road, Hammond Park (i.e. project area). The project area is 24km south of the Perth CBD and is separated from the Kwinana Freeway by a Western Power high voltage power line easement approximately 180m wide (Figure 1). The project area is approximately 1.86ha (Figure 1).

There are four fauna habitats in the project area. Vegetation in the project area is regrowth and generally in very poor condition and of low value. The site does not form part of an important ecological linkage for fauna.

The very small quantity of *Lomandra hermaphrodita* in the project area suggests that it is unlikely Graceful Sun-Moths (*Synemon gratiosa*) are present. The lack of suitable vegetation in the project area would also indicate that Southern Brown Bandicoots (*Isoodon obesulus fusciventer*) are not present.

The impact of clearing less than 2ha of low or very low quality Black-Cockatoo foraging habitat is not significant on these species, and does not warrant a referral to the Commonwealth Government under the EPBC Act (1999).

There is a very low possibility that the project area contains the Jewelled South-west Skink *(Ctenotus gemmula*), Black-striped snake (*Neelaps calonotus*) or Lined Skink (*Lerista lineata*), however, they were not caught or seen when the much larger adjacent Vivente project area was cleared. If present, these reptiles will be lost during vegetation clearing. There is cumulative effect of progressively clearing most of the *Banksia* and Jarrah woodland in the general area.

Conservation significant Rainbow Bee-eater (*Merops ornatus*), if they are in the project area, will move to adjacent areas once vegetation clearing commences and would not be significantly impacted.

It is recommended that a fauna salvage program by a suitably qualified zoologist is implemented during the vegetation clearing program.

1 INTRODUCTION

1.1 Background

Gold Estates Holdings Pty Ltd (Gold Estates) proposes to clear and develop Lot 15 Barfield Road, Hammond Park (i.e. project area). The project area is 24km south of the Perth CBD and is separated from the Kwinana Freeway by a Western Power high voltage power line easement that is approximately 180m wide (Figure 1). The project area is approximately 1.86ha (Figure 2).

1.2 Project objectives and scope of work

Terrestrial Ecosystems was commissioned by Gold Estates to undertake a Level 1 fauna risk assessment. The purpose of this Level 1 fauna risk assessment is to provide information to the appropriate government regulators to enable them to assess the potential impact of vegetation clearing on the fauna assemblage in the project area. The methodology broadly follows that described in the Environmental Protection Authority (EPA) *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002), *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004) and the EPA/Department of Environment and Conservation (DPAW) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA / DEC 2010).

A Level 1 fauna risk assessment involves undertaking a desktop review and site inspection. The objectives of this fauna risk assessment were to:

- provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, small mammals and birds) on and in the vicinity of the project area;
- identify the presence and/or potential risks of impacting on species of conservation significance that are present or likely to be present in the project area during vegetation clearing;
- determine if any additional surveys are required to assess the potential impact on fauna assemblages in the project area, in particular, impacts on species of conservation significance; and
- make recommendations that mitigate or minimise potential impacts on resident fauna.

As Black-Cockatoos are known to forage the banksia and eucalypt woodlands in the adjacent areas, an assessment of the potential for Black-Cockatoo species to breed and forage in the project area was also undertaken.

To achieve these objectives, Terrestrial Ecosystems has:

- reviewed Terrestrial Ecosystems fauna survey database [includes Western Australian Museum (WAM), Atlas of Living Australia (AoLA) and DPaW records] to identify potential vertebrate fauna within the area;
- reviewed DPaW listed Threatened and Priority species as recorded in NatureMap that are likely to be in the area;
- searched the Commonwealth government's on-line database to identify fauna species of national environmental significance that are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) potentially occurring in the area;
- reviewed previous fauna surveys conducted in the region;
- undertaken a site visit to identify available fauna habitat types and condition;
- mapped potential foraging habitat for Black-Cockatoos and recorded all potential Black-Cockatoo breeding trees with a diameter of 50cm or greater;
- undertaken an assessment of the potential risks to the fauna associated with clearing additional areas of native vegetation;
- provided a discussion of the likelihood of *EPBC Act 1999* and Western Australian (WA) *Wildlife Conservation Act 1950* listed species being present in the project area; and
- provided management recommendations to mitigate and minimise potential impacts on the fauna in the project area.

2 EXISTING ENVIRONMENT

2.1 Survey area

Lot 15 Barfield Road, Hammond Park (1.86ha) is approximately 24km south of the Perth CBD, in an area that is rapidly being developed for urban housing. Immediately to the west, the vegetation has been cleared and residential development is underway for the Vivente project. Other lots of land to the north and west of the project area have also been recently cleared for residential housing.

2.2 Topography

The project area is a very gently undulating sand plain on the western section of the Bassendean Dune System. There are no wetlands in the project area or nearby.

2.3 Vegetation

PGV Environmental's (2014) flora and vegetation assessment indicated the area had previously been cleared and the current vegetation is regrowth. PGV Environmental (2014) reported the following three flora and vegetation communities in the project area in addition to the cleared area:

Low open Woodland of *Banksia attenuata/B. menziesii* over open shrubland of *Xanthorrhoea preissii*
This vegetation type occurred in the north-east corner of the site. The Banksia trees were up to 4m high and in low densities. *Xanthorrhoea preissii* was the most dominant native understorey species at around 1m high and 10% cover. All other native species had very low coverage. *Gladiolus caryophyllaceus, Ursinia anthemoides* and Flat Weed (*Hypochaeris glabra*) were the most prevalent weed species. The soil was grey-brown sand.

Open shrubland of *Xanthorrhoea preissii*
A small section of *Xanthorrhoea preissii* shrubland occurred in the north central part of the site. The *Xanthorrhoea* shrubs were up to 1.2m high and 20% density. Very few native species were recorded in this vegetation type and no trees except several WA Christmas Trees (*Nuytsia floribunda*). Presumably the Banksia and possibly Jarrah trees that occurred previously in this area did not regenerate after clearing in the early 1970s. Introduced species were common, particularly *Ursinia anthemoides,* Veltdgrass (*Ehrharta longiflora*) and Flat Weed. The soil was grey sand.

Low woodland of *Eucalyptus marginata/ Banksia attenuata/B. menziesii* over weeds
Two stands of this vegetation type occurred, one in the north-west corner and the other in the south-west corner. Jarrah (*Eucalyptus marginata*) was the most common tree species up to 6m high and varying in density while *Banksia attenuata* and *B. menziesii* also occurred but in very low numbers. Few native understorey species were present while introduced species such as Veldtgrass and Ursinia were common. The soil was light grey sand.

2.4 Climate

The Perth bioregion experiences a Mediterranean climate with hot summers from December to March and mild winters from May to August (Gentilli 1972). Chart 1 shows the average mean monthly maximum and minimum temperatures and rainfall for Jandakot airport. Temperatures are highest in January – February. Perth receives the majority of its annual rainfall in winter (Chart 1). This rain is usually the result of low pressure cells moving in a westerly direction which bring moisture bearing clouds over the south-west of Western Australia.

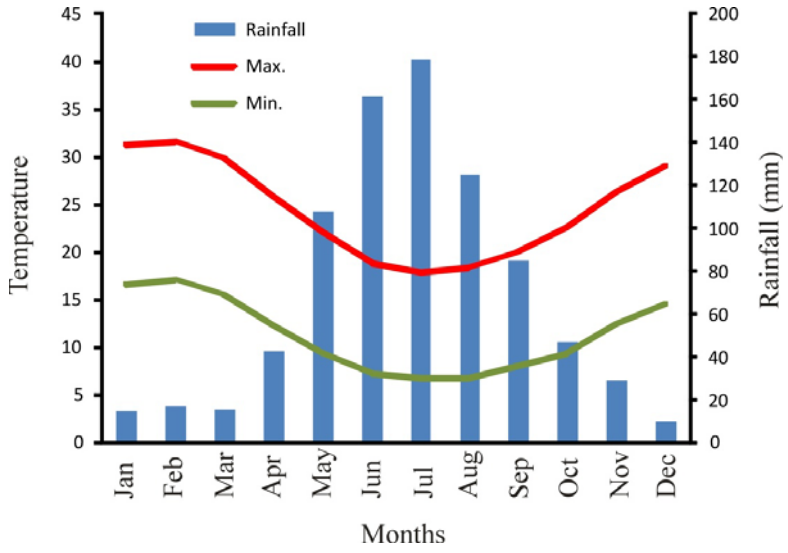


Chart 1. Mean monthly maximum and minimum temperatures and rainfall for Jandakot Airport (BOM November 2014; http://www.bom.gov.au/climate/averages/tables/cw_009172.shtml)

2.5 Land use

The dominant land use in the general area was large, semi-rural blocks mostly retaining much of the original native vegetation. The Southern Suburbs District Structure Plan – Stage 3 has rezoned this area from 'Urban Deferred' to 'Urban' under the Metropolitan Regional Scheme. The area has now been subdivided and the vegetation is being cleared for housing and urban development. Residential housing development has been rapid over the last 10 years in adjacent areas to the west and north of the project area.

2.6 Biological context for the project area

The frogs, reptiles, mammals and birds on the Swan Coastal Plain south of the Swan River have been surveyed on numerous occasions for a variety of purposes. Surveys in the vicinity of the project area which have been reviewed for this assessment include:

- 360 Environmental (2008) *Lot 9 Abernethy Road, Byford Spring Flora and Fauna Report*. Unpublished report for Australand Property Group, Perth.
- ATA Environmental (2006) *Vertebrate Fauna Assessment Brookdale Redevelopment Area*. Unpublished report for the Armadale Redevelopment Authority, Perth.
- Bamford Consulting Ecologists (2009) *Keane Road Strategic Link, Armadale Fauna Assessment*. Unpublished report for EnviroWorks Consulting, Perth.
- Ecoscape (Australia) Pty Ltd (2009) Fauna Survey for Lots 13, 14 and 18 Barfield Road and Lots 48-51 Rowley Road, Hammond Park. Unpublished report for Gold Estate and the Department of Housing, Perth.
- ENV (2009) *Jandakot Airport Fauna Survey*. Unpublished report for Jandakot Airport Holdings Pty Ltd, Perth.
- GHD (2006) *Fiona Stanley Heath Precinct Site Investigation Fauna Assessment March 2006*. Unpublished report for Department of Housing and Works, Perth.
- Gole C.A. (2003) *Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project*. Unpublished report Birds Australia and Perth Biodiversity Project, Perth.
- Harvey M.S., Dell J., How R.A. and Waldock J.M. (1997) *Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms Perth*. Unpublished report for the Australian Heritage Commission NEP Grant N95/49, Perth.
- How R. A., Harvey M.S., Dell J. and Waldock J.M. (1999) *Ground Fauna of Urban Bushland Remnants in Perth*. Unpublished report to the Australian Heritage Commission; NEP Grant N93/04, Perth.

- Phoenix Environmental Sciences (2011) *Vertebrate Fauna Survey for the Roe Highway Extension Project*. Unpublished report for South Metro Connect, Perth.
- Terrestrial Ecosystems' (2015) vertebrate fauna trapping and fauna salvage program data.
- Western Wildlife (2010) *Wetland and Migratory Bird Survey*. Unpublished report for South Metro Connect, Perth.

The most relevant data are from Terrestrial Ecosystems trapping and vertebrate fauna salvage program conducted prior to and during the clearing of vegetation in the Vivente Estate which is located immediately to the west of the project area. Ecoscape (2009) reported on a fauna survey for the Vivente Estate that was undertaken sometime (date not disclosed) before the approval for that development. The Phoenix Environmental Sciences (2011) and Western Wildlife (2010) undertook fauna surveys to support an application to clear vegetation for the Roe Highway extension. The 360 Environmental (2008), ATA Environmental (2006) and Bamford Consulting Ecologists (2009) reports are for projects to the east of the project area but on the Swan Coastal Plain. The Western Australian Museum (Harvey et al. 1997, How et al. 1999) and Gole (2003) reports are for remnant habitats in the region. The Fiona Stanley Hospital (GHD 2006) and the Jandakot airport surveys (ENV Australia 2009) are for other large scale projects on the Swan Coastal Plain in the vicinity of the project area.

In addition to the above reports, Terrestrial Ecosystems fauna survey database contains records from NatureMap, AoLA and the WAM collection for this area. These records include the results of historical surveys and incidental records that very often remain unreported.

3 METHODOLOGY

3.1 Desktop assessment

3.1.1 Conservation significant species

A search of the Department of the Environment's (DotE) Matters of National Environmental Significance (MNES) search tool (search coordinates 32.17459°S, 115.85403°E with a 10km buffer) was undertaken. The DPaW threatened and priority species database was searched via the records in NatureMap. In addition, a desktop search of the Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in the relevant section of the bioregion in the vicinity of the project area.

Other more general texts were also used to provide supplementary information on vertebrates in the bioregion, including Tyler *et al.* (2000) for frogs; Storr *et al.* (1983, 1990, 1999, 2002) for reptiles; Johnstone and Storr (1998, 2004) for birds; and Van Dyck and Strahan (2008) for mammals.

Collectively these sources of information were used to create lists of species expected to utilise the project area and the adjacent areas. It should be noted that these lists will include species that have been recorded in the general region but are possibly vagrants and they will not generally be found in the project area due to a lack of suitable habitat (e.g. wetland and shore birds). Vagrants can be recorded almost anywhere. 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 project area. 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 survey area. As a consequence many species will be included in the lists produced from database searches but will not be present in the actual project area.

3.2 Site assessment and reporting

Dr Scott Thompson undertook the reconnaissance survey and fauna habitat assessment with the assistance of Edward Swinhoe on 19 April 2016. Dr Graham Thompson prepared the report and Dr Scott Thompson reviewed the report before it was issued to the client. Both senior scientists have appropriate relevant post-graduate qualifications, extensive experience in conducting fauna assessments on the Swan Coastal Plain, have published research articles on biodiversity, fauna assemblages, conservation significant species, trapping techniques and temporal variations in trapped fauna assemblages and are therefore appropriately trained and experienced for the task of preparing this assessment. Both scientists were involved with the work at Vivente Estate and are familiar with the fauna assemblage present in the area.

3.2.1 Black-Cockatoo habitat assessment

As adjacent areas have been foraged by Black-Cockatoos, an assessment of the suitability of the habitat in the project area as a breeding and foraging site for Black-Cockatoos was undertaken. This assessment mapped Black-Cockatoo foraging habitat based on the rating system in Table 1.

Table 1. Rating system to be used for mapping foraging habitat for black-cockatoos

Rating	Description of vegetation		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
1	No or negligible foraging value. Examples: • Scattered food plants with foliage cover$^{\phi}$ of <5%. • Open pasture with limited scattered foraging trees. • Area largely devoid of any foraging species.	No or negligible foraging value. Examples: • Scattered food plants with foliage cover$^{\phi}$ of <5%. • Open pasture with limited scattered foraging trees. • Area largely devoid of any foraging species.	No or negligible foraging value. Examples: • Scattered food plants with foliage cover$^{\phi}$ of <5%. • Open pasture with limited scattered foraging trees. • Area largely devoid of any foraging species.

Rating	Description of vegetation		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
2	Very low foraging value. Examples: • Woodland or shrubland of banksias with 5-10%[#] foliage cover[ϕ]; or • Eucalypt woodland/mallee of small-fruited species; or • Eucalypt woodland/forest with 5-10%[#] marri foliage cover[ϕ].	Very low foraging value. Examples: • Marri, shrubby banksias with 5-10%[#] foliage cover[ϕ]; or • Open pasture with scattered foraging trees or clumps of foraging trees.	Very low foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or other potential sources of food with 5-10%[#] foliage cover[ϕ]; or • Open pasture with scattered foraging trees or clumps of foraging trees.
3	Low foraging value. Examples: • Woodland or shrubland of banksias with 10-20%[#] foliage cover[ϕ]. • Eucalypt woodland/forest with 10-20%[#] marri foliage cover[ϕ].	Low foraging value. Examples: • Marri, and/or shrubby banksias with 10-20%[#] foliage cover[ϕ]; • Open pasture with numerous scattered foraging trees or clumps of foraging trees.	Low foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or other potential sources of food with 10-20%[#] foliage cover[ϕ]. • Open pasture with numerous scattered foraging trees or clumps of foraging trees.
4	Moderate foraging value. Examples: • Woodland or shrubland of banksias with 20-40%[#] foliage cover[ϕ]; • Eucalypt woodland/forest with 20-40%[#] marri foliage cover[ϕ]; or • May have evidence of foraging by *C. latirostris*.	Moderate foraging value. Examples: • Marri, banksia and other foraging species with 20-40%[#] foliage cover[ϕ]; or • May have evidence of foraging by *C. baudinii*.	Moderate foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or other foraging species with 20-40%[#] foliage cover[ϕ]; or • May have evidence of foraging by *C. banksia naso*.
5	High foraging value. Examples: • Woodland or shrubland of banksias with 40-60%[#] foliage cover[ϕ]; • Eucalypt woodland/forest with 40-60%[#] marri foliage cover[ϕ] and evidence of foraging by *C. latirostris*; or • Thinned pine plantation with considerable evidence of foraging by *C. latirostris*.	High foraging value. Examples: • Marri, banksia and other foraging species with 40-60%[#] foliage cover[ϕ]. • Evidence of foraging by *C. baudinii*.	High foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or other foraging species with 40-60%[#] foliage cover[ϕ]. • Evidence of foraging by *C. banksia naso*.
6	Very high foraging value. Examples: • Eucalypt woodland/forest with >60%[#] marri foliage cover[ϕ] and evidence of foraging by *C. latirostris;* • Banksia woodlands of key species (e.g. *B. attenuata, B. menziesii, B. prionotes, B. sessilis*) with foliage cover[ϕ] >60%; • Intact pine plantation with the majority of cones foraged by *C. latirostris*; or • Majority of food plants showing evidence of foraging by *C. latirostris.*	Very high foraging value. Examples: • Marri and/or banksia and/or other foraging species with >60% foliage cover[ϕ]; or • Majority of food plants showing evidence of foraging by *C. baudinii.*	Very high foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or cape lilac and/or other foraging species with >60% foliage cover[ϕ]; or • Majority of food plants showing evidence of foraging by *C. banksii.*

[ϕ] Foliage cover refers to the percentage of ground surface shaded by vegetation, excluding litter and vegetation within 50mm of the ground, at midday. It can be estimated based on linear transects or plots. For the purpose of a black-cockatoo habitat assessment, it is estimated.

[#] If an area is degraded or under stress (e.g. dieback, water stress, drought, etc) the foraging value of the foliage cover (and seeds and nectar) may be lower than the percentage cover that is still present. In this case a lower rating than the percentage foliage cover is appropriate (i.e. 40-60% degraded foliage cover may be equivalent to 20-40% normal foliage cover). This issue should be discussed in the results.

Rating scales in Table 1 are a judgement made by Dr Scott Thompson, a zoologist with substantial experienced in black-cockatoo habitat assessments. The project area was also investigated for the evidence of foraging activity,

e.g. chewed banksia infructescences, marri and sheoak nuts, and all eucalypts with a diameter at breast height of 50cm or over were recorded.

3.3 Limitations

This Level 1 fauna risk assessment is based on information contained in the Commonwealth Government threatened species database, other published and unpublished fauna survey data for the bioregion and a site visit. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years are necessary to fully appreciate the fauna assemblage in the project area.

The EPA *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (2004) suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 2.

Table 2. Fauna survey limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out this assessment	No	The environmental scientists that undertook the field assessment and prepared this report are familiar with the vertebrate fauna of this bioregion.
Scope	No	All aspects of the scope of works have been addressed.
Proportion of fauna identified, recorded and/or collected	No	Not applicable.
Accuracy of previous survey work	Yes, negligible	Terrestrial Ecosystems has reported fauna survey data recorded by various authors, but is not in a position to vouch for the accuracy of this information. It is acknowledged that the taxonomy of Western Australian vertebrates is continually being revised and the nomenclature of some of the species listed in the appendices may have changed since publication by the authors.
Sources of information	Yes, negligible	Vertebrate fauna information was available from an on-line database and unpublished and published reports of surveys conducted in the bioregion in a variety of habitat types. Many of these surveys employed a low level of trapping effort which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Timing/weather/ season/ cycle	No	Weather was suitable during the site visit.
Disturbances which affected results of the survey	No	The project area had been cleared at an earlier date and most of the vegetation was regrowth. This was factored into this assessment.
Intensity of survey effort	No	No trapping surveys were undertaken.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	There were no problems with access.

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Availability of contextual information on the region	No	Fauna survey data are available for the general area.

Negligible – less than 20%; moderate -20-60%; significant – greater than 80%

4 RESULTS

4.1 Fauna habitats and condition

There are four fauna habitats present in the project area. One was largely devoid of vegetation and the vegetated area can be divided into three fauna habitat types based on the vegetation types, namely:

- Low Open Woodland *of Banksia attenuata/B. menziesii* over Open Shrubland of *Xanthorrhoea preissii*
- Open Shrubland - *Xanthorrhoea preissii*
- Low Woodland over weeds - *Eucalyptus marginata/ Banksia attenuata/B. menziesii*

Details of the vegetation in these three habitat types is contained in section 2.3 above.



Plate 1. Open unvegetated area



Plate 1. Open unvegetated area



Plate 3. Low Open woodland *of Banksia attenuata/B. menziesii* over open Shrubland of *Xanthorrhoea preissii*



Plate 4. Low open woodland *of Banksia attenuata/B. menziesii* over open shrubland of *Xanthorrhoea preissii*



Plate 5. Open shrubland of *Xanthorrhoea preissii*



Plate 6. Low woodland of *Eucalyptus marginata/ Banksia attenuata/B. menziesii* over weeds

Habitat quality is mapped in Figure 2. The vast majority of the project area (1.86 ha) is either highly degraded or disturbed and therefore of very low value for fauna.

Black-Cockatoo foraging habitat has been mapped and is shown in Figure 3. There are two different foraging habitats that are rated as 2 (i.e. very low foraging value; 1.49ha) and 3 (low foraging value; 0.37ha; see Table 1 for details). There were seven trees in or immediately adjacent to the project area (Figure 3; Table 3). None of these trees had hollows suitable as a nesting site for a Black Cockatoo.

Table 3. Black-Cockatoo tree assessment

Tree N^{o}	Tree type	Diameter at breast height	Hollow present
1	Jarrah	600	No
2	Jarrah	600	No
3	Jarrah	800	No
4	Jarrah	1300	No
5	Jarrah	700	No
6	Jarrah	800	No
7	Jarrah	500	No

4.2 Bioregional vertebrate fauna

Appendix B provides a summary of the fauna survey data that are available in the vicinity of the project area. The most relevant information is the results of the trapping and fauna salvage program that Terrestrial Ecosystems undertook for the Vivente project area. These are shown in Table 4.

Table 4. Vertebrate fauna caught in the trapping and fauna salvage program for the Vivente project area

Species		**Number**
Mammals		
Cat	*Felis catus*	1
Southern Brown Bandicoot	*Isoodon obesulus fusciventer*	11
House Mouse	*Mus musculus*	3
Brushtail Possum	*Trichosurus vulpechula*	1
Amphibians		
	Limnodynastes dorsalis	1
	Litoria adelaidensis	16
Reptiles		
	Ctenotus australis	1
Marbled Gecko	*Christinus marmoratus*	1
	Cryptoblepharus buchananii	23
	Delma fraseri	2
	Hemiergis quadrilineata	5
	Lialis burtonis	17
	Menetia greyii	1
	Pletholax gracilis	1
Bearded Dragon	*Pogona minor*	3
Dugite	*Pseudonaja affinis*	3
Bobtail	*Tiliqua rugosa*	62

There are appreciable differences among recorded fauna assemblages recorded in the vicinity of the project area shown in Appendix B. These differences are partially due to the low survey effort often deployed and they also reflect variations in soils and vegetation as well as temporal variations in the fauna assemblages.

Tables 5-8 provide a list of vertebrate species potentially found in the vicinity of the project area that have been compiled based on the fauna survey report results shown in Appendix B. Lists in these Tables are a significant over estimate of the actual species likely to be present as many of these species (e.g. water and shore birds) have specific habitat requirements not available in the project area, the project area is small, adjacent to new housing developments on the western and northern sides and it is immediately adjacent to a school. The highly degraded nature of the project area means that only a small subset of the vertebrate fauna assemblage that once was present is still present in the area.

Table 5. Birds potentially found in the vicinity of the project area

Family	Species	Common Name
Accipitridae	*Pandion cristatus*	Eastern Osprey
	Elanus axillaris	Black-shouldered Kite
	Haliaeetus leucogaster	White-bellied Sea-Eagle
	Haliastur sphenurus	Whistling Kite
	Accipiter fasciatus	Brown Goshawk
	Accipiter cirrocephalus	Collared Sparrowhawk
	Circus approximans	Swamp Harrier
	Aquila audax	Wedge-tailed Eagle
	Hieraaetus morphnoides	Little Eagle
	Pandion haliaetus	Osprey
Anatidae	*Biziura lobata*	Musk Duck
	Stictonetta naevosa	Freckled Duck
	Cygnus atratus	Black Swan
	Tadorna radjah	Radjah Shelduck
	Tadorna tadornoides	Australian Shelduck
	Chenonetta jubata	Australian Wood Duck
	Malacorhynchus membranaceus	Pink-eared Duck
	Anas rhynchotis	Australasian Shoveler
	Anas gracilis	Grey Teal
	Anas castanea	Chestnut Teal
	Anas platyrhynchos	Northern Mallard
	Anas superciliosa	Pacific Black Duck
	Aythya australis	Hardhead
	Oxyura australis	Blue-billed Duck
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar
Podargidae	*Podargus strigoides*	Tawny Frogmouth
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover
	Pluvialis squatarola	Grey Plover
	Charadrius dubius	Little Ringed Plover
	Charadrius ruficapillus	Red-capped Plover
	Elseyornis melanops	Black-fronted Dotterel
	Thinornis rubricollis	Hooded Plover
	Erythrogonys cinctus	Red-kneed Dotterel
	Vanellus tricolor	Banded Lapwing
	Vanellus miles	Masked Lapwing
Laridae	*Sternula nereis*	Fairy Tern
	Gelochelidon nilotica	Gull-billed Tern
	Chlidonias hybridus	Whiskered Tern
	Chlidonias leucopterus	White-winged Black Tern
	Chroicocephalus novaehollandiae	Silver Gull
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt
	Recurvirostra novaehollandiae	Red-necked Avocet
	Cladorhynchus leucocephalus	Banded Stilt
Scolopacidae	*Limosa limosa*	Black-tailed Godwit
	Limosa haemastica	Hudsonian Godwit
	Actitis hypoleucos	Common Sandpiper
	Tringa brevipes	Grey-tailed Tattler
	Tringa nebularia	Common Greenshank
	Tringa stagnatilis	Marsh Sandpiper
	Tringa glareola	Wood Sandpiper
	Calidris tenuirostris	Great Knot
	Calidris canutus	Red Knot
	Calidris ruficollis	Red-necked Stint
	Calidris subminuta	Long-toed Stint
	Calidris melanotos	Pectoral Sandpiper
	Calidris acuminata	Sharp-tailed Sandpiper
	Calidris ferruginea	Curlew Sandpiper
	Philomachus pugnax	Ruff
Stercorariidae	*Stercorarius longicauda*	Long-tailed Jaeger
Turnicidae	*Turnix varius*	Painted Button-quail
	Turnix velox	Little Button-quail
Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern
	Ixobrychus dubius	Australian Little Bitten
	Ardea alba	Great Egret
	Ardea pacifica	White-necked Heron
	Ardea modesta	Eastern Great Egret
	Ardea intermedia	Intermediate Egret
	Ardea ibis	Cattle Egret
	Egretta novaehollandiae	White-faced Heron
	Egretta garzetta	Little Egret
	Nycticorax caledonicus	Nankeen Night Heron
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis
	Threskiornis molucca	Australian White Ibis
	Threskiornis spinicollis	Straw-necked Ibis
	Platalea regia	Royal Spoonbill
	Platalea flavipes	Yellow-billed Spoonbill
Columbidae	*Columba livia*	Rock Dove
	Streptopelia senegalensis	Laughing Dove
	Streptopelia chinensis	Spotted Dove
	Phaps chalcoptera	Common Bronzewing
	Ocyphaps lophotes	Crested Pigeon
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra
	Todiramphus sanctus	Sacred Kingfisher
Meropidae	*Merops ornatus*	Rainbow Bee-eater
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo
	Chalcites lucidus	Shining Bronze-Cuckoo
	Cacomantis pallidus	Pallid Cuckoo
	Cacomantis flabelliformis	Fan-tailed Cuckoo
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco berigora	Brown Falcon
	Falco longipennis	Australian Hobby
	Falco subniger	Black Falcon
Phasianidae	*Coturnix ypsilophora*	Brown Quail
Rallidae	*Porphyrio porphyrio*	Purple Swamphen
	Gallirallus philippensis	Buff-banded Rail
	Porzana pusilla	Baillon's Crake
	Porzana fluminea	Australian Spotted Crake
	Porzana tabuensis	Spotless Crake
	Tribonyx ventralis	Black-tailed Native-hen
	Gallinula tenebrosa	Dusky Moorhen
	Fulica atra	Eurasian Coot
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren

Family	Species	Common Name
	Smicrornis brevirostris	Weebill
	Gerygone fusca	Western Gerygone
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill
	Acanthiza inornata	Western Thornbill
	Acanthiza apicalis	Inland Thornbill
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler
	Megalurus gramineus	Little Grassbird
	Cincloramphus mathewsi	Rufous Songlark
Artamidae	*Artamus cinereus*	Black-faced Woodswallow
	Artamus cyanopterus	Dusky Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Cracticus tibicen	Australian Magpie
	Strepera versicolor	Grey Currawong
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike
	Lalage sueurii	White-winged Triller
Climacteridae	*Climacteris rufa*	Rufous Treecreeper
Corvidae	*Corvus coronoides*	Australian Raven
	Corvus splendens	House Crow
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow
	Hirundo neoxena	Welcome Swallow
	Petrochelidon nigricans	Tree Martin
	Petrochelidon ariel	Fairy Martin
Maluridae	*Malurus splendens*	Splendid Fairy-wren
	Malurus elegans	Red-winged Fairy-wren
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill
	Lichenostomus virescens	Singing Honeyeater
	Manorina flavigula	Yellow-throated Miner
	Anthochaera lunulata	Western Wattlebird
	Anthochaera chrysoptera	Little Wattlebird
	Anthochaera carunculata	Red Wattlebird
	Epthianura albifrons	White-fronted Chat
	Glyciphila melanops	Tawny-crowned Honeyeater
	Lichmera indistincta	Brown Honeyeater
	Phylidonyris novaehollandiae	New Holland Honeyeater
	Phylidonyris niger	White-cheeked Honeyeater
	Melithreptus brevirostris	Brown-headed Honeyeater
	Melithreptus lunatus	White-naped Honeyeater
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark
Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird
	Daphoenositta chrysoptera	Varied Sittella
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler
	Pachycephala rufiventris	Rufous Whistler
	Colluricincla harmonica	Grey Shrike-thrush
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Petroicidae	*Petroica multicolor*	Pacific Robin

Table 6. Amphibians potentially found in the vicinity of the project area

Family	Species	Common Name
Hylidae	*Litoria adelaidensis*	Slender Tree Frog
	Litoria moorei	Motorbike Frog
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog
	Heleioporus psammophilus	Sand Frog
	Limnodynastes dorsalis	Western Banjo Frog
Myobatrachidae	*Crinia georgiana*	Quacking Frog
	Crinia glauerti	Clicking Frog
	Crinia insignifera	Squelching Froglet
	Myobatrachus gouldii	Turtle Frog
	Pseudophryne guentheri	Crawling Toadlet

Table 7. Mammals potentially found in the vicinity of the project area

	Species	Common Name
Canidae	*Canis lupus*	Dog
	Vulpes vulpes	Red Fox
Felidae	*Felis catus*	House Cat
Molossidae	*Austronomus australis*	White-striped Freetail Bat
	Mormopterus species 4	Southern Freetail Bat
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat
	Nyctophilus geoffroyi	Lesser Longeared Bat
	Nyctophilus major	Western Longeared Bat
	Vespadelus regulus	Southern Forest Bat
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus
	Phascogale tapoatafa	Brush-tailed Phascogale
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum
Tarsipedidae	*Tarsipes rostratus*	Honey Possum
Leporidae	*Oryctolagus cuniculus*	European Rabbit
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot
Muridae	*Hydromys chrysogaster*	Water Rat
	Mus musculus	House Mouse
	Rattus fuscipes	Bush Rat
	Rattus rattus	Black Rat

Table 8. Reptiles potentially found in the vicinity of the project area

Family	Species
Agamidae	*Ctenophorus adelaidensis*
	Pogona minor
Diplodactylidae	*Diplodactylus polyophthalmus*
	Strophurus spinigerus
Elapidae	*Acanthophis antarcticus*
	Brachyurophis fasciolata
	Brachyurophis semifasciata
	Demansia psammophis
	Echiopsis curta
	Elapognathus coronatus
	Neelaps bimaculatus
	Neelaps calonotos
	Notechis scutatus
	Parasuta gouldii
	Parasuta nigriceps
	Pseudonaja affinis
	Simoselaps bertholdi
Gekkonidae	*Christinus marmoratus*
Pygopodidae	*Aprasia pulchella*
	Aprasia repens
	Delma fraseri
	Delma grayii
	Lialis burtonis
	Pletholax gracilis

Family	Species
	Pygopus lepidopodus
Scincidae	*Acritoscincus trilineatum*
	Cryptoblepharus buchananii
	Ctenotus australis
	Ctenotus fallens
	Ctenotus gemmula
	Ctenotus impar
	Ctenotus labillardieri
	Egernia napoleonis
	Hemiergis initialis
	Hemiergis quadrilineata
	Lerista distinguenda
	Lerista elegans
	Lerista lineata
	Lerista lineopunctulata
	Menetia greyii
	Morethia lineoocellata
	Morethia obscura
	Tiliqua occipitalis
	Tiliqua rugosa
Typhlopidae	*Ramphotyphlops australis*
Varanidae	*Varanus gouldii*
	Varanus rosenbergi
	Varanus tristis

4.3 Conservation significant fauna

Conservation significant fauna are protected by the Commonwealth *EPBC Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the Western Australia (WA) *Wildlife Conservation Act 1950*. The WA *Wildlife Conservation Act 1950* provides for the publishing of the *Wildlife Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, the DPaW maintains a list of fauna that require monitoring under four priorities based on DPaW's knowledge of their distribution, abundance and threatening processes. The *EPBC Act 1999* and *Wildlife Conservation Act 1950* imply legislative requirements for the management of anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory protection, other than the DPaW wishes to monitor potential impacts on these species. Environmental consultants and proponents of developments are encouraged to avoid and minimise impacts on these species. Definitions of the significant fauna under the *WA Wildlife Conservation Act* are provided in Appendix C.

Appendix D shows the results of a search of the EPBC threatened species online database for adjacent areas. In the analysis below, marine, wetland and shorebirds have been excluded due to a lack of suitable habitat in or near the project area.

Thirteen threatened species of fauna and nine migratory/marine species of birds identified under the *EPBC Act 1999* potentially occur in the vicinity of the project area. There are nine species listed on the DPaW's Priority Fauna List that potentially occur in the vicinity of the project area. The following is an assessment of the likelihood of each of the species being impacted in the project area. Table 9 is a summary of this information.

Table 9. Species that are potentially found in the vicinity of the project area and that are listed as being of conservation significance under state or commonwealth government legislation or with DPAW

Species	Status under the Wildlife Conservation Act / DPAW	Status under the *EPBC Act*	Comment on potential impact that vegetation clearing will have on conservation significant species
Neopasiphae simplicior Native bee	Schedule 2	Critically Endangered	Unlikely to be found in the project area. Low potential impact.
Leioproctus douglasiellus Short-tongued bee	Schedule 2	Critically Endangered	Unlikely to be found in the project area. Low potential impact.
Calyptorhynchus latirotris Carnaby's Black-Cockatoo	Schedule 2	Endangered	Could be seen foraging in the vicinity of the project area. Low potential impact.
Bettongia penicillata ogilbyi Woylie	Schedule 1	Critically Endangered	Not present in the project area. Low potential impact.
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo	Schedule 3	Vulnerable	Could be seen foraging in the vicinity of the project area. Low potential impact.
Calyptorhynchus baudinii Baudin's Black-Cockatoo	Schedule 2	Vulnerable	May infrequently be seen in the vicinity of the project area. Low potential impact.
Dasyurus geoffroii Chuditch	Schedule 3	Vulnerable	Not present in the project area. Low potential impact.
Phascogale calura Red-tailed Phascogale	Schedule 6	Endangered	Not present in the project area. Low potential impact.
Myrmecobius fasciatus Numbat	Schedule 2	Vulnerable	Not present in the project area. Low potential impact.
Setonix brachyurus Quokka	Schedule 3	Vulnerable	Not present in the project area. Low potential impact.
Pseudocheirus occidentalis Western Ringtail Possum	Schedule 2	Vulnerable	Not present in the project area. Low potential impact.
Phascogale tapoatafa Southern Brush-tailed Phascogale	Schedule 3	Vulnerable	Not present in the project area. Low potential impact.
Leipoa ocellata Malleefowl	Schedule 3	Vulnerable	Unlikely to be found in the project area. Low potential impact.
Apus pacificus Fork-tailed Swift	Schedule 5	Migratory	May infrequently fly over the project area. Low potential impact.
Pandion haliaetus Osprey	Schedule 5	Migratory	Not present in the project area. Low potential impact.
Merops ornatus Rainbow Bee-eater	Schedule 5	Migratory	May be found in the vicinity of the project area. Low potential impact.
Ardea modesta Great Egret	Schedule 5	Migratory Wetland	Unlikely to be found in the project area. Low potential impact.
Ardea ibis Cattle Egret	Schedule 5	Migratory Wetland	Unlikely to be found in the project area. Low potential impact.
Motacilla cinerea Grey Wagtail	Schedule 5	Migratory	Not present in the project area. Low potential impact.
Haliaeetus leucogaster White-bellied Sea-eagle		Marine	May infrequently fly over the project area. Low potential impact.
Ctenotus gemmula	Priority 3		Very low possibly in the project area. There is a low possibility that some individuals could be lost during vegetation clearing.
Neelaps calonotos Black-striped Snake	Priority 3		Very low possibly in the project area. There is a low possibility that some individuals could be lost during vegetation clearing.
Lerista lineata Lined Skink	Priority 3		Very low possibly in the project area. There is a low possibility that some individuals could be lost during vegetation clearing.
Synemon gratiosa Graceful Sun-Moth	Priority 4		Low possibly in the project area. There is a low possibility that some individuals could be lost during vegetation clearing.
Macropus irma Western Brush Wallaby	Priority 4		Not present in the project area. Low potential impact.
Hydromys chrysogaster Water Rat	Priority 4		Not present in project area. Low potential impact.
Falsistrellus mackenziei Western False Pipistrelle	Priority 4		Unlikely to be found in the project area. Low potential impact.
Isoodon obesulus fusciventer Southern Brown Bandicoot	Priority 4		Unlikely to be found in the project area. Low potential impact.

Native Bee (*Neopasiphae simplicior*) – Critically Endangered under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

This critically endangered bee has been found at multiple locations including Port Gregory, Cannington, Forrestdale and Kooljerrenup Nature Reserve near Lake Clifton. It has been collected from the flowers of Thread-leaved Goodenia (*Goodenia filiformis*), Slender Lobelia (*Lobelia tenulor*), *Angianthus preissianus* and *Velleia* sp. (Houston 2000).

Terrestrial Ecosystems' assessment is that the proposed vegetation clearing is unlikely to impact on this species, as there is no suitable habitat and it is outside the species known geographic distribution.

Short-tongue bee (*Leioproctus douglasiellus*) – Critically Endangered under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

This small black bee occurs at four locations in the Perth metropolitan area, with each location considered a separate population. This bee is found on clay-based wetlands and vegetation that is subject to seasonal inundation. Terrestrial Ecosystems' assessment is that the proposed vegetation clearing is unlikely to impact on this species, as there is no suitable habitat and it is outside the species known geographic distribution.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) – Endangered under the *EPBC Act 1999* and Schedule 2under the *Wildlife Conservation Act 1950*

Carnaby's (or Short-billed) Black-Cockatoo (*Calyptorhynchus latirostris*) is a large, pied, cockatoo. Garnett et al. (2011) and the DSEWPaC (2011) reported that Carnaby's Black-Cockatoo inhabits the south-west of Western Australia, from Kalbarri to as east on the south coast as Esperance. It breeds inland and moves to the coastal areas when chicks have fledged (Saunders et al. 1985). Carnaby's Black-Cockatoos are highly gregarious, usually seen in trios, small parties or large flocks (up to 5000 birds; Perry 1948). These flocks usually contain males, females and immature birds.

In some locations, breeding populations have decreased or become locally extinct (Saunders 1986, Saunders and Ingram 1987). For example, in the Coomallo Creek area north of Perth, Black-Cockatoos laid 74 clutches in 1973, 75 in 1974, 82 in 1975 but only 20 in 1994 and 19 in 1996 (Saunders and Ingram 1987). Saunders (1986) reported finding 13 nests at Manmanning in 1969 but by 1977, the species had stopped breeding in the area. Saunders (1990) reported failed nestings due to predation by a cat, galahs broke Carnaby's Black-Cockatoo eggs and took over nests, while other adult birds were killed by vehicles and Wedge-tailed Eagles (*Aquilla audax*).

Carnaby's Black-Cockatoos are partly migratory and partly sedentary (Higgins 1999). In the drier regions of their geographic range where most of the native vegetation has been cleared (e.g. wheatbelt), Carnaby's Black-Cockatoos are postnuptial migrants (Saunders 1980, Saunders and Ingram 1995). After breeding, individuals in these areas migrate to feed in higher rainfall areas including the Swan Coastal Plain, and to a lesser extent, forests dominated by *E. marginata* (Jarrah), *C. calophylla* (Marri) and *E. diversicolor* (Karri; Saunders 1980). On the Swan Coastal Plain, Carnaby's Black-Cockatoos have been recorded foraging in most suburbs and in pine plantations within the greater Perth metropolitan area (Perry 1948). Vagrants have been recorded on Rottnest Island (Winnett 1989) and Garden Island (Wykes et al. 1999). These later two sightings clearly indicate that Carnaby's Black-Cockatoo will fly considerable distances over non-vegetated areas to forage.

Garnett et al. (2011) estimated there were between 10,000 and 60,000 birds in the population.

Saunders (1980) recorded non-breeding cockatoos at Coomallo Creek foraging within a 50km radius of their breeding area, whereas, cockatoos at Manmanning moved a much greater distance to the coastal plain during their non-breeding season. These data suggest that Carnaby's Black-Cockatoo move from areas where there is little food to southern and western coastal areas where food is presumably more plentiful during summer and autumn (Davies 1966, Saunders 1980).

Carnaby's Black-Cockatoo breed between July and November mostly in eucalypt woodland (Saunders 1980, 1986). Carnaby's Black-Cockatoo nest in tree hollows that are created by fire, fungi, termites or old age, with hollows between 2.5 and 12m above the ground (Saunders 1979a, Higgins 1999). Hollows are large, ranging from 10 to over 250cm in depth (Higgins 1999). These hollows are usually in live or dead smooth-barked *Eucalyptus salmonophloia* (Salmon Gum) or *Eucalyptus wandoo* (Wandoo). However, Carnaby's Black-Cockatoo will also nest in *E. longicornis* (Red Morrell), *E. loxophleba* (York Gum), *E. gomphocephala* (Tuart), *E. rudis* (Flooded Gum), *E. salubris* (Gimlet), *E. occidentalis* (Swamp Yate) and *C. calophylla* (Higgins 1999, Cale 2003). When

breeding, they most often forage in the surrounding shrubland and kwongan heath (Higgins 1999). On the Swan Coastal Plain, breeding could occur in *E. gomphocephala*, *E. rudis*, *E. occidentalis* and *C. calophylla*. Adults return to the same breeding area each year (Saunders 1977) and some use the same tree hollow for many years in succession to raise their chicks, others shift their nests among a number of trees in the same area (Saunders and Ingram 1998).

Eggs are laid on a mat of wood chips chewed from the sides of the hollow. Clutches are 1-2, but most often only one chick is raised. Incubation takes 29 days, and only the female incubates and broods (Johnstone and Kirkby 2011). Initially the female will return to the nest mid-morning to feed the chick, but after about 2-3 weeks both parents leave in the early morning and return late evening.

Young remain with their parents until the parents return to the breeding area in the following year (Saunders 1980). Immature birds probably do not move into the breeding areas until they are ready to breed, although little is known of the movements of immature Carnaby's Black-Cockatoo until they are ready to breed (Saunders 1977).

The breeding success of Carnaby's Black-Cockatoo is believed to be strongly influenced by the availability of food at breeding sites (Saunders et al. 1985). Saunders (1977) found that birds that foraged within one or two kilometres from nesting sites had greater fledgling success than those from populations that had to travel up to four kilometres to obtain food. In a study that monitored Carnaby's Black-Cockatoo's breeding over 25 years at Coomallo Creek, Saunders and Ingram (1998) showed that the number of breeding attempts halved by the end of the study. During this period, native vegetation cover was reduced from 90% in 1959 to 25% in 1996. Their study revealed that although there was a surplus of trees with hollows of sufficient sizes, clearing of adjacent foraging habitat had adversely impacted on the success of breeding birds. Therefore, breeding sites typically have nearby areas of scrub and heath where birds forage on seeds and flowers of numerous trees and shrubs including *Banksia*, *Hakea*, *Dryandra, Grevillea* and *Callistemon* spp. (Robinson 1965, Saunders 1980, Higgins 1999). Unlike other cockatoo species, Carnaby's Black-Cockatoo will not utilise cereal crops (Saunders et al. 1985), but will feed on *Erodium* seed (Saunders 1980).

At Coomallo Creek, Carnaby's Black-Cockatoo travelled on average 1.4km from their nests to forage, whereas at Manmanning they foraged more widely and travelled an average of 2.5km from their nest to forage (Saunders 1980). At Manmanning, road and railway reserves were extensively used for foraging, presumably as this was the closest food source to their nests. The availability of food near the nest influenced the time spent incubating eggs and fledging body mass (Saunders 1980). At Manmanning, Carnaby's Black-Cockatoo traversed agricultural land to forage in remnant plots of uncleared land.

The social organisation of breeding Carnaby's Black-Cockatoo is known (Saunders 1974, 1977, 1979b, 1980, Saunders et al. 1985, Saunders 1986, Higgins 1999). Carnaby's Black-Cockatoo start reproducing at about four years of age and continue for at least 15 years (Cale 2003). Strong pair bonds are then formed, often for life. Females lay one or two eggs asynchronously with an average of 8 days (range 1-12) between the laying of the first and second egg. Egg laying usually occurs in early July to mid-October, with inland birds laying approximately three weeks later than those closer to the coast. Females incubate their 1-2 eggs for 28-29 days (Saunders 1982). When two eggs are laid, it is extremely rare for both nestlings to successfully fledge. The female alone broods and feeds the young birds. Initially, the female, and later the chick, rely on the male for food during the brooding and hatching of the eggs (Saunders 1977, Saunders 1982). After two to three weeks, both parents forage and return at mid-morning and dusk to feed the young (Saunders 1977, Saunders 1982). The young are dependent on parents for several months after fledgling. Fledglings are independent after about 10-11 weeks (Saunders 1977).

Although flocks of Carnaby's Black-Cockatoo are seen foraging in the Perth metropolitan area during summer and autumn there are no published data of any breeding taking place in the greater Perth metropolitan area. It is also interesting that Carnaby's Black-Cockatoo will nest in the Moora town site (Davies 2005) but have not nested in the Perth metropolitan area. It is not known if they bred in the Perth area before European settlement.

Saunders (1980) reported Carnaby's Black-Cockatoo at Coomallo Creek (breeding area) foraged mostly on native plants, with the only exception being *Erodium* sp.. Higgins (1999) reported the habitat of Carnaby's Black-Cockatoo was uncleared or remnant woodlands dominated by *Eucalyptus*, particularly *E. wandoo* and *E. salmonophloia* and often in shrubland or kwongan heathland dominated by *Hakea*, *Dryandra*, *Banksia* and *Grevillea* and seasonally in *Pinus* plantations and less often in *C. calophylla*, *E. diversicolor* or *E. marginata*.

Since the 1930s, pine plantations have become an important feeding resource during the summer months (Perry 1948, Saunders 1974, 1980). The utilisation of pine plantations by cockatoos is likely to reflect the high energetic return of pine seeds, the concentrated food source and the loss of native habitat that has occurred on the Swan Coastal Plain since the 1930s.

The belief that Carnaby's Black-Cockatoo numbers are in serious decline has led to a recovery plan being released in 2012 (DEC 2013). This plan details the current status of the cockatoo and provides conservation measures to increase the population. The five broad recovery actions in this plan are:

- Protect and manage important habitat – identify, protect and manage habitat critical for survival (nesting, foraging and roosting) for Carnaby's Black-Cockatoos across their breeding and non-breeding range;
- Conduct research to inform management – undertake research into the biology, ecology, and conservation management of Carnaby's Black-Cockatoo;
- Undertake regular monitoring – monitor population parameters, habitat, threats and status of the Carnaby's Black-Cockatoo;
- Manage other impacts – monitor the impacts and implement strategies to reduce other factors detrimentally affecting Carnaby's Black-Cockatoo, and support rehabilitation programs;
- Undertake information and communication activities – develop and distribute awareness raising and guidance materials for decision makers, establish joint management agreements and provide for improved sharing of information between agencies; and
- Engage with the broader community – engage with and involve people across the community in the conservation of Carnaby's Black-Cockatoo.

There is a very limited foraging opportunities for Carnaby's Black-Cockatoo in the project area. If it did forage it is unlikely to return frequently due to the lack of foraging resource. Clearing of the vegetation is unlikely to significantly impact on Baudin's Black-Cockatoo.

Woylie (*Bettongia penicillata ogilbyi)* – Critically Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

Woylie numbers have significantly reduced in recent years after it was removed from the conservation significant species lists. The Woylie was once abundant in the south-west forest areas. Fox and cat predation, along with habitat destruction were thought to have significantly reduced its numbers (De Tores and Start 2008). The Woylie diet consists of underground fungi, tubes, bulbs and seeds.

They have not been recorded in the vicinity of the project area in recent years. They were not seen during the site visit. It is Terrestrial Ecosystems' assessment that they are not present in the project area.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Forest Red-tailed Black-Cockatoo is one of three large black-cockatoos found in Western Australia. *Calyptorhynchus banksii naso* frequents the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (Department of Sustainability Environment Water Population and Communities 2011). It was mostly seen in the hill interior, but small numbers of birds were seen at Mundijong, Baldivis, Karnup, Stakehill, Pinjarra, Coolup and in the Lake Clifton area (Johnstone and Kirkby 2011). In 2011, there was an increase in the number of Forest Red-tailed Black-Cockatoo on the coastal strip north from Rockingham to the northern metropolitan suburbs. The reason for the recent increase in abundance is unknown.

The Forest Red-tailed Black-Cockatoo nests in tree hollows with a depth of 1-5m that are predominately *C. calophylla*, *E. marginata* and *E. diversicolor*. The nest entrance is 12-41 cm, and similar to other black-cockatoos, it lays two eggs on wood chips in October and November, but most often only one survives. Incubation period is 29-31 days and only the female incubates and broods (Johnstone and Storr 1998).

Johnstone and Kirkby (2011) reported the Forest Red-tailed Black-Cockatoo to feed mostly on seeds from *C. calophylla*, *E. marginata*, but also on *Allocasuarina fraseriana* (Sheoak), *Persoonia longifolia* (Snottygobble),

Eucalyptus patens (Blackbutt) and introduced species such as *M. azedarach* (Cape Lilac) and *Corymbia citriodora* (Lemon-scented Gum).

Loss of breeding habitat in the form of suitable hollows and adequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks is a primary threat. Abbott (1998) reported that trees within its known breeding distribution was not a factor in limiting breeding. He estimated there were about 15,000 birds and Garnett et al. (2011) thought about 10% of these birds bred each year. Competition for nesting hollows by other cockatoos, Wood Ducks, Galahs and feral Honey Bees appears to also be a significant threat (Garnett et al. 2011).

There is very limited foraging habitat for Forest Red-tailed Black-Cockatoos with the consequence that they are unlikely to be seen regularly foraging in the project area, and if they do then they will move on quickly. Clearing of the vegetation is unlikely to significantly impact on Forest Red-tailed Black-Cockatoos.

Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) – Vulnerable under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

Baudin's Black-Cockatoo occurs in the humid and sub-humid forests of Western Australia, an area within the 750mm isohyet (Chapman 2007). It range extends from Gidgegannup and Clackline in the north to about 50km east of Albany and all the forest to the south-west coast (Chapman 2007).

Baudin's Black-Cockatoo is typically found in vagrant flocks and utilises the taller, more open E. marginata, Marri and Karri forests, where it feeds mainly on Marri seeds and various Proteaceous species. Johnstone and Kirkby (2008) reported Baudin's Black-Cockatoo feeding on the seeds of *C. calophylla, E. marginata, A. fraseriana, Banksia grandis, B. quercifolia, B. littoralis, B. ilicifolia, Hakea erinacea, H. prostrata, H. stenocarpa, H. trifurcata, H. lasianthoides, H. ruscifolia, H. lissocarpha, H. varia, H. cristata, H. marginata, Dryandra sessilis, D. squarrosa, D. praemorsa, Grevillea wilsonii, Xanthorrhoea preissii, Kingia australis, Reedia spathacea, Pinus radiata, Erodium* spp*. Jacaranda* spp*., Macadamia* spp*., Carya illinoinensis, Malus* spp., *Pyrus* spp., *Diospyros* spp. and *Quercus* spp.; and the nectar, buds and flowers of *C. calophylla,, C. citridora, E. marginata, E. wandoo, B. grandis, D. sessilis, D. lindleyana, D. squarrosa, Darwinia citriodora* and *Callistemom* spp. They also eat insect larvae and insects from under the bark. Baudin's Black-Cockatoo damages apples and pears in domestic and commercial orchards, and for this reason has been shot by orchardists (Chapman 2007).

Johnstone and Kirkby (2008) suggested that once chicks had fledged, birds leave the nesting area and family groups amalgamate to form larger flocks. These large flocks arrive in the non-breeding central and northern parts of the Darling Scarp in early February and March. This postnuptial nomad is seen in Collie, Bannister, North Dandalup, Serpentine, Jarrahdale, Wungong, Mundaring and Chidlow, and sometimes venture on to the adjacent coastal plain at Maida Vale, Kelmscott, Armadale, Byford, Mundijong, Lake Clifton, Bunbury, Capel, Busselton and Dunsborough (Johnstone and Kirkby 2008, Johnstone and Kirkby 2011). During the non-breeding period, Baudin's Black-Cockatoo utilises a number of roosts on a regular basis. Johnstone and Kirkby (2008) have recorded some of the larger roosts at Gidgegannup, Piesse Brook, Nganguring, Mundaring, Araluen, Wungong, North Dandalup and Serpentine. Other roosts are at Chidlow, Parkerville, Kalamunda, Kelmscott, Roleystone, Bedfordale, Gleneagle, Mundijong, Jarrahdale, Bannister and Crossman. Most of these roost sites are tall emergent eucalypts or Blackbutt and they are often near watercourses and in sheltered gullies. They seldom venture as far west as the project area.

It is known to breed in the southern forests north to Collie and east to near Kojonup in large vertical hollows of *E. diversicolor*, *C. calophylla* and *E. wandoo* (Johnstone and Kirkby 2008). Johnstone and Storr (1998) reported eggs are laid in August to December, with a clutch of 1-2, but normally only a single chick is fledged. Only the female incubates and broods.

Garnett et al. (2011) estimated the population to be around 10,00-15,000, with only 10% breeding in any year.

Garnett et al. (2011) reported the primary threat to this species is a lack of suitable hollows. Competition for hollows comes from other cockatoos, Galahs, Australian Shelducks, Wood Ducks and feral Honey Bees (Johnstone and Kirkby 2008, Garnett et al. 2011). Inadequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks are also a threat.

The Recovery Plan for Baudin's and Forest Red-tailed Black-Cockatoos (Chapman 2007) seeks to:

- develop and promote non-lethal means of stopping Baudin's damaging fruit in orchards;
- eliminate illegal shooting;

- develop and implement strategies to allow for the use of noise emitting devices in orchards;
- develop and implement as protocol for the easy removal of honeybees from nesting hollows;
- determine and implement ways to minimise the effects of mining on habitat loss;
- identify factors affecting the number of breeding attempts and breeding success and manage nest hollows to increase recruitment reduce habitat loss;
- map feeding and breeding habitat critical to the survival of this species;
- determine the population and distribution and patterns of movement for both species; and
- maintain the Cockatoo Care program.

Baudin's Black-Cockatoo may infrequently be seen foraging in the vicinity of the project area, but it is mostly seen on the Swan Coastal Plain much closer to the Darling Scarp. Clearing of the vegetation is unlikely to significantly impact on Baudin's Black-Cockatoo.

Chuditch, Western Quoll (*Dasyurus geoffroii*) – Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

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.

Chuditch were not seen during the site visit and there is no suitable habitat in the project area. Terrestrial Ecosystems' believes that the Chuditch is not present in the project area due to a lack of suitable habitat and there are no recent records in the vicinity.

Western Ringtail Possum (*Pseudocheirus occidentalis*) - Vulnerable under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

The Western Ringtail Possums distribution is patchy across is current range. The closest known population is south of Mandurah. It has a preference for Peppermint woodlands, but is also found in Jarrah/Marri forests and woodlands with adequate hollows, coastal heath, myrtaceous heaths and shrublands and karri forests.

Terrestrial Ecosystems' believes that the Western Ringtail Possum is not present in the project area due to a lack of suitable habitat and there are no recent records in the vicinity of the project area.

Red-tailed Phascogale (*Phascogale calura*) – Endangered under the *EPBC Act 1999* and Schedule 6 under the *Wildlife Conservation Act 1950*

This species was formerly widespread in woodland habitat through much of inland southern and central Australia. It is now restricted to remnants of mature Wandoo or Rock Oak woodland in the southern wheatbelt.

The Red-tailed Phascogale was not seen on site during surveys or caught during the trapping program of the Vivente project area. Terrestrial Ecosystems' assessment is that given the lack of recent records of this species in the vicinity of the project area and a lack of suitable habitat, the Red-tailed Phascogale is not present in the project area.

Numbat (*Myrmecobius fasciatus*) – Vulnerable under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

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).

The Numbat was not seen during the site visit nor caught during the trapping program of the Vivente project area and there are no recent records of this species in the general area. Terrestrial Ecosystems' assessment is that it is not present in the project area.

Southern Brush-tailed Phascogale (*Phascogale tapoatafa*) – Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

Southern Brush-tailed Phascogales are arboreal marsupials which require tree hollows in suitable woodland or forest and rely on abundant invertebrate prey to sustain populations. They are rarely detected in vertebrate fauna surveys as they are arboreal and trap shy. They are generally not found on the coastal plain south of the Swan River and there are no recent records for this Phascogale in the vicinity of the project area.

The Southern Brush-tailed Phascogale was not seen during the site visit or caught during the Vivente trapping program and given the recent lack of records of this species in the vicinity of the project area and a lack of suitable habitat in the project area, it Terrestrial Ecosystems' assessment that the Southern Brush-tailed Phascogale is not present in the project area.

Quokka (*Setonix brachyurus*) – Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

Quokkas were originally very common on the Swan Coastal Plain, however, their distribution is now limited to Rottnest Island and a few isolated areas in the south-west of WA. On the mainland, they prefer densely vegetated areas around wetlands and streams, whereas on Rottnest Island they inhabit low scrubby coastal vegetation where water is not readily available year-round. They are herbivorous, and feed on leaves, bark, succulent plants and grasses. There are no recent records of Quokka being found in the vicinity of the project area.

Quokkas were not seen during the site visit nor caught during the Vivente trapping program. Terrestrial Ecosystems' believes that Quokkas are not present in the project area due to lack of suitable habitat and the presence of introduced predators.

Malleefowl (*Leipoa ocellata)* - Schedule 3 under the *Wildlife Conservation Act 1950* and Vulnerable under the *EPBC Act 1999*.

Malleefowl are large, ground-dwelling birds that rarely fly unless alarmed or are perching for the night. Historically, Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards. Recently their range has contracted due to fox predation and land clearance. They have not been recorded in the Perth metropolitan area for many years. Malleefowl build distinctive nests that comprise a large mound of soil/rock covering a central core of leaf litter. These nest mounds range in diameter but can span more than five metres and may be up to one metre high. Malleefowl are generally monogamous and, once breeding commences, they pair for life. The presence of nest mounds provides an indication of the presence of Malleefowl in the area.

Malleefowl are not in the project area and it is Terrestrial Ecosystems' assessment that the proposed clearing in the project area will not have a significant impact on this species.

Fork-tailed Swift (*Apus pacificus*) - Migratory under the *EPBC Act 1999* and Schedule 5 under the *Wildlife Conservation Act 1950*

The Fork-tailed Swift breeds in north-east and mid-east Asia and winters in Australia and south New Guinea (Johnstone and Storr 1998). They arrive in the Kimberley in late September and in the Pilbara in November and the south-west in December, leaving late in April. Johnstone and Storr (1998) reported them as common in the Kimberley and uncommon to moderately common along the north-west, west and south-east coasts and scarce elsewhere. They are often seen in large flocks and can be attracted to thunderstorms or cyclonic events in the northern parts of the state.

As this is an aerial migratory species, ground disturbance activities on a localised scale are unlikely to significantly impact on Fork-tailed Swifts. They could infrequently be seen flying over the project area.

Rainbow Bee-eater (*Merops ornatus*) - Migratory under the *EPBC Act 1999 and* Schedule 5 under the *Wildlife Conservation Act 1950*

Rainbow Bee-eaters are abundant in Australia, and found in many parts of Western Australia except the sandy deserts and dry arid interior. Johnstone and Storr (1998) described them as resident, breeding visitors and

postnuptial nomads. They are generally migratory, moving south in late September and early October, having wintered from the Gascoyne to Indonesia.

Rainbow Bee-eaters are regularly seen across most of the wetter areas of Western Australia including around the project area. Given their abundance and wide spread distribution, ground disturbance activities on a localised scale are unlikely to significantly impact on Rainbow Bee-eaters.

Great Egret (*Ardea modesta*) - Migratory under the *EPBC Act 1999 and* Schedule 5 under the *Wildlife Conservation Act 1950*

Herons and egrets all depend to some extent upon surface water for hunting. The Great Egret is the largest of the Australian egrets, and is an elegant, white wader dependent upon floodwaters, rivers, shallow wetlands and intertidal mudflats. Its diet consists of a range of small, aquatic invertebrates and small vertebrates (Frith 1976).

Given the dependence of the Great Egret upon wetlands and waterways, it is unlikely to be seen in the project area.

Cattle Egret (*Ardea ibis*) - Migratory under the *EPBC Act 1999* and Schedule 5 under the *Wildlife Conservation Act 1950*

The smallest of the Australian egrets, this species has undertaken an invasion of Australia from the north, where it was originally more common in the Indonesian archipelago than Australia (Simpson and Day 2004). This invasion may have been assisted by the opening up of farming land and irrigation schemes, providing the pasturelands and shallow wetlands in which it prefers to forage. Johnstone and Storr (1998) noted the species distribution in Western Australia as being confined to the irrigation areas surrounding Kununurra, however, its migratory nature and current invasive tendencies suggest that it may occur elsewhere in the state, and may still be expanding its distribution.

Given the dependence of the Cattle Egret upon wetlands, waterways and pastures, it is unlikely to be seen in the project area.

Osprey (*Pandion haliaetus*) - Migratory under the *EPBC Act 1999* and Schedule 5 under the *Wildlife Conservation Act 1950*

Osprey are a large bird of prey that is found along the coast of Western Australia. They are typically found close to the coast, river and occasionally large wetlands. They feed mainly on fish and sea snakes and occasionally on large coastal lizards.

Osprey may infrequently be seen flying over the project area, but clearing the vegetation is unlikely to have a significant impact on this species.

Grey Wagtail (Motacilla cinerea) - Migratory under the *EPBC Act 1999* and Schedule 5 under the *Wildlife Conservation Act 1950*

The Grey Wagtail is a small yellow breasted bird with a grey back and head. Johnstone and Storr (2004) reported this migratory species as breeding in Palearctic from western Europe and north-west Africa to eastern Asia and wintering in Africa, south-east Asia, Indonesia, the Philippines, New Guinea and Australia. Its preferred habitat in Australia is banks and rocks in fast-running fresh water including rivers, streams and creeks where it feeds on insects. The Atlas of Living Australia records two sightings on the south-coast of Western Australia and none around the project area. It is highly unlikely to be seen in the project area due to a lack of suitable habitat.

Ctenotus gemmula – Priority 3 with DPAW

There are three geographic populations for this small skink. One is on the sand plain north of Perth, one is on the sand plain around the greater metropolitan area and the largest geographic distribution is along the south coast of Western Australia. Storr et al. (1999) reported its habitat as white sand plains, mainly in semi arid and sub-humid zones. There are two records in Terrestrial Ecosystems' fauna survey database for a *C. gemmula* in the vicinity of the project area, but since the project area had been previously cleared, there is a very low possibility that it could still occur in the project area. It was not recorded during vegetation clearing of Vivente.

Terrestrial Ecosystems' assessment is that there is a very low possibly this species could occur in the project area.

Black-striped Snake (*Neelaps calonotos*) – Priority 3 with DPaW

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. In its natural state, the project area would have been typical habitat for the Black-striped snake, but not since the project area has been cleared. It was not recorded during vegetation clearing in the Vivente project area.

Terrestrial Ecosystems' assessment is that there is a very low possibly this species could occur in the project area.

Lined Skink (*Lerista lineata*) – Priority 3 with DPaW

This species is found in coastal heaths and shrub lands on the lower west coast between Perth and Mandurah, including Rottnest Island, with isolated populations on the mid-west coast and Busselton. It has been caught on the sand plain south of the Swan River and could be found in the project area before it was cleared. It was not recorded during vegetation clearing in the Vivente project area, and is therefore unlikely to occur in the project area.

Graceful Sun-moth (*Synemon gratiosa*) – Priority 4 with DPaW

This species has brightly coloured orange hind-wings, and is similar in appearance to a butterfly. The breeding season is late February to early April, during which time adults are active during the day and they are thought to breed exclusively on *Lomandra* species, in particular *L. hermaphrodita* and *L. maritima*. PGV Environmental (2014) listed *L. hermaphrodita* as being present in the project area. Graceful Sun-moths occur along the Swan Coastal Plain between Moore River and Preston Beach and the species is under threat due to vegetation clearing and damage to the environment.

As there is a small quantity of *L. hermaphrodita* in the project area, there is a low possibility that the Graceful Sun-moth is present in the project area.

Western Brush Wallaby (*Macropus irma*) – Priority 4 with DPaW

This species was very common in the early days of settlement, however, its range has been seriously reduced and fragmented due to clearing for agriculture and there is a significant decline in abundance within most remaining habitat. It is now distributed across the south-west of WA from north of Kalbarri to Cape Arid. The optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets.

It was not seen during the site visit and Terrestrial Ecosystems' believes that it is not present in the project area because of a lack of suitable habitat.

Water Rat (*Hydromys chrysogaster*) – Priority 4 with DPaW

The water rat is found mainly near permanent bodies of freshwater, occasionally at temporary waterholes. It is also found in the streams, wetland, lakes and estuaries on the Swan Coastal Plain.

As there is no wetland on or near the project area, Terrestrial Ecosystems' believes the Water Rat it is not present in the project area.

Western False Pipistrelle (*Falsistrellus mackenziei*) – Priority 4 with DPaW

This insectivorous species is the largest vespertilinoid in WA and is confined to south-west WA, south of Perth and east to the wheatbelt. It is known to utilise the mature Karri forests but has also been recorded in Jarrah and Tuart woodland on the Swan Coastal Plain.

Terrestrial Ecosystems' believes it is unlikely to be recorded in a Banksia woodland on the Swan Coastal Plain.

Quenda or Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) – Priority 4 with DPaW

Quenda prefer dense scrub, with swampy vegetation but are found in a variety of other habitats. 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 was caught in the Vivente project area prior to the vegetation clearing program but due to a lack of suitable habitat in the project area it is highly unlikely to be present.

Threatened marine, wetland or shore birds

Anous tenuirostris melanops (Australian Lesser Noddy), *Botaurus poiciloptilus* (Australasian Bittern), *Calidris ferruginea* (Curlew Sandpiper), *Diomedea epomophora epomophora* (Southern Royal Albatross), *Diomedea epomophora sanfordi* (Northern Royal Albatross), *Diomedea exulans amsterdamensis* (Amsterdam Albatross), *Diomedea exulans exulans* (Tristan Albatross), *Diomedea exulans* (Wandering Albatross), *Macronectes giganteus* (Southern Giant Petrel), *Macronectes halli* (Northern Giant Petrel), *Pachyptila turtur subantarctica* (Fairy Prion), *Rostratula australis* (Australian Painted Snipe), *Sternula nereis nereis* (Australian Fairy Tern), *Thalassarche cauta cauta* (Shy Albatross), *Thalassarche cauta steadi* (White-capped Albatross), *Thalassarche melanophris* (Black-browed Albatross), *Thalassarche melanophris impavida* (Campbell Albatross), *Puffinus carneipes* (Flesh-footed Shearwater), *Sterna anaethetus* (Bridled Tern), *Charadrius rubricollis* (Hooded Plover), *Sterna caspia* (Caspian Tern), *Sterna dougallii* (Roseate Tern), *Thalassarche melanophris* (Black-browed Albatross), *Calidris acuminata* (Sharp-tailed Sandpiper), *Calidris canutus* (Red Knot), *Calidris melanotos* (Pectoral Sandpiper), *Calidris ruficollis* (Red-necked Stint), *Calidris subminuta* (Long-toed Stint), *Charadrius dubius* (Little Ringed Plover), *Charadrius ruficapillus* (Red-capped Plover), *Gallinago megala* (Swinhoe's Snipe), *Gallinago stenura* (Pin-tailed Snipe), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Himantopus himantopus* (Black-winged Stilt), *Larus pacificus* (Pacific Gull), *Limosa lapponica* (Bar-tailed Godwit), *Limosa limosa* (Black-tailed Godwit) and *Philomachus pugnax* (Ruff) were recorded in the EPBC threatened species database search in the vicinity of the project area, but they are marine, wetland or shore birds and therefore unlikely to be seen in the project area due to a lack of suitable habitat.

4.4 Risk assessment

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity in a particular area and region. Potential impacts on fauna from the proposed development are identified and briefly described above. Tables 9, 10 and 11 provide a summary of the risk assessment associated with this project.

The assessment contained in Table 11 is supported by more detailed discussion in sections above and the management recommendations below.

Table 10: Fauna impact risk assessment descriptors

Any risk assessment is a product of the likelihood of an impact occurring and the consequences of that impact. Likelihood and consequences are categorised and described below. These criteria do not fit all circumstances (e.g. adequacy of fauna survey data); however, they are useful in providing the reader with an appreciation of the level of likelihood and consequences of an event. 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. 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 12.

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may occur or one or more conservation significant species may be present in exceptional circumstances.
B	Unlikely	The environmental event could occur or one or more conservation significant species could be present at sometime.
C	Moderate	The environmental event should occur or one or more conservation significant species should be present at sometime.
D	Likely	The environmental event will probably occur or one or more conservation significant species will be present in most circumstances.
E	Almost certain	The environmental event is expected to occur or one or more conservation significant species is expected be present 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 or fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the project area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or a limited impact on species of conservation significance in the project area.
4	Major	Significant impact on conservation significant fauna or their habitat in the project 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 'endangered' under the *EPBC Act (1999)* at a regional scale.

Acceptability of Risk	
Level of risk	Management of risk
Low	No action required.
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. Will require a referral to the Commonwealth under the *EPBC Act 1999*.
Extreme	Unacceptable, project should be redesigned or not proceed.

Table 11. Levels of acceptable risk

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
Consequences	Insignificant (1)	Low	Low	Low	Low	Low
	Minor (2)	Low	Low	Low	Moderate	Moderate
	Moderate (3)	Low	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme

Table 12. Risk assessment

		Before Management				With Management		
Factor	Potential Impact	Inherent Risk			Risk Controls / Management	Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Inadequate fauna survey data.	Unknown loss of fauna, fauna of conservation significance, fauna assemblage(s) in development site.	A	1	Low				
Inadequate knowledge of potential impacts.	Unknown or poorly assessed impact(s) on fauna assemblage and conservation significant species.	A	2	Low				
Inadequate bioregional data for contextual purposes.	Incomplete analysis of data and appreciation of impacts on biodiversity values in a regional context.	C	2	Low				
Removal of habitat – site scale.	Almost complete loss of terrestrial fauna in cleared areas, severe impact on local fauna assemblage.	E	2	Moderate				
Significant reduction of habitats – local scale.	Loss of fauna and fauna habitat and impacts on local fauna assemblage (excluding conservation significant species).	A	2	Low				
Significant reduction of habitats – landscape scale.	Loss of fauna and fauna habitat and impacts on fauna in a landscape context (excluding conservation significant species).	A	1	Low				
Significant reduction of habitats – regional scale.	Loss of fauna and fauna habitat and impacts on fauna in a bioregional context (excluding conservation significant species).	A	1	Low				

		Before Management				With Management		
Factor	Potential Impact	Inherent Risk			Risk Controls / Management	Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Impact on resident or visiting conservation significant terrestrial species.	Loss of a localised population or a few individuals – *Calyptorhynchus banksii naso.*	A	1	Low				
	Loss of a localised population or a few individuals – *Calyptorhynchus latirostris*.	A	1	Low				
	Loss of a localised population or a few individuals – *Calyptorhynchus baudinii.*	A	1	Low				
	Loss of a localised population or a few individuals – *Synemon gratiosa.*	B	1	Low				
	Loss of a localised population or a few individuals – *Neelaps calonotus.*	B	2	Low				
	Loss of a localised population or a few individuals – *Lerista lineata.*	B	2	Low				
	Loss of a localised population or a few individuals – *Ctenotus gemmula.*	B	2	Low				
	Loss of a localised population or a few individuals – *Merops ornatus*.	A	1	Low				
	Loss of a localised population or a few individuals – *Isoodon obesulus*.	A	1	Low				

5 DISCUSSION

5.1 Adequacy of available vertebrate fauna data

The EPA *Terrestrial Biological Surveys as an Element of Biodiversity Protection:* Position Statement No. 3 (EPA 2002), *Guidance Statement for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia No. 56* (EPA 2004) and the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA / DEC 2010) are the three relevant documents to assess the adequacy of the available information and reporting for vertebrate fauna surveys in Western Australia.

Trapping and relocation data for the Vivente project area and reports by Phoenix Environmental Sciences (2011), Western Wildlife (2010), 360 Environmental (2008), ATA Environmental (2006), Bamford Consulting Ecologists (2009), GHD (2006) and ENV Australia (2009) in conjunction with data extracted from NatureMap, Atlas of Living Australia and the Western Australian Museum records and reports by the Western Australian Museum (Harvey et al. 1997, How et al. 1999) and Gole (2003) for remnant vegetation plots provide an adequate indication of the fauna likely to be in the vicinity of the project area.

5.2 Biodiversity values of the site

5.2.1 Condition of fauna habitat and extent of habitat degradation

There are four fauna habitat types present on the site (see section 2.3). Vegetation in the project area is regrowth and generally in very poor condition and of low value.

5.2.2 Ecological linkages

There are three substantial areas set aside as Bush Forever sites nearby; Thompsons Lake Nature Reserve (BFS 391), Harry Waring Marsupial Reserve (BFS 392) and Forrestdale Lake (BFS 345). In addition, there are three smaller areas; Mandogalup Road Bushland (BFS 268), Banjup Bushland (BFS 263) and Lyon Road Bushland (BFS 492) that would support a fauna assemblage similar to that in the project area. Birds can easily move between these sites, however, terrestrial mammals, reptiles and amphibians are mostly restricted by major roads, urban residential, agriculture and industrial developments. The project area was originally connected to the Vivente project area, but has been separated by the Barfield Road for many years, which has now been cleared.

The site does not form part of an important ecological linkage for fauna in the general area.

5.2.3 Size and scale of the proposed disturbance and potential impacts

The project area is less than 2ha and the vegetation is in poor condition, so potential impacts on vertebrate fauna, including threatened species is very low.

5.2.4 Conservation significant species

Given the area had previously been cleared and the project supports low quality habitat, the potential for the Black-striped Snake (*Neelaps calonotus*), *Ctenotus gemmula* and the Lined Skink (*Lerista lineata*) to be recorded in the project area is low. These species were not recorded when Vivente was cleared. Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) and the Rainbow Bee-eater (*Merops ornatus*) may infrequently forage in the project area, however, clearing of the vegetation is unlikely to have a significant impact on any of these species due to the low value of the habitat.

No tree hollows with the potential to be used as nesting sites by Black-Cockatoos are in the project area. Johnstone and Kirkby (2011) indicated that there were no records of Carnaby's Black-Cockatoo breeding in the vicinity of the project area. Forest Red-tailed Black-Cockatoos are known to breed in the grounds of Murdoch University to the north and in farmland around Baldivis to the south.

The very small quantity of *Lomandra hermaphrodita* would suggest that it is unlikely that Graceful Sun-Moths (*Synemon gratiosa*) were present in the project area. Southern Brown Bandicoots were trapped and relocated prior to vegetation clearing in the Vivente project area and in the Catholic Primary School grounds to the west of the project area, but the lack of suitable habitat in the project area would indicate that they are not present.

5.3 Potential environmental impacts

Clearing of vegetation will potentially affect vertebrate fauna in a number of ways, including:

- death/injury of fauna during vegetation clearing and development;
- loss of habitat; and
- fragmentation of fauna habitat.

5.3.1 Impacts on the fauna assemblage and fauna habitat

Level 1 fauna assessments are, in essence, an assessment of the risks associated with the proposed disturbance on the fauna either known or potentially in the area. Table 13 is a summary of that risk assessment for clearing vegetation and developing the project area.

Table 13. A summary of the assessed risk of impact on the fauna and fauna habitat it the project area

Issues	**Assessment**				
Formal conservation status for the area:	No			Yes	
Specifically for fauna	X				
Level of alteration to the original faunal habitat	Very High				Very Low
	1	2	3	4	5
surface soil				X	
vegetation		X			
by salinity					X
by non-farmed exotic species				X	
by farmed species					X
level of habitat fragmentation		X			
Knowledge of:	Very High				Very Low
	1	2	3	4	5
species in each biotope		X			
assemblage structure per biotope		X			
presence of rare and protected species		X			
presence of range restricted species		X			
presence of short range endemic invertebrates					?
presence of stygofauna					?
ecosystem values		X			
regional species and regional assemblages		X			
regional ecosystems		X			
Capacity to assess biodiversity values for each biotope at:	Very High				Very Low
	1	2	3	4	5
species level	X				
ecosystem levels	X				
ecological functional values	X				
regional significance of faunal assemblage	X				
Consequences of the proposed disturbance in the context of the:	Very High				Very Low
	1	2	3	4	5
level of existing disturbance	X				
size of area to be disturbed					X
scale of the disturbance				X	
significance of fauna habitat in a regional context					X
extent to which the area is a refuge for fauna					X
extent to which the disturbance will impact on rare or protected fauna					X
extent to which the fauna habitat is an ecologically important					X

Issues	Assessment				
remnant					
extent to which the habitat provides an ecological linkage(s) or corridor(s)					X
heterogeneity of habitat				X	
abundance of the habitat in the bioregion			X		

5.3.2 Impacts on Black-Cockatoos

Carnaby's Black-Cockatoo may infrequently forage in the areas of *Banksia* sp. and Forest Red-tailed Black-Cockatoos would forage in the *E. marginata*. However, there is a very low abundance of *Banksia* sp. and *E. marginata* in the project area.

Table 14 provides a summary of the assessed potential impact on Black-Cockatoos associated with the action of clearing the vegetation based on the criteria set out in the Department of Sustainability, Environment, Water, Population and Communities (2012) referral guidelines for Black-Cockatoos. This is followed by a more detailed assessment to support this summary table. Commonwealth referral guidelines (Department of Sustainability Environment Water Population and Communities 2011) do not define what is quality foraging habitat for Black-Cockatoos, so the criteria outlined in Table 1 have been used.

The Eco Logical Australia (2013) assessment of Carnaby's Black-Cockatoo foraging habitat in the Perth-Peel region used a measure of the number of Banksia trees or pods/hectare to estimate the foraging resource characteristics of particular areas. No indication of quality was provided in this report, however, tree and pod densities are provided for numerous sites, some in close proximity to the project area (i.e. Thomsons Lake Reserve, Harry Warring Marsupial Reserve, Beeliar Regional Park). Banksia tree and pod density were not measured in this assessment, but are likely to be much lower than those recorded for Thomson Lake Reserve and Harry Waring Marsupial Reserve.

Table 14. Summary assessment of whether an action will have a significant impact on the two species of Black-Cockatoos

High risk of significant impacts: referral recommended	Carnaby's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
Clearing of any known nesting tree.	No nesting trees were recorded on the project area.	No nesting trees were recorded on the project area.
Clearing or degradation of any part of a vegetation community known to contain breeding habitat.	The project is outside the DPaW mapped potential breeding habitat.	Is within the vicinity of a known breeding location.
Clearing of more than 1ha of quality foraging habitat.	Will not clear more than 1ha of quality foraging habitat.	Will not clear more than 1ha of quality foraging habitat.
Clearing or degradation (including pruning the top canopy) of a known night roosting site.	Clearing will not impact on a known roosting site.	Clearing will not impact on a known roosting site.
Creating a gap of greater than 4 km between patches of black cockatoo habitat (Breeding, foraging or roosting).	Clearing will not create a gap of greater than 4km between patches of Black-Cockatoo habitat.	Clearing will not create a gap of greater than 4km between patches of Black-Cockatoo habitat.
Uncertainty: referral recommended or contact the department		
Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.	Clearing will not impact on more than 1ha of foraging habitat.	Clearing will not impact on more than 1ha of foraging habitat.
Clearing or disturbance in areas surrounding black-cockatoo breeding, foraging or night roosting habitat that has the potential to degrade habitat through introduction of invasive species, edge effect, hydrological changes, increased human visitation or fire.	Based on the recent Great Cocky count (Byrne et al. 2015), there are roost sites to the west of the project area. The exact locations of these roosts are not shown so the distance from the project area cannot be determined	Based on the recent Great Cocky count (Byrne et al. 2015), there are roost sites to the north-west of the project area. The exact locations of these roosts are not shown and thus the distance from the project area cannot be

	from the report, but is a considerable distance away.	determined from the report, but is a considerable distance away.
Actions that do not directly affect the listed species but that have a potential for indirect impacts such as increasing competitors for nest hollows.	The project area contains no trees with hollows.	The project area contains no trees with hollows.
Actions with the potential to introduce known plant disease such as *Phytophthor*a spp. To an area where the pathogen was not previously known.	With the implementation of appropriate hygiene standards during vegetation clearing, diseases are unlikely to be introduced to the site.	With the implementation of appropriate hygiene standards during vegetation clearing, diseases are unlikely to be introduced to the site.
Low risk of significant impacts: referral may not be required.		
Actions that do not affect black-cockatoo habitat or individuals.		
Actions whose impacts occur outside the modelled distribution of the three black-cockatoos.		

Clearing of any known nesting tree (high risk)

Forest Red-tailed Black-Cockatoos are known to nest in farm land, rural residential, rural remnants and eucalypt woodland near Baldivis and at Murdoch University. The project area is between Baldivis and Murdoch University, but it contains no trees with hollows that may provide a suitable nesting site. The project area is outside the known potential area of nesting sites for Carnaby's Black-Cockatoo as shown on the DPaW maps.

Clearing of any part or degradation of breeding habitat (high risk)

Breeding habitat for Carnaby's Black-Cockatoo is defined as woodland or forest, but also breeds in former woodland or forest now present as isolated trees. Carnaby's Black-Cockatoo nests in hollows in live or dead trees of *E. salmonophloia*, *E. wandoo*, *E. gomphocephala*, *E. marginata, E. rudis*, *E. loxophleba*, *E. accedens*, *C. calophylla*, *E. diversicolor* and for Forest Red-tailed Cockatoos in woodland or forest, but may also breed in former woodland or forest now present as isolated trees. Nests are found in hollows in live or dead trees of *C. calophylla*, *E. diversicolor*, *E. wandoo*, *E. megacarpa*, *E. patens*, *E. gomphocephala* and *E. marginata* (Department of Sustainability Environment Water Population and Communities 2012; p.15). It is Terrestrial Ecosystems assessment that Carnaby's Black-Cockatoo are unlikely to nest in the vicinity of the project area as they have not nested in the project area thus far and the area is outside that defined by DPaW as a potential breeding site. However, with the recent increase in Forest Red-tailed Black-Cockatoos on the Swan Coastal Plain both south and north of the Swan River, and known breeding activity at Murdoch University and Baldivis, it is possible that this species may breed in the vicinity of the project area in the future. However, there are no suitable tree hollows in the project area.

Clearing of more than 1ha of quality foraging habitat (high risk)

The definition of what is 'quality habitat' is unknown, but based on the rating system provided in Table 1, the foraging habitat is assessed as poor or very poor. Therefore less than 1ha of quality foraging habitat will be cleared.

Clearing or degradation including pruning the top canopy of a known roosting site (high risk)

There is no evidence to indicate that Carnaby's or Forest Red-tailed Black-Cockatoos roost in the project area. However, Forest Red-tailed Black-Cockatoos regularly shift their roosting sites, and could periodically roost in the project area for a short period. The recently released 2015 Great Cocky Count (Byrne et al. 2015) indicates a roosting sites for Carnaby's Black-Cockatoo to the west and Forest Red-tailed Black-Cockatoos to the north-west, but both are a considerable distance away.

Degradation (such as through altered hydrology or fire regimes) of more than 1ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat (uncertainty)

It is proposed that less than 1ha of Black-Cockatoo foraging habitat will be cleared.

Clearing or disturbance in areas surrounding black cockatoo habitat that has the potential to degrade habitat through the introduction of invasive species, edge effects, hydrological changes, increased human visitation or fire (uncertainty)

The area to be cleared will be used for residential housing in a similar manner to other adjacent developments. So, this development will increase human visitation to the area.

Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows (uncertainty)

There was no other obvious indirect impact that clearing the vegetation might have on Black-Cockatoos and no suitable nesting hollows in the project area.

Action with the potential to introduce known plant diseases such as Phytophthora spp. *(uncertainty)*

Clearing of the vegetation is only likely to spread diseases such as *Phytophthora* spp., if appropriate standards of hygiene are not maintained in the equipment used to clear the vegetation. This aspect is able to be effectively managed and controlled by the land developer.

5.4 Native vegetation clearing principles

The *Environmental Protection Act* (*1986*) provides criteria to judge the potential impact of a development on clearing native vegetation. These criteria have been listed in Table 15 with a response to indicate how clearing of the vegetation in the project area might be judged against these principles.

Table 15. Assessment of impact on fauna using the Native Vegetation Clearing Principles

Principle	Response
It comprises a high level of biological diversity.	Clearing vegetation will not compromise a high level of biodiversity.
It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing the vegetation will not result in the loss of significant habitat necessary for the maintenance of fauna indigenous to Western Australia.
It includes, or is necessary for the continued existence or, rare flora.	Not applicable.
It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	The area does not contain a threatened ecological fauna community, but could support a number of conservation significant species.
It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The area is not a remnant and similar habitat exists in adjacent areas.
It is growing in, or in association with, an environment associated with a watercourses or wetland.	The area is not a wetland.
The clearing of the vegetation is likely to cause appreciable land degradation.	Not applicable.
The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Clearing of vegetation is unlikely to impact on the environmental values of the bioregion.
The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Not applicable.
The clearing of the vegetation is likely to cause, or exacerbate the incidence of flooding.	Not applicable.

6 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Gold Estates is seeking to develop Lot 15 Barfield Road, Hammond Park, adjacent to the recently cleared Vivente project area. The project area has a substantial area that is devoid of native trees and shrubs and the remaining area is regrowth. The project area has been assessed as low value fauna habitat and low or very low Black-Cockatoo foraging habitat. Although, there is a small quantity of *L. hermaphrodita* present on site, it is unlikely that Graceful Sun-moths are present.

The impact of clearing less than 2ha of low or very low quality foraging habitat on Black-Cockatoos is not significant, and does not warrant a referral to the Commonwealth Government under the EPBC Act (1999).

There is a very low possibility that the area contains the Jewelled South-west Skink *(Ctenotus gemmula*), Black-striped snake (*Neelaps calonotus*) or Lined Skink (*Lerista lineata*), however, they were not caught or seen when the much larger Vivente project area, which is located directly to the west of the project area, was cleared. If present, these reptiles will be lost during vegetation clearing. The cumulative effect of progressively clearing most of the *Banksia* and jarrah woodland in the general area may have an effect in the long term.

Conservation significant Rainbow Bee-eater (*Merops ornatus*), if they are in the project area, will move to adjacent bush land once vegetation clearing commences and would not be significantly impacted.

6.1 Recommendations

It is recommended that a fauna salvage program is implemented during the vegetation clearing program by a suitably qualified zoologist.

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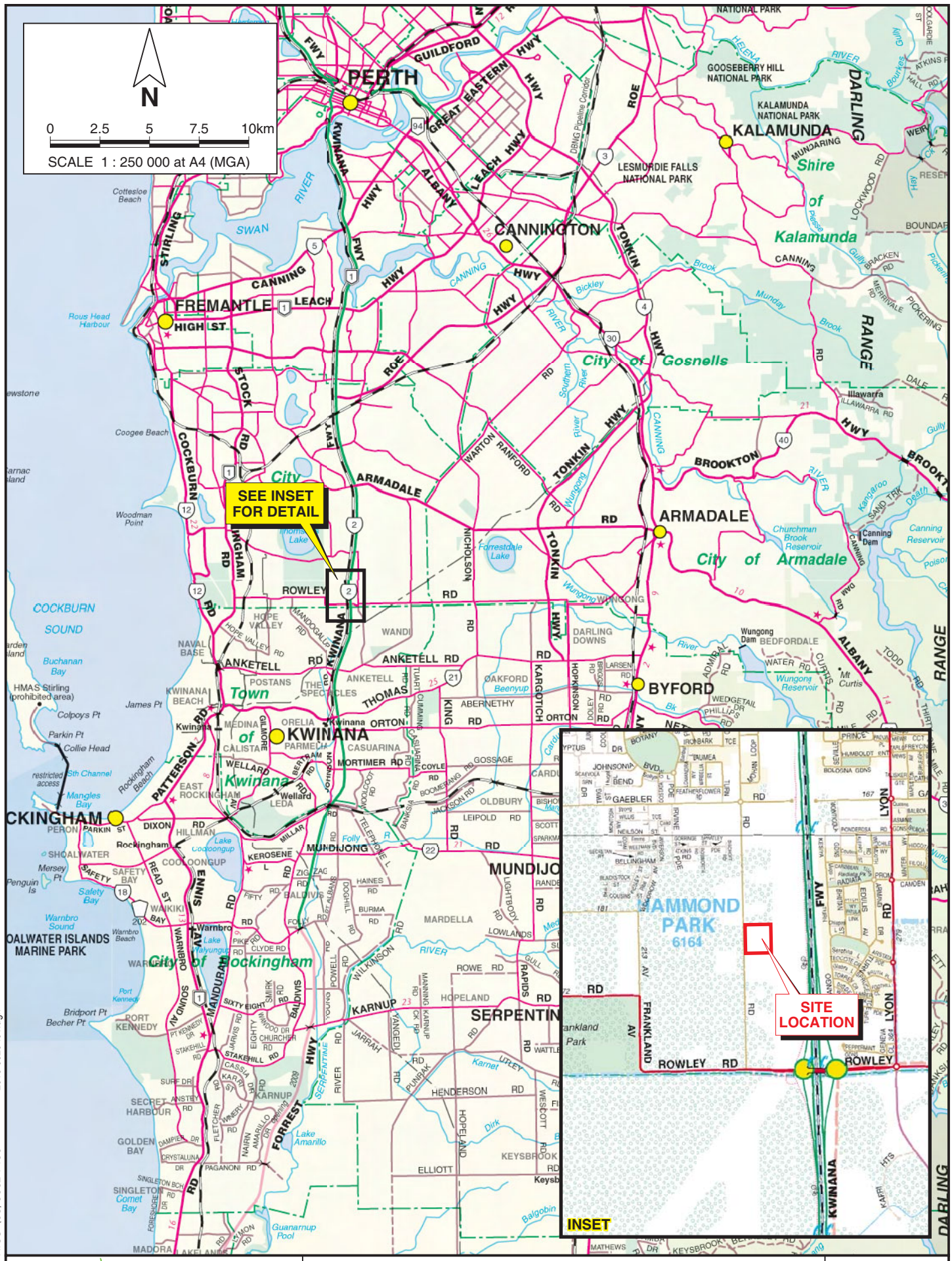
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2016-0020-f01.dgn

PINPOINT CARTOGRAPHICS (08) 9562 7136

TERRESTRIAL ECOSYSTEMS

Gold Estate Holdings Pty Ltd
LEVEL 1 FAUNA RISK ASSESSMENT
LOT 15 BARFIELD RD, HAMMOND PARK

Figure 1

REGIONAL LOCATION

Drawn: S. Thompson | Date: 27 Apr 2016 | Job: 2016-0020



CADASTRAL SOURCE: Landgate, April 2016.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown March 2016.

TERRESTRIAL ECOSYSTEMS

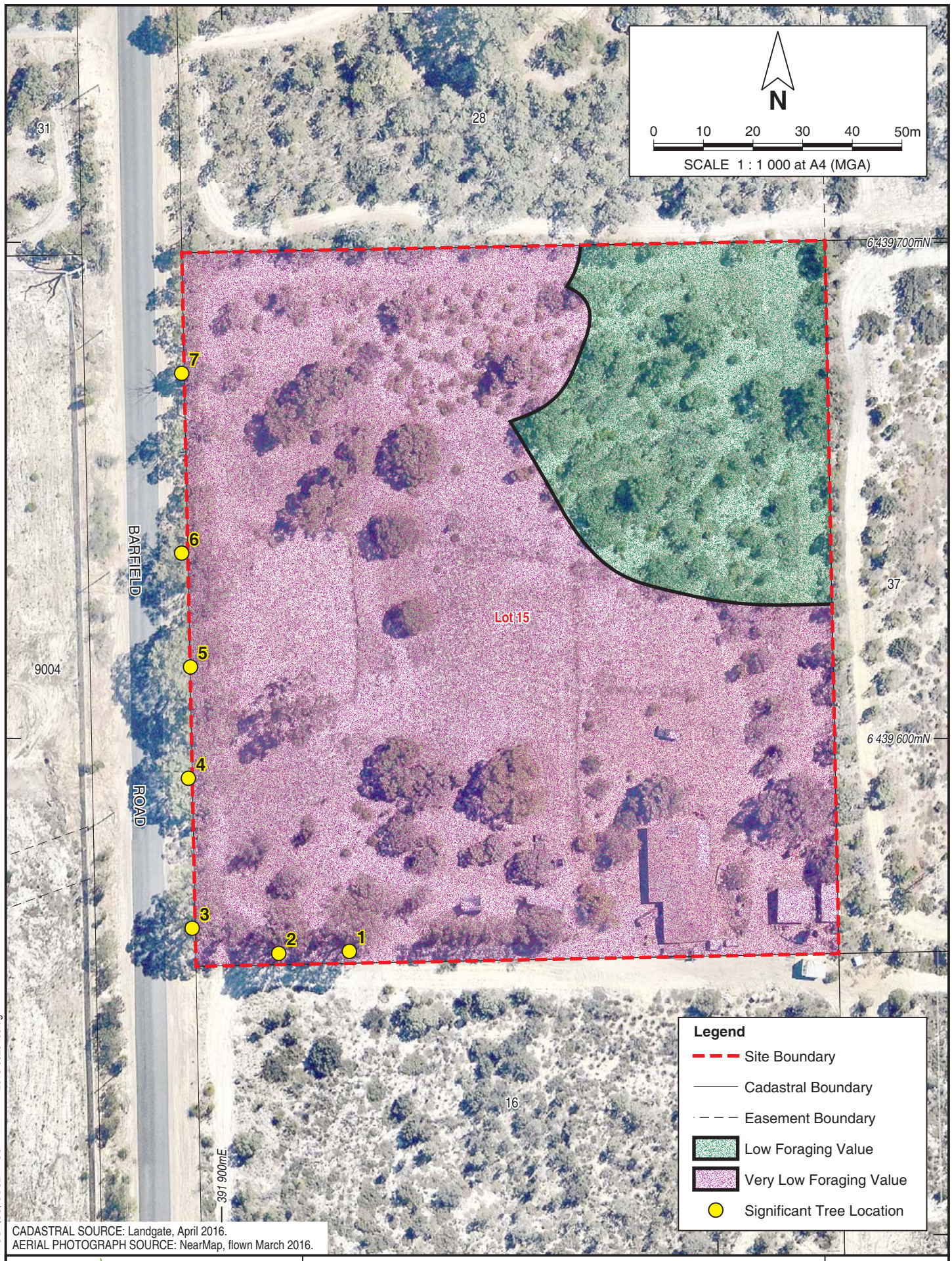
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LEVEL 1 FAUNA RISK ASSESSMENT
LOT 15 BARFIELD RD, HAMMOND PARK

HABITAT QUALITY

Figure 2

Drawn: S. Thompson | Date: 27 Apr 2016 | Job: 2016-0020

PINPOINT CARTOGRAPHICS (08) 9562 7136 2016-0020-f02.dgn



CADASTRAL SOURCE: Landgate, April 2016.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown March 2016.

PINPOINT CARTOGRAPHICS (08) 9562 7136 2016-0020-f03.dgn

TERRESTRIAL ECOSYSTEMS

Gold Estate Holdings Pty Ltd
LEVEL 1 FAUNA RISK ASSESSMENT
LOT 15 BARFIELD RD, HAMMOND PARK

BLACK COCKATOO FORAGING VALUE

Figure 3

Drawn: S. Thompson | Date: 27 Apr 2016 | Job: 2016-0020

Appendix A
Search Results from the *EPBC Act* (1999) On-line Database

Vertebrate Fauna Assessment – Lot 15 Barfield Rd, Hammond Park

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.

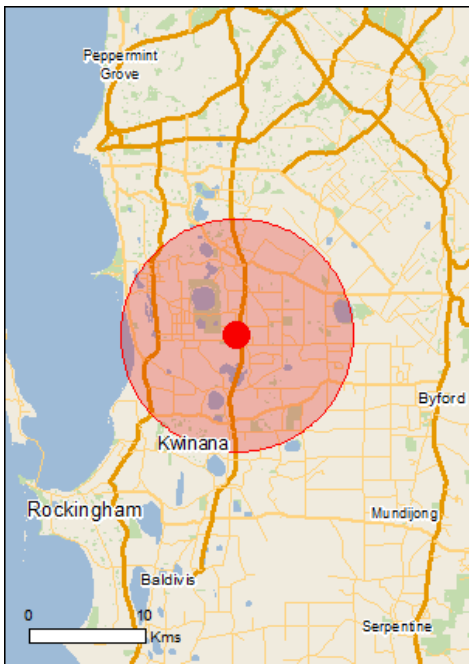
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 23/04/16 13:38:51

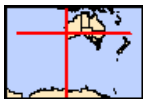
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 10.0Km



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:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	48
Listed Migratory Species:	53

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	78
Whales and Other Cetaceans:	13
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:	12
Regional Forest Agreements:	None
Invasive Species:	44
Nationally Important Wetlands:	4
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Forrestdale and thomsons lakes	Within Ramsar site
Peel-yalgorup system	30 - 40km upstream

Listed Threatened Ecological Communities [Resource Information]

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.

Name	Status	Type of Presence
Claypans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to 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 Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans amsterdamensis Amsterdam Albatross [82330]	Endangered	Species or species habitat may occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or

Name	Status	Type of Presence
		related behaviour likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Insects		
Leioproctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Species or species habitat likely to occur within area
Neopasiphae simplicior A native bee [66821]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder,	Vulnerable	Species or species

Name	Status	Type of Presence
Ngoor, Ngoolangit [25911]		habitat likely to occur within area
Setonix brachyurus		
Quokka [229]	Vulnerable	Species or species habitat may 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 known to occur within area
Darwinia foetida		
Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei		
Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica		
Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha		
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus balanites		
Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. incurva		
Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
Lepidosperma rostratum		
Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Thelymitra dedmaniarum		
Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	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
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

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		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
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
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may 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
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish		Species or species

Name	Threatened	Type of Presence
[66249]		habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Banksia	WA
Forrestdale Lake	WA
Gibbs Road	WA
Harry Waring Marsupial Reserve	WA
Modong	WA
Piara	WA
Thomsons Lake	WA
Unnamed WA39584	WA
Unnamed WA39752	WA
Unnamed WA48291	WA
Unnamed WA49561	WA
Wandi	WA

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
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

Name	Status	Type of Presence
		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
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
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species

Name	Status	Type of Presence
		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 linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		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
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		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
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
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

Nationally Important Wetlands [Resource Information]

Name	State
Forrestdale Lake	WA
Gibbs Road Swamp System	WA
Spectacles Swamp	WA
Thomsons Lake	WA

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

-32.17459 115.85403

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 B
Fauna Surveys in the Vicinity of the Project Area

Vertebrate Fauna Assessment – Lot 15 Barfield Rd, Hammond Park

Appendix B(1). Fauna survey data in the vicinity of the project area

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
Birds																										
Accipitridae	*Elanus axillaris*	Black-shouldered Kite												X						X						
	Haliastur sphenurus	Whistling Kite					2																			
	Accipiter fasciatus	Brown Goshawk														1	2		X			7	3	1		15
	Accipiter cirrocephalus	Collared Sparrowhawk												X												5
	Hieraaetus morphnoides	Little Eagle												X			7				1	1	1		5	5
	Pandion haliaetus	Osprey																	X							
Anatidae	*Biziura lobata*	Musk Duck																								5
	Stictonetta naevosa	Freckled Duck																								7
	Cygnus atratus	Black Swan					1																			
	Tadorna tadornoides	Australian Shelduck					25								X					X						
	Chenonetta jubata	Australian Wood Duck					59	X							X					X				1		
	Anas gracilis	Grey Teal					8													X						
	Anas castanea	Chestnut Teal																								5
	Anas superciliosa	Pacific Black Duck					26	X						X	X					X						10
	Oxyura australis	Blue-billed Duck																								1
Podargidae	*Podargus strigoides*	Tawny Frogmouth					1																			1
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover																								20
	Elseyornis melanops	Black-fronted Dotterel																		X						5
	Erythrogonys cinctus	Red-kneed Dotterel																								5
	Vanellus tricolor	Banded Lapwing												X												3
Laridae	*Chlidonias hybridus*	Whiskered Tern																								1
	Chroicocephalus novaehollandiae	Silver Gull						X																		
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt																		X						15
	Recurvirostra novaehollandiae	Red-necked Avocet																								2
	Cladorhynchus leucocephalus	Banded Stilt																								10
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper																								1
	Tringa stagnatilis	Marsh Sandpiper																								1
	Calidris subminuta	Long-toed Stint																								15
	Calidris acuminata	Sharp-tailed Sandpiper																								10
Stercorariidae	*Stercorarius longicauda*	Long-tailed Jaeger																								1

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
Turnicidae	*Turnix varius*	Painted Button-quail																								4
	Turnix velox	Little Button-quail																						1		
Ardeidae	*Ardea alba*	Great Egret																		X						
Ardeidae	*Ardea pacifica*	White-necked Heron					3																			
	Egretta novaehollandiae	White-faced Heron					31	X												X						
	Nycticorax caledonicus	Nankeen Night Heron					1																			
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican					1	X																		
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis																								
	Threskiornis molucca	Australian White Ibis					28	X						X						X						
	Threskiornis spinicollis	Straw-necked Ibis					238	X							X					X						
	Platalea flavipes	Yellow-billed Spoonbill						X																		
Columbidae	*Columba livia*	Rock Dove																	X		1				1	
	Streptopelia senegalensis	Laughing Dove					24	X						X	X	14			X			1				1
	Streptopelia chinensis	Spotted Dove					7	X						X					X							1
	Phaps chalcoptera	Common Bronzewing					15	X						X	X				X	X				1		1
	Ocyphaps lophotes	Crested Pigeon					8							X	X											
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra					6	X												X	2	2	13	1	2	
	Todiramphus sanctus	Sacred Kingfisher					7									2					5	4	12	3	2	2
Meropidae	*Merops ornatus*	Rainbow Bee-eater					34	X								3	1		X				3	1	1	10
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo					1							X	X											5
	Chalcites lucidus	Shining Bronze-Cuckoo					11							X	X										2	5
	Cacomantis pallidus	Pallid Cuckoo													X						1				1	
	Cacomantis flabelliformis	Fan-tailed Cuckoo					1							X												
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar																								5
Falconidae	*Falco cenchroides*	Nankeen Kestrel					21	X						X	X											10
	Falco berigora	Brown Falcon					1																			
	Falco longipennis	Australian Hobby												X					X				1			
	Falco subniger	Black Falcon																								5
Phasianidae	*Coturnix ypsilophora*	Brown Quail					1							X												5
Rallidae	*Porphyrio porphyrio*	Purple Swamphen					9	X												X						2
	Gallirallus philippensis	Buff-banded Rail																								10
	Porzana pusilla	Baillon's Crake																								
	Porzana fluminea	Australian Spotted Crake																		X						

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
	Porzana tabuensis	Spotless Crake																								2
	Tribonyx ventralis	Black-tailed Native-hen																								
	Gallinula tenebrosa	Dusky Moorhen						X												X						10
	Fulica atra	Eurasian Coot					20	X												X						5
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren					3								X					X						1
	Smicrornis brevirostris	Weebill					3	X							X										1	
	Gerygone fusca	Western Gerygone					42							X	X	2	7		X	X	23	6	44	15	36	10
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill					169							X	X					X			3	1	3	
	Acanthiza inornata	Western Thornbill						X																		20
	Acanthiza apicalis	Inland Thornbill					14								X					X						5
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler																		X						10
	Cincloramphus mathewsi	Rufous Songlark																								5
Artamidae	*Artamus cinereus*	Black-faced Woodswallow						X												X	2					15
	Artamus cyanopterus	Dusky Woodswallow																			1		2	2	17	
	Cracticus torquatus	Grey Butcherbird					21							X	X	1	2	X	X				1	1	X	5
	Cracticus tibicen	Australian Magpie					155	X						X	X	13	6	X	X	X	2	1	5	2	6	10
	Strepera versicolor	Grey Currawong																								1
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike					29	X						X	X	3	2	X	X	X	8	7	3	3	6	10
	Lalage sueurii	White-winged Triller					4																		1	
Climacteridae	*Climacteris rufa*	Rufous Treecreeper																								5
Corvidae	*Corvus coronoides*	Australian Raven					198	X						X	X	42	26	X	X	X	6	7	16	6	6	45
	Corvus splendens	House Crow																								5
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail																								1
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow																								5
	Hirundo neoxena	Welcome Swallow					26	X								4	1		X	X						100
	Petrochelidon nigricans	Tree Martin					25	X						X	X	42	9			X	12	21	12	35	1	
	Petrochelidon ariel	Fairy Martin																								5
Maluridae	*Malurus splendens*	Splendid Fairy-wren					173							X	X	9	9		X	X			16	8	22	5
	Malurus elegans	Red-winged Fairy-wren																								35
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill												X	X	15	3		X		1	3	2	17	13	10
	Lichenostomus virescens	Singing Honeyeater					29	X						X	X	36	23	X	X	X						
	Manorina flavigula	Yellow-throated Miner																								10
	Anthochaera lunulata	Western Wattlebird					3							X	X											35

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
	Anthochaera chrysoptera	Little Wattlebird						X								2			X							
	Anthochaera carunculata	Red Wattlebird					70	X						X	X	35	3	X	X	X	1		11	7	1	5
	Epthianura albifrons	White-fronted Chat						X														1				20
	Glyciphila melanops	Tawny-crowned Honeyeater													X											
	Lichmera indistincta	Brown Honeyeater					120	X						X	X	43	35	X	X	X	32	26	30	37	34	5
	Phylidonyris novaehollandiae	New Holland Honeyeater					63							X	X	35	10		X	X						8
	Phylidonyris niger	White-cheeked Honeyeater						X						X	X	11	1		X							1
	Melithreptus brevirostris	Brown-headed Honeyeater																								5
	Melithreptus lunatus	White-naped Honeyeater																								15
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark					94	X						X	X	8		X	X	X		1				10
Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit					16	X							X											5
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird					1														1	1	2		1	
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella														2	2		X		2	14			7	
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler												X	X											
	Pachycephala rufiventris	Rufous Whistler					32	X						X	X	28	27	X	X	X	22	19	36	27	31	
	Colluricincla harmonica	Grey Shrike-thrush					8	X						X	X		6		X				3		7	10
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote																								3
	Pardalotus striatus	Striated Pardalote					11							X		10	4	X	X	X	4	16	35	28	20	2
Petroicidae	*Petroica multicolor*	Pacific Robin					2												X							2
	Petroica goodenovii	Red-capped Robin													X											
	Eopsaltria georgiana	White-breasted Robin																								10
Rhipiduridae	*Rhipidura fuliginosa*	New Zealand Fantail					67									7										
	Rhipidura albiscapa	Grey Fantail													X				X	X		8	10	1	17	
	Rhipidura leucophrys	Willie Wagtail					53	X						X	X	24	1		X	X	2					2
Timaliidae	*Zosterops lateralis*	Silvereye					293	X						X	X	7	3	X	X	X	4	2	4	3	9	1
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant					5	X												X						
	Phalacrocorax carbo	Great Cormorant																								
	Phalacrocorax sulcirostris	Little Black Cormorant					2													X						
	Phalacrocorax varius	Pied Cormorant																								
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe					2	X												X						4
	Podiceps cristatus	Great Crested Grebe																								2
Procellariidae	*Daption capense*	Cape Petrel																								5
	Pachyptila desolata	Antarctic Prion																								2

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
	Pterodroma macroptera	Great-winged Petrel																								1
Cacatuidae	*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo	20				26							X									1		2	
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	4				2	X						X					X							
	Calyptorhynchus baudinii	Baudin's Black-Cockatoo																			1					
	Eolophus roseicapillus	Galah					85	X						X	X			X	X	X	1				2	
	Cacatua pastinator	Western Corella												X												
	Cacatua sanguinea	Little Corella					6																			
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet					56	X						X	X			X	X							1
	Polytelis anthopeplus	Regent Parrot					14																			
	Platycercus icterotis	Western Rosella																				1	31			2
	Barnardius zonarius	Australian Ringneck					60	X						X	X	1		X	X	X	2	5	9	3	9	8
	Purpureicephalus spurius	Red-capped Parrot					52							X	X	4	1		X	X	3	1	32	10	22	5
	Neophema elegans	Elegant Parrot					6														1		2	1	2	
Strigidae	*Ninox novaeseelandiae*	Southern Boobook					2																			3
Tytonidae	*Tyto alba*	Barn Owl					1																			5
Mammals																										
Suidae	*Sus scrofa*	Pig																								2
Canidae	*Canis lupus*	Dog						X							X											
	Vulpes vulpes	Red Fox	1	1	1										X								X	X	X	
Felidae	*Felis catus*	House Cat		1	1										X											30
Molossidae	*Austronomus australis*	White-striped Freetail Bat												X												
Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox																								1
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat		1										X												5
	Nyctophilus geoffroyi	Lesser Longeared Bat																								1
	Nyctophilus major	Western Longeared Bat																								1
	Vespadelus regulus	Southern Forest Bat												X												2
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus																								5
	Phascogale tapoatafa	Brush-tailed Phascogale																								2
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo													X						X	X				
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum		18																						4
Tarsipedidae	*Tarsipes rostratus*	Honey Possum																								6
Leporidae	*Oryctolagus cuniculus*	European Rabbit			4			X							X						X	X	X	X	X	
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna																								1

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot			25			28	4	3	7				X						X	X	X			30
Muridae	*Mus musculus*	House Mouse		26	23			9			1		2								15	7	9	20	7	50
	Rattus fuscipes	Bush Rat		1																						1
	Rattus rattus	Black Rat			5			2	2																	14
Amphibians																										
Hylidae	*Litoria adelaidensis*	Slender Tree Frog		7	4	10		X							X											155
	Litoria moorei	Motorbike Frog		8	36	9																				110
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog		518	81												2				78	34	6	11	1	730
	Heleioporus psammophilus	Sand Frog							4																	
	Limnodynastes dorsalis	Western Banjo Frog		1	2			X		1	1				X	6	1									270
Myobatrachidae	*Crinia georgiana*	Quacking Frog		158				X													5	8	2			105
	Crinia glauerti	Clicking Frog		11	1	4																2	1			145
	Crinia insignifera	Squelching Froglet		X				X							X	X					24	4	22	30	9	380
Myobatrachidae	*Myobatrachus gouldii*	Turtle Frog															1									220
	Pseudophryne guentheri	Crawling Toadlet																			2					6
Reptiles																										
Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon																								90
	Pogona minor	Bearded Dragon						X	1							2					10		1	4	3	42
Diplodactylidae	*Diplodactylus polyophthalmus*																									5
	Strophurus spinigerus																									1
Elapidae	*Brachyurophis fasciolata*																									5
	Brachyurophis semifasciata																									15
	Demansia psammophis								1	2	2															25
	Echiopsis curta	Bardick																				1				
	Elapognathus coronatus	Crowned Snake																								15
	Neelaps bimaculatus	Black-naped Snake																								5
	Notechis scutatus	Tiger Snake		3	2																					13
	Parasuta gouldii																1				1				3	9
	Parasuta nigriceps																									1
	PseuDPaWhis australis	Mulga Snake																								1
	Pseudonaja affinis	Dugite		2	1			X									1					1				47
	Pseudonaja mengdeni	Gwardar																								3
	Simoselaps bertholdi	Jan's Banded Snake																								6

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
	Simoselaps littoralis	West Coast Banded Snake																								1
Gekkonidae	*Christinus marmoratus*	Marbled Gecko		1																						30
Pygopodidae	*Aprasia pulchella*																									10
	Aprasia repens			2																	2	4	1	3	5	40
	Delma fraseri										1					2	3									95
	Delma grayii																									15
	Lialis burtonis			5													2						1			55
	Pletholax gracilis	Keeled Legless Lizard															2									28
	Pygopus lepidopodus	Common Scaly Foot							1	2		1														17
Scincidae	*Acritoscincus trilineatum*			30	2							1									4	4	2	4	2	95
	Cryptoblepharus buchananii			36	3	9		X				1				2	5				4	2	2	2	1	470
	Ctenotus australis				13			X								1	4									280
	Ctenotus fallens							X															1			10
	Ctenotus gemmula	(Swan Coastal plain)																								10
	Ctenotus impar																				5	X	1	5	1	95
	Ctenotus labillardieri																									10
	Egernia napoleonis																									20
	Hemiergis initialis																									30
	Hemiergis quadrilineata							X			1	1														35
	Lerista distinguenda																									10
	Lerista elegans			11	9			X			1					12	14				1	13	10	7	17	157
	Lerista lineata							X								1	8									
	Lerista lineopunctulata							X																		
	Menetia greyii			14	3	1		X		1	1	1				12	28				2		23	11	5	395
	Morethia lineoocellata				1																					25
	Morethia obscura			4																	8	5		1	10	20
	Tiliqua occipitalis	Western Bluetongue						1																		3
	Tiliqua rugosa			3	3			5		1	1				X	2	3				3	2	7	2		5
Typhlopidae	*Ramphotyphlops australis*			2												1					6	1	4	1	3	14
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor			3										X								1	2	1	4
	Varanus rosenbergi	Heath Monitor		1																						
	Varanus tristis	Racehorse Monitor																			X	4				
Chelidae	*Chelodina oblonga*	Oblong Turtle																								5

A 360 Environmental (2008) Lot 9 Abernethy Road, Byford Spring Flora and Fauna Report. Unpublished report for Australand Property Group, Perth

B ATA Environmental (2006) Vertebrate Fauna Assessment Brookdale Redevelopment Area. Unpublished report for the Armadale Redevelopment Authority Perth

C GHD (2006) Fiona Stanley Heath Precinct Site Investigation Fauna Assessment March 2006. Unpublished report for Department of Housing and Works, Perth.

D ENV (2009) Jandakot Airport Fauna Survey. Unpublished report for Jandakot Airport Holdings Pty Ltd, Perth.

E Bamford Consulting Ecologists (2009) Keane Road Strategic Link, Armadale Fauna Assessment. Unpublished report for EnviroWorks Consulting, Perth.

F How R. A., Harvey M.S., Dell J. and Waldock J.M. (1999) Ground Fauna of Urban Bushland Remnants in Perth. Unpublished report to the Australian Heritage Commission; NEP Grant N93/04; Perth.

G Gole C. A. (2003) Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project. Unpublished report Birds Australia and Perth Biodiversity Project; Perth.

H Harvey M. S., Dell J., How R.A. and Waldock J.M. (1997) Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms Perth. Unpublished report for the Australian Heritage Commission NEP Grant N95/49, Perth.

I NatureMap records for the area.

X Presence only

Appendix A(2). Fauna survey records in the vicinity of the project area

		Surveys	A												B												C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
Birds																											
Accipitridae	*Pandion cristatus*	Eastern Osprey																X	X					X	X		
	Elanus axillaris	Black-shouldered Kite											1														
	Haliaeetus leucogaster	White-bellied Sea-Eagle													X			X	X					X	X	X	
	Haliastur sphenurus	Whistling Kite						3	3	5			3		X			X	X	X	X	X	X		X	X	
	Accipiter fasciatus	Brown Goshawk						2	1	3			6	2													
	Circus approximans	Swamp Harrier						3							X			X	X	X			X	X	X	X	
	Aquila audax	Wedge-tailed Eagle						1		1	1																
	Pandion haliaetus	Osprey						1				1															
Anatidae	*Biziura lobata*	Musk Duck						3							X	X	X	X	X	X	X	X	X	X	X	X	
	Stictonetta naevosa	Freckled Duck													X												
	Cygnus atratus	Black Swan						3				1			X	X	X	X	X	X	X	X	X	X	X	X	
	Tadorna radjah	Radjah Shelduck						1							X											X	
	Tadorna tadornoides	Australian Shelduck						32	4						X	X	X	X	X	X	X	X	X	X	X	X	
	Chenonetta jubata	Australian Wood Duck													X		X	X	X	X	X			X	X	X	
	Malacorhynchus membranaceus	Pink-eared Duck						59							X		X	X		X		X	X	X	X	X	
	Anas rhynchotis	Australasian Shoveler						15							X		X	X	X	X	X	X	X	X	X	X	
	Anas gracilis	Grey Teal						36							X	X	X	X	X	X	X	X	X	X	X	X	
	Anas castanea	Chestnut Teal						1							X			X							X	X	
	Anas platyrhynchos	Northern Mallard													X				X	X		X	X		X	X	
	Anas superciliosa	Pacific Black Duck						93					2		X	X	X	X	X	X	X	X	X	X	X	X	
	Aythya australis	Hardhead													X		X	X	X	X	X	X	X	X	X	X	
	Oxyura australis	Blue-billed Duck						5							X		X	X		X		X	X	X	X	X	
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar							2																		
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover																								X	
	Pluvialis squatarola	Grey Plover																						X		X	
	Charadrius dubius	Little Ringed Plover													X											X	
	Charadrius ruficapillus	Red-capped Plover													X	X		X	X				X		X	X	
	Elseyornis melanops	Black-fronted Dotterel						1							X	X	X	X	X	X	X	X	X	X	X	X	
	Thinornis rubricollis	Hooded Plover																							X		
	Erythrogonys cinctus	Red-kneed Dotterel													X			X	X					X	X	X	
	Vanellus miles	Masked Lapwing																X						X		X	
Laridae	*Sternula nereis*	Fairy Tern													X												

		Surveys	A												B													C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
	Gelochelidon nilotica	Gull-billed Tern																								X	
	Chlidonias hybridus	Whiskered Tern													X									X	X	X	
	Chlidonias leucopterus	White-winged Black Tern																							X	X	
	Chroicocephalus novaehollandiae	Silver Gull						39		1	1				X	X	X	X	X	X		X	X	X	X	X	
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt						41				2			X	X	X	X	X	X	X	X	X	X	X	X	
	Recurvirostra novaehollandiae	Red-necked Avocet						1							X	X		X	X	X				X	X	X	
	Cladorhynchus leucocephalus	Banded Stilt													X	X		X	X	X		X		X	X	X	
Scolopacidae	*Limosa limosa*	Black-tailed Godwit													X									X	X		
	Limosa haemastica	Hudsonian Godwit																	X						X		
	Actitis hypoleucos	Common Sandpiper													X			X	X					X	X	X	
	Tringa brevipes	Grey-tailed Tattler																	X								
	Tringa nebularia	Common Greenshank													X			X	X	X		X	X	X	X	X	
	Tringa stagnatilis	Marsh Sandpiper													X			X	X	X					X		
	Tringa glareola	Wood Sandpiper													X		X	X		X					X	X	
	Calidris tenuirostris	Great Knot																	X						X		
	Calidris canutus	Red Knot																							X		
	Calidris ruficollis	Red-necked Stint													X			X	X					X	X	X	
	Calidris subminuta	Long-toed Stint																X							X	X	
	Calidris melanotos	Pectoral Sandpiper																X							X	X	
	Calidris acuminata	Sharp-tailed Sandpiper													X			X						X	X	X	
	Calidris ferruginea	Curlew Sandpiper													X			X	X						X	X	
	Philomachus pugnax	Ruff																							X	X	
Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern																							X		
	Ixobrychus dubius	Australian Little Bitten																X							X		
	Ardea pacifica	White-necked Heron													X			X		X	X		X	X	X		
	Ardea modesta	Eastern Great Egret						1							X		X	X	X	X	X	X	X	X	X	X	
	Ardea intermedia	Intermediate Egret													X												
	Ardea ibis	Cattle Egret																						X			
	Egretta novaehollandiae	White-faced Heron						4					1		X	X	X	X	X	X	X	X	X	X	X	X	
	Egretta garzetta	Little Egret													X			X	X	X			X	X	X	X	
	Nycticorax caledonicus	Nankeen Night Heron						1					3		X	X		X	X	X	X	X		X	X	X	
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican						1		8		1	2		X			X	X	X		X	X	X	X	X	
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis						31							X			X		X				X	X		
	Threskiornis molucca	Australian White Ibis						82	19	6	1	8	9	1	X	X	X	X	X	X	X	X	X	X	X	X	
	Threskiornis spinicollis	Straw-necked Ibis						7					31		X	X	X	X	X	X	X	X	X	X	X	X	

		Surveys	A												B												C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
	Platalea regia	Royal Spoonbill																							X		
	Platalea flavipes	Yellow-billed Spoonbill						1							X	X	X	X	X	X	X	X	X	X	X	X	
Columbidae	*Columba livia*	Rock Dove									10																
	Streptopelia senegalensis	Laughing Dove						6			1		1	4													
	Streptopelia chinensis	Spotted Dove						1	3	2	6	1	4														
	Ocyphaps lophotes	Crested Pigeon						2				1	6														
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra						6		5		4	2														
	Todiramphus sanctus	Sacred Kingfisher							1	3			2														
Meropidae	*Merops ornatus*	Rainbow Bee-eater						8	3			3	9	4													
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo																									
	Chalcites lucidus	Shining Bronze-Cuckoo						3				1	3														
Falconidae	*Falco cenchroides*	Nankeen Kestrel						1																			
	Falco longipennis	Australian Hobby						2	1		1			1													
Rallidae	*Porphyrio porphyrio*	Purple Swamphen						3							X			X	X	X	X	X	X	X	X	X	
	Gallirallus philippensis	Buff-banded Rail													X			X	X	X				X	X	X	
	Porzana pusilla	Baillon's Crake													X			X							X	X	
	Porzana fluminea	Australian Spotted Crake																X						X	X	X	
	Porzana tabuensis	Spotless Crake													X			X	X					X	X	X	
	Tribonyx ventralis	Black-tailed Native-hen						1							X							X		X	X		
	Gallinula tenebrosa	Dusky Moorhen						1							X	X		X	X	X	X	X	X	X	X	X	
	Fulica atra	Eurasian Coot						4							X	X	X	X	X	X	X	X	X	X	X	X	
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren						11	1				9	4													
	Smicrornis brevirostris	Weebill						30	15	33	9	6	13	12													
	Gerygone fusca	Western Gerygone						57	19	24	4	20	36	13													
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill						10	3	2	1	2	3														
	Acanthiza inornata	Western Thornbill						1		12		13															
	Acanthiza apicalis	Inland Thornbill						6	1				9														
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler						6							X			X	X	X				X	X	X	
	Megalurus gramineus	Little Grassbird													X			X						X	X	X	
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow												1													
	Cracticus torquatus	Grey Butcherbird						10	10	8	9	12	3	2													
	Cracticus tibicen	Australian Magpie						23	35	14	22	17	15	26													
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike						4	6	2	13	5	8	4													
Corvidae	*Corvus coronoides*	Australian Raven						45	55	63	61	33	47	11													
Hirundinidae	*Hirundo neoxena*	Welcome Swallow						10	7		4	3	2	3													

		Surveys	A												B													C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
	Petrochelidon nigricans	Tree Martin						7	6	1		1	18	10													
Maluridae	*Malurus splendens*	Splendid Fairy-wren						29	10			3	11	8													
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill								1	1			3													
	Lichenostomus virescens	Singing Honeyeater						14	9	9	14	5	6	25													
	Anthochaera lunulata	Western Wattlebird											1														
	Anthochaera carunculata	Red Wattlebird						35	50	54	55	36	22	20													
	Lichmera indistincta	Brown Honeyeater						55	32	28	34	38	36	28													
	Phylidonyris novaehollandiae	New Holland Honeyeater						14	67		5		91	3													
	Phylidonyris niger	White-cheeked Honeyeater												30													
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark						7	9	6	17	7	3	6													
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella							4					7													
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler						3	6	3	2	8	9	2													
	Colluricincla harmonica	Grey Shrike-thrush							2				2														
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote											4														
	Pardalotus striatus	Striated Pardalote						19	3	15	5	11	17	6													
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail						22	3	13		3	21														
	Rhipidura leucophrys	Willie Wagtail						10	5	8	1		2	4													
Timaliidae	*Zosterops lateralis*	Silvereye						101	51	32	21	16	39	6													
Anhingidae	*Anhinga melanogaster*	Australasian Darter						1							X			X	X	X			X	X	X	X	
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant						1							X		X	X	X	X	X	X	X	X	X	X	
	Phalacrocorax carbo	Great Cormorant							2						X				X	X				X	X	X	
	Phalacrocorax sulcirostris	Little Black Cormorant													X			X	X	X	X	X	X	X	X	X	
	Phalacrocorax varius	Pied Cormorant													X				X						X	X	
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe													X		X	X	X	X	X	X	X	X	X	X	
	Poliocephalus poliocephalus	Hoary-headed Grebe						9							X			X	X	X		X	X	X	X	X	
	Podiceps cristatus	Great Crested Grebe													X		X		X					X	X	X	
Cacatuidae	*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo						1		18	2	2		3													
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo						10		4	3		2	1													
	Eolophus roseicapillus	Galah						18	163	19	22	17	14	4													
	Cacatua sanguinea	Little Corella						35	17	2	3			2													
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet						57	99	104	162	117	89	67													
	Barnardius zonarius	Australian Ringneck						8	16	20	11	1	7	4													
	Purpureicephalus spurius	Red-capped Parrot						3		6		1	7	7													
	Neophema elegans	Elegant Parrot							1																		
Strigidae	*Ninox novaeseelandiae*	Southern Boobook							1			2	1														

		Surveys	A												B														C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
Mammals																											
Canidae	*Vulpes vulpes*	Red Fox										2															
Molossidae	*Austronomus australis*	White-striped Freetail Bat		X	X	X	X	X			X	X	X														
	Mormopterus species 4	Southern Freetail Bat	X			X			X				X														
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	X	X	X	X	X	X	X		X	X	X	X													1
	Nyctophilus geoffroyi	Lesser Longeared Bat			X	X	X	X	X		X	X	X	X													1
	Nyctophilus major	Western Longeared Bat																									1
	Vespadelus regulus	Southern Forest Bat	X	X	X	X	X	X	X		X	X	X	X													1
Dasyuridae	*Antechinus flavipes leucogaster*																										1
	Phascogale tapoatafa tapoatafa	Brush-tailed Phascogale																									2
Myrmecobiidae	*Myrmecobius fasciatus*	Numbat																									1
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo												2													
	Macropus irma	Western Brush Wallaby																									1
	Setonix brachyurus	Quokka																									7
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum										2	2														
Tarsipedidae	*Tarsipes rostratus*	Honey Possum																									6
Leporidae	*Oryctolagus cuniculus*	European Rabbit							5	2		2	3	2													
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot							5	23	19	10	21	19													25
Muridae	*Hydromys chrysogaster*	Water Rat																									1
	Mus musculus	House Mouse							7	1	1	1	6	2													5
	Rattus rattus	Black Rat											1														4
Amphibians																											
Hylidae	*Litoria adelaidensis*	Slender Tree Frog											4														30
	Litoria moorei	Motorbike Frog											7														20
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog							35	29		28	29														147
	Limnodynastes dorsalis	Western Banjo Frog						3		1	1	1	1														54
Myobatrachidae	*Crinia georgiana*	Quacking Frog											1														21
	Crinia glauerti	Clicking Frog											2														28
	Crinia insignifera	Squelching Froglet												4													77
	Myobatrachus gouldii	Turtle Frog						2																			44
	Pseudophryne guentheri	Crawling Toadlet																									6
Reptiles																											
Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon																									18
	Pogona minor	Bearded Dragon						1			1	2	1	4													
	Pogona minor minor	Bearded Dragon																									42

		Surveys	A												B													C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
Diplodactylidae	*Diplodactylus polyophthalmus*																										1
	Strophurus spinigerus spinigerus																										1
Elapidae	*Acanthophis antarcticus*	Southern Death Adder																									4
	Brachyurophis fasciolata																										1
	Brachyurophis semifasciata																										3
	Demansia psammophis																										4
	Elapognathus coronatus	Crowned Snake																									3
	Hydrophis elegans																										2
	Hydrophis ocellatus																										1
	Neelaps bimaculatus	Black-naped Snake																									1
	Neelaps calonotos	Black-striped Snake																									3
	Notechis scutatus	Tiger Snake						2	1			1	1														12
	Parasuta gouldii																										9
	Parasuta nigriceps																										1
	PseuDPaWhis australis	Mulga Snake																									1
	Pseudonaja affinis	Dugite							3		7	1	4														46
	Pseudonaja mengdeni	Gwardar																									3
	Simoselaps bertholdi	Jan's Banded Snake																									6
	Simoselaps littoralis	West Coast Banded Snake																									1
Gekkonidae	*Christinus marmoratus*	Marbled Gecko							1		1		1														4
Pygopodidae	*Aprasia pulchella*																										2
	Aprasia repens										2																7
	Delma fraseri																										19
	Delma grayii																										3
	Lialis burtonis								1	2	2	1	1	5													12
	Pletholax gracilis	Keeled Legless Lizard												2													28
	Pygopus lepidopodus	Common Scaly Foot												1													17
Scincidae	*Acritoscincus trilineatum*							4	1				9														16
	Cryptoblepharus buchananii							6	15	10	7	4	11	8													92
	Ctenotus australis								3	3	7	3	4	5													55
	Ctenotus fallens										21	2		2													1
	Ctenotus gemmula	(Swan Coastal plain)																									2
	Ctenotus impar																										19
	Ctenotus labillardieri																										2
	Egernia napoleonis							2	12	1			24														3

		Surveys	A												B													C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
	Hemiergis initialis																											6
	Hemiergis quadrilineata								22	10	8	6	9	15														5
	Lerista distinguenda																											2
	Lerista elegans							1						16														314
	Lerista lineata								2		1	1		2														132
	Menetia greyii							5		2	2	12		6														79
	Morethia lineoocellata								1		3	1																5
	Morethia obscura							2	5	11	9	13	6															4
	Tiliqua occipitalis	Western Bluetongue																										3
	Tiliqua rugosa							2		2	7	1	1	2														4
Typhlopidae	*Ramphotyphlops australis*																											13
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor																										4
Chelidae	*Chelodina oblonga*	Oblong Turtle						2																				1

A Phoenix Environmental Sciences (2011) Vertebrate Fauna Survey for the Roe Highway Extension Project. Unpublished report for South Metro Connect, Perth.

B Western Wildlife (2010) Wetland and migratory bird survey. Unpublished report for South Metro Connect, Perth.

C Western Australian Museum collection

Appendix C
Definitions of Significant Fauna under the WA *Wildlife Conservation Act 1950*

Vertebrate Fauna Assessment – Lot 15 Barfield Rd, Hammond Park

APPENDIX C
DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE WESTERN AUSTRALIAN *WILDLIFE CONSERVATION ACT 1950*

T - Threatened species

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna. Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR - Critically endangered species or Schedule 1

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna.

EN - Endangered species or Schedule 2

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna.

VU - Vulnerable species or Schedule 3

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna.

EX - Presumed extinct species or Schedule 4

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna.

IA - Migratory birds protected under an international agreement or Schedule 5

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD - Conservation dependent fauna or Schedule 6

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS - Other specially protected fauna or Schedule 7

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P - Priority species

Possibly threatened species that do not meet the relevant criteria, or are otherwise data deficient, are added to the Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Priority 4: Rare, Near Threatened and other species in need of monitoring

a) Rare. - Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
b) Near Threatened. - Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.
c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix 4
Fauna Management and Relocation Plan

FAUNA MANAGEMENT AND RELOCATION PLAN

LOT 15 BARFIELD ROAD, HAMMOND PARK

Prepared for:

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Report Date: 5 May 2016
Document No. GEH212_25_V1

STATEMENT OF LIMITATIONS

Scope of Services
This report has been prepared in accordance with the scope of work set out in the contract, or as otherwise agreed, between the Client and EndPlan Environmental* (EndPlan).

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

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

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

[*Wiske Pty Ltd as Trustee for Esk Family Trust trading as "EndPlan Environmental" ABN: 23 684 573 524]

DOCUMENT STATUS

DOCUMENT TITLE:					
FAUNA MANAGEMENT AND RELOCATION PLAN **LOT 15 BARFIELD ROAD, HAMMOND PARK**					
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EXECUTIVE SUMMARY

Gold Estates Holdings Pty Ltd (Gold Estates) is planning to develop their landholding comprising Lots 15 Barfield Road, Hammond Park (the site); a 1.8 ha area of freehold land located approximately 25 km south of the Perth CBD within the City of Cockburn municipal boundary.

This Fauna Management and Relocation Plan has been prepared in consultation with the City of Cockburn's Environmental Services unit and the Department of Parks and Wildlife (DPaW) Nature Protection Branch, and has been prepared to accompany an amendment to the approved Barfield Road Local Structure Plan (LSP) submission to the City of Cockburn.

The purpose of the Plan is to identify the potential direct and indirect impacts of the proposed development of the site on vertebrate fauna likely to inhabit the site and describes appropriate management practises to manage these potential impacts.

A Level 1 fauna assessment of the site consisting of a desktop investigation and a 'targeted' reconnaissance field survey for conservation significant fauna and fauna habitat was undertaken on the 19 April 2016 by Dr Scott Thompson from *Terrestrial Ecosystems Ltd*. Black-Cockatoo foraging habitat mapping identified two different foraging habitats that are rated as 2 (i.e. very low foraging value; 1.49ha) and 3 (low foraging value; 0.37ha). Seven mature trees in or immediately adjacent to the site were observed; however none of the trees had hollows suitable as a nesting site for a Black Cockatoo.

Management measures recommended to be implemented on-site include:

1. A pre-clearing vertebrate fauna trapping and relocation program conducted by a suitably qualified and experienced fauna specialist who has been issued with a Regulation 15 Licence by the Department of Parks and Wildlife (DPaW) prior to clearing commencing.
2. Pre-clearing fencing and wildlife crossing signage requirements.
3. An induction program to be conducted by the fauna specialist to all subcontractors involved in the clearing process.
4. Requirement for a fauna specialist to remain on-site throughout the clearing process.
5. Appropriate measures to deal with injured and feral fauna.

All fauna trapping and relocation conducted under this Plan will be undertaken in accordance with a Regulation 15 Licence conditions issued by the DPaW. The Licence generally require that the fauna specialist provide a '*Returns Report*' to the DPaW within 28 business days of clearing activities being substantially completed or the completion of all fauna relocation activities, whichever comes first. The fauna specialist will also provide a summary report to Gold Estates for submission to the City of Cockburn within 28 business days of all fauna relocation activities being completed.

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LIST OF ACRONYMS

CoC City of Cockburn
DotE Department of the Environment (Commonwealth)
DoP Department of Planning
DPaW Department of Parks and Wildlife
EPA Environmental Protection Authority
LSP Local Structure Plan
MRS Metropolitan Region Scheme
POS Public Open Space
TPS Town Planning Scheme
WAPC Western Australian Planning Commission

1. INTRODUCTION

1.1 Background

Gold Estates Holdings Pty Ltd (Gold Estates) is proposing to develop their 1.865 ha freehold landholding comprising Lot 15 Barfield Road, Hammond Park (the site) as an urban residential development. The site is legally described as Lot 15 on Diagram 30747, Volume 1913, Folio 170, with the Registered Proprietor being Gold Estates Holdings Pty Ltd.

The site, situated approximately 25 km south of the Perth CBD and within the City of Cockburn municipal boundary, is bounded by Barfield Road to the west, rural properties zoned for residential development to the north and south and a Western Power transmission line easement to the east (**Figure 1**).

1.2 Zoning and Landuse

The site is zoned 'Urban' under the provisions of the Metropolitan Region Scheme (MRS) and 'Development' under the provisions of the City of Cockburn Town Planning Scheme No. 3.

A review of Landgate's historical aerial photographs identified that in 1974 the site was totally cleared of all vegetation with subsequent regeneration occurring until houses were constructed firstly in the south-east corner of the site in the early 1980s and then another along Barfield Road in the 1990s (PGV Environmental, 2014).

To the north, west and northwest of the site is land zoned 'Urban' that is currently being developed (shown as uncleared except for residences and their associated outbuildings on some of the lots on the aerial photograph underlay). Directly to the east of the site is predominantly uncleared land some of which is constrained by a Western Power easement that lies immediately adjacent and to the west of the Kwinana Freeway.

Surrounding land uses are identified on **Figure 2**.

1.3 Purpose and Objectives of the Plan

This Plan has been prepared in consultation with the City of Cockburn's Environmental Services unit and the Department of Parks and Wildlife (DPaW) Nature Protection Branch.

The purpose of the Plan is to identify the potential direct and indirect impacts of the proposed subdivision development on vertebrate fauna likely to inhabit the site and describe appropriate management practises to manage these potential impacts.

The principal objectives of the Plan are to:

- Identify the species of native fauna which are likely to be found on-site and which may require relocation;
- Provide details of fauna relocation practices that will be used on-site;
- Minimise the impact of clearing activities upon fauna; and
- Minimise injury or death of individual fauna during development.

2. ENVIRONMENTAL CHARACTERISTICS

2.1 Topography

Topographic elevation at the site slopes gently from a high of 35 mAHD in the south-east corner down to 28 mAHD along the north-western portion (Department of Agriculture and Food Western Australia, 2014).

2.2 Landform

The site is located in the Bassendean Sands System (Churchward and McArthur, 1980). The Bassendean Sands System is characterised by low to very low relief dunes and discrete sand rises with intervening swampy areas often underlain with a weak iron-organic hardpan at depths that are generally greater than 2 m (Gozzard, 1983).

2.3 Soils

Soil-landscape mapping for the site reported in the *Perth Metropolitan Region 1:50,000 Environmental Geology Series Fremantle (Part of Sheets 2033 I and 2033 IV)* indicates that the site consists entirely of Bassendean Sand of Pleistocene aeolian origin (Gozzard, 1983). One soil unit, Bassendean B1 Phase (212Bs_B1), is located on the site (Department of Agriculture and Food Western Australia, 2014). This unit has deep bleached grey sands at the surface sometimes with a pale yellow B horizon that is fine to medium grained, sub-rounded quartz, moderately well sorted (Department of Agriculture and Food Western Australia, 2007). The permeability of the Bassendean Sand is classified as high (Gozzard, 1983).

2.4 Surface Water Hydrology

The *EPBC Protected Matters Search Tool* report (**Appendix 1**) identifies the site as being located upstream from the Peel-Yalgorup System catchment (Australian Government, 2015), while two Ramsar wetlands are located within 10 km of the site: Forrestdale Lake is located approximately 7.15 km to the north-east and Thomsons Lake approximately 2.57 km to the north-west.

The *Geomorphic Wetlands Swan Coastal Plain* dataset displays the location, boundary, geomorphic classification (wetland type) and management category of wetlands on the Swan Coastal Plain (Department of Parks and Wildlife, 2015). A search of Landgate's *WA Atlas* (Government of Western Australia, 2015) confirms that there are no wetlands identified in the *Geomorphic Wetlands Swan Coastal Plain* dataset as being located either on or adjacent to the site. The site investigations for the flora and vegetation survey confirmed the absence of wetlands on the site (PGV Environmental, 2014).

2.5 Groundwater

The Department of Water's (DoW) *Perth Groundwater Atlas* (2014) indicates that groundwater under the site in May 2003 was around 21m AHD and flowing in a westerly direction. The historical

maximum groundwater was around 23m AHD. The depth to the historic maximum water table ranges from 5-12m under the site.

2.6 Climate

The Hammond Park area experiences a Mediterranean climate with warm to hot, dry summers and mild, wet winters.

Based on long-term climate statistics collected by the Bureau of Meteorology (BoM) for the Jandakot Aero weather station (Station No. 009172) for the period 1989-2015, the mean annual rainfall is approximately 819.3 mm with approximately 79% of this falling in the May to August period. Mean minimum daily temperatures range from 6.7°C in July to 17.8°C in February while mean maximum temperatures range from 17.9°C in July to 31.4°C in January (Bureau of Meteorology, 2016).

The wind regime at the site is dominated by westerly winter winds, with storm force winds in excess of 50 kph from the northwest through to south-westerly directions. During summer, dominant wind conditions consist of south-easterly lighter morning winds with strong south-westerly sea breezes in the afternoon (Bureau of Meteorology, 2016).

2.7 Vegetation

2.7.1 Biogeographic Region

The site is located within the Swan Coastal Plain (SWA) Interim Biogeographic Regionalisation of Australia (IBRA) Region (Commonwealth of Australia, 2008a) and in the Swan Coastal Plain 2 (SWA2) subregion that is characterised by a low-lying coastal plain, mainly covered by woodlands (Mitchell *et al*., 2002).

2.7.2 Vegetation Complex

According to Heddle *et al*. (1980), the site is comprised of the Bassendean (Central and South) Vegetation Complex, described as ranging from woodland of *Eucalyptus marginata-Allocasuarina fraseriana-Banksia* species, to low woodland of *Melaleuca* species and sedgelands on moister sites.

2.7.3 Vegetation Type

During a spring survey conducted on-site (PGV Environmental, 2014), three vegetation types were recorded:

- ***Banksia attenuata/B. menziesii* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland:** This vegetation type occurred in the north-east corner of the site. The *Banksia* trees were up to 4m high and in low densities and *Xanthorrhoea preissii* was the most dominant native understorey species at around 1m high and having a 10% cover. All other native species had very low coverage. *Gladiolus caryophyllaceus, Ursinia anthemoides* and Flat Weed (*Hypochaeris glabra*) were the most prevalent weed species.

- ***Xanthorrhoea preissii* Open Shrubland:** A small section of *Xanthorrhoea preissii* shrubland occurred in the north central part of the site. The *Xanthorrhoea* shrubs were up to 1.2m high and 20% density. Very few native species were recorded in this vegetation type and no trees

except several WA Christmas Trees (*Nuytsia floribunda*). Presumably the *Banksia* and possibly Jarrah trees that occurred previously in this area did not regenerate after clearing in the early 1970s. Introduced species were common, particularly *Ursinia anthemoides*, Veltdgrass (*Ehrharta longiflora*) and Flat Weed.

- ***Eucalyptus marginata/ Banksia attenuata/B. menziesii* Low Woodland over weeds:** two stands of this vegetation type occurred, one in the north-west corner and the other in the south-west corner. Jarrah (*Eucalyptus marginata*) was the most common tree species up to 6m high and varying in density while *Banksia attenuata* and *B. menziesii* also occurred but in very low numbers. Few native understorey species were present while introduced species such as Veldtgrass and *Ursinia* were common.

Vegetation type mapping is shown in **Figure 3**.

2.7.4 Vegetation Condition

The vegetation condition of the site was assessed and mapped using the Keighery (1994) Bushland Condition Scale. The regrowth vegetation on most of the site is either Completely Degraded or Degraded with trees or shrubs in a weed dominated understorey. The *Banksia* woodland vegetation in the north-east corner was considered to be in Good condition as the understorey contained a reasonable number of native plant species and life forms (shrubs, herbs, orchids, sedges) but was partially cleared and contained an abundance of aggressive weeds (PGV Environmental, 2014).

Vegetation condition mapping is shown in **Figure 4**.

2.7.5 Flora

A flora species list, made of species observed in three 10m x 10m floristic quadrats, identified 62 vascular plant species including 19 introduced weed species (PGV Environmental, 2014). The low total of native species and high percentage of introduced species (31%) is indicative not only of the small size of the site but also the high degree of disturbance.

No Threatened Flora listed under the Western Australian *Wildlife Conservation Act* (1950), species listed under the *Environmental Protection and Biodiversity Conservation Act* (1999), or DPaW Priority listed species were found to be located on-site during the spring survey (PGV Environmental, 2014).

The spring flora and vegetation survey report is included as **Appendix 1**.

3. LIKELY FAUNA AND POTENTIAL IMPACTS

A Level 1 fauna assessment of the site, undertaken on the 19 April 2016 by *Terrestrial Ecosystems Ltd*, included a reconnaissance survey to undertake selective, low intensity sampling of the fauna and faunal assemblages (i.e. no fauna trapping was undertaken during the field survey, with the assessment consisting of a desktop investigation and a 'targeted' field survey for conservation significant fauna and fauna habitats).

The fauna survey report is included as **Appendix 2**.

3.1 Habitat Assessment

A fauna habitat assessment of the site was undertaken during the reconnaissance survey with four habitat types found to be present: one was largely devoid of vegetation and the vegetated area can be divided into three fauna habitat types based on the vegetation types, namely:

- *Banksia attenuata/B. menziesii* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland
- *Xanthorrhoea preissii* Open Shrubland
- *Eucalyptus marginata/ Banksia attenuata/B. menziesii* Low Woodland over weeds

Habitat quality is mapped in Figure 2 of **Appendix 2**.

3.2 Black-Cockatoo Foraging Assessment

As adjacent areas have been foraged by Black-Cockatoos, an assessment of the suitability of the habitat on-site as a breeding and foraging site for Black-Cockatoos was also undertaken. Black-Cockatoo foraging habitat was mapped and is shown in Figure 3 of **Appendix 2**. Two different foraging habitats were observed and are rated as 2 (i.e. very low foraging value; 1.49ha) and 3 (low foraging value; 0.37ha). Seven nature trees were identified in or immediately adjacent to the site: none of the trees had hollows suitable as a nesting site for a Black Cockatoo (Terrestrial Ecosystems, 2016).

3.3 Conservation Status

The conservation status of fauna is assessed under the Commonwealth *EPBC Act* 1999 and the Western Australian *Wildlife Conservation Act* (1950). The *Wildlife Conservation Act* 1950 classifies threatened species into Schedules. The DPaW has produced a supplementary list of Priority Fauna, using five categories. These species are not considered Threatened under *the Wildlife Conservation Act* but require on-going monitoring.

A search of the Department of the Environment's (DotE) Matters of National Environmental Significance (MNES) search tool (search coordinates 32.17459oS, 115.85403oE with a 10km buffer) was undertaken (refer to **Appendix 2**). The DPaW threatened and priority species database was searched via the records in NatureMap. In addition, a desktop search of the Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in the relevant section of the bioregion in the vicinity of the site (Terrestrial Ecosystems, 2016).

Table 1 identifies the 13 Threatened species of fauna and nine migratory/marine species of birds identified under the EPBC Act 1999 potentially occurring in the vicinity of the site. There are also eight species listed on the DPaW's Priority Fauna List that potentially occur in the vicinity of the site (Terrestrial Ecosystems, 2016).

TABLE 1
THREATENED AND PRIORITY FAUNA SEARCH RESULTS

SPECIES	COMMON NAME	*EPBC Act (1999) –* Status[2]	*Wildlife Conservation Act 1950 -* Status/DPaW[1]
Neopasiphae simplicior	Native bee	Critically Endangered	Schedule 2
Leiproctus douglasiellus	Short-tongued bee	Critically Endangered	Schedule 2
Bettonia penicillata ogilbyi	Woylie	Critically Endangered	Schedule 1
Calyptorhynchus latirostris	Carnaby's Cockatoo	Endangered	Schedule 2
Calyptorhynchus baudinii	Baudin's Black-Cockatoo	Vulnerable	Schedule 2
Calyptorhynchus banksii naso	Forest Red-tailed Black Cockatoo	Vulnerable	Schedule 3
Dasyurus geoffroii	Western Quoll, Chuditch	Vulnerable	Schedule 3
Phascogale calura	Red-tailed Phascogale	Endangered	Schedule 6
Myrmecobius fasciatus	Numbat	Vulnerable	Schedule 2
Setonix brachyurus	Quokka	Vulnerable	Schedule 3
Pseudocheirus occidentalis	Western Ringtail Possum	Vulnerable	Schedule 2
Phascogale tapoatafa	Southern Brush-tailed Phascogale	Vulnerable	Schedule 3
Leipoa ocellata	Malleefowl	Vulnerable	Schedule 3
Apus pacificus	Fork-tailed Swift	Migratory	Schedule 5
Pandion haliaetus	Osprey	Migratory	Schedule 5
Merops ornatus	Rainbow Bee-eater	Migratory	Schedule 5
Ardea alba	White Egret	Migratory Wetland	Schedule 5
Ardea modesta	Great Egret	Migratory Wetland	Schedule 5
Ardea ibis	Cattle Egret	Migratory Wetland	Schedule 5
Motacilla cinerea	Grey Wagtail	Migratory	Schedule 5
Apus pacificus	Fork-tailed Swift	Marine	Schedule 5
Haliaeetus leucogaster	White-bellied Sea-Eagle	Marine	Schedule 5
Ctenotus gemmula	Jewelled Sand Plain Ctenotus		Priority 3
Neelaps calonotos	Black-striped Snake		Priority 3
Lerista lineata	Lined Skink		Priority 3
Synemon gratiosa	Graceful Sun Moth		Priority 4
Macropus irma	Western Brush Wallaby		Priority 4
Hydromys chrysogaster	Water Rat		Priority 4
Falsistrellus mackenziei	Western False Pipistrelle		Priority 4
Isoodon obesulus fusciventer	Quenda, Southern Brown Bandicoot		Priority 4

Notes: [1] **Department of Parks and Wildlife (2016)**
[2] **Australian Government (2016)**

3.4 Native Fauna and Potential Impact

The following is an assessment of the likelihood of each of the conservation significant species being impacted by clearing of the site (Terrestrial Ecosystems, 2016).

Native Bee (*Neopasiphae simplicior*)
The Native Bee is listed as Critically Endangered under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*. This bee has been found at multiple locations including Port Gregory, Cannington, Forrestdale and Kooljerrenup Nature Reserve near Lake Clifton. It has been collected from

the flowers of Thread-leaved Goodenia (*Goodenia filiformis*), Slender Lobelia (*Lobelia tenulor*), *Angianthus preissianus* and *Velleia* sp. (Houston, 2000).

The proposed vegetation clearing is unlikely to impact on this species, as there is no suitable habitat and it is outside the species known geographic distribution (Terrestrial Ecosystems, 2016).

Short-tongue bee (Leioproctus douglasiellus)
The Short-tongue Bee is listed as Critically Endangered under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*. This small black bee occurs at four locations in the Perth metropolitan area, with each location considered a separate population. This bee is found on clay-based wetlands and vegetation that is subject to seasonal inundation.

The proposed vegetation clearing is unlikely to impact on this species, as there is no suitable habitat and it is outside the species known geographic distribution (Terrestrial Ecosystems, 2016).

Carnaby's Black Cockatoo (*Calyptorhynchus latirostris*)
Carnaby's Black-Cockatoo is listed as Endangered under the *EPBC Act* and as Schedule 2 under the *Wildlife Conservation Act* 1950*.* Carnaby's Black-Cockatoo inhabits the south-west of Western Australia and 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*) containing deep hollows. Nesting also occurs in Marri (*Corymbia calophylla)* and Tuart (*E. gomphocephala*) with breeding taking place from late July through December. 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 and Eucalypts (Department of Environment and Conservation, 2012). Carnaby's Cockatoos are also known to feed on grubs as well as plant parts (Dell and Hyder, 2009).

There is a very limited foraging opportunities for Carnaby's Black-Cockatoo on-site. If it did forage it is unlikely to return frequently due to the lack of foraging resource. Clearing of the vegetation is unlikely to significantly impact on Carnaby's Black-Cockatoo (Terrestrial Ecosystems, 2016).

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)
The Forest Red-tailed Black Cockatoo is listed Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*. The Forest Red-tailed Black-Cockatoo frequents the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (Department of Sustainability Environment Water Population and Communities, 2011). It was mostly seen in the hill interior, but small numbers of birds were seen at Mundijong, Baldivis, Karnup, Stakehill, Pinjarra, Coolup and in the Lake Clifton area (Johnstone and Kirkby, 2011). In 2011, there was an increase in the number of Forest Red-tailed Black-Cockatoo on the coastal strip north from Rockingham to the northern metropolitan suburbs. The Forest Red-tailed Black-Cockatoo nests in tree hollows with a depth of 1-5m that are predominantly *C. calophylla, E. marginata* and *E. diversicolor*. The nest entrance is 12-41 cm, and similar to other black-cockatoos, it lays two eggs on wood chips in October and November, but most often only one survives. Incubation period is 29-31 days and only the female incubates and broods (Johnstone and Storr 1998). Johnstone and Kirkby (2011) reported the Forest Red-tailed Black-Cockatoo to feed mostly on seeds from *C. calophylla, E. marginata,* but also on *Allocasuarina fraseriana* (Sheoak), *Persoonia longifolia* (Snottygobble), *Eucalyptus patens* (Blackbutt) and introduced species such as *M. azedarach* (Cape Lilac) and *Corymbia citriodora* (Lemon-scented Gum).

There is very limited foraging habitat for Forest Red-tailed Black-Cockatoos on-site with the consequence that they are unlikely to be seen regularly foraging on-site, and if they do then they will move on quickly. Clearing of the vegetation is unlikely to significantly impact on Forest Red-tailed Black-Cockatoos.

Baudin's Black Cockatoo (*Calyptorhynchus baudinii*)
Baudin's Black-Cockatoo is listed as vulnerable under the *EPBC Act* and as Schedule 1 under the Western Australian *Wildlife Conservation Act* 1950. Baudin's Black Cockatoo occurs in high-rainfall areas, usually at sites that are heavily forested and dominated by *Corymbia calophylla* (Marri) and Eucalyptus species, especially *E. diversicolor* (Karri) and *E. marginata* (Jarrah). It is claimed that the range of the species during the non-breeding season is determined by the distribution of Marri, and that nesting is confined to areas in which Karri occurs (Saunders, 1974).

Baudin's Black-Cockatoo may infrequently be seen foraging in the vicinity of the site, but it is mostly seen on the Swan Coastal Plain much closer to the Darling Scarp. Clearing of the vegetation is unlikely to significantly impact on Baudin's Black-Cockatoo (Terrestrial Ecosystems, 2016).

Woylie (*Bettongia penicillata ogilbyi*)
The Woylie is listed as Critically Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*. Woylie numbers have significantly reduced in recent years after it was removed from the conservation significant species lists. The Woylie was once abundant in the south-west forest areas. Fox and cat predation, along with habitat destruction were thought to have significantly reduced its numbers (De Tores and Start, 2008). The Woylie diet consists of underground fungi, tubes, bulbs and seeds.

As Woylie have not been recorded in the vicinity of the site in recent years and were not seen during the site visit, they are therefore not present on-site (Terrestrial Ecosystems, 2016).

Rainbow Bee-eater (*Merops ornatus*)
The Rainbow Bee-eater is listed as a Migratory and a Marine species under the *EPBC Act* 1999, and a Schedule 3 species under the *Wildlife Conservation Act*. The Rainbow Bee-eater was rare around Perth during the 19th century, and was recorded only infrequently before the 1920s. However, the Rainbow Bee-eater had begun to visit Perth regularly and in larger numbers by the late 1970s, and it colonized Rottnest Island in 1977 (Department of the Environment, 2014). The Rainbow Bee-eater occurs mainly in open forests and woodlands, shrublands, cleared or semi-cleared habitats, including farmland and areas of human habitation (Higgins, 1999). It usually occurs in open, cleared or lightly-timbered areas that are often, but not always, located in close proximity to permanent water (Department of the Environment, 2014).

The Rainbow Bee-eater is likely to utilise bushland in the vicinity of the site (Terrestrial Ecosystems, 2016).

Chuditch (*Dasyurus geoffroii*)
The Chuditch (Western Quoll) is listed as Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*. 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.

Chuditch were not seen during the site visit and there is no suitable habitat found on-site. The Chuditch is not present on-site due to a lack of suitable habitat and there are no recent records in the vicinity (Terrestrial Ecosystems, 2016).

Southern Brush-tailed Phascogale (*Phascogale tapoatafa*)
The Southern Brush-tailed Phascogale is listed as Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*. Southern Brush-tailed Phascogales are arboreal marsupials which require tree hollows in suitable woodland or forest and rely on abundant invertebrate prey to sustain populations. They are rarely detected in vertebrate fauna surveys as they are arboreal and trap shy and are generally not found on the coastal plain south of the Swan River; there are no recent records for this Phascogale in the vicinity of the site.

The Southern Brush-tailed Phascogale was not seen during the site visit or caught during the Vivente trapping program and given the recent lack of records of this species in the vicinity of the site and a lack of suitable habitat on-site this would indicate that the Southern Brush-tailed Phascogale is not present on-site (Terrestrial Ecosystems, 2016).

Quokka (*Setonix brachyurus)*
The Quokka is listed as Vulnerable under the *EPBC Act* and as Schedule 2 under the *Wildlife Conservation Act* 1950. The present distribution of the Quokka includes two offshore islands, Rottnest and Bald Island, and a number of sites on the south-west Western Australian mainland, ranging from just south of Perth to the Hunter River and including Two Peoples Bay Nature Reserve, Torndirrup National Park, Mt Manypeaks National Park and Stirling Range National Park (Maxwell, Burbidge and Morris 1996).

The Western Ringtail Possum is not present on-site due to a lack of suitable habitat and there are no recent records in the vicinity of the site (Terrestrial Ecosystems, 2016).

Red-tailed Phascogale (*Phascogale calura*)
The Red-tailed Phascogale is listed as endangered under the *EPBC Act* and as Schedule 1 under the *Wildlife Conservation Act* 1950. Extant populations of the Red-tailed Phascogale are restricted to remnants of native vegetation throughout the wheatbelt of south-western Western Australia (Kitchener, 1981).

The Red-tailed Phascogale was not seen on-site during the survey or caught during the trapping program of the Vivente project area. Given the lack of recent records of this species in the vicinity of the site and a lack of suitable habitat, the Red-tailed Phascogale is not present on-site (Terrestrial Ecosystems, 2016).

Numbat (*Myrmecobius fasciatus*)
The Numbat is listed as Vulnerable under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*. 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).

The Numbat was not seen during the site visit nor caught during the trapping program of the Vivente project area and there are no recent records of this species in the general area. The Numbat is not present on-site (Terrestrial Ecosystems, 2016).

Malleefowl (*Leipoa ocellata*)
The Malleefowl is listed as Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*. Malleefowl are large, ground-dwelling birds that rarely fly unless alarmed or are perching for the night. Historically, Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards. Recently their range has contracted due to fox predation and land clearance and they have not been recorded in the Perth metropolitan area for many years. Malleefowl build distinctive nests that comprise a large mound of soil/rock covering a central core of leaf litter that can span more than five metres in diameter and may be up to one metre high. The presence of nest mounds provides an indication of the presence of Malleefowl in the area.

Malleefowl are not on-site and the proposed clearing on-site will not have a significant impact on this species (Terrestrial Ecosystems, 2016).

3.5 Bioregional Fauna Species

Appendix 2 provides a summary of the fauna survey data that are available in the vicinity of the site. The most relevant information to the site is the results of the trapping and fauna salvage program that conducted for the Vivente project area in September 2014. These results are shown in **Table 2**.

TABLE 2
VERTEBRATE FAUNA TRAPPED AT 'VIVENTE'

SPECIES	COMMON NAME	NUMBER
Mammals:		
Felis catus	Cat	1
Isoodon obesulus fusciventer	Southern Brown Bandicoot	11
Mus musculus	House Mouse	3
Trichosurus vulpechula	Brushtail Possum	1
Amphibians:		
Limnodynastes dorsalis	Western Banjo or Pobblebonk Frog	1
Litoria adelaidensis	Slender Tree Frog	16
Reptiles:		
Ctenotus australis	Western Limestone Ctenotus	1
Christinus marmoratus	Marbled Gecko	1
Cryptoblepharus buchananii	Buchanen's Snake-eyed Skink	23
Delma fraseri	Fraser's Delma	2
Hemiergis quadrilineata	Two-toed Earless Skink	5
Lialis burtonis	Burton's Legless Lizard	17
Menetia greyii	Common Dwarf Skink	1
Pletholax gracilis	Keeled Legless Lizard	1
Pogona minor	Bearded Dragon	3
Pseudonaja affinis	Dugite	3
Tiliqua rugose	Bobtail	62

3.6 Potential Pest Species

It is likely that the following introduced pest species are inhabiting the site: fox (*Vulpes vulpes*), European rabbit (*Oryctolagus cuniculus*), feral or semi-domestic cats (*Felis catus*), and the introduced rat (*Rattus rattus*) as indications of their presence have been found in other fauna surveys undertaken in the general area.

Fox population densities range from 0.2 – 12 adults/km^2 in some urban areas with adults having well defined home ranges with relatively stable borders with the size range averaging approximately 30 ha (Animal Pest Management Services, 2011). The fox is an opportunistic predator and scavenger and has been recognised as a serious threat to Australian native fauna.

Rabbits are mostly nocturnal grazers preferring green grass and herbs thereby preventing regeneration by eating seeds and seedlings contributing to the decline in numbers of many native plants and animals (Department of Sustainability, Environment, Water, Population and Communities, 2011).

Feral cats are nocturnal hunters capable of killing prey up to their own body size. Home ranges of between 1-10 km^2 may be extended during times of food shortage. Feral cats have been implicated in the decline of numerous Australian terrestrial vertebrates and are thought to have contributed to the extinction of a number of small to medium sized ground-dwelling mammals and ground-nesting birds in arid Australia (Animal Pest Management Services, 2011).

Feral predators such as foxes and cats have the potential therefore to be concentrated in remnant bushland areas and to have an adverse impact on the abundance and native fauna species occurring within the site through predation. Rabbits can also have an adverse impact on the vegetation due to foraging activities.

4. MANAGEMENT ACTIONS, IMPLEMENTATION TIMING, RESPONSIBILITY AND REPORTING

4.1 Pre-clearing Trapping and Relocation

A fauna specialist will be commissioned by Gold Estates to undertake the pre-clearing vertebrate fauna trapping and relocation program for the site.

All personnel involved in the pre-clearing fauna trapping and relocation program will be professionals trained and experienced in fauna trapping, handling and release. At least one fauna specialist on-site will be trained and experienced in the identification, capture and safe handling of venomous snakes.

All fauna trapping and relocation conducted under this Plan will be undertaken in accordance with the Regulation 15 licence issued by the DPaW to the fauna specialist prior to clearing commencing.

4.2 Capture and Relocation Strategies

Prior to vegetation clearing commencing, the fauna specialist will undertake a trapping program on-site.

Southern Brown Bandicoot and other small iconic species:
Baited cage traps will be used to capture Southern Brown Bandicoot and other trappable native fauna for relocation (e.g. Bobtails, Brushtail possums). These traps will be located in areas where signs of Southern Brown Bandicoot and/or other native fauna activity are visible and in appropriate habitat types. The traps will be checked within four hours of sunrise every morning. The trapping program will be carried out for a minimum of five nights before clearing commences and be implemented within two weeks immediately prior to the planned vegetation clearing program commencing. The trapping program will be continued beyond the five nights if native animals are still being caught on the 5th day of trapping. If common native species (Bobtails, Brushtail Possums and Western Bearded Dragon) are still being caught the trapping program will be extended for an extra two nights. If the Southern Brown Bandicoot are still being caught the trapping will continue until there are two nights of trapping without capture of Southern Brown Bandicoot.

Animals captured in the traps will be temporarily held in calico or hessian bags and transported to the relocation sites that have been determined by the DPaW's Nature Protection Branch. All captured native animals (unless injured) will be released on the day of capture to the relocation site detailed on the Regulation 15 Licence.

Avifauna and habitat trees:
Concurrent with the trapping program, the will undertake a broad scale search of the site inspecting the significant habitat trees identified in Table 3 of **Appendix 2** and searching for the nests of Bush Birds that may be nesting in trees, shrubs and dense vegetation that were not previously identified as part of the significant habitat tree survey. Potential nests will be inspected from the ground to determine if there is any bird nesting activity.

Active nests will be identified and located using GPS. Unless there is obvious nesting activity this assessment will only be conducted from the ground. In the event that it is assessed that a nest is present, the tree will be gently bumped and shaken and then lowered to the ground as slowly as possible in order to retrieve the young birds. This method is similar to that approved by the DPaW for retrieving the Western Ringtail Possum and considered suitable for birds and chicks.

Any chicks of non-conservation significant species found during the vegetation clearing program will be removed and delivered to a DPaW registered wildlife carer for rehabilitation and subsequent release. If eggs are found and are determined by the fauna specialist to be viable, then they will be removed and transferred to a DPaW registered wildlife carer.

4.3 Other Vertebrate Fauna

The site is likely to support a depleted range of vertebrate fauna typically found on the Swan Coastal Plain. This will include some small reptiles, amphibians and mammals as shown in **Table 2**. It is inevitable that some of these will be lost during the vegetation clearing process.

The commonly seen Bobtail (*Tiliqua rugosa*) and Western Bearded Dragon (*Pogona minor*) are examples of fauna commonly caught and translocated during pre-clearing activities and will likely be caught in the same traps as Southern Brown Bandicoot. This occurs repeatedly on the Swan Coastal Plain using the same trapping protocol. Traps are left open during the day which enables Bobtails to be caught. Traps will be covered with hessian and cleared within four (4) hours of sunrise. All captured animals will be placed in hessian or calico bags and released on the same day into the same release sites.

A one-day targeted systematic active search of the site will be undertaken by a fauna specialist using standard hand foraging techniques including raking leaf litter, digging out holes, peeling back bark, and turning rocks and logs. All fauna captured will go into the same release sites. If a high number of reptiles is found (>90), the search will continue beyond the time allocated.

Reptiles will only be relocated prior to 3pm to ensure a sufficient period of daylight hours for the individual to continue foraging and find a suitable refuge before nightfall. If this timeframe cannot be achieved, reptiles will be held overnight in a calico bag and released the following morning.

4.4 Management of Venomous Snakes

Venomous snakes must only be handled by a trained and experienced fauna specialist and all necessary precautions (tools, protective clothing, etc.) will be taken to avoid snakebite. Under no circumstances should vegetation clearing or construction contractors handle any snakes found on-site. In the event that a snake is observed by a contractor, the fauna specialist should be contacted so that the animal can be safely removed from the site.

4.5 Management of Introduced or Feral Animals

Any introduced or feral animals (e.g. rabbits, foxes, feral cats) captured during the trapping and relocation program will be euthanized. Any domesticated cats located on-site will be taken to the Cat Haven for assessment. The Cat Haven endeavours to return cats to their owner (if they can be traced), re-homed or as a last resort euthanized.

4.6 Clearing Process

Assuming all planning and engineering approvals have been granted, the site will be totally cleared by earthmoving machinery over the course of approximately three days in October 2016.

Prior to clearing commencing the following will be implemented:

1. **Temporary fencing** will be installed along the Barfield Road site boundary to prevent fauna from moving onto the road.

2. **Wildlife crossing signage** will be erected along Barfield Road for the duration of the vegetation clearing program in order to alert motorists to this potential hazard.

3. **Induction program** will be conducted by the fauna specialist to all staff involved in the clearing process. The induction will include information pertaining to fauna management issues such as:

   - The importance of fauna and fauna habitats found on-site;
   - An appropriate clearing technique to minimise the possibility that fauna are injured or killed;
   - Retention of remnant vegetation outside of the clearing area (including a site walkover to ensure the high visibility flagging is in place);
   - Fauna protection and relocation to nearby native vegetation; and
   - Procedures to be implemented for encounters with injured fauna.

The fauna specialist will remain on-site throughout the vegetation clearing process in order to catch and relocate animals that flee from the vegetation clearing to reduce the number of animals that are lost during clearing.

The clearing will preferably be undertaken in an easterly direction so that fauna can escape into the adjoining powerline easement.

A bulldozer will be used to push over and pile up the vegetation with the vegetative debris being mulched and windrowed for later use in landscaping or disposal off-site. Following clearing, scrapers will be used to strip the topsoil, which will be mounded prior to being used in landscaping.

4.7 Injured Fauna

Large vertebrate fauna that are injured during the vegetation clearing process that are assessed by the fauna specialistof having a good chance of being satisfactorily rehabilitated will be delivered to a DPaW registered wildlife carer. The DPaW's Wild Care 24hr hotline number is (08) 9474 9055. Native Arc is a registered wildlife carer in Bibra Lake and is the closest to the site. Native Arc's contact details are 9417 7105 or 0432 483 414.

In the event that injured fauna are required to be transferred to a DPaW approved wildlife carer/centre, then **all** clearing activities will cease until the fauna specialist returns to the site.

Any fauna injured during the clearing process that are assessed as having little possibility of being satisfactorily rehabilitated and released will be humanely euthanized.

The assessment as to whether to euthanize will be made by the fauna specialist on-site. Euthanasia will be conducted according to euthanasia procedures which are based on ANZCCART recommendations. The methods include blunt force trauma to the brain case, cervical dislocation followed by blunt force trauma and/or pithing to destroy the brain case or lethal injection. The actual method used will depend upon the species that is injured and numerous other variables at the time. For reptiles, cervical

dislocation followed by blunt force trauma and/or pithing to destroy the brain case will be used while for birds and mammals blunt force trauma to the brain case is the likely method.

4.8 Implementation of Management Strategies

The specific management actions that are to be implemented on-site both before and during the clearing process and related performance indicators and responsibility are detailed in **Table 3** (over the page).

4.9 Reporting

All fauna trapping and relocation conducted under this plan will be undertaken in accordance with a Regulation 15 Licence issued by the DPaW. The Licence conditions generally require that the fauna specialist provide a '*Returns Report*' to the DPaW within 28 business days of clearing activities being substantially completed or the completion of all fauna relocation activities, whichever comes first.

In addition to providing the '*Returns Report*' to DPaW, the fauna specialist will provide a summary report to the client for submission to the City of Cockburn within 28 business days of all fauna relocation activities being completed.

4.10 Community Advice

Occasionally members of the local community will ask questions or express concern about the loss of vertebrate fauna during the vegetation clearing process. Some of these concerns can be alleviated if an explanation is provided about the measures and actions that have been implemented to minimise the lost and injury to fauna. It is also possible that a member of the public will request to see the DPaW Licence that has been approved for capture and relocation of vertebrate fauna.

The fauna specialist present on-site during the vegetation clearing process will be familiar with this Plan and will be available to answer any questions that members of the public might have about the process.

The DPaW Licence will be carried by the fauna specialist while working on-site and will be available for inspection if requested by a member of the public.

TABLE 3
MANAGEMENT ACTIONS, PERFORMANCE INDICATORS, TIMING AND RESPONSIBILITY

MANAGEMENT ACTION	PERFORMANCE INDICATOR	TIMING	RESPONSIBILITY
All fauna trapping and relocation under this Plan will be undertaken in accordance with the Regulation 15 Licence issued by the DPaW to the fauna specialist.	DPaW Regulation 15 Licence issued to Specialist Contractor (fauna specialist)	Pre-commencement of targeted trapping program (i.e. at least 2 weeks prior to vegetation clearing program commencing).	Specialist Contractor (fauna specialist)
A targeted trapping program will be implemented to capture and relocate Southern Brown Bandicoots, other small mammals and reptiles potentially inhabiting the site. The program will be implemented within the 2 weeks prior to the vegetation clearing program commencing. If a high number of reptiles are found (>90) the search will continue beyond the time allocated trapping time. In keeping with the requirements of the Regulation 15 Licence issued by the DPaW Nature Protection Branch to the fauna specialist, trapped fauna will be relocated the a DPaW approved site.	A minimum of 5 nights of trapping implemented. The trapping program will be continued beyond the 5 nights if native animals are still being caught on the 5th day of trapping. If common native species (Bobtails, Brushtail Possums and Western Bearded Dragon) are still being caught the trapping program will be extended for an extra 2 nights. If Southern Brown Bandicoots are still being caught the trapping will continue until there are 2 nights of trapping without capture of Southern Brown Bandicoot.	Trapping program to be implemented within the 2 weeks prior to the vegetation clearing program commencing.	Specialist Contractor (fauna specialist)
A fauna specialist will complete a one-day targeted systematic search of the site to capture fauna. The fauna specialist will use standard hand foraging techniques including raking leaf litter, digging out holes, peeling back bark, and turning rocks and logs.	Fauna specialist present on-site and field records of catches retained for inclusion in final report.	Within the 2 weeks prior to the vegetation clearing program commencing.	Specialist Contractor (fauna specialist)
Active nests (both conservation significant and non-conservation significant bird species) will be identified and located using GPS during the pre-clearing trapping program. Unless there is obvious nesting activity, this assessment will only be conducted from the ground during. Where trees with active nests are to be felled, the fauna specialist will undertake a visual inspection of the nests prior to felling in order to remove any chicks/eggs. Any chicks removed will be taken to a DPaW registered wildlife carer. If eggs are found and are determined by the fauna specialist to be viable, then they will be removed and transferred to a DPaW registered wildlife carer.	File notes provided to Client and Contractor if requested.	Duration of vegetation clearing program.	Specialist Contractor (fauna specialist)
Prior to clearing commencing, temporary fencing will be installed along the Barfield Road site boundary to prevent kangaroos from entering the roadway during the clearing process.	The civil contractor will install temporary fencing along the Barfield Road site boundary.	Prior to clearing commencing.	Civil Contractor

MANAGEMENT ACTION	PERFORMANCE INDICATOR	TIMING	RESPONSIBILITY
Prior to clearing commencing, wildlife crossing signage will be erected along each Barfield Road alerting motorists to the potential hazard. The signage will remain in place for the duration of the clearing program.	Wildlife crossing signage erected along Barfield Road will be in place for the duration of the clearing program.	Prior to clearing commencing.	Civil Contractor
Prior to vegetation clearing commencing, the Clearing Contractor will be provided with a brief induction by the fauna specialist. The induction will include information pertaining to fauna management issues such as: - The importance of fauna and fauna habitats found on-site; - An appropriate clearing technique to minimise the possibility that fauna are injured or killed; - Retention of remnant vegetation outside of the clearing area (including a site walkover to ensure the high visibility flagging is in place); - Fauna protection and relocation to nearby native vegetation; and - Procedures to be implemented for encounters with injured fauna.	Record of attendance at induction by Clearing Contractor.	On the first day of vegetation clearing immediately prior to clearing commencing.	Specialist contractor (fauna specialist) Clearing Contractor
A raised blade clearing technique will be used in the initial phase of the vegetation clearing program to minimise the number of small vertebrate fauna that are killed or injured.	Majority of topsoil remains intact during the first phase of vegetation clearing.	During initial vegetation clearing program.	Clearing Contractor
Vegetation clearing will be conducted from **west** - **east** to enable fauna to naturally move towards adjacent offsite bushland areas in the adjacent powerline easement.	Nil death/injury to fauna.	Duration of vegetation clearing program.	Construction Contractor Specialist Contractor (fauna specialist)
The fauna specialist will remain on-site throughout the vegetation clearing program and will be available to answer any queries that members of the public may have about the protection of vertebrate fauna during the vegetation clearing program.	File notes provided to Client and Contractor if requested.	Duration of vegetation clearing program.	Specialist Contractor (fauna specialist)
Native fauna injured during vegetation clearing and capable of being rehabilitated will be taken to a DPaW registered wildlife carer (DPaW's Wild Care 24hr hotline (08) 9474 9055).	Poster with nearest DPaW Wildlife Carers contact details is in the crib room.	Duration of vegetation clearing program.	Specialist Contractor (fauna specialist)

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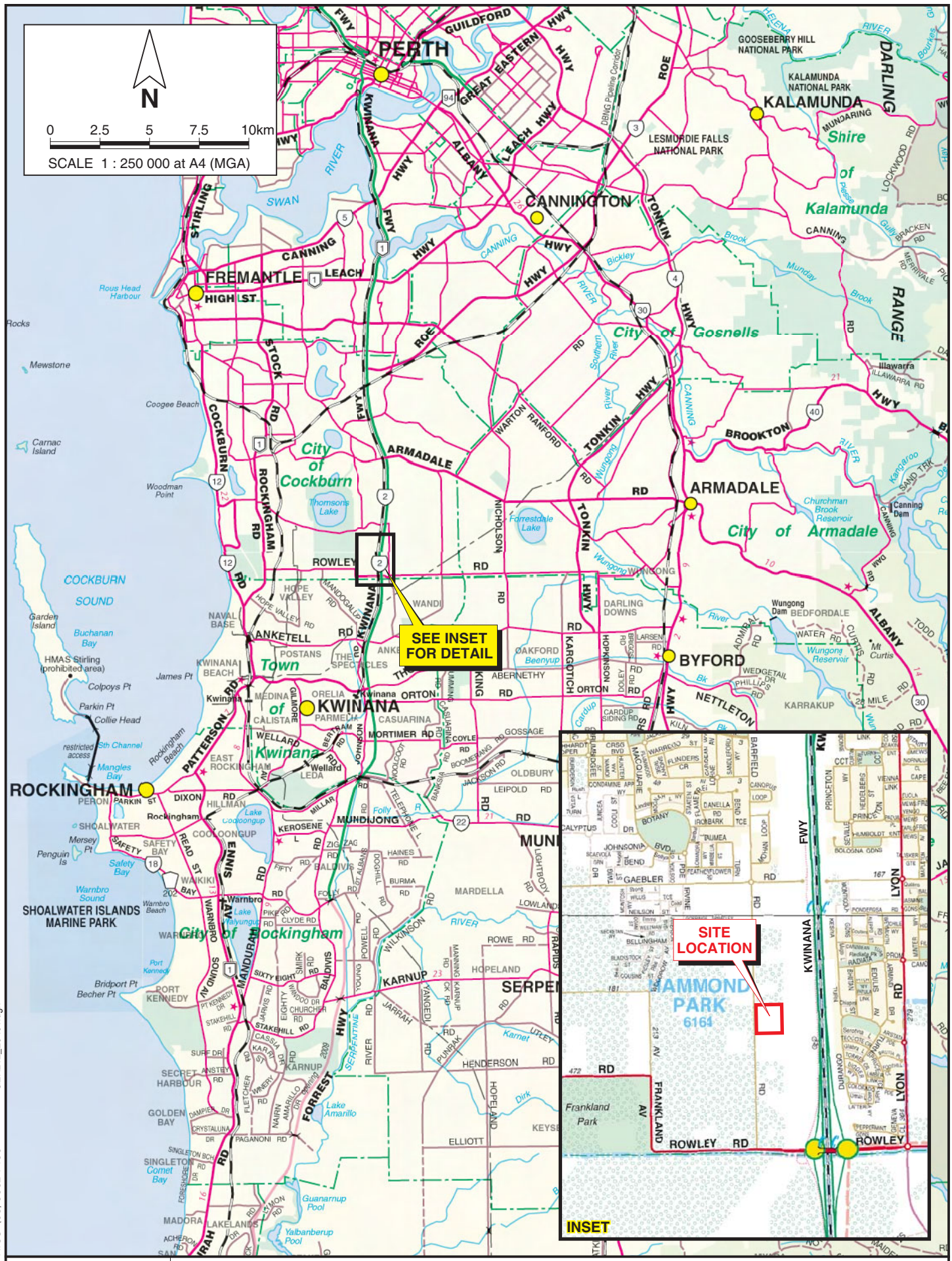
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FIGURES

FAUNA MANAGEMENT AND RELOCATION PLAN
LOT 15 BARFIELD ROAD, HAMMOND PARK



PINPOINT CARTOGRAPHICS (08) 9562 7136 GEH212_20-f01.dgn

EndPlan Environmental

Gold Estates Holdings Pty Ltd
FAUNA MANAGEMENT AND RELOCATION PLAN
LOT 15 BARFIELD ROAD, HAMMOND PARK

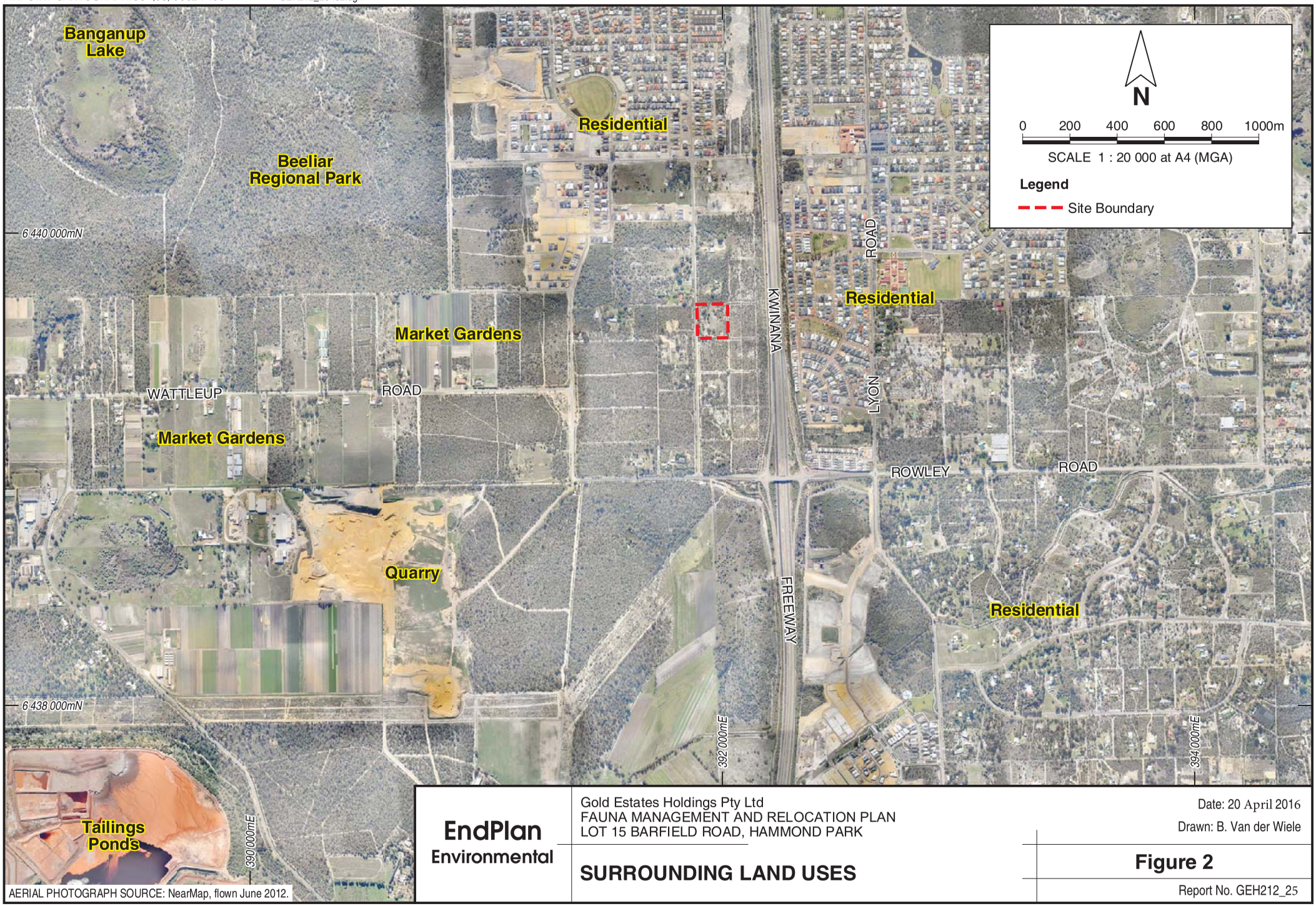
REGIONAL LOCATION

Date: 20 April 2016
Drawn: B. Van der Wiele

Figure 1

Report No. GEH212_25

PINPOINT CARTOGRAPHICS (08) 9562 7136 GEH212_20-f02.dgn



AERIAL PHOTOGRAPH SOURCE: NearMap, flown June 2012.

EndPlan Environmental

Gold Estates Holdings Pty Ltd
FAUNA MANAGEMENT AND RELOCATION PLAN
LOT 15 BARFIELD ROAD, HAMMOND PARK

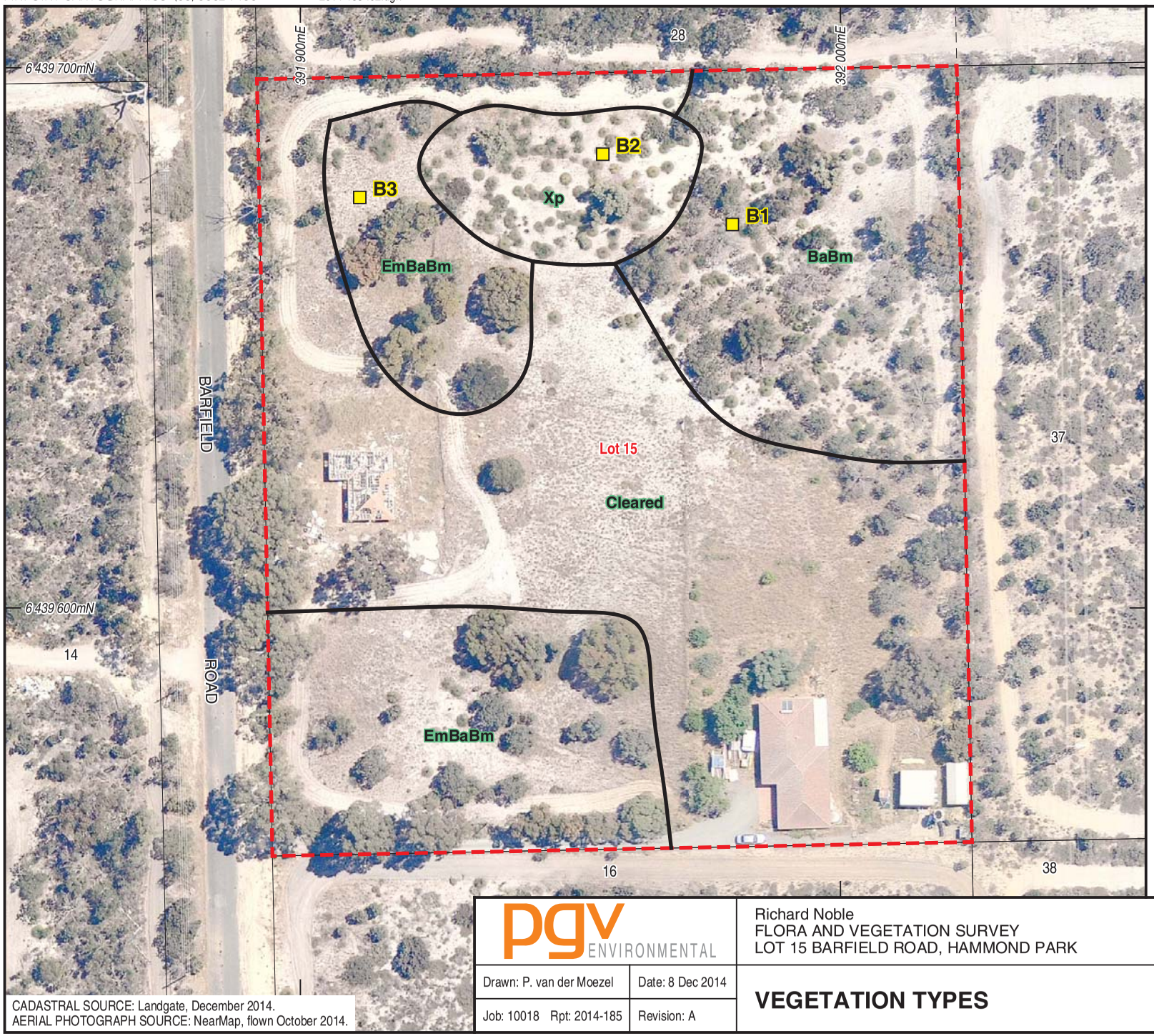
SURROUNDING LAND USES

Date: 20 April 2016
Drawn: B. Van der Wiele

Figure 2

Report No. GEH212_25

PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-185-f02.dgn



N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A4 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Quadrat Location
- Vegetation Type Boundary
- Xp Vegetation Type

Vegetation Types

BmBa *Banksia attenuata/B. menziesii* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland

Xp *Xanthorrhoea preissii* Open Shrubland

Em *Eucalyptus marginata/ Banksia attenuata/B. menziesii* Low Woodland over weeds

CADASTRAL SOURCE: Landgate, December 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2014.

pgv ENVIRONMENTAL

Richard Noble
FLORA AND VEGETATION SURVEY
LOT 15 BARFIELD ROAD, HAMMOND PARK

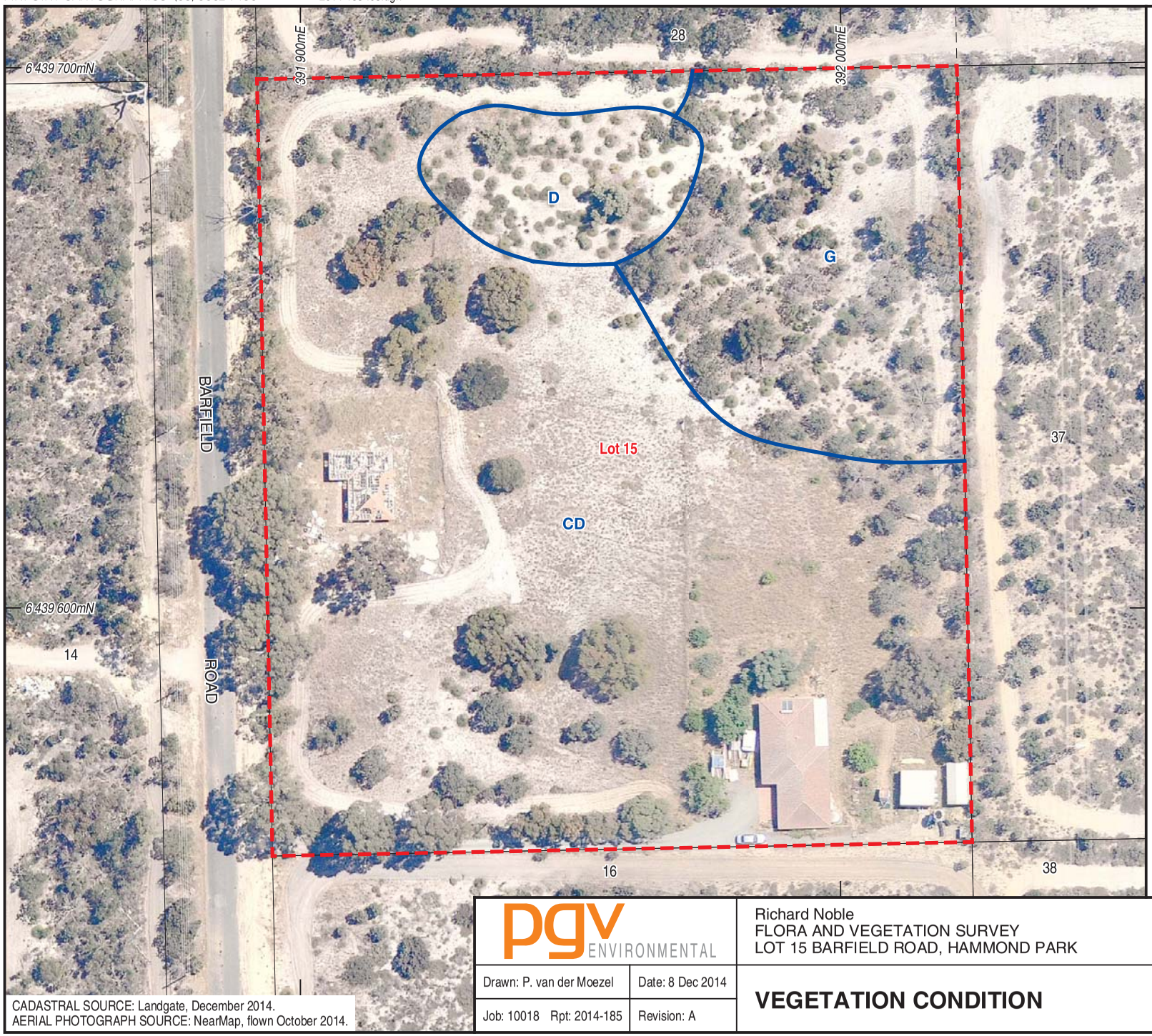
Drawn: P. van der Moezel | Date: 8 Dec 2014

Job: 10018 Rpt: 2014-185 | Revision: A

VEGETATION TYPES

Figure 3

PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-185-f03.dgn



N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A4 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Vegetation Condition Boundary
- G Vegetation Condition

Vegetation Condition
(SOURCE: Bush Forever, Govt. of W.A., 2000)

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 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.

Cl - Cleared
No native vegetation remaining.

CADASTRAL SOURCE: Landgate, December 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2014.

pgv ENVIRONMENTAL

Richard Noble
FLORA AND VEGETATION SURVEY
LOT 15 BARFIELD ROAD, HAMMOND PARK

Drawn: P. van der Moezel	Date: 8 Dec 2014
Job: 10018 Rpt: 2014-185	Revision: A

VEGETATION CONDITION

Figure 4

APPENDICES

FAUNA MANAGEMENT AND RELOCATION PLAN
LOT 15 BARFIELD ROAD, HAMMOND PARK

APPENDIX 1

FLORA AND VEGETATION SURVEY REPORT
(Source: PGV Environmental, 2014)

LOT 15 BARFIELD ROAD, HAMMOND PARK

FLORA AND VEGETATION SURVEY

Prepared for:	Richard Noble
Report Date:	9 December 2014
Version:	1
Report No.	2014-185

pgv ENVIRONMENTAL

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Figure 2: Vegetation Types

Figure 3: Vegetation Condition

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Appendix 1: DPaW Database Searches

Appendix 2: Species List

Appendix 3: Quadrat Data

1. INTRODUCTION

1.1 Purpose

The owners of Lot 15 Barfield Road, Hammond Park (the site), Richard Noble, plan to develop the site for residential purposes in accordance with its zoning. The site is approximately 1.8ha in size and located in the City of Cockburn, approximately 24km south of the Perth CBD.

The site has previously been cleared and contained two houses, one of which is no longer occupied. Native vegetation has regenerated on the site in some areas. As a result, Richard Noble commissioned PGV Environmental to undertake a Level 2 spring flora and vegetation survey of the site.

1.2 Scope of Works

The Level 2 Spring Flora and Vegetation Survey was undertaken in accordance with Guidance Statement 51: *Terrestrial Flora and Vegetation Surveys for Environmental Impact Assessment in Western Australia* (EPA, 2004) and included the following:

- Desktop search and review of DPaW's Declared Rare and Priority Flora database and Threatened Ecological Communities database;
- Examination of recent aerial photography and contour maps to provisionally identify vegetation types and condition;
- Field survey in spring using quadrats to record native and introduced species as well as a thorough site walkover of any areas of native vegetation;
- Recording of any significant plant species using a hand-held GPS;
- Description and mapping of vegetation types and vegetation condition; and
- Compilation of a flora list.

2. EXISTING ENVIRONMENT

2.1 Land Use

The site has previously been cleared as evidence by the 1974 aerial photograph (Landgate, 2014) (Plate 1). The site regenerated to some extent until houses were constructed firstly in the south-east corner in the early 1980s and then along Barfield Road in the 1990s. Only the house in the south-east corner is currently occupied.

Plate 1. 1974 Historic Aerial Photograph



2.2 Topography

The site slopes gently from a high of around 35m AHD in the south-east corner down to 28m AHD in the flatter north-west part (DAFWA, 2014).

2.3 Geology and Soils

The site is located on the Swan Coastal Plain on the Bassendean Dune System.

One soil unit is located on the site as follows (DAFWA, 2014):

- Bassendean B1 Phase (212Bs_B1) consisting of extremely low to very low relief dunes, undulating sandplain and discrete sand rises. Deep bleached grey sands sometimes with a pale yellow B horizon or a weak iron-organic hardpan at depths generally greater than 2m.

2.4 Hydrology

The Perth Groundwater Atlas indicates that groundwater under the site in May 2003 was around 21m AHD and flowing in a westerly direction. The historical maximum groundwater was around 23m AHD. The depth to the historic maximum watertable ranges from 5-12m under the site.

2.5 Wetlands

There are no wetlands located on the site as mapped in the *Geomorphic Wetlands of the Swan Coastal Plain* Database (Landgate, 2014). The site investigations for the flora and vegetation survey confirmed the absence of wetlands on the site.

3. FLORA AND VEGETATION

3.1 Methodology

A flora and vegetation survey of the site was conducted by Dr Paul van der Moezel on 26 September2014. The survey included sampling from three non-permanent 10m x 10m quadrats as well as a thorough walk through the site. Site coverage was high due to the very small site, and high degree of disturbance enabling easy access on foot through the understorey.

3.2 Desktop Searches

A search of the Department of Parks and Wildlife's (DPaW's) Threatened Flora Database, the WA Herbarium database and the Declared Rare and Priority Flora Species List (Appendix 1) identified four Threatened (Declared Rare) plant species that have been recorded within 5km of the site (Appendix 1). A further 11 Priority listed species were also recorded.

Table 1: List of Flora Species Identified from Database Searches within 5km of the Site.

Species	Common Name	Status Under Wildlife Conservation Act 1950	Status Under EPBC Act 1999
Caladenia huegelii	Grand Spider Orchid	Threatened	Endangered
Diuris micrantha	Dwarf Bee-orchid	Threatened	Vulnerable
Drakaea elastica	Glossy-leaved Hammer Orchid	Threatened	Endangered
Lepidosperma rostratum	Beaked Lepidosperma	Threatened	Endangered
Eremaea asterocarpa subsp. *brachyclada*		Priority 1	
Cyathochaeta teretifolia		Priority 3	
Eryngium pinnatifidum subsp. *palustre*		Priority 3	
Jacksonia gracillima		Priority 3	
Pimelea calcicola		Priority 3	
Stylidium paludicola		Priority 3	
Dodonaea hackettiana	Hackett's Hopbush	Priority 4	
Ornduffia submersa		Priority 4	
Thysanotus glaucus		Priority 4	
Tripterococcus paniculatus		Priority 4	
Verticordia lindleyi subsp. lindleyi		Priority 4	

The likelihood of each species occurring on the site is discussed in Table 2. One Threatened and four Priority species could potentially occur in the sandy soils on the site.

Table 2: Likelihood of Identified Significant Flora Species occurring on the Site

Scientific Name	Preferred Habitat	Likelihood of Presence on site
Caladenia huegelii	Sand or clay loam. Does not survive in disturbed areas.	Possible
Diuris micrantha	Brown loamy clay. Winter-wet swamps, in shallow water	No
Drakaea elastica	Low-lying situations adjoining winter-wet swamps. Does not survive in disturbed areas	No
Lepidosperma rostratum	Peaty and clay soils	No
Eremaea asterocarpa subsp. *brachyclada*	Deep grey sand	Possible
Cyathochaeta teretifolia	Grey sand, sandy clay. Swamps, creek edges	No
Eryngium pinnatifidum subsp. *palustre*	Winter-wet areas	No
Jacksonia gracillima	Grey and brown well-drained sand	Possible
Pimelea calcicola	Sand. Coastal limestone ridges	Unlikely
Stylidium paludicola	Swampy areas	No
Dodonaea hackettiana	Sand. Outcropping limestone	Possible
Ornduffia submersa	Wetland areas	No
Thysanotus glaucus	White, grey or yellow sand, sandy gravel	Possible
Tripterococcus paniculatus	Grey, black or peaty sand. Winter-wet flats	No
Verticordia lindleyi subsp. lindleyi	Grey, black or peaty sand. Winter-wet depressions	No

*sourced from Florabase (DPaW, 2014b)

A search of the DPaW Threatened and Priority Ecological Community database identified one Threatened and three Priority Ecological Communities have been recorded within 5km of the site as follows:

- SCP 26a - Melaleuca huegelii - Melaleuca acerosa (currently M. systena) shrublands on limestone ridges (Threatened – Endangered)
- SCP 24 - Northern Spearwood shrublands and woodlands (Priority 3)
- SCP 21c - Low lying Banksia attenuata woodlands or shrublands (Priority 3)
- SCP 22 – Banksia ilicifolia woodlands (Priority 3)

3.3 Survey Conditions

The conditions that the survey was undertaken in are presented in Table 4 in order to assess the adequacy of the survey. In summary, there were no constraints to the survey.

Table 4: Statement of Botanical Survey Conditions

ISSUE	CONSTRAINTS (YES/NO); SIGNIFICANT, MODERATE OR NEGLIGIBLE	COMMENT
Competency/experience of the consultant conducting the survey	No constraints	Dr Paul van der Moezel has extensive survey experience on the Swan Coastal Plain.
Proportion of the flora identified	No constraints	The timing of the survey in early October should have identified most of the native species on the site.
Sources of information (historic/recent or new data)	No constraints	The flora of the Swan Coastal Plain is relatively well documented.
Proportion of the task achieved and further work that may need to be undertaken	No constraints	No follow-up survey required.
Timing/weather/season/cycle	No constraints	Generally slightly below average rainfall in winter 2014. Late September survey ideal for identifying rare orchids and maximising flowering of most species.
Intensity of survey (e.g. In retrospect was the intensity adequate)	No constraints	The open understorey made access and coverage easy. Approximately 4 hours spent on site.
Completeness (e.g. was relevant area fully surveyed)	No constraints	
Resources (e.g. degree of expertise available for plant identification)	No constraints	Experienced botanist undertook plant identifications on site.
Remoteness and/or access problems	No constraints	Easily accessible sites traversed entirely on foot.
Availability of contextual (e.g. bioregional) information for the study area.	No constraints	Heddle *et al.* (1980), Government of Western Australia (2000), Gibson *et al*. (1994).

Fungi and nonvascular flora (e.g. algae, mosses and liverworts) were not specifically surveyed for during the survey.

3.4 Results

3.4.1 Flora

A combined total of 62 species were recorded from the site (Appendix 2). The total included 43 native and 19 (31%) introduced species. The low number of native species, even for a small 1.8ha site, and the high percentage of introduced species reflects the high degree of disturbance to the native vegetation on the site.

The highest number of species recorded in the three quadrats was 26 in the Banksia woodland in Good condition in the north-east corner (Appendix 3). The other two quadrats recorded contained

vegetation in Degraded to Completely Degraded condition and had species richness numbers of 8 and 16 with a high proportion of introduced species.

None of the species recorded is a Threatened (Declared Rare) or Priority listed species. The survey was undertaken at a time when the Threatened orchid species *Caladenia huegelii* would have been flowering.

3.4.2 Vegetation

Vegetation Complexes

The vegetation belongs to the Bassendean – Central and South vegetation complex as mapped by Heddle *et al*. (1980).

Vegetation Types

Three vegetation types were mapped (Figure 3) and described for the site based on the structure and composition of the dominant layers.

BmBa ***Banksia attenuata/B. menziesii* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland**

This vegetation type occurred in the north-east corner of the site. The Banksia trees were up to 4m high and in low densities. *Xanthorrhoea preissii* was the most dominant native understorey species at around 1m high and 10% cover. All other native species had very low coverage. *Gladiolus caryophyllaceus, Ursinia anthemoides* and Flat Weed (*Hypochaeris glabra*) were the most prevalent weed species. The soil was grey-brown sand. Quadrat B1 is representative of this vegetation type.

Xp ***Xanthorrhoea preissii* Open Shrubland**

A small section of *Xanthorrhoea preissii* shrubland occurred in the north central part of the site. The *Xanthorrhoea* shrubs were up to 1.2m high and 20% density. Very few native species were recorded in this vegetation type and no trees except several WA Christmas Trees (*Nuytsia floribunda*). Presumably the Banksia and possibly Jarrah trees that occurred previously in this area did not regenerate after clearing in the early 1970s. Introduced species were common, particularly *Ursinia anthemoides,* Veltdgrass (*Ehrharta longiflora*) and Flat Weed. The soil was grey sand. Quadrat B2 is representative of this vegetation type.

Em ***Eucalyptus marginata/ Banksia attenuata/B. menziesii* Low Woodland over weeds**

Two stands of this vegetation type occurred, one in the north-west corner and the other in the south-west corner. Jarrah (*Eucalyptus marginata*) was the most common tree species up to 6m high and varying in density while *Banksia attenuata* and *B. menziesii* also occurred but in very low numbers. Few native understorey species were present while introduced species such as Veldtgrass and Ursinia were common. The soil was light grey sand. Quadrat B3 is representative of this vegetation type.

Floristic Community Types

Floristic Community Types (FCT) are based on the whole floristic composition of the vegetation rather than being determined by soil type and geomorphology (Vegetation Complex) or the nature of the dominant species (Vegetation Types). The FCT level of vegetation is required to identify whether any of the vegetation on the site is a Threatened or Priority Ecological Community.

Most of the vegetation on the site is too degraded to assign a FCT.

Analysis of the FCT for the Banksia woodland quadrat B1 was undertaken by comparing the species in each quadrat to the species-Community type table 12 in Gibson *et al*. (1994). The analysis produced a strong correlation for the Banksia woodland vegetation with FCT 28 'Spearwood *Banksia attenuata* woodlands or *Banksia attenuata* – *Eucalyptus* woodland' with high similarities to FCT 21a 'Central *Banksia attenuata* – *Eucalyptus marginata* woodlands' and 23a 'Central *Banksia attenuata* – *B. menziesii* woodlands'. FCT 28, however, occurs on Spearwood sands on Cottesloe and Karrakatta soil types and was not recorded by Gibson *et al.* (1994) on Bassendean Sands. The vegetation is therefore most likely to be FCT21a which occurs on Bassendean soil types. While FCT23a also occurs on Bassendean Soils this FCT rarely contain Jarrah (*Eucalyptus marginata*) which is common on the site.

As a comparison, Bayley Environmental Services (2011) considered the regrowth Banksia woodland on Lots 42-44 Frankland Avenue, Hammond Park was either FCT 21a or 23a. Coffey Environments (2008) considered that the Banksia woodland on Lot 46 Frankland Avenue, Hammond Park was likely to be FCT 23a. PGV Environmental (2011) considered the Banksia woodland on Lot 3 Norkett Road, Mandogalup was most likely to be FCT21a. All three sites are within 2km of Lot 15.

3.4.3 Vegetation Condition

The vegetation condition over the site was assessed using the condition scale adopted in Bush Forever (Table 6). The native vegetation on most of the site is either Completely Degraded or Degraded with remnant trees or shrubs in a weed dominated understorey. The Banksia woodland vegetation in the north-east corner was considered to be in Good condition as the understorey contained a reasonable number of native plant species and life forms (shrubs, herbs, orchids, sedges) but was partially cleared and contained an abundance of aggressive weeds.

No presence of dieback was noted.

Table 6. Vegetation Condition Rating Scale.

Condition	Description
Pristine	Pristine or nearly so, no obvious signs of disturbance.
Excellent	Vegetation structure intact, disturbance affecting individual species and weeds are non-aggressive species.
Very Good	Vegetation structure altered, obvious signs of disturbance. For example, disturbance to vegetation structure caused by repeated fires, the presence of some more aggressive weeds, dieback, logging and grazing.

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

Source: Government of Western Australia, 2000.

3.4.4 Conservation Significance of Flora and Vegetation

Flora

None of the species recorded is a Threatened (Declared Rare) or Priority listed species or is listed in Bush Forever as a significant species.

Vegetation

The vegetation on most of the site is considered too degraded to have values for protection of vegetation.

The small area of Good condition Banksia woodland in the north-east corner of the site is considered to be representative of the Bassendean - Central and South Vegetation Complex as well as Floristic Community Type 21a.

The current extent of the Bassendean - Central and South Vegetation Complex remaining in the Swan Coastal Plain portion of the Perth Metropolitan Region is 10,919ha (24% of the original extent) of which 5,883ha or 13% has some existing or proposed protection. These percentages are above the Bush Forever targets of protecting at least 400ha or 10% of each vegetation complex in the Perth Metropolitan Region.

FCT21a occurs in the central part of the Swan Coastal Plain from Perth to Capel and is considered well reserved and a low conservation risk (Gibson *et al.* 1994). Accordingly FCT21a is not a Threatened or Priority Ecological Community.

Vegetation from the Bassendean-Central and South Vegetation Complex and FCT21a is protected in the nearby Bush Forever site 392 'Harry Waring Marsupial Reserve' (271.6ha including open water) located 1km west of Lot 15.

The vegetation on the site does not form any part of a local or regional linkage and has very limited values for fauna.

4. CONCLUSIONS AND SUMMARY

The Level 2 Flora and Vegetation Survey of Lot 15 Barfield Rod, Hammond resulted in the following findings:

- A total of 62 plant species including 43 native and 19 introduced species was recorded from the site. The low total of native species and high percentage of introduced species (31%) is indicative of not only small size of the site but the high degree of disturbance;
- No Threatened (Declared Rare) flora were recorded from either lot;
- Three vegetation types were recorded on the sandy soil types on the site, a Banksia woodland, a Jarrah/Banksia woodland and a Xanthorrhoea preissii Shrubland;
- The condition of the vegetation was mostly rated as Completely Degraded due to the past clearing on the site, low number of understorey species and prevalence of weeds. The Banksia woodland in the north-east corner of the site was rated as Good due to the higher number of native species in the understorey;
- The vegetation belongs to the Bassendean – Central and South vegetation complex which is well reserved on the southern Swan Coastal Plain;
- Most of the vegetation on the site was too degraded to assign a Floristic Community Type. The Banksia woodland vegetation type was considered to be representative of FCT 21a 'Central *Banksia attenuata* – *Eucalyptus marginata* woodlands' which is not a Threatened or Priority Ecological Community; and
- The vegetation on the site does not form part of any regional or local ecological linkage and has very limited values for fauna.

5. REFERENCES

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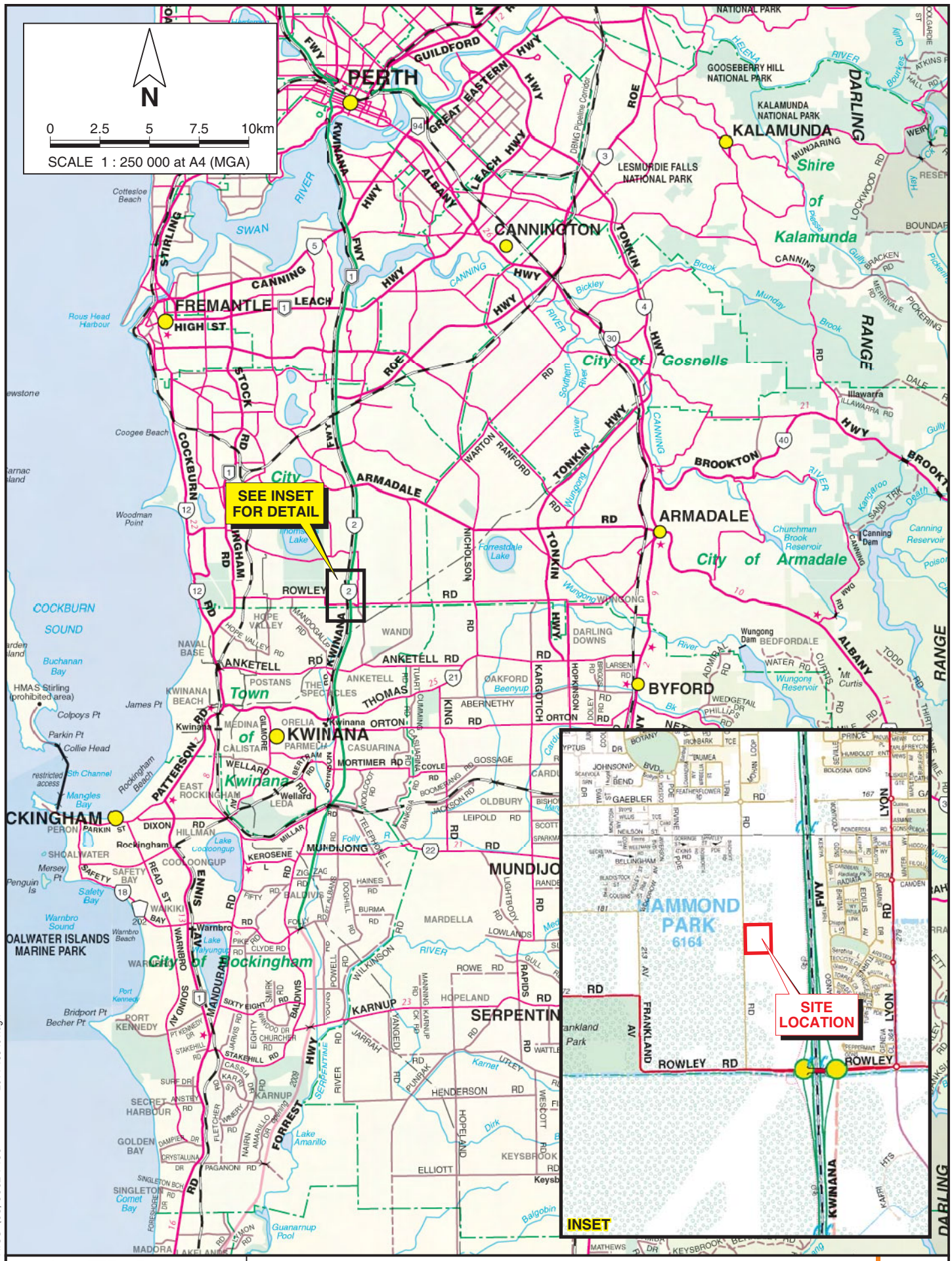
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FIGURES



PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-185-f01.dgn

pgv ENVIRONMENTAL

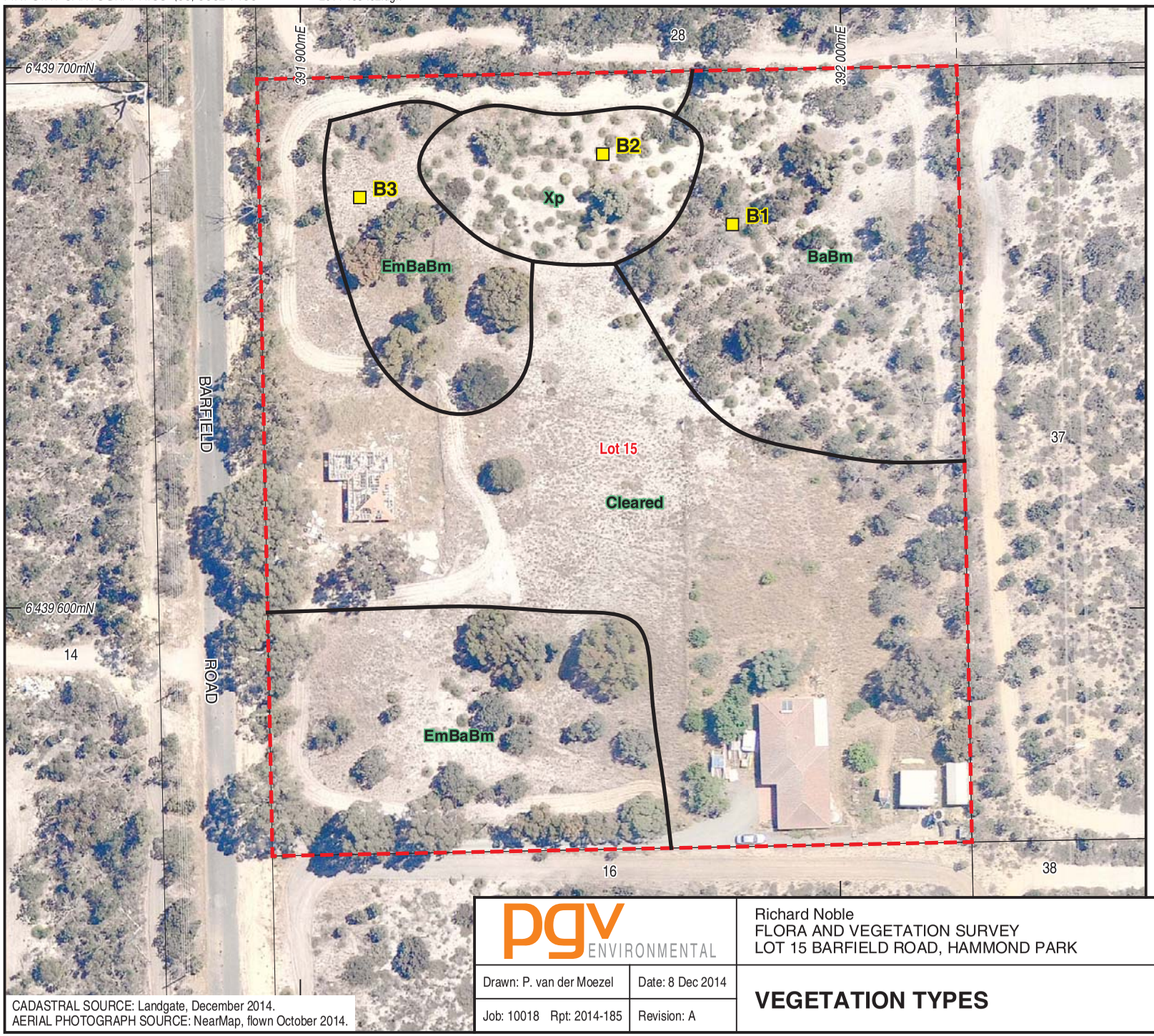
Richard Noble
FLORA AND VEGETATION SURVEY
LOT 15 BARFIELD ROAD, HAMMOND PARK

Drawn: P. van der Moezel	Date: 8 Dec 2014
Job: 10018 Rpt: 2014-185	Revision: A

SITE LOCATION

Figure 1

PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-185-f02.dgn



N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A4 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Quadrat Location
- Vegetation Type Boundary
- Xp Vegetation Type

Vegetation Types

BmBa *Banksia attenuata/B. menziesii* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland

Xp *Xanthorrhoea preissii* Open Shrubland

Em *Eucalyptus marginata/ Banksia attenuata/B. menziesii* Low Woodland over weeds

CADASTRAL SOURCE: Landgate, December 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2014.

pgv ENVIRONMENTAL

Drawn: P. van der Moezel | Date: 8 Dec 2014

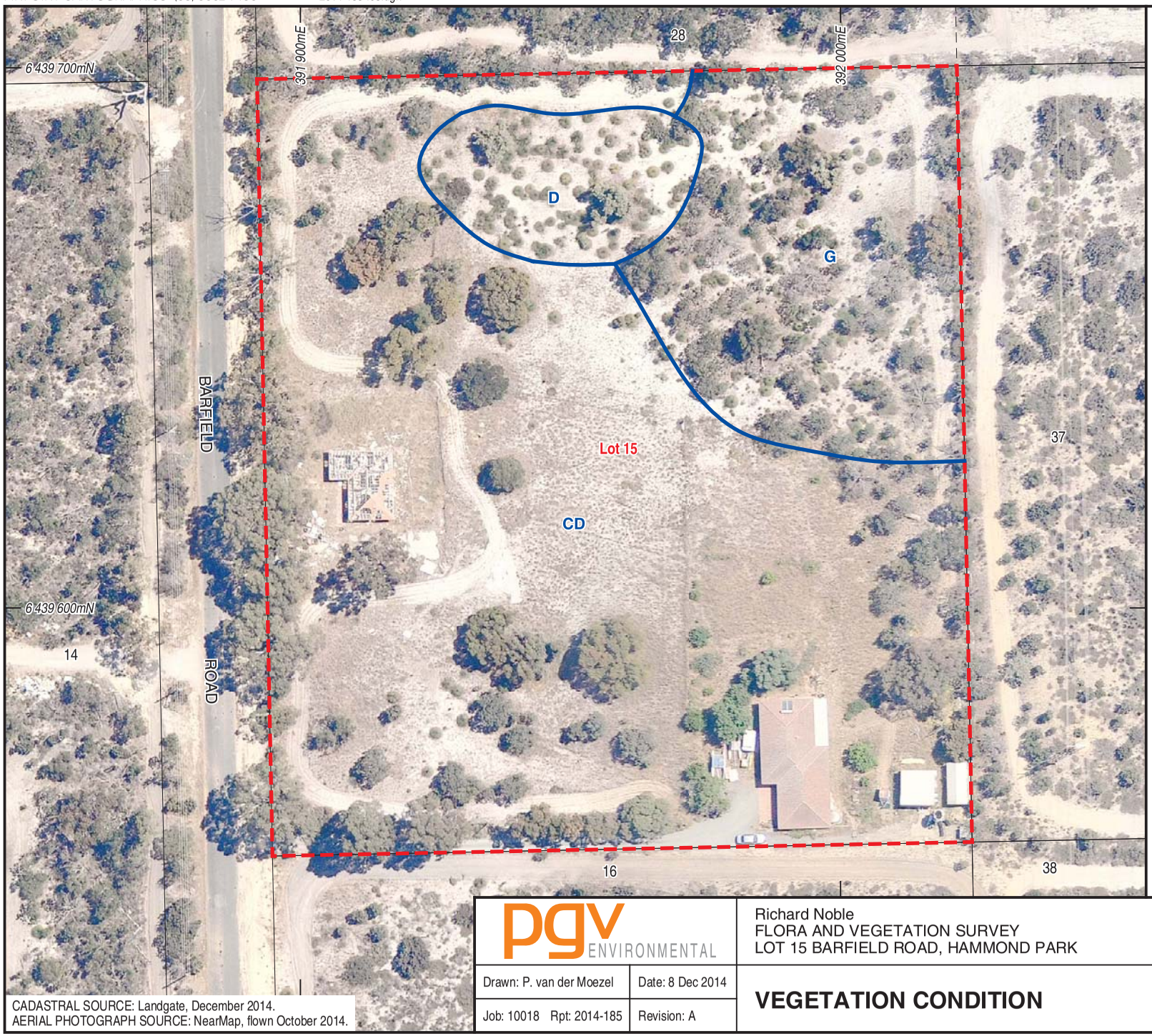
Job: 10018 Rpt: 2014-185 | Revision: A

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FLORA AND VEGETATION SURVEY
LOT 15 BARFIELD ROAD, HAMMOND PARK

VEGETATION TYPES

Figure 2

PINPOINT CARTOGRAPHICS (08) 9562 7136 2014-185-f03.dgn



N

0 10 20 30 40 50m

SCALE 1 : 1 000 at A4 (MGA)

Legend

- Site Boundary
- Cadastral Boundary
- Easement Boundary
- Vegetation Condition Boundary
- G Vegetation Condition

Vegetation Condition
(SOURCE: Bush Forever, Govt. of W.A., 2000)

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 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.

Cl - Cleared
No native vegetation remaining.

CADASTRAL SOURCE: Landgate, December 2014.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown October 2014.

pgv ENVIRONMENTAL

Richard Noble
FLORA AND VEGETATION SURVEY
LOT 15 BARFIELD ROAD, HAMMOND PARK

Drawn: P. van der Moezel	Date: 8 Dec 2014
Job: 10018 Rpt: 2014-185	Revision: A

VEGETATION CONDITION

Figure 3

APPENDIX 1

DPaW Database Searches

PopId	Nameid	Taxon	ConsStatus	WARank	PopNumber	SubPopCode	PopStatus	Location	District	Vesting	Purpose1	Purpose2	AreaOccupi
97306	1596	Caladenia huegelii	T	CR	59	A		The north western boundary of Wandi Nature Reserve (Reserve No. 36110), within the Town of Kwinana. Approximately 100m NE of 30 Blackboy Grove, Wandi.	SWAN COASTAL	CC	CFF		
97307	1596	Caladenia huegelii	T	CR	59	B		Wandi Nature Reserve (Reserve No. 36110), from 30 Blackboy Grove, Wandi head south along Wandi NR boundary fence for ca. 150m, then east ca. 200m (ca. 130m NW of the southern boundary fence).	SWAN COASTAL	CC	CFF		
97308	1596	Caladenia huegelii	T	CR	59	C		Western boundary of Wandi Nature Reserve (Reserve No. 36110). Halfway down track along W boundary. Approx 320m in from De Haer Rd. ~5m E of track. Town of Kwinana.	SWAN COASTAL	CC	CFF		
97309	1596	Caladenia huegelii	T	CR	59	D		The southern boundary of Wandi Nature Reserve (Reserve No. 36110). Approx 440m SW down De Haer Rd from E corner of Reserve, approx 40m in from Road verge. Within the Town of Kwinana.	SWAN COASTAL	CC	CFF		
97310	1596	Caladenia huegelii	T	CR	59	E		Approx 150m SW down De Haer Rd from E corner of Wandi Nature Reserve (Reserve No. 36110). Approx 10m in from Road verge. Within the Town of Kwinana.	SWAN COASTAL	CC	CFF		
97312	1596	Caladenia huegelii	T	CR	60	A		Private Property, 36 (Lot 149) Stefanelli Road, Wandi.	SWAN COASTAL	PRI			
97313	1596	Caladenia huegelii	T	CR	60	B		Private Property, Lot 51 (previously part of Lot 137 which was sudivided) Rowley Road, Wandi, scattered in bush in southern half of block.	SWAN COASTAL	PRI			
97314	1596	Caladenia huegelii	T	CR	60	C		Private Property, Lot 1 (previously pasrt of Lot 132) Wandi Road, Wandi, scattered in bush in northern half of block.	SWAN COASTAL	PRI			
106221	1596	Caladenia huegelii	T	CR	60	D		Private Property, Lot 52 (previously part of Lot 137 which was sudivided) Rowley Road, Wandi, scattered in bush in southern half of block.	SWAN COASTAL	PRI			
84954	1596	Caladenia huegelii	T	CR	61			Private Property 384 Bartram Street, Banjup, remnant at back of property.	SWAN COASTAL	PRI			
84955	1596	Caladenia huegelii	T	CR	62			Western edge of Denis De Young Reserve Banjup.	SWAN COASTAL	LGA	REC		
84960	1596	Caladenia huegelii	T	CR	67			Unvested Reserve No. 41438, east of Shirley Balla Swamp, Banjup.	SWAN COASTAL	NON	GVT		
84964	1596	Caladenia huegelii	T	CR	72			Private Property, Lot 3 (54 Oxley Road), Banjup. Ca. 20m S of water tank.	SWAN COASTAL	PRI			

84968	1596	Caladenia huegelii	T	CR	76			Private property. 22 Robinson Rd (Lot 31), Wandi. Remnant bush/garden bed close to house within 1m of driveway. Town of Kwinana.	SWAN COASTAL	PRI				
106981	1596	Caladenia huegelii	T	CR	78	A		Private Property Lot 674 Lyon Road, Wandi. Site is 720m north of Anketell Road. Plant is on the disturbed edge of the eastern firebreak that runs parallel to Lyon Road.	SWAN COASTAL	PRI				1
107683	1596	Caladenia huegelii	T	CR	78	B		Private Property Lot 52 Lyon Road, Wandi. Site is 430m north of Anketell Road. Plants are on the disturbed edge of the eastern firebreak that runs parallel to Lyon Road and approx 20m in the bushland.	SWAN COASTAL	PRI				
93196	16245	Cyathochaeta teretifolia	3		12			Private Property. Lot 100, Treeby Rd. Anketell. Kwinana.	SWAN COASTAL	PRI				
99184	4763	Dodonaea hackettiana	4		4	B		N verge of Wedge Rd, along the S edge of Kogolup Lake, Yangebup.	SWAN COASTAL	LGA	VER			
99185	4763	Dodonaea hackettiana	4		4	C		N edge of Thomsons Lake. W end of Haring Rd, Success.	SWAN COASTAL	NON	OTH			
99186	4763	Dodonaea hackettiana	4		4	D		NW edge of Thomsons Lake. 0.6 km W of Wedge Rd and 0.5 km E of Lorimer Rd.	SWAN COASTAL	NON	OTH			
99189	4763	Dodonaea hackettiana	4		5	A		Russell Rd, Wattleup. From Pearse Rd, E for approx 0.6 km.	SWAN COASTAL	LGA	VER			
99190	4763	Dodonaea hackettiana	4		5	B		S side of Russell Rd, Wattleup. NW corner of Harry Waring Marsupial Reserve.	SWAN COASTAL	CC	CFF	OTH		
99191	4763	Dodonaea hackettiana	4		5	C		S edge of Thomsons Lake. From 0.5 to 1.5 km E of Pearse Rd.	SWAN COASTAL	LGA	NRE	CFA		
99192	4763	Dodonaea hackettiana	4		5	D		Harry Waring Marsupial Reserve. W edges of Banganup (Toodjabubup) Lake.	SWAN COASTAL	CC	CFF	OTH		
99193	4763	Dodonaea hackettiana	4		5	E		Harry Waring Marsupial Reserve. E side of Banganup (Toodjabubup) Lake. 375 m S of Russell Rd.	SWAN COASTAL	CC	CFF	OTH		
99194	4763	Dodonaea hackettiana	4		5	F		WSW edge of Banganup (Toodjabubup) Lake. 0.5 km SE of the intersection of Russell and Pearse Rds,	SWAN COASTAL	PRI				
87256	4763	Dodonaea hackettiana	4		15			Near the Spectacles, Peel Estate. W side of Johnson Rd, 1 km N of Thomas Rd.	SWAN COASTAL	PRI				
97391	1639	Drakaea elastica	T	CR	2	A	X	**Extinct - Cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 33.	SWAN COASTAL	PRI				
97392	1639	Drakaea elastica	T	CR	2	B	X	**Extinct - cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 34.	SWAN COASTAL	PRI				
97393	1639	Drakaea elastica	T	CR	2	C	X	**Extinct - cleared for housing** Mandogalup, south west of Perth. 0.8km south of Hope Valley Rd on west side of Treeby Rd, on Lot 35.	SWAN COASTAL	PRI				
85074	1639	Drakaea elastica	T	CR	31			Private Property, Lot 129 Bodeman Road, Wandi. Plants scattered in bush in rear of block near western boundary. Shire of Kwinana.	SWAN COASTAL	PRI				

91803	14097	Eremaea asterocarpa subsp. brachyclada	1	1	Lot 147 Stefannelli Cl, Wandi; bushland S of driveway	SWAN COASTAL	PRI		
91804	14097	Eremaea asterocarpa subsp. brachyclada	1	2	Lot 137 Rowley Rd, Wandi; plants scattered in bushland in southern half of block	SWAN COASTAL	PRI		
91805	14097	Eremaea asterocarpa subsp. brachyclada	1	3	Lot 132 Wandi Dr, Wandi; bushland in eastern half of block	SWAN COASTAL	PRI		
91806	14097	Eremaea asterocarpa subsp. brachyclada	1	4	Lot 152 Stefanelli Cl, Wandi; bushland in S half of block	SWAN COASTAL	PRI		
91807	14097	Eremaea asterocarpa subsp. brachyclada	1	5	Lot 129 Bodeman Rd, Wandi; bushland to the west, north, south, and NE of house	SWAN COASTAL	PRI		
91808	14097	Eremaea asterocarpa subsp. brachyclada	1	6	Lot 130 Bodeman Rd, Wandi; bushland to the west, south, and SW of house	SWAN COASTAL	PRI		
93725	16998	Tripterococcus paniculatus	4	6	Reserve 41438 (Location 418), cnr of Liddlow & Gibbs Rds,Banjup.	SWAN COASTAL	NON	GVT	
92664	14714	Verticordia lindleyi subsp. lindleyi	4	22	Denis De Young Reserve, Banjup. East side of Liddelow Rd, ca. 475 m north of the junction with Oxley Rd.	SWAN COASTAL	LGA	REC	

Taxon	Status	Rank	IUCNCriteria	EPBC	DECRegion	DECDistrict	Distribution	FloweringPeriod
Dodonaea hackettiana	4				SWAN	SWAN COASTAL	Wattleup, Thompson Lake, Kings Park, Jandakot, Bibra Lake-The Spectacles, Gingin, Peron, Baldivis, Beeliar, Baldivis, Harry Waring Marsupial Reserve	Jul-Oct
Eremaea asterocarpa subsp. brachyclada	1				SWAN	SWAN COASTAL	Base of Darling Scarp, Wandi	
Eryngium pinnatifidum subsp. Palustre (G.J. Keighery 13459) PN	3				SWAN	SWAN COASTAL	Serpentine, Kenwick, Upper Swan, Gingin, Forrestdale, Bullsbrook, Mandurah, Arrowsmith, Capel	-
Jacksonia gracillima	3				SWAN,SWST	SWAN COASTAL,BLACKWOOD	Mundijong, Forrestdale, Capel, Elgin, Modong N.R., Forrestfield, Ambergate	Oct-Nov
Lepidosperma rostratum	T	EN	B1ab(iii)+2ab(iii)	EN	SWAN	SWAN COASTAL	Cannington, Kenwick, Forrestdale Lake NR	Aug
Ornduffia submersa	4				SCST,SWAN,SWST,WARR	PERTH HILLS,SWAN COASTAL,WELLINGTON,DONNELLY,FRANKLAND,ALBANY	Gunapin, Boyanup, Lake Muir, Denmark, Forrestdale, Kenwick, Frankland River, Lane Poole	Sep-Oct
Stylidium paludicola MS	3				SWAN,SWST	SWAN COASTAL,BLACKWOOD,WELLINGTON	Bullsbrook, Ruabon, Mandogalup, Lake Clifton, Cookernup, Capel, Dardanup	
Thysanotus glaucus	4				MWST,SCST,SWAN,SWST,WHTB	PERTH HILLS,SWAN COASTAL,BLACKWOOD,ALBANY,ESPERANCE,MOORA,GREAT SOUTHERN	Regans Ford, Forrestdale, Busselton, Lake King, West Mt Barren, Lesueur NPk	Nov-Feb
Tripterococcus paniculatus	4				SWAN,SWST	SWAN COASTAL,BLACKWOOD	Cannington, Armadale, Leeming, Forrestfield, Upper Swan, Willeton, Forrestdale, Busselton	Nov
Verticordia lindleyi subsp. lindleyi	4				MWST,SWAN	PERTH HILLS,SWAN COASTAL,MOORA	Gillingarra-Forrestdale, Cannington, Guildford, Muchea, Gingin, Murray River, Moore River, Serpentine	Nov-Jan

Taxon	Cons_ code	Site	Vegetation	Locality	Geocode_ me	Prec
Cyathochaeta teretifolia	3			In or adjacent to Emma Treeby Reserve, S Armadale Road, Banjup	MAN	3
Diuris micrantha	T	Swamp. Black peaty soil.	Miscellaneous rushes and sedges.	Mandogolup, Johnsons Road, Darling District	UNK	3
Dodonaea hackettiana	4			Thomson's Lake Reserve, Jandakot	MAN	3
Dodonaea hackettiana	4	Sand with outcropping limestone.	Tall danse Banksia forest.	24 km S of Perth, S of Thompson's Lake on Russell road	MAN	3
Dodonaea hackettiana	4			Russell Road (S side of Reserve) between Thomsons Lake and Marsupial Reserves, Wattleup	AUTO	2
Drakaea elastica	T	In deep grey sand on gradual slopes in undulating plain.	Low woodland of Banksia attenuata, B. menziesii, B. ilicifolia, and Jarrah over scrub of Adenanthos cygnorum and Kunzea over herbs.	Mandogalup, S of Perth, 0.8 km S of Hope Valley Road, along Treeby Road	MAN	3
Jacksonia gracillima	3	Flat, well-drained but adjacent to winter-wet swamp; pale grey sand.	Banksia woodland.	Bushland near Shirley Balla Swamp, north of Gibbs Rd, Banjup	GPS	1
Pimelea calcicola	3	Brown sand and protruding limestone.	Melaleuca/Acacia rostellifera patches. Associated vegetation: Dryandra sessilis, Phyllanthus calycinus, Hibbertia hypericoides, Ehrharta calycina.	ca 75 m N of Retta Street on E side of Cockburn Road, Mount Brown (Beeliar) Regional Park,	MAN	0
Stylidium paludicola	3	Near edge of swamp.	Amongst Juncus.	Jandakot Marsupial Breeding Station at Banganup Lake	MAN	0
Stylidium paludicola	3	Gentle slope, south aspect, surface soil is dark grey loamy sand and sub surface soil is very dark grey brown sandy loam, drainage is poor and wet during winter and spring only.	Melaleuca preissiana, Kunzea glabrescens low open forest over Astartea scoparia, Hypocalymma angustifolium open shrubland over Lepidosperma longitudinale open sedgeland. Vegetation is in a pristine to excellent condition with some rabbit diggings and pot	Robinson Road, Wandi	GPS	1
Tripterococcus paniculatus	4	Winter wet flats, peaty sand over clay.	Hypocalymma angustifolium low heath.	Gazetted Reserve 418 [Reserve No. 41438], Bartrum Road swamp, Jandakot	MAN	3

OBJECTID	OCC_UNIQUE	COM_ID	COM_NAME	CT_DESC	S_ID_COUNT	FIRST_S_ID	LAST_S_ID	BUFFER	BDY_ID	Shape_Leng	Shape_Area
209	1877	Limestone ridges (SCP 26a)	Melaleuca huegelii - Melaleuca acerosa (currently M. systena) shrublands on limestone ridges (Gibson et al. 1994 type 26a)	Endangered	1	ANKETELL01		500	318	0.03923105991	0.00011516805
1179	2650	SCP24	Northern Spearwood shrublands and woodlands	Priority 3	1	THOM02		500	1488	0.04065425830	0.00012864193
14416	3084	SCP22	Banksia ilicifolia woodlands	Priority 3	1	DEJONG01		500	0	0.03086091885	0.00007506911
14417	3156	SCP21c	Low lying Banksia attenuata woodlands or shrublands	Priority 3	1	DEJONG02		500	0	0.03086111380	0.00007507000
14869	3188	SCP21c	Low lying Banksia attenuata woodlands or shrublands	Priority 3	1	BAS34		200	0	0.01234285024	0.00001200577
14871	3190	SCP21c	Low lying Banksia attenuata woodlands or shrublands	Priority 3	1	BAS36		200	0	0.01234220938	0.00001200460
14873	3194	SCP21c	Low lying Banksia attenuata woodlands or shrublands	Priority 3	1	BAS40		200	0	0.01234716656	0.00001201365
14886	2981	SCP22	Banksia ilicifolia woodlands	Priority 3	1	BIW15		900	0	0.05554702582	0.00024321731
14887	2982	SCP22	Banksia ilicifolia woodlands	Priority 3	1	BIW16		200	0	0.01234601897	0.00001201155
14888	2983	SCP22	Banksia ilicifolia woodlands	Priority 3	1	BIW17		200	0	0.01234716664	0.00001201365

APPENDIX 2

Species List

SPECIES LIST – Lot 15 Barfield Road, Hammond

* = Introduced species

MONOCOTYLEDONS

ANARTHRIACEAE
Lyginia barbata

ASPARAGACEAE
Laxmannia squarrosa
Lomandra hermaphrodita
Lomandra preissii
Sowerbaea laxiflora
Thysanotus thyrsoideus

ASPHODELACEAE
**Trachyandra divaricata*

COLCHICACEAE
Burchardia congesta

CYPERACEAE
Schoenus lanatus

DASYPOGONACEAE
Dasypogon bromeliifolius

HAEMODORACEAE
Anigozanthos humilis
Anigozanthos manglesii
Conostylis aculeata

IRIDACEAE
**Freesia alba x leichtlinii*
**Gladiolus caryophyllaceus*
Patersonia occidentalis
**Romulea rosea*

ORCHIDACEAE
Caladenia flava
Caladenia longicauda subsp. *calcigena*
Microtis media subsp. *densiflora*

POACEAE
Amphipogon turbinatus
**Ehrharta longiflora*
**Pennisetum setaceum*

RESTIONACEAE
Desmocladus flexuosus

XANTHORRHOEACEAE
Xanthorrhoea preissii

DICOTYLEDONS

APIACEAE
Trachymene pilosa

ASTERACEAE
**Arctotheca calendula*
**Hypochaeris glabra*
**Podotheca angustifolia*
**Ursinia anthemoides*

CAMPANULACEAE
**Wahlenbergia capensis*

CARYOPHYLLACEAE
**Petrorhagia dubia*

CASUARINACEAE
Allocasuarina fraseriana

ERICACEAE
Leucopogon polymorphus
Lysinema ciliatum

EUPHORBIACEAE
**Euphorbia terracina*

FABACEAE
Acacia pulchella
Acacia stenoptera
Bossiaea eriocarpa
Daviesia triflora
Gompholobium tomentosum

Jacksonia furcellata
**Lupinus cosentinii*
**Trifolium arvense* var. *arvense*
**Trifolium campestre*

GERANIACEAE
**Pelargonium capitatum*

GOODENIACEAE
Lechenaultia floribunda

LAMIACEAE
Hemiandra pungens

LOGANIACEAE
Phyllangium paradoxum

LORANTHACEAE
Nuytsia floribunda

MOLLUGINACEAE
Macarthuria australis

MYRTACEAE
Eremaea pauciflora
Eucalyptus marginata
Scholtzia involucrata

PRIMULACEAE
**Lysimachia arvensis*

PROTEACEAE
Adenanthos cygnorum
Banksia attenuata
Banksia menziesii
Petrophile linearis

SCROPHULARIACEAE
**Dischisma capitatum*

STYLIDIACEAE
Stylidium brunonianum
Stylidium piliferum

APPENDIX 3

Quadrat Data

QUADRAT B1

50 391980 E 6439671 N

Vegetation: *Banksia menziesii/B. attenuata* Low Open Woodland over *Xanthorrhoea preissii* Open Shrubland

Condition: Good

Soil Type: Grey-brown sand

Landform: Very gentle slope



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Banksia menziesii	4	10
Banksia attenuata	4	5
Xanthorrhoea preissii	1.1	10
Jacksonia furcellata	1	<1
**Gladiolus caryophyllaceus*	0.6	1
Gompholobium tomentosum	0.5	<1
Patersonia occidentalis	0.5	<1
Burchardia congesta	0.5	<1
**Ehrharta longiflora*	0.4	1
Leucopogon polymorphus	0.4	<1
Conostylis aculeata	0.4	<1
Lyginia barbata	0.4	<1
Microtis media subsp. *densiflora*	0.4	<1
Stylidium brunonianum	0.4	<1
**Ursinia anthemoides*	0.3	5
Daviesia triflora	0.3	1
Dasypogon bromeliifolius	0.3	<1
Caladenia longicauda subsp. *calcigena*	0.3	<1
Anigozanthos humilis	0.3	<1
Scholtzia involucrata	0.2	1

SPECIES	HEIGHT (m)	COVER (%)
Amphipogon turbinatus	0.2	<1
Trachymene pilosa	0.1	2
Phyllangium paradoxum	0.1	1
Laxmannia squarrosa	0.1	<1
**Podotheca angustifolia*	0.1	<1
**Hypochaeris glabra*	Flat	5

* introduced species

QUADRAT B2

50 391956 E 6439684 N

Vegetation: *Xanthorrhoea preissii* Open Shrubland
Condition: Degraded
Soil Type: Grey sand
Landform: Flat



QUADRAT (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Xanthorrhoea preissii	1.2	20
**Ehrharta longiflora*	1	2
**Gladiolus caryophyllaceus*	0.6	1
**Petrorhagia dubia*	0.4	<1
**Ursinia anthemoides*	0.1	10
Laxmannia squarrosa	0.1	<1
**Podotheca angustifolia*	0.1	<1
**Hypochaeris glabra*	Flat	2

* introduced species

QUADRAT B3

50 391911 E 6439676 N

Vegetation: *Eucalyptus marginata* Low Woodland over weeds
Condition: Completely Degraded
Soil Type: Light grey sand
Landform: Flat



Quadrat (10 x 10m)

SPECIES	HEIGHT (m)	COVER (%)
Eucalyptus marginata	6	20
Banksia attenuata	3	2
Xanthorrhoea preissii	1	1
Acacia pulchella	0.8	<1
**Ehrharta longiflora*	0.6	20
**Gladiolus caryophyllaceus*	0.6	2
Burchardia congesta	0.4	<1
Lyginia barbata	0.4	<1
Allocasuarina fraseriana	0.4	<1
Gompholobium tomentosum	0.3	<1
Conostylis aculeata	0.3	<1
**Ursinia anthemoides*	0.2	4
**Petrorhagia dubia*	0.2	<1
**Triflium campestre*	0.1	<1
**Dischisma capitatum*	0.1	<1
**Hypochaeris glabra*	Flat	<1

* introduced species

APPENDIX 2

LEVEL 1 FAUNA SURVEY REPORT
(Source: Terrestrial Ecosystems Ltd., 2016)

Level 1 fauna risk assessment and Black-Cockatoo habitat assessment for Lot 15 Barfield Road, Hammond Park



Version 2. April 2016

Prepared for:

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Front Cover: Burton's Legless Lizard (*Lialis burtonis*)

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EXECUTIVE SUMMARY

Gold Estates Holdings Pty Ltd proposes to clear and develop Lot 15 Barfield Road, Hammond Park (i.e. project area). The project area is 24km south of the Perth CBD and is separated from the Kwinana Freeway by a Western Power high voltage power line easement approximately 180m wide (Figure 1). The project area is approximately 1.86ha (Figure 1).

There are four fauna habitats in the project area. Vegetation in the project area is regrowth and generally in very poor condition and of low value. The site does not form part of an important ecological linkage for fauna.

The very small quantity of *Lomandra hermaphrodita* in the project area suggests that it is unlikely Graceful Sun-Moths (*Synemon gratiosa*) are present. The lack of suitable vegetation in the project area would also indicate that Southern Brown Bandicoots (*Isoodon obesulus fusciventer*) are not present.

The impact of clearing less than 2ha of low or very low quality Black-Cockatoo foraging habitat is not significant on these species, and does not warrant a referral to the Commonwealth Government under the EPBC Act (1999).

There is a very low possibility that the project area contains the Jewelled South-west Skink *(Ctenotus gemmula*), Black-striped snake (*Neelaps calonotus*) or Lined Skink (*Lerista lineata*), however, they were not caught or seen when the much larger adjacent Vivente project area was cleared. If present, these reptiles will be lost during vegetation clearing. There is cumulative effect of progressively clearing most of the *Banksia* and Jarrah woodland in the general area.

Conservation significant Rainbow Bee-eater (*Merops ornatus*), if they are in the project area, will move to adjacent areas once vegetation clearing commences and would not be significantly impacted.

It is recommended that a fauna salvage program by a suitably qualified zoologist is implemented during the vegetation clearing program.

1 INTRODUCTION

1.1 Background

Gold Estates Holdings Pty Ltd (Gold Estates) proposes to clear and develop Lot 15 Barfield Road, Hammond Park (i.e. project area). The project area is 24km south of the Perth CBD and is separated from the Kwinana Freeway by a Western Power high voltage power line easement that is approximately 180m wide (Figure 1). The project area is approximately 1.86ha (Figure 2).

1.2 Project objectives and scope of work

Terrestrial Ecosystems was commissioned by Gold Estates to undertake a Level 1 fauna risk assessment. The purpose of this Level 1 fauna risk assessment is to provide information to the appropriate government regulators to enable them to assess the potential impact of vegetation clearing on the fauna assemblage in the project area. The methodology broadly follows that described in the Environmental Protection Authority (EPA) *Position Statement No. 3: Terrestrial Biological Surveys as an Element of Biodiversity Protection* (EPA 2002), *Guidance Statement No. 56: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia* (EPA 2004) and the EPA/Department of Environment and Conservation (DPAW) *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA / DEC 2010).

A Level 1 fauna risk assessment involves undertaking a desktop review and site inspection. The objectives of this fauna risk assessment were to:

- provide an indication of the vertebrate fauna assemblage (reptiles, amphibians, small mammals and birds) on and in the vicinity of the project area;
- identify the presence and/or potential risks of impacting on species of conservation significance that are present or likely to be present in the project area during vegetation clearing;
- determine if any additional surveys are required to assess the potential impact on fauna assemblages in the project area, in particular, impacts on species of conservation significance; and
- make recommendations that mitigate or minimise potential impacts on resident fauna.

As Black-Cockatoos are known to forage the banksia and eucalypt woodlands in the adjacent areas, an assessment of the potential for Black-Cockatoo species to breed and forage in the project area was also undertaken.

To achieve these objectives, Terrestrial Ecosystems has:

- reviewed Terrestrial Ecosystems fauna survey database [includes Western Australian Museum (WAM), Atlas of Living Australia (AoLA) and DPaW records] to identify potential vertebrate fauna within the area;
- reviewed DPaW listed Threatened and Priority species as recorded in NatureMap that are likely to be in the area;
- searched the Commonwealth government's on-line database to identify fauna species of national environmental significance that are protected under the *Environment Protection and Biodiversity Conservation Act 1999* (*EPBC Act 1999*) potentially occurring in the area;
- reviewed previous fauna surveys conducted in the region;
- undertaken a site visit to identify available fauna habitat types and condition;
- mapped potential foraging habitat for Black-Cockatoos and recorded all potential Black-Cockatoo breeding trees with a diameter of 50cm or greater;
- undertaken an assessment of the potential risks to the fauna associated with clearing additional areas of native vegetation;
- provided a discussion of the likelihood of *EPBC Act 1999* and Western Australian (WA) *Wildlife Conservation Act 1950* listed species being present in the project area; and
- provided management recommendations to mitigate and minimise potential impacts on the fauna in the project area.

2 EXISTING ENVIRONMENT

2.1 Survey area

Lot 15 Barfield Road, Hammond Park (1.86ha) is approximately 24km south of the Perth CBD, in an area that is rapidly being developed for urban housing. Immediately to the west, the vegetation has been cleared and residential development is underway for the Vivente project. Other lots of land to the north and west of the project area have also been recently cleared for residential housing.

2.2 Topography

The project area is a very gently undulating sand plain on the western section of the Bassendean Dune System. There are no wetlands in the project area or nearby.

2.3 Vegetation

PGV Environmental's (2014) flora and vegetation assessment indicated the area had previously been cleared and the current vegetation is regrowth. PGV Environmental (2014) reported the following three flora and vegetation communities in the project area in addition to the cleared area:

Low open Woodland of *Banksia attenuata/B. menziesii* over open shrubland of *Xanthorrhoea preissii*
This vegetation type occurred in the north-east corner of the site. The Banksia trees were up to 4m high and in low densities. *Xanthorrhoea preissii* was the most dominant native understorey species at around 1m high and 10% cover. All other native species had very low coverage. *Gladiolus caryophyllaceus, Ursinia anthemoides* and Flat Weed (*Hypochaeris glabra*) were the most prevalent weed species. The soil was grey-brown sand.

Open shrubland of *Xanthorrhoea preissii*
A small section of *Xanthorrhoea preissii* shrubland occurred in the north central part of the site. The *Xanthorrhoea* shrubs were up to 1.2m high and 20% density. Very few native species were recorded in this vegetation type and no trees except several WA Christmas Trees (*Nuytsia floribunda*). Presumably the Banksia and possibly Jarrah trees that occurred previously in this area did not regenerate after clearing in the early 1970s. Introduced species were common, particularly *Ursinia anthemoides,* Veltdgrass (*Ehrharta longiflora*) and Flat Weed. The soil was grey sand.

Low woodland of *Eucalyptus marginata/ Banksia attenuata/B. menziesii* over weeds
Two stands of this vegetation type occurred, one in the north-west corner and the other in the south-west corner. Jarrah (*Eucalyptus marginata*) was the most common tree species up to 6m high and varying in density while *Banksia attenuata* and *B. menziesii* also occurred but in very low numbers. Few native understorey species were present while introduced species such as Veldtgrass and Ursinia were common. The soil was light grey sand.

2.4 Climate

The Perth bioregion experiences a Mediterranean climate with hot summers from December to March and mild winters from May to August (Gentilli 1972). Chart 1 shows the average mean monthly maximum and minimum temperatures and rainfall for Jandakot airport. Temperatures are highest in January – February. Perth receives the majority of its annual rainfall in winter (Chart 1). This rain is usually the result of low pressure cells moving in a westerly direction which bring moisture bearing clouds over the south-west of Western Australia.

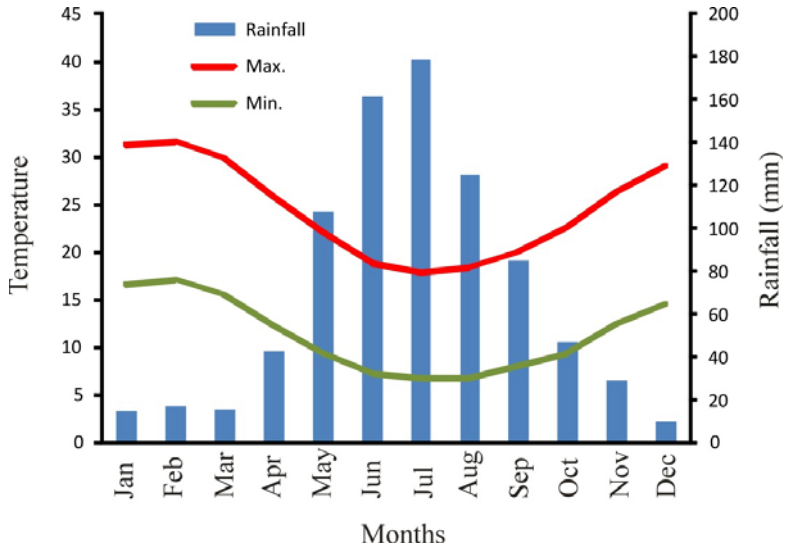


Chart 1. Mean monthly maximum and minimum temperatures and rainfall for Jandakot Airport (BOM November 2014; http://www.bom.gov.au/climate/averages/tables/cw_009172.shtml)

2.5 Land use

The dominant land use in the general area was large, semi-rural blocks mostly retaining much of the original native vegetation. The Southern Suburbs District Structure Plan – Stage 3 has rezoned this area from 'Urban Deferred' to 'Urban' under the Metropolitan Regional Scheme. The area has now been subdivided and the vegetation is being cleared for housing and urban development. Residential housing development has been rapid over the last 10 years in adjacent areas to the west and north of the project area.

2.6 Biological context for the project area

The frogs, reptiles, mammals and birds on the Swan Coastal Plain south of the Swan River have been surveyed on numerous occasions for a variety of purposes. Surveys in the vicinity of the project area which have been reviewed for this assessment include:

- 360 Environmental (2008) *Lot 9 Abernethy Road, Byford Spring Flora and Fauna Report*. Unpublished report for Australand Property Group, Perth.
- ATA Environmental (2006) *Vertebrate Fauna Assessment Brookdale Redevelopment Area*. Unpublished report for the Armadale Redevelopment Authority, Perth.
- Bamford Consulting Ecologists (2009) *Keane Road Strategic Link, Armadale Fauna Assessment*. Unpublished report for EnviroWorks Consulting, Perth.
- Ecoscape (Australia) Pty Ltd (2009) Fauna Survey for Lots 13, 14 and 18 Barfield Road and Lots 48-51 Rowley Road, Hammond Park. Unpublished report for Gold Estate and the Department of Housing, Perth.
- ENV (2009) *Jandakot Airport Fauna Survey*. Unpublished report for Jandakot Airport Holdings Pty Ltd, Perth.
- GHD (2006) *Fiona Stanley Heath Precinct Site Investigation Fauna Assessment March 2006*. Unpublished report for Department of Housing and Works, Perth.
- Gole C.A. (2003) *Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project*. Unpublished report Birds Australia and Perth Biodiversity Project, Perth.
- Harvey M.S., Dell J., How R.A. and Waldock J.M. (1997) *Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms Perth*. Unpublished report for the Australian Heritage Commission NEP Grant N95/49, Perth.
- How R. A., Harvey M.S., Dell J. and Waldock J.M. (1999) *Ground Fauna of Urban Bushland Remnants in Perth*. Unpublished report to the Australian Heritage Commission; NEP Grant N93/04, Perth.

- Phoenix Environmental Sciences (2011) *Vertebrate Fauna Survey for the Roe Highway Extension Project*. Unpublished report for South Metro Connect, Perth.
- Terrestrial Ecosystems' (2015) vertebrate fauna trapping and fauna salvage program data.
- Western Wildlife (2010) *Wetland and Migratory Bird Survey*. Unpublished report for South Metro Connect, Perth.

The most relevant data are from Terrestrial Ecosystems trapping and vertebrate fauna salvage program conducted prior to and during the clearing of vegetation in the Vivente Estate which is located immediately to the west of the project area. Ecoscape (2009) reported on a fauna survey for the Vivente Estate that was undertaken sometime (date not disclosed) before the approval for that development. The Phoenix Environmental Sciences (2011) and Western Wildlife (2010) undertook fauna surveys to support an application to clear vegetation for the Roe Highway extension. The 360 Environmental (2008), ATA Environmental (2006) and Bamford Consulting Ecologists (2009) reports are for projects to the east of the project area but on the Swan Coastal Plain. The Western Australian Museum (Harvey et al. 1997, How et al. 1999) and Gole (2003) reports are for remnant habitats in the region. The Fiona Stanley Hospital (GHD 2006) and the Jandakot airport surveys (ENV Australia 2009) are for other large scale projects on the Swan Coastal Plain in the vicinity of the project area.

In addition to the above reports, Terrestrial Ecosystems fauna survey database contains records from NatureMap, AoLA and the WAM collection for this area. These records include the results of historical surveys and incidental records that very often remain unreported.

3 METHODOLOGY

3.1 Desktop assessment

3.1.1 Conservation significant species

A search of the Department of the Environment's (DotE) Matters of National Environmental Significance (MNES) search tool (search coordinates 32.17459°S, 115.85403°E with a 10km buffer) was undertaken. The DPaW threatened and priority species database was searched via the records in NatureMap. In addition, a desktop search of the Terrestrial Ecosystems' fauna survey database was used to develop an appreciation of the vertebrate fauna assemblages in the relevant section of the bioregion in the vicinity of the project area.

Other more general texts were also used to provide supplementary information on vertebrates in the bioregion, including Tyler *et al.* (2000) for frogs; Storr *et al.* (1983, 1990, 1999, 2002) for reptiles; Johnstone and Storr (1998, 2004) for birds; and Van Dyck and Strahan (2008) for mammals.

Collectively these sources of information were used to create lists of species expected to utilise the project area and the adjacent areas. It should be noted that these lists will include species that have been recorded in the general region but are possibly vagrants and they will not generally be found in the project area due to a lack of suitable habitat (e.g. wetland and shore birds). Vagrants can be recorded almost anywhere. 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 project area. 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 survey area. As a consequence many species will be included in the lists produced from database searches but will not be present in the actual project area.

3.2 Site assessment and reporting

Dr Scott Thompson undertook the reconnaissance survey and fauna habitat assessment with the assistance of Edward Swinhoe on 19 April 2016. Dr Graham Thompson prepared the report and Dr Scott Thompson reviewed the report before it was issued to the client. Both senior scientists have appropriate relevant post-graduate qualifications, extensive experience in conducting fauna assessments on the Swan Coastal Plain, have published research articles on biodiversity, fauna assemblages, conservation significant species, trapping techniques and temporal variations in trapped fauna assemblages and are therefore appropriately trained and experienced for the task of preparing this assessment. Both scientists were involved with the work at Vivente Estate and are familiar with the fauna assemblage present in the area.

3.2.1 Black-Cockatoo habitat assessment

As adjacent areas have been foraged by Black-Cockatoos, an assessment of the suitability of the habitat in the project area as a breeding and foraging site for Black-Cockatoos was undertaken. This assessment mapped Black-Cockatoo foraging habitat based on the rating system in Table 1.

Table 1. Rating system to be used for mapping foraging habitat for black-cockatoos

Rating	Description of vegetation		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
1	No or negligible foraging value. Examples: • Scattered food plants with foliage cover$^{\phi}$ of <5%. • Open pasture with limited scattered foraging trees. • Area largely devoid of any foraging species.	No or negligible foraging value. Examples: • Scattered food plants with foliage cover$^{\phi}$ of <5%. • Open pasture with limited scattered foraging trees. • Area largely devoid of any foraging species.	No or negligible foraging value. Examples: • Scattered food plants with foliage cover$^{\phi}$ of <5%. • Open pasture with limited scattered foraging trees. • Area largely devoid of any foraging species.

Rating	Description of vegetation		
	Carnaby's Black-Cockatoo	Baudin's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
2	Very low foraging value. Examples: • Woodland or shrubland of banksias with 5-10%[#] foliage cover[ϕ]; or • Eucalypt woodland/mallee of small-fruited species; or • Eucalypt woodland/forest with 5-10%[#] marri foliage cover[ϕ].	Very low foraging value. Examples: • Marri, shrubby banksias with 5-10%[#] foliage cover[ϕ]; or • Open pasture with scattered foraging trees or clumps of foraging trees.	Very low foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or other potential sources of food with 5-10%[#] foliage cover[ϕ]; or • Open pasture with scattered foraging trees or clumps of foraging trees.
3	Low foraging value. Examples: • Woodland or shrubland of banksias with 10-20%[#] foliage cover[ϕ]. • Eucalypt woodland/forest with 10-20%[#] marri foliage cover[ϕ].	Low foraging value. Examples: • Marri, and/or shrubby banksias with 10-20%[#] foliage cover[ϕ]; • Open pasture with numerous scattered foraging trees or clumps of foraging trees.	Low foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or other potential sources of food with 10-20%[#] foliage cover[ϕ]. • Open pasture with numerous scattered foraging trees or clumps of foraging trees.
4	Moderate foraging value. Examples: • Woodland or shrubland of banksias with 20-40%[#] foliage cover[ϕ]; • Eucalypt woodland/forest with 20-40%[#] marri foliage cover[ϕ]; or • May have evidence of foraging by *C. latirostris*.	Moderate foraging value. Examples: • Marri, banksia and other foraging species with 20-40%[#] foliage cover[ϕ]; or • May have evidence of foraging by *C. baudinii*.	Moderate foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or other foraging species with 20-40%[#] foliage cover[ϕ]; or • May have evidence of foraging by *C. banksia naso*.
5	High foraging value. Examples: • Woodland or shrubland of banksias with 40-60%[#] foliage cover[ϕ]; • Eucalypt woodland/forest with 40-60%[#] marri foliage cover[ϕ] and evidence of foraging by *C. latirostris*; or • Thinned pine plantation with considerable evidence of foraging by *C. latirostris*.	High foraging value. Examples: • Marri, banksia and other foraging species with 40-60%[#] foliage cover[ϕ]. • Evidence of foraging by *C. baudinii*.	High foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or other foraging species with 40-60%[#] foliage cover[ϕ]. • Evidence of foraging by *C. banksia naso*.
6	Very high foraging value. Examples: • Eucalypt woodland/forest with >60%[#] marri foliage cover[ϕ] and evidence of foraging by *C. latirostris;* • Banksia woodlands of key species (e.g. *B. attenuata, B. menziesii, B. prionotes, B. sessilis*) with foliage cover[ϕ] >60%; • Intact pine plantation with the majority of cones foraged by *C. latirostris*; or • Majority of food plants showing evidence of foraging by *C. latirostris.*	Very high foraging value. Examples: • Marri and/or banksia and/or other foraging species with >60% foliage cover[ϕ]; or • Majority of food plants showing evidence of foraging by *C. baudinii.*	Very high foraging value. Examples: • Marri and/or sheoak and/or jarrah and/or cape lilac and/or other foraging species with >60% foliage cover[ϕ]; or • Majority of food plants showing evidence of foraging by *C. banksii.*

[ϕ] Foliage cover refers to the percentage of ground surface shaded by vegetation, excluding litter and vegetation within 50mm of the ground, at midday. It can be estimated based on linear transects or plots. For the purpose of a black-cockatoo habitat assessment, it is estimated.

[#] If an area is degraded or under stress (e.g. dieback, water stress, drought, etc) the foraging value of the foliage cover (and seeds and nectar) may be lower than the percentage cover that is still present. In this case a lower rating than the percentage foliage cover is appropriate (i.e. 40-60% degraded foliage cover may be equivalent to 20-40% normal foliage cover). This issue should be discussed in the results.

Rating scales in Table 1 are a judgement made by Dr Scott Thompson, a zoologist with substantial experienced in black-cockatoo habitat assessments. The project area was also investigated for the evidence of foraging activity,

e.g. chewed banksia infructescences, marri and sheoak nuts, and all eucalypts with a diameter at breast height of 50cm or over were recorded.

3.3 Limitations

This Level 1 fauna risk assessment is based on information contained in the Commonwealth Government threatened species database, other published and unpublished fauna survey data for the bioregion and a site visit. It is acknowledged that multiple surveys conducted in different seasons, repeated over several years are necessary to fully appreciate the fauna assemblage in the project area.

The EPA *Guidance for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia, No. 56* (2004) suggested that fauna surveys may be limited by many variables. Limitations associated with each of these variables are assessed in Table 2.

Table 2. Fauna survey limitations and constraints

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Competency and experience of the consultant carrying out this assessment	No	The environmental scientists that undertook the field assessment and prepared this report are familiar with the vertebrate fauna of this bioregion.
Scope	No	All aspects of the scope of works have been addressed.
Proportion of fauna identified, recorded and/or collected	No	Not applicable.
Accuracy of previous survey work	Yes, negligible	Terrestrial Ecosystems has reported fauna survey data recorded by various authors, but is not in a position to vouch for the accuracy of this information. It is acknowledged that the taxonomy of Western Australian vertebrates is continually being revised and the nomenclature of some of the species listed in the appendices may have changed since publication by the authors.
Sources of information	Yes, negligible	Vertebrate fauna information was available from an on-line database and unpublished and published reports of surveys conducted in the bioregion in a variety of habitat types. Many of these surveys employed a low level of trapping effort which significantly impacts on the capacity of these data to represent the fauna assemblages in the areas surveyed.
Timing/weather/ season/ cycle	No	Weather was suitable during the site visit.
Disturbances which affected results of the survey	No	The project area had been cleared at an earlier date and most of the vegetation was regrowth. This was factored into this assessment.
Intensity of survey effort	No	No trapping surveys were undertaken.
Resources	No	Adequate resources were available.
Remoteness and/or access problems	No	There were no problems with access.

Possible limitations	Constraint (yes/no); significant, moderate or negligible	Comment
Availability of contextual information on the region	No	Fauna survey data are available for the general area.

Negligible – less than 20%; moderate -20-60%; significant – greater than 80%

4 RESULTS

4.1 Fauna habitats and condition

There are four fauna habitats present in the project area. One was largely devoid of vegetation and the vegetated area can be divided into three fauna habitat types based on the vegetation types, namely:

- Low Open Woodland *of Banksia attenuata/B. menziesii* over Open Shrubland of *Xanthorrhoea preissii*
- Open Shrubland - *Xanthorrhoea preissii*
- Low Woodland over weeds - *Eucalyptus marginata/ Banksia attenuata/B. menziesii*

Details of the vegetation in these three habitat types is contained in section 2.3 above.



Plate 1. Open unvegetated area



Plate 1. Open unvegetated area



Plate 3. Low Open woodland *of Banksia attenuata/B. menziesii* over open Shrubland of *Xanthorrhoea preissii*



Plate 4. Low open woodland *of Banksia attenuata/B. menziesii* over open shrubland of *Xanthorrhoea preissii*



Plate 5. Open shrubland of *Xanthorrhoea preissii*



Plate 6. Low woodland of *Eucalyptus marginata/ Banksia attenuata/B. menziesii* over weeds

Habitat quality is mapped in Figure 2. The vast majority of the project area (1.86 ha) is either highly degraded or disturbed and therefore of very low value for fauna.

Black-Cockatoo foraging habitat has been mapped and is shown in Figure 3. There are two different foraging habitats that are rated as 2 (i.e. very low foraging value; 1.49ha) and 3 (low foraging value; 0.37ha; see Table 1 for details). There were seven trees in or immediately adjacent to the project area (Figure 3; Table 3). None of these trees had hollows suitable as a nesting site for a Black Cockatoo.

Table 3. Black-Cockatoo tree assessment

Tree N^{o}	Tree type	Diameter at breast height	Hollow present
1	Jarrah	600	No
2	Jarrah	600	No
3	Jarrah	800	No
4	Jarrah	1300	No
5	Jarrah	700	No
6	Jarrah	800	No
7	Jarrah	500	No

4.2 Bioregional vertebrate fauna

Appendix B provides a summary of the fauna survey data that are available in the vicinity of the project area. The most relevant information is the results of the trapping and fauna salvage program that Terrestrial Ecosystems undertook for the Vivente project area. These are shown in Table 4.

Table 4. Vertebrate fauna caught in the trapping and fauna salvage program for the Vivente project area

Species		**Number**
Mammals		
Cat	*Felis catus*	1
Southern Brown Bandicoot	*Isoodon obesulus fusciventer*	11
House Mouse	*Mus musculus*	3
Brushtail Possum	*Trichosurus vulpechula*	1
Amphibians		
	Limnodynastes dorsalis	1
	Litoria adelaidensis	16
Reptiles		
	Ctenotus australis	1
Marbled Gecko	*Christinus marmoratus*	1
	Cryptoblepharus buchananii	23
	Delma fraseri	2
	Hemiergis quadrilineata	5
	Lialis burtonis	17
	Menetia greyii	1
	Pletholax gracilis	1
Bearded Dragon	*Pogona minor*	3
Dugite	*Pseudonaja affinis*	3
Bobtail	*Tiliqua rugosa*	62

There are appreciable differences among recorded fauna assemblages recorded in the vicinity of the project area shown in Appendix B. These differences are partially due to the low survey effort often deployed and they also reflect variations in soils and vegetation as well as temporal variations in the fauna assemblages.

Tables 5-8 provide a list of vertebrate species potentially found in the vicinity of the project area that have been compiled based on the fauna survey report results shown in Appendix B. Lists in these Tables are a significant over estimate of the actual species likely to be present as many of these species (e.g. water and shore birds) have specific habitat requirements not available in the project area, the project area is small, adjacent to new housing developments on the western and northern sides and it is immediately adjacent to a school. The highly degraded nature of the project area means that only a small subset of the vertebrate fauna assemblage that once was present is still present in the area.

Table 5. Birds potentially found in the vicinity of the project area

Family	Species	Common Name
Accipitridae	*Pandion cristatus*	Eastern Osprey
	Elanus axillaris	Black-shouldered Kite
	Haliaeetus leucogaster	White-bellied Sea-Eagle
	Haliastur sphenurus	Whistling Kite
	Accipiter fasciatus	Brown Goshawk
	Accipiter cirrocephalus	Collared Sparrowhawk
	Circus approximans	Swamp Harrier
	Aquila audax	Wedge-tailed Eagle
	Hieraaetus morphnoides	Little Eagle
	Pandion haliaetus	Osprey
Anatidae	*Biziura lobata*	Musk Duck
	Stictonetta naevosa	Freckled Duck
	Cygnus atratus	Black Swan
	Tadorna radjah	Radjah Shelduck
	Tadorna tadornoides	Australian Shelduck
	Chenonetta jubata	Australian Wood Duck
	Malacorhynchus membranaceus	Pink-eared Duck
	Anas rhynchotis	Australasian Shoveler
	Anas gracilis	Grey Teal
	Anas castanea	Chestnut Teal
	Anas platyrhynchos	Northern Mallard
	Anas superciliosa	Pacific Black Duck
	Aythya australis	Hardhead
	Oxyura australis	Blue-billed Duck
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar
Podargidae	*Podargus strigoides*	Tawny Frogmouth
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover
	Pluvialis squatarola	Grey Plover
	Charadrius dubius	Little Ringed Plover
	Charadrius ruficapillus	Red-capped Plover
	Elseyornis melanops	Black-fronted Dotterel
	Thinornis rubricollis	Hooded Plover
	Erythrogonys cinctus	Red-kneed Dotterel
	Vanellus tricolor	Banded Lapwing
	Vanellus miles	Masked Lapwing
Laridae	*Sternula nereis*	Fairy Tern
	Gelochelidon nilotica	Gull-billed Tern
	Chlidonias hybridus	Whiskered Tern
	Chlidonias leucopterus	White-winged Black Tern
	Chroicocephalus novaehollandiae	Silver Gull
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt
	Recurvirostra novaehollandiae	Red-necked Avocet
	Cladorhynchus leucocephalus	Banded Stilt
Scolopacidae	*Limosa limosa*	Black-tailed Godwit
	Limosa haemastica	Hudsonian Godwit
	Actitis hypoleucos	Common Sandpiper
	Tringa brevipes	Grey-tailed Tattler
	Tringa nebularia	Common Greenshank
	Tringa stagnatilis	Marsh Sandpiper
	Tringa glareola	Wood Sandpiper
	Calidris tenuirostris	Great Knot
	Calidris canutus	Red Knot
	Calidris ruficollis	Red-necked Stint
	Calidris subminuta	Long-toed Stint
	Calidris melanotos	Pectoral Sandpiper
	Calidris acuminata	Sharp-tailed Sandpiper
	Calidris ferruginea	Curlew Sandpiper
	Philomachus pugnax	Ruff
Stercorariidae	*Stercorarius longicauda*	Long-tailed Jaeger
Turnicidae	*Turnix varius*	Painted Button-quail
	Turnix velox	Little Button-quail
Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern
	Ixobrychus dubius	Australian Little Bitten
	Ardea alba	Great Egret
	Ardea pacifica	White-necked Heron
	Ardea modesta	Eastern Great Egret
	Ardea intermedia	Intermediate Egret
	Ardea ibis	Cattle Egret
	Egretta novaehollandiae	White-faced Heron
	Egretta garzetta	Little Egret
	Nycticorax caledonicus	Nankeen Night Heron
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis
	Threskiornis molucca	Australian White Ibis
	Threskiornis spinicollis	Straw-necked Ibis
	Platalea regia	Royal Spoonbill
	Platalea flavipes	Yellow-billed Spoonbill
Columbidae	*Columba livia*	Rock Dove
	Streptopelia senegalensis	Laughing Dove
	Streptopelia chinensis	Spotted Dove
	Phaps chalcoptera	Common Bronzewing
	Ocyphaps lophotes	Crested Pigeon
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra
	Todiramphus sanctus	Sacred Kingfisher
Meropidae	*Merops ornatus*	Rainbow Bee-eater
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo
	Chalcites lucidus	Shining Bronze-Cuckoo
	Cacomantis pallidus	Pallid Cuckoo
	Cacomantis flabelliformis	Fan-tailed Cuckoo
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar
Falconidae	*Falco cenchroides*	Nankeen Kestrel
	Falco berigora	Brown Falcon
	Falco longipennis	Australian Hobby
	Falco subniger	Black Falcon
Phasianidae	*Coturnix ypsilophora*	Brown Quail
Rallidae	*Porphyrio porphyrio*	Purple Swamphen
	Gallirallus philippensis	Buff-banded Rail
	Porzana pusilla	Baillon's Crake
	Porzana fluminea	Australian Spotted Crake
	Porzana tabuensis	Spotless Crake
	Tribonyx ventralis	Black-tailed Native-hen
	Gallinula tenebrosa	Dusky Moorhen
	Fulica atra	Eurasian Coot
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren

Family	Species	Common Name
	Smicrornis brevirostris	Weebill
	Gerygone fusca	Western Gerygone
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill
	Acanthiza inornata	Western Thornbill
	Acanthiza apicalis	Inland Thornbill
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler
	Megalurus gramineus	Little Grassbird
	Cincloramphus mathewsi	Rufous Songlark
Artamidae	*Artamus cinereus*	Black-faced Woodswallow
	Artamus cyanopterus	Dusky Woodswallow
	Cracticus torquatus	Grey Butcherbird
	Cracticus tibicen	Australian Magpie
	Strepera versicolor	Grey Currawong
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike
	Lalage sueurii	White-winged Triller
Climacteridae	*Climacteris rufa*	Rufous Treecreeper
Corvidae	*Corvus coronoides*	Australian Raven
	Corvus splendens	House Crow
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow
	Hirundo neoxena	Welcome Swallow
	Petrochelidon nigricans	Tree Martin
	Petrochelidon ariel	Fairy Martin
Maluridae	*Malurus splendens*	Splendid Fairy-wren
	Malurus elegans	Red-winged Fairy-wren
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill
	Lichenostomus virescens	Singing Honeyeater
	Manorina flavigula	Yellow-throated Miner
	Anthochaera lunulata	Western Wattlebird
	Anthochaera chrysoptera	Little Wattlebird
	Anthochaera carunculata	Red Wattlebird
	Epthianura albifrons	White-fronted Chat
	Glyciphila melanops	Tawny-crowned Honeyeater
	Lichmera indistincta	Brown Honeyeater
	Phylidonyris novaehollandiae	New Holland Honeyeater
	Phylidonyris niger	White-cheeked Honeyeater
	Melithreptus brevirostris	Brown-headed Honeyeater
	Melithreptus lunatus	White-naped Honeyeater
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark
Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird
	Daphoenositta chrysoptera	Varied Sittella
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler
	Pachycephala rufiventris	Rufous Whistler
	Colluricincla harmonica	Grey Shrike-thrush
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote
	Pardalotus striatus	Striated Pardalote
Petroicidae	*Petroica multicolor*	Pacific Robin

Table 6. Amphibians potentially found in the vicinity of the project area

Family	Species	Common Name
Hylidae	*Litoria adelaidensis*	Slender Tree Frog
	Litoria moorei	Motorbike Frog
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog
	Heleioporus psammophilus	Sand Frog
	Limnodynastes dorsalis	Western Banjo Frog
Myobatrachidae	*Crinia georgiana*	Quacking Frog
	Crinia glauerti	Clicking Frog
	Crinia insignifera	Squelching Froglet
	Myobatrachus gouldii	Turtle Frog
	Pseudophryne guentheri	Crawling Toadlet

Table 7. Mammals potentially found in the vicinity of the project area

	Species	Common Name
Canidae	*Canis lupus*	Dog
	Vulpes vulpes	Red Fox
Felidae	*Felis catus*	House Cat
Molossidae	*Austronomus australis*	White-striped Freetail Bat
	Mormopterus species 4	Southern Freetail Bat
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat
	Nyctophilus geoffroyi	Lesser Longeared Bat
	Nyctophilus major	Western Longeared Bat
	Vespadelus regulus	Southern Forest Bat
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus
	Phascogale tapoatafa	Brush-tailed Phascogale
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum
Tarsipedidae	*Tarsipes rostratus*	Honey Possum
Leporidae	*Oryctolagus cuniculus*	European Rabbit
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot
Muridae	*Hydromys chrysogaster*	Water Rat
	Mus musculus	House Mouse
	Rattus fuscipes	Bush Rat
	Rattus rattus	Black Rat

Table 8. Reptiles potentially found in the vicinity of the project area

Family	Species
Agamidae	*Ctenophorus adelaidensis*
	Pogona minor
Diplodactylidae	*Diplodactylus polyophthalmus*
	Strophurus spinigerus
Elapidae	*Acanthophis antarcticus*
	Brachyurophis fasciolata
	Brachyurophis semifasciata
	Demansia psammophis
	Echiopsis curta
	Elapognathus coronatus
	Neelaps bimaculatus
	Neelaps calonotos
	Notechis scutatus
	Parasuta gouldii
	Parasuta nigriceps
	Pseudonaja affinis
	Simoselaps bertholdi
Gekkonidae	*Christinus marmoratus*
Pygopodidae	*Aprasia pulchella*
	Aprasia repens
	Delma fraseri
	Delma grayii
	Lialis burtonis
	Pletholax gracilis

Family	Species
	Pygopus lepidopodus
Scincidae	*Acritoscincus trilineatum*
	Cryptoblepharus buchananii
	Ctenotus australis
	Ctenotus fallens
	Ctenotus gemmula
	Ctenotus impar
	Ctenotus labillardieri
	Egernia napoleonis
	Hemiergis initialis
	Hemiergis quadrilineata
	Lerista distinguenda
	Lerista elegans
	Lerista lineata
	Lerista lineopunctulata
	Menetia greyii
	Morethia lineoocellata
	Morethia obscura
	Tiliqua occipitalis
	Tiliqua rugosa
Typhlopidae	*Ramphotyphlops australis*
Varanidae	*Varanus gouldii*
	Varanus rosenbergi
	Varanus tristis

4.3 Conservation significant fauna

Conservation significant fauna are protected by the Commonwealth *EPBC Act 1999*, and this list includes species covered by international treaties such as the Japan-Australia Migratory Bird Agreement (JAMBA) and China-Australia Migratory Bird Agreement (CAMBA) and the Western Australia (WA) *Wildlife Conservation Act 1950*. The WA *Wildlife Conservation Act 1950* provides for the publishing of the *Wildlife Conservation (Specially Protected Fauna) Notice* that lists species under multiple categories. In addition, the DPaW maintains a list of fauna that require monitoring under four priorities based on DPaW's knowledge of their distribution, abundance and threatening processes. The *EPBC Act 1999* and *Wildlife Conservation Act 1950* imply legislative requirements for the management of anthropogenic impacts to minimise the effects of disturbances on species and their habitats. Priority species have no statutory protection, other than the DPaW wishes to monitor potential impacts on these species. Environmental consultants and proponents of developments are encouraged to avoid and minimise impacts on these species. Definitions of the significant fauna under the *WA Wildlife Conservation Act* are provided in Appendix C.

Appendix D shows the results of a search of the EPBC threatened species online database for adjacent areas. In the analysis below, marine, wetland and shorebirds have been excluded due to a lack of suitable habitat in or near the project area.

Thirteen threatened species of fauna and nine migratory/marine species of birds identified under the *EPBC Act 1999* potentially occur in the vicinity of the project area. There are nine species listed on the DPaW's Priority Fauna List that potentially occur in the vicinity of the project area. The following is an assessment of the likelihood of each of the species being impacted in the project area. Table 9 is a summary of this information.

Table 9. Species that are potentially found in the vicinity of the project area and that are listed as being of conservation significance under state or commonwealth government legislation or with DPAW

Species	Status under the Wildlife Conservation Act / DPAW	Status under the *EPBC Act*	Comment on potential impact that vegetation clearing will have on conservation significant species
Neopasiphae simplicior Native bee	Schedule 2	Critically Endangered	Unlikely to be found in the project area. Low potential impact.
Leioproctus douglasiellus Short-tongued bee	Schedule 2	Critically Endangered	Unlikely to be found in the project area. Low potential impact.
Calyptorhynchus latirotris Carnaby's Black-Cockatoo	Schedule 2	Endangered	Could be seen foraging in the vicinity of the project area. Low potential impact.
Bettongia penicillata ogilbyi Woylie	Schedule 1	Critically Endangered	Not present in the project area. Low potential impact.
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo	Schedule 3	Vulnerable	Could be seen foraging in the vicinity of the project area. Low potential impact.
Calyptorhynchus baudinii Baudin's Black-Cockatoo	Schedule 2	Vulnerable	May infrequently be seen in the vicinity of the project area. Low potential impact.
Dasyurus geoffroii Chuditch	Schedule 3	Vulnerable	Not present in the project area. Low potential impact.
Phascogale calura Red-tailed Phascogale	Schedule 6	Endangered	Not present in the project area. Low potential impact.
Myrmecobius fasciatus Numbat	Schedule 2	Vulnerable	Not present in the project area. Low potential impact.
Setonix brachyurus Quokka	Schedule 3	Vulnerable	Not present in the project area. Low potential impact.
Pseudocheirus occidentalis Western Ringtail Possum	Schedule 2	Vulnerable	Not present in the project area. Low potential impact.
Phascogale tapoatafa Southern Brush-tailed Phascogale	Schedule 3	Vulnerable	Not present in the project area. Low potential impact.
Leipoa ocellata Malleefowl	Schedule 3	Vulnerable	Unlikely to be found in the project area. Low potential impact.
Apus pacificus Fork-tailed Swift	Schedule 5	Migratory	May infrequently fly over the project area. Low potential impact.
Pandion haliaetus Osprey	Schedule 5	Migratory	Not present in the project area. Low potential impact.
Merops ornatus Rainbow Bee-eater	Schedule 5	Migratory	May be found in the vicinity of the project area. Low potential impact.
Ardea modesta Great Egret	Schedule 5	Migratory Wetland	Unlikely to be found in the project area. Low potential impact.
Ardea ibis Cattle Egret	Schedule 5	Migratory Wetland	Unlikely to be found in the project area. Low potential impact.
Motacilla cinerea Grey Wagtail	Schedule 5	Migratory	Not present in the project area. Low potential impact.
Haliaeetus leucogaster White-bellied Sea-eagle		Marine	May infrequently fly over the project area. Low potential impact.
Ctenotus gemmula	Priority 3		Very low possibly in the project area. There is a low possibility that some individuals could be lost during vegetation clearing.
Neelaps calonotos Black-striped Snake	Priority 3		Very low possibly in the project area. There is a low possibility that some individuals could be lost during vegetation clearing.
Lerista lineata Lined Skink	Priority 3		Very low possibly in the project area. There is a low possibility that some individuals could be lost during vegetation clearing.
Synemon gratiosa Graceful Sun-Moth	Priority 4		Low possibly in the project area. There is a low possibility that some individuals could be lost during vegetation clearing.
Macropus irma Western Brush Wallaby	Priority 4		Not present in the project area. Low potential impact.
Hydromys chrysogaster Water Rat	Priority 4		Not present in project area. Low potential impact.
Falsistrellus mackenziei Western False Pipistrelle	Priority 4		Unlikely to be found in the project area. Low potential impact.
Isoodon obesulus fusciventer Southern Brown Bandicoot	Priority 4		Unlikely to be found in the project area. Low potential impact.

Native Bee (*Neopasiphae simplicior*) – Critically Endangered under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

This critically endangered bee has been found at multiple locations including Port Gregory, Cannington, Forrestdale and Kooljerrenup Nature Reserve near Lake Clifton. It has been collected from the flowers of Thread-leaved Goodenia (*Goodenia filiformis*), Slender Lobelia (*Lobelia tenulor*), *Angianthus preissianus* and *Velleia* sp. (Houston 2000).

Terrestrial Ecosystems' assessment is that the proposed vegetation clearing is unlikely to impact on this species, as there is no suitable habitat and it is outside the species known geographic distribution.

Short-tongue bee (*Leioproctus douglasiellus*) – Critically Endangered under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

This small black bee occurs at four locations in the Perth metropolitan area, with each location considered a separate population. This bee is found on clay-based wetlands and vegetation that is subject to seasonal inundation. Terrestrial Ecosystems' assessment is that the proposed vegetation clearing is unlikely to impact on this species, as there is no suitable habitat and it is outside the species known geographic distribution.

Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*) – Endangered under the *EPBC Act 1999* and Schedule 2under the *Wildlife Conservation Act 1950*

Carnaby's (or Short-billed) Black-Cockatoo (*Calyptorhynchus latirostris*) is a large, pied, cockatoo. Garnett et al. (2011) and the DSEWPaC (2011) reported that Carnaby's Black-Cockatoo inhabits the south-west of Western Australia, from Kalbarri to as east on the south coast as Esperance. It breeds inland and moves to the coastal areas when chicks have fledged (Saunders et al. 1985). Carnaby's Black-Cockatoos are highly gregarious, usually seen in trios, small parties or large flocks (up to 5000 birds; Perry 1948). These flocks usually contain males, females and immature birds.

In some locations, breeding populations have decreased or become locally extinct (Saunders 1986, Saunders and Ingram 1987). For example, in the Coomallo Creek area north of Perth, Black-Cockatoos laid 74 clutches in 1973, 75 in 1974, 82 in 1975 but only 20 in 1994 and 19 in 1996 (Saunders and Ingram 1987). Saunders (1986) reported finding 13 nests at Manmanning in 1969 but by 1977, the species had stopped breeding in the area. Saunders (1990) reported failed nestings due to predation by a cat, galahs broke Carnaby's Black-Cockatoo eggs and took over nests, while other adult birds were killed by vehicles and Wedge-tailed Eagles (*Aquilla audax*).

Carnaby's Black-Cockatoos are partly migratory and partly sedentary (Higgins 1999). In the drier regions of their geographic range where most of the native vegetation has been cleared (e.g. wheatbelt), Carnaby's Black-Cockatoos are postnuptial migrants (Saunders 1980, Saunders and Ingram 1995). After breeding, individuals in these areas migrate to feed in higher rainfall areas including the Swan Coastal Plain, and to a lesser extent, forests dominated by *E. marginata* (Jarrah), *C. calophylla* (Marri) and *E. diversicolor* (Karri; Saunders 1980). On the Swan Coastal Plain, Carnaby's Black-Cockatoos have been recorded foraging in most suburbs and in pine plantations within the greater Perth metropolitan area (Perry 1948). Vagrants have been recorded on Rottnest Island (Winnett 1989) and Garden Island (Wykes et al. 1999). These later two sightings clearly indicate that Carnaby's Black-Cockatoo will fly considerable distances over non-vegetated areas to forage.

Garnett et al. (2011) estimated there were between 10,000 and 60,000 birds in the population.

Saunders (1980) recorded non-breeding cockatoos at Coomallo Creek foraging within a 50km radius of their breeding area, whereas, cockatoos at Manmanning moved a much greater distance to the coastal plain during their non-breeding season. These data suggest that Carnaby's Black-Cockatoo move from areas where there is little food to southern and western coastal areas where food is presumably more plentiful during summer and autumn (Davies 1966, Saunders 1980).

Carnaby's Black-Cockatoo breed between July and November mostly in eucalypt woodland (Saunders 1980, 1986). Carnaby's Black-Cockatoo nest in tree hollows that are created by fire, fungi, termites or old age, with hollows between 2.5 and 12m above the ground (Saunders 1979a, Higgins 1999). Hollows are large, ranging from 10 to over 250cm in depth (Higgins 1999). These hollows are usually in live or dead smooth-barked *Eucalyptus salmonophloia* (Salmon Gum) or *Eucalyptus wandoo* (Wandoo). However, Carnaby's Black-Cockatoo will also nest in *E. longicornis* (Red Morrell), *E. loxophleba* (York Gum), *E. gomphocephala* (Tuart), *E. rudis* (Flooded Gum), *E. salubris* (Gimlet), *E. occidentalis* (Swamp Yate) and *C. calophylla* (Higgins 1999, Cale 2003). When

breeding, they most often forage in the surrounding shrubland and kwongan heath (Higgins 1999). On the Swan Coastal Plain, breeding could occur in *E. gomphocephala*, *E. rudis*, *E. occidentalis* and *C. calophylla*. Adults return to the same breeding area each year (Saunders 1977) and some use the same tree hollow for many years in succession to raise their chicks, others shift their nests among a number of trees in the same area (Saunders and Ingram 1998).

Eggs are laid on a mat of wood chips chewed from the sides of the hollow. Clutches are 1-2, but most often only one chick is raised. Incubation takes 29 days, and only the female incubates and broods (Johnstone and Kirkby 2011). Initially the female will return to the nest mid-morning to feed the chick, but after about 2-3 weeks both parents leave in the early morning and return late evening.

Young remain with their parents until the parents return to the breeding area in the following year (Saunders 1980). Immature birds probably do not move into the breeding areas until they are ready to breed, although little is known of the movements of immature Carnaby's Black-Cockatoo until they are ready to breed (Saunders 1977).

The breeding success of Carnaby's Black-Cockatoo is believed to be strongly influenced by the availability of food at breeding sites (Saunders et al. 1985). Saunders (1977) found that birds that foraged within one or two kilometres from nesting sites had greater fledgling success than those from populations that had to travel up to four kilometres to obtain food. In a study that monitored Carnaby's Black-Cockatoo's breeding over 25 years at Coomallo Creek, Saunders and Ingram (1998) showed that the number of breeding attempts halved by the end of the study. During this period, native vegetation cover was reduced from 90% in 1959 to 25% in 1996. Their study revealed that although there was a surplus of trees with hollows of sufficient sizes, clearing of adjacent foraging habitat had adversely impacted on the success of breeding birds. Therefore, breeding sites typically have nearby areas of scrub and heath where birds forage on seeds and flowers of numerous trees and shrubs including *Banksia*, *Hakea*, *Dryandra, Grevillea* and *Callistemon* spp. (Robinson 1965, Saunders 1980, Higgins 1999). Unlike other cockatoo species, Carnaby's Black-Cockatoo will not utilise cereal crops (Saunders et al. 1985), but will feed on *Erodium* seed (Saunders 1980).

At Coomallo Creek, Carnaby's Black-Cockatoo travelled on average 1.4km from their nests to forage, whereas at Manmanning they foraged more widely and travelled an average of 2.5km from their nest to forage (Saunders 1980). At Manmanning, road and railway reserves were extensively used for foraging, presumably as this was the closest food source to their nests. The availability of food near the nest influenced the time spent incubating eggs and fledging body mass (Saunders 1980). At Manmanning, Carnaby's Black-Cockatoo traversed agricultural land to forage in remnant plots of uncleared land.

The social organisation of breeding Carnaby's Black-Cockatoo is known (Saunders 1974, 1977, 1979b, 1980, Saunders et al. 1985, Saunders 1986, Higgins 1999). Carnaby's Black-Cockatoo start reproducing at about four years of age and continue for at least 15 years (Cale 2003). Strong pair bonds are then formed, often for life. Females lay one or two eggs asynchronously with an average of 8 days (range 1-12) between the laying of the first and second egg. Egg laying usually occurs in early July to mid-October, with inland birds laying approximately three weeks later than those closer to the coast. Females incubate their 1-2 eggs for 28-29 days (Saunders 1982). When two eggs are laid, it is extremely rare for both nestlings to successfully fledge. The female alone broods and feeds the young birds. Initially, the female, and later the chick, rely on the male for food during the brooding and hatching of the eggs (Saunders 1977, Saunders 1982). After two to three weeks, both parents forage and return at mid-morning and dusk to feed the young (Saunders 1977, Saunders 1982). The young are dependent on parents for several months after fledgling. Fledglings are independent after about 10-11 weeks (Saunders 1977).

Although flocks of Carnaby's Black-Cockatoo are seen foraging in the Perth metropolitan area during summer and autumn there are no published data of any breeding taking place in the greater Perth metropolitan area. It is also interesting that Carnaby's Black-Cockatoo will nest in the Moora town site (Davies 2005) but have not nested in the Perth metropolitan area. It is not known if they bred in the Perth area before European settlement.

Saunders (1980) reported Carnaby's Black-Cockatoo at Coomallo Creek (breeding area) foraged mostly on native plants, with the only exception being *Erodium* sp.. Higgins (1999) reported the habitat of Carnaby's Black-Cockatoo was uncleared or remnant woodlands dominated by *Eucalyptus*, particularly *E. wandoo* and *E. salmonophloia* and often in shrubland or kwongan heathland dominated by *Hakea*, *Dryandra*, *Banksia* and *Grevillea* and seasonally in *Pinus* plantations and less often in *C. calophylla*, *E. diversicolor* or *E. marginata*.

Since the 1930s, pine plantations have become an important feeding resource during the summer months (Perry 1948, Saunders 1974, 1980). The utilisation of pine plantations by cockatoos is likely to reflect the high energetic return of pine seeds, the concentrated food source and the loss of native habitat that has occurred on the Swan Coastal Plain since the 1930s.

The belief that Carnaby's Black-Cockatoo numbers are in serious decline has led to a recovery plan being released in 2012 (DEC 2013). This plan details the current status of the cockatoo and provides conservation measures to increase the population. The five broad recovery actions in this plan are:

- Protect and manage important habitat – identify, protect and manage habitat critical for survival (nesting, foraging and roosting) for Carnaby's Black-Cockatoos across their breeding and non-breeding range;
- Conduct research to inform management – undertake research into the biology, ecology, and conservation management of Carnaby's Black-Cockatoo;
- Undertake regular monitoring – monitor population parameters, habitat, threats and status of the Carnaby's Black-Cockatoo;
- Manage other impacts – monitor the impacts and implement strategies to reduce other factors detrimentally affecting Carnaby's Black-Cockatoo, and support rehabilitation programs;
- Undertake information and communication activities – develop and distribute awareness raising and guidance materials for decision makers, establish joint management agreements and provide for improved sharing of information between agencies; and
- Engage with the broader community – engage with and involve people across the community in the conservation of Carnaby's Black-Cockatoo.

There is a very limited foraging opportunities for Carnaby's Black-Cockatoo in the project area. If it did forage it is unlikely to return frequently due to the lack of foraging resource. Clearing of the vegetation is unlikely to significantly impact on Baudin's Black-Cockatoo.

Woylie (*Bettongia penicillata ogilbyi)* – Critically Endangered under the *EPBC Act 1999* and Schedule 1 under the *Wildlife Conservation Act 1950*

Woylie numbers have significantly reduced in recent years after it was removed from the conservation significant species lists. The Woylie was once abundant in the south-west forest areas. Fox and cat predation, along with habitat destruction were thought to have significantly reduced its numbers (De Tores and Start 2008). The Woylie diet consists of underground fungi, tubes, bulbs and seeds.

They have not been recorded in the vicinity of the project area in recent years. They were not seen during the site visit. It is Terrestrial Ecosystems' assessment that they are not present in the project area.

Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) – Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

The Forest Red-tailed Black-Cockatoo is one of three large black-cockatoos found in Western Australia. *Calyptorhynchus banksii naso* frequents the humid to sub-humid south-west of Western Australia from Gingin in the north, to Albany in the south and west to Cape Leeuwin and Bunbury (Department of Sustainability Environment Water Population and Communities 2011). It was mostly seen in the hill interior, but small numbers of birds were seen at Mundijong, Baldivis, Karnup, Stakehill, Pinjarra, Coolup and in the Lake Clifton area (Johnstone and Kirkby 2011). In 2011, there was an increase in the number of Forest Red-tailed Black-Cockatoo on the coastal strip north from Rockingham to the northern metropolitan suburbs. The reason for the recent increase in abundance is unknown.

The Forest Red-tailed Black-Cockatoo nests in tree hollows with a depth of 1-5m that are predominately *C. calophylla*, *E. marginata* and *E. diversicolor*. The nest entrance is 12-41 cm, and similar to other black-cockatoos, it lays two eggs on wood chips in October and November, but most often only one survives. Incubation period is 29-31 days and only the female incubates and broods (Johnstone and Storr 1998).

Johnstone and Kirkby (2011) reported the Forest Red-tailed Black-Cockatoo to feed mostly on seeds from *C. calophylla*, *E. marginata*, but also on *Allocasuarina fraseriana* (Sheoak), *Persoonia longifolia* (Snottygobble),

Eucalyptus patens (Blackbutt) and introduced species such as *M. azedarach* (Cape Lilac) and *Corymbia citriodora* (Lemon-scented Gum).

Loss of breeding habitat in the form of suitable hollows and adequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks is a primary threat. Abbott (1998) reported that trees within its known breeding distribution was not a factor in limiting breeding. He estimated there were about 15,000 birds and Garnett et al. (2011) thought about 10% of these birds bred each year. Competition for nesting hollows by other cockatoos, Wood Ducks, Galahs and feral Honey Bees appears to also be a significant threat (Garnett et al. 2011).

There is very limited foraging habitat for Forest Red-tailed Black-Cockatoos with the consequence that they are unlikely to be seen regularly foraging in the project area, and if they do then they will move on quickly. Clearing of the vegetation is unlikely to significantly impact on Forest Red-tailed Black-Cockatoos.

Baudin's Black-Cockatoo (*Calyptorhynchus baudinii*) – Vulnerable under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

Baudin's Black-Cockatoo occurs in the humid and sub-humid forests of Western Australia, an area within the 750mm isohyet (Chapman 2007). It range extends from Gidgegannup and Clackline in the north to about 50km east of Albany and all the forest to the south-west coast (Chapman 2007).

Baudin's Black-Cockatoo is typically found in vagrant flocks and utilises the taller, more open E. marginata, Marri and Karri forests, where it feeds mainly on Marri seeds and various Proteaceous species. Johnstone and Kirkby (2008) reported Baudin's Black-Cockatoo feeding on the seeds of *C. calophylla, E. marginata, A. fraseriana, Banksia grandis, B. quercifolia, B. littoralis, B. ilicifolia, Hakea erinacea, H. prostrata, H. stenocarpa, H. trifurcata, H. lasianthoides, H. ruscifolia, H. lissocarpha, H. varia, H. cristata, H. marginata, Dryandra sessilis, D. squarrosa, D. praemorsa, Grevillea wilsonii, Xanthorrhoea preissii, Kingia australis, Reedia spathacea, Pinus radiata, Erodium* spp. *Jacaranda* spp.*, Macadamia* spp.*, Carya illinoinensis, Malus* spp., *Pyrus* spp., *Diospyros* spp. and *Quercus* spp.; and the nectar, buds and flowers of *C. calophylla,, C. citridora, E. marginata, E. wandoo, B. grandis, D. sessilis, D. lindleyana, D. squarrosa, Darwinia citriodora* and *Callistemom* spp. They also eat insect larvae and insects from under the bark. Baudin's Black-Cockatoo damages apples and pears in domestic and commercial orchards, and for this reason has been shot by orchardists (Chapman 2007).

Johnstone and Kirkby (2008) suggested that once chicks had fledged, birds leave the nesting area and family groups amalgamate to form larger flocks. These large flocks arrive in the non-breeding central and northern parts of the Darling Scarp in early February and March. This postnuptial nomad is seen in Collie, Bannister, North Dandalup, Serpentine, Jarrahdale, Wungong, Mundaring and Chidlow, and sometimes venture on to the adjacent coastal plain at Maida Vale, Kelmscott, Armadale, Byford, Mundijong, Lake Clifton, Bunbury, Capel, Busselton and Dunsborough (Johnstone and Kirkby 2008, Johnstone and Kirkby 2011). During the non-breeding period, Baudin's Black-Cockatoo utilises a number of roosts on a regular basis. Johnstone and Kirkby (2008) have recorded some of the larger roosts at Gidgegannup, Piesse Brook, Nganguring, Mundaring, Araluen, Wungong, North Dandalup and Serpentine. Other roosts are at Chidlow, Parkerville, Kalamunda, Kelmscott, Roleystone, Bedfordale, Gleneagle, Mundijong, Jarrahdale, Bannister and Crossman. Most of these roost sites are tall emergent eucalypts or Blackbutt and they are often near watercourses and in sheltered gullies. They seldom venture as far west as the project area.

It is known to breed in the southern forests north to Collie and east to near Kojonup in large vertical hollows of *E. diversicolor*, *C. calophylla* and *E. wandoo* (Johnstone and Kirkby 2008). Johnstone and Storr (1998) reported eggs are laid in August to December, with a clutch of 1-2, but normally only a single chick is fledged. Only the female incubates and broods.

Garnett et al. (2011) estimated the population to be around 10,00-15,000, with only 10% breeding in any year.

Garnett et al. (2011) reported the primary threat to this species is a lack of suitable hollows. Competition for hollows comes from other cockatoos, Galahs, Australian Shelducks, Wood Ducks and feral Honey Bees (Johnstone and Kirkby 2008, Garnett et al. 2011). Inadequate feeding resources in the vicinity of nesting hollows to enable adults to feed chicks are also a threat.

The Recovery Plan for Baudin's and Forest Red-tailed Black-Cockatoos (Chapman 2007) seeks to:

- develop and promote non-lethal means of stopping Baudin's damaging fruit in orchards;
- eliminate illegal shooting;

- develop and implement strategies to allow for the use of noise emitting devices in orchards;
- develop and implement as protocol for the easy removal of honeybees from nesting hollows;
- determine and implement ways to minimise the effects of mining on habitat loss;
- identify factors affecting the number of breeding attempts and breeding success and manage nest hollows to increase recruitment reduce habitat loss;
- map feeding and breeding habitat critical to the survival of this species;
- determine the population and distribution and patterns of movement for both species; and
- maintain the Cockatoo Care program.

Baudin's Black-Cockatoo may infrequently be seen foraging in the vicinity of the project area, but it is mostly seen on the Swan Coastal Plain much closer to the Darling Scarp. Clearing of the vegetation is unlikely to significantly impact on Baudin's Black-Cockatoo.

Chuditch, Western Quoll (*Dasyurus geoffroii*) – Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

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.

Chuditch were not seen during the site visit and there is no suitable habitat in the project area. Terrestrial Ecosystems' believes that the Chuditch is not present in the project area due to a lack of suitable habitat and there are no recent records in the vicinity.

Western Ringtail Possum (*Pseudocheirus occidentalis*) - Vulnerable under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

The Western Ringtail Possums distribution is patchy across is current range. The closest known population is south of Mandurah. It has a preference for Peppermint woodlands, but is also found in Jarrah/Marri forests and woodlands with adequate hollows, coastal heath, myrtaceous heaths and shrublands and karri forests.

Terrestrial Ecosystems' believes that the Western Ringtail Possum is not present in the project area due to a lack of suitable habitat and there are no recent records in the vicinity of the project area.

Red-tailed Phascogale (*Phascogale calura*) – Endangered under the *EPBC Act 1999* and Schedule 6 under the *Wildlife Conservation Act 1950*

This species was formerly widespread in woodland habitat through much of inland southern and central Australia. It is now restricted to remnants of mature Wandoo or Rock Oak woodland in the southern wheatbelt.

The Red-tailed Phascogale was not seen on site during surveys or caught during the trapping program of the Vivente project area. Terrestrial Ecosystems' assessment is that given the lack of recent records of this species in the vicinity of the project area and a lack of suitable habitat, the Red-tailed Phascogale is not present in the project area.

Numbat (*Myrmecobius fasciatus*) – Vulnerable under the *EPBC Act 1999* and Schedule 2 under the *Wildlife Conservation Act 1950*

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).

The Numbat was not seen during the site visit nor caught during the trapping program of the Vivente project area and there are no recent records of this species in the general area. Terrestrial Ecosystems' assessment is that it is not present in the project area.

Southern Brush-tailed Phascogale (*Phascogale tapoatafa*) – Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

Southern Brush-tailed Phascogales are arboreal marsupials which require tree hollows in suitable woodland or forest and rely on abundant invertebrate prey to sustain populations. They are rarely detected in vertebrate fauna surveys as they are arboreal and trap shy. They are generally not found on the coastal plain south of the Swan River and there are no recent records for this Phascogale in the vicinity of the project area.

The Southern Brush-tailed Phascogale was not seen during the site visit or caught during the Vivente trapping program and given the recent lack of records of this species in the vicinity of the project area and a lack of suitable habitat in the project area, it Terrestrial Ecosystems' assessment that the Southern Brush-tailed Phascogale is not present in the project area.

Quokka (*Setonix brachyurus*) – Vulnerable under the *EPBC Act 1999* and Schedule 3 under the *Wildlife Conservation Act 1950*

Quokkas were originally very common on the Swan Coastal Plain, however, their distribution is now limited to Rottnest Island and a few isolated areas in the south-west of WA. On the mainland, they prefer densely vegetated areas around wetlands and streams, whereas on Rottnest Island they inhabit low scrubby coastal vegetation where water is not readily available year-round. They are herbivorous, and feed on leaves, bark, succulent plants and grasses. There are no recent records of Quokka being found in the vicinity of the project area.

Quokkas were not seen during the site visit nor caught during the Vivente trapping program. Terrestrial Ecosystems' believes that Quokkas are not present in the project area due to lack of suitable habitat and the presence of introduced predators.

Malleefowl (*Leipoa ocellata)* - Schedule 3 under the *Wildlife Conservation Act 1950* and Vulnerable under the *EPBC Act 1999*.

Malleefowl are large, ground-dwelling birds that rarely fly unless alarmed or are perching for the night. Historically, Malleefowl have been found in mallee regions of southern Australia from approximately the 26th parallel of latitude southwards. Recently their range has contracted due to fox predation and land clearance. They have not been recorded in the Perth metropolitan area for many years. Malleefowl build distinctive nests that comprise a large mound of soil/rock covering a central core of leaf litter. These nest mounds range in diameter but can span more than five metres and may be up to one metre high. Malleefowl are generally monogamous and, once breeding commences, they pair for life. The presence of nest mounds provides an indication of the presence of Malleefowl in the area.

Malleefowl are not in the project area and it is Terrestrial Ecosystems' assessment that the proposed clearing in the project area will not have a significant impact on this species.

Fork-tailed Swift (*Apus pacificus*) - Migratory under the *EPBC Act 1999* and Schedule 5 under the *Wildlife Conservation Act 1950*

The Fork-tailed Swift breeds in north-east and mid-east Asia and winters in Australia and south New Guinea (Johnstone and Storr 1998). They arrive in the Kimberley in late September and in the Pilbara in November and the south-west in December, leaving late in April. Johnstone and Storr (1998) reported them as common in the Kimberley and uncommon to moderately common along the north-west, west and south-east coasts and scarce elsewhere. They are often seen in large flocks and can be attracted to thunderstorms or cyclonic events in the northern parts of the state.

As this is an aerial migratory species, ground disturbance activities on a localised scale are unlikely to significantly impact on Fork-tailed Swifts. They could infrequently be seen flying over the project area.

Rainbow Bee-eater (*Merops ornatus*) - Migratory under the *EPBC Act 1999 and* Schedule 5 under the *Wildlife Conservation Act 1950*

Rainbow Bee-eaters are abundant in Australia, and found in many parts of Western Australia except the sandy deserts and dry arid interior. Johnstone and Storr (1998) described them as resident, breeding visitors and

postnuptial nomads. They are generally migratory, moving south in late September and early October, having wintered from the Gascoyne to Indonesia.

Rainbow Bee-eaters are regularly seen across most of the wetter areas of Western Australia including around the project area. Given their abundance and wide spread distribution, ground disturbance activities on a localised scale are unlikely to significantly impact on Rainbow Bee-eaters.

Great Egret (*Ardea modesta*) - Migratory under the *EPBC Act 1999 and* Schedule 5 under the *Wildlife Conservation Act 1950*

Herons and egrets all depend to some extent upon surface water for hunting. The Great Egret is the largest of the Australian egrets, and is an elegant, white wader dependent upon floodwaters, rivers, shallow wetlands and intertidal mudflats. Its diet consists of a range of small, aquatic invertebrates and small vertebrates (Frith 1976).

Given the dependence of the Great Egret upon wetlands and waterways, it is unlikely to be seen in the project area.

Cattle Egret (*Ardea ibis*) - Migratory under the *EPBC Act 1999* and Schedule 5 under the *Wildlife Conservation Act 1950*

The smallest of the Australian egrets, this species has undertaken an invasion of Australia from the north, where it was originally more common in the Indonesian archipelago than Australia (Simpson and Day 2004). This invasion may have been assisted by the opening up of farming land and irrigation schemes, providing the pasturelands and shallow wetlands in which it prefers to forage. Johnstone and Storr (1998) noted the species distribution in Western Australia as being confined to the irrigation areas surrounding Kununurra, however, its migratory nature and current invasive tendencies suggest that it may occur elsewhere in the state, and may still be expanding its distribution.

Given the dependence of the Cattle Egret upon wetlands, waterways and pastures, it is unlikely to be seen in the project area.

Osprey (*Pandion haliaetus*) - Migratory under the *EPBC Act 1999* and Schedule 5 under the *Wildlife Conservation Act 1950*

Osprey are a large bird of prey that is found along the coast of Western Australia. They are typically found close to the coast, river and occasionally large wetlands. They feed mainly on fish and sea snakes and occasionally on large coastal lizards.

Osprey may infrequently be seen flying over the project area, but clearing the vegetation is unlikely to have a significant impact on this species.

Grey Wagtail (Motacilla cinerea) - Migratory under the *EPBC Act 1999* and Schedule 5 under the *Wildlife Conservation Act 1950*

The Grey Wagtail is a small yellow breasted bird with a grey back and head. Johnstone and Storr (2004) reported this migratory species as breeding in Palearctic from western Europe and north-west Africa to eastern Asia and wintering in Africa, south-east Asia, Indonesia, the Philippines, New Guinea and Australia. Its preferred habitat in Australia is banks and rocks in fast-running fresh water including rivers, streams and creeks where it feeds on insects. The Atlas of Living Australia records two sightings on the south-coast of Western Australia and none around the project area. It is highly unlikely to be seen in the project area due to a lack of suitable habitat.

Ctenotus gemmula – Priority 3 with DPAW

There are three geographic populations for this small skink. One is on the sand plain north of Perth, one is on the sand plain around the greater metropolitan area and the largest geographic distribution is along the south coast of Western Australia. Storr et al. (1999) reported its habitat as white sand plains, mainly in semi arid and sub-humid zones. There are two records in Terrestrial Ecosystems' fauna survey database for a *C. gemmula* in the vicinity of the project area, but since the project area had been previously cleared, there is a very low possibility that it could still occur in the project area. It was not recorded during vegetation clearing of Vivente.

Terrestrial Ecosystems' assessment is that there is a very low possibly this species could occur in the project area.

Black-striped Snake (*Neelaps calonotos*) – Priority 3 with DPaW

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. In its natural state, the project area would have been typical habitat for the Black-striped snake, but not since the project area has been cleared. It was not recorded during vegetation clearing in the Vivente project area.

Terrestrial Ecosystems' assessment is that there is a very low possibly this species could occur in the project area.

Lined Skink (*Lerista lineata*) – Priority 3 with DPaW

This species is found in coastal heaths and shrub lands on the lower west coast between Perth and Mandurah, including Rottnest Island, with isolated populations on the mid-west coast and Busselton. It has been caught on the sand plain south of the Swan River and could be found in the project area before it was cleared. It was not recorded during vegetation clearing in the Vivente project area, and is therefore unlikely to occur in the project area.

Graceful Sun-moth (*Synemon gratiosa*) – Priority 4 with DPaW

This species has brightly coloured orange hind-wings, and is similar in appearance to a butterfly. The breeding season is late February to early April, during which time adults are active during the day and they are thought to breed exclusively on *Lomandra* species, in particular *L. hermaphrodita* and *L. maritima*. PGV Environmental (2014) listed *L. hermaphrodita* as being present in the project area. Graceful Sun-moths occur along the Swan Coastal Plain between Moore River and Preston Beach and the species is under threat due to vegetation clearing and damage to the environment.

As there is a small quantity of *L. hermaphrodita* in the project area, there is a low possibility that the Graceful Sun-moth is present in the project area.

Western Brush Wallaby (*Macropus irma*) – Priority 4 with DPaW

This species was very common in the early days of settlement, however, its range has been seriously reduced and fragmented due to clearing for agriculture and there is a significant decline in abundance within most remaining habitat. It is now distributed across the south-west of WA from north of Kalbarri to Cape Arid. The optimum habitat is open forest or woodland, particularly favouring open, seasonally wet flats with low grasses and open scrubby thickets.

It was not seen during the site visit and Terrestrial Ecosystems' believes that it is not present in the project area because of a lack of suitable habitat.

Water Rat (*Hydromys chrysogaster*) – Priority 4 with DPaW

The water rat is found mainly near permanent bodies of freshwater, occasionally at temporary waterholes. It is also found in the streams, wetland, lakes and estuaries on the Swan Coastal Plain.

As there is no wetland on or near the project area, Terrestrial Ecosystems' believes the Water Rat it is not present in the project area.

Western False Pipistrelle (*Falsistrellus mackenziei*) – Priority 4 with DPaW

This insectivorous species is the largest vespertilinoid in WA and is confined to south-west WA, south of Perth and east to the wheatbelt. It is known to utilise the mature Karri forests but has also been recorded in Jarrah and Tuart woodland on the Swan Coastal Plain.

Terrestrial Ecosystems' believes it is unlikely to be recorded in a Banksia woodland on the Swan Coastal Plain.

Quenda or Southern Brown Bandicoot (*Isoodon obesulus fusciventer*) – Priority 4 with DPaW

Quenda prefer dense scrub, with swampy vegetation but are found in a variety of other habitats. 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 was caught in the Vivente project area prior to the vegetation clearing program but due to a lack of suitable habitat in the project area it is highly unlikely to be present.

Threatened marine, wetland or shore birds

Anous tenuirostris melanops (Australian Lesser Noddy), *Botaurus poiciloptilus* (Australasian Bittern), *Calidris ferruginea* (Curlew Sandpiper), *Diomedea epomophora epomophora* (Southern Royal Albatross), *Diomedea epomophora sanfordi* (Northern Royal Albatross), *Diomedea exulans amsterdamensis* (Amsterdam Albatross), *Diomedea exulans exulans* (Tristan Albatross), *Diomedea exulans* (Wandering Albatross), *Macronectes giganteus* (Southern Giant Petrel), *Macronectes halli* (Northern Giant Petrel), *Pachyptila turtur subantarctica* (Fairy Prion), *Rostratula australis* (Australian Painted Snipe), *Sternula nereis nereis* (Australian Fairy Tern), *Thalassarche cauta cauta* (Shy Albatross), *Thalassarche cauta steadi* (White-capped Albatross), *Thalassarche melanophris* (Black-browed Albatross), *Thalassarche melanophris impavida* (Campbell Albatross), *Puffinus carneipes* (Flesh-footed Shearwater), *Sterna anaethetus* (Bridled Tern), *Charadrius rubricollis* (Hooded Plover), *Sterna caspia* (Caspian Tern), *Sterna dougallii* (Roseate Tern), *Thalassarche melanophris* (Black-browed Albatross), *Calidris acuminata* (Sharp-tailed Sandpiper), *Calidris canutus* (Red Knot), *Calidris melanotos* (Pectoral Sandpiper), *Calidris ruficollis* (Red-necked Stint), *Calidris subminuta* (Long-toed Stint), *Charadrius dubius* (Little Ringed Plover), *Charadrius ruficapillus* (Red-capped Plover), *Gallinago megala* (Swinhoe's Snipe), *Gallinago stenura* (Pin-tailed Snipe), *Haliaeetus leucogaster* (White-bellied Sea-Eagle), *Himantopus himantopus* (Black-winged Stilt), *Larus pacificus* (Pacific Gull), *Limosa lapponica* (Bar-tailed Godwit), *Limosa limosa* (Black-tailed Godwit) and *Philomachus pugnax* (Ruff) were recorded in the EPBC threatened species database search in the vicinity of the project area, but they are marine, wetland or shore birds and therefore unlikely to be seen in the project area due to a lack of suitable habitat.

4.4 Risk assessment

Fauna surveys to support Environmental Impact Assessments (EIA) are part of the environmental risk assessment undertaken to consider what potential impacts a development might have on the biodiversity in a particular area and region. Potential impacts on fauna from the proposed development are identified and briefly described above. Tables 9, 10 and 11 provide a summary of the risk assessment associated with this project.

The assessment contained in Table 11 is supported by more detailed discussion in sections above and the management recommendations below.

Table 10: Fauna impact risk assessment descriptors

Any risk assessment is a product of the likelihood of an impact occurring and the consequences of that impact. Likelihood and consequences are categorised and described below. These criteria do not fit all circumstances (e.g. adequacy of fauna survey data); however, they are useful in providing the reader with an appreciation of the level of likelihood and consequences of an event. 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. 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 12.

Likelihood		
Level	Description	Criteria
A	Rare	The environmental event may occur or one or more conservation significant species may be present in exceptional circumstances.
B	Unlikely	The environmental event could occur or one or more conservation significant species could be present at sometime.
C	Moderate	The environmental event should occur or one or more conservation significant species should be present at sometime.
D	Likely	The environmental event will probably occur or one or more conservation significant species will be present in most circumstances.
E	Almost certain	The environmental event is expected to occur or one or more conservation significant species is expected be present 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 or fauna assemblages in the area.
2	Minor	Impact on fauna localised and no significant impact on species of conservation significance in the project area. Loss of species at the local scale.
3	Moderate	An appreciable loss of fauna in a regional context or a limited impact on species of conservation significance in the project area.
4	Major	Significant impact on conservation significant fauna or their habitat in the project 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 'endangered' under the *EPBC Act (1999)* at a regional scale.

Acceptability of Risk	
Level of risk	Management of risk
Low	No action required.
Moderate	Avoid if possible, routine management with internal audit and review of monitoring results annually.
High	Externally approved management plan to reduce risks, monitor major risks annually with external audit and review of management plan outcomes annually. Will require a referral to the Commonwealth under the *EPBC Act 1999*.
Extreme	Unacceptable, project should be redesigned or not proceed.

Table 11. Levels of acceptable risk

		Likelihood				
		Rare or very low (A)	Unlikely or low (B)	Moderate (C)	Likely (D)	Almost certain (E)
Consequences	Insignificant (1)	Low	Low	Low	Low	Low
	Minor (2)	Low	Low	Low	Moderate	Moderate
	Moderate (3)	Low	Moderate	Moderate	High	High
	Major (4)	Moderate	Moderate	High	High	Extreme
	Catastrophic (5)	Moderate	High	High	Extreme	Extreme

Table 12. Risk assessment

		Before Management				With Management		
Factor	Potential Impact	Inherent Risk			Risk Controls / Management	Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Inadequate fauna survey data.	Unknown loss of fauna, fauna of conservation significance, fauna assemblage(s) in development site.	A	1	Low				
Inadequate knowledge of potential impacts.	Unknown or poorly assessed impact(s) on fauna assemblage and conservation significant species.	A	2	Low				
Inadequate bioregional data for contextual purposes.	Incomplete analysis of data and appreciation of impacts on biodiversity values in a regional context.	C	2	Low				
Removal of habitat – site scale.	Almost complete loss of terrestrial fauna in cleared areas, severe impact on local fauna assemblage.	E	2	Moderate				
Significant reduction of habitats – local scale.	Loss of fauna and fauna habitat and impacts on local fauna assemblage (excluding conservation significant species).	A	2	Low				
Significant reduction of habitats – landscape scale.	Loss of fauna and fauna habitat and impacts on fauna in a landscape context (excluding conservation significant species).	A	1	Low				
Significant reduction of habitats – regional scale.	Loss of fauna and fauna habitat and impacts on fauna in a bioregional context (excluding conservation significant species).	A	1	Low				

		Before Management				With Management		
Factor	Potential Impact	Inherent Risk			Risk Controls / Management	Residual Risk		
		Likelihood	Consequence	Significance		Likelihood	Consequence	Significance
Impact on resident or visiting conservation significant terrestrial species.	Loss of a localised population or a few individuals – *Calyptorhynchus banksii naso.*	A	1	Low				
	Loss of a localised population or a few individuals – *Calyptorhynchus latirostris*.	A	1	Low				
	Loss of a localised population or a few individuals – *Calyptorhynchus baudinii.*	A	1	Low				
	Loss of a localised population or a few individuals – *Synemon gratiosa.*	B	1	Low				
	Loss of a localised population or a few individuals – *Neelaps calonotus.*	B	2	Low				
	Loss of a localised population or a few individuals – *Lerista lineata.*	B	2	Low				
	Loss of a localised population or a few individuals – *Ctenotus gemmula.*	B	2	Low				
	Loss of a localised population or a few individuals – *Merops ornatus*.	A	1	Low				
	Loss of a localised population or a few individuals – *Isoodon obesulus*.	A	1	Low				

5 DISCUSSION

5.1 Adequacy of available vertebrate fauna data

The EPA *Terrestrial Biological Surveys as an Element of Biodiversity Protection:* Position Statement No. 3 (EPA 2002), *Guidance Statement for Assessment of Environmental Factors: Terrestrial Fauna Surveys for Environmental Impact Assessment in Western Australia No. 56* (EPA 2004) and the *Technical Guide – Terrestrial Vertebrate Fauna Surveys for Environmental Impact Assessment* (EPA / DEC 2010) are the three relevant documents to assess the adequacy of the available information and reporting for vertebrate fauna surveys in Western Australia.

Trapping and relocation data for the Vivente project area and reports by Phoenix Environmental Sciences (2011), Western Wildlife (2010), 360 Environmental (2008), ATA Environmental (2006), Bamford Consulting Ecologists (2009), GHD (2006) and ENV Australia (2009) in conjunction with data extracted from NatureMap, Atlas of Living Australia and the Western Australian Museum records and reports by the Western Australian Museum (Harvey et al. 1997, How et al. 1999) and Gole (2003) for remnant vegetation plots provide an adequate indication of the fauna likely to be in the vicinity of the project area.

5.2 Biodiversity values of the site

5.2.1 Condition of fauna habitat and extent of habitat degradation

There are four fauna habitat types present on the site (see section 2.3). Vegetation in the project area is regrowth and generally in very poor condition and of low value.

5.2.2 Ecological linkages

There are three substantial areas set aside as Bush Forever sites nearby; Thompsons Lake Nature Reserve (BFS 391), Harry Waring Marsupial Reserve (BFS 392) and Forrestdale Lake (BFS 345). In addition, there are three smaller areas; Mandogalup Road Bushland (BFS 268), Banjup Bushland (BFS 263) and Lyon Road Bushland (BFS 492) that would support a fauna assemblage similar to that in the project area. Birds can easily move between these sites, however, terrestrial mammals, reptiles and amphibians are mostly restricted by major roads, urban residential, agriculture and industrial developments. The project area was originally connected to the Vivente project area, but has been separated by the Barfield Road for many years, which has now been cleared.

The site does not form part of an important ecological linkage for fauna in the general area.

5.2.3 Size and scale of the proposed disturbance and potential impacts

The project area is less than 2ha and the vegetation is in poor condition, so potential impacts on vertebrate fauna, including threatened species is very low.

5.2.4 Conservation significant species

Given the area had previously been cleared and the project supports low quality habitat, the potential for the Black-striped Snake (*Neelaps calonotus*), *Ctenotus gemmula* and the Lined Skink (*Lerista lineata*) to be recorded in the project area is low. These species were not recorded when Vivente was cleared. Carnaby's Black-Cockatoo (*Calyptorhynchus latirostris*), Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*) and the Rainbow Bee-eater (*Merops ornatus*) may infrequently forage in the project area, however, clearing of the vegetation is unlikely to have a significant impact on any of these species due to the low value of the habitat.

No tree hollows with the potential to be used as nesting sites by Black-Cockatoos are in the project area. Johnstone and Kirkby (2011) indicated that there were no records of Carnaby's Black-Cockatoo breeding in the vicinity of the project area. Forest Red-tailed Black-Cockatoos are known to breed in the grounds of Murdoch University to the north and in farmland around Baldivis to the south.

The very small quantity of *Lomandra hermaphrodita* would suggest that it is unlikely that Graceful Sun-Moths (*Synemon gratiosa*) were present in the project area. Southern Brown Bandicoots were trapped and relocated prior to vegetation clearing in the Vivente project area and in the Catholic Primary School grounds to the west of the project area, but the lack of suitable habitat in the project area would indicate that they are not present.

5.3 Potential environmental impacts

Clearing of vegetation will potentially affect vertebrate fauna in a number of ways, including:

- death/injury of fauna during vegetation clearing and development;
- loss of habitat; and
- fragmentation of fauna habitat.

5.3.1 Impacts on the fauna assemblage and fauna habitat

Level 1 fauna assessments are, in essence, an assessment of the risks associated with the proposed disturbance on the fauna either known or potentially in the area. Table 13 is a summary of that risk assessment for clearing vegetation and developing the project area.

Table 13. A summary of the assessed risk of impact on the fauna and fauna habitat it the project area

Issues	**Assessment**				
Formal conservation status for the area:	No			Yes	
Specifically for fauna	X				
Level of alteration to the original faunal habitat	Very High				Very Low
	1	2	3	4	5
surface soil				X	
vegetation		X			
by salinity					X
by non-farmed exotic species				X	
by farmed species					X
level of habitat fragmentation		X			
Knowledge of:	Very High				Very Low
	1	2	3	4	5
species in each biotope		X			
assemblage structure per biotope		X			
presence of rare and protected species		X			
presence of range restricted species		X			
presence of short range endemic invertebrates					?
presence of stygofauna					?
ecosystem values		X			
regional species and regional assemblages		X			
regional ecosystems		X			
Capacity to assess biodiversity values for each biotope at:	Very High				Very Low
	1	2	3	4	5
species level	X				
ecosystem levels	X				
ecological functional values	X				
regional significance of faunal assemblage	X				
Consequences of the proposed disturbance in the context of the:	Very High				Very Low
	1	2	3	4	5
level of existing disturbance	X				
size of area to be disturbed					X
scale of the disturbance				X	
significance of fauna habitat in a regional context					X
extent to which the area is a refuge for fauna					X
extent to which the disturbance will impact on rare or protected fauna					X
extent to which the fauna habitat is an ecologically important					X

Issues	Assessment				
remnant					
extent to which the habitat provides an ecological linkage(s) or corridor(s)					X
heterogeneity of habitat				X	
abundance of the habitat in the bioregion			X		

5.3.2 Impacts on Black-Cockatoos

Carnaby's Black-Cockatoo may infrequently forage in the areas of *Banksia* sp. and Forest Red-tailed Black-Cockatoos would forage in the *E. marginata*. However, there is a very low abundance of *Banksia* sp. and *E. marginata* in the project area.

Table 14 provides a summary of the assessed potential impact on Black-Cockatoos associated with the action of clearing the vegetation based on the criteria set out in the Department of Sustainability, Environment, Water, Population and Communities (2012) referral guidelines for Black-Cockatoos. This is followed by a more detailed assessment to support this summary table. Commonwealth referral guidelines (Department of Sustainability Environment Water Population and Communities 2011) do not define what is quality foraging habitat for Black-Cockatoos, so the criteria outlined in Table 1 have been used.

The Eco Logical Australia (2013) assessment of Carnaby's Black-Cockatoo foraging habitat in the Perth-Peel region used a measure of the number of Banksia trees or pods/hectare to estimate the foraging resource characteristics of particular areas. No indication of quality was provided in this report, however, tree and pod densities are provided for numerous sites, some in close proximity to the project area (i.e. Thomsons Lake Reserve, Harry Warring Marsupial Reserve, Beeliar Regional Park). Banksia tree and pod density were not measured in this assessment, but are likely to be much lower than those recorded for Thomson Lake Reserve and Harry Waring Marsupial Reserve.

Table 14. Summary assessment of whether an action will have a significant impact on the two species of Black-Cockatoos

High risk of significant impacts: referral recommended	Carnaby's Black-Cockatoo	Forest Red-tailed Black-Cockatoo
Clearing of any known nesting tree.	No nesting trees were recorded on the project area.	No nesting trees were recorded on the project area.
Clearing or degradation of any part of a vegetation community known to contain breeding habitat.	The project is outside the DPaW mapped potential breeding habitat.	Is within the vicinity of a known breeding location.
Clearing of more than 1ha of quality foraging habitat.	Will not clear more than 1ha of quality foraging habitat.	Will not clear more than 1ha of quality foraging habitat.
Clearing or degradation (including pruning the top canopy) of a known night roosting site.	Clearing will not impact on a known roosting site.	Clearing will not impact on a known roosting site.
Creating a gap of greater than 4 km between patches of black cockatoo habitat (Breeding, foraging or roosting).	Clearing will not create a gap of greater than 4km between patches of Black-Cockatoo habitat.	Clearing will not create a gap of greater than 4km between patches of Black-Cockatoo habitat.
Uncertainty: referral recommended or contact the department		
Degradation (such as through altered hydrology or fire regimes) of more than 1 ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat.	Clearing will not impact on more than 1ha of foraging habitat.	Clearing will not impact on more than 1ha of foraging habitat.
Clearing or disturbance in areas surrounding black-cockatoo breeding, foraging or night roosting habitat that has the potential to degrade habitat through introduction of invasive species, edge effect, hydrological changes, increased human visitation or fire.	Based on the recent Great Cocky count (Byrne et al. 2015), there are roost sites to the west of the project area. The exact locations of these roosts are not shown so the distance from the project area cannot be determined	Based on the recent Great Cocky count (Byrne et al. 2015), there are roost sites to the north-west of the project area. The exact locations of these roosts are not shown and thus the distance from the project area cannot be

	from the report, but is a considerable distance away.	determined from the report, but is a considerable distance away.
Actions that do not directly affect the listed species but that have a potential for indirect impacts such as increasing competitors for nest hollows.	The project area contains no trees with hollows.	The project area contains no trees with hollows.
Actions with the potential to introduce known plant disease such as *Phytophthor*a spp. To an area where the pathogen was not previously known.	With the implementation of appropriate hygiene standards during vegetation clearing, diseases are unlikely to be introduced to the site.	With the implementation of appropriate hygiene standards during vegetation clearing, diseases are unlikely to be introduced to the site.
Low risk of significant impacts: referral may not be required.		
Actions that do not affect black-cockatoo habitat or individuals.		
Actions whose impacts occur outside the modelled distribution of the three black-cockatoos.		

Clearing of any known nesting tree (high risk)

Forest Red-tailed Black-Cockatoos are known to nest in farm land, rural residential, rural remnants and eucalypt woodland near Baldivis and at Murdoch University. The project area is between Baldivis and Murdoch University, but it contains no trees with hollows that may provide a suitable nesting site. The project area is outside the known potential area of nesting sites for Carnaby's Black-Cockatoo as shown on the DPaW maps.

Clearing of any part or degradation of breeding habitat (high risk)

Breeding habitat for Carnaby's Black-Cockatoo is defined as woodland or forest, but also breeds in former woodland or forest now present as isolated trees. Carnaby's Black-Cockatoo nests in hollows in live or dead trees of *E. salmonophloia*, *E. wandoo*, *E. gomphocephala*, *E. marginata, E. rudis*, *E. loxophleba*, *E. accedens*, *C. calophylla*, *E. diversicolor* and for Forest Red-tailed Cockatoos in woodland or forest, but may also breed in former woodland or forest now present as isolated trees. Nests are found in hollows in live or dead trees of *C. calophylla*, *E. diversicolor*, *E. wandoo*, *E. megacarpa*, *E. patens*, *E. gomphocephala* and *E. marginata* (Department of Sustainability Environment Water Population and Communities 2012; p.15). It is Terrestrial Ecosystems assessment that Carnaby's Black-Cockatoo are unlikely to nest in the vicinity of the project area as they have not nested in the project area thus far and the area is outside that defined by DPaW as a potential breeding site. However, with the recent increase in Forest Red-tailed Black-Cockatoos on the Swan Coastal Plain both south and north of the Swan River, and known breeding activity at Murdoch University and Baldivis, it is possible that this species may breed in the vicinity of the project area in the future. However, there are no suitable tree hollows in the project area.

Clearing of more than 1ha of quality foraging habitat (high risk)

The definition of what is 'quality habitat' is unknown, but based on the rating system provided in Table 1, the foraging habitat is assessed as poor or very poor. Therefore less than 1ha of quality foraging habitat will be cleared.

Clearing or degradation including pruning the top canopy of a known roosting site (high risk)

There is no evidence to indicate that Carnaby's or Forest Red-tailed Black-Cockatoos roost in the project area. However, Forest Red-tailed Black-Cockatoos regularly shift their roosting sites, and could periodically roost in the project area for a short period. The recently released 2015 Great Cocky Count (Byrne et al. 2015) indicates a roosting sites for Carnaby's Black-Cockatoo to the west and Forest Red-tailed Black-Cockatoos to the north-west, but both are a considerable distance away.

Degradation (such as through altered hydrology or fire regimes) of more than 1ha of foraging habitat. Significance will depend on the level and extent of degradation and the quality of the habitat (uncertainty)

It is proposed that less than 1ha of Black-Cockatoo foraging habitat will be cleared.

Clearing or disturbance in areas surrounding black cockatoo habitat that has the potential to degrade habitat through the introduction of invasive species, edge effects, hydrological changes, increased human visitation or fire (uncertainty)

The area to be cleared will be used for residential housing in a similar manner to other adjacent developments. So, this development will increase human visitation to the area.

Actions that do not directly affect the listed species but that have the potential for indirect impacts such as increasing competitors for nest hollows (uncertainty)

There was no other obvious indirect impact that clearing the vegetation might have on Black-Cockatoos and no suitable nesting hollows in the project area.

Action with the potential to introduce known plant diseases such as Phytophthora spp. *(uncertainty)*

Clearing of the vegetation is only likely to spread diseases such as *Phytophthora* spp., if appropriate standards of hygiene are not maintained in the equipment used to clear the vegetation. This aspect is able to be effectively managed and controlled by the land developer.

5.4 Native vegetation clearing principles

The *Environmental Protection Act* (*1986*) provides criteria to judge the potential impact of a development on clearing native vegetation. These criteria have been listed in Table 15 with a response to indicate how clearing of the vegetation in the project area might be judged against these principles.

Table 15. Assessment of impact on fauna using the Native Vegetation Clearing Principles

Principle	Response
It comprises a high level of biological diversity.	Clearing vegetation will not compromise a high level of biodiversity.
It comprises the whole or a part of, or is necessary for the maintenance of, a significant habitat for fauna indigenous to Western Australia.	Clearing the vegetation will not result in the loss of significant habitat necessary for the maintenance of fauna indigenous to Western Australia.
It includes, or is necessary for the continued existence or, rare flora.	Not applicable.
It comprises the whole or a part of, or is necessary for the maintenance of, a threatened ecological community.	The area does not contain a threatened ecological fauna community, but could support a number of conservation significant species.
It is significant as a remnant of native vegetation in an area that has been extensively cleared.	The area is not a remnant and similar habitat exists in adjacent areas.
It is growing in, or in association with, an environment associated with a watercourses or wetland.	The area is not a wetland.
The clearing of the vegetation is likely to cause appreciable land degradation.	Not applicable.
The clearing of the vegetation is likely to have an impact on the environmental values of any adjacent or nearby conservation area.	Clearing of vegetation is unlikely to impact on the environmental values of the bioregion.
The clearing of the vegetation is likely to cause deterioration in the quality of surface or underground water.	Not applicable.
The clearing of the vegetation is likely to cause, or exacerbate the incidence of flooding.	Not applicable.

6 SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Gold Estates is seeking to develop Lot 15 Barfield Road, Hammond Park, adjacent to the recently cleared Vivente project area. The project area has a substantial area that is devoid of native trees and shrubs and the remaining area is regrowth. The project area has been assessed as low value fauna habitat and low or very low Black-Cockatoo foraging habitat. Although, there is a small quantity of *L. hermaphrodita* present on site, it is unlikely that Graceful Sun-moths are present.

The impact of clearing less than 2ha of low or very low quality foraging habitat on Black-Cockatoos is not significant, and does not warrant a referral to the Commonwealth Government under the EPBC Act (1999).

There is a very low possibility that the area contains the Jewelled South-west Skink *(Ctenotus gemmula*), Black-striped snake (*Neelaps calonotus*) or Lined Skink (*Lerista lineata*), however, they were not caught or seen when the much larger Vivente project area, which is located directly to the west of the project area, was cleared. If present, these reptiles will be lost during vegetation clearing. The cumulative effect of progressively clearing most of the *Banksia* and jarrah woodland in the general area may have an effect in the long term.

Conservation significant Rainbow Bee-eater (*Merops ornatus*), if they are in the project area, will move to adjacent bush land once vegetation clearing commences and would not be significantly impacted.

6.1 Recommendations

It is recommended that a fauna salvage program is implemented during the vegetation clearing program by a suitably qualified zoologist.

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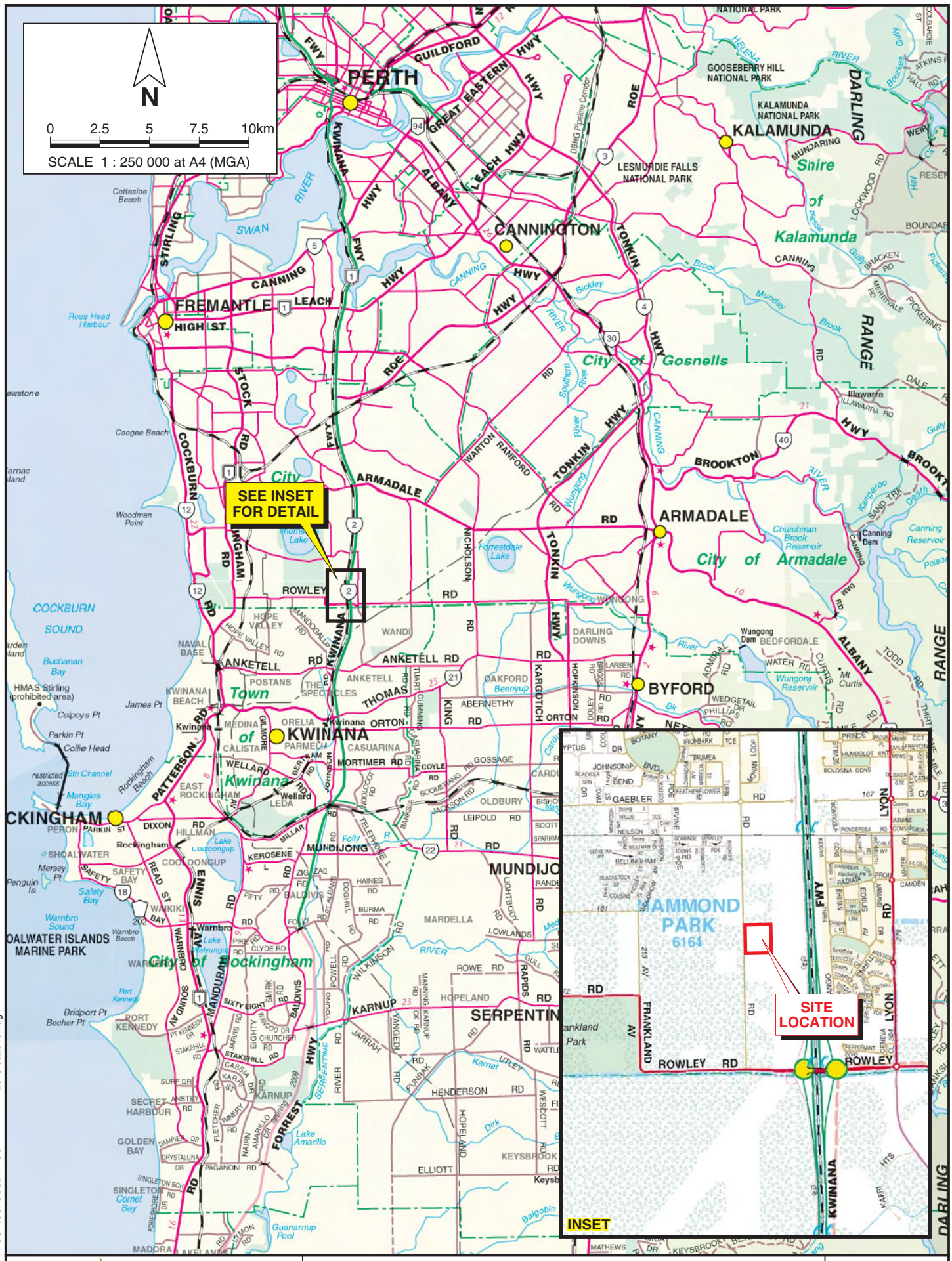
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PINPOINT CARTOGRAPHICS (08) 9562 7136

TERRESTRIAL ECOSYSTEMS

Gold Estate Holdings Pty Ltd
LEVEL 1 FAUNA RISK ASSESSMENT
LOT 15 BARFIELD RD, HAMMOND PARK

Figure 1

REGIONAL LOCATION

Drawn: S. Thompson | Date: 27 Apr 2016 | Job: 2016-0020



CADASTRAL SOURCE: Landgate, April 2016.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown March 2016.

TERRESTRIAL ECOSYSTEMS

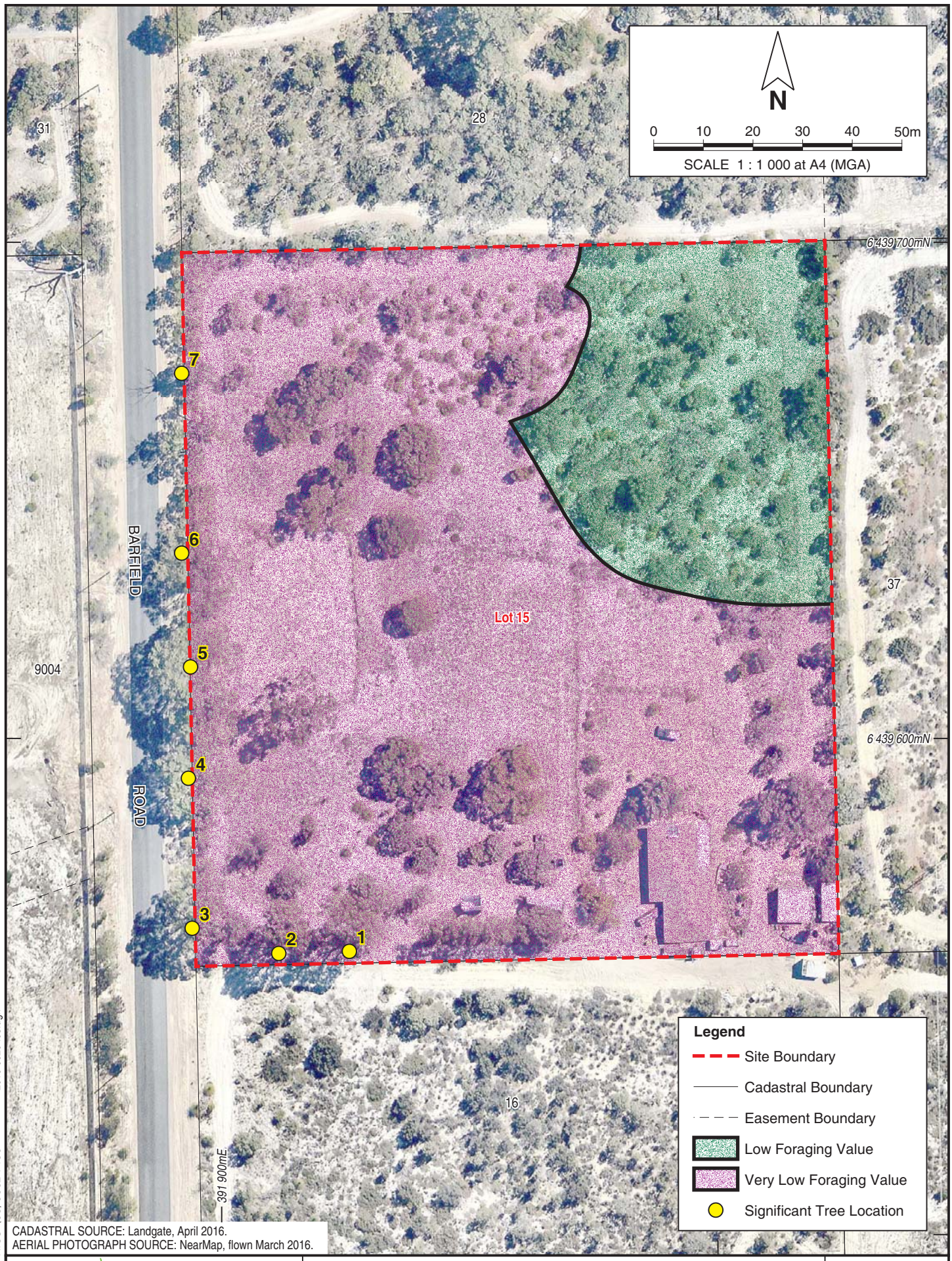
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LEVEL 1 FAUNA RISK ASSESSMENT
LOT 15 BARFIELD RD, HAMMOND PARK

HABITAT QUALITY

Figure 2

Drawn: S. Thompson | Date: 27 Apr 2016 | Job: 2016-0020

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CADASTRAL SOURCE: Landgate, April 2016.
AERIAL PHOTOGRAPH SOURCE: NearMap, flown March 2016.

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TERRESTRIAL ECOSYSTEMS

Gold Estate Holdings Pty Ltd
LEVEL 1 FAUNA RISK ASSESSMENT
LOT 15 BARFIELD RD, HAMMOND PARK

BLACK COCKATOO FORAGING VALUE

Figure 3

Drawn: S. Thompson | Date: 27 Apr 2016 | Job: 2016-0020

Appendix A
Search Results from the *EPBC Act* (1999) On-line Database

Vertebrate Fauna Assessment – Lot 15 Barfield Rd, Hammond Park

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.

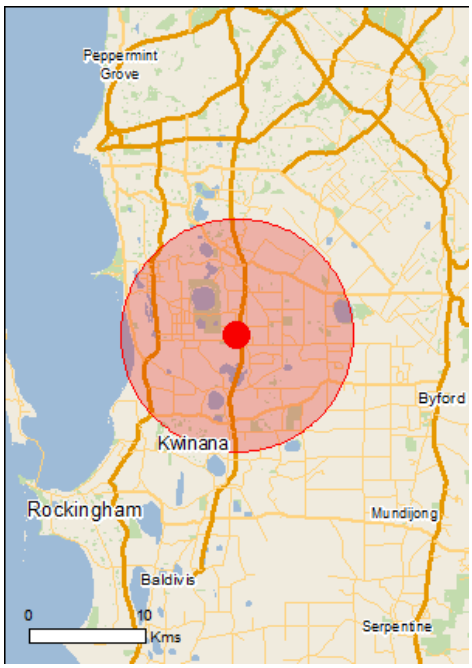
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

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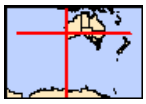
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

Coordinates
Buffer: 10.0Km



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:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	48
Listed Migratory Species:	53

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	78
Whales and Other Cetaceans:	13
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:	12
Regional Forest Agreements:	None
Invasive Species:	44
Nationally Important Wetlands:	4
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Forrestdale and thomsons lakes	Within Ramsar site
Peel-yalgorup system	30 - 40km upstream

Listed Threatened Ecological Communities [Resource Information]

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.

Name	Status	Type of Presence
Claypans of the Swan Coastal Plain	Critically Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to 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 Black-Cockatoo, Long-billed Black-Cockatoo [769]	Vulnerable	Roosting known to occur within area
Calyptorhynchus latirostris Carnaby's Black-Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Breeding likely to occur within area
Diomedea epomophora epomophora Southern Royal Albatross [25996]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea epomophora sanfordi Northern Royal Albatross [82331]	Endangered	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans amsterdamensis Amsterdam Albatross [82330]	Endangered	Species or species habitat may occur within area
Diomedea exulans exulans Tristan Albatross [82337]	Endangered	Species or species habitat may occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or

Name	Status	Type of Presence
		related behaviour likely to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Pachyptila turtur subantarctica Fairy Prion (southern) [64445]	Vulnerable	Species or species habitat known to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Sternula nereis nereis Australian Fairy Tern [82950]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Thalassarche cauta cauta Shy Albatross, Tasmanian Shy Albatross [82345]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta steadi White-capped Albatross [82344]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche melanophris impavida Campbell Albatross [82449]	Vulnerable	Species or species habitat may occur within area
Insects		
Leioproctus douglasiellus a short-tongued bee [66756]	Critically Endangered	Species or species habitat likely to occur within area
Neopasiphae simplicior A native bee [66821]	Critically Endangered	Species or species habitat likely to occur within area
Mammals		
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species habitat known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder,	Vulnerable	Species or species

Name	Status	Type of Presence
Ngoor, Ngoolangit [25911]		habitat likely to occur within area
Setonix brachyurus		
Quokka [229]	Vulnerable	Species or species habitat may 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 known to occur within area
Darwinia foetida		
Muchea Bell [83190]	Critically Endangered	Species or species habitat likely to occur within area
Diuris micrantha		
Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei		
Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat known to occur within area
Drakaea elastica		
Glossy-leafed Hammer-orchid, Praying Virgin [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha		
Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat known to occur within area
Eucalyptus balanites		
Cadda Road Mallee, Cadda Mallee [24264]	Endangered	Species or species habitat likely to occur within area
Grevillea curviloba subsp. incurva		
Narrow curved-leaf Grevillea [64909]	Endangered	Species or species habitat may occur within area
Lepidosperma rostratum		
Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to occur within area
Thelymitra dedmaniarum		
Cinnamon Sun Orchid [65105]	Endangered	Species or species habitat may occur within area
Reptiles		
Caretta caretta		
Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas		
Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea		
Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Natator depressus		
Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Sharks		
Carcharias taurus (west coast population)		
Grey Nurse Shark (west coast population) [68752]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	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
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Migratory Marine Species		
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Carcharodon carcharias Great White Shark [64470]	Vulnerable	Species or species habitat known to occur within area
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Lamna nasus Porbeagle, Mackerel Shark [83288]		Species or species habitat may occur within area
Manta alfredi Reef Manta Ray, Coastal Manta Ray, Inshore Manta Ray, Prince Alfred's Ray, Resident Manta Ray [84994]		Species or species habitat may occur within area
Manta birostris Giant Manta Ray, Chevron Manta Ray, Pacific Manta Ray, Pelagic Manta Ray, Oceanic Manta Ray [84995]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Rhincodon typus Whale Shark [66680]	Vulnerable	Species or species habitat may occur within area
Migratory Terrestrial Species		
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
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
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

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		
Anous tenuirostris melanops Australian Lesser Noddy [26000]	Vulnerable	Species or species habitat may occur within area
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
Calidris acuminata Sharp-tailed Sandpiper [874]		Roosting known to occur within area
Calidris canutus Red Knot, Knot [855]		Roosting known to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Roosting known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Roosting known to occur within area
Calidris ruficollis Red-necked Stint [860]		Roosting known to occur within area
Calidris subminuta Long-toed Stint [861]		Roosting known to occur within area
Charadrius dubius Little Ringed Plover [896]		Roosting known to occur within area
Charadrius ruficapillus Red-capped Plover [881]		Roosting known to occur within area
Diomedea amsterdamensis Amsterdam Albatross [64405]	Endangered*	Species or species habitat may occur within area
Diomedea dabbenena Tristan Albatross [66471]	Endangered*	Species or species habitat may occur within area
Diomedea epomophora (sensu stricto) Southern Royal Albatross [1072]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Diomedea exulans (sensu lato) Wandering Albatross [1073]	Vulnerable	Foraging, feeding or related behaviour likely to occur within area

Name	Threatened	Type of Presence
Diomedea sanfordi Northern Royal Albatross [64456]	Endangered*	Foraging, feeding or related behaviour likely to occur within area
Gallinago megala Swinhoe's Snipe [864]		Roosting likely to occur within area
Gallinago stenura Pin-tailed Snipe [841]		Roosting likely to occur within area
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
Himantopus himantopus Black-winged Stilt [870]		Roosting known to occur within area
Larus pacificus Pacific Gull [811]		Foraging, feeding or related behaviour may occur within area
Limosa lapponica Bar-tailed Godwit [844]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Roosting known to occur within area
Macronectes giganteus Southern Giant Petrel [1060]	Endangered	Species or species habitat may occur within area
Macronectes halli Northern Giant Petrel [1061]	Vulnerable	Species or species habitat may 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
Numenius minutus Little Curlew, Little Whimbrel [848]		Roosting likely to occur within area
Pachyptila turtur Fairy Prion [1066]		Species or species habitat known to occur within area
Pandion haliaetus Osprey [952]		Species or species habitat known to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Roosting known to occur within area
Puffinus assimilis Little Shearwater [59363]		Foraging, feeding or related behaviour known to occur within area
Puffinus carneipes Flesh-footed Shearwater, Fleshy-footed Shearwater [1043]		Species or species habitat likely to occur within area
Recurvirostra novaehollandiae Red-necked Avocet [871]		Roosting known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area

Name	Threatened	Type of Presence
Sterna anaethetus Bridled Tern [814]		Foraging, feeding or related behaviour likely to occur within area
Sterna caspia Caspian Tern [59467]		Foraging, feeding or related behaviour known to occur within area
Sterna dougallii Roseate Tern [817]		Foraging, feeding or related behaviour likely to occur within area
Thalassarche cauta (sensu stricto) Shy Albatross, Tasmanian Shy Albatross [64697]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thalassarche impavida Campbell Albatross, Campbell Black-browed Albatross [64459]	Vulnerable*	Species or species habitat may occur within area
Thalassarche melanophris Black-browed Albatross [66472]	Vulnerable	Species or species habitat may occur within area
Thalassarche steadi White-capped Albatross [64462]	Vulnerable*	Foraging, feeding or related behaviour likely to occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Roosting known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Roosting known to occur within area
Fish		
Acentronura australe Southern Pygmy Pipehorse [66185]		Species or species habitat may occur within area
Campichthys galei Gale's Pipefish [66191]		Species or species habitat may occur within area
Heraldia nocturna Upside-down Pipefish, Eastern Upside-down Pipefish, Eastern Upside-down Pipefish [66227]		Species or species habitat may occur within area
Hippocampus angustus Western Spiny Seahorse, Narrow-bellied Seahorse [66234]		Species or species habitat may occur within area
Hippocampus breviceps Short-head Seahorse, Short-snouted Seahorse [66235]		Species or species habitat may occur within area
Hippocampus subelongatus West Australian Seahorse [66722]		Species or species habitat may occur within area
Histiogamphelus cristatus Rhino Pipefish, Macleay's Crested Pipefish, Ring-back Pipefish [66243]		Species or species habitat may occur within area
Lissocampus caudalis Australian Smooth Pipefish, Smooth Pipefish		Species or species

Name	Threatened	Type of Presence
[66249]		habitat may occur within area
Lissocampus fatiloquus Prophet's Pipefish [66250]		Species or species habitat may occur within area
Lissocampus runa Javelin Pipefish [66251]		Species or species habitat may occur within area
Maroubra perserrata Sawtooth Pipefish [66252]		Species or species habitat may occur within area
Mitotichthys meraculus Western Crested Pipefish [66259]		Species or species habitat may occur within area
Nannocampus subosseus Bonyhead Pipefish, Bony-headed Pipefish [66264]		Species or species habitat may occur within area
Phycodurus eques Leafy Seadragon [66267]		Species or species habitat may occur within area
Phyllopteryx taeniolatus Common Seadragon, Weedy Seadragon [66268]		Species or species habitat may occur within area
Pugnaso curtirostris Pugnose Pipefish, Pug-nosed Pipefish [66269]		Species or species habitat may occur within area
Solegnathus lettiensis Gunther's Pipehorse, Indonesian Pipefish [66273]		Species or species habitat may occur within area
Stigmatopora argus Spotted Pipefish, Gulf Pipefish [66276]		Species or species habitat may occur within area
Stigmatopora nigra Widebody Pipefish, Wide-bodied Pipefish, Black Pipefish [66277]		Species or species habitat may occur within area
Stigmatopora olivacea a pipefish [74966]		Species or species habitat may occur within area
Urocampus carinirostris Hairy Pipefish [66282]		Species or species habitat may occur within area
Vanacampus margaritifer Mother-of-pearl Pipefish [66283]		Species or species habitat may occur within area
Vanacampus phillipi Port Phillip Pipefish [66284]		Species or species habitat may occur within area
Vanacampus poecilolaemus Longsnout Pipefish, Australian Long-snout Pipefish, Long-snouted Pipefish [66285]		Species or species habitat may occur within area
Mammals		
Arctocephalus forsteri Long-nosed Fur-seal, New Zealand Fur-seal [20]		Species or species habitat may occur within area
Neophoca cinerea Australian Sea-lion [22]	Vulnerable	Foraging, feeding or

Name	Threatened	Type of Presence
		related behaviour likely to occur within area
Reptiles		
Caretta caretta Loggerhead Turtle [1763]	Endangered	Foraging, feeding or related behaviour known to occur within area
Chelonia mydas Green Turtle [1765]	Vulnerable	Foraging, feeding or related behaviour known to occur within area
Dermochelys coriacea Leatherback Turtle, Leathery Turtle, Luth [1768]	Endangered	Foraging, feeding or related behaviour known to occur within area
Disteira kingii Spectacled Seasnake [1123]		Species or species habitat may occur within area
Natator depressus Flatback Turtle [59257]	Vulnerable	Foraging, feeding or related behaviour known to occur within area

Whales and other Cetaceans [Resource Information]

Name	Status	Type of Presence
Mammals		
Balaenoptera acutorostrata Minke Whale [33]		Species or species habitat may occur within area
Balaenoptera edeni Bryde's Whale [35]		Species or species habitat may occur within area
Balaenoptera musculus Blue Whale [36]	Endangered	Species or species habitat likely to occur within area
Caperea marginata Pygmy Right Whale [39]		Species or species habitat may occur within area
Delphinus delphis Common Dophin, Short-beaked Common Dolphin [60]		Species or species habitat may occur within area
Eubalaena australis Southern Right Whale [40]	Endangered	Breeding known to occur within area
Grampus griseus Risso's Dolphin, Grampus [64]		Species or species habitat may occur within area
Lagenorhynchus obscurus Dusky Dolphin [43]		Species or species habitat may occur within area
Megaptera novaeangliae Humpback Whale [38]	Vulnerable	Congregation or aggregation known to occur within area
Orcinus orca Killer Whale, Orca [46]		Species or species habitat may occur within area
Stenella attenuata Spotted Dolphin, Pantropical Spotted Dolphin [51]		Species or species habitat may occur within area
Tursiops aduncus Indian Ocean Bottlenose Dolphin, Spotted Bottlenose Dolphin [68418]		Species or species habitat likely to occur

Name	Status	Type of Presence
		within area
Tursiops truncatus s. str.		
Bottlenose Dolphin [68417]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Banksia	WA
Forrestdale Lake	WA
Gibbs Road	WA
Harry Waring Marsupial Reserve	WA
Modong	WA
Piara	WA
Thomsons Lake	WA
Unnamed WA39584	WA
Unnamed WA39752	WA
Unnamed WA48291	WA
Unnamed WA49561	WA
Wandi	WA

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
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

Name	Status	Type of Presence
		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
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
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area
Cenchrus ciliaris Buffel-grass, Black Buffel-grass [20213]		Species or species

Name	Status	Type of Presence
		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 linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		Species or species habitat likely to occur within area
Genista monspessulana Montpellier Broom, Cape Broom, Canary Broom, Common Broom, French Broom, Soft Broom [20126]		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
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to occur within area
Pinus radiata Radiata Pine Monterey Pine, Insignis Pine, Wilding Pine [20780]		Species or species habitat may occur within area
Protasparagus densiflorus Asparagus Fern, Plume Asparagus [5015]		Species or species habitat likely to occur within area
Protasparagus plumosus Climbing Asparagus-fern, Ferny Asparagus [11747]		Species or species habitat likely to occur within area
Rubus fruticosus aggregate Blackberry, European Blackberry [68406]		Species or species habitat likely to occur within area
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		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
Solanum elaeagnifolium Silver Nightshade, Silver-leaved Nightshade, White Horse Nettle, Silver-leaf Nightshade, Tomato Weed, White Nightshade, Bull-nettle, Prairie-berry, Satansbos, Silver-leaf Bitter-apple, Silverleaf-nettle, Trompillo [12323]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
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

Nationally Important Wetlands [Resource Information]

Name	State
Forrestdale Lake	WA
Gibbs Road Swamp System	WA
Spectacles Swamp	WA
Thomsons Lake	WA

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

-32.17459 115.85403

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 B
Fauna Surveys in the Vicinity of the Project Area

Vertebrate Fauna Assessment – Lot 15 Barfield Rd, Hammond Park

Appendix B(1). Fauna survey data in the vicinity of the project area

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
Birds																										
Accipitridae	*Elanus axillaris*	Black-shouldered Kite												X						X						
	Haliastur sphenurus	Whistling Kite					2																			
	Accipiter fasciatus	Brown Goshawk														1	2		X			7	3	1		15
	Accipiter cirrocephalus	Collared Sparrowhawk												X												5
	Hieraaetus morphnoides	Little Eagle												X			7				1	1	1		5	5
	Pandion haliaetus	Osprey																	X							
Anatidae	*Biziura lobata*	Musk Duck																								5
	Stictonetta naevosa	Freckled Duck																								7
	Cygnus atratus	Black Swan					1																			
	Tadorna tadornoides	Australian Shelduck					25								X					X						
	Chenonetta jubata	Australian Wood Duck					59	X							X					X				1		
	Anas gracilis	Grey Teal					8													X						
	Anas castanea	Chestnut Teal																								5
	Anas superciliosa	Pacific Black Duck					26	X						X	X					X						10
	Oxyura australis	Blue-billed Duck																								1
Podargidae	*Podargus strigoides*	Tawny Frogmouth					1																			1
Charadriidae	*Charadrius ruficapillus*	Red-capped Plover																								20
	Elseyornis melanops	Black-fronted Dotterel																		X						5
	Erythrogonys cinctus	Red-kneed Dotterel																								5
	Vanellus tricolor	Banded Lapwing												X												3
Laridae	*Chlidonias hybridus*	Whiskered Tern																								1
	Chroicocephalus novaehollandiae	Silver Gull						X																		
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt																		X						15
	Recurvirostra novaehollandiae	Red-necked Avocet																								2
	Cladorhynchus leucocephalus	Banded Stilt																								10
Scolopacidae	*Actitis hypoleucos*	Common Sandpiper																								1
	Tringa stagnatilis	Marsh Sandpiper																								1
	Calidris subminuta	Long-toed Stint																								15
	Calidris acuminata	Sharp-tailed Sandpiper																								10
Stercorariidae	*Stercorarius longicauda*	Long-tailed Jaeger																								1

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
Turnicidae	*Turnix varius*	Painted Button-quail																								4
	Turnix velox	Little Button-quail																						1		
Ardeidae	*Ardea alba*	Great Egret																		X						
Ardeidae	*Ardea pacifica*	White-necked Heron					3																			
	Egretta novaehollandiae	White-faced Heron					31	X												X						
	Nycticorax caledonicus	Nankeen Night Heron					1																			
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican					1	X																		
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis																								
	Threskiornis molucca	Australian White Ibis					28	X						X						X						
	Threskiornis spinicollis	Straw-necked Ibis					238	X							X					X						
	Platalea flavipes	Yellow-billed Spoonbill						X																		
Columbidae	*Columba livia*	Rock Dove																	X		1				1	
	Streptopelia senegalensis	Laughing Dove					24	X						X	X	14			X			1				1
	Streptopelia chinensis	Spotted Dove					7	X						X					X							1
	Phaps chalcoptera	Common Bronzewing					15	X						X	X				X	X				1		1
	Ocyphaps lophotes	Crested Pigeon					8							X	X											
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra					6	X												X	2	2	13	1	2	
	Todiramphus sanctus	Sacred Kingfisher					7									2					5	4	12	3	2	2
Meropidae	*Merops ornatus*	Rainbow Bee-eater					34	X								3	1		X				3	1	1	10
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo					1							X	X											5
	Chalcites lucidus	Shining Bronze-Cuckoo					11							X	X										2	5
	Cacomantis pallidus	Pallid Cuckoo													X						1				1	
	Cacomantis flabelliformis	Fan-tailed Cuckoo					1							X												
Caprimulgidae	*Eurostopodus argus*	Spotted Nightjar																								5
Falconidae	*Falco cenchroides*	Nankeen Kestrel					21	X						X	X											10
	Falco berigora	Brown Falcon					1																			
	Falco longipennis	Australian Hobby												X					X				1			
	Falco subniger	Black Falcon																								5
Phasianidae	*Coturnix ypsilophora*	Brown Quail					1							X												5
Rallidae	*Porphyrio porphyrio*	Purple Swamphen					9	X												X						2
	Gallirallus philippensis	Buff-banded Rail																								10
	Porzana pusilla	Baillon's Crake																								
	Porzana fluminea	Australian Spotted Crake																		X						

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
	Porzana tabuensis	Spotless Crake																								2
	Tribonyx ventralis	Black-tailed Native-hen																								
	Gallinula tenebrosa	Dusky Moorhen						X												X						10
	Fulica atra	Eurasian Coot					20	X												X						5
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren					3								X					X						1
	Smicrornis brevirostris	Weebill					3	X							X										1	
	Gerygone fusca	Western Gerygone					42							X	X	2	7		X	X	23	6	44	15	36	10
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill					169							X	X					X			3	1	3	
	Acanthiza inornata	Western Thornbill						X																		20
	Acanthiza apicalis	Inland Thornbill					14								X					X						5
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler																		X						10
	Cincloramphus mathewsi	Rufous Songlark																								5
Artamidae	*Artamus cinereus*	Black-faced Woodswallow						X												X	2					15
	Artamus cyanopterus	Dusky Woodswallow																			1		2	2	17	
	Cracticus torquatus	Grey Butcherbird					21							X	X	1	2	X	X				1	1	X	5
	Cracticus tibicen	Australian Magpie					155	X						X	X	13	6	X	X	X	2	1	5	2	6	10
	Strepera versicolor	Grey Currawong																								1
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike					29	X						X	X	3	2	X	X	X	8	7	3	3	6	10
	Lalage sueurii	White-winged Triller					4																		1	
Climacteridae	*Climacteris rufa*	Rufous Treecreeper																								5
Corvidae	*Corvus coronoides*	Australian Raven					198	X						X	X	42	26	X	X	X	6	7	16	6	6	45
	Corvus splendens	House Crow																								5
Estrildidae	*Stagonopleura oculata*	Red-eared Firetail																								1
Hirundinidae	*Cheramoeca leucosterna*	White-backed Swallow																								5
	Hirundo neoxena	Welcome Swallow					26	X								4	1		X	X						100
	Petrochelidon nigricans	Tree Martin					25	X						X	X	42	9			X	12	21	12	35	1	
	Petrochelidon ariel	Fairy Martin																								5
Maluridae	*Malurus splendens*	Splendid Fairy-wren					173							X	X	9	9		X	X			16	8	22	5
	Malurus elegans	Red-winged Fairy-wren																								35
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill												X	X	15	3		X		1	3	2	17	13	10
	Lichenostomus virescens	Singing Honeyeater					29	X						X	X	36	23	X	X	X						
	Manorina flavigula	Yellow-throated Miner																								10
	Anthochaera lunulata	Western Wattlebird					3							X	X											35

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
	Anthochaera chrysoptera	Little Wattlebird						X								2			X							
	Anthochaera carunculata	Red Wattlebird					70	X						X	X	35	3	X	X	X	1		11	7	1	5
	Epthianura albifrons	White-fronted Chat						X														1				20
	Glyciphila melanops	Tawny-crowned Honeyeater													X											
	Lichmera indistincta	Brown Honeyeater					120	X						X	X	43	35	X	X	X	32	26	30	37	34	5
	Phylidonyris novaehollandiae	New Holland Honeyeater					63							X	X	35	10		X	X						8
	Phylidonyris niger	White-cheeked Honeyeater						X						X	X	11	1		X							1
	Melithreptus brevirostris	Brown-headed Honeyeater																								5
	Melithreptus lunatus	White-naped Honeyeater																								15
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark					94	X						X	X	8		X	X	X		1				10
Motacilidae	*Anthus novaeseelandiae*	Australasian Pipit					16	X							X											5
Nectariniidae	*Dicaeum hirundinaceum*	Mistletoebird					1														1	1	2		1	
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella														2	2		X		2	14			7	
Pachycephalidae	*Pachycephala pectoralis*	Golden Whistler												X	X											
	Pachycephala rufiventris	Rufous Whistler					32	X						X	X	28	27	X	X	X	22	19	36	27	31	
	Colluricincla harmonica	Grey Shrike-thrush					8	X						X	X		6		X				3		7	10
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote																								3
	Pardalotus striatus	Striated Pardalote					11							X		10	4	X	X	X	4	16	35	28	20	2
Petroicidae	*Petroica multicolor*	Pacific Robin					2												X							2
	Petroica goodenovii	Red-capped Robin													X											
	Eopsaltria georgiana	White-breasted Robin																								10
Rhipiduridae	*Rhipidura fuliginosa*	New Zealand Fantail					67									7										
	Rhipidura albiscapa	Grey Fantail													X				X	X		8	10	1	17	
	Rhipidura leucophrys	Willie Wagtail					53	X						X	X	24	1		X	X	2					2
Timaliidae	*Zosterops lateralis*	Silvereye					293	X						X	X	7	3	X	X	X	4	2	4	3	9	1
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant					5	X												X						
	Phalacrocorax carbo	Great Cormorant																								
	Phalacrocorax sulcirostris	Little Black Cormorant					2													X						
	Phalacrocorax varius	Pied Cormorant																								
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe					2	X												X						4
	Podiceps cristatus	Great Crested Grebe																								2
Procellariidae	*Daption capense*	Cape Petrel																								5
	Pachyptila desolata	Antarctic Prion																								2

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
	Pterodroma macroptera	Great-winged Petrel																								1
Cacatuidae	*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo	20				26							X									1		2	
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo	4				2	X						X					X							
	Calyptorhynchus baudinii	Baudin's Black-Cockatoo																			1					
	Eolophus roseicapillus	Galah					85	X						X	X			X	X	X	1				2	
	Cacatua pastinator	Western Corella												X												
	Cacatua sanguinea	Little Corella					6																			
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet					56	X						X	X			X	X							1
	Polytelis anthopeplus	Regent Parrot					14																			
	Platycercus icterotis	Western Rosella																				1	31			2
	Barnardius zonarius	Australian Ringneck					60	X						X	X	1		X	X	X	2	5	9	3	9	8
	Purpureicephalus spurius	Red-capped Parrot					52							X	X	4	1		X	X	3	1	32	10	22	5
	Neophema elegans	Elegant Parrot					6														1		2	1	2	
Strigidae	*Ninox novaeseelandiae*	Southern Boobook					2																			3
Tytonidae	*Tyto alba*	Barn Owl					1																			5
Mammals																										
Suidae	*Sus scrofa*	Pig																								2
Canidae	*Canis lupus*	Dog						X							X											
	Vulpes vulpes	Red Fox	1	1	1										X								X	X	X	
Felidae	*Felis catus*	House Cat		1	1										X											30
Molossidae	*Austronomus australis*	White-striped Freetail Bat												X												
Pteropodidae	*Pteropus scapulatus*	Little Red Flying Fox																								1
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat		1										X												5
	Nyctophilus geoffroyi	Lesser Longeared Bat																								1
	Nyctophilus major	Western Longeared Bat																								1
	Vespadelus regulus	Southern Forest Bat												X												2
Dasyuridae	*Antechinus flavipes*	Yellow-footed Antechinus																								5
	Phascogale tapoatafa	Brush-tailed Phascogale																								2
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo													X						X	X				
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum		18																						4
Tarsipedidae	*Tarsipes rostratus*	Honey Possum																								6
Leporidae	*Oryctolagus cuniculus*	European Rabbit			4			X							X						X	X	X	X	X	
Tachyglossidae	*Tachyglossus aculeatus*	Short-beaked Echidna																								1

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot			25			28	4	3	7				X						X	X	X			30
Muridae	*Mus musculus*	House Mouse		26	23			9			1		2								15	7	9	20	7	50
	Rattus fuscipes	Bush Rat		1																						1
	Rattus rattus	Black Rat			5			2	2																	14
Amphibians																										
Hylidae	*Litoria adelaidensis*	Slender Tree Frog		7	4	10		X							X											155
	Litoria moorei	Motorbike Frog		8	36	9																				110
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog		518	81												2				78	34	6	11	1	730
	Heleioporus psammophilus	Sand Frog							4																	
	Limnodynastes dorsalis	Western Banjo Frog		1	2			X		1	1				X	6	1									270
Myobatrachidae	*Crinia georgiana*	Quacking Frog		158				X													5	8	2			105
	Crinia glauerti	Clicking Frog		11	1	4																2	1			145
	Crinia insignifera	Squelching Froglet		X				X							X	X					24	4	22	30	9	380
Myobatrachidae	*Myobatrachus gouldii*	Turtle Frog															1									220
	Pseudophryne guentheri	Crawling Toadlet																			2					6
Reptiles																										
Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon																								90
	Pogona minor	Bearded Dragon						X	1							2					10		1	4	3	42
Diplodactylidae	*Diplodactylus polyophthalmus*																									5
	Strophurus spinigerus																									1
Elapidae	*Brachyurophis fasciolata*																									5
	Brachyurophis semifasciata																									15
	Demansia psammophis								1	2	2															25
	Echiopsis curta	Bardick																				1				
	Elapognathus coronatus	Crowned Snake																								15
	Neelaps bimaculatus	Black-naped Snake																								5
	Notechis scutatus	Tiger Snake		3	2																					13
	Parasuta gouldii																1				1				3	9
	Parasuta nigriceps																									1
	PseuDPaWhis australis	Mulga Snake																								1
	Pseudonaja affinis	Dugite		2	1			X									1					1				47
	Pseudonaja mengdeni	Gwardar																								3
	Simoselaps bertholdi	Jan's Banded Snake																								6

		Surveys	A	B				C	J						E	F		G			H					I
Family	Species	Common Name	Abernethy Rd Byford	Site 1	Site 2	Site 3	Unknown	Fiona Stanley Hospital	Site 1	Site 2	Site 3	Site 4	Site 6	Unknown	Keane Rd	Jandakot Airport 1	Jandakot Airport 2	Hume Road Wildlife Reserve	Ken Hurst Park	Shreeve Road Wetland Res	Brickwood Reserve 2	Brickwood Reserve 3	Cardup Reserve 1	Cardup Reserve 2	Cardup Reserve 3	Unknown
	Simoselaps littoralis	West Coast Banded Snake																								1
Gekkonidae	*Christinus marmoratus*	Marbled Gecko		1																						30
Pygopodidae	*Aprasia pulchella*																									10
	Aprasia repens			2																	2	4	1	3	5	40
	Delma fraseri										1					2	3									95
	Delma grayii																									15
	Lialis burtonis			5													2						1			55
	Pletholax gracilis	Keeled Legless Lizard															2									28
	Pygopus lepidopodus	Common Scaly Foot							1	2		1														17
Scincidae	*Acritoscincus trilineatum*			30	2							1									4	4	2	4	2	95
	Cryptoblepharus buchananii			36	3	9		X				1				2	5				4	2	2	2	1	470
	Ctenotus australis				13			X								1	4									280
	Ctenotus fallens							X															1			10
	Ctenotus gemmula	(Swan Coastal plain)																								10
	Ctenotus impar																				5	X	1	5	1	95
	Ctenotus labillardieri																									10
	Egernia napoleonis																									20
	Hemiergis initialis																									30
	Hemiergis quadrilineata							X			1	1														35
	Lerista distinguenda																									10
	Lerista elegans			11	9			X			1					12	14				1	13	10	7	17	157
	Lerista lineata							X								1	8									
	Lerista lineopunctulata							X																		
	Menetia greyii			14	3	1		X		1	1	1				12	28				2		23	11	5	395
	Morethia lineoocellata				1																					25
	Morethia obscura			4																	8	5		1	10	20
	Tiliqua occipitalis	Western Bluetongue						1																		3
	Tiliqua rugosa			3	3			5		1	1				X	2	3				3	2	7	2		5
Typhlopidae	*Ramphotyphlops australis*			2												1					6	1	4	1	3	14
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor			3										X								1	2	1	4
	Varanus rosenbergi	Heath Monitor		1																						
	Varanus tristis	Racehorse Monitor																			X	4				
Chelidae	*Chelodina oblonga*	Oblong Turtle																								5

A 360 Environmental (2008) Lot 9 Abernethy Road, Byford Spring Flora and Fauna Report. Unpublished report for Australand Property Group, Perth

B ATA Environmental (2006) Vertebrate Fauna Assessment Brookdale Redevelopment Area. Unpublished report for the Armadale Redevelopment Authority Perth

C GHD (2006) Fiona Stanley Heath Precinct Site Investigation Fauna Assessment March 2006. Unpublished report for Department of Housing and Works, Perth.

D ENV (2009) Jandakot Airport Fauna Survey. Unpublished report for Jandakot Airport Holdings Pty Ltd, Perth.

E Bamford Consulting Ecologists (2009) Keane Road Strategic Link, Armadale Fauna Assessment. Unpublished report for EnviroWorks Consulting, Perth.

F How R. A., Harvey M.S., Dell J. and Waldock J.M. (1999) Ground Fauna of Urban Bushland Remnants in Perth. Unpublished report to the Australian Heritage Commission; NEP Grant N93/04; Perth.

G Gole C. A. (2003) Bird Survey in selected Perth Metropolitan Reserves. A Joint Biodiversity Conservation Project between Birds Australia WA and Perth Biodiversity Project. Unpublished report Birds Australia and Perth Biodiversity Project; Perth.

H Harvey M. S., Dell J., How R.A. and Waldock J.M. (1997) Ground Fauna of Bushland Remnants on the Ridge Hill Shelf and Pinjarra Plain Landforms Perth. Unpublished report for the Australian Heritage Commission NEP Grant N95/49, Perth.

I NatureMap records for the area.

X Presence only

Appendix A(2). Fauna survey records in the vicinity of the project area

		Surveys	A												B												C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
Birds																											
Accipitridae	*Pandion cristatus*	Eastern Osprey																X	X					X	X		
	Elanus axillaris	Black-shouldered Kite											1														
	Haliaeetus leucogaster	White-bellied Sea-Eagle													X			X	X					X	X	X	
	Haliastur sphenurus	Whistling Kite						3	3	5			3		X			X	X	X	X	X	X		X	X	
	Accipiter fasciatus	Brown Goshawk						2	1	3			6	2													
	Circus approximans	Swamp Harrier						3							X			X	X	X			X	X	X	X	
	Aquila audax	Wedge-tailed Eagle						1		1	1																
	Pandion haliaetus	Osprey						1				1															
Anatidae	*Biziura lobata*	Musk Duck						3							X	X	X	X	X	X	X	X	X	X	X	X	
	Stictonetta naevosa	Freckled Duck													X												
	Cygnus atratus	Black Swan						3				1			X	X	X	X	X	X	X	X	X	X	X	X	
	Tadorna radjah	Radjah Shelduck						1							X											X	
	Tadorna tadornoides	Australian Shelduck						32	4						X	X	X	X	X	X	X	X	X	X	X	X	
	Chenonetta jubata	Australian Wood Duck													X		X	X	X	X	X			X	X	X	
	Malacorhynchus membranaceus	Pink-eared Duck						59							X		X	X		X		X	X	X	X	X	
	Anas rhynchotis	Australasian Shoveler						15							X		X	X	X	X	X	X	X	X	X	X	
	Anas gracilis	Grey Teal						36							X	X	X	X	X	X	X	X	X	X	X	X	
	Anas castanea	Chestnut Teal						1							X			X							X	X	
	Anas platyrhynchos	Northern Mallard													X				X	X		X	X		X	X	
	Anas superciliosa	Pacific Black Duck						93					2		X	X	X	X	X	X	X	X	X	X	X	X	
	Aythya australis	Hardhead													X		X	X	X	X	X	X	X	X	X	X	
	Oxyura australis	Blue-billed Duck						5							X		X	X		X		X	X	X	X	X	
Aegothelidae	*Aegotheles cristatus*	Australian Owlet-nightjar							2																		
Charadriidae	*Pluvialis fulva*	Pacific Golden Plover																								X	
	Pluvialis squatarola	Grey Plover																						X		X	
	Charadrius dubius	Little Ringed Plover													X											X	
	Charadrius ruficapillus	Red-capped Plover													X	X		X	X				X		X	X	
	Elseyornis melanops	Black-fronted Dotterel						1							X	X	X	X	X	X	X	X	X	X	X	X	
	Thinornis rubricollis	Hooded Plover																							X		
	Erythrogonys cinctus	Red-kneed Dotterel													X			X	X					X	X	X	
	Vanellus miles	Masked Lapwing																X						X		X	
Laridae	*Sternula nereis*	Fairy Tern													X												

		Surveys	A												B													C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
	Gelochelidon nilotica	Gull-billed Tern																								X	
	Chlidonias hybridus	Whiskered Tern													X									X	X	X	
	Chlidonias leucopterus	White-winged Black Tern																							X	X	
	Chroicocephalus novaehollandiae	Silver Gull						39		1	1				X	X	X	X	X	X		X	X	X	X	X	
Recurvirostridae	*Himantopus himantopus*	Black-winged Stilt						41				2			X	X	X	X	X	X	X	X	X	X	X	X	
	Recurvirostra novaehollandiae	Red-necked Avocet						1							X	X		X	X	X				X	X	X	
	Cladorhynchus leucocephalus	Banded Stilt													X	X		X	X	X		X		X	X	X	
Scolopacidae	*Limosa limosa*	Black-tailed Godwit													X									X	X		
	Limosa haemastica	Hudsonian Godwit																	X						X		
	Actitis hypoleucos	Common Sandpiper													X			X	X					X	X	X	
	Tringa brevipes	Grey-tailed Tattler																	X								
	Tringa nebularia	Common Greenshank													X			X	X	X		X	X	X	X	X	
	Tringa stagnatilis	Marsh Sandpiper													X			X	X	X					X		
	Tringa glareola	Wood Sandpiper													X		X	X		X					X	X	
	Calidris tenuirostris	Great Knot																	X						X		
	Calidris canutus	Red Knot																							X		
	Calidris ruficollis	Red-necked Stint													X			X	X					X	X	X	
	Calidris subminuta	Long-toed Stint																X							X	X	
	Calidris melanotos	Pectoral Sandpiper																X							X	X	
	Calidris acuminata	Sharp-tailed Sandpiper													X			X						X	X	X	
	Calidris ferruginea	Curlew Sandpiper													X			X	X						X	X	
	Philomachus pugnax	Ruff																							X	X	
Ardeidae	*Botaurus poiciloptilus*	Australasian Bittern																							X		
	Ixobrychus dubius	Australian Little Bitten																X							X		
	Ardea pacifica	White-necked Heron													X			X		X	X		X	X	X		
	Ardea modesta	Eastern Great Egret						1							X		X	X	X	X	X	X	X	X	X	X	
	Ardea intermedia	Intermediate Egret													X												
	Ardea ibis	Cattle Egret																						X			
	Egretta novaehollandiae	White-faced Heron						4					1		X	X	X	X	X	X	X	X	X	X	X	X	
	Egretta garzetta	Little Egret													X			X	X	X			X	X	X	X	
	Nycticorax caledonicus	Nankeen Night Heron						1					3		X	X		X	X	X	X	X		X	X	X	
Pelecanidae	*Pelecanus conspicillatus*	Australian Pelican						1		8		1	2		X			X	X	X		X	X	X	X	X	
Threskiornithidae	*Plegadis falcinellus*	Glossy Ibis						31							X			X		X				X	X		
	Threskiornis molucca	Australian White Ibis						82	19	6	1	8	9	1	X	X	X	X	X	X	X	X	X	X	X	X	
	Threskiornis spinicollis	Straw-necked Ibis						7					31		X	X	X	X	X	X	X	X	X	X	X	X	

		Surveys	A												B												C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
	Platalea regia	Royal Spoonbill																							X		
	Platalea flavipes	Yellow-billed Spoonbill						1							X	X	X	X	X	X	X	X	X	X	X	X	
Columbidae	*Columba livia*	Rock Dove									10																
	Streptopelia senegalensis	Laughing Dove						6			1		1	4													
	Streptopelia chinensis	Spotted Dove						1	3	2	6	1	4														
	Ocyphaps lophotes	Crested Pigeon						2				1	6														
Alcedinidae	*Dacelo novaeguineae*	Laughing Kookaburra						6		5		4	2														
	Todiramphus sanctus	Sacred Kingfisher							1	3			2														
Meropidae	*Merops ornatus*	Rainbow Bee-eater						8	3			3	9	4													
Cuculidae	*Chalcites basalis*	Horsfield's Bronze-Cuckoo																									
	Chalcites lucidus	Shining Bronze-Cuckoo						3				1	3														
Falconidae	*Falco cenchroides*	Nankeen Kestrel						1																			
	Falco longipennis	Australian Hobby						2	1		1			1													
Rallidae	*Porphyrio porphyrio*	Purple Swamphen						3							X			X	X	X	X	X	X	X	X	X	
	Gallirallus philippensis	Buff-banded Rail													X			X	X	X				X	X	X	
	Porzana pusilla	Baillon's Crake													X			X							X	X	
	Porzana fluminea	Australian Spotted Crake																X						X	X	X	
	Porzana tabuensis	Spotless Crake													X			X	X					X	X	X	
	Tribonyx ventralis	Black-tailed Native-hen						1							X							X		X	X		
	Gallinula tenebrosa	Dusky Moorhen						1							X	X		X	X	X	X	X	X	X	X	X	
	Fulica atra	Eurasian Coot						4							X	X	X	X	X	X	X	X	X	X	X	X	
Acanthizidae	*Sericornis frontalis*	White-browed Scrubwren						11	1				9	4													
	Smicrornis brevirostris	Weebill						30	15	33	9	6	13	12													
	Gerygone fusca	Western Gerygone						57	19	24	4	20	36	13													
	Acanthiza chrysorrhoa	Yellow-rumped Thornbill						10	3	2	1	2	3														
	Acanthiza inornata	Western Thornbill						1		12		13															
	Acanthiza apicalis	Inland Thornbill						6	1				9														
Acrocephalidae	*Acrocephalus australis*	Australian Reed-Warbler						6							X			X	X	X				X	X	X	
	Megalurus gramineus	Little Grassbird													X			X						X	X	X	
Artamidae	*Artamus cyanopterus*	Dusky Woodswallow												1													
	Cracticus torquatus	Grey Butcherbird						10	10	8	9	12	3	2													
	Cracticus tibicen	Australian Magpie						23	35	14	22	17	15	26													
Campephagidae	*Coracina novaehollandiae*	Black-faced Cuckoo-Shrike						4	6	2	13	5	8	4													
Corvidae	*Corvus coronoides*	Australian Raven						45	55	63	61	33	47	11													
Hirundinidae	*Hirundo neoxena*	Welcome Swallow						10	7		4	3	2	3													

		Surveys	A												B													C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
	Petrochelidon nigricans	Tree Martin						7	6	1		1	18	10													
Maluridae	*Malurus splendens*	Splendid Fairy-wren						29	10			3	11	8													
Meliphagidae	*Acanthorhynchus superciliosus*	Western Spinebill								1	1			3													
	Lichenostomus virescens	Singing Honeyeater						14	9	9	14	5	6	25													
	Anthochaera lunulata	Western Wattlebird											1														
	Anthochaera carunculata	Red Wattlebird						35	50	54	55	36	22	20													
	Lichmera indistincta	Brown Honeyeater						55	32	28	34	38	36	28													
	Phylidonyris novaehollandiae	New Holland Honeyeater						14	67		5		91	3													
	Phylidonyris niger	White-cheeked Honeyeater												30													
Monarchidae	*Grallina cyanoleuca*	Magpie-Lark						7	9	6	17	7	3	6													
Neosittidae	*Daphoenositta chrysoptera*	Varied Sittella							4					7													
Pachycephalidae	*Pachycephala rufiventris*	Rufous Whistler						3	6	3	2	8	9	2													
	Colluricincla harmonica	Grey Shrike-thrush							2				2														
Pardalotidae	*Pardalotus punctatus*	Spotted Pardalote											4														
	Pardalotus striatus	Striated Pardalote						19	3	15	5	11	17	6													
Rhipiduridae	*Rhipidura albiscapa*	Grey Fantail						22	3	13		3	21														
	Rhipidura leucophrys	Willie Wagtail						10	5	8	1		2	4													
Timaliidae	*Zosterops lateralis*	Silvereye						101	51	32	21	16	39	6													
Anhingidae	*Anhinga melanogaster*	Australasian Darter						1							X			X	X	X			X	X	X	X	
Phalacrocoracidae	*Microcarbo melanoleucos*	Little Pied Cormorant						1							X		X	X	X	X	X	X	X	X	X	X	
	Phalacrocorax carbo	Great Cormorant							2						X				X	X				X	X	X	
	Phalacrocorax sulcirostris	Little Black Cormorant													X			X	X	X	X	X	X	X	X	X	
	Phalacrocorax varius	Pied Cormorant													X				X						X	X	
Podicipedidae	*Tachybaptus novaehollandiae*	Australasian Grebe													X		X	X	X	X	X	X	X	X	X	X	
	Poliocephalus poliocephalus	Hoary-headed Grebe						9							X			X	X	X		X	X	X	X	X	
	Podiceps cristatus	Great Crested Grebe													X		X		X					X	X	X	
Cacatuidae	*Calyptorhynchus banksii naso*	Red-tailed Black-Cockatoo						1		18	2	2		3													
	Calyptorhynchus latirostris	Carnaby's Black-Cockatoo						10		4	3		2	1													
	Eolophus roseicapillus	Galah						18	163	19	22	17	14	4													
	Cacatua sanguinea	Little Corella						35	17	2	3			2													
Psittacidae	*Trichoglossus haematodus*	Rainbow Lorikeet						57	99	104	162	117	89	67													
	Barnardius zonarius	Australian Ringneck						8	16	20	11	1	7	4													
	Purpureicephalus spurius	Red-capped Parrot						3		6		1	7	7													
	Neophema elegans	Elegant Parrot							1																		
Strigidae	*Ninox novaeseelandiae*	Southern Boobook							1			2	1														

		Surveys	A												B														C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
Mammals																											
Canidae	*Vulpes vulpes*	Red Fox										2															
Molossidae	*Austronomus australis*	White-striped Freetail Bat		X	X	X	X	X			X	X	X														
	Mormopterus species 4	Southern Freetail Bat	X			X			X				X														
Vespertilionidae	*Chalinolobus gouldii*	Gould's Wattled Bat	X	X	X	X	X	X	X		X	X	X	X													1
	Nyctophilus geoffroyi	Lesser Longeared Bat			X	X	X	X	X		X	X	X	X													1
	Nyctophilus major	Western Longeared Bat																									1
	Vespadelus regulus	Southern Forest Bat	X	X	X	X	X	X	X		X	X	X	X													1
Dasyuridae	*Antechinus flavipes leucogaster*																										1
	Phascogale tapoatafa tapoatafa	Brush-tailed Phascogale																									2
Myrmecobiidae	*Myrmecobius fasciatus*	Numbat																									1
Macropodidae	*Macropus fuliginosus*	Western Grey Kangaroo												2													
	Macropus irma	Western Brush Wallaby																									1
	Setonix brachyurus	Quokka																									7
Phalangeridae	*Trichosurus vulpecula*	Common Brushtail Possum										2	2														
Tarsipedidae	*Tarsipes rostratus*	Honey Possum																									6
Leporidae	*Oryctolagus cuniculus*	European Rabbit							5	2		2	3	2													
Peramelidae	*Isoodon obesulus*	Southern Brown Bandicoot							5	23	19	10	21	19													25
Muridae	*Hydromys chrysogaster*	Water Rat																									1
	Mus musculus	House Mouse							7	1	1	1	6	2													5
	Rattus rattus	Black Rat											1														4
Amphibians																											
Hylidae	*Litoria adelaidensis*	Slender Tree Frog											4														30
	Litoria moorei	Motorbike Frog											7														20
Limnodynastidae	*Heleioporus eyrei*	Moaning Frog							35	29		28	29														147
	Limnodynastes dorsalis	Western Banjo Frog						3		1	1	1	1														54
Myobatrachidae	*Crinia georgiana*	Quacking Frog											1														21
	Crinia glauerti	Clicking Frog											2														28
	Crinia insignifera	Squelching Froglet												4													77
	Myobatrachus gouldii	Turtle Frog						2																			44
	Pseudophryne guentheri	Crawling Toadlet																									6
Reptiles																											
Agamidae	*Ctenophorus adelaidensis*	Southern Heath Dragon																									18
	Pogona minor	Bearded Dragon						1			1	2	1	4													
	Pogona minor minor	Bearded Dragon																									42

		Surveys	A												B													C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
Diplodactylidae	*Diplodactylus polyophthalmus*																										1
	Strophurus spinigerus spinigerus																										1
Elapidae	*Acanthophis antarcticus*	Southern Death Adder																									4
	Brachyurophis fasciolata																										1
	Brachyurophis semifasciata																										3
	Demansia psammophis																										4
	Elapognathus coronatus	Crowned Snake																									3
	Hydrophis elegans																										2
	Hydrophis ocellatus																										1
	Neelaps bimaculatus	Black-naped Snake																									1
	Neelaps calonotos	Black-striped Snake																									3
	Notechis scutatus	Tiger Snake						2	1			1	1														12
	Parasuta gouldii																										9
	Parasuta nigriceps																										1
	PseuDPaWhis australis	Mulga Snake																									1
	Pseudonaja affinis	Dugite							3		7	1	4														46
	Pseudonaja mengdeni	Gwardar																									3
	Simoselaps bertholdi	Jan's Banded Snake																									6
	Simoselaps littoralis	West Coast Banded Snake																									1
Gekkonidae	*Christinus marmoratus*	Marbled Gecko							1		1		1														4
Pygopodidae	*Aprasia pulchella*																										2
	Aprasia repens										2																7
	Delma fraseri																										19
	Delma grayii																										3
	Lialis burtonis								1	2	2	1	1	5													12
	Pletholax gracilis	Keeled Legless Lizard												2													28
	Pygopus lepidopodus	Common Scaly Foot												1													17
Scincidae	*Acritoscincus trilineatum*							4	1				9														16
	Cryptoblepharus buchananii							6	15	10	7	4	11	8													92
	Ctenotus australis								3	3	7	3	4	5													55
	Ctenotus fallens										21	2		2													1
	Ctenotus gemmula	(Swan Coastal plain)																									2
	Ctenotus impar																										19
	Ctenotus labillardieri																										2
	Egernia napoleonis							2	12	1			24														3

		Surveys	A												B													C
Family	Species	Common Name	Anabat 1	Anabat 3	Anabat 4	Anabat 5	Bibra Lake	Opportunistic	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6	Bibra Lake	Fawcett Rd Wetland	Horse Paddock Swamp	Kogolup Lake	Lake Coogee	Little Rush Lake	Lower Swamp	Manning Lake	Market Garden Swamp	North Lake	Thompson Lake	Yangebup Lake	Unknown
	Hemiergis initialis																											6
	Hemiergis quadrilineata								22	10	8	6	9	15														5
	Lerista distinguenda																											2
	Lerista elegans							1						16														314
	Lerista lineata								2		1	1		2														132
	Menetia greyii							5		2	2	12		6														79
	Morethia lineoocellata								1		3	1																5
	Morethia obscura							2	5	11	9	13	6															4
	Tiliqua occipitalis	Western Bluetongue																										3
	Tiliqua rugosa							2		2	7	1	1	2														4
Typhlopidae	*Ramphotyphlops australis*																											13
Varanidae	*Varanus gouldii*	Bungarra or Sand Monitor																										4
Chelidae	*Chelodina oblonga*	Oblong Turtle						2																				1

A Phoenix Environmental Sciences (2011) Vertebrate Fauna Survey for the Roe Highway Extension Project. Unpublished report for South Metro Connect, Perth.

B Western Wildlife (2010) Wetland and migratory bird survey. Unpublished report for South Metro Connect, Perth.

C Western Australian Museum collection

Appendix C
Definitions of Significant Fauna under the WA *Wildlife Conservation Act 1950*

Vertebrate Fauna Assessment – Lot 15 Barfield Rd, Hammond Park

APPENDIX C
DEFINITIONS OF SIGNIFICANT FAUNA UNDER THE WESTERN AUSTRALIAN *WILDLIFE CONSERVATION ACT 1950*

T - Threatened species

Published as Specially Protected under the *Wildlife Conservation Act 1950*, and listed under Schedules 1 to 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna. Threatened fauna is that subset of 'Specially Protected Fauna' declared to be 'likely to become extinct' pursuant to section 14(4) of the Wildlife Conservation Act. The assessment of the conservation status of these species is based on their national extent and ranked according to their level of threat using IUCN Red List categories and criteria as detailed below.

CR - Critically endangered species or Schedule 1

Threatened species considered to be facing an extremely high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 1 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna.

EN - Endangered species or Schedule 2

Threatened species considered to be facing a very high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 2 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna.

VU - Vulnerable species or Schedule 3

Threatened species considered to be facing a high risk of extinction in the wild. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 3 of the Wildlife Conservation (Specially Protected Fauna) Notice for Threatened Fauna.

EX - Presumed extinct species or Schedule 4

Species which have been adequately searched for and there is no reasonable doubt that the last individual has died. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 4 of the Wildlife Conservation (Specially Protected Fauna) Notice for Presumed Extinct Fauna.

IA - Migratory birds protected under an international agreement or Schedule 5

Birds that are subject to an agreement between the government of Australia and the governments of Japan (JAMBA), China (CAMBA) and The Republic of Korea (ROKAMBA), and the Bonn Convention, relating to the protection of migratory birds. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 5 of the Wildlife Conservation (Specially Protected Fauna) Notice.

CD - Conservation dependent fauna or Schedule 6

Fauna of special conservation need being species dependent on ongoing conservation intervention to prevent it becoming eligible for listing as threatened. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 6 of the Wildlife Conservation (Specially Protected Fauna) Notice.

OS - Other specially protected fauna or Schedule 7

Fauna otherwise in need of special protection to ensure their conservation. Published as Specially Protected under the *Wildlife Conservation Act 1950*, in Schedule 7 of the Wildlife Conservation (Specially Protected Fauna) Notice.

P - Priority species

Possibly threatened species that do not meet the relevant criteria, or are otherwise data deficient, are added to the Priority Fauna Lists under Priorities 1, 2 or 3. These three categories are ranked in order of priority for survey and evaluation of conservation status so that consideration can be given to their declaration as threatened fauna. Species that are adequately known, are rare but not threatened, or meet criteria for near threatened, or that have been recently removed from the threatened species or other specially protected fauna lists for other than taxonomic reasons, are placed in Priority 4. These species require regular monitoring. Assessment of Priority codes is based on the Western Australian distribution of the species, unless the distribution in WA is part of a contiguous population extending into adjacent States, as defined by the known spread of locations.

Priority 1: Poorly-known species

Species that are known from one or a few locations (generally five or less) which are potentially at risk. All occurrences are either: very small; or on lands not managed for conservation, e.g. agricultural or pastoral lands, urban areas, road and rail reserves, gravel reserves and active mineral leases; or otherwise under threat of habitat destruction or degradation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under immediate threat from known threatening processes. Such species are in urgent need of further survey.

Priority 2: Poorly-known species

Species that are known from one or a few locations (generally five or less), some of which are on lands managed primarily for nature conservation, e.g. national parks, conservation parks, nature reserves and other lands with secure tenure being managed for conservation. Species may be included if they are comparatively well known from one or more locations but do not meet adequacy of survey requirements and appear to be under threat from known threatening processes. Such species are in urgent need of further survey.

Priority 3: Poorly-known species

Species that are known from several locations, and the species does not appear to be under imminent threat, or from few but widespread locations with either large population size or significant remaining areas of apparently suitable habitat, much of it not under imminent threat. Species may be included if they are comparatively well known from several locations but do not meet adequacy of survey requirements and known threatening processes exist that could affect them. Such species are in need of further survey.

Priority 4: Rare, Near Threatened and other species in need of monitoring

a) Rare. - Species that are considered to have been adequately surveyed, or for which sufficient knowledge is available, and that are considered not currently threatened or in need of special protection, but could be if present circumstances change. These species are usually represented on conservation lands.
b) Near Threatened. - Species that are considered to have been adequately surveyed and that are close to qualifying for Vulnerable, but are not listed as Conservation Dependent.
c) Species that have been removed from the list of threatened species during the past five years for reasons other than taxonomy.

Appendix 5
Desktop assessment results (Parks and Wildlife 2007-, DEE 2019b)

NatureMap
Mapping Western Australia's biodiversity

NatureMap Species Report

Created By Guest user on 03/04/2019

Kingdom	Plantae
Current Names Only	Yes
Core Datasets Only	Yes
Method	'By Circle'
Centre	115° 51' 15" E,32° 10' 29" S
Buffer	5km
Group By	Conservation Status

Conservation Status	Species	Records
Non-conservation taxon	596	4262
Priority 2	1	1
Priority 3	5	11
Priority 4	4	20
Rare or likely to become extinct	3	24
TOTAL	**609**	**4318**

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
Rare or likely to become extinct					
1.	1596	*Caladenia huegelii (Grand Spider Orchid)*		T	
2.	12938	*Diuris micrantha*		T	
3.	1639	*Drakaea elastica (Glossy-leaved Hammer Orchid)*		T	
Priority 2					
4.	42022	*Poranthera moorokatta*		P2	
Priority 3					
5.	16245	*Cyathochaeta teretifolia*		P3	
6.	20462	*Jacksonia gracillima*		P3	
7.	5237	*Pimelea calcicola*		P3	
8.	8163	*Pithocarpa corymbulosa (Corymbose Pithocarpa)*		P3	
9.	25800	*Stylidium paludicola*		P3	
Priority 4					
10.	4763	*Dodonaea hackettiana (Hackett's Hopbush)*		P4	
11.	4035	*Kennedia beckxiana (Cape Arid Kennedia)*		P4	
12.	44444	*Tripterococcus sp. Brachylobus (A.S. George 14234)*		P4	
13.	14714	*Verticordia lindleyi subsp. lindleyi*		P4	
Non-conservation taxon					
14.		*?Adenanthos obovatus*			Y
15.		*?Amphipogon turbinatus*			Y
16.		*?Anigozanthos humilis*			Y
17.		*?Arnocrinum preissii*			
18.		*?Austrostipa compressa*			
19.		*?Austrostipa semibarbata*			Y
20.		*?Boronia ramosa*			Y
21.		*?Briza maxima*			Y
22.		*?Burchardia congesta*			Y
23.		*?Caesia sp.*			Y
24.		*?Caladenia discoidea*			Y
25.		*?Calandrinia sp.*			Y
26.		*?Calytrix angulata*			
27.		*?Calytrix flavescens*			Y
28.		*?Calytrix sp.*			Y
29.		*?Chamaescilla corymbosa*			
30.		*?Cirsium vulgare*			Y
31.		*?Conostylis aculeata*			Y
32.		*?Conostylis juncea*			Y
33.		*?Conostylis sp.*			Y
34.		*?Conyza bonariensis*			
35.		*?Dampiera linearis*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
36.		*?Dasypogon bromeliifolius*			Y
37.		*?Ehrharta calycina*			
38.		*?Epilobium hirtigerum*			Y
39.		*?Epilobium sp.*			
40.		*?Eremaea pauciflora*			
41.		*?Euchiton sphaericus*			Y
42.		*?Gonocarpus pithyoides*			Y
43.		*?Haemodorum spicatum*			
44.		*?Hemiandra sp.*			Y
45.		*?Hibbertia subvaginata*			Y
46.		*?Hovea pungens*			Y
47.		*?Hovea trisperma var. trisperma*			Y
48.		*?Hybanthus calycinus*			Y
49.		*?Hypocalymma angustifolia*			Y
50.		*?Kunzea glabrescens*			
51.		*?Lactuca serriola*			
52.		*?Lepidosperma sp.*			Y
53.		*?Lepidosperma squamatum s.l.*			
54.		*?Leptomeria empetriformis*			Y
55.		*?Leucopogon conostephioides*			Y
56.		*?Lomandra caespitosa*			
57.		*?Lomandra sp.*			Y
58.		*?Lomandra suaveolens*			Y
59.		*?Lotus subbiflorus*			
60.		*?Lysimachia arvensis*			Y
61.		*?Mesomelaena pseudostygia*			Y
62.		*?Opercularia vaginata*			Y
63.		*?Pelargonium capitatum*			
64.		*?Petrophile linearis*			
65.		*?Petrorhagia dubia*			Y
66.		*?Philotheca spicata*			Y
67.		*?Phlebocarya ciliata*			
68.		*?Phlebocarya filifolia*			Y
69.		*?Phlebocarya sp.*			Y
70.		*?Phyllanthus calycinus*			Y
71.		*?Podotheca sp.*			Y
72.		*?Pterostylis sanguinea*			
73.		*?Rhodanthe citrina*			
74.		*?Rytidosperma occidentalis*			
75.		*?Schoenus curvifolius*			Y
76.		*?Sowerbaea laxiflora*			
77.		*?Stylidium repens*			Y
78.		*?Stylidium schoenoides*			Y
79.		*?Thysanotus manglesianus/patersonii complex*			Y
80.		*?Urospermum picroides*			
81.		*?Vicia sativa*			Y
82.		*?Wahlenbergia capensis*			
83.		*?Wahlenbergia preissii*			
84.		*?Wahlenbergia sp.*			Y
85.		*?Xanthorrhoea brunonis*			Y
86.		*?Zantedeschia aethiopica*			Y
87.		*Acacia ?pulchella*			
88.	3262	*Acacia cochlearis (Rigid Wattle)*			
89.	3282	*Acacia cyclops (Coastal Wattle)*			
90.	3374	*Acacia huegelii*			
91.	17861	*Acacia longifolia*	Y		
92.	3502	*Acacia pulchella (Prickly Moses)*			
93.	15481	*Acacia pulchella var. glaberrima*			
94.	3527	*Acacia saligna (Orange Wattle, Kudjong)*			
95.	30032	*Acacia saligna subsp. saligna*			
96.		*Acacia sp.*			
97.	3557	*Acacia stenoptera (Narrow Winged Wattle)*			
98.	3581	*Acacia trigonophylla*			
99.	3602	*Acacia willdenowiana (Grass Wattle)*			
100.	1775	*Adenanthos cygnorum (Common Woollybush)*			
101.	11837	*Adenanthos cygnorum subsp. cygnorum (Common Woollybush)*			
102.	1791	*Adenanthos obovatus (Basket Flower)*			
103.	17202	*Agonis flexuosa var. flexuosa*			
104.	184	*Aira caryophyllea (Silvery Hairgrass)*	Y		
105.		*Aira caryophyllea/cupaniana group*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
106.	185	*Aira cupaniana (Silvery Hairgrass)*	Y		
107.	187	*Aira praecox (Early Hairgrass)*	Y		
108.	1728	*Allocasuarina fraseriana (Sheoak, Kondil)*			
109.	1732	*Allocasuarina humilis (Dwarf Sheoak)*			
110.	198	*Amphipogon laguroides*			
111.	20184	*Amphipogon laguroides subsp. laguroides*			
112.	200	*Amphipogon turbinatus*			
113.	7833	*Angianthus preissianus*			
114.		*Anigozanthos ?humilis*			
115.	11434	*Anigozanthos humilis subsp. humilis*			
116.	1411	*Anigozanthos manglesii (Mangles Kangaroo Paw, Kurulbrang)*			
117.	11261	*Anigozanthos manglesii subsp. manglesii*			
118.		*Anigozanthos sp.*			
119.	3688	*Aotus gracillima*			
120.	3692	*Aotus procumbens*			
121.	7838	*Arctotheca calendula (Cape Weed, African Marigold)*	Y		
122.	1264	*Arnocrinum preissii*			
123.	8779	*Asparagus asparagoides (Bridal Creeper)*	Y		
124.	20283	*Astartea scoparia (Common Astartea)*			
125.		*Asteraceae sp.*			
126.	7851	*Asteridea pulverulenta (Common Bristle Daisy)*			
127.	6334	*Astroloma pallidum (Kick Bush)*			
128.	2471	*Atriplex prostrata (Hastate Orache)*	Y		
129.		*Austrostipa ?compressa*			
130.		*Austrostipa ?semibarbata*			Y
131.	17234	*Austrostipa compressa*			
132.	17240	*Austrostipa flavescens*			
133.	17245	*Austrostipa mollis*			
134.	17253	*Austrostipa semibarbata*			
135.		*Austrostipa sp.*			
136.	37421	*Austrostipa sp. Marchagee (B.R. Maslin 1407)*			
137.	233	*Avena barbata (Bearded Oat)*	Y		
138.	36441	*Babingtonia camphorosmae (Camphor Myrtle)*			
139.		*Banksia ?menziesii*			Y
140.	1800	*Banksia attenuata (Slender Banksia, Piara)*			
141.	32580	*Banksia dallanneyi var. dallanneyi*			
142.	1822	*Banksia ilicifolia (Holly-leaved Banksia)*			
143.	1830	*Banksia littoralis (Swamp Banksia, Pungura)*			
144.	1834	*Banksia menziesii (Firewood Banksia)*			
145.	32077	*Banksia sessilis var. cygnorum*			
146.		*Banksia sp.*			
147.	1852	*Banksia telmatiaea (Swamp Fox Banksia)*			
148.	741	*Baumea articulata (Jointed Rush)*			
149.	743	*Baumea juncea (Bare Twigrush)*			
150.	5382	*Beaufortia elegans (Elegant Beaufortia)*			
151.	48868	*Bellardia viscosa*	Y		
152.	749	*Bolboschoenus caldwellii (Marsh Club-rush)*			
153.	4413	*Boronia crenulata (Aniseed Boronia)*			
154.	11503	*Boronia crenulata subsp. crenulata var. crenulata*			
155.	16636	*Boronia crenulata subsp. viminea*			
156.	4417	*Boronia dichotoma*			
157.	11381	*Boronia ramosa subsp. anethifolia*			
158.	3710	*Bossiaea eriocarpa (Common Brown Pea)*			
159.	6341	*Brachyloma preissii (Globe Heath)*			
160.	8661	*Brachypodium distachyon (False Brome)*	Y		
161.	3000	*Brassica tournefortii (Mediterranean Turnip)*	Y		
162.	244	*Briza maxima (Blowfly Grass)*	Y		
163.	245	*Briza minor (Shivery Grass)*	Y		
164.		*Briza sp.*			
165.	249	*Bromus diandrus (Great Brome)*	Y		
166.	12770	*Burchardia congesta*			
167.	1276	*Caesia micrantha (Pale Grass Lily)*			
168.	1277	*Caesia occidentalis*			
169.		*Caesia sp.*			
170.		*Caladenia ?flava*			
171.	15330	*Caladenia arenicola*			
172.	1586	*Caladenia discoidea (Dancing Orchid)*			
173.	1592	*Caladenia flava (Cowslip Orchid)*			
174.	15352	*Caladenia georgei*			
175.	1599	*Caladenia latifolia (Pink Fairy Orchid)*			

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176.		*Caladenia sp.*			
177.	2848	*Calandrinia corrigioloides (Strap Purslane)*			
178.	2856	*Calandrinia liniflora (Parakeelya)*			
179.		*Calandrinia sp.*			
180.	19309	*Calectasia narragara*			
181.	34942	*Callitriche brutia subsp. brutia*	Y		
182.	36600	*Callitris pyramidalis (Swamp Cypress)*			
183.	5411	*Calothamnus hirsutus*			
184.	5415	*Calothamnus lateralis*			
185.	5426	*Calothamnus quadrifidus (One-sided Bottlebrush, Kwowdjard)*			
186.		*Calytrix ?angulata*			Y
187.	5439	*Calytrix angulata (Yellow Starflower)*			
188.	5458	*Calytrix flavescens (Summer Starflower)*			
189.	5460	*Calytrix fraseri (Pink Summer Calytrix)*			
190.	5476	*Calytrix sapphirina*			
191.		*Calytrix sp.*			
192.	2795	*Carpobrotus edulis (Hottentot Fig)*	Y		
193.	1162	*Cartonema philydroides*			
194.	2951	*Cassytha flava (Dodder Laurel)*			
195.	2957	*Cassytha racemosa (Dodder Laurel)*			
196.	11799	*Cassytha racemosa forma racemosa*			
197.	41568	*Cenchrus setaceus (Fountain Grass)*	Y		
198.	6542	*Centaurium tenuiflorum*	Y		
199.	1125	*Centrolepis drummondiana*			
200.	1134	*Centrolepis polygyna (Wiry Centrolepis)*			
201.	2889	*Cerastium glomeratum (Mouse Ear Chickweed)*	Y		
202.	18156	*Chamaecytisus palmensis (Tagasaste)*	Y		
203.	1280	*Chamaescilla corymbosa (Blue Squill)*			
204.	11299	*Chamaescilla corymbosa var. corymbosa*			
205.	2490	*Chenopodium glaucum (Glaucous Goosefoot)*	Y		
206.	7937	*Cirsium vulgare (Spear Thistle, Scotch Thistle)*	Y		
207.	4550	*Comesperma calymega (Blue-spike Milkwort)*			
208.	15611	*Conospermum stoechadis subsp. stoechadis (Common Smokebush)*			
209.	6348	*Conostephium pendulum (Pearl Flower)*			
210.	6349	*Conostephium preissii*			
211.		*Conostylis ?juncea*			Y
212.	1418	*Conostylis aculeata (Prickly Conostylis)*			
213.	11826	*Conostylis aculeata subsp. aculeata*			
214.	1436	*Conostylis juncea*			
215.	1454	*Conostylis setigera (Bristly Cottonhead)*			
216.	11597	*Conostylis setigera subsp. setigera*			
217.		*Conyza ?bonariensis*			
218.	7939	*Conyza bonariensis (Flaxleaf Fleabane)*	Y		
219.		*Conyza sp.*			
220.	20074	*Conyza sumatrensis*	Y		
221.	48259	*Cortaderia selloana subsp. selloana*	Y		
222.	17104	*Corymbia calophylla (Marri)*			
223.	1285	*Corynotheca micrantha (Sand Lily)*			
224.	7945	*Cotula coronopifolia (Waterbuttons)*	Y		
225.		*Crassula ?colorata*			Y
226.	3137	*Crassula colorata (Dense Stonecrop)*			
227.	11709	*Crassula colorata var. acuminata*			
228.	3139	*Crassula exserta*			
229.	3140	*Crassula glomerata*	Y		
230.	19625	*Cymbalaria muralis subsp. muralis*	Y		
231.	806	*Cyperus polystachyos (Bunchy Sedge)*			
232.	816	*Cyperus tenuiflorus (Scaly Sedge)*	Y		
233.	7454	*Dampiera linearis (Common Dampiera)*			
234.	7462	*Dampiera pedunculata*			
235.	35618	*Darwinia sp. Karonie (K. Newbey 8503)*			
236.	1218	*Dasypogon bromeliifolius (Pineapple Bush)*			
237.	6218	*Daucus glochidiatus (Australian Carrot)*			
238.	3832	*Daviesia physodes*			
239.	3845	*Daviesia triflora*			
240.	16595	*Desmocladus flexuosus*			
241.	299	*Deyeuxia quadriseta (Reed Bentgrass)*			
242.	1259	*Dianella revoluta (Blueberry Lily)*			
243.	11636	*Dianella revoluta var. divaricata*			
244.	1287	*Dichopogon capillipes*			
245.	17838	*Dielsia stenostachya*			

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246.	9027	*Diplolaena drummondii*			
247.	19649	*Disa bracteata*	Y		
248.	7054	*Dischisma arenarium*	Y		
249.		*Diuris corymbosa/magnifica*			
250.		*Drosera ?porrecta*			
251.		*Drosera ?sp. "climbing"*			
252.	3095	*Drosera erythrorhiza (Red Ink Sundew)*			
253.	3098	*Drosera glanduligera (Pimpernel Sundew)*			
254.	3106	*Drosera macrantha (Bridal Rainbow)*			
255.	3109	*Drosera menziesii (Pink Rainbow)*			
256.	48710	*Drosera micrantha*			
257.	3118	*Drosera pallida (Pale Rainbow)*			
258.	29178	*Drosera porrecta*			
259.		*Drosera sp.*			
260.		*Drosera sp. "climbing"*			
261.	3135	*Drosera zonaria (Painted Sundew)*			
262.	6681	*Echium plantagineum (Paterson's Curse)*	Y		
263.		*Ehrharta ?longiflora*			Y
264.	347	*Ehrharta calycina (Perennial Veldt Grass)*	Y		
265.	349	*Ehrharta longiflora (Annual Veldt Grass)*	Y		
266.		*Ehrharta sp.*			
267.	1643	*Elythranthera brunonis (Purple Enamel Orchid)*			
268.	1645	*Epiblema grandiflorum (Babe-in-a-cradle)*			
269.	6133	*Epilobium hirtigerum (Hairy Willow Herb)*			
270.	13949	*Eremaea asterocarpa*			
271.	13950	*Eremaea asterocarpa subsp. asterocarpa*			
272.	5541	*Eremaea pauciflora*			
273.	14104	*Eremaea pauciflora var. pauciflora*			
274.	15446	*Eryngium pinnatifidum subsp. pinnatifidum*			
275.		*Eucalyptus ?camaldulensis x robusta*			Y
276.		*Eucalyptus ?rudis*			Y
277.	5615	*Eucalyptus decipiens (Limestone Marlock, Moit)*			
278.	5708	*Eucalyptus marginata (Jarrah, Djara)*			
279.	13547	*Eucalyptus marginata subsp. marginata (Jarrah)*			
280.	5763	*Eucalyptus rudis (Flooded Gum, Kulurda)*			
281.	13511	*Eucalyptus rudis subsp. rudis*			
282.	5790	*Eucalyptus todtiana (Coastal Blackbutt)*			
283.	3872	*Euchilopsis linearis (Swamp Pea)*			
284.	15137	*Euchiton sphaericus*			
285.	20014	*Euphorbia hyssopifolia*	Y		
286.	4648	*Euphorbia terracina (Geraldton Carnation Weed)*	Y		
287.	3880	*Eutaxia virgata*			
288.	20216	*Ficinia nodosa (Knotted Club Rush)*			
289.	1747	*Ficus carica (Common Fig)*	Y		
290.		*Fumaria ?capreolata*			Y
291.	2969	*Fumaria capreolata (Whiteflower Fumitory)*	Y		
292.		*Fumaria sp.*			
293.	907	*Gahnia trifida (Coast Saw-sedge)*			
294.	7323	*Galium murale (Small Goosegrass)*	Y		
295.	20247	*Gamochaeta calviceps*	Y		
296.	19195	*Gamochaeta pensylvanica*	Y		
297.	20475	*Gastrolobium capitatum*			
298.	20473	*Gastrolobium ebracteolatum*			
299.	20483	*Gastrolobium linearifolium*			
300.	4339	*Geranium molle (Dove's Foot Cranesbill)*	Y		
301.	1520	*Gladiolus caryophyllaceus (Wild Gladiolus)*	Y		
302.	6587	*Gomphocarpus fruticosus (Narrowleaf Cottonbush)*	Y		
303.	3957	*Gompholobium tomentosum (Hairy Yellow Pea)*			
304.	6161	*Gonocarpus pithyoides*			
305.	7538	*Goodenia pulchella*			
306.	14282	*Gratiola pubescens*			
307.	2032	*Grevillea leucopteris (White Plume Grevillea)*			
308.	1475	*Haemodorum spicatum (Mardja)*			
309.	2197	*Hakea prostrata (Harsh Hakea)*			
310.	2216	*Hakea varia (Variable-leaved Hakea)*			
311.	3961	*Hardenbergia comptoniana (Native Wisteria)*			
312.	6710	*Heliotropium europaeum (Common Heliotrope)*	Y		
313.	6839	*Hemiandra pungens (Snakebush)*			
314.	38320	*Hemiandra sp. Jurien (B.J. Conn & M.E. Tozer BJC 3885)*			
315.	1293	*Hensmania turbinata*			

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316.	5134	*Hibbertia huegelii*			
317.	5135	*Hibbertia hypericoides (Yellow Buttercups)*			
318.	45534	*Hibbertia hypericoides subsp. hypericoides*			
319.	5162	*Hibbertia racemosa (Stalked Guinea Flower)*			
320.		*Hibbertia racemosa/subvaginata*			Y
321.	48381	*Hibbertia striata*			
322.	5173	*Hibbertia subvaginata*			
323.	5176	*Hibbertia vaginata*			
324.	444	*Holcus lanatus (Yorkshire Fog)*	Y		
325.	6222	*Homalosciadium homalocarpum*			
326.	3966	*Hovea pungens (Devil's Pins, Puyenak)*			
327.	3968	*Hovea trisperma (Common Hovea)*			
328.	12859	*Hovea trisperma var. trisperma*			
329.	12741	*Hyalosperma cotula*			
330.	5216	*Hybanthus calycinus (Wild Violet)*			
331.	6226	*Hydrocotyle callicarpa (Small Pennywort)*			
332.	5817	*Hypocalymma angustifolium (White Myrtle, Kudjid)*			
333.	35070	*Hypocalymma angustifolium subsp. Swan Coastal Plain (G.J. Keighery 16777)*			
334.	5825	*Hypocalymma robustum (Swan River Myrtle)*			
335.	8086	*Hypochaeris glabra (Smooth Catsear)*	Y		
336.	9352	*Hypochaeris radicata (Flat Weed, Cats-ear)*	Y		
337.	1070	*Hypolaena exsulca*			
338.	17841	*Hypolaena pubescens*			
339.		*Iridaceae sp.*			Y
340.	20200	*Isolepis cernua var. setiformis*			
341.	917	*Isolepis marginata (Coarse Club-rush)*			
342.	19700	*Isotropis cuneifolia subsp. cuneifolia*			
343.	8092	*Ixiolaena viscosa (Sticky Ixiolaena)*			
344.	4012	*Jacksonia furcellata (Grey Stinkwood)*			
345.	4029	*Jacksonia sternbergiana (Stinkwood, Kapur)*			
346.	1178	*Juncus bufonius (Toad Rush)*	Y		
347.	1186	*Juncus microcephalus*	Y		
348.	1188	*Juncus pallidus (Pale Rush)*			
349.	1190	*Juncus planifolius (Broadleaf Rush)*			
350.	4044	*Kennedia prostrata (Scarlet Runner)*			
351.	5832	*Kunzea ericifolia (Spearwood, Pondil)*			
352.	15498	*Kunzea glabrescens (Spearwood)*			
353.	20019	*Lachnagrostis filiformis*			
354.	8096	*Lactuca serriola (Prickly Lettuce)*	Y		
355.	18585	*Lagenophora huegelii*			
356.	467	*Lagurus ovatus (Hare's Tail Grass)*	Y		
357.	4052	*Latrobea tenella*			
358.	1307	*Laxmannia ramosa (Branching Lily)*			
359.	11911	*Laxmannia ramosa subsp. ramosa*			
360.	11464	*Laxmannia sessiliflora subsp. australis*			
361.	1309	*Laxmannia squarrosa*			
362.	7572	*Lechenaultia expansa*			
363.	7574	*Lechenaultia floribunda (Free-flowering Leschenaultia)*			
364.	44490	*Leontodon rhagadioloides*	Y		
365.		*Lepidosperma ?aff. costale*			Y
366.		*Lepidosperma ?sp. Brixton Street broad inflorescence*			Y
367.		*Lepidosperma ?sp. Darling Scarp*			Y
368.		*Lepidosperma aff. Brixton Street*			Y
369.	925	*Lepidosperma angustatum*			
370.	937	*Lepidosperma longitudinale (Pithy Sword-sedge)*			
371.	940	*Lepidosperma pubisquameum*			
372.	944	*Lepidosperma scabrum*			
373.		*Lepidosperma scabrum (inland form)*			Y
374.		*Lepidosperma sp.*			
375.		*Lepidosperma sp. Brixton Street broad inflorescence*			
376.		*Lepidosperma sp. Brixton Street broadish inflorescence*			Y
377.		*Lepidosperma sp. Brixton Street narrow inflorescence*			
378.		*Lepidosperma sp. Darling Scarp*			
379.		*Lepidosperma sp. terete*			Y
380.	945	*Lepidosperma squamatum*			
381.		*Lepidosperma squamatum s.l.*			
382.	946	*Lepidosperma striatum*			
383.	1653	*Leporella fimbriata (Hare Orchid)*			
384.	1077	*Leptocarpus canus (Hoary Twine-rush)*			
385.	1080	*Leptocarpus scariosus*			

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386.	2342	*Leptomeria cunninghamii*			
387.	2344	*Leptomeria empetriformis*			
388.	2350	*Leptomeria pauciflora (Sparse-flowered Currant Bush)*			
389.	5850	*Leptospermum laevigatum (Coast Teatree)*	Y		
390.	6360	*Leucopogon australis (Spiked Beard-heath)*			
391.	6374	*Leucopogon conostephioides*			
392.	6436	*Leucopogon propinquus*			
393.	7676	*Levenhookia pusilla (Midget Stylewort)*			
394.		*Levenhookia pusilla/stipitata*			
395.	7677	*Levenhookia stipitata (Common Stylewort)*			
396.	9289	*Lobelia anceps (Angled Lobelia)*			
397.	7408	*Lobelia tenuior (Slender Lobelia)*			
398.	6515	*Logania vaginalis (White Spray)*			
399.	478	*Lolium rigidum (Wimmera Ryegrass)*	Y		
400.		*Lomandra ?caespitosa*			
401.		*Lomandra ?hermaphrodita*			Y
402.		*Lomandra ?nigricans*			
403.		*Lomandra ?preissii*			
404.		*Lomandra ?suaveolens*			
405.	1223	*Lomandra caespitosa (Tufted Mat Rush)*			
406.		*Lomandra caespitosa/suaveolens*			Y
407.	1228	*Lomandra hermaphrodita*			
408.	14542	*Lomandra micrantha subsp. micrantha*			
409.	1234	*Lomandra nigricans*			
410.	1239	*Lomandra preissii*			
411.	1243	*Lomandra sericea (Silky Mat Rush)*			
412.		*Lomandra sp.*			
413.	1246	*Lomandra suaveolens*			
414.	8564	*Lotus subbiflorus*	Y		
415.	4065	*Lupinus angustifolius (Narrowleaf Lupin)*	Y		
416.	1198	*Luzula meridionalis (Field Woodrush)*			
417.	1097	*Lyginia barbata*			
418.		*Lyginia barbata/imberbis*			
419.	18049	*Lyginia imberbis*			
420.	1656	*Lyperanthus serratus (Rattle Beak Orchid)*			
421.	36375	*Lysimachia arvensis (Pimpernel)*	Y		
422.	6456	*Lysinema ciliatum (Curry Flower)*			
423.	5281	*Lythrum hyssopifolia (Lesser Loosestrife)*	Y		
424.	2838	*Macarthuria apetala*			
425.	2839	*Macarthuria australis*			
426.	18119	*Macrozamia fraseri*			
427.	85	*Macrozamia riedlei (Zamia, Djiridji)*			
428.	4079	*Medicago polymorpha (Burr Medic)*	Y		
429.		*Melaleuca ?thymoides*			Y
430.	5900	*Melaleuca cuticularis (Saltwater Paperbark)*			
431.	13271	*Melaleuca huegelii subsp. huegelii*			
432.	5921	*Melaleuca incana (Grey Honeymyrtle)*			
433.	13273	*Melaleuca incana subsp. incana*			
434.	5926	*Melaleuca lateritia (Robin Redbreast Bush)*			
435.	5946	*Melaleuca pauciflora*			
436.	5952	*Melaleuca preissiana (Moonah)*			
437.	5959	*Melaleuca rhaphiophylla (Swamp Paperbark)*			
438.	5964	*Melaleuca seriata*			
439.	18598	*Melaleuca systena*			
440.	5978	*Melaleuca teretifolia (Banbar)*			
441.	5980	*Melaleuca thymoides*			
442.	4085	*Melilotus indicus*	Y		
443.	3050	*Menkea australis (Fairy Spectacles)*			
444.	953	*Mesomelaena graciliceps*			
445.	955	*Mesomelaena pseudostygia*			
446.	957	*Mesomelaena tetragona (Semaphore Sedge)*			
447.	485	*Microlaena stipoides (Weeping Grass)*			
448.	1658	*Microtis atrata (Swamp Mignonette Orchid)*			
449.	15419	*Microtis media subsp. media*			
450.	14344	*Millotia tenuifolia var. tenuifolia (Soft Millotia)*			
451.	4666	*Monotaxis occidentalis*			
452.	6189	*Myriophyllum crispatum*			
453.	6199	*Myriophyllum tillaeoides*			
454.		*Myrtaceae sp.*			
455.	492	*Neurachne alopecuroidea (Foxtail Mulga Grass)*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
456.	6974	*Nicotiana glauca (Tree Tobacco)*	Y		
457.	2401	*Nuytsia floribunda (Christmas Tree, Mudja)*			
458.	6140	*Oenothera mollissima*	Y		
459.	18255	*Opercularia vaginata (Dog Weed)*			
460.	36177	*Ornduffia albiflora*			
461.	4113	*Ornithopus compressus (Yellow Serradella)*	Y		
462.	527	*Paspalum dilatatum*	Y		
463.	1550	*Patersonia occidentalis (Purple Flag, Koma)*			
464.	30471	*Patersonia occidentalis var. angustifolia*			
465.	30472	*Patersonia occidentalis var. occidentalis*			
466.	4343	*Pelargonium capitatum (Rose Pelargonium)*	Y		
467.	4346	*Pelargonium littorale*			
468.	6006	*Pericalymma ellipticum (Swamp Teatree)*			
469.	16477	*Pericalymma ellipticum var. ellipticum*			
470.	2273	*Persoonia saccata (Snottygobble)*			
471.	2299	*Petrophile linearis (Pixie Mops)*			
472.	2301	*Petrophile macrostachya*			
473.	2312	*Petrophile striata*			
474.	19825	*Petrorhagia dubia*	Y		
475.	18529	*Philotheca spicata (Pepper and Salt)*			
476.	1478	*Phlebocarya ciliata*			
477.	1479	*Phlebocarya filifolia*			
478.		*Phlebocarya sp.*			
479.	16177	*Phyllangium paradoxum*			
480.	4675	*Phyllanthus calycinus (False Boronia)*			
481.	2793	*Phytolacca octandra (Red Ink Plant)*	Y		
482.	18117	*Pimelea rosea subsp. rosea*			
483.	6249	*Platysace compressa (Tapeworm Plant)*			
484.	6253	*Platysace filiformis*			
485.	4524	*Platytheca galioides*			
486.	571	*Poa annua (Winter Grass)*	Y		
487.		*Poaceae sp.*			
488.	8175	*Podolepis gracilis (Slender Podolepis)*			
489.		*Podotheca ?chrysantha*			Y
490.		*Podotheca ?gnaphalioides*			
491.	8182	*Podotheca angustifolia (Sticky Longheads)*			
492.		*Podotheca angustifolia/gnaphalioides*			Y
493.	8183	*Podotheca chrysantha (Yellow Podotheca)*			
494.	8184	*Podotheca gnaphalioides (Golden Long-heads)*			
495.		*Podotheca sp.*			
496.	2905	*Polycarpon tetraphyllum (Fourleaf Allseed)*	Y		
497.	582	*Polypogon monspeliensis (Annual Beardgrass)*	Y		
498.	4691	*Poranthera microphylla (Small Poranthera)*			
499.		*Poranthera microphylla/moorokatta*			
500.	1670	*Prasophyllum drummondii (Swamp Leek Orchid)*			
501.	10853	*Prasophyllum plumiforme*			
502.	8189	*Pseudognaphalium luteoalbum (Jersey Cudweed)*			
503.	15426	*Pterostylis aspera*			
504.	44723	*Pterostylis glebosa*			
505.	12217	*Pterostylis sanguinea*			
506.		*Pterostylis sp.*			
507.	2742	*Ptilotus manglesii (Pom Poms, Mulamula)*			
508.	4177	*Pultenaea ochreata*			
509.	4181	*Pultenaea reticulata*			
510.	16367	*Pyrorchis nigricans (Red beaks, Elephants ears)*			
511.	8195	*Quinetia urvillei*			
512.	6012	*Regelia ciliata*			
513.	4822	*Rhamnus alaternus (Buckthorn)*	Y		
514.	13300	*Rhodanthe citrina*			
515.	14485	*Romulea flava var. minor*	Y		
516.	1556	*Romulea rosea (Guildford Grass)*	Y		
517.	14924	*Romulea rosea var. communis*	Y		
518.	10970	*Rostraria cristata*	Y		
519.	2429	*Rumex acetosella (Sorrel)*	Y		
520.	40426	*Rytidosperma occidentale*			
521.	2907	*Sagina procumbens (Spreading Pearlwort)*	Y		
522.	11647	*Samolus repens var. repens*			
523.	7603	*Scaevola canescens (Grey Scaevola)*			
524.	978	*Schoenus brevisetis*			
525.	982	*Schoenus clandestinus*			

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
526.	984	*Schoenus curvifolius*			
527.	986	*Schoenus efoliatus*			
528.	992	*Schoenus grandiflorus (Large Flowered Bogrush)*			
529.	1017	*Schoenus subbulbosus*			
530.	16251	*Schoenus subflavus subsp. long leaves (K.L. Wilson 2865)*			
531.	6033	*Scholtzia involucrata (Spiked Scholtzia)*			
532.	6	*Selaginella gracillima (Tiny Clubmoss)*			
533.	25878	*Senecio condylus*			
534.		*Senecio diaschides/glomeratus*			Y
535.	2909	*Silene gallica (French Catchfly)*	Y		
536.	15972	*Silene gallica var. gallica*	Y		
537.	8225	*Siloxerus humifusus (Procumbent Siloxerus)*			
538.	7020	*Solanum linnaeanum (Apple of Sodom)*	Y		
539.	7022	*Solanum nigrum (Black Berry Nightshade)*	Y		
540.	8230	*Sonchus asper (Rough Sowthistle)*	Y		
541.	9367	*Sonchus hydrophilus (Native Sowthistle)*			
542.	8231	*Sonchus oleraceus (Common Sowthistle)*	Y		
543.	1312	*Sowerbaea laxiflora (Purple Tassels)*			
544.	4211	*Sphaerolobium vimineum (Leafless Globe Pea)*			
545.	2918	*Stellaria media (Chickweed)*	Y		
546.	2316	*Stirlingia latifolia (Blueboy)*			
547.		*Stylidium ?araeophyllum*			Y
548.	25831	*Stylidium araeophyllum (Stilt Walker)*			
549.		*Stylidium araeophyllum/neurophyllum*			
550.	7693	*Stylidium brunonianum (Pink Fountain Triggerplant)*			
551.	7696	*Stylidium calcaratum (Book Triggerplant)*			
552.	7699	*Stylidium carnosum (Fleshy-leaved Triggerplant)*			
553.	25829	*Stylidium neurophyllum (Coastal Plain Triggerplant)*			
554.	7774	*Stylidium piliferum (Common Butterfly Triggerplant)*			
555.	7785	*Stylidium repens (Matted Triggerplant)*			
556.	25806	*Stylidium scariosum*			
557.	7798	*Stylidium schoenoides (Cow Kicks)*			
558.		*Stylidium sp.*			
559.	1260	*Stypandra glauca (Blind Grass)*			
560.	25902	*Symphyotrichum squamatum (Bushy Starwort)*	Y		
561.	15532	*Synaphea spinulosa subsp. spinulosa*			
562.		*Thelymitra benthamiana/crinita/fuscolutea*			Y
563.	11143	*Thelymitra graminea*			
564.		*Thelymitra sp.*			
565.	1716	*Thelymitra tigrina (Tiger Orchid)*			
566.		*Thysanotus ?arbuscula*			Y
567.		*Thysanotus ?thyrsoideus*			
568.	1318	*Thysanotus arbuscula*			
569.	1319	*Thysanotus arenarius*			
570.	1338	*Thysanotus manglesianus (Fringed Lily)*			
571.		*Thysanotus manglesianus/patersonii complex*			
572.	1339	*Thysanotus multiflorus (Many-flowered Fringe Lily)*			
573.	1343	*Thysanotus patersonii*			
574.		*Thysanotus sp.*			
575.	1351	*Thysanotus sparteus*			
576.	1357	*Thysanotus thyrsoideus*			
577.	1358	*Thysanotus triandrus*			
578.	6280	*Trachymene pilosa (Native Parsnip)*			
579.	1361	*Tricoryne elatior (Yellow Autumn Lily)*			
580.	1363	*Tricoryne tenella*			
581.	1038	*Tricostularia neesii*			
582.		*Trifolium ?campestre*			
583.	17145	*Trifolium angustifolium var. angustifolium*	Y		
584.	17763	*Trifolium campestre var. campestre (Hop Clover)*	Y		
585.		*Trifolium campestre/dubium*			
586.	14738	*Trifolium resupinatum var. resupinatum*	Y		
587.		*Trifolium sp.*			
588.	4360	*Tropaeolum majus (Garden Nasturtium)*	Y		
589.	8254	*Urospermum picroides (False Hawkbit)*	Y		
590.	8255	*Ursinia anthemoides (Ursinia)*	Y		
591.	38388	*Ursinia anthemoides subsp. anthemoides*	Y		
592.	15725	*Verbesina encelioides*	Y		
593.	15432	*Verticordia densiflora var. densiflora*			
594.	4320	*Vicia hirsuta (Hairy Vetch)*	Y		
595.	11474	*Vicia sativa subsp. nigra*	Y		

	Name ID	Species Name	Naturalised	Conservation Code	[1]Endemic To Query Area
596.	4325	*Viminaria juncea (Swishbush, Koweda)*			
597.	722	*Vulpia bromoides (Squirrel Tail Fescue)*	Y		
598.		*Vulpia sp.*			
599.		*Wahlenbergia ?capensis*			
600.	7384	*Wahlenbergia capensis (Cape Bluebell)*	Y		
601.	7389	*Wahlenbergia preissii*			
602.		*Wahlenbergia sp.*			
603.	8282	*Waitzia suaveolens (Fragrant Waitzia)*			
604.	1251	*Xanthorrhoea brunonis*			
605.	1256	*Xanthorrhoea preissii (Grass tree, Palga)*			
606.		*Xanthorrhoea sp.*			
607.	6289	*Xanthosia huegelii*			
608.	2331	*Xylomelum occidentale (Woody Pear, Djandin)*			
609.	1049	*Zantedeschia aethiopica (Arum Lily)*	Y		

Conservation Codes
T - Rare or likely to become extinct
X - Presumed extinct
IA - Protected under international agreement
S - Other specially protected fauna
1 - Priority 1
2 - Priority 2
3 - Priority 3
4 - Priority 4
5 - Priority 5

[1] For NatureMap's purposes, species flagged as endemic are those whose records are wholely contained within the search area. Note that only those records complying with the search criterion are included in the calculation. For example, if you limit records to those from a specific datasource, only records from that datasource are used to determine if a species is restricted to the query area.

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.

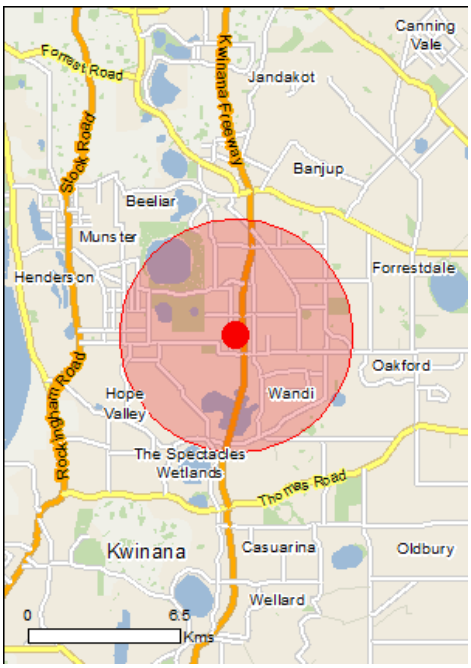
Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

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

Report created: 03/04/19 14:37:08

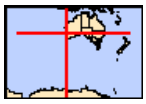
Summary
Details
- Matters of NES
- Other Matters Protected by the EPBC Act
- Extra Information

Caveat
Acknowledgements



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Coordinates
Buffer: 5.0Km



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:	2
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	1
Listed Threatened Species:	20
Listed Migratory Species:	17

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:	1
Commonwealth Heritage Places:	None
Listed Marine Species:	26
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Australian Marine Parks:	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:	5
Regional Forest Agreements:	None
Invasive Species:	40
Nationally Important Wetlands:	3
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Wetlands of International Importance (Ramsar) [Resource Information]

Name	Proximity
Forrestdale and thomsons lakes	Within Ramsar site
Peel-yalgorup system	30 - 40km upstream

Listed Threatened Ecological Communities [Resource Information]

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.

Name	Status	Type of Presence
Banksia Woodlands of the Swan Coastal Plain ecological community	Endangered	Community likely to occur within area

Listed Threatened Species [Resource Information]

Name	Status	Type of Presence
Birds		
Botaurus poiciloptilus Australasian Bittern [1001]	Endangered	Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calyptorhynchus banksii naso Forest Red-tailed Black-Cockatoo, Karrak [67034]	Vulnerable	Species or species habitat known to occur within area
Calyptorhynchus baudinii Baudin's Cockatoo, Long-billed Black-Cockatoo [769]	Endangered	Species or species habitat likely to occur within area
Calyptorhynchus latirostris Carnaby's Cockatoo, Short-billed Black-Cockatoo [59523]	Endangered	Species or species habitat known to occur within area
Leipoa ocellata Malleefowl [934]	Vulnerable	Species or species habitat likely to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Rostratula australis Australian Painted-snipe, Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Mammals		
Dasyurus geoffroii Chuditch, Western Quoll [330]	Vulnerable	Species or species

Name	Status	Type of Presence
		habitat known to occur within area
Pseudocheirus occidentalis Western Ringtail Possum, Ngwayir, Womp, Woder, Ngoor, Ngoolangit [25911]	Critically Endangered	Species or species habitat likely to occur within area
Other		
Westralunio carteri Carter's Freshwater Mussel, Freshwater Mussel [86266]	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 known to occur within area
Diuris micrantha Dwarf Bee-orchid [55082]	Vulnerable	Species or species habitat known to occur within area
Diuris purdiei Purdie's Donkey-orchid [12950]	Endangered	Species or species habitat likely to occur within area
Drakaea elastica Glossy-leafed Hammer Orchid, Glossy-leaved Hammer Orchid, Warty Hammer Orchid [16753]	Endangered	Species or species habitat known to occur within area
Drakaea micrantha Dwarf Hammer-orchid [56755]	Vulnerable	Species or species habitat likely to occur within area
Eleocharis keigheryi Keighery's Eleocharis [64893]	Vulnerable	Species or species habitat may occur within area
Lepidosperma rostratum Beaked Lepidosperma [14152]	Endangered	Species or species habitat likely to 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		
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
Calidris canutus Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area

Name	Threatened	Type of Presence
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat known to occur within area
Calidris ruficollis Red-necked Stint [860]		Species or species habitat known to occur within area
Calidris subminuta Long-toed Stint [861]		Species or species habitat known to occur within area
Charadrius dubius Little Ringed Plover [896]		Species or species habitat known to occur within area
Limosa limosa Black-tailed Godwit [845]		Species or species habitat known to occur within area
Numenius madagascariensis Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Philomachus pugnax Ruff (Reeve) [850]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Other Matters Protected by the EPBC Act

Commonwealth Land [Resource Information]

The Commonwealth area listed below may indicate the presence of Commonwealth land in this vicinity. Due to the unreliability of the data source, all proposals should be checked as to whether it impacts on a Commonwealth area, before making a definitive decision. Contact the State or Territory government land department for further information.

Name
Commonwealth Land -

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		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat known to occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species

Name	Threatened	Type of Presence
		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
[Calidris acuminata](#) Sharp-tailed Sandpiper [874]		Species or species habitat known to occur within area
[Calidris canutus](#) Red Knot, Knot [855]	Endangered	Species or species habitat likely to occur within area
[Calidris ferruginea](#) Curlew Sandpiper [856]	Critically Endangered	Species or species habitat known to occur within area
[Calidris melanotos](#) Pectoral Sandpiper [858]		Species or species habitat known to occur within area
[Calidris ruficollis](#) Red-necked Stint [860]		Species or species habitat known to occur within area
[Calidris subminuta](#) Long-toed Stint [861]		Species or species habitat known to occur within area
[Charadrius dubius](#) Little Ringed Plover [896]		Species or species habitat known to occur within area
[Charadrius ruficapillus](#) Red-capped Plover [881]		Species or species habitat known to occur within area
[Haliaeetus leucogaster](#) White-bellied Sea-Eagle [943]		Species or species habitat known to occur within area
[Himantopus himantopus](#) Pied Stilt, Black-winged Stilt [870]		Species or species habitat known to occur within area
[Limosa limosa](#) Black-tailed Godwit [845]		Species or species habitat known 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
[Numenius madagascariensis](#) Eastern Curlew, Far Eastern Curlew [847]	Critically Endangered	Species or species habitat may occur within area
[Pandion haliaetus](#) Osprey [952]		Species or species habitat likely to occur within area
[Philomachus pugnax](#) Ruff (Reeve) [850]		Species or species habitat known to occur within area

Name	Threatened	Type of Presence
Recurvirostra novaehollandiae Red-necked Avocet [871]		Species or species habitat known to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Thinornis rubricollis Hooded Plover [59510]		Species or species habitat known to occur within area
Tringa glareola Wood Sandpiper [829]		Species or species habitat known to occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat known to occur within area
Tringa stagnatilis Marsh Sandpiper, Little Greenshank [833]		Species or species habitat known to occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Harry Waring Marsupial Reserve	WA
Thomsons Lake	WA
Unnamed WA48291	WA
Unnamed WA49561	WA
Wandi	WA

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
Passer montanus Eurasian Tree Sparrow [406]		Species or species habitat likely to occur within area
Streptopelia chinensis Spotted Turtle-Dove [780]		Species or species

Name	Status	Type of Presence
		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
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
Vulpes vulpes Red Fox, Fox [18]		Species or species habitat likely to occur within area
Plants		
Anredera cordifolia Madeira Vine, Jalap, Lamb's-tail, Mignonette Vine, Anredera, Gulf Madeiravine, Heartleaf Madeiravine, Potato Vine [2643]		Species or species habitat likely to occur within area
Asparagus aethiopicus Asparagus Fern, Ground Asparagus, Basket Fern, Sprengi's Fern, Bushy Asparagus, Emerald Asparagus [62425]		Species or species habitat likely to occur within area
Asparagus asparagoides Bridal Creeper, Bridal Veil Creeper, Smilax, Florist's Smilax, Smilax Asparagus [22473]		Species or species habitat likely to occur within area
Asparagus plumosus Climbing Asparagus-fern [48993]		Species or species habitat likely to occur within area
Brachiaria mutica Para Grass [5879]		Species or species habitat may occur within area

Name	Status	Type of Presence
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 linifolia Flax-leaved Broom, Mediterranean Broom, Flax Broom [2800]		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
Lycium ferocissimum African Boxthorn, Boxthorn [19235]		Species or species habitat likely to occur within area
Olea europaea Olive, Common Olive [9160]		Species or species habitat may occur within area
Opuntia spp. Prickly Pears [82753]		Species or species habitat likely to 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
Sagittaria platyphylla Delta Arrowhead, Arrowhead, Slender Arrowhead [68483]		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

Nationally Important Wetlands [Resource Information]

Name	State
Gibbs Road Swamp System	WA
Spectacles Swamp	WA
Thomsons Lake	WA

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.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

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

-32.17472 115.85417

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
-Department of Land and Resource Management, Northern Territory
-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, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

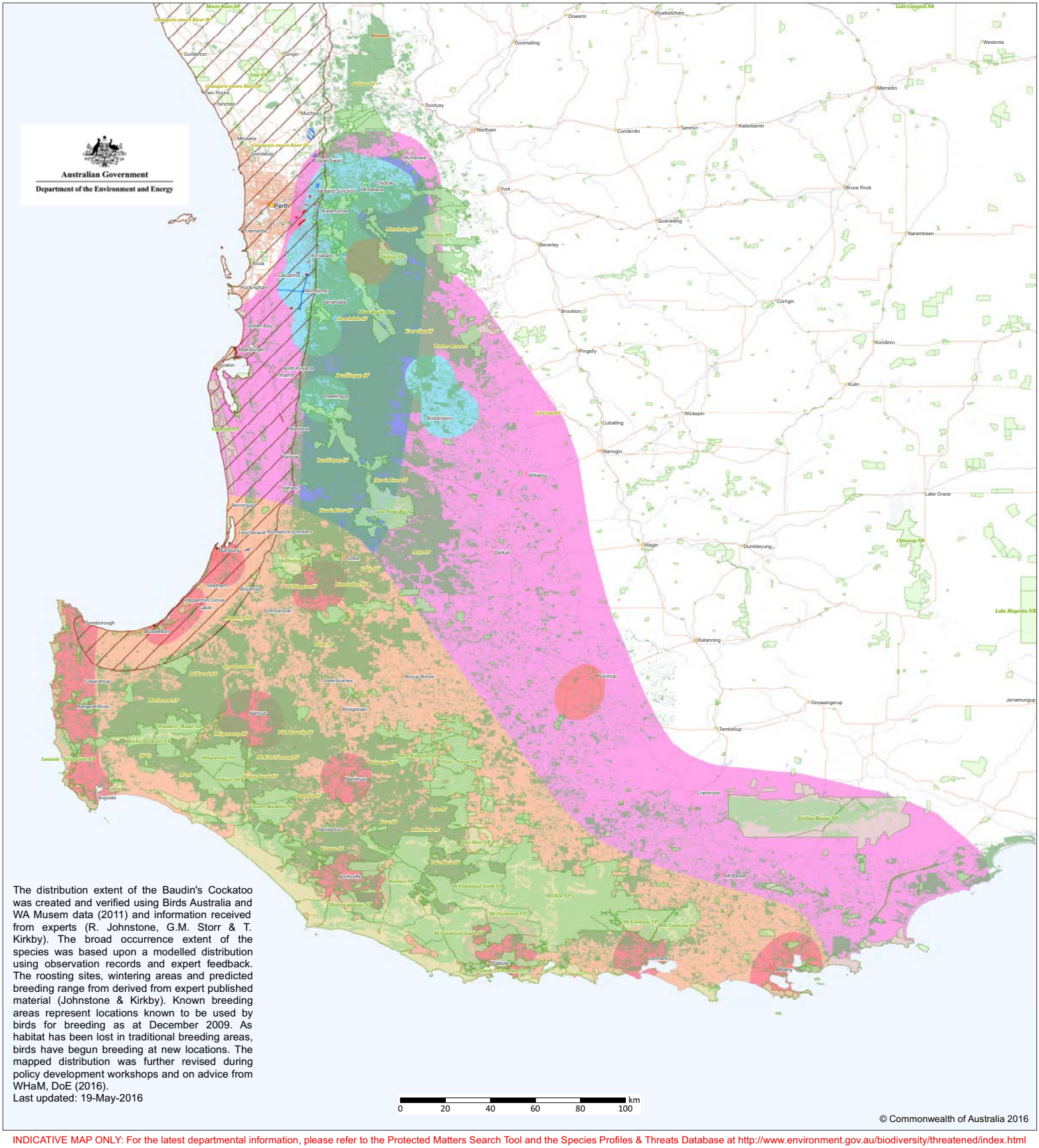
The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

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

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Appendix 6
Black cockatoo distribution maps

Map 2: Modelled distribution for Baudin's Cockatoo (*Calyptorhynchus baudinii*)



The distribution extent of the Baudin's Cockatoo was created and verified using Birds Australia and WA Musem data (2011) and information received from experts (R. Johnstone, G.M. Storr & T. Kirkby). The broad occurrence extent of the species was based upon a modelled distribution using observation records and expert feedback. The roosting sites, wintering areas and predicted breeding range from derived from expert published material (Johnstone & Kirkby). Known breeding areas represent locations known to be used by birds for breeding as at December 2009. As habitat has been lost in traditional breeding areas, birds have begun breeding at new locations. The mapped distribution was further revised during policy development workshops and on advice from WHaM, DoE (2016).
Last updated: 19-May-2016

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INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool and the Species Profiles & Threats Database at http://www.environment.gov.au/biodiversity/threatened/index.html

Produced by:
Environmental Resources Information Network 2016

Contextual data source:
National Vegetation Information System (NVIS 4.2) 2016
Interim Biogeographic Regionalisation for Australia (IBRA) version 7 2012
Collaborative Australian Protected Area Database (CAPAD) 2014
Geoscience Australia GEODATA TOPO 250K Topographic Data Series 3 2006

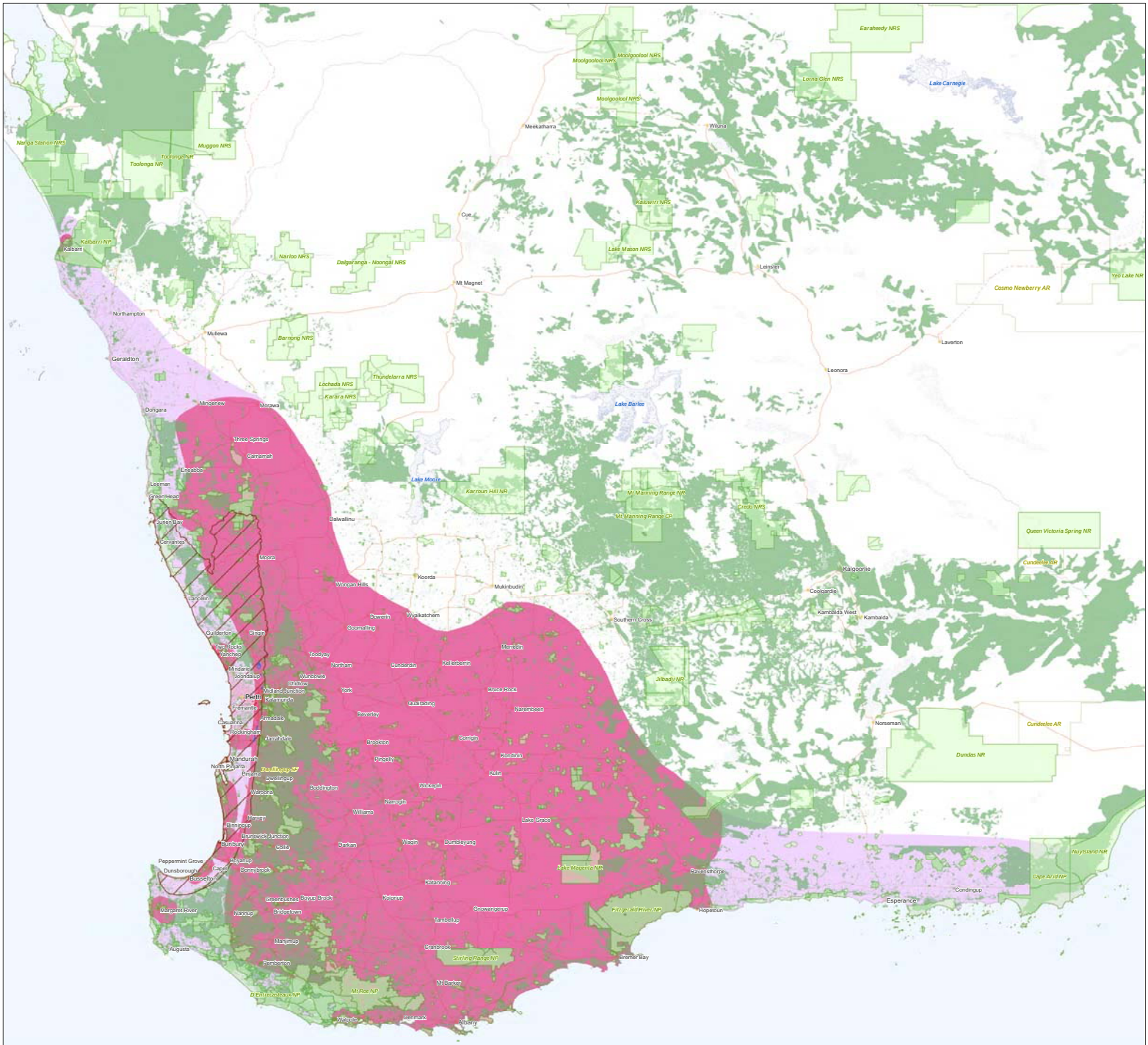
Projection: Geographic
Datum: GDA94

Ecological Communities
- Corymbia calophylla - Xanthorrhea preissii woodlands and shrublands of the Swan Coastal Plain
- Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain
- Banksia Woodlands of the Swan Coastal Plain
- Conservation Areas
- Jarrah, Karri and Marri (NVIS 4.2)

Species
- Known Breeding Areas
- Predicted Breeding Range
- Known Foraging Areas
- Main Wintering Area
- Species Likely to Occur

- Cities & Towns
- Roads (sealed)
- Roads (unsealed)
- Railways
- State Border
- Major Rivers
- Lakes/Reservoirs
- Non-perennial Lakes

Map 3: Modelled distribution for Carnaby's Cockatoo (*Calyptorhynchus latirostris*)



The distribution extent of the Carnaby's Cockatoo was created and verified using Birds Australia and WA Museum data (2016) and information received from experts (R. Johnstone, 2011). The broad occurrence extent of the species was based upon a modelled distribution using observation records and expert feedback. The mapped distribution was revised during policy development workshops and on advice from WHaM, DoE (2016).
Last updated: 19-May-2016.

Australian Government
Department of the Environment and Energy

0 50 100 150 200 250 km

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INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool and the Species Profiles & Threats Database at http://www.environment.gov.au/biodiversity/threatened/index.html

Produced by:
Environmental Resources Information Network 2016

Contextual data source:
National Vegetation Information System (NVIS 4.2) 2016
Interim Biogeographic Regionalisation for Australia (IBRA) version 7 2012
Collaborative Australian Protected Area Database (CAPAD) 2014
Geoscience Australia GEODATA TOPO 250K Topographic Data Series 3 2006

Projection: Geographic
Datum: GDA94

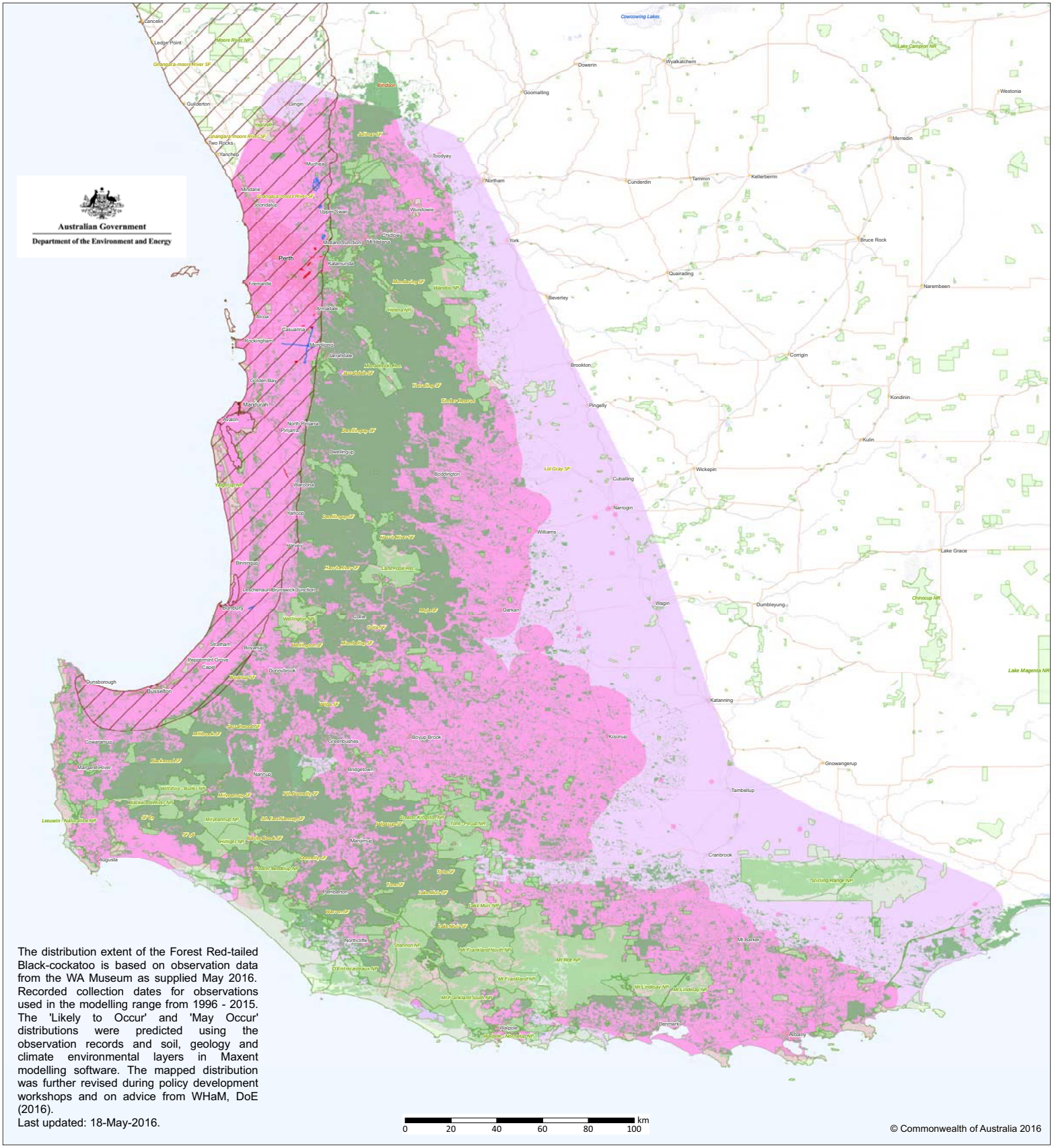
Conservation Areas
Jarrah, Karri, Marri, Salmon Gum, Wandoo, Banksia, Grevillea, Dryandra and Hakea (NVIS 4.2)

Species
Breeding Range
Non-breeding Range

Ecological Communites
Corymbia calophylla - Xanthorrhea preissii woodlands and shrublands of the Swan Coastal Plain
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain
Banksia Woodlands of the Swan Coastal Plain

Cities & Towns
Roads (sealed)
Roads (unsealed)
State Border
Major Rivers
Lakes/Reservoirs
Non-perennial Lakes

Map 4: Modelled distribution for Forest Red-tailed Black-Cockatoo (*Calyptorhynchus banksii naso*)



The distribution extent of the Forest Red-tailed Black-cockatoo is based on observation data from the WA Museum as supplied May 2016. Recorded collection dates for observations used in the modelling range from 1996 - 2015. The 'Likely to Occur' and 'May Occur' distributions were predicted using the observation records and soil, geology and climate environmental layers in Maxent modelling software. The mapped distribution was further revised during policy development workshops and on advice from WHaM, DoE (2016).
Last updated: 18-May-2016.

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INDICATIVE MAP ONLY: For the latest departmental information, please refer to the Protected Matters Search Tool and the Species Profiles & Threats Database at http://www.environment.gov.au/biodiversity/threatened/index.html

Produced by:
Environmental Resources Information Network 2016

Contextual data source:
National Vegetation Information System (NVIS 4.2) 2016
Interim Biogeographic Regionalisation for Australia (IBRA) version 7 2012
Collaborative Australian Protected Area Database (CAPAD) 2014
Geoscience Australia GEODATA TOPO 250K Topographic Data Series 3 2006

Projection: Geographic
Datum: GDA94

Conservation Areas
Jarrah, Karri and Marri (NVIS 4.2)

Species
Likely to Occur
May Occur

Ecological Communities
Corymbia calophylla - Xanthorrhea preissii woodlands and shrublands of the Swan Coastal Plain
Corymbia calophylla - Kingia australis woodlands on heavy soils of the Swan Coastal Plain
Banksia Woodlands of the Swan Coastal Plain

Cities & Towns
Roads (sealed)
Roads (unsealed)
Railways
State Border
Major Rivers
Lakes/Reservoirs
Non-perennial Lakes